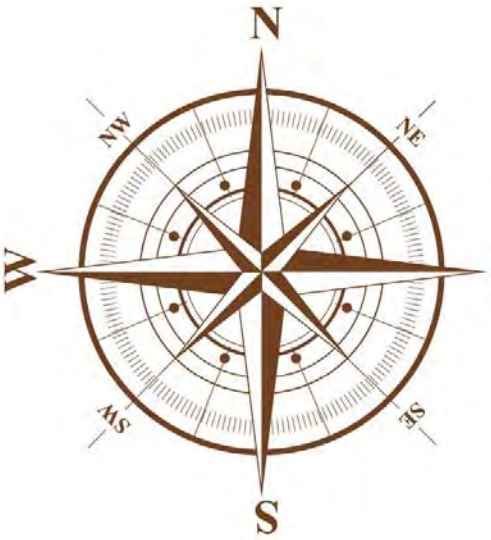

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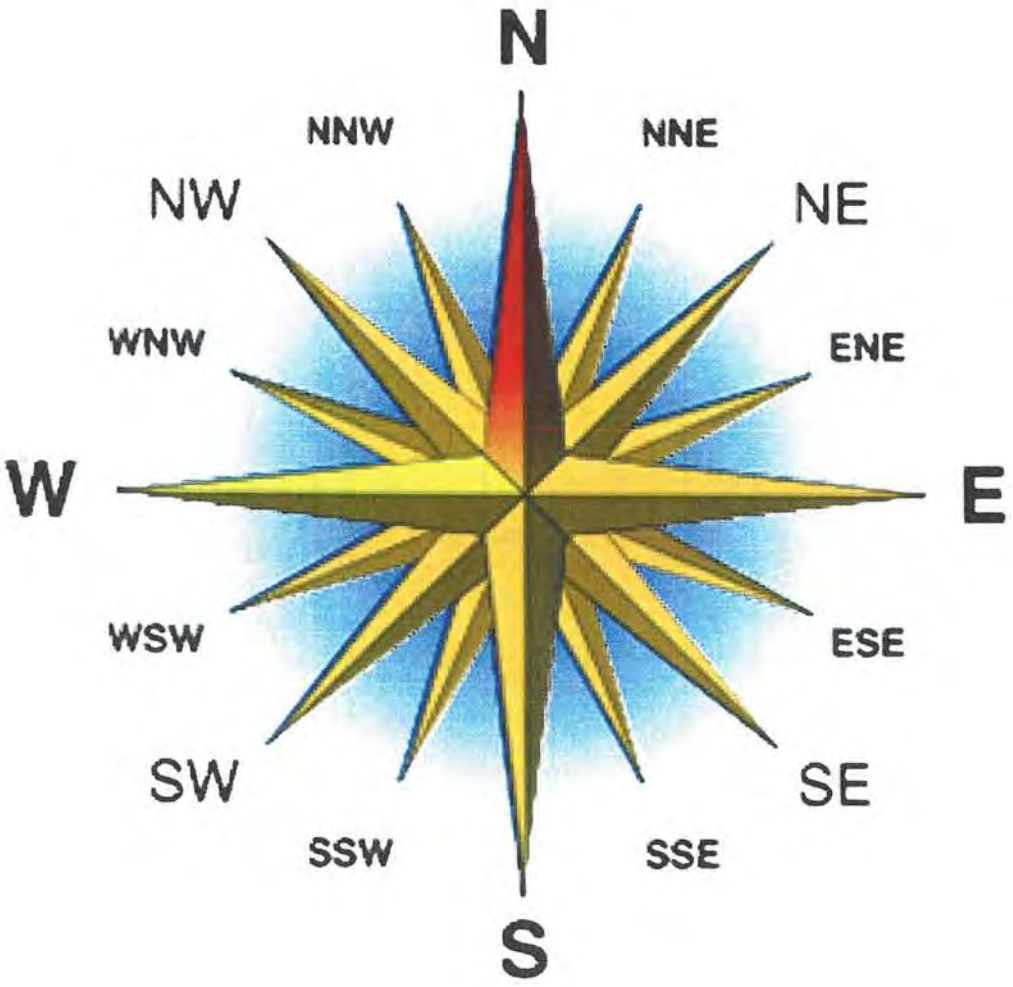
Chief Mate

SQA Navigation Past Papers

March 2005 to Nov 2009



Use Nautical Almanac NA 0000 (same as 1977)

	Mar-05	Jul-05	Nov-05	Mar-06	Jul-06	Nov-06	Mar-07	Jul-07	Nov-07	Mar-08	Jul-08	Nov-08	Mar-09	Jul-09	Nov-09
Sailing calculation only	X				X		X	X		X		X		X	
Sailing calc. with Data sheets		X	X	X		X					X		X		X
Sailing with Plotting		X		X									X		
Fuel Burn Sailing				X						X					
Radar Plotting	X			X	X			X	X	X	X			X	
Rdzvs - Dble Approx.							X			X	X				
Rdzvs - Plotting			X												X
Tide - UK									X				X		
Tide - Pacific				X	X										
Tidal Stream										X					
Celestial	X	X				X	X	X				X		X	X
Parallel Indexing													X		
ICE												X			X
TRS	X		X						X	X		X	X	X	
Position Fixing			X	X	X	X	X							X	
IMO Routing				X			X		X		X		X		X
Weather Routing		X						X							
Routing Charts		X													
UKC	X														
Pilotage/Manoeuvering		X						X							
BPG		X					X								
Fatigue			X												
Watchkeeping						X									
Standing Orders						X									
Meteorology					X	X	X				X				
Co Tidal/Co Range									X		X				
Publications											X				
Passage Planning															
Obligatory Reports												X			
SAR												X			X
Emergency	X														
AMVER															

CM SQA NAV MARCH 2005.

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

1. A vessel leaves Brisbane, Queensland, Australia, bound for Papeete, Tahiti, on the recommended Great Circle track. Close to this track lies the island of Rarotonga in the Cook Islands.

Departure position off Brisbane	26° 49'S 153° 10'E
Arrival position off Papeete	17° 30'S 149° 36'W
Position off Rarotonga	21° 10'S 159° 47'W

Calculate EACH of the following:

(a) the Great Circle distance; (15)

(b) the initial course; (15)

(c) the position of the vertex; (15)

(d) the distance off Rarotonga when passing north or south of the island. (15)

2. A vessel is proceeding on a course of 313°T at 12 knots following a Traffic Separation Scheme in conditions of restricted visibility.
The radar plot of FIVE vessels conducted between 1000hrs and 1015hrs is shown on Worksheet Q2.

(a) Complete the plot and analyse the situation as it exists at 1015hrs. (25)

(b) Determine the alteration of course and/or speed required at 1015hrs to improve the situation, stating reasons for any action taken by own vessel. (25)

3. Time at ship 1200hrs on 4 August 1976.
A vessel in position 63° 15'N 42° 50'W is steering a course of 133°T at 16 knots.

(a) Calculate the DR position at Civil Twilight. (25)

(b) State why no time is given in the Nautical Almanac for Nautical Twilight in high latitudes on this date. (5)

(c) The view of a passing vessel, just before sunset, indicates evidence of abnormal refraction.

State the precautions that should be taken when planning and plotting star sights, to minimise the effects of abnormal refraction. (5)

4. (a) With reference to a Watchkeeper obtaining shallow water soundings which are not evident on the relevant charts:

(i) list the information that should be contained in the report of the incident; (8)

(ii) state the sources of information which will help the observer compile such a report. (2)

(b) With reference to a new port which has been opened up for trade:

(i) list the information which a mariner should report; (8)

(ii) state the agency to which the report should be sent, if the mariner is using British Admiralty charts. (2)

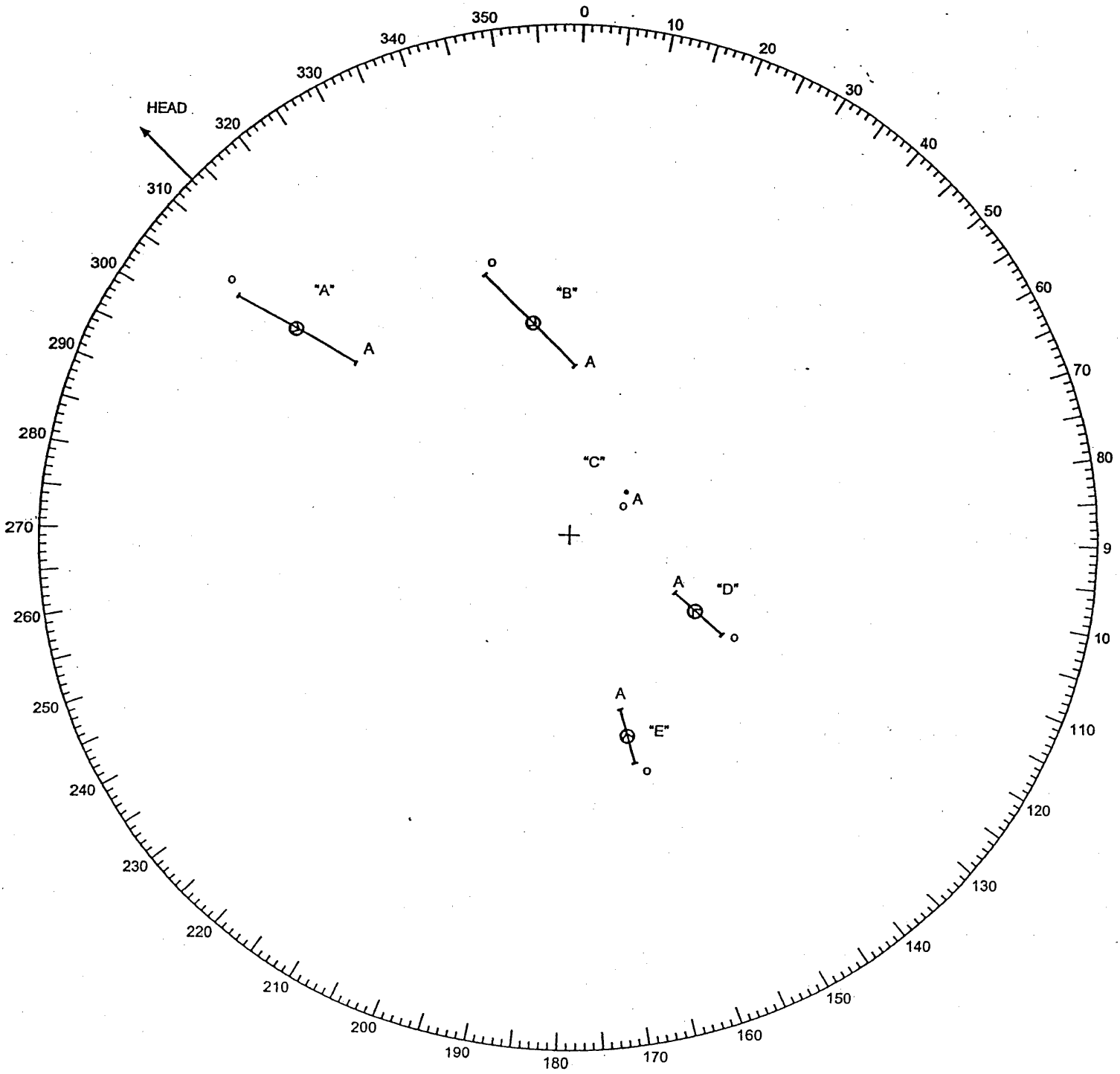
(c) State why the information obtained from Q4(a) and Q4(b) should be reported to the appropriate authority. (5)

5. A container vessel is lying alongside a berth in a Far Eastern port and has nearly completed discharge. A weather report is received warning of the arrival of a severe typhoon in the area.

State the options which may be open to the Master to deal with this emergency, including the advantages, precautions and hazards of EACH option. (30)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Signature of Candidate .....

Examination Centre .....

CM: SQA NAVIGATION (NEW) 5/7/5 032-73

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

1. A 56 000GT bulk carrier is to due to make a loaded passage between Durban (South Africa) to Melbourne (Victoria, Australia) in December. The following landfall and departure positions are to be used:

Departure Position	30° 00.0'S	31° 30.0'E
Landfall Position	39° 00.0'S	144° 00.0'E

The Master asks the navigating officer to consider the following routes between the positions:

The recommended route as per Ocean Passages of the World
The direct great circle route
A composite great circle route with a limiting latitude of 42°S

(a) With reference to Datasheet Q1(a), outline the recommended route as per Ocean Passages of the World. (4)

(b) On Worksheet Q1(b) indicate EACH of the following:

(i) the direct great circle track; (4)

(ii) the composite great circle route. (6)

(c) From Worksheet Q1(b) estimate EACH of the following:

(i) the position of the vertex for the direct great circle route; (2)

(ii) the position of the vertices for the composite great circle route. (4)

(d) Calculate the total distance on passage if the composite great circle route is used (assume an extra 136miles will be added, sailing to and from the respective pilot stations). (30)

(e) Calculate the ETA at the Melbourne pilot station, if the vessel drops the Durban pilot at 0640hrs ST, 18th December and maintains an average speed of 15.8 knots. (7)

2. When carrying out an appraisal of any passage, various environmental and climatic factors must be considered. Admiralty routeing charts will invariably be used when carrying out the above appraisal.

For the passage from Durban to Melbourne:

(a) outline the relevant information that a Routeing chart can provide; (15)

(b) describe how this information should be used to assist in planning the passage; (14)

(c) describe THREE navigational considerations that should also be considered when appraising the above passage. (6)

3. (a) Describe the circumstances when weather routeing is most effective. (5)

(b) Compare the advantages and disadvantages of shore based routeing and shipboard routeing. (20)

(c) Describe FIVE objectives of weather routeing. (10)

4. After several days of continuous cloud cover, the sky clears and the Master and OOW obtain simultaneous sights of the sun and the moon, to check the vessel's position against the GPS.

Ship's time 0750hrs on 28th December
DR Position 41° 20.0'S 132° 15.0'E

Sextant Altitude of the Suns Lower limb	33° 45.4'
Index error	3.6' off the arc
Height of Eye	16.9m
Chronometer read	10h 56m 31s
Chronometer error	3m 02s Fast on GMT

(a) Calculate the direction of the sun's position line and a point through which it passes. (20)

(b) The simultaneous observation of the moon, worked with the same DR gave an intercept 6.2' away on a bearing 342°T

Determine the position of the vessel at 0750hrs. (10)

(c) The compass bearing of the moon at the time the sight was taken was observed to be 302°C and the variation was noted as 44°E.

Calculate the deviation for the direction of the ship's head. (3)

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5. Due to weather delays the vessel is expected to reach the Melbourne pilot station at 0600hrs ST on the 2nd January.

(a) Outline the preparations that the OOW should undertake on the bridge prior to the Engine room being given 1 hour notice of standby. (10)

(b) Outline the information that should be exchanged between the Master and Pilot, as soon as the Pilot arrives on the bridge. (15)

(c) Explain the responsibilities of the OOW while the vessel is under pilotage. (15)

5 JULY 2005

3 NAVIGATION DATASHEET Q1(a)

6.156 INDIAN OCEAN

North-west and North coasts of Australia → Durban or Cape Town—October to April

6.156

Diagrams: (6.122) and (6.151) for Durban or (6.150) for Cape Town

From Torres Strait. The route follows the Ocean Route at 6.122.2 to 11° 30′ S, 118° 00′ E, thence:
Either, great circle to Durban:
Or, great circle to 35° S, 65° E, thence:
Rhumb line to a landfall on Cape Recife, thence:
Coastwise as at 6.56 to Cape Town.

6.156.1

From Darwin. The route is through North Sahul Passage to join the route from Torres Strait SE of Timor.

6.165.2

From places between Darwin and Yampi Sound. Routes are by the recommended tracks (6.121) to 15° 30′ S, 120° 00′ E, thence either great circle direct to Durban or great circle to join the route from Torres Strait to Cape Town in 35° S, 65° E.

6.156.3

From places West of Yampi Sound. The route is as direct as navigation permits to 20° S, 115° E, off Monte Bello Islands, thence either great circle to Durban or great circle to join the route from Torres Strait to Cape Town in 35° S, 65° E.

North-west and north coasts of Australia → Durban and Cape Town—May to September

6.156.4

From Yampi Sound and all places farther East. Routes are by the recommended tracks (6.121) to 15° 30′ S, 120° 00′ E, thence great circle to 30° 00′ S, 56° 30′ E, thence along the parallel of 30° S to Durban, or continuing thence for Cape Town as at 6.56.

6.156.5

From places West of Yampi Sound. Routes are as direct as navigation permits to 20° S, 115° E, thence great circle to join the route from ports N of Yampi Sound in 30° 00′ S, 56° 30′ E.

6.156.6

Distances in miles:

		Durban	*Cape Town (G)*
Torres Strait	Oct–April	6350	7000
	May–Sept	6260	7050
Darwin	Oct–April	5710	6370
	May–Sept	5580	6370
Port Hedland	Oct–April	4730	5360
	May–Sept	4750	5540

(G) For distances to Cape Agulhas (15 miles S of), subtract 130 miles.

Cape Town → West and South coasts of Australia—October to April

6.157

Diagram (6.157)

Routes are across the Agulhas Current to 36° 45′ S, 19° 00′ E, 145 miles S of Cape of Good Hope, thence:
Rhumb line to 40° S, 55° E, thence:
Along the parallel of 40° S.
For Fremantle the route continues by great circle from 40° S, 77° E.
For Adelaide and Melbourne routes continue by great circle from 40° S, 100° E.
For Hobart the route continues by great circle from Melbourne, thence great circle to South West Cape, Tasmania, thence as navigation permits to Hobart.

6.157.1

Shorter but more boisterous routes are:
Through 36° 45′ S, 19° 00′ E, thence:
Rhumb line to 44° S, 40° E, thence:
Rhumb line to 45° S, 65° E, thence:
Along the parallell of 45° S.
For Fremantle the route is by great circle from 45° S 65° E.
For Adelaide the route leaves the parallel of 45° S in 92° 26′ E and follows the great circle to Investigator Strait.
For Melbourne the route leaves the parallel of 45° S in 107° 20′ E and follows the great circle to Cape Otway, thence as direct as navigation permits.
For Hobart the route continues along the parallel of 45° S to 130° E, thence by great circle to destination.

Cape Town → West and South coasts of Australia—May to September

6.157.2

To avoid the probability of foul weather farther S, routes are:
Through 35° 30′ S, 20° 00′ E, thence:
Along the parallel of 35° 30′ S, which, if strictly followed, passes close under West Cape Howe to Investigator Strait which leads to Adelaide.
For Fremantle, the route is by great circle leaving the parallel of 35° 30′ S in 90° E.
For ports East of Adelaide, routes are by great circle leaving the paralle of 35° 30′ S in 115° 00′ E, S of Cape Leeuwin.

6.157.3

The possibility of encountering icebergs on these routes at any time of the year cannot be discounted, see 6.43.

6.157.4

Distances in miles.

Cape Town to:	*Oct–April* (a′) (6.157)	(6.157.1)	*May–Sept (G)* (6.157.2)
Fremantle	4840	4790	4870
Adelaide	5820	5660	5950
Port Phillip for Melbourne*	6030	5820	6230
Hobart	6150	5870	6400

* Port Phillip to Melbourne: 40 miles.
(a′) For distance from Cape of Good Hope (145 miles S of), subtract 180 miles.
(G) For distances from Cape Agulhas (15 miles S of), subtract 130 miles.

Durban → West and South coasts of Australia

6.158

Diagram (6.157)

October to April, routes join those at 6.157 from Cape Town, by great circle from Durban to 40° S, 77° E.

6.158.1

May to September, routes join those from Cape Town by great circle from Durban to 35° 30′ S, 67° 30′ E.

6.158.2

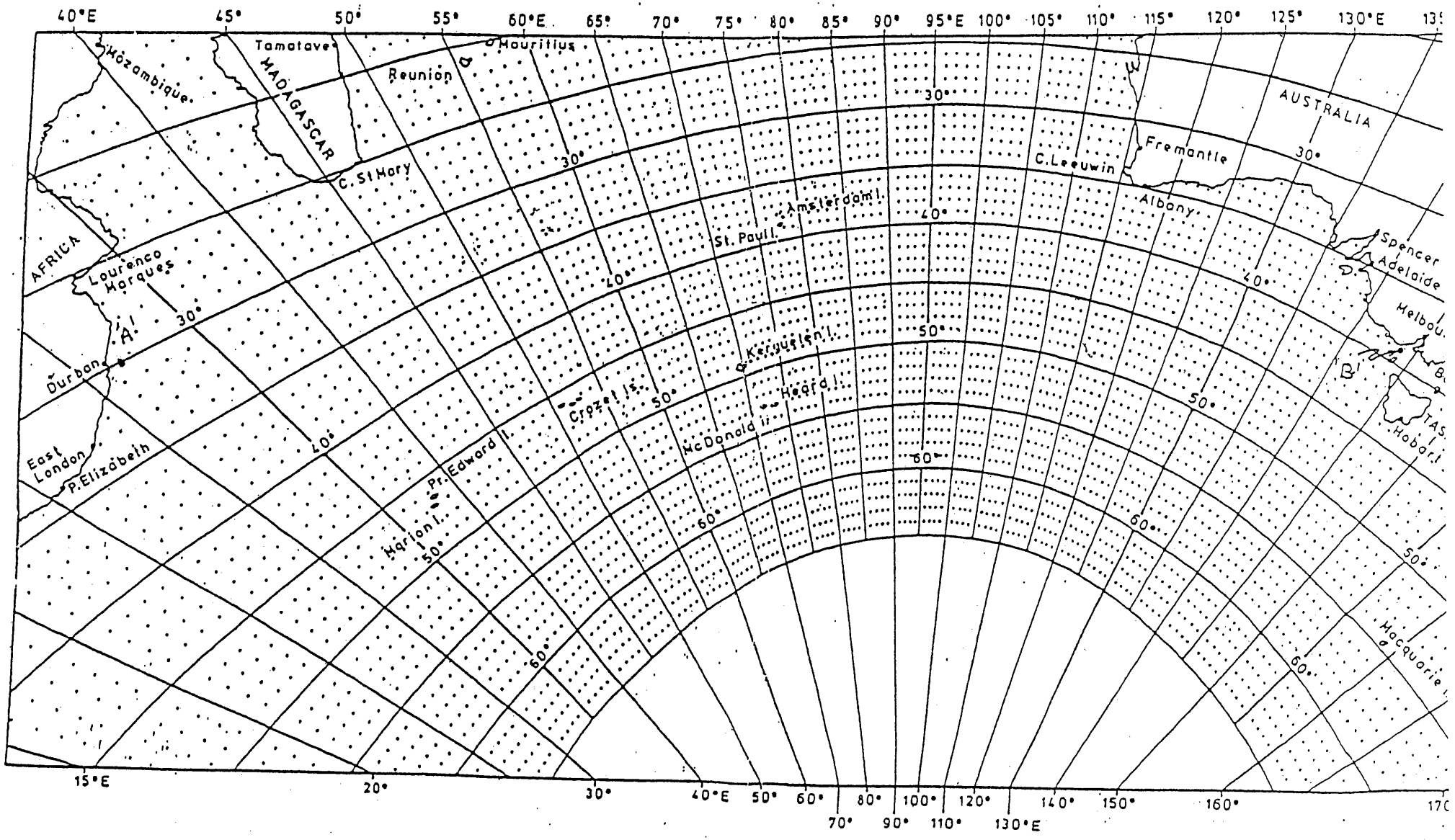
Distances in miles.

Durban to:	*Oct–April*	*May–Sept*
Fremantle	4250	4270
Adelaide	5230	5350
Port Phillip for Melbourne*	5440	5630
Hobart	5560	5800

* Port Phillip to Melbourne: 40 miles.

(This Worksheet must be returned with your answer book)

Gnomonic Chartlet of South Indian Ocean



SQA-CM-07/as Q1

Candidate's Name .....

Examination Centre .....

SQA - CM - 11/05

NAVIGATION —

Attempt ALL questions

Marks for each part question are shown in brackets

1. A tug and tow is to make a passage from Cape Town (S. Africa) to Colombo (Sri Lanka) in early May. With reference to Datasheets Q1(A)–(D):

   (a) outline the navigational and environmental factors which should be taken into consideration when appraising the passage; (14)

   (b) explain why there are multiple routes, for a passage from Cape Town to Colombo, both East and West of Madagascar; (6)

   (c) describe the recommended routes available to the Master for EACH of the following:

      (i) a passage to the West of Madagascar; (9)

      (ii) a passage to the East of Madagascar; (9)

   (d) if the vessel departs Cape Town at 2000hrs (ST) on the 2nd May, and follows the recommended route Eastwards of Madagascar, calculate the ETA (ST) at Colombo if a speed of 7.5 knots is maintained throughout. (12)

2. At 1000hrs GMT on the 12th May, whilst in position 24° 00.0'S · 52° 36.0'E the Master of the tug receives a weather facsimile indicating a late season tropical storm reported in position 16°S, 52°E. The forecast track for the next 12 hours is 185°T at 16 knots. The tug is presently steering 060°T at 7 knots.

   (a) (i) On Worksheet Q2(a) plot the present position of the storm and the tug. (2)

      (ii) Indicate the probable tracks the storm could follow. (3)

   (b) Outline the procedures to be adopted on the bridge on receipt of the facsimile. (12)

   (c) Outline THREE possible actions open to the Master to avoid encountering the worst of the storm. (12)

   (d) State, giving reasons, which of these options a prudent Master would choose. (15)

3. FOUR vessels are engaged in a parallel track search, steaming line abreast, on a course of 295°T at 10 knots. The track separation is 4 miles.

To ease language problems the vessels are labelled *A* to *D* in alphabetical order, with *A* being the most Southerly vessel and *D* being the most Northerly. Vessel *C* is nominated as CSS.

At 1240hrs, with visibility decreasing to 2 miles, vessel *A* is instructed to take up a position bearing 135°R at a distance of 2 miles from the CSS. The manoeuvre is to commence at 1300hrs.

(a) Determine the course required by vessel *A* to take up station as soon as possible, assuming a maximum speed of 15 knots. (15)

(b) Determine the time vessel *A* will reach the new station. (5)

(c) Determine the bearing on which vessel *A* will first sight vessel *B*, assuming the visibility is 2 miles. (14)

Note: Assume all alterations of course and speed are instantaneous

4. STCW 95 and several other relevant publications contain guidance to Masters on determining the composition of the Bridge team under varying operational conditions.

Outline the various factors that should be considered by the Master when deciding appropriate manning levels necessary on the bridge. (30)

5. With reference to the proposed passage by the tug and tow, the One and a Half Degree channel is flanked to the North and the South by the Maldive Islands. These consist of numerous low lying islands, banks, reefs and shoals.

(a) Outline the difficulties in maintaining navigational accuracy, likely to be encountered, when approaching and transiting the Maldives between May and September. (24)

(b) Explain why a fully operational GPS receiver would be an advantage when transiting the islands. (6)

(c) Outline the precautions that should be observed by the Officer of the Watch when using parallel indexing to monitor the vessels progress in the passage. (12)

ROUTES BETWEEN EAST COAST OF AFRICA, ARABIAN SEA AND BAY OF BENGAL

CAPE TOWN → DURBAN AND MOZAMBIQUE CHANNEL

6.55
Diagram (6.55)
Dominant factors are the Agulhas Current (6.36) flowing S and W with considerable strength, and the heavy seas and swells generated by S gales. Counter-currents are common near the coast between Cape Agulhas and Durban, though such currents are very narrow to the E of East London. Eddies between these counter-currents and the Agulhas Current can create local onshore sets, sometimes strong, which have been the cause of many strandings, particularly to the W of Cape Saint Francis. See Admiralty Sailing Directions.

6.55.1
From Cape Town the route to Durban keeps as close to the land as safe navigation permits in order to be out of the strength of the Agulhas Current, and to obtain the possible benefit of counter-currents, whilst avoiding the heavy and dangerous seas, and abnormal waves (1.18), which may be encountered in the vicinity of the 200 m (109 fm) contour during S and SW gales, particularly off East London.

At all times great care should be taken to avoid salient points, and to be vigilant against indraughts into bays. If uncertain of the position, depths of more than 75 m (41 fm) should be maintained.
Tankers, other than those in ballast carrying only residual cargo navigating off the coast of South Africa are governed by regulations regarding the offing to lie kept: see Admiralty Sailing Directions.

An Area to be Avoided (1.29) of radius 6 miles, is centered in 35° Ol.7' S, 20° 51.2' E.
For Mozambique Channel, the route continues from Durban as at 6,57.1.

6.55.2
From Cape Town to Mozambique Channel, passage can also be made keeping to seaward of the main part of the Agulhas Current, and passing through:

36°45' S, 19°00' E, thence:
Great circle to 34° 30' S, 32° 30' E, thence:
Rhumb line, nothing to the W, to 30° 00' S, 38° 20' E, thence:
Through the E part of Mozambique Channel, passing E of Ile Europa, to join the N-bound route (6.57.1) in 17° 00' S, 42 15' E.
This route is 275 miles longer than the coastal route.

6.55.3
Distance:
From Cape Town to Durban (keeping inshore): 800miles

Mozambique Channel —> Durban or Cape Town
6.56
Diagram (6.55)
The S-bound route through Mozambique Channel (6.57.2) is on the W side of the channel, in the Mozambique Current. Thence the Agulhas Current should be held by keeping from 20 to 30 miles from the coast as far as Mossel Bay. During SW gales off the SE African coast a very dangerous sea will be experienced near the seaward edge of the continental shelf (1.18).

[OVER

There is considerably less sea near the coast, and if a distance of about 3 miles or less is kept off the shore, the reduction in the sea will more than compensate for the loss of favorable current. As directed in 6.55.1, a depth of 75 m (41 fm) should be maintained if uncertain of the vessels position.

After passing Mossel Bay, course should be shaped to round Cape Agulhas and Cape of Good Hope.
Tankers, other than those in ballast carrying only residual cargo, must pay due attention to the regulations regarding the offing to be kept off the coasts of South Africa; see Admiralty Sailing Directions.

Distance: Durban to Cape Town 825 miles.

Routes through Mozambique Channel
6.57
Diagram (6.55)
When choosing between a route through Mozambique Channel or one E of Madagascar, consideration should be given, not only to the navigational hazards presented by the islands and shoals in the N approach to Mozambique Channel, but to the restrictions they impose on freedom of maneuver on the approach of a tropical storm, of which little warning may be expected in these waters.

The currents near the W coast of Madagascar are little known, in mid-channel and extending at least halfway towards Madagascar, the predominant flow is NE-going at rates of about ¾ knot, but both direction and rate are highly variable.

On the African side of the channel, the Mozambique Current sets strongly in a SSW direction, following the coast; in the region of Mozambique this current is thought to extend about 50 miles off the coast during most of the year, increasing to nearly 100 miles in June, July and August. It is strongest from October to February, rates of 4 knots being attained occasionally.

Inshore counter currents are common near Blanco de Sofia and in Bhatia de Maputo.
The situation in Mozambique Channel, where strong SSW-going currents suddenly give place to moderate or possibly strong currents in the opposite direction, has obvious dangers. The boundaries of the currents vary with season and weather, and their rates may differ by as much as 4 knots from those anticipated.
6.57.1
North-bound. From the vicinity of Durban, the route opens from the coast to a distance of about 100 miles and passes through:
27° 15'S, 36°00'E, thence:
17° 00' S, 42° 15' E, passing either W of Bassas da India or E of Ile Europe, thence:
11° 35' S, 42° 50' E, thence to destination.
The route E of Ile Europa will encounter less adverse current but is 30 miles longer.
6.57.2
South-bound. From 11° 35' S, 42° 50' E the route is
through:
15° 00'S. 41°20'E, in the full strength of the Mozambique current thence:
17° 00'S. 40°20'E. thence:
25°00'S. 35° 30'E. thence to destination.

Cape Town and Durban → Colombo or Bay of Bengal
6.67

Diagram (6.55) with Diagrams (6.65) for Colombo or (6.67) for Bay of Bengal
West of Madagascar.
To One and Half Degree Channel, routes are as at 6.55.1 or 6.55.2 as far as 17° 00'S, 42° 15'E, off Ile Juan de Nova in Mozambique Channel, thence seasonal as follows.

April to October, through 8° 30' S, 50° 40' E, 30 miles NW of Wizard Reef, passing 30 miles E of Geyser Reef and Iles Glorieuses, thence to One and Half Degree Channel, taking care to avoid the islands and shoal water at the SE extremity of Seychelles Bank.

Attention must be paid to the currents S of 5° S, especially near Wizard Reef, where they will probably be NW-going, and to the W-going current which sets strongly past Iles Glorieuses and Geyser Reef: see Admiralty Sailing Directions.

6.67.1
November to March, between Ile Anjouan and Ile Mayotte, thence:
9° 30' S, 45° 30' E, 30 miles W of Aldabra Group, thence:
3° 00'S, 54° 00'E', 50 miles NW of Seychelles Group, thence;
To One and Half Degree Channel.

Attention must be paid to the W-going current which flows strongly past the N point of Madagascar.
From One and Half Degree Channel, routes at all seasons are as direct as navigation permits to destinations. To Rangoon, the shortest route is through Preparis South Channel.

6.67.2
East of Madagascar.
Routes are as at 6.55.1 until the S end of Madagascar has been rounded at a distance of 60 miles or more offshore, thence seasonal as follows:
May to September, 60 miles SE of Mauritius, thence,
E of Diego Garcia, thence as navigation permits to destination, using Ten Degrees Channel if bound Rangoon.

6.67.3
October to March, through 14° 00'S, 60° 00'E, thence as navigation permits to destination, using Preparis South Channel if bound Rangoon.

6.67.4
In April either route may be used.

6.67.5
From Cape of Good Hope (145 miles S of). The route is by great circle to 34° 30' S, 32° 30' E, thence by great circle to join the routes passing E of Madagascar in 26° 45' S, 47'45' E.

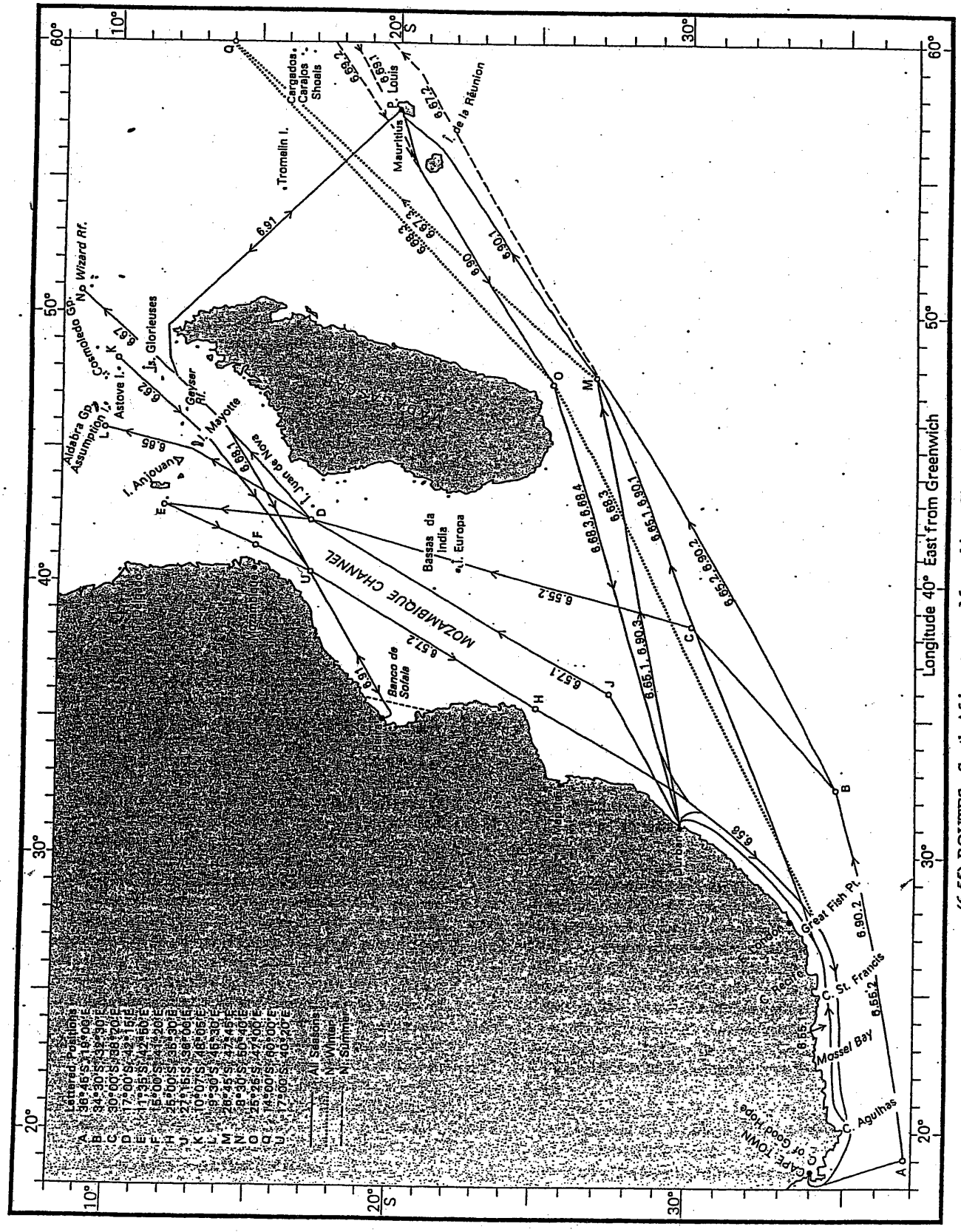
6.67.6
Distances in miles:

	Cape Town	Durban	Cape Town	Durban
West of Madagascar	April to October		November to March	
Colombo	4510(A)	3710	4640(A)	3850
Madras	5030(A)	4240	5160(A)	4370
Paradip	5480(A)	4690	5620(A)	4830
Calcutta Approach †	5560(A)	4770	5690(A)	4900
Rangoon River Entrance*.	5660(A)	4870	5790(A)	5000

	Cape Town	Durban	Cape Town	Durban
East of Madagascar	April to October		November to March	
Colombo	4450(a)	3690	4380(a)	3620
Madras	4930(a)	4170	4880(a)	4130
Paradip	5360(a)	4600	5310(a)	4560
Calcutta Approach †	5430(a)	4670	5390(a)	4630
Rangoon River Entrance*	5520(a)	4770	5470(a)	4740

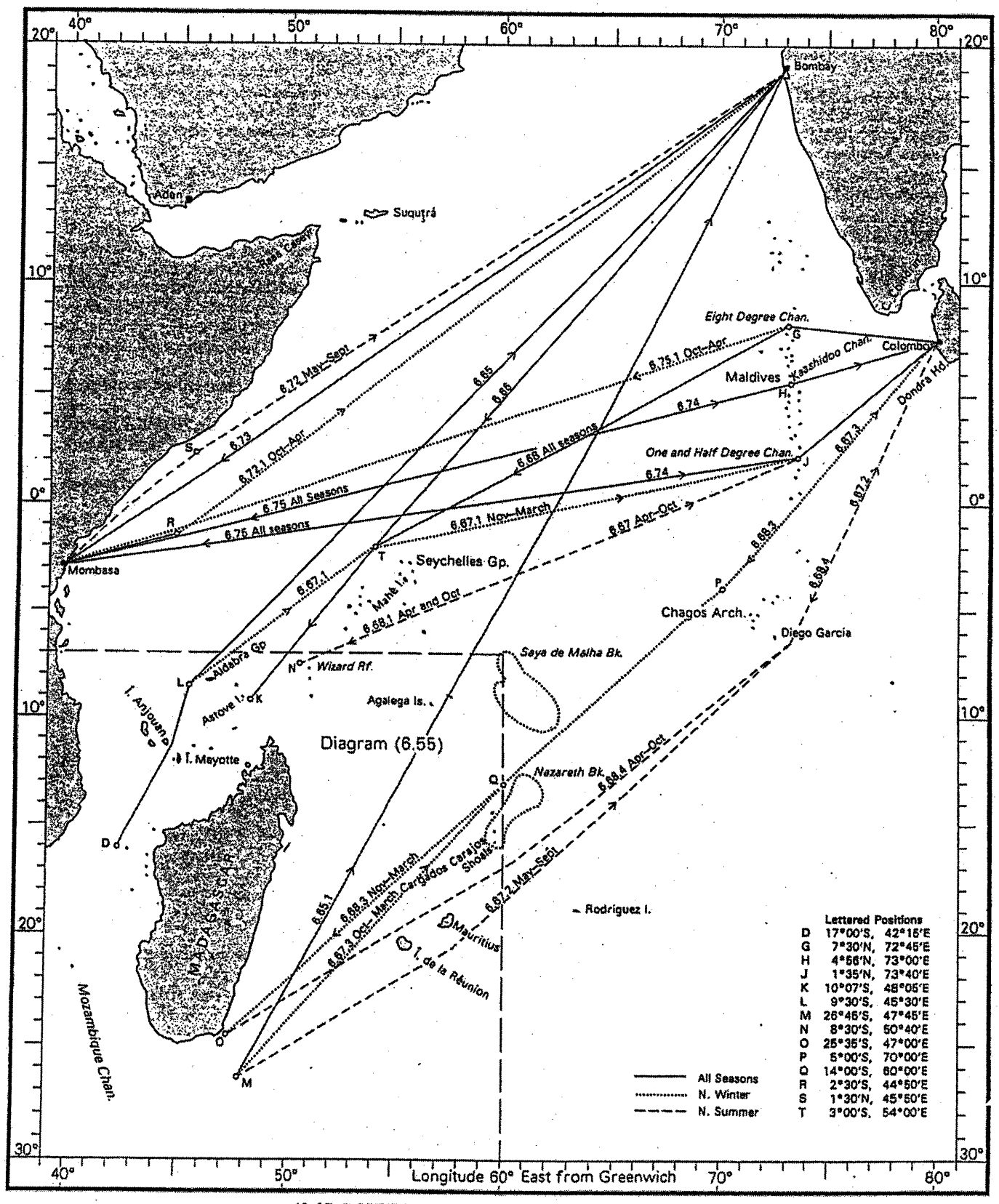
† Calcutta approach to Calcutta- add 125 mls
* Rangoon River entrance to Rangoon – add 40 mls
(A) For Cape of Good Hope (145 mls S of), add 95 mls
(a) For Cape of Good Hope (145 mls S of), subtract 20 mls

INDIAN OCEAN



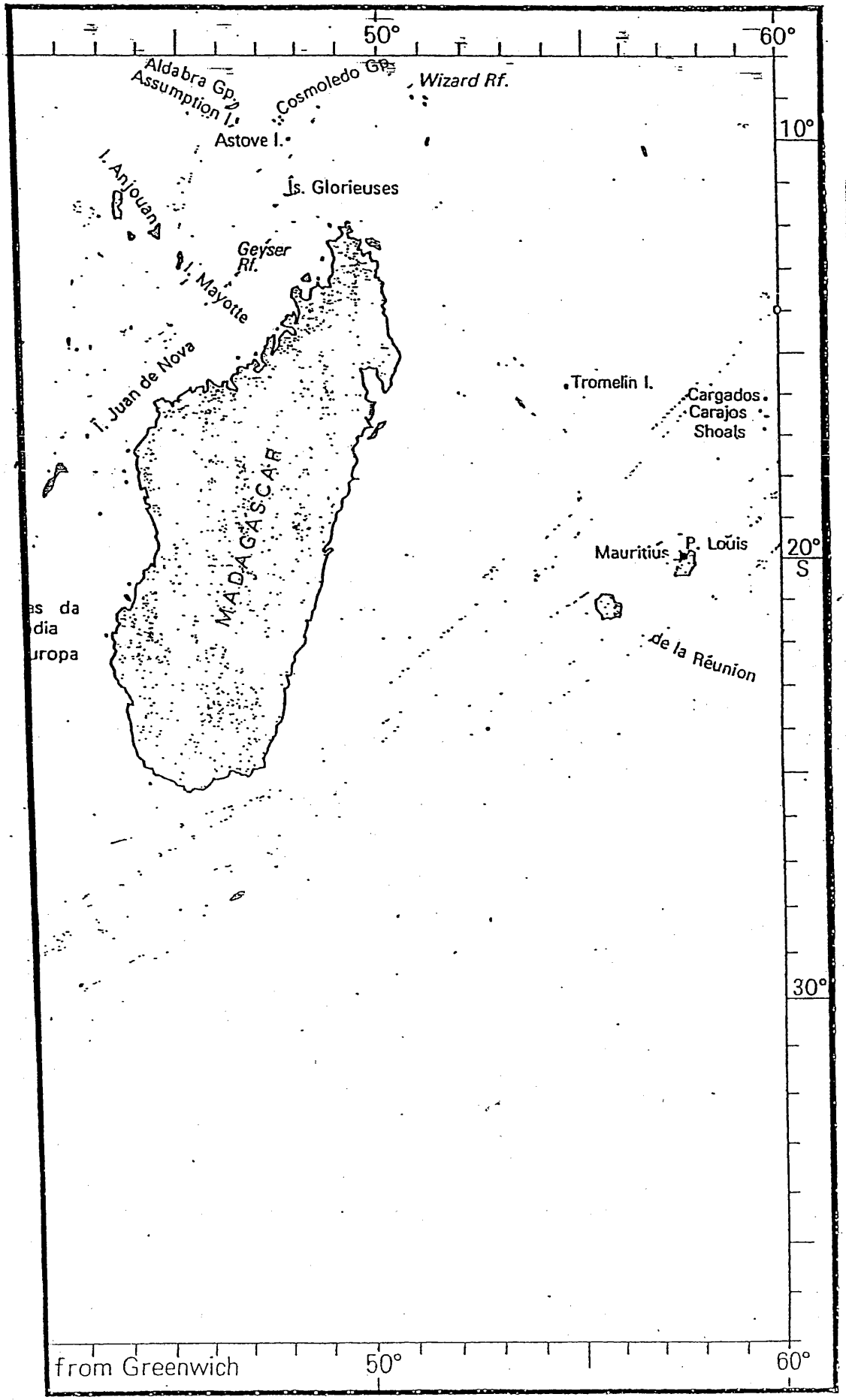
(6.55) ROUTES—South Africa ⟷ Mozambique Channel and Port Louis.

INDIAN OCEAN



(6.65) ROUTES—Africa ⟷ Bombay and Colombo.

(This Worksheet must be returned with your answer book)



Candidate's Name

Examination Centre

SQA - CM - MARCH 2006

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

1. A vessel is chartered to carry a gas separation module, for an oil production platform, from Jacksonville (Florida, USA) to Trondheim (Norway). On completion of loading the vessel will be 210 tonnes over her winter displacement. The vessel consumes 42 tonne of fuel and water per day at a service speed of 16 knots. The vessel is expected to sail on the morning of 11th April.

   The charterers have requested that the vessel takes the shortest possible distance to position 61° 14.0'N 6° 40.0'W and thence proceeds directly to the Trondheim Pilot station, however the vessel must stay outside the accepted iceberg limit as stated in Ocean Passages of the World.

   The Master is to use a departure position of 30° 00.0'N 79° 40.0'W.

   With reference to Datasheet Q1(A) - (B) and using Worksheet Q1(b):

   (a) calculate the shortest possible distance between the departure position and 61° 14.0'N 6° 40.0'W; (40)

   (b) on Worksheet Q1(b) indicate the route to be followed to 61° 14.0'N 6° 40.0'W. (10)

2. An accommodation module for the platform in Q1 is to be loaded onto a barge and towed, from its building dock in Nantucket Bay, to Boston for transhipment to a heavy lift vessel. The route is via the Cape Cod Canal (ATT 2805).

   With the module in its loaded position the barge has a freeboard of 4.6m. The overall height of the module and its supports is 18.3m above the deck of the barge.

   The tow must pass under a bridge at the Eastern entrance to the Cape Cod Canal which has a charted elevation of 25.2m.

   US Federal regulations state that a minimum clearance of 4m below the bridge must be maintained at all times.

   Using the Pacific and Atlantic Ocean Tide Tables and Worksheet Q2, determine the latest time the tow can pass under the bridge on the AM flood tide on the 9th April and still comply with the Federal regulations. (30)

3. The vessel in Q1 is fitted with all modern aids to navigation and communications systems, including GPS, ECDIS, ARPA and Loran C.

   (a) Outline the availability and likely accuracy of EACH of the following position fixing methods when used on an ocean passage in high northern latitudes in summer:

   (i) Loran C; (5)

   (ii) Celestial observations. (5)

   (b) Outline the MAIN features of an *Electronic Navigational Chart (ENC)*. (10)

   (c) Outline the current MCA guidance regarding the use of *Raster Navigational Charts* in ECDIS systems. (10)

4. Whilst navigating in the approaches to Trondheim the vessel will be required to use a traffic separation scheme.

   (a) Outline the bridge procedures to be adopted when approaching or navigating in a traffic separation scheme. (15)

   (b) State, giving reasons, the manning requirements of BOTH the bridge and the engine room for the situation described in Q4(a). (15)

   (c) Explain the precautions that should be taken when using parallel indexing to monitor the vessels progress along its track. (10)

5. Whilst in the traffic separation scheme the following observations were made on radar (6' Range Scale). Own vessel was proceeding on a course of 125°T at 8 knots down the centre of the SE bound lane. Visibility was estimated to be 7 cables in fog.

	Target A		Target B		Target C	
Time	Range	Bearing	Range	Bearing	Range	Bearing
1010	5.70	172.0°T	4.5	104.5°T	3.5	305.0°T
1016	4.60	173.0°T	4.0	105.5°T	3.0	305.0°T
1022	3.50	174.0°T	3.5	106.0°T	2.5	305.0°T

   (a) On Worksheet Q5 - Radar Plotting sheet, prepare a full report on all THREE targets. (30)

   (b) Determine the required alteration of course at 1028hrs to pass target *A* at a distance of one mile, assuming all alterations of course and/or speed are instantaneous. (10)

   (c) Comment on the navigational significance of your action. (5)

   (d) If own vessel resumes course at 1040hrs, determine the new CPA of target B. (5)

Western approaches to English Channel.

2.19

After SW or W gales, a set towards the mouth of the Channel may be expected, at a rate depending on the locality, strength, and duration of the gale. In winter, sets of up to 1½ knots are sometimes recorded, mainly in directions between ENE and SE, but the tidal streams are responsible for most of the water movement within the 200 m line.

Bay of Biscay

2.20

Off the mouth of the Bay of Biscay the current is trending SE and S to form the beginning of the Portugal Current (2.15). A branch enters the bay and recurves W along the N coast of Spain, but over most of the bay the currents are highly variable with a tendency for directions between E and S to predominate. The speeds for the most part do not exceed 1 knot and very rarely reach 2 knots.

Following W or NW gales E-going sets occur off the N coast of Spain, sometimes attaining a rate of 3 knots off Bilbao and 4–5 knots at the head of the bay particularly when current and tidal stream are in the same direction.

ICE

General remarks

2.25

The following brief account of ice in the North Atlantic Ocean is by no means comprehensive. Before undertaking voyages through areas in which ice is likely to be met, *The Mariner's Handbook* and the relevant Admiralty Sailing Directions should be studied, as well as the monthly Routeing Charts, which show the ice limits. These limits are also shown approximately on Diagrams (1.13a) and (1.13b), but they may not always agree with the Routeing Charts which endeavour to show the extreme limits on a monthly basis as far as this is possible with the limited and variable data available.

2.25.1

Five-day Ice Charts, obtainable from the Director General, Meteorological Office, Met.O.1a(1), Headquarters Annexe, Eastern Road, Bracknell, Berks, RG12 2UR should also be studied.

Facsimile broadcasts of ice charts are also available, as set out in *Admiralty List of Radio Signals Vol 5*.

A factor always to be borne in mind where ice conditions are concerned is their great variability. For this reason, and on account of the sparsity of observations in many areas, the charted positions of ice limits must be regarded as approximate. The dates which follow refer to average conditions.

Ice limits and drift

2.26

The Routeing Charts show the influence of the ocean currents (2.15 and 2.17) in setting the pack ice over much of the area of the Grand Banks of Newfoundland from the latter part of January until May, while the E part of the ocean remains ice-free to high latitudes.

Almost all the icebergs which menace the North Atlantic routes originate in the glaciers of the W coast of Greenland where they are calved at a rate of several thousand a year. Most are carried N by the West Greenland Current, round the head of Baffin Bay, and then S by the Canadian and Labrador Currents, and when they finally reach the shipping routes they may be several years old. The bergs calved on the E coast of Greenland also drift S, and may be met off Kap Farvel. Some drift across the East Greenland Current and may be met throughout the year on the E flank of that current, extending SW from the W extremity of Iceland. Others drift round Kap Farvel, but they do not survive the relatively warm water of Davis Strait and are not a source of danger on the regular transatlantic routes. Icebergs may be found beyond the limits of the pack ice at all seasons, but mostly in early summer; in winter many are frozen into the pack ice.

Ice in specific localities

2.27

Kap Farvel. The greatest distance at which bergs are met S of Kap Farvel is generally about 120 miles. This usually occurs in May when they may be encountered as far E as 66° N, 32° W. Their least extent is in December. Bergs are not usually met S of 48° N between September and December, but may be encountered in any month N of 52° N.

2.27.1

Saint Lawrence River below Montreal is closed by ice between early December and mid-April. Commercial navigation ceases in most parts of the Gulf of Saint Lawrence by mid-December; in the S part, navigation is not considered safe between early December and mid-April.

2.27.2

Strait of Belle Isle is generally not navigable from late December until June.

2.27.3

Cabot Strait is usually navigable from mid-April until February. Pack ice arrives from N off Cape Race about the end of January in an ordinary season, extending round the coasts of the Avalon Peninsula in February, until early May.

2.27.4

The Grand Banks of Newfoundland are entirely free of pack ice between July and December inclusive. Pack ice reaches the banks in January and extends farthest S in March and April, on the E edge of the banks. In very rare seasons, dangerous pack ice may extend to the Tail of the Bank and even S of it but, on average, the floes begin to break up on reaching 45° N

In the region of the Grand Banks, the worst season fc icebergs is between March and July, with April, May and June as the months of greatest frequency. Bergs are not often found S of 40° N or E of 40° W, though occasionally they may be considerably outside these limits. They are particularly prevelant around the E flank of the banks, on which many of them ground. More detail is given in Admiralty Sailing Directions.

2.27.5

Denmark Strait is normally free of ice on its E side throughout the year, but on rare occasions, as in the spring of 1968, the ice spreads across from Greenland to close the strait. Icebergs may be met throughout the year on both sides of Denmark Strait.

2.27.6

White Sea is normally closed to navigation from about mid-December to mid-May.

2.27.7

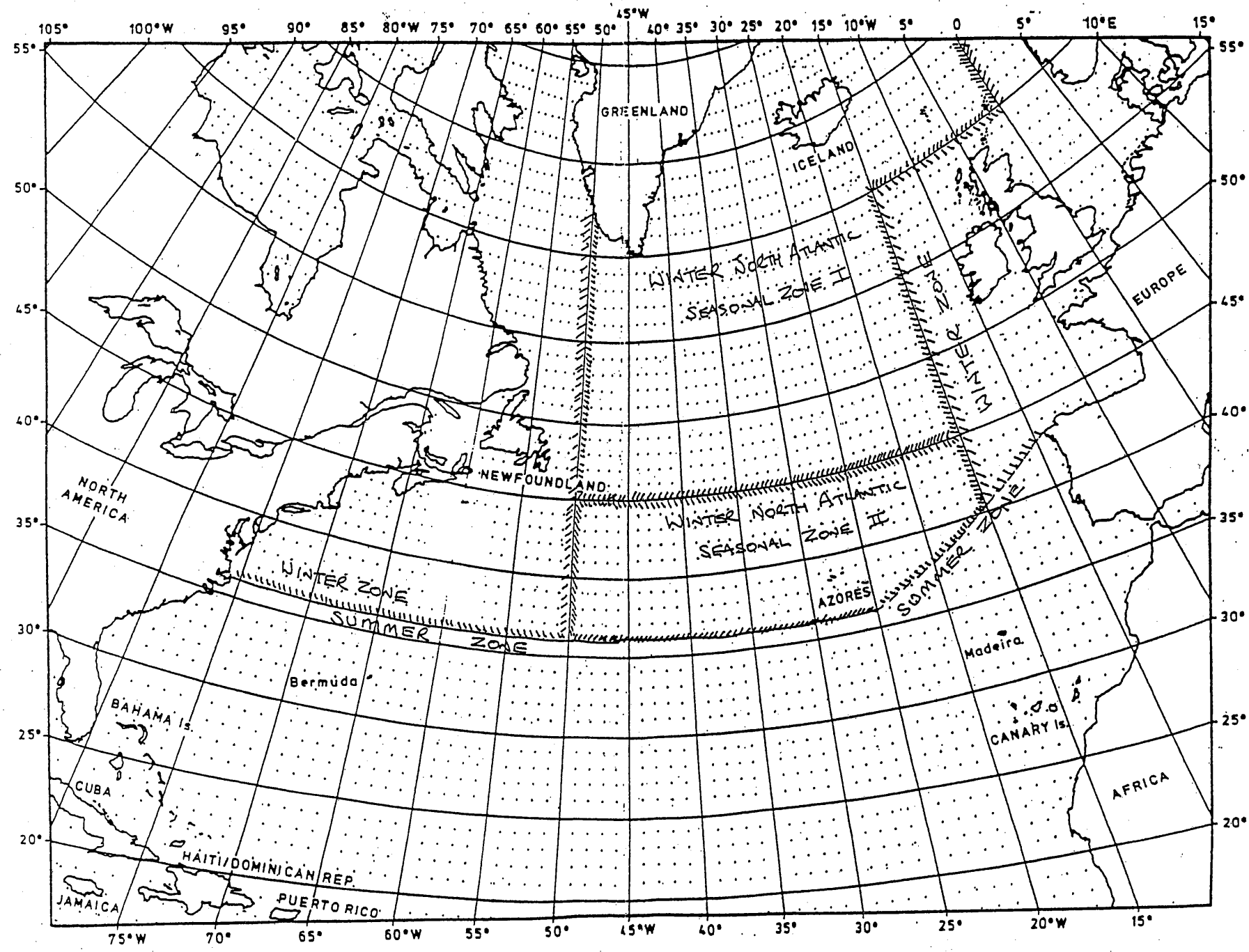
Kol'skiy Zaliv. The N part remains open throughout the year but, from December to April ice forms along the shore and at times breaks away, to be carried out to sea. It may be a hindrance for three or four days at a time in exceptionally cold winters.

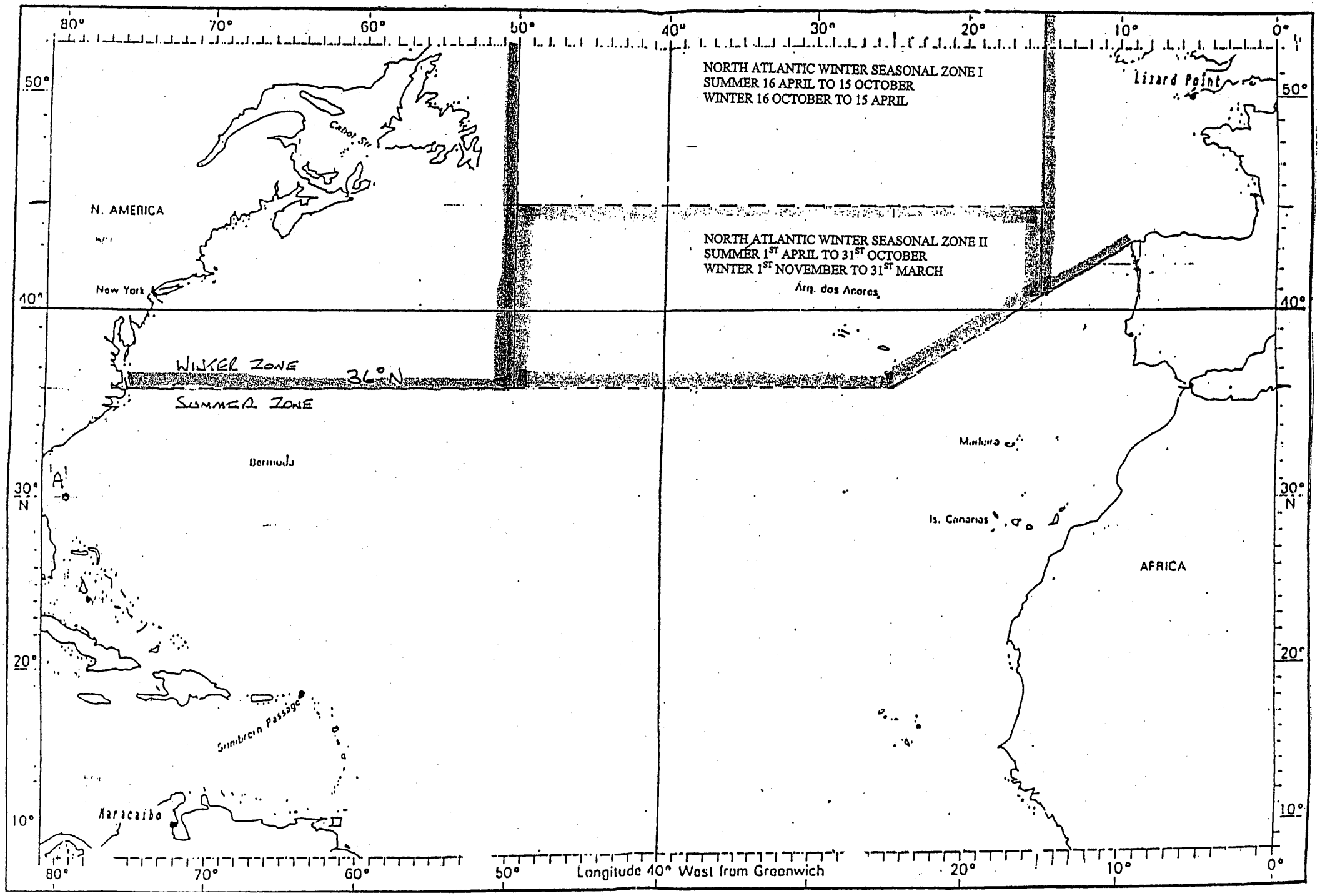
2.27.8

Norwegian coast. None of the main ports on the W coast is ever closed by ice, and the closure of Oslo is rare.

WORKSHEET Q1(b)

(This Worksheet must be returned with your answer book)




NORTH ATLANTIC WINTER SEASONAL ZONE I
SUMMER 16 APRIL TO 15 OCTOBER
WINTER 16 OCTOBER TO 15 APRIL
NORTH ATLANTIC WINTER SEASONAL ZONE II
SUMMER 1ST APRIL TO 31ST OCTOBER
WINTER 1ST NOVEMBER TO 31ST MARCH
N. AMERICA
AFRICA
Lizard Point
New York
Arq. dos Acores
Bermuda
Is. Canarias
Maracaibo
Sombrero Passage
WINTER ZONE
SUMMER ZONE
36°N
80°
70°
60°
50°
40°
30°
20°
10°
0°
50°
40°
30° N
20°
10°
Longitude 40° West from Greenwich

UNITED STATES – BOSTON

LAT 42°21'N LONG 71°03'W

TIME ZONE +0500 — TIMES AND HEIGHTS OF HIGH AND LOW WATERS — YEAR 0000

JANUARY

	Time	m		Time	m		Time	m		Time	m
	0327	2.7	**16**	0421	3.1	**1**	0418	2.8	**16**	0541	2.9
	0929	0.5		1030	0.1		1038	0.3		1205	0.3
M	1538	2.7	TU	1645	2.9	TH	1646	2.7	F	1822	2.6
	2156	0.3		2255	0.1		2257	0.3			
	0413	2.7	**17**	0519	3.0	**2**	0510	2.9	**17**	0018	0.5
	1021	0.5		1133	0.2		1136	0.2		0640	2.8
TU	1629	2.7	W	1749	2.8	F	1744	2.6	SA	1308	0.3
	2245	0.3		2353	0.2		2352	0.3		1925	2.5
	0501	2.7	**18**	0617	3.0	**3**	0606	3.0	**18**	0117	0.5
	1115	0.4		1237	0.2		1236	0.2		0739	2.8
W	1723	2.7	TH	1853	2.7	SA	1845	2.7	SU	1408	0.3
	2336	0.3								2023	2.5
	0552	2.8	**19**	0051	0.3	**4**	0051	0.3	**19**	0212	0.5
	1211	0.3		0715	3.0		0704	3.1		0833	2.9
TH	1819	2.7	F	1339	0.2	SU	1336	0.0	M	1500	0.2
				1954	2.6		1947	2.7		2114	2.6
	0029	0.3	**20**	0147	0.4	**5**	0150	0.2	**20**	0302	0.4
	0644	3.0		0810	3.0		0804	3.3		0921	2.9
F	1308	0.2	SA	1436	0.2	M	1435	−0.2	TU	1544	0.2
	1916	2.7		2050	2.6		2047	2.8		2158	2.6
	01.	0.2	**21**	0239	0.4	**6**	0248	0.0	**21**	0347	0.4
	0736	3.1		0900	3.0		0902	3.4		1005	3.0
SA	1404	0.0	SU	1526	0.1	TU	1532	−0.4	W	1624	0.1
	2013	2.8		2140	2.6		2144	3.0		2238	2.7
	0217	0.2	**22**	0327	0.4	**7**	0344	−0.1	**22**	0428	0.3
	0829	3.3		0945	3.0		0958	3.6		1045	3.0
SU	1459	−0.2	M	1609	0.1	W	1625	−0.5	TH	1701	0.1
	2109	2.9		2224	2.7		2239	3.1		2314	2.8
	0310	0.0	**23**	0410	0.3	**8**	0439	−0.3	**23**	0507	0.2
	0922	3.4		1027	3.0		1053	3.7		1122	3.1
M	1552	−0.4	TU	1649	0.0	TH	1717	−0.6	F	1736	0.0
	2204	3.0		2304	2.7	O	2331	3.3	●	2349	2.8
	0403	−0.1	**24**	0451	0.3	**9**	0532	−0.4	**24**	0546	0.2
	1015	3.6		1106	3.1		1147	3.7		1159	3.1
TU	1644	−0.5	W	1727	0.0	F	1807	−0.6	SA	1812	0.0
O	2257	3.1	●	2341	2.7						
	0456	−0.2	**25**	0531	0.3	**10**	0022	3.4	**25**	0024	2.9
	1108	3.7		1145	3.1		0625	−0.4		0625	0.1
W	1736	−0.6	TH	1804	0.0	SA	1239	3.6	SU	1236	3.0
	2349	3.2					1857	−0.6		1848	0.0
	0548	−0.2	**26**	0017	2.7	**11**	0112	3.4	**26**	0059	2.9
	1201	3.7		0610	0.2		0717	−0.4		0704	0.1
TH	1P··	−0.6	F	1222	3.1	SU	1332	3.5	M	1314	3.0
				1840	0.0		1946	−0.5		1925	0.1
	0042	3.2	**27**	0054	2.8	**12**	0203	3.3	**27**	0135	3.0
	0641	−0.3		0650	0.2		0810	−0.3		0745	0.1
F	1255	3.7	SA	1300	3.0	M	1425	3.3	TU	1354	3.0
	1918	−0.6		1918	0.0		2037	−0.3		2004	0.1
	0135	3.2	**28**	0130	2.8	**13**	0254	3.2	**28**	0213	3.0
	0735	−0.2		0730	0.2		0905	−0.1		0828	0.1
SA	1349	3.5	SU	1339	3.0	TU	1520	3.1	W	1437	2.9
	2011	−0.5		1956	0.1		2128	−0.1		2046	0.2
	0229	3.2	**29**	0208	2.8	**14**	0347	3.1			
	0831	−0.2		0812	0.3		1002	0.0			
SU	1446	3.4	M	1420	2.9	W	1617	2.9			
	2104	−0.3		2036	0.1		2222	0.2			
	0324	3.1	**30**	0248	2.8	**15**	0442	3.0			
	0929	0.0		0857	0.3		1102	0.2			
M	1544	3.1	TU	1504	2.8	TH	1718	2.7			
	2158	−0.1		2119	0.2		2319	0.3			
			31	0331	2.8						
				0945	0.3						
			W	1553	2.7						
				2205	0.2						

FEBRUARY

	Time	m		Time	m		Time	m		Time	m
	0256	3.0	**16**	0405	3.0	**1**	0414	3.1	**16**	0520	2.7
	0916	0.1		1028	0.2		1046	0.1		1146	0.5
TH	1524	2.8	F	1645	2.6	SU	1700	2.7	M	1807	2.5
	2133	0.2		2243	0.5		2305	0.4			
	0343	3.0	**17**	0501	2.8	**2**	0517	3.1	**17**	0003	0.7
	1009	0.2		1127	0.3		1149	0.1		0620	2.7
F	1618	2.7	SA	1746	2.5	M	1805	2.7	TU	1244	0.5
	2226	0.3		2342	0.6					1904	2.5
	0437	3.0	**18**	0601	2.7	**3**	0009	0.3	**18**	0101	0.6
	1107	0.2		1230	0.4		0623	3.1		0717	2.7
SA	1718	2.6	SU	1849	2.5	TU	1253	0.0	W	1337	0.4
	2324	0.3					1909	2.8		1955	2.6
	0537	3.0	**19**	0042	0.6	**4**	0113	0.2	**19**	0154	0.5
	1210	0.1		0702	2.7		0728	3.2		0810	2.8
SU	1821	2.7	M	1330	0.4	W	1354	−0.1	TH	1425	0.4
				1947	2.5		2011	3.0		2041	2.7
	0027	0.3	**20**	0139	0.6	**5**	0215	0.0	**20**	0243	0.4
	0640	3.1		0759	2.8		0831	3.3		0858	2.9
M	1313	0.0	TU	1423	0.4	TH	1451	−0.2	F	1508	0.3
	1926	2.7		2039	2.6		2107	3.2		2123	2.9
	0129	0.2	**21**	0231	0.5	**6**	0313	−0.2	**21**	0328	0.3
	0744	3.2		0850	2.9		0929	3.4		0942	3.0
TU	1414	−0.2	W	1509	0.3	F	1544	−0.3	SA	1548	0.2
	2028	2.9		2124	2.7		2200	3.3		2202	3.0
	0230	0.0	**22**	0318	0.4	**7**	0408	−0.3	**22**	0410	0.1
	0846	3.4		0935	2.9		1023	3.4		1024	3.0
W	1512	−0.3	TH	1550	0.2	SA	1634	−0.3	SU	1628	0.2
	2126	3.0		2204	2.8	O	2249	3.4		2239	3.1
	0328	−0.2	**23**	0400	0.3	**8**	0459	−0.4	**23**	0451	0.0
	0944	3.5		1017	3.0		1114	3.4		1104	3.0
TH	1606	−0.4	F	1627	0.1	SU	1721	−0.3	M	1707	0.1
	2220	3.2		2241	2.9		2335	3.5	●	2317	3.2
	0423	−0.3	**24**	0441	0.2	**9**	0548	−0.4	**24**	0533	−0.1
	1039	3.6		1055	3.0		1203	3.4		1145	3.0
F	1657	−0.5	SA	1704	0.1	M	1807	−0.2	TU	1747	0.1
O	2311	3.4	●	2316	3.0					2355	3.3
	0516	−0.4	**25**	0520	0.1	**10**	0020	3.5	**25**	0615	−0.2
	1131	3.6		1133	3.1		0636	−0.4		1227	3.0
SA	1745	−0.5	SU	1740	0.1	TU	1251	3.3	W	1828	0.1
				2351	3.0		1853	−0.1			
	0000	3.4	**26**	0559	0.0	**11**	0105	3.4	**26**	0035	3.3
	0607	−0.5		1211	3.1		0723	−0.3		0659	−0.2
SU	1222	3.5	M	1817	0.1	W	1339	3.1	TH	1311	3.0
	1833	−0.5					1939	0.1		1912	0.2
	0047	3.5	**27**	0026	3.1	**12**	0151	3.3	**27**	0119	3.3
	0657	−0.4		0639	0.0		0811	−0.1		0746	−0.2
M	1312	3.4	TU	1250	3.0	TH	1427	2.9	F	1358	3.0
	1920	−0.3		1855	0.1		2026	0.2		1959	0.2
	0134	3.4	**28**	0103	3.1	**13**	0238	3.1	**28**	0207	3.3
	0747	−0.3		0720	−0.1		0901	0.1		0836	−0.1
TU	1402	3.2	W	1330	3.0	F	1518	2.8	SA	1450	2.9
	2008	−0.1		1936	0.1		2115	0.4		2051	0.3
	0222	3.3	**29**	0143	3.1	**14**	0328	3.0	**29**	0300	3.2
	0838	−0.2		0805	0.0		0953	0.2		0931	−0.1
W	1454	3.0	TH	1415	2.9	SA	1612	2.6	SU	1546	2.8
	2057	0.1		2020	0.2		2208	0.6		2148	0.3
	0312	3.1	**30**	0228	3.1	**15**	0422	2.8	**30**	0359	3.2
	0931	0.0		0853	0.0		1049	0.4		1030	0.0
TH	1548	2.8	F	1504	2.8	SU	1709	2.5	M	1647	2.8
	2148	0.3		2109	0.3		2304	0.7		2250	0.3
			31	0318	3.1						
				0947	0.1						
			SA	1559	2.7						
				2204	0.3						

MARCH

APRIL

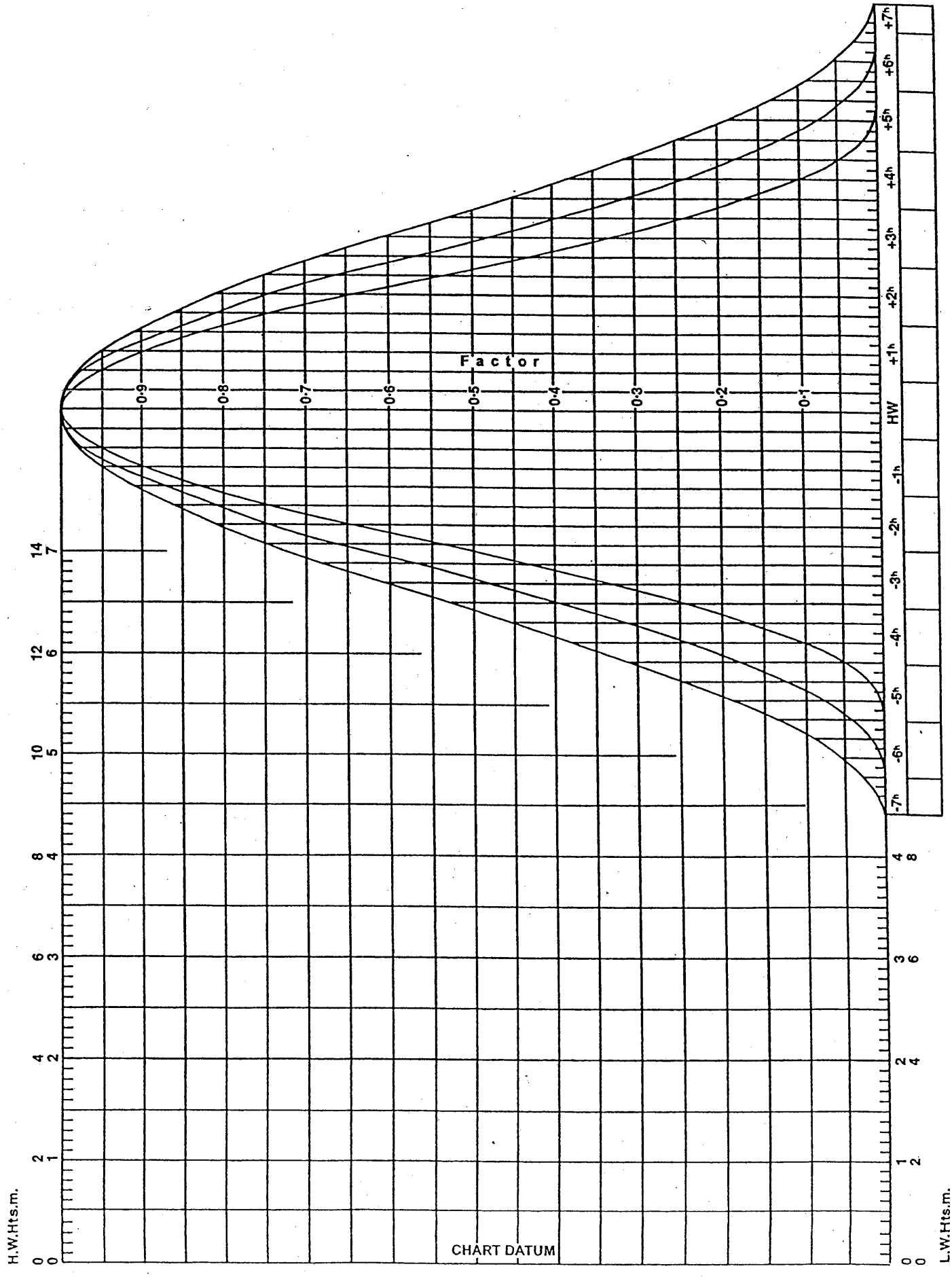
UNITED STATES, LONG ISLAND SOUND TO CASCO BAY

No.	PLACE	Lat. N.	Long. W.	TIME DIFFERENCES MHW	TIME DIFFERENCES MLW	HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS	M.L. Z_0 m.	
				Zone +0500							
2809	**BOSTON** ..... (see page 16)					**3.1**	**2.7**	**0.4**	**0.0**		
2762	Plum Island	41 10	72 12	−0120	−0117	−2.2	−1.9	−0.2	0.0	0.46	
2764	Herod Point	40 58	72 50	−0017	−0022	−1.1	−1.0	−0.1	0.0	0.94	
2765	Port Jefferson	40 57	73 05	+0006	+0008	−0.9	−0.9	−0.1	0.0	1.07	
2767	Lloyd Harbour	40 55	73 26	−0007	−0005	−0.7	−0.6	−0.1	0.0	1.22	
2769	Willetts Point ..... U	40 48	73 47	+0012	+0015	−0.6	−0.6	−0.1	−0.1	1.19	
2771	Stamford	41 02	73 33	+0006	+0009	−0.6	−0.6	−0.1	−0.1	1.19	
2772	Bridgeport ..... U	41 10	73 11	−0010	−0006	−0.9	−0.8	−0.1	0.0	1.10	
2773	New Haven Harbour	41 18	72 55	0000	+0002	−1.0	−1.0	−0.2	−0.1	0.98	
2773a	Hoadley Point	41 15	72 44	−0013	−0011	−1.3	−1.2	−0.2	0.0	0.9	x
2774	Falkner Island	41 13	72 39	−0023	−0033	−1.3	−1.2	−0.2	0.0	0.88	
2740	**SANDY HOOK** ..... (see page 15)					**1.6**	**1.3**	**0.3**	**0.0**		
	Connecticut River										
2775	Saybrook Jetty	41 16	72 21	+0254	+0255	−0.4	−0.3	−0.1	0.0	0.61	
	River Thames										
2776	New London ..... U	41 22	72 06	+0130	+0200	−0.7	−0.5	−0.1	0.0	0.49	
	ATLANTIC OCEAN										
2777	Watch Hill Point	41 18	71 52	+0045	+0050	−0.7	−0.6	−0.2	0.0	0.43	
2779	Block Island (Old Harbour)	41 10	71 33	−0014	−0010	−0.6	−0.5	−0.1	0.0	0.46	
	Narragansett Bay										
2780	Point Judith	41 22	71 29	−0010	−0005	−0.5	−0.5	−0.1	0.0	0.49	
2781	Newport ..... U	41 30	71 20	+0003	−0024	−0.4	−0.3	−0.1	0.0	0.55	
2783	Providence	41 48	71 24	+0004	−0052	−0.1	−0.1	0.0	0.0	0.73	
2784	Bristol	41 40	71 17	+0025	−0030	−0.2	−0.2	−0.1	0.0	0.67	
2785	Sakonnet	41 28	71 12	−0010	−0025	−0.5	−0.5	−0.1	0.0	0.52	
	Buzzards Bay										
2786	New Bedford	41 36	70 54	+0010	−0025	−0.4	−0.3	−0.1	−0.1	0.58	
2787	Cape Cod Canal W. Entrance	41 44	70 37	+0108	+0153	−0.4	−0.3	−0.1	0.0	0.58	*
	Nantucket Sound										
2790	Woods Hole (Great Harbour)	41 31	70 40	−0022	+0119	−1.0	−0.8	−0.2	0.0	0.30	
2791	Hyannis Port	41 38	70 18	+0435	+0355	−0.6	−0.4	−0.2	0.0	0.49	
2792	Monomoy Point	41 33	70 00	+0413	+0407	−0.4	−0.2	−0.1	0.0	0.58	
2793	Vineyard Haven	41 27	70 36	+0358	+0335	−1.0	−0.8	−0.2	0.0	0.27	
2794	Gay Head	41 21	70 50	−0006	+0020	−0.6	−0.5	−0.2	0.0	0.46	
2809	**BOSTON** ..... (see page 16)					**3.1**	**2.7**	**0.4**	**0.0**		
	Nantucket Island										
2797	Siasconset	41 16	69 58	+0015	+0019	−2.7	−2.4	−0.3	0.0	0.18	
2798	Great Point	41 23	70 03	+0041	+0026	−2.1	−1.8	−0.3	0.0	0.49	
2799	Nantucket Harbour	41 17	70 06	+0107	+0052	−2.1	−1.8	−0.3	0.0	0.49	
2800	Muskeget Island	41 20	70 18	+0023	+0013	−2.4	−2.1	−0.3	0.0	0.34	
2802	Chatham	41 40	69 56	+0030	+0024	−0.9	−0.8	−0.1	0.0	1.07	
2803	Race Point	42 04	70 15	−0003	−0004	−0.1	−0.1	0.0	0.0	1.46	
2805	Cape Cod Canal E. Entrance	41 46	70 30	0000	0000	−0.3	−0.3	−0.1	−0.1	1.40	
2806	Gurnet Point	42 00	70 36	+0002	+0007	−0.1	−0.1	0.0	0.0	1.49	
2807	Cohasset Harbour	42 15	70 47	+0002	−0004	−0.2	−0.2	0.0	0.0	1.43	
2809	BOSTON	42 21	71 03	STANDARD PORT			See Table V			1.59	
2811	Salem	42 31	70 53	+0002	+0001	−0.2	−0.2	0.0	0.0	1.43	
2813	Merrimack River Entrance	42 49	70 49	+0010	+0015	−0.3	−0.3	−0.1	−0.1	1.34	
2814	Portsmouth	43 05	70 45	+0003	+0003	−0.4	−0.4	−0.1	−0.1	1.28	
2815	Cape Porpoise	43 22	70 26	0000	+0003	−0.2	−0.2	0.0	−0.1	1.43	
2816	Portland ..... U	43 40	70 15	−0011	−0009	−0.1	−0.1	0.0	−0.1	1.49	
2818	Potts Harbour	43 44	70 01	−0009	−0008	−0.1	−0.2	0.0	−0.1	1.46	

⊖ No data.
* See notes on page 360.
U Tides predicted in United States Tide Tables.
d Differences approximate.
x M.L. inferred.

WORKSHEET Q2

(This Worksheet must be returned with your answer book)



July 2006

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a fully laden iron ore carrier (106 000 GT) which is to make a passage from Darwin (N.Territory, Australia) to Iquique (Chile), via the Torres Strait, in March.

1. (a) Using Datasheets Q1(a)(1) - (3):

   (i) outline the recommended route from the Torres Strait to Iquique; (8)

   (ii) identify FOUR potential hazards which should be taken into account during the appraisal of the passage. (12)

   (b) With reference to Datasheet Q1(b), describe the general weather and winds that may be expected on passage from the Torres Strait to Iquique (20)

2. The vessel is to sail the shortest route from 28° 30'.0S 170° 00'.0E to 20° 12'.0S 70° 10'.0W calculate EACH of the following:

   (a) the distance; (10)

   (b) the position of the vertex; (15)

   (c) the distance off Isla San Ambrosia 26° 20'.0S 79° 52'.0W, when the vessel crosses latitude 26° 20'S. (25)

3. On departure the vessel is expected to have a maximum draught aft of 14.0m.

   En route to the main outbound channel the vessel is required to cross a sand bank with a charted depth of 9.4m, approximately 20 minutes steaming from the berth. The Master has stated that the vessel must have a minimum UKC of 1.0m and in addition, an allowance for squat of 10% of the draught must be considered.

   In the event the vessel completes cargo at 1900 standard time on the 21st March.

   (a) Using Worksheet Q3(a), determine the latest time the vessel can leave the berth on the PM ebb tide of the 21st March and comply with the Masters requirements. (20)

   (b) Just prior to sailing the Chief Engineer advises that there is a problem with the engine which requires a replacement part to be fitted. In the event the repair is completed at 2300hrs (standard time) on the 22nd March.

   Determine the earliest tide the vessel can then sail on thereafter. (5)

   (c) Explain how meteorological conditions can influence the accuracy of tidal predictions. (15)

[OVER

4. (a) Outline the main components of the Global Maritime Distress and Safety System (GMDSS). (15)

(b) Describe the criteria used to determine the GMDSS equipment required for an ocean going vessel. (8)

(c) Outline the GMDSS equipment which must be carried for the proposed voyage from Darwin to Iquique. (7)

5. Whilst approaching the coast off Iquique, in dense fog, the OOW makes the following observations on the radar (12 Mile Range). The vessel is steering 050°(T) at 10.0 knots.

	Target A		Target B		Target C	
Time	Bearing	Range	Bearing	Range	Bearing	Range
0810	075°(T)	11.0	336°(T)	11.1	170°(T)	6.0
0822	075°(T)	9.0	337°(T)	9.3	170°(T)	5.2
0834	075°(T)	7.0	338°(T)	7.6	170°(T)	4.4

(a) On Worksheet Q5, complete the plot for all three targets. (10)

(b) Prepare a full report on all three targets at 0834hrs. (15)

(c) Determine the maximum speed required after 0846hrs to ensure that all targets clear the vessel with a minimum CPA of 2.0 miles. (15)

Note: assume change of speed has instantaneous effect.

SOUTH PACIFIC TRANS-OCEAN ROUTES

Southern Routes across Pacific Ocean

7.270

Diagram (7.270)

East-bound. The most S route usually adopted, referred to as the Southern Route, passes through the following positions:

48° 30′ S, 165° 00′ W
50° 00′ S, 140° 00′ W
51° 30′ S, 120° 00′ W
52° 45′ S, 100° 00′ W
55° 00′ S, 80° 00′ W

When the great circle between the terminal positions passes S of this route, it is best to steer, by great circle if possible, to join the route at a convenient position. Similarly, it is best to leave the route at a position enabling the destination to be made, by great circle if possible, without passing S of the above route.

Icebergs may be encountered on the Southern Route in all seasons, see 7.45.

Passages for which the Southern Route or part of it, are appropriate can best be seen from Chart 5098, the gnomonic chart for the South Pacific and Southern Oceans.

The following are the best joining and leaving positions:

	From	*Join in*
	Hobart or Snares Islands	48° 30′ S, 165° 00′ W
	Cook Strait	49° 30′ S, 150° 00′ W
	Auckland	50° 00′ S, 140° 00′ W
	For	*Leave in*
	Callao	48° 30′ S, 165° 00′ W
	Iquique	49° 30′ S, 150° 00′ W
	Valparaíso	50° 00′ S, 140° 00′ W
	Estrecho de Magallanes	52° 45′ S, 100° 00′ W
	Cabo de Hornos	55° 00′ S, 80° 00′ W

From Sydney or Brisbane for Callao and destinations farther S, the route is through Cook Strait. Alternatively from Sydney for Valparaíso and ports farther S, the route S of New Zealand is practicable and only slightly longer.

7.270.1

Diagram (7.275)

West-bound. Routes across the South Pacific Ocean lie far N of the Southern Route, following the parallel of 30° S for various distances between the meridians of 120° W and 150° W.

7.270.2

East-bound. Distances in miles by the above routes (except where indicated by notes):

	Callao	*Iquique*	*Valparaíso*	*Estrecho de Magallanes*‡	*Cabo de Hornos*
Hobart	6780	6700	6120	5430	5670
Port Phillip (*a*)	7040	6960	6370	5680	5930
Sydney**	6940*	6880	6290	5600	5850
Sydney***	—	—	6330	5640	5880
Caloundra Head (*b*)	7110	7050	6460	5770	6020
Wellington	5720*	5660	5070	4380	4630
Auckland	5840†	5820†	5250	4560	4810

† Direct.
‡ 5 miles NNW of Cabo Pilar.
* Direct after passing N of Chatham Islands.
** Via Cook Strait.
*** Via Snares Islands.
(*a*) Melbourne to Port Phillip: 40 miles.
(*b*) Brisbane to Caloundra Head: 35 miles. Routes via Cook Strait.

Torres Strait → South America

7.271

Diagrams (7.271), (7.270)

Routes are through Bligh Entrance, thence through 28°-30′ S, 170° 00′ E, passing S of Bellona Reefs and the submarine volcano (27° 45′ S, 169° 09′ E), thence as follows.

7.271.1

Cabo de Hornos or Estrecho de Magallanes. Great circle to join the Southern Route (7.270) in 50° 00′ S, 140° 00′ W.

7.271.2

Valparaíso or Iquique. Great circle to destination: that to Iquique passing close S of Isla San Ambrosio.

7.271.3.

Callao. Great circle to 38° 00′ S, 150° 00′ W, thence great circle to Callao.

Maria Theresa Reef (36° 50′ S, 136° 39′ W), the existence of which is doubtful, lies close N of the track.

7.271.4

Distances: Cabo de Hornos 7360 miles;
†Estrecho de Magallanes 7110 miles;
Valparaíso 7800 miles;
Iquique 8340 miles;
Callao 8300 miles.

†5 miles NNW of Cabo Pilar.

Hobart → Panama

7.272

Diagrams (7.271), (7.270)

The route is by great circle to 47° 50′ S, 167° 50′ E, ENE of Snares Islands, thence great circle to Gulf of Panama.

Distance: 7640 miles.

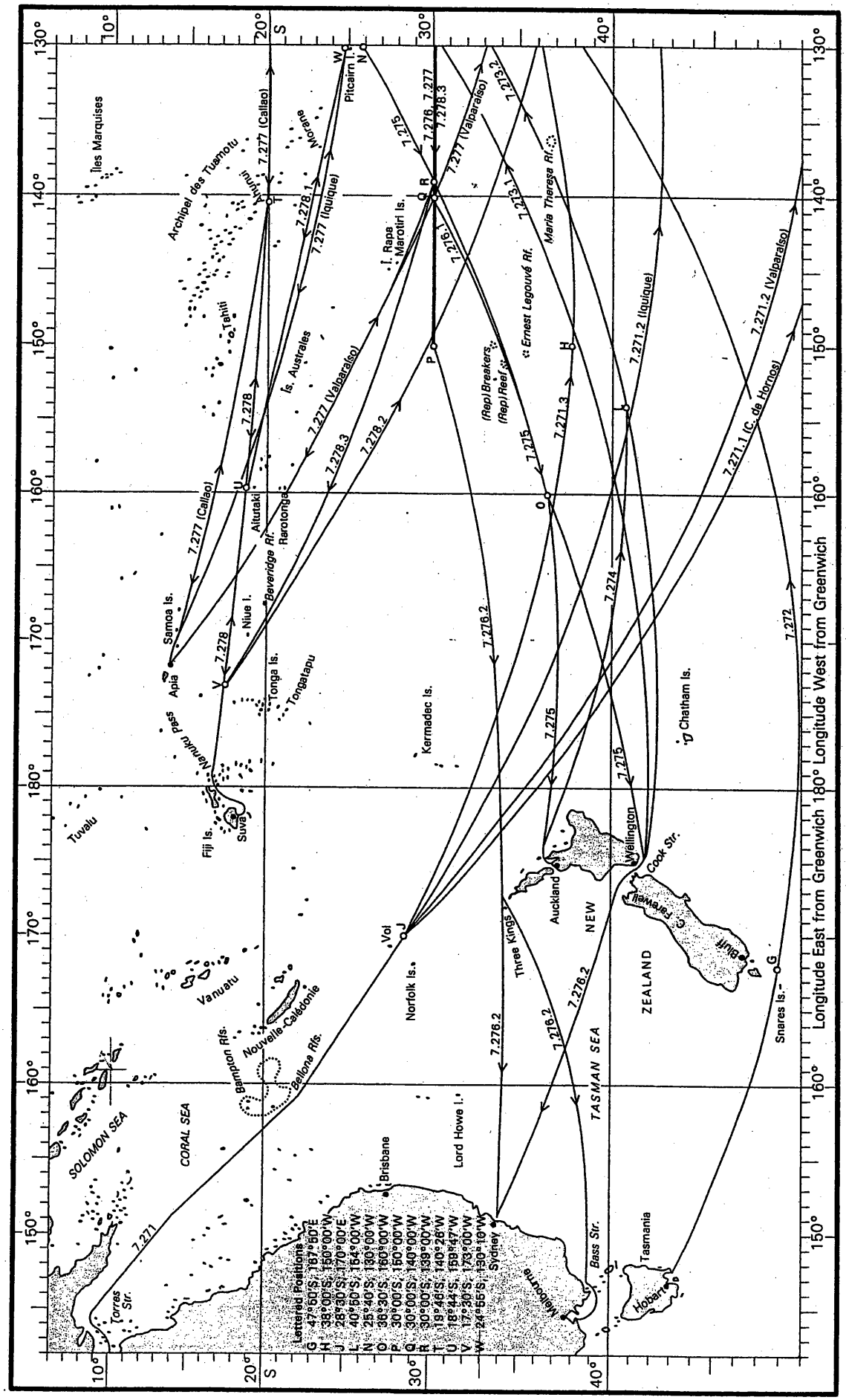
Wellington → Panama

7.273

Diagrams (7.271), (7.270)

Routes are by great circle to:

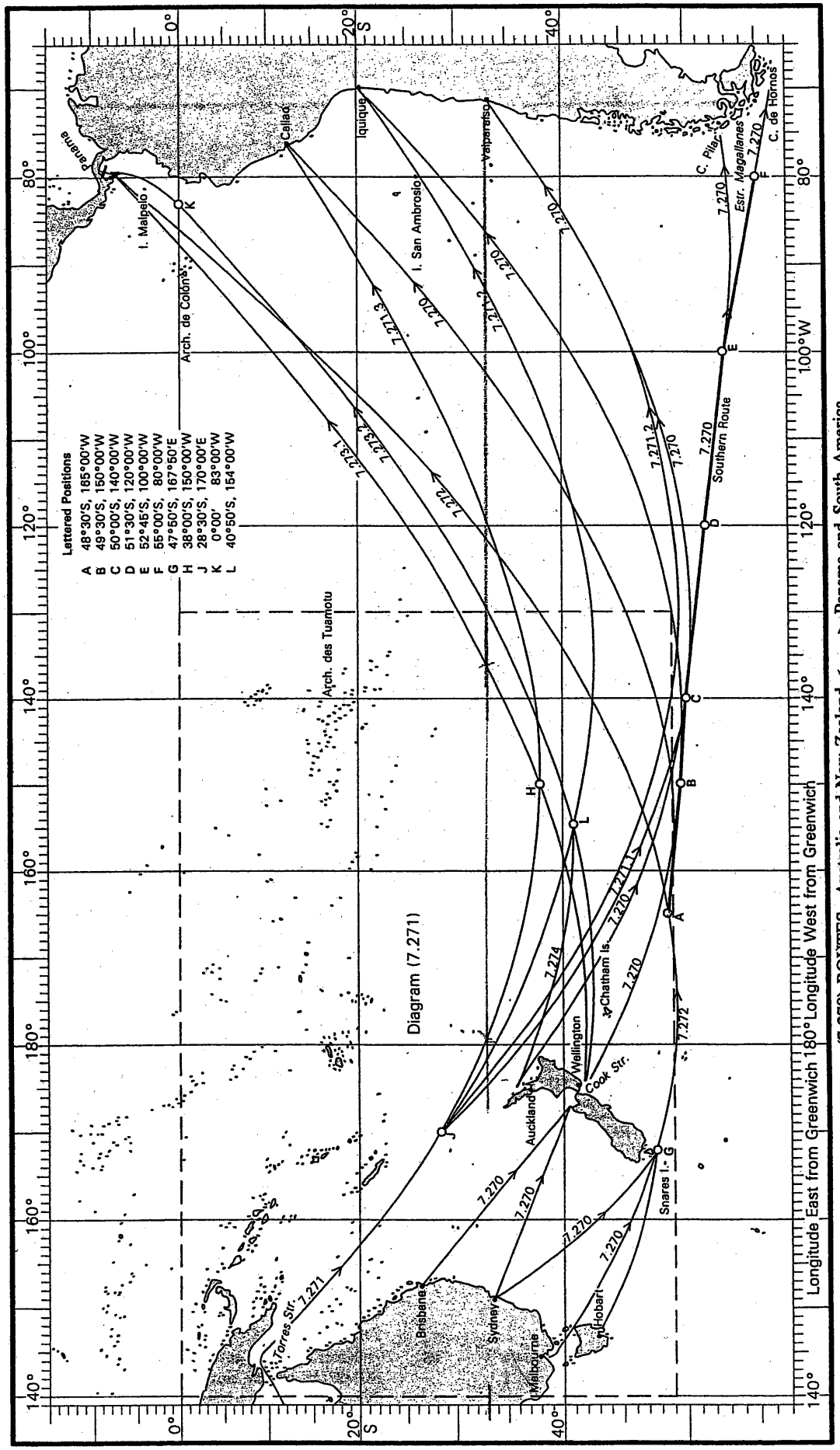
PACIFIC OCEAN AND ADJACENT SEAS



(7.271) ROUTES— South America ⟷ Apia, Suva, New Zealand and Australia.

Longitude East from Greenwich 180° Longitude West from Greenwich

PACIFIC OCEAN AND ADIACENT SEAS



(7.270) ROUTES—Australia and New Zealand ⟷ Panama and South America.

JULY '06 Q.116)

SOUTH PACIFIC OCEAN

South-east Trade Wind

7.17

The South-east Trade Wind blows on the equatorial side of the oceanic high pressure area situated in about 30°S.

The S limit of the Trade Wind is situated in 15°S to 20°S in winter and in 30° S in summer.

In the vicinity of the W coast of South America the Trade Wind blows from between S and SE, while farther W the direction becomes predominantly E. It becomes SE again in winter W of about 160°E and over the seas N of Australia, where it is sometimes known as the South- east Monsoon. The average strength of the Trade Wind is about force 4, but it often freshens to force 5 or 6 over large areas.

Over the open ocean the characteristic weather of the steady South-east Trade Wind is fair with occasional showers; skies are about half covered with small cumulus clouds, and there is a slight haze which reduces visibility to between about 8 and 15 miles. Showers, cloud and haze generally increase when the wind freshens.

Over the seas N of Australia, during the season when the South-east Trade Wind prevails in these regions, namely from April to September or October, cloud amounts and rainfall are small; extensive dust haze prevails, especially towards the end of the season, due to the persistent offshore winds from the increasingly dry interior of the continent.

Fog and mist are rather common towards the coast of South America over the cold waters of the Peru Current (7.34) but rarely occur elsewhere.

Variables

7.18

Between the S limit of the South-east Trade Wind and the N limit of the Westerlies, there is a wide belt of variable winds of mainly moderate strength. The approximate area covered by this belt extends from 25°S to 40°S in summer, and from 20°S to 30°S in winter. It does not, however, extend completely across the ocean. To the E of about 85°W, S to SE winds prevail, forming a S extension of the South-east Trade

Over the greater part of the area winds are likely to reach force 7 or above on 1-3 days per month, rising to 3-6 days per month towards the S limits of the zone. This latter frequency is also reached in many months over large areas W of about 160°W.

The weather is variable, being governed largely by the E-moving anticyclones already mentioned. Near the centres of these anticyclones it is fair or fine, while the intervening troughs of low pressure are characterised by cloudy, unsettled weather, with rainfall increasing towards the S. To the E of 85°W to 90°W, rainfall becomes progressively smaller towards the N and E, and it is very infrequent in the vicinity of the American coast. In this area, cloud amounts are often large, and overcast skies are common in winter.

Visibility is generally good in the N part of the zone except when reduced by rain, but the frequency of moderate and poor visibility increases with latitude towards the S limits of 40°S in summer and 30°S in winter; visibility of less than 5 miles is recorded in some ten to fifteen per cent of ships' observations in summer, and five per cent in winter. It is generally associated with winds from some N point.

In the extreme E part of the zone, over the cold waters of the Peru Current, fog is rather prevalent, and off the W coast of South America it occurs on 3-5 days per month towards the S limit of the zone.

The Westerlies

7.19

The Westerlies or `Roaring Forties' predominate S of the belt of high pressure described in articles 7.17 and 7.18. As in the zone of the Westerlies in other oceans, the almost continuous passage of depressions from W to E causes the wind to vary greatly in both direction and strength. Gales are very common, especially in winter, during which season winds are likely to reach force 7 or above on 5-10 days per months over most of the area between 30°S and 40°S.

As in the Westerlies of other oceans, the weather is very variable, periods of overcast skies and rain or snow associated with the fronts of E-moving depressions alternating with fair weather. Fine weather is seldom prolonged and cloud amounts are generally large at all times.

Visibility also varies greatly; with winds from a S point it is generally good, while N winds are often associated with moderate or poor visibility. Fog is rather common in summer and may be expected on 3-5 days per month.

AUSTRALIA, NORTH COAST - DARWIN

LAT 12°28'S LONG 130°51'E

TIME ZONE -0930

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 0000

JANUARY

	TIME	M		TIME	M
1	0259	5.4	16	0154	5.2
F	1022	1.7	SA	0927	2.0
	1708	6.3		1649	6.0
	2305	3.7		2241	4.0
2	0358	5.5	17	0318	5.3
SA	1107	1.5	SU	1031	1.6
	1753	6.6		1740	6.6
	2351	3.4		2336	3.6
3	0447	5.6	18	0427	5.6
SU	1145	1.4	M	1126	1.1
	1832	6.9		1826	7.1
4	0024	3.1	19	0020	3.1
M	0531	5.8	TU	0524	6.1
	1219	1.3		1217	0.7
	1907	7.0	●	1909	7.5
5	0053	2.9	20	0102	2.7
TU	0611	6.0	W	0617	6.5
	1253	1.2		1303	0.5
	1939	7.1		1949	7.7
6	-23	2.7	21	0143	2.3
W	0651	6.2	TH	0708	6.8
	1325	1.2		1345	0.4
	2010	7.1		2025	7.9
7	0155	2.6	22	0225	1.9
TH	0728	6.2	F	0759	6.9
	1355	1.3		1425	0.6
	2038	7.0		2059	7.8
8	0229	2.5	23	0309	1.7
F	0804	6.1	SA	0849	6.9
	1423	1.6		1504	1.0
	2106	6.9		2131	7.7
9	0304	2.5	24	0354	1.6
SA	0840	6.0	SU	0939	6.6
	1444	1.8		1539	1.6
	2132	6.7		2202	7.4
10	0342	2.6	25	0440	1.6
SU	0920	5.7	M	1030	6.2
	1502	2.2		1613	2.3
	2158	6.6		2232	6.9
11	0423	2.6	26	0529	1.8
M	1004	5.5	TU	1125	5.8
	1524	2.6		1647	3.1
	26	6.3		2259	6.3
12	0510	2.7	27	0623	2.0
TU	1057	5.2	W	1232	5.3
	1600	3.1		1733	3.7
	2257	6.0		2329	5.7
13	0603	2.6	28	0723	2.3
W	1205	5.1	TH	1411	5.2
	1700	3.7		1904	4.3
	2338	5.6			
14	0705	2.6	29	0023	5.1
TH	1332	5.0	F	0838	2.4
	1837	4.1		1557	5.4
				2219	4.3
15	0036	5.4	30	0222	4.8
F	0815	2.3	SA	0958	2.3
	1533	5.4		1707	5.9
	2103	4.3		2337	3.8
			31	0401	4.9
			SU	1108	2.1
				1756	6.3

FEBRUARY

	TIME	M		TIME	M
1	0015	3.4	16	0438	5.5
M	0501	5.3	TU	1126	1.4
	1158	1.8		1817	7.0
	1835	6.6			
2	0043	3.0	17	0019	2.8
TU	0547	5.7	W	0538	6.2
	1236	1.6		1219	0.9
O	1908	6.9	●	1858	7.5
3	0108	2.7	18	0059	2.2
W	0625	6.1	TH	0631	6.8
	1307	1.4		1304	0.5
	1938	7.1		1935	7.9
4	0131	2.5	19	0139	1.6
TH	0702	6.3	F	0721	7.3
	1334	1.3		1342	0.4
	2004	7.2		2008	8.1
5	0157	2.2	20	0219	1.1
F	0735	6.5	SA	0807	7.5
	1359	1.3		1419	0.6
	2026	7.2		2037	8.1
6	0226	2.1	21	0257	0.8
SA	0807	6.5	SU	0850	7.4
	1421	1.4		1452	1.1
	2047	7.2		2104	7.9
7	0256	2.0	22	0336	0.8
SU	0838	6.5	M	0932	7.1
	1438	1.7		1523	1.7
	2107	7.1		2129	7.4
8	0326	1.9	23	0413	1.0
M	0911	6.3	TU	1013	6.7
	1454	2.0		1551	2.4
	2125	6.9		2151	6.9
9	0358	1.9	24	0450	1.4
TU	0948	6.1	W	1055	6.1
	1515	2.4		1617	3.1
	2144	6.6		2208	6.2
10	0430	2.0	25	0529	1.9
W	1029	5.9	TH	1145	5.5
	1544	2.9		1652	3.8
	2205	6.2		2227	5.6
11	0505	2.2	26	0620	2.4
TH	1118	5.6	F	1307	5.1
	1627	3.5		1802	4.3
	2228	5.8		2254	4.9
12	0549	2.3	27	0738	2.8
F	1224	5.3	SA	1542	5.2
	1731	4.1		2313	4.2
	2305	5.3			
13	0701	2.5	28	0216	4.4
SA	1447	5.2	SU	0940	2.9
	1939	4.5		1702	5.6
				2342	3.6
14	0032	4.9	29	0432	4.8
SU	0851	2.4	M	1110	2.5
	1637	5.7		1746	6.1
	2244	4.1			
15	0308	4.9			
M	1021	2.0			
	1732	6.4			
	2336	3.5			

MARCH

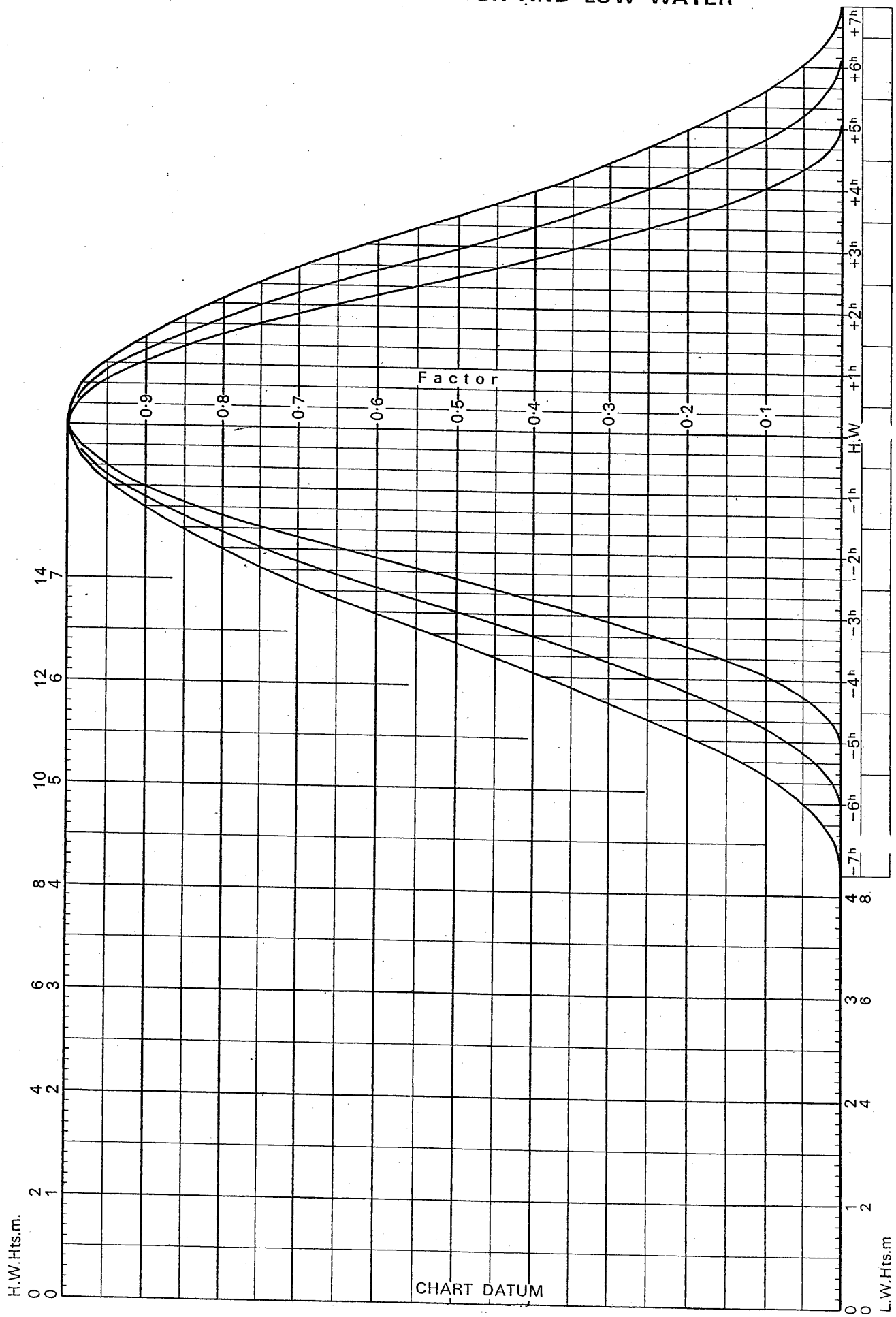
	TIME	M		TIME	M
1	0008	3.2	16	0443	5.8
TU	0523	5.4	W	1114	1.6
	1155	2.1		1751	6.9
	1820	6.4			
2	0032	2.8	17	0001	2.3
W	0559	5.9	TH	0540	6.5
	1228	1.8		1204	1.1
	1849	6.7		1830	7.4
3	0053	2.4	18	0041	1.5
TH	0631	6.3	F	0631	7.2
O	1254	1.5		1246	0.9
	1914	6.9	●	1904	7.7
4	0114	2.1	19	0120	0.9
F	0701	6.6	SA	0716	7.6
	1319	1.4		1323	0.9
	1937	7.1		1933	7.9
5	0138	1.8	20	0157	0.5
SA	0730	6.8	SU	0758	7.7
	1341	1.4		1357	1.1
	1956	7.2		1959	7.8
6	0205	1.6	21	0232	0.4
SU	0759	6.9	M	0837	7.6
	1402	1.5		1428	1.6
	2013	7.2		2024	7.6
7	0232	1.4	22	0306	0.5
M	0827	6.9	TU	0913	7.3
	1423	1.8		1458	2.1
	2030	7.1		2047	7.1
8	0259	1.3	23	0338	0.9
TU	0857	6.8	W	0949	6.8
	1445	2.1		1527	2.7
	2047	6.9		2108	6.5
9	0327	1.4	24	0408	1.4
W	0931	6.7	TH	1024	6.3
	1512	2.5		1556	3.2
	2107	6.6		2126	5.9
10	0355	1.5	25	0440	2.0
TH	1008	6.4	F	1105	5.7
	1545	2.9		1633	3.7
	2128	6.2		2146	5.2
11	0427	1.8	26	0527	2.6
F	1051	6.0	SA	1203	5.2
	1624	3.5		1738	4.1
	2153	5.7		2138	4.6
12	0510	2.2	27	0650	3.1
SA	1151	5.5	SU	1451	5.0
	1721	4.1		2245	4.0
	2228	5.2			
13	0627	2.6	28	0241	4.3
SU	1404	5.2	M	0853	3.2
	1933	4.4		1622	5.3
				2309	3.5
14	0019	4.7	29	0423	4.9
M	0830	2.6	TU	1036	2.8
	1610	5.6		1705	5.7
	2231	3.9		2332	3.0
15	0326	5.0	30	0503	5.5
TU	1008	2.2	W	1120	2.4
	1707	6.3		1737	6.1
	2320	3.1		2353	2.6
			31	0537	6.0
			TH	1152	2.1
				1804	6.4

APRIL

	TIME	M		TIME	M
1	0014	2.2	16	0012	1.1
F	0609	6.4	SA	0616	7.2
	1220	1.9		1217	1.6
	1828	6.7	●	1815	7.2
2	0038	1.8	17	0050	0.6
SA	0640	6.7	SU	0700	7.5
	1246	1.8		1253	1.7
O	1850	6.9		1843	7.3
3	0104	1.4	18	0124	0.4
SU	0711	6.9	M	0738	7.6
	1310	1.8		1327	1.8
	1908	7.0		1910	7.2
4	0130	1.1	19	0156	0.4
M	0740	7.1	TU	0815	7.5
	1335	1.9		1359	2.1
	1926	7.0		1938	7.0
5	0157	1.0	20	0227	0.6
TU	0809	7.2	W	0849	7.2
	1400	2.0		1430	2.5
	1946	6.9		2004	6.6
6	0224	0.9	21	0256	1.0
W	0839	7.1	TH	0922	6.8
	1429	2.3		1502	2.8
	2008	6.7		2030	6.1
7	0253	1.0	22	0325	1.5
TH	0913	6.9	F	0954	6.3
	1503	2.6		1535	3.2
	2035	6.4		2058	5.6
8	0325	1.3	23	0358	2.1
F	0951	6.6	SA	1031	5.8
	1539	3.0		1615	3.5
	2104	6.0		2134	5.0
9	0403	1.7	24	0447	2.7
SA	1036	6.1	SU	1120	5.3
	1623	3.5		1716	3.8
	2138	5.5		2245	4.5
10	0455	2.2	25	0606	3.1
SU	1138	5.6	M	1246	5.0
	1727	3.9		2031	3.9
	2238	5.0			
11	0622	2.6	26	0122	4.4
M	1329	5.3	TU	0748	3.3
	1957	4.0		1446	5.1
				2158	3.4
12	0115	4.7	27	0327	4.8
TU	0810	2.7	W	0921	3.1
	1520	5.6		1547	5.4
	2153	3.3		2228	2.9
13	0323	5.2	28	0419	5.3
W	0938	2.4	TH	1020	2.8
	1621	6.1		1626	5.7
	2248	2.6		2256	2.5
14	0433	6.0	29	0459	5.8
TH	1044	2.0	F	1102	2.6
	1706	6.6		1657	6.0
	2332	1.8		2323	2.0
15	0528	6.6	30	0537	6.2
F	1135	1.7	SA	1137	2.4
	1743	7.0		1724	6.3
				2353	1.5

Q3a.

FOR FINDING THE HEIGHT OF THE TIDE AT TIMES BETWEEN HIGH AND LOW WATER



NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a tanker which is to make a fully laden passage from Louisiana Offshore Oil Port, LOOP, (28°53'N 90°01'W) to a landfall position off Cape Town (S.Africa) (33°53'S 18°26'E). The vessel is due to clear LOOP on the 13th September.

1. (a) With reference to Datasheets Q1(1) – (4), outline the recommended routes for the proposed passage. (10)

   (b) With reference to the great circle leg of the passage, calculate EACH of the following:

   (i) the distance on the great circle leg; (10)

   (ii) the final course on arrival at the landfall position; (10)

   (iii) the position of the vertex. (15)

2. When carrying out the appraisal of the Caribbean leg of the passage, it is noted that several hazards will be encountered.

   (a) Describe EACH of the following:

   (i) the navigational hazards that are likely to be encountered; (12)

   (ii) the meteorological hazards that are likely to be encountered. (8)

   (b) Datasheet Q1(3) shows an alternate route from the Mississippi delta to the exit channel from the Caribbean, passing through the Old Bahama Channel and the Mona Passage. Comment on why this is not listed as an alternate route for the proposed passage. (8)

   (c) Outline the watchkeeping procedures that should be implemented to deal with the hazards described in Q2(a). (12)

3. On Worksheet Q3, chartlet of the South Atlantic Ocean, indicate EACH of the following:

   (a) the general pressure distribution over the Ocean; (5)

   (b) the general wind circulation; (10)

   (c) the main ocean currents; (15)

   (d) any environmental hazards. (5)

[OVER

4. Whilst on passage across the South Atlantic Ocean, the Master wishes to verify the accuracy of the GPS using celestial observations.

   (a) Discuss the availability and use of celestial observations to verify the vessel's position. (8)

   (b) The vessel intends to take star sights during morning twilight on the 26th September, whilst in DR position 22° 17'S 42° 36'W. Ships time (GMT -3hrs)

   With reference to Datasheet Q4:

   (i) determine which stars are available for observation, stating their altitudes and azimuths; (14)

   (ii) state, with reasons, which stars are best suited for a four star fix. (8)

   (c) Discuss the factors that should be considered when selecting stars for determining the vessel's position. (10)

5. Masters standing orders form an important part in ensuring the safety of the navigational watch.

   (a) Describe the contents of Masters Standing Orders, outlining the factors that should be taken into account when compiling them. (20)

   (b) Compile Masters standing orders for EACH of the following situations:

   (i) making a landfall; (10)

   (ii) maintaining an anchor watch. (10)

CHAPTER 4

CARIBBEAN SEA AND GULF OF MEXICO

WINDS AND WEATHER

General description

4.1

Over the Caribbean Sea, NE to E winds prevail throughout the year, while over the Gulf of Mexico the wind is generally lighter and more variable in direction, though frequently from between NE and SE. In coastal waters, strong N winds may reach gale force at times over the Gulf. For the whole area, wind speeds are mainly light or moderate except for occasional hurricanes, see 2.5, which may affect the area from June to November. Most hurricanes track N of Cuba, and they rarely occur S of 15° N.

The weather over the area is generally partly cloudy with scattered showers. Sunny spells are frequent and, from May to December, periods of heavy rain and thunderstorms are frequent. Squalls may occur at anytime, but fog seldom occurs at sea.

Visibility is generally good throughout the year though it may at times be drastically reduced by heavy rain.

For Northers, see 2.3.

SWELL

General description

4.5

Swells are generally lower in the Gulf of Mexico than in the Caribbean Sea.

In the Caribbean Sea the prevailing direction is from NE to E; in the Gulf of Mexico, from March to September it is from E to SE, and from October to February it is from NE.

Highest swells occur in an area round 13° N, 77° W in the Caribbean Sea, especially in June and July, when the frequency of swell greater than 4 m is 20 per cent. These swells are invariably short or average in length.

CURRENTS

General description

4.11

The North Equatorial Current (2.15) flows WNW through the Caribbean Sea with little change of direction until it approaches Yucatan Channel where it turns to the N. It leaves an anti-clockwise eddy in the S part of the sea, S of about 12° N. There is also an E-going counter-current close to the S coast of E and central Cuba.

In the Gulf of Mexico, part of the N-going flow from Yucatan Channel fans out in directions between SW and NW. Currents setting in these directions occupy most of the Gulf W of a line from Cabo Catoche to close W of the Mississippi delta. From the NW flow along this line, water fans out NE and then shortly recurves to join the SE flow extending from the Mississippi delta to the W approaches to Straits of Florida. This SE-going stream joins the NE-going stream which emerges from Yucatan Channel and the combined flow continues E, and through Straits of Florida as the Florida Current. The emerging stream meeting the NW flowing water of the North Sub-tropical Current, turns N off the E coast of Florida and forms the beginning of the Gulf Stream.

Along the W coast of Florida there is a N-going current which, with the SE flow coming from the Mississippi delta, forms an anti-clockwise eddy in the E part of the Gulf of Mexico.

There is little seasonal variation in the pattern of the currents.

The average current rates in most of the Caribbean Sea are about 1 knot, increasing on the W side of Yucatan Channel to about 4 knots. The strongest currents are observed in Straits of Florida in about 25° 00′ N, 80° 00′ W and for about 300 miles N from that position. Here the average rate is nearly 3 knots in summer and 2½ knots in winter.

Over most of the Gulf of Mexico the average rates are about 1 knot, but N-going sets of about 1½ knots are reported in summer near the Mexican coast N of Tampico and SE-going sets of a similar magnitude for much of the year between the Mississippi delta and Cuba.

NOTES AND CAUTIONS

Navigation

4.15

In the Caribbean Sea and Gulf of Mexico, and in the channels leading thereto, great care is necessary near the cays and banks, as some of the charts are based on old and imperfect surveys.

Furthermore, depths over the shoals may be less than those charted owing to the growth of the coral of which many of them are composed or to the imprecise nature of the least depths reported over them. Shoal water should be approached with caution at all times and given a wide berth when conditions for fixing are poor: many of the banks are steep-to.

4.15.1

Caution. Strong currents can be expected in the entrances and channels leading to the Caribbean Sea and Gulf of Mexico, particularly in Straits of Florida.

Having chosen the route, the mariner should invariably consult Admiralty Sailing Directions for details of currents and tidal streams affecting it.

Entrance Channels

4.16

Diagram (4.21)

The Caribbean Sea may be approached through Crooked Island Passage, Caicos Passage or Turks Island Passage, all of which lead to Windward Passage.

Crooked Island Passage is the most frequently used.

Caicos Passage is not lighted, and Turks Island Passage, not lighted in its S approach, is not recommended for N-bound vessels at night.

Other entrances in common use are:

Mona Passage, which is much frequented and presents no difficulty. Although subject to heavy squalls it is safer than Turks Island Passage.

Sombrero Passage, which is not lighted in its S approach.

The Channel between Saint Lucia and Saint Vincent.

The passages N and S of Tobago.

In many cases routes through the various passages differ little in distance, and selection will depend principally on the ship's particular requirements.

For distances from these passages, see 4.29–4.29.8.

ROUTES

English Channel ↔ Caribbean Sea and Gulf of Mexico

4.21

Diagram (4.21)

Routes are as follows.

Belize. Providence Channels or Turks Island Passage and Windward Passage are suitable.

Kingston or Colón. Turks Island Passage and Windward Passage are suitable.

Colón or Curaçao. Mona Passage or Sombrero Passage are suitable.

Gulf of Mexico may be approached, either N of Cuba, through Providence Channels or Old Bahama Channel and Nicholas Channel, or S of Cuba through Caribbean Sea and Yucatan Channel. For routes within Gulf of Mexico, see Admiralty Sailing Directions.

Straits of Florida, through which the current runs strongly to the N, is best for departure from Gulf of Mexico.

For distance through these passages, see 4.29.8 and 2.85.4.

Bermuda → Habana

4.22

Diagram (4.21)

The route is through North-East Providence Channel, North-West Providence Channel and Straits of Florida.

Distance: 1130 miles.

4.22.1

For low-powered vessels, routes from the W end of the North-West Providence Channel are:

Either,

Across Straits of Florida to Fowey Rocks, thence:
Close off Florida Reefs, as directed in Admiralty Sailing Directions, to Sand Key, thence:
Across the Florida Current again to Habana.

Or, preferably by day,

Along the W edge of Great Bahama Bank to Habana. See Admiralty Sailing Directions.

Habana → Bermuda

4.23

Diagram (4.21)

The route is through Straits of Florida, thence direct from the NW end of Little Bahama Bank.

For Caution on approaching Bermuda, see 2.38.

Distance: 1150 miles.

Bermuda ↔ Kingston

4.24

Diagram (4.21)

From Bermuda the route is through either Crooked Island Passage or Caicos Passage (see 4.16), thence W of Great Inagua Island and through Windward Passage.

Cautions. Morant Cays have been the scene of many wrecks. Currents in their vicinity vary greatly, both in direction and rate. If passing them at night, ships should keep well N of them.

For Caution on approaching Bermuda, see 2.38.

4.24.1

Distances:

Via Crooked Island Passage 1180 miles;
Via Caicos Passage 1110 miles.

Colón (for Panama Canal) ↔ Gulf of Mexico

4.25

Diagram (4.21)

North-bound. From the entrance to the canal between the breakwaters off Colón, the route runs NNE to round New Bank at a prudent distance, thence direct to Yucatan Channel.

South-bound. From Yucatan Channel the route is:

To a position outside the 200 m depth contour off South-West Point, Grand Cayman Island, thence:
To a point off the SW extremity of Pedro Bank, thence:

Either, direct to Colón, passing between New Bank and Alice Shoal or, if unsure of the position, the route continues SE till New Bank has been cleared and a SSW course can be set for Colón.

Caution. New Bank and Alice Shoal are charted mainly from a survey of 1835.

Due allowance must be paid to the prevailing W-going current between Colón and Jamaica.

A vessel entering the W part of Gulf of Mexico from the Caribbean Sea should be kept in the deep water in Yucatan Channel, all precautions being taken against the N-going current and her position continually checked to identify the point of crossing the edge of Campeche Bank.

The edge of the bank is generally marked by ripplings, and only a short distance within it the water becomes discoloured. The bank has not been subjected to a modern survey, and new reports of shoal patches are often received, so sounding should be continuous when crossing it. Dangers on the bank are steep-to and sometimes indicated by discoloured water.

For routes W of Thunder Knoll, and from Yucatan Channel to ports in Gulf of Mexico, see Admiralty Sailing Directions.

4.25.1

Distances from Colón, passing W of New Bank: if passing E of New Bank, add 15 miles:

Cabo Catoche (28 miles ENE of) 965 miles;
Cabo San Antonio (10 miles W of) 900 miles;
New Orleans (Mississippi River South Pass) 1380 miles;
S entrance to Panama Canal (Balboa) 45 miles.

Yucatan Channel ↔ Eastern part of Caribbean Sea

4.26

Diagram (4.21)

Cabo Catoche should be given a wide berth on account of the shoals N of it.

East-bound. From 7 miles S of Cabo San Antonio, the route is:

Along the S coast of Cuba to pass 5 miles S of Cabo Cruz, thence:
5 miles S of Navassa Island, thence:
5 miles S of Pointe de Gravios, thence:
To a position 5 miles S of Alta Vela.

This track, mostly under the lee of the land, makes use of the E-going counter-current (4.11). Off the coast of Cuba between Cabo San Antonio and Cabo Cruz, special caution is required because onshore sets sometimes run strongly.

West-bound. From Alta Vela the route passes N of Jamaica, thence as direct as navigation permits to Cabo San Antonio.

Eastern part of Caribbean Sea → South American ports

4.27

Diagram (4.21)

For destinations E of the Caribbean Sea, the best route from Alta Vela passes between Saint Lucia and Saint Vincent and S of Barbados.

Colón (for Panama Canal) ↔ Trinidad, Galleons Passage and Tobago

4.28

Diagram (4.21)

East-bound passages are best made keeping close inshore, passing S of Aruba and Curaçao, and through Canal de Margarita.

West-bound, advantage can be taken of the W-going North Equatorial Current, by passing N of the outlying islands and dangers.

Distances from Colón (by either route):
Trinidad (Port of Spain) 1140 miles;
Galleons Passage 1170 miles;
Tobago (15 miles N of North Point) 1180 miles.

Distances from entrances to Caribbean Sea

4.29

Diagram (4.21)

Straits of Florida (N end)
Dry Tortugas (24° 30′ N, 83° 05′ W) 285 miles;
(From Dry Tortugas (24° 25′ N, 83° 00′ W) to N end 290 miles.)
New Orleans (Mississippi River Gulf Outlet Canal) 720 miles;
Habana 285 miles.

4.29.1

North-East Providence Channel
Dry Tortugas (24° 30′ N, 83° 05′ W) 380 miles;
New Orleans (Mississippi River Gulf Outlet Canal) 805 miles:
Habana 370 miles.

4.29.2

Crooked Island Passage (from landfall on San Salvador) via Old Bahama Channel:
Habana 585 miles;
New Orleans (Mississippi River Gulf Outlet Canal) 1060 miles.
Via Windward Passage:
Kingston 480 miles;
Belize 1080 miles;
Colón 980 miles.

4.29.3

Caicos Passage via Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1070 miles;
Habana 590 miles.
Kingston, passing W of Great Inagua Island 390 miles.

4.29.4

Turks Island Passage via Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1160 miles;
Habana 685 miles.
Via Windward Passage:
Belize 1030 miles;
Colón 925 miles;
Kingston 420 miles.
To Tampico and ports in Gulf of Mexico farther S, Yucatan Channel gives the shortest route: to ports N and E of Tampico, Old Bahama Channel gives the shortest.

4.29.5

Mona Passage
Kingston 520 miles;
Curaçao 390 miles;
Colón 885 miles;
Belize 1180 miles.

4.29.6

Sombrero Passage
Kingston 755 miles;
Curaçao 500 miles;
Colón 1090 miles;
Belize 1410 miles.

4.29.7

Saint Lucia/Saint Vincent Channel
Barbados (Bridgetown) 85 miles;
Kingston 950 miles;
Curaçao 480 miles;
Colón 1150 miles;
Belize 1590 miles.
Via Mona Passage and Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1860 miles;
Habana 1370 miles.

4.29.8

Galleons Passage
Kingston 1010 miles;
Curaçao 480 miles;
Via Mona Passage and Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1960 miles.

but the track reaches 53° S, and it cannot therefore be recommended on account of ice and weather.

The normal route is:

Rhumb line to 43° 00′ S, 47° 00′ W, thence:
Rhumb line to 41° 10′ S, 40° 00′ W, thence:
Rhumb line to 40° 20′ S, 33°00′ W, thence:
Great circle to destination, passing S of Gough Island.

Distances:

Cape Town 3800 miles;
Cape Agulhas (15 miles S of) 3840 miles;
Cape of Good Hope (145 miles S of) 3760 miles.

3.57.1

For low-powered vessels, routes are by rhumb line to 36° S, 40° W, thence rhumb line to 36° S, 25° W, thence by great circle to destination, passing S of Tristan da Cunha Group.

Cabo de Hornos → Cape Town or the Indian Ocean

3.58

Diagram (3.48)

Routes are either through Estrecho de Le Maire or E of Islas de los Estados, as at 3.36, to join the routes from the Falkland Islands (3.57) off Stanley.

Distances:

Cape Town 4230 miles;
Cape Agulhas (15 miles S of) 4270 miles;
Cape of Good Hope (145 miles S of) 4190 miles.

Cape Town → Galleons Passage and Colón (for Panama Canal)

3.59

Diagrams (3.42), (4.21)

From Cape Town or Cape Agulhas routes are by great circle to 4° 40′ S, 34° 35′ W, off Cabo Calcanhar, thence direct to Galleons Passage (2.107), thence as at 4.28 to Colón.

Distances in miles.

	Cape Town	Cape Agulhas (15′ S of)
Galleons Passage	5260	5360
Colón	6430	6530

Cape Town → Northern part of Caribbean Sea and Gulf of Mexico

3.60

Diagrams (3.42), (4.21)

From Cape Town and Cape Agulhas routes are:
Great circle to 4° 40′ S, 34° 35′ E, off Cabo Calcanhar, thence:
Direct to Saint Lucia/Saint Vincent Channel as at 2.107, thence:
As at 4.26 to Yucatan Channel, or to Mona Passage and through Old Bahama Channel to Gulf of Mexico.

Distances to Saint Lucia/Saint Vincent Channel:

From Cape Town 5340 miles;
From Cape Agulhas (15 miles S of) 5440 miles.

Cape Town ↔ Cabot Strait, Halifax or New York

3.61

Diagrams (3.42), (2.82)

For Cabot Strait or Halifax routes are:

From Cape Agulhas. As navigation permits to round Cape Point, thence great circle to 14° 40′ N, 24° 55′ W. (Routes to or from Cape Agulhas are not shown on diagrams.)
From Cape Town. Great circle to 14° 40′ N, 24° 55′ W.
To Cape of Good Hope (145 miles S of). Great circle from 14° 40′ N, 24° 55′ W.

Between Cabot Strait or Halifax and 14° 40′ N, 24° 55′ W the route is by great circle.

In Cabot Strait, a Traffic Separation Scheme (1.28) has been established.

3.61.1

For New York, all routes are by great circle to or from destination.

3.61.2

Distances in miles.

	Cabot Strait	Halifax	New York
Cape Town	6450	6490	6790
Cape Agulhas (15 miles S of)	6560	6600	6900
Cape of Good Hope (145 miles S of)	6580	6630	6910

South-west coast of Africa and Gulf of Guinea ↔ Colón (for Panama Canal)

3.62

Diagrams (3.42), (4.21)

From ports S of Douala, routes are by great circle to Galleons Passage, thence as at 4.28 to Colón.

From places between Douala and Takoradi, routes are round Cape Palmas, thence great circle to 11° 35′ N, 60° 35′ W (15 miles N of Tobago), thence as at 4.28 to Colón.

3.62.1

W-bound, benefit may be obtained by making use of the W-going South Equatorial Current (3.12) and North Equatorial Current (2.15 and 4.11).

E-bound, currents in general are unfavourable, but it may be possible to make use of the E-going Equatorial Counter-current and Guinea Current.

3.62.2

Distances to Colón:

Lobito 5830 miles	Bonny River 5240 miles
Pointe Noire 5620 miles	Lagos 5040 miles
Libreville 5410 miles	Takoradi 4730 miles
Douala 5400 miles	Cape Palmas (20′ SSW of) 4350 miles

Gulf of Guinea ↔ North American ports

3.63

Diagrams (3.42), (2.82)

Routes are direct to Cape Palmas, thence:
Direct to 4° 20′ N, 9° 20′ W, thence:
Direct to 14° 40′ N, 24° 55′ W, SW of Arquipélago de Cabo Verde, thence:
Great circle to destination.

From Lobito, however, the route is direct to 14° 40′ N, 24° 55′ W.

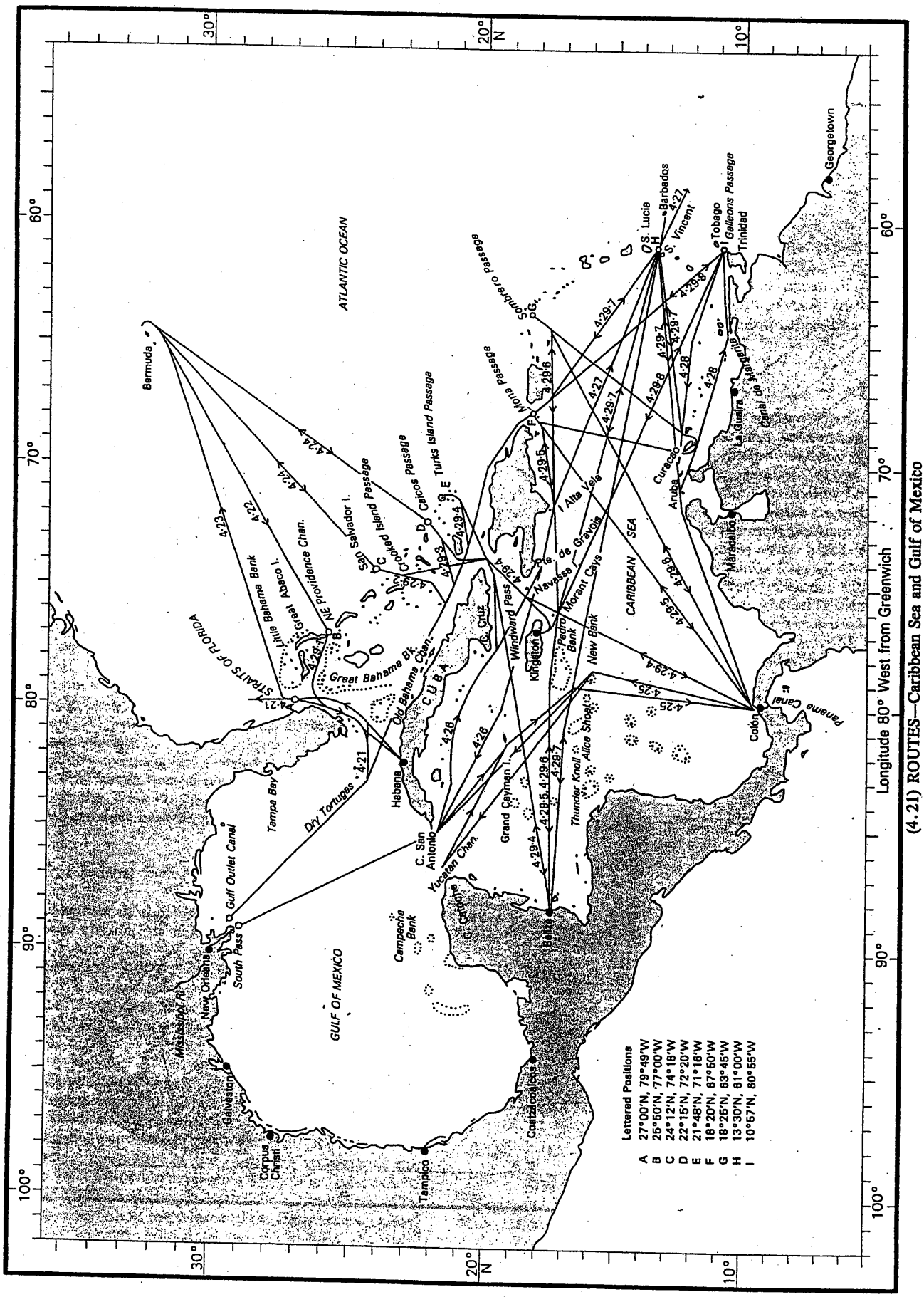
In Cabot Strait, a Traffic Separation Scheme (1.28) has been established.

3.63.1

Distances in miles.

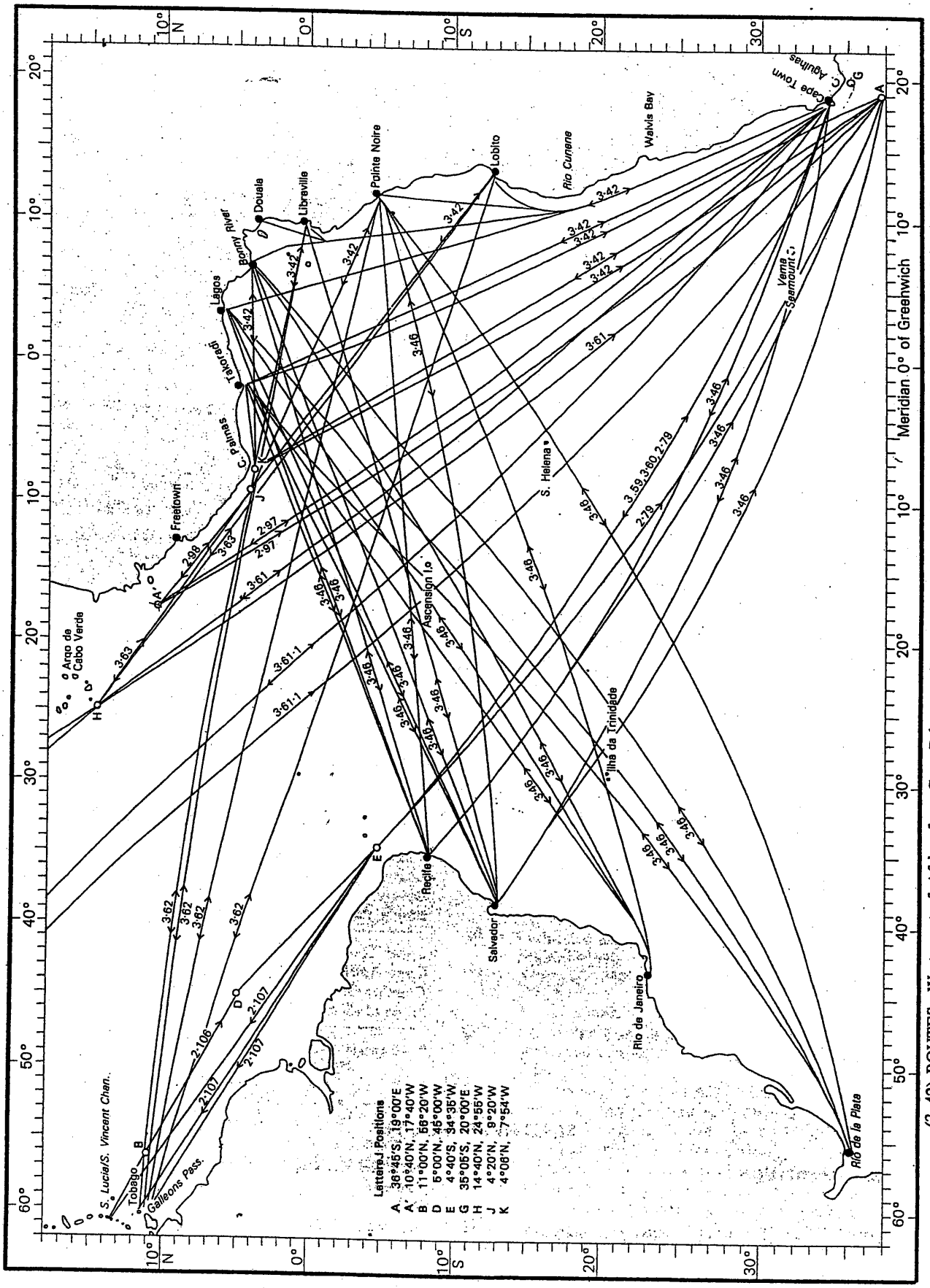
	Cabot Strait	Halifax	New York
Lobito	5430	5470	5780
Pointe Noire	5120	5160	5480
Libreville	4880	4920	5240
Douala	4870	4910	5230
Bonny River	4720	4760	5080
Lagos	4520	4560	4880
Takoradi	4200	4240	4560
Cape Palmas (20′ SSW of)	3820	3860	4180

CARIBBEAN SEA AND GULF OF MEXICO



(4.21) ROUTES—Caribbean Sea and Gulf of Mexico

SOUTH ATLANTIC OCEAN



(3.42) ROUTES—West coast of Africa from Cape Palmas to Cape Agulhas, and routes across northern part of South Atlantic Ocean

G.M.T. (UT)	ARIES	VENUS −3.4		MARS +0.8		JUPITER −1.9		SATURN +0.8	
	G.H.A.	G.H.A.	Dec.	G.H.A.	Dec.	G.H.A.	Dec.	G.H.A.	Dec.
d h	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
25 00	3 41.9	208 30.4	N11 20.9	258 16.6	N23 11.2	268 32.2	N22 58.4	215 25.4	N14 00.2
01	18 44.4	223 30.0	19.9	273 17.5	11.1	283 34.4	58.4	230 27.6	00.1
02	33 46.8	238 29.5	18.9	288 18.5	11.1	298 36.6	58.4	245 29.8	14 00.0
03	48 49.3	253 29.1	·· 17.9	303 19.4	·· 11.0	313 38.8	·· 58.4	260 32.0	13 59.9
04	63 51.8	268 28.6	16.8	318 20.4	10.9	328 41.1	58.4	275 34.2	59.8
05	78 54.2	283 28.1	15.8	333 21.3	10.8	343 43.3	58.4	290 36.4	59.7
06	93 56.7	298 27.7	N11 14.8	348 22.3	N23 10.7	358 45.5	N22 58.4	305 38.6	N13 59.7
07	108 59.2	313 27.2	13.8	3 23.2	10.6	13 47.7	58.4	320 40.8	59.6
08	124 01.6	328 26.7	12.8	18 24.2	10.5	28 49.9	58.4	335 43.0	59.5
S 09	139 04.1	343 26.3	·· 11.8	33 25.2	·· 10.4	43 52.2	·· 58.4	350 45.2	·· 59.4
U 10	154 06.6	358 25.8	10.7	48 26.1	10.3	58 54.4	58.4	5 47.3	59.3
N 11	169 09.0	13 25.3	09.7	63 27.1	10.2	73 56.6	58.4	20 49.5	59.2
D 12	184 11.5	28 24.9	N11 08.7	78 28.0	N23 10.1	88 58.8	N22 58.4	35 51.7	N13 59.1
A 13	199 13.9	43 24.4	07.7	93 29.0	10.0	104 01.0	58.4	50 53.9	59.0
Y 14	214 16.4	58 24.0	06.7	108 29.9	09.9	119 03.3	58.4	65 56.1	58.9
15	229 18.9	73 23.5	·· 05.6	123 30.9	·· 09.8	134 05.5	·· 58.3	80 58.3	·· 58.9
16	244 21.3	88 23.0	04.6	138 31.8	09.7	149 07.7	58.3	96 00.5	58.8
17	259 23.8	103 22.6	03.6	153 32.8	09.6	164 09.9	58.3	111 02.7	58.7
18	274 26.3	118 22.1	N11 02.6	168 33.8	N23 09.5	179 12.1	N22 58.3	126 04.9	N13 58.6
19	289 28.7	133 21.7	01.5	183 34.7	09.4	194 14.4	58.3	141 07.1	58.5
20	304 31.2	148 21.2	11 00.5	198 35.7	09.3	209 16.6	58.3	156 09.3	58.4
21	319 33.7	163 20.7	10 59.5	213 36.6	·· 09.2	224 18.8	·· 58.3	171 11.5	·· 58.3
22	334 36.1	178 20.3	58.5	228 37.6	09.1	239 21.0	58.3	186 13.7	58.2
23	349 38.6	193 19.8	57.4	243 38.6	09.0	254 23.2	58.3	201 15.9	58.2
26 00	4 41.1	208 19.4	N10 56.4	258 39.5	N23 08.9	269 25.5	N22 58.3	216 18.0	N13 58.1
01	19 43.5	223 18.9	55.4	273 40.5	08.8	284 27.7	58.3	231 20.2	58.0
02	34 46.0	238 18.4	54.4	288 41.4	08.7	299 29.9	58.3	246 22.4	57.9
03	49 48.4	253 18.0	·· 53.3	303 42.4	·· 08.6	314 32.1	·· 58.3	261 24.6	·· 57.8
04	64 50.9	268 17.5	52.3	318 43.4	08.5	329 34.4	58.3	276 26.8	57.7
05	79 53.4	283 17.1	51.3	333 44.3	08.4	344 36.6	58.3	291 29.0	57.6
06	94 55.8	298 16.6	N10 50.3	348 45.3	N23 08.3	359 38.8	N22 58.2	306 31.2	N13 57.5
07	109 58.3	313 16.1	49.2	3 46.2	08.2	14 41.0	58.2	321 33.4	57.4
08	125 00.8	328 15.7	48.2	18 47.2	08.1	29 43.3	58.2	336 35.6	57.4
M 09	140 03.2	343 15.2	·· 47.2	33 48.2	·· 08.0	44 45.5	·· 58.2	351 37.8	·· 57.3
O 10	155 05.7	358 14.8	46.1	48 49.1	07.9	59 47.7	58.2	6 40.0	57.2
N 11	170 08.2	13 14.3	45.1	63 50.1	07.8	74 49.9	58.2	21 42.2	57.1
D 12	185 10.6	28 13.9	N10 44.1	78 51.1	N23 07.7	89 52.2	N22 58.2	36 44.4	N13 57.0
A 13	200 13.1	43 13.4	43.0	93 52.0	07.6	104 54.4	58.2	51 46.6	56.9
Y 14	215 15.6	58 13.0	42.0	108 53.0	07.5	119 56.6	58.2	66 48.8	56.8
15	230 18.0	73 12.5	·· 41.0	123 54.0	·· 07.4	134 58.9	·· 58.2	81 51.0	·· 56.7
16	245 20.5	88 12.0	39.9	138 54.9	07.3	150 01.1	58.2	96 53.1	56.7
17	260 22.9	103 11.6	38.9	153 55.9	07.2	165 03.3	58.2	111 55.3	56.6
18	275 25.4	118 11.1	N10 37.9	168 56.9	N23 07.1	180 05.5	N22 58.2	126 57.5	N13 56.5
19	290 27.9	133 10.7	36.8	183 57.8	07.0	195 07.8	58.2	141 59.7	56.4
20	305 30.3	148 10.2	35.8	198 58.8	06.9	210 10.0	58.2	157 01.9	56.3
21	320 32.8	163 09.8	·· 34.7	213 59.8	·· 06.8	225 12.2	·· 58.2	172 04.1	·· 56.2
22	335 35.3	178 09.3	33.7	229 00.7	06.7	240 14.5	58.1	187 06.3	56.1
23	350 37.7	193 08.9	32.7	244 01.7	06.6	255 16.7	58.1	202 08.5	56.0
27 00	5 40.2	208 08.4	N10 31.6	259 02.7	N23 06.5	270 18.9	N22 58.1	217 10.7	N13 56.0
01	20 42.7	223 08.0	30.6	274 03.6	06.4	285 21.2	58.1	232 12.9	55.9
02	35 45.1	238 07.5	29.5	289 04.6	06.3	300 23.4	58.1	247 15.1	55.8
03	50 47.6	253 07.1	·· 28.5	304 05.6	·· 06.2	315 25.6	·· 58.1	262 17.3	·· 55.7
04	65 50.1	268 06.6	27.5	319 06.6	06.1	330 27.9	58.1	277 19.5	55.6
05	80 52.5	283 06.1	26.4	334 07.5	06.0	345 30.1	58.1	292 21.7	55.5
06	95 55.0	298 05.7	N10 25.4	349 08.5	N23 05.9	0 32.3	N22 58.1	307 23.9	N13 55.4
07	110 57.4	313 05.2	24.3	4 09.5	05.8	15 34.6	58.1	322 26.1	55.3
08	125 59.9	328 04.8	23.3	19 10.4	05.7	30 36.8	58.1	337 28.3	55.3
T 09	141 02.4	343 04.3	·· 22.2	34 11.4	·· 05.6	45 39.0	·· 58.1	352 30.5	·· 55.2
U 10	156 04.8	358 03.9	21.2	49 12.4	05.5	60 41.3	58.1	7 32.7	55.1
E 11	171 07.3	13 03.4	20.2	64 13.4	05.4	75 43.5	58.1	22 34.9	55.0
S 12	186 09.8	28 03.0	N10 19.1	79 14.3	N23 05.3	90 45.7	N22 58.1	37 37.1	N13 54.9
D 13	201 12.2	43 02.5	18.1	94 15.3	05.2	105 48.0	58.1	52 39.3	54.8
A 14	216 14.7	58 02.1	17.0	109 16.3	05.1	120 50.2	58.0	67 41.5	54.7
Y 15	231 17.2	73 01.6	·· 16.0	124 17.3	·· 05.0	135 52.4	·· 58.0	82 43.7	·· 54.6
16	246 19.6	88 01.2	14.9	139 18.2	04.9	150 54.7	58.0	97 45.8	54.6
17	261 22.1	103 00.7	13.9	154 19.2	04.7	165 56.9	58.0	112 48.0	54.5
18	276 24.5	118 00.3	N10 12.8	169 20.2	N23 04.6	180 59.1	N22 58.0	127 50.2	N13 54.4
19	291 27.0	132 59.8	11.8	184 21.2	04.5	196 01.4	58.0	142 52.4	54.3
20	306 29.5	147 59.4	10.7	199 22.1	04.4	211 03.6	58.0	157 54.6	54.2
21	321 31.9	162 59.0	·· 09.7	214 23.1	·· 04.3	226 05.8	·· 58.0	172 56.8	·· 54.1
22	336 34.4	177 58.5	08.6	229 24.1	04.2	241 08.1	58.0	187 59.0	54.0
23	351 36.9	192 58.1	07.6	244 25.1	04.1	256 10.3	58.0	203 01.2	53.9
	h m								
Mer. Pass.	23 37.4	v −0.5	d 1.0	v 1.0	d 0.1	v 2.2	d 0.0	v 2.2	d 0.1

STARS		
Name	S.H.A.	Dec.
	° ′	° ′
Acamar	315 38.5	S40 23.4
Achernar	335 46.3	S57 20.8
Acrux	173 40.0	S62 58.5
Adhara	255 33.7	S28 56.3
Aldebaran	291 20.2	N16 27.9
Alioth	166 44.9	N56 04.9
Alkaid	153 20.6	N49 25.7
Al Na'ir	28 17.1	S47 04.1
Alnilam	276 13.6	S 1 12.9
Alphard	218 22.8	S 8 33.6
Alphecca	126 34.1	N26 47.7
Alpheratz	358 11.0	N28 58.2
Altair	62 34.4	N 8 48.8
Ankaa	353 41.8	S42 25.5
Antares	112 59.5	S26 22.9
Arcturus	146 20.6	N19 18.1
Atria	108 25.6	S68 59.4
Avior	234 29.3	S59 26.1
Bellatrix	279 00.8	N 6 19.8
Betelgeuse	271 30.4	N 7 24.2
Canopus	264 08.1	S52 40.8
Capella	281 14.1	N45 58.4
Deneb	49 49.5	N45 12.4
Denebola	183 01.4	N14 41.9
Diphda	349 22.6	S18 06.4
Dubhe	194 25.3	N61 52.2
Elnath	278 46.6	N28 35.2
Eltanin	90 58.7	N51 29.9
Enif	34 13.3	N 9 46.6
Fomalhaut	15 53.3	S29 44.3
Gacrux	172 31.5	S56 59.3
Gienah	176 20.3	S17 25.0
Hadar	149 26.7	S60 16.0
Hamal	328 30.9	N23 21.5
Kaus Aust.	84 19.5	S34 23.7
Kochab	137 20.0	N74 15.1
Markab	14 04.8	N15 05.3
Menkar	314 43.0	N 4 00.2
Menkent	148 39.7	S36 15.6
Miaplacidus	221 45.9	S69 37.4
Mirfak	309 18.6	N49 46.8
Nunki	76 31.6	S26 19.4
Peacock	54 01.3	S56 48.5
Pollux	244 00.8	N28 04.7
Procyon	245 28.0	N 5 17.0
Rasalhague	96 31.5	N12 34.8
Regulus	208 12.4	N12 04.6
Rigel	281 37.9	S 8 13.5
Rigil Kent.	140 29.0	S60 44.6
Sabik	102 43.5	S15 41.7
Schedar	350 10.6	N56 25.0
Shaula	96 58.6	S37 05.3
Sirius	258 57.5	S16 41.0
Spica	159 00.0	S11 02.6
Suhail	223 12.5	S43 20.4
Vega	80 57.1	N38 46.2
Zuben'ubi	137 35.5	S15 56.9

	S.H.A.	Mer. Pass.
	° ′	h m
Venus	203 38.3	10 07
Mars	253 58.5	6 45
Jupiter	264 44.4	6 01
Saturn	211 37.0	9 33

0000 SEPTEMBER 25, 26, 27 (SUN., MON., TUES.)

G.M.T. (UT)	SUN G.H.A.	SUN Dec.	MOON G.H.A.	MOON v	MOON Dec.	MOON d	MOON H.P.
d h	° ′	° ′	° ′	′	° ′	′	′
25 00	182 02.0	S 0 43.3	29 56.4	11.0	S 7 03.7	9.9	57.7
01	197 02.3	44.3	44 26.4	11.0	6 53.8	9.9	57.7
02	212 02.5	45.3	58 56.4	11.0	6 43.9	10.0	57.7
03	227 02.7	·· 46.3	73 26.4	11.1	6 33.9	10.0	57.7
04	242 02.9	47.2	87 56.5	11.1	6 23.9	10.0	57.6
05	257 03.1	48.2	102 26.6	11.2	6 13.9	10.1	57.6
06	272 03.3	S 0 49.2	116 56.8	11.1	S 6 03.8	10.1	57.6
07	287 03.6	50.1	131 26.9	11.3	5 53.7	10.1	57.6
08	302 03.8	51.1	145 57.2	11.3	5 43.6	10.1	57.6
S 09	317 04.0	·· 52.1	160 27.5	11.3	5 33.5	10.2	57.5
U 10	332 04.2	53.1	174 57.8	11.3	5 23.3	10.2	57.5
N 11	347 04.4	54.0	189 28.1	11.4	5 13.1	10.1	57.5
D 12	2 04.6	S 0 55.0	203 58.5	11.4	S 5 03.0	10.3	57.5
A 13	17 04.9	56.0	218 28.9	11.5	4 52.7	10.2	57.5
Y 14	32 05.1	57.0	232 59.4	11.5	4 42.5	10.2	57.4
15	47 05.3	·· 57.9	247 29.9	11.6	4 32.3	10.3	57.4
16	62 05.5	58.9	262 00.5	11.5	4 22.0	10.3	57.4
17	77 05.7	0 59.9	276 31.0	11.6	4 11.7	10.3	57.4
18	92 05.9	S 1 00.9	291 01.6	11.7	S 4 01.4	10.3	57.3
19	107 06.2	01.8	305 32.3	11.7	3 51.1	10.3	57.3
20	122 06.4	02.8	320 03.0	11.7	3 40.8	10.4	57.3
21	137 06.6	·· 03.8	334 33.7	11.7	3 30.4	10.3	57.3
22	152 06.8	04.8	349 04.4	11.8	3 20.1	10.3	57.3
23	167 07.0	05.7	3 35.2	11.8	3 09.8	10.4	57.2
26 00	182 07.2	S 1 06.7	18 06.0	11.9	S 2 59.4	10.4	57.2
01	197 07.4	07.7	32 36.9	11.9	2 49.0	10.4	57.2
02	212 07.7	08.7	47 07.8	11.9	2 38.6	10.3	57.2
03	227 07.9	·· 09.6	61 38.7	11.9	2 28.3	10.4	57.2
04	242 08.1	10.6	76 09.6	12.0	2 17.9	10.4	57.1
05	257 08.3	11.6	90 40.6	12.0	2 07.5	10.4	57.1
06	272 08.5	S 1 12.5	105 11.6	12.0	S 1 57.1	10.4	57.1
07	287 08.7	13.5	119 42.6	12.1	1 46.7	10.4	57.1
08	302 08.9	14.5	134 13.7	12.1	1 36.3	10.4	57.0
M 09	317 09.2	·· 15.5	148 44.8	12.1	1 25.9	10.4	57.0
O 10	332 09.4	16.4	163 15.9	12.1	1 15.5	10.4	57.0
N 11	347 09.6	17.4	177 47.0	12.2	1 05.1	10.4	57.0
D 12	2 09.8	S 1 18.4	192 18.2	12.2	S 0 54.7	10.4	57.0
A 13	17 10.0	19.4	206 49.4	12.2	0 44.3	10.4	56.9
Y 14	32 10.2	20.3	221 20.6	12.3	0 33.9	10.4	56.9
15	47 10.4	·· 21.3	235 51.9	12.3	0 23.5	10.3	56.9
16	62 10.7	22.3	250 23.2	12.3	0 13.2	10.4	56.9
17	77 10.9	23.3	264 54.5	12.3	S 0 02.8	10.4	56.8
18	92 11.1	S 1 24.2	279 25.8	12.3	N 0 07.6	10.3	56.8
19	107 11.3	25.2	293 57.1	12.4	0 17.9	10.3	56.8
20	122 11.5	26.2	308 28.5	12.4	0 28.2	10.4	56.8
21	137 11.7	·· 27.2	322 59.9	12.4	0 38.6	10.3	56.8
22	152 11.9	28.1	337 31.3	12.4	0 48.9	10.3	56.7
23	167 12.2	29.1	352 02.7	12.5	0 59.2	10.3	56.7
27 00	182 12.4	S 1 30.1	6 34.2	12.5	N 1 09.5	10.3	56.7
01	197 12.6	31.1	21 05.7	12.5	1 19.8	10.2	56.7
02	212 12.8	32.0	35 37.2	12.5	1 30.0	10.3	56.6
03	227 13.0	·· 33.0	50 08.7	12.5	1 40.3	10.2	56.6
04	242 13.2	34.0	64 40.2	12.6	1 50.5	10.2	56.6
05	257 13.4	34.9	79 11.8	12.6	2 00.7	10.2	56.6
06	272 13.7	S 1 35.9	93 43.4	12.5	N 2 10.9	10.2	56.5
07	287 13.9	36.9	108 14.9	12.7	2 21.1	10.2	56.5
08	302 14.1	37.9	122 46.6	12.6	2 31.3	10.1	56.5
T 09	317 14.3	·· 38.8	137 18.2	12.6	2 41.4	10.1	56.5
U 10	332 14.5	39.8	151 49.8	12.7	2 51.5	10.1	56.5
E 11	347 14.7	40.8	166 21.5	12.7	3 01.6	10.1	56.4
S 12	2 14.9	S 1 41.8	180 53.2	12.6	N 3 11.7	10.1	56.4
D 13	17 15.1	42.7	195 24.8	12.8	3 21.8	10.0	56.4
A 14	32 15.4	43.7	209 56.6	12.7	3 31.8	10.0	56.4
Y 15	47 15.6	·· 44.7	224 28.3	12.7	3 41.8	10.0	56.3
16	62 15.8	45.7	239 00.0	12.7	3 51.8	9.9	56.3
17	77 16.0	46.6	253 31.7	12.8	4 01.7	9.9	56.3
18	92 16.2	S 1 47.6	268 03.5	12.8	N 4 11.6	9.9	56.3
19	107 16.4	48.6	282 35.3	12.8	4 21.5	9.9	56.3
20	122 16.6	49.5	297 07.1	12.8	4 31.4	9.8	56.2
21	137 16.8	·· 50.5	311 38.9	12.8	4 41.2	9.8	56.2
22	152 17.0	51.5	326 10.7	12.8	4 51.0	9.8	56.2
23	167 17.3	52.5	340 42.5	12.8	5 00.8	9.7	56.2
	S.D. 16.0	d 1.0	S.D. 15.7		15.5		15.4

Lat.	Twilight Naut.	Twilight Civil	Sunrise	Moonrise 25	Moonrise 26	Moonrise 27	Moonrise 28
°	h m	h m	h m	h m	h m	h m	h m
N 72	03 21	04 48	05 56	17 28	17 22	17 17	17 12
N 70	03 37	04 54	05 55	17 22	17 22	17 23	17 23
68	03 50	04 59	05 54	17 17	17 22	17 27	17 33
66	04 01	05 03	05 54	17 13	17 22	17 31	17 40
64	04 09	05 06	05 54	17 10	17 22	17 34	17 47
62	04 16	05 09	05 53	17 07	17 22	17 37	17 52
60	04 22	05 12	05 53	17 04	17 22	17 39	17 57
N 58	04 27	05 14	05 53	17 02	17 22	17 41	18 02
56	04 32	05 16	05 53	17 00	17 22	17 43	18 06
54	04 36	05 17	05 52	16 58	17 22	17 45	18 09
52	04 39	05 19	05 52	16 56	17 22	17 47	18 12
50	04 42	05 20	05 52	16 55	17 22	17 48	18 15
45	04 48	05 22	05 52	16 51	17 22	17 51	18 22
N 40	04 53	05 24	05 51	16 48	17 22	17 54	18 27
35	04 56	05 26	05 51	16 46	17 22	17 56	18 31
30	04 59	05 27	05 50	16 44	17 22	17 59	18 36
20	05 02	05 28	05 50	16 40	17 22	18 02	18 43
N 10	05 04	05 28	05 49	16 37	17 22	18 05	18 49
0	05 03	05 27	05 48	16 34	17 22	18 08	18 55
S 10	05 02	05 26	05 47	16 30	17 22	18 12	19 01
20	04 59	05 24	05 46	16 27	17 22	18 15	19 07
30	04 53	05 21	05 45	16 23	17 22	18 19	19 15
35	04 49	05 19	05 44	16 21	17 22	18 21	19 19
40	04 44	05 16	05 43	16 19	17 22	18 23	19 24
45	04 38	05 13	05 42	16 16	17 22	18 26	19 29
S 50	04 30	05 08	05 41	16 12	17 22	18 30	19 36
52	04 26	05 06	05 40	16 11	17 22	18 32	19 39
54	04 22	05 04	05 39	16 09	17 22	18 33	19 43
56	04 17	05 01	05 38	16 07	17 22	18 35	19 47
58	04 11	04 58	05 37	16 05	17 22	18 37	19 51
S 60	04 04	04 55	05 36	16 03	17 22	18 40	19 56

Lat.	Sunset	Twilight Civil	Twilight Naut.	Moonset 25	Moonset 26	Moonset 27	Moonset 28
°	h m	h m	h m	h m	h m	h m	h m
N 72	17 45	18 52	20 17	02 40	04 27	06 11	07 54
N 70	17 46	18 46	20 02	02 50	04 31	06 08	07 44
68	17 46	18 42	19 49	02 58	04 33	06 06	07 36
66	17 47	18 38	19 40	03 05	04 36	06 04	07 30
64	17 47	18 35	19 31	03 11	04 37	06 02	07 25
62	17 48	18 32	19 25	03 16	04 39	06 01	07 20
60	17 48	18 30	19 19	03 20	04 41	05 59	07 16
N 58	17 49	18 28	19 14	03 24	04 42	05 58	07 13
56	17 49	18 26	19 10	03 27	04 43	05 57	07 09
54	17 49	18 24	19 06	03 30	04 44	05 56	07 07
52	17 50	18 23	19 03	03 33	04 45	05 55	07 04
50	17 50	18 22	19 00	03 36	04 46	05 55	07 02
45	17 50	18 20	18 54	03 41	04 48	05 53	06 57
N 40	17 51	18 18	18 49	03 45	04 49	05 51	06 53
35	17 51	18 17	18 46	03 49	04 50	05 50	06 49
30	17 52	18 16	18 43	03 52	04 51	05 49	06 46
20	17 53	18 15	18 40	03 58	04 53	05 47	06 40
N 10	17 54	18 15	18 39	04 03	04 55	05 46	06 35
0	17 55	18 15	18 39	04 08	04 57	05 44	06 31
S 10	17 56	18 17	18 41	04 13	04 58	05 43	06 26
20	17 57	18 19	18 45	04 18	05 00	05 41	06 21
30	17 58	18 22	18 50	04 23	05 02	05 39	06 16
35	17 59	18 25	18 54	04 26	05 03	05 38	06 13
40	18 00	18 27	18 59	04 30	05 04	05 37	06 09
45	18 02	18 31	19 06	04 34	05 05	05 35	06 05
S 50	18 03	18 36	19 14	04 39	05 07	05 33	06 00
52	18 04	18 38	19 18	04 41	05 07	05 33	05 58
54	18 05	18 40	19 23	04 44	05 08	05 32	05 55
56	18 06	18 43	19 28	04 46	05 09	05 31	05 53
58	18 07	18 46	19 34	04 49	05 10	05 30	05 50
S 60	18 08	18 50	19 41	04 53	05 11	05 29	05 46

Day	SUN Eqn. of Time 00ʰ	SUN Eqn. of Time 12ʰ	SUN Mer. Pass.	MOON Mer. Pass. Upper	MOON Mer. Pass. Lower	MOON Age	MOON Phase
	m s	m s	h m	h m	h m	d	
25	08 08	08 18	11 52	22 45	10 21	12	
26	08 28	08 39	11 51	23 33	11 09	13	○
27	08 49	08 59	11 51	24 20	11 56	14	

LAT 22°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	*Alpheratz		Hamal		*RIGEL		CANOPUS		ACHERNAR		*Peacock		Enif	
0	39 03 002		35 21 036		13 54 093		13 56 142		50 29 160		37 37 214		43 44 310	
1	39 04 001		35 54 035		14 49 093		14 31 141		50 48 160		37 06 214		43 01 309	
2	39 04 000		36 25 034		15 45 093		15 06 141		51 07 161		36 35 214		42 18 308	
3	39 04 359		36 56 033		16 40 092		15 41 141		51 24 162		36 03 215		41 33 307	
4	39 02 357		37 26 032		17 36 092		16 16 141		51 41 163		35 31 215		40 49 306	
5	38 59 356		37 55 031		18 32 092		16 51 141		51 58 163		35 00 215		40 04 305	
6	38 54 355		38 23 030		19 27 091		17 26 141		52 13 164		34 28 215		39 18 304	
7	38 49 354		38 51 029		20 23 091		18 02 140		52 28 165		33 55 215		38 32 304	
8	38 43 353		39 18 028		21 18 090		18 37 140		52 42 166		33 23 215		37 45 303	
9	38 36 352		39 43 027		22 14 090		19 13 140		52 56 166		32 51 216		36 58 302	
10	38 27 351		40 08 026		23 10 090		19 48 140		53 08 167		32 19 216		36 11 301	
11	38 18 350		40 32 025		24 05 089		20 24 140		53 20 168		31 46 216		35 24 301	
12	38 07 349		40 55 024		25 01 089		21 00 140		53 31 169		31 14 216		34 36 300	
13	37 56 347		41 17 023		25 57 089		21 36 140		53 41 170		30 41 216		33 47 299	
14	37 43 346		41 38 022		26 52 088		22 12 140		53 51 171		30 08 216		32 59 299	
	*Hamal		ALDEBARAN		RIGEL		*CANOPUS		ACHERNAR		*FOMALHAUT		Alpheratz	
15	41 58 020		24 59 058		27 48 088		22 48 140		53 59 172		61 09 248		37 29 345	
16	42 16 019		25 46 058		28 43 087		23 24 139		54 07 173		60 17 248		37 15 344	
17	42 34 018		26 33 057		29 39 087		24 01 139		54 14 173		59 25 248		36 59 343	
18	42 51 017		27 19 056		30 35 087		24 37 139		54 20 174		58 34 249		36 43 342	
19	43 06 016		28 05 056		31 30 086		25 13 139		54 25 175		57 42 249		36 25 341	
20	43 21 014		28 51 055		32 26 086		25 49 139		54 29 176		56 50 249		36 07 340	
21	43 34 013		29 37 054		33 21 085		26 26 139		54 32 177		55 58 249		35 47 339	
22	43 46 012		30 22 054		34 16 085		27 02 139		54 35 178		55 06 249		35 27 338	
23	43 57 011		31 06 053		35 12 084		27 38 139		54 36 179		54 14 249		35 06 337	
24	44 07 009		31 51 052		36 07 084		28 15 139		54 37 180		53 22 249		34 44 336	
25	44 15 008		32 35 052		37 02 084		28 51 139		54 36 181		52 30 249		34 21 335	
26	44 23 007		33 18 051		37 58 083		29 28 139		54 35 182		51 38 249		33 57 334	
27	44 29 006		34 01 050		38 53 083		30 04 139		54 33 183		50 46 249		33 33 333	
28	44 34 004		34 43 049		39 48 082		30 40 139		54 30 184		49 54 249		33 07 332	
29	44 37 003		35 25 049		40 43 082		31 17 139		54 26 184		49 02 249		32 41 332	
	Hamal		*ALDEBARAN		SIRIUS		*CANOPUS		ACHERNAR		*FOMALHAUT		Alpheratz	
30	44 40 002		36 07 048		23 25 099		31 53 139		54 21 185		48 10 249		32 14 331	
31	44 41 000		36 48 047		24 19 099		32 29 139		54 16 186		47 18 249		31 46 330	
32	44 40 359		37 28 046		25 14 099		33 05 140		54 09 187		46 26 249		31 18 329	
33	44 39 358		38 08 045		26 09 098		33 41 140		54 02 188		45 34 249		30 49 328	
34	44 36 357		38 47 044		27 04 098		34 17 140		53 53 189		44 42 249		30 19 327	
35	44 32 355		39 25 043		28 00 098		34 53 140		53 44 190		43 50 249		29 49 326	
36	44 27 354		40 03 042		28 55 097		35 29 140		53 34 191		42 58 249		29 18 326	
37	44 21 353		40 40 041		29 50 097		36 05 140		53 23 192		42 06 249		28 46 325	
38	44 13 351		41 17 040		30 45 097		36 41 140		53 12 192		41 14 249		28 13 324	
39	44 04 350		41 52 039		31 40 097		37 16 140		53 00 193		40 22 249		27 40 323	
40	43 54 349		42 27 038		32 36 096		37 51 141		52 46 194		39 30 249		27 07 322	
41	43 43 348		43 02 037		33 31 096		38 27 141		52 32 195		38 38 249		26 33 322	
42	43 31 346		43 35 036		34 26 096		39 02 141		52 18 196		37 46 249		25 58 321	
43	43 17 345		44 07 035		35 22 095		39 37 141		52 02 196		36 54 248		25 23 320	
44	43 02 344		44 39 034		36 17 095		40 12 141		51 46 197		36 03 248		24 47 320	
	*CAPELLA		BETELGEUSE		SIRIUS		*CANOPUS		ACHERNAR		*FOMALHAUT		Hamal	
45	15 30 024		38 19 060		37 12 095		40 46 142		51 29 198		35 11 248		42 47 343	
46	15 52 023		39 07 059		38 08 094		41 21 142		51 12 199		34 19 248		42 30 342	
47	16 14 022		39 55 059		39 03 094		41 55 142		50 54 199		33 28 248		42 12 340	
48	16 34 022		40 42 058		39 59 094		42 29 142		50 35 200		32 36 248		41 53 339	
49	16 55 021		41 29 057		40 54 093		43 03 143		50 16 201		31 45 248		41 32 338	
50	17 14 020		42 15 056		41 50 093		43 36 143		49 56 201		30 53 248		41 11 337	
51	17 33 020		43 01 055		42 46 093		44 09 143		49 35 202		30 02 247		40 49 336	
52	17 52 019		43 47 055		43 41 092		44 42 144		49 14 203		29 11 247		40 26 335	
53	18 10 018		44 32 054		44 37 092		45 15 144		48 52 203		28 19 247		40 02 334	
54	18 27 018		45 17 053		45 32 092		45 48 145		48 30 204		27 28 247		39 37 333	
55	18 44 017		46 01 052		46 28 091		46 20 145		48 07 204		26 37 247		39 11 332	
56	19 00 016		46 44 051		47 24 091		46 51 145		47 44 205		25 46 246		38 44 331	
57	19 15 016		47 27 050		48 19 091		47 23 146		47 20 206		24 55 246		38 16 330	
58	19 30 015		48 09 049		49 15 090		47 54 146		46 56 206		24 04 246		37 48 329	
59	19 44 014		48 50 048		50 10 090		48 25 147		46 31 207		23 13 246		37 18 328	
	CAPELLA		BETELGEUSE		*SIRIUS		CANOPUS		*ACHERNAR		Diphda		*Hamal	
60	19 58 014		49 31 047		51 06 090		48 55 147		46 06 207		43 34 265		36 48 327	
61	20 10 013		50 11 045		52 02 089		49 25 148		45 41 208		42 38 265		36 17 326	
62	20 23 012		50 50 044		52 57 089		49 54 148		45 15 208		41 43 265		35 45 325	
63	20 34 012		51 29 043		53 53 088		50 23 149		44 48 208		40 47 265		35 13 324	
64	20 45 011		52 06 042		54 49 088		50 51 150		44 22 209		39 52 264		34 40 323	
65	20 55 010		52 43 041		55 44 088		51 19 150		43 55 209		38 57 264		34 06 322	
66	21 04 009		53 19 039		56 40 087		51 47 151		43 27 210		38 01 264		33 31 321	
67	21 13 009		53 53 038		57 35 087		52 13 152		42 59 210		37 06 263		32 56 320	
68	21 21 008		54 27 036		58 31 086		52 40 152		42 31 210		36 11 263		32 21 320	
69	21 28 007		54 59 035		59 26 086		53 05 153		42 03 211		35 16 263		31 44 319	
70	21 35 006		55 31 034		60 22 085		53 30 154		41 35 211		34 21 262		31 07 318	
71	21 41 006		56 01 032		61 17 085		53 55 154		41 06 211		33 25 262		30 30 317	
72	21 46 005		56 30 030		62 12 084		54 18 155		40 36 212		32 30 262		29 52 316	
73	21 50 004		56 57 029		63 08 084		54 41 156		40 07 212		31 35 262		29 13 316	
74	21 54 003		57 23 027		64 03 083		55 04 157		39 37 212		30 40 261		28 34 315	
	*CAPELLA		POLLUX		PROCYON		*Suhail		CANOPUS		*ACHERNAR		Hamal	
75	21 57 003		26 14 040		42 43 059		35 13 128		55 25 158		39 08 213		27 54 314	
76	21 59 002		26 50 039		43 31 059		35 56 128		55 46 159		38 37 213		27 14 313	
77	22 01 001		27 25 039		44 18 058		36 40 128		56 06 159		38 07 213		26 33 313	
78	22 02 000		27 59 038		45 05 057		37 23 128		56 25 160		37 37 213		25 52 312	
79	22 02 000		28 33 037		45 51 056		38 07 129		56 43 161		37 06 214		25 11 311	
80	22 01 359		29 06 036		46 37 055		38 50 129		57 00 162		36 35 214		24 29 311	
81	22 00 358		29 39 035		47 23 054		39 34 129		57 17 163		36 04 214		23 47 310	
82	21 58 357		30 11 035		48 07 053		40 17 129		57 32 164		35 33 214		23 04 310	
83	21 55 357		30 42 034		48 52 052		41 00 129		57 47 165		35 02 214		22 21 309	
84	21 51 356		31 12 033		49 35 051		41 44 129		58 00 166		34 30 214		21 37 308	
85	21 47 355		31 42 032		50 18 050		42 27 129		58 13 168		33 59 215		20 53 308	
86	21 42 354		32 12 031		51 00 049		43 10 129		58 24 169		33 27 215		20 09 307	
87	21 36 354		32 40 030		51 42 048		43 53 130		58 35 170		32 56 215		19 25 307	
88	21 30 353		33 08 030		52 23 047		44 35 130		58 44 171		32 24 215		18 40 306	
89	21 23 352		33 35 029		53 03 045		45 18 130		58 53 172		31 52 215		17 55 305	

LAT 22°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	POLLUX		*REGULUS		ACRUX		CANOPUS		*ACHERNAR		*ALDEBARAN		CAPELLA	
90	34 01 028		20 34 067		16 44 152		59 00 173		31 20 215		46 11 330		21 15 35	
91	34 27 027		21 25 066		17 10 152		59 06 174		30 48 215		45 42 325		21 06 351	
92	34 51 026		22 16 066		17 36 152		59 11 175		30 16 215		45 13 327		20 57 350	
93	35 15 025		23 06 065		18 03 153		59 15 177		29 44 215		44 42 326		20 47 349	
94	35 38 024		23 57 065		18 30 151		59 17 178		29 11 215		44 10 325		20 37 349	
95	36 00 023		24 47 064		18 56 151		59 19 179		28 39 215		43 38 324		20 25 348	
96	36 21 022		25 37 064		19 23 151		59 19 179		28 07 215		43 05 323		20 13 347	
97	36 41 021		26 27 063		19 50 151		59 18 181		27 34 216		42 31 322		20 01 347	
98	37 01 020		27 16 062		20 17 151		59 17 183		27 02 216		41 56 321		19 47 346	
99	37 19 019		28 05 062		20 44 151		59 13 184		26 30 216		41 20 320		19 33 345	
100	37 37 018		28 54 061		21 11 151		59 09 185		25 57 216		40 44 319		19 19 344	
101	37 53 017		29 43 061		21 38 151		59 04 186		25 25 216		40 07 318		19 04 344	
102	38 08 016		30 31 060		22 05 151		58 57 187		24 53 216		39 29 317		18 48 343	
103	38 23 015		31 19 059		22 32 151		58 50 188		24 20 215		38 51 316		18 31 342	
104	38 36 013		32 07 059		23 00 151		58 41 190		23 48 215		38 12 315		18 14 342	
	POLLUX		*REGULUS		Grenah		*ACRUX		CANOPUS		*RIGEL		BETELGEUSE	
105	38 49 012		32 54 058		16 42 102		23 27 151		58 31 191		60 50 294		56 23 329	
106	39 00 011		33 41 057		17 36 102		23 54 151		58 21 192		59 59 293		55 54 328	
107	39 10 010		34 28 057		18 31 102		24 21 151		58 09 193		59 08 292		55 24 326	
108	39 20 009		35 14 056		19 25 101		24 49 151		57 56 194		58 16 291		54 52 325	
109	39 28 008		36 00 055		20 20 101		25 16 151		57 42 195		57 24 290		54 19 323	
110	39 35 007		36 45 054		21 14 101		25 43 151		57 27 196		56 32 289		53 46 322	
111	39 41 006		37 30 053		22 09 101		26 11 151		57 11 197		55 39 289		53 11 320	
112	39 46 004		38 14 053		23 04 100		26 38 151		56 54 198		54 46 288		52 35 319	
113	39 49 003		38 58 052		23 58 100		27 05 151		56 37 199		53 53 287		51 58 318	
114	39 52 002		39 42 051		24 53 100		27 32 151		56 18 200		53 00 286		51 20 317	
115	39 54 001		40 25 050		25 48 099		27 59 151		55 59 201		52 06 286		50 4 5	
116	39 54 000		41 07 049		26 43 099		28 27 151		55 39 202		51 13 285		50 4 4	
117	39 53 359		41 49 048		27 38 099		28 54 151		55 18 203		50 19 284		49 2 3	
118	39 51 358		42 30 047		28 33 098		29 21 151		54 56 203		49 25 284		48 41 312	
119	39 49 356		43 11 046		29 28 098		29 48 151		54 33 204		48 31 283		47 59 311	
	*REGULUS		SPICA		*ACRUX		CANOPUS		*RIGEL		BETELGEUSE		POLLUX	
120	43 51 045		12 26 097		30 14 151		54 10 205		47 36 282		47 17 310		39 44 355	
121	44 30 044		13 22 097		30 41 151		53 46 206		46 42 282		46 34 309		39 39 354	
122	45 09 043		14 17 096		31 08 151		53 21 207		45 47 281		45 51 305		39 33 353	
123	45 46 042		15 12 096		31 34 152		52 56 207		44 53 281		45 07 307		39 26 352	
124	46 23 041		16 08 096		32 01 152		52 30 208		43 58 280		44 22 306		39 17 351	
125	47 00 040		17 03 095		32 27 152		52 04 209		43 03 280		43 37 305		39 08 350	
126	47 35 039		17 58 095		32 54 152		51 37 209		42 08 279		42 51 304		38 57 348	
127	48 10 038		18 54 095		33 20 152		51 09 210		41 13 279		42 05 304		38 46 347	
128	48 43 037		19 49 094		33 46 152		50 41 211		40 18 278		41 18 303		38 33 346	
129	49 16 035		20 45 094		34 11 152		50 13 211		39 23 278		40 31 302		38 19 345	
130	49 48 034		21 40 093		34 37 153		49 44 212		38 28 277		39 44 301		38 05 344	
131	50 18 033		22 36 093		35 03 153		49 14 212		37 33 277		38 56 300		37 49 343	
132	50 48 031		23 31 093		35 28 153		48 44 213		36 37 276		38 08 300		37 32 342	
133	51 16 030		24 27 092		35 53 153		48 14 213		35 42 276		37 19 299		37 14 341	
134	51 43 029		25 23 092		36 18 153		47 43 214		34 47 275		36 30 298		36 56 340	
	REGULUS		*SPICA		ACRUX		*CANOPUS		SIRIUS		BETELGEUSE		*POLLUX	
135	52 10 027		26 18 092		36 43 154		47 12 214		57 30 273		35 41 297		36 36 339	
136	52 34 026		27 14 091		37 07 154		46 40 215		56 35 273		34 52 297		36 16 338	
137	52 58 024		28 09 091		37 31 154		46 08 215		55 39 272		34 02 296		35 54 337	
138	53 20 023		29 05 091		37 55 155		45 36 216		54 44 272		33 12 295		35 32 336	
139	53 41 021		30 01 090		38 19 155		45 04 216		53 48 272		32 21 295		35 09 335	
140	54 01 020		30 56 090		38 43 155		44 31 216		52 52 271		31 31 294		34 45 334	
141	54 19 018		31 52 090		39 06 155		43 58 217		51 57 271		30 40 294		34 20 333	
142	54 35 017		32 48 089		39 29 156		43 24 217		51 01 270		29 49 293		33 54 332	
143	54 50 015		33 43 089		39 52 156		42 51 217		50 06 270		28 58 292		33 28 331	
144	55 04 013		34 39 088		40 14 156		42 17 218		49 10 270		28 06 292		33 01 330	
145	55 16 012		35 34 088		40 36 157		41 43 218		48 14 269		27 14 291		32 33	
146	55 26 010		36 30 088		40 58 157		41 08 218		47 19 269		26 22 291		32 0	
147	55 35 008		37 26 087		41 20 157		40 34 218		46 23 269		25 30 290		31 35 28	
148	55 42 006		38 21 087		41 41 158		39 59 219		45 28 268		24 38 290		31 05 327	
149	55 47 005		39 17 086		42 02 158		39 24 219		44 32 268		23 46 289		30 34 326	
	REGULUS		*ARCTURUS		SPICA		*ACRUX		CANOPUS		SIRIUS		*PROCYON	
150	55 51 003		15 23 061		40 12 086		42 22 159		38 49 219		43 36 268		45 45 304	
151	55 53 001		16 12 061		41 08 085		42 42 159		38 14 219		42 41 267		44 59 303	
152	55 53 359		17 00 060		42 03 085		43 02 160		37 39 220		41 45 267		44 12 302	
153	55 52 358		17 48 060		42 58 085		43 21 160		37 03 220		40 50 267		43 25 301	
154	55 49 356		18 36 059		43 54 084		43 40 160		36 28 220		39 54 266		42 37 300	
155	55 44 354		19 24 059		44 49 084		43 58 161		35 52 220		38 59 266		41 49 300	
156	55 37 353		20 11 058		45 44 083		44 17 161		35 16 220		38 03 266		41 00 299	
157	55 29 351		20 58 057		46 40 083		44 34 162		34 40 220		37 08 265		40 11 298	
158	55 20 349		21 45 057		47 35 082		44 51 162		34 04 220		36 12 265		39 22 297	
159	55 08 347		22 32 056		48 30 082		45 08 163		33 28 220		35 17 265		38 33 297	
160	54 56 346		23 18 056		49 25 081		45 24 163		32 52 221		34 21 264		37 43 296	
161	54 41 344		24 03 055		50 20 081		45 40 164		32 16 221		33 26 264		36 53 295	
162	54 25 343		24 49 055		51 14 080		45 55 164		31 40 221		32 31 264		36 02 295	
163	54 08 341		25 34 054		52 09 079		46 10 165		31 04 221		31 36 263		35 11 294	
164	53 49 339		26 19 053		53 04 079		46 24 166		30 27 221		30 40 263		34 21 293	
	*ARCTURUS		ANTARES		*ACRUX		CANOPUS		SIRIUS		*PROCYON		REGULUS	
165	27 03 053		16 28 112		46 37 166		29 51 221		29 45 263		33 29 293		53 28 338	
166	27 47 052		17 20 112		46 50 167		29 15 221		28 50 262		32 38 292		53 07 336	
167	28 31 051		18 11 112		47 03 167		28 38 221		27 55 262		31 46 292		52 44 335	
168	29 14 051		19 03 112		47 15 168		28 02 221		27 00 262		30 54 291		52 19 333	
169	29 57 050		19 55 111		47 26 169		27 25 221		26 05 262		30 02 290		51 54 332	
170	30 39 049		20 47 111		47 37 169		26 49 221		25 10 261		29 10 290		51 27 330	
171	31 21 048		21 39 111		47 47 170		26 13 221		24 15 261		28 18 289		50 59 329	
172	32 02 048		22 31 111		47 57 170		25 36 221		23 20 261		27 25 289		50 30 328	
173	32 43 047		23 23 110		48 06 171		25 00 221		22 25 260		26 32 288		50 00 326	
174	33 23 046		24 15 110		48 14 172		24 24 221		21 30 260		25 40 288		49 28 325	
175	34 03 045		25 07 110		48 22 172		23 48 221		20 35 260		24 46 287		48 56	
176	34 42 044		26 00 110		48 29 173		23 11 221		19 41 259		23 53 287		48 23	
177	35 21 044		26 52 109		48 35 174		22 35 220		18 46 259		23 00 286		47 49 322	
178	35 59 043		27 45 109		48 41 174		21 59 220		17 51 259		22 06 286		47 14 320	
179	36 36 042		28 37 109		48 46 175		21 23 220		16 57 258		21 13 285		46 38 319	

27 MARCH 2007

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a 2,000 TEU container vessel which is to make a passage from Wellington (New Zealand) to Buenos Aries (Argentina) in June. Expected service speed is 16.0 knots.

1. (a) Outline FIVE factors to be considered when planning East↔West ocean passages. (15)

(b) The vessel's charterer's have advised that they wish to route the vessel via Cape Horn (Chile) and have requested the distances for both rhumb line and composite great circle routes (limiting Lat 58°20'S) for the following departure and landfall positions.

Departure Position Wellington	41°22'.0S 174°50'.0E
Landfall Position Cape Horn	56°20'.0S 67°20'.0W

Calculate EACH of the following:

(i) the rhumb line distance; (9)

(ii) the composite great circle distance; (18)

(iii) the ETA at the landfall position off Cape Horn if the vessel leaves Wellington at 2215hrs Standard Time on the 8th June and follows the composite great circle route. (8)

2. The vessel encounters heavy weather two days out from Wellington and an engine room rating is seriously injured during a fall.

At 0330hrs GMT on the 10th June, whilst in position 46°15'.0S 178°24'.0W, the Master makes contact with a New Zealand warship, in position 48°30'.0S 179°54'.0E, and agrees to rendezvous with the warship at sunrise the following day. The container vessel is to maintain its current course and speed of 148°(T) x 18 knots.

Calculate EACH of the following:

(a) the GMT of Sunrise; (20)

(b) the rendezvous position; (10)

(c) the course and speed required by the warship to make the rendezvous. (10)

3. On arrival at the rendezvous position the Captain of the warship decides conditions are still too severe to transfer the casualty by boat and asks the master to prepare for a helicopter evacuation of the casualty.

(a) Outline the bridge procedures that should be adopted when planning and conducting helicopter operations. (20)

(b) Produce a bridge checklist that could be used to ensure that the vessel is ready for the transfer of the casualty. (15)

4. Vessels planning to undertake ocean passages at high latitudes are likely to encounter several navigational and meteorological/climatological hazards.

(a) Outline THREE navigational problems that may be encountered by the container vessel, when at its most southerly latitude, should the vessel's GPS system fail. (15)

(b) Outline TWO meteorological/climatological hazards that may be encountered by the vessel. (8)

(c) On the 14th June, whilst in DR position 58°05'.0S 125°36'.0W the OOW makes the following observation of the star Achernar

Time at Ship	2215hrs
Chronometer read	6h 23m 15s
Chronometer error	2m 35s Slow on GMT
Compass Bearing	203°(C)
Variation	34°W

Calculate the deviation of the compass for the direction of the ship's head. (20)

5. Whilst approaching Buenos Aries the vessel will transit an IMO approved Traffic Separation Scheme.

(a) Outline the stated IMO objectives of Traffic Separation and Routeing schemes. (17)

(b) State, with reasons, the manning levels to be observed on the bridge when a vessel transits a Traffic Separation Scheme with heavy traffic. (15)

0000 JUNE 9, 10, 11 (THURS., FRI., SAT.)

G.M.T. (UT)	SUN G.H.A.	SUN Dec.	MOON G.H.A.	MOON v	MOON Dec.	MOON d	MOON H.P.
d h	° ′	° ′	° ′	′	° ′	′	′
9 00	180 14.4	N22 54.1	265 15.7	13.5	S 0 37.5	10.1	56.1
01	195 14.3	54.4	279 48.2	13.5	0 27.4	10.2	56.1
02	210 14.2	54.6	294 20.7	13.6	0 17.2	10.2	56.0
03	225 14.1	54.8	308 53.3	13.7	S 0 07.0	10.2	56.0
04	240 13.9	55.0	323 26.0	13.6	N 0 03.2	10.1	56.0
05	255 13.8	55.2	337 58.6	13.7	0 13.3	10.2	55.9
06	270 13.7	N22 55.4	352 31.3	13.7	N 0 23.5	10.1	55.9
07	285 13.6	55.6	7 04.0	13.8	0 33.6	10.1	55.9
T 08	300 13.5	55.8	21 36.8	13.8	0 43.7	10.1	55.8
H 09	315 13.3	56.0	36 09.6	13.8	0 53.8	10.1	55.8
U 10	330 13.2	56.2	50 42.4	13.8	1 03.9	10.1	55.8
R 11	345 13.1	56.4	65 15.2	13.9	1 14.0	10.0	55.8
S 12	0 13.0	N22 56.7	79 48.1	13.9	N 1 24.0	10.1	55.7
D 13	15 12.9	56.9	94 21.0	13.9	1 34.1	10.0	55.7
A 14	30 12.7	57.1	108 53.9	13.9	1 44.1	10.0	55.7
Y 15	45 12.6	57.3	123 26.8	14.0	1 54.1	10.0	55.6
16	60 12.5	57.5	137 59.8	14.0	2 04.1	9.9	55.6
17	75 12.4	57.7	152 32.8	14.0	2 14.0	10.0	55.6
18	90 12.2	N22 57.9	167 05.8	14.0	N 2 24.0	9.9	55.6
19	105 12.1	58.1	181 38.8	14.0	2 33.9	9.9	55.5
20	120 12.0	58.3	196 11.8	14.1	2 43.8	9.9	55.5
21	135 11.9	58.5	210 44.9	14.1	2 53.7	9.9	55.5
22	150 11.7	58.7	225 18.0	14.1	3 03.6	9.8	55.4
23	165 11.6	58.9	239 51.1	14.1	3 13.4	9.8	55.4
10 00	180 11.5	N22 59.1	254 24.2	14.2	N 3 23.2	9.8	55.4
01	195 11.4	59.3	268 57.4	14.1	3 33.0	9.8	55.4
02	210 11.2	59.5	283 30.5	14.2	3 42.8	9.7	55.3
03	225 11.1	59.7	298 03.7	14.2	3 52.5	9.8	55.3
04	240 11.0	22 59.8	312 36.9	14.2	4 02.3	9.7	55.3
05	255 10.9	23 00.0	327 10.1	14.2	4 12.0	9.6	55.3
06	270 10.8	N23 00.2	341 43.3	14.2	N 4 21.6	9.7	55.2
07	285 10.6	00.4	356 16.5	14.2	4 31.3	9.6	55.2
08	300 10.5	00.6	10 49.7	14.3	4 40.9	9.6	55.2
F 09	315 10.4	00.8	25 23.0	14.2	4 50.5	9.5	55.2
R 10	330 10.3	01.0	39 56.2	14.3	5 00.0	9.6	55.1
I 11	345 10.1	01.2	54 29.5	14.3	5 09.6	9.5	55.1
D 12	0 10.0	N23 01.4	69 02.8	14.2	N 5 19.1	9.4	55.1
A 13	15 09.9	01.6	83 36.0	14.3	5 28.5	9.5	55.1
Y 14	30 09.8	01.8	98 09.3	14.3	5 38.0	9.4	55.1
15	45 09.6	01.9	112 42.6	14.3	5 47.4	9.4	55.0
16	60 09.5	02.1	127 15.9	14.3	5 56.8	9.3	55.0
17	75 09.4	02.3	141 49.2	14.3	6 06.1	9.3	55.0
18	90 09.3	N23 02.5	156 22.5	14.3	N 6 15.4	9.3	55.0
19	105 09.1	02.7	170 55.8	14.4	6 24.7	9.2	54.9
20	120 09.0	02.9	185 29.2	14.3	6 33.9	9.3	54.9
21	135 08.9	03.0	200 02.5	14.3	6 43.2	9.1	54.9
22	150 08.8	03.2	214 35.8	14.3	6 52.3	9.2	54.9
23	165 08.6	03.4	229 09.1	14.4	7 01.5	9.1	54.9
11 00	180 08.5	N23 03.6	243 42.5	14.3	N 7 10.6	9.0	54.8
01	195 08.4	03.8	258 15.8	14.3	7 19.6	9.1	54.8
02	210 08.2	03.9	272 49.1	14.3	7 28.7	9.0	54.8
03	225 08.1	04.1	287 22.4	14.3	7 37.7	8.9	54.8
04	240 08.0	04.3	301 55.7	14.4	7 46.6	8.9	54.8
05	255 07.9	04.5	316 29.1	14.3	7 55.5	8.9	54.7
06	270 07.7	N23 04.7	331 02.4	14.3	N 8 04.4	8.8	54.7
07	285 07.6	04.8	345 35.7	14.3	8 13.2	8.8	54.7
S 08	300 07.5	05.0	0 09.0	14.3	8 22.0	8.8	54.7
A 09	315 07.4	05.2	14 42.3	14.3	8 30.8	8.7	54.7
T 10	330 07.2	05.4	29 15.6	14.3	8 39.5	8.7	54.6
U 11	345 07.1	05.5	43 48.9	14.3	8 48.2	8.6	54.6
R 12	0 07.0	N23 05.7	58 22.2	14.3	N 8 56.8	8.6	54.6
D 13	15 06.8	05.9	72 55.5	14.2	9 05.4	8.5	54.6
A 14	30 06.7	06.0	87 28.7	14.3	9 13.9	8.5	54.6
Y 15	45 06.6	06.2	102 02.0	14.2	9 22.4	8.5	54.6
16	60 06.5	06.4	116 35.2	14.3	9 30.9	8.4	54.5
17	75 06.3	06.5	131 08.5	14.2	9 39.3	8.4	54.5
18	90 06.2	N23 06.7	145 41.7	14.3	N 9 47.7	8.3	54.5
19	105 06.1	06.9	160 15.0	14.2	9 56.0	8.3	54.5
20	120 06.0	07.0	174 48.2	14.2	10 04.3	8.2	54.5
21	135 05.8	07.2	189 21.4	14.2	10 12.5	8.2	54.5
22	150 05.7	07.4	203 54.6	14.2	10 20.7	8.1	54.5
23	165 05.6	07.5	218 27.8	14.1	10 28.8	8.1	54.4
	S.D. 15.8	d 0.2	S.D. 15.2		15.0		14.9

Lat.	Twilight Naut.	Twilight Civil	Sunrise	Moonrise 9	Moonrise 10	Moonrise 11	Moonrise 12
°	h m	h m	h m	h m	h m	h m	h m
N 72	▭	▭	▭	00 28	00 22	00 15	00 08
N 70	▭	▭	▭	00 27	00 26	00 25	00 25
68	▭	▭	▭	00 26	00 30	00 34	00 39
66	////	////	00 29	00 26	00 33	00 41	00 50
64	////	////	01 39	00 25	00 36	00 47	00 59
62	////	////	02 14	00 25	00 38	00 52	01 07
60	////	01 03	02 39	00 24	00 40	00 56	01 14
N 58	////	01 46	02 59	00 24	00 42	01 00	01 20
56	////	02 14	03 15	00 24	00 44	01 04	01 25
54	00 57	02 35	03 29	00 24	00 45	01 07	01 30
52	01 37	02 53	03 41	00 23	00 46	01 10	01 35
50	02 03	03 07	03 51	00 23	00 48	01 13	01 39
45	02 47	03 36	04 13	00 23	00 50	01 18	01 47
N 40	03 17	03 58	04 31	00 22	00 53	01 23	01 55
35	03 39	04 16	04 45	00 22	00 55	01 27	02 01
30	03 58	04 31	04 58	00 21	00 56	01 31	02 07
20	04 26	04 55	05 20	00 21	00 59	01 38	02 16
N 10	04 48	05 15	05 38	00 20	01 02	01 43	02 25
0	05 07	05 33	05 56	00 20	01 05	01 49	02 33
S 10	05 24	05 50	06 13	00 20	01 07	01 54	02 41
20	05 40	06 07	06 31	00 19	01 10	02 00	02 50
30	05 56	06 25	06 52	00 19	01 13	02 07	03 00
35	06 04	06 36	07 04	00 18	01 15	02 11	03 05
40	06 13	06 47	07 18	00 18	01 17	02 15	03 12
45	06 23	07 01	07 34	00 18	01 20	02 20	03 20
S 50	06 35	07 16	07 54	00 17	01 23	02 26	03 29
52	06 40	07 23	08 04	00 17	01 24	02 29	03 33
54	06 45	07 31	08 15	00 17	01 26	02 32	03 38
56	06 51	07 40	08 27	00 17	01 27	02 36	03 43
58	06 58	07 50	08 41	00 17	01 29	02 40	03 49
S 60	07 05	08 02	08 58	00 16	01 31	02 44	03 56

Lat.	Sunset	Twilight Civil	Twilight Naut.	Moonset 9	Moonset 10	Moonset 11	Moonset 12
°	h m	h m	h m	h m	h m	h m	h m
N 72	▭	▭	▭	13 01	14 39	16 18	17 58
N 70	▭	▭	▭	12 58	14 31	16 02	17 33
68	▭	▭	▭	12 57	14 24	15 50	17 15
66	23 36	////	////	12 55	14 19	15 40	17 00
64	22 21	////	////	12 54	14 14	15 32	16 48
62	21 45	////	////	12 53	14 10	15 25	16 38
60	21 20	22 58	////	12 52	14 06	15 18	16 29
N 58	21 01	22 14	////	12 51	14 03	15 13	16 21
56	20 44	21 45	////	12 51	14 00	15 08	16 14
54	20 30	21 24	23 03	12 50	13 58	15 04	16 08
52	20 18	21 07	22 22	12 49	13 56	15 00	16 03
50	20 08	20 52	21 56	12 49	13 53	14 56	15 58
45	19 46	20 23	21 12	12 48	13 49	14 49	15 48
N 40	19 28	20 01	20 42	12 47	13 45	14 43	15 39
35	19 13	19 43	20 19	12 46	13 42	14 37	15 31
30	19 01	19 28	20 01	12 45	13 39	14 32	15 25
20	18 39	19 03	19 33	12 44	13 34	14 24	15 13
N 10	18 20	18 43	19 10	12 43	13 30	14 17	15 04
0	18 03	18 25	18 52	12 42	13 26	14 10	14 54
S 10	17 46	18 09	18 35	12 41	13 22	14 03	14 45
20	17 28	17 52	18 19	12 39	13 18	13 56	14 35
30	17 07	17 33	18 03	12 38	13 13	13 48	14 24
35	16 55	17 23	17 54	12 37	13 10	13 43	14 18
40	16 41	17 11	17 45	12 36	13 07	13 38	14 10
45	16 24	16 58	17 35	12 35	13 03	13 32	14 02
S 50	16 04	16 42	17 24	12 34	12 59	13 24	13 51
52	15 54	16 35	17 19	12 33	12 57	13 21	13 47
54	15 44	16 27	17 13	12 33	12 54	13 17	13 42
56	15 31	16 18	17 07	12 32	12 52	13 13	13 36
58	15 17	16 08	17 00	12 31	12 49	13 08	13 29
S 60	15 00	15 57	16 53	12 31	12 46	13 03	13 22

Day	SUN Eqn. of Time 00ʰ	SUN Eqn. of Time 12ʰ	SUN Mer. Pass.	MOON Mer. Pass. Upper	MOON Mer. Pass. Lower	MOON Age	MOON Phase
	m s	m s	h m	h m	h m	d	
9	00 58	00 52	11 59	06 31	18 53	22	
10	00 46	00 40	11 59	07 15	19 37	23	
11	00 34	00 28	12 00	07 59	20 21	24	

0000 JUNE 15, 16, 17 (WED., THURS., FRI.)

G.M.T. (UT)	ARIES	VENUS −3.9		MARS +1.3		JUPITER −1.5		SATURN +0.6	
	G.H.A.	G.H.A.	Dec.	G.H.A.	Dec.	G.H.A.	Dec.	G.H.A.	Dec.
d h	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
15 00	263 09.8	226 34.6	N11 36.0	228 35.3	N12 47.2	188 11.9	N22 14.8	126 59.8	N17 43.9
01	278 12.3	241 34.7	36.7	243 36.0	47.9	203 13.7	14.8	142 02.0	43.8
02	293 14.7	256 34.9	37.4	258 36.7	48.5	218 15.6	14.9	157 04.2	43.8
03	308 17.2	271 35.0	·· 38.1	273 37.3	·· 49.1	233 17.4	·· 14.9	172 06.4	·· 43.7
04	323 19.6	286 35.1	38.8	288 38.0	49.7	248 19.3	15.0	187 08.6	43.6
05	338 22.1	301 35.2	39.5	303 38.7	50.3	263 21.1	15.1	202 10.9	43.6
06	353 24.6	316 35.4	N11 40.1	318 39.4	N12 51.0	278 23.0	N22 15.1	217 13.1	N17 43.5
W 07	8 27.0	331 35.5	40.8	333 40.1	51.6	293 24.8	15.2	232 15.3	43.4
E 08	23 29.5	346 35.6	41.5	348 40.8	52.2	308 26.6	15.3	247 17.5	43.4
D 09	38 32.0	1 35.8	·· 42.2	3 41.5	·· 52.8	323 28.5	·· 15.3	262 19.7	·· 43.3
N 10	53 34.4	16 35.9	42.9	18 42.2	53.4	338 30.3	15.4	277 21.9	43.2
E 11	68 36.9	31 36.0	43.6	33 42.8	54.1	353 32.2	15.5	292 24.2	43.1
S 12	83 39.4	46 36.1	N11 44.3	48 43.5	N12 54.7	8 34.0	N22 15.5	307 26.4	N17 43.1
D 13	98 41.8	61 36.3	45.0	63 44.2	55.3	23 35.9	15.6	322 28.6	43.0
A 14	113 44.3	76 36.4	45.7	78 44.9	55.9	38 37.7	15.6	337 30.8	42.9
Y 15	128 46.7	91 36.5	·· 46.4	93 45.6	·· 56.5	53 39.5	·· 15.7	352 33.0	·· 42.9
16	143 49.2	106 36.6	47.1	108 46.3	57.2	68 41.4	15.8	7 35.2	42.8
17	158 51.7	121 36.7	47.8	123 47.0	57.8	83 43.2	15.8	22 37.5	42.7
18	173 54.1	136 36.9	N11 48.5	138 47.6	N12 58.4	98 45.1	N22 15.9	37 39.7	N17 42.7
19	188 56.6	151 37.0	49.1	153 48.3	59.0	113 46.9	15.9	52 41.9	42.6
20	203 59.1	166 37.1	49.8	168 49.0	12 59.6	128 48.8	16.0	67 44.1	42.5
21	219 01.5	181 37.2	·· 50.5	183 49.7	13 00.3	143 50.6	·· 16.1	82 46.3	·· 42.4
22	234 04.0	196 37.3	51.2	198 50.4	00.9	158 52.4	16.1	97 48.5	42.4
23	249 06.5	211 37.4	51.9	213 51.1	01.5	173 54.3	16.2	112 50.8	42.3
16 00	264 08.9	226 37.6	N11 52.6	228 51.8	N13 02.1	188 56.1	N22 16.3	127 53.0	N17 42.2
01	279 11.4	241 37.7	53.3	243 52.4	02.7	203 58.0	16.3	142 55.2	42.2
02	294 13.9	256 37.8	54.0	258 53.1	03.3	218 59.8	16.4	157 57.4	42.1
03	309 16.3	271 37.9	·· 54.7	273 53.8	·· 04.0	234 01.7	·· 16.4	172 59.6	·· 42.0
04	324 18.8	286 38.0	55.4	288 54.5	04.6	249 03.5	16.5	188 01.8	41.9
05	339 21.2	301 38.1	56.1	303 55.2	05.2	264 05.4	16.6	203 04.1	41.9
06	354 23.7	316 38.2	N11 56.8	318 55.9	N13 05.8	279 07.2	N22 16.6	218 06.3	N17 41.8
07	9 26.2	331 38.3	57.5	333 56.6	06.4	294 09.0	16.7	233 08.5	41.7
T 08	24 28.6	346 38.5	58.2	348 57.3	07.0	309 10.9	16.8	248 10.7	41.7
H 09	39 31.1	1 38.6	·· 58.9	3 57.9	·· 07.6	324 12.7	·· 16.8	263 12.9	·· 41.6
U 10	54 33.6	16 38.7	11 59.6	18 58.6	08.3	339 14.6	16.9	278 15.1	41.5
R 11	69 36.0	31 38.8	12 00.2	33 59.3	08.9	354 16.4	16.9	293 17.4	41.5
S 12	84 38.5	46 38.9	N12 00.9	49 00.0	N13 09.5	9 18.3	N22 17.0	308 19.6	N17 41.4
D 13	99 41.0	61 39.0	01.6	64 00.7	10.1	24 20.1	17.1	323 21.8	41.3
A 14	114 43.4	76 39.1	02.3	79 01.4	10.7	39 21.9	17.1	338 24.0	41.2
Y 15	129 45.9	91 39.2	·· 03.0	94 02.1	·· 11.3	54 23.8	·· 17.2	353 26.2	·· 41.2
16	144 48.4	106 39.3	03.7	109 02.7	11.9	69 25.6	17.2	8 28.4	41.1
17	159 50.8	121 39.4	04.4	124 03.4	12.6	84 27.5	17.3	23 30.6	41.0
18	174 53.3	136 39.5	N12 05.1	139 04.1	N13 13.2	99 29.3	N22 17.4	38 32.9	N17 41.0
19	189 55.7	151 39.6	05.8	154 04.8	13.8	114 31.2	17.4	53 35.1	40.9
20	204 58.2	166 39.7	06.5	169 05.5	14.4	129 33.0	17.5	68 37.3	40.8
21	220 00.7	181 39.8	·· 07.2	184 06.2	·· 15.0	144 34.9	·· 17.6	83 39.5	·· 40.7
22	235 03.1	196 39.9	07.9	199 06.8	15.6	159 36.7	17.6	98 41.7	40.7
23	250 05.6	211 40.0	08.6	214 07.5	16.2	174 38.5	17.7	113 43.9	40.6
17 00	265 08.1	226 40.1	N12 09.3	229 08.2	N13 16.8	189 40.4	N22 17.7	128 46.1	N17 40.5
01	280 10.5	241 40.2	10.0	244 08.9	17.4	204 42.2	17.8	143 48.4	40.5
02	295 13.0	256 40.3	10.7	259 09.6	18.1	219 44.1	17.9	158 50.6	40.4
03	310 15.5	271 40.4	·· 11.4	274 10.3	·· 18.7	234 45.9	·· 17.9	173 52.8	·· 40.3
04	325 17.9	286 40.4	12.1	289 11.0	19.3	249 47.8	18.0	188 55.0	40.2
05	340 20.4	301 40.5	12.8	304 11.6	19.9	264 49.6	18.0	203 57.2	40.2
06	355 22.8	316 40.6	N12 13.5	319 12.3	N13 20.5	279 51.5	N22 18.1	218 59.4	N17 40.1
07	10 25.3	331 40.7	14.2	334 13.0	21.1	294 53.3	18.2	234 01.6	40.0
08	25 27.8	346 40.8	14.8	349 13.7	21.7	309 55.1	18.2	249 03.8	40.0
F 09	40 30.2	1 40.9	·· 15.5	4 14.4	·· 22.3	324 57.0	·· 18.3	264 06.1	·· 39.9
R 10	55 32.7	16 41.0	16.2	19 15.1	22.9	339 58.8	18.3	279 08.3	39.8
I 11	70 35.2	31 41.1	16.9	34 15.8	23.5	355 00.7	18.4	294 10.5	39.7
D 12	85 37.6	46 41.2	N12 17.6	49 16.4	N13 24.1	10 02.5	N22 18.5	309 12.7	N17 39.7
A 13	100 40.1	61 41.2	18.3	64 17.1	24.8	25 04.4	18.5	324 14.9	39.6
Y 14	115 42.6	76 41.3	19.0	79 17.8	25.4	40 06.2	18.6	339 17.1	39.5
15	130 45.0	91 41.4	·· 19.7	94 18.5	·· 26.0	55 08.0	·· 18.6	354 19.3	·· 39.4
16	145 47.5	106 41.5	20.4	109 19.2	26.6	70 09.9	18.7	9 21.5	39.4
17	160 50.0	121 41.6	21.1	124 19.9	27.2	85 11.7	18.8	24 23.8	39.3
18	175 52.4	136 41.7	N12 21.8	139 20.5	N13 27.8	100 13.6	N22 18.8	39 26.0	N17 39.2
19	190 54.9	151 41.7	22.5	154 21.2	28.4	115 15.4	18.9	54 28.2	39.2
20	205 57.3	166 41.8	23.2	169 21.9	29.0	130 17.3	18.9	69 30.4	39.1
21	220 59.8	181 41.9	·· 23.9	184 22.6	·· 29.6	145 19.1	·· 19.0	84 32.6	·· 39.0
22	236 02.3	196 42.0	24.6	199 23.3	30.2	160 21.0	19.1	99 34.8	38.9
23	251 04.7	211 42.1	25.3	214 24.0	30.8	175 22.8	19.1	114 37.0	38.9
Mer. Pass.	h m 6 22.4	*v* 0.1	*d* 0.7	*v* 0.7	*d* 0.6	*v* 1.8	*d* 0.1	*v* 2.2	*d* 0.1

STARS

Name	S.H.A.	Dec.
	° ′	° ′
Acamar	315 39.3	S40 23.6
Achernar	335 47.3	S57 20.8
Acrux	173 39.4	S62 58.8
Adhara	255 34.2	S28 56.7
Aldebaran	291 20.8	N16 27.7
Alioth	166 44.4	N56 05.2
Alkaid	153 20.0	N49 25.8
Al Na'ir	28 17.6	S47 03.9
Alnilam	276 14.2	S 1 13.1
Alphard	218 22.9	S 8 33.8
Alphecca	126 33.7	N26 47.6
Alpheratz	358 11.6	N28 57.8
Altair	62 34.4	N 8 48.6
Ankaa	353 42.6	S42 25.5
Antares	112 59.2	S26 22.9
Arcturus	146 20.3	N19 18.1
Atria	108 24.8	S68 59.2
Avior	234 29.5	S59 26.5
Bellatrix	279 01.4	N [illegible]
Betelgeuse	271 31.0	N [illegible]
Canopus	264 08.7	S52 41.2
Capella	281 15.0	N45 58.4
Deneb	49 49.6	N45 11.9
Denebola	183 01.3	N14 41.9
Diphda	349 23.2	S18 06.5
Dubhe	194 25.1	N61 52.6
Elnath	278 47.3	N28 35.2
Eltanin	90 58.2	N51 29.6
Enif	34 13.6	N 9 46.3
Fomalhaut	15 53.8	S29 44.3
Gacrux	172 30.9	S56 59.5
Gienah	176 20.2	S17 25.2
Hadar	149 26.0	S60 16.1
Hamal	328 31.6	N23 21.2
Kaus Aust.	84 19.4	S34 23.6
Kochab	137 18.2	N74 15.2
Markab	14 05.3	N15 05.[illegible]
Menkar	314 43.7	N 4 00.[illegible]
Menkent	148 39.3	S36 15.[illegible]
Miaplacidus	221 45.9	S [illegible]
Mirfak	309 19.6	N49 46.[illegible]
Nunki	76 31.5	S26 19.[illegible]
Peacock	54 01.4	S56 48.[illegible]
Pollux	244 01.2	N28 04.[illegible]
Procyon	245 28.4	N 5 16.[illegible]
Rasalhague	96 31.3	N12 34.
Regulus	208 12.5	N12 04.
Rigel	281 38.5	S 8 13.
Rigil Kent.	140 28.2	S60 44.
Sabik	102 43.3	S15 41.
Schedar	350 11.5	N56 24.
Shaula	96 58.3	S37 05.
Sirius	258 58.0	S16 41.
Spica	158 59.7	S11 02.
Suhail	223 12.6	S43 20.
Vega	80 56.9	N38 45
Zuben'ubi	137 35.2	S15 56

	S.H.A.	Mer. Pass
	° ′	h m
Venus	322 28.6	[illegible] 53
Mars	324 42.8	44
Jupiter	284 47.2	[illegible] 23
Saturn	223 44.1	15 26

NAVIGATION

10 JULY 2007

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a bulk carrier which is to make a fully laden passage between Port Headland (W.Australia) and Mombassa (Kenya) in June. The vessel's service speed is expected to be 15 knots.

1. (a) Outline FIVE factors that should be considered when planning an ocean passage. (10)

   (b) The following departure and landfall positions are to be used for the passage, Datasheets Q1(1) and Q1(2) are included for reference:

Port Headland	Departure Position	20°12'.0S 118°37'.0E
Mombassa	Landfall Position	4°05'.0S 39°43'.0E

   Assume that the vessel is under pilotage for a total distance of 87 miles from the berth to the departure position.

   Calculate EACH of the following:

   (i) the *shortest* distance from Port Headland to the landfall position; (10)

   (ii) the course of the vessel at the departure position. (10)

   (c) When appraising the passage it is noted that the vessel will pass close to the Agalega Islands which have a report of shoal water close to the North of the islands in position 10°04'.0S 56°39'.0E.

   Calculate the distance the vessel will pass off the shoal when crossing longitude 56°39'.0E. (15)

2. Weather routing is often effectively used by vessels making trans oceanic passages.

   (a) Outline FIVE factors that should be considered when deciding to weather route the ship. (20)

   (b) Describe THREE types of weather routing currently available to vessels. (12)

   (c) Outline the benefits of carrying out shipboard routing. (8)

3. Whilst approaching the Agalega Islands, on the evening of the 28th June, the Master wishes to verify the vessel's position as given by the GPS. He instructs the OOW to take a set of star sights during evening twilight.
The following observations are made, whilst steering 288°(T) at 14 knots, using a DR position, based on the GPS, of 10°09'.0S 57°40'.0E.

Conditions were partly cloudy with a clear horizon and no moon. Wind ESE Force 5

Time	Star	Azimuth	True Alt	Calc Alt
1804	Arcturus	N 42°E	42°34'.2	42°41'.9
1808	Procyon	N 78°W	18°48'.0	18°57'.2
1818	Rigel Kent	S 21°E	39°41'.8	39°35'.5

(a) Determine the vessel's Most Probable Position (MPP) at 1815hrs, assuming a systematic error. (25)

(b) In light of the position determined in Q3(a) and the proximity of the Agalega Islands to the planned track, explain the actions a prudent Master should take, given the vessel's MPP at 1815hrs. (15)

4. Whilst approaching the port of Mombassa, in the early hours of the morning, the OOW obtains radar plots of four targets as shown in Worksheet Q4. Visibility is approximately 1 mile in thick haze.

The vessel is currently steering 295°(T) at 12 knots. Plots were commenced at 0400hrs and the plots cover a 20 minute period.

(a) Analyse the situation for all FOUR targets at 0420hrs. (20)

(b) Determine the alteration of course required at 0425hrs to ensure that all targets pass at a distance of at least 1.5 miles, giving reasons for the answer. (20)

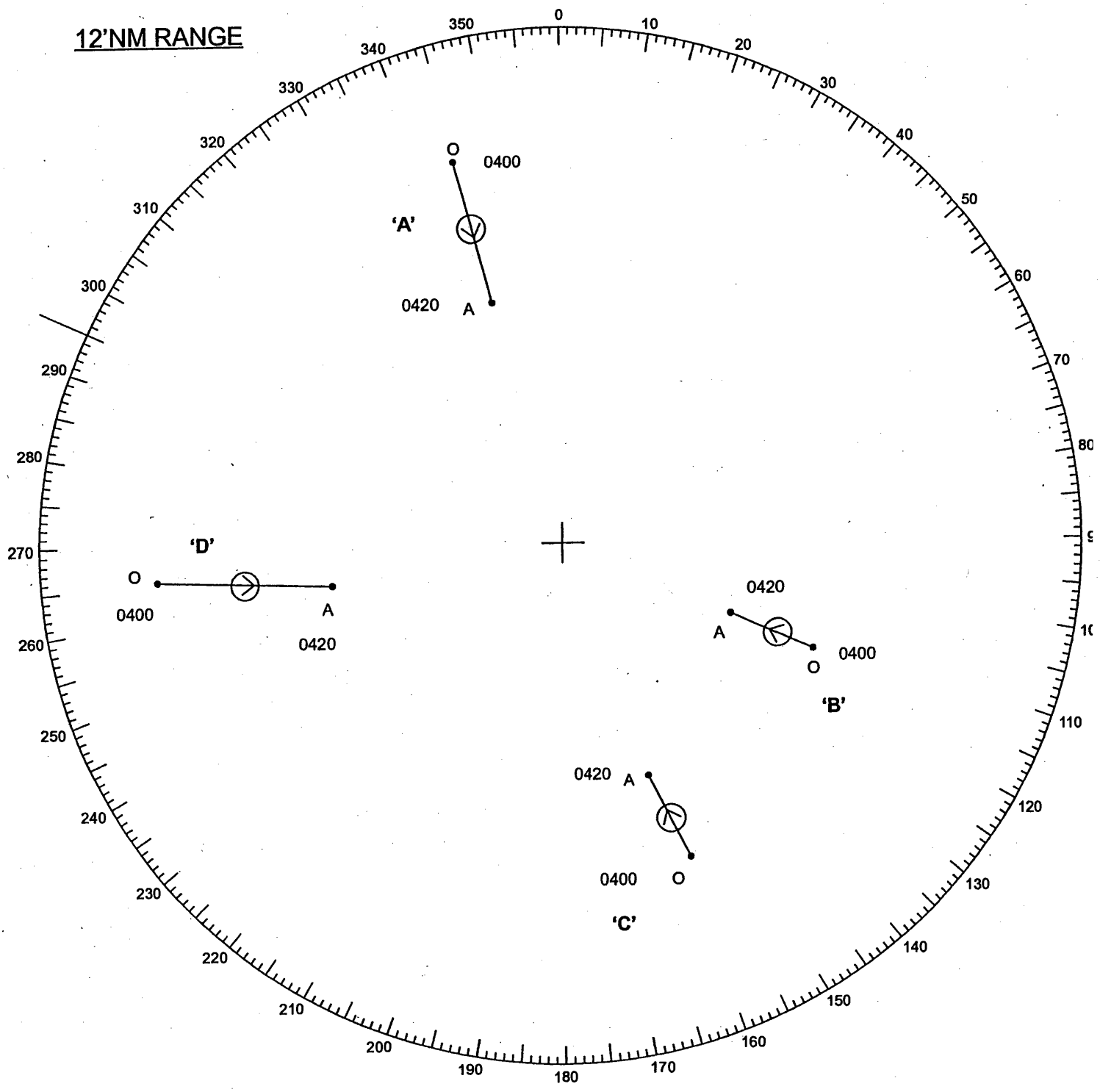
5. (a) Outline the information that should be discussed as part of the Master-Pilot exchange. (20)

(b) Describe the procedures that should be adopted on the bridge prior to arrival at the pilot station. (15)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET

12'NM RANGE



Signature of Candidate .....

Examination Centre .....

West and South coasts of Australia → Durban or Cape Town

6.159

Diagram (6.157)

All routes throughout the year pass through or N of 30° S, 100° E.

From the S coast of Australia and Tasmania this position is approached through 34° 37′ S, 115° 08′ E, 15 miles S of Cape Leeuwin, and thence by rhumb line.

Although a great circle track from Tasmania direct to 30° S, 100° E might appear preferable, it would only save about 20 miles, and adverse winds with head seas would be more likely.

6.159.1

From 30° S, 100° E, routes are seasonal as follows:

October to April, for Durban, by great circle.

For Cape Town:

Great circle to 35° S, 65° E, thence:

Rhumb line to a landfall on Cape Recife, thence:

Coastwise as at 6.56.

6.159.2

May to September, routes are along the parallel of 30° S to Durban, continuing thence for Cape Town as at 6.56.

6.159.3

Distance in miles:

	Fremantle	*Adelaide*	*Port Phillip for Melbourne*	*Hobart*
Durban				
October–April	4350	5510	5800	5980
May–September	4410	5570	5860	6040
Cape Town(G)				
October–April	4970	6130	6420	6600
May–September	5200	6360	6650	6830

* Port Phillip to Melbourne: 40 miles.

(G) For distances to Cape Agulhas (15 miles S of), subtract 130 miles.

Cape Town → New Zealand and Pacific Ocean

6.160

Diagram (6.160)

October to April, routes are as at 6.157 for Hobart as far as 41° 30′ S, 122° 50′ E, thence:

Either, great circle to 47° 50′ S, 167° 50′ E, ENE of Snares Islands; Or, great circle passing close S of Tasmania to Cook Strait.

6.160.1

If the shorter route to Hobart as at 6.157.1 is taken, it should be left in 45° S, 130° E, and great circles followed thence to Snares Islands or Cook Strait.

6.160.2

May to September, routes are as at 6.157.2 for ports E of Adelaide as far as 35° 30′ S, 115° 00′ E, S of Cape Leeuwin, thence:

Great circle to a landfall on South West Cape, Tasmania, thence:

Great circle to Snares Islands or Cook Strait.

6.160.3

Distances in miles from Cape Town:

	Snares Islands	*Cook Strait (Wellington)*
Oct–April: (6.160)	6970(a′)	7380(a′)
Shorter route (6.160.1)	6650(a′)	7100(a′)
May–Sept	7240(G)	7630(G)

(a′) For distance from Cape of Good Hope (145 miles S of), subtract 180 miles.

(G) For distance from Cape Agulhas (15 miles S of), subtract 130 miles.

Mombasa ↔ Selat Sunda

6.161

Diagram (6.161)

From Mombasa the route passes 50 miles N of Seychelles Group, thence through 4° 00′ S, 73° 30′ E, passing 50 miles N of Chagos Archipelago, thence to Selat Sunda.

Distance: 3980 miles.

Mombasa ↔ Singapore

6.162

Diagrams (6.161)

From Mombasa the route is:

Through One and Half Degree Channel, thence:

Through Selat Benggala, thence:

Through Malacca Strait to Singapore.

Distances: 3990 miles.

Mombasa ↔ North and west coasts of Australia

6.163

Diagram (6.161)

For Torres Strait and Darwin, in either direction, routes from Mombasa are either, as at 6.161 to Selat Sunda, thence:

Through Java and Flores Seas, and Selat Wetar, as in Java, Flores and Banda Seas Route of 6.122.4;

6.163.1

Or, 50 miles N of Seychelles Group, thence:

Through 4° 00′ S, 73° 30′ E, passing N of Chago Archipelago, thence:

Joining the Ocean Route of 6.122.2 in 11° 30′ S, 118° 00′ E.

6.163.2

For places between Darwin and Cape Leeuwin East-bound. From Mombasa routes are:

50 miles N of Seychelles Group, thence:

Through 4° 00′ S, 73° 30′ E, thence:

Through 10° S, 80° E, thence:

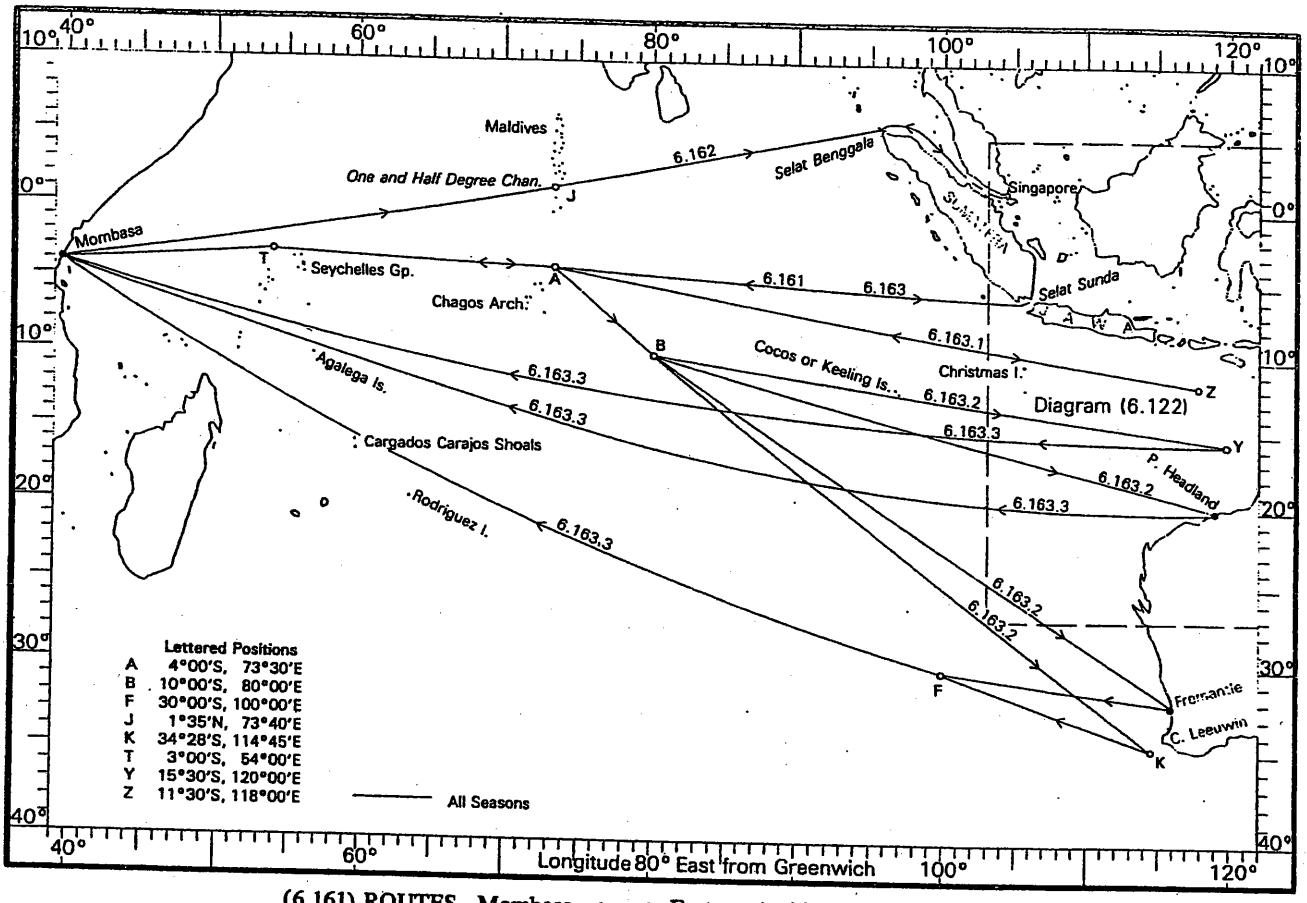
As direct as navigation permits, either to the appropriate recommended track (6.121), or to destination.

6.163.3

West-bound. From the Australian coast S of Darwin, routes are by great circle, as near as navigation permits, keeping N of 30° S, 100° E.

6.163.4

INDIAN OCEAN



(6.161) ROUTES—Mombasa ⟷ Eastern Archipelago and Australia.

6.163.4
Distances in miles:
From Mombasa:

	Java, Flores & Banda Seas Route	*Ocean Route*
Torres Strait	6170	6150
Darwin	5620	5520

	E-bound	*W-bound*
Port Hedland	4790	4720
Fremantle	4840	4570
Cape Leeuwin	4860	4530

Aden → Selat Sunda

6.164
Diagram (6.164)
October to April, the route is round Raas Caseyr, thence through One and Half Degree Channel, and thence to Selat Sunda.

6.164.1
May to September, the route is:
N of Suquṭrá to 13° 00′ N, 55° 00′ E, thence:
Through Eight Degree Channel, thence:
Landfall on Dondra Head (as at 6.78.2), thence:
To Selat Sunda.

6.164.2
Distances in miles.

	Oct–April	*May–Sept*
Selat Sunda	3840	3860
Routeing Position (6° 25′ S, 102° 30′ E)	3650	3670

6.164.3
For low-powered vessels, routes are as follows.
October to April, round Raas Caseyr thence:
1° 00′ S, 72° 20′ E, in March and April direct, but in October to February via 3° 00′ N, 60° 00′ E, thence:
2° 20′ S, 76° 30′ E, thence:
3° 00′ S, 94° 30′ E, thence:
To Selat Sunda.

6.164.4
May to September, as for fully-powered vessels as far as Dondra Head, thence:
Across the equator in 96° 30′ E, thence:
Along the W coast of Sumatera by either the outer route, W of all the islands, or the middle route between the islands in the offing and those adjacent to the coast (see Admiralty Sailing Directions) to Selat Sunda.

Selat Sunda → Aden

6.165
Diagram (6.164)
October to April, the route is to a landfall on Dondra Head, thence as at 6.79 to Aden.
Distance (N or S of Suquṭrá): 3860 miles.

6.165.1
May to September, the route is:
Through One and Half Degree Channel, thence:
8° 00′ N, 52° 40′ E, thence:
Round Raas Caseyr to Aden.
Distance: 3940 miles.

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a 100,000 tonne product tanker which is to make a fully laden passage from Belize (Central America) to Southampton (UK) in mid September.

1. The vessel's owners have requested that the Master follow the shortest possible route, as per Ocean Passages of the World, to a landfall position 5miles South of Bishop Rock (49°47'.0N 6°27'.0W).

   Using Datasheets Q1(1), Q1(2) and Q1(3)

   (a) Analyse the possible routes that the vessel could follow and determine the most appropriate route, stating the distance on passage. (25)

   (b) For the route chosen in Q1(a), describe sequentially, the navigational hazards the vessel will encounter until the vessel clears the Caribbean. (15)

2 At 1530hrs UT on the 21st September, whilst in DR position 18°50'.0N 80°00'.0W the vessel receives the following tropical storm advisory from the National Hurricane Centre in Miami. The vessel is currently making 17 knots on a course of 080°(T).

21st September 1500hrs UT

Tropical Storm Grace	*Position 16°45'.0N 67°00'.0W*
Central Pressure	*976 mb*
Predicted Track	*295°(T) at 17 knots*
Forecast Winds	*60 knots within 90 nmls*
	50 knots within 130 nmls
	40 knots within 170 nmls

Storm is expected to maintain current track for next 24 hrs and reach hurricane intensity within the next 12 hours.

(a) Using Worksheet Q2:

   (i) plot the position of the vessel and the storm centre at 1530hrs UT; (4)

   (ii) indicate the likely positions of the storm centre for the next 12 and 24 hours. (4)

(b) Describe the changing weather conditions that the vessel would expect to encounter if it were to maintain its present course and speed for the next 24 hours. (16)

(c) Outline the possible courses of action open to the Master to avoid the worst of the storm, indicating which one would be most suitable if action was taken at 1830hrs UT. (16)

3. The vessel has successfully cleared the storm and exited the Caribbean, the vessel receives new orders to proceed to Antwerp via the Dover straits.

The British Admiralty produces Admiralty Routeing charts and also a number of charts that give passage planning guidance for certain areas of the world.

(a) Compare and contrast the different types of information contained in each of the above and comment on how they may be used by the navigator. (30)

(b) Explain how the Master of a deep draught vessel can make use of Co-Tidal/Co Range Charts when planning a passage through shallow, confined waters. (15)

4. At 0400hrs, whilst proceeding in the NE bound lane of the Straits Traffic Separation Scheme, four targets are plotted on radar, over a 20 minute period, as shown on Worksheet Q4. Visibility was estimated to be 0.5 miles and the vessel was steering 015°(T) at 12 knots. Target A has been identified as a lighthouse. An extensive area of shoal water lies 4 miles to starboard.

(a) Analyse the situation at 0420hrs for targets B,C and D. (15)

(b) Determine the set and rate of the tide affecting the vessel. (5)

(c) Outline the action the Master should take at 0425hrs to ensure targets C & D have minimum CPA of 2.0 miles and any subsequent action necessary, stating full reasons for the answer. (25)

5. A vessel is due to enter the port of Antwerp via the locks at Boudewjinluis (European Tide Tables port No 1539a).

The vessel is expected to arrive off the lock entrance on the AM flood tide on the 18th April.

The charted depth of the lock sill is 6.8m and the vessel's draught is 9.8m. The vessel must clear the locks with 1.5m under the keel.

Using Worksheet Q5, determine the earliest time (UT) the vessel can enter the locks. (30)

CHAPTER 4

CARIBBEAN SEA AND GULF OF MEXICO

WINDS AND WEATHER

General description
4.1

Over the Caribbean Sea, NE to E winds prevail throughout the year, while over the Gulf of Mexico the wind is generally lighter and more variable in direction, though frequently from between NE and SE. In coastal waters, strong N winds may reach gale force at times over the Gulf. For the whole area, wind speeds are mainly light or moderate except for occasional hurricanes, see 2.5, which may affect the area from June to November. Most hurricanes track N of Cuba, and they rarely occur S of 15° N.

The weather over the area is generally partly cloudy with scattered showers. Sunny spells are frequent and, from May to December, periods of heavy rain and thunderstorms are frequent. Squalls may occur at anytime, but fog seldom occurs at sea.

Visibility is generally good throughout the year though it may at times be drastically reduced by heavy rain.

For Northers, see 2.3.

SWELL

General description
4.5

Swells are generally lower in the Gulf of Mexico than in the Caribbean Sea.

In the Caribbean Sea the prevailing direction is from NE to E; in the Gulf of Mexico, from March to September it is from E to SE, and from October to February it is from NE.

Highest swells occur in an area round 13° N, 77° W in the Caribbean Sea, especially in June and July, when the frequency of swell greater than 4 m is 20 per cent. These swells are invariably short or average in length.

CURRENTS

General description
4.11

The North Equatorial Current (2.15) flows WNW through the Caribbean Sea with little change of direction until it approaches Yucatan Channel where it turns to the N. It leaves an anti-clockwise eddy in the S part of the sea, S of about 12° N. There is also an E-going counter-current close to the S coast of E and central Cuba.

In the Gulf of Mexico, part of the N-going flow from Yucatan Channel fans out in directions between SW and NW. Currents setting in these directions occupy most of the Gulf W of a line from Cabo Catoche to close W of the Mississippi delta. From the NW flow along this line, water fans out NE and then shortly recurves to join the SE flow extending from the Mississippi delta to the W approaches to Straits of Florida. This SE-going stream joins the NE-going stream which emerges from Yucatan Channel and the combined flow continues E, and through Straits of Florida as the Florida Current. The emerging stream meeting the NW flowing water of the North Sub-tropical Current, turns N off the E coast of Florida and forms the beginning of the Gulf Stream.

Along the W coast of Florida there is a N-going current which, with the SE flow coming from the Mississippi delta, forms an anti-clockwise eddy in the E part of the Gulf of Mexico.

There is little seasonal variation in the pattern of the currents.

The average current rates in most of the Caribbean Sea are about 1 knot, increasing on the W side of Yucatan Channel to about 4 knots. The strongest currents are observed in Straits of Florida in about 25° 00′ N, 80° 00′ W and for about 300 miles N from that position. Here the average rate is nearly 3 knots in summer and 2½ knots in winter.

Over most of the Gulf of Mexico the average rates are about 1 knot, but N-going sets of about 1½ knots are reported in summer near the Mexican coast N of Tampico and SE-going sets of a similar magnitude for much of the year between the Mississippi delta and Cuba.

NOTES AND CAUTIONS

Navigation
4.15

In the Caribbean Sea and Gulf of Mexico, and in the channels leading thereto, great care is necessary near the cays and banks, as some of the charts are based on old and imperfect surveys.

Furthermore, depths over the shoals may be less than those charted owing to the growth of the coral of which many of them are composed or to the imprecise nature of the least depths reported over them. Shoal water should be approached with caution at all times and given a wide berth when conditions for fixing are poor: many of the banks are steep-to.

4.15.1

Caution. Strong currents can be expected in the entrances and channels leading to the Caribbean Sea and Gulf of Mexico, particularly in Straits of Florida.

Having chosen the route, the mariner should invariably consult Admiralty Sailing Directions for details of currents and tidal streams affecting it.

Entrance Channels
4.16

Diagram (4.21)

The Caribbean Sea may be approached through Crooked Island Passage, Caicos Passage or Turks Island Passage, all of which lead to Windward Passage.

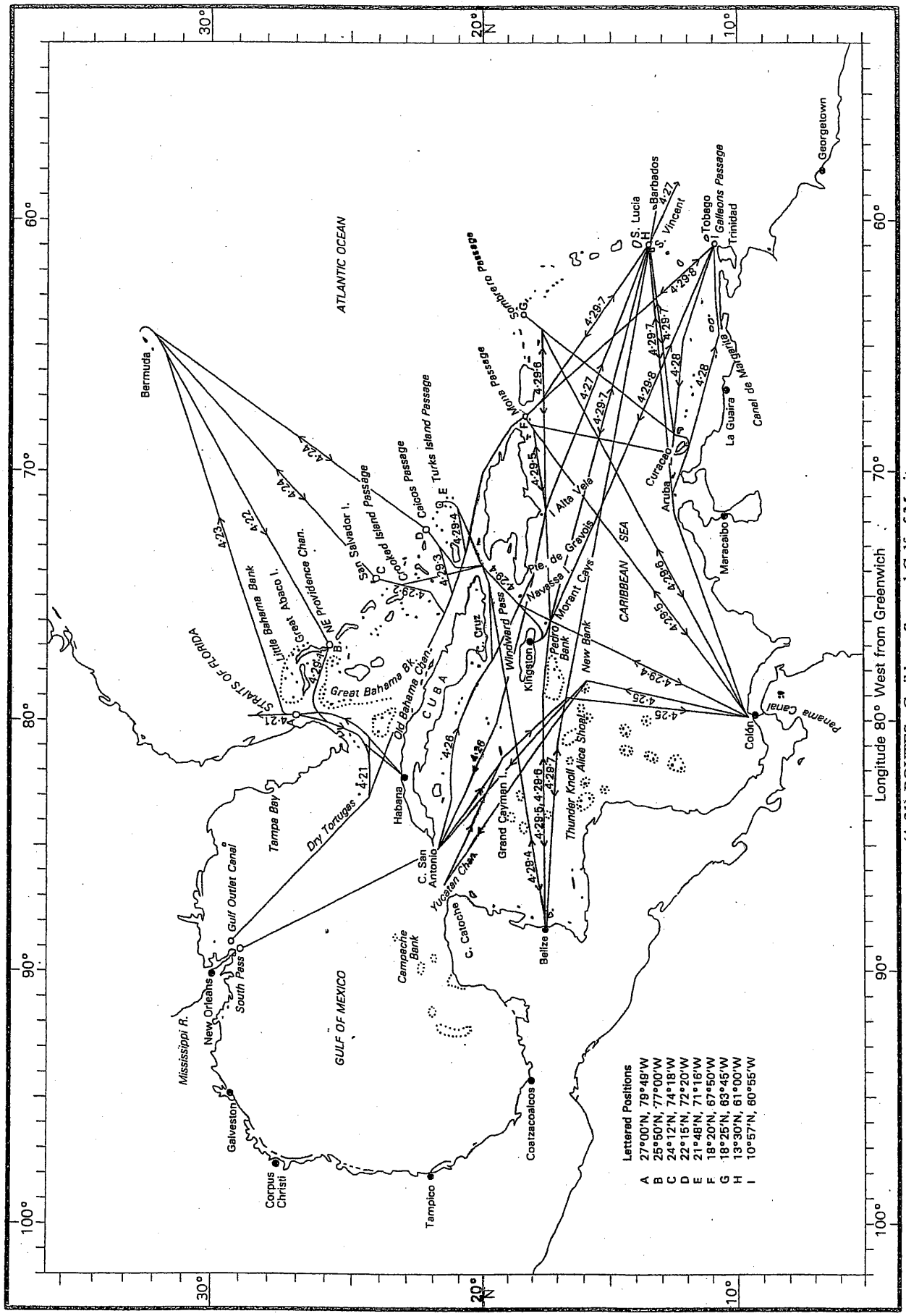
Crooked Island Passage is the most frequently used.

Caicos Passage is not lighted, and Turks Island Passage, not lighted in its S approach, is not recommended for N-bound vessels at night.

Other entrances in common use are:

Mona Passage, which is much frequented and presents no difficulty. Although subject to heavy squalls it is safer than Turks Island Passage.

Sombrero Passage, which is not lighted in its S approach.



(4.21) ROUTES—Caribbean Sea and Gulf of Mexico

The Channel between Saint Lucia and Saint Vincent.

The passages N and S of Tobago.

In many cases routes through the various passages differ little in distance, and selection will depend principally on the ship's particular requirements.

For distances from these passages, see 4.29–4.29.8.

ROUTES

English Channel ↔ Caribbean Sea and Gulf of Mexico

4.21

Diagram (4.21)

Routes are as follows.

Belize. Providence Channels or Turks Island Passage and Windward Passage are suitable.

Kingston or Colón. Turks Island Passage and Windward Passage are suitable.

Colón or Curaçao. Mona Passage or Sombrero Passage are suitable.

Gulf of Mexico may be approached, either N of Cuba, through Providence Channels or Old Bahama Channel and Nicholas Channel, or S of Cuba through Caribbean Sea and Yucatan Channel. For routes within Gulf of Mexico, see Admiralty Sailing Directions.

Straits of Florida, through which the current runs strongly to the N, is best for departure from Gulf of Mexico.

For distance through these passages, see 4.29.8 and 2.85.4.

Bermuda → Habana

4.22

Diagram (4.21)

The route is through North-East Providence Channel, North-West Providence Channel and Straits of Florida.

Distance: 1130 miles.

4.22.1

For low-powered vessels, routes from the W end of the North-West Providence Channel are:

Either,

Across Straits of Florida to Fowey Rocks, thence:
Close off Florida Reefs, as directed in Admiralty Sailing Directions, to Sand Key, thence:
Across the Florida Current again to Habana.

Or, preferably by day,

Along the W edge of Great Bahama Bank to Habana. See Admiralty Sailing Directions.

Habana → Bermuda

4.23

Diagram (4.21)

The route is through Straits of Florida, thence direct from the NW end of Little Bahama Bank.

For Caution on approaching Bermuda, see 2.38.

Distance: 1150 miles.

Bermuda ↔ Kingston

4.24

Diagram (4.21)

From Bermuda the route is through either Crooked Island Passage or Caicos Passage (see 4.16), thence W of Great Inagua Island and through Windward Passage.

Cautions. Morant Cays have been the scene of many wrecks. Currents in their vicinity vary greatly, both in direction and rate. If passing them at night, ships should keep well N of them.

For Caution on approaching Bermuda, see 2.38.

4.24.1

Distances:

Via Crooked Island Passage 1180 miles;
Via Caicos Passage 1110 miles.

Colón (for Panama Canal) ↔ Gulf of Mexico

4.25

Diagram (4.21)

North-bound. From the entrance to the canal between the breakwaters off Colón, the route runs NNE to round New Bank at a prudent distance, thence direct to Yucatan Channel.

South-bound. From Yucatan Channel the route is:

To a position outside the 200 m depth contour off South-West Point, Grand Cayman Island, thence:

To a point off the SW extremity of Pedro Bank, thence:

Either, direct to Colón, passing between New Bank and Alice Shoal or, if unsure of the position, the route continues SE till New Bank has been cleared and a SSW course can be set for Colón.

Caution. New Bank and Alice Shoal are charted mainly from a survey of 1835.

Due allowance must be paid to the prevailing W-going current between Colón and Jamaica.

A vessel entering the W part of Gulf of Mexico from the Caribbean Sea should be kept in the deep water in Yucatan Channel, all precautions being taken against the N-going current and her position continually checked to identify the point of crossing the edge of Campeche Bank.

The edge of the bank is generally marked by ripplings, and only a short distance within it the water becomes discoloured. The bank has not been subjected to a modern survey, and new reports of shoal patches are often received, so sounding should be continuous when crossing it. Dangers on the bank are steep-to and sometimes indicated by discoloured water.

For routes W of Thunder Knoll, and from Yucatan Channel to ports in Gulf of Mexico, see Admiralty Sailing Directions.

4.25.1

Distances from Colón, passing W of New Bank: if passing E of New Bank, add 15 miles:

Cabo Catoche (28 miles ENE of) 965 miles;
Cabo San Antonio (10 miles W of) 900 miles;
New Orleans (Mississippi River South Pass) 1380 miles;
S entrance to Panama Canal (Balboa) 45 miles.

Yucatan Channel ↔ Eastern part of Caribbean Sea

4.26

Diagram (4.21)

Cabo Catoche should be given a wide berth on account of the shoals N of it.

East-bound. From 7 miles S of Cabo San Antonio, the route is:

Along the S coast of Cuba to pass 5 miles S of Cabo Cruz, thence:
5 miles S of Navassa Island, thence:
5 miles S of Pointe de Gravios, thence:
To a position 5 miles S of Alta Vela.

This track, mostly under the lee of the land, makes use of the E-going counter-current (4.11). Off the coast of Cuba between Cabo San Antonio and Cabo Cruz, special caution is required because onshore sets sometimes run strongly.

West-bound. From Alta Vela the route passes N of Jamaica, thence as direct as navigation permits to Cabo San Antonio.

Eastern part of Caribbean Sea → South American ports

4.27

Diagram (4.21)

For destinations E of the Caribbean Sea, the best route from Alta Vela passes between Saint Lucia and Saint Vincent and S of Barbados.

Colón (for Panama Canal) ↔ Trinidad, Galleons Passage and Tobago

4.28

Diagram (4.21)

East-bound passages are best made keeping close inshore, passing S of Aruba and Curaçao, and through Canal de Margarita.

West-bound, advantage can be taken of the W-going North Equatorial Current, by passing N of the outlying islands and dangers.

Distances from Colón (by either route):
Trinidad (Port of Spain) 1140 miles;
Galleons Passage 1170 miles;
Tobago (15 miles N of North Point) 1180 miles.

Distances from entrances to Caribbean Sea

4.29

Diagram (4.21)

Straits of Florida (N end)
Dry Tortugas (24° 30′ N, 83° 05′ W) 285 miles;
(From Dry Tortugas (24° 25′ N, 83° 00′ W) to N end 290 miles.)
New Orleans (Mississippi River Gulf Outlet Canal) 720 miles;
Habana 285 miles.

4.29.1

North-East Providence Channel
Dry Tortugas (24° 30′ N, 83° 05′ W) 380 miles;
New Orleans (Mississippi River Gulf Outlet Canal) 805 miles:
Habana 370 miles.

4.29.2

Crooked Island Passage (from landfall on San Salvador) via Old Bahama Channel:
Habana 585 miles;
New Orleans (Mississippi River Gulf Outlet Canal) 1060 miles.
Via Windward Passage:
Kingston 480 miles;
Belize 1080 miles;
Colón 980 miles.

4.29.3

Caicos Passage via Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1070 miles;
Habana 590 miles.
Kingston, passing W of Great Inagua Island 390 miles.

4.29.4

Turks Island Passage via Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1160 miles;
Habana 685 miles.
Via Windward Passage:
Belize 1030 miles;
Colón 925 miles;
Kingston 420 miles.

To Tampico and ports in Gulf of Mexico farther S, Yucatan Channel gives the shortest route: to ports N and E of Tampico, Old Bahama Channel gives the shortest.

4.29.5

Mona Passage
Kingston 520 miles;
Curaçao 390 miles;
Colón 885 miles;
Belize 1180 miles.

4.29.6

Sombrero Passage
Kingston 755 miles;
Curaçao 500 miles;
Colón 1090 miles;
Belize 1410 miles.

4.29.7

Saint Lucia/Saint Vincent Channel
Barbados (Bridgetown) 85 miles;
Kingston 950 miles;
Curaçao 480 miles;
Colón 1150 miles;
Belize 1590 miles.
Via Mona Passage and Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1860 miles;
Habana 1370 miles.

4.29.8

Galleons Passage
Kingston 1010 miles;
Curaçao 480 miles;
Via Mona Passage and Old Bahama Channel:
New Orleans (Mississippi River Gulf Outlet Canal) 1960 miles.

and the North Atlantic Current (2.15), as well as the predominantly W winds of the N part of the North Atlantic Ocean. For directions for passage via Straits of Florida to the departure position (27° 00′ N, 79° 49′ W), off Jupiter Inlet, see Admiralty Sailing Directions.

West-bound passages are recommended either through Providence Channels or through Old Bahama Channel and Nicholas Channel.

Routes in Gulf of Mexico and Caribbean Sea, and the approaches thereto, are continued in Chapter 4.

Straits of Florida → Vigo and European coast farther North

2.82

Diagrams (2.82, 2.63)

From 27° 00′ N, 79° 49′ W, at the N end of Straits of Florida, routes are:
Through 30° 00′ N, 79° 40′ W, keeping in the main body of the Gulf Stream, thence:
Through 35° 30′ N, 72° 40′ W, thence:
Great circle to Position BS (42° 30′ N, 50° 00′ W), thence: As at 2.63.4 to destination.

2.82.1

Distances from Straits of Florida:

Nordkapp 4660 miles;	Fastnet 3520 miles;
Trondheim 4220 miles;	Bishop Rock 3640 miles;
Bergen 4060 miles;	La Gironde* 3870 miles;
Cape Wrath 3730 miles;	Vigo 3610 miles.
Inishtrahull 3620 miles;	

* 70 miles from Bordeaux.

Straits of Florida → Lisboa and Strait of Gibraltar

2.83

Diagram (2.82)

From 27° 00′ N, 79° 49′ W, at the N end of Straits of Florida, routes are:
Through 30° 00′ N, 79° 40′ W, keeping in the main body of the Gulf Stream, thence:
Great circle to Lisboa or Strait of Gibraltar, in the latter case adjusting course to avoid the islands of Arquipélago dos Açores.

For information on W coasts of Spain and Portugal and Strait of Gibraltar, see 2.33 and 2.34.

2.83.1

Distances from Straits of Florida: Lisboa 3630 miles;
** Strait of Gibraltar 3840 miles

** 6 miles S of Europa Point.

Bishop Rock → North-East Providence Channel

2.84

Diagram (2.82)

The route is by great circle to Position BS (42° 30′ N, 50° 00′ W), thence by another great circle.

2.84.1

For low-powered vessels, an alternative route may be preferred by great circle to 36° 00′ N, 35° 00′ W, thence by another great circle.

2.84.2

Distance: (via Position BS): 3500 miles.

West Indies passages or Bermuda ↔ Europe

2.85

Diagram (2.85) for West Indies passages; (2.82) for Bermuda

Subject to the ordinary requirements of navigation, including on certain routes avoidance of Bermuda (2.38) and passage through Arquipélago dos Açores, routes are by great circles. See also 2.31–2.34.

2.85.1

Diagram (2.82)

Alternatively, W-bound vessels particularly low-powered ones, from Bay of Biscay or places farther N, bound for Sombrero Passage or the passages farther W, may prefer the following routes to avoid the effects of the E-going North Atlantic Current and the predominance of W winds and head seas in the N part of the North Atlantic Ocean.

2.85.2

From S part of Bay of Biscay:
Rhumb line to 44° 15′ N, 8° 30′ W, thence:
Rhumb line to 36° 40′ N, 24° 45′ W, thence:
Great circle to 30° 00′ N, 45° 30′ W, thence:
Great circle to destination.

2.85.3

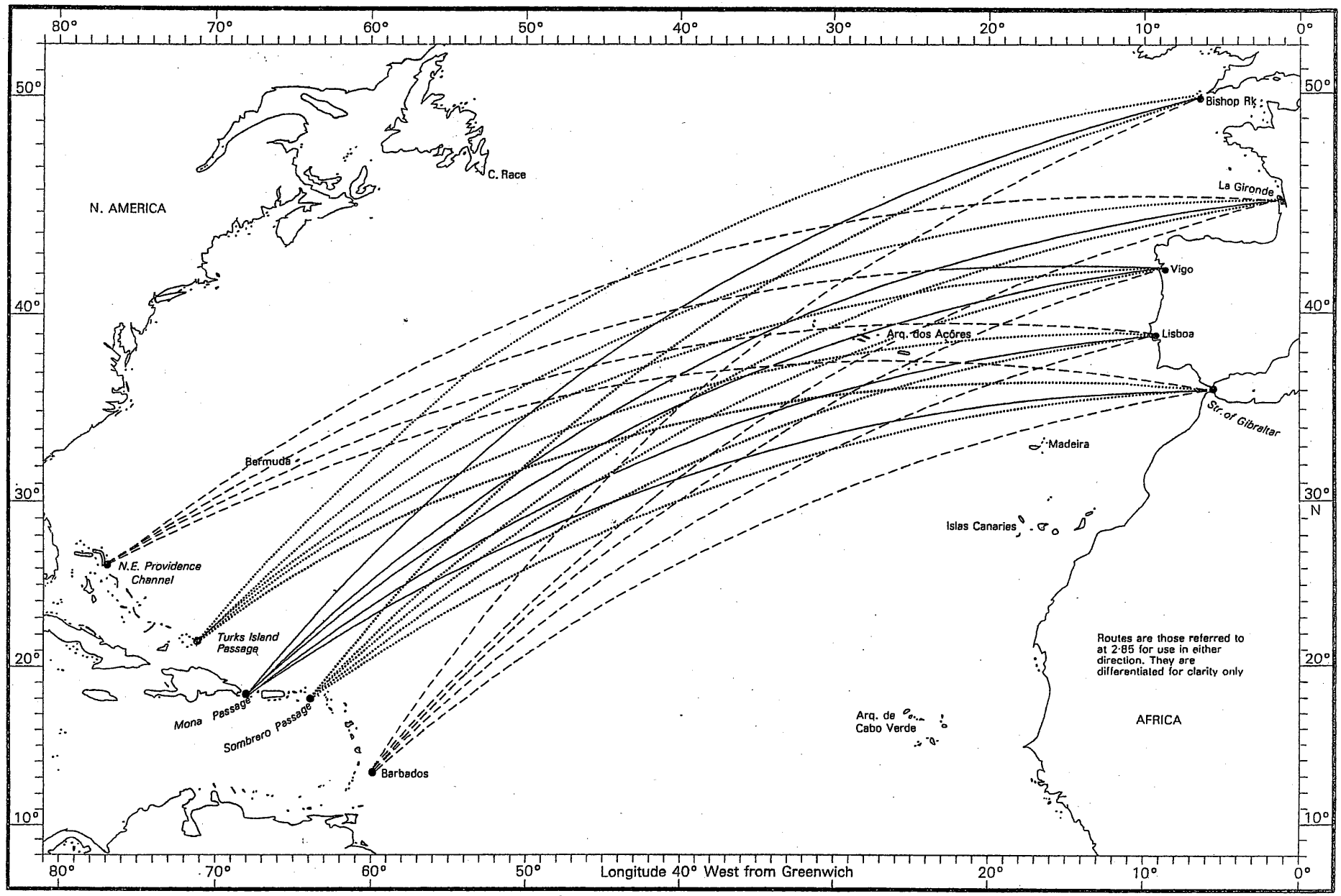
From N part of Bay of Biscay and places farther N:
Great circle to join the route at 2.85.2 in 36° 40′ N, 24° 45′ W, passing N of 44° 15′ N, 8° 30′ W.

2.85.4

Distances in miles.

	Great Circle					*Alternative Route*	
	Bishop Rock	*La Gironde*†	*Vigo*	*Lisboa*	*Strait of Gibraltar***	*Bishop Rock*	*La Gironde*†
NE Providence Channel	See 2.84	3730	3450	3450	3670	See 2.84.1	3980
Turks Island Passage	3450	3650	3330	3310	3510	3710	3770
Mona Passage	3470	3640	3310	3260	3450	3640	3700
Sombrero Passage	3310	3470	3120	3070	3250	3450	3510
Barbados	3410	3530	3170	3080	3230		
Bermuda	2760	2980	2690	2690	2930		

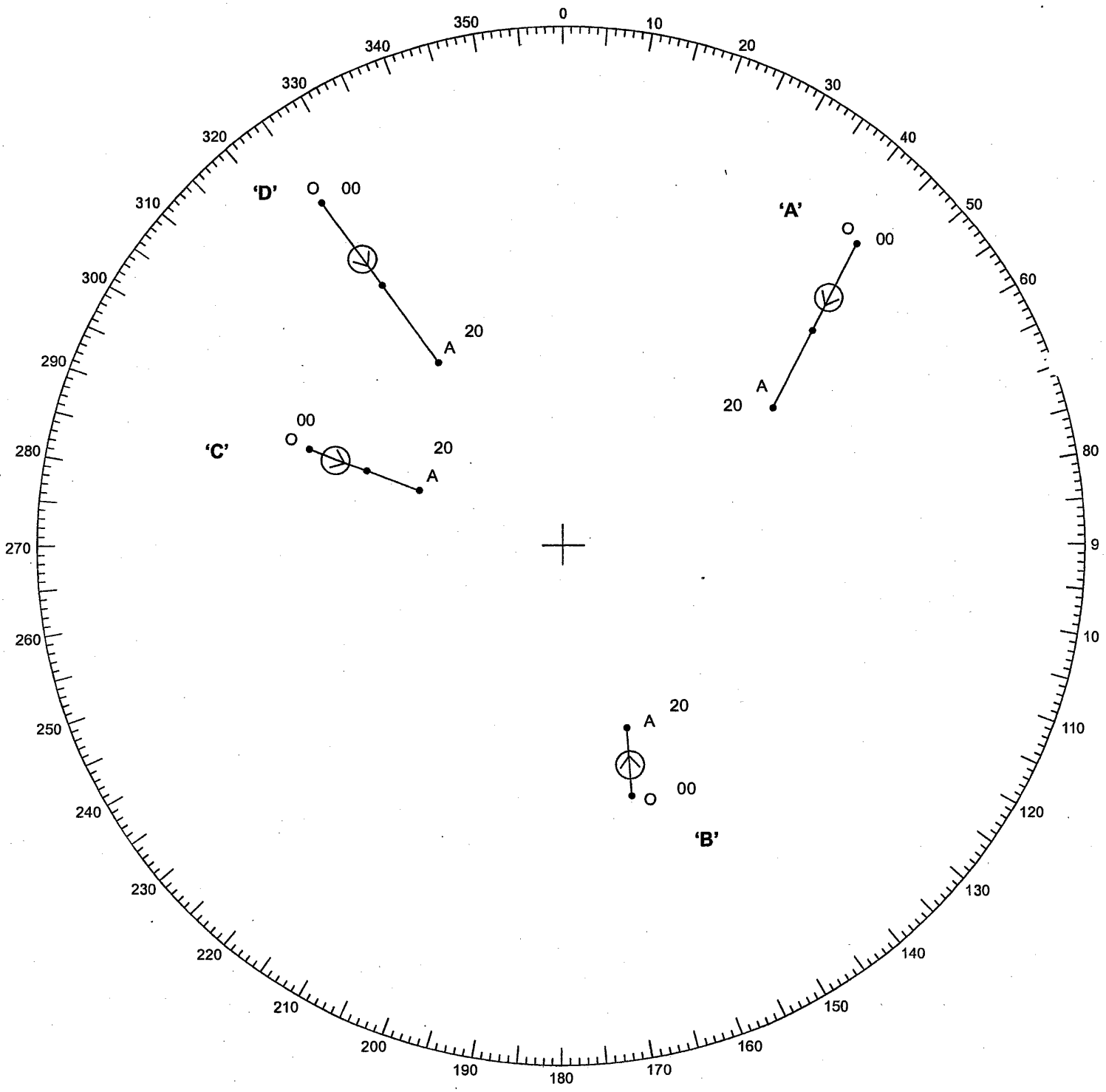
† 70 miles from Bordeaux.
** 6 miles S of Europa Point.



85) ROUTES—West Indies Passages ⟷ Europe.

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



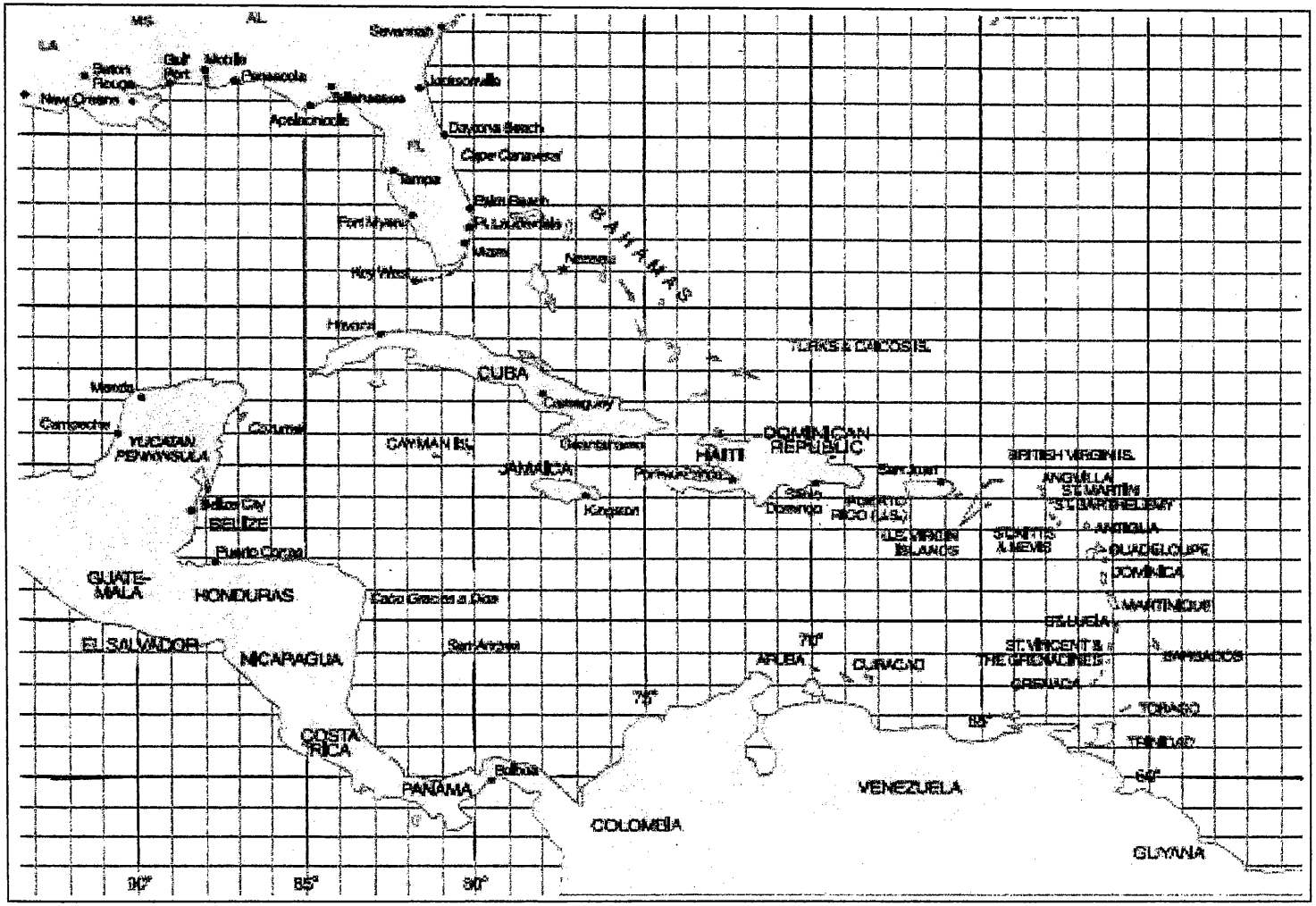
Range Scale 0 1 2 3 4 5 6 7 8 9 10 11 12

(This is not a metric scale)

Signature of Candidate .....

Examination Centre .....

CHARTLET CARIBBEAN SEA



Candidate's Name .....

Examination Centre .....

BELGIUM - ANTWERP (PROSPERPOLDER)

LAT 51°21'N LONG 4°14'E

TIME ZONE - 0100

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 0000

JANUARY

	TIME	M		TIME	M
1 TH	0357	5.5	16 F	0424	5.1
	1041	0.1		1058	0.4
	1619	5.8		1637	5.2
	2301	0.2		2302	0.5
2 F	0447	5.5	17 SA	0459	5.1
	1133	0.0		1133	0.4
	1708	5.8		1711	5.2
	2349	0.3		2334	0.5
3 SA	0533	5.5	18 SU	0532	5.1
	1222	-0.1		1207	0.3
	1757	5.7		1744	5.3
4 SU	0035	0.5	19 M	0008	0.6
	0619	5.4		0603	5.2
	1310	-0.1		1241	0.3
	1846	5.6		1818	5.3
5 M	0121	0.7	20 TU	0043	0.6
	0707	5.3		0635	5.1
	1357	0.0		1316	0.3
	1938	5.4		1855	5.2
6 TU	0205	0.8	21 W	0121	0.7
	0755	5.1		0712	5.1
	1443	0.1		1351	0.3
	2030	5.1		1935	5.2
7 W	0251	0.9	22 TH	0159	0.7
	0846	5.0		0754	5.0
	1529	0.3		1430	0.4
	2129	4.9		2022	5.1
8 TH	0341	1.0	23 F	0244	0.7
	0945	4.7		0843	4.9
	1619	0.5		1517	0.4
	2234	4.7		2118	4.9
9 F	0435	1.0	24 SA	0338	0.7
	1055	4.6		0945	4.8
	1713	0.7		1619	0.5
	2339	4.6		2226	4.8
10 SA	0540	1.0	25 SU	0449	0.7
	1203	4.5		1058	4.7
	1821	0.8		1736	0.6
				2342	4.7
11 SU	0038	4.6	26 M	0611	0.7
	0700	0.9		1215	4.7
	1302	4.6		1853	0.5
	1930	0.8			
12 M	0131	4.7	27 TU	0057	4.8
	0802	0.7		0727	0.5
	1354	4.8		1328	5.0
	2023	0.7		2004	0.3
13 TU	0220	4.9	28 W	0204	5.0
	0853	0.5		0837	0.3
	1442	4.9		1429	5.3
	2108	0.6		2105	0.2
14 W	0305	5.0	29 TH ●	0258	5.2
	0938	0.4		0939	0.1
	1524	5.0		1521	5.6
	2149	0.5		2202	0.1
15 TH O	0348	5.0	30 F	0348	5.4
	1020	0.4		1034	-0.1
	1603	5.1		1609	5.8
	2227	0.5		2251	0.2
			31 SA	0433	5.5
				1123	-0.2
				1655	5.8
				2336	0.3

FEBRUARY

	TIME	M		TIME	M
1 SU	0516	5.6	16 M	0508	5.4
	1208	-0.3		1147	0.1
	1739	5.8		1720	5.5
				2351	0.4
2 M	0018	0.4	17 TU	0537	5.4
	0557	5.6		1221	0.1
	1250	-0.2		1754	5.5
	1822	5.7			
3 TU	0057	0.5	18 W	0027	0.4
	0638	5.5		0610	5.4
	1330	-0.1		1255	0.1
	1904	5.4		1829	5.5
4 W	0134	0.6	19 TH	0102	0.4
	0720	5.4		0645	5.4
	1406	0.0		1328	0.2
	1948	5.2		1907	5.4
5 TH	0211	0.7	20 F	0137	0.4
	0802	5.2		0726	5.3
	1443	0.2		1405	0.3
	2033	4.9		1951	5.2
6 F	0251	0.7	21 SA	0218	0.4
	0849	4.9		0812	5.1
	1522	0.5		1447	0.4
	2124	4.6		2044	4.9
7 SA	0339	0.8	22 SU	0308	0.5
	0949	4.5		0911	4.8
	1613	0.8		1546	0.5
	2233	4.3		2152	4.6
8 SU	0441	0.9	23 M	0419	0.6
	1112	4.2		1028	4.6
	1722	1.0		1711	0.7
	2356	4.1		2316	4.3
9 M	0610	1.0	24 TU	0547	0.7
	1231	4.3		1201	4.6
	1852	1.0		1836	0.6
10 TU	0104	4.3	25 W	0046	4.4
	0735	0.7		0716	0.5
	1333	4.5		1321	4.9
	1959	0.8		1957	0.4
11 W	0202	4.6	26 TH	0155	4.8
	0833	0.5		0833	0.3
	1425	4.8		1420	5.3
	2050	0.6		2100	0.2
12 TH	0250	4.8	27 F	0249	5.1
	0921	0.3		0932	0.0
	1508	5.0		1510	5.6
	2132	0.5		2152	0.2
13 F O	0331	5.0	28 SA ●	0334	5.3
	1002	0.3		1021	-0.2
	1545	5.2		1555	5.8
	2209	0.4		2235	0.2
14 SA	0406	5.2			
	1038	0.2			
	1619	5.3			
	2244	0.4			
15 SU	0438	5.3			
	1113	0.2			
	1649	5.4			
	2316	0.4			

MARCH

	TIME	M		TIME	M
1 SU	0414	5.5	16 M	0407	5.4
	1106	-0.3		1045	0.1
	1635	5.8		1621	5.5
	2316	0.3		2252	0.4
2 M	0452	5.6	17 TU	0438	5.5
	1147	-0.3		1119	0.1
	1715	5.8		1654	5.6
	2354	0.3		2329	0.3
3 TU	0530	5.7	18 W	0509	5.6
	1224	-0.2		1156	0.1
	1753	5.7		1727	5.6
4 W	0029	0.4	19 TH	0005	0.3
	0607	5.6		0544	5.6
	1256	-0.1		1232	0.1
	1831	5.5		1804	5.6
5 TH	0102	0.4	20 F	0042	0.3
	0645	5.5		0621	5.5
	1327	0.1		1307	0.2
	1907	5.2		1843	5.4
6 F	0135	0.4	21 SA	0120	0.3
	0721	5.2		0703	5.4
	1359	0.3		1344	0.3
	1944	4.9		1928	5.2
7 SA	0211	0.5	22 SU	0201	0.3
	0802	4.9		0752	5.2
	1433	0.5		1427	0.4
	2026	4.5		2023	4.8
8 SU	0250	0.6	23 M	0253	0.4
	0854	4.4		0854	4.8
	1515	0.9		1531	0.6
	2125	4.1		2134	4.4
9 M	0343	0.9	24 TU	0407	0.6
	1017	4.0		1017	4.5
	1624	1.2		1658	0.8
	2302	3.8		2306	4.1
10 TU	0525	1.1	25 W	0540	0.6
	1156	4.0		1157	4.6
	1819	1.2		1831	0.7
11 W	0034	3.9	26 TH	0039	4.3
	0703	0.9		0713	0.4
	1307	4.3		1313	5.0
	1933	0.9		1949	0.5
12 TH	0135	4.3	27 F	0142	4.7
	0806	0.5		0825	0.1
	1401	4.7		1409	5.3
	2025	0.6		2047	0.3
13 F	0223	4.7	28 SA	0232	5.0
	0854	0.3		0918	-0.1
	1443	5.0		1454	5.6
	2108	0.4		2134	0.3
14 SA	0304	5.0	29 SU ●	0312	5.3
	0935	0.2		1002	-0.2
	1518	5.3		1534	5.7
	2145	0.4		2214	0.3
15 SU O	0338	5.2	30 M	0349	5.4
	1012	0.2		1042	-0.1
	1550	5.4		1610	5.7
	2219	0.4		2252	0.3
			31 TU	0426	5.6
				1119	-0.1
				1647	5.7
				2327	0.3

APRIL

	TIME	M		TIME	M
1 W	0502	5.7	16 TH	0444	5.6
	1151	0.0		1130	0.1
	1723	5.6		1705	5.7
				2346	0.2
2 TH	0000	0.3	17 F	0522	5.6
	0537	5.6		1210	0.1
	1222	0.1		1744	5.6
	1758	5.4			
3 F	0034	0.3	18 SA	0028	0.2
	0614	5.4		0603	5.6
	1252	0.3		1250	0.2
	1832	5.2		1828	5.3
4 SA	0104	0.3	19 SU	0110	0.2
	0649	5.2		0649	5.4
	1321	0.4		1331	0.3
	1906	4.9		1917	5.0
5 SU	0137	0.4	20 M	0157	0.2
	0726	4.8		0742	5.1
	1352	0.7		1420	0.5
	1942	4.5		2016	4.7
6 M	0212	0.6	21 TU	0254	0.4
	0812	4.4		0851	4.8
	1430	0.9		1528	0.7
	2033	4.0		2129	4.4
7 TU	0256	0.8	22 W	0410	0.5
	0932	4.0		1019	4.6
	1522	1.3		1652	0.8
	2212	3.7		2301	4.3
8 W	0414	1.1	23 TH	0534	0.4
	1109	3.9		1149	4.8
	1742	1.4		1819	0.8
	2347	3.8			
9 TH	0622	0.9	24 F	0022	4.5
	1228	4.2		0659	0.3
	1857	1.0		1256	5.1
				1931	0.6
10 F	0057	4.2	25 SA	0120	4.8
	0727	0.6		0804	0.1
	1324	4.7		1348	5.3
	1951	0.7		2026	0.4
11 SA	0147	4.7	26 SU	0206	5.0
	0818	0.3		0854	0.0
	1408	5.0		1430	5.4
	2034	0.5		2110	0.4
12 SU	0226	5.0	27 M	0246	5.2
	0900	0.2		0936	0.0
	1443	5.3		1508	5.5
	2111	0.4		2149	0.4
13 M	0301	5.2	28 TU	0322	5.3
	0936	0.2		1013	0.1
	1517	5.5		1545	5.5
	2148	0.4	●	2226	0.3
14 TU O	0334	5.4	29 W	0359	5.5
	1013	0.2		1048	0.2
	1550	5.6		1620	5.5
	2226	0.3		2259	0.3
15 W	0407	5.5	30 TH	0435	5.5
	1051	0.1		1120	0.3
	1627	5.7		1657	5.4
	2305	0.3		2334	0.3

No.	PLACE		Lat. N.	Long. E.	TIME DIFFERENCES High Water (Zone −0100)		Low Water		HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS	M.L. Z_0 m.	
1539	**ANTWERP (PROSPERPOLDER)**		(see page 28)		**0000 and 1200**	**0500 and 1700**	**0000 and 1200**	**0600 and 1800**	**5·8**	**4·2**	**1·0**	**0·0**	2·66	
	Belgium													
1539a	Boudewijnsluis		51 17	4 20	+0013	+0005	+0025	+0020	0·0	+0·1	0·0	0·0	2·68	*c*
1539b	Royersluis	B	51 14	4 24	+0030	+0015	+0045	+0041	+0·3	+0·3	0·0	0·0	2·68	*c*
1539c	Boom		51 05	4 22	+0125	+0110	+0155	+0150	−0·2	+0·6	−0·4	+0·6	2·85	
1539d	Ghent		51 03	3 44	+0430	+0415	+0630	+0600	−3·5	−2·4	−0·8	+0·1	1·0	*x*
1534	**VLISSINGEN (FLUSHING)**				**0300 and 1500**	**0900 and 2100**	**0400 and 1600**	**1000 and 2200**	**4·9**	**4·0**	**1·0**	**0·5**		
1540	Cadzand (Wielingen Sluis)		51 23	3 23	−0030	−0025	−0020	−0025	−0·2	−0·2	−0·1	−0·1	⊙	
1562	Zeebrugge	BN	51 21	3 12	−0035	−0015	−0020	−0035	−0·1	−0·2	+0·1	−0·1	2·36	
1564	Oostende	B	51 14	2 55	−0055	−0040	−0030	−0045	+0·2	+0·2	+0·1	−0·1	2·36	
1565	Nieuwpoort		51 09	2 43	−0110	−0050	−0035	−0045	+0·4	+0·3	+0·2	−0·1	2·37	
1568	**DUNKERQUE**				**0200 and 1400**	**0800 and 2000**	**0200 and 1400**	**0900 and 2100**	**5·8**	**4·8**	**1·5**	**0·6**	3·20	
	France													
1569	Gravelines		51 01	2 06	−0010	−0010	−0020	0000	+0·1	+0·1	−0·1	−0·1	3·19	
1570	**CALAIS**		50 58	1 51		STANDARD PORT				See Table V			4·02	
1571	Wissant		50 53	1 40	−0030	⊙	⊙	⊙	+1·7	+1·5	+0·6	+0·6	⊙	
1572	**BOULOGNE**		50 44	1 35		STANDARD PORT				See Table V			5·01	
1579	**DIEPPE**				**0100 and 1300**	**0600 and 1800**	**0000 and 1200**	**0700 and 1900**	**9·3**	**7·2**	**2·6**	**0·7**		
1573	Le Touquet, Étaples		50 31	1 35	+0012	⊙	⊙	⊙	−0·3	0·0	+0·2	+0·3	⊙	
1574	Berck		50 24	1 34	+0008	⊙	⊙	⊙	0·0	+0·1	+0·3	+0·3	⊙	
	La Somme													
1575	Le Hourdel		50 13	1 34	+0021	+0026	⊙	⊙	+0·7	+0·7	⊙	⊙	⊙	
1576	St. Valéry		50 11	1 37	+0028	+0040	⊙	⊙	+0·7	+0·8	⊙	⊙	⊙	
1577	Cayeux		50 11	1 29	+0007	+0010	−0008	+0013	+0·9	+0·7	+0·2	+0·3	5·50	
1578	Le Treport		50 04	1 22	+0001	+0005	+0005	+0011	+0·1	+0·2	−0·1	0·0	5·02	
1579	**DIEPPE**		49 56	1 05		STANDARD PORT				See Table V			4·97	
1580	St. Valery-en-Caux		49 52	0 42	−0018	−0016	−0007	−0013	−0·4	−0·1	−0·1	+0·3	4·88	
1581	Fecamp	F	49 46	0 22	−0022	−0018	−0034	−0043	−1·4	−0·7	0·0	+0·1	4·47	
1581a	Antifer		49 39	0 09	−0046	−0039	−0051	−0100	−1·3	−0·6	+0·4	+0·5	4·73	
1582	**LE HAVRE**		(see page 198)		**0000 and 1200**	**0500 and 1700**	**0000 and 1200**	**0700 and 1900**	**7·9**	**6·6**	**3·0**	**1·2**	4·87	
	La Seine													
1583	Honfleur		49 25	0 14	−0140	−0015	+0005	+0040	+0·2	+0·1	0·0	0·0	⊙	★
1584	Tancarville		49 28	0 28	−0105	+0025	+0105	+0140	0·0	0·0	+0·3	+1·0	⊙	★
1585	Quillebeouf		49 28	0 32	−0045	+0030	+0120	+0200	0·0	+0·1	+0·5	+1·4	⊙	★
1586	Vatteville		49 29	0 40	+0004	+0100	+0225	+0250	+0·1	0·0	+1·1	+2·4	⊙	★
1587	Caudebec		49 32	0 44	+0020	+0115	+0230	+0300	−0·2	0·0	+1·2	+2·5	⊙	★
1588	Duclair		49 29	0 53	+0225	+0300	+0355	+0410	−0·2	−0·1	+1·7	+3·3	⊙	
1589	Rouen		49 27	1 06	+0440	+0415	+0525	+0525	−0·1	0·0	+1·9	+3·6	⊙	
1590	Trouville		49 22	0 05	−0035	−0015	0000	−0010	−0·1	−0·2	−0·2	−0·1	4·50	
			N.	**W.**										
1591	Dives		49 18	0 06	−0055	⊙	⊙	−0115	−0·4	−0·5	−0·6	−0·3	⊙	
1592	Ouistreham		49 17	0 15	−0020	−0010	−0005	−0010	−0·2	−0·2	−0·2	−0·2	4·44	
1593	Courseulles		49 20	0 27	−0100	⊙	⊙	−0040	−0·8	−1·0	−0·7	−0·3	3·95	
1594	Port-en-Bessin		49 21	0 45	−0045	−0040	−0040	−0045	−0·7	−0·6	−0·3	−0·1	4·22	

⊙ No data.
★ See notes on page 344.
B Tides predicted in Belgian Tide Tables.
F Tides predicted in French Tide Tables.
N Tides predicted in Netherlands Tide Tables.
x M.L. inferred.

FRANCE, NORTH COAST; CHANNEL ISLANDS

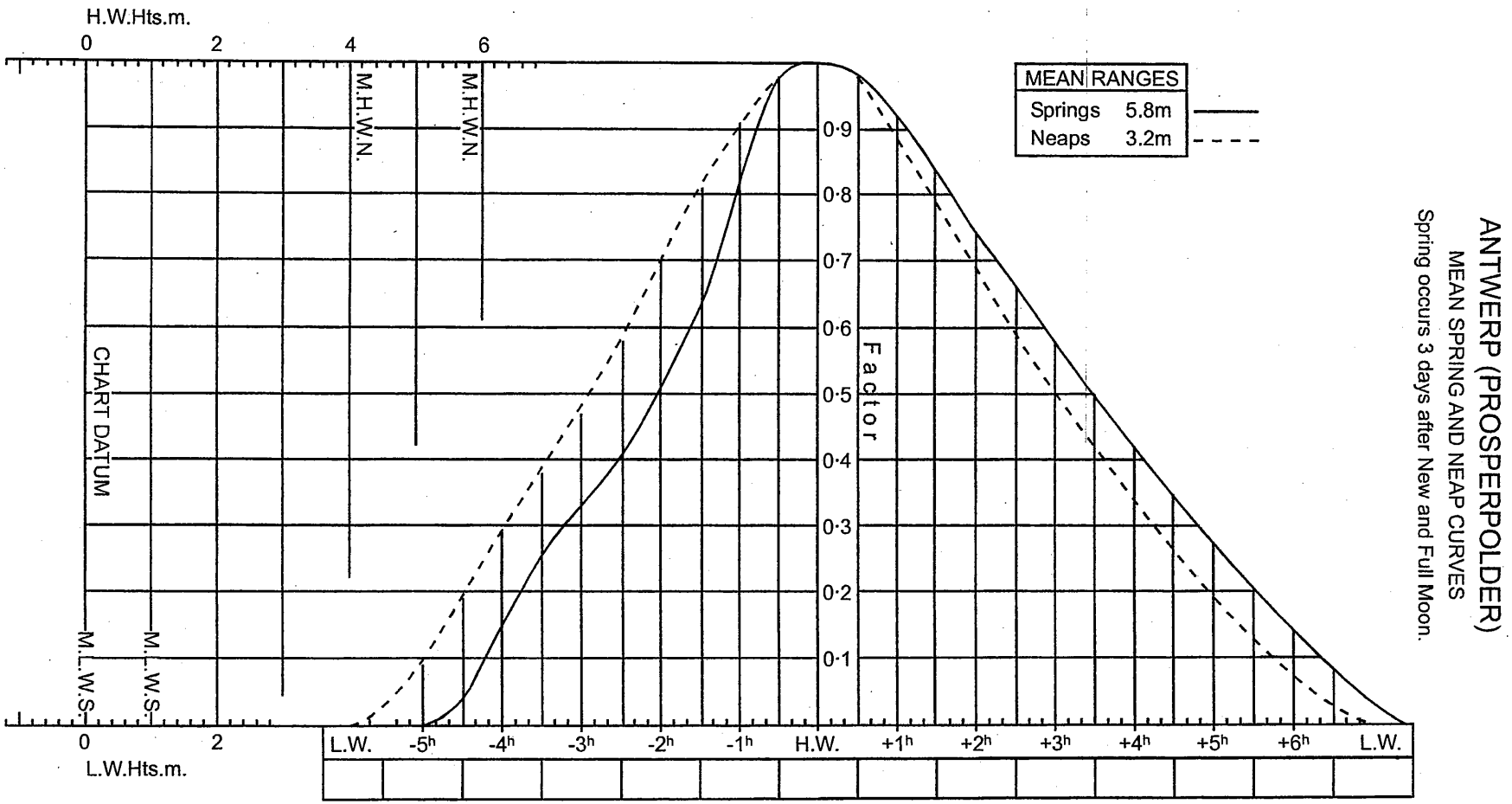
No.	PLACE	Lat. N.	Long. W.	TIME DIFFERENCES High Water (Zone −0100)		Low Water		HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS	M.L. Z_0 m.	
1600	**CHERBOURG**			**0300 and 1500**	**1000 and 2200**	**0400 and 1600**	**1000 and 2200**	**6·3**	**5·0**	**2·5**	**1·1**		
1598	St. Vaast	49 35	1 16	+0105	+0055	+0120	+0100	+0·3	+0·3	−0·2	−0·2	3·80	
1599	Barfleur	49 40	1 15	+0100	+0100	+0050	+0040	+0·2	+0·3	0·0	+0·1	3·94	
1600	**CHERBOURG**	49 39	1 38	STANDARD PORT					See Table V			3·78	
1601	Omonville	49 43	1 50	−0015	−0010	−0020	−0025	−0·1	−0·1	+0·1	0·0	3·76	
1602	Goury	49 43	1 56	−0100	−0045	−0110	−0120	+1·6	+1·5	+0·9	+0·1	4·84	
1605	**ST. HELIER**			**0300 and 1500**	**0900 and 2100**	**0200 and 1400**	**0900 and 2100**	**11·1**	**8·1**	**4·1**	**1·3**		
	Channel Islands			(Zone U.T. (G.M.T.))									
	Alderney												
1603	Braye	49 43	2 12	+0050	+0040	+0025	+0105	−4·8	−3·4	−1·5	−0·5	3·62	
	Sark												
1603a	Maseline Pier	49 26	2 21	+0005	+0015	+0005	+0010	−2·1	−1·5	−0·6	−0·3	4·87	
	Guernsey												
1604	St. Peter Port	49 27	2 31	0000	+0012	−0008	+0002	−2·1	−1·4	−0·6	−0·3	4·99	
	Jersey												
1605	**ST. HELIER**	49 11	2 07	STANDARD PORT					See Table V			6·06	
1606	St. Catherine Bay	49 13	2 01	0000	+0010	+0010	+0010	0·0	−0·1	0·0	+0·1	6·0	x
1606a	Bouley Bay	49 14	2 05	+0002	+0002	+0004	+0004	−0·3	−0·3	−0·1	−0·1	5·76	
1607	Les Ecrehou	49 17	1 56	+0004	+0012	+0010	+0020	−0·2	+0·3	−0·3	0·0	6·12	
1608	Les Minquiers	48 58	2 08	+0007	0000	−0008	+0013	+0·5	+0·8	−0·1	+0·1	6·48	
1605	**ST. HELIER**			**0100 and 1300**	**0800 and 2000**	**0200 and 1400**	**0700 and 1900**	**11·1**	**8·1**	**4·1**	**1·3**		
	France			(Zone −0100)									
1609	Iles Chausey	48 52	1 49	+0044	+0048	+0104	+0058	+1·9	+1·8	+0·8	+0·7	7·50	
1610	Dielette	49 33	1 52	+0116	+0119	+0115	+0120	−1·4	−0·7	−0·5	0·0	5·51	
1611	Carteret	49 22	1 47	+0100	+0110	+0120	+0115	+0·1	+0·4	0·0	+0·2	6·30	
1612	Granville	48 50	1 36	+0040	+0049	+0115	+0053	+1·9	+1·7	+0·5	+0·1	7·21	
1613	Cancale	48 40	1 51	+0035	+0050	+0115	+0100	+2·4	+2·2	+1·0	+0·8	7·76	
1614	St. Malo	F 48 38	2 02	+0034	+0044	+0105	+0050	+1·1	+1·1	+0·3	+0·2	6·85	
1615	Erquy	48 38	2 28	+0030	+0040	+0035	+0032	+0·3	+0·6	0·0	+0·1	6·40	
1616	Dahouet	48 35	2 34	+0031	+0038	+0027	+0036	+0·2	+0·6	−0·2	0·0	⊙	
1617	Le Légué	48 32	2 44	+0030	+0045	+0035	+0031	+0·3	+0·6	0·0	+0·1	6·3	x
1618	Binic	48 36	2 49	+0030	+0045	+0035	+0031	+0·3	+0·6	0·0	+0·1	6·3	x
1619	Portrieux	48 38	2 49	+0030	+0045	+0030	+0030	+0·3	+0·5	0·0	+0·1	6·38	
1620	Paimpol	48 47	3 02	+0025	+0038	+0025	+0040	−0·6	−0·3	−0·9	−0·7	5·53	
1621	Ile de Bréhat	48 51	3 00	+0020	+0040	+0010	+0015	−0·6	−0·1	−0·4	−0·1	5·86	
1622	Les Heaux de Brehat	F 48 55	3 05	+0031	+0030	−0011	+0042	−1·2	−0·5	−0·7	−0·2	5·51	
1623	Lezardrieux	48 47	3 06	+0026	+0038	+0015	+0035	−0·9	−0·5	−0·6	−0·3	5·56	
1624	Plougrescant	48 51	3 13	−0005	+0004	−0005	+0010	−1·4	−0·6	−0·6	+0·1	5·55	
1625	Tréguier	48 47	3 13	−0004	+0012	−0025	+0015	−1·3	−0·6	−0·8	−0·2	5·46	
1626	Ploumanac'h	48 50	3 29	0000	+0005	−0025	0000	−2·1	−1·0	−0·7	−0·2	5·15	

SEASONAL CHANGES IN MEAN LEVEL

No.	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1	July 1	Aug. 1	Sep. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1
1534–1571	0·0	0·0	−0·1	−0·1	−0·1	−0·1	0·0	0·0	0·0	+0·1	+0·1	+0·1	0·0
1572–1581a	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	0·0	0·0	0·0
1582–1602	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1	0·0
1603–1626	Negligible												

WORKSHEET Q5

(This Worksheet must be returned with your answer book)



Candidate's Name .....

Examination Centre ....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

Question 1 and 2 refer to a fully loaded bulk carrier which is to make a passage from Manilla (Phillipines) to Seattle (Washington, USA). The vessel's service speed will be 15.0 knots.

1. The vessel intends to take a coastal route, via the Balintang Channel, to a departure position of 31° 00'.0N 140°00'.0E, then sail the shortest allowable distance to a landfall position, off the Juan De Fuca Strait, in 48° 30'.0N 124° 47'.0W.

   The distance from Manilla to the departure position is 1810 miles and on arrival at the departure position it is expected that the vessel's Winter loadline will be overloaded by 240 tonnes. The vessel consumes 42 tonnes of stores and water per day. The vessel departs Manilla at 0400hrs Standard Time on the 12th October.

   With reference to Datasheet Q1, calculate EACH of the following:

   (a) the shortest distance between Manilla and the landfall position off the Juan de Fuca Strait which complies with all the relevant regulations; (40)

   (b) the ETA (local Standard Time) at the landfall position. (10)

2. At 1800hrs UT on the 14th October, whilst in position 25°55'.0N 129° 45'.0E the vessel receives a Typhoon advisory from the Japanese National Weather Centre.

   Super Typhoon Irma is presently 360 miles to the SSE of the vessel's position and is proceeding NNW at 15 knots. Winds of 100+ knots are forecast within 120 miles of the storm centre.

   (a) On Worksheet Q2, plot the position of the vessel and the storm, indicating the likely area the storm will move into in the next 24 hours. (4)

   (b) Describe the wind, weather and swell conditions likely to be encountered at the vessel's present position during the next 24 hours. (15)

   (c) Outline the actions a prudent Master should take to avoid encountering the worst of the storm, described in Q2(b). (15)

   (d) Outline the bridge procedures that should be followed on board the vessel, prior to encountering the storm. (12)

3. During severe weather an engine room rating suffers a serious injury after falling in the engine room.

At 1000hrs UT on the 17th September the rating's condition starts to deteriorate and contact is made with an American warship which agrees to rendezvous with the vessel at sunrise the following day, to render medical assistance.
After consultation between the two vessels it is agreed that own vessel will maintain present heading of 083°(T) and speed of 13.0 knots.

Own vessel position at 1000hrs UT	35°24'.0N 146°42'.0E
Warship position at 1000hrs UT	33°36'.0N 149°04'.0E

Calculate EACH of the following:

(a) the UT of Sunrise; (15)

(b) the rendezvous position; (10)

(c) the course and speed required by the warship to make the rendezvous. (10)

4. A vessel encounters restricted visibility whilst proceeding in a traffic separation scheme on a heading of 115°(T) at 10.0 knots. Four targets are observed on radar (12 mile range), as depicted on Worksheet Q4. It is noted that target C is a lighthouse, marking the middle of the separation zone. The plot covers the period from 1218hrs to 1236hrs.

(a) Prepare a full report for targets A,B and D. (15)

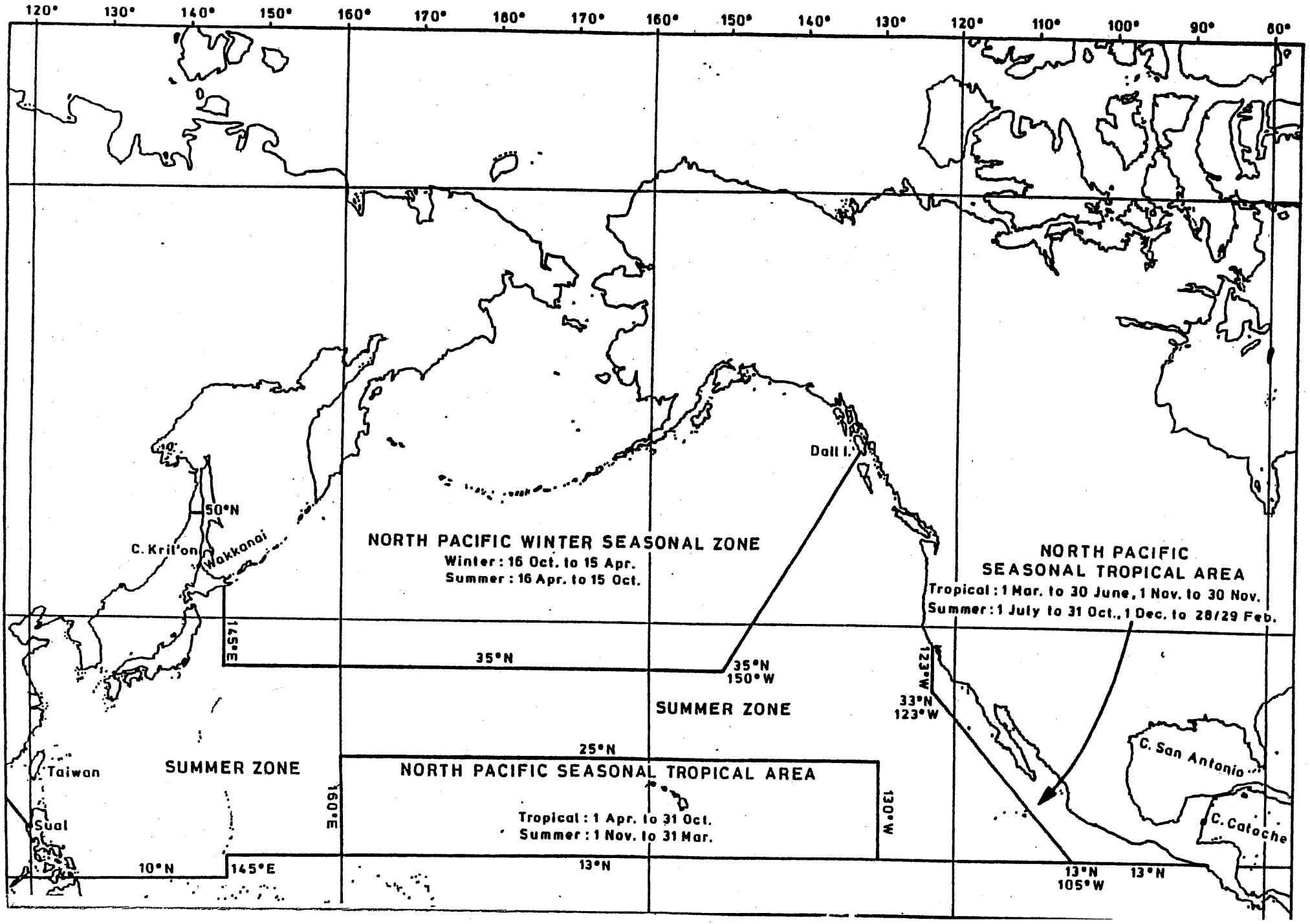
(b) Analyse the situation at 1236hrs. (15)

(c) State, with reasons, an action a prudent Master could take at 1242hrs to resolve the situation and ensure that all targets have a CPA of at least 1 mile. (20)

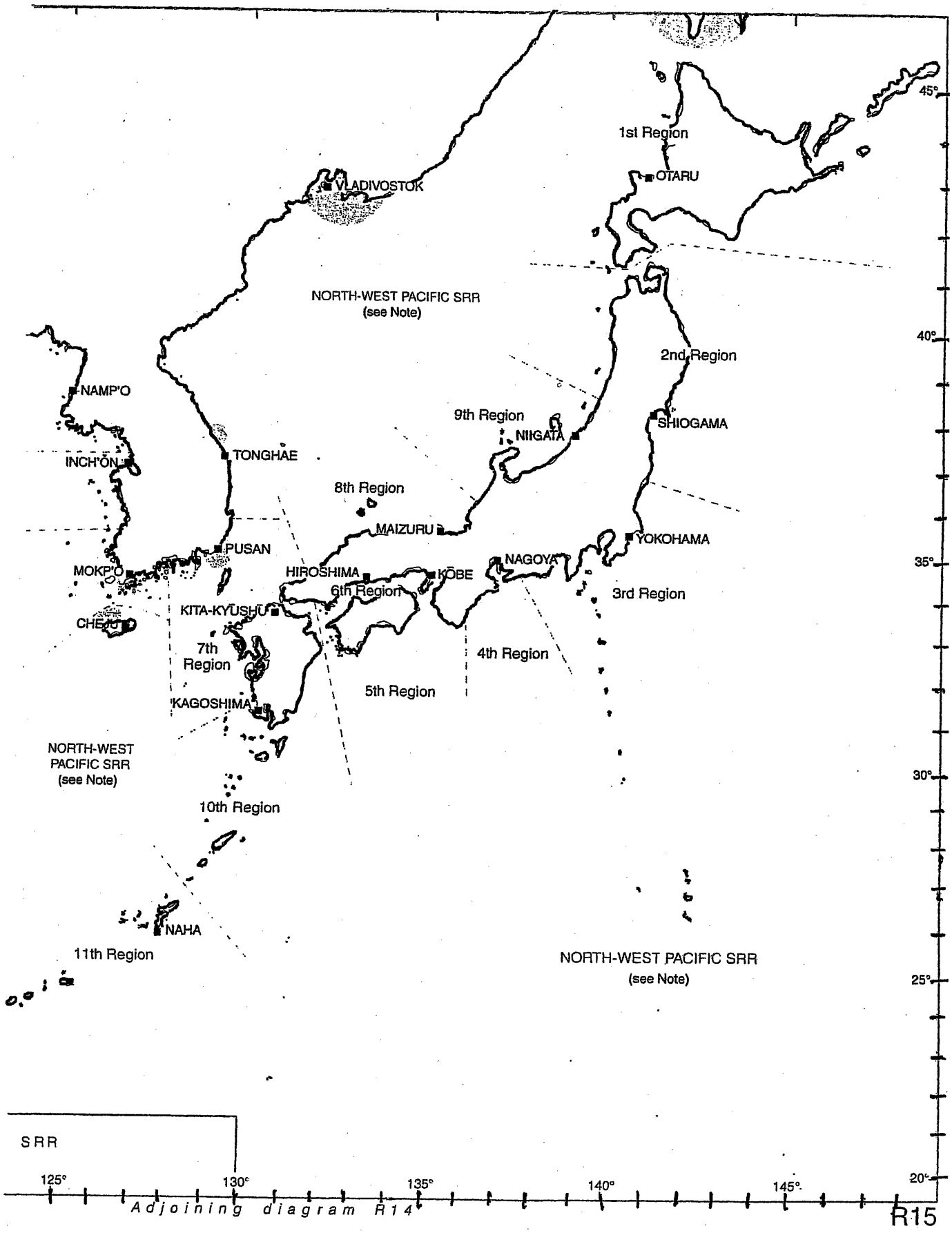
5. A tug and tow is due to transit through the Seymour Narrows, British Columbia at 0840hrs Standard Time on the 20th March. The maximum speed of the tow is 9.0 knots and the vessel will be steering a course of 180° (T) during the transit.

(a) With reference to the Pacific and Atlantic Ocean Tide Tables and using Worksheet Q5, determine the vessel's speed over the ground at 0840hrs. (12)

(b) Discuss the implications of the vessel's speed determined in Q5(a), including any actions that the Master should take. (7)


120° 130° 140° 150° 160° 170° 180° 170° 160° 150° 140° 130° 120° 110° 100° 90° 80°
Dall I.
50°N
C. Kril'on
Wakkanai
NORTH PACIFIC WINTER SEASONAL ZONE
Winter : 16 Oct. to 15 Apr.
Summer : 16 Apr. to 15 Oct.
NORTH PACIFIC
SEASONAL TROPICAL AREA
Tropical : 1 Mar. to 30 June, 1 Nov. to 30 Nov.
Summer : 1 July to 31 Oct., 1 Dec. to 28/29 Feb.
145°E
35°N
35°N
150°W
123°W
33°N
123°W
SUMMER ZONE
25°N
Taiwan
SUMMER ZONE
NORTH PACIFIC SEASONAL TROPICAL AREA
160°E
130°W
Tropical : 1 Apr. to 31 Oct.
Summer : 1 Nov. to 31 Mar.
C. San Antonio
C. Calache
Sual
10°N
145°E
13°N
13°N
105°W
13°N

(This Worksheet must be returned with your answer book)



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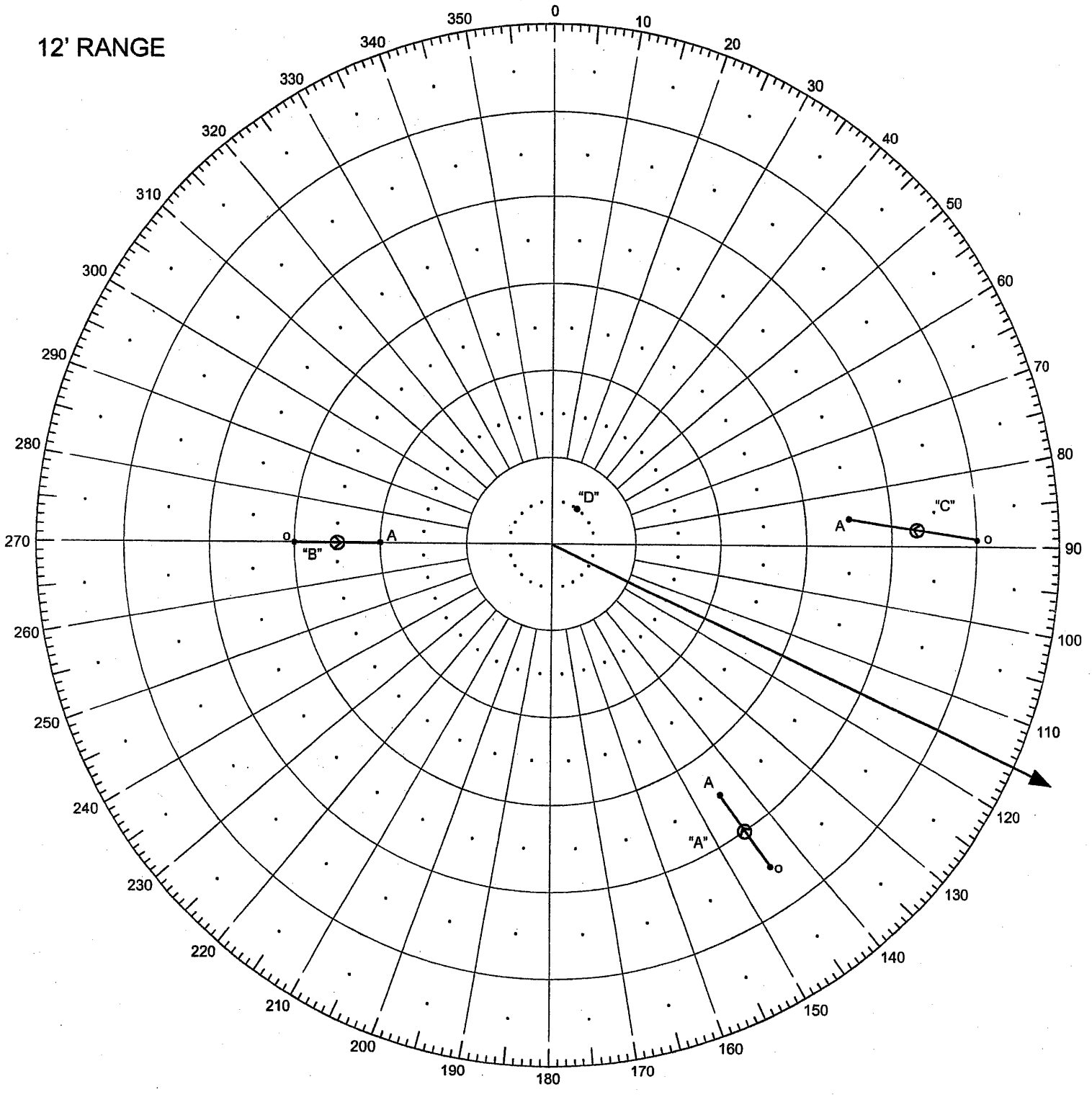
(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Range Scale 0 1 2 3 4 5 6 7 8 9 10 11 12

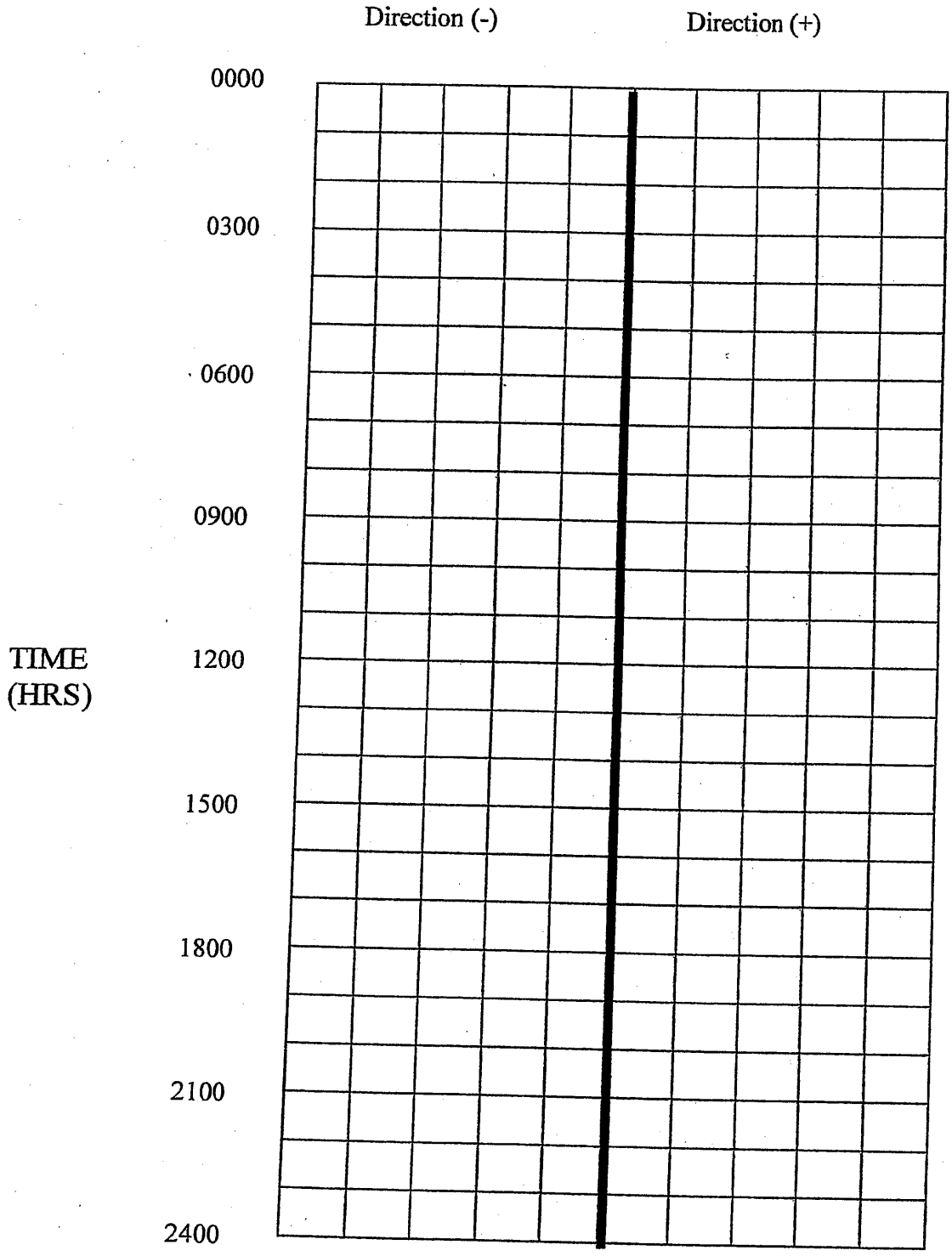
(This is not a metric scale)

Signature of Candidate .....

Examination Centre .....

WORKSHEET Q5
(This Worksheet must be returned with your answer book)

RATE (KNTS)



Scale to be adjusted as required

Candidate's Name ..... Examination Centre .....

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

TUESDAY, 8 JULY 2008

0915 - 1215 hrs

Examination paper inserts:

Datasheets Q1 Worksheet Q1(d) Worksheet Q2 Radar Plotting Sheet

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination answer book	Graph paper
Navigation Formulae Datasheet	
Nautical Almanac	
Nautical Tables	

July 2008

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

A product carrier with a load displacement of 88,000 tonnes is to make a ballast passage between Colombo (Sri Lanka), and Aden (Yemen), in June. In Aden the vessel will load a full cargo of petroleum, kerosene and naptha for Antwerp (Belgium). The vessel's owners have indicated they require a service speed of 14.0 knots for both passages.

1. With reference to Datasheet Q1:

   (a) outline THREE reasons why there are multiple routes recommended for the passage from Colombo to Aden; (9)

   (b) the master decides to follow the appropriate route for large vessels, calculate the distance on passage to Aden, using the following departure and landfall positions:

Departure Position	6°55'.0N	79°47'.0E
Landfall Position	12°45'.0N	44°55'.0E

   (20)

   (c) if the vessel departs Colombo at 1800hrs (ST) on the 5th June, determine the ETA at the landfall position; (6)

   (d) indicate on Worksheet Q1(d), the weather likely to be encountered on passage from Colombo to Aden. (10)

2. On approach to Aden pilot station the vessel encounters thick haze reducing visibility to less than 5 cables. The wind is SW'ly force 6.

The OOW is plotting FOUR targets on radar, on the 6 mile range, and the situation at 0200hrs is shown on Worksheet Q2. From information received from the Pilot station it is known that target B is a vessel at anchor. The vessel's course is 298°(T) and speed 10.0 knots. The plots were commenced at 0148hrs.

(a) For targets A, C and D, determine EACH of the following:

(i) the vessel's course; (3)

(ii) the vessel's speed; (3)

(iii) the vessel's aspect. (3)

(b) Determine the set and rate of the current. (3)

(c) Summarise the situation at 0200hrs (4)

(d) (i) On Worksheet Q2 determine, the single alteration of course required at 0200hrs to ensure that ALL targets will pass with a CPA of at least 1 mile. (12)

(ii) Determine the revised CPA of ALL targets. (12)

Note: Assume alteration of course has immediate effect.

3. At 1800hrs UT on the 23rd June the vessel has an engine room fire which results in one of the GP ratings suffering severe burns. The Master contacts a French warship in the area and it is agreed to transfer the casualty to the warship to receive medical treatment.

It is agreed to rendezvous at sunrise the following morning to effect the transfer. The tanker will maintain its current course of 285°(T) and increase speed to 16.0 knots.

Position of Tanker at 1800hrs UT 37°25'.0N 6°51'.0E
Position of Warship at 1800hrs UT 40°09'.0N 4°32'.0E

Calculate EACH of the following:

(a) the UT of Sunrise; (15)

(b) the rendezvous position; (15)

(c) the course and speed required by the warship to make the rendezvous. (15)

4. The UKHO produces a number of charts that are specifically designed to assist mariners in planning passages in areas of heavy traffic and confined waters, such as Dover Straits, Red Sea and Malacca Strait.

(a) Outline the main categories of information that can be found on these charts. (18)

(b) Explain how Co Tidal /Co Range charts can be used by deep draughts vessels transiting the Dover Straits. (10)

(c) State, with reasons, FOUR other publications which should be consulted when appraising a passage. (12)

5. (a) State the appropriate manning levels on the bridge, outlining the duties of EACH member of the bridge team, for EACH of the following situations:

(i) navigation in a Traffic Separation Scheme with dense traffic with restricted visibility; (12)

(ii) navigation in clear weather, during darkness, on a ocean passage; (6)

(b) Outline the information that should be contained in the Masters Night Orders for making the landfall of Aden. (12)

CHAPTER 6

INDIAN OCEAN

WINDS AND WEATHER

6.1

The following description of the winds and weather of the region of the Indian Ocean amplifies the general statement given in *The Mariner's Handbook*. More precise information about oceanic winds and weather or detailed information about specific localities should be sought in the appropriate Admiralty Sailing Directions. In reading the following description reference should be made to World Climatic (Diagrams (1.13a) and (1.13b)) and to Routeing Charts 5126(1) to 5126(12).

North Indian Ocean

6.2

The Winds and weather of the whole North Indian Ocean are dominated by the alteration of the Monsoons, which are seasonal winds generated by the changes in pressure resulting from the heating and cooling of the land mass of Asia.

South-west Monsoon

6.3

From June to September the heating of the Asiatic land mass results in the establishment of a large area of low pressure centred approximately over the NW part of India. The South-east Trade Wind of the South Indian Ocean is drawn across the equator, deflected to the right by the effects of the earth's rotation, and joins the cyclonic circulation round the area of low pressure mentioned above. The resulting SW wind, felt in the North Indian Ocean, the Arabian Sea, and the Bay of Bengal from June to September is known as the South-west Monsoon. The general distribution of pressure and wind at this season is shown on Diagram (1.13b), from which it will be noted that in the E part of the Arabian Sea the prevailing wind direction is more nearly W than SW.

The strength of the wind varies considerably between different parts of the ocean. It is strongest in the W part of the Arabian Sea where, over a considerable area, the wind averages force 6 at the height of the season and reaches force 7 or above on more than 10 days per month; the worst area is some 250 miles E of Suquṭrá, where in July about half the observations report winds of force 7 or above.

In the extreme N part, and in the E part of the Arabian Sea in July and August, the monsoon wind averages about force 4, although it often freshens to force 5 or 6, and attains force 7 on more than 3 to 6 days per month N of about 10° N.

In the Bay of Bengal the average strength of the monsoon wind is force 4 to 5; over the greater part of the bay the wind reaches force 7 or above on 5 to 10 days per month in July and August.

Between the equator and about 5° N, and E of 60° E, winds are generally lighter and only average about force 3; they are also considerably more variable in direction, though generally from between S and W.

In Malacca Strait the wind is mostly light and is subject to considerable variation in direction and strength due to land and sea breezes and other local influences. In the N part of the strait the winds are most often SW, while in the S the most frequent direction is SE. Although the Monsoon is generally light, there are often periods of stronger winds accompanied by squalls which sometimes reach gale force. Of particular note are the squalls, widely known as 'Sumatras', which blow from some W point and occur most frequently at night; they are described in Admiralty Sailing Directions.

The weather over most of the North Indian Ocean during the South-west Monsoon season is cloudy and unsettled, with considerable rainfall, especially off the W coasts of India and Burma, where it is very heavy. In the W part of the Arabian Sea, however, cloud amount and rainfall decrease towards the N and W and both are generally small in the vicinity of the African and Arabian coasts. Rainfall is also small at this time in the immediate vicinity of the E coasts of Sri Lanka and India as far N as about 15° N.

Visibility is good in most parts of the area except when reduced by rain, and in the N and W parts of the Arabian Sea where it is often only moderate and sometimes poor within about 200 miles of the coast particularly during the South-west Monsoon period, when, although the sky may be clear, the surface visibility may be reduced; in this latter zone in July and August visibility is likely to be less than 5 miles on about 50 per cent of occasions because of dust haze.

The waters off the S Arabian coast in the vicinity of the Kuria Muria Islands are frequently affected by sea fog during the South-west Monsoon.

North-east Monsoon

6.4

From November to March, a NE wind is experienced in the North Indian Ocean, the Arabian Sea, and the Bay of Bengal. This wind is known as the North-east Monsoon. The general distribution of pressure and wind at this season is shown on Diagram (1.13a), from which it will be observed that over the E part of Arabian Sea, and towards the equator, the prevailing wind direction is more nearly N than NE.

There are two areas in which the Monsoon is subject to considerable interruption, or in which the wind is rather variable in direction. The first is in the Arabian Sea N of about 20° N, where the variations in the direction and strength of the wind are caused by the passage of depressions across Iran or along the Makrán coast, and the second is between the equator and about 5° N, and E of about 90° E, where winds, though mostly N, are generally light and somewhat variable in direction.

Over the greater part of the North Indian Ocean the strength of the North-east Monsoon averages force 3 to 4 at the height of the season, though towards the equator it averages force 2 to 3, except W of about 55° E; it is also only light in the Malacca Strait. Winds are likely to reach force 7 only on rare occasions.

The weather in the Arabian Sea and Bay of Bengal is generally fine with small amounts of cloud and little or no rain. Cloudiness and rainfall increase towards the S and E, especially in December and January when considerable rain occurs in the S part of the Bay of Bengal S of a line joining the N extremities of Sri Lanka and Sumatera.

6.77.4
For oilfields seaward of Bombay, see 6.45.

Aden → Dondra Head or Colombo

6.78
Diagram (6.76)
In the Gulf of Aden and N of Suquṭrá, allowance must be made for the possibility of a set towards the S shore.
Vessels using Eight Degree Channel should keep nearer to Minicoy Island than to Maldives; see Admiralty Sailing Directions.

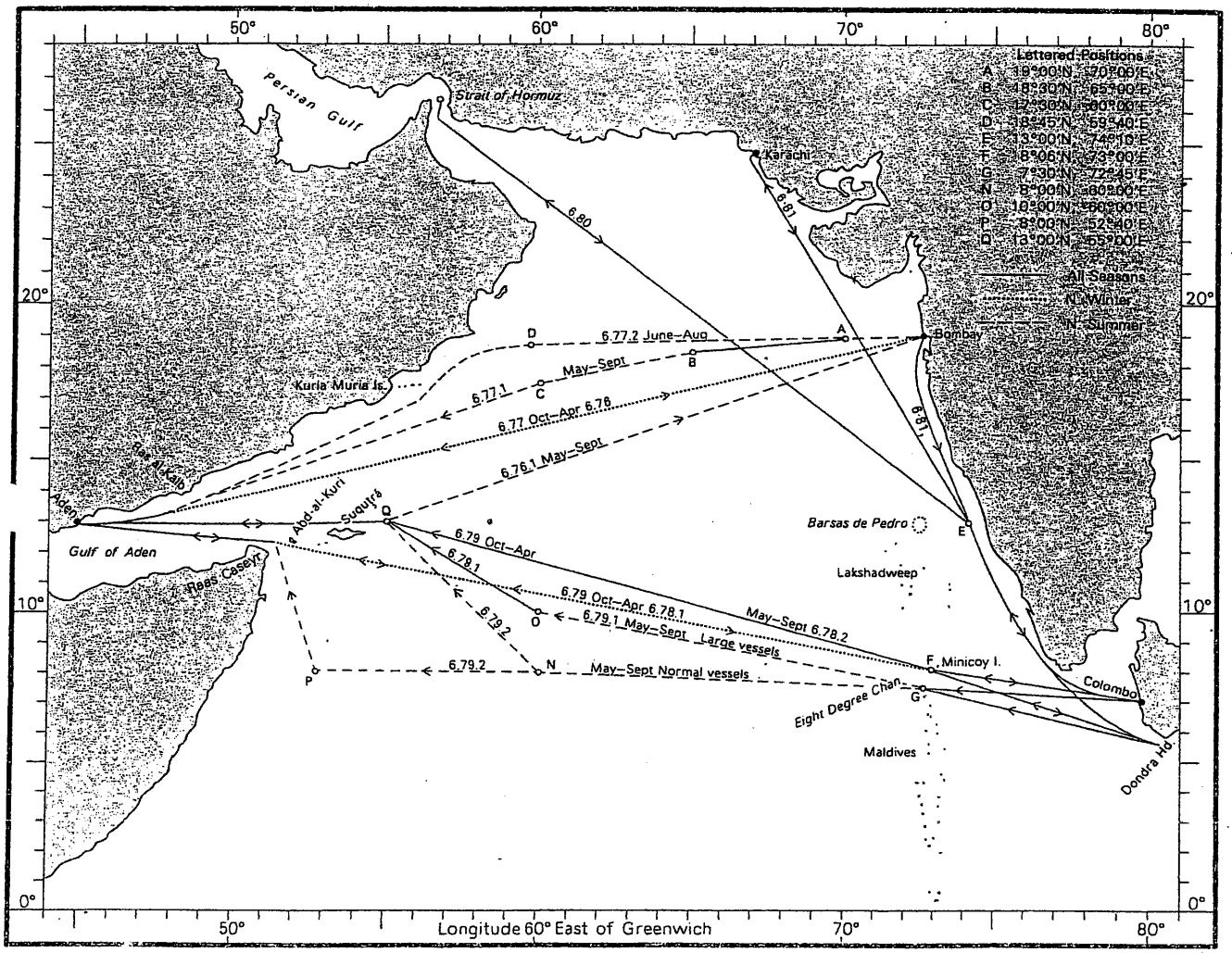
6.78.1
October to April, the route is between Raas Caseyr and 'Abd al Kūrī (6.58.3), thence through Eight Degree Channel.
Distances: Colombo 2080 miles;
Dondra Head 2140 miles.

6.78.2
May to September, to avoid the heavy cross-sea S of Suquṭrá caused by the South-west Monsoon, the route is through
13° 00′ N, 55° 00′ E, passing N of Suquṭrá, thence:
Either direct or through Eight Degree Channel.
Distances:
Colombo 2110 miles;
Dondra Head (10 miles S of) 2170 miles.

Dondra Head and Colombo → Aden

6.79
Diagram (6.76)
October to April, routes are through Eight Degree Channel, thence:
Either S of Suquṭrá, bearing in mind the difficulty of identifying the landfall (6.58.3),
Or through 13° 00′ N, 55° 00′ E, thence N of Suquṭrá, observing the directions at 6.58.2
Distances:
S of Suquṭrá:
Dondra Head (10 miles S of) 2140 miles;
Colombo 2080 miles.
N of Suquṭrá:
Dondra Head (10 miles S of) 2170 miles;
Colombo 2110 miles.

6.79.1
May to September, the choice of a route depends



(6.76) ROUTES across Arabian Sea.

largely on the power and sea-keeping qualities of a vessel.

For large vessels of high power, routes are:

Through Eight Degree Channel, thence:
10° 00′ N, 60° 00′ E, thence:
13° 00′ N, 55° 00′ E, thence:
N of Suquṭrá to Aden.

Distances:
Dondra Head (10 miles S of) 2190 miles;
Colombo 2130 miles.

6.79.2

For normal vessels, routes are:

Through Eight Degree Channel on the parallel of 7° 30′ N, thence:
8° 00′ N, 60° 00′ E, thence:
Either,
8° 00′ N, 52° 40′ E and round Raas Caseyr to Aden;
Or,
13° 00′ N, 55° 00′ E and N of Suquṭrá to Aden.

Distances;
S of Suquṭrá:
Dondra Head (10 miles S of) 2310 miles;
Colombo 2260 miles.
N of Suquṭrá:
Dondra Head (10 miles S of) 2250 miles;
Colombo 2200 miles.

6.79.3

For low-powered vessels, alternative routes are:

Either, through Eight Degree Channel, thence:
6° 00′ N, 67° 00′ E, thence:
6° 00′ N, 60° 00′ E, thence:
8° 00′ N, 52° 40′ E and round Raas Caseyr to Aden.

6.79.4

Or, provided that Olivelifuri, the islet marking the N side of the entrance to Kaashidoo Channel, can be made between sunrise and noon, the route is:
Through Kaashidoo Channel, thence:
4° 44′ N, 60° 00′ E, thence:
8° 00′ N, 52° 40′ E, and round Raas Caseyr to Aden.

6.79.5

For all small vessels, the route is:
Through One and Half Degree Channel, thence:
2° 00′ N, 60° 00′ E, thence:
8° 00′ N, 52° 40′ E and round Raas Caseyr to Aden.

Strait of Hormuz ↔ Colombo or Dondra Head

6.80

Diagram (6.76)

The route from the Traffic Separation Scheme (1.28) through Strait of Hormuz is as direct as navigation permits to 13° 00′ N, 74° 10′ E, off the Malabar coast, to avoid Barsas de Pedro and the shoals E of Lakshadweep, thence to destination.

Distances:
Colombo 1800 miles;
Dondra Head (10 miles S of) 1880 miles.

Karāchi and Bombay ↔ Colombo or Dondra Head

6.81

Diagram (6.76)

Routes are as direct as navigation permits.

For oilfields seaward of Bombay, see 6.45.

For the possibility of onshore sets, see Admiralty Sailing Directions.

Distances in miles:

	Bombay	*Colombo*	*Dondra Head (10 miles S of)*
Karāchi	500	1340	1420
Bombay	—	885	960

Selat Benggala

6.82

This channel, off the N end of Sumatera, offers a deep-water route for E-bound approach or W-bound departure for vessels using Malacca Strait. SW or NW winds prevail in it according to season. There is usually a NW-going current of 1 or 2 knots in the fairway, but near the SW shore the streams are tidal, and low-powered vessels needing anchorage while the stream is adverse may take advantage of this. See Admiralty Sailing Directions.

Malacca Strait

6.83

Malacca Strait and Singapore Strait together form the main seaway used by vessels from Europe and India bound Malaysian ports, Singapore and ports farther NE. They provide the shortest route for ships trading between the Persian Gulf and Japan.

The least depth in the fairway is about 25 m, but there are many areas of sandwaves: depths and the configuration of the channel are liable to change. Deep draught vessels should therefore take particular note of the latest reports of depths in or near the fairway.

Tidal streams are strong. Navigational aids are difficult to maintain and may be unreliable.

Local fishing craft with nets may be encountered in Malacca Strait.

Rules for vessels navigating through Malacca Strait and Singapore Strait are given in Admiralty Sailing Directions.

These factors, and the density of traffic, make navigation through the straits difficult, particularly for deep draught vessels. In addition, the long run of more than 250 miles through the straits demands long periods of considerable vigilance to maintain the required safe standard of navigation.

Distance:
Selat Benggala to Singapore (N or S of Pulau We): 615 miles.

ROUTES TO AND FROM PORT LOUIS (MAURITIUS)

Port Louis ↔ Cape Town or Durban

6.90

Diagram (6.55)

West-bound from Port Louis routes are to 20 miles SE of Madagascar, thence seasonal as at 68.3 or 68.4.

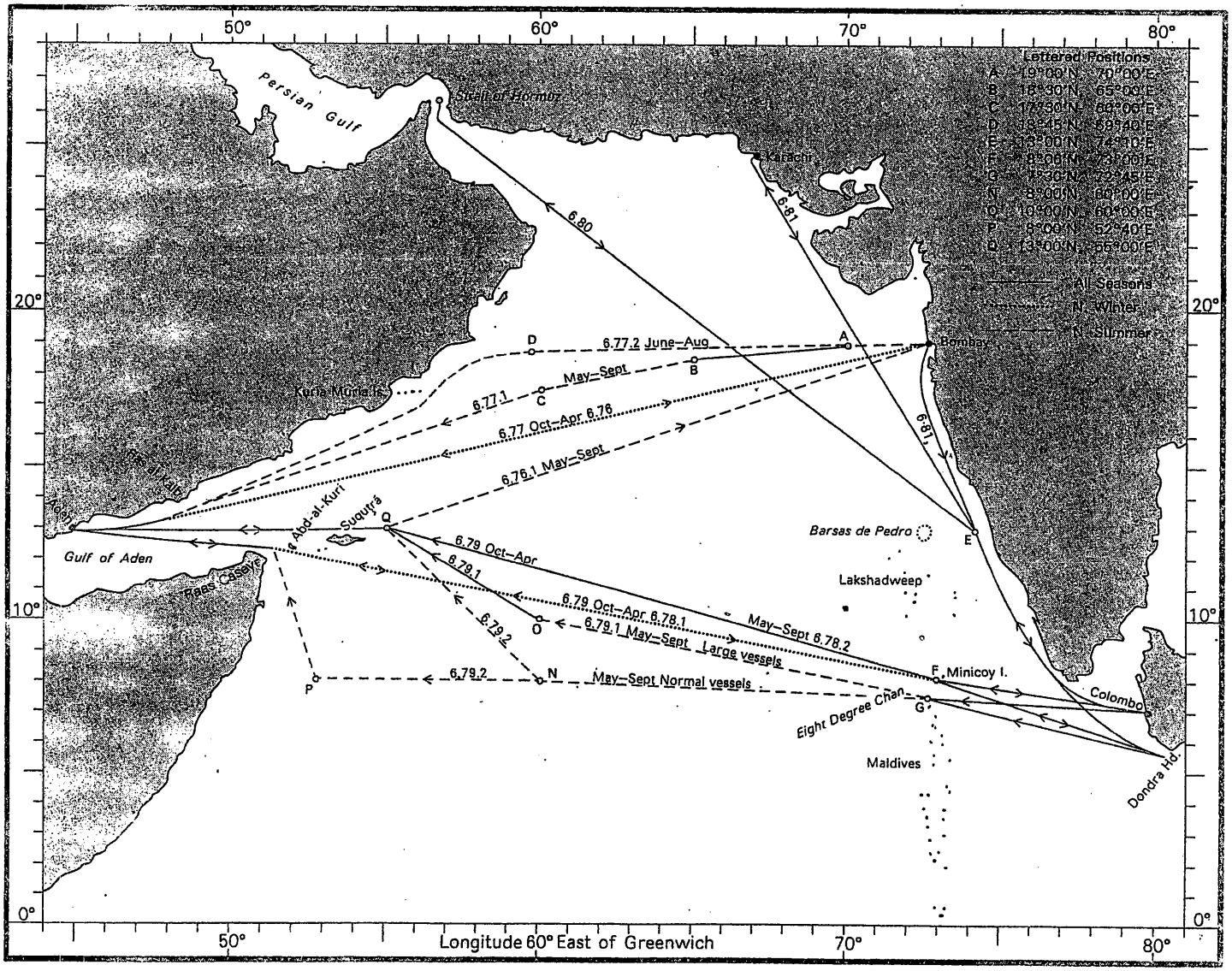
6.90.1

East-bound from Cape Town routes are:

Either as at 6.55.1 as far as Great Fish Point, thence:
Round the S end of Madagascar at a distance of 60 miles or more offshore, to seaward of the strongest part of the Madagascar Current (6.36), thence:
As navigation permits to Port Louis.

WORKSHEET Q1(d)

(This Worksheet must be returned with your answer book)



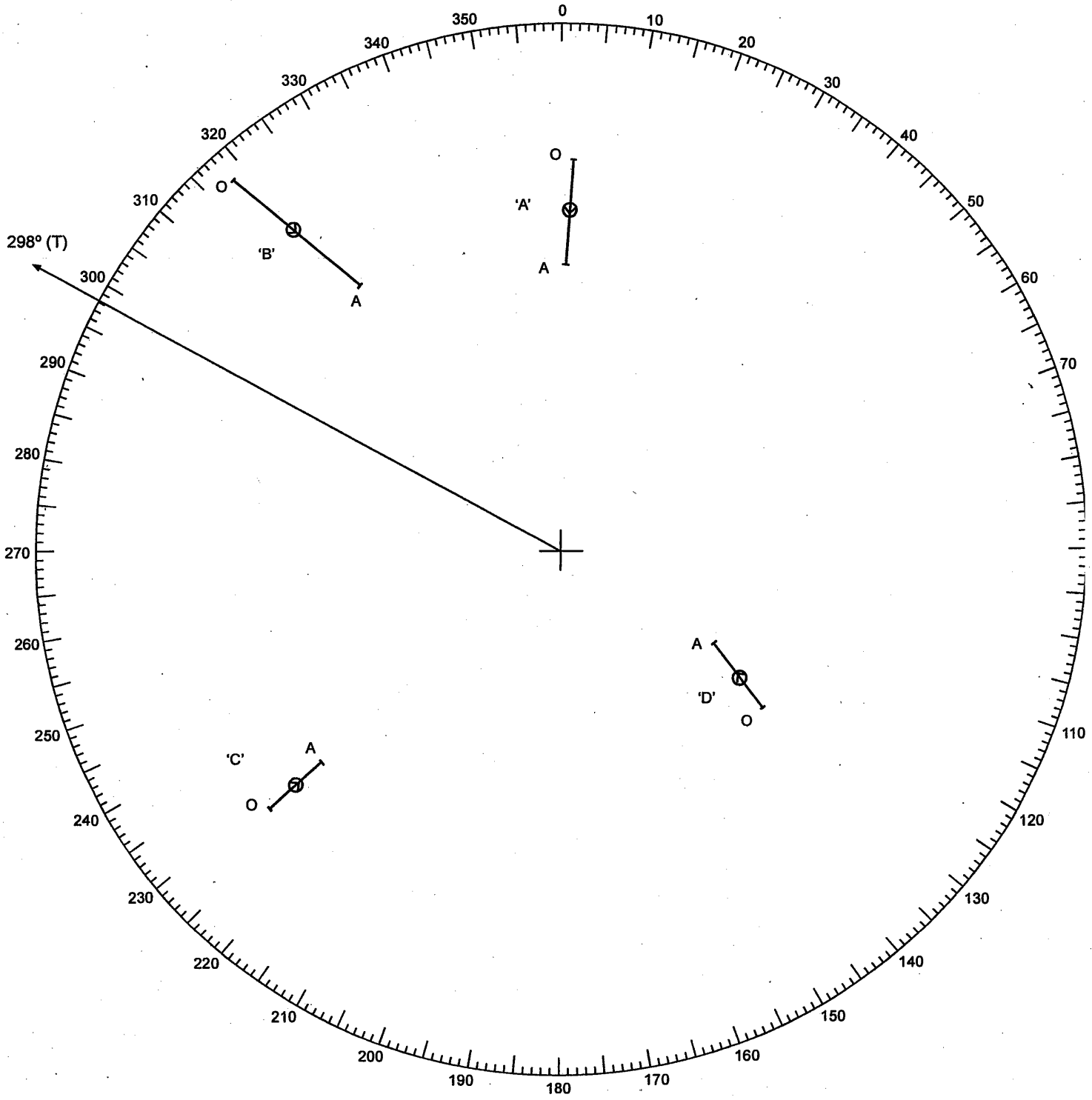
(6.76) ROUTES across Arabian Sea.

Candidate's Name .....

Examination Centre .....

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Range Scale 0 1 2 3 4 5 6

(This is not a metric scale)

Signature of Candidate .....

Examination Centre .....

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

TUESDAY, 25 NOVEMBER 2008

0915 - 1215 hrs

Examination paper inserts:

Datasheet Q2(a)(1)
Datasheet Q2(a)(2)
Radar Plotting Sheet

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination answer book
Navigation Formulae Datasheet
Nautical Almanac
Nautical Tables
Graph paper

November 2008.

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 38,000 GT container vessel is to make a fully laden passage from Gothenburg (Sweden) to Montreal (Quebec, Canada) in September. The vessel has an all seasons load line and has a service speed of 19.5 knots.

1. The vessel's owners have indicated that the vessel is to pass to the North of Scotland and transit the Belle Isle Strait prior to entering the St Lawrence river.

   The departure and landfall positions for the trans oceanic leg of the passage are as follows;

Departure Position	58°43'.0N	5°00'.0W	(5 miles N of Cape Wrath)
Landfall Position	51°44'.0N	56°00'.0W	(Entrance to Belle Isle Strait)

   With reference to the departure and landfall positions, calculate EACH of the following:

   (a) the great circle distance; (10)

   (b) the initial course on the great circle track; (10)

   (c) the position of the vertex; (15)

   (d) the ETA at the landfall position if the vessel departs from Cape Wrath at 2130hrs (Daylight Saving Time) on the 21st September. (8)

   Note: Assume the vessel will be on Quebec Standard Time when entering the Belle Isle Strait.

2. Vessels approaching Newfoundland and the Grand Banks from seaward are likely to encounter several navigational hazards.

   (a) With reference to Datasheets Q2(a)(1) and Q2(a)(2), outline SIX hazards which a vessel may encounter during passage at anytime in the year. (18)

   (b) Vessels encountering certain types of navigational hazards are required by law to pass on information to other vessels and coast radio stations in the vicinity.

   (i) Detail the circumstances to which these regulations apply. (10)

   (ii) Describe the information that is required to be transmitted for each type of hazard. (16)

3. (a) The following observation was obtained during morning twlight on the 22nd September.

DR Position 59°01'.6N 9°40'.6W
Chronometer read 4h 30m 18s Chronometer Error 3m 26s Slow on UT
Compass Bearing of Polaris 354°(C)
Variation 6°(E)

Calculate the deviation of the compass for the direction of the ship's head. (20)

(b) A short time later, whilst in DR position 59°04'.0N 10°26'.0W, the sun was observed to rise bearing 080°(C). Assuming the variation and the vessel's course remained constant throughout the period determine the compass deviation for the second observation. (15)

(c) Outline TWO factors which should be taken into account when deciding which of the two values for deviation is likely to be the more accurate. (10)

4. At 0600hrs UT on the 25th September the vessel receives a request from MRCC Halifax to take part in a search and rescue operation for a 38ft lobster boat. The crew have reported that the lobster boat collided with a submerged object and sank within minutes. They have abandoned the vessel and were last reported to be adrift in a 12 man liferaft.

(a) Outline SIX factors to be considered when choosing a vessel to act as the On Scene Coordinator (OSC) during search and rescue operations. (12)

(b) (i) State the publications that should be consulted during a search and rescue operation. (5)

(ii) Outline the information that is available to determine a search datum position, from the publications stated in Q4(b)(i). (6)

(c) Explain, with the aid of a sketch, the method used to determine a datum search position, assuming the distress position is known. (12)

5. (a) For a vessel operating in pack ice in the approaches to the Belle Isle Strait, outline FIVE factors that should be taken into account when maintaining a navigational plot of the vessel's position. (15)

(b) Outline SIX factors that the Master must take into account when manoeuvring the vessel in ice. (18)

Newfoundland Banks

2.17

After passing the Strait of Belle Isle and the E coast of Newfoundland, the Labrador Current covers the whole of the Grand Banks except, during summer, the extreme S part. A large branch of the current follows the E edge of the bank; this is the part which carries ice farthest S to reach the transatlantic shipping routes. Another branch rounds Cape Race and sets SW. Although some of the water that has passed on to the Grand Banks continues in a more S direction, especially during August to October, the bulk of it sets SW and continues, as a SW- going set, to fill thee region between Newfoundland Nova Scotia, and the Gulf Stream.

The Labrador Current subsequently continues S along the coast of the United States as a cold current as far as about 36° N from November to January, 37° N from February to April, 38° N from May to July, and 40° N from August to October. Between the S limit of the Labrador Current and the Tail of the Bank, the warm and cold waters converge on a line which is known as the 'Northern Edge' (or sometimes the North Wall) of the Gulf Stream.

The E end of the Northern Edge presents the greatest hydrographic contrasts to be found in the world, the water changing from the olive or bottle green of the Arctic side to the indigo blue of the Gulf Stream. A temperature change of 12° C to 0° C has been recorded within a ship's length.

The currents off the coasts of Labrador and Newfoundland are complex; for details, reference should be made to Admiralty Sailing Directions.

ICE

General remarks

2.25

The following brief account of ice in the North Atlantic Ocean is by no means comprehensive. Before undertaking voyages through areas in which ice is likely to be met, The Mariner's Handbook and the relevant Admiralty Sailing Directions should be studied, as well as the monthly Routeing Charts, which show the ice limits. These limits are also shown approximately on Diagrams (1) and (1b), but they may not always agree with the Routeing Charts, which endeavour to show the extreme limits on a monthly basis as far as this is possible with the limited and variable data available.

2.25.1

Five-day Ice Charts, obtainable from the Director General, Meteorological Office, Met.O. I a(l), Headquarters Annexe, Eastern Road, Bracknell, Berks, RGI2 2UR should also be studied.

Facsimile broadcasts of ice charts are also available, as set out in Admiralty List of Radio Signals Vol 5.

A factor always to be borne in mind where ice conditions are concerned is their great variability. For this reason, and on account of the sparsity of observations in many areas, the charted positions of ice limits must be regarded as approximate. The dates which follow refer to average conditions.

Ice limits' and drift

2.26

The Routeing Charts show the influence of the ocean currents (2.15 and 2.17) in setting the pack ice over much of the area of the Grand Banks of Newfoundland from the latter part of January until May, while the E part of the ocean remains ice-free to high latitudes.

Almost all the icebergs which menace the North Atlantic routes originate in the glaciers of the W coast of Greenland where they are calved at a rate of several thousand a year. Most are carried N by the West Greenland Current, round the head of Baffin Bay, and then S by the Canadian and Labrador Currents, and when they finally reach the shipping routes they may be several years old. The bergs calved on the E coast of Greenland also drift S, and may be met off Kap Farvel.

Some drift across the East Greenland Current and may be met throughout the year on the E flank of that current, extending SW from the W extremity of Iceland.

Others drift round Kap Farvel, but they do not survive the relatively warm water of Davis Strait and are not a source of danger on the regular transatlantic routes. Icebergs may be found beyond the limits of the pack ice at all seasons, but mostly in early summer; in winter many are frozen into the pack ice.

Ice in specific localities

2.27

Kap Farvel. The greatest distance at which bergs are met S of Kap Farvel is generally about 120 miles. This usually occurs in May when they may be encountered as far E as 66° N, 32° W. Their least extent is in December. Bergs are not usually met S of 48° N between September and December, but may be encountered in any month N of 52° N.

2.27.1

Saint Lawrence River below Montreal is closed by ice between early December and mid-April. Commercial navigation ceases in most pans of the Gulf of Saint Lawrence by mid-December; in the S pan, navigation is not considered safe between early December and mid-April.

2.27.2

Strait of Belle Isle is generally not navigable from late December until June.

2.27.3

Cabot Strait is usually navigable from mid-April until February. Pack ice arrives from N off Cape Race about the end of January in an ordinary season, extending round the coasts of the Avalon Peninsula in February, until early May.

2.27.4

The Grand Banks of Newfoundland are entirely free of pack ice between July and December inclusive. Pack ice reaches the banks in January and extends farthest S in March and April, on the E edge of the banks. In very rare seasons, dangerous pack ice may extend to the Tail of the Bank and even S of it but, on average, the floes begin to break up on reaching 45° N.

In the region of the Grand Banks, the worst season for icebergs is between March and July, with April, May and June as the months of greatest frequency. Bergs are not often found S of 40° N or E of 40°W, though occasionally they may be considerably outside these limits. They are particularly prevalent around the E flank of the banks, on which many of them ground. More detail is given in Admiralty Sailing Directions.

2.27.5

Denmark Strait is normally free of ice on its E side throughout the year, but on rare occasions, as in the spring of 1968, the ice spreads across from Greenland to close the strait. Icebergs may be met throughout the year on both sides of Denmark Strait.

Ice Information Services

2.28

Ice information, comprising up-to-date reports and forecasts from Gulf of Saint Lawrence, the Grand Banks of Newfoundland, Greenland, Iceland and the NW approaches to Europe are transmitted from the coast radio stations listed in Admiralty List of Radio Signals Vol 5, and can be obtained from the Meteorological Office, Met.O. 1 a(1), Headquarters Annexe, Eastern Road, Bracknell, Berks, RGl2 2UR.

International Ice Patrol is operated by the US Coast Guard with the primary object of collecting data and warning shipping of the amount and extent of icebergs and sea ice in the vicinity of the Grand Banks. The service operates principally between the parallels of 39o N and 50° N and the meridians of 42° and 60° W during the ice season from February or March until about theend of June.

In spite of the efforts of the International Ice Patrol bergs are known to drift unnoticed into the usual routes in the vicinity of the Grand Banks. For details of the International Ice Patrol, see Admiralty Sailing Directions and Admiralty List of Radio Signals Vol 5.

Ice Advisory Service, maintained by the Canadian Coast Guard during the winter navigational season, is based on aerial reconnaissance. Reports of existing and forecast ice conditions are broadcast from certain Canadian radio stations. For details of the service, see Admiralty Sailing Directions and Admiralty List of Radio Signals Vol 5, Ice Navigation in Canadian Waters issued by the Canadian Coast Guard, should also be consulted.

2.28.1

Caution. Carefully conducted tests by the International Ice Patrol have shown that radar cannot provide positive assurance for iceberg detection. Seawater is a better reflector than ice. This means that unless a berg or growler is observed outside the area of `sea return' or `clutter' it will not be detected by radar.

The average range of detection of a dangerous growler, if detected, is only 4 miles.

Radar is a valuable aid, but its use cannot replace the traditional caution exercised during a passage passing near the Grand Banks during the ice season.

NOTES AND CAUTIONS

Strait of Belle Isle

2.35

Approaching from the E in low visibility, soundings on the banks E of Newfoundland and Labrador will be found of great assistance if not certain of the position.

A Traffic Separation Scheme (1.28) has been established in the Strait.

Newfoundland coasts

2.36

Fog is exceedingly prevalent off the S coast of Newfoundland, especially in summer. The set of the current and the indraughts into the deep bays, particularly on their E sides, should be guarded against.

Approaching from the E in thick weather, radiobeacons on the E coast of Newfoundland or other radio aids, and soundings over the Grand Banks and Ballard Bank should indicate the position with enough accuracy to round Cape Race in safety.

Although the current between the Grand Banks and Newfoundland ordinarily sets SW at a rate which may slightly exceed 1 knot, it is not unusual, particularly for a short period before a gale, for the current to be so disturbed as to set across its ordinary direction or even to be reversed on the surface. Close inshore, it is affected by the tidal steams.

The currents between Cape Race and Saint Pierre are irregular, with a greatest rate of 1 knot, and are influenced by the wind, and, near the shore, by the tidal streams. See Admiralty Sailing Directions.

Approaching from the W, Cape Pine and Cape Race should not be closed in depths of less than 55 m unless certain of the position.

Grand Banks of Newfoundland

2.37

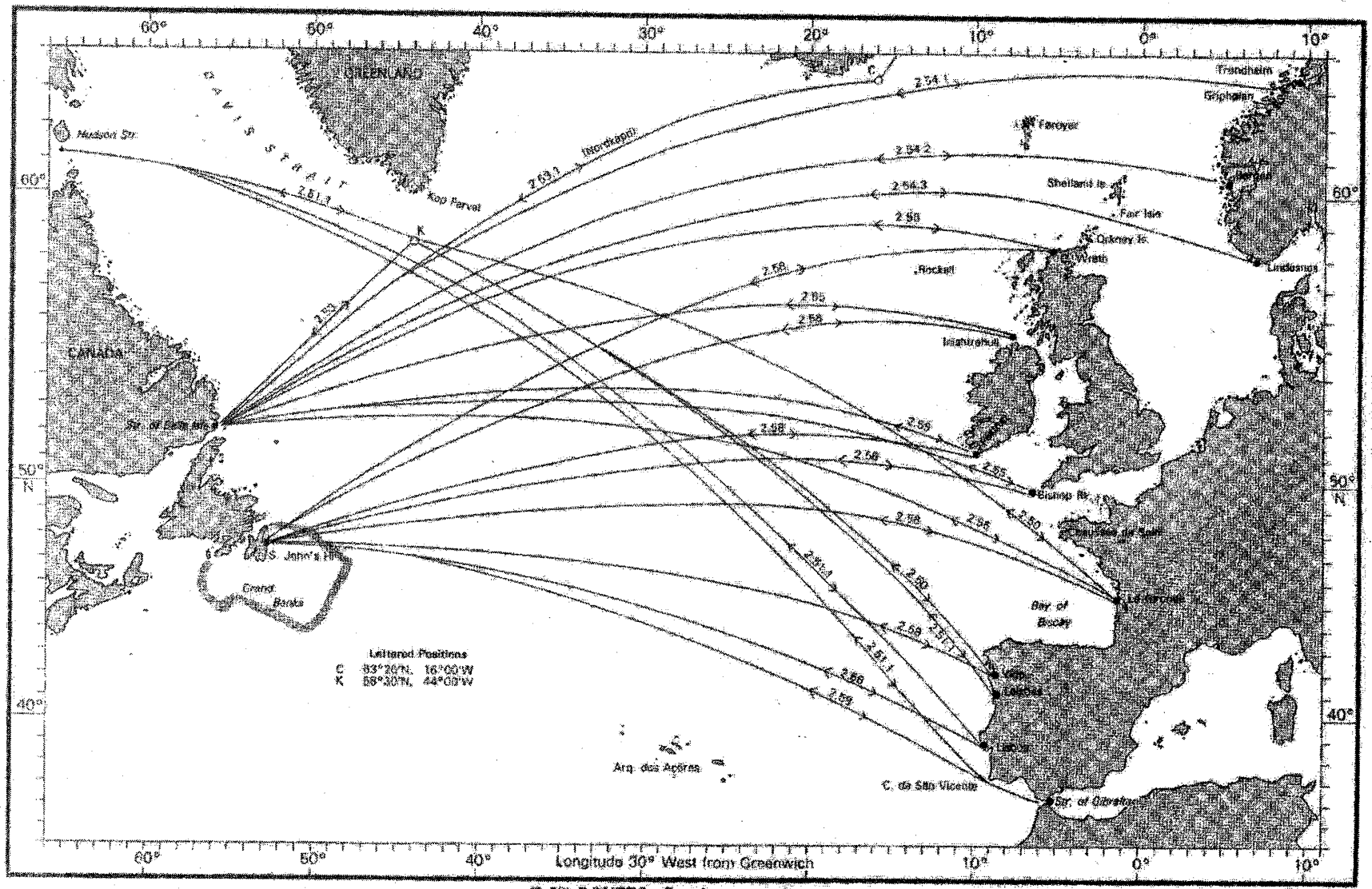
The principal shipping routes from N European ports to ports on the E coast of the US, and to the Gulf of Saint Lawrence through Cabot Strait, lead over or near the Grand Banks.

They are among the busiest routes in the world. At the same time they are amongst the most dangerous.

Icebergs, growlers and pack ice are common in this region notorious for the frequency and density of its fogs. Many depressions pass close to the area so that gales are frequent and severe. In addition, many fishing vessels are found throughout the year on the Grand Banks, as well as vessels and platforms used to exploit oil, gas and mineral deposits.

In view of these hazards the International Convention for the Safety of Life at Sea, (1974) advises that all ships proceeding on voyages in the vicinity of the Grand Banks should avoid as far as practicable, the fishing banks of Newfoundland N of 43° N and to pass outside regions known or believed to he endangered by ice.

The International Ice Patrol Service also advises against venturing into pack ice N of 45° 30' N before the middle of April.



(2.50) ROUTES—Canada ⟷ Europe.

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
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MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

TUESDAY, 31 MARCH 2009

0915 - 1215 hrs

Examination paper inserts:

Worksheet Q1 Worksheet Q2(c)(1) and Q2(c)(2) Worksheet Q5 - Radar Plotting Sheet

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination answer book	UK and Ireland Tide Tables
Navigation Formulae Datasheet	Graph paper
Nautical Almanac	
Nautical Tables	

March 2009

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 12,500GT refrigerated cargo vessel has been chartered to carry fruit from Ecuador to the UK. The vessel will carry general cargo on the southbound passage. The vessel is due to make a fully loaded passage from Barry (European Tide Tables No 513) to Guyaquil (Ecuador), via the Panama Canal, in the month January. The vessel is expected to sail with a draught 5.2m and the service speed is 19.5 knots.

1. The vessel is due to complete cargo operations on the morning of the 8th January.

   In order to leave the dock the vessel must pass through a set of locks which have a sill with a charted depth of 0.5m. The Master requires a minimum underkeel clearance of 1.5m to be maintained at all times.

   (a) Calculate the height of tide required to clear the lock sill. (5)

   (b) Using Worksheet Q1, determine the latest time on the afternoon ebb tide of the 8th January that the vessel can pass through the locks. (25)

   (c) Describe TWO meteorological factors which can affect tidal heights, stating what affect they have on the height of tide experienced compared to that predicted. (10)

2. The Master has been asked by the charterers to consider two routes between the following positions:

Departure Position	49°47'.0N 6°50'.0W
Landfall Position	18°20'.0N 67°50'.0W

   The routes being considered are:

   - a direct great circle track

   OR

   - a direct rhumb line track

   (a) Calculate the distance on passage for EACH route. (18)

   (b) Assuming the direct great circle route experiences an adverse current of 1 knot for a distance of 1500 miles, calculate the difference in the ETA's for EACH route. (10)

   (c) Plot the direct great circle track on Worksheet Q2(c)(1) and Worksheet Q2(c)(2). (17)

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3. With reference to Admiralty Routeing Charts:

(a) outline the information that can be obtained from a wind rose; (10)

(b) state the other information that can be found on a routeing chart; (14)

(c) describe how the information found on a routeing chart can be used when appraising the proposed passage. (16)

4. Vessels on passage between Central America and NW Europe may encounter tropical revolving storms (TRS).

(a) Describe the warning signs of an approaching tropical storm. (12)

(b) Sketch a plan view of a TRS, in the northern hemisphere, indicating ALL the relevant features. (8)

(c) Explain how shipboard observations can be used to determine the vessel's position relative to the centre of a tropical revolving storm. (10)

(d) If the Master suspects that his vessel is within 200 miles of the centre of a TRS, state the recommended actions open to the Master to avoid the worst effects of the storm. (12)

5. The coastline in the vicinity of Guyaquil is mainly low lying and appears indistinct when approaching from the North. There is a prominent lighthouse situated one mile offshore and the Master intends to use this as a target for parallel indexing. The cross index range will be taken as 3 miles to port when the vessel is steering 180°(T).

When the light bears 061°(T), the Master intends to alter course to 120°(T) to make the final three mile approach run to the fairway buoy.

(a) On Worksheet Q5, indicate the parallel index lines that would be required for the track, using the lighthouse as a target, as they would appear on the radar display, assuming it is on the 6 mile range. (10)

(b) On the Worksheet Q5 indicate on the parallel index line the position of the lighthouse when the vessel passes the fairway buoy and determine the range and bearing of the light at that time. (10)

Note: On Worksheet Q5 candidates should only indicate the parallel index lines. No attempt should be made to indicate a coastline.

(c) Describe the precautions that should be observed when using parallel index techniques. (13)

ENGLAND, WEST COAST - PORT OF BRISTOL (AVONMOUTH)

LAT 51°30'N LONG 2°43'W

TIME ZONE UT (GMT) TIMES AND HEIGHTS OF HIGH AND LOW WATERS YEAR 0000

JANUARY

	TIME	M		TIME	M
1	0227	1.4	**16**	0223	1.8
TH	0754	13.3	F	0759	12.2
	1453	1.1		1446	2.0
	2020	13.1		2022	12.0
2	0315	1.3	**17**	0301	1.9
F	0843	13.4	SA	0830	12.2
	1541	1.1		1522	2.1
	2108	13.1		2053	12.0
3	0359	1.5	**18**	0335	2.0
SA	0929	13.2	SU	0903	12.3
	1623	1.3		1555	2.2
	2153	12.8		2124	12.1
4	0438	1.8	**19**	0406	2.1
SU	1014	12.9	M	0935	12.4
	1702	1.6		1624	2.3
	2237	12.3		2156	12.0
5	0516	2.2	**20**	0434	2.2
M	1058	12.4	TU	1009	12.3
	1739	2.1		1652	2.4
	2320	11.8		2228	11.8
6	0551	2.6	**21**	0501	2.4
TU	1143	11.9	W	1044	12.0
	1815	2.5		1719	2.5
				2304	11.5
7	0004	11.3	**22**	0530	2.7
W	0629	3.0	TH	1123	11.6
	1229	11.4		1751	2.8
	1857	2.9		2344	11.0
8	0052	10.8	**23**	0608	3.0
TH	0714	3.3	F	1208	11.2
	1324	11.0		1834	3.1
	1948	3.2			
9	0149	10.5	**24**	0036	10.5
F	0816	3.6	SA	0659	3.5
	1426	10.7		1314	10.7
	2054	3.4		1933	3.6
10	0257	10.5	**25**	0206	10.2
SA	0928	3.6	SU	0818	3.9
	1538	10.7		1447	10.5
	2159	3.2		2115	3.8
11	0410	10.7	**26**	0335	10.6
SU	1034	3.2	M	1014	3.6
	1648	11.0		1607	10.9
	2302	2.9		2254	3.3
12	0513	11.2	**27**	0449	11.3
M	1137	2.8	TU	1139	2.8
	1744	11.5		1723	11.6
13	0003	2.4	**28**	0017	2.5
TU	0605	11.7	W	0557	12.1
	1235	2.4		1253	2.0
	1832	11.8		1829	12.3
14	0056	2.1	**29**	0124	1.8
W	0649	12.0	TH	0656	12.8
	1323	2.1		1354	1.3
	1913	12.0	●	1924	12.9
15	0142	1.9	**30**	0220	1.2
TH	0727	12.2	F	0745	13.4
	1406	2.0		1447	0.9
O	1949	12.0		2012	13.3
			31	0308	0.9
			SA	0830	13.7
				1532	0.7
				2054	13.4

FEBRUARY

	TIME	M		TIME	M
1	0350	0.9	**16**	0322	1.5
SU	0912	13.7	M	0843	13.0
	1612	0.7		1541	1.7
	2134	13.3		2103	12.8
2	0426	1.1	**17**	0355	1.5
M	0952	13.6	TU	0915	13.1
	1644	1.1		1610	1.6
	2212	13.0		2135	12.8
3	0455	1.6	**18**	0423	1.6
TU	1030	13.1	W	0948	13.0
	1712	1.6		1635	1.8
	2248	12.5		2206	12.5
4	0522	2.0	**19**	0445	1.8
W	1108	12.4	TH	1021	12.6
	1737	2.1		1658	2.1
	2323	11.8		2238	12.0
5	0546	2.5	**20**	0509	2.2
TH	1144	11.7	F	1055	11.9
	1804	2.6		1725	2.5
	2358	11.1		2312	11.2
6	0614	3.0	**21**	0542	2.8
F	1227	10.9	SA	1136	11.1
	1838	3.1		1801	3.0
				2356	10.5
7	0043	10.4	**22**	0625	3.4
SA	0653	3.6	SU	1234	10.3
	1323	10.2		1853	3.7
	1930	3.7			
8	0151	9.8	**23**	0126	9.8
SU	0806	4.2	M	0735	4.1
	1442	9.8		1419	9.8
	2104	4.1		2042	4.3
9	0321	9.7	**24**	0311	9.9
M	0956	4.0	TU	0959	3.9
	1617	10.0		1553	10.2
	2230	3.6		2241	3.6
10	0449	10.3	**25**	0438	10.8
TU	1112	3.4	W	1129	2.9
	1725	10.7		1719	11.2
	2339	2.9			
11	0547	11.0	**26**	0008	2.5
W	1214	2.7	TH	0550	11.9
	1814	11.3		1245	1.8
				1822	12.2
12	0036	2.3	**27**	0114	1.5
TH	0631	11.6	F	0645	12.8
	1306	2.2		1342	1.0
	1853	11.7		1912	13.0
13	0126	1.9	**28**	0208	0.8
F	0707	12.0	SA	0730	13.5
O	1351	2.0		1432	0.5
	1928	12.0	●	1954	13.4
14	0208	1.7			
SA	0740	12.3			
	1432	1.9			
	2001	12.3			
15	0247	1.6			
SU	0811	12.6			
	1508	1.8			
	2032	12.6			

MARCH

	TIME	M		TIME	M
1	0253	0.5	**16**	0225	1.3
SU	0811	13.8	M	0744	13.0
	1514	0.3		1446	1.4
	2032	13.7		2005	13.0
2	0331	0.5	**17**	0301	1.1
M	0849	14.0	TU	0818	13.3
	1549	0.4		1519	1.2
	2108	13.7		2039	13.2
3	0402	0.7	**18**	0335	1.0
TU	0925	13.8	W	0851	13.5
	1617	0.8		1550	1.2
	2142	13.4		2111	13.2
4	0427	1.1	**19**	0403	1.1
W	1000	13.4	TH	0925	13.2
	1640	1.2		1616	1.4
	2214	12.8		2143	12.7
5	0447	1.6	**20**	0428	1.5
TH	1031	12.6	F	1000	12.6
	1659	1.7		1638	1.8
	2242	12.0		2217	12.0
6	0506	2.0	**21**	0452	2.0
F	1102	11.7	SA	1037	11.7
	1720	2.2		1705	2.3
	2312	11.2		2252	11.1
7	0530	2.6	**22**	0526	2.6
SA	1136	10.7	SU	1119	10.7
	1750	2.9		1743	3.0
	2346	10.3		2342	10.1
8	0605	3.3	**23**	0611	3.4
SU	1222	9.7	M	1229	9.8
	1831	3.7		1838	3.8
9	0042	9.3	**24**	0120	9.5
M	0657	4.2	TU	0730	4.0
	1342	8.9		1409	9.5
	1938	4.5		2039	4.3
10	0229	8.9	**25**	0258	9.8
TU	0911	4.7	W	0948	3.5
	1545	9.0		1545	10.1
	2200	4.3		2230	3.3
11	0421	9.5	**26**	0428	10.8
W	1048	3.8	TH	1113	2.4
	1658	9.9		1708	11.2
	2313	3.4		2354	2.2
12	0519	10.5	**27**	0534	12.0
TH	1149	2.9	F	1227	1.4
	1744	10.8		1805	12.3
13	0011	2.6	**28**	0056	1.2
F	0600	11.3	SA	0625	12.9
	1241	2.3		1321	0.7
	1824	11.5		1850	13.0
14	0100	2.0	**29**	0145	0.7
SA	0636	12.0	SU	0709	13.4
	1326	1.9		1408	0.4
	1859	12.1	●	1930	13.4
15	0144	1.6	**30**	0227	0.5
SU	0710	12.5	M	0747	13.7
	1408	1.6		1446	0.4
O	1933	12.6		2005	13.6
			31	0303	0.5
			TU	0822	13.8
				1518	0.5
				2040	13.7

APRIL

	TIME	M		TIME	M
1	0331	0.7	**16**	0312	0.8
W	0857	13.7	TH	0829	13.4
	1543	0.7		1529	1.0
	2112	13.4		2050	13.2
2	0355	1.0	**17**	0345	0.9
TH	0929	13.2	F	0908	13.1
	1606	1.0		1559	1.3
	2142	12.8		2128	12.7
3	0414	1.3	**18**	0414	1.3
F	0959	12.4	SA	0948	12.4
	1626	1.5		1626	1.8
	2207	12.0		2207	11.9
4	0434	1.8	**19**	0445	1.9
SA	1027	11.4	SU	1033	11.4
	1648	2.0		1658	2.4
	2234	11.0		2255	10.9
5	0459	2.4	**20**	0523	2.5
SU	1058	10.4	M	1127	10.5
	1716	2.7		1740	3.1
	2305	10.1			
6	0533	3.2	**21**	0000	10.1
M	1137	9.4	TU	0615	3.2
	1753	3.6		1239	9.8
	2351	9.2		1843	3.7
7	0618	4.1	**22**	0120	9.9
TU	1241	8.6	W	0745	3.5
	1846	4.4		1359	9.8
				2036	3.8
8	0116	8.5	**23**	0243	10.2
W	0735	4.7	TH	0927	2.9
	1450	8.5		1527	10.4
	2042	4.7		2204	2.9
9	0328	9.0	**24**	0404	11.1
TH	1002	4.2	F	1042	2.1
	1609	9.4		1642	11.4
	2228	3.8		2322	2.0
10	0430	10.0	**25**	0509	12.1
F	1104	3.2	SA	1154	1.4
	1659	10.4		1737	12.2
	2327	2.9			
11	0515	11.0	**26**	0025	1.3
SA	1158	2.5	SU	0558	12.7
	1742	11.4		1250	1.0
				1822	12.8
12	0022	2.2	**27**	0114	1.0
SU	0556	11.9	M	0641	13.0
	1250	2.0		1335	0.9
	1821	12.1		1902	13.1
13	0112	1.7	**28**	0155	1.0
M	0635	12.6	TU	0719	13.2
	1337	1.6		1413	0.9
	1900	12.7	●	1937	13.2
14	0157	1.2	**29**	0230	1.0
TU	0714	13.1	W	0755	13.3
	1418	1.2		1444	0.9
O	1937	13.1		2011	13.3
15	0236	0.9	**30**	0258	1.0
W	0752	13.4	TH	0830	13.1
	1456	1.0		1511	1.0
	2013	13.3		2043	13.0

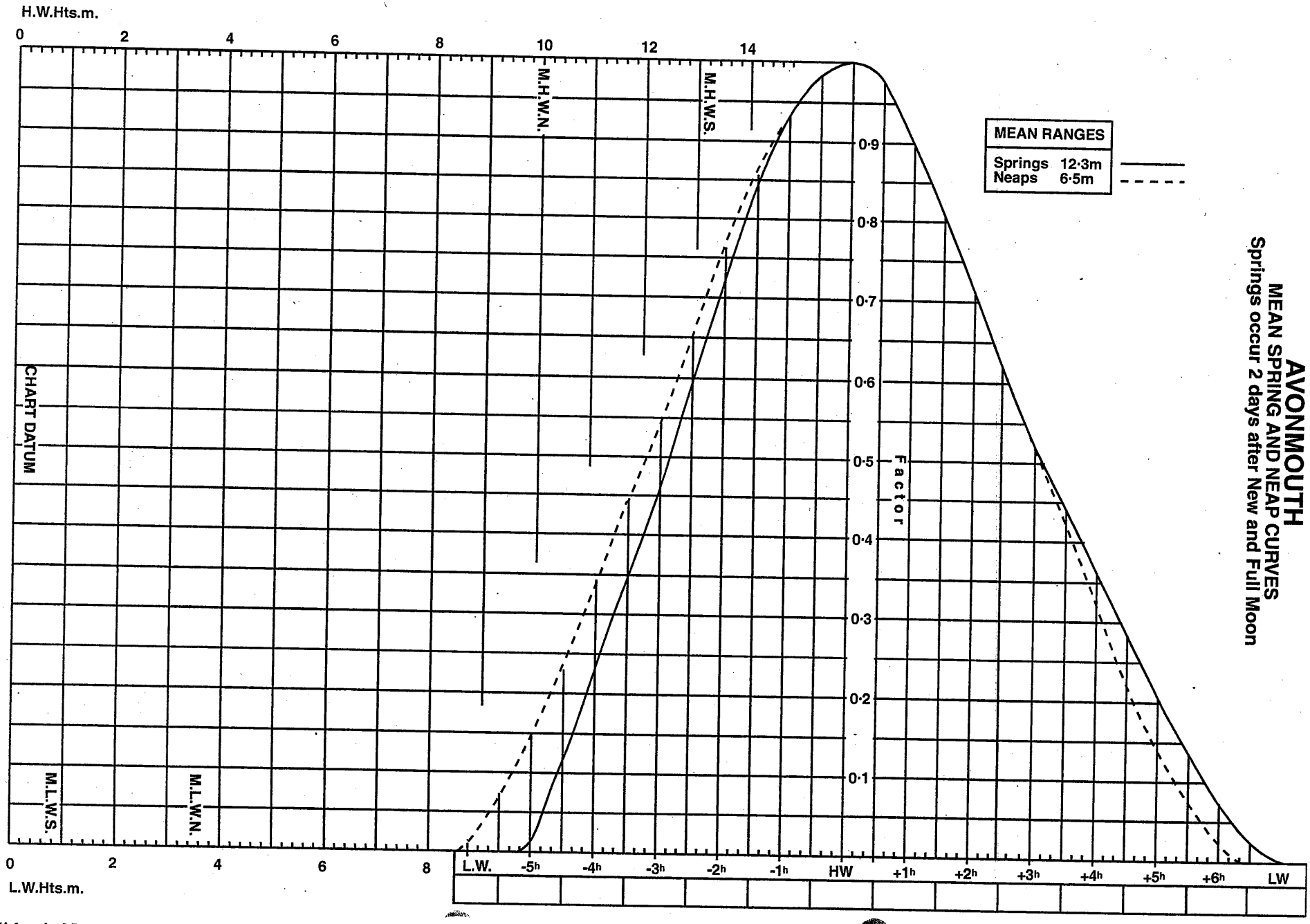
No.	PLACE	Lat. N.	Long. W.	TIME DIFFERENCES High Water	TIME DIFFERENCES Low Water	HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS	M.L. Z_0 m.	
				(Zone U.T. (G.M.T.))							
523	**PORT OF BRISTOL (AVONMOUTH)** (see page 24)			**0600 and 1800**	**1100 and 2300**	**0300 and 1500**	**0800 and 2000**	**13·2**	**10·0**	**3·5**	**0·9**		
513	Barry	51 23	3 16	−0030	−0015	−0125	−0030	−1·8	−1·3	+0·2	0·0	6·11	
513a	Flatholm	51 23	3 07	−0015	−0015	−0045	−0045	−1·4	−1·2	+0·2	+0·1	6·2	*x*
513b	Steepholm	51 20	3 06	−0020	−0020	−0050	−0050	−1·6	−1·4	+0·1	−0·1	6·1	*x*
514	Cardiff	51 27	3 09	−0015	−0015	−0100	−0030	−1·0	−0·6	+0·1	0·0	6·45	
515	Newport	51 33	2 59	−0020	−0010	0000	−0020	−1·1	−1·0	−0·6	−0·7	6·04	
	River Wye												
516	Chepstow	51 39	2 40	+0020	+0020	⊙	⊙	⊙	⊙	⊙	⊙	⊙	
523	**PORT OF BRISTOL (AVONMOUTH)** (see page 24)			**0000 and 1200**	**0600 and 1800**	**0000 and 1200**	**0700 and 1900**	**13·2**	**10·0**	**3·5**	**0·9**		
	England												
	River Severn												
517	Sudbrook	51 35	2 43	+0010	+0010	+0025	+0015	+0·2	+0·1	−0·1	+0·1	⊙	
518	Beachley (Aust.)	51 36	2 38	+0010	+0015	+0040	+0025	−0·2	−0·2	−0·5	−0·3	6·43	
519	Inward Rocks	51 39	2 37	+0020	+0020	+0105	+0045	−1·0	−1·1	−1·4	−0·6	5·66	*c*
520	Narlwood Rocks	51 39	2 36	+0025	+0025	+0120	+0100	−1·9	−2·0	−2·3	−0·8	⊙	★
521	White House	51 40	2 33	+0025	+0025	+0145	+0120	−3·0	−3·1	−3·6	−1·0	3·93	*c*
522	Berkeley	51 42	2 30	+0030	+0045	+0245	+0220	−3·8	−3·9	−3·4	−0·5	3·43	*c*
522a	Sharpness Dock	51 43	2 29	+0035	+0050	+0305	+0245	−3·9	−4·2	−3·3	−0·4	⊙	★
522b	Wellhouse Rock	51 44	2 29	+0040	+0055	+0320	+0305	−4·1	−4·4	−3·1	−0·2	3·26	*c*
522c	Epney	51 42	2 24	+0130	⊙	⊙	⊙	−9·4	⊙	⊙	⊙	⊙	★
522d	Minsterworth	51 50	2 23	+0140	⊙	⊙	⊙	−10·1	⊙	⊙	⊙	⊙	★
522e	Llanthony	51 51	2 21	+0215	⊙	⊙	⊙	−10·7	⊙	⊙	⊙	⊙	★
523	**PORT OF BRISTOL (AVONMOUTH)** (see page 24)			**0200 and 1400**	**0800 and 2000**	**0300 and 1500**	**0800 and 2000**	**13·2**	**10·0**	**3·5**	**0·9**	6·92	
	River Avon												
523a	Shirehampton	51 29	2 41	0000	0000	+0035	+0010	−0·7	−0·7	−0·8	0·0	⊙	
523b	Sea Mills	51 29	2 39	+0005	+0005	+0105	+0030	−1·4	−1·5	−1·7	−0·1	⊙	
524	Bristol (Cumberland Basin)	51 27	2 37	+0010	+0010	§	§	−2·9	−3·0	§	§	⊙	
524a	Portishead	51 30	2 45	−0002	0000	⊙	⊙	−0·1	−0·1	⊙	⊙	⊙	
525	Clevedon	51 27	2 52	−0010	−0020	−0025	−0015	−0·4	−0·2	+0·2	0·0	6·8	*x*
526	English and Welsh Grounds	51 28	2 59	−0008	−0008	−0030	−0030	−0·5	−0·8	−0·3	0·0	6·5	*ax*
527	Weston-super-Mare	51 21	2 59	−0020	−0030	−0130	−0030	−1·2	−1·0	−0·8	−0·2	6·1	*x*
	River Parrett												
528	Burnham	51 14	3 00	−0020	−0025	−0030	0000	−2·3	−1·9	−1·4	−1·1	⊙	
529	Bridgwater	51 08	3 00	−0015	−0030	+0305	+0455	−8·6	−8·1	§	§	⊙	★
530	Hinkley Point	51 13	3 08	−0020	−0025	−0100	−0040	−1·7	−1·6	+0·1	−0·1	5·0	*x*
531	Watchet	51 11	3 20	−0035	−0050	−0145	−0040	−1·9	−1·5	+0·1	+0·1	5·88	
532	Minehead	51 13	3 28	−0035	−0045	−0100	−0100	−2·6	−1·9	−0·1	0·0	5·71	
533	Porlock Bay	51 13	3 38	−0045	−0055	−0205	−0050	−3·0	−2·2	−0·1	−0·1	5·62	
534	Lynmouth	51 14	3 49	−0055	−0115	⊙	⊙	−3·6	−2·7	⊙	⊙	⊙	
496	**MILFORD HAVEN** (see page 22)			**0100 and 1300**	**0700 and 1900**	**0100 and 1300**	**0700 and 1900**	**7·0**	**5·2**	**2·5**	**0·7**		
535	Ilfracombe	51 13	4 07	−0030	−0015	−0035	−0055	+2·2	+1·7	+0·5	0·0	4·98	
	Rivers Taw and Torridge												
536	Appledore	51 03	4 12	−0020	−0025	+0015	−0045	+0·5	0·0	−0·9	−0·5	3·64	*c*
537	Yelland Marsh	51 04	4 10	−0010	−0015	+0100	−0015	−0·4	−0·9	−1·7	−1·1	2·52	*c*
538	Fremington	51 05	4 07	−0010	−0015	+0030	−0030	−0·5	−1·2	−1·6	+0·1	⊙	★
539	Barnstaple	51 05	4 04	0000	−0015	−0155	−0245	−2·9	−3·8	−2·2	−0·4	⊙	★
540	Bideford	51 01	4 12	−0020	−0025	0000	0000	−1·1	−1·6	−2·5	−0·7	⊙	★
541	Clovelly	51 00	4 24	−0030	−0030	−0020	−0040	+1·3	+1·1	+0·2	+0·2	⊙	
542	Lundy Island	51 10	4 40	−0030	−0030	−0020	−0040	+1·0	+0·7	+0·2	+0·1	4·2	*x*
543	Bude	50 50	4 33	−0040	−0040	−0035	−0045	+0·7	+0·6	⊙	⊙	⊙	
544	Boscastle	50 41	4 42	−0045	−0010	−0110	−0100	+0·3	+0·4	+0·2	+0·2	4·02	

SEASONAL CHANGES IN MEAN LEVEL

No.	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1	July 1	Aug. 1	Sep. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1
475–482	+0·1	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1
482a–512	0·0	0·0	0·0	0·0	0·0	0·0	−0·1	0·0	0·0	0·0	+0·1	+0·1	0·0
513–534	0·0	0·0	0·0	0·0	−0·1	−0·1	0·0	0·0	0·0	0·0	0·0	0·0	0·0
535–544	+0·1	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1

WORKSHEET Q1

(This Worksheet must be returned with your answer book)

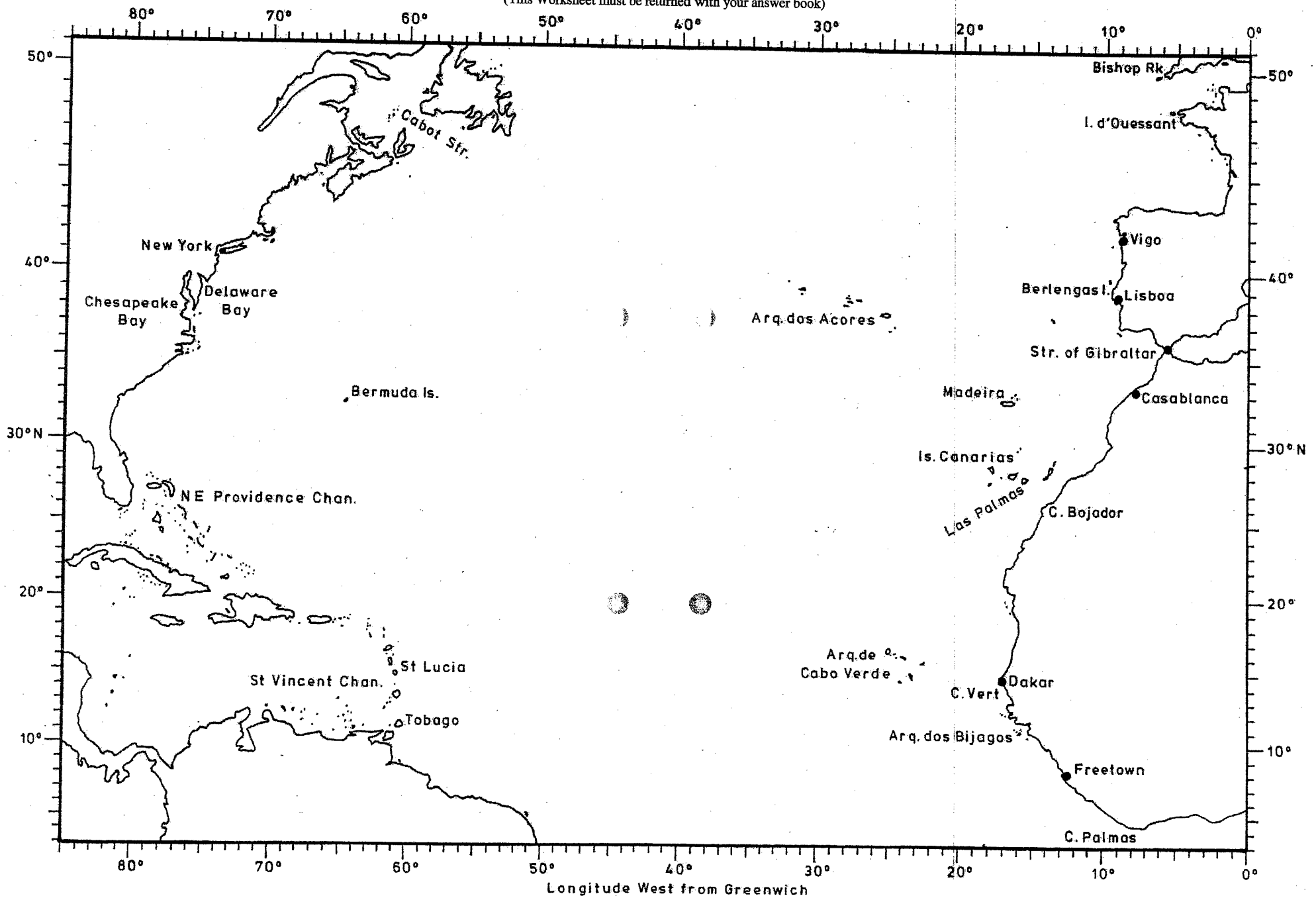


Candidate's Name ....

Examination Cent. .....

March 2009

WORKSHEET Q2(c)(2)
(This Worksheet must be returned with your answer book)

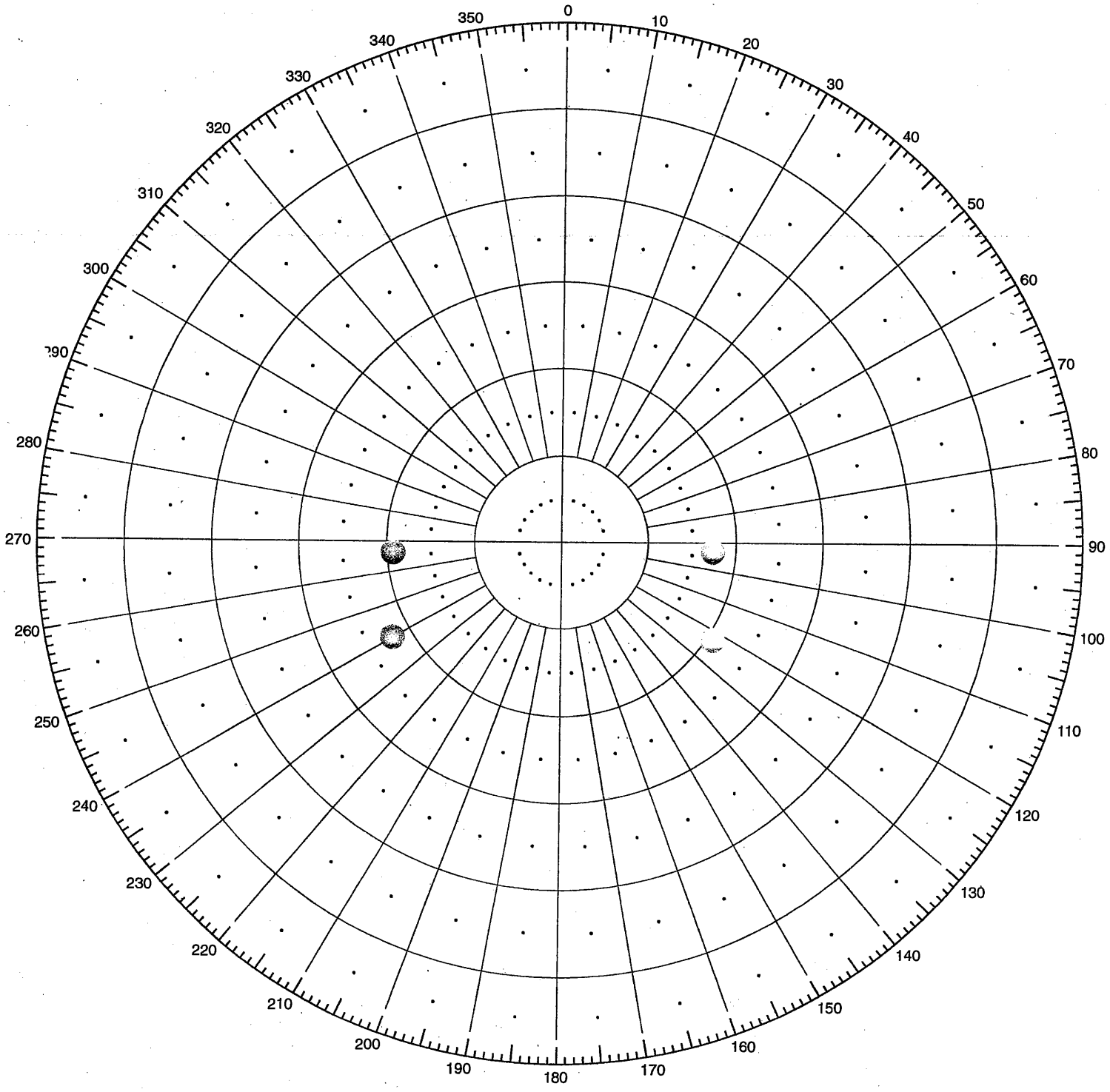


Candidate's Name ..... Examination Centre

March 2009

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



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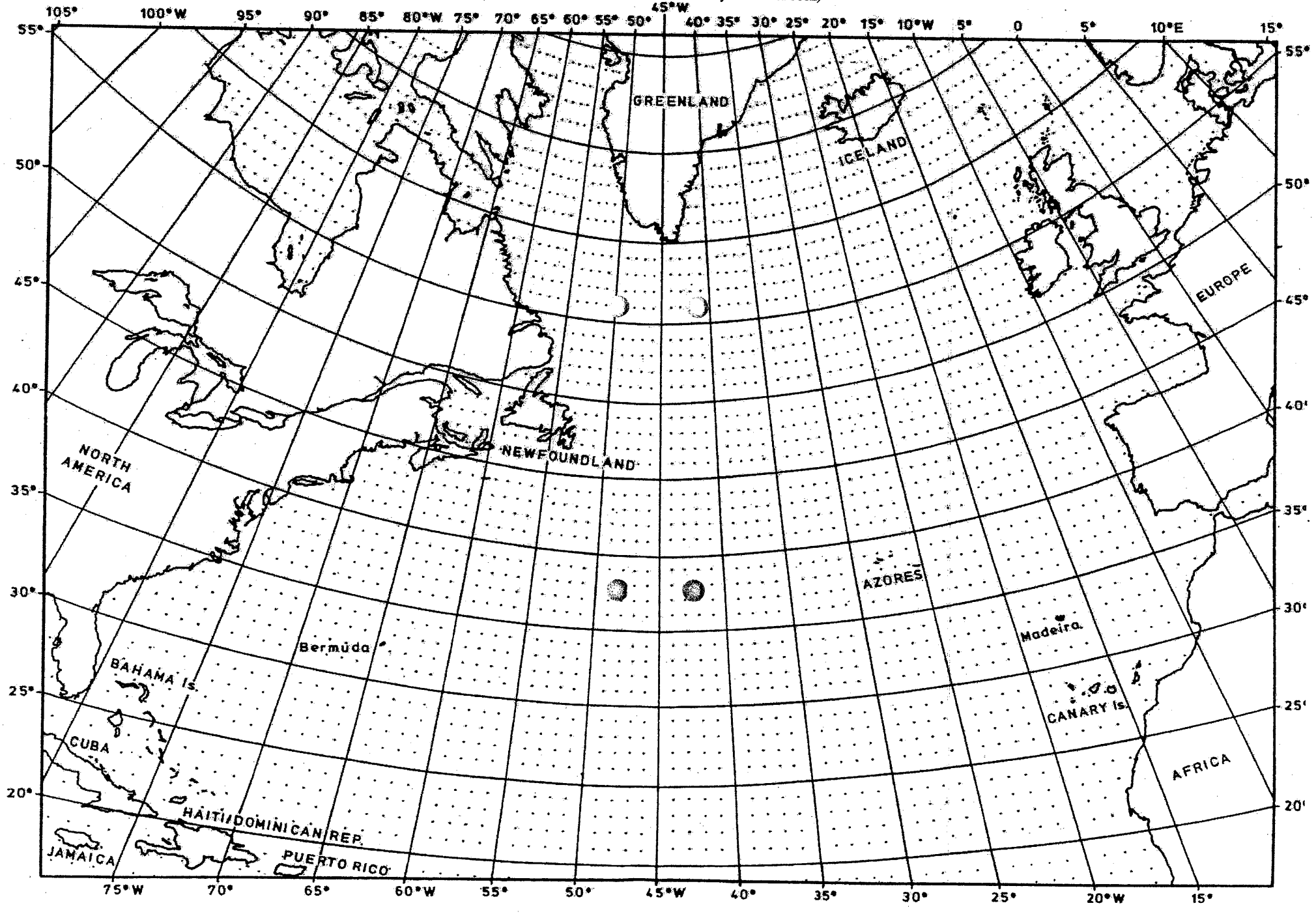
WORKSHEET Q2(c)(1)

(This Worksheet must be returned with your answer book)



March 2009

Candidate's Name

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

MONDAY, 13 JULY 2009

0915 - 1215 hrs

Examination paper inserts:

Radar Plotting Sheet Worksheet Q5

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination answer book	UK and Ireland Tide Tables
Navigation Formulae Datasheet	Pacific and Atlantic Oceans Tide Tables
Nautical Almanac	Graph paper
Nautical Tables	

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a 63,000 GT container ship which is to make a passage from Botany Bay (New South Wales, Australia) to Seattle (Washington State, USA) in early August. The vessel is fitted with all navigational equipment in accordance with statutory requirements.

1. Ocean Passages of the World advises that the vessel should proceed from Botany Bay as for routes from Sydney to Honolulu but when crossing the Equator in longitude 178°50'.0W, take a direct great circle track to the landfall position off the entrance to the Juan de Fuca Strait 48°30'.0N 124°47'.0W.

   (a) Calculate the distance on passage between the position where the vessel crosses the equator and the landfall position. (10)

   (b) Determine the vessel's initial course, on the great circle track on crossing the equator. (10)

   (c) State the position of the Vertex nearest to the landfall position. (6)

   (d) Ocean Passages of the World warns mariners that the above track passes close to a dangerous shoal in position 8°16'.0N 173°26'.0W. Determine the distance off the shoal when the vessel crosses longitude 173°26'.0W, stating whether the vessel will pass North or South. (14)

2. The voyage plan indicates that the vessel will pass off the shoal at 2200hrs on the 8th August. The visibility in the area is clear with only light cloud cover.

The Master instructs the Chief Officer to obtain stars during evening twilight to check the vessel's position with the GPS prior to passing the shoal later in the evening. Sunset is expected at 1802hrs with civil twilight occurring at 1826hrs.

The following results are obtained whilst steering 040°(T) at 23 knots, using a GPS position of 3°30'.0N 173°59'.0W for each sight.

Time	Star	Brg° (T)	True ZD	Calc ZD
1821	Vega	010°	40° 18'.2	40° 22'.1
1825	Arcturus	082°	56° 29'.6	56° 25'.0
1831	Fomalhaut	175°	60° 51'.7	60° 58'.0
1835	Nunki	240°	60° 08'.7	60° 12'.3
1839	Altair	290°	40° 16'.4	40° 20'.1
1844	Alphecca	045°	48° 29'.0	48° 26'.3

(a) Identify, giving reasons, which of the above are best suited to obtain a FIVE star fix of the vessel's position. (10)

(b) The Chief Officer eventually chooses Vega, Altair and Nunki to plot a fix. Determine the vessel's most probable position (MPP) at 1830hrs, assuming there are no random errors. (20)

(c) Comment on the reliability of EACH of the following:

(i) the MPP; (5)

(ii) the GPS position. (5)

3. Tropical Revolving Storms (TRS) are common in the North Pacific Ocean in the late summer months especially from August to October.

(a) Describe the warning signs of an approaching TRS. (10)

(b) For a vessel, within the storm field of a TRS, in the Northern Hemisphere:

(i) explain how onboard observations can be used to determine the vessel's position relative to the storms track; (10)

(ii) outline the actions a prudent master should take to avoid the worst of the storm. (15)

4. Vessels engaged on passages between Australia and the west coast of the USA often have to pass through groups of islands where accurate navigation is essential.

Discuss the availability, accuracy and sources of error in EACH of the following:

(a) Celestial Observations; (10)

(b) Global Satellite Navigation System (GSNS); (15)

(c) Radar. (15)

5. On the approach to Port Angeles Pilot Station the vessel is proceeding in the appropriate lane of the Juan De Fuca Traffic Separation Scheme, steering 100°(T) at a speed of 12 knots. Visibility is estimated to be one nautical mile.

At 1220hrs the Officer of the Watch completes a 20 min radar plot as indicated on Worksheet Q5. Target A is known to be a beacon in the middle of the 2 mile wide traffic separation zone.

(a) Prepare a full report and analysis for targets B, C and D. (21)

(b) Determine the set and rate of any tidal stream affecting the vessel. (4)

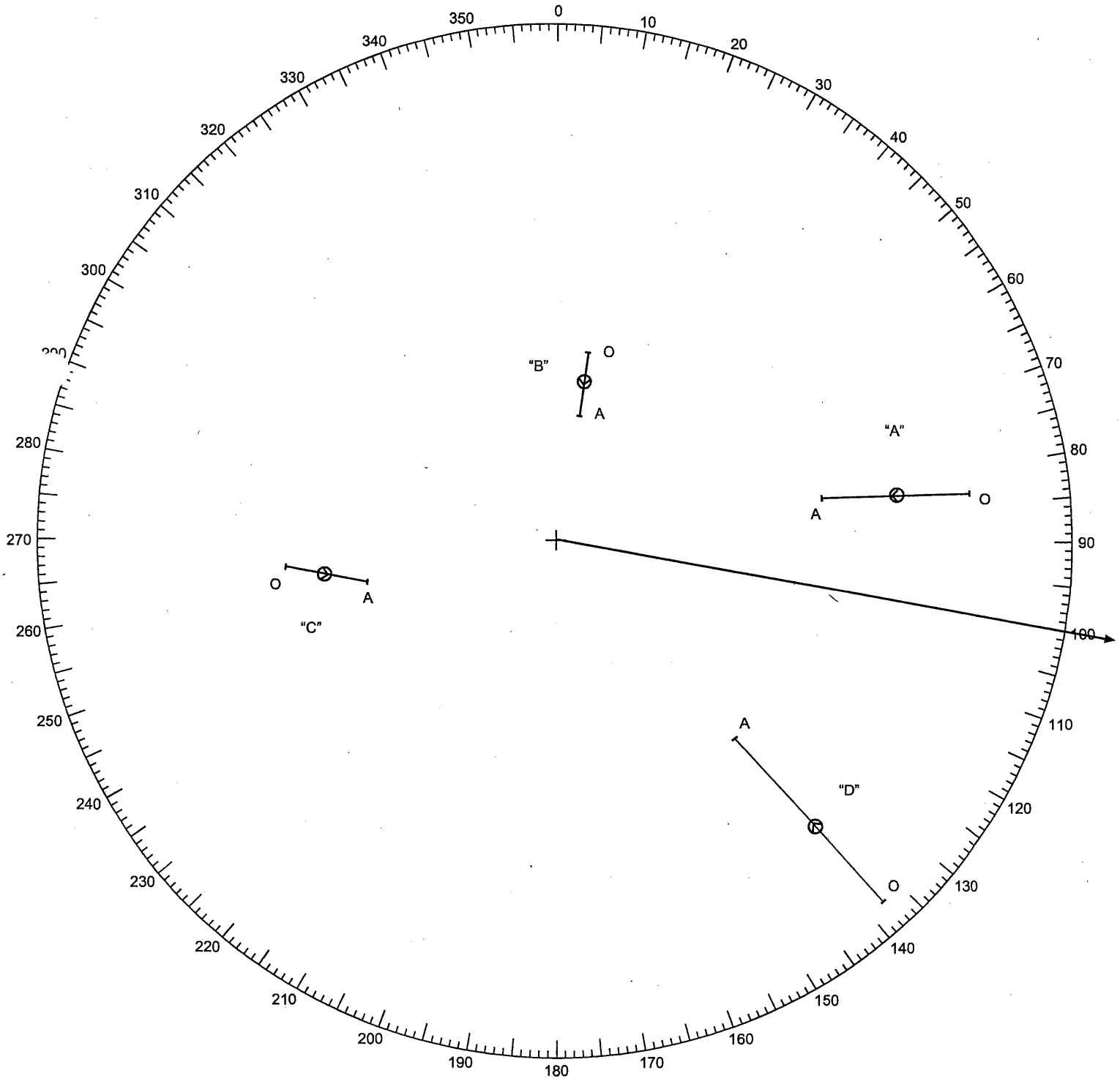
(c) Determine the reduction in speed required at 1224hrs to ensure target D passes the vessel with a CPA of 2 miles. (4)

(d) Assuming the reduction has an instantaneous effect, determine the new CPA for targets A, B and C. (6)

(e) With respect to target A, state, giving reasons, what action the vessel should take once target D has passed its CPA. (10)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



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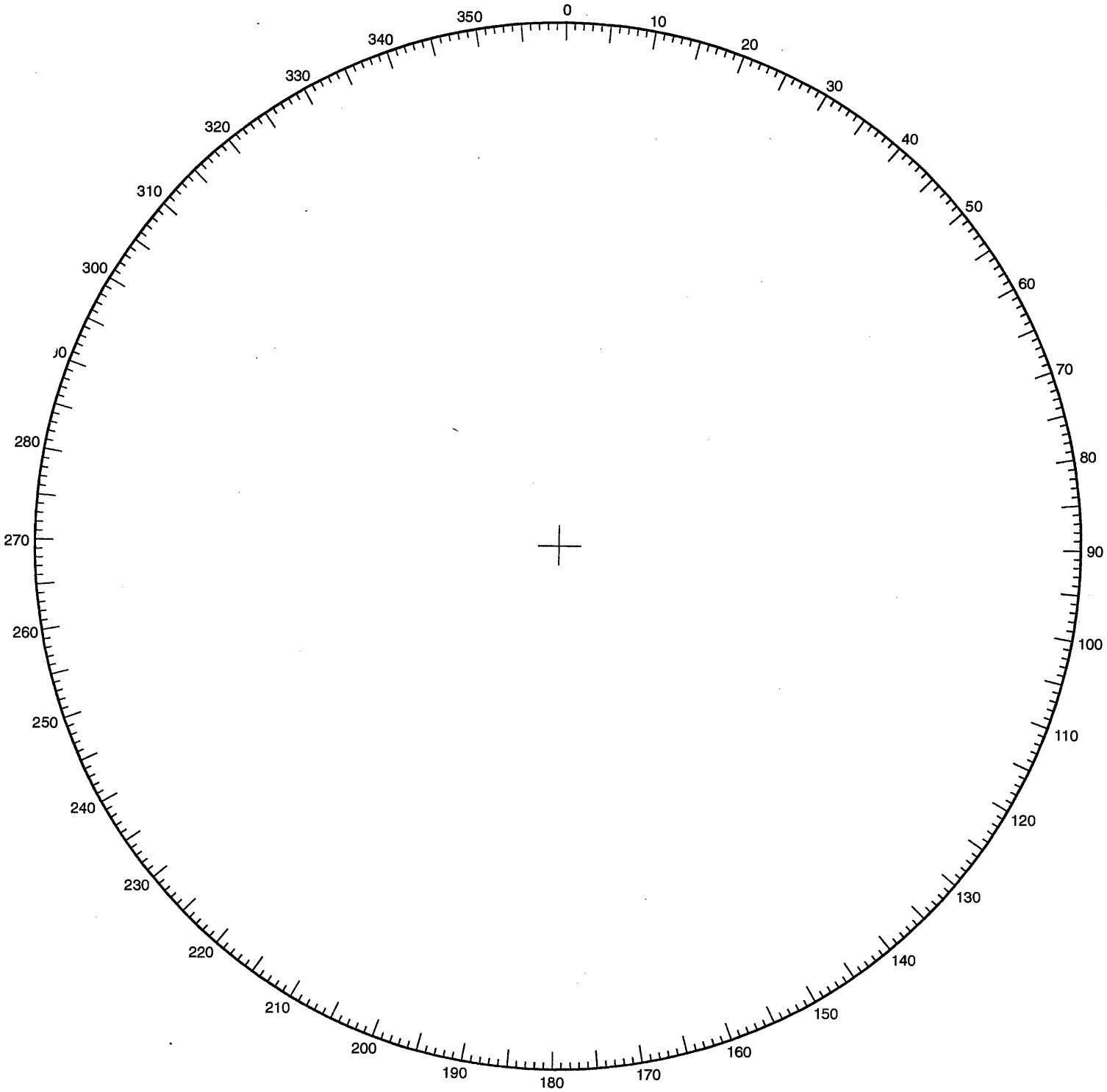
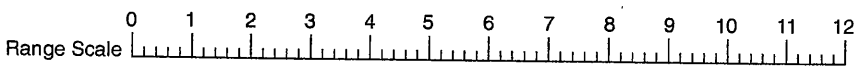
Signature of Candidate .....

Examination Centre .....

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET





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Signature of Candidate .....

Examination Centre .....

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

TUESDAY, 24 NOVEMBER 2009

0915 - 1215 hrs

Examination paper inserts:

Radar Plotting Sheet Datasheets Q1(1) and Q1(2) Worksheet Q2

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination answer book	UK and Ireland Tide Tables
Navigation Formulae Datasheet	Pacific and Atlantic Oceans Tide Tables
Nautical Almanac	Graph paper
Nautical Tables	

Nov '09

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to an 88,000 GT bulk carrier which has been chartered to carry coal between South Africa and Australia. The vessel is presently in Durban (S.Africa) and due to complete cargo operations and sail for Adelaide (South Australia) on the 18th January. Service speed is 15.8 knots.

1. With reference to Datasheets Q1(1) and Q1(2):

   (a) outline the main factors that the master should take into account when appraising passages between South Africa and Australia; (10)

   (b) the master decides to follow the recommended route; calculate the total distance on passage between the following departure and landfall positions. (22)

   Departure Position 29°51'.0S 31°06'.0E
   Landfall Position 34°48'.0S 138°23'.0E

   (c) if the vessel departs at 0400hrs (ST) on the 18th January, calculate the ETA at the landfall position assuming Standard Time for the destination is being kept on arrival. (8)

2. At 0630hrs the Master receives a request from the South African Maritime Rescue Co-ordination Centre (MRCC) to assist in a search for an overdue fishing vessel. Currently there are four vessels on scene engaged in a parallel track search pattern, some 60 miles SE of the vessel's present position.

   (a) Describe the preparations that should be made on the bridge whilst en route to the search area. (15)

   (b) Outline the factors that must be taken into account when selecting a search pattern for SAR operations at sea. (10)

   (c) On arrival in the area visibility is poor and radio communication is made with the On Scene Coordinator (OSC).

   At 1030hrs own vessel is identified on radar, bearing 306°(T) at a distance of 10 miles from the OSC. The OSC is currently steering 100°(T) at 8.0 knots with the three assisting vessels on his port beam.

   The OSC requests that own vessel takes up station 4 miles on his starboard beam.

   On Worksheet Q2, determine the course to steer and the ETA on station if own vessel proceeds at a speed of 15 knots. (15)

[OVER

3. Vessels engaged on passages across the Southern Indian Ocean may encounter icebergs at any time of year.

(a) Describe the sources and type of information that are available to the Master regarding icebergs. (10)

(b) Outline the factors that should be considered by a prudent Master when determining the risks involved in encountering dangerous ice. (20)

(c) Outline the reporting procedure that is to be followed by the Master on encountering dangerous ice. (8)

4. Bad weather and poor visibility are common on Southern Ocean passages. After several days with very poor visibility the Office of the Watch manages to obtain two observations of the SUN's lower limb on the 26th March.

At 1532hrs the following observation was obtained.

GPS Position	39°07'.0S 95°16'.0E
Chronometer read	9h 26m 26s
Chronometer error	1m 54s Fast on UT
Sextant Altitude	24°44'.8 (SUN's Lower Limb)
Index Error	3'.4 on the arc
Height of eye	21.4m

(a) Determine EACH of the following:

(i) the direction of the position line; (15)

(ii) the intercept. (15)

(b) A forenoon sight taken at 1020hrs gave an intercept of 3'.2 Away on a bearing of 025°(T) using a DR position of 39°07'.0S 93°36'.0E.
The vessel was steering 090°(T) at 14 knots throughout the period.

Determine the observed position of the vessel at 1532hrs, using the information from both sights. (20)

5. (a) State the appropriate manning levels on the bridge, outlining the duties of EACH member of the bridge team, for EACH of the following situations, in clear weather:

(i) navigation in a Traffic Separation Scheme with dense traffic; (15)

(ii) navigation during darkness on a ocean passage. (5)

(b) Describe the content of the Masters Night Orders. (12)

Passage between South Africa and Australia

6.153

Between the South-east Trade Winds and the Roaring Forties, there is a zone of light variable winds lying with its axis in about 35° S in the S summer and 30° S in the S winter.

The Southern Ocean Current, with a mean rate of ½ knot or less, has an indefinite N boundary in the South Indian Ocean, but E-going sets predominate as far N as 30° S, or the S limit of the South-east Trade Wind.

The rhumb line between Cape Agulhas and Cape Leeuwin coincides with the parallel of 35° S, and is 4711 miles in length. The corresponding great circle is only 4501 miles in length, but its vertex is in about 45° S, in the storm-ridden waters of the Roaring Forties. Great circles to places farther along the S coast of Australia pass even farther S, increasing the probability of encountering ice bergs, and approaching the limit of pack ice (6.42).

It is therefore evident that any attempt to shorten a voyage by great circle sailing between the two continents is likely, except on the most N tracks, to put a vessel at risk of delay due to the weather, and in the case of W-bound voyages, due to stronger adverse currents, with an additional risk that pack ice may be encountered.

Consequently, E-bound routes to the S and W coasts of Australia usually comprise a composite route with a limiting latitude of 40° S in summer and 35° 30′ S, in winter.

W-bound routes, to avoid the head winds and adverse currents of the direct routes, keep well to the N. From the S and W coasts of Australia they pass in all seasons through or N of 30° S, 100° E. If bound Cape Agulhas in the S summer, the route continues from 30° S, 100° E by great circle to join the parallel of 35° S in 65° E, which it follows to a landfall on Cape Saint Francis: in the S winter it follows the parallel of 30° S to the African coast off Durban before turning S to continue coastwise as at 6.56.

Voyages between South Africa and the NW and W coasts of Australia are little affected by the foregoing considerations. However, in view of the possibility of encountering hurricanes off the NW coast of Australia, the routes for Darwin and the Arafura Sea from October to April keep away from the coast and pass close S of Roti and Timor.

For restrictions on tankers, other than those in ballast carrying only residual cargo, navigating off the coast of South Africa, see Admiralty Sailing Directions.

Cape Town → North-west and North coasts of Australia—October to April

6.154

Diagrams (6.150) and (6.122)

For Torres Strait. The route is:

Across the Agulhas Current to 36° 45′ S, 19° 00′ E, 145 miles S of Cape of Good Hope, thence:
Rhumb line to 39° S, 45° E, thence:
Great circle to 11° 30′ S, 118° 00′ E, to avoid the possibility of hurricanes, thence:
Continuing by the Ocean Route (6.122.2) through Timor and Arafura Seas.

6.154.1

For Darwin. The route is that for Torres Strait as far as 11° 30′ S, 118° 00′ E, thence through either Osborn Passage or North Sahul Passage.

6.154.2

For destinations between Darwin and Yampi Sound. The route is that for Torres Strait as far as 39° S, 45° E, thence:

Great circle to 35° 30′ S, 80° 00′ E, thence:
Great circle to 15° 30′ S, 120° 00′ E, thence:
Joining the recommended track (6.121) S of Browse Islet, thence to destination.

6.154.3

For destinations West of Yampi Sound. The route is that for destinations between Darwin and Yampi Sound as far as the meridian of 115° E, thence as direct as navigation permits to destination.

Cape Town → North-west and North coasts of Australia—May to September

6.154.4

For Torres Strait, Darwin and other destinations East of Yampi Sound. The route, in spite of the adverse Agulhas Current, is:

Along the parallel of 35° 30′ S as far as 80° E, thence:
Great circle to 15° 30′ S, 120° 00′ E, thence:
Joining the recommended track (6.121) S of Browse Islet.

6.154.5

For destinations West of Yampi Sound. The route is that for destinations E of Yampi Sound as far as 35° 30′ S, 80° 00′ E, thence: great circle to 19° S, 115° E, thence as direct as navigation permits to destination.

6.154.6

Distances in miles from Cape Town:

	Oct–April	*May–Sept*
Torres Strait	7050(a′)	6880(G)
Darwin: via North Sahul Passage	6410(a′)	—
via coastal route	*6370(a′)	**6200(G)
Port Hedland	5430(a′)	5400(G)

* Via Osborn Passage. ** Via Browse Islet.

(a′) For distance from Cape of Good Hope (145 miles S of), subtract 180 miles.

(G) For distance from Cape Agulhas (15 miles S of), subtract 130 miles.

Durban → North-west and North coasts of Australia

6.155

Diagrams (6.151) and (6.122)

For Torres Strait and Darwin, from October to April routes are by great circle to 11° 30′ S, 118° 00′ E, thence as at 6.154 or 6.154.1.

6.155.1

May to September routes are by great circle to 15° 30′ S, 120° 00′ E, thence joining the recommended track (6.121) S of Browse Islet.

6.155.2

For destinations between Darwin and Yampi Sound. Routes at all seasons are by great circle to 15° 30′ S, 120° 00′ E, thence as at 6.154.2 to destination.

6.155.3

For destinations West of Yampi Sound. Routes at all seasons are by great circle to 19° S, 115° E, thence as direct as navigation permits to destination.

6.155.4

Distances in miles from Durban:

	Oct–April	*May–Sept*
Torres Strait	6350	6250
Darwin: via North Sahul Passage	5720	—
via coastal route	*5670	**5570
Port Hedland	4770	4770

* Via Osborn Passage, ** Via Browse Islet.

North-west and North coasts of Australia → Durban or Cape Town—October to April

6.156

Diagrams: (6.122) and (6.151) for Durban or (6.150) for Cape Town

From Torres Strait. The route follows the Ocean Route at 6.122.2 to 11° 30′ S, 118° 00′ E, thence:
Either, great circle to Durban:
Or, great circle to 35° S, 65° E, thence:
Rhumb line to a landfall on Cape Recife, thence:
Coastwise as at 6.56 to Cape Town.

6.156.1

From Darwin. The route is through North Sahul Passage to join the route from Torres Strait SE of Timor.

6.165.2

From places between Darwin and Yampi Sound. Routes are by the recommended tracks (6.121) to 15° 30′ S, 120° 00′ E, thence either great circle direct to Durban or great circle to join the route from Torres Strait to Cape Town in 35° S, 65° E.

6.156.3

From places West of Yampi Sound. The route is as direct as navigation permits to 20° S, 115° E, off Monte Bello Islands, thence either great circle to Durban or great circle to join the route from Torres Strait to Cape Town in 35° S, 65° E.

North-west and north coasts of Australia → Durban and Cape Town—May to September

6.156.4

From Yampi Sound and all places farther East. Routes are by the recommended tracks (6.121) to 15° 30′ S, 120° 00′ E, thence great circle to 30° 00′ S, 56° 30′ E, thence along the parallel of 30° S to Durban, or continuing thence for Cape Town as at 6.56.

6.156.5

From places West of Yampi Sound. Routes are as direct as navigation permits to 20° S, 115° E, thence great circle to join the route from ports N of Yampi Sound in 30° 00′ S, 56° 30′ E.

6.156.6

Distances in miles:

		Durban	*Cape Town (G)*
Torres Strait	Oct–April	6350	7000
	May–Sept	6260	7050
Darwin	Oct–April	5710	6370
	May–Sept	5580	6370
Port Hedland	Oct–April	4730	5360
	May–Sept	4750	5540

(G) For distances to Cape Agulhas (15 miles S of), subtract 130 miles.

Cape Town → West and South coasts of Australia—October to April

6.157

Diagram (6.157)

Routes are across the Agulhas Current to 36° 45′ S, 19° 00′ E, 145 miles S of Cape of Good Hope, thence:
Rhumb line to 40° S, 55° E, thence:
Along the parallel of 40° S.

For Fremantle the route continues by great circle from 40° S, 77° E.

For Adelaide and Melbourne routes continue by great circle from 40° S, 100° E.

For Hobart the route continues by great circle from 40° S, 100° E to 41° 30′ S, 122° 50′ E, on the route to Melbourne, thence great circle to South West Cape, Tasmania, thence as navigation permits to Hobart.

6.157.1

Shorter but more boisterous routes are:
Through 36° 45′ S, 19° 00′ E, thence:
Rhumb line to 44° S, 40° E, thence:
Rhumb line to 45° S, 65° E, thence:
Along the parallell of 45° S.

For Fremantle the route is by great circle from 45° S 65° E.

For Adelaide the route leaves the parallel of 45° S in 92° 26′ E and follows the great circle to Investigator Strait.

For Melbourne the route leaves the parallel of 45° S in 107° 20′ E and follows the great circle to Cape Otway, thence as direct as navigation permits.

For Hobart the route continues along the parallel of 45° S to 130° E, thence by great circle to destination.

Cape Town → West and South coasts of Australia—May to September

6.157.2

To avoid the probability of foul weather farther S, routes are:
Through 35° 30′ S, 20° 00′ E, thence:
Along the parallel of 35° 30′ S, which, if strictly followed, passes close under West Cape Howe to Investigator Strait which leads to Adelaide.

For Fremantle, the route is by great circle leaving the parallel of 35° 30′ S in 90° E.

For ports East of Adelaide, routes are by great circle leaving the paralle of 35° 30′ S in 115° 00′ E, S of Cape Leeuwin.

6.157.3

The possibility of encountering icebergs on these routes at any time of the year cannot be discounted, see 6.43.

6.157.4

Distances in miles.

Cape Town to:	*Oct–April* (a′) (6.157)	(6.157.1)	*May–Sept(G)* (6.157.2)
Fremantle	4840	4790	4870
Adelaide	5820	5660	5950
Port Phillip for Melbourne*	6030	5820	6230
Hobart	6150	5870	6400

* Port Phillip to Melbourne: 40 miles.

(a′) For distance from Cape of Good Hope (145 miles S of), subtract 180 miles.

(G) For distances from Cape Agulhas (15 miles S of), subtract 130 miles.

Durban → West and South coasts of Australia

6.158

Diagram (6.157)

October to April, routes join those at 6.157 from Cape Town, by great circle from Durban to 40° S, 77° E.

6.158.1

May to September, routes join those from Cape Town by great circle from Durban to 35° 30′ S, 67° 30′ E.

6.158.2

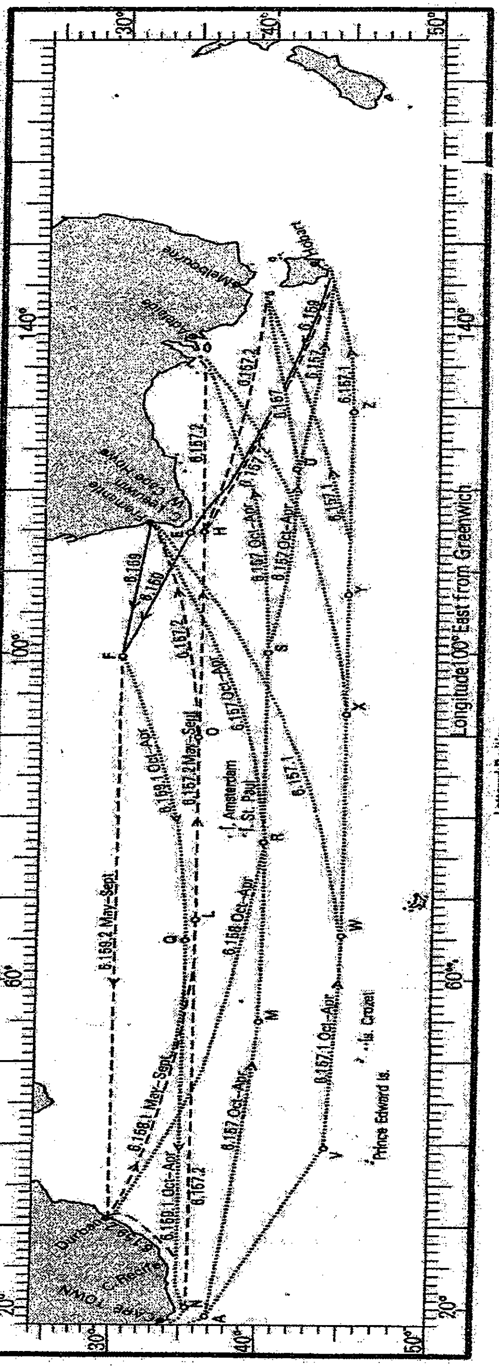
Distances in miles.

Durban to:	*Oct–April*	*May–Sept*
Fremantle	4250	4270
Adelaide	5230	5350
Port Phillip for Melbourne*	5440	5630
Hobart	5560	5800

* Port Phillip to Melbourne: 40 miles.

INDIAN OCEAN

(6.157) ROUTES—Cape Town and Durban ⟷ South Australia.



Lettered Positions

A	36°45'S, 19°00'E	L	36°30'S, 67°00'E	R	40°00'S, 77°00'E	X	45°00'S, 92°20'E
E	34°37'S, 115°08'E	M	40°00'S, 55°00'E	S	40°00'S, 100°00'E	Y	45°00'S, 107°20'E
F	30°00'S, 100°00'E	N	35°30'S, 20°00'E	U	41°30'S, 122°50'E	Z	45°00'S, 130°00'E
H	36°30'S, 115°00'E	O	36°30'S, 90°00'E	V	44°00'S, 40°00'E		
J	47°50'S, 167°50'E	Q	35°00'S, 65°00'E	W	45°00'S, 65°00'E		

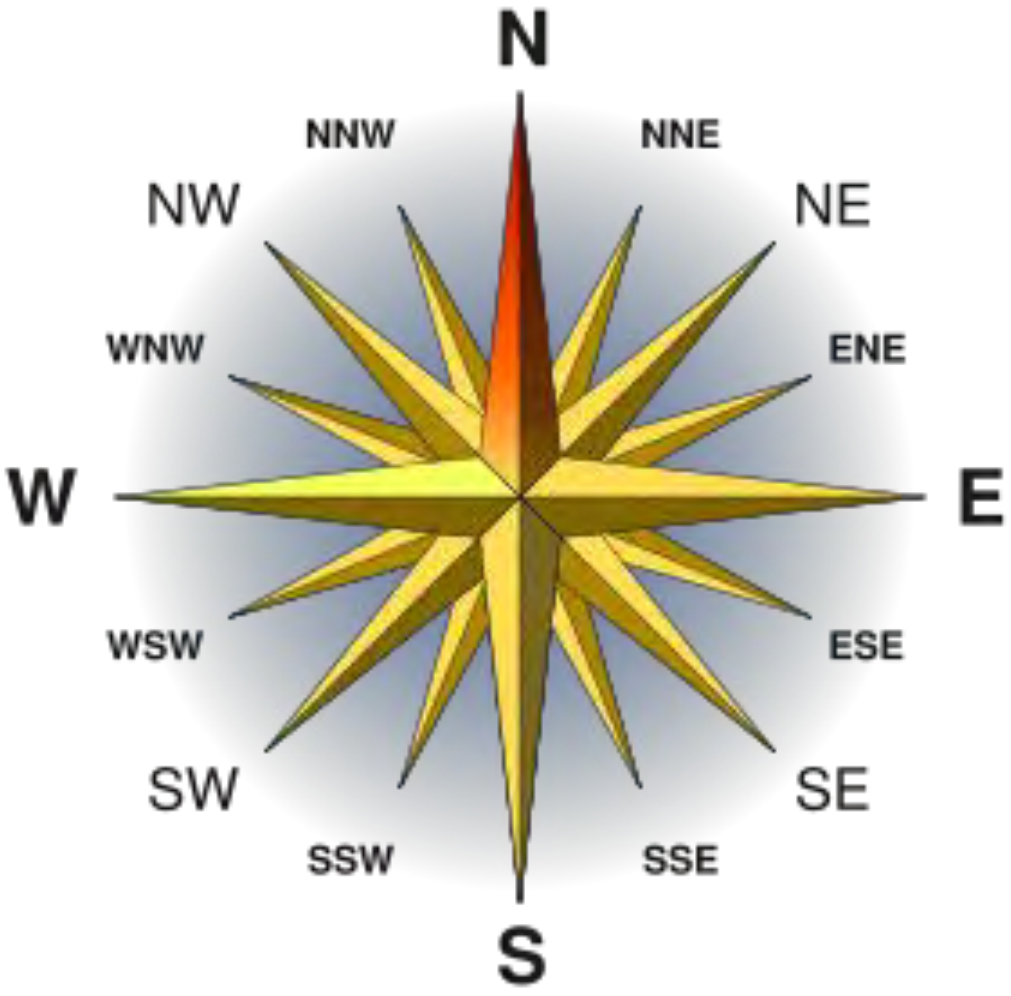
Paper	Q.	Answer
Mar '05	**1**	(a) 3204nm, (b) 092.5°T, (c)26° 55.6'S 158° 46.3'E (d) 19.4'N
	3	(a) 61°33.2'N, 038° 54.3'W
July '05	**1**	(c) (i)Approx 51° 06'S 095° 00'E (ii) 42°S and approx. 83° E and 119° E. (d) 5452 nm, (e) ETA Jan 1st 2344 ST.
	4	(a)&(b) PL 002.6°/182.6°T through 41° 23.3'S 132° 28.3'E (c) Deviation 4° W
Nov '05	**1**	ETA Colombo May 27d 16h 50m ST
	3	(a) 351°T, (b) ETA 1345, (c) Brg 016°T
Mar '06	**1**	1529.2 + 529.8 + 1762.2 = 3821nm
	2	Latest time 9th April @ 0844hrs
	5	(b) A/C @ 1028 to178°T (d) B @ 1040 = CPA 0.3nm, TCPA 1121, BCPA 008°T
July '06	**2**	(a) 6253, (b) 42° 26'S, 136° 26.6'W, (c) 35.1nm
	3	(a) 21st March 2122hrs, (b) 3rd April 1848hrs
	5	(c) Reduce to 4.6 kts to maintain a minimum of 2.0 nm CPA with all targets.
Nov '06	**1**	(a) 3426.2nm, (b) S 71.5° E, (c) 38° 4.7'S, 49° 26.2'E
Mar '07	**1**	(b) (i) 4704nm, (ii) 4283 nm, (iii) 19th June 0956 ST
	2	(a) 10th June 1933 GMT, (b) 50° 20'S 174° 33.9'W (c) S 63.0° E / 15.1 kts
	4	(c) 6.8°W
July '07	**1**	(b) (i) 4778, (ii) 270°T, (c) **15.4'** North of shoal
	3	10° 17'.4 S 057°45'.3 E
	4	(b) A/C 320°T
Nov '07	**4**	(c) Reduce speed to 5 kts
	5	0400 hrs UT
Mar '08	**1**	(a) 6372.5nm (b) 29th Sept 05 50 ST
	3	(a) 17th 1948 UTC (b) 35° 39'.5 N 149° 17.47' E (c) 005°T x 12.65k
	5	(b) 2kts astern
July '08	**1**	(b) 2138.5nm (c) ETA = 11th 2115 GMT or 12th 0015 ST
	2	(a) (i) A = 262°T C = 322°T D = 305°T (ii) A = 9.5k C = 9.5k D= 14.4k (iii) A = R81° C =G86° D =R3° (b) 050° x 2.0k (d) i) A/C to starboard by 28° to 326°T(ii) A =1.2 B =1.0 C=1.9 D=1.1
	3	(a) Sunrise : 24th June at 0424 UT (b) 38° 08'.1 N 3° 27.4' E (c) 202.4°T 12.6 knots
Nov '08	**1**	(a) 1748.8nm (b) 278.8°T (c) 59°7.6' N 015°16.8'W (d) 25th 1011 ST
	3	(a) 0.9° – 1.1° W (b) 3.3°E - 3½°E

Mar '09	**1**	(a) 6.2 m. (b) 8th 1626.
	2	(a) GC Dist = 3449.9 nm, R/L Dist = 3519.7nm. (b) GC steaming time 181.1 hrs, R/L steaming time 180.5 hrs. GC route is 0.6 hrs longer.
July '09	**1**	(a) Dist = 4026.4 (b) Initial Course 035.6° (c) Vertex Lat 54° 23.4N Long 88° 50 0 W (d) 46.9' South of Island.
	2	(b) MPP Lat 3° 29.4 N Long 173° 56.7 W
	5	(a) Target B 120° 13.2 0.1 1257 G 78° Target C 100° 18 1.8 1302 R 23° Target D 009° 9 0 1244 R 53° (b) Set 324° T 3 Knots (c) Reduce to 5 knots (d) Target A = 1.1 Target B = 2.2 Target C = 1.8 Target D = 2.0
Nov '09	**1**	b) 5210.1nm c) 1st Feb 0515 ST
	2	CTS 121.5°T ETA 1200hrs
	4	a) i) 25.5°/205.5°T ii) 4.6nm (A) b) 39°13.7S 95°18.4E

Chief Mate

SQA Navigation Past Papers

March 2010 to March 2015



Use Nautical Almanac NA 0000 (same as 1977)

	Mar-10	Jul-10	Nov-10	Mar-11	Jul-11	Nov-11	Mar-12	Jul-12	Dec-12	Mar-13	Jul-13	Nov-13	Mar-14	Jul-14	Nov-14
Sailing calculation only				X	X		X		X						
Sailing calc. with Data sheets	X		X					X			X	X	X	X	
Sailing with Plotting			X			X							X		
Fuel Burn Sailing		X								X					X
Radar Plotting		X		X		X	X	X	X				X		
Rdzvs - Dble Approx.			X		X										
Rdzvs - Plotting										X	X				
Tide - UK								X							
Tide - Pacific	X		X			X									
Tidal Stream										X			X		
Celestial		X		X	X	X			X	X		X		X	X
Parallel Indexing															
MGN/MSN												X			
ICE									X				X		
TRS	X	X			X				X		X			X	X
Position Fixing					X										X
IMO Routeing							X	X				X	X		
Weather Routeing						X									
Routing Charts									X		X				
UKC															
Pilotage/Manoeuvering					X					X					
BPG			X							X					
Manning/ Fatigue							X	X					X		
Watchkeeping			X		X					X					
Standing Orders							X		X		X		X	X	
Meteorology			X						X			X		X	
Co Tidal/Co Range															
Publications	X			X								X			
Passage Planning		X		X			X	X							
Obligatory Reports										X	X				
SAR															
Emergency															
AMVER	X														
Navtex															X
AIS															

16 MARCH 2010

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to a 6800 GT refrigerated cargo vessel chartered to carry fruit between ports in the southern and western Caribbean Sea and the East coast of the USA. The vessel has been laid up in the port of Falmouth (UK) and is to proceed to New York to load agricultural equipment for discharge in Caracas (Venezuela). The vessel's service speed is 22 knots and summer draft is 6.8 metres.

1. Vessels are required to ensure that navigational charts and publications are corrected up to date prior to commencing a passage. This is usually done by using weekly Admiralty Notices to Mariners and chart tracings.

   Vessels are also required to ensure that all relevant radio navigational warnings are taken into account when received.

   (a) Describe the context and content of EACH of the following:

   (i) Admiralty Weekly Notices to Mariners; (8)
   (ii) Navarea warnings; (12)
   (iii) Coastal warnings. (8)

   (b) Vessels are required to carry charts and publications sufficient to allow planning of the ships intended voyage.
   State the publications required, for the vessel in question. (12)

2. The vessel is due to depart Falmouth, in ballast, on the 4th February.
   The owners have asked the Master to compare the distances between Bishop Rock and New York via the following routes:

   - The recommended route as per Datasheet Q2(1) and Q2(2)
   - The direct rhumbline route

   The following departure and landfall positions should be used.

   Departure Position 49°47'.0N 6°27'.0W (5 miles South of Bishop Rock)
   Landfall Position ~~48~~ 40°20'.0N 73°50'.0W (Approaches to New York)

   (a) Calculate the difference in distance between the two routes. (20)

   (b) Explain why the recommended route is preferred to the rhumb line track. (10)

   (c) Explain how a Gnomonic chart can be used in conjunction with a Mercator chart when planning a great circle passage. (15)

[OVER

3: En route the vessel is diverted to Boston USA.

The Master is advised that the vessel will berth in Bangor (ATT Pacific and Atlantic extracts No 2833). On consulting the chart it is found that the vessel will have to pass under a bridge (charted height 22m above MHWS) to reach the berth. The anticipated draught on arrival is 5.3m. The top of the main mast is 28.6m above the keel. The charted depth below the bridge is 6.8m. The Master requires a minimum clearance under the bridge of 2.0m.

If the vessel is due to pass under the bridge during the AM ebb tide on the 17th March, determine EACH of the following:

(a) the maximum height of tide permissible to safely pass under the bridge; (10)

(b) using Worksheet Q3, the earliest time the vessel can pass under the bridge; (20)

(c) the underkeel clearance at that time. (5)

4 At 1200UT on the 22nd September the vessel is in position 41°N 70°W on passage from Boston to Havana, Cuba.

The Master has been monitoring Tropical Storm Mike which has been developing in the Atlantic Ocean some 700 miles to the East of the Leeward Islands. The position of the storm over the previous 24 hours is given below.

211200UT	19.1°N 50.2°W
221200UT	20.2°N 56.5°W

The latest advisory from the National Hurricane Centre in Miami is for the storm to maintain its current track of 285°(T) at 16 knots, and expect the storm to reach hurricane strength over the next 24hrs. Gales force winds are expected to extend up to 120 miles from the centre.

(a) Describe the preparations that should be made when a vessel is due to encounter heavy weather. (15)

(b) The vessel is currently heading for a position due East of Miami on the meridian of 80°W at 20 knots.

(i) On Worksheet Q4, plot the positions and future tracks of both the vessel and the storm at 221200UT and for the following 48 hours. (6)

(ii) Comment on the advisability of the vessel's planned track given the advisory from NHC Miami. (9)

(iii) At 231200UT the Chief Engineer advises the Master that the vessel will have to stop for 12 hours to effect temporary repairs to one of the main engine bearings. He also advises that the vessel will have to proceed at 10 knots for a further 12 hours after repairs have been completed.

In light of the Chief Engineers advice, what options are open to the Master at 231200UT. (15)

5. Vessels trading between the East coast of the USA and ports in the Caribbean encounter numerous navigational hazards when approaching and navigating through the Caribbean sea.

(a) With reference to Datasheet Q5(a), outline the main navigational hazards to be considered when passage planning in these waters. (20)

(b) Vessels transiting the waters are encouraged to take part in the AMVER programme. Describe the various types of AMVER reports to be made. (15)

ROUTES BETWEEN CABOT STRAIT OR NORTH AMERICAN PORTS AND EUROPE

References

2.62

Traffic Separation Schemes, see 1.28.
Weather Routeing, see 1.24.
Ice, see 2.25–2.28.
Western approaches to the English Channel, see 2.31.
Île d'Ouessant, 2.32.
Bay of Biscay and W coasts of Spain and Portugal, see 2.33.
Strait of Gibraltar, see 2.34.
Newfoundland coasts, see 2.36.
Grand Banks of Newfoundland, see 2.37.
Distances, see 2.67.

Routes between North American ports and Departure Positions

2.62.1

Diagram (2.63)

Recommended routes between Cabot Strait, Halifax or the N part of the E coast of the United States and Europe skirt the S side of the Grand Banks, passing through, or S of, Position BS, 42° 30′ N, 50° 00′ W, to avoid the hazards of crossing the Grand Banks (2.37).

There are alternative routes to or from Biscay ports and places farther N, passing 20 miles S of Cape Race. They are usable between May and November.

In recommending routes to and from ports SW of Cape Race, account must be taken of the seasonal movement of ice in the Grand Banks area (2.27.4). It can never be assumed that a particular route will be clear of ice; constant study of ice reports, and the utmost vigilance at sea, are essential.

2.62.2

From Cabot Strait, routes from the Traffic Separation Scheme (1.28) are either S of the Grand Banks to Position BS, or along the S coast of Newfoundland to Cape Race.

2.62.3

From Halifax, routes are either through 43° 00′ N, 60° 00′ W (50 miles S of Sable Island) to Position BS, or direct to Cape Race.

2.62.4

From Boston, routes are direct to either Position BS or Cape Race.

2.62.5

From places between Boston and Chesapeake Bay, routes are either direct to Position BS, or to 43° 00′ N, 60° 00′ W and thence to Cape Race. Routes from New York and its vicinity pass S of Nantucket Lanby.

From Chesapeake Bay to Strait of Gibraltar, the route is by great circle to Cabo de São Vicente, passing S of Position BS, thence as navigation permits.

Position BS ↔ Europe

2.63

Diagrams (2.63), (2.48)

To Nordkapp. Great circle to 57° 50′ N, 18° 00′ W, thence great circle to 70° 45′ N, 20° 30′ W, thence as navigation permits.

2.63.1

To Trondheim. Great circle to 61° 14′ N, 6° 40′ W (10 miles S of Føroyar), thence rhumb line to the pilot ground in Griphølen, thence through Indreleia.

2.63.2

To Bergen. Great circle to a landfall on Sumburgh Head, thence as navigation permits.

2.63.3

To Cape Wrath. Great circle to 57° 50′ N, 18° 00′ W, thence direct.

2.63.4

To places S of Cape Wrath. Great circle to destination.

Cape Race ↔ Europe

2.64

Diagrams (2.63), (2.48)

To Nordkapp. Great circle to 57° 50′ N, 18° 00′ W, thence as at 2.63.

2.64.1

To Trondheim. Great circle to the pilot ground in Griphølen, thence through Indreleia.

2.64.2

To Bergen. Great circle to a landfall on Sumburgh Head, thence as navigation permits (as at 2.63.2).

2.64.3

To Cape Wrath. Great circle to 57° 50′ N, 18° 00′ W, thence direct.

2.64.4

To places between Cape Wrath and Bay of Biscay. Great circle to destination.

West-bound alternative route

2.65

Diagram (2.63)

From Strait of Gibraltar bound for New York, some advantage in weather and currents may be obtained by passing 20 miles S of São Miguel, Arquipélago dos Açores, thence by rhumb line to Nantucket Lanby, thence as navigation permits.

Distance: 3240 miles.

2.66

For low-powered West-bound vessels, routes are as follows.

From Strait of Gibraltar bound for Halifax, by rhumb line, S of Arquipélago dos Açores, to 36° 00′ N, 45° 00′ W, thence as navigation permits.

2.66.1

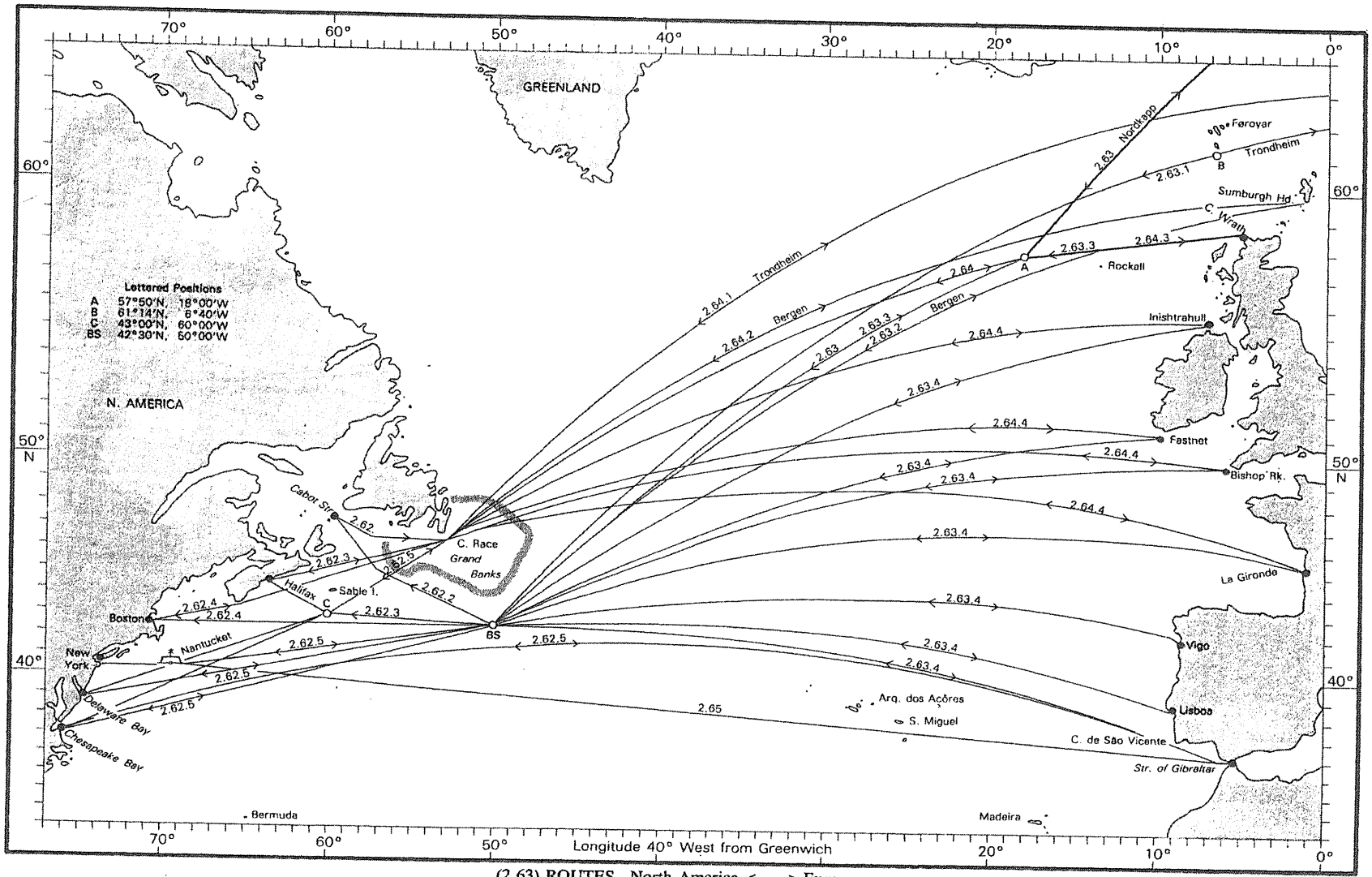
From Vigo, Lisboa or Strait of Gibraltar bound for Boston, Chesapeake Bay, or places between them, routes are seasonal.

May–September, S of Arquipélago dos Açores, thence:

Along the parallel of 36° N to 65° W, thence:
As navigation permits to destination.

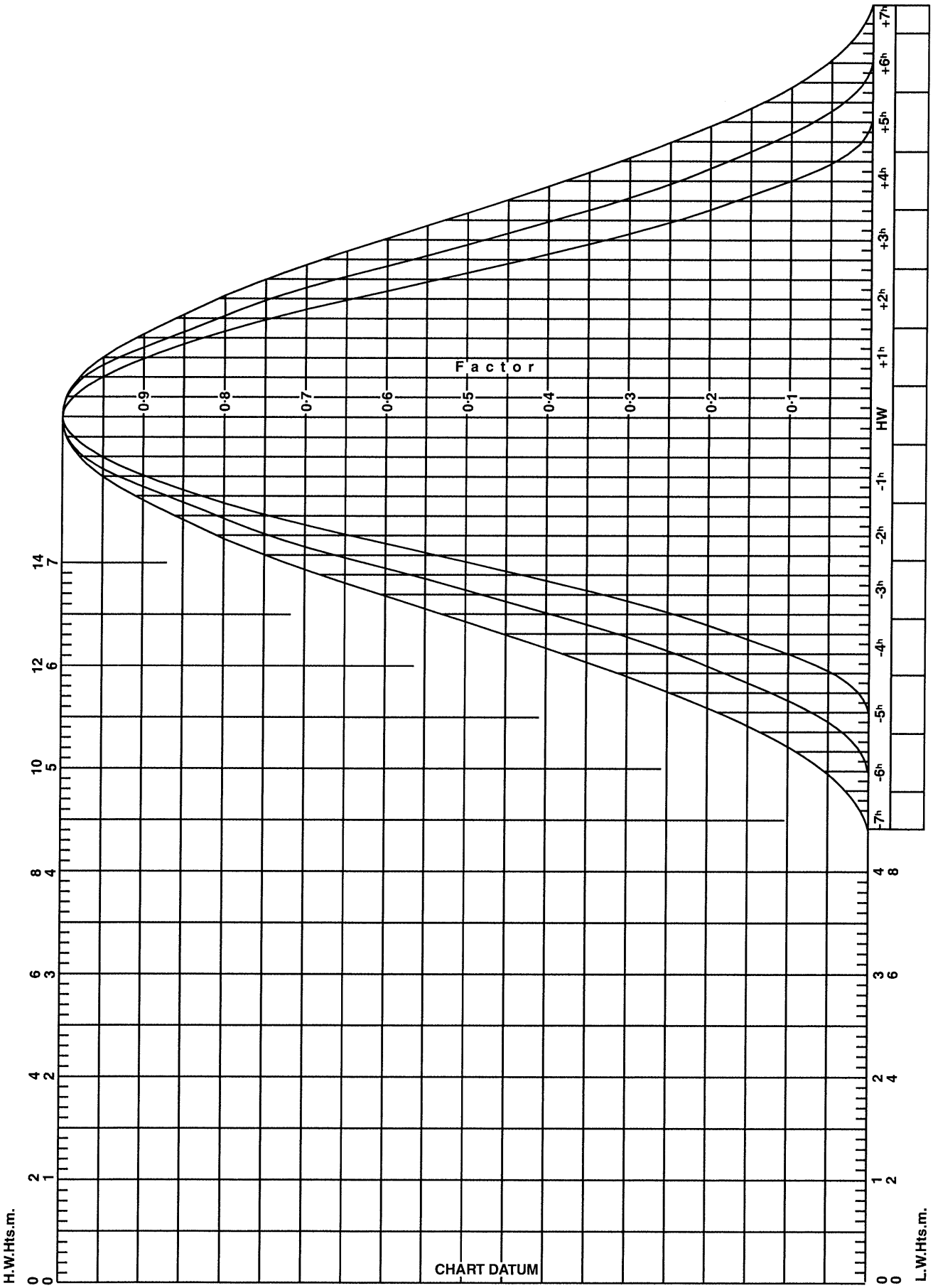
2.66.2

October–April, direct to 33° 15′ N, 20° 00W, thence:
Along the parallel of 33° 15′ N to 65° 00′ W, thence:
As navigation permits to destination.



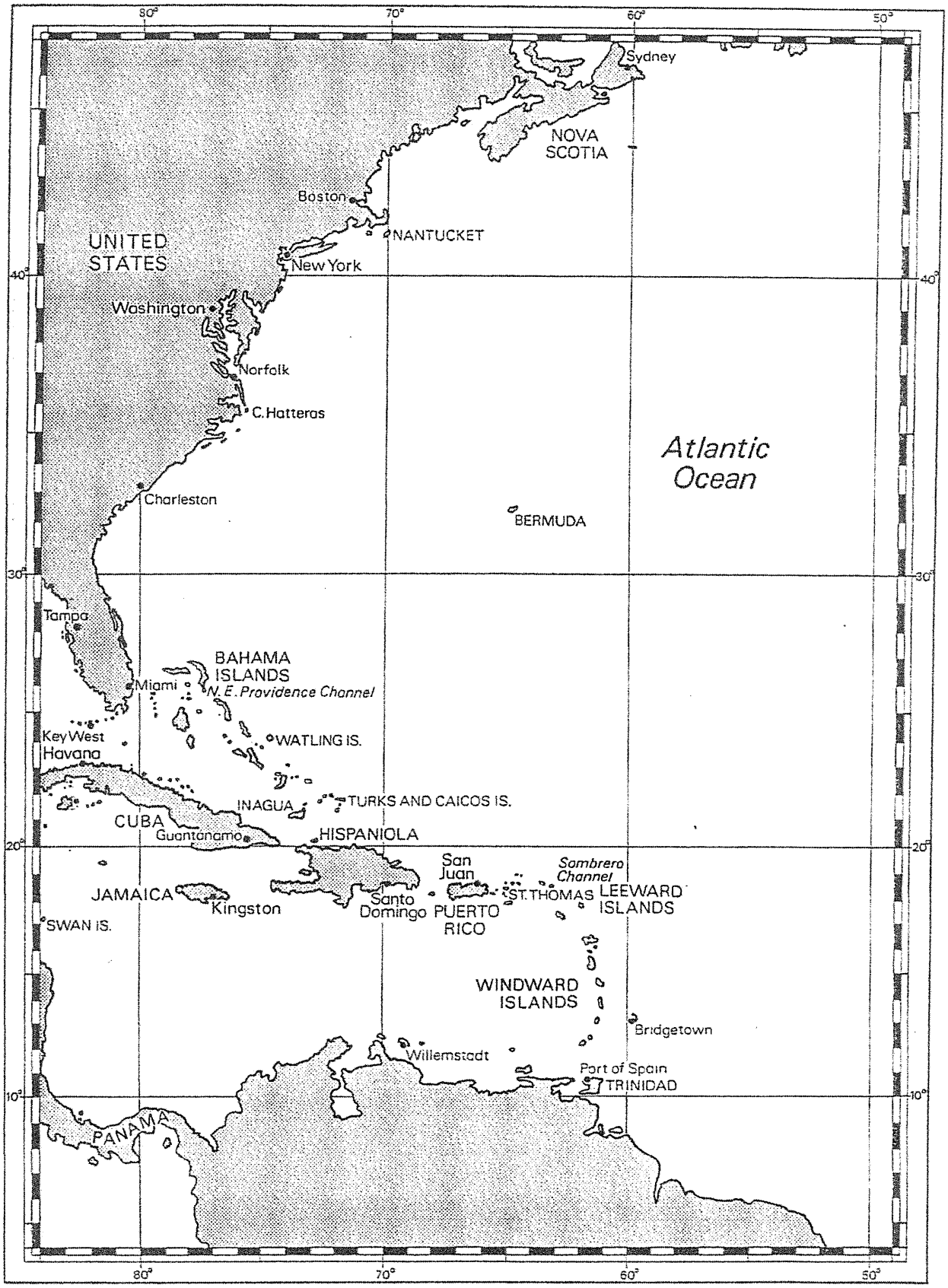
(2.63) ROUTES—North America ⟷ Europe.

(This Worksheet must be returned with your answer book)



Candidate's Name ..... Examination Centre .....

(This Worksheet must be returned with your answer book)



Candidate's Name ..... Examination Centre .....

CHAPTER 4

CARIBBEAN SEA AND GULF OF MEXICO

WINDS AND WEATHER

General description

4.1

Over the Caribbean Sea, NE to E winds prevail throughout the year, while over the Gulf of Mexico the wind is generally lighter and more variable in direction, though frequently from between NE and SE. In coastal waters, strong N winds may reach gale force at times over the Gulf. For the whole area, wind speeds are mainly light or moderate except for occasional hurricanes, see 2.5, which may affect the area from June to November. Most hurricanes track N of Cuba, and they rarely occur S of 15° N.

The weather over the area is generally partly cloudy with scattered showers. Sunny spells are frequent and, from May to December, periods of heavy rain and thunderstorms are frequent. Squalls may occur at anytime, but fog seldom occurs at sea.

Visibility is generally good throughout the year though it may at times be drastically reduced by heavy rain.

For Northers, see 2.3.

SWELL

General description

4.5

Swells are generally lower in the Gulf of Mexico than in the Caribbean Sea.

In the Caribbean Sea the prevailing direction is from NE to E; in the Gulf of Mexico, from March to September it is from E to SE, and from October to February it is from NE.

Highest swells occur in an area round 13° N, 77° W in the Caribbean Sea, especially in June and July, when the frequency of swell greater than 4 m is 20 per cent. These swells are invariably short or average in length.

CURRENTS

General description

4.11

The North Equatorial Current (2.15) flows WNW through the Caribbean Sea with little change of direction until it approaches Yucatan Channel where it turns to the N. It leaves an anti-clockwise eddy in the S part of the sea, S of about 12° N. There is also an E-going counter-current close to the S coast of E and central Cuba.

In the Gulf of Mexico, part of the N-going flow from Yucatan Channel fans out in directions between SW and NW. Currents setting in these directions occupy most of the Gulf W of a line from Cabo Catoche to close W of the Mississippi delta. From the NW flow along this line, water fans out NE and then shortly recurves to join the SE flow extending from the Mississippi delta to the W approaches to Straits of Florida. This SE-going stream joins the NE-going stream which emerges from Yucatan Channel and the combined flow continues E, and through Straits of Florida as the Florida Current. The emerging stream meeting the NW flowing water of the North Sub-tropical Current, turns N off the E coast of Florida and forms the beginning of the Gulf Stream.

Along the W coast of Florida there is a N-going current which, with the SE flow coming from the Mississippi delta, forms an anti-clockwise eddy in the E part of the Gulf of Mexico.

There is little seasonal variation in the pattern of the currents.

The average current rates in most of the Caribbean Sea are about 1 knot, increasing on the W side of Yucatan Channel to about 4 knots. The strongest currents are observed in Straits of Florida in about 25° 00′ N, 80° 00′ W and for about 300 miles N from that position. Here the average rate is nearly 3 knots in summer and 2½ knots in winter.

Over most of the Gulf of Mexico the average rates are about 1 knot, but N-going sets of about 1½ knots are reported in summer near the Mexican coast N of Tampico and SE-going sets of a similar magnitude for much of the year between the Mississippi delta and Cuba.

NOTES AND CAUTIONS

Navigation

4.15

In the Caribbean Sea and Gulf of Mexico, and in the channels leading thereto, great care is necessary near the cays and banks, as some of the charts are based on old and imperfect surveys.

Furthermore, depths over the shoals may be less than those charted owing to the growth of the coral of which many of them are composed or to the imprecise nature of the least depths reported over them. Shoal water should be approached with caution at all times and given a wide berth when conditions for fixing are poor: many of the banks are steep-to.

4.15.1

Caution. Strong currents can be expected in the entrances and channels leading to the Caribbean Sea and Gulf of Mexico, particularly in Straits of Florida.

Having chosen the route, the mariner should invariably consult Admiralty Sailing Directions for details of currents and tidal streams affecting it.

Entrance Channels

4.16

Diagram (4.21)

The Caribbean Sea may be approached through Crooked Island Passage, Caicos Passage or Turks Island Passage, all of which lead to Windward Passage.

Crooked Island Passage is the most frequently used.

Caicos Passage is not lighted, and Turks Island Passage, not lighted in its S approach, is not recommended for N-bound vessels at night.

Other entrances in common use are:

Mona Passage, which is much frequented and presents no difficulty. Although subject to heavy squalls it is safer than Turks Island Passage.

Sombrero Passage, which is not lighted in its S approach.

The Channel between Saint Lucia and Saint Vincent.

The passages N and S of Tobago.

In many cases routes through the various passages differ little in distance, and selection will depend principally on the ship's particular requirements.

For distances from these passages, see 4.29–4.29.8.

ROUTES

English Channel ↔ Caribbean Sea and Gulf of Mexico

4.21

Diagram (4.21)

Routes are as follows.

Belize. Providence Channels or Turks Island Passage and Windward Passage are suitable.

Kingston or Colón. Turks Island Passage and Windward Passage are suitable.

Colón or Curaçao. Mona Passage or Sombrero Passage are suitable.

Gulf of Mexico may be approached, either N of Cuba, through Providence Channels or Old Bahama Channel and Nicholas Channel, or S of Cuba through Caribbean Sea and Yucatan Channel. For routes within Gulf of Mexico, see Admiralty Sailing Directions.

Straits of Florida, through which the current runs strongly to the N, is best for departure from Gulf of Mexico.

For distance through these passages, see 4.29.8 and 2.85.4.

Bermuda → Habana

4.22

Diagram (4.21)

The route is through North-East Providence Channel, North-West Providence Channel and Straits of Florida.

Distance: 1130 miles.

4.22.1

For low-powered vessels, routes from the W end of the North-West Providence Channel are:

Either,

Across Straits of Florida to Fowey Rocks, thence:
Close off Florida Reefs, as directed in Admiralty Sailing Directions, to Sand Key, thence:
Across the Florida Current again to Habana.

Or, preferably by day,

Along the W edge of Great Bahama Bank to Habana. See Admiralty Sailing Directions.

Habana → Bermuda

4.23

Diagram (4.21)

The route is through Straits of Florida, thence direct from the NW end of Little Bahama Bank.

For Caution on approaching Bermuda, see 2.38.

Distance: 1150 miles.

Bermuda ↔ Kingston

4.24

Diagram (4.21)

From Bermuda the route is through either Crooked Island Passage or Caicos Passage (see 4.16), thence W of Great Inagua Island and through Windward Passage.

Cautions. Morant Cays have been the scene of many wrecks. Currents in their vicinity vary greatly, both in direction and rate. If passing them at night, ships should keep well N of them.

For Caution on approaching Bermuda, see 2.38.

4.24.1

Distances:

Via Crooked Island Passage 1180 miles;
Via Caicos Passage 1110 miles.

Colón (for Panama Canal) ↔ Gulf of Mexico

4.25

Diagram (4.21)

North-bound. From the entrance to the canal between the breakwaters off Colón, the route runs NNE to round New Bank at a prudent distance, thence direct to Yucatan Channel.

South-bound. From Yucatan Channel the route is:

To a position outside the 200 m depth contour off South-West Point, Grand Cayman Island, thence:

To a point off the SW extremity of Pedro Bank, thence:

Either, direct to Colón, passing between New Bank and Alice Shoal or, if unsure of the position, the route continues SE till New Bank has been cleared and a SSW course can be set for Colón.

Caution. New Bank and Alice Shoal are charted mainly from a survey of 1835.

Due allowance must be paid to the prevailing W-going current between Colón and Jamaica.

A vessel entering the W part of Gulf of Mexico from the Caribbean Sea should be kept in the deep water in Yucatan Channel, all precautions being taken against the N-going current and her position continually checked to identify the point of crossing the edge of Campeche Bank.

The edge of the bank is generally marked by ripplings, and only a short distance within it the water becomes discoloured. The bank has not been subjected to a modern survey, and new reports of shoal patches are often received, so sounding should be continuous when crossing it. Dangers on the bank are steep-to and sometimes indicated by discoloured water.

For routes W of Thunder Knoll, and from Yucatan Channel to ports in Gulf of Mexico, see Admiralty Sailing Directions.

4.25.1

Distances from Colón, passing W of New Bank: if passing E of New Bank, add 15 miles:

Cabo Catoche (28 miles ENE of) 965 miles;
Cabo San Antonio (10 miles W of) 900 miles;
New Orleans (Mississippi River South Pass) 1380 miles;
S entrance to Panama Canal (Balboa) 45 miles.

Yucatan Channel ↔ Eastern part of Caribbean Sea

4.26

Diagram (4.21)

Cabo Catoche should be given a wide berth on account of the shoals N of it.

East-bound. From 7 miles S of Cabo San Antonio, the route is:

JUL 2010

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 70000 GT bulk carrier is to make a loaded passage between Iquique (Chile) to Hobart (Tasmania) via the Cook Strait (New Zealand).
The vessel will discharge part of the cargo of sulphate in Wellington (North Island New Zealand).
The vessel's owners have indicated they require a service speed of 14.0 knots.
On departure Iquique the vessel is overloaded with respect to her Winter displacement by 340 tonnes and is expected to consume 36 tonnes of fuel and 10 tonnes of water per day on passage.

1 The following departure and landfall positions should be used for the passage to Wellington:

Departure position Iquique	20°15'.0S 70°20'.0W
Landfall position Wellington	41°42'.0S 175°18'.0E

With reference to Datasheet Q1:

(a) (i) determine the distance to steam to bring the vessel to her Winter displacement; (4)

(ii) calculate the distance between the departure position and an appropriate vertex on lat 33 degrees South; (5)

(b) calculate the shortest legal distance between the departure and landfall positions; (26)

(c) if the vessel leaves the departure position on the 5th June at 0300hrs (ST), determine the ETA at the landfall position, assuming that the vessel will arrive keeping Standard Time for Wellington. (10)

2 On the evening of the 13th June, whilst in DR position 28°42'.0S 94°36'.0W the Master requests the OOW to obtain a set of star sights to check the vessel's GPS receiver. The vessel clocks are on UT -6hrs and the vessel is steaming on a course of 235°(T) at 14 knots. Weather conditions are clear with some low broken cloud cover to the Northwest of the vessel.

(a) Calculate the UT of civil twilight for an evening star sight. (6)

(b) The OOW obtains the following results:

Time	Star	Azimuth	True Alt	Calc Alt
1745	Canopus	142° (T)	42° 19'.7	42° 23'.6
1750	Arcturus	270° (T)	54° 12'.3	54° 13'.7
1758	Alphard	062° (T)	28° 15'.6	28° 09'.7
1815	Antares	224° (T)	19° 16'.0	19° 21'.7

(i) Plot all FOUR stars for 1800hrs. (12)

(ii) State, with reasons, which of these are best suited for determining the vessel's position. (12)

(c) Determine the vessel's position at 1800hrs. (5)

3 Vessels approaching the coast of New Zealand often have problems in making a landfall due to heavy cloud cover and poor visibility in winter.

(a) List the factors that should be taken into account when planning a landfall after a long ocean passage. (12)

(b) Discuss SIX of the most important factors to be taken into account when choosing a safe anchorage. (18)

4 The vessel is approaching the entrance to Wellington Harbour in heavy seas and poor visibility, estimated to be 2 miles.

The OOW commences plotting three radar targets, at 0300hrs and obtains the following radar plot over a 15 minute period as shown on Worksheet Q4.

The vessel is steering 315° (T) at 10 knots and target B is known to be an island, with deep clear water all around.

(a) Prepare a full report on targets A and C. (15)

(b) Determine the effect of any set and drift the vessel may be experiencing. (6)

(c) Determine the alteration of course that should be made at 0320hrs to ensure that ALL targets pass at a distance of at least 1.5 miles. (15)

(d) If the vessel alters 50° to starboard at 0325hrs, find EACH of the following:

(a) the new CPA of Target B; (6)

(b) the time when Target B should be sighted visually. (8)

Note: Assume all alterations have an instantaneous effect

5 Tropical Revolving Storms are common at certain times of the year in the South Pacific Ocean, especially to the North of New Zealand and off the East Coast of Australia.

(a) Sketch a plan view of a TRS in the Western South Pacific Ocean, indicating the likely track prior to and after recurving. (12)

(b) Outline the actions that should be taken by the Master in EACH of the following scenarios, assuming that the storm has recurved:

(i) the vessel is to the north of the storms track but within the storm field; (5)

(ii) the vessel is to the south of the storms track but within the storm field; (5)

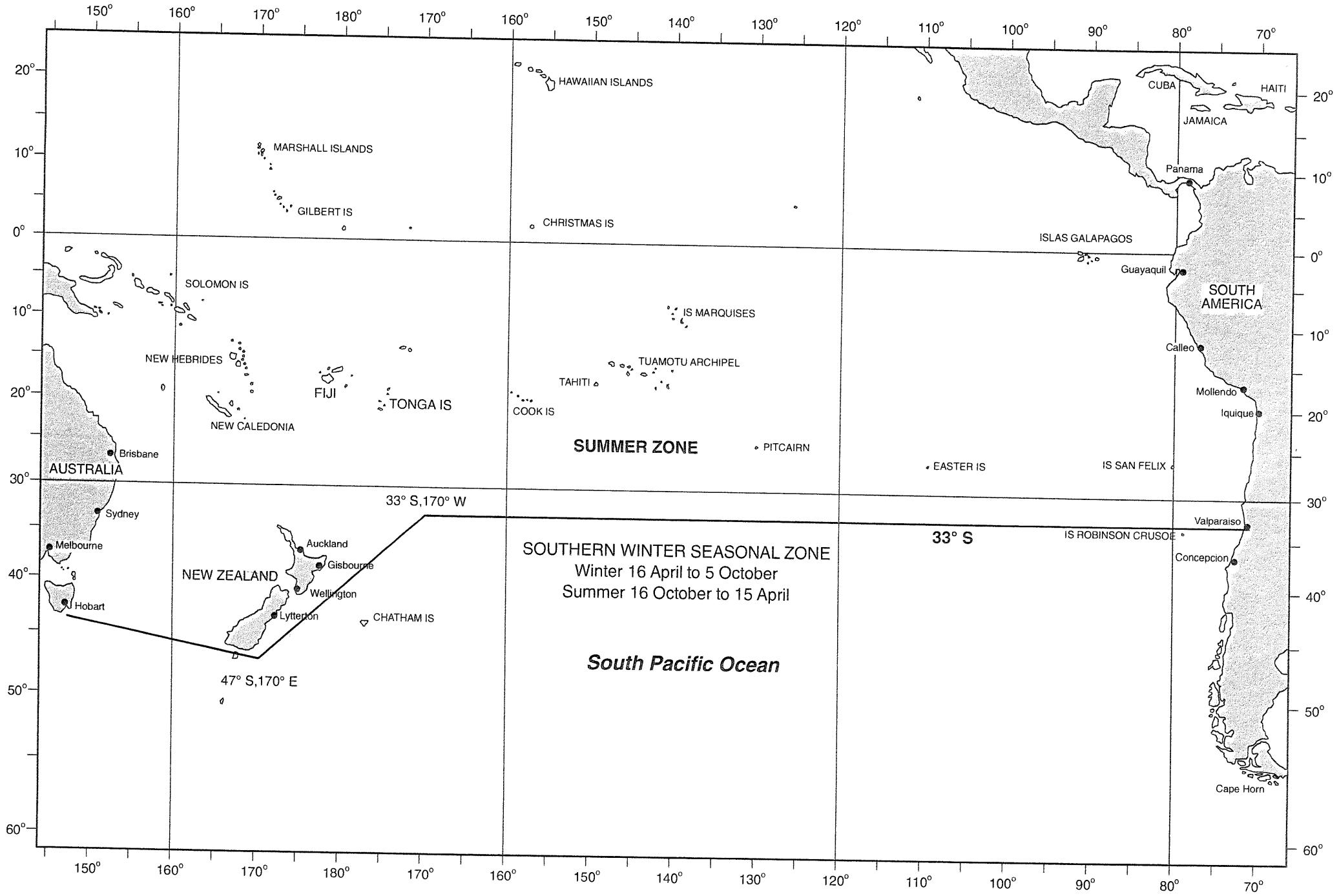
(iii) the vessel is in the path of the storm. (3)

(c) Compile a set of Masters standing orders for use when the vessel encounters heavy weather for EACH of the following:

(i) the OOW; (7)

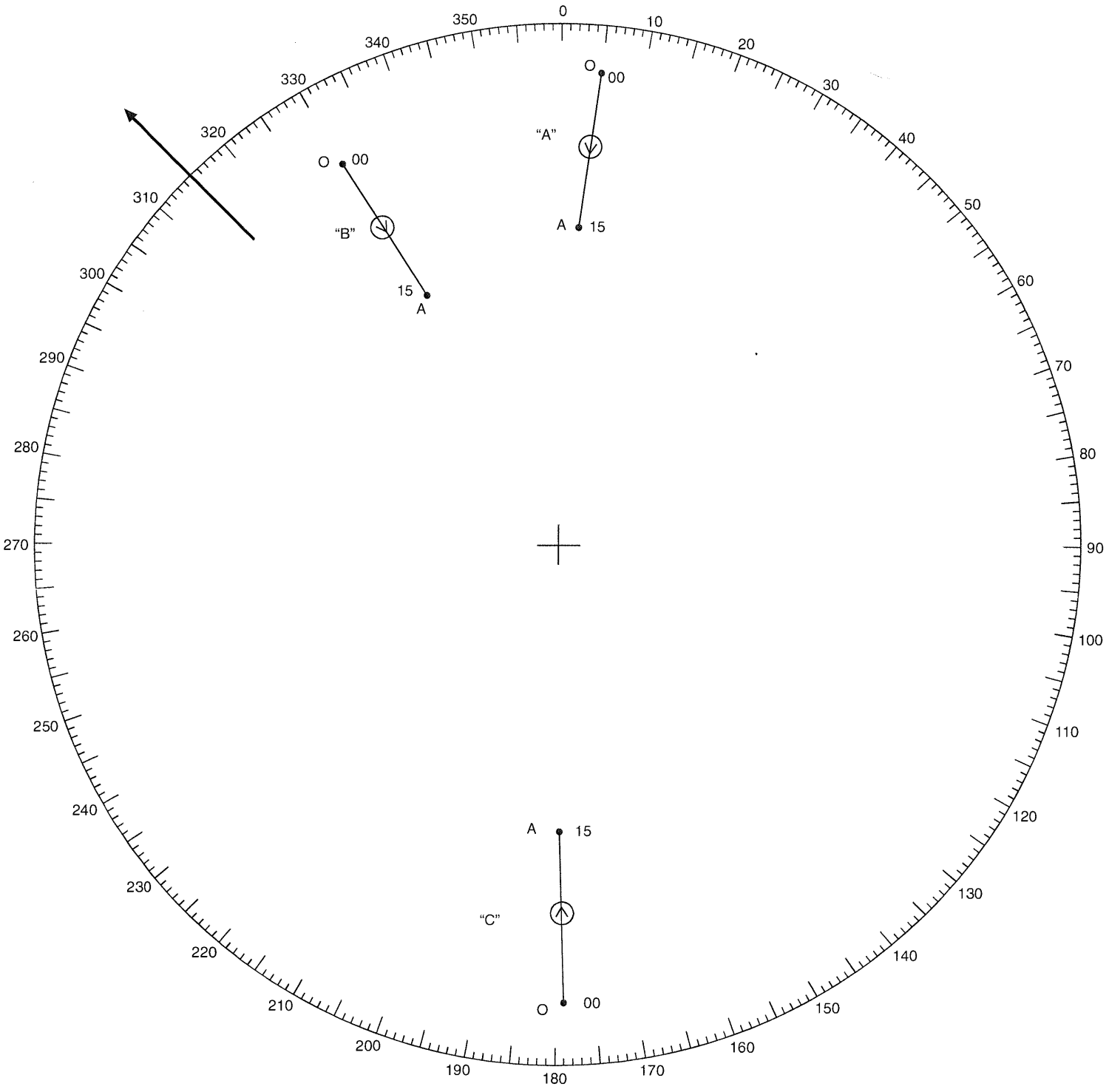
(ii) general standing orders which are relevant to the safety of the vessel. (8)

DATASHEET Q1



(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Range Scale 0 1 2 3 4 5 6

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Signature of Candidate .....

Examination Centre .....

NOV 2010

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 58,000 GT bulk carrier is engaged on a long term charter to carry phosphates between, Yap and Prince Rupert (British Columbia, Canada).The vessel is equipped with all aids to navigation as per statutory requirements and is to make a loaded passage northbound in September.

The service speed is 15.5 knots.

1 The vessel departs Yap and follows the recommended route from Ocean Passages of the World to the Dixon Entrance as per Datasheets Q1(1) and Q1(2).

Using the following positions as departure and landfall positions:

Departure Position	9°28'.0N 138° 09'.0E
Landfall Position	54°30'.0N 132° 30'.0W

(a) Calculate EACH of the following:

(i) the total distance on passage; (10)

(ii) the final course at the Dixon Entrance; (12)

(iii) the position of the vertex. (15)

(b) If the vessel leaves the departure position at 0400 ST on the 12th September, determine the ETA at the Dixon Entrance assuming the vessel will be on Standard Time for Prince Rupert at that time. (8)

2 (a) With reference to Worksheet Q2:

(i) identify Ocean Currents A, B, C, D, E and F; (12)

(ii) state TWO reasons why the route is ice free throughout the year. (4)

(b) Indicate on Worksheet Q2, EACH of the following, for the time of the year stated in Question 1:

(i) the normal pressure distribution; (6)

(ii) the general wind circulation; (10)

(iii) the maximum limit of sea ice. (3)

3 Whilst on passage south of the Aleutian Islands the vessel encounters severe weather and a crew member suffers a serious head injury whilst securing equipment on deck.

At 0800 hrs UT on the 21st September, whilst in position 52° 48'.0N, 166° 24'.0W the Master makes contact with a US Coastguard cutter in position 55° 18'.0N , 163° 06'.0W and agrees to rendezvous at sunrise the following morning to effect the transfer of the casualty to the cutter.

It is agreed that the bulk carrier will maintain a course of 055° (T) and speed of 13.5 knots.

Determine EACH of the following:

(a) the UT of sunrise; (15)

(b) the rendezvous position; (10)

(c) the course and speed required by the coastguard cutter to make the rendezvous. (10)

4 (a) State the specific responsibilities of EACH of the following when operating together as a bridge team:

(i) the Master; (8)

(ii) the Pilot; (6)

(iii) the Officer of the Watch. (6)

(b) State the additional responsibilities of the OOW when the master is not present on the bridge when a pilot is on board. (5)

(c) With reference to Master/Pilot exchange, outline FIVE items of information that:

(i) the Master should give to the Pilot *immediately* on reaching the bridge; (10)

(ii) the Pilot should give to the Master immediately on reaching the bridge. (10)

5 The vessel completes cargo operations with a draft of 15.4 metres and en route to the open sea, is required to cross a shoal patch with a charted depth of 12.0 meters, in the approaches to Cleveland Passage (ATT 8656). The Master requires that a minimum UKC of 1.2 metres is maintained at all times.

The vessel is due to transit the passage on the PM ebb tide on the 2nd August.

(a) Using Worksheet Q5, determine the latest time that the vessel can cross the shoal. (25)

(b) State, giving reasons, how much reliance the Master should place on the tidal data obtained in Q5(a). (5)

(c) Determine the next tide the vessel can safely transit the Cleveland Passage, if the vessel is delayed by 48 hours leaving the berth. (10)

7.334.1
Distances in miles:

	Juan de Fuca Strait			*Prince Rupert (via Dixon Entrance)*		
	Direct	*Via Honolulu*	*Via Suva*	*Direct*	*Via Honolulu*	*Via Suva*
Sydney	6740	6780	6810	6780	6890	6960
Caloundra Head for Brisbane	6340	6380	6590	6380	6490	6740

(Brisbane to Caloundra Head: 35 miles.)

Torres Strait ↔ San Diego or San Francisco

7.335
Diagrams (7.319), (7.334)
From Bougainville Strait, a direct great circle to San Diego passes close S of Honolulu; it is clear of all charted dangers. Great circles from Bougainville Strait to ports N of San Diego pass through Marshall Islands and Hawaiian Islands.
Routes via Honolulu (7.232.1–7.232.3 and 7.247) are therefore usually preferred being clear of dangers and inappreciably longer than direct great circles.

7.335.1
Distances in miles from Torres Strait (7.53.1) by routes passing E of Rossel Spit and through Bougainville Strait.

	Via Honolulu	*Direct*
San Diego	6580	6575
San Francisco	6390	6360

For distances by other routes to Bougainville Strait or Honolulu, see 7.183.4 or 7.232.1–7.232.3.

Torres Strait ↔ Juan de Fuca Strait or Prince Rupert

7.336
Diagrams (7.319), (7.334)
From Bougainville Strait, direct great circles to Juan de Fuca Strait and ports farther N on the coast of Canada pass through Marshall Islands and Hawaiian Islands.
Routes from Bougainville Strait by the great circle to Honolulu (7.232.1), which passes clear of charted dangers, and thence by great circle to destination, are often used, particularly when W-bound.

7.336.1
Alternative routes passing NW of Marshall Islands and Hawaiian Islands, are shorter than the routes via Honolulu and for an E-bound passage may encounter more favourable conditions.
From Bougainville Strait these routes are by rhumb line to 20 miles E of Mortlock Islands, thence great circle to 12° 00′ N, 165° 00′ E, 20 miles NW of Bikini Atoll, thence:
For Prince Rupert, by great circle to Dixon Entrance, thence as navigation permits.
For Juan de Fuca Strait, by Great circle for Dixon Entrance as far as 30° 00′ N, 179° 35′ E, thence great circle.

7.336.2
Alternatively, passage can be made through the channel between New Ireland and Bougainville Island, thence joining the route from Bougainville Strait in 12° 00′ N, 165° 00′ E, by great circle which passes about 20 miles SE of Pingelap Atoll.

7.336.3
Distances in miles from Torres Strait (7.53.1) by routes passing E of Rossel Spit to the channel between New Ireland and Bougainville Island or Bougainville Strait, and via Bougainville Strait and Honolulu. For distances by other routes through Solomon Sea, see 7.183.4.

	Juan de Fuca Strait	*Prince Rupert*
Via Honolulu	6580	6710
Via Bougainville Strait	6460	6320
Via New Ireland/Bougainville Island Channel	6530	6390

Guam and Yap ↔ North America

7.337
Diagram (7.334)
Routes pass through Mariana Islands keeping as near as practicable to great circle tracks.
Distances in miles:

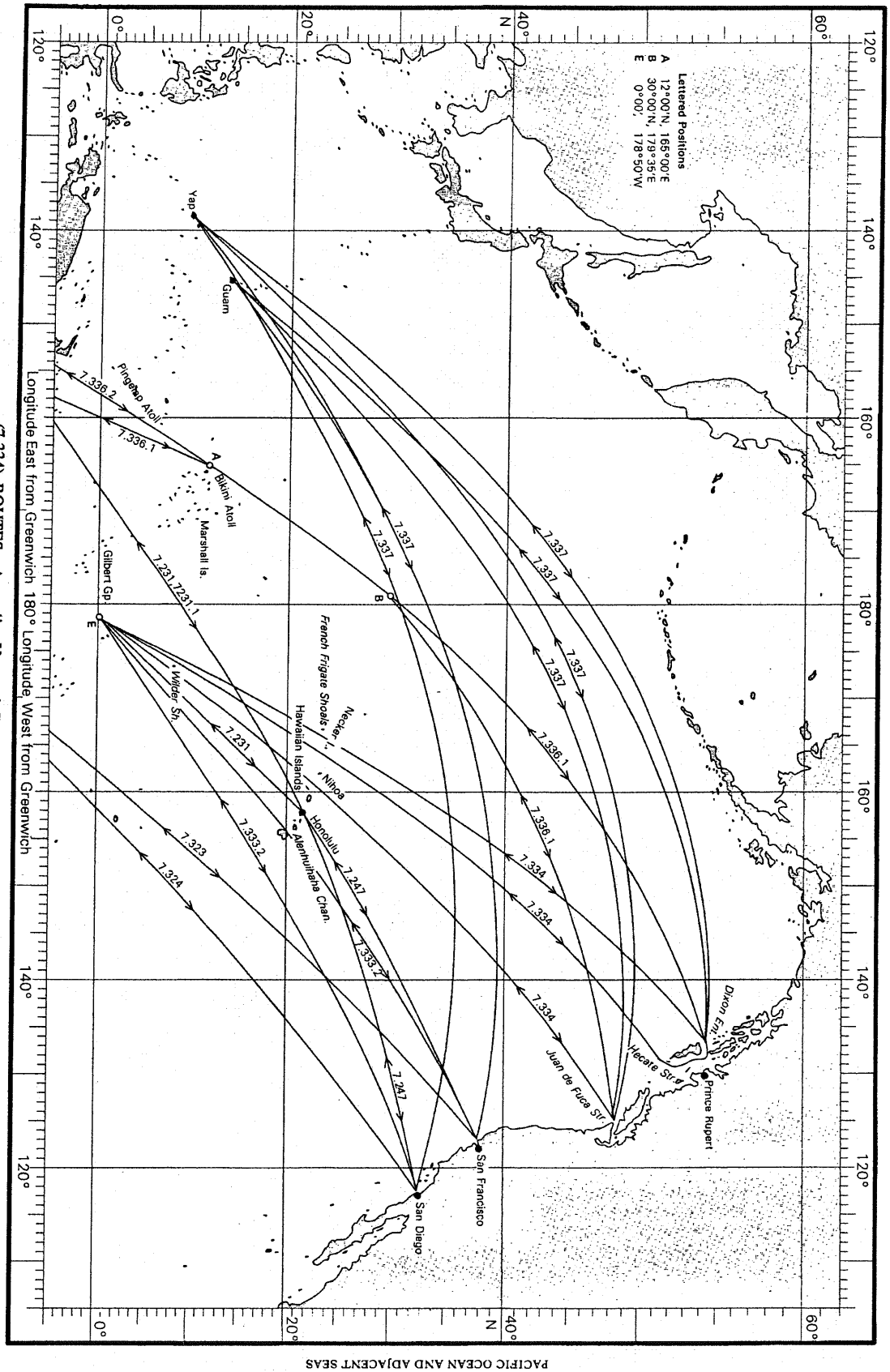
	Guam	*Yap*
San Diego	5380	5830
San Francisco	5050	5500
Juan de Fuca Strait	4830	5260
Prince Rupert	4600	5010

7.337.1
For low-powered vessels west-bound in winter, the following routes may be preferred to avoid the worst of the weather and adverse current:
From Juan de Fuca Strait, rhumb line to 32° N, 145° W, thence along the parallel of 32° N to 180°, thence great circle to Guam or Yap.
From Prince Rupert, through Hecate Strait, thence rhumb line to join the route from Juan de Fuca Strait in 32° N, 145° W.

NORTH PACIFIC TRANS-OCEAN ROUTES

General information

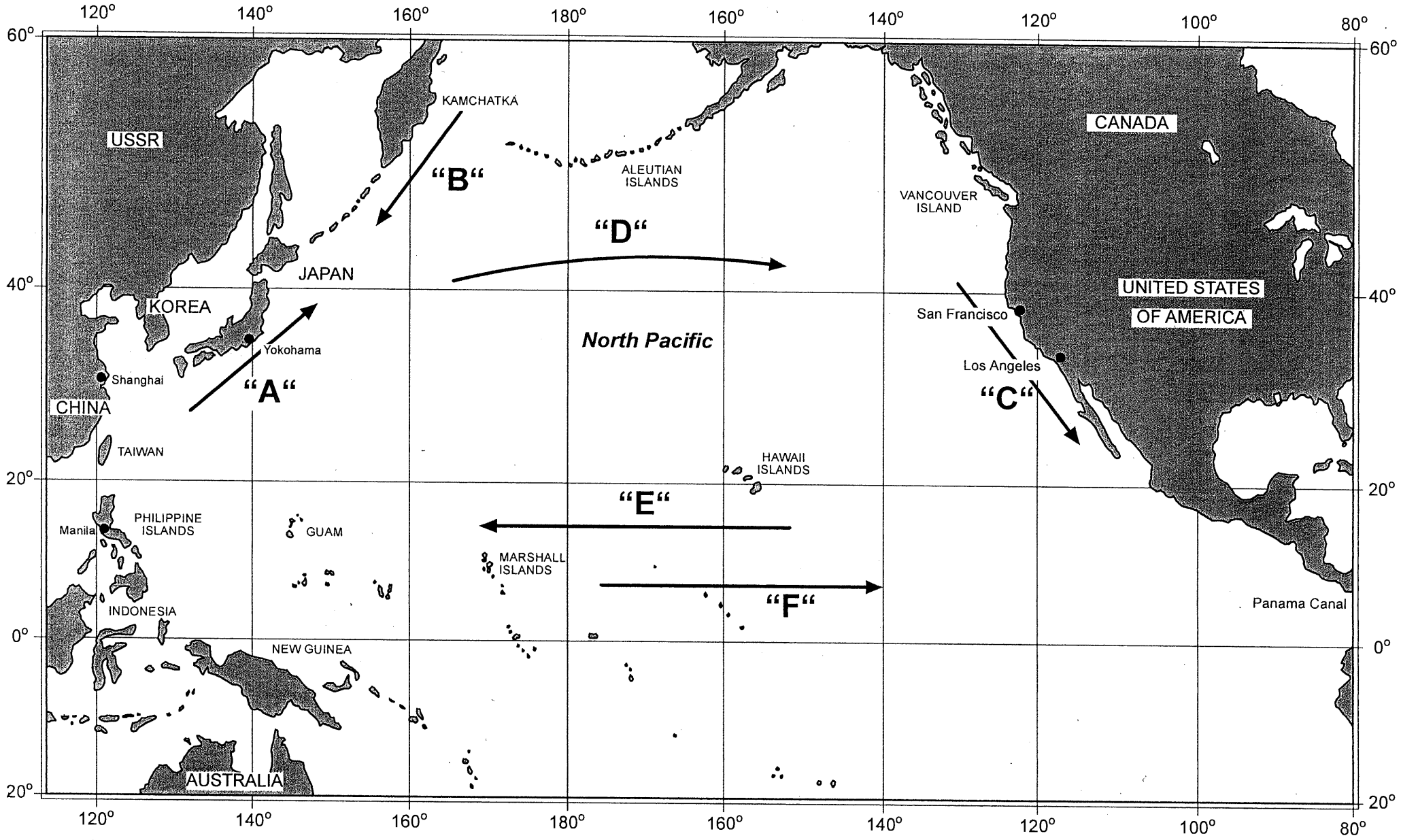
7.350
Broadly speaking, the trend of the coastline bordering the N Pacific basin follows the arc of a great circle. In fact, a great circle drawn between a position in Luzon Strait and a position on the coast of British Columbia will pass through the Sea of Japan and Bering Sea, while a great circle between Luzon Strait and the coast of California will pass close to Yokohama and not far S of the Aleutian Islands.



(7.334) ROUTES—Australia, Yap and Guam ⟷ North America

WORKSHEET Q2

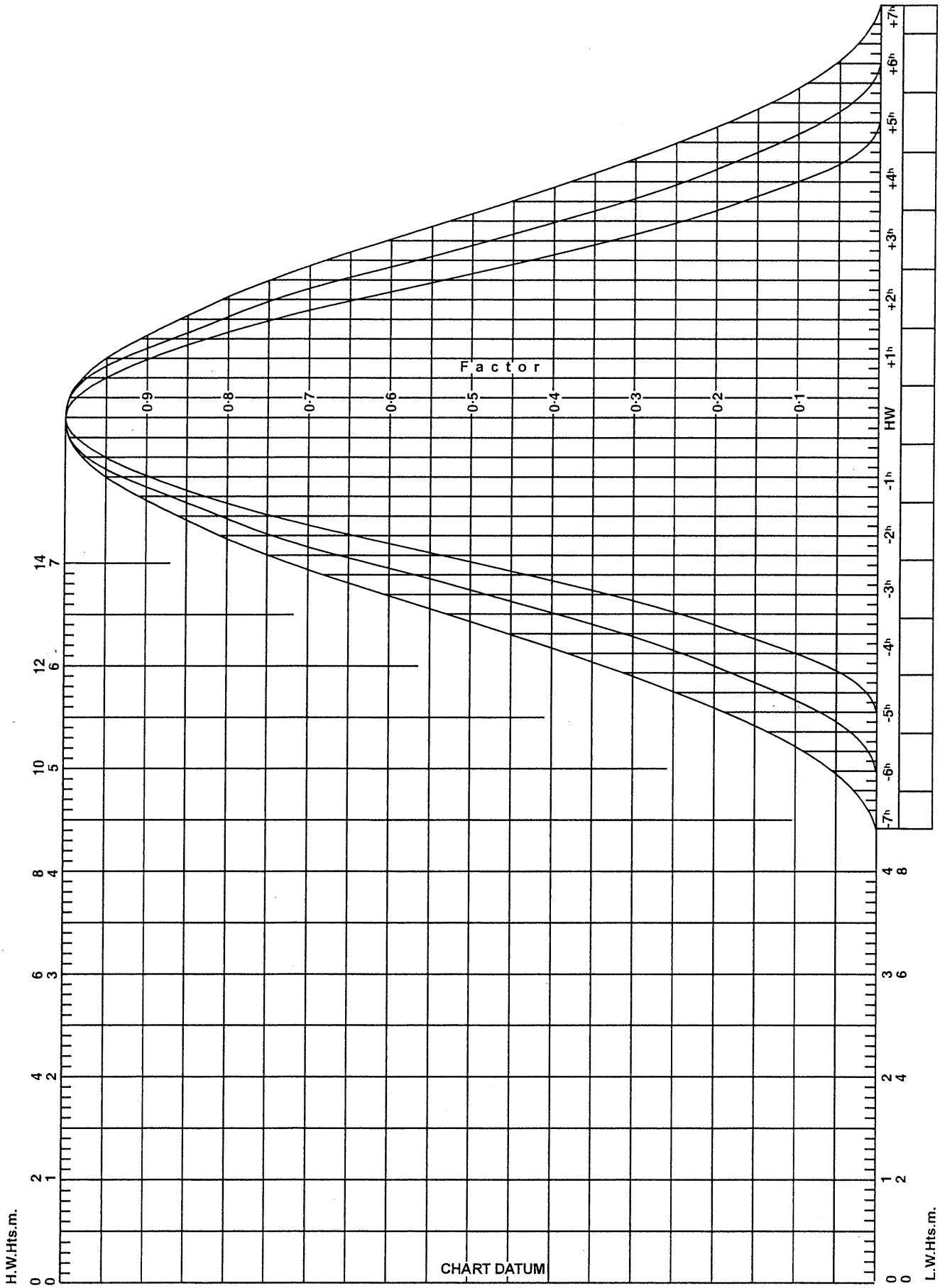
(This Worksheet must be returned with your answer book)



Candidate's Name .....

Examination Centre .....

(This Worksheet must be returned with your answer book)



Candidate's Name ..... Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

An 10000 GT general cargo vessel is to make a loaded passage between Charleston (South Carolina, USA) to Odessa (Ukraine) calling at Nouakchott (Mauretania) and Istanbul (Turkey) en route The vessel's owners have indicated they require a service speed of 19.0 knots.

1 The vessel's owners have requested that it follows the shortest possible route between Charleston and Nouakchott, using the following positions for the ocean passage.

Departure position 32°48'.0N 79°51'.0W
Landfall position 18°03'.0N 16°18'.0W

(a) Calculate the total distance on passage. (10)

(b) Determine the latitude and longitude of the vessel at the northernmost point along the track. (20)

(c) Determine the distance off the island of Bermuda (32°21'N 64°48'W) when the vessel crosses longitude 64°48'W, stating whether the vessel passes North or South of the island. (10)

2 Prior to departure the Master decides to increase the passing distance to 30 miles due south of Bermuda due to the fact that the island is surrounded by low lying islands, banks and reefs on which there are numerous wrecks and obstructions.

At the vessel's intended service speed it will be due to pass Bermuda approx 2 hours after sunrise on the 13th September.

The OOW obtains the following observations during morning twilight on the 13th under clear skies, good visibility and calm seas. The vessel was steaming at 19 knots on a course of 095°(T).

Time	Object	Azimuth	True Alt	Calc Alt
0545 hrs	Arcturus	037°(T)	41°15'.7	41°10'.9
0550 hrs	Rigel	130°(T)	43°13'.8	43°20'.4
0555 hrs	Vega	315°(T)	36°45'.3	36°39'.4
0603 hrs	Canopus	220°(T)	58°19'.5	58°27'.1

(a) Determine the vessel's position at 0600 hrs, using a DR position of 31°45'N 65°24'W to work each sight. (25)

(b) At 0620 hrs the OOW obtains a radar range and bearing of what is thought to be one of the low lying islands south of Bermuda at a range of 26 miles.

The vessel's GPS receiver puts the vessel 0.5 miles to the south of the vessel's charted track, the radar observation puts the vessel 4 miles to the south of the track and the celestial observation above puts the vessel approximately 10 miles to the north of the vessel's track.

Discuss the reliability of EACH of the above observations. (15)

(c) State, with reasons, what action should be taken by the OOW to ensure that the Master's orders, regarding the passing distance off Bermuda, are complied with. (5)

3 The UK Maritime and Coastguard Agency publish guidance to mariners in the form of Marine Guidance Notes (MGN's).

Outline the current MCA guidance regarding EACH of the following topics:

(a) the precautions to be observed when using parallel indexing techniques on a modern marine radar; (15)

(b) the dangers of a misaligned heading marker; (3)

(c) the procedures for rectifying a misaligned heading marker; (12)

(d) the alarms that must be fitted to ECDIS systems to ensure safety of navigation. (10)

4 The vessel arrives in Istanbul and anchors to await a pilot, prior to transiting the Bosporus on the northbound passage to Odessa. The Bosporus is covered by a Traffic Separation Scheme for its entire length and in places the passage is extremely narrow (only 8 cables wide from shore to shore). The passage is also very shallow in places with numerous banks, shoals and wrecks.
It is also dangerous due to the fact that there are strong currents, sharp bends and frequent close quarters situations during the transit.

(a) Describe the preparations to be made on the bridge prior to undertaking such a passage. (20)

(b) Discuss THREE factors that the master must take into consideration regarding the manoeuvrability of the vessel during the transit. (9)

(c) Outline the precautions that should be taken in the event of an engine or steering gear failure. (6)

5 The vessel is approaching the pilot boarding station, off Odessa, in restricted visibility at a speed of 12 knots. The vessel is steering 355°(T) and the engine is on manoeuvring.

Between 0555 hrs and 0615 hrs the OOW obtains a radar plot, of three targets, as shown on Worksheet Q5.

(a) Prepare a full report on EACH target. (15)

(b) Outline the vessel's most appropriate course of action to resolve the situation for EACH target. (9)

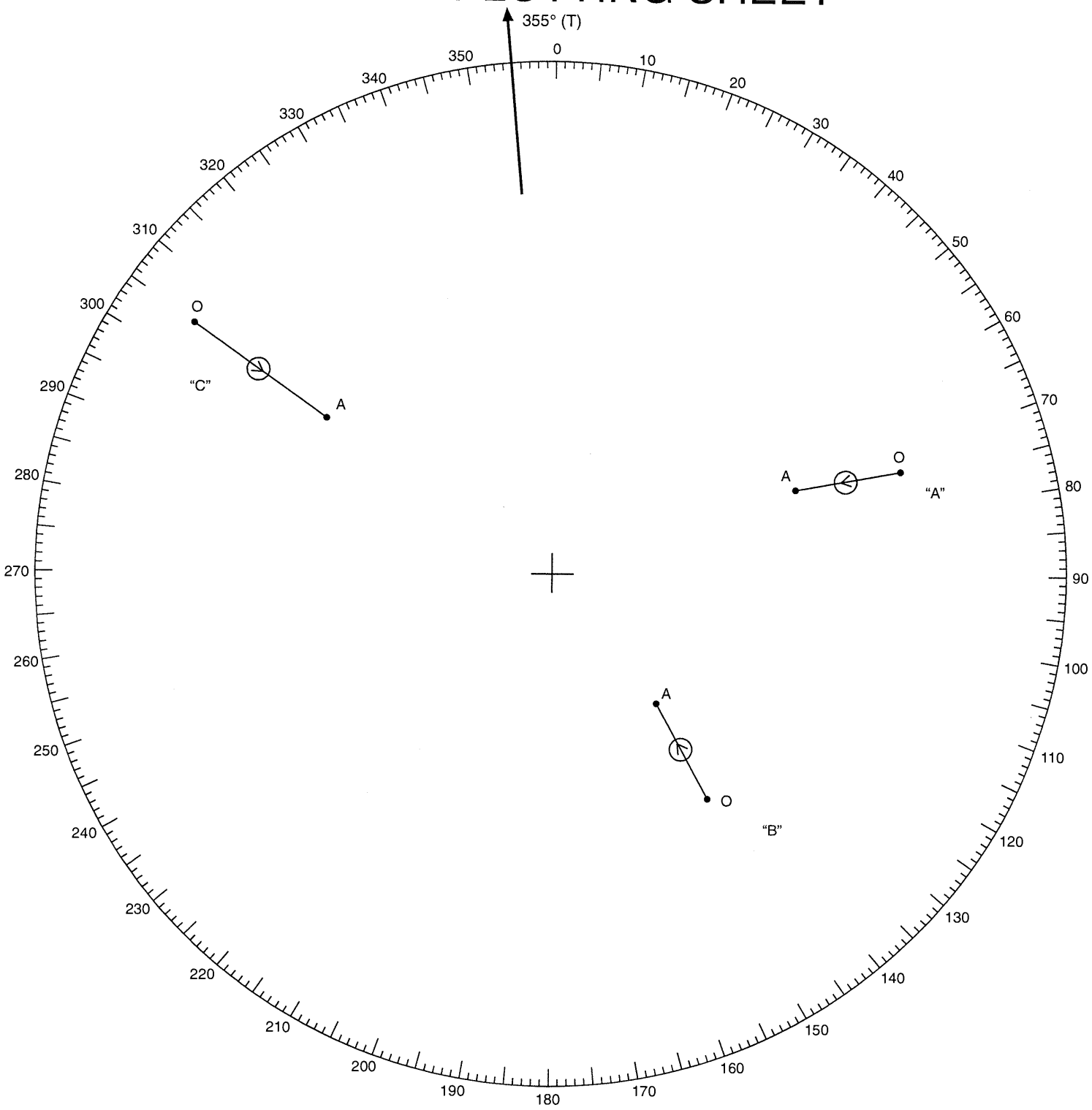
(c) Determine the alteration of course and/or speed, at 0620 hrs, which would result in target *B* passing at a distance of 1.4 miles. (6)

Note: assume alterations of course and speed have instantaneous effect

(d) Determine the range and bearing of targets *A* and *C* when target *B* is abeam, having taken the action determined in Q5(c). (10)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Range Scale 0 1 2 3 4 5 6 7 8 9 10 11 12

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Signature of Candidate .....

Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 115000 GT bulk carrier is to make a loaded passage between Valparaiso (Chile) to Yokohama (Japan), carrying a cargo of phosphates and is expected to have a departure draught of 16.6 metres. The vessel carries navigation equipment as per statute and has a service speed of 16.0 knots. The vessel is due to depart Valparaiso on the 1st September.

1 The vessel is to use the following as departure and landfall positions.

Departure Position 33°03'.0S 71°48'.0W
Landfall Position 35°18'.0N 139°42'.0E

Calculate EACH of the following:

(a) the great circle distance; (10)

(b) the final course on the great circle track; (15)

(c) the position of the vertex, lying North of the Equator. (15)

2 On the morning of the 11th September the OOW makes the following simultaneous celestial observations:

Time at ship	0900 hrs
DR Position	11°40'.0S 121°42'.0W
Chronometer read	5h 06m 28s
Chronometer error	3m 16s slow on UT
Sextant Altitude of Suns LL	43°39'.3
Index error	2'.4 off the arc
Height of Eye	12.6 m

Sextant Altitude of VENUS on the meridian 62°17'.7 (Bearing North)

(a) Determine the direction of the position line and the intercept for the SUN. (15)

(b) Determine the latitude at the time of the observation of the VENUS. (15)

(c) Determine, by graphical means, the vessel's position at 0900 hrs. (10)

3 On the 20th September, whilst in position 17°15'N 164°30'E, the vessel receives the following typhoon advisory from the Japanese National Weather Centre:

200000UT
Typhoon Charlie
Position 15°00'N 167°30'E
Track 295°(T)
Speed of advance 12 knots
Winds 55 knots out to 120 miles
95 knots within 70 miles

(a) Draw a plan view of a northern hemisphere TRS showing all the salient features and indicating the likely paths. (9)

(b) (i) Determine the range and bearing of the storm centre at 200000 UT. (10)

(ii) Determine, with the aid of a sketch, whether the vessel lies to the North or South of the forecast track. (5)

(c) Describe the changes that would be observed during the next 12 hours with respect to EACH of the following:

(i) wind direction and strength; (6)

(ii) swell height and direction; (5)

(iii) barometric pressure. (5)

(d) State the possible actions that are available to the Master to ensure the vessel clears the area as fast as possible and avoids the worst effects of the storm. (10)

4 Whilst taking evasive action to avoid the storm one of the engine room ratings falls and breaks a leg. The Master decides that the rating needs immediate medical attention and makes contact with a US warship at 0830 hrs UT on the 21st September.

The vessel's current position is 21°30'.0N 167°24'.0E. The warship is in position 24°54'.0N 172°36'.0E. It is agreed to rendezvous at sunrise the following day with own vessel maintaining a course of 345°(T) and at a maximum speed of 18 knots.

Calculate EACH of the following:

(a) the UT of sunrise; (15)

(b) the rendezvous position; (15)

(c) the course and speed required by the warship to make the rendezvous. (10)

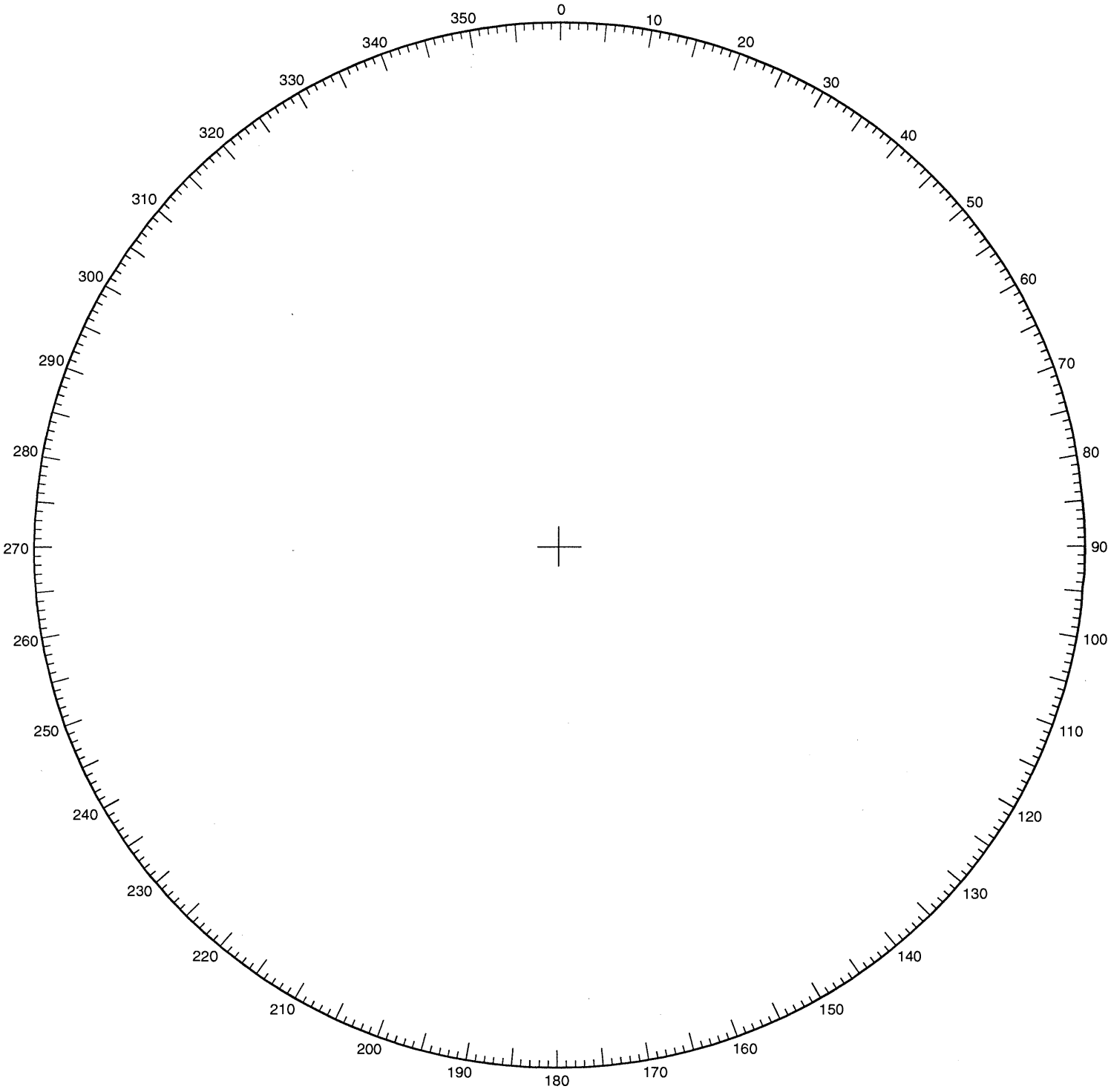
5 (a) Several publications contain guidance to Masters on determining the composition of the Bridge team under varying operational conditions.

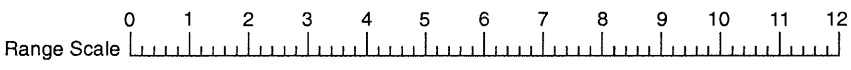
Outline TEN factors that should be considered by the Master when determining appropriate manning levels necessary on the bridge. (20)

(b) Describe FIVE items of information that the Pilot should tell the Master, when proceeding up river to the berth. (10)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET





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Signature of Candidate .....

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NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 325 meter container vessel is on a long term charter to carry cargo between South Africa, New Zealand and the East Coast of the United States.
The vessel carries navigation equipment as per statute and has a service speed of 22.0 knots. The vessel is due to depart Capetown (South Africa) on the 10th November , bound for Wellington (New Zealand)

1 The vessel is to use the following as departure and landfall positions:

Departure Position 34°50'.0S 21°00'.0E
Landfall Position 40°00'.0S 173°48'.0E

And a limiting latitude of 45°S

(a) Indicate the vessel's intended track on Worksheet Q1. (5)

(b) Calculate EACH of the following:

(i) the position of the vertices; (15)

(ii) the total distance on passage; (15)

(iii) the direct rhumb line course and distance between the departure and landfall positions. (10)

2 Weather routeing is often effectively used by vessels making trans oceanic passages.

(a) Outline FIVE factors that should be considered when deciding to weather route a vessel. (20)

(b) Describe THREE types of weather routeing currently available to vessels. (12)

(c) Outline the benefits of carrying out shipboard weather routeing. (8)

3 Whilst approaching Wellington the vessel encounters heavy rain and gale force Southerly winds, with visibility estimated to be approximately 1 nautical mile. The vessel is steering 067°(T) at a speed of 12 knots.

The OOW obtains the following radar plot between 0448 hrs and 0508 hrs as shown on Worksheet Q3. Target A is known to be an island.

(a) Prepare a full analysis of the situation of 0508 hrs with regard to Targets B and C. (14)

(b) Determine the direction and rate of the tidal stream. (4)

(c) Determine the action required by own vessel at 0513 hrs, to ensure that all targets pass at a distance of at least 1.5 miles. (10)

Note: assume all alterations of course and speed are instantaneous

(d) Explain how the action taken in Q3(c) meets the requirements of Rules 19 and 8 of the IRPCS. (12)

4 On departure from Wellington, the vessel sails a great circle track to Balboa (Panama). Whilst on passage across the South Pacific Ocean, the Master wishes to verify the accuracy of the GPS using celestial observations.

(a) Discuss the accuracy of EACH of the following, with regard to verifying the vessels:

(i) star sights; (3)

(ii) consecutive sun sights with an intervening run. (5)

(b) Discuss the factors that should be considered when selecting stars for determining the vessel's position. (10)

(c) The vessel intends to take star sights during morning twilight on the 31st December, whilst in DR position 22°42'.0S 124°36'.0W.
Ship's time (UT -8hrs)

Using Datasheet Q4, determine EACH of the following:

(i) the likely period of observation at the ship; (8)

(ii) which stars are available for observation; (7)

(iii) which are best suited for a four star fix, stating the reasons. (7)

5 On the 16th January, whilst approaching Balboa (ATT 9487), the vessel loses engine power and has to take immediate action to avoid colliding with another vessel. In taking action the vessel grounds on a mudbank with a charted depth of 9.3 metres at 1300 hrs.

The vessel's draft is 13.2 metres.

(a) Compile an emergency checklist to be followed in the case of the vessel grounding. (15)

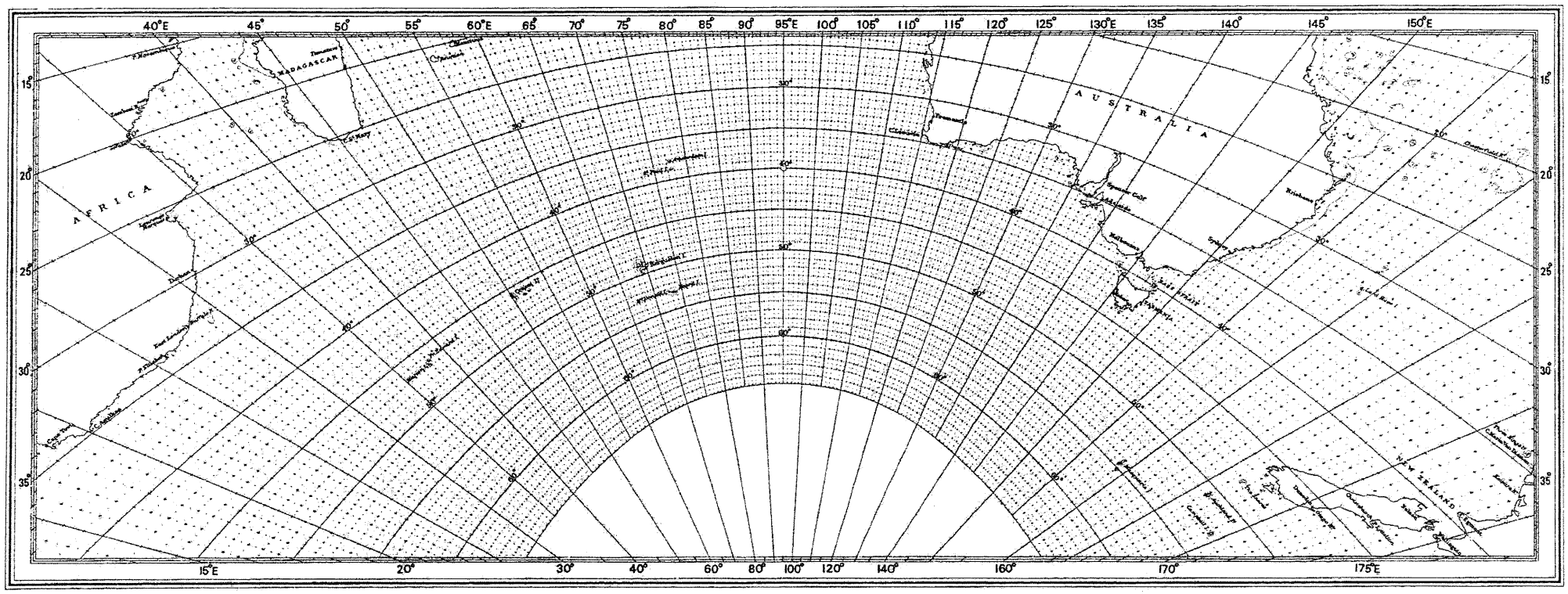
(b) The vessel is found to be seaworthy but in order to float the vessel free of the mudbank, 0.8 meters of additional buoyancy will be required to break the vessel free of the mud.

Determine the earliest time the vessel could be refloated, using ATT Pacific and Atlantic Ocean and Worksheet Q5. (20)

WORKSHEET Q1
(This Worksheet must be returned with your answer book)

GNOMONIC CHART FOR FACILITATING GREAT CIRCLE SAILING

INDIAN AND SOUTHERN OCEANS



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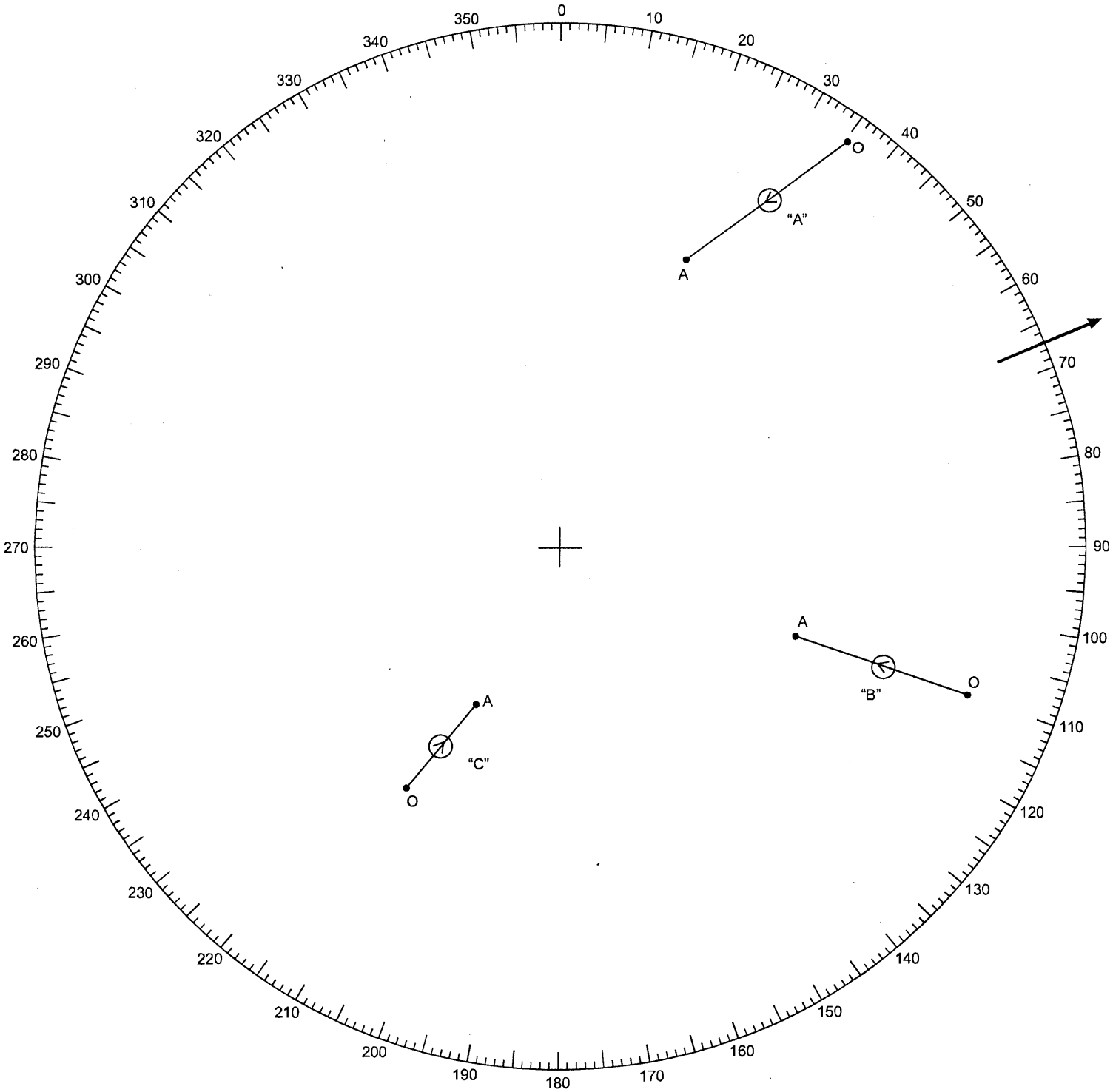
RADAR PLOTTING SHEET



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Examination Centre .....

LAT 22°S

LHA T	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	ARCTURUS		*ANTARES		ACRUX		*Suhail		Alphard		REGULUS		*Denebola	
180	37 13	041	29 30	109	48 51	176	48 26	229	50 40	284	46 01	318	53 08	355
181	37 49	040	30 23	109	48 55	176	47 44	229	49 46	283	45 23	317	53 02	353
182	38 25	039	31 15	108	48 58	177	47 02	229	48 52	283	44 45	316	52 55	352
183	38 59	038	32 08	108	49 01	178	46 20	230	47 57	282	44 06	315	52 46	350
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185	40 07	036	33 54	108	49 04	179	44 54	230	46 08	281	42 46	313	52 24	347
186	40 39	035	34 47	108	49 04	180	44 12	230	45 13	280	42 05	312	52 11	346
187	41 11	034	35 40	107	49 04	181	43 29	230	44 19	280	41 23	311	51 57	344
188	41 42	033	36 33	107	49 03	181	42 46	231	43 24	279	40 41	310	51 41	342
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191	43 09	030	39 13	107	48 56	183	40 36	231	40 39	278	38 31	308	50 44	338
192	43 36	029	40 06	107	48 53	184	39 53	231	39 44	277	37 47	307	50 23	337
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194	44 27	026	41 53	106	48 44	185	38 26	231	37 53	276	36 17	305	49 37	334
	ARCTURUS		*Rasalhague		ANTARES		*ACRUX		Suhail		*REGULUS		Denebola	
195	44 51	025	14 35	070	42 46	106	48 38	186	37 43	231	35 32	305	49 12	333
196	45 14	024	15 27	069	43 40	106	48 32	187	36 59	232	34 45	304	48 45	331
197	45 36	023	16 19	069	44 33	106	48 25	187	36 16	232	33 59	303	48 18	330
198	45 57	021	17 11	068	45 27	106	48 18	188	35 32	232	33 12	302	47 50	329
199	46 17	020	18 02	068	46 20	106	48 10	189	34 48	232	32 25	302	47 20	327
200	46 35	019	18 54	067	47 14	106	48 01	189	34 05	232	31 38	301	46 50	326
201	46 52	017	19 45	067	48 07	105	47 52	190	33 21	232	30 50	300	46 19	325
202	47 09	016	20 36	066	49 01	105	47 42	191	32 37	232	30 01	300	45 46	324
203	47 23	015	21 27	066	49 55	105	47 31	191	31 54	232	29 13	299	45 13	323
204	47 37	013	22 17	065	50 48	105	47 20	192	31 10	232	28 24	298	44 39	322
205	47 49	012	23 08	065	51 42	105	47 08	192	30 27	232	27 35	298	44 04	321
206	48 00	011	23 58	064	52 36	105	46 56	193	29 43	232	26 46	297	43 29	320
207	48 10	009	24 48	064	53 29	105	46 43	194	28 59	232	25 56	297	42 52	319
208	48 18	008	25 37	063	54 23	105	46 30	194	28 16	231	25 06	296	42 15	318
209	48 25	007	26 27	062	55 17	105	46 16	195	27 32	231	24 16	295	41 37	317
	ARCTURUS		*Rasalhague		ANTARES		*RIGIL KENT.		ACRUX		Gienah		*Denebola	
210	48 31	005	27 16	062	56 11	105	50 44	173	46 02	195	64 43	276	40 58	316
211	48 35	004	28 05	061	57 04	105	50 51	174	45 47	196	63 48	275	40 19	315
212	48 38	002	28 53	061	57 58	105	50 57	174	45 31	196	62 52	275	39 39	314
213	48 40	001	29 42	060	58 52	105	51 02	175	45 15	197	61 57	274	38 59	313
214	48 40	359	30 30	059	59 46	105	51 06	176	44 59	197	61 01	274	38 18	312
215	48 38	358	31 17	059	60 39	105	51 10	177	44 42	198	60 06	273	37 36	311
216	48 36	357	32 05	058	61 33	105	51 13	177	44 25	198	59 10	273	36 54	310
217	48 32	355	32 52	057	62 27	105	51 15	178	44 07	199	58 15	272	36 11	309
218	48 26	354	33 38	057	63 21	105	51 17	179	43 49	199	57 19	272	35 28	309
219	48 19	352	34 25	056	64 14	105	51 17	180	43 30	200	56 24	271	34 44	308
220	48 11	351	35 10	055	65 08	106	51 17	180	43 11	200	55 28	271	34 00	307
221	48 02	349	35 56	054	66 01	106	51 16	181	42 51	201	54 32	271	33 16	306
222	47 51	348	36 41	054	66 55	106	51 15	182	42 31	201	53 37	270	32 31	306
223	47 39	347	37 25	053	67 48	106	51 12	183	42 11	202	52 41	270	31 45	305
224	47 25	345	38 09	052	68 42	106	51 09	184	41 50	202	51 45	270	30 59	304
	Alphecca		Rasalhague		*ALTAIR		Peacock		*RIGIL KENT.		*SPICA		ARCTURUS	
225	40 31	010	38 53	051	12 46	075	23 14	144	51 05	184	64 28	292	47 11	344
226	40 40	009	39 36	050	13 39	074	23 47	144	51 01	185	63 36	291	46 55	343
227	40 48	007	40 19	049	14 33	074	24 20	144	50 55	186	62 44	290	46 38	341
228	40 55	006	41 01	048	15 26	074	24 52	144	50 49	187	61 51	289	46 19	340
229	41 00	005	41 42	048	16 20	073	25 25	144	50 42	187	60 58	288	46 00	339
230	41 05	004	42 23	047	17 13	073	25 58	144	50 35	188	60 05	287	45 39	338
231	41 08	003	43 03	046	18 06	072	26 31	144	50 27	189	59 12	286	45 17	336
232	41 10	002	43 42	045	18 59	072	27 04	144	50 18	190	58 18	285	44 54	335
233	41 11	000	44 21	044	19 52	071	27 36	144	50 08	190	57 24	284	44 31	334
234	41 11	359	44 59	043	20 44	071	28 09	144	49 58	191	56 31	284	44 06	333
235	41 10	358	45 36	042	21 37	070	28 42	144	49 47	192	55 36	283	43 40	332
236	41 07	357	46 13	040	22 29	070	29 15	144	49 35	192	54 42	282	43 13	330
237	41 03	356	46 48	039	23 21	069	29 47	144	49 23	193	53 48	282	42 45	329
238	40 59	355	47 23	038	24 13	069	30 20	144	49 10	194	52 53	281	42 16	328
239	40 53	353	47 57	037	25 05	068	30 53	144	48 56	194	51 59	281	41 46	327
	VEGA		*ALTAIR		Peacock		*RIGIL KENT.		SPICA		*ARCTURUS		Alphecca	
240	19 07	031	25 56	068	31 25	144	48 42	195	51 04	280	41 15	326	40 46	352
241	19 36	031	26 48	067	31 58	144	48 27	196	50 09	279	40 44	325	40 38	351
242	20 04	030	27 39	067	32 30	144	48 12	196	49 14	279	40 11	324	40 28	350
243	20 31	029	28 30	066	33 03	145	47 56	197	48 19	278	39 38	323	40 18	349
244	20 58	029	29 20	065	33 35	145	47 39	198	47 24	278	39 04	322	40 07	348
245	21 25	028	30 11	065	34 07	145	47 22	198	46 29	277	38 30	321	39 54	346
246	21 50	027	31 01	064	34 39	145	47 04	199	45 34	277	37 55	320	39 40	345
247	22 16	027	31 51	064	35 11	145	46 46	199	44 38	276	37 19	319	39 26	344
248	22 40	026	32 41	063	35 43	145	46 28	200	43 43	276	36 42	318	39 10	343
249	23 04	025	33 30	062	36 14	145	46 08	200	42 48	275	36 05	317	38 53	342
250	23 27	024	34 19	062	36 46	146	45 49	201	41 52	275	35 27	317	38 36	341
251	23 50	024	35 08	061	37 17	146	45 29	201	40 57	274	34 48	316	38 17	340
252	24 12	023	35 56	060	37 48	146	45 08	202	40 01	274	34 09	315	37 57	339
253	24 33	022	36 45	060	38 19	146	44 47	202	39 06	274	33 29	314	37 37	338
254	24 54	021	37 32	059	38 50	146	44 26	203	38 10	273	32 49	313	37 15	337
	*VEGA		ALTAIR		*Peacock		RIGIL KENT.		*SPICA		ARCTURUS		Alphecca	
255	25 13	021	38 20	058	39 21	147	44 04	203	37 15	273	32 08	312	36 53	336
256	25 32	020	39 07	057	39 51	147	43 42	204	36 19	272	31 27	312	36 29	335
257	25 51	019	39 53	056	40 21	147	43 19	204	35 24	272	30 45	311	36 05	334
258	26 09	018	40 39	056	40 51	148	42 56	205	34 28	272	30 03	310	35 40	333
259	26 26	017	41 25	055	41 21	148	42 33	205	33 32	271	29 20	310	35 14	332
260	26 42	016	42 10	054	41 51	148	42 09	205	32 37	271	28 37	309	34 48	331
261	26 57	016	42 55	053	42 20	149	41 45	206	31 41	270	27 54	308	34 20	330
262	27 12	015	43 39	052	42 49	149	41 20	206	30 45	270	27 10	307	33 52	329
263	27 26	014	44 23	051	43 17	149	40 56	207	29 50	270	26 25	307	33 23	328
264	27 39	013	45 06	050	43 45	150	40 31	207	28 54	269	25 41	306	32 53	327
265	27 51	012	45 49	049	44 13	150	40 05	207	27 59	269	24 56	306	32 22	326
266	28 02	011	46 30	048	44 41	150	39 40	208	27 03	269	24 10	305	31 51	325
267	28 13	011	47 12	047	45 08	151	39 14	208	26 07	268	23 24	304	31 19	325
268	28 23	010	47 52	046	45 35	151	38 48	208	25 12	268	22 38	304	30 47	324
269	28 32	009	48 32	045	46 01	152	38 22	208	24 16	267	21 52	303	30 14	323

LAT 22°S

LHA T	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	*VEGA		ALTAIR		*FOMALHAUT		Peacock		RIGIL KENT.		*ANTARES		* Alphecca	
270	28 40	008	49 11	044	24 04	114	46 28	152	37 55	209	68 30	254	29 40	322
271	28 47	007	49 49	043	24 55	114	46 53	153	37 28	209	67 37	254	29 06	321
272	28 54	006	50 27	042	25 46	114	47 18	153	37 01	209	66 43	254	28 31	321
273	28 59	005	51 03	040	26 37	113	47 43	154	36 34	209	65 50	254	27 55	320
274	29 04	004	51 39	039	27 28	113	48 07	154	36 07	210	64 56	255	27 19	319
275	29 08	004	52 13	038	28 19	113	48 31	155	35 39	210	64 03	255	26 42	318
276	29 11	003	52 47	036	29 11	113	48 54	156	35 12	210	63 09	255	26 05	318
277	29 13	002	53 19	035	30 02	113	49 17	156	34 44	210	62 15	255	25 27	317
278	29 14	001	53 51	034	30 53	112	49 39	157	34 16	210	61 21	255	24 49	316
279	29 15	000	54 21	032	31 45	112	50 01	157	33 47	211	60 28	255	24 10	316
280	29 14	359	54 50	031	32 36	112	50 22	158	33 19	211	59 34	255	23 31	315
281	29 13	358	55 18	029	33 28	112	50 43	159	32 51	211	58 40	255	22 52	314
282	29 11	357	55 44	028	34 19	112	51 03	159	32 22	211	57 46	255	22 12	314
283	29 08	356	56 09	026	35 11	112	51 22	160	31 53	211	56 53	255	21 31	313
284	29 04	356	56 33	024	36 03	112	51 40	161	31 25	211	55 59	255	20 50	312
	*DENEB		FOMALHAUT		*ACHERNAR		RIGIL KENT.		*ANTARES		Rasalhague		VEGA	
285	19 02	018	36 55	112	13 39	147	30 56	211	55 05	255	49 26	326	28 59	355
286	19 20	018	37 46	111	14 10	147	30 27	211	54 11	255	48 55	325	28 53	354
287	19 36	017	38 38	111	14 41	146	29 58	211	53 18	255	48 23	324	28 47	353
288	19 52	016	39 30	111	15 11	146	29 29	212	52 24	255	47 49	323	28 40	352
289	20 08	016	40 22	111	15 42	146	29 00	212	51 30	255	47 15	322	28 31	351
290	20 22	015	41 14	111	16 13	146	28 30	212	50 37	255	46 40	320	28 22	350
291	20 36	014	42 06	111	16 45	146	28 01	212	49 43	255	46 04	319	28 13	349
292	20 50	014	42 58	111	17 16	146	27 32	212	48 49	255	45 28	318	28 02	349
293	21 03	013	43 50	111	17 47	146	27 03	212	47 56	254	44 50	317	27 50	348
294	21 15	012	44 42	111	18 19	145	26 33	212	47 02	254	44 12	316	27 38	347
295	21 26	011	45 34	111	18 51	145	26 04	212	46 09	254	43 33	315	27 25	346
296	21 37	011	46 26	111	19 22	145	25 35	212	45 15	254	42 54	314	27 11	345
297	21 46	010	47 18	111	19 54	145	25 05	212	44 21	254	42 13	313	26 57	344
298	21 56	009	48 10	111	20 26	145	24 36	212	43 28	254	41 32	312	26 41	343
299	22 04	008	49 02	111	20 58	145	24 07	212	42 35	254	40 51	311	26 25	343
	DENEB		Enif		*FOMALHAUT		ACHERNAR		*RIGIL KENT.		ANTARES		*VEGA	
300	22 12	008	49 29	041	49 54	111	21 30	145	23 37	212	41 41	254	26 08	342
301	22 19	007	50 05	040	50 46	111	22 02	145	23 08	212	40 48	253	25 50	341
302	22 25	006	50 40	039	51 38	111	22 34	145	22 39	212	39 55	253	25 32	340
303	22 31	005	51 15	037	52 30	111	23 06	145	22 10	212	39 01	253	25 13	339
304	22 36	005	51 48	036	53 22	111	23 39	145	21 40	212	38 08	253	24 53	339
305	22 40	004	52 20	035	54 14	111	24 11	145	21 11	212	37 15	253	24 32	338
306	22 43	003	52 51	033	55 06	111	24 43	145	20 42	211	36 22	253	24 11	337
307	22 46	002	53 21	032	55 58	111	25 15	144	20 13	211	35 29	253	23 49	336
308	22 48	002	53 50	030	56 50	111	25 48	144	19 44	211	34 36	252	23 26	336
309	22 49	001	54 18	029	57 42	111	26 20	144	19 15	211	33 43	252	23 03	335
310	22 50	000	54 44	027	58 34	111	26 52	144	18 47	211	32 50	252	22 39	334
311	22 49	359	55 09	026	59 26	112	27 25	144	18 18	211	31 57	252	22 15	333
312	22 48	359	55 33	024	60 17	112	27 57	144	17 49	211	31 04	252	21 49	333
313	22 47	358	55 55	023	61 09	112	28 29	145	17 21	211	30 11	251	21 24	332
314	22 44	357	56 16	021	62 00	112	29 02	145	16 52	211	29 18	251	20 57	331
	Alpheratz		*Diphda		ACHERNAR		*Peacock		ANTARES		*ALTAIR		DENEB	
315	22 03	043	37 59	096	29 34	145	54 31	189	28 26	251	54 40	329	22 41	356
316	22 41	043	38 54	096	30 06	145	54 22	190	27 33	251	54 11	327	22 37	355
317	23 18	042	39 50	096	30 38	145	54 13	190	26 41	251	53 40	326	22 32	355
318	23 55	041	40 45	095	31 10	145	54 02	191	25 48	250	53 08	324	22 27	354
319	24 32	041	41 41	095	31 42	145	53 51	192	24 56	250	52 35	323	22 20	353
320	25 08	040	42 36	095	32 14	145	53 39	193	24 04	250	52 01	322	22 13	352
321	25 43	039	43 31	095	32 46	145	53 26	194	23 12	250	51 27	320	22 06	352
322	26 18	039	44 27	094	33 18	145	53 12	195	22 19	249	50 51	319	21 57	351
323	26 53	038	45 22	094	33 50	145	52 57	196	21 27	249	50 14	318	21 48	350
324	27 27	037	46 18	094	34 21	146	52 42	196	20 36	249	49 36	317	21 39	350
325	28 00	036	47 13	093	34 53	146	52 26	197	19 44	249	48 58	316	21 28	349
326	28 32	036	48 09	093	35 24	146	52 09	198	18 52	248	48 18	315	21 17	348
327	29 04	035	49 04	093	35 55	146	51 52	199	18 00	248	47 38	313	21 05	347
328	29 36	034	50 00	092	36 26	146	51 34	199	17 09	248	46 58	312	20 52	347
329	30 07	033	50 56	092	36 57	146	51 15	200	16 17	248	46 16	311	20 39	346
	*Alpheratz		Diphda		*ACHERNAR		Peacock		*Nunki		ALTAIR		DENEB	
330	30 37	032	51 51	092	37 28	147	50 55	201	47 27	254	45 34	310	20 25	345
331	31 06	031	52 47	091	37 58	147	50 35	202	46 33	254	44 51	309	20 11	344
332	31 35	031	53 42	091	38 28	147	50 15	202	45 39	254	44 08	308	19 56	344
333	32 03	030	54 38	091	38 59	147	49 53	203	44 46	254	43 24	308	19 40	343
334	32 30	029	55 34	090	39 29	148	49 32	203	43 52	254	42 40	307	19 23	342
335	32 56	028	56 29	090	39 58	148	49 09	204	42 59	254	41 55	306	19 06	342
336	33 22	027	57 25	090	40 28	148	48 46	205	42 06	254	41 10	305	18 48	341
337	33 47	026	58 21	089	40 57	148	48 23	205	41 12	254	40 24	304	18 30	340
338	34 11	025	59 16	089	41 26	149	47 59	206	40 19	253	39 37	303	18 11	340
339	34 34	024	60 12	088	41 55	149	47 34	206	39 25	253	38 51	302	17 51	339
340	34 57	023	61 07	088	42 23	149	47 09	207	38 32	253	38 04	302	17 31	338
341	35 18	022	62 03	087	42 51	150	46 44	207	37 39	253	37 16	301	17 10	338
342	35 39	021	62 59	087	43 19	150	46 18	208	36 46	253	36 28	300	16 49	337
343	35 59	020	63 54	087	43 46	151	45 52	208	35 53	253	35 40	300	16 27	336
344	36 17	019	64 50	086	44 14	151	45 25	209	35 00	252	34 51	299	16 04	336
	Alpheratz		*Hamal		*ACHERNAR		Peacock		Nunki		*ALTAIR		Enif	
345	36 35	018	26 03	048	44 40	151	44 58	209	34 07	252	34 03	298	53 02	327
346	36 52	017	26 44	047	45 07	152	44 31	210	33 14	252	33 13	297	52 31	326
347	37 08	016	27 25	046	45 33	152	44 03	210	32 21	252	32 24	297	52 00	324
348	37 23	015	28 05	046	45 59	153	43 35	210	31 28	252	31 34	296	51 27	323
349	37 37	014	28 44	045	46 24	153	43 07	211	30 35	252	30 44	296	50 53	322
350	37 50	013	29 23	044	46 49	154	42 38	211	29 42	251	29 54	295	50 18	321
351	38 02	012	30 02	043	47 13	154	42 09	212	28 50	251	29 03	294	49 42	319
352	38 13	011	30 40	043	47 37	155	41 40	212	27 57	251	28 12	294	49 05	318
353	38 23	010	31 17	042	48 00	155	41 10	212	27 05	251	27 21	293	48 28	317
354	38 32	009	31 54	041	48 23	156	40 41	213	26 12	250	26 30	293	47 49	316
355	38 40	008	32 30	040	48 46	157	40 11	213	25 20	250	25 39	292	47 10	315
356	38 47	006	33 06	039	49 07	157	39 40	213	24 27	250	24 47	292	46 30	314
357	38 52	005	33 41	039	49 29	158	39 10	213	23 35	250	23 55	291	45 50	313
358	38 57	004	34 15	038	49 50	158	38 39	214	22 43	250	23 03	291	45 09	312
359	39 01	003	34 48	037	50 10	159	38 08	214	21 51	249	22 11	290	44 27	311

LAT 22°S

LHA ↑	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	*Alpheratz		Hamal		*RIGEL		CANOPUS		ACHERNAR		*Peacock		Enif	
0	39 03 002		35 21 036		13 54 093		13 56 142		50 29 160		37 37 214		43 44 310	
1	39 04 001		35 54 035		14 49 093		14 31 141		50 48 160		37 06 214		43 01 309	
2	39 04 000		36 25 034		15 45 093		15 06 141		51 07 161		36 35 214		42 18 308	
3	39 04 359		36 56 033		16 40 092		15 41 141		51 24 162		36 03 215		41 33 307	
4	39 02 357		37 26 032		17 36 092		16 16 141		51 41 163		35 31 215		40 49 306	
5	38 59 356		37 55 031		18 32 092		16 51 141		51 58 163		35 00 215		40 04 305	
6	38 54 355		38 23 030		19 27 091		17 26 141		52 13 164		34 28 215		39 18 304	
7	38 49 354		38 51 029		20 23 091		18 02 140		52 28 165		33 55 215		38 32 304	
8	38 43 353		39 18 028		21 18 090		18 37 140		52 42 166		33 23 215		37 45 303	
9	38 36 352		39 43 027		22 14 090		19 13 140		52 56 166		32 51 216		36 58 302	
10	38 27 351		40 08 026		23 10 090		19 48 140		53 08 167		32 19 216		36 11 301	
11	38 18 350		40 32 025		24 05 089		20 24 140		53 20 168		31 46 216		35 24 301	
12	38 07 349		40 55 024		25 01 089		21 00 140		53 31 169		31 14 216		34 36 300	
13	37 56 347		41 17 023		25 57 089		21 36 140		53 41 170		30 41 216		33 47 299	
14	37 43 346		41 38 022		26 52 088		22 12 140		53 51 171		30 08 216		32 59 299	
	*Hamal		ALDEBARAN		RIGEL		*CANOPUS		ACHERNAR		*FOMALHAUT		Alpheratz	
15	41 58 020		24 59 058		27 48 088		22 48 140		53 59 172		61 09 248		37 29 345	
16	42 16 019		25 46 058		28 43 087		23 24 139		54 07 173		60 17 248		37 15 344	
17	42 34 018		26 33 057		29 39 087		24 01 139		54 14 173		59 25 248		36 59 343	
18	42 51 017		27 19 056		30 35 087		24 37 139		54 20 174		58 34 249		36 43 342	
19	43 06 016		28 05 056		31 30 086		25 13 139		54 25 175		57 42 249		36 25 341	
20	43 21 014		28 51 055		32 26 086		25 49 139		54 29 176		56 50 249		36 07 340	
21	43 34 013		29 37 054		33 21 085		26 26 139		54 32 177		55 58 249		35 47 339	
22	43 46 012		30 22 054		34 16 085		27 02 139		54 35 178		55 06 249		35 27 338	
23	43 57 011		31 06 053		35 12 084		27 38 139		54 36 179		54 14 249		35 06 337	
24	44 07 009		31 51 052		36 07 084		28 15 139		54 37 180		53 22 249		34 44 336	
25	44 15 008		32 35 052		37 02 084		28 51 139		54 36 181		52 30 249		34 21 335	
26	44 23 007		33 18 051		37 58 083		29 28 139		54 35 182		51 38 249		33 57 334	
27	44 29 006		34 01 050		38 53 083		30 04 139		54 33 183		50 46 249		33 33 333	
28	44 34 004		34 43 049		39 48 082		30 40 139		54 30 184		49 54 249		33 07 332	
29	44 37 003		35 25 049		40 43 082		31 17 139		54 26 184		49 02 249		32 41 332	
	Hamal		*ALDEBARAN		SIRIUS		*CANOPUS		ACHERNAR		*FOMALHAUT		Alpheratz	
30	44 40 002		36 07 048		23 25 099		31 53 139		54 21 185		48 10 249		32 14 331	
31	44 41 000		36 48 047		24 19 099		32 29 139		54 16 186		47 18 249		31 46 330	
32	44 40 359		37 28 046		25 14 099		33 05 140		54 09 187		46 26 249		31 18 329	
33	44 39 358		38 08 045		26 09 098		33 41 140		54 02 188		45 34 249		30 49 328	
34	44 36 357		38 47 044		27 04 098		34 17 140		53 53 189		44 42 249		30 19 327	
35	44 32 355		39 25 043		28 00 098		34 53 140		53 44 190		43 50 249		29 49 326	
36	44 27 354		40 03 042		28 55 097		35 29 140		53 34 191		42 58 249		29 18 326	
37	44 21 353		40 40 041		29 50 097		36 05 140		53 23 192		42 06 249		28 46 325	
38	44 13 351		41 17 040		30 45 097		36 41 140		53 12 192		41 14 249		28 13 324	
39	44 04 350		41 52 039		31 40 097		37 16 140		53 00 193		40 22 249		27 40 323	
40	43 54 349		42 27 038		32 36 096		37 51 141		52 46 194		39 30 249		27 07 322	
41	43 43 348		43 02 037		33 31 096		38 27 141		52 32 195		38 38 249		26 33 322	
42	43 31 346		43 35 036		34 26 096		39 02 141		52 18 196		37 46 249		25 58 321	
43	43 17 345		44 07 035		35 22 095		39 37 141		52 02 196		36 54 248		25 23 320	
44	43 02 344		44 39 034		36 17 095		40 12 141		51 46 197		36 03 248		24 47 320	
	*CAPELLA		BETELGEUSE		SIRIUS		*CANOPUS		ACHERNAR		*FOMALHAUT		Hamal	
45	15 30 024		38 19 060		37 12 095		40 46 142		51 29 198		35 11 248		42 47 343	
46	15 52 023		39 07 059		38 08 094		41 21 142		51 12 199		34 19 248		42 30 342	
47	16 14 022		39 55 059		39 03 094		41 55 142		50 54 199		33 28 248		42 12 340	
48	16 34 022		40 42 058		39 59 094		42 29 142		50 35 200		32 36 248		41 53 339	
49	16 55 021		41 29 057		40 54 093		43 03 143		50 16 201		31 45 248		41 32 338	
50	17 14 020		42 15 056		41 50 093		43 36 143		49 56 201		30 53 248		41 11 337	
51	17 33 020		43 01 055		42 46 093		44 09 143		49 35 202		30 02 247		40 49 336	
52	17 52 019		43 47 055		43 41 092		44 42 144		49 14 203		29 11 247		40 26 335	
53	18 10 018		44 32 054		44 37 092		45 15 144		48 52 203		28 19 247		40 02 334	
54	18 27 018		45 17 053		45 32 092		45 48 145		48 30 204		27 28 247		39 37 333	
55	18 44 017		46 01 052		46 28 091		46 20 145		48 07 204		26 37 247		39 11 332	
56	19 00 016		46 44 051		47 24 091		46 51 145		47 44 205		25 46 246		38 44 331	
57	19 15 016		47 27 050		48 19 091		47 23 146		47 20 206		24 55 246		38 16 330	
58	19 30 015		48 09 049		49 15 090		47 54 146		46 56 206		24 04 246		37 48 329	
59	19 44 014		48 50 048		50 10 090		48 25 147		46 31 207		23 13 246		37 18 328	
	CAPELLA		BETELGEUSE		*SIRIUS		CANOPUS		*ACHERNAR		Diphda		*Hamal	
60	19 58 014		49 31 047		51 06 090		48 55 147		46 06 207		43 34 265		36 48 327	
61	20 10 013		50 11 045		52 02 089		49 25 148		45 41 208		42 38 265		36 17 326	
62	20 23 012		50 50 044		52 57 089		49 54 148		45 15 208		41 43 265		35 45 325	
63	20 34 012		51 29 043		53 53 088		50 23 149		44 48 208		40 47 265		35 13 324	
64	20 45 011		52 06 042		54 49 088		50 51 150		44 22 209		39 52 264		34 40 323	
65	20 55 010		52 43 041		55 44 088		51 19 150		43 55 209		38 57 264		34 06 322	
66	21 04 009		53 19 039		56 40 087		51 47 151		43 27 210		38 01 264		33 31 321	
67	21 13 009		53 53 038		57 35 087		52 13 152		42 59 210		37 06 263		32 56 320	
68	21 21 008		54 27 036		58 31 086		52 40 152		42 31 210		36 11 263		32 21 320	
69	21 28 007		54 59 035		59 26 086		53 05 153		42 03 211		35 16 263		31 44 319	
70	21 35 006		55 31 034		60 22 085		53 30 154		41 35 211		34 21 262		31 07 318	
71	21 41 006		56 01 032		61 17 085		53 55 154		41 06 211		33 25 262		30 30 317	
72	21 46 005		56 30 030		62 12 084		54 18 155		40 36 212		32 30 262		29 52 316	
73	21 50 004		56 57 029		63 08 084		54 41 156		40 07 212		31 35 262		29 13 316	
74	21 54 003		57 23 027		64 03 083		55 04 157		39 37 212		30 40 261		28 34 315	
	*CAPELLA		POLLUX		PROCYON		*Suhail		CANOPUS		*ACHERNAR		Hamal	
75	21 57 003		26 14 040		42 43 059		35 13 128		55 25 158		39 08 213		27 54 314	
76	21 59 002		26 50 039		43 31 059		35 56 128		55 46 159		38 37 213		27 14 313	
77	22 01 001		27 25 039		44 18 058		36 40 128		56 06 159		38 07 213		26 33 313	
78	22 02 000		27 59 038		45 05 057		37 23 128		56 25 160		37 37 213		25 52 312	
79	22 02 000		28 33 037		45 51 056		38 07 129		56 43 161		37 06 214		25 11 311	
80	22 01 359		29 06 036		46 37 055		38 50 129		57 00 162		36 35 214		24 29 311	
81	22 00 358		29 39 035		47 23 054		39 34 129		57 17 163		36 04 214		23 47 310	
82	21 58 357		30 11 035		48 07 053		40 17 129		57 32 164		35 33 214		23 04 310	
83	21 55 357		30 42 034		48 52 052		41 00 129		57 47 165		35 02 214		22 21 309	
84	21 51 356		31 12 033		49 35 051		41 44 129		58 00 166		34 30 214		21 37 308	
85	21 47 355		31 42 032		50 18 050		42 27 129		58 13 168		33 59 215		20 53 308	
86	21 42 354		32 12 031		51 00 049		43 10 129		58 24 169		33 27 215		20 09 307	
87	21 36 354		32 40 030		51 42 048		43 53 130		58 35 170		32 56 215		19 25 307	
88	21 30 353		33 08 030		52 23 047		44 35 130		58 44 171		32 24 215		18 40 306	
89	21 23 352		33 35 029		53 03 045		45 18 130		58 53 172		31 52 215		17 55 305	

LAT 22°S

LHA ↑	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	POLLUX		*REGULUS		ACRUX		CANOPUS		*ACHERNAR		*ALDEBARAN		CAPELLA	
90	34 01 028		20 34 067		16 44 152		59 00 173		31 20 215		46 11 330		21 15 352	
91	34 27 027		21 25 066		17 10 152		59 06 174		30 48 215		45 42 328		21 06 351	
92	34 51 026		22 16 066		17 36 152		59 11 175		30 16 215		45 13 327		20 57 350	
93	35 15 025		23 06 065		18 03 151		59 15 177		29 44 215		44 42 326		20 47 349	
94	35 38 024		23 57 065		18 30 151		59 17 178		29 11 215		44 10 325		20 37 349	
95	36 00 023		24 47 064		18 56 151		59 19 179		28 39 215		43 38 324		20 25 348	
96	36 21 022		25 37 064		19 23 151		59 19 180		28 07 215		43 05 323		20 13 347	
97	36 41 021		26 27 063		19 50 151		59 18 181		27 34 216		42 31 322		20 01 347	
98	37 01 020		27 16 062		20 17 151		59 17 183		27 02 216		41 56 321		19 47 346	
99	37 19 019		28 05 062		20 44 151		59 13 184		26 30 216		41 20 320		19 33 345	
100	37 37 018		28 54 061		21 11 151		59 09 185		25 57 216		40 44 319		19 19 344	
101	37 53 017		29 43 061		21 38 151		59 04 186		25 25 216		40 07 318		19 04 344	
102	38 08 016		30 31 060		22 05 151		58 57 187		24 53 216		39 29 317		18 48 343	
103	38 23 015		31 19 059		22 32 151		58 50 188		24 20 215		38 51 316		18 31 342	
104	38 36 013		32 07 059		23 00 151		58 41 190		23 48 215		38 12 315		18 14 342	
	POLLUX		*REGULUS		Gienah		*ACRUX		CANOPUS		*RIGEL		BETELGEUSE	
105	38 49 012		32 54 058		16 42 102		23 27 151		58 31 191		60 50 294		56 23 329	
106	39 00 011		33 41 057		17 36 102		23 54 151		58 21 192		59 59 293		55 54 328	
107	39 10 010		34 28 057		18 31 102		24 21 151		58 09 193		59 08 292		55 24 326	
108	39 20 009		35 14 056		19 25 101		24 49 151		57 56 194		58 16 291		54 52 325	
109	39 28 008		36 00 055		20 20 101		25 16 151		57 42 195		57 24 290		54 19 323	
110	39 35 007		36 45 054		21 14 101		25 43 151		57 27 196		56 32 289		53 46 322	
111	39 41 006		37 30 053		22 09 101		26 11 151		57 11 197		55 39 289		53 11 320	
112	39 46 004		38 14 053		23 04 100		26 38 151		56 54 198		54 46 288		52 35 319	
113	39 49 003		38 58 052		23 58 100		27 05 151		56 37 199		53 53 287		51 58 318	
114	39 52 002		39 42 051		24 53 100		27 32 151		56 18 200		53 00 286		51 20 317	
115	39 54 001		40 25 050		25 48 099		27 59 151		55 59 201		52 06 286		50 42 315	
116	39 54 000		41 07 049		26 43 099		28 27 151		55 39 202		51 13 285		50 02 314	
117	39 53 359		41 49 048		27 38 099		28 54 151		55 18 203		50 19 284		49 22 313	
118	39 51 358		42 30 047		28 33 098		29 21 151		54 56 203		49 25 284		48 41 312	
119	39 49 356		43 11 046		29 28 098		29 48 151		54 33 204		48 31 283		47 59 311	
	*REGULUS		SPICA		*ACRUX		CANOPUS		*RIGEL		BETELGEUSE		POLLUX	
120	43 51 045		12 26 097		30 14 151		54 10 205		47 36 282		47 17 310		39 44 355	
121	44 30 044		13 22 097		30 41 151		53 46 206		46 42 282		46 34 309		39 39 354	
122	45 09 043		14 17 096		31 08 151		53 21 207		45 47 281		45 51 308		39 33 353	
123	45 46 042		15 12 096		31 34 152		52 56 207		44 53 281		45 07 307		39 26 352	
124	46 23 041		16 08 096		32 01 152		52 30 208		43 58 280		44 22 306		39 17 351	
125	47 00 040		17 03 095		32 27 152		52 04 209		43 03 280		43 37 305		39 08 350	
126	47 35 039		17 58 095		32 54 152		51 37 209		42 08 279		42 51 304		38 57 348	
127	48 10 038		18 54 095		33 20 152		51 09 210		41 13 279		42 05 304		38 46 347	
128	48 43 037		19 49 094		33 46 152		50 41 211		40 18 278		41 18 303		38 33 346	
129	49 16 035		20 45 094		34 11 152		50 13 211		39 23 278		40 31 302		38 19 345	
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131	50 18 033		22 36 093		35 03 153		49 14 212		37 33 277		38 56 300		37 49 343	
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133	51 16 030		24 27 092		35 53 153		48 14 213		35 42 276		37 19 299		37 14 341	
134	51 43 029		25 23 092		36 18 153		47 43 214		34 47 275		36 30 298		36 56 340	
	REGULUS		*SPICA		ACRUX		*CANOPUS		SIRIUS		BETELGEUSE		*POLLUX	
135	52 10 027		26 18 092		36 43 154		47 12 214		57 30 273		35 41 297		36 36 339	
136	52 34 026		27 14 091		37 07 154		46 40 215		56 35 273		34 52 297		36 16 338	
137	52 58 024		28 09 091		37 31 154		46 08 215		55 39 272		34 02 296		35 54 337	
138	53 20 023		29 05 091		37 55 155		45 36 216		54 44 272		33 12 295		35 32 336	
139	53 41 021		30 01 090		38 19 155		45 04 216		53 48 272		32 21 295		35 09 335	
140	54 01 020		30 56 090		38 43 155		44 31 216		52 52 271		31 31 294		34 45 334	
141	54 19 018		31 52 090		39 06 155		43 58 217		51 57 271		30 40 294		34 20 333	
142	54 35 017		32 48 089		39 29 156		43 24 217		51 01 270		29 49 293		33 54 332	
143	54 50 015		33 43 089		39 52 156		42 51 217		50 06 270		28 58 292		33 28 331	
144	55 04 013		34 39 088		40 14 156		42 17 218		49 10 270		28 06 292		33 01 330	
145	55 16 012		35 34 088		40 36 157		41 43 218		48 14 269		27 14 291		32 33 329	
146	55 26 010		36 30 088		40 58 157		41 08 218		47 19 269		26 22 291		32 04 328	
147	55 35 008		37 26 087		41 20 157		40 34 218		46 23 269		25 30 290		31 35 328	
148	55 42 006		38 21 087		41 41 158		39 59 219		45 28 268		24 38 290		31 05 327	
149	55 47 005		39 17 086		42 02 158		39 24 219		44 32 268		23 46 289		30 34 326	
	REGULUS		*ARCTURUS		SPICA		*ACRUX		CANOPUS		SIRIUS		*PROCYON	
150	55 51 003		15 23 061		40 12 086		42 22 159		38 49 219		43 36 268		45 45 304	
151	55 53 001		16 12 061		41 08 085		42 42 159		38 14 219		42 41 267		44 59 303	
152	55 53 359		17 00 060		42 03 085		43 02 160		37 39 220		41 45 267		44 12 302	
153	55 52 358		17 48 060		42 58 085		43 21 160		37 03 220		40 50 267		43 25 301	
154	55 49 356		18 36 059		43 54 084		43 40 160		36 28 220		39 54 266		42 37 300	
155	55 44 354		19 24 059		44 49 084		43 58 161		35 52 220		38 59 266		41 49 300	
156	55 37 353		20 11 058		45 44 083		44 17 161		35 16 220		38 03 266		41 00 299	
157	55 29 351		20 58 057		46 40 083		44 34 162		34 40 220		37 08 265		40 11 298	
158	55 20 349		21 45 057		47 35 082		44 51 162		34 04 220		36 12 265		39 22 297	
159	55 08 347		22 32 056		48 30 082		45 08 163		33 28 220		35 17 265		38 33 297	
160	54 56 346		23 18 056		49 25 081		45 24 163		32 52 221		34 21 264		37 43 296	
161	54 41 344		24 03 055		50 20 081		45 40 164		32 16 221		33 26 264		36 53 295	
162	54 25 343		24 49 055		51 14 080		45 55 164		31 40 221		32 31 264		36 02 295	
163	54 08 341		25 34 054		52 09 079		46 10 165		31 04 221		31 36 263		35 11 294	
164	53 49 339		26 19 053		53 04 079		46 24 166		30 27 221		30 40 263		34 21 293	
	*ARCTURUS		ANTARES		*ACRUX		CANOPUS		SIRIUS		*PROCYON		REGULUS	
165	27 03 053		16 28 112		46 37 166		29 51 221		29 45 263		33 29 293		53 28 338	
166	27 47 052		17 20 112		46 50 167		29 15 221		28 50 262		32 38 292		53 07 336	
167	28 31 051		18 11 112		47 03 167		28 38 221		27 55 262		31 46 292		52 44 335	
168	29 14 051		19 03 112		47 15 168		28 02 221		27 00 262		30 54 291		52 19 333	
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170	30 39 049		20 47 111		47 37 169		26 49 221		25 10 261		29 10 290		51 27 330	
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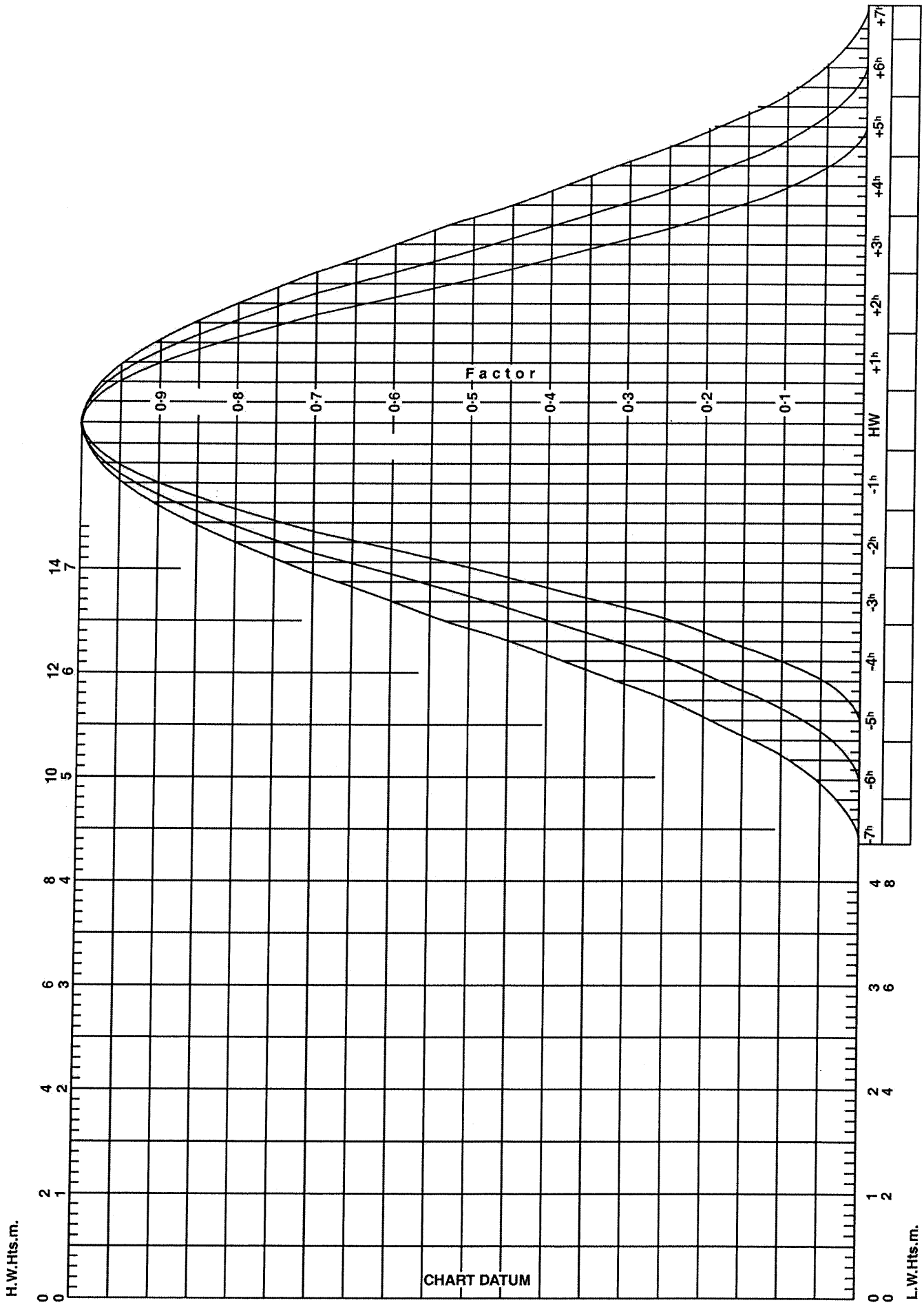
172	32 02 048		22 31 111		47 57 170		25 36 221		23 20 261		27 25 289		50 30 328	
173	32 43 047		23 23 110		48 06 171		25 00 221		22 25 260		26 32 288		50 00 326	
174	33 23 046		24 15 110		48 14 172		24 24 221		21 30 260		25 40 288		49 28 325	
175	34 03 045		25 07 110		48 22 172		23 48 221		20 35 260		24 46 287		48 56 324	
176	34 42 044		26 00 110		48 29 173		23 11 221		19 41 259		23 53 287		48 23 323	
177	35 21 044		26 52 109		48 35 174		22 35 220		18 46 259		23 00 286		47 49 322	
178	35 59 043		27 45 109		48 41 174		21 59 220		17 51 259		22 06 286		47 14 320	
179	36 36 042		28 37 109		48 46 175		21 23 220		16 57 258		21 13 285		46 38 319	

(This Worksheet must be returned with your answer book)



Candidate's Name ..... Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

An 88,000 GT bulk carrier is to make a loaded passage between Freemantle (W Australia) to Antwerp (Belgium), via the Suez Canal.
The vessel's owners have indicated they require a service speed of 14.0 knots.

1 The vessel is to follow a great circle track from a departure position off Freemantle to a landfall position off Raas Caseyr, as indicated below.

Departure Position	33°02'.0S 115°45'.0E
Landfall Position	11°50'.0N 51°17'.0E

(a) Calculate EACH of the following:

(i) the distance on the great circle track; (10)

(ii) the initial great circle course; (10)

(iii) the position of the vertex. (15)

(b) State the relationship between the position of the vertex and the point where the GC track crosses the equator, stating the longitude when the vessel crosses the equator. (5)

2 (a) Outline SIX of the precise objectives of the IMO Ships Routeing schemes that would be appropriate to an area such as the Gulf of Aden and Red Sea. (18)

(b) State THREE different sources where information on traffic separation schemes in the Red Sea may be found. (3)

(c) Certain classes of vessels are permitted to use the inshore traffic zones of traffic separation schemes. Detail the circumstances under which they may do so. (9)

3 (a) With reference to Datasheet Q3(1), explain why there are multiple routes in the vicinity of the island of Suqutra for both outbound and inbound passages in the Gulf of Aden. (15)

(b) With reference to Datasheet Q3(2), describe the main navigational factors to be considered when approaching and rounding Raas Caseyr. (15)

(c) Explain why restricted visibility is often encountered in the vicinity of Suqutra. (5)

4 (a) State the appropriate manning levels on the bridge, outlining the duties of EACH member of the bridge team, for EACH of the following situations:

(i) navigation in a Traffic Separation Scheme with dense traffic; (15)

(ii) navigation in clear weather, during darkness, on a ocean passage. (8)

(b) In general terms outline the factors that should be considered when writing a set of Master's Standing Orders. (22)

5 A vessel is proceeding at 12 knots on a course of 065°(T) in restricted visibility, estimated to be approximately 1.0 nautical mile.

The OOW commences plotting three targets, on the 12 nml range, at 0006 hrs and the resultant plot completed at 0018 hrs is shown on Worksheet Q5.

(a) Complete the plot for ALL THREE targets. (6)

(b) Determine EACH of the following:

(i) course and speed of Target A; (2)

(ii) course and speed of Target B; (2)

(iii) CPA, TCPA and speed of Target C. (3)

(c) Determine the alteration of course required at 0024 hrs to allow Target B to pass clear with a CPA of 2 miles. (6)

(d) At 0024 hrs the OOW alters course 60° to starboard, maintaining a speed of 12 knots.

Comment on the action taken by the OOW with reference to Rule 19 of the IRPCS. (10)

(e) At 0027 hrs the vessel is settled on a course of 125° (T) and the following information is obtained from Target C.

Time	Range	Bearing
0027	6.1 nml	228° (T)
0033	5.1 nml	228° (T)
0039	4.1 nml	228° (T)

Determine what action, if any, has been taken by target C. (9)

(f) State, with reasons, what action should be taken by the OOW at 0039 hrs. (12)

6.165.2
For low-powered vessels routes are:
November to March:
Between Pulau-pulau Mentawi and Sumatera, thence:
Through Selat Siberut, thence:
Across the equator in 97° 00′ E, thence:
1° 50′ N, 95° 00′ E, thence:
5° 00′ N, 90° 00′ E, thence:
5° 30′ N, 85° 00′ E, thence:
Through the Traffic Separation Scheme (1.28) off Dondra Head, thence:
As at 6.79 to Aden.

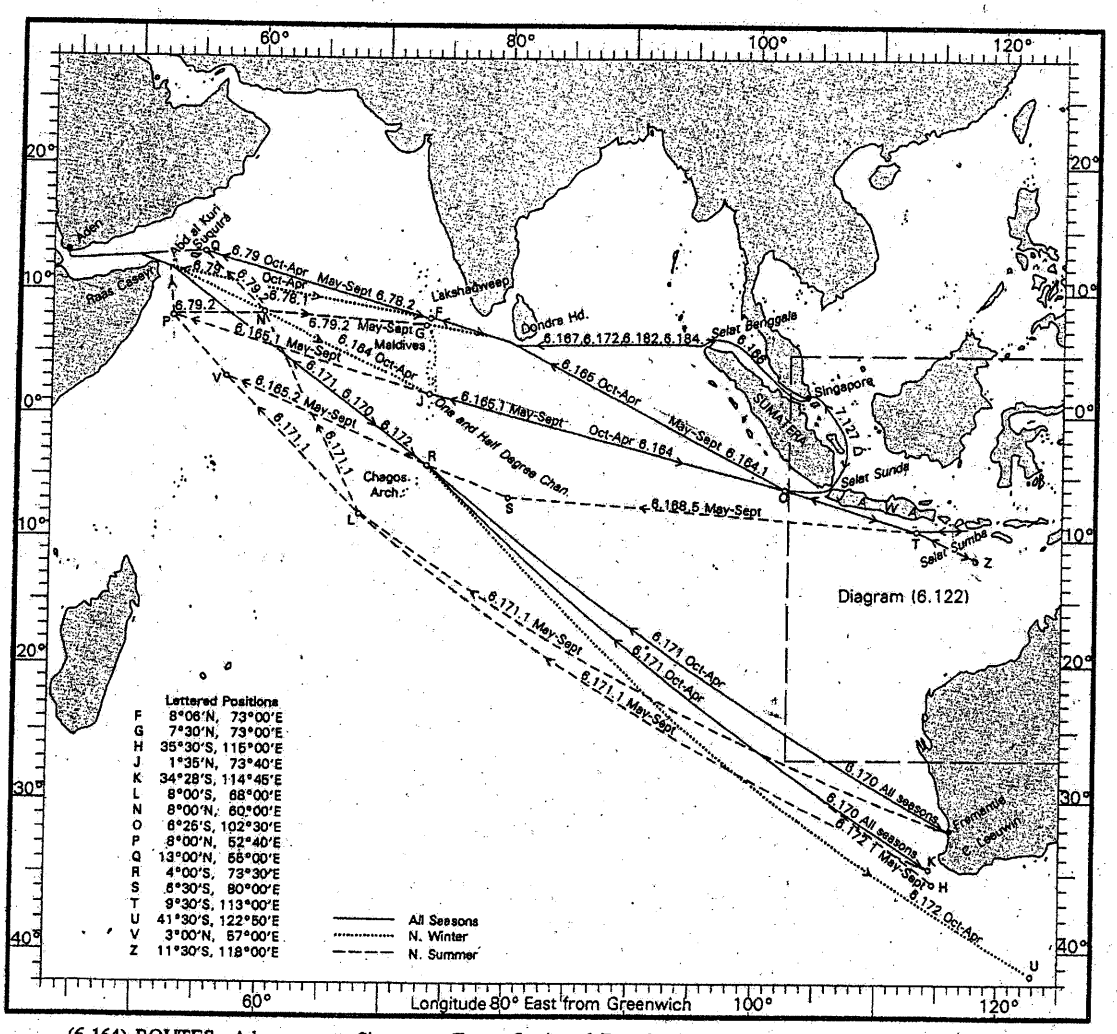
6.165.3
April, May, June and September:
Through 8° 00′ S, 68° 00′ E, passing close S of Chagos Archipelago, thence:
8° 00′ N, 52° 40′ E, thence:
Round Raas Caseyr to Aden.

6.165.4
July and August:
Through 2° 30′ S, 65° 00′ E, thence:
1° 10′ S, 61° 30′ E, thence:
8° 00′ N, 52° 40′ E, thence:
Round Raas Caseyr to Aden.

Aden ↔ Singapore

6.166
Diagrams (6.164)
Routes are as for the Malacca Strait route of 6.167–6.167.2 (E-bound) or 6.168.2 and 168.4 (W-bound).

6.166.1
East-bound, alternative routes are those at 6.164 and 6.164.1 from Aden to Selat Sunda, thence as at 7.127 to Singapore.



(6.164) ROUTES—Aden ⟷ Singapore, Torres Strait and Darwin, South Australia and South Pacific Ocean.

the approach of a tropical storm, of which little warning may be expected in these waters.

The currents near the W coast of Madagascar are little known. In mid-channel and extending at least halfway towards Madagascar, the predominant flow is NE-going at rates of about ¾ knot, but both direction and rate are highly variable.

On the African side of the channel, the Mozambique Current sets strongly in a SSW direction, following the coast; in the region of Mozambique this current is thought to extend about 50 miles off the coast during most of the year, increasing to nearly 100 miles in June, July and August. It is strongest from October to February, rates of 4 knots being attained occasionally. Inshore counter currents are common near Banco de Sofala and in Bahia de Maputo.

The situation in Mozambique Channel, where strong SSW-going currents suddenly give place to moderate or possibly strong currents in the opposite direction, has obvious dangers. The boundaries of the currents vary with season and weather, and their rates may differ by as much as 4 knots from those anticipated.

6.57.1

North-bound. From the vicinity of Durban, the route opens from the coast to a distance of about 100 miles and passes through:

27° 15′ S, 36° 00′ E, thence:
17° 00′ S, 42° 15′ E, passing either W of Bassas da India or E of Île Europe, thence:
11° 35′ S, 42° 50′ E, thence to destination.

The route E of Île Europa will encounter less adverse current but is 30 miles longer.

6.57.2

South-bound. From 11° 35′ S, 42° 50′ E the route is through:

15°00′S, 41°20′E, in the full strength of the Mozambique current thence:
17°00′S, 40°20′E, thence:
25°00′S, 35°30′E, thence to destination.

Mozambique Channel ↔ Aden

6.58

Diagram (6.58)

The East African Current flows continually N from Cabo Delgado coastwise past Mombasa, giving way in about 2° S to the Somali Current.

The Somali Current is SW-going from December to February at rates of about 2 knots, occasionally reaching 3 or 4 knots. In March the SW-going set weakens but continues S of about 4° N; N of that latitude the current turns to the NE. Between April and May the S part of the current turns to the NE, so that a NE-going current is established along the whole coast until September, often with rates of from 4 to 5 knots, and sometimes as much as 7 knots. In October the NE-going current starts to weaken, and gives way in November to a SW-going set between 5° N and 10° N, which starts offshore. North of 10° N, the NE-going set continues inshore until December when it turns to establish the SW-going current along the whole coast.

A definite width cannot be assigned to the coastal currents between Cabo Delgado and Raas Caseyr; the NE-going current which reaches its full strength between June and September is stronger nearer the coast and decreases rapidly at a distance of over 50 miles offshore. S-bound shipping will therefore benefit by keeping a good offing.

6.58.1

Rounding Raas Caseyr. Passage may be made, either N of Suquṭrá, giving that island a berth of at least 40 miles, or between 'Abd al Kūrī and Raas Caseyr, but the latter is the usual route. Particularly during the South-west Monsoon, when better conditions of wind and sea can be expected S of Suquṭrá.

Ships not fitted with radar or other radio position-finding system, uncertain of their position, should however take the route N of Suquṭrá where, if stormy, there is ample searoom (see 6.58.2).

6.58.2

Suquṭrá. Owing to the imperfect nature of the survey, navigation in the vicinity of Suquṭrá must be undertaken with caution.

It is dangerous for vessels not fitted with radar to make Rhiy di-Irīsal the E point of Suquṭrá, during either monsoon. In the North-east Monsoon the land may be obscured about sunset by heavy rain squalls; in the South-west Monsoon the lower land E of the mountain range is often obscured by haze. Depths off Rhiy di-Irīsal are considerable, and sounding gives no warning of the dangers which extend from the shore. Currents in the vicinity are strong and irregular.

6.58.3

Raas Caseyr and the coastline in its vicinity are charted from old and imperfect surveys, and should be regarded as approximate and approached with caution.

Many wrecks have occurred on the coast S of Raas Caseyr, and great caution is necessary when steering NW and N towards and past this headland in the South-west Monsoon. The weather and sea are then at their worst, the N-going current at its strongest, and the land generally covered by thick haze.

A resemblance exists between the profiles of Raas Caseyr and Raas Shannaqiif, 10 miles SSW, but Raas Shannaqiff is 927 m high, and Raas Caseyr only 238 m; they are separated by a broad comparatively low sandy plain. In hazy weather, the steep fall of Raas Shannaqiff may perhaps be dimly seen when it bears less than about 270°. If Raas Caseyr has not been sighted, as often happens if the haze is thicker near sea level and obscures that light-coloured hill, Raas Shannaqiff may be mistaken for Raas Caseyr with disastrous results.

In the South-west Monsoon Raas Xaafuun should be made before Raas Caseyr.

By day there is usually a gradual change in colour of the water from blue to dark green as the land is approached; the sea also becomes smoother and swell tends to come from E of S when N and W of Raas Xaafuun.

When making Raas Caluula and Raas Caseyr from the Gulf of Aden, allowance must be made for the possibility of a SW or onshore set, particularly during the North-east Monsoon.

6.58.4

Routes. To summarise, for passages between Mozambique Channel and Gulf of Aden, the normal route in both directions passes between 'Abd al Kūrī and Raas Caseyr, and between intermediate coastal destinations passages should normally be made coastwise in both directions.

6.58.5

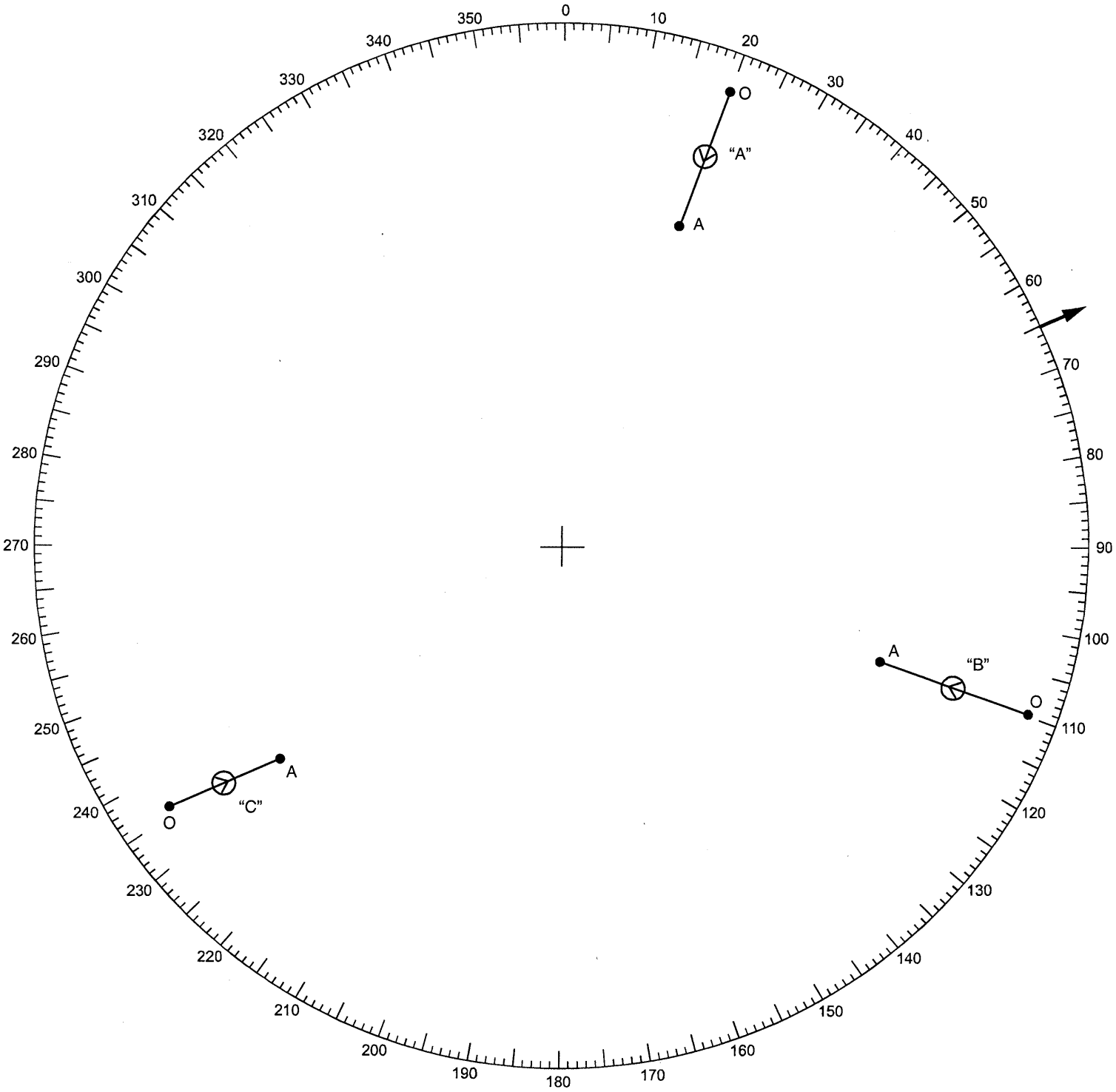
South-bound, however, the strongest effects of the South-west Monsoon (June–August) and of the NE-going current between Raas Caseyr and Comoros may be avoided by passing through:

8° 00′ N, 52° 40′ E, thence:
1° 10′ N, 55°00′ E, thence:
Joining the route through Mozambique Channel in 11° 35′ S, 42° 50′ E.

This adds 220 miles to the distance between Raas Caseyr and Comoros.

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Range Scale 0 1 2 3 4 5 6 7 8 9 10 11 12

(This is not a metric scale)

Signature of Candidate .....

Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 325 metre container vessel is on a long term charter to carry cargo between North West Europe, Southern Africa, New Zealand and the East Coast of the United States. The vessel carries navigation equipment as per statute and has a service speed of 22.0 knots. The vessel is due to depart Zeebrugge (Belgium) on the 8th January with an expected departure draft of 12.8m, bound for Wellington (New Zealand), via Durban (South Africa)

1 On leaving the berth in Zeebrugge (ATT No 1562) the vessel will have to cross a shoal patch in the outbound channel with a charted depth of 11.2 metres.

The vessel will encounter the shoal 20 minutes after leaving the berth and the Master requires an underkeel clearance (UKC) of 2.5 metres at all times.

(a) (i) Determine the height of tide required to maintain the vessels required UKC. (5)

(ii) Using Worksheet Q1, find the earliest time the vessel can leave the berth on the PM flood tide on the 8th. (25)

(b) A deep low pressure area, located in the Southern North Sea, is causing Southerly offshore gales across the whole of the area.

Outline TWO factors that may affect the accuracy of the tidal height predictions found in Admiralty Tide Tables, given the current weather conditions. (6)

(c) Explain why interpolation between the neap and spring curves requires to be more accurate for the flood tide than the ebb tide, for the port of Zeebrugge. (4)

2 The vessel clears Zeebrugge and enters the SW bound lane of the Dover Straits Traffic Separation Scheme. Weather conditions remain the same as on departure Zeebrugge, with heavy rain and driving spray seriously affecting visibility. Dense traffic expected off the port of Dover.

(a) State the ideal manning levels on the bridge to ensure the vessel is navigated safely during the passage through the Straits. (5)

(b) Outline the duties and responsibilities of EACH of the team members. (20)

(c) Outline FIVE objectives of IMO approved Traffic routeing schemes which are applicable to the Dover Straits. (10)

3 At 0040 hrs the vessel is proceeding in the general direction of traffic flow in the SW bound lane, and is steering 240° (T) at a speed of 12 knots.

The visibility is estimated to be 1.0 mile and the vessel's engines are on standby and ready for immediate manoeuvre.

Worksheet Q3 shows a radar plot, on the 6 mile range, obtained by the OOW, over a 10 minute period, the plot being completed at 0050 hours.

(a) On Worksheet Q3, for targets A,B and C, determine EACH of the following:

(i) the course and speed; (6)

(ii) the CPA and Time of CPA; (6)

(iii) the aspect at 0050 hrs. (6)

(b) With reference to Datasheet Q3(b), outline the likely intentions of EACH target vessel with respect to Rule 10 of the IRCPS. (6)

(c) Determine the action that a prudent master would take at 0055 hrs to ensure that all targets pass at least 1.0 mile clear of the vessel. (9)

Note: assume that any alteration of course and/or speed have instantaneous effect.

(d) Explain fully how the action taken in Q3(c) complies with Rule 19 of the IRPCS. (15)

4 The vessel arrives in Durban on the 22nd January and the Master is advised that the vessel is to make an additional call at Freemantle (W Australia).

(a) With reference to Datasheet Q4, state the recommended route for the time of year for such a passage. (5)

(b) Indicate the recommended route on Worksheet Q4(b). (10)

(c) Calculate the total distance on passage given the following departure and landfall positions: (20)

Departure position 29°52'.0S 31°02'.0E
Landfall position 32°03'.0S 115° 44'.0E

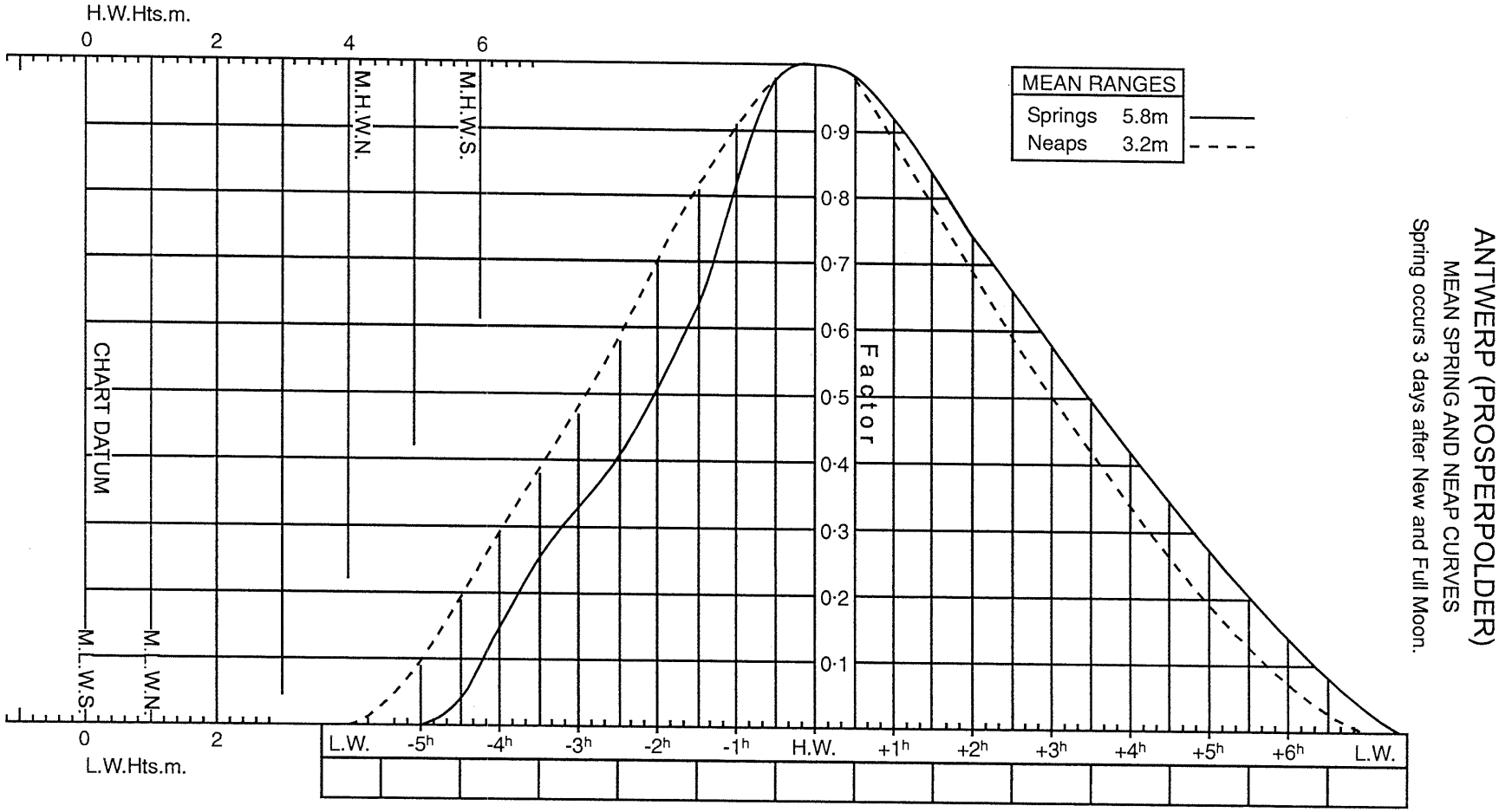
(d) If the vessel departs Durban at 0530 hrs (Standard Time) on the 24th January, calculate the ETA at Freemantle (Standard Time) assuming an additional 30 miles will be added to the distance calculated in Q4(c) to allow for pilotage. (10)

5 (a) Outline TEN factors to be taken into account when planning a landfall after a long ocean passage. (20)

(b) Outline SIX navigational factors which should be considered by the Master when selecting a suitable anchorage. (12)

WORKSHEET Q1

(This Worksheet must be returned with your answer book)



ANTWERP (PROSPERPOLDER)

MEAN SPRING AND NEAP CURVES

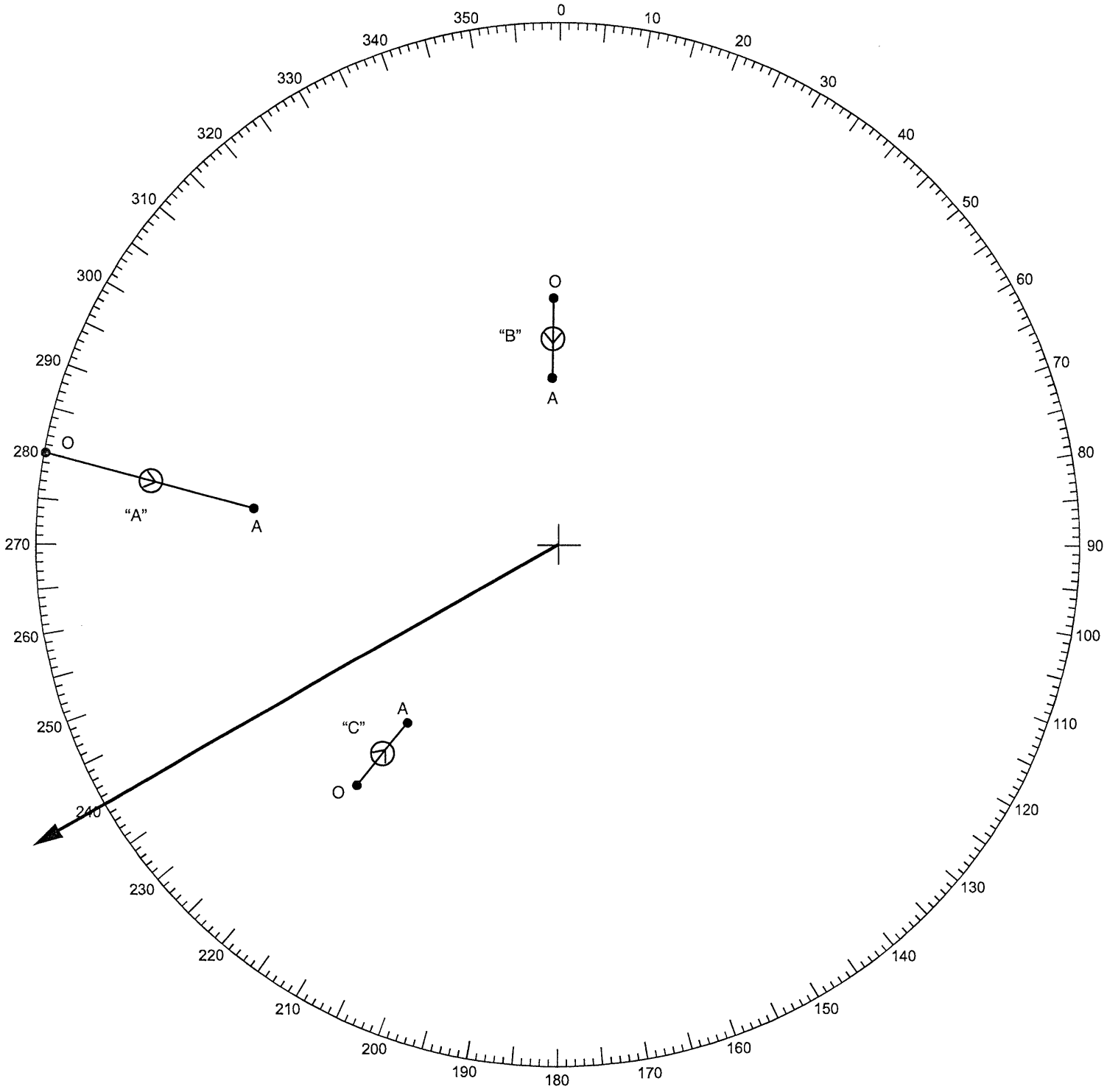
Spring occurs 3 days after New and Full Moon.

Candidate's Name .....

Examination Centre .....

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



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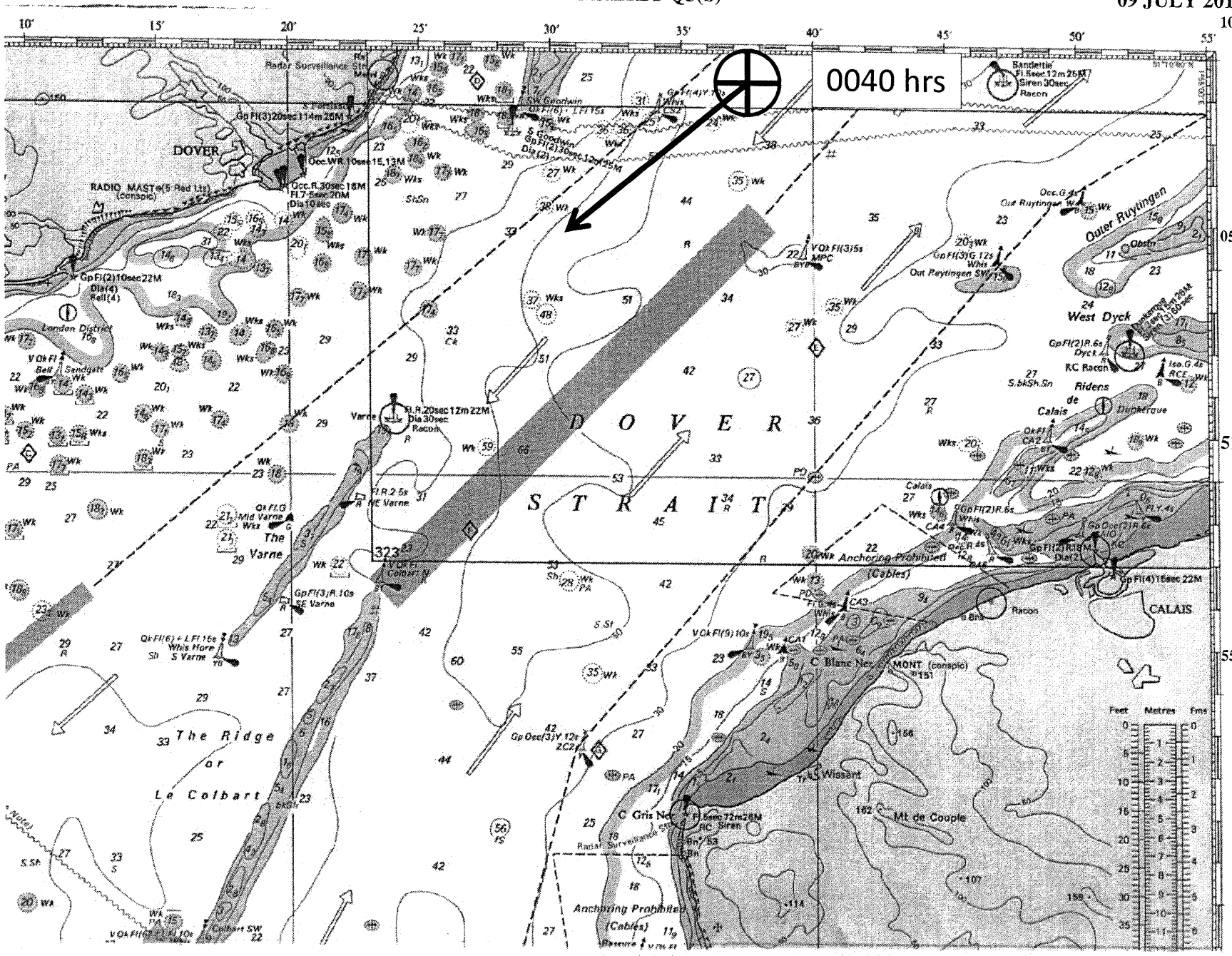
0040 hrs
DOVER
D O V E R
S T R A I T
The Varne
The Ridge
or
Le Colbart
Outer Ruytingen
West Dyck
Ridens
de
Calais
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CALAIS
Wissant
Mt de Couple
C Gris Nez
C Blanc Nez
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Anchoring Prohibited
(Cables)
Feet
Metres
Fms
10'
15'
20'
25'
30'
35'
40'
45'
50'
55'
05'
51°
55'

6.156

North-west and North coasts of Australia → Durban or Cape Town—October to April

6.156

Diagrams: (6.122) and (6.151) for Durban or (6.150) for Cape Town

From Torres Strait. The route follows the Ocean Route at 6.122.2 to 11° 30′ S, 118° 00′ E, thence:
Either, great circle to Durban:
Or, great circle to 35° S, 65° E, thence:
Rhumb line to a landfall on Cape Recife, thence:
Coastwise as at 6.56 to Cape Town.

6.156.1

From Darwin. The route is through North Sahul Passage to join the route from Torres Strait SE of Timor.

6.165.2

From places between Darwin and Yampi Sound. Routes are by the recommended tracks (6.121) to 15° 30′ S, 120° 00′ E, thence either great circle direct to Durban or great circle to join the route from Torres Strait to Cape Town in 35° S, 65° E.

6.156.3

From places West of Yampi Sound. The route is as direct as navigation permits to 20° S, 115° E, off Monte Bello Islands, thence either great circle to Durban or great circle to join the route from Torres Strait to Cape Town in 35° S, 65° E.

North-west and north coasts of Australia → Durban and Cape Town—May to September

6.156.4

From Yampi Sound and all places farther East. Routes are by the recommended tracks (6.121) to 15° 30′ S, 120° 00′ E, thence great circle to 30° 00′ S, 56° 30′ E, thence along the parallel of 30° S to Durban, or continuing thence for Cape Town as at 6.56.

6.156.5

From places West of Yampi Sound. Routes are as direct as navigation permits to 20° S, 115° E, thence great circle to join the route from ports N of Yampi Sound in 30° 00′ S, 56° 30′ E.

6.156.6

Distances in miles:

		Durban	*Cape Town (G)*
Torres Strait	Oct–April	6350	7000
	May–Sept	6260	7050
Darwin	Oct–April	5710	6370
	May–Sept	5580	6370
Port Hedland	Oct–April	4730	5360
	May–Sept	4750	5540

(G) For distances to Cape Agulhas (15 miles S of), subtract 130 miles.

Cape Town → West and South coasts of Australia—October to April

6.157

Diagram (6.157)

Routes are across the Agulhas Current to 36° 45′ S, 19° 00′ E, 145 miles S of Cape of Good Hope, thence:
Rhumb line to 40° S, 55° E, thence:
Along the parallel of 40° S.

For Fremantle the route continues by great circle from 40° S, 77° E.

For Adelaide and Melbourne routes continue by great circle from 40° S, 100° E.

For Hobart the route continues by great circle from 40° S, 100° E to 41° 30′ S, 122° 50′ E, on the route to Melbourne, thence great circle to South West Cape, Tasmania, thence as navigation permits to Hobart.

6.157.1

Shorter but more boisterous routes are:
Through 36° 45′ S, 19° 00′ E, thence:
Rhumb line to 44° S, 40° E, thence:
Rhumb line to 45° S, 65° E, thence:
Along the parallell of 45° S.

For Fremantle the route is by great circle from 45° S 65° E.

For Adelaide the route leaves the parallel of 45° S in 92° 26′ E and follows the great circle to Investigator Strait.

For Melbourne the route leaves the parallel of 45° S in 107° 20′ E and follows the great circle to Cape Otway, thence as direct as navigation permits.

For Hobart the route continues along the parallel of 45° S to 130° E, thence by great circle to destination.

Cape Town → West and South coasts of Australia—May to September

6.157.2

To avoid the probability of foul weather farther S, routes are:
Through 35° 30′ S, 20° 00′ E, thence:
Along the parallel of 35° 30′ S, which, if strictly followed, passes close under West Cape Howe to Investigator Strait which leads to Adelaide.

For Fremantle, the route is by great circle leaving the parallel of 35° 30′ S in 90° E.

For ports East of Adelaide, routes are by great circle leaving the paralle of 35° 30′ S in 115° 00′ E, S of Cape Leeuwin.

6.157.3

The possibility of encountering icebergs on these routes at any time of the year cannot be discounted, see 6.43.

6.157.4

Distances in miles.

Cape Town to:	*Oct–April* (a′) (6.157)	(6.157.1)	*May–Sept (G)* (6.157.2)
Fremantle	4840	4790	4870
Adelaide	5820	5660	5950
Port Phillip for Melbourne*	6030	5820	6230
Hobart	6150	5870	6400

* Port Phillip to Melbourne: 40 miles.
(a′) For distance from Cape of Good Hope (145 miles S of), subtract 180 miles.
(G) For distances from Cape Agulhas (15 miles S of), subtract 130 miles.

Durban → West and South coasts of Australia

6.158

Diagram (6.157)

October to April, routes join those at 6.157 from Cape Town, by great circle from Durban to 40° S, 77° E.

6.158.1

May to September, routes join those from Cape Town by great circle from Durban to 35° 30′ S, 67° 30′ E.

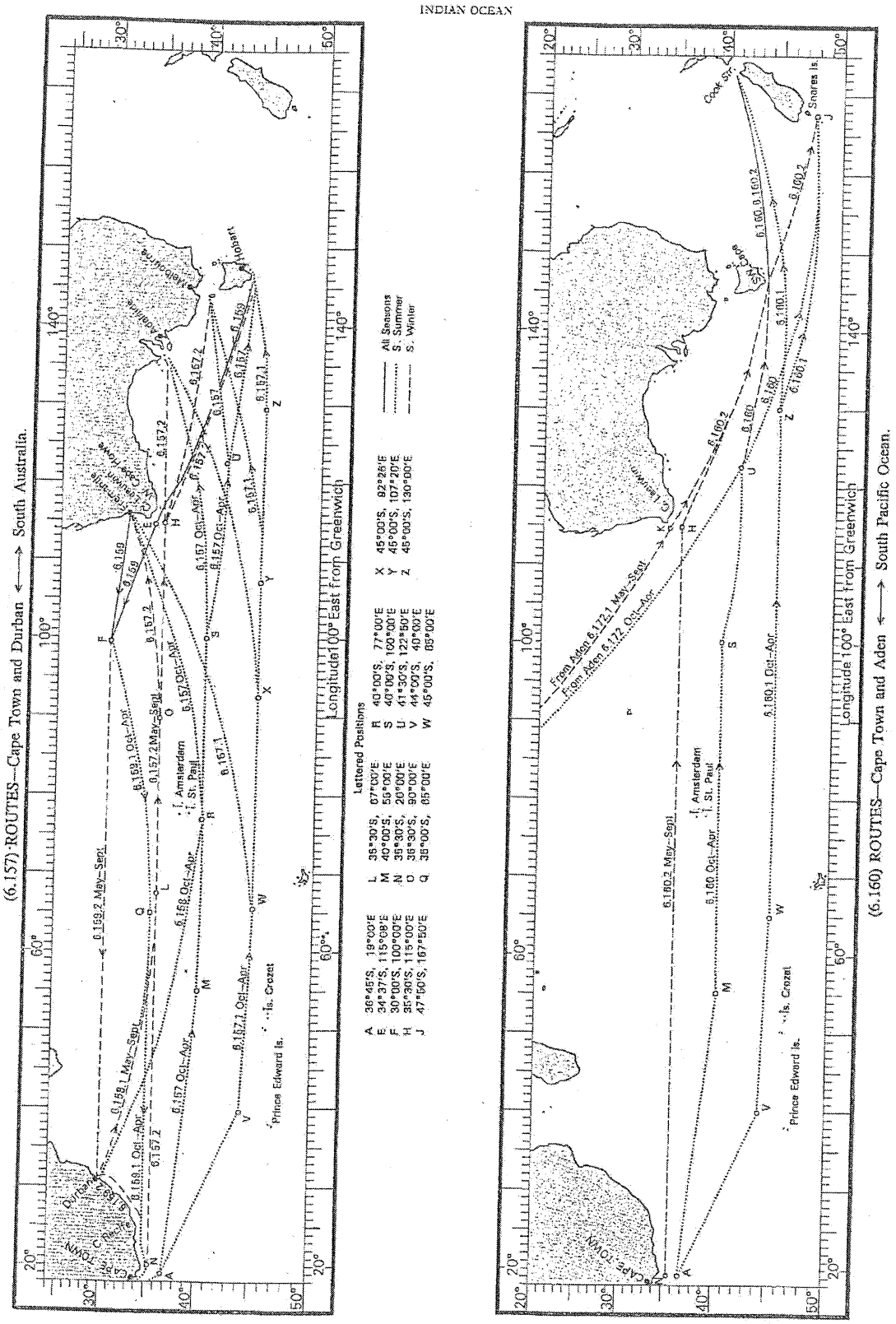
6.158.2

Distances in miles.

Durban to:	*Oct–April*	*May–Sept*
Fremantle	4250	4270
Adelaide	5230	5350
Port Phillip for Melbourne*	5440	5630
Hobart	5560	5800

* Port Phillip to Melbourne: 40 miles.

(This Worksheet must be returned with your answer book)



Candidate's Name ..... Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

An ore carrier (100,000 GT) is on a long term charter to carry iron ore from Lulea (Northern Sweden) to Los Angeles (California USA). The normal route taken by the vessel on leaving the Baltic Sea is to transit the English Channel then take a great circle route from Bishop Rock to the Mona Passage thence via the Panama Canal and onwards to Los Angeles. The homeward voyage follows the same route in reverse.

The vessel is fitted with all navigational aids as per statute and has a service speed of 17 knots.

1 Vessels operating in the Baltic Sea during the winter season often encounter ice conditions.

(a) Outline the navigational hazards to be taken into account in EACH of the following situations:

(i) entering pack ice; (3)

(ii) manoeuvring the vessel in pack ice; (8)

(iii) approaching port in ice conditions. (10)

(b) With reference to the accuracy of navigational aids, outline the problems that may be encountered in ice conditions and high latitudes, when using EACH of the following;

(i) Echo Sounder; (5)

(ii) Gyro compass; (5)

(iii) Radar. (4)

2 Whilst approaching the Dover Straits, in dense fog, the OOW makes the following observations on the radar (6 Mile Range). The vessel is steering 230° (T) at 5 knots.

	Target A		Target B		Target C	
Time	Bearing	Range	Bearing	Range	Bearing	Range
0910	255°(T)	5.5 miles	156°(T)	5.5	350°(T)	3.0 miles
0916	255°(T)	4.5 miles	157°(T)	4.6	350°(T)	2.6 miles
0922	255°(T)	3.6 miles	158½°(T)	3.8	350°(T)	2.2 miles

(a) On Worksheet Q2 complete the plot for all THREE targets. (15)

(b) Prepare a full report on all THREE targets at 0922 hrs. (15)

(c) Determine, for EACH target, the reduction in speed of own vessel, at 0928 hrs, that will ensure the target passes at a distance of 1.0 mile. (3)

Note: assume change of speed has instantaneous effect.

(d) State, with reasons, the actions that should be taken by a prudent Master at 0928 hrs. (7)

3 Using the following departure and landfall positions:

Departure Position 49°47'.0N 6°27'.0W (Bishop Rock)
Landfall Position 18°20'.0N 67°50'.0W (Mona Passage)

(a) Calculate EACH of the following:

(i) the rhumbline distance; (8)

(ii) the great circle distance; (10)

(iii) the initial great circle course. (10)

(b) The distance from the Mona Passage to Cristobal (Panama) is 1810 miles.

The vessel is due to make the southbound passage in mid February and it is estimated that if the vessel follows the great circle track its speed will be reduced by 3 knots for a period of 72 hours due to adverse head seas. The rhumbline route will be unaffected.

Calculate the steaming time to Cristobal, for both the rhumbline and great circle route, stating which of the TWO routes is the more economical. (7)

4 (a) The British Admiralty produces Ocean Routeing charts for each month of the year for the main oceans of the world.

Outline the type of information found on such charts for EACH of the following specific categories:

(i) Ocean wind patterns; (5)

(ii) Ocean currents; (5)

(iii) Tropical Revolving storms. (3)

(b) (i) Outline the warning signs of an approaching TRS. (10)

(ii) Explain how onboard observations can be used to determine the vessel's position relative to the centre of the TRS. (6)

(iii) A vessel is in the storm field of an approaching N Atlantic TRS. The TRS has already recurved and the vessel lies in the advance quadrant of the northern half of the TRS.

State the action that a prudent Master would take in this situation. (6)

(c) Outline how the OOW can use on board observations to predict the time when a vessel will encounter fog at sea. (10)

(d) Compile a set of Masters Standing Orders for a vessel operating in restricted visibility. (10)

5 On the subsequent north bound passage the OOW makes the following celestial observations:

Date 20th March DR position 24°18'.0N 61°40'.0W

Time at ship 0918hrs

Chronometer Read	1h 20m 42s	Index Error	2'.4 off the arc
Chronometer Error	3m 20s slow on UT	Height of Eye	18.4 m

Sextant Altitude of the Suns Lower Limb 41°50'.5
Variation 6°W
Compass Bearing of the Sun 117°(C)

Determine EACH of the following:

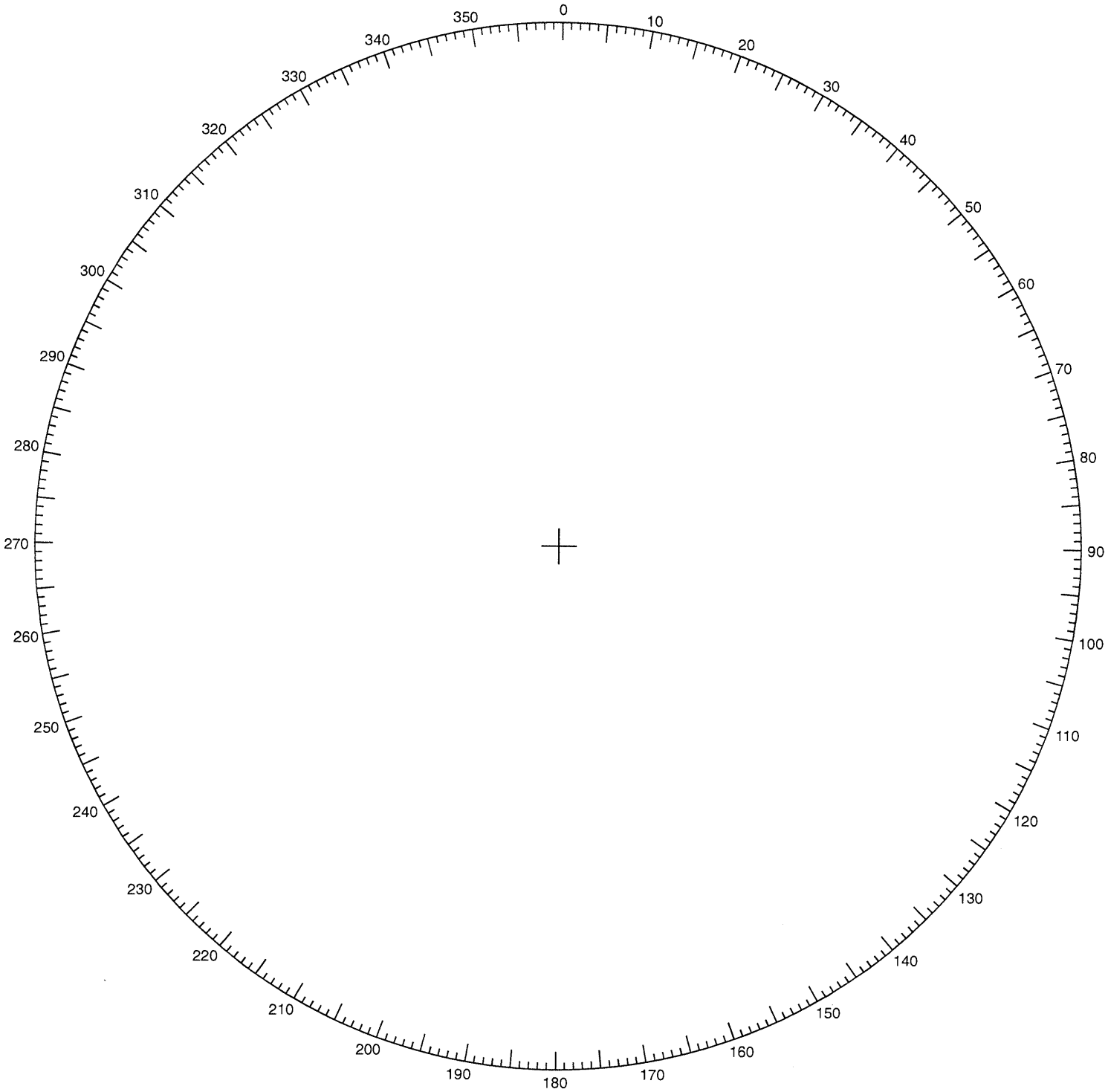
(a) the direction of the position line; (15)

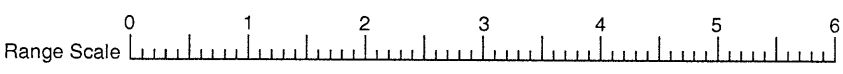
(b) a position through which the position line passes; (15)

(c) the deviation of the magnetic compass for the direction of the ship's head. (5)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET





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Signature of Candidate .....

Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 190 metre bulk carrier, summer displacement 102,000 tonnes, is on a long term charter to carry phosphates between Chile and South Africa, via Brisbane (Queensland, Australia) and Dampier (W Australia). The vessel is currently loading in Antofagasta (Chile) and is due to complete cargo operations on the 14th May.

The vessel carries navigation equipment as per statute and has a service speed of 15.5 knots.

1 On departure the vessel will have overloaded her Winter load displacement by 324 tonnes and the daily consumption is 36 tonnes per day. The boundary between the summer and seasonal Winter Zone lies along the parallel of 32°S.

The charterers ask the Master to follow the shortest legal route between the following departure and landfall positions:

Departure position	23°29'.0S 70°25'.0W
Landfall position	27°30'.0S 153°00'.0E

(a) Calculate the shortest legal distance between the departure and landfall positions. (35)

(b) On Worksheet Q1:

(i) indicate the route as calculated in Q1(a); (10)

(ii) indicate the direct great circle track. (1)

(c) Explain why it would not be possible to do a direct great circle track, between the departure and landfall positions, at any time of the year. (4)

2 The vessel departs Brisbane on the 7th June and is due to transit the Torres Straits on the 12th June.

(a) Using Datasheet Q2, for Hammond Rock Lighthouse, and Worksheet Q2, determine the Tidal stream the vessel will encounter if the ETA off Hammond Rock is 0920 hrs on the 12th. (15)

(b) When approaching the narrowest part of the strait the vessel encounters an actual depth which is considerably shallower than the charted depth at that position.

(i) Outline the information that should be included when submitting a report of shallower than normal depths. (15)

(ii) State the authority to which such a report should be sent. (5)

3 The vessel proceeds to Dampier to complete the final loading programme prior to departing for South Africa. Pilotage in Dampier is compulsory.

(a) Outline the preparations to be made on the bridge prior to arrival in port, with specific reference to the vessel's propulsion and steering systems. (10)

(b) Outline FIVE items of information the Master should pass to to the Pilot immediately the pilot arrives in the wheelhouse. (10)

(c) Outline the duties and responsibilities of the OOW and under pilotage when working as part of the bridge team in the absence of the Master on the bridge. (20)

4 On the 23rd June, whilst on passage to Capetown, the Master instructs the OOW to obtain a set of AM start sights to check the accuracy of the vessel's GPS receiver. The vessel's DR position is 26°12'.0S 103°42'.0E (Ship's clocks are set on UT + 7hrs).

(a) Determine the likely observation period in which star sights may be taken as indicated by the ship's clocks. (15)

(b) Outline the criteria for selecting stars for stellar observations. (12)

(c) Using Datasheet Q4, determine which stars are most appropriate for a four star fix, stating reasons for EACH choice. (8)

5 At 0400 hrs on the 8th July the vessel receives a distress call from a MV Alice, carrying a timber deck cargo, in position 31°48'.0S 34°25'.0E, advising that the vessel's cargo has shifted and is listing heavily to stbd. The vessel in distress is heading for a landfall position of 35°30'.0S 20°00'.0E and is making good a speed of 10 knots.

At 0400 hrs own vessel is position 28°42'.0S 33°54'.0E. It is agreed that own vessel will rendezvous with the MV Alice as soon as possible. MV Alice will maintain its course and speed throughout.

Determine EACH of the following:

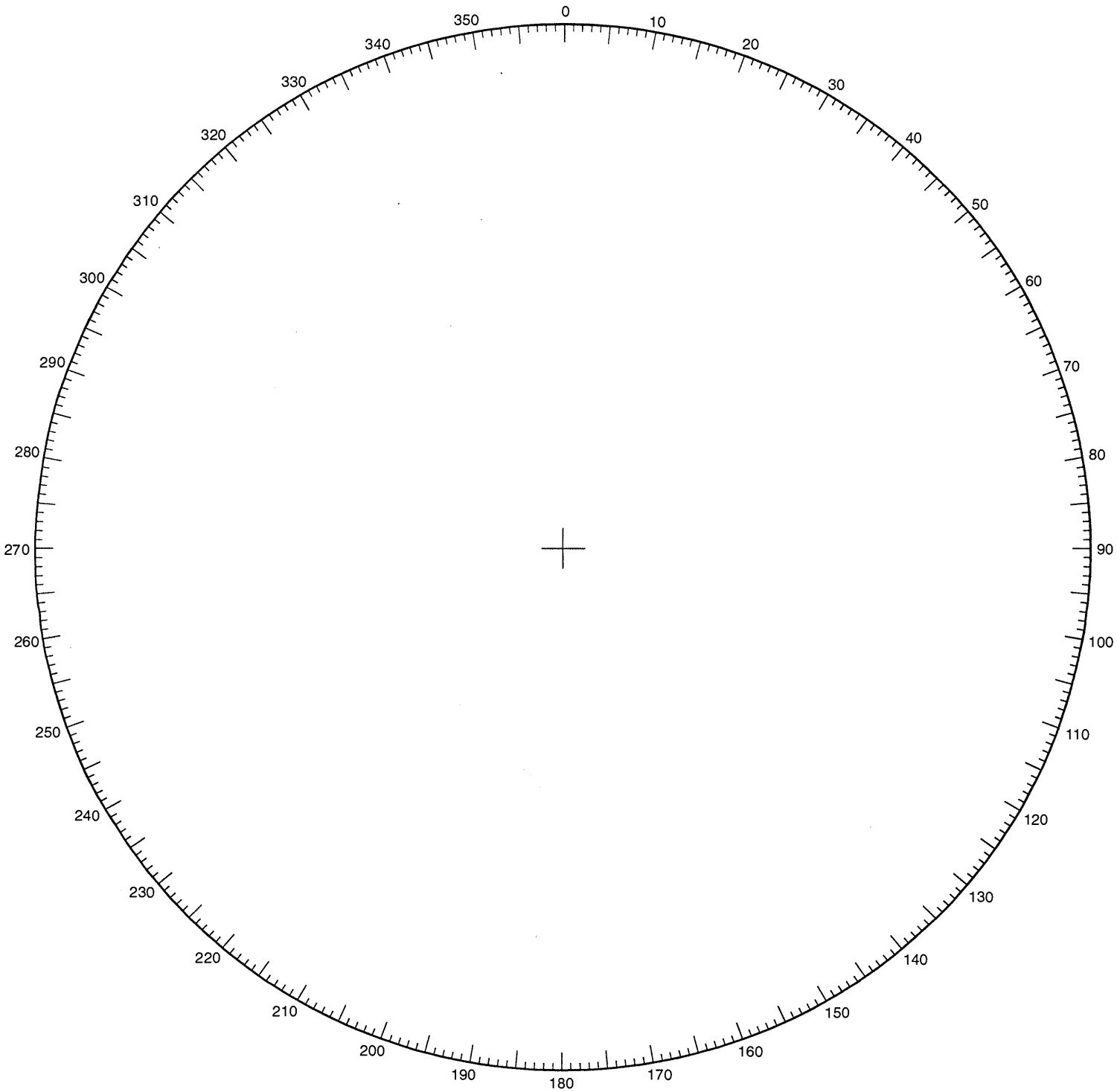
(a) the true course of MV Alice; (10)

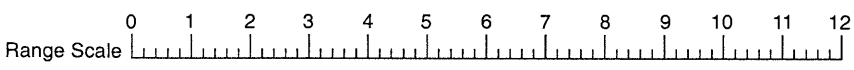
(b) the course to steer to rendezvous with MV Alice as soon as possible; (21)

(c) the time at which the MV Alice will be sighted on radar assuming it will be detected at a range of 15 miles. (9)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET





(This is not a metric scale)

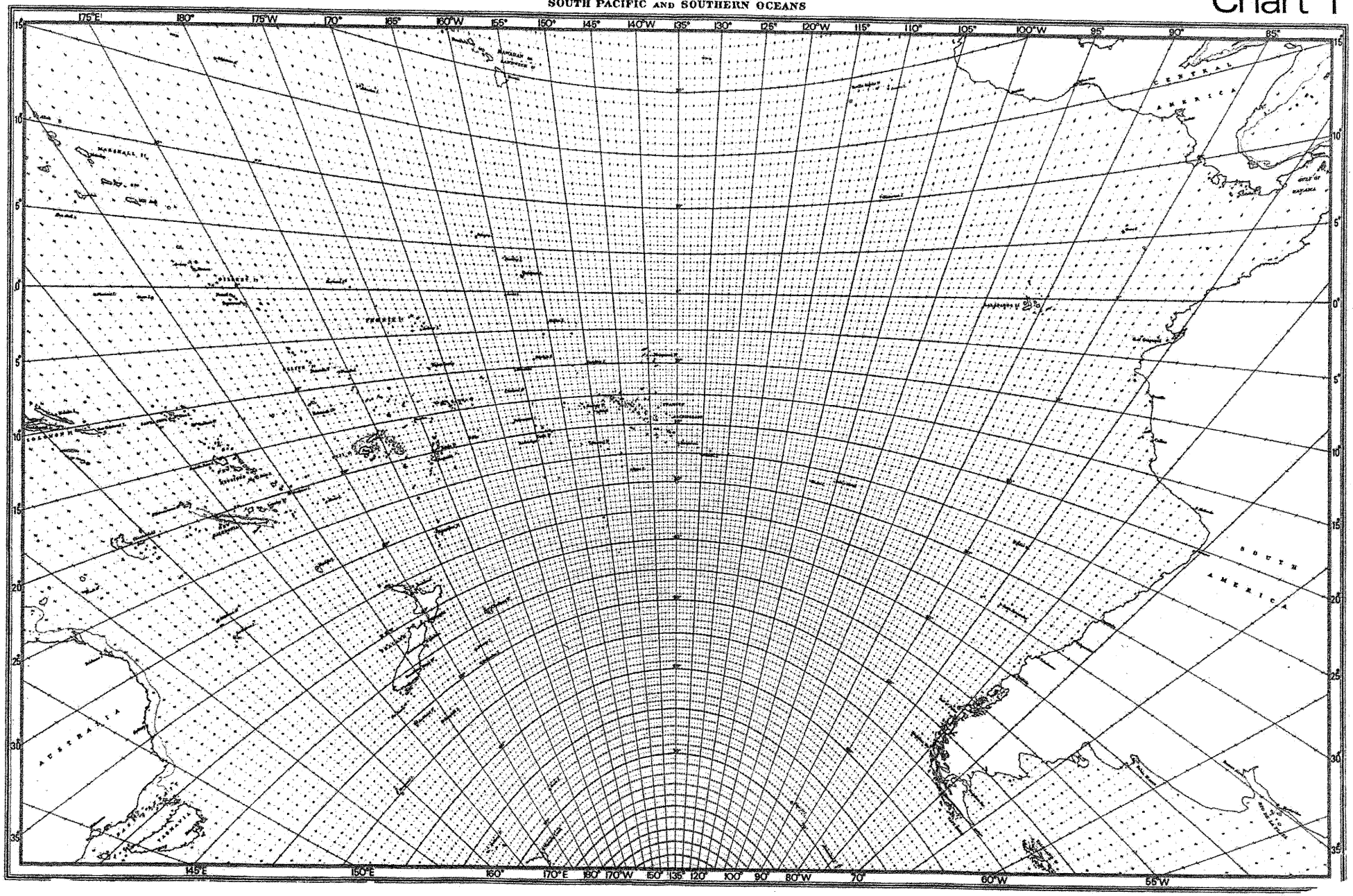
Signature of Candidate .....

Examination Centre .....

WORKSHEET Q1
(This Worksheet must be returned with your answer book)

GNOMONIC CHART FOR FACILITATING GREAT CIRCLE SAILING
SOUTH PACIFIC AND SOUTHERN OCEANS

Chart T



Candidate's Name .....

Examination Centre .....

AUSTRALIA, TORRES STRAIT – HAMMOND ROCK LIGHTHOUSE

LAT 10°30'S LONG 142°13'E

TIDAL STREAM PREDICTIONS (RATES IN KNOTS)

TIME ZONE −1000 POSITIVE (+) DIRECTION 060 NEGATIVE (−) DIRECTION 260 YEAR 1999

APRIL

	SLACK Time	MAXIMUM Time	Rate		SLACK Time	MAXIMUM Time	Rate
1 TH	0412	0111	−4.8	**16** F	0306	0609	5.2
	1044	0725	5.2		0912	1215	−5.2
	1619	1330	−3.9		1516	1825	5.7
O	2249	1934	4.9	●	2131		
2 F	0445	0145	−4.1	**17** SA	0350	0041	−5.8
	1110	0755	4.5		0951	0651	5.4
	1650	1400	−3.5		1604	1259	−5.8
	2328	2008	4.4		2223	1914	6.0
3 SA	0514	0218	−3.4	**18** SU	0437	0129	−5.8
	1132	0821	3.7		1033	0736	5.3
	1719	1426	−3.1		1657	1346	−6.1
		2039	3.8		2319	2006	6.0
4 SU	0004	0247	−2.6	**19** M	0528	0221	−5.3
	0537	0844	3.0		1119	0825	4.9
	1150	1449	−2.8		1754	1438	−6.0
	1747	2109	3.3			2104	5.7
5 M	0043	0315	−1.8	**20** TU	0021	0319	−4.7
	0556	0903	2.3		0625	0919	4.2
	1206	1513	−2.4		1210	1536	−5.7
	1817	2140	2.7		1859	2210	5.2
6 TU	0126	0345	−1.2	**21** W	0132	0427	−3.9
	0613	0923	1.8		0731	1023	3.5
	1223	1540	−2.1		1310	1645	−5.3
	1852	2218	2.3		2012	2326	4.7
7 W	0222	0421	−0.7	**22** TH	0253	0546	−3.4
	0629	0948	1.4		0851	1140	2.9
	1246	1615	−1.8		1420	1802	−5.0
	1938	2312	1.9		2132		
8 TH	0346	0518	−0.3	**23** F	0418	0049	4.5
	0656	1029	1.0		1020	0714	−3.3
	1323	1711	−1.6		1542	1305	2.7
	2044				2253	1926	−5.0
9 F	0530	0030	1.7	**24** SA	0535	0210	4.7
	0814	0649	−0.2		1142	0833	−3.6
	1429	1146	0.8		1703	1426	3.0
	2203	1832	−1.6			2042	−5.2
10 SA	0619	0153	1.9	**25** SU	0005	0319	5.0
	1020	0815	−0.5		0639	0939	−4.2
	1600	1325	0.9		1246	1535	3.5
	2315	1954	−2.0		1815	2147	−5.5
11 SU	0645	0252	2.3	**26** M	0107	0417	5.2
	1135	0907	−1.0		0730	1033	−4.7
	1715	1436	1.5		1343	1632	3.9
		2055	−2.6		1917	2243	−5.7
12 M	0012	0336	2.9	**27** TU	0201	0506	5.1
	0709	0945	−1.8		0814	1119	−5.0
	1224	1528	2.3		1430	1721	4.2
	1815	2144	−3.5		2011	2331	−5.6
13 TU	0059	0415	3.5	**28** W	0249	0548	4.8
	0735	1020	−2.6		0850	1200	−5.1
	1307	1613	3.2		1512	1805	4.3
	1905	2229	−4.3		2058		
14 W	*0142*	*0451*	*4.2*	**29** TH	*0331*	*0015*	*−5.2*
	0804	1057	−3.5		0921	0625	4.3
	1348	1656	4.2		1549	1234	−4.9
	1954	2312	−5.0		2140	1844	4.1
15 TH	0224	0529	4.8	**30** F	0409	0052	−4.7
	0836	1134	−4.4		0945	0657	3.6
	1431	1740	5.0		1623	1304	−4.7
	2042	2355	−5.6		2217	1918	3.8

MAY

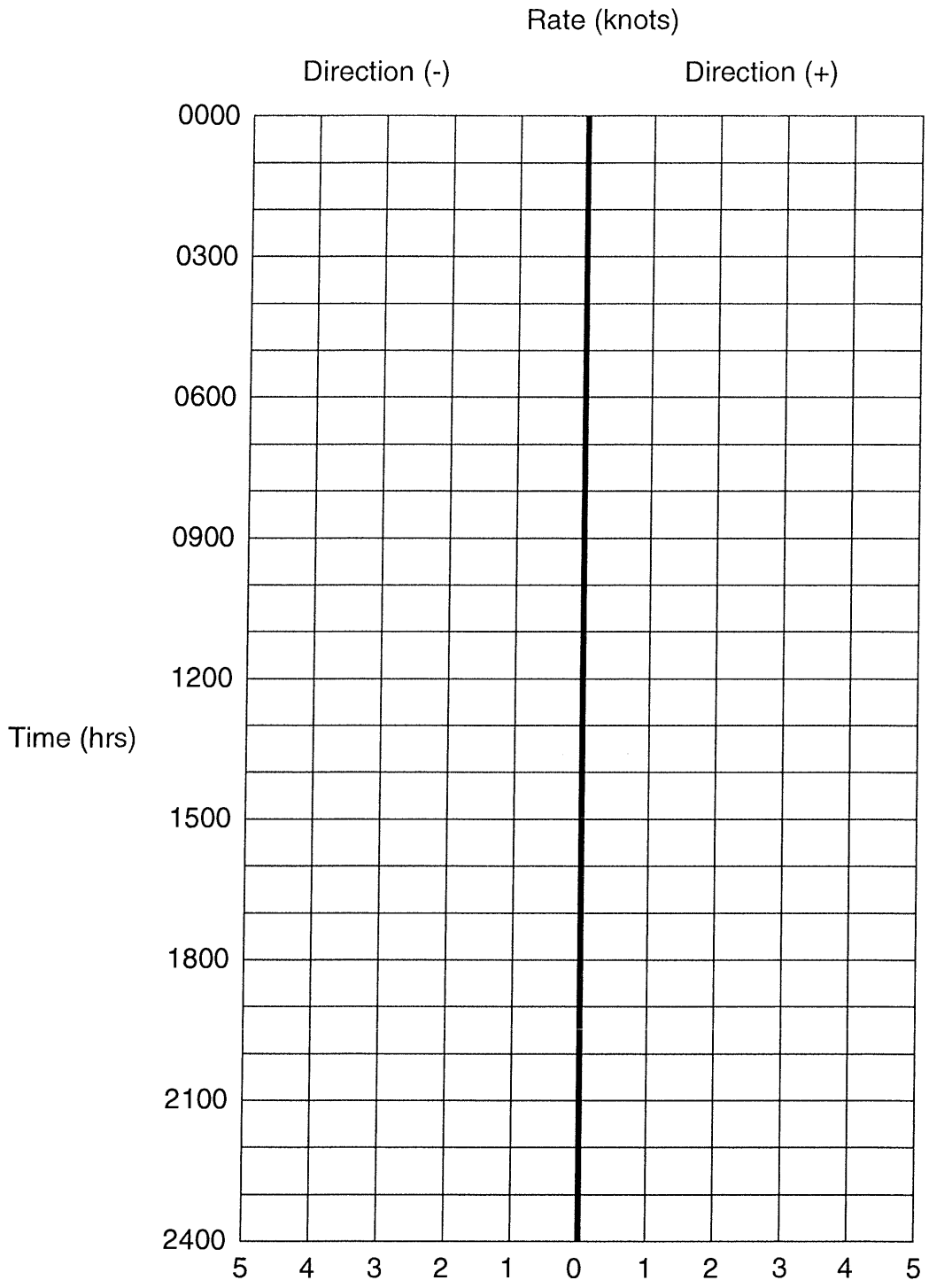
	SLACK Time	MAXIMUM Time	Rate		SLACK Time	MAXIMUM Time	Rate
1 SA	0442	0126	−4.0	**16** SU	0342	0024	−6.1
	1003	0723	2.9		0910	0628	4.6
	1654	1330	−4.4		1607	1242	−7.1
O	2250	1948	3.4		2205	1904	5.6
2 SU	0511	0155	−3.4	**17** M	0432	0116	−6.0
	1016	0745	2.3		0957	0716	4.5
	1724	1353	−4.1		1702	1332	−7.4
	2321	2016	3.0		2305	2000	5.7
3 M	0535	0222	−2.8	**18** TU	0527	0212	−5.6
	1026	0803	1.8		1045	0809	4.2
	1753	1414	−3.8		1801	1427	−7.3
	2349	2045	2.5			2100	5.4
4 TU	0559	0246	−2.2	**19** W	0008	0313	−5.1
	1033	0820	1.4		0628	0906	3.6
	1825	1435	−3.5		1139	1527	−7.0
		2114	2.1		1906	2205	5.0
5 W	0020	0314	−1.8	**20** TH	0116	0420	−4.5
	0625	0838	1.0		0738	1011	3.0
	1044	1500	−3.3		1238	1633	−6.5
	1901	2147	1.8		2016	2316	4.6
6 TH	0055	0346	−1.4	**21** F	0230	0536	−4.1
	0658	0903	0.7		0859	1125	2.5
	1058	1533	−3.1		1345	1746	−6.0
	1947	2231	1.6		2130		
7 F	0141	0431	−1.1	**22** SA	0344	0032	4.3
	0749	0941	0.5		1023	0655	−4.1
	1123	1621	−2.9		1503	1245	2.3
	2046	2330	1.3		2245	1903	−5.7
8 SA	0240	0539	−1.1	**23** SU	0453	0145	4.2
	0911	1045	0.3		1140	0809	−4.3
	1211	1728	−2.8		1624	1404	2.4
	2152				2354	2017	−5.6
9 SU	0346	0041	1.4	**24** M	0553	0252	4.2
	1035	0656	−1.3		1244	0914	−4.8
	1345	1214	0.4		1739	1513	2.8
	2256	1847	−3.0			2123	−5.5
10 M	0445	0145	1.7	**25** TU	0056	0349	4.1
	1130	0801	−1.9		0644	1007	−5.1
	1534	1337	0.9		1338	1612	3.1
	2350	1959	−3.5		1845	2220	−5.4
11 TU	0534	0240	2.2	**26** W	0150	0438	3.8
	1215	0852	−2.7		0726	1053	−5.3
	1702	1443	1.7		1425	1702	3.3
		2100	−4.1		1941	2311	−5.1
12 W	0038	0328	2.8	**27** TH	0239	0520	3.5
	0618	0938	−3.7		0800	1133	−5.4
	1258	1538	2.7		1507	1746	3.4
	1813	2153	−4.8		2030	2354	−4.9
13 TH	0124	0412	3.5	**28** F	0321	0556	3.0
	0700	1022	−4.7		0829	1207	−5.3
	1342	1630	3.7		1545	1825	3.3
	1915	2244	−5.5		2112		
14 F	*0209*	*0456*	*4.0*	**29** SA	*0400*	*0031*	*−4.8*
	0742	1107	−5.7		0850	0626	2.5
	1428	1720	4.6		1618	1237	−5.1
	2012	2333	−5.9		2147	1909	3.0
15 SA	0254	0541	4.4	**30** SU	0433	0104	−3.8
	0825	1153	−6.5		0905	0651	2.0
	1516	1812	5.2		1649	1302	−4.9
●	2108			O	2219	1930	2.8
				31 M	0502	0133	−3.3
					0917	0713	1.5
					1718	1325	−4.7
					2247	1958	2.5

JUNE

	SLACK Time	MAXIMUM Time	Rate		SLACK Time	MAXIMUM Time	Rate
1 TU	0529	0159	−2.6	**16** W	0519	0205	−5.5
	0928	0731	1.2		1027	0757	3.9
	1748	1346	−4.5		1800	1417	−7.9
	2315	2025	2.2			2054	5.4
2 W	0555	0224	−2.5	**17** TH	0620	0304	−5.1
	0940	0750	1.0			0854	3.5
	1819	1410	−4.4		1121	1515	−7.5
	2342	2053	2.0		1900	2155	5.0
3 TH	0621	0250	−2.2	**18** F	0101	0408	−4.7
	0957	0813	0.8		0727	0956	3.0
	1855	1437	−4.2		1219	1617	−6.9
		2126	1.8		2004	2259	4.5
4 F	0013	0322	−2.0	**19** SA	0205	0515	−4.4
	0655	0842	0.7		0841	1104	2.5
	1021	1512	−4.1		1323	1724	−6.2
	1936	2204	1.6		2112		
5 SA	0048	0401	−1.9	**20** SU	0309	0006	4.0
	0740	0921	0.6		0959	0626	−4.3
	1056	1556	−3.9		1433	1218	2.2
	2025	2252	1.5		2221	1835	−5.6
6 SU	0134	0454	−1.9	**21** M	0411	0114	3.6
	0840	1017	0.5		1115	0735	−4.3
	1149	1653	−3.8		1551	1333	2.1
	2121	2349	1.5		2330	1946	−5.1
7 M	0229	0557	−2.1	**22** TU	0508	0217	3.3
	0949	1131	0.6		1221	0839	−4.5
	1307	1801	−3.8		1707	1445	2.3
	2220					2054	−4.7
8 TU	0329	0051	1.6	**23** W	0032	0315	3.0
	1052	0703	−2.6		0558	0935	−4.8
	1445	1252	0.9		1316	1546	2.5
	2316	1915	−4.0		1816	2154	−4.5
9 W	0428	0151	2.0	**24** TH	0129	0405	2.8
	1148	0806	−3.3		0640	1023	−4.9
	1620	1406	1.6		1406	1640	2.7
		2023	−4.3		1916	2245	−4.2
10 TH	0010	0247	2.5	**25** F	0218	0448	2.5
	0523	0902	−4.3		0715	1103	−5.0
	1240	1513	2.5		1448	1725	2.8
	1742	2125	−4.8		2007	2330	−3.9
11 F	0100	0340	3.0	**26** SA	0300	0524	2.2
	0615	0955	−5.3		0744	1138	−5.1
	1330	1612	3.5		1525	1804	2.8
	1853	2223	−5.2		2049		
12 SA	0150	0430	3.5	**27** SU	0337	0008	−3.6
	0706	1046	−6.3		0807	0555	1.9
	1421	1709	4.3		1558	1208	−5.0
	1959	2318	−5.6		2126	1837	2.8
13 SU	0240	0520	4.0	**28** M	0409	0041	−3.3
	0756	1138	−7.2		0827	0621	1.6
	1513	1804	5.0		1628	1235	−5.0
	2100				2158	1907	2.7
14 M	*0330*	*0014*	*−5.7*	**29** TU	*0435*	*0109*	*−3.1*
	0845	0611	4.2		0846	0644	1.5
	1606	1230	−7.8		1656	1300	−4.9
●	2200	1900	5.4	O	2227	1935	2.6
15 TU	0424	*0108*	*−5.7*	**30** W	0459	*0135*	*−2.9*
	0935	0703	4.2		0906	0706	1.4
	1701	1322	−8.0		1725	1324	−4.9
	2259	1956	5.5		2254	2002	2.5

CURRENT INCLUDED IN PREDICTIONS.

(This Worksheet must be returned with your answer book)



Scale to be adjusted as required

Candidate's Name ..... Examination Centre .....

LAT 26°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦ARCTURUS		ANTARES		♦RIGIL KENT		ACRUX		CANOPUS		♦Alphard		REGULUS	
180	34 04	040	30 13	107	45 52	153	52 35	175	23 57	221	50 03	289	43 26	321
181	34 38	039	31 04	107	46 16	154	52 39	176	22 22	221	49 12	288	42 52	320
182	35 11	038	31 56	106	46 40	154	52 43	176	22 47	221	48 20	287	42 17	319
183	35 44	037	32 48	106	47 03	154	52 46	177	22 11	221	47 29	286	41 41	318
184	36 16	036	33 40	105	47 26	155	52 48	178	21 36	221	46 37	286	41 05	317
185	36 47	035	34 32	105	47 49	155	52 50	179	21 01	220	45 45	285	40 28	316
186	37 18	034	35 24	105	48 11	156	52 51	179	20 26	220	44 53	284	39 50	315
187	37 47	033	36 16	105	48 33	156	52 51	180	19 51	220	44 01	284	39 11	314
188	38 16	032	37 08	105	48 54	157	52 50	181	19 17	220	43 08	283	38 32	313
189	38 44	031	38 00	104	49 15	157	52 49	182	18 42	220	42 15	282	37 52	312
190	39 11	030	38 52	104	49 36	158	52 47	182	18 08	220	41 23	282	37 12	311
191	39 38	029	39 45	104	49 56	158	52 45	183	17 33	219	40 30	281	36 31	310
192	40 03	028	40 37	104	50 15	159	52 41	184	16 59	219	39 37	281	35 50	309
193	40 28	026	41 29	103	50 35	160	52 37	185	16 25	219	38 44	280	35 08	309
194	40 51	025	42 22	103	50 53	160	52 33	185	15 52	219	37 51	280	34 25	308
	ARCTURUS		♦Rasalhague		ANTARES		RIGIL KENT		♦ACRUX		Suhail		♦REGULUS	
195	41 14	024	12 47	069	43 15	103	51 11	161	52 27	186	40 24	234	33 43	307
196	41 35	023	13 37	068	44 07	103	51 29	161	52 21	187	39 40	234	32 59	306
197	41 56	022	14 27	068	45 00	102	51 45	162	52 14	188	38 57	234	32 16	305
198	42 16	021	15 17	067	45 53	102	52 02	163	52 07	188	38 13	234	31 31	305
199	42 34	019	16 07	067	46 45	102	52 16	163	51 59	189	37 30	234	30 47	304
200	42 51	018	16 56	066	47 36	102	52 33	164	51 50	190	36 46	234	30 02	303
201	43 08	017	17 46	066	48 31	101	52 47	165	51 41	190	36 03	234	29 17	302
202	43 23	016	18 35	065	49 24	101	53 01	165	51 31	191	35 19	234	28 31	302
203	43 37	014	19 24	065	50 17	101	53 14	166	51 20	192	34 36	234	27 45	301
204	43 50	013	20 12	064	51 10	101	53 27	167	51 09	192	33 53	234	26 59	300
205	44 01	012	21 01	063	52 03	100	53 39	168	50 57	193	33 09	233	26 12	300
206	44 12	011	21 49	063	52 56	100	53 50	168	50 45	194	32 26	233	25 25	299
207	44 21	009	22 37	062	53 49	100	54 00	169	50 32	194	31 43	233	24 38	298
208	44 29	008	23 24	062	54 42	100	54 10	170	50 19	195	31 00	233	23 50	298
209	44 36	007	24 12	061	55 35	099	54 19	171	50 05	195	30 16	233	23 02	297
	♦ARCTURUS		Rasalhague		♦Nunki		RIGIL KENT		ACRUX		♦Suhail		Denebola	
210	44 42	005	24 59	060	24 37	109	54 27	172	49 50	196	29 33	233	38 32	318
211	44 46	004	25 45	060	25 29	108	54 35	172	49 35	197	28 50	233	37 56	317
212	44 50	003	26 32	059	26 20	108	54 42	173	49 19	197	28 08	233	37 19	316
213	44 51	001	27 18	058	27 11	108	54 48	174	49 03	198	27 25	232	36 42	315
214	44 52	000	28 04	058	28 03	107	54 53	175	48 46	198	26 42	232	36 03	314
215	44 52	359	28 49	057	28 54	107	54 57	176	48 29	199	26 59	232	35 25	314
216	44 50	357	29 34	056	29 46	107	55 01	177	48 12	199	25 17	232	34 45	313
217	44 47	356	30 19	056	30 37	106	55 04	177	47 54	200	24 35	232	34 05	312
218	44 42	355	31 03	055	31 29	106	55 06	178	47 35	200	23 52	232	33 25	311
219	44 37	353	31 47	054	32 21	106	55 07	179	47 16	201	23 10	231	32 44	310
220	44 30	352	32 30	053	33 13	106	55 07	180	46 57	201	22 28	231	32 02	309
221	44 22	351	33 13	053	34 05	105	55 07	181	46 37	202	21 46	231	31 21	309
222	44 13	349	33 56	052	34 57	105	55 06	182	46 17	202	21 04	231	30 38	308
223	44 02	348	34 38	051	35 49	105	55 04	182	45 56	203	20 22	231	29 55	307
224	43 50	347	35 20	050	36 41	105	55 01	183	45 36	203	19 41	230	29 12	306
	Alphecca		Rasalhague		♦Nunki		Peacock		♦Suhail		SPICA		♦ARCTURUS	
225	36 39	010	36 01	049	37 33	104	26 00	143	54 58	184	63 18	299	43 38	346
226	36 47	009	36 41	048	38 26	104	26 33	143	54 53	185	62 30	298	43 24	344
227	36 55	008	37 21	047	39 18	104	27 05	143	54 48	186	61 42	297	43 09	343
228	37 02	006	38 01	047	40 10	103	27 38	143	54 42	187	60 54	296	42 52	342
229	37 07	005	38 40	046	41 03	103	28 11	143	54 36	187	60 05	294	42 35	341
230	37 12	004	39 18	045	41 55	103	28 44	142	54 28	188	59 16	293	42 17	339
231	37 15	003	39 55	044	42 48	103	29 17	142	54 20	189	58 26	292	41 57	338
232	37 17	002	40 32	043	43 41	102	29 50	142	54 11	190	57 36	291	41 37	337
233	37 19	001	41 08	042	44 33	102	30 22	142	54 02	191	56 46	290	41 15	336
234	37 19	000	41 44	041	45 26	102	30 55	142	53 51	191	55 55	290	40 53	335
235	37 18	359	42 19	040	46 19	102	31 28	142	53 40	192	55 04	289	40 29	334
236	37 16	358	42 53	038	47 12	101	32 01	142	53 28	193	54 13	288	40 05	332
237	37 14	356	43 26	037	48 04	101	32 34	142	53 16	194	53 21	287	39 39	331
238	37 10	355	43 58	036	48 57	101	33 07	142	53 03	194	52 30	286	39 13	330
239	37 05	354	44 29	035	49 50	101	33 40	142	52 49	195	51 38	286	38 46	329
	♦VEGA		ALTAIR		♦Peacock		RIGIL KENT		♦SPICA		ARCTURUS		Alphecca	
240	15 30	031	23 54	066	34 13	142	52 35	196	50 46	285	38 18	328	36 59	353
241	15 58	030	24 43	066	34 46	143	52 20	197	49 54	284	37 49	327	36 52	352
242	16 24	029	25 32	065	35 19	143	52 04	197	49 01	283	37 19	326	36 44	351
243	16 51	029	26 21	064	35 51	143	51 48	198	48 09	283	36 49	325	36 34	350
244	17 16	028	27 09	064	36 24	143	51 31	198	47 16	282	36 18	324	36 24	349
245	17 42	027	27 58	063	36 57	143	51 14	199	46 23	281	35 46	323	36 13	348
246	18 06	027	28 46	062	37 29	143	50 56	200	45 30	281	35 13	322	36 01	346
247	18 30	026	29 33	062	38 02	143	50 37	200	44 37	280	34 40	321	35 48	345
248	18 54	025	30 21	061	38 34	143	50 18	201	43 44	280	34 06	320	35 34	344
249	19 18	025	31 08	060	39 06	143	49 59	201	42 51	279	33 31	319	35 19	343
250	19 39	024	31 54	060	39 38	143	49 39	202	41 58	278	32 56	319	35 03	342
251	20 00	023	32 41	059	40 10	144	49 18	203	41 04	278	32 20	318	34 46	341
252	20 21	022	33 27	058	40 42	144	48 57	203	40 11	277	31 43	317	34 28	340
253	20 41	022	34 12	057	41 14	144	48 36	204	39 17	277	31 06	316	34 09	339
254	21 01	021	34 57	057	41 46	144	48 14	204	38 24	276	30 28	315	33 50	338
	♦VEGA		ALTAIR		FOMALHAUT		♦Peacock		RIGIL KENT		♦SPICA		ARCTURUS	
255	21 20	020	35 42	056	12 51	117	42 17	144	47 52	205	37 30	276	29 50	314
256	21 38	019	36 26	055	13 39	117	42 48	145	47 29	205	36 36	275	29 11	314
257	21 56	019	37 10	054	14 28	116	43 20	145	47 06	205	35 43	275	28 32	313
258	22 12	018	37 54	053	15 18	116	43 50	145	46 43	206	34 49	274	27 52	312
259	22 29	017	38 37	052	16 05	116	44 21	145	46 19	206	33 56	274	27 12	311
260	22 44	016	39 19	052	16 54	115	44 52	146	45 55	207	33 01	273	26 31	311
261	22 59	015	40 01	051	17 42	115	45 22	146	45 31	207	32 06	273	25 50	310
262	23 13	015	40 43	050	18 31	115	45 52	146	45 06	207	31 14	272	25 08	309
263	23 26	014	41 24	049	19 20	114	46 22	147	44 41	208	30 20	272	24 26	309
264	23 38	013	42 04	048	20 10	114	46 51	147	44 16	208	29 26	272	23 44	308
265	23 50	012	42 43	047	20 59	114	47 20	147	43 50	208	28 32	271	23 01	307
266	24 01	011	43 22	046	21 49	113	47 49	148	43 25	209	27 38	271	22 18	306
267	24 11	011	44 01	045	22 38	113	48 18	148	42 58	209	26 44	270	21 34	306
268	24 21	010	44 38	044	23 28	113	48 46	149	42 32	209	25 50	270	20 51	305
269	24 29	009	45 15	043	24 18	112	49 14	149	42 06	210	24 56	269	20 06	305

LAT 26°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	VEGA		♦ALTAIR		FOMALHAUT		♦Peacock		RIGIL KENT		♦ANTARES		Alphecca	
270	24 37	008	45 51	041	25 07	112	49 41	150	41 39	219	59 51	264	26 49	324
271	24 44	007	46 27	040	25 57	112	50 08	150	41 12	219	58 57	264	26 16	323
272	24 51	006	47 01	039	26 47	112	50 35	151	40 45	219	58 03	263	25 44	322
273	24 56	005	47 35	038	27 35	111	51 01	151	40 17	211	57 10	263	25 10	321
274	25 01	005	48 07	037	28 23	111	51 27	152	39 50	211	56 16	263	24 36	321
275	25 05	004	48 39	035	29 10	111	51 52	152	39 22	211	55 23	263	24 02	320
276	25 08	003	49 10	034	30 00	111	52 17	153	38 54	211	54 29	263	23 27	319
277	25 10	002	49 40	033	30 50	110	52 42	153	38 26	211	53 36	262	22 51	318
278	25 12	001	50 08	032	31 50	110	53 05	154	37 58	212	52 42	262	22 15	318
279	25 12	000	50 36	030	32 41	110	53 29	155	37 30	212	51 49	262	21 39	317
280	25 12	359	51 03	029	33 31	110	53 52	155	37 01	212	50 56	262	21 02	316
281	25 11	359	51 28	027	34 22	109	54 14	156	36 33	212	50 02	262	20 24	316
282	25 09	358	51 52	026	35 13	109	54 35	157	36 04	212	59 09	261	19 46	315
283	25 07	357	52 15	024	36 04	109	54 56	157	35 36	212	58 16	261	19 08	314
284	25 04	356	52 36	023	36 55	109	55 17	158	35 07	212	57 22	261	18 29	314
	♦DENEB		FOMALHAUT		♦ACHERNAR		RIGIL KENT		♦ANTARES		Rasalhague		VEGA	
285	18 01	018	37 46	108	18 44	146	34 38	212	56 29	261	46 18	329	24 59	355
286	18 17	018	38 37	108	17 14	146	34 09	212	55 36	261	45 50	328	24 54	354
287	18 33	017	39 29	108	17 44	146	33 40	213	54 43	260	45 21	327	24 49	353
288	18 49	016	40 20	108	18 15	145	33 11	213	53 50	260	44 51	326	24 42	353
289	19 03	016	41 11	108	18 45	145	32 42	213	52 56	260	44 20	325	24 35	352
290	19 18	015	42 03	107	19 16	145	32 13	213	52 03	260	43 48	325	24 26	351
291	19 31	014	42 54	107	19 47	145	31 44	213	51 10	259	43 16	322	24 17	350
292	19 44	013	43 46	107	20 18	145	31 14	213	50 17	259	42 42	321	24 08	349
293	19 56	013	44 37	107	20 49	145	30 45	213	49 24	259	42 08	320	23 57	348
294	17 08	012	45 29	107	21 21	144	30 16	213	48 32	259	41 33	319	23 46	348
295	17 19	011	46 21	107	21 52	144	29 47	213	47 39	258	40 58	318	23 34	347
296	17 29	011	47 12	106	22 24	144	29 18	213	46 46	258	40 21	317	23 21	346
297	17 38	010	48 04	106	22 55	144	28 48	213	45 53	258	39 44	316	23 08	345
298	17 47	009	48 56	106	23 27	144	28 19	213	45 00	258	39 06	315	22 53	344
299	17 56	008	49 48	106	23 59	144	27 50	213	44 08	257	38 28	314	22 38	343
	DENEB		Enif		♦FOMALHAUT		ACHERNAR		RIGIL KENT		ANTARES		♦VEGA	
300	18 03	008	45 59	039	50 40	106	24 31	144	27 21	213	43 15	257	22 23	343
301	18 10	007	46 32	038	51 32	106	25 03	144	26 52	213	42 23	257	22 06	342
302	18 16	006	47 04	036	52 24	105	25 35	143	26 23	213	41 30	257	21 49	341
303	18 22	006	47 36	035	53 16	105	26 07	143	25 54	212	40 38	256	21 31	340
304	18 27	005	48 06	034	54 08	105	26 39	143	25 25	212	39 45	256	21 13	340
305	18 31	004	48 36	033	55 00	105	27 12	143	24 56	212	38 53	256	20 54	339
306	18 34	003	49 04	031	55 52	105	27 44	143	24 27	212	38 01	256	20 34	338
307	18 37	003	49 32	030	56 44	105	28 16	143	23 59	212	37 08	255	20 14	337
308	18 39	002	49 58	029	57 36	105	28 49	143	23 30	212	36 16	255	19 52	337
309	18 40	001	50 23	027	58 28	105	29 21	143	23 01	212	35 24	255	19 31	336
310	18 41	000	50 47	026	59 20	105	29 54	143	22 33	212	34 32	255	19 08	335
311	18 41	000	51 10	024	60 12	105	30 26	143	22 05	212	33 40	254	18 45	334
312	18 40	359	51 32	023	61 05	105	30 59	143	21 36	212	32 48	254	18 22	334
313	18 39	358	51 52	021	61 57	105	31 31	143	21 08	211	31 56	254	17 57	333
314	18 37	357	52 11	020	62 49	105	32 04	143	20 40	211	31 05	253	17 33	332
	Alphecca		♦Diphda		ACHERNAR		♦RIGIL KENT		ANTARES		♦ALTAIR		DENEB	
315	18 38	049	37 48	093	32 36	143	20 12	211	30 13	253	51 19	332	18 34	357
316	19 15	042	38 42	093	33 09	143	19 44	211	29 22	253	50 53	331	18 30	356
317	19 50	041	39 36	092	33 41	143	19 17	211	28 30	253	50 26	329	18 26	355
318	20 26	041	40 29	092	34 14	143	18 49	211	27 39	252	49 58	328	18 21	354
319	21 00	040	41 23	092	34 46	143	18 22	210	26 47	252	49 29	327	18 16	354
320	21 35	039	42 17	091	35 18	143	17 55	210	25 56	252	48 59	325	18 09	353
321	22 09	038	43 11	091	35 51	143	17 27	210	25 05	251	48 28	324	18 02	352
322	22 42	038	44 05	090	36 23	143	17 01	210	24 14	251	47 56	323	17 55	351
323	23 14	037	44 59	090	36 55	143	16 34	210	23 23	251	47 23	322	17 46	351
324	23 47	036	45 53	089	37 27	144	16 07	209	22 32	250	46 49	320	17 37	350
325	24 18	035	46 47	089	37 59	144	15 41	209	21 41	250	46 14	319	17 28	349
326	24 49	035	47 41	088	38 31	144	15 15	209	20 50	250	45 38	318	17 17	349
327	25 19	034	48 35	088	39 03	144	14 48	209	20 00	250	45 02	317	17 06	348
328	25 49	033	49 29	088	39 35	144	14 23	209	19 09	249	44 25	316	16 55	347
329	26 18	032	50 22	087	40 06	144	13 57	208	18 19	249	43 47	315	16 42	346
	♦Alphenitz		Diphda		♦ACHERNAR		Peacock		♦Nunki		ALTAIR		Enif	
330	26 47	031	51 16	087	40 38	144	55 01	202	43 54	259	43 08	314	53 53	354
331	27 15	031	52 10	086	41 09	145	54 40	203	43 01	259	42 29	313	53 48	352
332	27 42	030	53 04	085	41 40	145	54 18	204	47 09	259	41 49	312	53 38	350
333	28 08	029	53 58	085	42 11	145	53 56	204	46 16	258	41 09	311	53 28	349
334	28 34	028	54 51	084	42 42	145	53 34	205	45 23	258	40 28	310	53 17	347
335	28 59	027	55 45	084	43 12	146	53 11	206	44 30	258	39 46	309	53 04	345
336	29 23	026	56 39	083	43 43	146	52 47	206	43 38	258	39 04	308	52 50	344
337	29 47	025	57 32	083	44 13	146	52 23	207	42 45	257	38 21	307	52 34	342
338	30 09	024	58 26	082	44 43	146	51 58	208	41 52	257	37 38	306	52 17	341
339	30 31	024	59 19	081	45 13	147	51 32	208	41 00	257	36 54	306	51 58	339
340	30 52	023	60 12	081	45 42	147	51 07	209	40 07	257	36 10	305	51 39	338
341	31 13	022	61 05	080	46 11	147	50 41	209	39 15	256	35 26	304	51 17	336
342	31 32	021	61 58	079	46 40	148	50 14	210	38 23	256	34 41	303	50 55	335
343	31 51	020	62 51	078	47 09	148	49 47	210	37 30	256	33 56	302	50 31	333
344	32 09	019	63 44	078	47 37	149	49 20	211	36 38	255	33 10	302	50 07	332
	Alphenitz		♦Hamal		♦ACHERNAR		Peacock		Nunki		♦ALTAIR		Enif	
345	32 25	018	22 49	047	48 05	149	48 52	211	35 46	255	32 24	301	49 41	331
346	32 42	017	23 26	046	48 33	149	48 24	212	34 54	255	31 37	300	49 14	329
347	32 57	016	24 07	045	49 00	150	47 55	212	34 02	255	30 50	299	48 46	328
348	33 11	015	24 45	044	49 27	150	47 26	212	33 10	254	30 03	299	48 16	327
349	33 25	014	25 23	044	49 54	151	46 57	213	32 18	254	29 16	298	47 46	325
350	33 37	013	26 00	043	50 20	151	46 28	213	31 26	254	28 28	297	47 15	324
351	33 49	012	26 36	042	50 45	152	45 58	214	30 34	253	27 40	297	46 43	323
352	33 59	011	27 12	041	51 11	152	45 28	214	29 43	253	26 52	296	46 10	322
353	34 09	010	27 47	041	51 36	153	44 58	214	28 51	253	26 03	295	45 36	321
354	34 18	009	28 22	040	52 00	153	44 28	214	28 00	253	25 14	295	45 02	319
355	34 25	008	28 57	039	52 24	154	43 57	215	27 08	252	24 25	294	44 26	318
356	34 32	007	29 30	038	52 47	155	43 26	215	26 17	252	23 36	294	43 50	317
357	34 38	006	30 03	037	53 10	155	42 55	215	25 26	252	22 47	293	43 13	316
358	34 42	004	30 36	036	53 32	156	42 24	216	24 34	251	21 57	292	42 35	315
359	34 46	003	31 07	036	53 54	157	41 53	216	23 43	251	21 07	292	41 57	314

LAT 26°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦ Alpheratz		Hamal		♦ RIGEL		CANOPUS		ACHERNAR		♦ Peacock		Enif	
0	34 49	002	31 38	035	13 39	093	16 56	141	54 15	157	41 21	216	41 18	313
1	34 51	001	32 09	034	14 33	092	17 30	141	54 35	158	40 49	216	40 38	312
2	34 51	000	32 38	033	15 27	092	18 05	141	54 55	159	40 17	216	39 58	311
3	34 51	359	33 07	032	16 21	091	18 39	140	55 14	160	39 45	216	39 17	310
4	34 50	358	33 36	031	17 14	091	19 14	140	55 33	160	39 13	217	38 35	309
5	34 47	357	34 03	030	18 08	090	19 48	140	55 51	161	38 41	217	37 53	308
6	34 44	356	34 30	029	19 02	090	20 23	140	56 08	162	38 09	217	37 11	308
7	34 40	355	34 55	028	19 56	090	20 58	140	56 24	163	37 36	217	36 28	307
8	34 35	354	35 21	027	20 50	089	21 33	139	56 39	164	37 04	217	35 45	306
9	34 28	353	35 45	026	21 44	089	22 08	139	56 54	165	36 31	217	35 01	305
10	34 21	352	36 08	025	22 38	088	22 43	139	57 08	166	35 58	217	34 16	304
11	34 13	351	36 30	024	23 32	088	23 19	139	57 21	166	35 26	217	33 32	304
12	34 04	350	36 52	023	24 26	087	23 54	139	57 33	167	34 53	217	32 47	303
13	33 54	349	37 13	022	25 20	087	24 30	139	57 45	168	34 20	218	32 01	302
14	33 43	348	37 32	021	26 13	086	25 06	138	57 55	169	33 47	218	31 15	301
	♦ Hamal		ALDEBARAN		RIGEL		♦ CANOPUS		ACHERNAR		♦ FOMALHAUT		Alpheratz	
15	37 51	020	22 21	057	27 07	086	25 41	138	58 05	170	62 54	255	33 31	347
16	38 09	019	23 06	056	28 01	085	26 17	138	58 13	171	62 02	255	33 18	346
17	38 25	018	23 51	056	28 55	085	26 53	138	58 21	172	61 10	255	33 04	345
18	38 41	016	24 35	055	29 48	084	27 29	138	58 28	173	60 18	255	32 49	344
19	38 56	015	25 19	054	30 42	084	28 05	138	58 34	174	59 25	255	32 33	343
20	39 10	014	26 03	054	31 36	083	28 41	138	58 39	175	58 33	255	32 17	342
21	39 22	013	26 46	053	32 29	083	29 18	138	58 43	176	57 41	255	31 59	341
22	39 34	012	27 29	052	33 23	082	29 54	138	58 46	177	56 49	255	31 41	340
23	39 44	011	28 12	052	34 16	082	30 30	138	58 48	178	55 57	255	31 22	339
24	39 54	009	28 54	051	35 10	081	31 06	138	58 49	179	55 05	255	31 02	338
25	40 02	008	29 36	050	36 03	081	31 43	138	58 49	181	54 13	255	30 41	337
26	40 10	007	30 17	049	36 56	080	32 19	138	58 48	182	53 21	255	30 19	336
27	40 16	006	30 57	049	37 49	080	32 55	138	58 46	183	52 29	255	29 57	335
28	40 21	005	31 38	048	38 42	079	33 32	138	58 43	184	51 37	254	29 34	334
29	40 25	004	32 17	047	39 35	079	34 08	138	58 39	185	50 45	254	29 10	333
	Hamal		ALDEBARAN		♦ SIRIUS		CANOPUS		♦ ACHERNAR		FOMALHAUT		♦ Alpheratz	
30	40 27	002	32 56	046	23 38	098	34 44	138	58 34	186	49 53	254	28 45	332
31	40 29	001	33 35	045	24 31	097	35 21	138	58 28	187	49 01	254	28 20	331
32	40 29	000	34 13	044	25 25	097	35 57	138	58 22	188	48 09	254	27 54	331
33	40 29	359	34 50	044	26 18	097	36 33	138	58 14	189	47 18	254	27 27	330
34	40 27	358	35 27	043	27 12	096	37 10	138	58 06	190	46 26	254	26 59	329
35	40 24	356	36 03	042	28 05	096	37 46	138	57 56	191	45 34	253	26 31	328
36	40 20	355	36 39	041	28 59	096	38 22	138	57 45	192	44 43	253	26 02	327
37	40 15	354	37 14	040	29 53	095	38 58	138	57 34	193	43 51	253	25 33	326
38	40 09	353	37 48	039	30 46	095	39 34	138	57 22	194	42 59	253	25 03	326
39	40 01	352	38 21	038	31 40	094	40 10	138	57 09	194	42 08	253	24 32	325
40	39 53	350	38 54	037	32 34	094	40 46	138	56 55	195	41 16	252	24 01	324
41	39 43	349	39 26	036	33 28	094	41 22	139	56 40	196	40 25	252	23 29	323
42	39 33	348	39 57	035	34 22	093	41 57	139	56 24	197	39 34	252	22 57	323
43	39 21	347	40 28	034	35 15	093	42 33	139	56 08	198	38 43	252	22 24	322
44	39 08	346	40 57	033	36 09	092	43 08	139	55 51	199	37 51	252	21 50	321
	♦ ALDEBARAN		BETELGEUSE		SIRIUS		♦ CANOPUS		ACHERNAR		♦ FOMALHAUT		Hamal	
45	41 26	032	35 50	058	37 03	092	43 43	139	55 34	200	37 00	251	38 54	345
46	41 53	030	36 35	057	37 57	091	44 18	140	55 15	200	36 09	251	38 39	343
47	42 20	029	37 21	056	38 51	091	44 53	140	54 56	201	35 18	251	38 23	342
48	42 46	028	38 05	056	39 45	091	45 28	140	54 36	202	34 27	251	38 06	341
49	43 11	027	38 50	055	40 39	090	46 03	140	54 16	203	33 36	250	37 49	340
50	43 35	026	39 33	054	41 33	090	46 37	141	53 55	203	32 46	250	37 30	339
51	43 58	024	40 17	053	42 27	089	47 11	141	53 33	204	31 55	250	37 10	338
52	44 20	023	41 00	052	43 21	089	47 45	141	53 11	205	31 04	250	36 49	337
53	44 40	022	41 42	051	44 15	088	48 19	142	52 48	205	30 14	249	36 28	336
54	45 00	021	42 24	050	45 08	088	48 52	142	52 25	206	29 23	249	36 05	335
55	45 18	019	43 05	049	46 02	087	49 25	142	52 01	207	28 33	249	35 42	334
56	45 36	018	43 45	048	46 56	087	49 58	143	51 37	207	27 43	249	35 17	333
57	45 52	017	44 25	047	47 50	086	50 31	143	51 12	208	26 53	248	34 52	332
58	46 07	015	45 05	046	48 44	086	51 03	144	50 47	208	26 02	248	34 26	331
59	46 21	014	45 43	045	49 38	085	51 35	144	50 21	209	25 12	248	33 59	330
	ALDEBARAN		BETELGEUSE		♦ SIRIUS		CANOPUS		♦ ACHERNAR		FOMALHAUT		♦ Hamal	
60	46 33	013	46 21	044	50 31	085	52 06	145	49 55	209	24 23	248	33 32	329
61	46 45	011	46 58	043	51 25	084	52 37	145	49 28	210	23 33	247	33 04	328
62	46 55	010	47 34	042	52 19	084	53 08	146	49 01	210	22 43	247	32 35	327
63	47 03	009	48 10	041	53 12	083	53 38	146	48 34	211	21 53	247	32 05	326
64	47 11	007	48 44	039	54 06	083	54 08	147	48 06	211	21 04	246	31 34	325
65	47 17	006	49 18	038	54 59	082	54 37	147	47 38	211	20 15	246	31 03	324
66	47 22	004	49 51	037	55 53	081	55 06	148	47 10	212	19 25	246	30 31	323
67	47 26	003	50 23	036	56 46	081	55 35	149	46 41	212	18 36	245	29 59	323
68	47 27	002	50 54	034	57 39	080	56 02	149	46 12	213	17 47	245	29 26	322
69	47 28	000	51 23	033	58 32	079	56 30	150	45 43	213	16 58	245	28 52	321
70	47 28	359	51 52	031	59 25	079	56 56	151	45 14	213	16 10	245	28 18	320
71	47 26	357	52 19	030	60 18	078	57 22	152	44 44	214	15 21	244	27 43	319
72	47 23	356	52 46	029	61 11	077	57 47	152	44 14	214	14 33	244	27 07	318
73	47 18	355	53 11	027	62 03	076	58 12	153	43 44	214	13 44	244	26 31	318
74	47 12	353	53 35	025	62 55	075	58 36	154	43 14	214	12 56	243	25 55	317
	BETELGEUSE		PROCYON		♦ Suhail		CANOPUS		♦ ACHERNAR		Hamal		♦ ALDEBARAN	
75	53 57	024	40 16	057	37 22	126	58 59	155	42 43	215	26 18	316	47 05	352
76	54 19	022	41 01	056	38 05	126	59 22	156	42 12	215	24 40	315	46 57	350
77	54 38	021	41 46	055	38 49	126	59 43	157	41 41	215	24 02	315	46 47	349
78	54 57	019	42 30	054	39 33	126	60 04	158	41 10	215	23 23	314	46 36	348
79	55 14	017	43 13	053	40 16	126	60 24	159	40 39	216	22 44	313	46 24	346
80	55 29	016	43 56	052	41 00	126	60 43	160	40 07	216	22 05	313	46 11	345
81	55 43	014	44 39	051	41 43	126	61 01	161	39 36	216	21 25	312	45 58	344
82	55 55	012	45 21	050	42 27	126	61 18	162	39 04	216	20 45	311	45 40	342
83	56 06	011	46 02	049	43 10	126	61 34	163	38 32	216	20 04	311	45 23	341
84	56 15	009	46 43	048	43 54	126	61 48	164	38 01	216	19 23	310	45 05	340
85	56 22	007	47 22	047	44 37	126	62 02	166	37 29	216	18 41	309	44 45	338
86	56 28	005	48 02	046	45 20	127	62 15	167	36 58	217	17 59	309	44 25	337
87	56 32	003	48 40	045	46 04	127	62 27	168	36 24	217	17 17	308	44 03	336
88	56 35	002	49 18	044	46 47	127	62 37	169	35 52	217	16 34	307	43 41	335
89	56 36	000	49 55	043	47 30	127	62 47	171	35 20	217	15 51	307	43 17	333

LAT 26°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	POLLUX		♦ REGULUS		ACRUX		♦ CANOPUS		ACHERNAR		♦ RIGEL		BETELGEUSE	
90	30 18	027	18 37	068	20 04	151	62 55	172	34 47	217	69 14	327	56 35	358
91	30 42	026	19 26	065	20 30	151	63 02	173	34 15	217	68 43	325	56 32	356
92	31 06	025	20 15	065	20 56	151	63 08	175	33 43	217	68 11	322	56 28	354
93	31 28	024	21 04	064	21 22	151	63 12	176	33 10	217	67 38	320	56 22	353
94	31 50	023	21 52	064	21 48	151	63 15	177	32 38	217	67 02	318	56 14	351
95	32 11	022	22 41	063	22 14	151	63 17	179	32 05	217	66 26	316	56 05	349
96	32 31	021	23 29	062	22 41	151	63 18	180	31 33	217	65 48	314	55 54	347
97	32 51	021	24 18	062	23 07	151	63 17	181	31 00	217	65 09	313	55 41	346
98	33 09	020	25 04	061	23 34	150	63 15	183	30 28	217	64 28	311	55 27	344
99	33 27	019	25 51	061	24 00	150	63 12	184	29 55	217	63 47	309	55 11	342
100	33 43	018	26 38	060	24 27	150	63 08	185	29 23	217	63 05	308	54 54	341
101	33 59	017	27 24	059	24 54	150	63 02	187	28 50	217	62 22	306	54 36	339
102	34 14	015	28 10	059	25 20	150	62 56	188	28 18	217	61 38	305	54 16	337
103	34 28	014	28 56	058	25 47	150	62 48	189	27 45	217	60 53	303	53 54	336
104	34 41	013	29 42	057	26 14	150	62 38	191	27 13	217	60 07	302	53 31	334
	POLLUX		♦ REGULUS		Gienah		♦ ACRUX		CANOPUS		♦ RIGEL		BETELGEUSE	
105	34 53	012	30 27	056	17 09	102	26 41	150	62 28	152	59 21	301	53 07	333
106	35 04	011	31 11	056	18 02	101	27 08	150	62 16	193	58 35	300	52 42	331
107	35 14	010	31 56	055	18 55	101	27 35	150	62 04	194	57 48	298	52 16	330
108	35 23	009	32 40	054	19 48	100	28 02	150	61 50	195	57 00	297	51 49	328
109	35 31	008	33 23	053	20 41	100	28 29	150	61 35	197	56 12	296	51 19	327
110	35 38	007	34 06	053	21 34	100	28 56	150	61 19	198	55 23	295	50 49	326
111	35 45	006	34 49	052	22 27	099	29 23	150	61 02	199	54 34	294	50 18	324
112	35 50	005	35 31	051	23 20	099	29 51	150	60 44	200	53 45	293	49 46	323
113	35 54	004	36 12	050	24 13	099	30 18	150	60 25	201	52 56	292	49 13	322
114	35 57	003	36 54	049	25 07	098	30 45	150	60 06	202	52 06	292	48 40	320
115	35 59	002	37 34	048	26 00	098	31 12	150	59 45	203	51 15	291	48 05	319
116	36 00	001	38 14	047	26 54	097	31 39	150	59 23	204	50 25	290	47 29	318
117	36 00	359	38 54	046	27 47	097	32 06	150	59 01	205	49 34	289	46 53	317
118	35 59	358	39 32	046	28 41	097	32 33	150	58 38	206	48 43	288	46 16	316
119	35 57	357	40 10	045	29 34	096	33 00	150	58 14	207	47 52	288	45 38	315
	♦ REGULUS		SPICA		ACRUX		CANOPUS		♦ RIGEL		BETELGEUSE		POLLUX	
120	40 48	044	12 31	097	33 26	150	57 50	208	47 00	287	44 59	314	35 54	356
121	41 25	043	13 24	096	33 53	150	57 24	208	46 08	286	44 20	313	35 49	355
122	42 01	042	14 18	096	34 20	150	56 58	209	45 16	285	43 40	312	35 44	354
123	42 36	040	15 12	095	34 47	150	56 32	210	44 24	285	42 59	311	35 38	353
124	43 11	039	16 05	095	35 13	151	56 05	211	43 32	284	42 18	310	35 31	352
125	43 45	038	16 59	094	35 40	151	55 37	211	42 40	284	41 36	309	35 23	351
126	44 18	037	17 53	094	36 06	151	55 09	212	41 47	283	40 53	308	35 14	350
127	44 50	036	18 47	094	36 32	151	54 40	213	40 55	282	40 11	307	35 04	349
128	45 21	035	19 40	093	36 58	151	54 11	213	40 02	282	39 27	306	34 52	348
129	45 52	034	20 34	093	37 24	151	53 41	214	39 09	281	38 43	305	34 40	347
130	46 21	032	21 28	092	37 50	151	53 11	214	38 16	281	37 59	304	34 27	346
131	46 49	031	22 22	092	38 16	152	52 40	215	37 23	280	37 14	303	34 13	344
132	47 17	030	23 16	091	38 42	152	52 09	215	36 30	279	36 29	303	33 59	343
133	47 43	029	24 10	091	39 07	152	51 37	216	35 37	279	35 43	302	33 43	342
134	48 08	027	25 04	091	39 32	152	51 06	216	34 43	278	34 57	301	33 26	341
	REGULUS		♦ SPICA		ACRUX		♦ CANOPUS		RIGEL		BETELGEUSE		♦ POLLUX	
135	48 33	026	25 58	090	39 57	152	50 33	217	33 50	278	34 11	300	33 08	340
136	48 56	025	26 52	090	40 22	153	50 01	217	32 56	277	33 24	300	32 50	339
137	49 17	023	27 46	089	40 47	153	49 28	218	32 03	277	32 37	299	32 30	338
138	49 38	022	28 40	089	41 11	153	48 55	218	31 09	276	31 50	298	32 10	338
139	49 57	020	29 33	088	41 36	153	48 22	218	30 16	276	31 02	297	31 49	337
140	50 16	019	30 27	088	42 00	154	47 48	219	29 22	275	30 14	297	31 27	336
141	50 32	017	31 21	087	42 23	154	47 14	219	28 28	275	29 26	296	31 05	335
142	50 48	016	32 15	087	42 47	154	46 40	219	27 35	274	28 37	295	30 41	334
143	51 02	014	33 09	087	43 10	155	46 06	220	26 41	274	27 48	295	30 17	333
144	51 15	013	34 03	086	43 33	155	45 31	220	25 47	273	26 59	294	29 52	332
145	51 26	011	34 57	086	43 56	155	44 56	220	24 53	273	26 10	294	29 26	331
146	51 36	010	35 50	085	44 18	156	44 21	220	23 59	272	25 20	293	29 00	330
147	51 45	008	36 44	085	44 40	156	43 46	221	23 05	272	24 31	292	28 33	329
148	51 52	007	37 38	084	45 02	156	43 11	221	22 12	272	23 41	292	28 05	328
149	51 57	005	38 31	084	45 23	157	42 36	221	21 18	271	22 50	291	27 36	328
	REGULUS		♦ Denebola		SPICA		♦ ACRUX		CANOPUS		♦ SIRIUS		PROCYON	
150	51 20	356	44 00	031	43 52	080	47 24	159	39 01	222	44 03	272	43 53	308
151	52 04	002	42 02	035	40 18	083	46 06	158	41 25	221	43 10	271	43 10	307
152	52 05	000	42 33	034	41 12	082	46 25	158	40 49	222	42 16	271	42 26	306
153	52 04	359	43 03	033	42 05	081	46 45	158	40 13	222	41 22	270	41 42	305
154	52 03	357	43 32	032	42 58	081	47 05	159	39 37	222	40 28	270	40 57	304
155	51 59	356	44 00	031	43 52	080	47 24	159	39 01	222	39 34	269	40 12	303
156	51 54	354	44 27	030	44 45	080	47 43	160	38 25	222	38 40	269	39 27	302
157	51 48	352	44 53	028	45 38	079	48 01	160	37 49	222	37 46	268	38 41	301
158	51 40	351	45 18	027	46 31	078	48 19	161	37 13	222	36 52	268	37 55	301
159	51 31	349	45 42	026	47 23	078	48 36	161	36 37	222	35 58	268	37 08	300
160	51 20	348	46 05	025	48 16	077	48 53	162	36 00	222	35 04	267	36 21	299
161	51 08	346	46 27	023	49 09	077	49 10	163	35 24	222	34 11	267	35 34	298
162	50 54	345	46 48	022	50 01	076	49 26	163	34 48	222	33 17	266	34 46	297
163	50 40	343	47 08	021	50 53	075	49 41	164	34 11	222	32 23	266	33 58	297
164	50 23	342	47 26	019	51 45	074	49 56	164	33 35	222	31 29	266	33 10	296
	ARCTURUS		♦ ANTARES		ACRUX		♦ CANOPUS		SIRIUS		PROCYON		♦ REGULUS	
165	24 24	052	17 28	111	50 11	165	32 59	222	30 35	265	32 21	295	50 06	340
166	25 06	051	18 19	111	50 24	165	32 22	222	29 42	265	31 32	295	49 47	339
167	25 48	050	19 09	111	50 36	166	31 46	222	28 48	264	30 43	294	49 27	337
168	26 29	049	19 59	110	50 50	167	31 10	222	27 54	264	29 54	293	49 06	336
169	27 10	049	20 50	110	51 02	167	30 33	222	27 01	264	29 04	293	48 43	335
170	27 50	048	21 41	110	51 14	168	29 57	222	26 07	263	28 14	292	48 19	333
171	28 30	047	22 31	110	51 25	169	29 21	222	25 14	263	27 24	291	47 55	332
172	29 09	046	23 22	109	51 35	169	28 45	222	24 20	262	26 34	291	47 29	331
173	29 48	046	24 13	109	51 45	170	28 08	222	23 27	262	25 43	290	47 02	329
174	30 26	045	25 04	109	51 54	171	27 32	222	22 33	262	24 53	290	46 34	328
175	31 04	044	25 55	108	52 02	171	26 55	222	21 40	261	24 02	289	46 05	327
176	31 41	043	26 47	108	52 10	172	26 20	222	20 47	261	23 11	289	45 35	326
177	32 18	042	27 38	108	52 17	173	25 45	222	19 53	261	22 20	288	45 04	325
178	32 54	041	28 29	107	52 24	174	25 09	222	19 00	260	21 28	287	44 32	323
179	33 29	041	29 21	107	52 30	174	24 33	221	18 07	260	20 37	287	44 00	322

LAT 26°S

LHA Υ	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	◆ Alpheratz		Hamal		◆ RIGEL		CANOPUS		ACHERNAR		◆ Peacock		Enif	
0	34 49	002	31 38	035	13 39	093	16 56	141	54 15	157	41 21	216	41 18	313
1	34 51	001	32 09	034	14 33	092	17 30	141	54 35	158	40 49	216	40 38	312
2	34 51	000	32 38	033	15 27	092	18 05	141	54 55	159	40 17	216	39 58	311
3	34 51	359	33 07	032	16 21	091	18 39	140	55 14	160	39 45	216	39 17	310
4	34 50	358	33 36	031	17 14	091	19 14	140	55 33	160	39 13	217	38 35	309
5	34 47	357	34 03	030	18 08	090	19 48	140	55 51	161	38 41	217	37 53	308
6	34 44	356	34 30	029	19 02	090	20 23	140	56 08	162	38 09	217	37 11	308
7	34 40	355	34 55	028	19 56	090	20 58	140	56 24	163	37 36	217	36 28	307
8	34 35	354	35 20	027	20 50	089	21 33	139	56 39	164	37 04	217	35 45	306
9	34 28	353	35 45	026	21 44	089	22 08	139	56 54	165	36 31	217	35 01	305
10	34 21	352	36 08	025	22 38	088	22 43	139	57 08	166	35 58	217	34 16	304
11	34 13	351	36 30	024	23 32	088	23 19	139	57 21	166	35 26	217	33 32	304
12	34 04	350	36 52	023	24 26	087	23 54	139	57 33	167	34 53	217	32 47	303
13	33 54	349	37 13	022	25 20	087	24 30	139	57 45	168	34 20	218	32 01	302
14	33 43	348	37 32	021	26 13	086	25 06	138	57 55	169	33 47	218	31 15	301
	◆ Hamal		ALDEBARAN		RIGEL		◆ CANOPUS		ACHERNAR		◆ FOMALHAUT		Alpheratz	
15	37 51	020	22 21	057	27 07	086	25 41	138	58 05	170	62 54	255	33 31	347
16	38 09	019	23 06	056	28 01	085	26 17	138	58 13	171	62 02	255	33 18	346
17	38 25	018	23 51	056	28 55	085	26 53	138	58 21	172	61 10	255	33 04	345
18	38 41	016	24 35	055	29 48	084	27 29	138	58 28	173	60 18	255	32 49	344
19	38 56	015	25 19	054	30 42	084	28 05	138	58 34	174	59 25	255	32 33	343
20	39 10	014	26 03	054	31 36	083	28 41	138	58 39	175	58 33	255	32 17	342
21	39 22	013	26 46	053	32 29	083	29 18	138	58 43	176	57 41	255	31 59	341
22	39 34	012	27 29	052	33 23	082	29 54	138	58 46	177	56 49	255	31 41	340
23	39 44	011	28 12	052	34 16	082	30 30	138	58 48	178	55 57	255	31 22	339
24	39 54	009	28 54	051	35 09	081	31 06	138	58 49	179	55 05	255	31 02	338
25	40 02	008	29 35	050	36 03	081	31 43	138	58 49	181	54 13	255	30 41	337
26	40 10	007	30 17	049	36 56	080	32 19	138	58 48	182	53 21	255	30 19	336
27	40 16	006	30 57	049	37 49	080	32 55	138	58 46	183	52 29	255	29 57	335
28	40 21	005	31 38	048	38 42	079	33 32	138	58 43	184	51 37	254	29 34	334
29	40 25	004	32 17	047	39 35	079	34 08	138	58 39	185	50 45	254	29 10	333
	Hamal		ALDEBARAN		◆ SIRIUS		CANOPUS		◆ ACHERNAR		FOMALHAUT		◆ Alpheratz	
30	40 27	002	32 56	046	23 38	098	34 44	138	58 34	186	49 53	254	28 45	332
31	40 29	001	33 35	045	24 31	097	35 21	138	58 28	187	49 01	254	28 20	331
32	40 29	000	34 13	044	25 25	097	35 57	138	58 21	188	48 09	254	27 54	331
33	40 29	359	34 50	044	26 18	097	36 33	138	58 14	189	47 18	254	27 27	330
34	40 27	358	35 27	043	27 12	096	37 10	138	58 05	190	46 26	254	26 59	329
35	40 24	356	36 03	042	28 05	096	37 46	138	57 56	191	45 34	253	26 31	328
36	40 20	355	36 39	041	28 59	096	38 22	138	57 45	192	44 43	253	26 02	327
37	40 15	354	37 14	040	29 53	095	38 58	138	57 34	193	43 51	253	25 33	326
38	40 09	353	37 48	039	30 46	095	39 34	138	57 22	194	42 59	253	25 03	326
39	40 01	352	38 21	038	31 40	094	40 10	138	57 09	194	42 08	253	24 32	325
40	39 53	350	38 54	037	32 34	094	40 46	138	56 55	195	41 16	252	24 01	324
41	39 43	349	39 26	036	33 28	094	41 22	139	56 40	196	40 25	252	23 29	323
42	39 33	348	39 57	035	34 22	093	41 57	139	56 24	197	39 34	252	22 57	323
43	39 21	347	40 28	034	35 15	093	42 33	139	56 08	198	38 43	252	22 24	322
44	39 08	346	40 57	033	36 09	092	43 08	139	55 51	199	37 51	252	21 50	321
	◆ ALDEBARAN		BETELGEUSE		SIRIUS		◆ CANOPUS		ACHERNAR		◆ FOMALHAUT		Hamal	
45	41 26	032	35 50	058	37 03	092	43 43	139	55 34	200	37 00	251	38 54	345
46	41 53	030	36 35	057	37 57	091	44 18	140	55 15	200	36 09	251	38 39	343
47	42 20	029	37 21	056	38 51	091	44 53	140	54 56	201	35 18	251	38 23	342
48	42 46	028	38 05	056	39 45	091	45 28	140	54 36	202	34 27	251	38 06	341
49	43 11	027	38 50	055	40 39	090	46 03	140	54 16	203	33 36	250	37 49	340
50	43 35	026	39 33	054	41 33	090	46 37	141	53 55	203	32 46	250	37 30	339
51	43 58	024	40 17	053	42 27	089	47 11	141	53 33	204	31 55	250	37 10	338
52	44 20	023	41 00	052	43 21	089	47 45	141	53 11	205	31 04	250	36 49	337
53	44 40	022	41 42	051	44 15	088	48 19	142	52 48	205	30 14	249	36 28	336
54	45 00	021	42 24	050	45 08	088	48 52	142	52 25	206	29 23	249	36 05	335
55	45 18	019	43 05	049	46 02	087	49 25	142	52 01	207	28 33	249	35 42	334
56	45 36	018	43 45	048	46 56	087	49 58	143	51 37	207	27 43	249	35 17	333
57	45 52	017	44 25	047	47 50	086	50 31	143	51 12	208	26 53	248	34 52	332
58	46 07	015	45 05	046	48 44	086	51 03	144	50 47	208	26 02	248	34 26	331
59	46 21	014	45 43	045	49 38	085	51 35	144	50 21	209	25 12	248	33 59	330
	ALDEBARAN		BETELGEUSE		◆ SIRIUS		CANOPUS		◆ ACHERNAR		FOMALHAUT		◆ Hamal	
60	46 33	013	46 21	044	50 31	085	52 06	145	49 55	209	24 23	248	33 32	329
61	46 45	011	46 58	043	51 25	084	52 37	145	49 28	210	23 33	247	33 04	328
62	46 55	010	47 34	042	52 19	084	53 08	146	49 01	210	22 43	247	32 35	327
63	47 03	009	48 10	041	53 12	083	53 38	146	48 34	211	21 53	247	32 05	326
64	47 11	007	48 44	039	54 06	083	54 08	147	48 06	211	21 04	246	31 34	325
65	47 17	006	49 18	038	54 59	082	54 37	147	47 38	211	20 15	246	31 03	324
66	47 22	004	49 51	037	55 53	081	55 06	148	47 10	212	19 25	246	30 31	323
67	47 25	003	50 23	036	56 46	081	55 35	149	46 41	212	18 36	245	29 59	323
68	47 27	002	50 54	034	57 39	080	56 02	149	46 12	213	17 47	245	29 26	322
69	47 28	000	51 23	033	58 32	079	56 30	150	45 43	213	16 58	245	28 52	321
70	47 28	359	51 52	031	59 25	079	56 56	151	45 14	213	16 10	245	28 18	320
71	47 26	357	52 19	030	60 18	078	57 22	152	44 44	214	15 21	244	27 43	319
72	47 23	356	52 46	029	61 11	077	57 47	152	44 14	214	14 33	244	27 07	318
73	47 18	355	53 11	027	62 03	076	58 12	153	43 44	214	13 44	244	26 31	318
74	47 12	353	53 35	025	62 55	075	58 36	154	43 14	214	12 56	243	25 55	317
	BETELGEUSE		PROCYON		◆ Suhail		CANOPUS		◆ ACHERNAR		Hamal		◆ ALDEBARAN	
75	53 57	024	40 16	057	37 22	126	58 59	155	42 43	215	25 18	316	47 05	352
76	54 19	022	41 01	056	38 05	126	59 22	156	42 12	215	24 40	315	46 57	350
77	54 38	021	41 46	055	38 49	126	59 43	157	41 41	215	24 02	315	46 47	349
78	54 57	019	42 30	054	39 33	126	60 04	158	41 10	215	23 23	314	46 36	348
79	55 14	017	43 13	053	40 16	126	60 24	159	40 39	216	22 44	313	46 24	346
80	55 29	016	43 56	052	41 00	126	60 43	160	40 07	216	22 05	313	46 11	345
81	55 43	014	44 39	051	41 43	126	61 01	161	39 36	216	21 25	312	45 56	344
82	55 55	012	45 21	050	42 27	126	61 18	162	39 04	216	20 45	311	45 40	342
83	56 06	011	46 02	049	43 10	126	61 34	163	38 32	216	20 04	311	45 23	341
84	56 15	009	46 43	048	43 54	126	61 49	164	38 01	216	19 23	310	45 05	340
85	56 22	007	47 22	047	44 37	126	62 02	166	37 29	216	18 41	309	44 45	338
86	56 28	005	48 02	046	45 20	127	62 15	167	36 56	217	17 59	309	44 25	337
87	56 32	003	48 40	045	46 04	127	62 27	168	36 24	217	17 17	308	44 03	336
88	56 35	002	49 18	044	46 47	127	62 37	169	35 52	217	16 34	307	43 41	335
89	56 36	000	49 55	043	47 30	127	62 47	171	35 20	217	15 51	307	43 17	333

LAT 26°S

LHA Υ	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	POLLUX		◆ REGULUS		ACRUX		◆ CANOPUS		ACHERNAR		◆ RIGEL		BETELGEUSE	
90	30 18	027	18 37	066	20 04	151	62 55	172	34 47	217	69 14	327	56 35	358
91	30 42	026	19 26	065	20 30	151	63 02	173	34 15	217	68 43	325	56 32	356
92	31 06	025	20 15	065	20 56	151	63 08	175	33 43	217	68 11	322	56 28	354
93	31 28	024	21 04	064	21 22	151	63 12	176	33 10	217	67 38	320	56 22	353
94	31 50	023	21 52	064	21 48	151	63 15	177	32 38	217	67 02	318	56 14	351
95	32 11	022	22 41	063	22 14	151	63 17	179	32 05	217	66 26	316	56 05	349
96	32 31	021	23 29	062	22 41	151	63 18	180	31 33	217	65 48	314	55 54	347
97	32 51	021	24 16	062	23 07	151	63 17	181	31 00	217	65 09	313	55 41	346
98	33 09	020	25 04	061	23 34	150	63 15	183	30 28	217	64 28	311	55 27	344
99	33 27	019	25 51	061	24 00	150	63 12	184	29 55	217	63 47	309	55 11	342
100	33 43	018	26 38	060	24 27	150	63 08	185	29 23	217	63 05	308	54 54	341
101	33 59	017	27 24	059	24 54	150	63 02	187	28 50	217	62 22	306	54 36	339
102	34 14	015	28 10	059	25 20	150	62 56	188	28 18	217	61 38	305	54 16	337
103	34 28	014	28 56	058	25 47	150	62 48	189	27 45	217	60 53	303	53 54	336
104	34 41	013	29 42	057	26 14	150	62 38	191	27 13	217	60 07	302	53 31	334
	POLLUX		◆ REGULUS		Gienah		◆ ACRUX		CANOPUS		◆ RIGEL		BETELGEUSE	
105	34 53	012	30 27	056	17 09	102	26 41	150	62 28	192	59 21	301	53 07	333
106	35 04	011	31 11	056	18 02	101	27 08	150	62 16	193	58 35	300	52 42	331
107	35 14	010	31 56	055	18 55	101	27 35	150	62 04	194	57 48	298	52 16	330
108	35 23	009	32 40	054	19 48	100	28 02	150	61 50	195	57 00	297	51 48	328
109	35 31	008	33 23	053	20 41	100	28 29	150	61 35	197	56 12	296	51 19	327
110	35 38	007	34 06	053	21 34	100	28 56	150	61 19	198	55 23	295	50 49	326
111	35 45	006	34 49	052	22 27	099	29 23	150	61 02	199	54 34	294	50 18	324
112	35 50	005	35 31	051	23 20	099	29 51	150	60 44	200	53 45	293	49 46	323
113	35 54	004	36 12	050	24 13	099	30 18	150	60 25	201	52 56	292	49 13	322
114	35 57	003	36 54	049	25 07	098	30 45	150	60 06	202	52 06	292	48 40	320
115	35 59	002	37 34	048	26 00	098	31 12	150	59 45	203	51 15	291	48 05	319
116	36 00	001	38 14	047	26 54	097	31 39	150	59 23	204	50 25	290	47 29	318
117	36 00	359	38 54	046	27 47	097	32 06	150	59 01	205	49 34	289	46 53	317
118	35 59	358	39 32	046	28 41	097	32 33	150	58 38	206	48 43	288	46 16	316
119	35 57	357	40 10	045	29 34	096	33 00	150	58 14	207	47 52	288	45 38	315
	◆ REGULUS		SPICA		◆ ACRUX		CANOPUS		◆ RIGEL		BETELGEUSE		POLLUX	
120	40 48	044	12 31	097	33 26	150	57 50	208	47 00	287	44 59	314	35 54	356
121	41 25	043	13 24	096	33 53	150	57 24	208	46 08	286	44 20	313	35 49	355
122	42 01	042	14 18	096	34 20	150	56 58	209	45 16	285	43 40	312	35 44	354
123	42 36	040	15 12	095	34 47	150	56 32	210	44 24	285	42 59	311	35 38	353
124	43 11	039	16 05	095	35 13	151	56 05	211	43 32	284	42 18	310	35 31	352
125	43 45	038	16 59	094	35 40	151	55 37	211	42 40	284	41 36	309	35 23	351
126	44 18	037	17 53	094	36 06	151	55 09	212	41 47	283	40 53	308	35 14	350
127	44 50	036	18 47	094	36 32	151	54 40	213	40 55	282	40 11	307	35 04	349
128	45 21	035	19 40	093	36 58	151	54 11	213	40 02	282	39 27	306	34 52	348
129	45 52	034	20 34	093	37 24	151	53 41	214	39 09	281	38 43	305	34 40	347
130	46 21	032	21 28	092	37 50	151	53 11	214	38 16	281	37 59	304	34 27	346
131	46 49	031	22 22	092	38 16	152	52 40	215	37 23	280	37 14	303	34 13	344
132	47 17	030	23 16	091	38 42	152	52 09	215	36 30	279	36 29	303	33 59	343
133	47 43	029	24 10	091	39 07	152	51 37	216	35 37	279	35 43	302	33 43	342
134	48 08	027	25 04	091	39 32	152	51 06	216	34 43	278	34 57	301	33 26	341
	REGULUS		◆ SPICA		ACRUX		◆ CANOPUS		RIGEL		BETELGEUSE		◆ POLLUX	
135	48 33	026	25 58	090	39 57	152	50 33	217	33 50	278	34 11	300	33 08	340
136	48 56	025	26 52	090	40 22	153	50 01	217	32 56	277	33 24	300	32 50	339
137	49 17	023	27 46	089	40 47	153	49 28	218	32 03	277	32 37	299	32 30	338
138	49 38	022	28 40	089	41 11	153	48 55	218	31 09	276	31 50	298	32 10	338
139	49 57	020	29 33	088	41 35	153	48 22	218	30 16	276	31 02	297	31 49	337
140	50 16	019	30 27	088	41 59	154	47 48	219	29 22	275	30 14	297	31 27	336
141	50 32	017	31 21	087	42 23	154	47 14	219	28 28	275	29 26	296	31 05	335
142	50 48	016	32 15	087	42 47	154	46 40	219	27 35	274	28 37	295	30 41	334
143	51 02	014	33 09	087	43 10	155	46 06	220	26 41	274	27 48	295	30 17	333
144	51 15	013	34 03	086	43 33	155	45 31	220	25 47	273	26 59	294	29 52	332
145	51 26	011	34 57	086	43 56	155	44 56	220	24 53	273	26 10	294	29 26	331
146	51 36	010	35 50	085	44 18	156	44 21	220	23 59	272	25 20	293	29 00	330
147	51 45	008	36 44	085	44 40	156	43 46	221	23 05	272	24 31	292	28 33	329
148	51 52	007	37 38	084	45 02	156	43 11	221	22 12	272	23 41	292	28 05	328
149	51 57	005	38 31	084	45 23	157	42 36	221	21 18	271	22 50	291	27 36	328
	REGULUS		◆ Denebola		SPICA		◆ ACRUX		CANOPUS		◆ SIRIUS		PROCYON	
150	52 01	004	41 30	036	39 25	083	45 44	157	42 00	221	44 03	272	43 53	308
151	52 04	002	42 02	035	40 18	083	46 05	158	41 25	221	43 10	271	43 10	307
152	52 05	000	42 33	034	41 12	082	46 25	158	40 49	222	42 16	271	42 26	306
153	52 04	359	43 03	033	42 05	081	46 45	158	40 13	222	41 22	270	41 42	305
154	52 03	357	43 32	032	42 58	081	47 05	159	39 37	222	40 28	270	40 57	304
155	51 59	356	44 00	031	43 52	080	47 24	159	39 01	222	39 34	269	40 12	303
156	51 54	354	44 27	030	44 45	080	47 43	160	38 25	222	38 40	269	39 27	302
157	51 48	352	44 53	028	45 38	079	48 01	160	37 49	222	37 46	268	38 41	301
158	51 40	351	45 18	027	46 31	078	48 19	161	37 13	222	36 52	268	37 55	301
159	51 31	349	45 42	026	47 23	078	48 36	161	36 37	222	35 58	268	37 08	300
160	51 20	348	46 05	025	48 16	077	48 53	162	36 00	222	35 04	267	36 21	299
161	51 08	346	46 27	023	49 09	077	49 10	163	35 24	222	34 11	267	35 34	298
162	50 54	345	46 48	022	50 01	076	49 26	163	34 48	222	33 17	266	34 46	297
163	50 40	343	47 08	021	50 53	075	49 41	164	34 11	222	32 23	266	33 58	297
164	50 23	342	47 26	019	51 45	074	49 56	164	33 35	222	31 29	266	33 10	296
	ARCTURUS		◆ ANTARES		ACRUX		◆ CANOPUS		SIRIUS		PROCYON		◆ REGULUS	
165	24 24	052	17 28	111	50 11	165	32 59	222	30 35	265	32 21	295	50 06	340
166	25 06	051	18 19	111	50 24	165	32 22	222	29 42	265	31 32	295	49 47	339
167	25 48	050	19 09	111	50 38	166	31 46	222	28 48	264	30 43	294	49 27	337
168	26 29	049	19 59	110	50 50	167	31 10	222	27 54	264	29 54	293	49 06	336
169	27 10	049	20 50	110	51 02	167	30 33	222	27 01	264	29 04	293	48 43	335
170	27 50	048	21 41	110	51 14	168	29 57	222	26 07	263	28 14	292	48 19	333
171	28 30	047	22 31	110	51 25	169	29 21	222	25 14	263	27 24	291	47 55	332
172	29 09	046	23 22	109	51 35	169	28 45	222	24 20	262	26 34	291	47 29	331
173	29 48	046	24 13	109	51 45	170	28 08	222	23 27	262	25 43	290	47 02	329
174	30 26	045	25 04	109	51 54	171	27 32	222	22 33	262	24 53	290	46 34	328
175	31 04	044	25 55	108	52 02	171	26 56	222	21 40	261	24 02	289	46 05	327
176	31 41	043	26 47	108	52 10	172	26 20	222	20 47	261	23 11	289	45 35	326
177	32 18	042	27 38	108	52 17	173	25 45	222	19 53	261	22 20	288	45 04	325
178	32 54	041	28 29	107	52 24	174	25 09	222	19 00	260	21 28	287	44 32	323
179	33 29	041	29 21	107	52 29	174	24 33	221	18 07	260	20 37	287	44 00	322

LAT 26°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	◆ ARCTURUS		ANTARES		◆ RIGIL KENT		ACRUX		CANOPUS		◆ Alphard		REGULUS	
180	34 04	040	30 13	107	45 52	153	52 35	175	23 57	221	50 03	289	43 26	321
181	34 38	039	31 04	107	46 16	154	52 39	176	23 22	221	49 12	288	42 52	320
182	35 11	038	31 56	106	46 40	154	52 43	176	22 47	221	48 20	287	42 17	319
183	35 44	037	32 48	106	47 03	154	52 46	177	22 11	221	47 29	286	41 41	318
184	36 16	036	33 40	106	47 26	155	52 48	178	21 36	221	46 37	286	41 05	317
185	36 47	035	34 32	105	47 49	155	52 50	179	21 01	220	45 45	285	40 28	316
186	37 18	034	35 24	105	48 11	156	52 51	179	20 26	220	44 53	284	39 50	315
187	37 47	033	36 16	105	48 33	156	52 51	180	19 51	220	44 01	284	39 11	314
188	38 16	032	37 08	105	48 54	157	52 50	181	19 17	220	43 08	283	38 32	313
189	38 44	031	38 00	104	49 15	157	52 49	182	18 42	220	42 15	282	37 52	312
190	39 11	030	38 52	104	49 36	158	52 47	182	18 08	220	41 23	282	37 12	311
191	39 38	029	39 45	104	49 56	158	52 45	183	17 33	219	40 30	281	36 31	310
192	40 03	028	40 37	104	50 15	159	52 41	184	16 59	219	39 37	281	35 50	309
193	40 28	026	41 29	103	50 35	160	52 37	185	16 25	219	38 44	280	35 08	309
194	40 51	025	42 22	103	50 53	160	52 33	185	15 52	219	37 51	280	34 25	308
	ARCTURUS		◆ Rasalhague		ANTARES		RIGIL KENT		◆ ACRUX		Suhail		◆ REGULUS	
195	41 14	024	12 47	069	43 15	103	51 11	161	52 27	186	40 24	234	33 43	307
196	41 35	023	13 37	068	44 07	103	51 29	161	52 21	187	39 40	234	32 59	306
197	41 56	022	14 27	068	45 00	102	51 45	162	52 14	188	38 57	234	32 16	305
198	42 16	021	15 17	067	45 53	102	52 02	163	52 07	188	38 13	234	31 31	305
199	42 34	019	16 07	067	46 45	102	52 18	163	51 59	189	37 30	234	30 47	304
200	42 51	018	16 56	066	47 38	102	52 33	164	51 50	190	36 46	234	30 02	303
201	43 08	017	17 46	066	48 31	101	52 47	165	51 41	190	36 03	234	29 17	302
202	43 23	016	18 35	065	49 24	101	53 01	165	51 31	191	35 19	234	28 31	302
203	43 37	014	19 24	065	50 17	101	53 14	166	51 20	192	34 36	234	27 45	301
204	43 50	013	20 12	064	51 10	101	53 27	167	51 09	192	33 53	234	26 59	300
205	44 01	012	21 01	063	52 03	100	53 39	168	50 57	193	33 09	233	26 12	300
206	44 12	011	21 49	063	52 56	100	53 50	168	50 45	194	32 26	233	25 25	299
207	44 21	009	22 37	062	53 49	100	54 00	169	50 32	194	31 43	233	24 38	298
208	44 29	008	23 24	062	54 42	100	54 10	170	50 19	195	31 00	233	23 50	298
209	44 36	007	24 12	061	55 35	099	54 19	171	50 05	195	30 16	233	23 02	297
	◆ ARCTURUS		Rasalhague		◆ Nunki		RIGIL KENT		ACRUX		◆ Suhail		Denebola	
210	44 42	005	24 59	060	24 37	109	54 27	172	49 50	196	29 33	233	38 32	318
211	44 46	004	25 45	060	25 29	108	54 35	172	49 35	197	28 50	233	37 56	317
212	44 50	003	26 32	059	26 20	108	54 42	173	49 19	197	28 08	233	37 19	316
213	44 51	001	27 18	058	27 11	108	54 48	174	49 03	198	27 25	232	36 42	315
214	44 52	000	28 04	058	28 03	107	54 53	175	48 46	198	26 42	232	36 03	314
215	44 52	359	28 49	057	28 54	107	54 57	176	48 29	199	25 59	232	35 25	314
216	44 50	357	29 34	056	29 46	107	55 01	177	48 12	199	25 17	232	34 45	313
217	44 47	356	30 19	056	30 37	106	55 04	177	47 54	200	24 35	232	34 05	312
218	44 42	355	31 03	055	31 29	106	55 06	178	47 35	200	23 52	232	33 25	311
219	44 37	353	31 47	054	32 21	106	55 07	179	47 16	201	23 10	231	32 44	310
220	44 30	352	32 30	053	33 13	106	55 07	180	46 57	201	22 28	231	32 02	309
221	44 22	351	33 13	053	34 05	105	55 07	181	46 37	202	21 46	231	31 21	309
222	44 13	349	33 56	052	34 57	105	55 06	182	46 17	202	21 04	231	30 38	308
223	44 02	348	34 38	051	35 49	105	55 04	182	45 56	203	20 22	231	29 55	307
224	43 50	347	35 20	050	36 41	105	55 01	183	45 36	203	19 41	230	29 12	306
	Alphecca		Rasalhague		◆ Nunki		Peacock		◆ RIGIL KENT		SPICA		◆ ARCTURUS	
225	36 39	010	36 01	049	37 33	104	26 00	143	54 58	184	63 18	299	43 38	346
226	36 47	009	36 41	048	38 26	104	26 33	143	54 53	185	62 30	298	43 24	344
227	36 55	008	37 21	047	39 18	104	27 05	143	54 48	186	61 42	297	43 09	343
228	37 02	006	38 01	047	40 10	103	27 38	143	54 42	187	60 54	296	42 52	342
229	37 07	005	38 40	046	41 03	103	28 11	143	54 36	187	60 05	294	42 35	341
230	37 12	004	39 18	045	41 55	103	28 44	142	54 28	188	59 16	293	42 17	339
231	37 15	003	39 55	044	42 48	103	29 17	142	54 20	189	58 26	292	41 57	338
232	37 17	002	40 32	043	43 41	102	29 50	142	54 11	190	57 36	291	41 37	337
233	37 19	001	41 08	042	44 33	102	30 22	142	54 02	191	56 46	290	41 15	336
234	37 19	000	41 44	041	45 26	102	30 55	142	53 51	191	55 55	290	40 53	335
235	37 18	359	42 19	040	46 19	102	31 28	142	53 40	192	55 04	289	40 29	334
236	37 16	358	42 53	038	47 12	101	32 01	142	53 29	193	54 13	288	40 05	332
237	37 14	356	43 26	037	48 04	101	32 34	142	53 16	194	53 21	287	39 39	331
238	37 10	355	43 58	036	48 57	101	33 07	142	53 03	194	52 30	286	39 13	330
239	37 05	354	44 29	035	49 50	101	33 40	142	52 49	195	51 38	286	38 46	329
	◆ VEGA		ALTAIR		◆ Peacock		RIGIL KENT		◆ SPICA		ARCTURUS		Alphecca	
240	15 30	031	23 54	066	34 13	142	52 35	196	50 46	285	38 18	328	36 59	353
241	15 58	030	24 43	066	34 46	143	52 20	197	49 54	284	37 49	327	36 52	352
242	16 24	030	25 32	065	35 19	143	52 04	197	49 01	283	37 19	326	36 44	351
243	16 51	029	26 21	064	35 51	143	51 48	198	48 09	283	36 49	325	36 34	350
244	17 16	028	27 09	064	36 24	143	51 31	198	47 16	282	36 18	324	36 24	349
245	17 42	027	27 58	063	36 57	143	51 14	199	46 23	281	35 46	323	36 13	348
246	18 06	027	28 46	062	37 29	143	50 56	200	45 30	281	35 13	322	36 01	346
247	18 30	026	29 33	062	38 02	143	50 37	200	44 37	280	34 40	321	35 48	345
248	18 54	025	30 21	061	38 34	143	50 18	201	43 44	280	34 06	320	35 34	344
249	19 16	025	31 08	060	39 06	143	49 59	201	42 51	279	33 31	319	35 19	343
250	19 39	024	31 54	060	39 38	143	49 39	202	41 58	278	32 56	319	35 03	342
251	20 00	023	32 41	059	40 10	144	49 18	203	41 04	278	32 20	318	34 46	341
252	20 21	022	33 27	058	40 42	144	48 57	203	40 11	277	31 43	317	34 28	340
253	20 41	022	34 12	057	41 14	144	48 36	204	39 17	277	31 06	316	34 09	339
254	21 01	021	34 57	057	41 46	144	48 14	204	38 24	276	30 28	315	33 50	338
	◆ VEGA		ALTAIR		FOMALHAUT		◆ Peacock		RIGIL KENT		◆ SPICA		ARCTURUS	
255	21 20	020	35 42	056	12 51	117	42 17	144	47 52	205	37 30	276	29 50	314
256	21 38	019	36 26	055	13 39	117	42 48	145	47 29	205	36 36	275	29 11	314
257	21 56	019	37 10	054	14 28	116	43 20	145	47 07	205	35 43	275	28 32	313
258	22 12	018	37 54	053	15 16	116	43 50	145	46 43	206	34 49	274	27 52	312
259	22 29	017	38 37	052	16 05	116	44 21	145	46 19	206	33 55	274	27 12	311
260	22 44	016	39 19	052	16 54	115	44 52	146	45 55	207	33 01	273	26 31	311
261	22 59	015	40 01	051	17 42	115	45 22	146	45 31	207	32 08	273	25 50	310
262	23 13	015	40 43	050	18 31	115	45 52	146	45 06	207	31 14	272	25 08	309
263	23 26	014	41 24	049	19 20	114	46 22	147	44 41	208	30 20	272	24 26	308
264	23 38	013	42 04	048	20 10	114	46 51	147	44 16	208	29 26	272	23 44	308
265	23 50	012	42 43	047	20 59	114	47 20	147	43 50	208	28 32	271	23 01	307
266	24 01	011	43 22	046	21 49	113	47 49	148	43 25	209	27 38	271	22 18	306
267	24 11	011	44 01	045	22 38	113	48 18	148	42 59	209	26 44	270	21 34	306
268	24 21	010	44 38	044	23 28	113	48 46	149	42 32	209	25 50	270	20 51	305
269	24 29	009	45 15	043	24 18	112	49 14	149	42 06	210	24 56	269	20 06	305

LAT 26°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	VEGA		◆ ALTAIR		FOMALHAUT		◆ Peacock		RIGIL KENT		◆ ANTARES		Alphecca	
270	24 37	008	45 51	041	25 07	112	49 41	150	41 39	210	69 51	264	26 49	324
271	24 44	007	46 27	040	25 57	112	50 08	150	41 12	210	68 57	264	26 16	323
272	24 51	006	47 01	039	26 47	112	50 35	151	40 45	210	68 03	263	25 44	322
273	24 56	005	47 35	038	27 38	111	51 01	151	40 17	211	67 10	263	25 10	321
274	25 01	005	48 07	037	28 28	111	51 27	152	39 50	211	66 16	263	24 36	321
275	25 05	004	48 39	035	29 18	111	51 52	152	39 22	211	65 23	263	24 02	320
276	25 08	003	49 10	034	30 09	111	52 17	153	38 54	211	64 29	263	23 27	319
277	25 10	002	49 40	033	30 59	110	52 42	153	38 26	211	63 36	262	22 51	318
278	25 12	001	50 08	032	31 50	110	53 05	154	37 58	212	62 42	262	22 15	318
279	25 12	000	50 36	030	32 41	110	53 29	155	37 30	212	61 49	262	21 39	317
280	25 12	359	51 03	029	33 31	110	53 52	155	37 01	212	60 56	262	21 02	316
281	25 11	359	51 28	027	34 22	109	54 14	156	36 33	212	60 02	262	20 24	316
282	25 09	358	51 52	026	35 13	109	54 35	157	36 04	212	59 09	261	19 46	315
283	25 07	357	52 15	024	36 04	109	54 56	157	35 36	212	58 16	261	19 08	314
284	25 04	356	52 36	023	36 55	109	55 17	158	35 07	212	57 22	261	18 29	314
	◆ DENEB		FOMALHAUT		◆ ACHERNAR		RIGIL KENT		◆ ANTARES		Rasalhague		VEGA	
285	15 01	018	37 46	108	16 44	146	34 38	212	56 29	261	46 18	329	24 59	355
286	15 17	018	38 37	108	17 14	146	34 09	212	55 36	261	45 50	328	24 54	354
287	15 33	017	39 29	108	17 44	146	33 40	213	54 43	260	45 21	327	24 49	353
288	15 49	016	40 20	108	18 15	145	33 11	213	53 50	260	44 51	326	24 42	353
289	16 03	016	41 11	108	18 45	145	32 42	213	52 56	260	44 20	325	24 35	352
290	16 18	015	42 03	107	19 16	145	32 13	213	52 03	260	43 48	323	24 26	351
291	16 31	014	42 54	107	19 47	145	31 44	213	51 10	259	43 16	322	24 17	350
292	16 44	013	43 46	107	20 18	145	31 15	213	50 17	259	42 42	321	24 08	349
293	16 56	013	44 37	107	20 49	145	30 45	213	49 24	259	42 08	320	23 57	348
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296	17 29	011	47 12	106	22 24	144	29 18	213	46 46	258	40 21	317	23 21	346
297	17 38	010	48 04	106	22 55	144	28 49	213	45 53	258	39 44	316	23 08	345
298	17 47	009	48 56	106	23 27	144	28 19	213	45 00	258	39 06	315	22 53	344
299	17 56	008	49 48	106	23 59	144	27 50	213	44 08	257	38 28	314	22 38	343
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300	18 03	008	45 59	039	50 40	106	24 31	144	27 21	213	43 15	257	22 23	343
301	18 10	007	46 32	038	51 32	106	25 03	144	26 52	213	42 23	257	22 06	342
302	18 16	006	47 04	036	52 24	105	25 35	143	26 23	213	41 30	257	21 49	341
303	18 22	006	47 36	035	53 16	105	26 07	143	25 54	212	40 38	256	21 31	340
304	18 27	005	48 06	034	54 08	105	26 39	143	25 25	212	39 45	256	21 13	340
305	18 31	004	48 36	033	55 00	105	27 12	143	24 56	212	38 53	256	20 54	339
306	18 34	003	49 04	031	55 52	105	27 44	143	24 27	212	38 01	256	20 34	338
307	18 37	003	49 32	030	56 44	105	28 16	143	23 59	212	37 08	255	20 14	337
308	18 39	002	49 58	029	57 36	105	28 49	143	23 30	212	36 16	255	19 52	337
309	18 40	001	50 23	027	58 28	105	29 21	143	23 02	212	35 24	255	19 31	336
310	18 41	000	50 47	026	59 20	105	29 54	143	22 33	212	34 32	255	19 08	335
311	18 41	000	51 10	024	60 12	105	30 26	143	22 05	212	33 40	254	18 45	334
312	18 40	359	51 32	023	61 05	105	30 59	143	21 36	212	32 48	254	18 22	334
313	18 39	358	51 52	021	61 57	105	31 31	143	21 08	211	31 56	254	17 57	333
314	18 37	357	52 11	020	62 49	105	32 04	143	20 40	211	31 05	253	17 33	332
	Alpheratz		◆ Diphda		ACHERNAR		◆ RIGIL KENT		ANTARES		◆ ALTAIR		DENEB	
315	18 38	043	37 48	093	32 36	143	20 12	211	30 13	253	51 19	332	18 34	357
316	19 15	042	38 42	093	33 09	143	19 44	211	29 22	253	50 53	331	18 30	356
317	19 50	041	39 36	092	33 41	143	19 17	211	28 30	253	50 26	329	18 26	355
318	20 26	041	40 29	092	34 14	143	18 49	211	27 39	252	49 58	328	18 21	354
319	21 00	040	41 23	092	34 46	143	18 22	210	26 47	252	49 29	327	18 16	354
320	21 35	039	42 17	091	35 18	143	17 55	210	25 56	252	48 59	325	18 09	353
321	22 09	038	43 11	091	35 51	143	17 28	210	25 05	251	48 28	324	18 02	352
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323	23 14	037	44 59	090	36 55	143	16 34	210	23 23	251	47 23	322	17 46	351
324	23 47	036	45 53	089	37 27	144	16 07	209	22 32	250	46 49	320	17 37	350
325	24 18	035	46 47	089	37 59	144	15 41	209	21 41	250	46 14	319	17 28	349
326	24 49	035	47 41	088	38 31	144	15 15	209	20 51	250	45 38	318	17 17	349
327	25 19	034	48 35	088	39 03	144	14 48	209	20 00	250	45 02	317	17 06	348
328	25 49	033	49 29	088	39 35	144	14 23	209	19 09	249	44 25	316	16 55	347
329	26 18	032	50 22	087	40 06	144	13 57	208	18 19	249	43 47	315	16 42	346
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330	26 47	031	51 16	087	40 38	144	55 01	202	48 54	259	43 08	314	53 53	354
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339	30 31	024	59 19	081	45 13	147	51 32	208	41 00	257	36 54	306	51 58	339
340	30 52	023	60 12	081	45 42	147	51 07	209	40 07	257	36 10	305	51 39	338
341	31 13	022	61 05	080	46 11	147	50 41	209	39 15	256	35 26	304	51 17	336
342	31 32	021	61 58	079	46 40	148	50 14	210	38 23	256	34 41	303	50 55	335
343	31 51	020	62 51	078	47 09	148	49 47	210	37 30	256	33 56	302	50 31	333
344	32 09	019	63 44	078	47 37	149	49 20	211	36 38	255	33 10	302	50 07	332
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345	32 26	018	22 49	047	48 05	149	48 52	211	35 46	255	32 24	301	49 41	331
346	32 42	017	23 28	046	48 33	149	48 24	212	34 54	255	31 37	300	49 14	329
347	32 57	016	24 07	045	49 00	150	47 55	212	34 02	255	30 50	299	48 46	328
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358	34 42	004	30 36	036	53 32	156	42 24	216	24 34	251	21 57	292	42 35	315
359	34 46	003	31 07	036	53 54	157	41 53	216	23 43	251	21 07	292	41 57	314

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 14500 GT cargo vessel, operating at a speed of 17.0 knots, sails between Argentina and the South Pacific Islands, she is fitted with the current required aids to navigation.

1. The vessel rounds Cape Horn (Cabo de Hornos) bound for Papeete, 17°30'.0S 149°36'.0W.

   (a) With reference to Datasheets Q1(1) and Q1(2) identify the route recommended for this passage. (4)

   (b) Calculate EACH of the following:

      (i) the distance of the great circle distance leg to Papeete; (8)

      (ii) the initial course on this leg; (7)

      (iii) the position of the southern vertex; (12)

      (iv) the distance the vessel passes due East of the Submarine Volcano in position 29°00'.0S 140°15'.0W. (14)

2. At 1300 hrs UT on 10th December, in position 27°25'.0S 141°10'.0W, the vessel receives a DSC distress message that a sailing vessel, in position 25°04'.0S 139°43'.0W, requires assistance and is motoring at 8.0 knots towards the Pitcairn Islands, 25°04'.0S 130°05'.0W.

   (a) Calculate EACH of the following:

      (i) the course to steer to rendezvous as soon as possible; (15)

      (ii) the time (UT) of the rendezvous; (8)

      (iii) the rendezvous position. (7)

   (b) Calculate how much time remains before Sunset to provide assistance. (5)

3. (a) SOLAS Chapter V Regulation 34 – Safe Navigation and Avoidance of Dangerous Situations requires that *"An appraisal of all information available must be made before detailed plans can be drawn up"*.

(i) State the purpose of the appraisal process. (6)

(ii) Outline what the appraisal process should provide to the Master and the Bridge team. (12)

(b) The Admiralty produce Routeing Charts to assist in appraising and planning ocean voyages.

With reference to the route in Q1:

(i) state FOUR types of information from Routeing Charts that may be used during the appraisal; (4)

(ii) explain how the information from Q3(b)(i) would influence the selection of a route in the Planning stage of Voyage Planning. (8)

4. (a) State the seasons and the most probable months when hurricanes may be encountered in the Western South Pacific. (5)

(b) Draw a plan view through a Southern Hemisphere hurricane before it recurves. (8)

(c) The following weather conditions are observed:

Wind SE Force 8 and slowly backing, swell NNE and pressure falling steadily.

(i) Sketch the situation and identify the vessel's position within the storm field. (7)

(ii) State, with reasons, the actions the Master should take to manoeuvre the vessel to minimise the effect of the storm on the vessel. (6)

(iii) Illustrate and describe the expected effect of the actions in Q4(c)(ii), if the storm maintains its current movement. (12)

(d) Some hours later the wind direction steadies and then starts to veer, with the pressure continuing to fall.

(i) Identify any change in the storm's movement. (5)

(ii) State, with reasons, any subsequent actions the Master should take in light of the changed conditions and any safety considerations of such actions. (12)

5. (a) IMO requires that a *look-out* must be maintained at all times while the vessel is on passage. State what the purpose is of keeping a *look-out*. (7)

(b) Outline the factors that should be included in the Master's Night Orders for making a landfall at Papeete. (14)

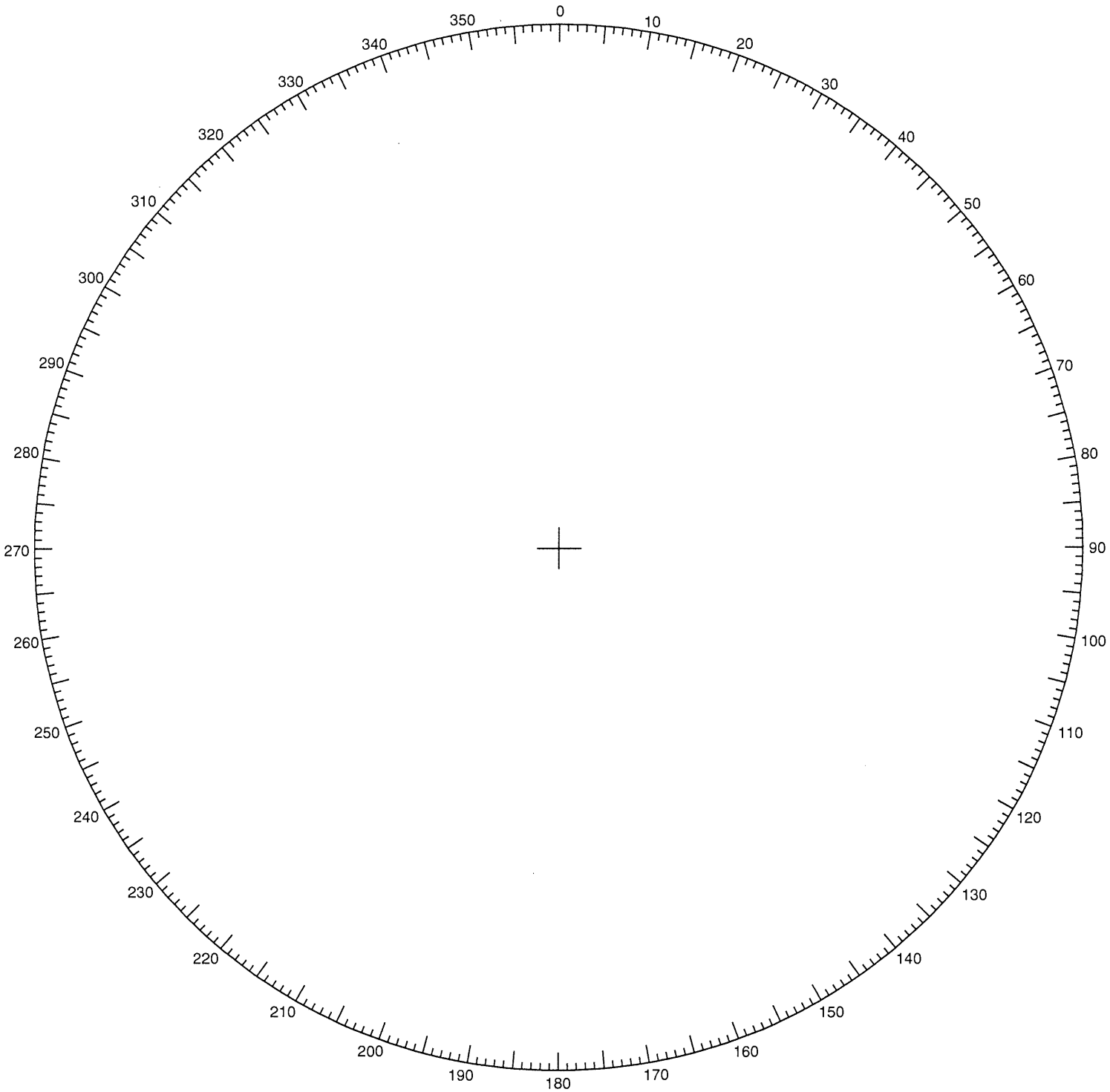
(c) Approaching Papeete, an unexpected shallow water sounding is observed on the Echo Sounder.

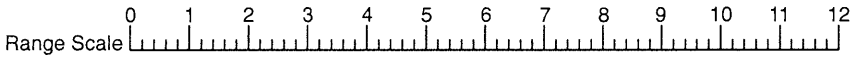
(i) State to whom the report should be sent and which form should be used to make the report. (4)

(ii) Describe the details that should be included on the form with respect to the shallow water sounding. (10)

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET





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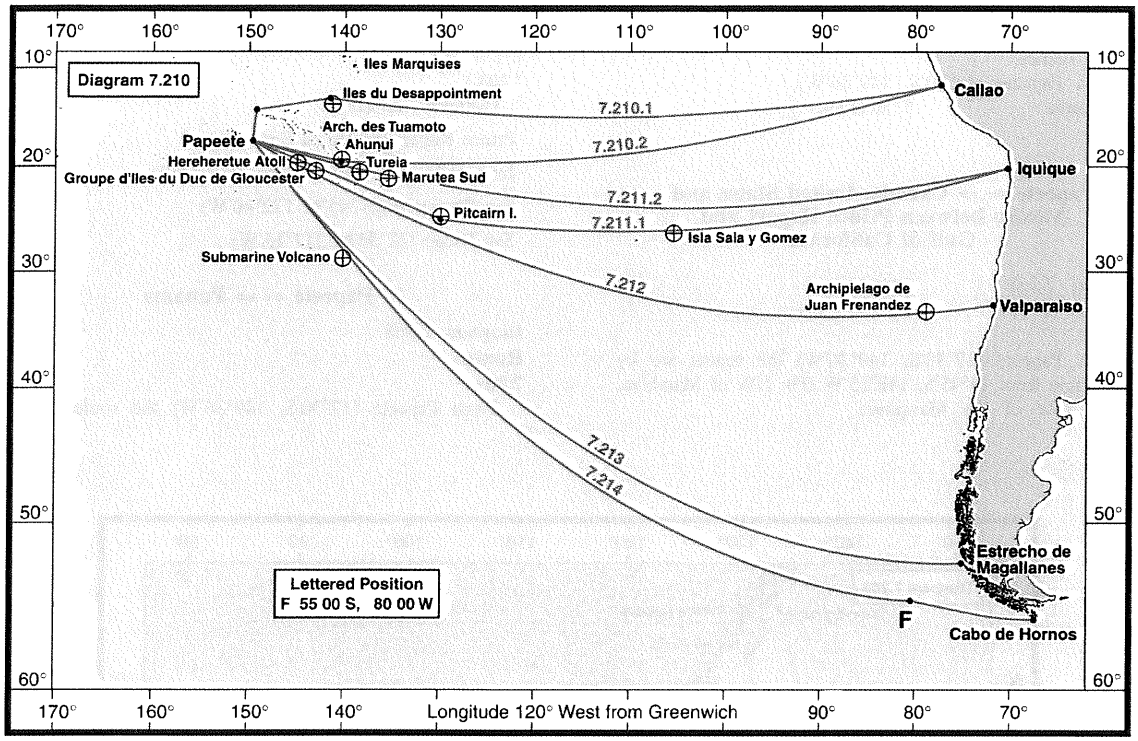
Signature of Candidate.....

Examination Centre.....



7.210 Papeete ⇐ ⇒ Callao;
7.211 Papeete ⇐ ⇒ Iquique;
7.212 Papeete ⇐ ⇒ Valparaíso
7.213 Papeete ⇐ ⇒ Estrecho de Magallanes
7.214 Papeete ⇐ ⇒ Cabo de Hornos

7.209.1
W and N of Archipel des Tuamoto (18°00′S, 141°00′W), thence:
Great circle to Gulf of Panama (8°00′N, 79°00′W).

7.209.2
An alternative route from Papeete leads:
Through Passe de Fakarava (16°00′S, 145°50′W), thence:
Great circle to Gulf of Panama (8°00′N, 79°00′W).
The pass is not lighted and good electronic aids are essential. For details, see *Pacific Islands Pilot, Volume III.*

7.209.3
A route West-bound from Gulf of Panama is:
Great circle to a landfall on Tepoto (14°06′S, 141°27′W), one of Îles du Désappointment, thence:
Through Passe de Fakarava.

7.209.4
Distances:

W and N of Archipel des Tuamoto	4610 miles.
Through Passe de Fakarava	4500 miles.

Papeete ⇐ ⇒ Callao

Diagram 7.210

Routes

7.210
From Papeete (17°30′S, 149°36′W) the alternative routes are:

7.210.1
W and N of Archipel des Tuamoto (18°00′S, 141°00′W), to position N of Îles du Désappointment (14°10′S, 141°20′W), thence:
Great circle to Callao (12°02′S, 77°14′W).

7.210.2
Through Archipel des Tuamoto (18°00′S, 141°00′W) to a position S of Ahunui (19°40′S, 140°25′W), thence:
Great circle to Callao (12°02′S, 77°14′W).

7.210.3
Distances:

W and N of Archipel des Tuamoto	4370 miles.
Through Archipel des Tuamoto	4210 miles.

Papeete ⇐ ⇒ Iquique

Diagram 7.210

Routes

7.211
From Papeete (17°30′S, 149°36′W) the alternative routes are:

7.211.1
S of Archipel des Tuamoto (18°00′S, 141°00′W) to Pitcairn Island (25°04′S, 130°05′W), thence:
Great circle, passing close N of Isla Sala y Gomez (26°28′S, 105°28′W), to Iquique (20°12′S, 70°10′W).

7.211.2
Great circle through Archipel des Tuamoto (18°00′S, 141°00′W), S of Ahunui (19°40′S, 140°25′W) and N of Tureia (20°50′S, 138°35′W) and Marutea Sud

(21°30'S, 135°35'W), to Iquique (20°12'S, 70°10'W).

7.211.3

Distances:

S of Archipel des Tuamoto	4510 miles.
Through Archipel des Tuamoto	4480 miles.

Papeete ⇐ ⇒ Valparaíso

Diagram 7.210

Routes

7.212

From Papeete (17°30'S, 149°36'W) the route is:

S of Hereheretue Atoll (19°52'S, 145°00'W) and Groupe d'Îles du Duc de Gloucester (20°38'S, 143°17'W), thence:

Great circle, passing close S of Archipiélago de Juan Fernandez (33°40'S, 78°50'W), to Valparaíso (33°02'S, 71°37'W).

Distance 4260 miles.

Papeete ⇐ ⇒ Estrecho de Magallanes

Diagram 7.210

Routes

7.213

From Papeete (17°30'S, 149°36'W) the route is by great circle to position 52°38'S, 74°46'W, 5 miles NNW of Cabo Pilar, at the W entrance to Estrecho de Magallanes.

Distance 4040 miles.

Papeete ⇐ ⇒ Cabo de Hornos

Diagram 7.210

Routes

7.214

From Papeete (17°30'S, 149°36'W) the route is:

Great circle to 55°00'S, 80°00'W **(F)**, on the Southern Route (7.216), passing close N of the submarine volcano (29°00'S, 140°15'W) reported in 1981, thence:

Rhumb line to a position 56°04'S, 67°15'W, 5 miles S of Cabo de Hornos.

Distance 4300 miles.

SOUTH PACIFIC TRANS-OCEAN PASSAGES

GENERAL INFORMATION

Coverage

7.215

This section contains details of the following passages:

Main E-bound routes:

Southern Route (7.216).
Southern Route connections to other routes (7.218).
From Torres Strait to South America (7.221).
From Hobart to Panama (7.222).
From Wellington to Panama (7.223).
From Auckland to Panama (7.224).

Main W-bound routes:

West-bound Route (7.225).
From Panama to New Zealand (7.226).
Chile and Perú to East coast of Australia and New Zealand (7.227).

Other main routes:

To and from Apia and South America (7.228).
To and from Suva and South America (7.229)

MAIN EAST-BOUND ROUTES ACROSS SOUTHERN PACIFIC OCEAN

Southern Route

Diagram 7.216

Details

7.216

The most S route usually adopted, referred to as the Southern Route, passes E-bound through the following positions:

48°30'S, 165°00'W **(A)**
49°30'S, 150°00'W **(B)**
50°00'S, 140°00'W **(C)**
51°30'S, 120°00'W **(D)**
52°45'S, 100°00'W **(E)**
55°00'S, 80°00'W **(F)**

Joining Southern Route

7.217

When great circle passages, between terminal points, pass S of the Southern Route it is best to steer, by great circle, to join this route at a convenient position.

Similarly it is best to leave the Southern Route at a position to enable the destination to be reached by great circle, if possible, without passing S of the above route.

Passages for which the Southern Route, or part of it, are appropriate can best be seen from *Chart 5098 Gnomic Chart - South Pacific and Southern Oceans.*

Southern Route connections to other routes

7.218

The following are the best joining and leaving positions:

From	**Join in**
Hobart or Snares Island	48°30'S, 165°00'W **(A)**
Cook Strait	49°30'S, 150°00'W **(B)**
Auckland	50°00'S, 140°00'W **(C)**
For	**Leave in**
Callao	48°30'S, 165°00'W **(A)**
Iquique	49°30'S, 150°00'W **(B)**
Valparaíso	50°00'S, 140°00'W **(C)**
Estrecho de Magallanes	52°45'S, 100°00'W **(E)**
Cabo de Hornos	55°00'S, 80°00'W **(F)**

From Sydney or Brisbane for Callao and destinations farther S, the route is through Cook Strait.

Alternatively from Sydney for Valparaíso and destinations farther S, the route S of New Zealand is practicable and only slightly longer.

Ice

7.219

Icebergs may be encountered on the Southern Route in all seasons, for details see 7.34.

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 75000 GT Bulk Carrier is chartered for 12 months to sail between the Republic of South Africa and Brazil, operating at a speed of 15.7 knots.

1. The vessel makes consecutive voyages between Cape Town and Rio de Janeiro.

   (a) With reference to Datasheets Q1(1), (2) and (3):

   (i) identify the route recommended for EACH passage; (4)

   (ii) explain why there are different recommended routes. (8)

   (b) Compare and contrast the use of great circle and rhumb line sailing. (10)

   (c) Using the following positions, calculate EACH of the following:

Cape Town	33°58'.0S 018°22'.0E
Rio de Janeiro	23°06'.0S 043°07'.0W

   (i) the distance saved by following the great circle route; (20)

   (ii) the ETA at Rio de Janeiro (Standard Time) if the vessel leaves Cape Town on 7th June at 0700 hrs (Standard Time), following the recommended route. (8)

2. Vessels on ocean voyages encounter differing environmental conditions.

   (a) On Worksheet Q2(a) illustrate EACH of the following:

   (i) the pressure systems for this ocean; (5)

   (ii) the prevailing wind circulation; (6)

   (iii) the predominant current distribution; (15)

   (iv) the environmental hazards. (6)

   (b) Explain the presentation of current information as displayed on Admiralty Routeing Charts. (8)

3. At $08^h52^m00^s$ UT on 10th June, while in position 30°18'.0S 003°09'.0W, steering 280°T, the OOW makes an observation of the SUN's lower limb.

Sextant altitude	18°20'.3
Index Error (on the arc)	0'.8
Height of Eye	20.2 m

(a) Calculate EACH of the following:

(i) the direction of the position line; (7)

(ii) the intercept. (8)

(b) At $12^h00^m00^s$ UT the OOW observes the sextant altitude of the SUN's lower limb on the meridian as 36°48'.1N.

(i) Calculate the latitude at Meridian Passage. (6)

(ii) Determine the vessel's observed position at Meridian Passage. (12)

(c) Discuss the availability, accuracy and limitations of celestial observations in the Southern Oceans in June. (12)

4. SOLAS requires that ocean going vessels are to carry certain nautical publications.

(a) List the 14 publications a vessel is required to carry as detailed in the Mariners Handbook NP100. (14)

(b) Describe the contents of these publications which would be of benefit in appraising the routes described in Q1. (16)

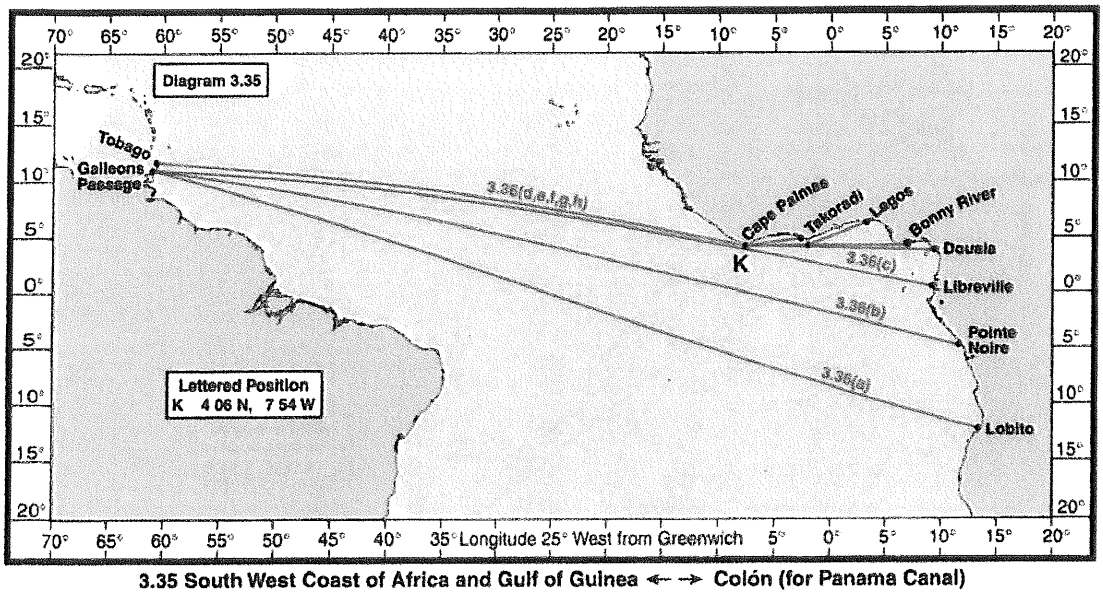
5. (a) MSN1767 provides guidance on *Hours of Work, Safe Manning and Watchkeeping*.

(i) Outline the factors to be taken into account in establishing Safe Manning requirements with respect to navigational duties. (8)

(ii) State the Minimum Hours of Rest (Regulation 5). (8)

(b) (i) Outline the Bridge equipment that should be tested prior to departure from port. (16)

(ii) State the current MCA guidance on the testing of Heading Control Systems. (8)



3.35 South West Coast of Africa and Gulf of Guinea ⇐ ⇒ Colón (for Panama Canal)

Routes

3.36

From ports S of Douala (3°54'N, 9°32'E), routes are by great circle to Galleons Passage (10°57'N, 60°55'W), thence as at 4.15 to Colón (9°23'N, 79°55'W).

From places between Douala and Takoradi (4°53'N, 1°44'W) routes are:

Round position (4°06'N, 7°54'W) (K) 20 miles SSW of Cape Palmas, thence:

By great circle to 11°35'N, 60°35'W (15 miles N of Tobago), thence:

As at 4.15 to Colón.

Distances

3.36.1

Distances to Colón from:

(a)	Lobito	5830 miles
(b)	Pointe Noire	5620 miles
(c)	Libreville	5410 miles
(d)	Douala	5400 miles
(e)	Bonny River	5240 miles
(f)	Lagos	5040 miles
(g)	Takoradi	4730 miles
(h)	Cape Palmas*	4350 miles

* (20 miles SSW of)

Gulf of Guinea ⇐ ⇒ North American ports

Diagram 3.37

General information

3.37

In Cabot Strait a Traffic Separation Scheme has been established.

Routes

3.38

Routes are:

Direct to position (4°06'N, 7°54'W) (K) 20 miles SSW of Cape Palmas, thence:

Direct to 4°20'N, 9°20'W, thence:

Direct to 14°40'N, 24°55'W (H), to the SW of Arquipélago de Cabo Verde, thence:

By great circle to destination.

3.38.1

From Lobito (12°19'S, 13°35'E), however, the route is direct to 14°40'N, 24°55'W (H).

3.38.2

Distances:

	Cabot Strait	Halifax	New York
Lobito	5430	5470	5780
Pointe Noire	5120	5160	5480
Libreville	4880	4920	5240
Douala	4870	4910	5230
Bonny River	4720	4760	5080
Lagos	4520	4560	4880
Takoradi	4200	4240	4560
Cape Palmas*	3820	3860	4180

* (20 miles SSW of)

SOUTHERN PASSAGES

General information

3.39

South of about 25°S, E-bound routes are, in general, by great circle, but W-bound routes are by rhumb line to reduce headwinds and adverse currents.

For information for rounding Cape of Good Hope, see 3.16.

Rio de Janiero ⇒ Cape Town or the Indian Ocean

Diagram 3.40

Routes

3.40

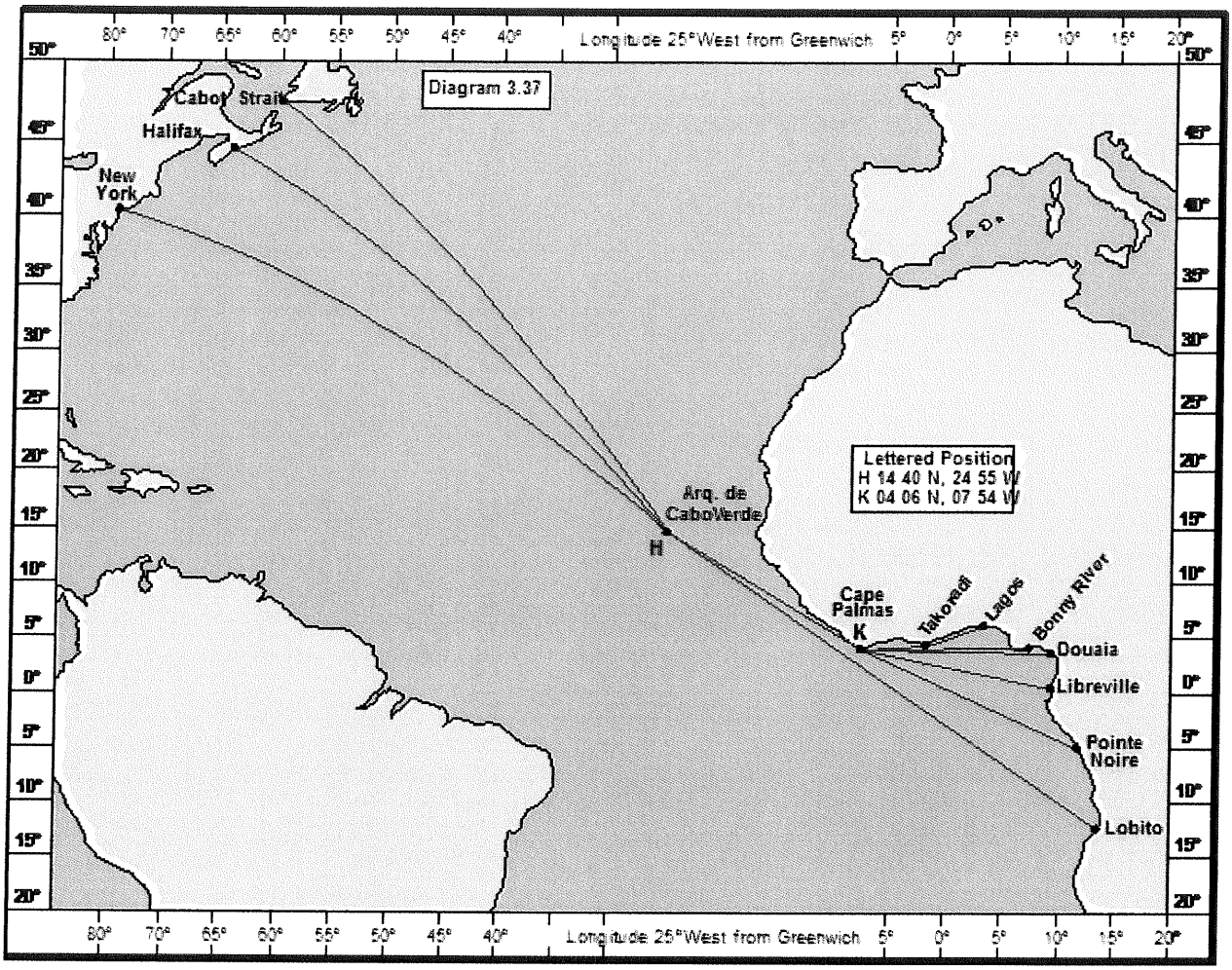
Routes are by great circle.

3.40.1

Distances:

Cape Town	3280 miles
Cape Agulhas*	3350 miles
Cape of Good Hope†	3290 miles

* (15 miles S of) † (145 miles S of)



3.37 Gulf of Guinea ⟵ ⟶ North American Ports

Cape Town or the India Ocean → Río de Janiero

Diagram 3.40

Routes

3.41

Routes are direct by rhumb line.

Caution. Vema Seamount (31°48'S, 8°20'E) (3.32) lies close N of the route from Cape Town (33°53'S, 18°26'E).

3.41.1

Distances:

Cape Town	3320 miles
Cape Agulhas*	3390 miles

* (15 miles S of)

3.41.2

An alternative route for low powered vessels is given at 8.63.3

Río de la Plata → Cape Town or the the Indian Ocean

Diagram 3.40

Routes

3.42

Routes are by great circle.

3.42.1

Parts of the tracks lie within the extreme iceberg limits.

The most S points on the route are:

For Cape Town	41°00'S 20°00'W
For Cape Agulhas	41°50'S 18°15'W
For Cape of Good Hope	42°30'S 17°30'W

† (145 miles south of)

3.42.2

Distances:

Cape Town	3610 miles
Cape Agulhas*	3650 miles
Cape of Good Hope	3570 miles

*(15 miles S of)

† (145 miles S of)

3.42.3

An alternative route for low powered vessels is given at 8.85.

Cape Town or the Indian Ocean → Río de la Plata

Diagram 3.40

Routes

3.43

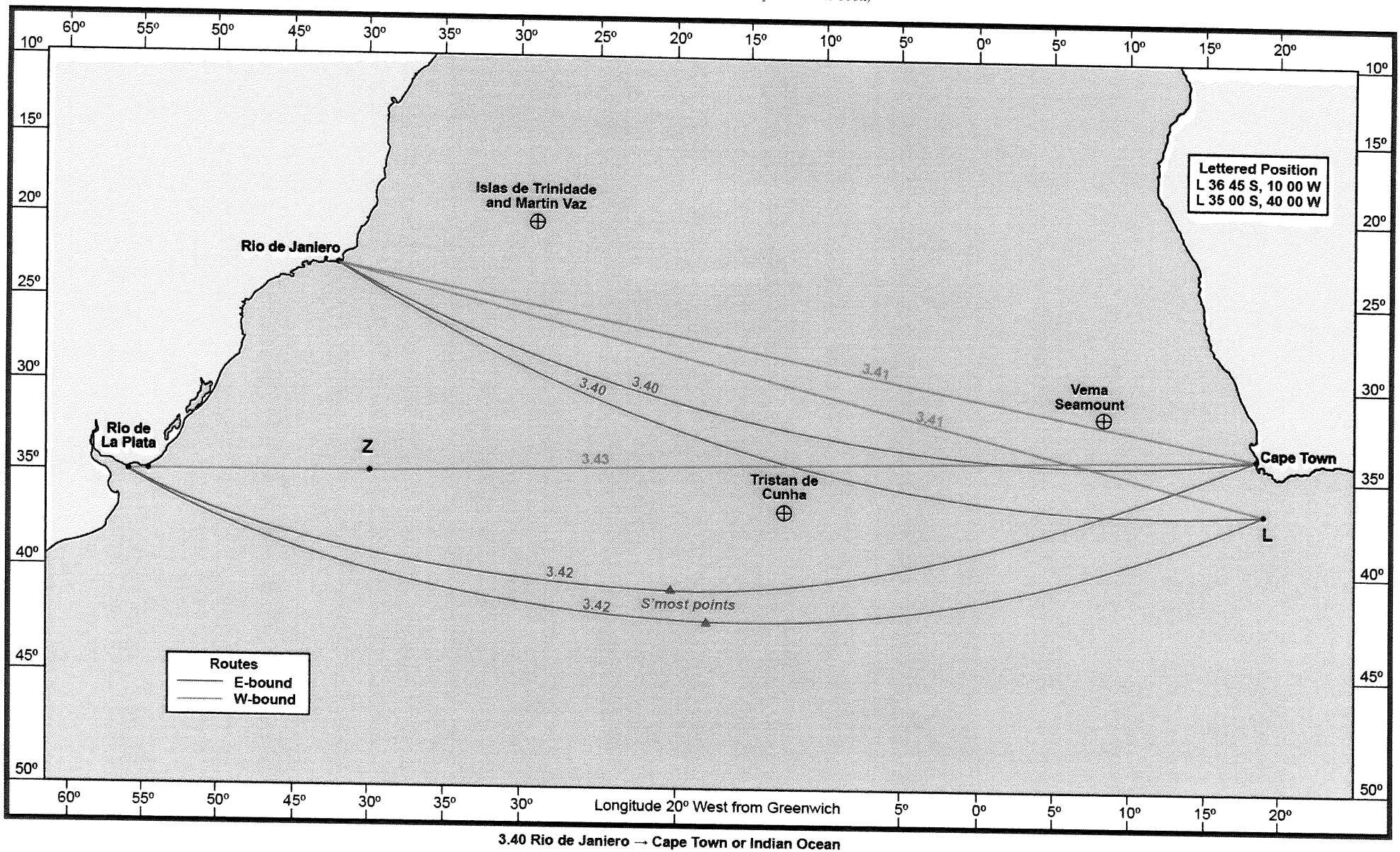
Routes are by thumb line:

To 35°00'S 40°00'W (**Z**), thence:

Rhumb line to Río de la Plata.

DATASHEET Q1(3)
(This Worksheet must be returned with your answer book)

28 NOVEMBER 2013



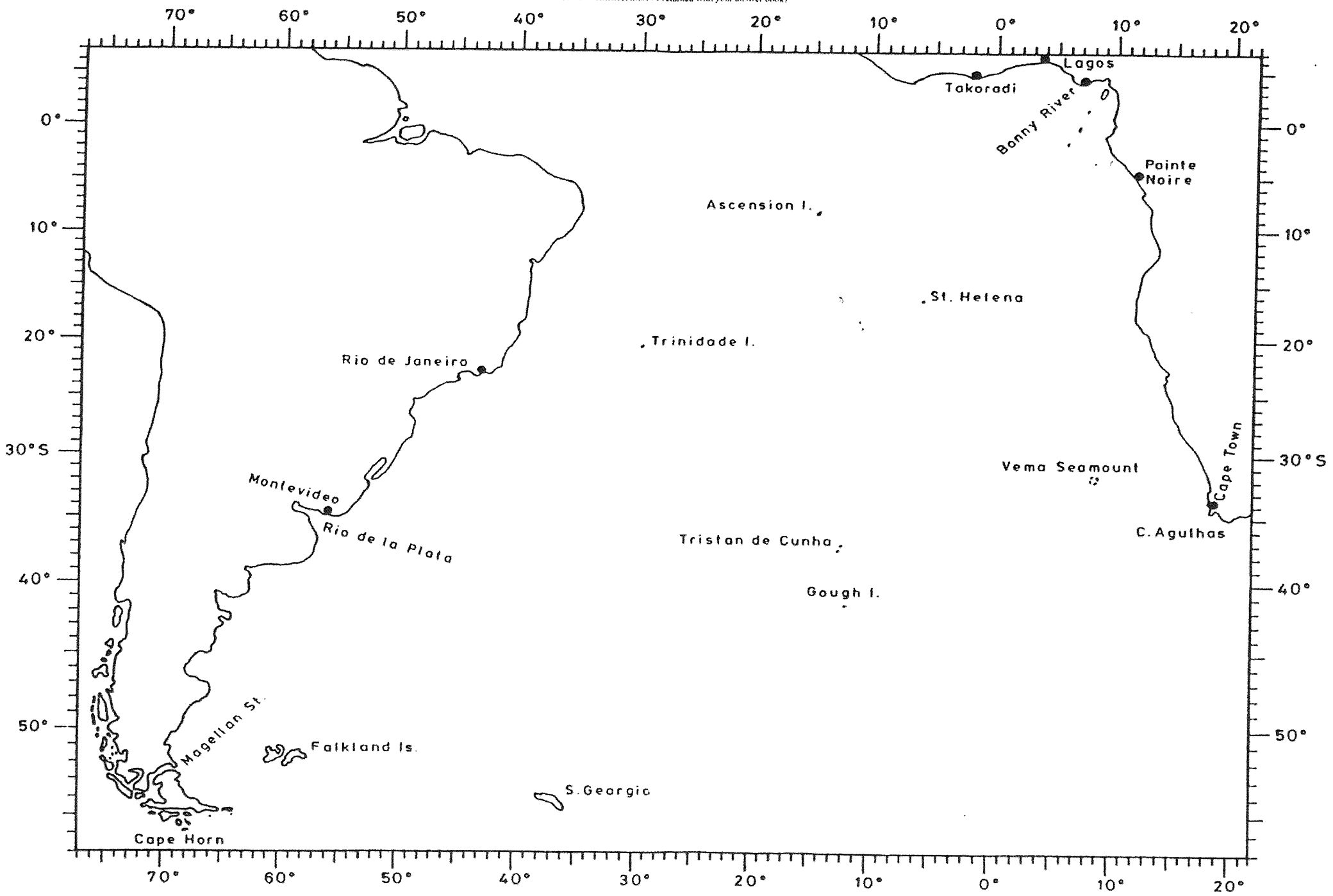
3.40 Rio de Janiero → Cape Town or Indian Ocean
3.41 Cape Town or Indian Ocean → Rio de Janiero
3.42 Rio de La Plata → Cape Town or Indian Ocean
3.43 Cape Town or Indian Ocean → Rio de La Plata

Candidate's Name .....

Examination Centre .....

WORKSHEET Q2 (a)

(This Worksheet must be returned with your answer book)



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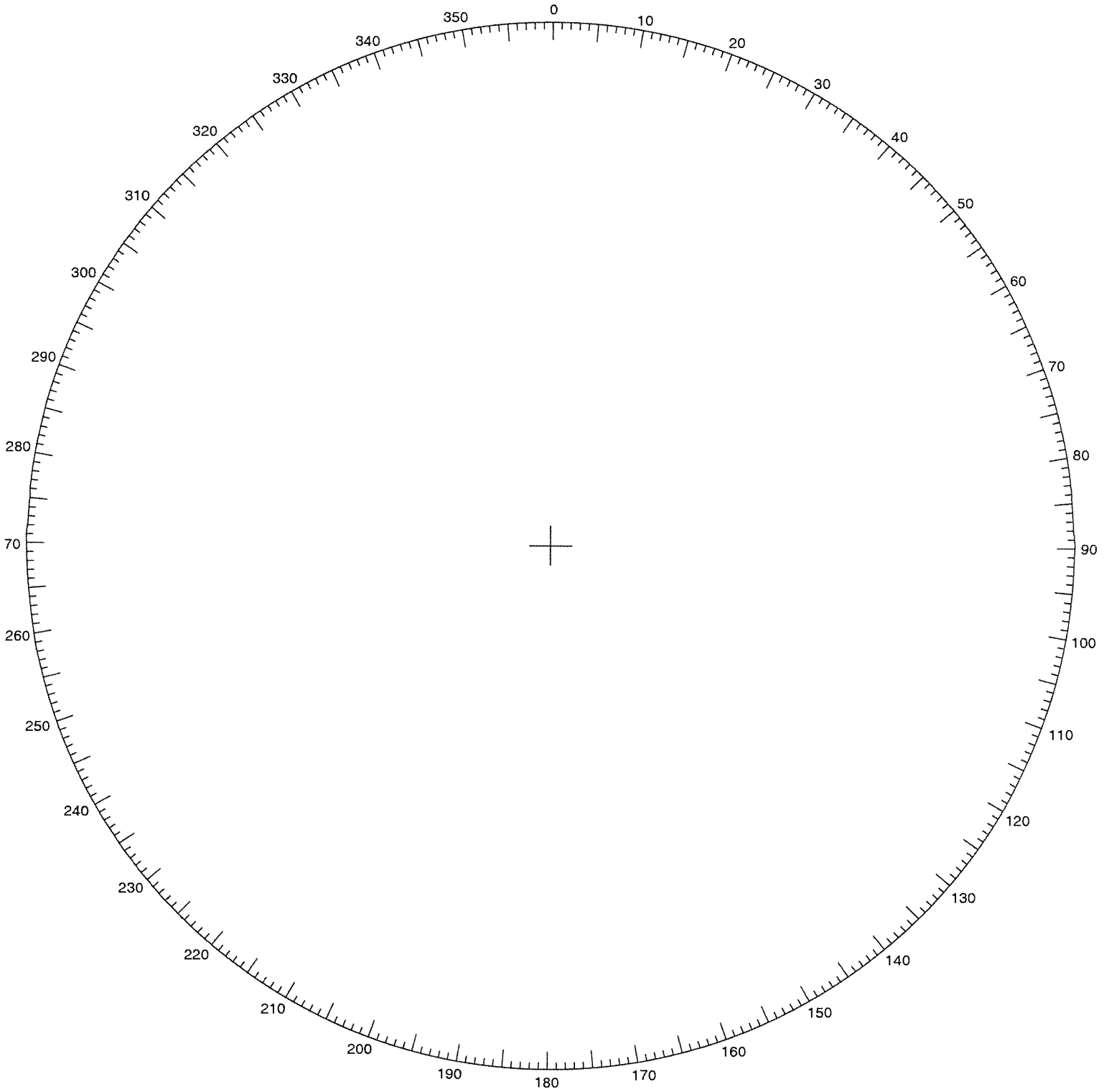
RADAR PLOTTING SHEET



Range Scale 0 1 2 3 4 5 6 7 8 9 10 11 12

(This is not a metric scale)

Signature of Candidate .....

Examination Centre .....

3. Tidal Stream Atlases are required to be carried onboard vessels.

   (a) Explain the purpose and the procedure to use a Tidal Stream Atlas. (12)

   (b) A vessel is 10' West of Bishop Rock (49°52'N 006°27'W) at 2259 hrs UT on8th December, with reference to Datasheet Q3 and the Admiralty Tide Tables:

      (i) identify the tide and tidal range affecting the vessel; (10)

      (ii) calculate the direction and rate of the tidal stream. (8)

4. (a) Rule 6 of The International Regulations for Preventing Collisions at Sea 1972 outlines the requirements for vessels to maintain *a safe speed.*

      (i) State why vessels should proceed at a safe speed. (5)

      (ii) State the factors that should be taken into account by all vessels. (12)

   (b) Approaching the Bishop Rock Traffic Separation Scheme the vessel encounters thick fog with visibility less than 0'.2.

      The vessel's course is 090°(T) and the speed has been reduced to 8.0 knots.

      The OOW plots THREE targets, from 1736 hrs to 1748 hrs, on the 6 mile range as shown on Worksheet Q4.

      TARGET B is identified from AIS as an ODAS buoy moored at the start of the separation zone.

      (i) Provide a complete analysis of TARGETS A and C at 1748 hrs. (10)

      (ii) Determine the set and drift of the tide at 1748 hrs. (4)

      (iii) On Worksheet Q4 determine the alteration of course or speed required at 1754 hrs to ensure TARGET C passes with a CPA of at least 1 mile. (10)

      (iv) Explain how the chosen course of action complies with Rule 19 of The International Regulations for Preventing Collisions at Sea 1972. (9)

5. (a) State the appropriate manning level on the bridge when navigating in a Traffic Separation Scheme with dense traffic and restricted visibility, outlining the duties of EACH member of the bridge team. (15)

   (b) State, with reasons, the appropriate manning level for navigation on an ocean passage during daylight in clear visibility. (7)

   (c) IMO adopts certain Traffic Routeing Schemes; outline the stated criteria used in deciding whether or not to adopt or amend a traffic separation scheme. (8)

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 12000 GT General Cargo vessel makes regular voyages, throughout the year, from the Caribbean to Europe. She is fitted with all current aids to navigation and carries the minimum manning for her certificate.

1. The vessel sails from NE Providence Channel to a position 5' South of Bishop Rock.

   (a) With reference to Datasheets Q1(1), (2) and (3):

      (i) identify the route recommended for the passage; (2)

      (ii) state the season for icebergs near the Grand Banks of Newfoundland; (2)

      (iii) state the general limits for icebergs near the Grand Banks of Newfoundland. (2)

   (b) With reference to Datasheet Q1(2) identify the waypoints for the NE Providence Channel and the position 5' South of Bishop Rock. (2)

   (c) Using the waypoints identified in Q1(b) calculate EACH of the following:

      (i) the great circle distance; (6)

      (ii) the initial course; (8)

      (iii) the position of the vertex. (12)

   (d) On Worksheets Q1(c)(1) and Q1(c)(2) draw the great circle track. (16)

2. Ice can present a serious hazard to any vessel.

   (a) Outline the guidance provided in the Mariners Handbook NP100 on EACH of the following:

      (i) the preparations before the vessel approaches ice; (8)

      (ii) the considerations before entering ice; (14)

      (iii) when making an entry. (10)

   (b) Write a section of the Master's Standing Orders regarding navigating in or near ice. (8)

year on the E flank of that current, extending SW from the W extremity of Iceland. Others drift round Kap Farvel, but they do not survive the relatively warm waters of the Davis Strait and are not a source of danger on the regular transatlantic routes.

3 Icebergs may be found beyond the limits of the pack ice at all seasons, but mostly in early summer, in winter many are frozen into the pack ice.

Ice in specific localities

2.22

1 **Kap Farvel.** The greatest distance at which bergs are met S of Kap Farvel is generally about 120 miles. This usually occurs in May when they may be encountered as far S as 66°N and as far E as 32°W. Their least extent is in December. Bergs are not usually met S of 48°N between September and December, but may well be encountered in any month N of 52°N.

2.23

1 **Saint Lawrence River.** Below Montreal the river is closed by ice between early December and mid-April. Commercial navigation ceases in most parts of the Gulf of Saint Lawrence by mid-December; in the S part navigation is not considered safe between early December and mid-April.

2.24

1 **Strait of Belle Isle.** The Strait is generally not navigable from late December until June.

2.25

1 **Cabot Strait.** The Strait is usually navigable from mid-April until February. Pack ice arrives from N of Cape Race about the end of January in an ordinary season, extending round the coasts of the Avalon Peninsular in February, until early May.

2.26

1 **The Grand Banks of Newfoundland.** The Grand Banks are entirely free of pack ice between July and December inclusive. Pack ice reaches the banks in January and extends farthest S in March and April, on the E edge of the banks. In very rare seasons, dangerous pack ice may extend to the Tail of the Bank and even S of it but, on average, the floes begin to break up on reaching 45°N.

2 In the region of the Grand Banks, the worst season for icebergs is between March and July, with April, May and June as the months of greatest frequency. Bergs are not often found S of 40°N or E of 40°W, though occasionally they may be considerably outside these limits. They are particularly prevalent around the E flanks of the banks, on which many of them ground. More detail is given in the relevant volume of *Admiralty Sailing Directions.*

2.27

1 **Denmark Strait.** The strait is normally free of ice on its E side throughout the year, but on rare occasions, as in the spring of 1968, the ice spreads across from Greenland to close the strait. Icebergs may be met throughout the year on both sides of the Denmark Strait.

2.28

1 **White Sea.** The White Sea is normally closed to navigation from about mid-December to mid-May.

2.29

1 **Kol'skiy Zaliv.** The N part remains open throughout the year but, from December to April ice forms along the shore and at times breaks away, to be carried out to sea. It may be a hindrance for three or four days at a time in exceptionally cold winters.

2.30

1 **Norwegian coast.** None of the main ports on the W coasts is ever closed by ice, and the closure of Oslo is rare.

2.31

1 **North Sea.** Serious ice conditions in the entrances to German, Netherlands and Danish ports, lasting from 1 to 4 weeks, occur about two or three times in ten years at some time between mid-January and early March.

Ice Information Services

2.32

1 Ice information, comprising up-to-date reports and forecasts from the Gulf of Saint Lawrence, the Grand Banks of Newfoundland, Greenland, Iceland and the NW approaches to Europe are transmitted from the coast radio stations listed in the relevant volume of *Admiralty List of Radio Signals.*

2.33

1 **International Ice Patrol.** This service is operated by the US Coast Guard with the primary object of collecting data and warning shipping of the amount and extent of icebergs and sea ice in the vicinity of the Grand Banks. The service operates principally between the parallels of 39° and 50°N and the meridians of 42° and 60°W during the ice season from February or March until about the end of June.

2 In spite of the efforts of the International Ice Patrol bergs are known to drift unnoticed into the usual routes in the vicinity of the Grand Banks. For details of the International Ice Patrol see the relevant volumes of *Admiralty Sailing Directions* and *Admiralty List of Radio Signals.*

2.34

1 **Ice Advisory Service.** This service, maintained by the Canadian Coast Guard during the winter navigational season, is based on aerial reconnaissance. Reports of existing and forecast ice conditions are broadcast from certain Canadian radio stations. For details of the service see the relevant volumes of *Admiralty Sailing Directions* and *Admiralty List of Radio Signals.* The volume *Ice Navigation in Canadian Waters*, issued by the Canadian Coast Guard, should also be consulted.

2.35

1 **Caution.** Tests conducted by the International Ice Patrol have shown that radar cannot provide positive assurance for iceberg detection. Sea-water is a better reflector than ice. this means that unless a berg or growler is observed outside the area of 'sea return' or 'clutter' it will not be detected by radar. The average range of detection of a dangerous growler, if detected at all, is only 4 miles.

2 Radar is a valuable aid, but its use cannot replace the traditional caution exercised during a passage passing near the Grand Banks during the ice season.

NOTES AND CAUTIONS

Meteorological and Oceanographic Data Buoys

2.36

1 Automated buoys are deployed in the world oceans under the auspices of the World Meteorological Organisation. They make routine measurements of wind speed and direction, air temperature and humidity, atmospheric pressure, currents and sea surface temperature, which data is transmitted via satellite.

2 Those automated buoys established in permanent or semi-permanent positions are shown on Admiralty charts.

3 Further details are given in *Annual Summary of Admiralty Notices to Mariner.*

To and from West Indies passages or Bermuda and Europe, including alternative routes for W-bound vessels (2.84).

References

2.79

1 **Cautions:**

Western approaches to the English Channel, see 2.37.
Île d'Ouessant, see 2.38.
Bay of Biscay and west coasts of Spain and Portugal, see 2.39.
Strait of Gibraltar, see 2.40.
Grand Banks of Newfoundland, see 2.43.
Bermuda, see 2.44.
Caribbean Sea entrance channels, see 4.7.

PASSAGES

Diagram 2.80

Approaches to Gulf of Mexico

2.80

1 East-bound passages from Gulf of Mexico are recommended through Straits of Florida, thence N to take full advantage of the Florida Current, the Gulf Stream and North Atlantic Current (2.14), as well as the predominantly W winds in the N part of the North Atlantic Ocean.

2 For directions for passage through Straits of Florida to the departure point (27°00′N, 79°49′W), off Jupiter Inlet, see *West Indies Pilot, Volume I.*

3 West-bound passages are recommended either through Providence Channels or through Old Bahama Channel and Nicholas Channel.

4 Passages in Gulf of Mexico and Caribbean Sea, and the approaches thereto, are continued in Chapter 4.

Straits of Florida ⇒ Vigo and European coast farther North

Diagram 2.80

Routes

2.81

1 From the departure point, off Jupiter Inlet, the route leads to position 42°30′N, 50°00′W **(BS)** thence to destinations in N Europe (2.69).

2.81.1

1 From 27°00′N, 79°49′W **(A)**, at the N end of the Straits of Florida, the routes are:

Through 30°00′N, 79°40′W **(G)**, keeping in the main body of the Gulf Stream, thence:
Through 35°30′N, 72°40′W **(B)**, thence:
Great circle to position (42°30′N, 50°00′W) **(BS)**, thence:
As at 2.69 to destination.

2.81.2

1 Distances from Straits of Florida:

Nordkapp	4660 miles.
Trondheim	4220 miles.
Bergen	4060 miles.
Cape Wrath	3730 miles.
Inishtrahull	3620 miles.
Fastnet Rock	3520 miles.
Bishop Rock	3640 miles.
La Gironde*	3870 miles.
Vigo	3610 miles.

* 70 miles from Bordeaux

Straits of Florida ⇒ Lisboa and Strait of Gibraltar

Diagram 2.80

Routes

2.82

1 From 27°00′N, 79°49′W **(A)**, at the N end of the Straits of Florida, the routes are:

2.82.1

Lisboa:

Through 30°00′N, 79°40′W **(G)**, keeping in the main body of the Gulf Stream, thence:
By great circle to Lisboa (38°36′N, 9°24′W).

Distance 3630 miles.

2.82.2

Strait of Gibraltar:

Through 30°00′N, 79°40′W **(G)**, keeping in the main body of the Gulf Stream, thence:
By great circle to Strait of Gibraltar (36°00′N, 5°21′W), adjusting course to avoid the islands of Arquipélago dos Açores, see 2.115.

Distance 3840 miles.

Bishops Rock ⇒ North-East Providence Channel

Diagram 2.80

Routes

2.83

1 From a position (49°47′N, 6°27′W) 5 miles S of Bishop Rock the route is:

By great circle to position (42°30′N, 50°00′W) **(BS)**, thence:
By great circle to destination (25°50′N, 77°00′W).

Distance 3500 miles.

2.83.1

Alternative recommended routes for low-powered vessels can be found at 8.17.

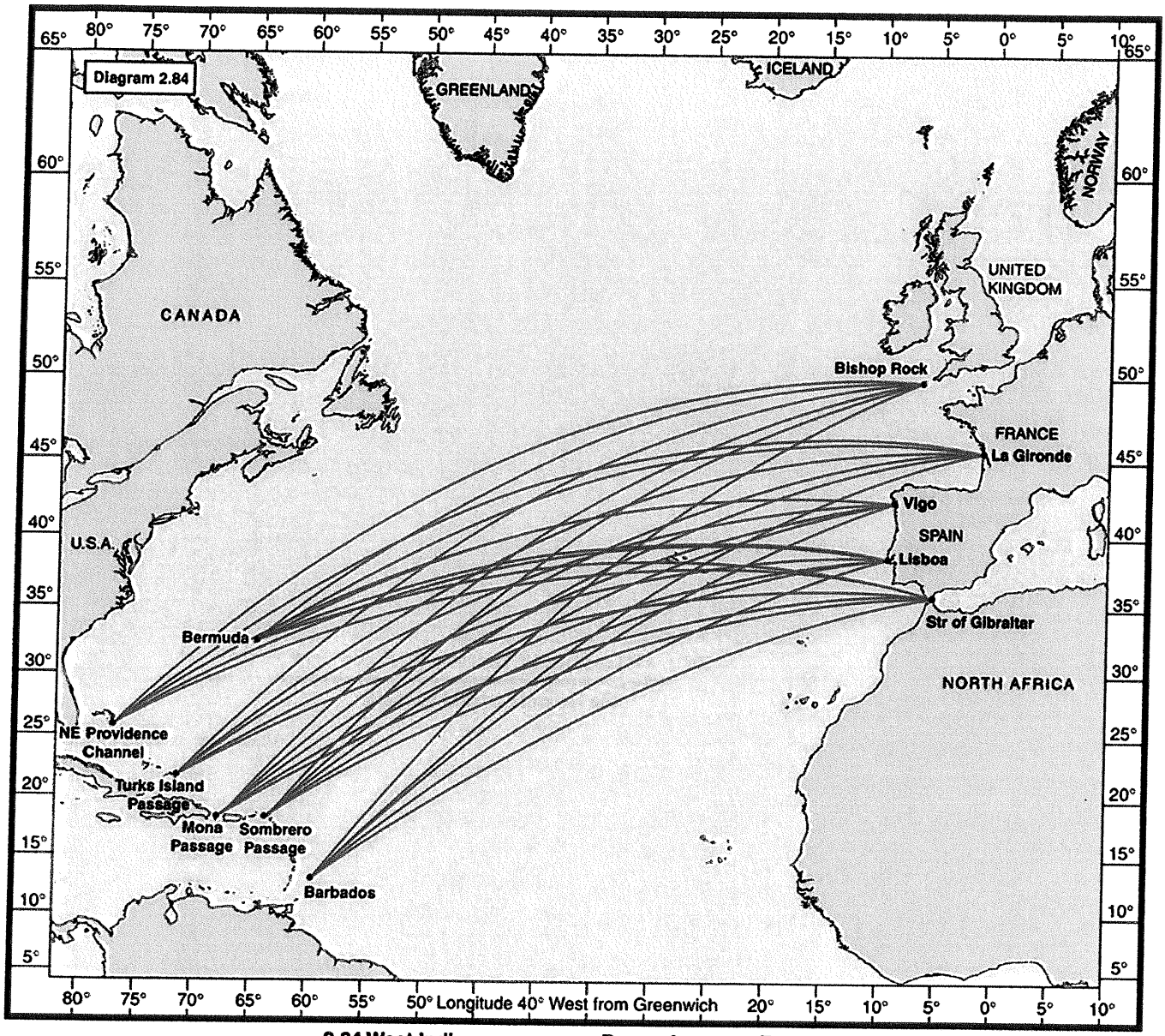
West Indies passages or Bermuda ⇐ ⇒ Europe

Diagram 2.84

Routes

2.84

1 Subject to the ordinary requirements of navigation, including, on certain routes, avoidance of Bermuda (2.44) and passage through the islands of Arquipélago dos Açores, see 2.115, the routes are by great circles.



2.84 West Indies passages or Bermuda ← → Europe

Diagram 2.85

Alternative routes for west-bound vessels

2.85

1 For W-bound vessels from the Bay of Biscay and places farther N the following routes may be preferable in order to avoid the effects of the E-going North Atlantic Current and the predominance of W winds and head seas in the N part of the North Atlantic Ocean.

2.85.1

1 From the S part of the Bay of Biscay:

Rhumb line to 44°15'N, 8°30'W (F), thence:
Rhumb line to 36°40'N, 24°45'W (D), thence:
Great circle to 30°00'N, 45°30'W (E), thence:
By great circle to destination.

2.85.2

1 From the N part of the Bay of Biscay and places farther N:

Great circle to join Route 2.85.1 in 36°40'N, 24°45'W (D), thence:
As for Route 2.85.1 to destination.

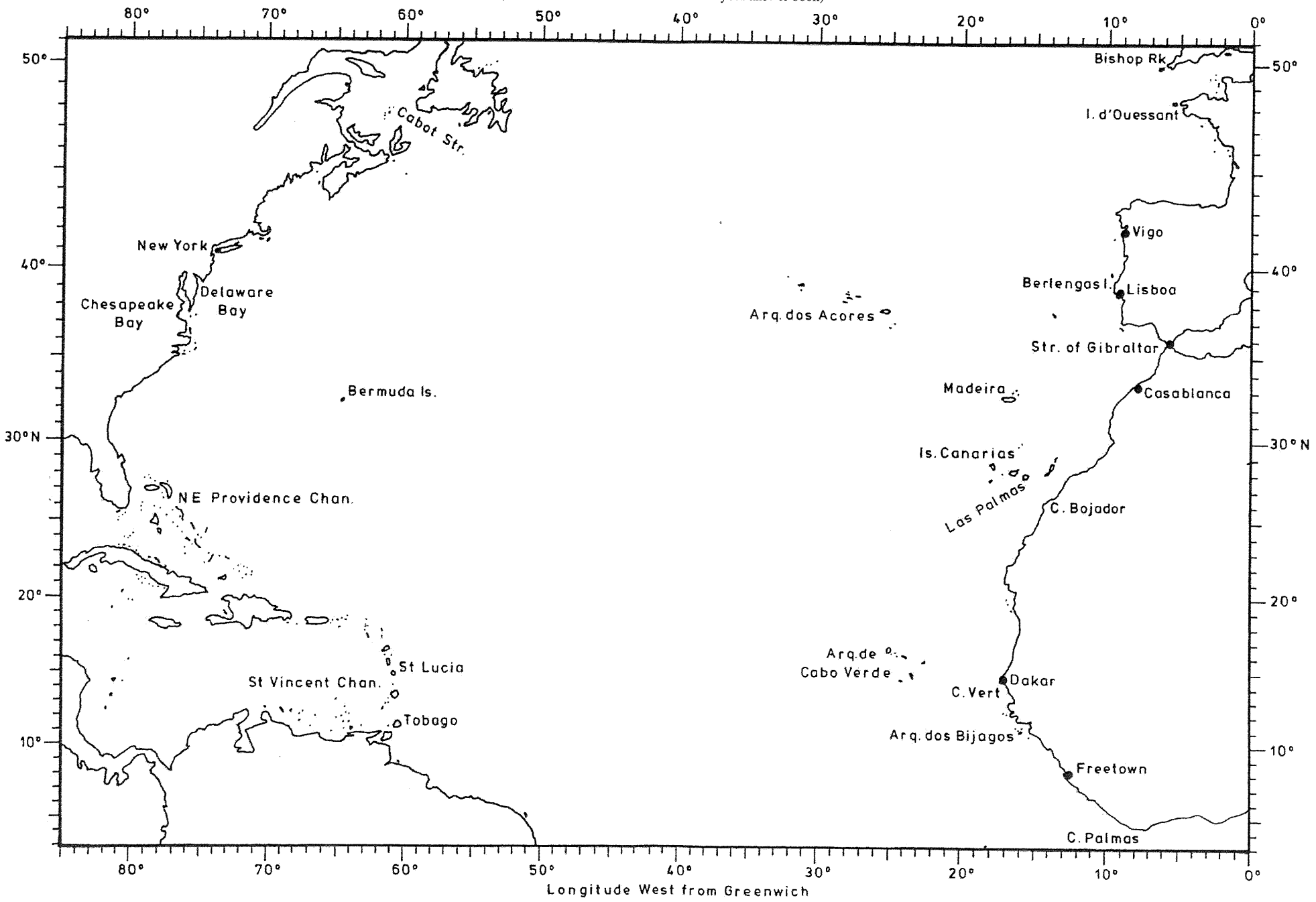
Distances in miles

2.86

	Great circles (2.84)					Alternative W-bound routes (2.85)	
	Bishop Rock	La Gironde	Vigo	Lisboa	Strait of Gibraltar	Bishop Rock	La Gironde
NE Providence Channel	See 2.83	3730	3450	3450	3670		3980
Turks Island Passage	3450	3650	3330	3310	3510	3710	3770

WORKSHEET Q1(c)(1)

(This Worksheet must be returned with your answer book)

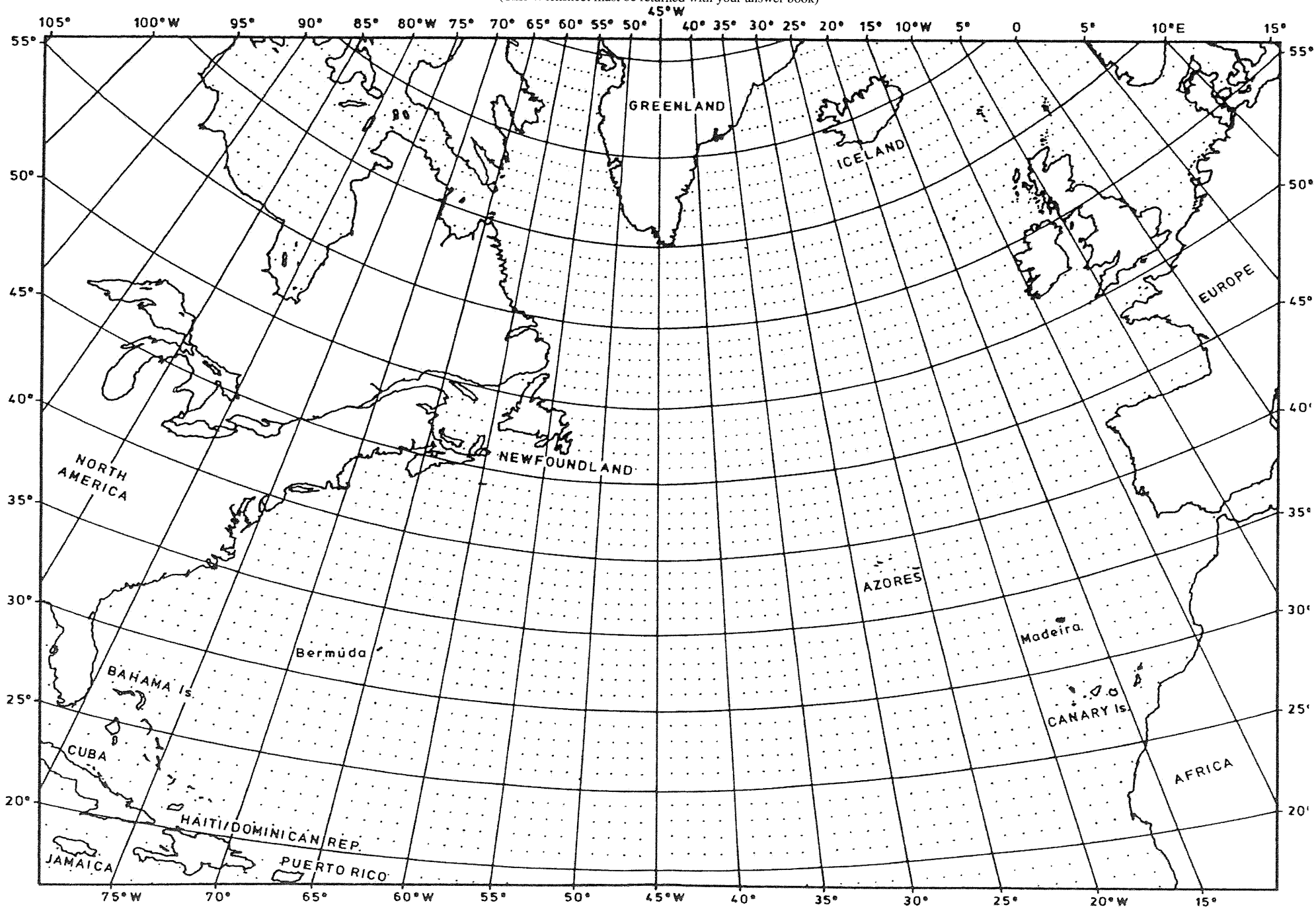


Candidate's Name .....

Examination Centre .....

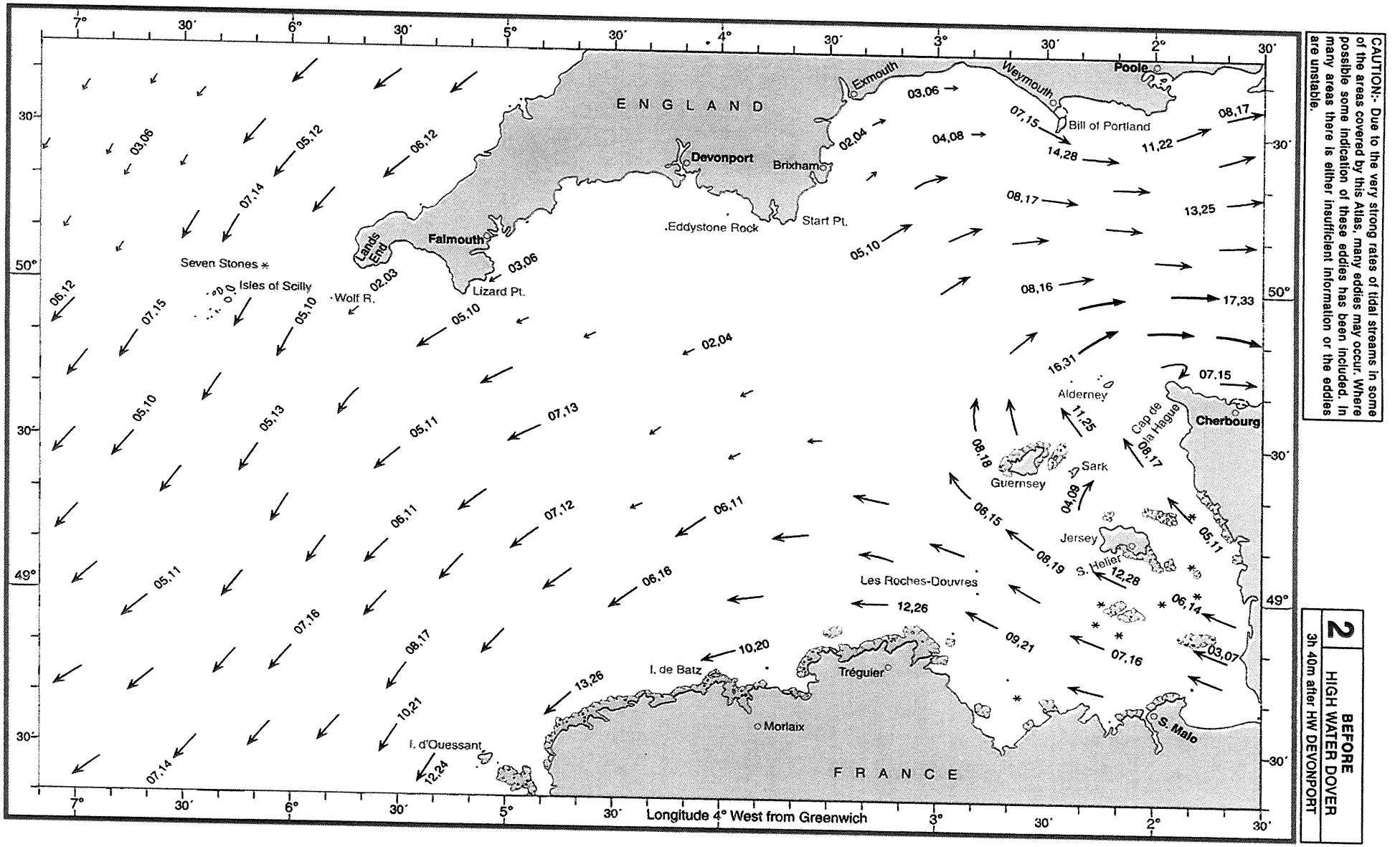
WORKSHEET Q1(c)(2)

(This Worksheet must be returned with your answer book)



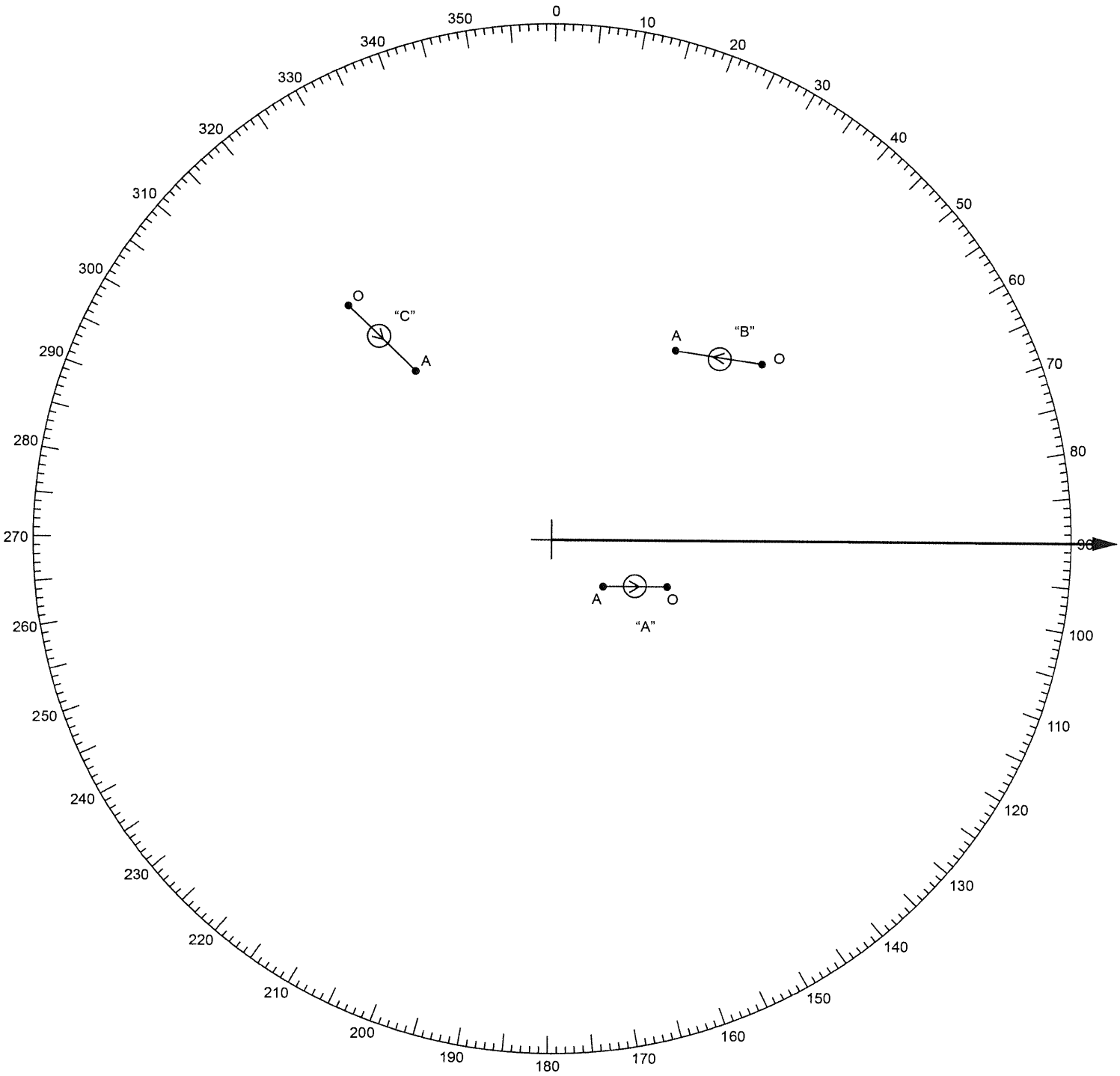
Candidate's Name .....

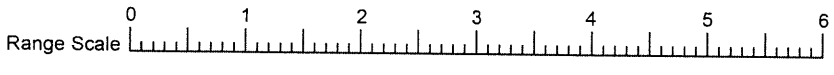
Examination Centre .....


ENGLAND
FRANCE
Exmouth
Weymouth
Poole
Bill of Portland
Devonport
Brixham
Eddystone Rock
Start Pt.
Falmouth
Lands End
Lizard Pt.
Seven Stones
Isles of Scilly
Wolf R.
Alderney
Cherbourg
Cap de la Hague
Guernsey
Sark
Jersey
S. Helier
Les Roches-Douvres
I. de Batz
Tréguier
Morlaix
S. Malo
I. d'Ouessant
Longitude 4° West from Greenwich
CAUTION:- Due to the very strong rates of tidal streams in some of the areas covered by this Atlas, many eddies may occur. Where possible some indication of these eddies has been included. In many areas there is either insufficient information or the eddies are unstable.
2
BEFORE
HIGH WATER DOVER
3h 40m after HW DEVONPORT

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET





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Tgt 'A': Arrow to be drawn 'O' to 'A'.
(Ref: SQA info)

Signature of Candidate .....

Examination Centre .....

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 24500 GT Tanker, with a service speed of 16.0 knots, is chartered to sail between ports in Western Australia and the East Coast of Africa; she is fitted with the current required Aids to Navigation.

1. The vessel makes a series of voyages between Mombasa (Kenya) and Port Headland (Western Australia).

   (a) With reference to Datasheets Q1(1), Q1(2) and Q1(3) identify and describe the routes recommended for this passage and discuss why there is a different route Eastbound to Westbound. (20)

   (b) Calculate EACH of the following:

      (i) the distance by the recommended route from Mombasa 04°05'S 039°43'E, to Port Headland pilot station 20°16'S 118°36'E; (20)

      (ii) the ETA at Port Headland pilots, Standard Time, if the vessel sails from Mombasa at 0800 ST 12th January. (10)

2. On Worksheet Q2 for a voyage in January, illustrate and name the following:

   (a) the pressure distribution over the Ocean; (6)

   (b) the associated wind circulation; (8)

   (c) the main Ocean currents; (14)

   (d) the approximate location of meteorological hazards. (7)

3. (a) SOLAS Chapter V Regulation 19 – *"Carriage requirements for shipborne navigational systems and equipment"* details the navigational equipment to be carried by ocean going vessels.

List 15 items of the navigational equipment that must be carried for the voyage in Q1. (15)

(b) On the passage to Port Headland on 22nd January in position 019°48'S 107°35'E the OOW observes Venus in the western sky just after sunset bearing 264°C.

Chronometer 11h 37m 07s with an error of 2m 27s slow.
Variation 1.5°E

(i) Calculate the deviation of the magnetic compass. (15)

(ii) Explain what the OOW and Master should do if a large Deviation is obtained. (10)

4. The vessel is due to complete loading in Port Headland in 12 hours when a Tropical Cyclone warning is received:

"Tropical Cyclone NARELLE in position 13°30'S 116°00'E is now moving in a direction of SSW at 7 knots. Central pressure estimated as 970hPa with maximum winds of 70 knots."

(a) On Worksheet Q4 plot the position of the storm and the area it could be influencing in 12 hours. (6)

(b) Outline the factors that the Master must consider for EACH of the following actions, in light of the proximity of Tropical Cyclone NARELLE:

(i) remaining in the port; (12)

(ii) sailing to an anchorage; (10)

(iii) sailing to the open sea. (12)

5. (a) In the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) one of the Master's responsibilities is to *"Issue appropriate orders in a clear and simple manner"*, with regard to Navigation.

Explain how the Master complies with this responsibility. (10)

(b) Describe the contents of Master's Standing Orders and outline the factors that should be taken into account when compiling them. (25)

Distances
6.107.3

	Fremantle	Adelaide	Port Phillip*	Hobart
Durban				
October to April	4350	5510	5800	5980
May to September	4410	5570	5860	6040
Cape Town				
October to April	4970[(a)]	6130[(a)]	6420[(a)]	6600[(a)]
May to September	5200[(a)]	6360[(a)]	6650[(a)]	6830[(a)]

* Port Phillip to Melbourne: 40 miles
(a) For Cape Agulhas (15 miles S of) subtract 130 miles.

Cape Town ⇒ New Zealand and Pacific Ocean

Diagram 6.108
Routes
6.108
Routes are seasonal.

October to April
6.108.1
Routes are:
As at 6.105.1 for Hobart as far as 41°30′S. 122°50′E (**U**), thence:
(a) Either:
Great circle to 47°50′S, 167°50′E (**J**), ENE of Snares Islands (48°01′S, 166°36′E).
(b) Or:
Great circle passing close S of Tasmania to Cook Strait (41°00′S, 174°30′E).

October to April (alternative route)
6.108.2
If the shorter route (6.105.2) to Hobart is taken it should be left in 45°00′S, 130°00′E (**Z**), thence:
Great circle to Snares Islands (48°01′S, 166°36′E) or Cook Strait (41°00′S, 174°30′E).

May to September
6.108.3
Routes are:
As at 6.105.3 for ports E of Adelaide as far as 35°30′S, 115°00′E (**H**), S of Cape Leeuwin, thence:
Great circle to a landfall off South West Cape, Tasmania (43°35′S, 146°03′E), thence:
Great circle to Snares Islands (48°01′S, 166°36′E) or Cook Strait (41°00′S, 174°30′E).

Distances
6.108.4
From Cape Town (33°53′S, 18°26′E):

	Oct to April		May to Sept
	6.108.1[(b)]	**6.108.2**[(b)]	**6.108.3**[(a)]
Snares Islands	6970	6650	7240
Cook Strait	7380	7100	7630

(a) For Cape Agulhas (15 miles S of) subtract 130 miles.
(b) For Cape of Good Hope (145 miles S of) subtract 180 miles.

PASSAGES BETWEEN MOMBASA AND SINGAPORE OR AUSTRALIA

Mombasa ⇐ ⇒ Selat Sunda

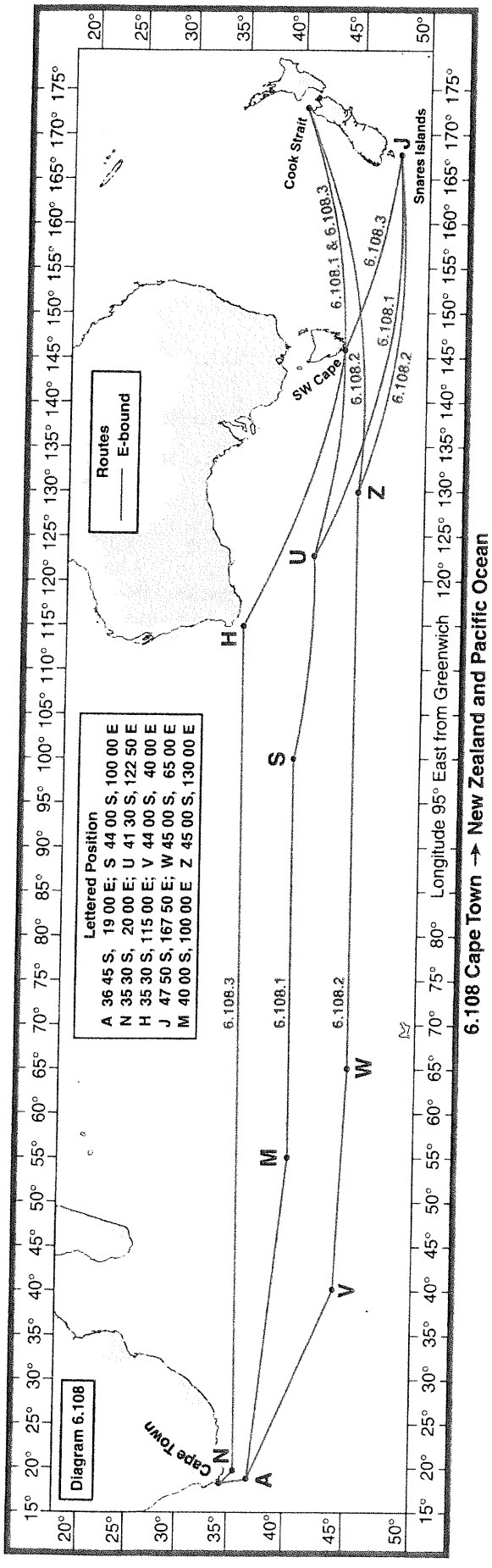
Diagram 6.109
Route
6.109
From Mombasa (4°05′S, 39°43′E) the route:
Passes through 3°00′S, 54°00′E (**T**), 50 miles N of the Seychelles Group, thence:
Through 4°00′S, 73°30′E (**A**), passing 50 miles N of Chagos Archipelago (6°30′S, 72°00′E), thence:
To Selat Sunda (6°00′S, 105°52′E).
Distance 3980 miles.

Mombasa ⇐ ⇒ Singapore

Diagram 6.109
Route
6.110
From Mombasa (4°05′S, 39°43′E) the route is:
Through One and Half Degree Channel (1°24′N, 73°20′E) (**J**), thence:
To the N approaches to the Malacca Strait, described at 6.61, thence:
Through Malacca Strait (6.62) to Singapore (1°12′N, 103°51′E).
Distance 3990 miles.

Mombasa ⇐ ⇒ North and West coasts of Australia

Diagram 6.109
Routes
6.111
For Torres Strait (10°36′S, 141°51′E) and **Darwin** (12°25′S, 130°47′E) the routes are:
(a) Either:
As at 6.109 to Selat Sunda (6°00′S, 105°52′E), thence:
Through Java, Flores and Banda Seas routes of 6.87.5.
(b) Or:
Passing through 3°00′S, 54°00′E (**T**), 50 miles N of the Seychelles Group, thence:
Through 4°00′S, 73°30′E (**A**), passing 50 miles N of Chagos Archipelago, thence:
Joining the Ocean route of 6.87.3 in 11°30′S, 118°00′E (**Z**).
6.111.1
For places between Darwin (12°25′S, 130°47′E) and **Cape Leeuwin** (34°23′S, 115°08′E) the routes are directional:



(a) **East-bound** from Mombasa (4°05′S, 39°43′E) the routes are:

Passing through 3°00′S, 54°00′E (**T**), 50 miles N of the Seychelles Group, thence:
Through 4°00′S, 73°30′E (**A**), thence:
Through 10°00′S, 80°00′E (**B**), thence:
As direct as navigation permits, either to the appropriate recommended track (6.85) (**Y**), or:
To destination.

(b) **West-bound** from the Australian coast S of Darwin (12°25′S, 130°47′E) are:

By great circle, as near as navigation permits, keeping N of 30°00′S, 100°00′E (**F**).

Distances

6.111.2

From Mombasa (4°05′S, 39°43′E):

	Java, Flores & Banda Seas Route (6.87.5)	Ocean Route (6.87.3)
Torres Strait	6170	6150
Darwin	5620	5520
	E-bound	**W-bound**
Port Hedland	4790	4720
Fremantle	4840	4570
Cape Leeuwin*	4860	4530

* 20 miles SW 34°28′S, 114°45′E (**K**).

PASSAGES BETWEEN ADEN AND SINGAPORE, AUSTRALIA OR NEW ZEALAND

Aden ⇒ Selat Sunda

Diagram 6.112

Routes

6.112

Routes are seasonal.

6.112.1

October to April the route is:

Round Raas Caseyr (11°50′N, 51°17′E), thence:
Through One and Half Degree Channel (1°24′N, 73°20′E) (**J**), thence:
Direct to Selat Sunda (6°00′S, 105°52′E).

6.112.2

May to September the route is:

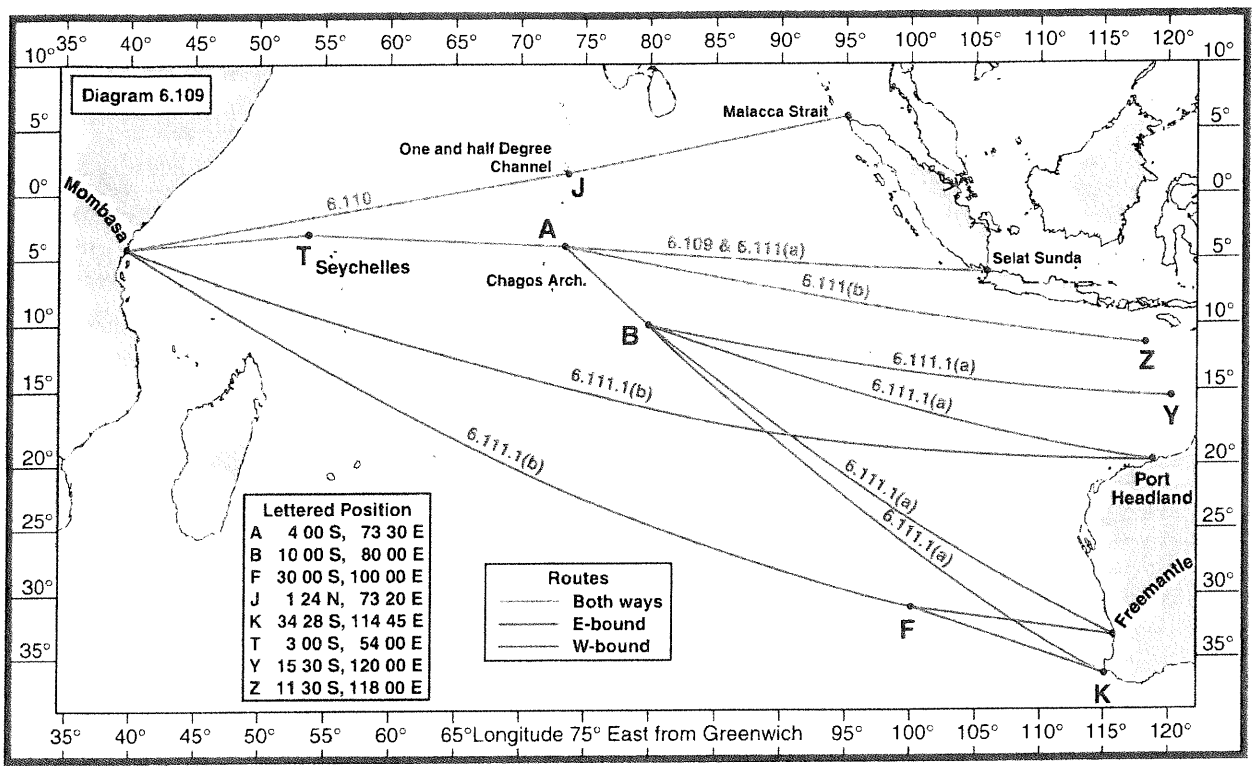
N of Suquṭrá (12°30′N, 54°00′E) to 13°00′N, 55°00′E (**Q**), thence:
Through Eight Degree Channel (7°24′N, 73°00′E) (**F**), thence:
Landfall (5°45′N, 80°36′E), 10 miles S of Dondra Head, thence:
To Selat Sunda (6°00′S, 105°52′E).

Distances

6.112.3

From Aden:

	Oct to April	May to Sept
Selat Sunda	3840	3860
Position (O) 6°25′S, 102°30′E	3650	3670



6.109 Mombasa ← → Selat Sunda
6.110 Mombasa ← → Singapore
6.111 Mombasa ← → North and west coast of Australia

Low-powered vessels

6.112.4

Low-powered, or hampered, vessels may find the routes described at 9.137 more suitable for their use.

Selat Sunda ⇒ Aden

Diagram 6.112

Routes

6.113

Routes are seasonal.

6.113.1

October to April the route is:

To a landfall (5°45′N, 80°36′E), 10 miles S of Dondra Head, thence:

Through Eight Degree Channel (7°24′N, 73°00′E) (**F**), thence:

(a) Either:

S of Suquṭrá (12°30′N, 54°00′E), thence:

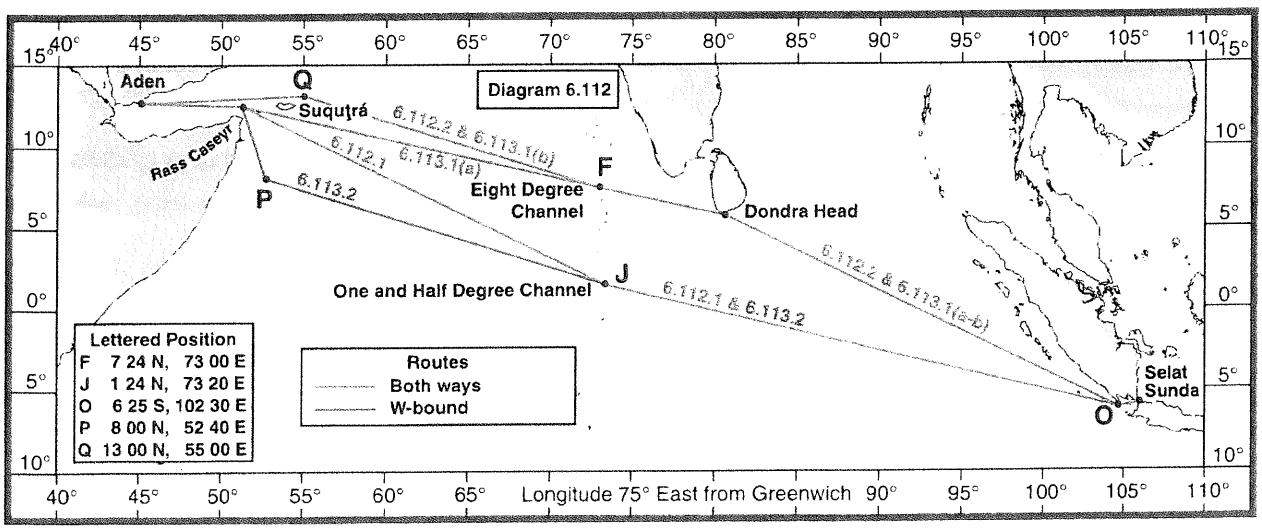
Between Raas Caseyr (11°50′N, 51°17′E) and 'Abd al Kūrī (12°10′N, 52°15′E), bearing mind the difficulty of identifying the landfall (6.38.3), thence:

Direct to Aden (12°45′N, 44°57′E).

(b) Or:

Through 13°00′N, 55°00′E (**Q**), thence:

Passing N of Suquṭrá (12°30′N, 54°00′E), thence:



6.112 Aden → Selat Sunda
6.113 Selat Sunda → Aden

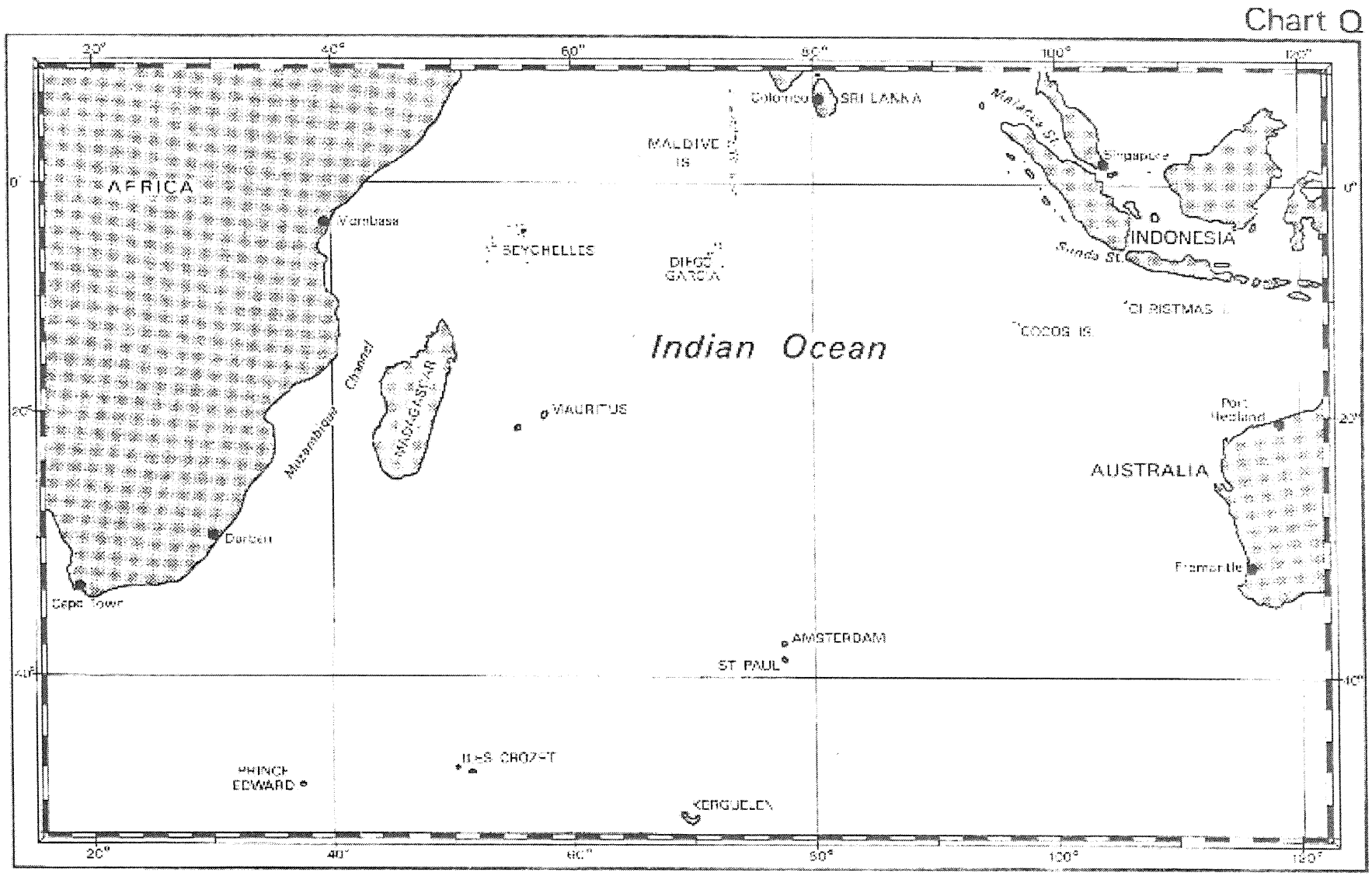
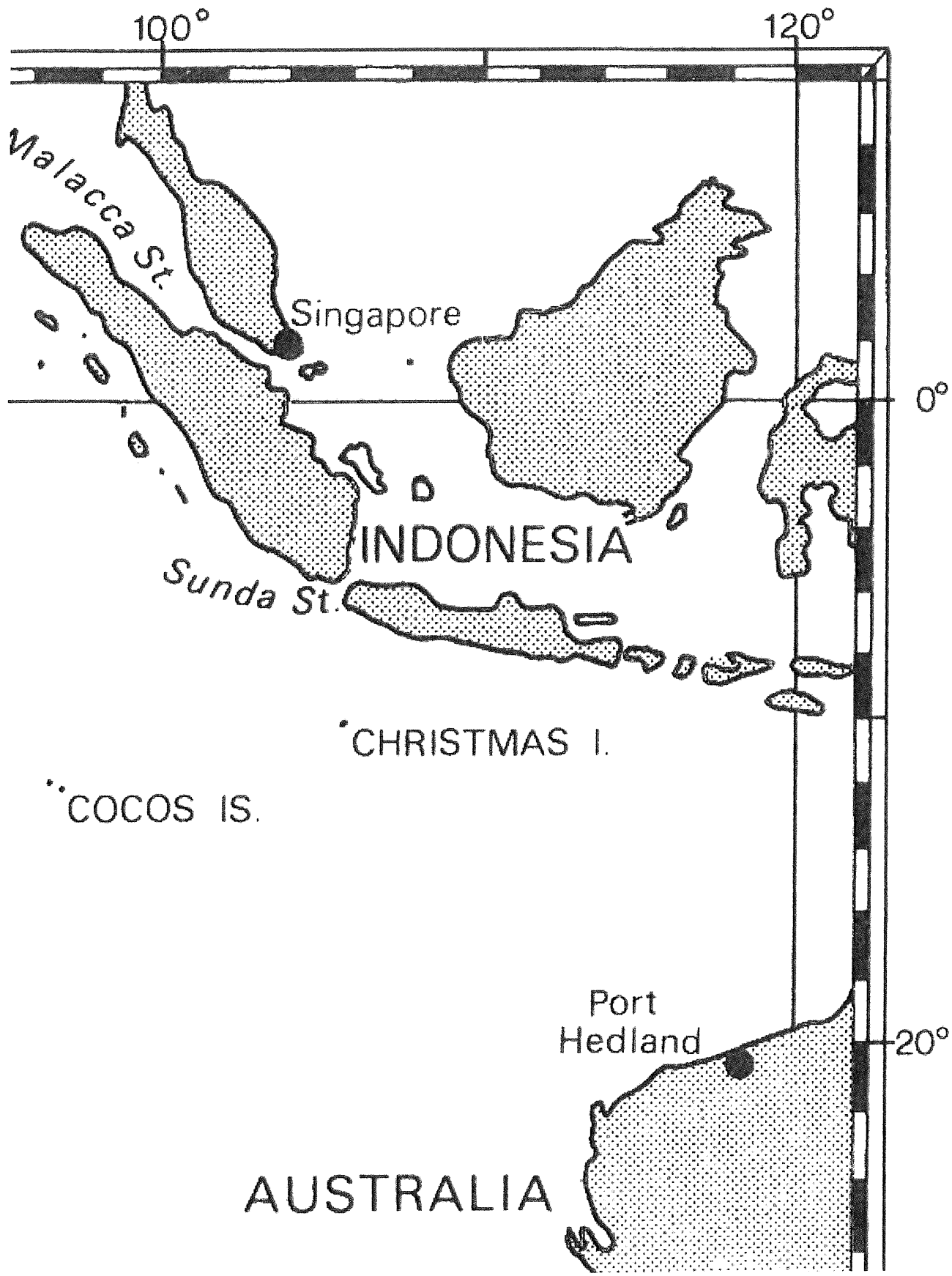


Chart Q
30°
40°
60°
80°
100°
120°
0°
20°
40°
AFRICA
Mombasa
SEYCHELLES
DIEGO GARCIA
MALDIVE IS
Colombo
SRI LANKA
Malacca St.
Singapore
INDONESIA
Sunda St.
CHRISTMAS I.
COCOS IS.
Indian Ocean
Mozambique Channel
MADAGASCAR
MAURITIUS
Port Hedland
AUSTRALIA
Fremantle
Durban
Cape Town
AMSTERDAM
ST PAUL
PRINCE EDWARD
CROZET
KERGUELEN


100°
120°
Malacca St.
Singapore
0°
INDONESIA
Sunda St.
CHRISTMAS I.
COCOS IS.
Port
Hedland
20°
AUSTRALIA

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY -
DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

THURSDAY 27 NOVEMBER 2014

0915 - 1215 hrs

Examination paper inserts:

Radar Plotting Sheet Datasheet Q1(1) and Q1(2), Q2 (1) and Q2 (2) Worksheet Q4

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination answer book Navigation Formulae Datasheet Nautical Almanac Nautical Tables	UK and Ireland Tide Tables Pacific and Atlantic Oceans Tide Tables Graph paper

NAVIGATION

Attempt ALL questions

Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 17500 GT Cargo Vessel, with a service speed of 16.2 knots, sails on a long term charter between Florida and the Eastern Mediterranean, she is fitted with the current required Aids to Navigation.

1. The vessel sails from Fort Lauderdale, 26°08'N 080°08'W, Florida, on 2nd March bound for Lisboa, Portugal.

   (a) With reference to Datasheets Q1(1) and Q1(2), identify the route recommended for this passage and estimate the position of the vertex. (6)

   (b) At the start of the great circle the vessel's Winter Marks are submerged by 188 tonnes and she consumes 36 t of fuel and 8 t of water per day. The southern limit of North Atlantic Winter Seasonal Zone II, from 1 November to 31 March, is 36°N.

   Using departure position **'A'**, calculate EACH of the following:

   (i) the distance the vessel must steam to consume the excess tonnage; (6)

   (ii) the distance to an appropriate vertex on the Limiting Latitude of 36°N; (7)

   (iii) the shortest legal distance to Lisboa, assuming a direct great circle is not possible; (18)

   (iv) the ETA at Lisboa (Standard Time) if the vessel passes position **'A'** at 1045 on 2nd March (Florida Standard Time). (8)

2. At 2140 UT on the evening of 9th March, in position 39°52'N 017°40'W vessel steering 098°T at the service speed, the Master writes in his Night Orders for the Officer of the Watch to take stars the following morning.

   (a) Calculate EACH of the following:

   (i) the UT of Civil Twilight on 10th March; (10)

   (ii) the vessel's DR position at Civil Twilight; (7)

   (b) Using Datasheet Q2:

   (i) identify the stars available to be observed at Civil Twilight; (10)

   (ii) state, with reasons, which FOUR stars would be most suitable for a high confidence fix. (8)

3. (a) The Maritime and Coastguard Agency issues information to the Maritime Industry in the form of Marine Notices.

(i) State the purpose of Merchant Shipping Notices. (3)

(ii) Describe the contents of MSN 1781 The Merchant Shipping (Distress Signal and Prevention of Collisions) Regulations 1997 - Amendments to Annex IV (Distress Signals). (6)

(b) Maritime Safety Information is broadcast via the World Wide Navigational Warning System (WWNWS) and may be received by NAVTEX.

(i) Outline the function of the WWNWS and the different radio navigational warnings. (10)

(ii) State FIVE of the categories of information concerning principal shipping routes. (10)

(iii) Explain the function and purpose of a NAVTEX receiver. (6)

(iv) NAVTEX messages are grouped into different subjects:

(1) State those that cannot be rejected by a NAVTEX receiver; (3)

(2) State those that should not be rejected by a NAVTEX receiver. (2)

4. On a subsequent eastbound voyage while in position 31°40'N 076°30'W steering 075°, the vessel receives a warning that a category 2 hurricane is in position 28°00'N 065°30'W moving NNW at 12 knots, with estimated wind speeds of 50 knots at 120' and 75 knots at 80' from the centre.

(a) On Worksheet Q4 plot:

(i) the position of the storm and the vessel; (2)

(ii) the vessel's DR position and the area of influence of the storm in 24 hours. (7)

(b) Describe the expected weather the vessel would encounter over the above 24 hours, if both the vessel and the storm continue on their current paths. (14)

(c) Discuss THREE possible courses of action the Master could take to avoid the worst of the storm influence. (12)

(d) Explain which single action from 4(c) a prudent Master should take. (5)

5. Vessels engaged on coastal and ocean voyages need to rely on various navigational aids and position fixing systems.

Discuss the availability, accuracy and sources of error (both Random and Systematic) of EACH of the following:

(a) Global Navigation Satellite Systems (GNSS); (10)

(b) Celestial observations; (15)

(c) Terrestrial observations. (15)

To and from West Indies passages or Bermuda and Europe, including alternative routes for W-bound vessels (2.84).

References

2.79

1 **Cautions:**

Western approaches to the English Channel, see 2.37.
Île d'Ouessant, see 2.38.
Bay of Biscay and west coasts of Spain and Portugal, see 2.39.
Strait of Gibraltar, see 2.40.
Grand Banks of Newfoundland, see 2.43.
Bermuda, see 2.44.
Caribbean Sea entrance channels, see 4.7.

PASSAGES

Diagram 2.80

Approaches to Gulf of Mexico

2.80

1 East-bound passages from Gulf of Mexico are recommended through Straits of Florida, thence N to take full advantage of the Florida Current, the Gulf Stream and North Atlantic Current (2.14), as well as the predominantly W winds in the N part of the North Atlantic Ocean.

2 For directions for passage through Straits of Florida to the departure point (27°00′N, 79°49′W), off Jupiter Inlet, see *West Indies Pilot, Volume I.*

3 West-bound passages are recommended either through Providence Channels or through Old Bahama Channel and Nicholas Channel.

4 Passages in Gulf of Mexico and Caribbean Sea, and the approaches thereto, are continued in Chapter 4.

Straits of Florida ⇒ Vigo and European coast farther North

Diagram 2.80

Routes

2.81

1 From the departure point, off Jupiter Inlet, the route leads to position 42°30′N, 50°00′W **(BS)** thence to destinations in N Europe (2.69).

2.81.1

1 From 27°00′N, 79°49′W **(A)**, at the N end of the Straits of Florida, the routes are:

Through 30°00′N, 79°40′W **(G)**, keeping in the main body of the Gulf Stream, thence:
Through 35°30′N, 72°40′W **(B)**, thence:
Great circle to position (42°30′N, 50°00′W) **(BS)**, thence:
As at 2.69 to destination.

2.81.2

1 Distances from Straits of Florida:

Nordkapp	4660 miles.
Trondheim	4220 miles.
Bergen	4060 miles.
Cape Wrath	3730 miles.
Inishtrahull	3620 miles.
Fastnet Rock	3520 miles.
Bishop Rock	3640 miles.
La Gironde*	3870 miles.
Vigo	3610 miles.

* 70 miles from Bordeaux

Straits of Florida ⇒ Lisboa and Strait of Gibraltar

Diagram 2.80

Routes

2.82

1 From 27°00′N, 79°49′W **(A)**, at the N end of the Straits of Florida, the routes are:

2.82.1

Lisboa:

Through 30°00′N, 79°40′W **(G)**, keeping in the main body of the Gulf Stream, thence:
By great circle to Lisboa (38°36′N, 9°24′W).

Distance 3630 miles.

2.82.2

Strait of Gibraltar:

Through 30°00′N, 79°40′W **(G)**, keeping in the main body of the Gulf Stream, thence:
By great circle to Strait of Gibraltar (36°00′N, 5°21′W), adjusting course to avoid the islands of Arquipélago dos Açores, see 2.115.

Distance 3840 miles.

Bishops Rock ⇒ North-East Providence Channel

Diagram 2.80

Routes

2.83

1 From a position (49°47′N, 6°27′W) 5 miles S of Bishop Rock the route is:

By great circle to position (42°30′N, 50°00′W) **(BS)**, thence:
By great circle to destination (25°50′N, 77°00′W).

Distance 3500 miles.

2.83.1

Alternative recommended routes for low-powered vessels can be found at 8.17.

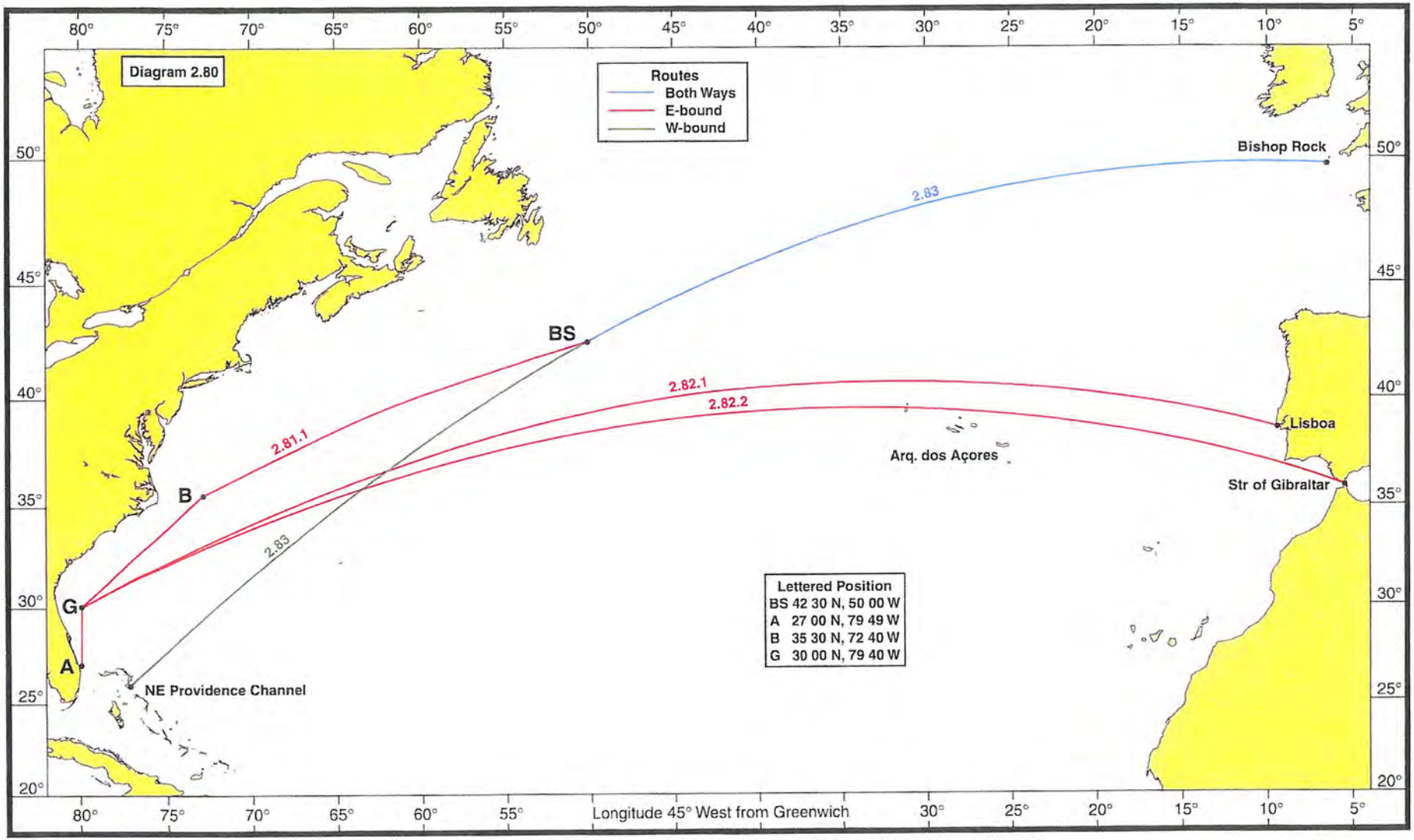
West Indies passages or Bermuda ⇐ ⇒ Europe

Diagram 2.84

Routes

2.84

1 Subject to the ordinary requirements of navigation, including, on certain routes, avoidance of Bermuda (2.44) and passage through the islands of Arquipélago dos Açores, see 2.115, the routes are by great circles.



2.80 Routes between Straits of Florida or NE Providence Channel and Europe

LAT 40°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦CAPELLA		ALDEBARAN		♦Diphda		FOMALHAUT		ALTAIR		♦VEGA		Kochab	
0	34 06	056	26 24	090	31 10	168	18 58	194	26 55	256	29 58	297	27 39	348
1	34 44	056	27 10	091	31 19	169	18 46	195	26 09	259	29 17	298	27 29	348
2	35 22	056	27 56	091	31 28	170	18 34	196	25 24	260	28 36	298	27 20	348
3	36 01	057	28 42	092	31 35	171	18 21	197	24 39	261	27 56	299	27 11	349
4	36 39	057	29 28	093	31 42	172	18 07	198	23 54	261	27 16	299	27 02	349
5	37 16	057	30 13	093	31 48	173	17 53	199	23 08	262	26 36	300	26 53	349
6	37 56	058	30 59	094	31 53	174	17 38	199	22 23	263	25 56	300	26 45	349
7	38 35	058	31 45	095	31 57	175	17 22	200	21 37	263	25 16	301	26 37	350
8	39 14	058	32 31	095	32 00	177	17 06	201	20 51	264	24 37	301	26 28	350
9	39 53	058	33 17	096	32 02	178	16 49	202	20 05	265	23 57	301	26 21	350
10	40 33	059	34 02	097	32 04	179	16 31	203	19 20	265	23 18	302	26 13	351
11	41 12	059	34 48	098	32 04	180	16 13	204	18 34	266	22 39	302	26 05	351
12	41 51	059	35 33	098	32 04	181	15 54	205	17 48	267	22 01	303	25 58	351
13	42 31	060	36 19	099	32 02	182	15 35	205	17 02	267	21 22	303	25 51	351
14	43 11	060	37 04	100	32 00	183	15 15	206	16 16	268	20 44	304	25 44	352
	♦CAPELLA		BETELGEUSE		RIGEL		♦Diphda		Enif		♦DENEB		Kochab	
15	43 51	060	17 03	095	14 06	114	31 57	184	37 24	249	43 30	299	25 38	352
16	44 31	061	17 49	095	14 48	114	31 53	186	36 41	250	42 50	299	25 31	352
17	45 11	061	18 34	096	15 30	115	31 48	187	35 58	251	42 10	299	25 25	352
18	45 51	061	19 20	097	16 12	116	31 42	188	35 15	251	41 30	300	25 19	353
19	46 31	061	20 06	097	16 53	117	31 36	189	34 31	252	40 50	300	25 14	353
20	47 11	062	20 51	098	17 34	117	31 28	190	33 47	253	40 11	300	25 08	353
21	47 52	062	21 37	099	18 14	118	31 20	191	33 03	254	39 31	301	25 03	354
22	48 32	062	22 22	099	18 55	119	31 10	192	32 19	255	38 52	301	24 58	354
23	49 13	062	23 07	100	19 35	120	31 00	193	31 34	255	38 12	301	24 53	354
24	49 54	063	23 53	101	20 15	121	30 49	194	30 50	256	37 33	302	24 48	354
25	50 35	063	24 38	102	20 54	121	30 37	195	30 05	257	36 54	302	24 44	355
26	51 16	063	25 23	102	21 33	122	30 25	197	29 20	258	36 15	302	24 40	355
27	51 57	063	26 08	103	22 12	123	30 11	198	28 35	258	35 37	303	24 36	355
28	52 38	063	26 52	104	22 50	124	29 57	199	27 50	259	34 58	303	24 33	356
29	53 19	064	27 37	104	23 28	125	29 42	200	27 05	260	34 20	303	24 29	356
	♦CAPELLA		BETELGEUSE		RIGEL		♦Diphda		Alpheratz		♦DENEB		Kochab	
30	54 00	064	28 21	105	24 06	125	29 26	201	64 50	253	33 41	304	24 26	356
31	54 41	064	29 06	106	24 43	126	29 09	202	64 06	254	33 03	304	24 23	357
32	55 22	064	29 50	107	25 20	127	28 51	203	63 21	255	32 25	305	24 21	357
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38	59 31	065	34 10	111	28 52	132	26 51	209	58 51	261	28 41	307	24 09	359
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40	60 54	065	35 35	113	29 59	134	26 05	211	57 20	262	27 28	308	24 08	359
41	61 36	065	36 17	114	30 31	135	25 41	212	56 35	263	26 52	308	24 07	359
42	62 18	065	36 59	115	31 04	136	25 17	213	55 49	264	26 15	308	24 07	000
43	62 59	065	37 41	116	31 35	137	24 51	214	55 03	265	25 39	309	24 07	000
44	63 41	065	38 22	117	32 06	138	24 26	215	54 18	265	25 04	309	24 07	000
	♦Dubhe		POLLUX		SIRIUS		♦RIGEL		Diphda		♦Alpheratz		DENEB	
45	22 14	026	31 06	078	12 46	125	32 36	139	23 59	216	53 32	266	24 28	310
46	22 34	026	31 51	078	13 23	126	33 06	140	23 32	217	52 46	267	23 53	310
47	22 55	027	32 36	079	14 00	127	33 35	141	23 04	217	52 00	268	23 18	310
48	23 16	027	33 22	080	14 37	127	34 03	142	22 36	218	51 14	268	22 43	311
49	23 37	027	34 07	080	15 13	128	34 31	143	22 07	219	50 28	269	22 08	311
50	23 58	028	34 52	081	15 49	129	34 58	144	21 38	220	49 42	270	21 34	312
51	24 20	028	35 37	081	16 25	130	35 25	146	21 08	221	48 56	270	21 00	312
52	24 41	028	36 23	082	17 00	131	35 50	147	20 38	222	48 10	271	20 26	313
53	25 03	029	37 08	082	17 35	131	36 15	148	20 07	223	47 24	272	19 52	313
54	25 26	029	37 54	083	18 09	132	36 39	149	19 36	224	46 38	272	19 19	314
55	25 48	029	38 40	083	18 43	133	37 03	150	19 04	224	45 52	273	18 46	314
56	26 11	030	39 25	084	19 16	134	37 25	151	18 31	225	45 07	273	18 13	315
57	26 34	030	40 11	085	19 49	135	37 47	152	17 58	226	44 21	274	17 40	315
58	26 57	030	40 57	085	20 22	135	38 08	154	17 25	227	43 35	275	17 08	315
59	27 20	031	41 43	086	20 54	136	38 28	155	16 51	228	42 49	275	16 35	316
	♦Dubhe		POLLUX		PROCYON		♦SIRIUS		RIGEL		♦Hamal		Schedar	
60	27 44	031	42 29	086	21 26	137	21 25	137	38 47	156	61 12	244	54 01	314
61	28 08	031	43 14	087	30 28	111	21 57	138	39 05	157	60 30	245	53 28	314
62	28 32	032	44 00	088	31 11	112	22 27	139	39 23	158	59 49	246	52 55	314
63	28 56	032	44 46	088	31 54	113	22 57	140	39 39	160	59 06	247	52 22	314
64	29 20	032	45 32	089	32 36	113	23 26	141	39 55	161	58 24	248	51 49	314
65	29 45	032	46 18	089	33 18	114	23 55	142	40 10	162	57 41	249	51 16	314
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69	31 25	033	49 22	092	36 04	118	25 45	145	40 58	167	54 47	253	49 04	314
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71	32 16	034	50 54	093	37 24	120	26 36	147	41 17	170	53 18	255	47 58	314
72	32 41	034	51 40	094	38 04	120	27 00	148	41 24	171	52 34	256	47 25	314
73	33 07	034	52 25	095	38 43	121	27 24	149	41 31	172	51 49	257	46 52	314
74	33 33	035	53 11	096	39 22	122	27 48	150	41 37	174	51 04	258	46 19	314
	♦Dubhe		POLLUX		PROCYON		♦SIRIUS		RIGEL		♦Hamal		Schedar	
75	33 59	035	53 57	096	40 01	123	28 10	151	41 41	175	50 19	259	45 47	314
76	34 26	035	54 43	097	40 39	124	28 32	152	41 45	176	49 34	260	45 14	315
77	34 52	035	55 28	098	41 17	125	28 53	153	41 47	178	48 49	260	44 41	315
78	35 19	036	56 14	099	41 54	126	29 14	154	41 48	179	48 03	261	44 08	315
79	35 48	036	56 59	100	42 31	128	29 33	155	41 49	180	47 18	262	43 36	315
80	36 13	036	57 44	100	43 07	129	29 52	156	41 48	182	46 32	263	43 03	315
81	36 40	036	58 29	101	43 43	130	30 10	157	41 46	183	45 47	263	42 31	315
82	37 07	036	59 14	102	44 18	131	30 28	158	41 43	184	45 01	264	41 59	315
83	37 34	036	59 59	103	44 52	132	30 44	159	41 39	186	44 15	265	41 26	315
84	38 01	037	60 44	104	45 26	133	31 00	160	41 34	187	43 30	266	40 54	316
85	38 29	037	61 28	105	45 59	134	31 15	162	41 28	188	42 44	266	40 22	316
86	38 56	037	62 13	106	46 32	135	31 29	163	41 21	190	41 58	267	39 50	316
87	39 24	037	62 57	107	47 04	137	31 42	164	41 13	191	41 12	268	39 18	316
88	39 52	037	63 40	108	47 35	138	31 55	165	41 03	192	40 26	268	38 46	316
89	40 20	037	64 24	109	48 05	139	32 06	166	40 53	193	39 40	269	38 15	317

LAT 40°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦Dubhe		REGULUS		PROCYON		♦SIRIUS		RIGEL		ALDEBARAN		♦Mirfak	
90	40 47	037	28 49	089	48 35	141	32 17	167	40 42	195	60 21	224	61 14	303
91	41 15	038	29 34	100	49 04	142	32 27	168	40 30	196	59 49	225	60 35	303
92	41 43	038	30 20	100	49 32	143	32 36	169	40 17	197	59 16	227	59 57	303
93	42 12	038	31 05	101	49 59	145	32 44	170	40 02	199	58 42	228	59 18	303
94	42 40	038	31 50	102	50 25	146	32 51	172	39 47	200	58 07	230	58 39	303
95	43 08	038	32 35	102	50 50	147	32 57	173	39 31	201	57 32	231	58 01	303
96	43 36	038	33 20	103	51 14	148	33 03	174	39 14	202	56 55	233	57 22	303
97	44 05	038	34 04	104	51 38	150	33 07	175	38 57	203	56 19	234	56 44	303
98	44 33	038	34 49	105	52 00	152	33 11	176	38 38	205	55 41	235	56 05	303
99	45 01	038	35 33	106	52 21	153	33 14	177	38 18	206	55 03	236	55 26	303
100	45 30	038	36 17	106	52 41	155	33 15	178	37 58	207	54 24	238	54 48	303
101	45 58	038	37 01	107	53 00	156	33 16	180	37 36	208	53 45	239	54 09	303
102	46 27	038	37 45	108	53 18	158	33 16	181	37 14	209	53 06	240	53 30	303
103	46 55	038	38 29	109	53 34	160	33 15	182	36 51	211	52 26	241	52 52	303
104	47 23	038	39 12	110	53 50	161	33 13	183	36 27	212	51 45	242	52 13	303
	♦Kochab		Denebola		♦REGULUS		SIRIUS		RIGEL		♦ALDEBARAN		Mirfak	
105	31 23	016	22 40	090	39 55	111	33 10	184	36 03	213	51 04	243	51 35	303
106	31 37	017	23 26	090	40 38	111	33 06	185	35 38	214	50 23	244	50 57	303
107	31 50	017	24 12	091	41 21	112	33 02	186	35 12	215	49 41	245	50 18	304
108	32 03	017	24 58	092	42 03	113	32 56	188	34 45	216	48 59	246	49 40	304
109	32 17	017	25 44	092	42 45	114	32 50	189	34 18	217	48 17	247	49 02	304
110	32 30	017	26 30	093	43 27	115	32 42	190	33 50	218	47 34	248	48 24	304
111	32 44	016	27 16	094	44 09	116	32 34	191	33 21	219	46 52	249	47 46	304
112	32 58	016	28 02	094	44 50	117	32 25	192	32 51	220	46 08	250	47 08	304
113	33 12	016	28 48	095	45 31	118	32 15	193	32 21	221	45 25	251	46 30	304
114	33 27	016	29 33	096	46 11	119	32 04	194	31 51	222	44 41	252	45 52	305
115	33 41	018	30 19	096	46 51	120	31 52	195	31 20	223	43 58	253	45 14	305
116	33 55	018	31 05	097	47 31	121	31 40	196	30 48	224	43 14	254	44 36	305
117	34 10	019	31 50	098	48 10	122	31 26	198	30 16	225	42 29	255	43 58	305
118	34 25	019	32 36	099	48 48	123	31 12	199	29 43	226	41 45	255	43 21	306
119	34 40	019	33 21	099	49 26	124	30 57	200	29 09	227	41 00	256	42 44	306
	♦Kochab		Denebola		♦REGULUS		SIRIUS		RIGEL		♦ALDEBARAN		CAPELLA	
120	34 54	019	34 06	100	50 04	126	30 41	201	28 35	228	40 16	257	60 01	295
121	35 09	019	34 52	101	50 41	127	30 24	202	28 01	229	39 31	258	59 19	295
122	35 25	019	35 37	101	51 18	128	30 07	203	27 26	230	38 46	259	58 38	295
123	35 40	019	36 22	102	51 54	129	29 48	204	26 51	231	38 01	259	57 56	295
124	35 55	020	37 07	103	52 29	131	29 29	205	26 15	232	37 15	260	57 15	296
125	36 10	020	37 51	104	53 03	132	29 09	206	25 39	232	36 30	261	56 33	296
126	36 26	020	38 36	105	53 37	133	28 49	207	25 02	233	35 45	262	55 52	296
127	36 42	020	39 20	105	54 10	135	28 28	208	24 25	234	34 59	262	55 11	296
128	36 57	020	40 05	106	54 43	136	28 06	209	23 47	235	34 14	263	54 29	296
129	37 13	020	40 49	107	55 14	137	27 43	210	23 10	236	33 28	264	53 48	296
130	37 29	020	41 32	108	55 45	139	27 20	211	22 31	237	32 42	264	53 07	297
131	37 45	020	42 16	109	56 15	140	26 55	212	21 53	237	31 56	265	52 26	297
132	38 01	020	43 00	110	56 44	142	26 31	213	21 14	238	31 11	266	51 45	297
133	38 17	020	43 43	110	57 11	144	26 05	214	20 35	239	30 25	266	51 04	297
134	38 33	020	44 26	111	57 38	145	25 39	215	19 55	240	29 39	267	50 23	297
	Kochab		♦ARCTURUS		SPICA		REGULUS		♦SIRIUS		BETELGEUSE		♦CAPELLA	
135	38 49	021	20 23	082	10 06	114	58 04	147	25 13	216	37 35	244	49 42	298
136	39 05	021	21 09	082	10 48	115	58 29	148	24 46	217	36 53	245	49 02	298
137	39 21	021	21 54	083	11 30	115	58 52	150	24 18	218	36 11	246	48 21	298
138	39 37	021	22 40	084	12 11	116	59 14	152	23 49	219	35 29	247	47 40	298
139	39 54	021	23 26	084	12 52	117	59 35	154	23 20	220	34 47	248	47 00	299
140	40 10	021	24 11	085	13 33	118	59 55	156	22 51	220	34 04	249	46 20	299
141	40 26	021	24 57	085	14 14	118	60 13	157	22 21	221	33 21	249	45 39	299
142	40 43	021	25 43	086	14 54	119	60 30	159	21 50	222	32 38	250	44 59	299
143	40 59	021	26 29	087	15 34	120	60 46	161	21 19	223	31 55	251	44 19	300
144	41 15	021	27 15	087	16 14	121	61 00	163	20 47	224	31 11	252	43 39	300
145	41 32	021	28 01	088	16 53	121	61 12	165	20 15	225	30 27	253	42 59	300
146	41 48	021	28 47	088	17 32	122	61 23	167	19 43	226	29 43	253	42 20	300
147	42 05	021	29 33	089	18 11	123	61 32	169	19 10	226	28 59	254	41 40	301
148	42 21	021	30 19	090	18 50	124	61 40	171	18 36	227	28 15	255	41 01	301
149	42 37	021	31 05	090	19 28	124	61 46	173	18 02	228	27 31	256	40 21	301
	♦Kochab		ARCTURUS		♦SPICA		REGULUS		PROCYON		♦POLLUX		CAPELLA	
150	42 54	021	31 51	091	20 05	125	61 51	175	43 04	232	59 58	257	39 42	302
151	43 10	021	32 37	092	20 43	126	61 54	177	42 28	233	59 13	258	39 03	302
152	43 27	021	33 22	092	21 20	127	61 55	180	41 51	234	58 28	259	38 24	302
153	43 43	021	34 08	093	21 56	128	61 55	182	41 14	235	57 43	260	37 45	303
154	43 59	021	34 54	094	22 32	129	61 52	184	40 36	236	56 57	260	37 07	303
155	44 16	021	35 40	094	23 08	129	61 49	186	39 58	237	56 12	261	36 28	303
156	44 32	021	36 26	095	23 43	130	61 43	188	39 19	238	55 26	262	35 50	304
157	44 48	021	37 12	096	24 18	131	61 36	190	38 40	239	54 41	263	35 11	304
158	45 04	021	37 57	096	24 53	132	61 28	192	38 01	240	53 55	264	34 33	304
159	45 20	020	38 43	097	25 27	133	61 17	194	37 21	241	53 10	264	33 55	305
160	45 36	020	39 29	098	26 00	134	61 05	196	36 41	241	52 24	265	33 18	305
161	45 52	020	40 14	099	26 33	135	60 52	198	36 00	242	51 38	266	32 40	305
162	46 08	020	40 59	099	27 05	136	60 37	200	35 19	243	50 52	267	32 03	305
163	46 24	020	41 45	100	27 37	137	60 21	202	34 38	244	50 06	267	31 25	306
164	46 39	020	42 30	101	28 09	137	60 03	204	33 56	245	49 20	268	30 48	306
	♦Kochab		ARCTURUS		♦SPICA		REGULUS		PROCYON		♦POLLUX		CAPELLA	
165	46 55	020	43 15	102	28 39	138	59 44	205	33 15	246	48 34	269	30 11	307
166	47 11	020	44 00	102	29 10	139	59 24	207	32 32	247	47 48	269	29 35	307
167	47 26	020	44 45	103	29 39	140	59 02	209	31 50	248	47 02	270	28 58	308
168	47 41	019	45 29	104	30 08	141	58 39	211	31 07	248	46 16	271	28 22	308
169	47 56	019	46 14	105	30 37	142	58 15	212	30 25	249	45 31	271	27 46	308
170	48 12	019	46 58	106	31 05	143	57 50	214	29 42	250	44 45	272	27 10	309
171	48 26	019	47 42	107	31 32	144	57 24	216	28 58	251	43 59	272	26 34	309
172	48 41	019	48 26	108	31 58	145	56 56	217	28 15	252	43 13	273	25 58	309
173	48 56	019	49 10	108	32 24	146	56 28	219	27 31	252	42 27	274	25 23	310
174	49 10	018	49 54	109	32 49	147	55 59	220	26 47	253	41 41	274	24 48	310
175	49 25	018	50 37	110	33 13	149	55 28	222	26 03	254	40 55	275	24 13	311
176	49 39	018	51 20	111	33 37	150	54 57	223	25 19	255	40 09	275	23 38	311
177	49 53	018	52 02	112	34 00	151	54 25	225	24 35	255	39 24	276	23 04	312
178	50 07	017	52 45	113	34 22	152	53 52	226	23 50	256	38 38	277	22 29	312
179	50 21	017	53 27	114	34 43	153	53 19	228	23 05	257	37 52	277	21 55	312

LAT 40°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦VEGA		Alphecca		ARCTURUS		♦SPICA		REGULUS		♦POLLUX		CAPELLA	
180	17 49	054	43 53	090	54 08	116	35 04	154	52 45	229	37 07	278	21 21	313
181	18 26	054	44 39	090	54 50	117	35 23	155	52 10	230	36 21	278	20 48	313
182	19 04	055	45 24	091	55 31	118	35 42	156	51 34	231	35 36	279	20 15	314
183	19 42	055	46 10	092	56 11	119	36 00	157	50 58	233	34 50	279	19 41	314
184	20 20	056	46 56	092	56 51	120	36 18	159	50 21	234	34 05	280	19 09	315
185	20 58	056	47 42	093	57 31	121	36 34	160	49 44	235	33 20	280	18 36	315
186	21 36	057	48 28	094	58 09	123	36 49	161	49 06	236	32 35	281	18 04	316
187	22 15	057	49 14	094	58 48	124	37 04	162	48 27	237	31 50	282	17 32	316
188	22 53	058	50 00	095	59 26	125	37 18	163	47 48	238	31 05	282	17 00	317
189	23 32	058	50 45	096	60 03	127	37 30	165	47 09	239	30 20	283	16 28	317
190	24 12	059	51 31	097	60 39	128	37 42	166	46 29	241	29 35	283	15 57	317
191	24 51	059	52 17	097	61 15	130	37 53	167	45 49	242	28 50	284	15 26	318
192	25 30	060	53 02	098	61 50	131	38 03	168	45 08	243	28 06	284	14 56	318
193	26 10	060	53 48	099	62 24	133	38 12	169	44 27	244	27 21	285	14 25	318
194	26 50	061	54 33	100	62 57	135	38 19	171	43 46	245	26 37	285	13 55	319
	DENEB		♦VEGA		ARCTURUS		♦SPICA		REGULUS		♦POLLUX		Dubhe	
195	13 02	041	27 30	061	63 29	136	38 26	172	43 04	245	25 53	286	62 07	331
196	13 32	041	28 11	061	64 01	138	38 32	173	42 22	246	25 08	286	61 44	330
197	14 03	042	28 51	062	64 31	140	38 37	174	41 40	247	24 24	287	61 21	329
198	14 34	042	29 32	062	65 00	142	38 41	176	40 58	248	23 40	288	60 57	329
199	15 05	043	30 12	063	65 27	144	38 44	177	40 15	249	22 57	288	60 33	328
200	15 36	043	30 53	063	65 54	146	38 46	178	39 32	250	22 13	289	60 09	328
201	16 07	044	31 34	064	66 19	148	38 47	179	38 48	251	21 30	289	59 45	327
202	16 39	044	32 15	064	66 42	150	38 47	161	38 05	252	20 46	290	59 20	327
203	17 11	045	32 57	064	67 05	152	38 46	182	37 21	252	20 03	290	58 54	327
204	17 44	045	33 39	065	67 25	155	38 44	183	36 37	253	19 20	291	58 29	326
205	18 17	046	34 20	065	67 44	157	38 41	184	35 53	254	18 37	291	58 03	326
206	18 49	046	35 02	066	68 01	159	38 37	186	35 09	255	17 54	292	57 37	325
207	19 23	046	35 44	066	68 16	162	38 32	167	34 24	256	17 12	292	57 11	325
208	19 56	047	36 25	067	68 30	164	38 25	188	33 40	256	16 29	293	56 45	325
209	20 30	047	37 09	067	68 41	167	38 18	189	32 55	257	15 47	294	56 18	324
	DENEB		♦VEGA		Rasalhague		ANTARES		♦SPICA		REGULUS		♦Dubhe	
210	21 04	048	37 51	067	35 30	104	14 56	146	38 10	191	32 10	256	55 51	324
211	21 38	048	38 33	068	36 15	105	15 22	146	38 01	192	31 25	259	55 24	324
212	22 12	049	39 16	068	36 59	106	15 47	147	37 51	193	30 40	259	54 57	324
213	22 47	049	39 59	069	37 43	107	16 11	148	37 40	194	29 55	260	54 30	323
214	23 22	050	40 42	069	38 27	108	16 35	149	37 28	196	29 10	261	54 02	323
215	23 57	050	41 25	069	39 11	109	16 59	150	37 16	197	28 24	262	53 34	323
216	24 32	050	42 08	070	39 54	109	17 22	151	37 02	198	27 39	262	53 07	323
217	25 08	051	42 51	070	40 37	110	17 44	152	36 47	199	26 53	263	52 39	323
218	25 44	051	43 34	071	41 20	111	18 06	152	36 32	200	26 07	264	52 11	323
219	26 19	052	44 18	071	42 03	112	18 27	153	36 15	202	25 22	264	51 43	322
220	26 56	052	45 01	071	42 46	113	18 47	154	35 58	203	24 36	265	51 15	322
221	27 32	052	45 45	072	43 28	114	19 07	155	35 40	204	23 50	266	50 47	322
222	28 09	053	46 29	072	44 10	115	19 26	156	35 21	205	23 04	266	50 18	322
223	28 45	053	47 12	073	44 51	116	19 44	157	35 01	206	22 18	267	49 50	322
224	29 22	054	47 56	073	45 33	117	20 02	158	34 40	207	21 32	268	49 22	322
	DENEB		♦ALTAIR		Rasalhague		ANTARES		♦SPICA		Denebola		♦Dubhe	
225	29 59	054	18 51	094	45 13	118	20 19	159	34 19	208	41 23	252	48 54	322
226	30 37	054	19 36	095	45 54	119	20 36	159	33 57	209	40 39	253	48 25	322
227	31 14	055	20 22	096	47 34	120	20 51	160	33 34	211	39 55	254	47 57	322
228	31:52	055	21 08	096	48 14	121	21 07	161	33 10	212	39 11	255	47 28	322
229	32 29	056	21 54	097	48 53	122	21 21	162	32 46	213	38 26	256	47 00	322
230	33 07	056	22 39	098	49 32	123	21 35	163	32 20	214	37 42	256	46 31	322
231	33 46	056	23 25	098	50 10	124	21 48	164	31 54	215	36 57	257	46 03	322
232	34 24	057	24 10	099	50 48	125	22 00	165	31 28	216	36 12	258	45 34	322
233	35 02	057	24 55	100	51 25	127	22 11	166	31 01	217	35 27	259	45 06	322
234	35 41	057	25 41	100	52 01	128	22 22	167	30 33	218	34 42	259	44 38	322
235	36 20	058	26 26	101	52 37	129	22 32	168	30 04	219	33 57	260	44 09	322
236	36 59	058	27 11	102	53 13	130	22 41	169	29 35	220	33 11	261	43 41	322
237	37 38	058	27 56	102	53 47	132	22 50	170	29 06	221	32 26	262	43 13	322
238	38 17	059	28 41	103	54 21	133	22 58	171	28 35	222	31 40	262	42 44	322
239	38 56	059	29 25	104	54 54	134	23 05	172	28 04	223	30 55	263	42 16	322
	♦DENEB		ALTAIR		Nunki		♦ANTARES		ARCTURUS		♦Alkaid		Kochab	
240	39 36	059	30 10	105	12 06	140	23 11	173	59 28	235	64 59	303	54 56	352
241	40 15	060	30 54	105	12 35	141	23 16	174	58 50	236	64 21	303	54 49	351
242	40 55	060	31 38	106	13 04	142	23 21	175	58 12	237	63 42	302	54 42	351
243	41 35	060	32 23	107	13 32	143	23 25	176	57 33	239	63 03	302	54 34	351
244	42 15	061	33 06	108	13 59	144	23 28	177	56 53	240	62 24	302	54 27	350
245	42 55	061	33 50	109	14 26	144	23 30	178	56 13	241	61 45	302	54 19	350
246	43 35	061	34 33	109	14 53	145	23 32	179	55 33	242	61 06	302	54 10	349
247	44 15	061	35 17	110	15 19	146	23 33	180	54 52	243	60 27	302	54 02	349
248	44 56	062	36 00	111	15 44	147	23 33	180	54 11	244	59 48	302	53 53	349
249	45 36	062	36 42	112	16 09	148	23 32	181	53 29	246	59 09	302	53 43	348
250	46 17	062	37 25	113	16 33	148	23 30	182	52 47	247	58 29	302	53 34	348
251	46 58	063	38 07	114	16 57	149	23 28	183	52 05	248	57 50	302	53 24	347
252	47 38	063	38 49	115	17 20	150	23 25	184	51 22	249	57 11	302	53 14	347
253	48 19	063	39 31	115	17 43	151	23 21	185	50 39	250	56 32	302	53 03	347
254	49 00	063	40 12	116	18 05	152	23 16	186	49 56	251	55 53	302	52 53	346
	♦DENEB		ALTAIR		Nunki		♦ANTARES		ARCTURUS		♦Alkaid		Kochab	
255	49 41	064	40 53	117	18 26	153	23 11	187	49 13	251	55 14	302	52 42	346
256	50 23	064	41 34	118	18 47	154	23 05	188	48 29	252	54 35	302	52 30	346
257	51 04	064	42 14	119	19 07	155	22 58	189	47 45	253	53 56	302	52 19	345
258	51 45	064	42 54	120	19 27	155	22 50	190	47 01	254	53 17	302	52 07	345
259	52 27	064	43 33	121	19 45	156	22 41	191	46 17	255	52 38	302	51 55	345
260	53 08	065	44 12	122	20 03	157	22 32	192	45 32	256	51 59	302	51 43	344
261	53 50	065	44 51	123	20 21	158	22 22	193	44 47	257	51 20	302	51 31	344
262	54 31	065	45 29	124	20 38	159	22 11	194	44 03	258	50 41	302	51 18	344
263	55 13	065	46 07	126	20 54	160	22 00	195	43 18	258	50 02	303	51 05	344
264	55 55	065	46 44	127	21 09	161	21 48	196	42 33	259	49 24	303	50 52	343
265	56 37	066	47 21	128	21 24	162	21 35	197	41 47	260	48 45	303	50 39	343
266	57 19	066	47 57	129	21 38	163	21 21	198	41 02	261	48 06	303	50 25	343
267	58 01	066	48 32	130	21 51	164	21 07	199	40 17	261	47 28	303	50 12	343
268	58 43	066	49 07	131	22 04	165	20 52	200	39 31	262	46 50	303	49 58	342
269	59 25	066	49 41	133	22 16	166	20 36	201	38 46	263	46 11	304	49 44	342

LAT 40°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦Alpheratz		ALTAIR		Nunki		♦ANTARES		ARCTURUS		♦Alkaid		Kochab	
270	16 41	066	50 15	134	22 27	166	20 19	201	38 00	264	45 33	304	49 30	342
271	17 23	066	50 47	135	22 37	167	20 02	202	37 14	264	44 55	304	49 15	342
272	18 05	067	51 19	136	22 47	168	19 44	203	36 29	265	44 17	304	49 01	342
273	18 47	067	51 51	138	22 56	169	19 26	204	35 43	266	43 39	305	48 46	341
274	19 30	068	52 21	139	23 04	170	19 07	205	34 57	266	43 01	305	48 32	341
275	20 12	068	52 51	141	23 12	171	18 47	206	34 11	267	42 23	305	48 17	341
276	20 55	069	53 19	142	23 18	172	18 27	207	33 25	268	41 46	305	48 02	341
277	21 38	069	53 47	144	23 24	173	18 06	208	32 39	268	41 08	305	47 46	341
278	22 21	070	54 14	145	23 29	174	17 44	208	31 53	269	40 31	306	47 31	341
279	23 05	071	54 40	147	23 33	175	17 22	209	31 07	270	39 54	306	47 16	340
280	23 48	071	55 05	148	23 37	176	16 59	210	30 21	270	39 17	306	47 00	340
281	24 32	072	55 28	150	23 40	177	16 36	211	29 35	271	38 40	307	46 45	340
282	25 15	072	55 51	151	23 41	178	16 12	212	28 49	272	38 03	307	46 29	340
283	25 59	073	56 12	153	23 43	179	15 47	213	28 03	272	37 26	307	46 13	340
284	26 43	073	56 33	155	23 43	180	15 22	214	27 18	273	36 49	307	45 58	340
	♦Alpheratz		Enif		ALTAIR		♦Rasalhague		ARCTURUS		Alkaid		♦Kochab	
285	27 27	074	42 45	118	56 52	156	56 50	220	26 32	273	36 13	308	45 42	340
286	28 11	074	43 25	119	57 10	156	56 20	222	25 46	274	35 37	308	45 26	340
287	28 55	075	44 05	120	57 26	160	55 49	223	25 00	275	35 01	308	45 10	340
288	29 40	075	44 45	121	57 41	162	55 17	225	24 14	275	34 25	309	44 53	339
289	30 24	076	45 24	122	57 55	163	54 44	226	23 28	276	33 49	309	44 37	339
290	31 09	076	46 03	123	58 07	165	54 11	227	22 43	276	33 13	309	44 21	339
291	31 54	077	46 41	124	58 18	167	53 37	229	21 57	277	32 36	310	44 05	339
292	32 39	077	47 19	125	58 28	169	53 02	230	21 12	278	32 02	310	43 49	339
293	33 23	078	47 56	126	58 36	171	52 27	231	20 26	278	31 27	310	43 32	339
294	34 08	079	48 33	128	58 43	173	51 50	233	19 41	279	30 52	311	43 16	339
295	34 54	079	49 09	129	58 48	175	51 14	234	18 55	279	30 17	311	42 59	339
296	35 39	080	49 44	130	58 51	177	50 36	235	18 10	280	29 43	311	42 43	339
297	36 24	080	50 19	131	58 53	178	49 58	236	17 25	281	29 08	312	42 27	339
298	37 09	081	50 54	133	58 54	180	49 20	237	16 40	281	28 34	312	42 10	339
299	37 55	081	51 27	134	58 53	182	48 41	238	15 55	282	28 00	312	41 54	339
	♦Mirfak		Alpheratz		Enif		ALTAIR		Rasalhague		♦Alphecca		Kochab	
300	18 13	039	38 40	082	52 00	135	58 50	184	48 02	239	34 22	278	41 37	339
301	18 43	040	39 26	082	52 32	138	58 46	186	47 22	240	33 37	279	41 21	339
302	19 12	040	40 11	083	53 03	138	58 40	188	46 42	242	32 52	279	41 05	339
303	19 42	041	40 57	083	53 34	139	58 33	190	46 01	243	32 06	280	40 48	339
304	20 12	041	41 43	084	54 03	141	58 25	192	45 20	244	31 21	280	40 32	339
305	20 42	041	42 28	085	54 32	142	58 15	194	44 39	245	30 36	281	40 15	339
306	21 13	042	43 14	085	54 59	144	58 03	195	43 57	245	29 51	281	39 59	339
307	21 43	042	44 00	086	55 26	145	57 50	197	43 15	246	29 06	282	39 43	339
308	22 14	043	44 46	086	55 52	147	57 36	199	42 33	247	28 21	282	39 27	339
309	22 46	043	45 32	087	56 16	148	57 20	201	41 50	248	27 36	283	39 10	339
310	23 17	043	46 16	088	56 40	150	57 03	203	41 08	249	26 51	283	38 54	339
311	23 49	044	47 03	088	57 02	152	56 45	204	40 24	250	26 06	284	38 38	339
312	24 21	044	47 49	089	57 24	153	56 25	206	39 41	251	25 22	285	38 22	340
313	24 53	045	48 35	089	57 43	155	56 05	208	38 58	252	24 37	285	38 06	340
314	25 25	045	49 21	090	58 02	157	55 43	209	38 14	253	23 53	286	37 50	340
	♦Mirfak		Hamal		Diphda		♦FOMALHAUT		ALTAIR		♦VEGA		Kochab	
315	25 58	045	24 32	079	12 05	126	15 13	154	55 20	211	62 35	279	37 34	340
316	26 31	046	25 17	080	12 42	127	15 33	154	54 56	212	61 50	280	37 18	340
317	27 04	046	26 02	080	13 19	128	15 52	155	54 31	214	61 04	280	37 03	340
318	27 37	047	26 48	081	13 55	128	16 11	156	54 04	216	60 19	280	36 47	340
319	28 11	047	27 33	081	14 31	129	16 30	157	53 37	217	59 34	281	36 31	340
320	28 44	047	28 19	082	15 06	130	16 47	158	53 09	218	58 49	281	36 16	340
321	29 18	048	29 04	083	15 41	131	17 04	159	52 40	220	58 04	282	36 00	340
322	29 52	048	29 50	083	16 16	132	17 21	160	52 10	221	57 19	282	35 45	341
323	30 26	048	30 35	084	16 50	132	17 36	160	51 39	223	56 34	282	35 30	341
324	31 01	049	31 21	084	17 24	133	17 52	161	51 08	224	55 49	283	35 15	341
325	31 35	049	32 07	085	17 57	134	18 06	162	50 35	225	55 04	283	35 00	341
326	32 10	049	32 53	086	18 30	135	18 20	163	50 02	227	54 20	284	34 45	341
327	32 45	050	33 39	086	19 02	136	18 33	164	49 29	228	53 35	284	34 30	341
328	33 20	050	34 24	087	19 34	136	18 45	165	48 54	229	52 50	284	34 15	341
329	33 56	050	35 10	087	20 06	137	18 57	165	48 19	230	52 06	285	34.00	342
	♦CAPELLA		Hamal		Diphda		♦FOMALHAUT		ALTAIR		♦VEGA		Kochab	
330	16 37	043	35 56	088	20 36	138	19 08	167	47 44	231	51 21	285	33 46	342
331	17 09	044	36 42	089	21 07	139	19 18	168	47 07	233	50 37	285	33 32	342
332	17 41	044	37 28	089	21 37	140	19 28	168	46 31	234	49 53	286	33 17	342
333	18 13	045	38 14	090	22 05	141	19 36	169	45 53	235	49 09	286	33 03	342
334	18 45	045	39 00	091	22 35	142	19 45	170	45 15	236	48 25	287	32 49	342
335	19 18	045	39 46	091	23 03	143	19 52	171	44 37	237	47 41	287	32 35	343
336	19 51	046	40 32	092	23 31	143	19 59	172	43 58	238	46 57	287	32 21	343
337	20 24	046	41 18	093	23 58	144	20 05	173	43 19	239	46 13	288	32 08	343
338	20 57	047	42 04	093	24 24	145	20 10	174	42 39	240	45 29	288	31 54	343
339	21 31	047	42 50	094	24 50	146	20 14	175	41 59	241	44 46	289	31 41	343
340	22 05	048	43 35	095	25 15	147	20 18	176	41 19	242	44 02	289	31 28	343
341	22 39	048	44 21	095	25 40	148	20 21	177	40 38	243	43 19	289	31 15	344
342	23 13	049	45 07	096	26 04	149	20 23	178	39 57	244	42 35	290	31 02	344
343	23 48	049	45 53	097	26 27	150	20 25	179	39 16	245	41 52	290	30 49	344
344	24 23	049	46 38	097	26 50	151	20 26	179	38 34	246	41 09	291	30 37	344
	♦CAPELLA		ALDEBARAN		Diphda		♦FOMALHAUT		ALTAIR		♦VEGA		Kochab	
345	24 58	050	14 57	081	27 12	152	20 26	180	37 52	247	40 26	291	30 24	344
346	25 33	050	15 43	081	27 33	153	20 25	181	37 10	248	39 43	291	30 12	345
347	26 08	051	16 28	082	27 53	154	20 24	182	36 27	248	39 01	292	30 00	345
348	26 44	051	17 14	083	28 13	155	20 21	183	35 44	249	38 18	292	29 48	345
349	27 20	051	17 59	083	28 32	156	20 18	184	35 01	250	37 36	293	29 36	345
350	27 56	052	18 45	084	28 51	157	20 15	185	34 18	251	36 53	293	29 25	346
351	28 32	052	19 31	084	29 08	158	20 10	186	33 34	252	36 11	294	29 13	346
352	29 09	053	20 16	085	29 25	159	20 05	187	32 50	252	35 29	294	29 02	346
353	29 45	053	21 02	086	29 41	160	19 59	188	32 06	253	34 47	294	28 51	346
354	30 22	053	21 48	086	29 56	161	19 53	189	31 22	254	34 05	295	28 40	346
355	30 59	054	22 34	087	30 10	162	19 45	190	30 38	255	33 24	295	28 30	347
356	31 36	054	23 20	088	30 24	163	19 37	191	29 54	256	32 42	296	28 19	347
357	32 13	054	24 06	088	30 37	164	19 29	191	29 09	256	32 01	296	28 09	347
358	32 51	055	24 52	089	30 49	166	19 19	192	28 24	257	31 20	297	27 59	347
359	33 28	055	25 38	089	31 00	167	19 09	193	27 40	258	30 39	297	27 49	348

(This Worksheet must be returned with your answer book)

Candidate's Name ..... Examination Centre .....

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY - DECK OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 78 (as amended) CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

THURSDAY , 26 MARCH 2015

0915 - 1215 hrs

Examination paper inserts:

Radar Plotting Sheet Datasheets Q1(1), Q1(2) and Q1(3) Datasheet Q2 Datasheet Q4 Worksheet Q5

Notes for the guidance of candidates:

1. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
2. Non-programmable calculators may be used.
3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook Graph paper Formulae sheet	MCA Approved Extracts Nautical Tables

NAVIGATION

Attempt ALL questions
Marks for each part question are shown in brackets

All questions refer to the vessel described below.

A 1500 TEU feeder container vessel, with a service speed of 18 kts, sails on a long-term charter between Northern Europe and the Mediterranean; she is fitted with the current required
Aids to Navigation.

1. The vessel is to transit through the Straits of Gibraltar en-route to Napoli, Italy.

   (a) With reference to Datasheets Q1(1), (2) and (3):

      (i) identify the recommended route from Gibraltar Bay to Napoli, stating the waypoints and the reasons why it is recommended; (10)

      (ii) using the position of the waypoints from Q1(a)(i) calculate the course on EACH leg and the total distance from the Straits of Gibraltar to Napoli. (15)

   (b) Calculate the ETA at Napoli (Standard Time) if the vessel leaves the Straits of Gibraltar at 1830 6th June (Gibraltar Standard Time). (10)

2. Datasheet Q2 shows the extract from IMO Ships' Routeing for the Gibraltar Strait traffic separation scheme.

(a) With reference to the symbol centred at 36°00'N 005°22'W:

(i) identify the symbol; (3)

(ii) state, with reasons, the significance of the area indicated by the symbol. (7)

(b) With respect to Rule 10 of The International Regulations for Preventing Collisions at Sea 1972 (Traffic Separation Schemes), discuss fully the following proposed routes:

(i) 'A' departing Gibraltar heading West; (6)

(ii) 'B' departing Tanger heading East. (8)

(c) Outline the main objectives of IMO Ships' Routeing systems. (16)

(d) GIBREP is a mandatory reporting system for vessels transiting through the Strait of Gibraltar.

(i) Explain the purpose of such a local reporting system. (6)

(ii) State TWO other similar reporting systems. (4)

3. (a) The Maritime and Coastguard Agency issues information to the Maritime Industry in the form of Marine Notices.

(i) State the purpose of Marine Guidance Notes. (5)

(ii) Summarise the key points relating to MGN 379: Navigation: Use of Electronic Navigation Aids. (15)

(b) An Automatic Identification System (AIS) is required to be carried by vessels over 300 GT.

(i) Outline the main features of AIS. (12)

(ii) Outline the dangers of using AIS for collision avoidance. (8)

4. Prior to making landfall off Capo Spartivento in the early morning on the 11th June the Master requests the Officer of the Watch to take a star sight during evening twilight using a DR position 38°46'N 008°23'E.

(a) For the observation during evening twilight:

(i) calculate the UT of Civil Twilight; (6)

(ii) identify, using Datasheet Q4, which stars will be available for the observation; (6)

(iii) select the most suitable stars for a 4 star fix. (4)

(b) The OOW manages to make the following observations, using the DR provided, with thick cloud and a poor horizon to the south; during the observation period the vessel's course was 075°.

Time UT	Star	Azimuth	True Alt	Calc Alt
1908	Deneb	042°	12° 49.3'	13° 02.5'
1923	Vega	062°	28° 54.2'	29° 03.7'
1942	Dubhe	330°	59° 33.6'	59° 41.8'

Find the vessel's Most Probable Position at 1930 UT, assuming no random error exists. (16)

(c) Discuss the reliability of the fix obtained in Q4(b). (8)

5. On the return voyage the vessel follows the recommended route, and is approaching the rock of Gibraltar on a course of 227°T, with the intention to anchor in Gibraltar bay.

Europa Point is the southern-most point on Gibraltar and the Master has decided on a 2.5 mile cross-index range to stbd. The radar is set up on a Relative Motion ground stabilised display.

(a) When Europa Point is abeam to starboard the course is altered to 270°T for 3 miles and the course then altered 325°T for the 4 mile approach into the bay.

(i) On Worksheet Q5 draw the parallel index lines that would be required for the track to the anchorage position, as they would appear on the 6 mile range. (12)

(ii) State the range and bearing of Europa Point when the vessel is anchored. (6)

(b) Describe the precautions that should be observed prior to using parallel indexing techniques. (12)

(c) State FIVE precautions the OOW should consider for this part of the passage. (5)

LAT 39°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦ CAPELLA		ALDEBARAN		♦ Diphda		FOMALHAUT		ALTAIR		♦ VEGA		Kochab	
0	33 32	055	26 24	090	32 08	168	19 56	194	27 06	259	29 30	298	26 40	348
1	34 10	055	27 10	090	32 18	169	19 44	195	26 20	260	28 49	298	26 31	348
2	34 49	056	27 57	091	32 27	170	19 32	196	25 35	260	28 08	299	26 21	349
3	35 27	056	28 43	092	32 34	171	19 18	197	24 48	261	27 27	299	26 12	349
4	36 06	056	29 30	092	32 41	172	19 05	198	24 02	262	26 46	300	26 03	349
5	36 45	057	30 17	093	32 47	173	18 50	199	23 16	262	26 06	300	25 54	349
6	37 24	057	31 03	093	32 52	174	18 35	200	22 30	263	25 26	301	25 46	350
7	38 03	057	31 50	094	32 57	175	18 19	200	21 44	264	24 45	301	25 38	350
8	38 42	057	32 36	095	33 00	177	18 02	201	20 57	264	24 06	301	25 29	350
9	39 22	058	33 23	095	33 02	178	17 45	202	20 11	265	23 26	302	25 21	350
10	40 01	058	34 09	096	33 04	179	17 27	203	19 24	266	22 46	302	25 14	351
11	40 41	058	34 55	097	33 04	180	17 08	204	18 38	266	22 07	303	25 06	351
12	41 21	059	35 42	098	33 04	181	16 49	205	17 51	267	21 28	303	24 59	351
13	42 00	059	36 28	098	33 02	182	16 29	206	17 05	268	20 49	304	24 52	351
14	42 40	059	37 14	099	33 00	183	16 09	206	16 18	268	20 10	304	24 45	352
	♦ CAPELLA		BETELGEUSE		RIGEL		♦ Diphda		Enif		♦ DENEB		Kochab	
15	43 20	059	17 08	094	14 30	114	32 57	185	37 46	250	43 01	300	24 38	352
16	44 01	060	17 54	095	15 13	114	32 53	186	37 02	251	42 21	300	24 32	352
17	44 41	060	18 41	096	15 55	115	32 48	187	36 18	251	41 40	300	24 26	353
18	45 21	060	19 27	096	16 38	116	32 42	188	35 33	252	41 00	301	24 20	353
19	46 02	060	20 13	097	17 20	116	32 35	189	34 49	253	40 20	301	24 14	353
20	46 42	061	20 59	098	18 01	117	32 27	190	34 04	254	39 40	301	24 09	353
21	47 23	061	21 46	098	18 43	118	32 18	191	33 19	255	39 00	301	24 03	354
22	48 04	061	22 32	099	19 24	119	32 09	192	32 34	255	38 20	302	23 58	354
23	48 45	061	23 18	100	20 04	119	31 58	193	31 49	256	37 41	302	23 53	354
24	49 26	061	24 04	100	20 45	120	31 47	195	31 04	257	37 01	302	23 49	355
25	50 07	062	24 49	101	21 25	121	31 35	196	30 18	257	36 22	303	23 44	355
26	50 48	062	25 35	102	22 05	122	31 22	197	29 33	258	35 43	303	23 40	355
27	51 29	062	26 21	102	22 44	123	31 08	198	28 47	259	35 04	303	23 36	355
28	52 10	062	27 06	103	23 23	123	30 53	199	28 01	260	34 25	304	23 33	356
29	52 51	062	27 52	104	24 02	124	30 38	200	27 15	260	33 46	304	23 29	356
	♦ CAPELLA		BETELGEUSE		RIGEL		♦ Diphda		Alphecca		♦ DENEB		Kochab	
30	53 33	062	28 37	105	24 41	125	30 22	201	65 06	255	33 08	304	23 26	356
31	54 14	063	29 22	105	25 19	126	30 05	202	64 21	256	32 29	305	23 23	357
32	54 56	063	30 07	106	25 56	127	29 47	203	63 36	257	31 51	305	23 21	357
33	55 37	063	30 51	107	26 33	128	29 28	204	62 50	258	31 13	305	23 18	357
34	56 19	063	31 36	108	27 10	128	29 09	205	62 04	259	30 35	306	23 16	357
35	57 00	063	32 20	108	27 46	129	28 48	206	61 18	260	29 57	306	23 14	358
36	57 42	063	33 04	109	28 22	130	28 27	207	60 32	261	29 20	306	23 12	358
37	58 23	063	33 48	110	28 58	131	28 06	208	59 46	262	28 42	307	23 11	358
38	59 05	063	34 32	111	29 32	132	27 43	209	59 00	262	28 05	307	23 10	359
39	59 47	063	35 15	112	30 07	133	27 20	210	58 14	263	27 28	308	23 09	359
40	60 28	063	35 59	113	30 41	134	26 56	211	57 28	264	26 51	308	23 08	359
41	61 10	063	36 42	113	31 14	135	26 32	212	56 41	265	26 14	308	23 07	000
42	61 52	063	37 24	114	31 47	136	26 07	213	55 55	266	25 38	309	23 07	000
43	62 33	063	38 07	115	32 19	137	25 41	214	55 08	266	25 02	309	23 07	000
44	63 15	063	38 49	116	32 51	138	25 15	215	54 22	267	24 26	310	23 07	000
	♦ Dubhe		POLLUX		SIRIUS		♦ RIGEL		Diphda		♦ Alphecca		DENEB	
45	21 20	026	30 53	077	13 20	125	33 22	139	24 48	216	53 35	268	23 50	310
46	21 41	026	31 39	078	13 58	126	33 52	140	24 20	217	52 48	268	23 14	310
47	22 01	027	32 25	078	14 36	126	34 22	141	23 52	218	52 02	269	22 39	311
48	22 22	027	33 10	079	15 13	127	34 51	142	23 23	219	51 15	270	22 04	311
49	22 44	027	33 56	079	15 50	128	35 19	143	22 54	219	50 29	270	21 29	312
50	23 05	028	34 42	080	16 27	129	35 47	144	22 24	220	49 42	271	20 54	312
51	23 27	028	35 28	081	17 03	129	36 14	145	21 53	221	48 55	271	20 19	313
52	23 49	028	36 14	081	17 39	130	36 40	146	21 22	222	48 09	272	19 45	313
53	24 11	029	37 00	082	18 14	131	37 06	147	20 51	223	47 22	273	19 11	313
54	24 33	029	37 46	082	18 49	132	37 30	149	20 19	224	46 36	273	18 37	314
55	24 56	029	38 32	083	19 24	133	37 54	150	19 46	225	45 49	274	18 04	314
56	25 19	030	39 19	083	19 58	133	38 18	151	19 14	225	45 03	274	17 31	315
57	25 42	030	40 05	084	20 31	134	38 40	152	18 40	226	44 16	275	16 58	315
58	26 05	030	40 51	084	21 05	135	39 01	153	18 06	227	43 30	275	16 25	316
59	26 29	030	41 38	085	21 37	136	39 22	154	17 32	228	42 43	276	15 52	316
	♦ Dubhe		POLLUX		PROCYON		♦ SIRIUS		RIGEL		♦ Hamal		Schedar	
60	26 52	031	42 24	085	30 06	110	22 09	137	39 42	156	61 38	245	53 19	315
61	27 16	031	43 11	086	30 49	110	22 41	138	40 01	157	60 55	246	52 46	315
62	27 40	031	43 57	087	31 33	111	23 12	139	40 19	158	60 12	248	52 13	315
63	28 05	032	44 44	087	32 16	112	23 43	139	40 35	159	59 29	249	51 40	315
64	28 29	032	45 30	088	33 00	113	24 13	140	40 52	161	58 45	250	51 07	315
65	28 54	032	46 17	088	33 42	114	24 42	141	41 07	162	58 01	251	50 34	315
66	29 19	032	47 04	089	34 25	114	25 11	142	41 21	163	57 17	252	50 01	315
67	29 44	033	47 50	090	35 07	115	25 39	143	41 34	164	56 33	253	49 28	315
68	30 09	033	48 37	090	35 49	116	26 07	144	41 46	166	55 48	254	48 55	315
69	30 34	033	49 24	091	36 31	117	26 34	145	41 57	167	55 03	255	48 22	315
70	31 00	033	50 10	092	37 12	118	27 00	146	42 07	168	54 18	256	47 49	315
71	31 26	034	50 57	092	37 53	119	27 26	147	42 16	170	53 33	257	47 16	315
72	31 52	034	51 43	093	38 34	120	27 51	148	42 24	171	52 47	257	46 43	315
73	32 18	034	52 30	094	39 14	121	28 16	149	42 30	172	52 02	258	46 10	315
74	32 44	034	53 16	094	39 54	122	28 40	150	42 36	174	51 16	259	45 37	315
	♦ Dubhe		POLLUX		PROCYON		♦ SIRIUS		RIGEL		♦ Hamal		Schedar	
75	33 10	034	54 03	095	40 34	123	29 03	151	42 41	175	50 30	260	45 04	315
76	33 37	035	54 49	096	41 13	124	29 25	152	42 44	176	49 44	261	44 31	315
77	34 03	035	55 36	097	41 51	125	29 47	153	42 47	178	48 58	261	43 59	315
78	34 30	035	56 22	097	42 29	126	30 08	154	42 48	179	48 12	262	43 26	315
79	34 57	035	57 08	098	43 07	127	30 28	155	42 49	180	47 26	263	42 53	316
80	35 24	035	57 54	099	43 44	128	30 47	156	42 48	182	46 40	264	42 21	316
81	35 51	036	58 40	100	44 21	129	31 06	157	42 46	183	45 53	264	41 48	316
82	36 18	036	59 26	101	44 57	130	31 23	158	42 43	184	45 07	265	41 16	316
83	36 46	036	60 12	101	45 32	131	31 40	159	42 39	186	44 20	266	40 43	316
84	37 13	036	60 58	102	46 07	132	31 56	160	42 33	187	43 34	266	40 11	316
85	37 41	036	61 43	103	46 41	134	32 12	161	42 27	188	42 47	267	39 39	316
86	38 08	036	62 28	104	47 14	135	32 26	162	42 20	190	42 01	268	39 07	317
87	38 36	037	63 13	105	47 47	136	32 40	164	42 11	191	41 14	268	38 35	317
88	39 04	037	63 58	106	48 19	137	32 53	165	42 02	192	40 27	269	38 03	317
89	39 32	037	64 43	107	48 51	139	33 04	166	41 52	194	39 41	270	37 31	317

LAT 39°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦ Dubhe		REGULUS		PROCYON		♦ SIRIUS		RIGEL		ALDEBARAN		♦ Mirfak	
90	40 00	037	28 58	098	49 21	140	33 15	167	41 40	195	61 04	225	60 40	305
91	40 28	037	29 44	099	49 51	141	33 26	168	41 27	196	60 30	227	60 02	304
92	40 56	037	30 30	100	50 19	143	33 35	169	41 14	198	59 56	228	59 23	304
93	41 24	037	31 16	100	50 47	144	33 43	170	40 59	199	59 21	230	58 45	304
94	41 52	037	32 02	101	51 14	145	33 50	171	40 44	200	58 45	231	58 06	304
95	42 20	037	32 47	102	51 40	147	33 57	173	40 27	201	58 09	232	57 28	304
96	42 49	037	33 33	103	52 06	148	34 02	174	40 10	203	57 31	234	56 49	304
97	43 17	037	34 19	103	52 30	150	34 07	175	39 51	204	56 53	235	56 11	304
98	43 45	038	35 04	104	52 53	151	34 11	176	39 32	205	56 15	236	55 32	304
99	44 14	038	35 49	105	53 14	153	34 13	177	39 12	206	55 36	238	54 53	304
100	44 42	038	36 34	106	53 35	154	34 15	178	38 51	207	54 56	239	54 15	304
101	45 11	038	37 19	106	53 55	156	34 16	180	38 29	209	54 16	240	53 36	304
102	45 39	038	38 03	107	54 13	158	34 16	181	38 06	210	53 35	241	52 57	304
103	46 08	038	38 48	108	54 30	159	34 15	182	37 43	211	52 54	242	52 19	304
104	46 36	038	39 32	109	54 46	161	34 13	183	37 18	212	52 13	243	51 40	304
	♦ Kochab		Denebola		♦ REGULUS		SIRIUS		RIGEL		♦ ALDEBARAN		CAPELLA	
105	30 26	016	22 40	089	40 16	110	34 10	184	36 53	213	51 31	245	69 57	299
106	30 39	017	23 26	090	41 00	111	34 06	185	36 27	214	50 48	246	69 16	298
107	30 52	017	24 13	091	41 43	111	34 01	186	36 01	215	50 06	247	68 35	298
108	31 06	017	25 00	091	42 27	112	33 56	188	35 33	216	49 23	248	67 54	298
109	31 19	017	25 46	092	43 10	113	33 49	189	35 05	218	48 40	249	67 12	298
110	31 33	017	26 33	093	43 52	114	33 41	190	34 37	219	47 56	249	66 31	297
111	31 47	017	27 19	093	44 35	115	33 33	191	34 07	220	47 12	250	65 49	297
112	32 01	018	28 06	094	45 17	116	33 24	192	33 37	221	46 28	251	65 08	297
113	32 15	018	28 53	094	45 58	117	33 13	193	33 06	222	45 44	252	64 26	297
114	32 30	018	29 39	095	46 40	118	33 02	194	32 35	223	44 59	253	63 45	297
115	32 44	018	30 25	096	47 21	119	32 50	196	32 03	224	44 15	254	63 03	297
116	32 58	018	31 12	097	48 01	120	32 37	197	31 31	225	43 30	255	62 21	297
117	33 13	018	31 58	097	48 41	121	32 23	198	30 58	226	42 45	256	61 40	297
118	33 28	019	32 44	098	49 21	122	32 09	199	30 24	227	42 00	256	60 58	297
119	33 43	019	33 30	099	50 00	123	31 53	200	29 50	227	41 14	257	60 16	297
	♦ Kochab		Dubhe		♦ REGULUS		SIRIUS		RIGEL		♦ ALDEBARAN		CAPELLA	
120	33 58	019	34 16	099	50 39	125	31 37	201	29 15	228	40 29	258	59 35	297
121	34 13	019	35 02	100	51 17	126	31 20	202	28 40	229	39 43	259	58 53	297
122	34 28	019	35 48	101	51 54	127	31 02	203	28 05	230	38 57	259	58 11	297
123	34 43	019	36 34	101	52 31	128	30 43	204	27 29	231	38 11	260	57 30	297
124	34 58	019	37 20	102	53 07	130	30 24	205	26 52	232	37 25	261	56 48	297
125	35 14	019	38 05	103	53 43	131	30 03	206	26 15	233	36 39	262	56 07	297
126	35 29	020	38 51	104	54 18	132	29 42	207	25 38	234	35 53	262	55 25	297
127	35 45	020	39 36	105	54 52	134	29 20	208	25 00	235	35 07	263	54 44	297
128	36 01	020	40 21	105	55 26	135	28 58	209	24 22	235	34 21	264	54 02	297
129	36 17	020	41 06	106	55 58	136	28 35	210	23 43	236	33 34	264	53 21	298
130	36 32	020	41 50	107	56 30	138	28 11	211	23 04	237	32 48	265	52 40	298
131	36 48	020	42 35	108	57 01	139	27 46	212	22 25	238	32 01	266	51 58	298
132	37 04	020	43 19	109	57 30	141	27 21	213	21 45	239	31 15	266	51 17	298
133	37 20	020	44 03	110	57 59	143	26 55	214	21 05	239	30 28	267	50 36	298
134	37 36	020	44 47	110	58 27	144	26 29	215	20 25	240	29 42	268	49 55	298
	Kochab		♦ ARCTURUS		SPICA		REGULUS		♦ SIRIUS		BETELGEUSE		♦ CAPELLA	
135	37 52	020	20 14	081	10 31	114	58 54	146	26 01	216	38 01	245	49 14	299
136	38 09	020	21 01	082	11 13	115	59 19	148	25 34	217	37 18	246	48 33	299
137	38 25	020	21 47	082	11 56	115	59 44	149	25 05	218	36 35	247	47 52	299
138	38 41	020	22 33	083	12 38	116	60 07	151	24 36	219	35 52	248	47 12	299
139	38 57	020	23 19	084	13 19	117	60 29	153	24 07	220	35 09	248	46 31	299
140	39 14	021	24 06	084	14 01	117	60 49	155	23 36	221	34 26	249	45 50	300
141	39 30	021	24 52	085	14 42	118	61 08	157	23 06	222	33 42	250	45 10	300
142	39 46	021	25 39	085	15 23	119	61 26	159	22 35	222	32 58	251	44 29	300
143	40 03	021	26 25	086	16 04	120	61 42	161	22 03	223	32 14	252	43 49	300
144	40 19	021	27 12	087	16 44	120	61 57	163	21 31	224	31 30	252	43 09	301
145	40 36	021	27 58	087	17 24	121	62 10	165	20 58	225	30 45	253	42 29	301
146	40 52	021	28 45	088	18 04	122	62 22	167	20 25	226	30 00	254	41 49	301
147	41 09	021	29 31	089	18 44	123	62 31	169	19 51	227	29 15	255	41 09	301
148	41 25	021	30 18	089	19 23	123	62 40	171	19 17	227	28 30	255	40 29	302
149	41 41	021	31 05	090	20 01	124	62 46	173	18 42	228	27 45	256	39 50	302
	♦ Kochab		ARCTURUS		♦ SPICA		REGULUS		PROCYON		♦ POLLUX		CAPELLA	
150	41 58	021	31 51	090	20 40	125	62 51	175	43 41	232	60 10	259	39 10	302
151	42 14	021	32 38	091	21 18	126	62 54	177	43 04	233	59 25	259	38 31	303
152	42 30	021	33 25	092	21 56	127	62 55	180	42 26	234	58 39	260	37 52	303
153	42 47	020	34 11	092	22 33	127	62 55	182	41 48	235	57 53	261	37 13	303
154	43 03	020	34 58	093	23 10	128	62 52	184	41 09	236	57 07	262	36 34	304
155	43 19	020	35 44	094	23 46	129	62 48	186	40 30	237	56 20	263	35 55	304
156	43 36	020	36 31	094	24 22	130	62 43	188	39 51	238	55 34	264	35 16	304
157	43 52	020	37 17	095	24 58	131	62 35	190	39 11	239	54 48	264	34 38	304
158	44 08	020	38 04	096	25 33	132	62 26	192	38 31	240	54 01	265	33 59	305
159	44 24	020	38 50	096	26 07	133	62 15	194	37 50	241	53 15	266	33 21	305
160	44 40	020	39 36	097	26 41	133	62 03	196	37 09	242	52 28	266	32 43	305
161	44 56	020	40 23	098	27 15	134	61 49	198	36 27	243	51 42	267	32 05	306
162	45 12	020	41 09	098	27 48	135	61 34	200	35 46	244	50 55	268	31 27	306
163	45 27	020	41 55	099	28 21	136	61 17	202	35 04	245	50 08	268	30 50	306
164	45 43	020	42 41	100	28 53	137	60 58	204	34 21	246	49 22	269	30 13	307
	♦ Kochab		ARCTURUS		♦ SPICA		REGULUS		PROCYON		♦ POLLUX		CAPELLA	
165	45 59	019	43 27	101	29 24	138	60 38	206	33 39	246	48 35	270	29 35	307
166	46 14	019	44 12	102	29 55	139	60 17	208	32 56	247	47 49	270	28 58	308
167	46 29	019	44 58	102	30 25	140	59 54	210	32 13	248	47 02	271	28 21	308
168	46 45	019	45 44	103	30 55	141	59 31	212	31 29	249	46 15	272	27 45	308
169	47 00	019	46 29	104	31 24	142	59 06	213	30 46	250	45 29	272	27 08	309
170	47 15	019	47 14	105	31 53	143	58 39	215	30 02	251	44 42	273	26 32	309
171	47 30	019	47 59	106	32 20	144	58 12	217	29 18	251	43 56	273	25 56	309
172	47 44	018	48 44	106	32 47	145	57 44	218	28 33	252	43 09	274	25 20	310
173	47 59	018	49 29	107	33 14	146	57 14	220	27 49	253	42 23	275	24 44	310
174	48 13	018	50 13	108	33 39	147	56 44	221	27 04	254	41 36	275	24 09	311
175	48 28	018	50 57	109	34 04	148	56 13	223	26 20	254	40 50	276	23 33	311
176	48 42	018	51 41	110	34 29	149	55 40	224	25 35	255	40 03	276	22 58	311
177	48 56	017	52 25	111	34 52	150	55 07	226	24 49	256	39 17	277	22 24	312
178	49 10	017	53 08	112	35 15	151	54 34	227	24 04	256	38 31	277	21 49	312
179	49 23	017	53 51	113	35 37	153	53 59	229	23 19	257	37 45	278	21 15	313

LAT 39°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦VEGA		Alphecca		ARCTURUS		♦SPICA		REGULUS		♦POLLUX		CAPELLA	
180	17 14	054	43 52	089	54 34	114	35 58	154	53 24	230	36 58	278	20 40	313
181	17 51	054	44 38	089	55 16	115	36 18	155	52 48	231	36 12	279	20 07	314
182	18 29	055	45 25	090	55 58	116	36 37	156	52 11	232	35 26	280	19 33	314
183	19 07	055	46 12	091	56 39	118	36 56	157	51 34	234	34 40	280	19 00	314
184	19 46	056	46 58	091	57 21	119	37 13	158	50 56	235	33 54	281	18 26	315
185	20 24	056	47 45	092	58 01	120	37 30	160	50 18	236	33 09	281	17 53	315
186	21 03	056	48 31	093	58 41	121	37 46	161	49 39	237	32 23	282	17 21	316
187	21 42	057	49 18	093	59 21	123	38 01	162	48 59	238	31 37	282	16 48	316
188	22 21	057	50 04	094	60 00	124	38 15	163	48 19	239	30 52	283	16 16	317
189	23 01	058	50 51	095	60 38	125	38 28	164	47 39	240	30 06	283	15 45	317
190	23 40	058	51 37	095	61 16	127	38 40	166	46 58	241	29 21	284	15 13	318
191	24 20	059	52 24	096	61 53	128	38 51	167	46 17	242	28 36	284	14 42	318
192	25 00	059	53 10	097	62 29	130	39 01	168	45 36	243	27 51	285	14 11	319
193	25 40	060	53 56	098	63 04	132	39 11	169	44 54	244	27 06	285	13 40	319
194	26 20	060	54 43	098	63 39	133	39 19	171	44 11	245	26 21	286	13 10	320
	DENEB		♦VEGA		Alphecca		♦SPICA		REGULUS		♦POLLUX		Dubhe	
195	12 17	041	27 01	061	55 29	099	39 26	172	43 29	246	25 36	286	61 14	332
196	12 47	041	27 42	061	56 15	100	39 32	173	42 46	247	24 51	287	60 52	331
197	13 18	042	28 22	061	57 01	101	39 37	174	42 03	248	24 07	287	60 29	330
198	13 49	042	29 03	062	57 46	102	39 41	176	41 19	249	23 22	288	60 06	330
199	14 20	042	29 45	062	58 32	102	39 44	177	40 36	250	22 38	288	59 42	329
200	14 52	043	30 26	063	59 17	103	39 46	178	39 52	251	21 54	289	59 18	329
201	15 24	043	31 08	063	60 03	104	39 47	179	39 08	252	21 10	290	58 54	328
202	15 56	044	31 49	063	60 48	105	39 47	181	38 23	252	20 26	290	58 29	328
203	16 29	044	32 31	064	61 33	106	39 46	182	37 39	253	19 42	291	58 04	327
204	17 01	045	33 13	064	62 17	107	39 44	183	36 54	254	18 59	291	57 39	327
205	17 34	045	33 55	065	63 02	108	39 41	185	36 09	255	18 15	292	57 13	327
206	18 08	046	34 37	065	63 46	110	39 36	186	35 24	256	17 32	292	56 48	326
207	18 41	046	35 20	066	64 29	111	39 31	187	34 39	256	16 49	293	56 22	326
208	19 15	047	36 02	066	65 13	112	39 25	188	33 54	257	16 06	293	55 55	326
209	19 49	047	36 45	066	65 56	113	39 18	190	33 08	258	15 23	294	55 29	325
	DENEB		♦VEGA		Rasalhague		ANTARES		♦SPICA		REGULUS		♦Dubhe	
210	20 23	048	37 28	067	35 45	104	15 46	146	39 09	191	32 22	259	55 02	325
211	20 58	048	38 10	067	36 30	105	16 12	146	39 00	192	31 37	259	54 35	325
212	21 33	048	38 53	068	37 15	105	16 37	147	38 50	193	30 51	260	54 08	324
213	22 08	049	39 37	068	38 00	106	17 02	148	38 38	195	30 05	261	53 41	324
214	22 43	049	40 20	068	38 45	107	17 27	149	38 26	196	29 19	261	53 14	324
215	23 18	050	41 03	069	39 29	108	17 51	150	38 13	197	28 33	262	52 46	324
216	23 54	050	41 47	069	40 14	109	18 14	150	37 59	198	27 46	263	52 19	324
217	24 30	050	42 30	069	40 58	109	18 37	151	37 44	199	27 00	263	51 51	323
218	25 06	051	43 14	070	41 42	110	18 59	152	37 28	201	26 14	264	51 23	323
219	25 42	051	43 58	070	42 25	111	19 20	153	37 11	202	25 27	265	50 55	323
220	26 19	052	44 42	071	43 09	112	19 41	154	36 53	203	24 41	265	50 27	323
221	26 55	052	45 26	071	43 52	113	20 01	155	36 35	204	23 54	266	49 59	323
222	27 32	052	46 10	071	44 34	114	20 21	156	36 15	205	23 08	267	49 31	323
223	28 09	053	46 54	072	45 17	115	20 39	157	35 55	206	22 21	267	49 03	323
224	28 46	053	47 38	072	45 59	116	20 58	158	35 34	208	21 35	268	48 34	323
	DENEB		♦ALTAIR		Rasalhague		ANTARES		♦SPICA		Denebola		♦Dubhe	
225	29 24	054	18 55	094	46 41	117	21 15	158	35 12	209	41 41	253	48 06	323
226	30 01	054	19 41	094	47 22	118	21 32	159	34 49	210	40 56	254	47 38	322
227	30 39	054	20 28	095	48 03	119	21 48	160	34 25	211	40 11	255	47 09	322
228	31 17	055	21 14	096	48 44	120	22 03	161	34 01	212	39 26	256	46 41	322
229	31 55	055	22 01	096	49 24	121	22 18	162	33 36	213	38 41	256	46 12	322
230	32 34	055	22 47	097	50 04	122	22 32	163	33 10	214	37 55	257	45 44	322
231	33 12	056	23 33	098	50 43	123	22 45	164	32 44	215	37 10	258	45 16	322
232	33 51	056	24 19	098	51 22	124	22 58	165	32 16	216	36 24	259	44 47	322
233	34 29	056	25 05	099	52 00	126	23 09	166	31 49	217	35 38	259	44 19	322
234	35 08	057	25 51	100	52 38	127	23 20	167	31 20	218	34 53	260	43 50	322
235	35 47	057	26 37	101	53 15	128	23 31	168	30 51	219	34 07	261	43 22	323
236	36 27	057	27 23	101	53 51	129	23 40	169	30 21	220	33 20	262	42 54	323
237	37 06	058	28 09	102	54 27	131	23 49	170	29 51	221	32 34	262	42 25	323
238	37 45	058	28 54	103	55 02	132	23 57	171	29 20	222	31 48	263	41 57	323
239	38 25	058	29 40	103	55 36	133	24 04	172	28 48	223	31 02	264	41 29	323
	♦DENEB		ALTAIR		Nunki		♦ANTARES		ARCTURUS		♦Alkaid		Kochab	
240	39 05	059	30 25	104	12 52	140	24 10	173	60 02	236	64 26	305	53 56	352
241	39 45	059	31 10	105	13 22	141	24 16	174	59 23	237	63 48	304	53 49	352
242	40 25	059	31 55	106	13 51	142	24 21	175	58 44	239	63 09	304	53 42	351
243	41 05	059	32 40	106	14 20	143	24 25	176	58 04	240	62 30	304	53 35	351
244	41 45	060	33 24	107	14 48	143	24 28	177	57 23	241	61 52	304	53 28	350
245	42 25	060	34 09	108	15 15	144	24 30	178	56 42	242	61 13	303	53 20	350
246	43 06	060	34 53	109	15 42	145	24 32	179	56 00	243	60 34	303	53 11	350
247	43 46	061	35 37	110	16 09	146	24 33	180	55 18	245	59 55	303	53 03	349
248	44 27	061	36 21	110	16 34	147	24 33	180	54 36	246	59 16	303	52 54	349
249	45 08	061	37 05	111	17 00	147	24 32	181	53 53	247	58 37	303	52 45	348
250	45 49	061	37 48	112	17 25	148	24 30	182	53 10	248	57 57	303	52 35	348
251	46 29	062	38 31	113	17 49	149	24 28	183	52 27	249	57 18	303	52 25	348
252	47 11	062	39 14	114	18 12	150	24 25	184	51 44	250	56 39	303	52 15	347
253	47 52	062	39 56	115	18 35	151	24 21	185	51 00	251	56 00	303	52 05	347
254	48 33	062	40 38	116	18 58	152	24 16	186	50 16	252	55 21	303	51 54	347
	♦DENEB		ALTAIR		Nunki		♦ANTARES		ARCTURUS		♦Alkaid		Kochab	
255	49 14	062	41 20	117	19 20	153	24 10	187	49 31	253	54 42	303	51 43	346
256	49 56	063	42 02	118	19 41	153	24 04	188	48 47	253	54 03	303	51 32	346
257	50 37	063	42 43	118	20 01	154	23 57	189	48 02	254	53 23	303	51 21	346
258	51 19	063	43 24	119	20 21	155	23 49	190	47 17	255	52 44	303	51 09	345
259	52 00	063	44 04	120	20 40	156	23 40	191	46 32	256	52 05	303	50 57	345
260	52 42	063	44 44	121	20 59	157	23 31	192	45 46	257	51 26	303	50 45	345
261	53 24	064	45 24	123	21 17	158	23 21	193	45 01	258	50 47	303	50 33	345
262	54 06	064	46 03	124	21 34	159	23 10	194	44 15	258	50 08	303	50 20	344
263	54 47	064	46 41	125	21 50	160	22 58	195	43 29	259	49 30	304	50 08	344
264	55 29	064	47 19	126	22 06	161	22 45	196	42 44	260	48 51	304	49 55	344
265	56 11	064	47 57	127	22 21	162	22 32	197	41 58	261	48 12	304	49 41	343
266	56 53	064	48 34	128	22 35	163	22 18	198	41 11	261	47 33	304	49 28	343
267	57 35	064	49 10	129	22 49	164	22 03	199	40 25	262	46 55	304	49 14	343
268	58 17	065	49 46	130	23 02	164	21 48	200	39 39	263	46 16	304	49 01	343
269	59 00	065	50 21	132	23 14	165	21 32	201	38 53	264	45 38	305	48 47	343

LAT 39°N

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	♦Alpheratz		ALTAIR		Nunki		♦ANTARES		ARCTURUS		♦Alkaid		Kochab	
270	16 16	065	50 56	133	23 25	168	21 15	202	38 06	264	44 59	305	48 33	342
271	16 59	066	51 30	134	23 36	167	20 58	202	37 20	265	44 21	305	48 18	342
272	17 41	066	52 03	136	23 46	168	20 40	203	36 34	266	43 43	305	48 04	342
273	18 24	067	52 35	137	23 55	169	20 21	204	35 47	266	43 05	305	47 49	342
274	19 07	068	53 06	138	24 03	170	20 01	205	35 00	267	42 27	305	47 35	342
275	19 50	068	53 37	140	24 11	171	19 41	206	34 14	268	41 49	306	47 20	341
276	20 34	069	54 06	141	24 18	172	19 20	207	33 27	268	41 11	306	47 05	341
277	21 17	069	54 35	143	24 24	173	18 59	208	32 41	269	40 33	306	46 50	341
278	22 01	070	55 03	144	24 29	174	18 37	209	31 54	270	39 56	306	46 35	341
279	22 44	070	55 30	146	24 33	175	18 14	210	31 07	270	39 18	307	46 19	341
280	23 28	071	55 55	147	24 37	176	17 51	210	30 21	271	38 41	307	46 04	341
281	24 12	071	56 20	149	24 39	177	17 27	211	29 34	271	38 04	307	45 48	340
282	24 57	072	56 43	151	24 41	178	17 03	212	28 48	272	37 27	307	45 33	340
283	25 41	072	57 06	152	24 43	179	16 38	213	28 01	273	36 50	308	45 17	340
284	26 25	073	57 27	154	24 43	180	16 12	214	27 14	273	36 13	308	45 01	340
	♦Alpheratz		Enif		ALTAIR		♦Rasalhague		ARCTURUS		Alkaid		♦Kochab	
285	27 10	073	43 13	117	57 47	156	57 36	221	26 28	274	35 36	308	44 45	340
286	27 55	074	43 54	118	58 05	157	57 04	223	25 41	274	35 00	309	44 29	340
287	28 39	074	44 35	119	58 22	159	56 32	224	24 55	275	34 23	309	44 13	340
288	29 24	075	45 15	120	58 38	161	56 00	226	24 08	276	33 47	309	43 57	340
289	30 09	075	45 56	121	58 52	163	55 26	227	23 22	276	33 11	309	43 41	340
290	30 55	076	46 35	122	59 05	165	54 51	228	22 36	277	32 35	310	43 25	340
291	31 40	076	47 14	123	59 17	167	54 16	230	21 50	277	31 59	310	43 09	340
292	32 25	077	47 53	124	59 27	169	53 40	231	21 03	278	31 24	310	42 52	340
293	33 11	077	48 31	126	59 35	171	53 04	232	20 17	279	30 48	311	42 36	340
294	33 56	078	49 09	127	59 42	173	52 26	234	19 31	279	30 13	311	42 20	339
295	34 42	078	49 46	128	59 47	174	51 49	235	18 45	280	29 38	311	42 03	339
296	35 28	079	50 23	129	59 51	176	51 10	236	17 59	280	29 03	312	41 47	339
297	36 13	079	50 58	130	59 53	178	50 31	237	17 13	281	28 28	312	41 31	339
298	36 59	080	51 34	132	59 54	180	49 52	238	16 28	282	27 54	312	41 14	339
299	37 45	080	52 08	133	59 53	182	49 12	239	15 42	282	27 19	313	40 58	339
	♦Mirfak		Alpheratz		♦Enif		ALTAIR		Rasalhague		♦Alphecca		Kochab	
300	17 27	039	38 31	081	52 42	134	59 50	184	48 32	240	34 14	279	40 41	339
301	17 56	039	39 17	082	53 15	136	59 46	186	47 51	241	33 28	279	40 25	339
302	18 26	040	40 03	082	53 47	137	59 40	188	47 10	242	32 42	280	40 08	339
303	18 56	040	40 50	083	54 19	138	59 32	190	46 28	243	31 56	280	39 52	339
304	19 26	041	41 36	083	54 49	140	59 23	192	45 46	244	31 10	281	39 36	339
305	19 57	041	42 22	084	55 19	141	59 13	194	45 04	245	30 24	281	39 19	339
306	20 28	042	43 09	084	55 48	143	59 01	196	44 22	246	29 39	282	39 03	340
307	20 59	042	43 55	085	56 15	144	58 47	198	43 39	247	28 53	282	38 47	340
308	21 30	042	44 41	085	56 42	146	58 32	200	42 56	248	28 07	283	38 30	340
309	22 02	043	45 28	086	57 07	148	58 16	201	42 12	249	27 22	283	38 14	340
310	22 33	043	46 14	087	57 32	149	57 59	203	41 29	250	26 37	284	37 58	340
311	23 05	044	47 01	087	57 55	151	57 40	205	40 45	251	25 52	284	37 42	340
312	23 38	044	47 48	088	58 17	153	57 19	207	40 00	252	25 06	285	37 26	340
313	24 10	044	48 34	088	58 38	154	56 58	208	39 16	252	24 21	286	37 10	340
314	24 43	045	49 21	089	58 57	156	56 35	210	38 31	253	23 37	286	36 54	340
315	25 16	045	24 20	079	12 41	126	16 07	153	56 11	212	62 25	281	36 38	340
316	25 49	045	25 06	079	13 18	127	16 27	154	55 46	213	61 39	281	36 22	340
317	26 22	046	25 52	080	13 55	128	16 47	155	55 20	215	60 53	282	36 06	340
318	26 56	046	26 38	080	14 32	128	17 06	156	54 53	216	60 08	282	35 50	340
319	27 29	047	27 24	081	15 09	129	17 25	157	54 25	218	59 22	282	35 35	340
320	28 03	047	28 10	081	15 45	130	17 43	158	53 56	219	58 36	283	35 19	341
321	28 38	047	28 56	082	16 20	131	18 00	159	53 26	221	57 51	283	35 04	341
322	29 12	048	29 42	083	16 55	131	18 17	159	52 55	222	57 06	283	34 48	341
323	29 46	048	30 29	083	17 30	132	18 33	160	52 23	224	56 20	284	34 33	341
324	30 21	048	31 15	084	18 05	133	18 48	161	51 51	225	55 35	284	34 18	341
325	30 56	049	32 01	084	18 39	134	19 03	162	51 17	226	54 50	284	34 03	341
326	31 31	049	32 48	085	19 12	135	19 17	163	50 43	227	54 05	285	33 48	341
327	32 06	049	33 34	085	19 45	135	19 30	164	50 09	229	53 20	285	33 33	341
328	32 41	049	34 21	086	20 18	136	19 43	165	49 33	230	52 35	286	33 18	342
329	33 17	050	35 07	087	20 50	137	19 55	166	48 57	231	51 50	286	33 03	342
	♦CAPELLA		Hamal		Diphda		♦FOMALHAUT		ALTAIR		♦VEGA		Kochab	
330	15 54	043	35 54	087	21 21	138	20 06	167	48 21	232	51 05	286	32 49	342
331	16 25	043	36 40	088	21 52	139	20 17	167	47 43	233	50 20	287	32 34	342
332	16 58	044	37 27	088	22 23	140	20 26	168	47 06	235	49 36	287	32 20	342
333	17 30	044	38 14	089	22 52	141	20 35	169	46 27	236	48 51	287	32 06	342
334	18 03	045	39 00	090	23 22	141	20 44	170	45 49	237	48 07	288	31 52	343
335	18 36	045	39 47	090	23 51	142	20 51	171	45 09	238	47 22	288	31 38	343
336	19 09	046	40 33	091	24 19	143	20 58	172	44 30	239	46 38	288	31 24	343
337	19 43	046	41 20	092	24 47	144	21 04	173	43 50	240	45 54	289	31 11	343
338	20 16	047	42 07	092	25 14	145	21 10	174	43 09	241	45 10	289	30 57	343
339	20 50	047	42 53	093	25 40	146	21 14	175	42 28	242	44 26	290	30 44	343
340	21 24	047	43 40	094	26 06	147	21 18	176	41 47	243	43 42	290	30 30	344
341	21 59	048	44 26	094	26 31	148	21 21	177	41 05	244	42 58	290	30 17	344
342	22 34	048	45 13	095	26 55	149	21 23	178	40 23	245	42 15	291	30 04	344
343	23 08	049	45 59	096	27 19	150	21 25	179	39 41	246	41 31	291	29 52	344
344	23 44	049	46 46	096	27 42	151	21 26	179	38 58	246	40 48	291	29 39	344
	♦CAPELLA		ALDEBARAN		Diphda		♦FOMALHAUT		ALTAIR		♦VEGA		Kochab	
345	24 19	049	14 48	081	28 05	152	21 26	180	38 15	247	40 04	292	29 26	345
346	24 54	050	15 34	081	28 26	153	21 25	181	37 32	248	39 21	292	29 14	345
347	25 30	050	16 20	082	28 47	154	21 24	182	36 49	249	38 38	293	29 02	345
348	26 06	051	17 06	082	29 08	155	21 21	183	36 05	250	37 55	293	28 50	345
349	26 42	051	17 52	083	29 27	156	21 18	184	35 21	251	37 12	293	28 38	345
350	27 19	051	18 38	084	29 46	157	21 15	185	34 37	252	36 29	294	28 27	346
351	27 55	052	19 25	084	30 04	158	21 10	186	33 53	252	35 47	294	28 15	346
352	28 32	052	20 11	085	30 21	159	21 05	187	33 08	253	35 04	295	28 04	346
353	29 09	053	20 58	085	30 37	160	20 59	188	32 23	254	34 22	295	27 53	346
354	29 46	053	21 44	086	30 53	161	20 52	189	31 39	255	33 40	295	27 42	347
355	30 23	053	22 31	087	31 08	162	20 45	190	30 54	255	32 58	296	27 31	347
356	31 01	054	23 17	087	31 21	163	20 36	191	30 08	256	32 16	296	27 21	347
357	31 38	054	24 04	088	31 34	164	20 27	192	29 23	257	31 34	297	27 10	347
358	32 16	054	24 50	088	31 47	165	20 18	192	28 38	258	30 53	297	27 00	348
359	32 54	055	25 37	089	31 58	166	20 07	193	27 52	258	30 11	297	26 50	348

PASSAGES

GENERAL INFORMATION

Detail
5.9

Passages from the Strait of Gibraltar and Bûr Sa'îd (Port Said) to principal ports in the Mediterranean Sea are given below.

Main routes through the Adriatic and Aegean Seas are given in the appropriate volumes of *Admiralty Sailing Directions*.

Dhiórix Korínthou
5.10

The saving of distance by using Dhiórix Korínthou (Corinth Canal) instead of entering the Aegean Sea through Stenó Elafonísou is most marked in the case of passages between ports in the Adriatic Sea or on the W coast of Greece and ports in the Aegean or Black Seas. To a lesser degree there is a saving of distance between Stretto di Messina and ports in the Aegean or Black Seas.

Thus the saving from:

Brindisi to Piraiévs is about 130 miles and to İstanbul about 100 miles:

Messina to Piraiévs is about 80 miles and to İstanbul about 50 miles.

For a description and for regulations regarding the canal, including pilotage, maximum permissible draughts and times of opening see *Mediterranean Pilot, Volume III* and for approaches to its SE entrance see *Mediterranean Pilot, Volume IV*.

ROUTES

Strait of Gibraltar ⇒ West part of Mediterranean Sea except south shore

Diagram 5.11

Routes
5.11

Full advantage should be taken of the E-going current by keeping well away from the Spanish coast and passing about 20 miles off Cabo de Gata (36°43′N, 2°11′W).

For ports between Barcelona and Genoa
5.11.1

Routes for ships passing N of Islas Baleares (39°45′N, 3°00′E) continue about 20 miles off the Spanish coast until departure can be taken for destination from abreast of Cabo de San Antonio (38°48′N, 0°12′E).

For Napoli
5.11.2

Routes pass close S of Capo Spartivento (38°53′N, 8°51′E) thence as navigation permits.

For Palermo or Messina
5.11.3

Routes are direct to the N coast of Sicilia, passing:

N of the dangers extending N from Îles de la Galite (37°30′N, 8°55′E) and giving Keith Reef (37°49′N, 10°55′E) a wide berth.

West part of Mediterranean Sea except south shore ⇒ Strait of Gibraltar

Diagram 5.11

5.12

All routes make Cabo de Gata (36°43′N, 2°11′W), thence follow the coast as closely as navigation permits to Strait of Gibraltar (36°00′N, 5°21′W), to avoid the full strength of the E-going current.

From Marseille or Barcelona
5.12.1

Routes make the Spanish coast at Cabo de San Antonio (38°48′N, 0°12′E) and thence follow it to Cabo de Gata (36°43′N, 2°11′W).

From North Italian ports
5.12.2

Routes passing:

N of Islas Baleares (39°45′N, 3°00′E) make the Spanish coast at Cabo de Palos (37°58′N, 0°41′W) and thence follow the coast to Cabo de Gata (36°43′N, 2°11′W).

S of Islas Baleares make Cabo de Gata direct.

From Napoli
5.12.3

Routes pass close S of Capo Spartivento (38°53′N, 8°51′E) thence as navigation permits to Cabo de Gata (36°43′N, 2°11′W).

From Messina or Palermo
5.12.4

Routes are direct to Cabo de Gata (36°43′N, 2°11′W), giving Keith Reef (37°49′N, 10°55′E) and the banks extending N from Îles de la Galite (37°30′N, 8°55′E) a wide berth.

From other ports
5.12.5

Routes are as direct as navigation permits to Cabo de Gata (36°43′N, 2°11′W).

Strait of Gibraltar ⇒ East part of Mediterranean Sea and Algerian coast

Diagram 5.11

Routes
5.13

From Strait of Gibraltar (36°00′N, 5°21′W) full advantage should be taken of the E-going current by keeping well away from the Spanish coast.

For Isola di Pantelleria
5.13.1

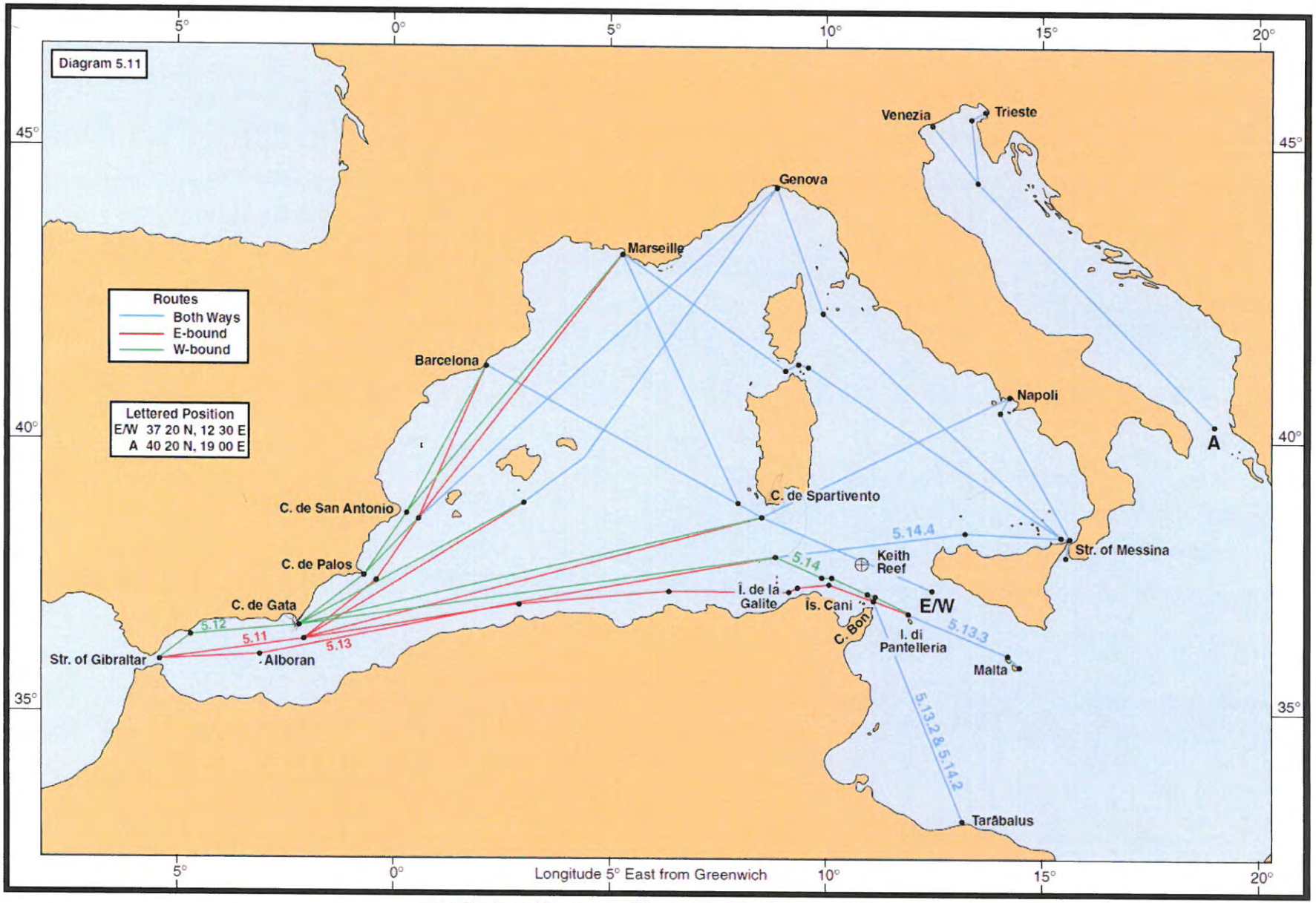
The route passes:

Ten miles N of Alborán (35°56′N, 3°02′W), thence:

Along the African coast, keeping 10 to 20 miles off the salient points, and:

Through Canal de la Galite (37°18′N, 9°00′E), passing 5 miles N of Cap Serrat (37°14′N, 9°13′E), Les Fratelli (37°18′N, 9°24′E) and Ras Ben Sekka (37°21′N, 9°45′E), thence:

Through the Traffic Separation Schemes off Îles Cani (37°21′N, 10°07′E) and Cap Bon (37°05′N, 11°03′E), thence:



5.11 Strait of Gibraltar → West part of Mediterranean Sea
5.12 West part of Mediterranean Sea → Strait of Gibraltar
5.13 Strait of Gibraltar → East part of Mediterranean Sea

Five miles N of Isola di Pantelleria (36°47′N, 12°00′E).

For North African ports depart from the above route as appropriate.

For Tarābulus

5.13.2

The route continues direct to Tarābulus (32°56′N, 13°12′E) from the end of the Traffic Separation Scheme off Cap Bon, described at 5.13.1.

For Malta

5.13.3

The route from 5 miles N of Isola di Pantelleria, described at 5.13.1, continues passing 5 miles N of Ghawdex (36°03′N, 14°15′E), thence to Malta (35°55′N, 14°33′E).

Diagram 5.14

For other destinations

5.13.4

Routes continue from 5 miles N of Isola di Pantelleria, described at 5.13.1, as direct as navigation permits to destination.

East part of Mediterranean Sea and Algerian coast ⇒ Strait of Gibraltar

Diagram 5.11

Routes

5.14

All routes make Cabo de Gata (36°43′N, 2°11′W), thence follow the coast as closely as navigation permits to Strait of Gibraltar (36°00′N, 5°21′W), to avoid the full strength of the E-going current.

From East Mediterranean ports

5.14.1

From E Mediterranean ports, except Tarābulus, routes are as navigation permits:

To a position 5 miles N of Isola di Pantelleria (36°47′N, 12°00′E), thence:

Through the Traffic Separation Schemes off Cap Bon (37°05′N, 11°03′E) and Îles Cani (37°21′N, 10°07′E) to a position 25 miles N of Îles de la Galite (37°30′N, 8°55′E), thence:

To Cabo de Gata (36°43′N, 2°11′W), avoiding the full strength of the E-going current, thence:

Along the Spanish coast to the Strait of Gibraltar (36°00′N, 5°21′W), keeping as close to the coast as navigation permits.

From Tarābulus

5.14.2

From Tarābulus (32°56′N, 13°12′E) the route is direct to join the route described at 5.14.2 at the end of the Traffic Separation Scheme, off Cap Bon (37°05′N, 11°03′E).

From Algerian coast

5.14.3

Routes join that described at 5.14.2 off Cabo de Gata (36°43′N, 2°11′W).

From Adriatic Sea or Dhiórix Korínthou

5.14.4

Slightly shorter routes are:

Through Stretto di Messina (38°12′N, 15°36′E), where a Traffic Separation Scheme is in force, thence:

Along the N coast of Sicilia, thence:

Joining route described at 5.14.2 N of Îles de la Galite (37°30′N, 8°55′E).

Routes to and from Bûr Sa'îd (Port Said)

Diagram 5.14

Routes

5.15

For descriptions of routes through the Adriatic and Aegean Seas see the appropriate volumes of *Admiralty Sailing Directions*.

5.15.1

Between places in the W part of Mediterranean Sea S and W of Barcelona (41°20′N, 2°10′E) and Bûr Sa'îd (31°21′N, 32°33′E):

E-bound routes should join the routes described at 5.13, as appropriate:

W-bound routes are as described at 5.14 until N of Îles de la Galite (37°30′N, 8°55′E), thence either:

Following that route for W ports, or:

As navigation permits to other destinations.

5.15.2

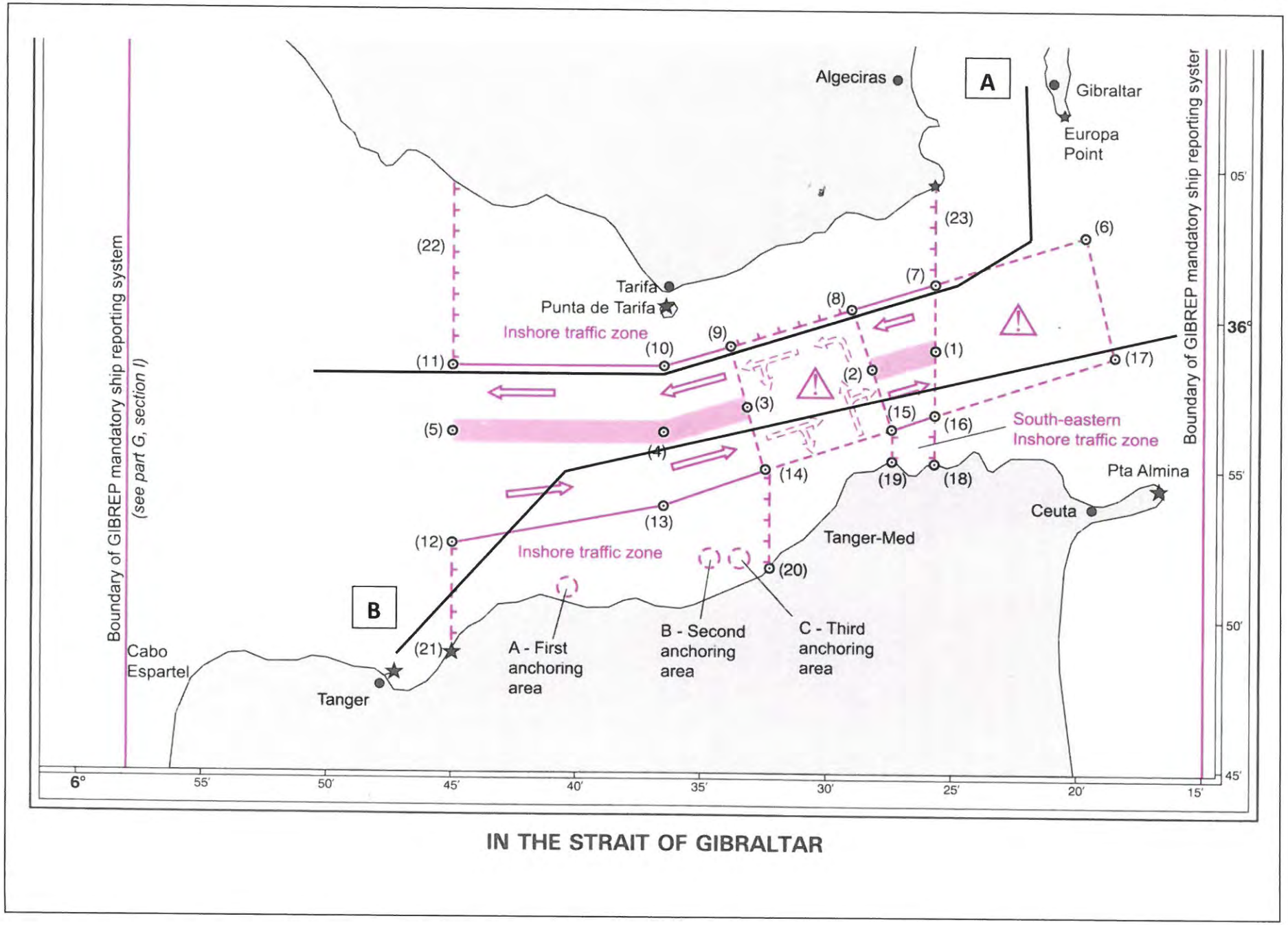
Between Bûr Sa'îd (31°21′N, 32°33′E) and other places in Mediterranean Sea, including Barcelona, routes are direct.

Distances through Mediterranean Sea

5.16

The list gives the E-bound distances. Where E-bound and W-bound routes differ appreciably in distance a note indicates the difference.

	Strait of Gibraltar	Bûr Sa'îd
Algiers (36°46′N, 3°05′E)	415	1500
Barcelona (41°20′N, 2°10′E)	525 [a]	1590 [b]
Marseille (43°18′N, 5°20′E)	705 [a]	1510 [c]
Genova (44°23′N, 8°53′E)	865 [ad]	1420
Napoli (40°50′N, 14°17′E)	980	1110
Stretto di Messina (38°12′N, 15°36′E)	1030	935
Venezia (45°24′N, 12°29′E)	1720 [ef]	1300
Trieste (45°39′N, 13°44′E)	1720 [ef]	1300
Stenó Elafonísou (36°25′N, 22°57′E)	1380 [e]	565
Piraiévs (37°56′N, 23°37′E) (via Dhiórix Korínthou)	1430 [e]	—
Piraiévs (via Aegean Sea)	1490 [e]	590
Thessaloníki (40°37′N, 22°56′E)	1700 [e]	730 [g]
Çanakkale Boğazı (SW entrance) (40°09′N, 26°24′E)	1650 [e]	650 [g]
İzmir (38°25′N, 27°00′E)	1640 [e]	610 [g]
Beirut (33°55′N, 35°31′E)	2020 [e]	220



IN THE STRAIT OF GIBRALTAR

Paper	Q.	Answer
Mar '10	**2**	a) GC Comp 2919.1nm, RL 2911.6, Diff- 7.5nm
	3	a) H.O.T – 1.2m b) 0902/ 17th March c) UKC 2.7m
Jul '10	**1**	a) (i) 2483.6 nm (ii) 3032.6 nm b) 5767.7 nm c) 22nd Jun 2259 ST
	2	a) 13th Jun 2354 UT c) 3 star solution 28° 34'.6 S 094° 35'.0 W 4 star solution 28° 32'.4 S 094° 33'.7 W
	4	a) Target "A" - 003° (T), 3'.6, 0.35nm, 31 min (0346), R 87°, 270°, 8.0 kts Target "B" - 179° (T), 3'.3, Collision, 25 min (0340), G 25°, 334°, 16.8 kts b) Set- 109° (T), Drift – 0.85 nm c) A/C 33° to STBD (348° (T)) d) a) 1.6 nm b) 0326 hrs
Nov '10	**1**	a) i) 4915.7 nm ii) 095° (T) iii) 54° 39'.3 N 138° 38'.4 W b) 24th Sep 1509
	3	a) 21st 1639 UT b) 53° 54'.9 N 163° 43'.8 W c) 194.8° (T) 9.9 knts
	5	a) 2nd 1648 c) V/L is neaped, 25th Aug PM Flood Tide
Mar '11	**1**	a) GC Dist = 3504.7 nm b) 32° 51'.5 N 076° 00'.0 W c) 0.5 nm to North
	2	a) 31° 53'.0 N 065° 22'.4 W
	5	(a) Target A 322º 13.5 1.0 0703 R 72º Target B 346º 19.2 0.7 0645 R 25º Target C 057º 9.6 0 0648 G 68º (c) 2.1 knots (d) Target A = 049º x 4.9 Target C = 318º x 4.8
Jul '11	**1**	a) GC Dist = 9237.1 nm b) Final Course 274.2° (T) c) Vertex 35° 31'.0 N 132° 28'.1 E
	2	a) P/L 162.1° to 342.1°, Int 5'.6 (Away) b) 11° 36'.0 S c) 11° 36'.0 S 121° 49'.4 W
	3	b) 128° (T), 219.4 nm
	4	a) 21st 1843 UT b) 24° 27'.6 N 166° 32'.3 E c) 265.4° (T), 32.4 knts
Nov '11	**1**	a) (i) 45° 00' S 66° 54'.2 E, 45° 00' S 140° 50'.7 E (ii) Dist = 6781.9 nm (iii) 092.4° (T), 7314.2 nm
	3	(a) Target B 356º 8.7 0.1 0535 R 65.5º Target C 057º 18.9 0.8 0540 R 29º (b) 359º (T) , 3.6 knots (c) 6.0 knots
	4	(c) (i) Between 0456 to 0524, 31st Dec (ii) 172° 59'.9
	5	(b) 19th Jan 0251

Mar '12	**1**	a) (i) GC Dist = 4560.1 nm (ii) 294.5° (T) (iii) 40° 15'.9 S 155° 36'.3 E
	5	(b) (i) Tgt A: Co 154° (T) Spd 11.5 kts (ii) Tgt B: Co 332° (T) Spd 12.5 kts (iii) Tgt C: CPA 1.8 nm TCPA 34 min (0052) Spd 25.5 kts (c) 106° (T) (e) A/C to 091° (T) A/S to 17.0 kts
Jul '12	**1**	(a) (i) 4.1m ii) 2044 hrs
	3	(a) (i) Course 158º 222º 255º Speed 10.8 15.6 7.2 (ii) CPA 0.5 0.1 0.0 TCPA 14m at 0104 21m at 0111 29m at 0119 (iii) Aspect R 61º R 44º G 145º (c) Stop vessel
	4	(c) 4237.2 nm (d) 1st 1328 ST
Dec '12	**2**	(b) Course 098º 298º 204º Speed 5.2 9.0 7.8 CPA 0.0 0.5 0.0 TCPA 23m at 0945 26m at 0948 27m at 0949 Aspect R 23º G 40½º R 34º (c) A- 0.0 kts B- 3.5 kts C- 0.0 kts
	3	(a) (i) RL- 3535.5 (ii) GC- 3464.5 (iii) 260.2º (T) (b) RL is economical by 8h 32m
	5	(a) 24.2º (T) ~ 204.2º (T) (b) 24° 21'.6 N 61° 48'.6 W (c) 3.2° E
Mar '13	**1**	(a) 7109.4 nm
	2	(a) 4.8 kts, 260º (T)
	4	(a) Between 0612 to 0639, 23rd Jun (c) Hamal/Peacock, Canopus/Enif
	5	(a) 252.9º (T) (b) 212º (T) (c) 2052 hrs
Jul '13	**1**	(b) (i) 3845.2 nm (ii) 276.4º (T) (iii) 55° 14'.9 S 72° 14'.1 W (iv) 33.1 nm
	2	(a) (i) 054º (T) (ii) 11th 0253 UT (iii) 25° 04'.0 S 137° 40'.4 W , (b) 1h 01m
Nov '13	**1**	(c) (i) GC 3258.6 RL 3315.0 Saved 56.4nm (ii) 15th 2109
	3	(a) (i) 137.9º ~ 317.9º (T) (ii) 7.3 Towards (b) (i) 30° 04'.5 S (ii) 30° 04'.5 S 003° 58'.3 W

Mar '14	**1**	(c) (i) GC 3494.8 nm (ii) 045.7° (T) (iii) 49° 52'.5 N 11° 04'.9 W
	4	(b)(i) Target 'A' Target 'C' Course 090º 108º Speed 12.5 4.3 CPA 1.4 0.6 TCPA 10m at 1758 10m at 1758 Aspect R 138º G 33º (b)(ii) Set 255º, Drift 0.6 (b)(iii) 2.5 kts
Jul '14	**1**	(b)(i) Dist 4885.1nm (ii) ETA 24th Jan 2019 ST
	3	(b) 13.6° E
Nov 14	**1**	(b) (i) Distance to consume excess tonnage 1661.2 (ii) Distance to Vertex = 1903 (iii) Shortest legal distance to Lisboa 3643.0 (iv) ETA March 12th 0138 (Standard Time)
	2	(a) (i) UT of civil twilight 0651 (ii) DR 39° 31.3'N 014°28.3'W (iii) Stars from SR table for LHA 256° Lat 40°N
March 15	**1**	(a) Route 5.11.2. Route is clear of all dangers and takes full advantage of the East Going Current WP 1 to 2 Co 081.5°T Dist 155.7 WP 2 to 3 Co 074.1°T Dist 547.4 WP 3 to 4 Co 065° T Dist 277.1 Total Distance 980.2' (b) ETA June 9th 01.57 hrs (Assumes Italy Keeping Summer Time)
	4	(a) (i) UT = 10th 19 22 hrs (ii) Stars = Deneb, Altair, Rasalhaugh, Antares, Spica, Denebola, Dubhe. (iii) Dubhe and Antares, with Denebola and Altair. (Two pairs on opposite horizons) (b) MPP = 38°44.5'N 008° 22.2'E