032 – Chief Mate

NAVIGATION

PAST PAPERS

July ‘20 – October ‘22

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –
DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 8 JULY 2020

0915 - 1215 hrs

Materials to be supplied by examination centres:

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet Nautical Almanac (Edition Sept 2011) Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Worksheet Q2 Worksheet Q5 Radar Plotting sheet

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.

2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.

3. Non-programmable calculators may be used.

4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All questions refer to a General Cargo Ship.
The ship is loading at two European ports: Antwerp, Belgium, and Oporto, Portugal.
The ship is to discharge at Charleston, U.S.A. and Georgetown, Guyana.
Voyage to be undertaken in January.
Service speed 18.0 knots.

1. The Charterer requires the fastest route between Oporto (41°12'N 8°44'W) and Charleston (32°48'N 79°50'W).

   To assist in the voyage appraisal and to determine the required ocean route to meet the Charterer's requirements, the Master requires the direct Great Circle and Rhumb Line tracks to be sketched on to the Ocean Routeing Chart.

   (a) To enable the tracks to be sketched, determine EACH the following:

   (i) the initial course of the direct Great Circle; (6)

   (ii) the final course of the direct Great Circle; (6)

   (iii) the position of the vertex of the direct Great Circle. (10)

   (b) From the Ocean Routeing Chart it is estimated that the Gulf Stream will have an average adverse effect of 1.2 knots for the Great Circle route, whereas the Rhumb Line route will only experience an average 0.5 knot adverse effect. Determine the predicted fastest route. (18)

2. Using Worksheet Q2, between the Parallels of Latitude of 60°N and 20°S, indicate EACH of the following for the month of January:

   (a) TEN predominant Currents; (10)

   (b) prevailing winds; (8)

   (c) pressure systems; (6)

   (d) recognised ice limits; (2)

   (e) potential Tropical Revolving Storm area; (2)

   (f) gale force wind area; (2)

   (g) area where restricted visibility is highly likely. (2)

3. Loading in Antwerp has been delayed due to adverse weather conditions and is now expected to be completed by 1200 hrs 5th January.

However, due to meteorological forecasts indicating low pressure and associated strong winds, the Master is concerned that, if further delays are encountered, the ship will be prevented from loading all the intended cargo as the ship will become *Neaped*.

The intended draft on departure is 7.0 m.

The Company ISM stipulates that a squat allowance of 10% of the draught must be applied for canal passages and a minimum UKC of 1.0 m must be maintained.
On departure, the ship must transit the canal locks at Boudewijnsluis (ATT Vol 1, Index No. 1539a) charted depth of 3.8 m.

(a) Determine the last predicted HW time at Boudewijnluis that will allow the ship to fully load the intended cargo. (14)

(b) The last opportunity to transit the canal at Boudewijnluis, to comply with the required ETA at Oporto, is the morning HW 9th January.

Determine the maximum draft if further adverse weather conditions delay the ship until this time. (10)

(c) Explain how each of the forecast meteorological elements; low pressure and strong winds, can influence the actual tide level in comparison to the predicted tide level. (12)

(d) Explain why the use of the Antwerp Tidal Curve may be inaccurate for the calculation of Boudewijnluis tides. (4)

4. The passage from Antwerp to Oporto requires the transit of the Dover Straits.

(a) (i) Outline the purpose and functions of the Channel Navigation Information Service (CNIS). (8)

(ii) State THREE topics about which the CNIS will transmit warnings. (6)

(b) CALDOVREP is a mandatory reporting scheme for ships over 300 grt transiting the Dover Straits.

(i) State the statutory information to be reported to CALDOVREP. (8)

(ii) State THREE sources of information regarding the requirements of CALDOVREP. (6)

(c) The meteorological forecast during the transit of the Dover Straits is N'ly winds, force 8. Heavy rain. Poor visibility. Traffic density is anticipated to be high.

Outline the bridge manning level, stating the duties of each member, for the Dover Straits transit. (12)

5. At 0912 hrs, Ship Time, 22nd January, using the GPS position of 35°35'.5N 52°55'.3W as the observation DR position, the Third Officer obtains a morning sight of the SUN.

The Third Officer's calculation gives an Intercept 12.5' Towards, Azimuth S50° W.

At 1144 hrs, Ship Time, a Meridian Passage observation of the SUN, lower limb, gave a sextant altitude 34°47.9'

Ship keeping Zone Time.
Index Error 0.2 on the arc.
Height of Observer 10.6 m.
Ship steering 260°T throughout.

(a) Determine the observed latitude of the ship at 1200 hrs Ship Time. (12)

(b) Using Worksheet Q5 Radar Plotting Sheet or other suitable means, determine the observed position of the ship at 1200 hrs Ship Time. (20)

(c) The Third Officer informs the Master that the 1200 hrs observed position is approximately 16 miles westwards of the 1200 hrs GPS position.

(i) Identify, stating reasons, the probable cause of the discrepancy between the 1200 hrs Observed and GPS positions. (6)

(ii) In light of the probable cause identified in Q5(c)(i), state any FIVE relevant points of discussion that the Master may consider necessary with the Third Officer. (10)

Chart J

80°
60°
40°
20°
0°
GREENLAND
Denmark
Strait
ICELAND
Bergen
60°
Cape Wrath
GREAT BRITAIN
Liverpool
IRELAND
Milford Haven
London
Rotterdam
FASTNET ROCK
NEWFOUNDLAND
NORTH
AMERICA
Atlantic
USHANT
EUROPE
SABLE ISLAND
New York
40°
AZORES
Gibraltar
Ocean
BERMUDA
CANARY IS.
FLORIDA
Northeast Providence
Channel
AFRICA
20°
CUBA
HAITI
CAPE
VERDE IS.
Dakar
Georgetown
0°
SOUTH
AMERICA
20°

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 19 AUGUST 2020

0915 - 1215 hrs

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Examination paper inserts:

Worksheet Q2 Datasheet Q3 Worksheet Q5

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Maritime & Coastguard Agency

SQA

NAVIGATION

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All questions refer to a 5,000 teu Container Ship. The ship is charted to sail from Brisbane, Queensland, Australia, to Seattle, Washington, USA, via Honiara, Solomon Islands.
Ship Service Speed 18.5 knots.

1. The Voyage Plan identifies:

   Brisbane to Honiara:

   30 miles of coastal passage to waypoint 27°12'S 153°36'E;
   Rhumb Line to waypoint 09°30'S 159°24'E;
   50 miles coastal passage to Honiara.

   Honiara to Seattle:
   100 miles coastal passage to waypoint 08°06'S 160°24'E;

   Great Circle to waypoint Latitude 48°30'N Longitude 124°48'W:
   160 miles coastal Passage to Seattle.

   (a) Determine the total distance of the voyage. (18)

   (b) The Chart Party requires the ship to tender a 'Notice of Readiness' at Seattle no later than 2400 hrs, Standard Time, 23rd January.

   It is estimated that 36 hours will be required for the all operations in Honiara.

   (i) Determine the latest time, Standard Time, for departure Brisbane to tender the required Notice of Readiness on arrival Seattle. (10)

   (ii) Outline whether a Great Circle, instead of the proposed Rhumb Line, from Brisbane to Honiara would offer an appreciable saving of distance. (4)

   (c) To assist in the passage across the Pacific Ocean, the ship is to be weather routed.

   Describe, with the aid of a diagram, the process for determining a 'Least Time Track'. (18)

2. At 0000 hrs (UT), 8th January, whilst on passage to Honiara, the ship is advised of a Tropical Revolving Storm (TRS) in position 12°00'S 177°00'W.

The movement of the storm centre is forecast as 260°T x 8.0 knots.

Own ship's present position: 24°00'S 154°30'E, steering 019°T.

(a) Using Worksheet Q2, plot the positions of own ship and TRS at 0000 hrs (UT) 8th January. (2)

(b) Using Worksheet Q2, plot the D.R. position of own ship at 0000 hrs (UT) 10th January and the possible area of influence of the storm for the 48 hours up to 0000 hrs (UT) 10th January. (5)

(c) Outline the meteorological and oceanographical conditions anticipated at the ship for the period from 0000 hrs (UT) 8th January to 0000 hrs (UT) 10th January. (7)

(d) The Master and the Navigating Officers meet to discuss the implications of the approaching TRS and the effect on the passage to Honiara.

State, with reasons, the actions, that a prudent Master would consider appropriate to ensure the safety of the ship. (15)

(e) Outline the contents, in relation to the TRS, of the Master's Night Order to be compiled on the evening of the 8th January. (10)

3. The International Aeronautical and Maritime Search and Rescue (IAMSAR) manual is a publication required on UK registered ships.

(a) State the means by which IAMSAR Vol III manual is made a statutory publication for UK registered ships. (4)

(b) Outline the primary purpose of the IAMSAR Vol III manual. (5)

(c) At 1800 hrs (UT) 14th January, a distress message states that a ship is being abandoned in position 08°00'N 175°15'E. The ship's personnel are taking to liferafts. It is known that the ship is equipped with enclosed liferafts, fitted with drogues.

Wind estimated as NE, Force 5.

The Ocean Routeing Chart shows the predominant current to be the North Equatorial Current at 1.8 knots.

Four ships are proceeding to the search area. The ETA of the first ship to arrive at the search area is 0600 hrs (UT) 16th January and the 3 other ships all arriving by 0900 hrs (UT) 16th January.

With reference to Datasheet Q3, determine the *datum point* of the initial search at the time that the first ship will arrive on scene. (16)

(d) State EIGHT factors when determining which of the four ships should take the role of the On Scene Coordinator. (8)

(e) State, giving reasons, which search pattern(s) would be considered the most appropriate. (6)

(f) If the initial search is unsuccessful, outline the use of EACH of the following charts to assist in the search operation:

(i) Current Rose Chart. (3)

(ii) Vector Mean Current Chart. (3)

4. (a) Outline the considerations when planning a safe landfall at the end of an ocean passage. (10)

(b) Parallel Indexing is to be used for the passage through the Admiralty Inlet.

(i) Outline the considerations when determining an appropriate reference point for the proposed index. (10)

(ii) State the precautions and checks, as outlined in current MCA guidance, regarding Navigation - Use of Electronic Navigation Aids, when using Parallel Indexing techniques. (10)

5 A ship is to make a transit of Admiralty Inlet during daylight hours on the 23rd January.

(a) Determine EACH of the following:

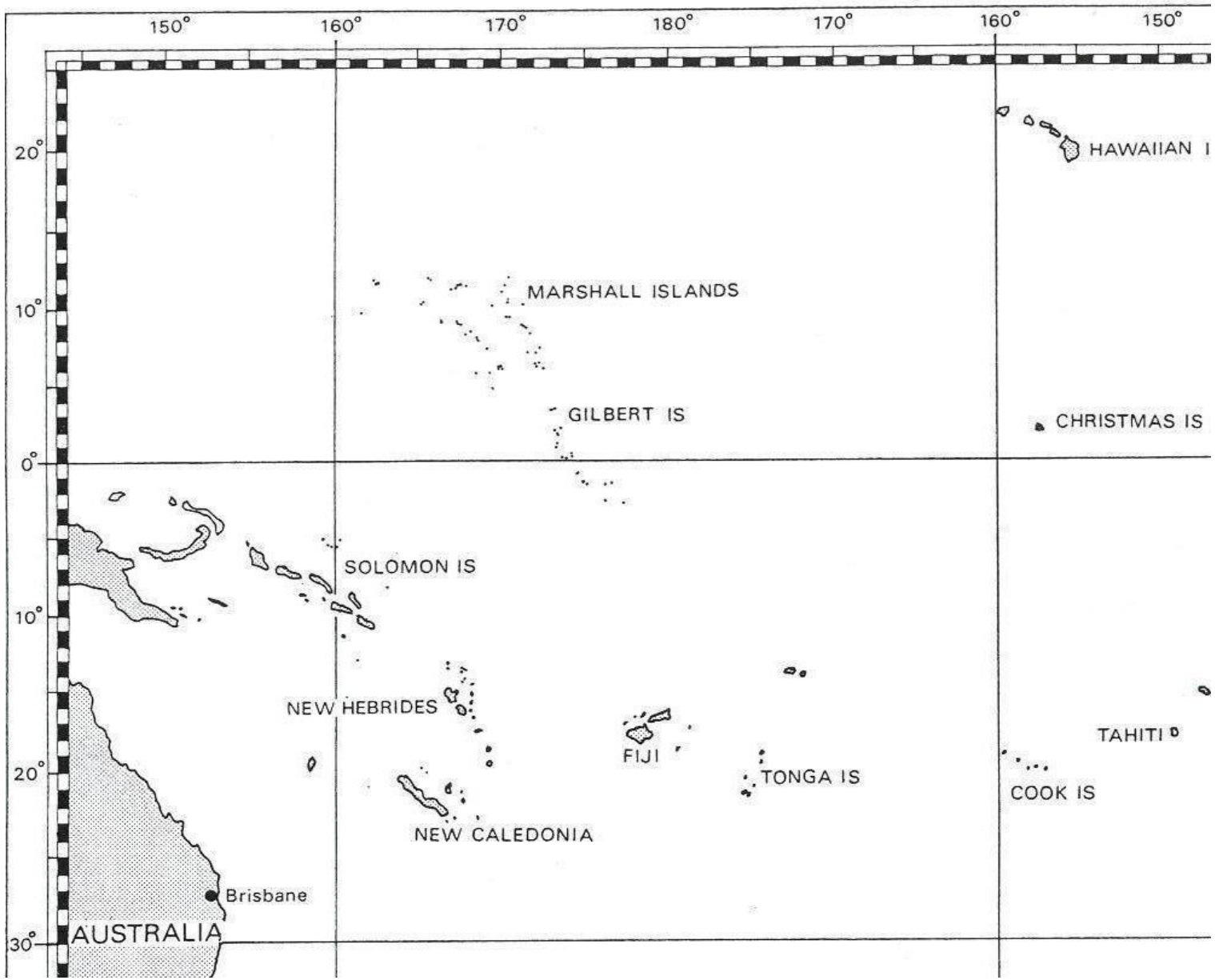
(i) the earliest time such a transit could begin; (5)

(ii) the latest time such a transit would have to be completed. (5)

(b) On Worksheet Q5, construct a Tidal Stream Curve for Admiralty Inlet for the 23rd January. (16)

(c) Due to engine problems the Master decides that the ship can only safely make the transit when the strength of the tidal stream is 1.5 knots or less.

Identify, having due regard to Q5(a) and Q5(b), the relevant periods when the ship can safely make the transit. (10)


150°
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HAWAIIAN I
MARSHALL ISLANDS
GILBERT IS
CHRISTMAS IS
SOLOMON IS
NEW HEBRIDES
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TONGA IS
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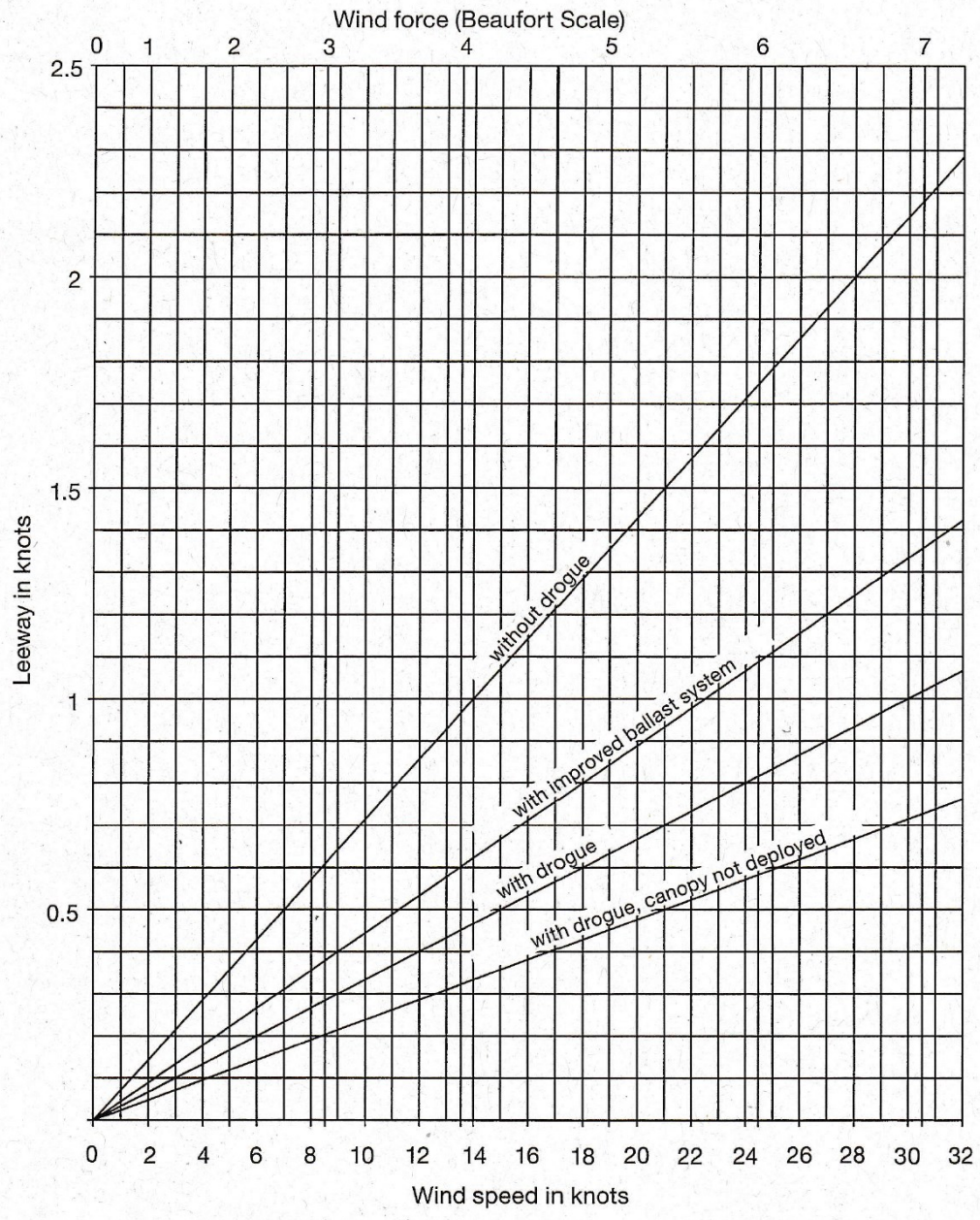
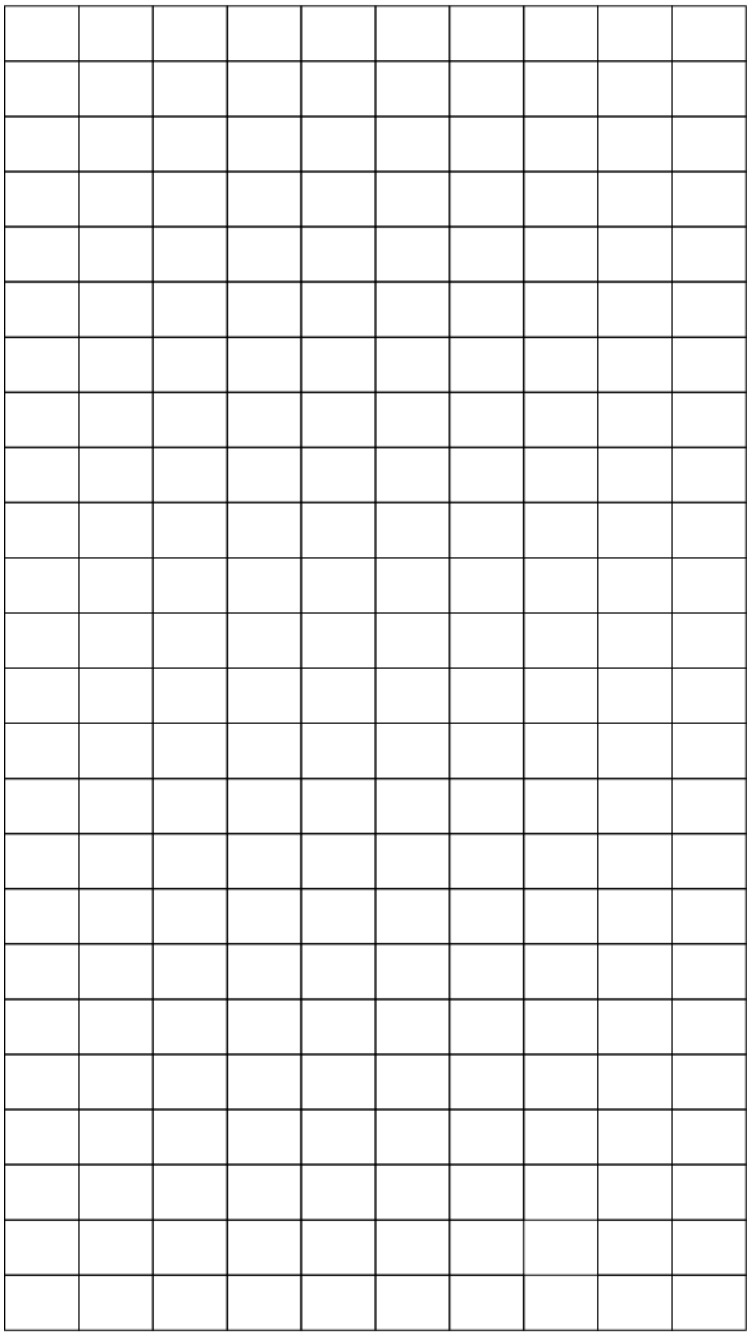
COOK IS
NEW CALEDONIA
Brisbane
AUSTRALIA



Liferaft leeway

TIDAL STREAM CURVE

Direction (-) Direction (+)



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RATE (KNOTS)

Scale to be adjusted as required

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –
DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 07 OCTOBER 2020

0915 - 1215 hrs

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Examination paper inserts:

Worksheet Q2(1) - January Worksheet Q2(2) - July Datasheet Q4 Co-Tidal Co-Range Chart Worksheet Q5

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Maritime & Coastguard Agency

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NAVIGATION

Attempt ALL questions

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All questions refer to a VLCC on a one year time charter, trading between the Persian Gulf and Japan.
Service speed 15.5 knots, fuel consumption 120 tpd.
Maximum manoeuvring speed 12.0 knots, fuel consumption 95 tpd.
Loaded Draft 18.6 m.
Ballast Draft 12.8 m.

1. An initial assessment of the passage between The Gulf and Japan shows a total distance of 7,177 miles. The total distance includes a 210 miles section of the Malacca Straits and Singapore Straits, which will be undertaken at the ship's maximum manoeuvring speed.

   (a) Find EACH of the following:

   (i) total steaming time for the passage; (4)

   (ii) total fuel consumption for the passage. (4)

   (b) It is intended to use the 'Nine Degree Channel' to pass between the Laccadive Islands and The Maldives.
   Consideration is being given to the options of using a Great Circle or a Rhumb Line ocean passage, between the Gulf of Oman and the Nine Degree Channel.

Waypoints:	Gulf of Oman	24°30'N	058°45'E
	Nine Degree Channel	09°48'N	072°05'E

   Find EACH of the following:

   (i) the saving of distance if a Great Circle route is used; (18)

   (ii) the initial course of the east bound Great Circle; (5)

   (iii) the initial course of the west bound Great Circle; (5)

   (iv) the course of the east bound rhumb line; (2)

   (v) the course of the west bound rhumb line. (2)

   (c) State, giving reasons, whether a Great Circle or a Rhumb line passage would be the most appropriate. (5)

2. The Arabian Sea and the North Indian Ocean experience significant changes of wind patterns and predominant currents during the year.

(a) Using Worksheets Q2(1) January and Q2(2) July, indicate and name EACH of the following:

(i) pressure systems; (10)

(ii) wind patterns; (8)

(iii) predominant currents. (9)

(b) Explain, in detail, how the annual change of the SUN's declination affects the predominant current direction in the Indian Ocean, North of the Equator. (13)

3. The Singapore Straits are one of the busiest shipping areas of the world. There are limited navigational waters, large vessels transit the area and there is a high density of crossing traffic.

IMO has implemented a Routeing Scheme in the area to assist in the safety of navigation.

(a) State the SEVEN objectives of an IMO Routeing Scheme. (7)

(b) Explain the practical implications, as specified in IRPCS, Rule 10, when passage planning for EACH of the following situations:

(i) a passage through the full length of a traffic lane in a Traffic Separation Scheme; (10)

(ii) a passage in the vicinity of a Traffic Separation Scheme. (4)

(c) In preparation for the 4 hour passage of the Singapore Straits, the Master conducts a Bridge Team meeting 12 hours prior to the transit. State the contents of the discussion. (10)

(d) State the Bridge duties and responsibilities of the Master immediately prior to the commencement of the transit and whilst conning the ship through the Singapore Straits. (8)

4. During an east bound, loaded passage, of the Malacca Straits the Master intends to transit the area of the 'Pyramid Shoals' (2°33'N 101°40'E) on the afternoon High Water 26th March and to commence the passage of the Singapore Straits, waypoint 1°10'N 103°30'E, at the commencement of daylight 27th March.

The Admiralty Tide Tables for Port Dickson, Malaysia, 26th March, state:

HW 1545 hrs, 2.8 m.

Ship keeping Zone Time.

Charted Depth, at position indicated on Datasheet Q4, 19.1 m.

(a) With reference to the required position, as indicated on Datasheet Q4, determine EACH of the following:

(i) the predicted time at which HW will occur (Ship's Clocks / Ship Time); (10)

(ii) the predicted UKC at the time determined in Q4(a)(i). (4)

(b) The distance from the indicated position at Pyramid Shoal to the commencement waypoint at Singapore Strait is 165 miles.

Find EACH of the following:

(i) the commencement of daylight, 27th March, at Singapore Straits (Ship's Clocks / Ship Time); (8)

(ii) the average speed required from the position indicated on Datasheet Q4 to the Singapore Straits. (4)

5. On passage from the Singapore Straits to Japan, Worksheet Q5 shows a Radar Plot.

Plot commenced at 2110 hrs and is for 12 minutes.
Radar range 12 miles.
Own ship steering 040°T at service speed.
Clear visibility.

(a) Make a full appraisal of the THREE Target Vessels at 2122 hrs. (18)

(b) At 2130 hrs the Third Officer informs the Master that a traffic situation is developing that requires the Master to immediately attend the Bridge.

(i) The Master's Standing Orders should specify the actions that the Master requires the OOW to undertake in such a developing traffic situation. In addition to calling the Master, state the other actions that the Third Officer should complete in preparation for the Master's arrival on the Bridge. (5)

(ii) On arrival on the Bridge, state the information that the Master requires from the Third Officer to assess the situation. (5)

(c) With regards to the situation at 2130 hrs, discuss EACH of the following courses of action available to the Master:

(i) a bold alteration of course to starboard; (6)

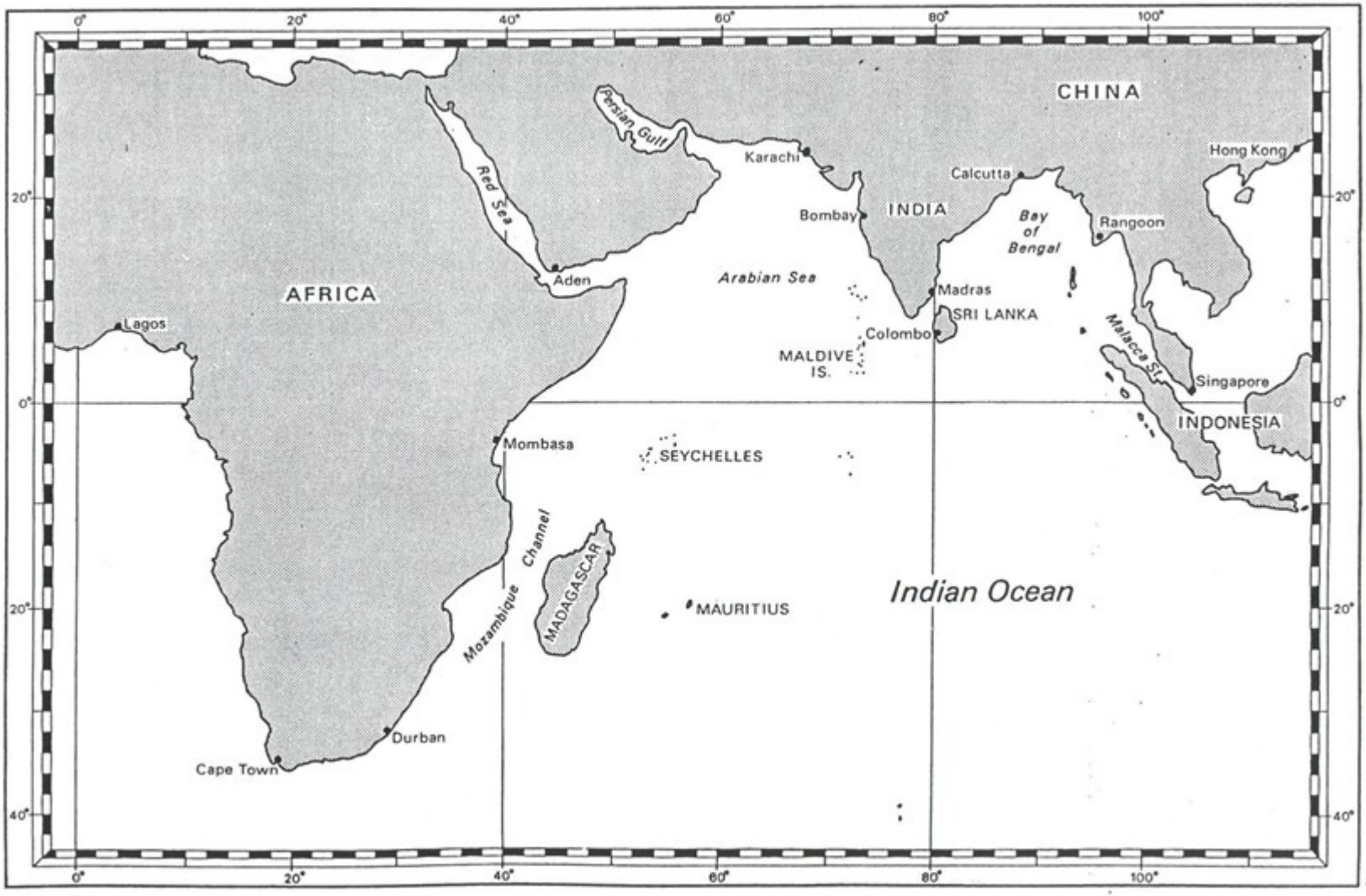
(ii) immediately taking all way off the vessel; (6)

(iii) a bold alteration of course to port. (6)

Note: Assume all actions instantaneous at 2130 hrs.

(d) With regard to Q5(c)(iii), state any justification under IRPCS for this option. (4)

Chart R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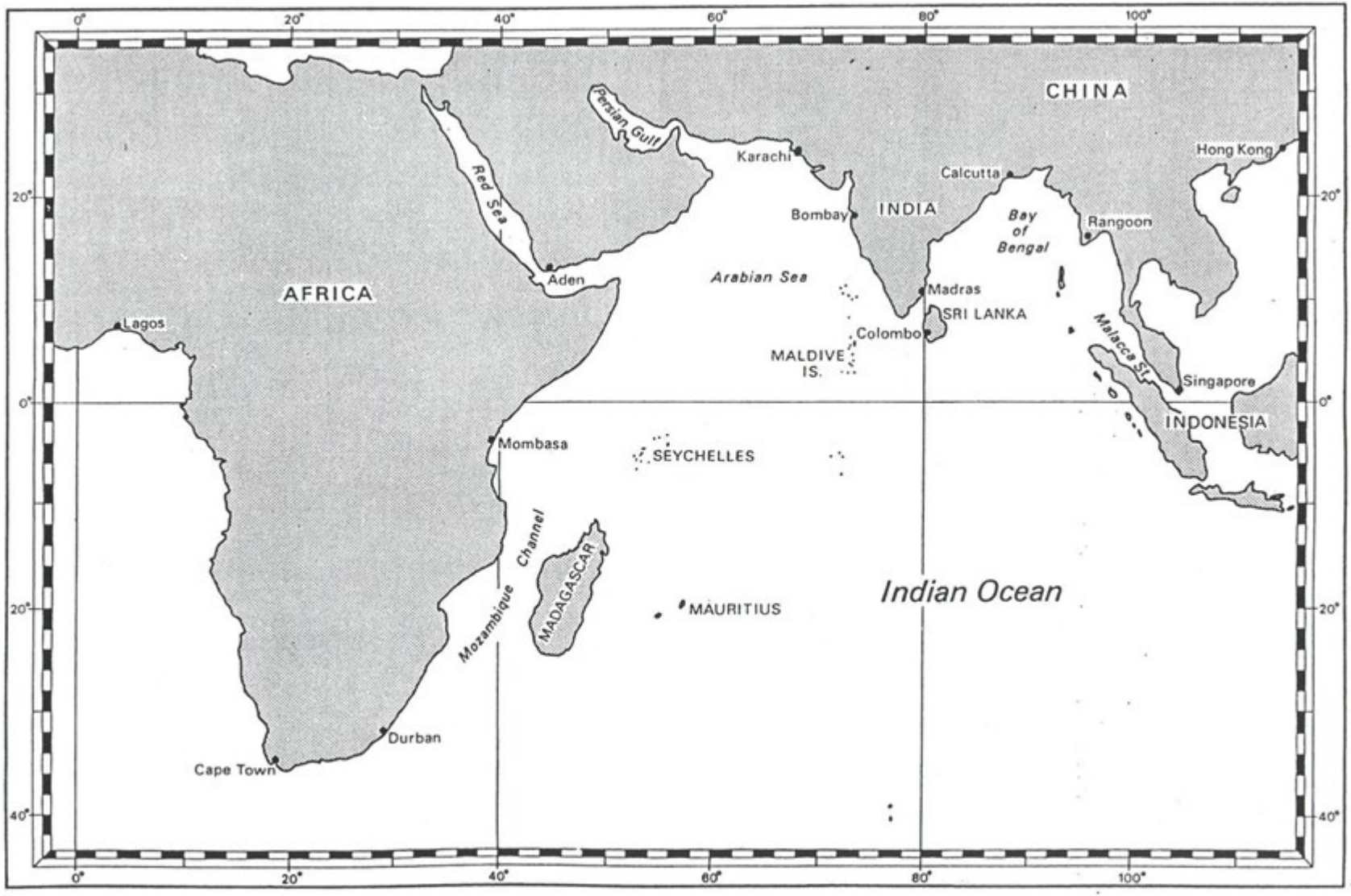
Calcutta
Karachi
Persian Gulf
Red Sea
Bombay
INDIA
Bay of Bengal
Rangoon
Aden
Arabian Sea
AFRICA
Madras
SRI LANKA
Lagos
Colombo
MALDIVE IS.
Malacca Str.
Singapore
INDONESIA
Mombasa
SEYCHELLES
Channel
MADAGASCAR
Indian Ocean
Mozambique
MAURITIUS
Durban
Cape Town

Chart R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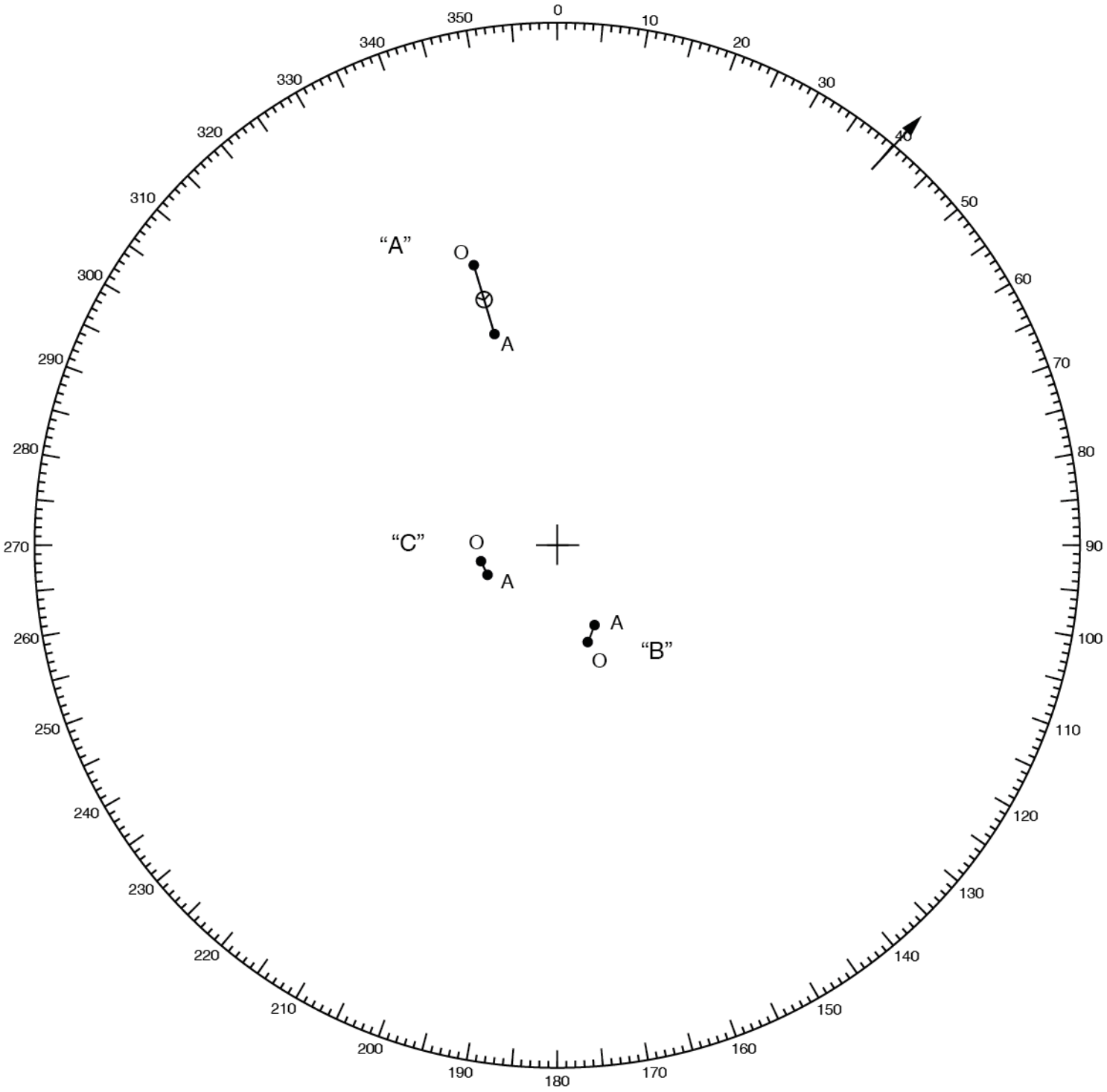
Hong Kong
Bombay
INDIA
Bay of Bengal
Rangoon
Aden
Arabian Sea
AFRICA
Madras
SRI LANKA
Lagos
Colombo
MALDIVE IS.
Malacca St.
Singapore
INDONESIA
Mombasa
SEYCHELLES
Mozambique Channel
MADAGASCAR
MAURITIUS
Indian Ocean
Durban
Cape Town

One Fathom Bank
3·6m
3·8m
South Sands
3·4m
5h30
3·2m
Required Position
Port Dickson
6h30 2.3m
Pyramid Shoal
6h
3·0m
2·8m
2·6m
6h30
2·4m
7h
2·0m
2·2m
1·8m
Raleigh Shoal
7h30
Bagan Si Api Api

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 .....

For Targets "B" and "C" the Relative Track arrows have been omitted for the clarity of the plot

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –
DECK OFFICER

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032-73 - NAVIGATION

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Examination paper inserts:

Datasheet Q2(1) Datasheet Q2(2) Datasheet Q2(3) Worksheet Q3 Radar Plotting sheet Worksheet Q4

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SQA

NAVIGATION

Attempt ALL questions

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All questions refer to 12,000 TEU container ship, on passage from Antwerp, Belgium, to Boston, USA, and Miami, USA.
Service speed 18.0 knots.

1. Prior to any sea passage, a Voyage Plan must be completed.

   (a) (i) State the means by which a Voyage Plan is a statutory requirement for the intended voyage. (4)

   (ii) State the Master's statutory obligation regarding a Voyage Plan. (5)

   (iii) Outline how the requirements of the International Safety Management Code assist in the completion of a Voyage Plan. (6)

   (b) Outline how an Ocean Routeing Chart can be used to assist in the appraisal of the intended passage. (12)

   (c) State the purpose of EACH of the following stages of a Voyage Plan, outlining the information that should be determined for EACH stage:

   (i) execution; (10)

   (ii) monitoring. (6)

2. The voyage requires a transit of the Dover Straits.

(a) Compare and contrast information shown in Tidal Stream Atlases with that available on a navigational chart by use of tidal diamond data. (10)

(b) At 0600 hrs UT the ship will commence the 3 hour, SW bound passage, of the Dover Straits at position 51°22'N 1°52'E.

The planned track is shown on Datasheets Q2(1), Q2(2) and Q2(3).

The Voyage Plan specifies that the Dover Straits passage will be at 'Full Ahead' manoeuvring speed 15.0 knots.

HW Dover 0930 hrs, Spring Tides.

With reference to Datasheets Q2(1),Q2(2) and Q2(3):

Summarise the predicted effect of the tidal stream, outlining the likely effect of the set and rate of the tidal stream on the ship, for EACH of the following periods:

(i) 0600 to 0700 hrs UT; (7)

(ii) 0700 to 0800 hrs UT; (7)

(iii) 0800 to 0900 hrs UT. (7)

(c) At 0730 hrs UT the ship is in position 51° 05'.0N 001° 30'.1E. Determine the set and rate of the predicted tidal stream at this position. (3)

3. (a) Whilst on passage across the N Atlantic Ocean the OOW obtains the following stellar observations:

Star	Ship Time	True Alt	Calc Alt	Bearing
Sirius	0602 hrs	80°44'.3	80°45'.3	045 °T
Canopus	0607 hrs	34°18'.1	34°18'.1	115 °T
Arcturus	0615 hrs	11°58'.7	11°56'.2	161 °T

The skies were clear, the ship was rolling and the horizon not distinct due to a pronounced swell and misty conditions.

The OOW used the 0600 hrs DR position 42°30'N 38°45'W for the calculations and selected 0600 hrs for the time of the ship's observed position.

Ship steering 255°T.

Using Worksheet Q3 or other suitable means, determine the 0600 hrs position. (20)

(b) At 0700 hrs the Master attends the Bridge as routine. On inspecting the star plot the Master questions the OOW.

State, outlining reasons, for EACH of the following:

(i) the suitability of the star selection; (10)

(ii) the suitability of selecting 0600 hrs as the time of the obtained position; (6)

(iii) the validity of obtaining a MPP from the plot. (4)

4. At 1200 hrs UT, 22nd September, whilst on passage from Boston to Miami, the ship is in position 39°05'N 71°02'W and making for waypoint 26°00'N 80°00'W by Rhumb Line.

The Master has been monitoring the development of a Tropical Revolving Storm, developing to the NE of the West Indies, and receives an update from the National Hurricane Centre. The storm has now developed into a category 2 storm and at 1200/22nd UT is in position 20°10'N 56°30'W.

The storm is predicted to maintain its current track of 285°T at 16.0 knots.

(a) Calculate the bearing and distance of the storm at 1200 hrs UT, 22nd September. (6)

(b) Sketch a plan view of the storm, naming all features. (10)

(c) On Worksheet Q4, plot EACH of the following:

(i) the ship's position at 1200/22nd UT and its DR positions at 1200/23 UT & 1200/24th UT; (6)

(ii) the position of the storm at 1200/22nd UT; (2)

(iii) the possible area of influence of the storm during the 48 hours up to 1200/24th UT. (6)

(d) The Master chairs a meeting with the ship's Management Level members to discuss the options in relation to the TRS. Outline the factors for EACH of the following options:

(i) the ship heading due East; (4)

(ii) the ship heading South South East; (4)

(iii) the ship continuing on the planned passage. (4)

(e) The Master has continued on the planned passage.

At 1200/23rd the National Hurricane Centre advises that the storm is now in position 21°10'N 63°30'W. The storm has increased to a category 3 storm and presently heading 280°T at 16.0 knots.

(i) State the advisability of continuing with the planned passage. (2)

(ii) Outline the reasons for answer Q4(e)(i). (6)

5. (a) Current Maritime and Coastguard Agency guidance recommends that manoeuvring information in the form of a pilot card, wheelhouse poster and manoeuvring booklet should be provided.

(i) State the purpose of the Pilot Card. (10)

(ii) State the general topics of information that should be contained in the recommended Wheelhouse Poster. (10)

(iii) State the seven sections of the Manoeuvring Booklet. (7)

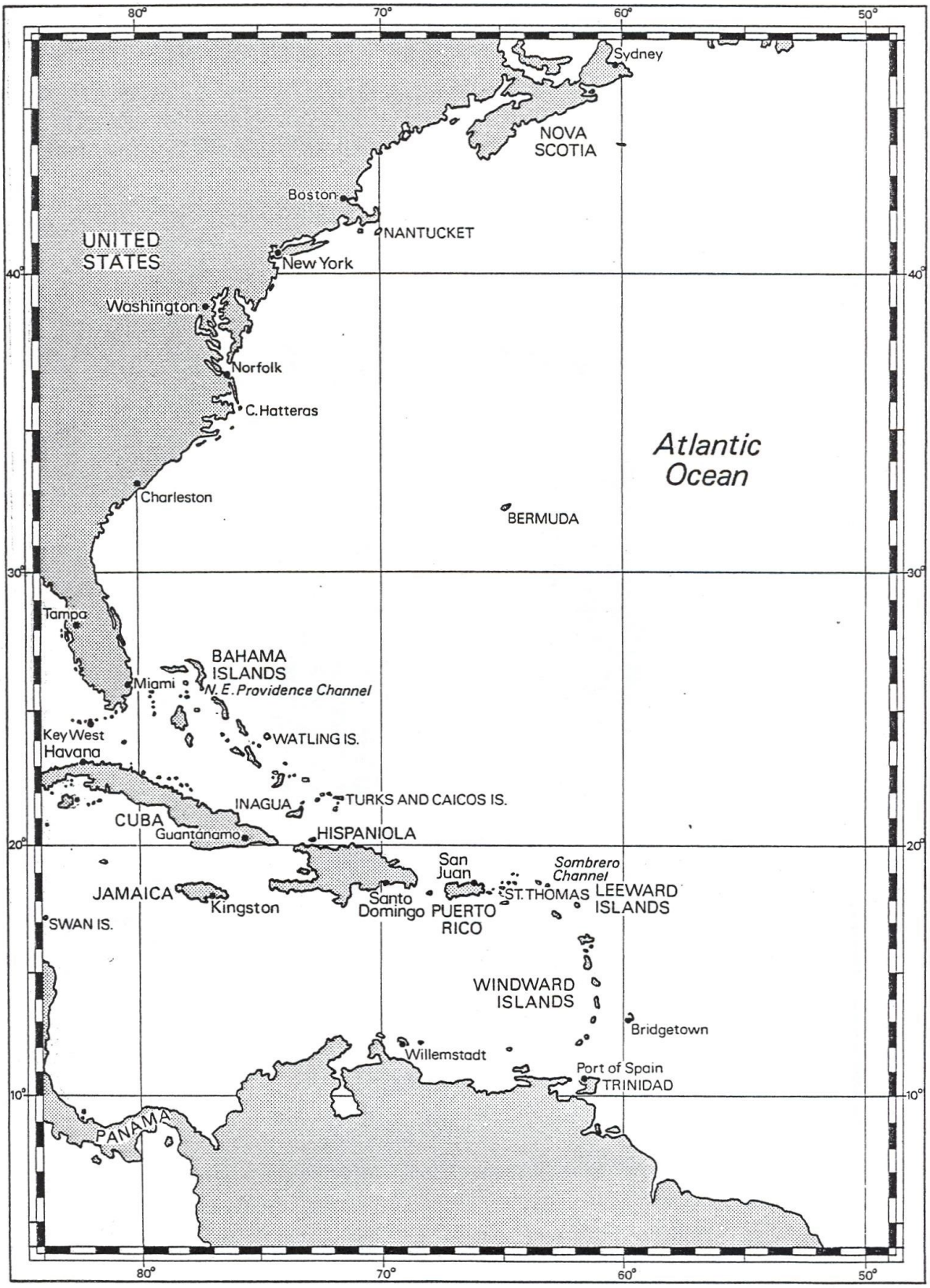
(b) Current Maritime and Coastguard Agency guidance warns of the Dangers of Interaction.

State the key points of the Maritime Guidance Note on this subject. (6)

3
BEFORE
HW DOVER
NP 249
N Foreland
Ramsgate
Deal
DOVER
S Foreland
Folkestone
Goodwin Sands
South Falls
Sandettie Bank
The Varne
Dungeness
The Ridge (Le Colbart)
Bullock Bank
Les Ridens
Cap Gris-Nez
Calais
Boulogne-sur-Mer
NP 250
11.19
13.22
14.25
12.21
15.28
12.21
13.24
18.33
10.19
18.32
16.29
08.13
07.17
15.28
06.15
15.28
19.32
10.19
16.28
04.06
19.27
14.25
14.26
14.25
12.21
20.29
07.18
05.09
03.06
05.09
14.24
16.27
03.05
04.08
01.03
02.04
1°
10'
20'
1°30'
40'
50'
20'
10'
51° 00'
50'
Longitude 1°30' East from Greenwich

2
BEFORE
HW DOVER
NP 249
N Foreland
Ramsgate
Deal
Goodwin Sands
South Falls
Sandettie Bank
S Foreland
DOVER
Folkestone
SLACK
The Varne
Dungeness
SLACK
SLACK
The Ridge
(Le Colbart)
SLACK
Bullock Bank
Les Ridens
Calais
Cap Gris-Nez
Boulogne-sur-Mer
NP 250
08.14
09.17
08.15
09.15
07.12
04.08
06.10
09.16
05.08
11.20
06.14
04.13
08.15
10.18
07.13
03.07
07.12
08.12
04.07
07.13
06.10
05.09
10.15
04.11
02.04
04.07
05.09
03.06
04.08
06.12
05.09
1°
10'
20'
1°30'
40'
50'
20'
10'
51° 00'
50'
Longitude 1°30' East from Greenwich

1 BEFORE HW DOVER
NP 249
N Foreland
Ramsgate
Deal
Goodwin Sands
South Falls
SLACK
SLACK
SLACK
Sandettie Bank
S Foreland
DOVER
Folkestone
The Varne
Dungeness
The Ridge (Le Colbart)
Bullock Bank
Les Ridens
NP 250
Calais
Cap Gris-Nez
Boulogne-sur-Mer
Longitude 1°30' East from Greenwich


80°
70°
60°
50°
40°
30°
20°
10°
Sydney
NOVA SCOTIA
Boston
NANTUCKET
UNITED STATES
New York
Washington
Norfolk
C. Hatteras
Atlantic Ocean
Charleston
BERMUDA
Tampa
BAHAMA ISLANDS
N. E. Providence Channel
Miami
Key West
Havana
WATLING IS.
INAGUA
TURKS AND CAICOS IS.
CUBA
Guantánamo
HISPANIOLA
San Juan
Sombrero Channel
JAMAICA
Kingston
Santo Domingo
PUERTO RICO
ST. THOMAS
LEEWARD ISLANDS
SWAN IS.
WINDWARD ISLANDS
Bridgetown
Willemstadt
Port of Spain
TRINIDAD
PANAMA

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY - DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 24 MARCH 2021

0915 - 1215 hrs

Materials to be supplied by examination centres:

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet Nautical Almanac (Edition Sept 2011) Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011) Graph paper

Examination paper inserts:

Datasheet Q1 Datasheet Q3 Worksheet Q4 Radar Plotting Sheet Datasheet Q5(1) Datasheet Q5(2)

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.
2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
3. Non-programmable calculators may be used.
4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets.

All questions refer to a General Cargo ship on passage from Alexander Bay, S. Africa to San Matias Gulf, Argentina.
The passage is to be undertaken during the month of July.
Service speed 14.5 knots.
Fuel consumption 38 tpd.

1. The ship is required to undertake a Composite Great Circle, limiting Latitude 40°00'S, across the S. Atlantic Ocean.

   Using ocean waypoints: Dep 28°36'S 016°38'E
   Arr 40°00'S 061°10'W

   (a) Determine EACH of the following:

   (i) the position of the vertex on the limiting latitude for the required ocean passage; (8)

   (ii) the total distance of the required ocean passage. (10)

   (b) At Alexander Bay, the ship is to load the maximum permissible cargo in relation to the International Loadline Regulations. With reference to Datasheet Q1, determine EACH of the following:

   (i) the position of the vessel when crossing into the Winter Seasonal Zone; (12)

   (ii) the total distance steamed to the position in Q1(b)(i); (7)

   (iii) the additional amount of cargo that may be loaded, beyond the ship's 'Winter' marks, in Alexander Bay whilst still ensuring the vessel is at the appropriate loadline at the position in Q1(b)(i). (5)

[OVER

2. After departure from Alexander Bay, the Master and the Bridge Team discuss the poor quality of information available for the port.

(a) State EACH of the following:

(i) the means by which the Master can provide additional and corrected information to the UKHO appertaining to the port; (3)

(ii) TEN of the topics that the UKHO specify as of interest regarding port information. (10)

(b) Whilst on passage the ship encounters a storm of force 10 for which no warning has been received. SOLAS Ch V, Regulations 31, states that the Master must communicate the information.

State EACH of the following:

(i) the information required to be communicated in the danger message; (7)

(ii) the other specified circumstances when a danger message must be communicated. (5)

3. (a) Explain EACH of the following terms:

(i) Dew Point; (4)

(ii) Relative Humidity. (4)

(b) Outline the process of the formation of EACH of the following:

(i) Advection Fog (Sea Fog); (5)

(ii) Radiation Fog (Land Fog); (5)

(iii) Sea Smoke (Frost Smoke). (5)

(c) During the S. Atlantic passage the following end of watch meteorological observations were recorded:

Time	Dry Bulb Temperature	Wet Bulb Temperature	Sea Temperature
0800 hrs	16.0°C	12.5°C	14.5°C
1200 hrs	18.0°C	13.5°C	14.0°C
1600 hrs	16.0°C	13.0°C	14.0°C
2000 hrs	13.0°C	12.0°C	13.5°C

With reference to Datasheet Q3, determine, using the appropriate method, the predicted time that fog may form. (20)

4. At 0800 hrs UT, 11th June, whilst in position 39°55'S 25°16'W a VHF Pan Pan message is received from a yacht. The yacht has been dismasted during a storm, losing its GPS aerial, navigation lights and radar reflector. The yacht crew has jury rigged sails but request immediate assistance.

The Yachtmaster states that the 0800 hrs DR position is 43°25'S 30°50'W, they are steering NW at 5.0 knots but the Westerly wind is estimated to be causing 10° of leeway.

The Master instructs the Chief Engineer to increase the ship speed to its maximum 16.0 knots.

(a) Using Worksheet Q4 or other appropriate means, determine EACH of the following:

(i) the initial bearing and distance of the yacht; (8)

(ii) the course required to rendezvous with the yacht as soon as possible (assume no leeway effect on own ship); (15)

(iii) the ETA at the rendezvous position. (5)

(b) On passage to the rendezvous, the Bridge Team are discussing the difficulties of locating the yacht due to the prevailing meteorological conditions and the yacht's unreliable navigational information.

List TEN actions that should be considered if no visual contact is made with the yacht at the estimated rendezvous time. (10)

5. Due to the deviation necessary to assist the yacht, the ocean passage plan has been amended.

The ship is now steering 290°T to the required end of ocean passage waypoint and has resumed Service Speed. The ship's clocks have been adjusted to Argentina Standard Time in preparation for port arrival.

At 2200 hrs, Ship Time, 24th June, position 41°40'S 57°55'W, the Master compiles his night orders in preparation for making landfall the following morning.

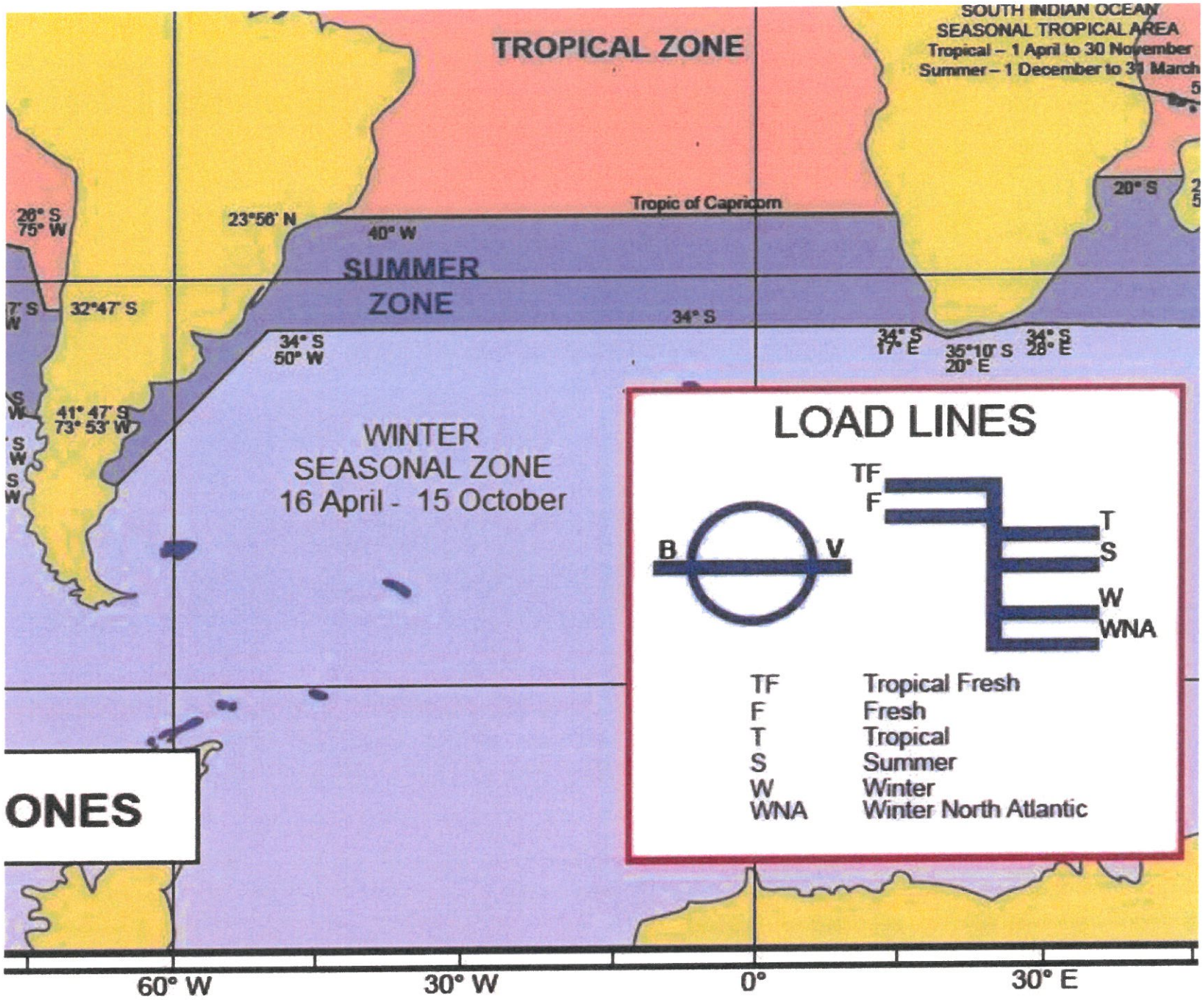
(a) State the factors and contents that the Master should consider when compiling the Night Orders for the outlined scenario. (12)

(b) The Master's Night Orders stipulate that preparations for a morning star fix are to be undertaken, in case the expected landfall has not been made.

With reference to Datasheet Q5(1) and Q5(2), determine EACH of the following:

(i) the predicted ship's time of Civil Twilight; (15)

(ii) the available stars most suited to a four star fix, stating reasons. (25)


TROPICAL ZONE
SOUTH INDIAN OCEAN
SEASONAL TROPICAL AREA
Tropical – 1 April to 30 November
Summer – 1 December to 31 March
Tropic of Capricorn
20° S
23°56' N
40° W
SUMMER
ZONE
32°47' S
34° S
34° S
50° W
34° S
17° E
35°10' S
20° E
34° S
28° E
41° 47' S
73° 53' W
WINTER
SEASONAL ZONE
16 April - 15 October
LOAD LINES
TF
F
T
S
W
WNA
B
V
TF Tropical Fresh
F Fresh
T Tropical
S Summer
W Winter
WNA Winter North Atlantic
ONES
60° W
30° W
0°
30° E

DEWPOINT (°C)

(For use with marine screen)

Dry Bulb	Depression of Wet Bulb																									Dry Bulb
°C	0°	0·2°	0·4°	0·6°	0·8°	1·0°	1·2°	1·4°	1·6°	1·8°	2·0°	2·5°	3·0°	3·5°	4·0°	4·5°	5·0°	5·5°	6·0°	6·5°	7·0°	7·5°	8·0°	8·5°	9·0°	°C
40	40	40	40	39	39	39	39	38	38	38	38	37	36	36	35	34	34	33	32	32	31	30	29	29	28	40
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18	18	18	17	17	17	16	16	16	15	15	15	14	13	12	11	10	8	7	6	4	3	1	−0	−2	−5	18
17	17	17	16	16	16	15	15	15	14	14	14	13	12	11	9	8	7	6	4	3	1	−0	−3	−5	−7	17
16	16	16	15	15	15	14	14	14	13	13	12	11	10	9	8	7	6	4	3	1	0	−2	−5	−7	−10	16
15	15	15	14	14	14	13	13	12	12	12	11	10	9	8	7	6	4	3	1	0	−2	−5	−7	−10	−14	15
14	14	14	13	13	13	12	12	11	11	11	10	9	8	7	6	4	3	1	0	−2	−4	−7	−10	−13	−18	14
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11	11	11	10	10	9	9	9	8	8	7	7	6	4	3	1	0	−2	−4	−6	−8	−12	−15	−21	−30		11
10	10	10	9	9	8	8	8	7	7	6	6	4	3	2	0	−2	−3	−6	−8	−11	−15	−19	−27			10
9	9	9	8	8	7	7	6	6	5	5	4	3	2	0	−1	−3	−5	−8	−10	−14	−18					9
8	8	8	7	7	6	6	5	5	4	4	3	2	0	−1	−3	−5	−7	−10	−13	−17						8
7	7	7	6	6	5	5	4	4	3	3	2	1	−1	−3	−4	−7	−9	−12	−16							7
6	6	6	5	5	4	4	3	3	2	1	1	−0	−2	−4	−6	−9	−11	−15								6
5	5	5	4	4	3	2	2	1	1	0	0	−2	−4	−6	−8	−10	−14	−15								5
4	4	4	3	2	2	1	1	0	0	−1	−1	−3	−5	−7	−10	−11	−14	−18								4
3	3	3	2	1	1	0	0	−1	−2	−2	−3	−5	−7	−8	−11	−14	−17									3
2	2	2	1	0	0	−1	−1	−2	−3	−3	−4	−5	−8	−10	−13	−16										2
1	1	1	0	−1	−1	−2	−2	−3	−4	−4	−5	−7	−9	−12	−15	−19										1
0	0	−1	−1	−2	−2	−3	−4	−4	−5	−6	−7	−9	−11	−14	−18											0
−1	−1	−2	−2	−3	−4	−4	−5	−6	−6	−7	−8	−10	−13	−17												−1
−2	−2	−3	−4	−4	−5	−6	−6	−7	−8	−9	−10	−12	−15	−19												−2
−3	−3	−4	−5	−5	−6	−7	−8	−9	−9	−10	−11	−14	−18													−3
−4	−5	−5	−6	−7	−7	−8	−9	−10	−11	−12	−13	−16														−4
−5	−6	−6	−7	−8	−9	−10	−10	−11	−13	−14	−15	−18														−5
−6	−7	−7	−8	−9	−10	−11	−12	−13	−14	−15	−17															−6
−7	−8	−9	−9	−10	−11	−12	−13	−15	−16	−17	−19															−7
−8	−9	−10	−11	−12	−13	−14	−15	−16	−18	−19																−8
−9	−10	−11	−12	−13	−14	−15	−17	−18	−19																	−9
−10	−11	−12	−13	−14	−15	−17	−18																			−10
−11	−12	−13	−14	−16	−17	−18																				−11
−12	−13	−14	−16	−17	−18																					−12
−13	−15	−16	−17	−18																						−13
−14	−16	−17	−18																							−14
−15	−17	−18	−19																							−15
−16	−18	−19																								−16
−17	−19																									−17

LAT 41°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	Alpheratz		Hamal		◆RIGEL		CANOPUS		◆RIGIL KENT		Peacock		◆Enif	
0	19 49	002	19 00	031	13 50	089	28 17	137	16 59	199	52 42	227	30 18	321
1	19 51	001	19 23	030	14 35	088	28 48	136	16 44	199	52 09	227	29 49	320
2	19 51	000	19 45	029	15 21	088	29 19	136	16 30	198	51 36	227	29 19	319
3	19 51	359	20 07	028	16 06	087	29 51	136	16 16	198	51 03	227	28 49	318
4	19 50	358	20 28	027	16 51	086	30 22	135	16 02	197	50 30	227	28 18	317
5	19 48	357	20 49	026	17 36	086	30 54	135	15 49	197	49 57	227	27 47	316
6	19 46	356	21 08	025	18 21	085	31 26	135	15 36	196	49 24	227	27 15	315
7	19 43	356	21 28	025	19 06	084	31 58	134	15 23	196	48 51	227	26 43	314
8	19 39	355	21 46	024	19 51	083	32 31	134	15 11	196	48 19	226	26 10	313
9	19 34	354	22 04	023	20 36	083	33 03	134	14 59	195	47 46	226	25 36	312
10	19 29	353	22 21	022	21 21	082	33 36	133	14 47	195	47 13	226	25 02	311
11	19 23	352	22 37	021	22 06	081	34 09	133	14 36	194	46 40	226	24 28	310
12	19 16	351	22 53	020	22 51	081	34 42	133	14 25	194	46 08	226	23 53	309
13	19 09	350	23 08	019	23 36	080	35 16	133	14 15	193	45 35	226	23 18	309
14	19 01	349	23 22	018	24 20	079	35 49	132	14 04	193	45 03	226	22 43	308
	◆Hamal		RIGEL		◆CANOPUS		RIGIL KENT		◆Peacock		FOMALHAUT		Alpheratz	
15	23 36	017	25 05	079	36 23	132	13 55	192	44 30	226	62 50	285	18 52	348
16	23 49	016	25 49	078	36 56	132	13 45	192	43 58	226	62 06	284	18 42	347
17	24 01	015	26 33	077	37 30	131	13 36	191	43 25	225	61 22	283	18 32	346
18	24 12	014	27 17	076	38 04	131	13 27	191	42 53	225	60 38	282	18 21	346
19	24 23	013	28 01	076	38 38	131	13 19	190	42 21	225	59 53	281	18 09	345
20	24 33	012	28 45	075	39 13	131	13 11	190	41 49	225	59 09	280	17 57	344
21	24 42	011	29 28	074	39 47	130	13 04	189	41 17	225	58 24	280	17 44	343
22	24 50	010	30 12	073	40 22	130	12 56	189	40 45	225	57 39	279	17 30	342
23	24 58	009	30 55	073	40 56	130	12 50	188	40 14	224	56 55	278	17 16	341
24	25 04	008	31 38	072	41 31	130	12 43	188	39 42	224	56 10	277	17 01	340
25	25 10	007	32 21	071	42 06	129	12 37	187	39 11	224	55 25	276	16 45	339
26	25 15	006	33 04	070	42 41	129	12 31	187	38 39	224	54 40	275	16 29	338
27	25 20	005	33 46	069	43 16	129	12 26	186	38 08	223	53 55	275	16 12	338
28	25 23	004	34 29	068	43 52	129	12 21	186	37 37	223	53 09	274	15 54	337
29	25 26	003	35 11	068	44 27	129	12 17	185	37 06	223	52 24	273	15 36	336
	◆Hamal		RIGEL		SIRIUS		◆CANOPUS		RIGIL KENT		◆Peacock		FOMALHAUT	
30	25 28	002	35 52	067	24 48	091	45 02	128	12 12	185	36 35	223	51 39	273
31	25 29	001	36 34	066	25 33	090	45 38	128	12 09	185	36 04	223	50 54	272
32	25 29	000	37 15	065	26 18	090	46 13	128	12 05	184	35 34	222	50 09	271
33	25 29	359	37 56	064	27 04	089	46 49	128	12 02	184	35 04	222	49 23	271
34	25 28	358	38 36	063	27 49	088	47 25	128	12 00	183	34 33	222	48 38	270
35	25 26	357	39 16	062	28 34	088	48 01	128	11 58	183	34 03	221	47 53	269
36	25 23	356	39 56	061	29 20	087	48 37	127	11 56	182	33 33	221	47 07	269
37	25 19	355	40 36	060	30 05	086	49 13	127	11 54	182	33 04	221	46 22	268
38	25 15	354	41 15	059	30 50	086	49 49	127	11 53	181	32 34	221	45 37	267
39	25 09	353	41 54	058	31 35	085	50 25	127	11 53	181	32 05	220	44 52	267
40	25 03	352	42 32	057	32 20	084	51 01	127	11 53	180	31 35	220	44 07	266
41	24 57	351	43 10	056	33 05	084	51 37	127	11 53	180	31 06	220	43 21	265
42	24 49	350	43 47	055	33 50	083	52 13	127	11 53	179	30 38	219	42 36	265
43	24 41	349	44 24	054	34 35	082	52 50	127	11 54	179	30 09	219	41 51	264
44	24 31	348	45 01	053	35 20	081	53 26	127	11 56	178	29 40	219	41 06	264
	◆RIGEL		SIRIUS		CANOPUS		◆RIGIL KENT		Peacock		◆FOMALHAUT		Hamal	
45	45 36	052	38 05	081	54 02	127	11 57	178	29 12	218	40 21	263	24 22	347
46	46 12	051	36 49	080	54 39	127	11 59	177	28 44	218	39 36	263	24 11	346
47	46 46	050	37 34	079	55 15	127	12 02	177	28 16	218	38 51	262	23 59	345
48	47 21	048	38 18	078	55 51	127	12 05	176	27 49	217	38 07	261	23 47	344
49	47 54	047	39 02	078	56 28	127	12 08	176	27 21	217	37 22	261	23 34	343
50	48 27	046	39 47	077	57 04	127	12 12	175	26 54	217	36 37	260	23 21	342
51	48 59	045	40 31	076	57 40	127	12 16	175	26 27	216	35 53	260	23 06	341
52	49 31	043	41 15	075	58 17	127	12 20	174	26 00	216	35 08	259	22 51	340
53	50 01	042	41 58	074	58 53	127	12 25	174	25 33	216	34 24	259	22 35	339
54	50 31	041	42 42	074	59 29	127	12 31	173	25 07	215	33 39	258	22 19	338
55	51 00	039	43 25	073	60 05	127	12 36	173	24 41	215	32 55	258	22 02	337
56	51 29	038	44 08	072	60 42	127	12 42	172	24 15	215	32 11	257	21 44	336
57	51 56	037	44 51	071	61 18	127	12 49	172	23 50	214	31 27	256	21 25	335
58	52 22	035	45 34	070	61 53	128	12 55	171	23 24	214	30 43	256	21 06	334
59	52 48	034	46 16	069	62 29	128	13 03	171	22 59	213	29 59	255	20 46	333
	ALDEBARAN		◆SIRIUS		Suhail		◆RIGIL KENT		ACHERNAR		◆Diphda		Hamal	
60	31 51	010	46 58	068	35 01	120	13 10	170	62 11	222	42 19	284	20 26	333
61	31 59	009	47 40	067	35 40	120	13 18	170	61 40	223	41 35	283	20 04	332
62	32 06	008	48 22	066	36 19	120	13 26	169	61 09	223	40 51	282	19 43	331
63	32 11	007	49 03	065	36 59	119	13 35	169	60 38	223	40 07	281	19 20	330
64	32 17	006	49 44	064	37 38	119	13 44	168	60 07	224	39 22	281	18 57	329
65	32 21	005	50 25	063	38 18	118	13 53	168	59 36	224	38 38	280	18 34	328
66	32 24	004	51 05	062	38 58	118	14 03	167	59 04	224	37 53	279	18 09	327
67	32 26	002	51 45	061	39 38	118	14 13	167	58 32	225	37 08	278	17 45	326
68	32 28	001	52 24	060	40 18	117	14 24	166	58 01	225	36 24	278	17 19	326
69	32 28	000	53 03	059	40 59	117	14 34	166	57 29	225	35 39	277	16 53	325
70	32 28	359	53 41	057	41 39	117	14 46	165	56 57	225	34 54	276	16 27	324
71	32 27	358	54 19	056	42 20	116	14 57	165	56 25	225	34 09	276	16 00	323
72	32 25	357	54 56	055	43 00	116	15 09	165	55 52	225	33 23	275	15 33	322
73	32 22	356	55 33	054	43 41	115	15 21	164	55 20	226	32 38	274	15 05	321
74	32 18	354	56 09	052	44 22	115	15 34	164	54 48	226	31 53	273	14 36	321
	BETELGEUSE		◆SIRIUS		Suhail		◆RIGIL KENT		ACHERNAR		◆Diphda		ALDEBARAN	
75	39 56	018	56 45	051	45 03	115	15 47	163	54 15	226	31 08	273	32 13	353
76	40 09	017	57 20	050	45 44	114	16 00	163	53 43	226	30 23	272	32 07	352
77	40 22	016	57 54	048	46 25	114	16 14	162	53 11	226	29 37	271	32 01	351
78	40 34	014	58 27	047	47 07	114	16 28	162	52 38	226	28 52	271	31 53	350
79	40 44	013	59 00	045	47 48	113	16 42	161	52 06	226	28 07	270	31 45	349
80	40 54	012	59 31	044	48 30	113	16 57	161	51 33	226	27 22	269	31 36	348
81	41 03	010	60 02	042	49 12	113	17 12	161	51 00	226	26 36	269	31 26	347
82	41 10	009	60 32	040	49 53	113	17 27	160	50 28	226	25 51	268	31 15	346
83	41 17	008	61 00	039	50 35	112	17 42	160	49 55	226	25 06	268	31 03	344
84	41 23	007	61 28	037	51 17	112	17 58	159	49 23	226	24 21	267	30 50	343
85	41 27	005	61 55	035	51 59	112	18 15	159	48 51	226	23 35	266	30 37	342
86	41 31	004	62 20	033	52 41	111	18 31	158	48 18	226	22 50	266	30 23	341
87	41 34	003	62 44	031	53 24	111	18 48	158	47 46	226	22 05	265	30 08	340
88	41 35	001	63 07	029	54 06	111	19 05	158	47 13	226	21 20	264	29 52	339
89	41 36	000	63 29	027	54 48	110	19 23	157	46 41	225	20 35	264	29 35	338

LAT 41°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	PROCYON		Alphard		◆Suhail		RIGIL KENT		◆ACHERNAR		RIGEL		◆BETELGEUSE	
90	38 28	032	33 57	070	55 31	110	19 40	157	46 09	225	55 42	340	41 35	359
91	38 52	031	34 39	069	56 13	110	19 58	156	45 37	225	55 26	338	41 33	357
92	39 15	030	35 21	068	56 56	110	20 17	156	45 04	225	55 09	337	41 31	356
93	39 37	029	36 03	067	57 39	109	20 35	155	44 32	225	54 50	335	41 27	355
94	39 58	028	36 45	066	58 21	109	20 54	155	44 00	225	54 30	333	41 22	353
95	40 19	026	37 26	066	59 04	109	21 14	155	43 29	225	54 10	332	41 16	352
96	40 39	025	38 07	065	59 47	109	21 33	154	42 57	225	53 48	330	41 09	351
97	40 58	024	38 48	064	60 30	108	21 53	154	42 25	224	53 25	329	41 02	349
98	41 16	023	39 28	063	61 13	108	22 13	154	41 53	224	53 01	327	40 53	348
99	41 33	021	40 09	062	61 56	108	22 33	153	41 22	224	52 36	326	40 43	347
100	41 49	020	40 48	061	62 39	108	22 54	153	40 50	224	52 10	324	40 32	345
101	42 04	019	41 28	060	63 22	107	23 15	152	40 19	224	51 43	323	40 20	344
102	42 18	018	42 07	059	64 06	107	23 36	152	39 48	224	51 15	321	40 07	343
103	42 31	016	42 45	058	64 49	107	23 57	152	39 17	223	50 46	320	39 54	342
104	42 43	015	43 23	057	65 32	107	24 19	151	38 46	223	50 17	319	39 39	340
	PROCYON		REGULUS		◆Gienah		RIGIL KENT		◆ACHERNAR		RIGEL		◆BETELGEUSE	
105	42 55	014	21 28	051	19 33	097	24 40	151	38 15	223	49 46	317	39 23	339
106	43 05	012	22 03	050	20 18	096	25 03	151	37 44	223	49 15	316	39 07	338
107	43 14	011	22 37	049	21 03	095	25 25	150	37 13	222	48 43	315	38 49	337
108	43 22	010	23 11	048	21 48	095	25 47	150	36 43	222	48 11	314	38 31	336
109	43 29	008	23 44	047	22 33	094	26 10	150	36 13	222	47 38	312	38 12	334
110	43 35	007	24 17	046	23 18	094	26 33	149	35 42	222	47 04	311	37 52	333
111	43 40	005	24 50	045	24 04	093	26 57	149	35 12	221	46 29	310	37 31	332
112	43 43	004	25 22	044	24 49	092	27 20	149	34 42	221	45 54	309	37 09	331
113	43 46	003	25 53	043	25 34	092	27 44	148	34 13	221	45 19	308	36 47	330
114	43 48	001	26 24	043	26 19	091	28 08	148	33 43	221	44 43	307	36 24	329
115	43 48	000	26 54	042	27 05	090	28 32	148	33 14	220	44 06	305	35 59	327
116	43 47	359	27 24	041	27 50	090	28 56	147	32 44	220	43 29	304	35 35	326
117	43 46	357	27 53	040	28 35	089	29 21	147	32 15	220	42 51	303	35 09	325
118	43 43	356	28 22	039	29 21	088	29 45	147	31 46	220	42 13	302	34 43	324
119	43 39	354	28 50	038	30 06	088	30 10	146	31 18	219	41 35	301	34 16	323
	REGULUS		◆SPICA		RIGIL KENT		◆ACHERNAR		RIGEL		BETELGEUSE		◆PROCYON	
120	29 17	037	13 46	093	30 35	146	30 49	219	40 56	300	33 49	322	43 34	353
121	29 44	036	14 31	092	31 01	146	30 21	219	40 17	299	33 20	321	43 28	352
122	30 10	035	15 16	092	31 26	146	29 53	218	39 37	298	32 52	320	43 21	350
123	30 36	034	16 01	091	31 52	145	29 25	218	38 57	297	32 22	319	43 13	349
124	31 00	033	16 47	090	32 18	145	28 57	218	38 16	296	31 52	318	43 04	348
125	31 25	032	17 32	090	32 44	145	28 29	217	37 36	296	31 21	317	42 54	346
126	31 48	031	18 17	089	33 10	145	28 02	217	36 55	295	30 50	316	42 42	345
127	32 11	030	19 03	088	33 36	144	27 35	217	36 13	294	30 18	315	42 30	344
128	32 33	028	19 48	088	34 03	144	27 08	216	35 32	293	29 46	314	42 17	342
129	32 54	027	20 33	087	34 29	144	26 41	216	34 50	292	29 13	313	42 03	341
130	33 14	026	21 18	086	34 56	144	26 15	216	34 08	291	28 40	312	41 47	340
131	33 34	025	22 03	086	35 23	143	25 49	215	33 26	290	28 06	311	41 31	338
132	33 53	024	22 49	085	35 50	143	25 22	215	32 43	290	27 31	310	41 14	337
133	34 11	023	23 34	084	36 17	143	24 57	215	32 00	289	26 57	309	40 56	336
134	34 28	022	24 19	084	36 45	143	24 31	214	31 17	288	26 21	308	40 37	335
	REGULUS		◆SPICA		RIGIL KENT		◆ACHERNAR		CANOPUS		SIRIUS		◆PROCYON	
135	34 44	021	25 04	083	37 12	142	24 06	214	61 21	233	52 16	300	40 17	333
136	35 00	019	25 49	082	37 40	142	23 41	213	60 45	233	51 36	299	39 57	332
137	35 15	018	26 33	082	38 08	142	23 16	213	50 09	233	50 57	298	39 35	331
138	35 28	017	27 18	081	38 36	142	22 51	213	59 32	233	50 16	297	39 13	330
139	35 41	016	28 03	080	39 04	142	22 27	212	58 56	233	49 36	296	38 50	329
140	35 53	015	28 47	079	39 32	142	22 03	212	58 20	233	48 55	295	38 26	327
141	36 04	014	29 32	079	40 00	141	21 39	211	57 44	233	48 13	294	38 01	326
142	36 15	012	30 16	078	40 28	141	21 16	211	57 07	233	47 32	293	37 35	325
143	36 24	011	31 00	077	40 57	141	20 53	211	56 31	233	46 50	292	37 09	324
144	36 32	010	31 45	076	41 25	141	20 30	210	55 55	233	46 08	291	36 42	323
145	36 40	009	32 28	076	41 54	141	20 07	210	55 18	233	45 25	290	36 14	322
146	36 46	008	33 12	075	42 22	141	19 45	209	54 42	233	44 42	289	35 46	321
147	36 52	006	33 56	074	42 51	141	19 23	209	54 06	233	43 59	288	35 17	320
148	36 56	005	34 39	073	43 20	140	19 01	209	53 29	233	43 16	287	34 47	319
149	37 00	004	35 23	072	43 49	140	18 39	208	52 53	233	42 33	286	34 17	318
	REGULUS		◆SPICA		RIGIL KENT		◆ACHERNAR		CANOPUS		SIRIUS		◆PROCYON	
150	37 03	003	36 06	072	44 18	140	18 18	208	52 17	233	41 49	285	33 46	317
151	37 04	002	36 49	071	44 46	140	17 57	207	51 40	233	41 06	285	33 15	316
152	37 05	000	37 31	070	45 16	140	17 37	207	51 04	233	40 22	284	32 43	315
153	37 05	359	38 14	069	45 45	140	17 16	206	50 28	233	39 38	283	32 10	314
154	37 03	358	38 56	068	46 14	140	16 56	206	49 52	233	38 53	282	31 37	313
155	37 01	357	39 38	067	46 43	140	16 37	205	49 16	233	38 09	281	31 04	312
156	36 58	355	40 19	066	47 12	140	16 17	205	48 40	233	37 25	281	30 30	311
157	36 54	354	41 01	066	47 41	140	15 58	205	48 04	232	36 40	280	29 55	310
158	36 49	353	41 42	065	48 10	140	15 40	204	47 28	232	35 55	279	29 20	309
159	36 43	352	42 23	064	48 40	140	15 21	204	46 52	232	35 11	278	28 44	308
160	36 36	351	43 03	063	49 09	140	15 03	203	46 17	232	34 26	278	28 08	307
161	36 28	349	43 43	062	49 38	140	14 46	203	45 41	232	33 41	277	27 32	306
162	36 19	348	44 23	061	50 07	140	14 28	202	45 05	232	32 56	276	26 55	305
163	36 09	347	45 02	060	50 36	140	14 11	202	44 30	231	32 11	276	26 18	304
164	35 58	346	45 41	059	51 05	140	13 55	201	43 55	231	31 26	275	25 40	303
	SPICA		◆ANTARES		RIGIL KENT		ACHERNAR		◆CANOPUS		SIRIUS		◆REGULUS	
165	46 19	058	22 21	106	51 35	140	13 39	201	43 19	231	30 41	274	35 47	345
166	46 57	056	23 05	106	52 04	140	13 23	200	42 44	231	29 55	273	35 34	343
167	47 35	055	23 49	105	52 33	140	13 07	200	42 09	231	29 10	273	35 21	342
168	48 12	054	24 32	105	53 01	140	12 52	199	41 34	230	28 25	272	35 07	341
169	48 48	053	25 16	104	53 30	140	12 37	199	40 59	230	27 40	271	34 51	340
170	49 24	052	26 00	103	53 59	141	12 23	198	40 25	230	26 54	271	34 35	339
171	49 59	051	26 44	103	54 28	141	12 09	198	39 50	230	26 09	270	34 19	338
172	50 34	049	27 29	102	54 56	141	11 55	197	39 16	229	25 24	269	34 01	336
173	51 08	048	28 13	102	55 25	141	11 42	197	38 41	229	24 39	269	33 42	335
174	51 41	047	28 57	101	55 53	141	11 29	196	38 07	229	23 53	268	33 23	334
175	52 14	045	29 42	101	56 22	142	11 16	196	37 33	229	23 08	268	33 03	333
176	52 46	044	30 26	100	56 50	142	11 04	195	36 59	228	22 23	267	32 42	332
177	53 17	043	31 11	099	57 18	142	10 53	195	36 26	228	21 38	266	32 21	331
178	53 47	041	31 56	099	57 45	142	10 41	194	35 52	228	20 52	266	31 58	330
179	54 17	040	32 40	098	58 13	143	10 30	194	35 18	227	20 07	265	31 35	329

LAT 41°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	● ARCTURUS		ANTARES		● RIGIL KENT		ACHERNAR		CANOPUS		● Suhail		REGULUS	
180	22 05	035	33 28	098	58 43	143	10 21	193	34 44	227	58 27	251	31 08	328
181	22 30	034	34 13	097	59 10	143	10 10	193	34 11	227	57 44	251	30 44	327
182	22 55	033	34 58	096	59 37	144	10 01	192	33 38	227	57 02	250	30 19	326
183	23 20	032	35 43	096	60 04	144	9 51	192	33 05	226	56 19	250	29 53	325
184	23 43	031	36 28	095	60 30	144	9 43	191	32 33	226	55 36	250	29 26	324
185	24 06	030	37 13	095	60 57	145	9 34	191	32 00	226	54 54	250	28 59	323
186	24 29	029	37 59	094	61 22	145	9 26	190	31 28	225	54 11	249	28 31	322
187	24 50	028	38 44	093	61 48	146	9 18	189	30 56	225	53 29	249	28 03	321
188	25 11	027	39 29	093	62 13	146	9 11	189	30 24	225	52 47	249	27 34	320
189	25 32	026	40 14	092	62 38	147	9 04	188	29 52	224	52 05	248	27 05	319
190	25 51	025	40 59	092	63 03	148	8 58	188	29 21	224	51 23	248	26 34	318
191	26 10	024	41 45	091	63 27	148	8 52	187	28 49	224	50 41	248	26 04	317
192	26 29	023	42 30	090	63 50	149	8 46	187	28 18	223	49 59	248	25 33	316
193	26 46	022	43 15	090	64 14	149	8 41	186	27 47	223	49 17	247	25 01	315
194	27 03	021	44 01	089	64 36	150	8 36	186	27 17	222	48 35	247	24 29	314
	● ARCTURUS		ANTARES		● Peacock		ACHERNAR		CANOPUS		● Suhail		REGULUS	
195	27 19	020	44 46	088	23 22	146	8 32	185	26 46	222	47 54	247	23 56	313
196	27 34	019	45 31	088	23 47	146	8 28	185	26 16	222	47 12	246	23 23	312
197	27 49	018	46 16	087	24 13	145	8 25	184	25 46	221	46 31	246	22 49	312
198	28 02	017	47 01	086	24 39	145	8 22	184	25 16	221	45 49	246	22 15	311
199	28 15	016	47 47	085	25 05	145	8 19	183	24 47	221	45 08	245	21 40	310
200	28 28	015	48 32	085	25 31	144	8 17	182	24 17	220	44 27	245	21 05	309
201	28 39	014	49 17	084	25 57	144	8 15	182	23 48	220	43 46	245	20 30	308
202	28 49	013	50 02	083	26 24	144	8 14	181	23 19	219	43 05	244	19 54	307
203	28 58	012	50 47	082	26 51	143	8 13	181	22 51	219	42 25	244	19 18	307
204	29 08	011	51 32	082	27 18	143	8 13	180	22 22	219	41 44	244	18 41	306
205	29 16	010	52 16	081	27 46	143	8 13	180	21 54	218	41 04	243	18 04	305
206	29 23	009	53 01	080	28 13	142	8 13	179	21 27	218	40 23	243	17 27	304
207	29 30	008	53 46	079	28 41	142	8 14	179	20 59	217	39 43	242	16 49	303
208	29 35	006	54 30	078	29 09	142	8 15	178	20 32	217	39 03	242	16 11	303
209	29 40	005	55 14	077	29 38	141	8 17	178	20 05	216	38 23	242	15 33	302
	● ARCTURUS		ANTARES		● Peacock		ACHERNAR		CANOPUS		● Suhail		SPICA	
210	29 44	004	55 58	077	30 06	141	8 19	177	19 38	216	37 43	241	59 14	343
211	29 47	003	56 42	076	30 35	141	8 22	176	19 11	216	37 04	241	59 00	341
212	29 49	002	57 26	075	31 03	140	8 25	176	18 45	215	36 24	241	58 45	340
213	29 50	001	58 10	074	31 32	140	8 28	175	18 19	215	35 45	240	58 29	338
214	29 51	000	58 53	073	32 02	140	8 32	175	17 54	214	35 05	240	58 11	336
215	29 50	359	59 36	072	32 31	139	8 37	174	17 28	214	34 26	239	57 52	334
216	29 49	358	60 19	071	33 01	139	8 41	174	17 03	213	33 47	239	57 32	333
217	29 47	357	61 01	069	33 30	139	8 46	173	16 39	213	33 08	238	57 10	331
218	29 44	356	61 44	068	34 00	139	8 52	173	16 14	212	32 30	238	56 47	329
219	29 40	355	62 26	067	34 30	138	8 58	172	15 50	212	31 52	238	56 24	328
220	29 35	353	63 07	066	35 00	138	9 05	172	15 26	211	31 14	237	55 59	326
221	29 29	352	63 48	065	35 31	138	9 11	171	15 03	211	30 35	237	55 33	324
222	29 23	351	64 29	063	36 01	138	9 19	170	14 40	210	29 58	237	55 06	323
223	29 16	350	65 09	062	36 32	137	9 26	170	14 17	210	29 20	236	54 38	321
224	29 08	349	65 49	060	37 03	137	9 34	169	13 55	209	28 42	236	54 09	320
	Rasalhague		● Nunki		Peacock		ACHERNAR		● Acrux		SPICA		● ARCTURUS	
225	25 34	043	39 48	092	37 34	137	9 43	169	58 32	212	53 40	318	28 59	346
226	26 04	042	40 33	092	38 05	137	9 52	168	58 08	213	53 09	317	28 49	347
227	26 34	041	41 19	091	38 36	136	10 01	168	57 43	213	52 38	316	28 38	348
228	27 04	040	42 04	090	39 07	136	10 11	167	57 18	214	52 08	314	28 27	349
229	27 32	039	42 49	089	39 39	136	10 21	167	56 53	214	51 33	313	28 15	344
230	28 00	038	43 35	089	40 10	136	10 32	166	56 28	214	51 00	312	28 02	343
231	28 28	037	44 20	088	40 42	136	10 43	166	56 03	214	50 26	310	27 48	342
232	28 55	036	45 05	088	41 14	135	10 54	165	55 37	215	49 51	309	27 33	341
233	29 21	035	45 50	087	41 46	135	11 06	165	55 11	215	49 15	308	27 18	340
234	29 47	034	46 36	086	42 18	135	11 18	164	54 45	215	48 39	307	27 02	339
235	30 12	033	47 21	086	42 50	135	11 30	164	54 19	215	48 03	306	26 45	338
236	30 36	032	48 06	085	43 22	135	11 43	163	53 53	216	47 26	304	26 28	337
237	31 00	031	48 51	084	43 54	134	11 57	163	53 26	216	46 48	303	26 09	336
238	31 23	030	49 36	083	44 26	134	12 10	162	53 00	216	46 10	302	25 50	335
239	31 45	029	50 21	083	44 59	134	12 24	162	52 33	216	45 32	301	25 31	334
	Rasalhague		● ALTAIR		Peacock		● ACHERNAR		ACRUX		● SPICA		ARCTURUS	
240	32 06	028	17 15	061	45 31	134	12 39	161	52 07	216	44 53	300	25 10	333
241	32 27	027	17 54	060	46 04	134	12 53	161	51 40	216	44 13	299	24 49	332
242	32 47	026	18 34	059	46 37	134	13 08	160	51 13	216	43 34	298	24 27	331
243	33 06	024	19 12	059	47 09	134	13 24	160	50 46	216	42 54	297	24 05	330
244	33 24	023	19 51	058	47 42	134	13 40	159	50 19	217	42 13	296	23 42	329
245	33 42	022	20 29	057	48 15	134	13 56	159	49 52	217	41 32	295	23 18	328
246	33 58	021	21 07	056	48 48	134	14 13	158	49 25	217	40 51	294	22 54	327
247	34 14	020	21 44	055	49 20	133	14 30	158	48 58	217	40 10	293	22 29	326
248	34 29	019	22 22	055	49 53	133	14 47	157	48 31	217	39 28	293	22 04	325
249	34 43	018	22 58	054	50 26	133	15 05	157	48 04	217	38 46	292	21 37	324
250	34 57	016	23 35	053	50 59	133	15 23	156	47 37	217	38 04	291	21 11	323
251	35 09	015	24 11	052	51 32	133	15 41	156	47 10	217	37 21	290	20 43	323
252	35 21	014	24 46	051	52 05	133	16 00	155	46 42	217	36 39	289	20 16	322
253	35 31	013	25 21	050	52 38	133	16 19	155	46 15	217	35 56	288	19 47	321
254	35 41	012	25 56	049	53 11	133	16 38	155	45 48	217	35 13	287	19 18	320
	Rasalhague		● ALTAIR		FOMALHAUT		● ACHERNAR		RIGIL KENT		● SPICA		Alphecca	
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256	35 58	009	27 04	048	19 56	112	17 16	154	60 36	216	33 48	286	19 13	339
257	36 05	008	27 37	047	20 40	112	17 38	153	60 03	216	33 02	285	18 57	338
258	36 11	007	28 10	046	21 22	111	17 58	153	59 36	216	32 18	284	18 39	337
259	36 16	006	28 42	045	22 04	111	18 19	152	59 09	217	31 34	283	18 21	336
260	36 20	005	29 13	044	22 47	110	18 40	152	58 42	217	30 50	283	18 03	335
261	36 23	003	29 45	043	23 29	110	19 02	151	58 15	217	30 06	282	17 44	335
262	36 25	002	30 15	042	24 12	109	19 24	151	57 47	218	29 22	281	17 24	334
263	36 26	001	30 45	041	24 55	109	19 46	151	57 18	218	28 37	280	17 04	333
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265	36 26	359	31 43	039	26 21	107	20 31	150	56 23	218	27 08	279	16 21	331
266	36 24	357	32 11	038	27 04	107	20 54	149	55 55	219	26 23	278	15 59	330
267	36 22	356	32 39	037	27 47	106	21 17	149	55 27	219	25 38	278	15 36	329
268	36 18	355	33 06	036	28 31	106	21 40	149	54 58	219	24 53	277	15 13	329
269	36 14	354	33 32	035	29 15	105	22 04	148	54 30	219	24 08	276	14 49	328

LAT 41°S

LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	ALTAIR		Enif		● FOMALHAUT		ACHERNAR		● RIGIL KENT		ANTARES		● Rasalhague	
270	33 57	034	17 54	058	29 58	105	22 28	148	54 01	219	66 22	301	36 08	352
271	34 22	033	18 13	058	30 42	104	22 53	147	53 32	220	65 43	299	36 02	351
272	34 46	032	18 31	057	31 26	104	23 17	147	53 03	220	65 03	298	35 54	350
273	35 09	030	18 49	057	32 10	103	23 42	147	52 34	220	64 23	297	35 46	348
274	35 32	029	19 07	056	32 54	103	24 07	146	52 05	220	63 42	295	35 37	348
275	35 54	028	19 44	055	33 39	102	24 32	146	51 36	220	63 01	294	35 27	347
276	36 15	027	21 21	054	34 23	101	24 58	145	51 07	220	62 20	293	35 16	345
277	36 35	026	21 58	053	35 07	101	25 23	145	50 38	220	61 38	292	35 04	344
278	36 54	025	22 34	053	35 52	100	25 50	145	50 09	220	60 55	290	34 51	343
279	37 13	024	23 09	052	36 37	100	26 16	144	49 40	220	60 13	289	34 38	342
280	37 30	022	23 45	051	37 21	099	26 42	144	49 10	220	59 30	288	34 23	341
281	37 47	021	24 20	050	38 05	099	27 09	144	48 41	220	58 47	287	34 08	340
282	38 03	020	24 54	049	38 51	098	27 36	143	48 12	220	58 03	286	33 51	338
283	38 18	019	25 28	048	39 36	097	28 03	143	47 43	220	57 20	285	33 34	337
284	38 32	017	26 02	047	40 21	097	28 30	143	47 14	220	56 36	284	33 17	336
	ALTAIR		Enif		● FOMALHAUT		ACHERNAR		● RIGIL KENT		ANTARES		● Rasalhague	
285	38 45	016	26 35	046	41 05	096	28 58	142	46 44	220	55 52	283	32 58	335
286	38 57	015	27 07	045	41 51	096	29 26	142	46 15	220	55 09	282	32 38	334
287	39 09	014	27 39	045	42 36	095	29 54	142	45 46	220	54 24	282	32 18	333
288	39 19	012	28 11	044	43 21	095	30 22	141	45 17	220	53 39	281	31 57	332
289	39 28	011	28 42	043	44 06	094	30 50	141	44 48	220	52 55	280	31 36	331
290	39 37	010	29 12	042	44 51	093	31 19	141	44 19	220	52 10	279	31 13	330
291	39 44	008	29 42	041	45 36	093	31 47	141	43 50	220	51 25	278	30 50	329
292	39 50	007	30 11	040	46 22	092	32 16	140	43 21	220	50 40	277	30 28	328
293	39 56	006	30 40	039	47 07	091	32 45	140	42 52	220	49 55	277	30 01	327
294	40 00	005	31 08	038	47 52	091	33 14	140	42 24	219	49 10	276	29 36	326
295	40 03	004	31 35	037	48 37	090	33 44	139	41 55	219	48 25	275	29 10	325
296	40 05	002	32 02	036	49 23	090	34 13	139	41 26	219	47 40	274	28 44	324
297	40 07	001	32 28	035	50 08	089	34 43	139	40 58	219	46 55	274	28 17	323
298	40 07	000	32 53	034	50 53	088	35 13	139	40 29	219	46 10	273	27 49	322
299	40 08	358	33 18	032	51 38	087	35 43	138	40 01	219	45 25	272	27 20	321
300	33 42	031	FOMALHAUT		● ACHERNAR		RIGIL KENT		● ANTARES		Rasalhague		ALTAIR	
301	34 05	030	52 24	087	36 13	138	39 33	216	44 39	272	26 51	320	40 05	357
302	34 28	029	53 54	086	37 14	138	39 37	216	43 54	271	26 22	319	40 02	356
303	34 49	028	54 39	085	37 45	137	38 09	216	43 09	270	25 52	318	39 58	355
304	35 10	027	55 24	084	38 15	137	37 41	216	42 24	270	25 21	317	39 53	353
305	35 30	026	56 09	083	38 46	137	37 13	216	41 38	269	24 50	316	39 47	352
306	35 50	025	56 54	082	39 17	137	36 46	217	40 53	268	24 18	315	39 40	351
307	36 08	024	57 39	081	39 48	137	36 19	217	40 08	268	23 46	314	39 33	349
308	36 26	022	58 24	081	40 19	136	35 51	217	39 22	267	23 13	313	39 24	348
309	36 43	021	59 08	080	40 51	136	35 24	217	38 37	267	22 40	312	39 14	347
310	36 59	020	59 53	079	41 22	135	34 57	216	37 52	266	22 07	312	39 03	346
311	37 14	019	60 37	078	41 54	135	34 30	216	37 07	265	21 32	311	38 52	344
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316	38 15	013	37 55	081	44 33	135	20 45	181	32 19	215	33 22	252	37 39	338
317	38 25	011	38 40	080	45 05	135	20 45	180	31 53	215	32 37	252	37 22	337
318	38 33	010	39 24	079	45 37	135	20 44	180	31 27	214	31 52	251	37 04	336
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323	39 01	004	43 05	075	48 18	134	20 47	178	29 21	213	28 10	258	35 21	330
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325	39 06	001	44 32	074	49 23	134	20 51	178	28 32	212	26 41	257	34 35	328
326	39 06	000	45 16	073	49 56	134	20 53	177	28 08	212	25 57	257	34 10	327
327	39 06	359	45 59	072	50 28	134	20 55	177	27 44	212	25 13	256	33 45	326
328	39 04	358	46 42	071	51 01	134	20 58	176	27 21	211	24 29	255	33 19	325
329	39 02	356	47 24	070	51 33	134	21 01	176	26 57	211	23 45	255	32 53	324
330	48 07	069	52 06	134	21 04	176	26 34	211	23 02	254	23 02	254	32 26	323
331	48 49	068	52 38	134	21 08	175	26 11	210	49 26	276	31 58	322	38 59	355
332	49 31	067	53 11	134	21 12	175	25 48	210	48 41	276	31 29	321	38 54	354
333	50 12	066	53 43	134	21 16	175	25 25	210	47 56	275	31 00	320	38 49	353
334	50 54	065	54 15	134	21 20	174	25 03	209	47 11	274	30 31	319	38 42	351
335	51 34	064	54 48	134	21 25	174	24 41	209	46 26	274	30 00	318	38 35	350
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337	52 55	062	55 52	135	21 35	173	23 57	208	44 55	272	28 58	316	38 17	348
338	53 35	061	56 24	135	21 41	173	23 36	208	44 10	272	28 26	315	38 07	348
339	54 14	059	56 57	135	21 46	172	23 15	208	43 25	271	27 54	314	37 56	345
340	54 53	058	57 29	135	21 53	172	22 54	207	42 40	270	27 21	313	37 44	344
341	55 31	057	58 00	135	21 59	172	22 33	207	41 54	270	26 47	312	37 31	343
342	56 09	056	58 32	136	22 06	171	22 13	206	41 09	269	26 13	311	37 17	341
343	56 46	054	59 04	136	22 13	171	21 53	206	40 24	268	25 39	310	37 02	340
344	57 22	053	59 35	136	22 20	171	21 33	206	39 39	268	25 04	309	36 46	339
345	18 06	016	57 58	052	20 58	143	21 14	205	38 53	267	24 29	308	36 30	338
346	18 18	015	58 34	050	21 28	142	20 55	205	38 08	266	23 53	307	36 12	337
347	18 29	014	59 08	049	21 53	142	20 36	205	37 23	266	23 17	307	35 54	336
348	18 40	013	59 42	047	22 22	141	20 17	204	36 38	265	22 41	306	35 35	334
349	18 50	012	60 15	046	22 50	141	19 58	204	35 53	265	22 04	305	35 15	333
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357	19 43	005	64 02	032	26 45	138	17 42	200	29 54	260	16 56	299	32 08	325
358	19 47	004	64 25	030	27 16	138	17 27	200	29 09	259	16 18	298	31 41	324
359	19 49	003	64 47	028	27 47	137	17 11	200	28 25	259	15 36	297	31 14	323
									27 41	258	14 55	296	30 46	321

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 07 JULY 2021

1315 - 1615 hrs

Materials to be supplied by examination centres

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet Nautical Almanac Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Worksheet Q1 Worksheet Q5 Radar Plotting Sheet

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.

2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.

3. Non-programmable calculators may be used.

4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer

All questions refer to a 5,000 gt cargo ship, chartered to transport an offshore drill derrick from Shirehampton, UK, to Rotterdam, Netherlands

1. The drill derrick is scheduled to be loaded at Shirehampton (ATT UK & Ireland, Index No. 523a.) on the morning of 19th March.

   Port regulations stipulate that ships, whilst manoeuvring in the vicinity of Shirehampton berths, must maintain a minimum clearance of 1.5 m beneath the cargo gantry cranes.

   Due to weather forecasts, indicating wind strengths above the permitted loading operation parameters, the Master is concerned that significant delays may result in the ship becoming neaped.

   (a) From the following information:

   Vertical Clearance, above HAT, of gantry cranes 17.5 m.
   The drill derrick extends 23.5 m above the deck level.
   Draught on departure 4.7 m
   Keel to deck level 8.9 m

   Identify the last predicted Low Water at Shirehampton that will allow the ship to manoeuvre off the berth prior to the ship becoming neaped. (20)

   (b) Loading operations are actually completed at 1500 hours on the 20th March and the ship is preparing for port departure.

   A 45 minute period of time has been allocated for the unmooring operation and the manoeuvre to clear the berths.

   Determine the latest time that the ship can commence the unmooring operation so as to clear the berth, complying with the Port regulations. (15)

2. The 4 hours outbound pilotage passage, from Shirehampton to the Pilot disembarkation position, will be with surveillance and assistance from the Avonmouth Vessel Traffic Service.

Statutory publications specify the functions of Vessel Traffic Services.

(a) State EACH of the following:

(i) the main functions of Vessel Traffic Services; (7)

(ii) the information that a Vessel Traffic Service should provide to assist in the safe navigation and the protection of the marine environment. (4)

(b) Outline the Master's responsibilities with respect to the outbound pilotage passage:

(i) prior to the commencement of the pilotage passage; (8)

(ii) upon the arrival of the pilot on the bridge; (8)

(iii) during the pilotage passage. (6)

(c) In the event of the Master's absence from the bridge during the pilotage passage, outline the procedure the OOW should follow if in doubt of the Pilot's intentions. (5)

3. The planned passage is:

Coastal passage from Avonmouth Pilot Station to Wolf Rock waypoint, 49°53'N 05°51'W, distance 135 miles;

Wolf Rock waypoint to Lizard Point waypoint, 49°53'N 05°12'W;

Lizard Point waypoint to Start Point waypoint, 50°08'N 03°45'W;

Start Point waypoint to Dover Straits TSS waypoint, 50°20'N 00°05'E;

Coastal from Dover Straits TSS waypoint to Rotterdam Pilot Station, distance 182 miles.

(a) Determine the total distance from the Avonmouth Pilot Station to the Rotterdam Pilot Station. (25)

(b) The Avonmouth Pilot is disembarked at 1810 hours 22nd March, Standard Time.

To meet the tidal requirement at Rotterdam, the Rotterdam Pilot is to be embarked at 1500 hours 24th March, Standard Time.

The coastal passage from the Dover Straits TSS waypoint to the Rotterdam Pilot Station will be at manoeuvring speed, full ahead, 10.5 knots.

Determine the speed required from the Avonmouth Pilot Station to the Dover Straits TSS waypoint in order to meet the ETA requirement at Rotterdam Pilot Station. (15)

Note: Assume no Tidal Stream throughout.

4. During the month of March, the south coast of England is an area susceptible to reduced visibility due to Radiation Fog.

(a) Explain the process by which Radiation Fog may occur over the coastal waters of South England. (10)

(b) In anticipation of reduced visibility, Parallel Indexing is to be used during critical parts of the passage.

State EACH of the following:

(i) the reason why Parallel Indexing should not be the 'Primary' means of monitoring the vessel's position; (2)

(ii) FOUR factors to consider when determining a suitable reference point for a Parallel Index; (4)

(iii) the precautions contained within the current MCA guidance, with respect to the radar, when using Parallel Indexing. (8)

(c) Parallel Indexing may be used with different radar configurations.

Explain the radar screen presentation and the movements of PI lines when Parallel Indexing on EACH of the following ground stabilised modes:

(i) Relative Motion; (5)

(ii) True Motion. (5)

(d) Current MCA guidance advises that the adjustment of a radar heading marker should not be carried out "when alongside a berth using the berth's alignment."

Outline THREE reasons why using the berth alignment is bad practice. (6)

5. Whilst proceeding in the middle of the appropriate traffic lane through the Dover Straits Traffic Separation Scheme, during restricted visibility, course 022°T, the speed has been reduced to 6.0 knots.

Worksheet Q5 shows the radar plot between 0730 hours and 0742 hours using a radar range of 6.0 miles.

Targets A and C have been identified as cross channel ferries, using the French port of Boulogne.

Target B has been identified as ZC1 buoy, marking the eastern edge of the NNE traffic lane.

(a) Determine the course, speed and CPA distance of Targets A, C and D. (15)

(b) Outline the apparent movement of Targets A, C and D with respect to the Traffic Separation Scheme. (6)

(c) State the set and rate of the tidal stream experienced. (4)

(d) The bridge team are discussing the appropriate action required to resolve the developing situation.

With respect to IRPCS, safe navigation within a Traffic Separation Scheme and any other factors, outline EACH of the following:

(i) FIVE considerations for a reduction of speed; (5)

(ii) THREE considerations for an increase of speed. (3)

(e) At 0806 hours, after having taken manoeuvring action, Targets A, C and D have passed clear and the risk of collision with these THREE targets no longer exists. ZC1 buoy is now bearing 018°T, range 2.2 miles.

Find EACH of the following:

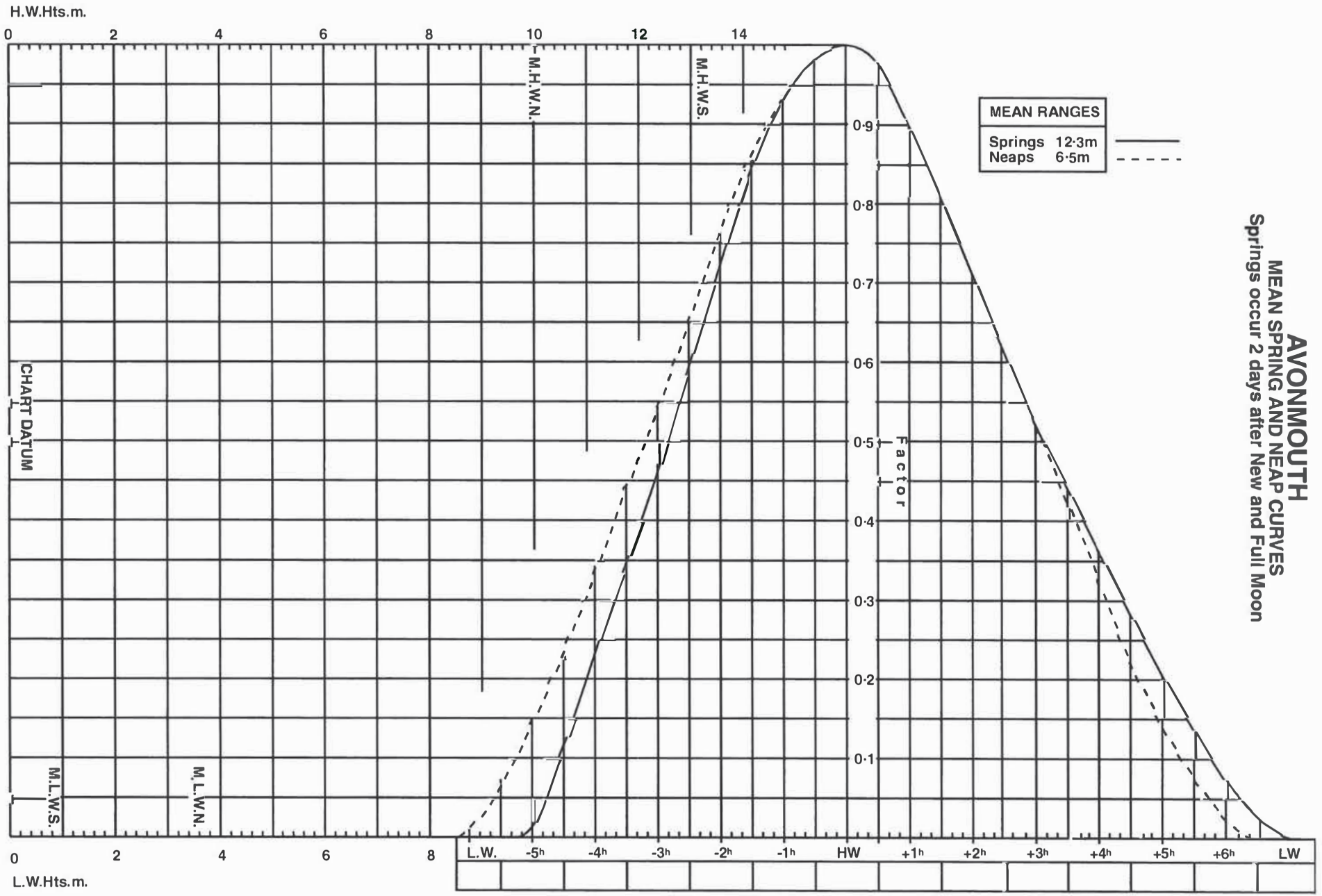
(i) the required course to pass ZC1 buoy at CPA 0.5 mile; (10)

(ii) the time at which ZC1 buoy will be at the CPA position. (4)

Note: Assume tidal stream constant and ship speed 6.0 knots throughout.

WORKSHEET Q1

(This Worksheet must be returned with your answer book)

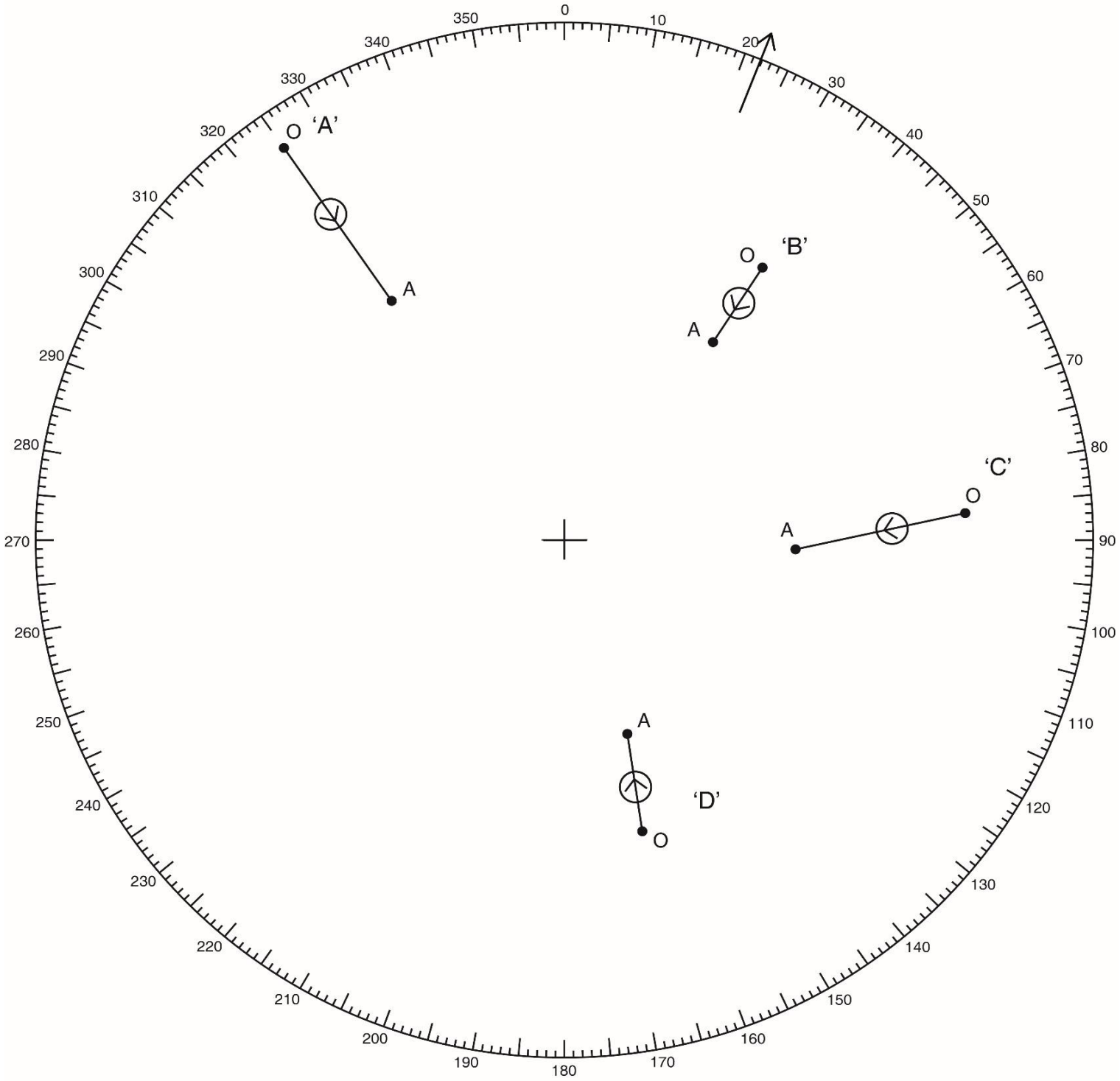


Candidate's Name .....

Examination Centre .....

(This Worksheet must be returned with your answer book)

RADAR PLOTTING SHEET



Signature of Candidate .....

Examination Centre .....

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 06 OCTOBER 2021

0915 - 1215 hrs

Materials to be supplied by examination centres

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet Nautical Almanac Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Worksheet Q2 Datasheet Q4(1) Luminous Range Diagram. Datasheet Q4(2) Geographical Range Table.

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4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer

All questions relate to a 12,500 gt bulk carrier, service speed 15.0 knots.
The ship is to make a voyage from Cape Town, South Africa to Tubarao, Brazil, and Georgetown, Guyana, during January.

The Charterer requires the ship to undertake a 'Least Time' voyage.

1. The South Atlantic Ocean passage will be:

   Dep Cape Town, waypoint 33°54'S 18°12'E.
   Arr Tubarao landfall, waypoint 20°06'S 38°48'W.

   (a) To appraise and plan the ocean passage, calculate EACH of the following:

      (i) the Rhumb Line course and distance; (10)

      (ii) the Great Circle initial course; (6)

      (iii) the Great Circle final course; (6)

      (iv) the Great Circle distance. (6)

   (b) The ship commences the Great Circle ocean passage at 2015 hours, on the 15th January, South Africa Standard Time.

      A navigation warning has been received, giving details of shipping containers lost overboard from a ship. The last known position of the containers is stated as 30°58'S 08°04'W.

      Due to the proximity of the containers to the planned Great Circle track the Master requires further information.

      Assuming the Departure Cape Town position is the vertex of the Great Circle, determine EACH of the following:

      (i) the distance that the Great Circle track will pass to the south of the last known position of the containers; (12)

      (ii) the ETA, Zone Time, that the ship will be to the south of the last known position of the containers. (10)

2. (a) Using Worksheet Q2, sketch and name the following meteorological and oceanographic features for January:

(i) the atmospheric pressure systems; (4)

(ii) the prevailing wind systems; (8)

(iii) the ocean currents. (8)

(b) State TWO factors as to the reason why Tropical Revolving Storms are very infrequent in the South Atlantic Ocean. (4)

(c) On Worksheet Q2, sketch the Rhumb Line track and the approximate Great Circle track from Cape Town to Tubarao. (4)

(d) With reference to Worksheet Q2, outline the factors to be considered when assessing whether the Rhumb Line track or the Great Circle track will offer the required 'Least Time' passage. (10)

3. At sunrise on the 23rd January, DR 28°47'S 30°18'W, an observation of the SUN gave a bearing of 110°C. Variation 3½° E.

(a) Determine the deviation of the magnetic compasses. (15)

(b) At 1140 hours, Ship Time, the Third Officer informs the master that a compass error, by azimuth of the SUN, has shown an unexpected deviation of 2°E.

(i) State, giving reasons, which observation would be the most reliable. (7)

(ii) State any discussion and advice that the Master may consider appropriate with the Third Officer regarding his observation of the SUN. (10)

4. The appraisal of a safe landfall is an important aspect of ocean passage planning.

(a) State, giving reasons, SIX factors to consider when planning a safe landfall. (18)

(b) The ship is expected to make visual landfall by sighting the Tubarao Point light during the first hour of the 0400 hours – 0800 hours watch, 25th January.

Charted characteristics of light: FlWR10s23m18M

Height of Eye 12.0 m.

The forecast is for N'ly winds of Force 4, visibility 10 to 15 miles, occasional rain showers.

During the evening of 24th January, the Master compiles Night Orders regarding the expected landfall.

(i) To provide specific guidance to the OOW, determine, with reference to Datasheets Q4(1) and Q4(2), the predicted range at which Tubarao Point light will be first sighted. (6)

(ii) State, with reasons, the other instructions and guidance that should be included in the Master's Night Orders on the evening of the 24th January, to assist the OOW in making a safe landfall. (24)

5. The Master, the senior member of 'Management Level', is required to "ensure that all functions within the designated area of responsibility are properly performed." (STCW 1978, as amended.)

Whilst on passage observations of an inexperienced OOW's Bridge watchkeeping practices, the Master notes deficiencies regarding the OOW's procedure for handing over the watch and the monitoring of shipboard operations.

Guidance is contained in Statutory Publications regarding 'Handing Over the Watch' and 'Monitoring Shipboard Operations'.

(a) State EACH of the following:

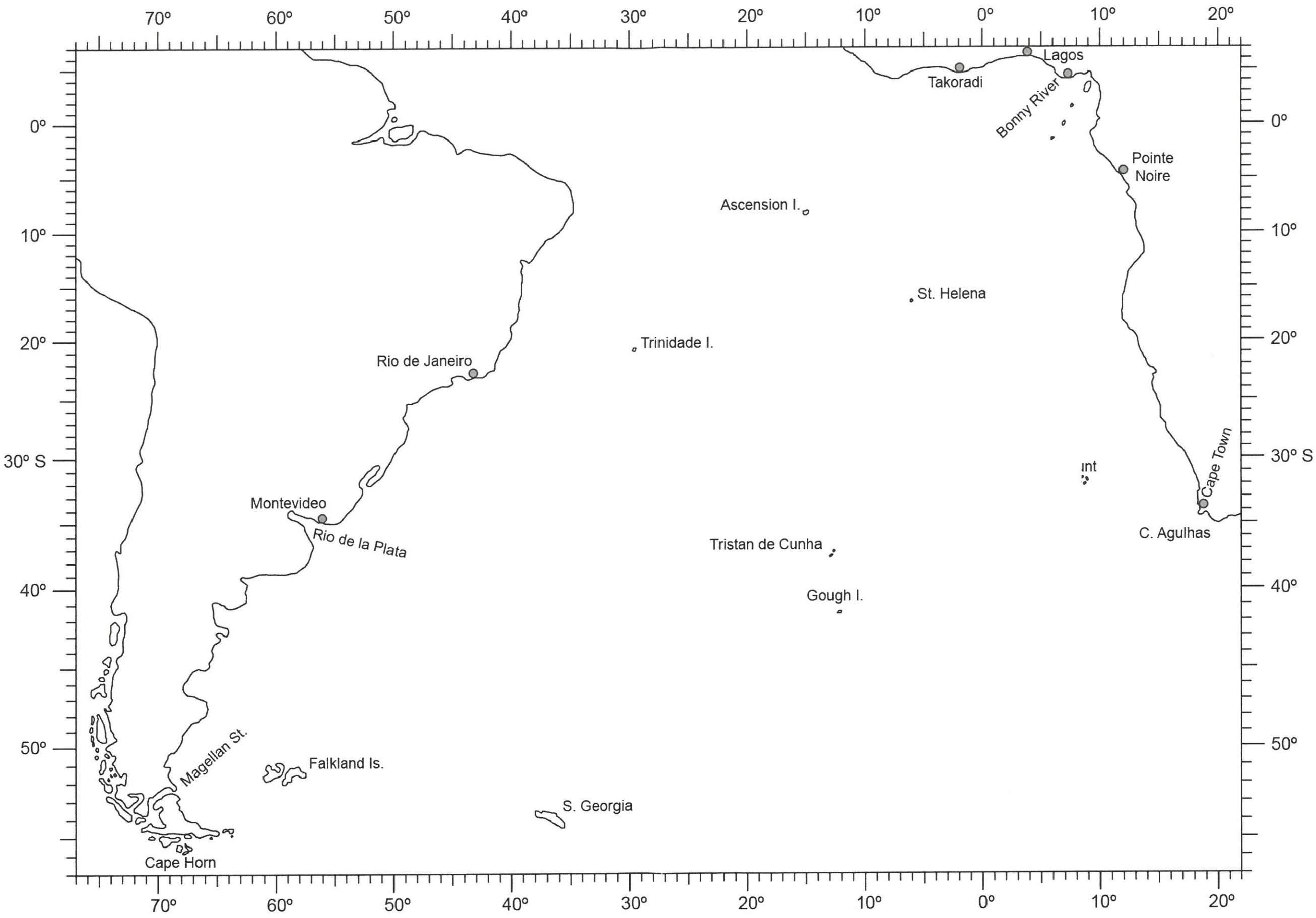
(i) THREE requirements that the OOW must ensure prior to commencing handing over the watch, whilst on passage, to the relieving OOW; (9)

(ii) TWO situations when the OOW should not hand over the watch, whilst on passage, to the relieving OOW; (4)

(iii) FIVE requirements to ensure that the OOW is maintaining a high level of general awareness of the ship and its routine operations whilst on passage. (15)

(b) The Master requires the OOW to study publications regarding 'handing over the watch' and the 'monitoring of shipboard operations'.

State TWO publications, required to be carried on board, that would assist the OOW in these matters. (4)

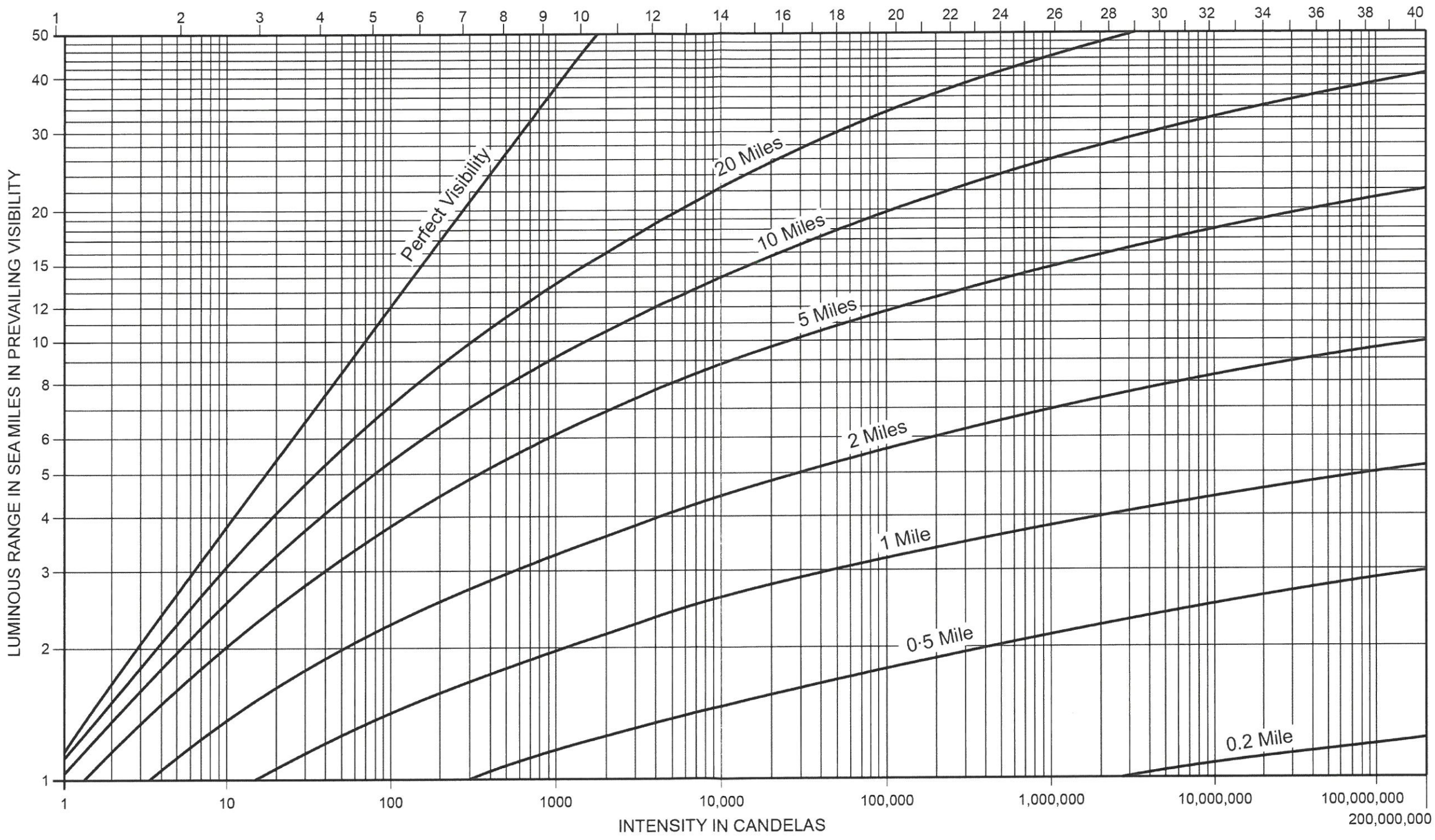


Candidate's Name .....

Examination Centre .....

LUMINOUS RANGE DIAGRAM

HD574



GEOGRAPHICAL RANGE TABLE

Elevation in		Height of Eye of Observer in feet/**metres**																						
ft		3	7	10	13	16	20	23	26	30	33	39	46	52	59	66	72	79	85	92	98	115	131	148
	m	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**35**	**40**	**45**
		Range in Sea Miles																						
0	**0**	2·0	2·9	3·5	4·1	4·5	5·0	5·4	5·7	6·1	6·4	7·0	7·6	8·1	8·6	9·1	9·5	10·0	10·4	10·7	11·1	12·0	12·8	13·6
3	**1**	4·1	4·9	5·5	6·1	6·6	7·0	7·4	7·8	8·1	8·5	9·1	9·6	10·2	10·6	11·1	11·6	12·0	12·4	12·8	13·2	14·0	14·9	15·7
7	**2**	4·9	5·7	6·4	6·9	7·4	7·8	8·2	8·6	9·0	9·3	9·9	10·5	11·0	11·5	12·0	12·4	12·8	13·2	13·6	14·0	14·9	15·7	16·5
10	**3**	5·5	6·4	7·0	7·6	8·1	8·5	8·9	9·3	9·6	9·9	10·6	11·1	11·6	12·1	12·6	13·0	13·5	13·9	14·3	14·6	15·5	16·4	17·1
13	**4**	6·1	6·9	7·6	8·1	8·6	9·0	9·4	9·8	10·2	10·5	11·1	11·7	12·2	12·7	13·1	13·6	14·0	14·4	14·8	15·2	16·1	16·9	17·7
16	**5**	6·6	7·4	8·1	8·6	9·1	9·5	9·9	10·3	10·6	11·0	11·6	12·1	12·7	13·2	13·6	14·1	14·5	14·9	15·3	15·7	16·6	17·4	18·2
20	**6**	7·0	7·8	8·5	9·0	9·5	9·9	10·3	10·7	11·1	11·4	12·0	12·6	13·1	13·6	14·1	14·5	14·9	15·3	15·7	16·1	17·0	17·8	18·6
23	**7**	7·4	8·2	8·9	9·4	9·9	10·3	10·7	11·1	11·5	11·8	12·4	13·0	13·5	14·0	14·5	14·9	15·3	15·7	16·1	16·5	17·4	18·2	19·0
26	**8**	7·8	8·6	9·3	9·8	10·3	10·7	11·1	11·5	11·8	12·2	12·8	13·3	13·9	14·4	14·8	15·3	15·7	16·1	16·5	16·9	17·8	18·6	19·4
30	**9**	8·1	9·0	9·6	10·2	10·6	11·1	11·5	11·8	12·2	12·5	13·1	13·7	14·2	14·7	15·2	15·6	16·0	16·4	16·8	17·2	18·1	18·9	19·7
33	**10**	8·5	9·3	9·9	10·5	11·0	11·4	11·8	12·2	12·5	12·8	13·5	14·0	14·5	15·0	15·5	15·9	16·4	16·8	17·2	17·5	18·4	19·3	20·0
36	**11**	8·8	9·6	10·3	10·8	11·3	11·7	12·1	12·5	12·8	13·2	13·8	14·3	14·9	15·4	15·8	16·3	16·7	17·1	17·5	17·9	18·8	19·6	20·4
39	**12**	9·1	9·9	10·6	11·1	11·6	12·0	12·4	12·8	13·1	13·5	14·1	14·6	15·2	15·7	16·1	16·6	17·0	17·4	17·8	18·2	19·1	19·9	20·7
43	**13**	9·4	10·2	10·8	11·4	11·9	12·3	12·7	13·1	13·4	13·7	14·4	14·9	15·4	15·9	16·4	16·8	17·3	17·7	18·1	18·4	19·3	20·2	20·9
46	**14**	9·6	10·5	11·1	11·7	12·1	12·6	13·0	13·3	13·7	14·0	14·6	15·2	15·7	16·2	16·7	17·1	17·6	18·0	18·3	18·7	19·6	20·4	21·2
49	**15**	9·9	10·7	11·4	11·9	12·4	12·8	13·2	13·6	14·0	14·3	14·9	15·5	16·0	16·5	17·0	17·4	17·8	18·2	18·6	19·0	19·9	20·7	21·5
52	**16**	10·2	11·0	11·6	12·2	12·7	13·1	13·5	13·9	14·2	14·5	15·2	15·7	16·2	16·7	17·2	17·7	18·1	18·5	18·9	19·2	20·1	21·0	21·7
56	**17**	10·4	11·2	11·9	12·4	12·9	13·3	13·7	14·1	14·5	14·8	15·4	16·0	16·5	17·0	17·4	17·9	18·3	18·7	19·1	19·5	20·4	21·2	22·0
59	**18**	10·6	11·5	12·1	12·7	13·2	13·6	14·0	14·4	14·7	15·0	15·7	16·2	16·7	17·2	17·7	18·1	18·6	19·0	19·4	19·7	20·6	21·5	22·2
62	**19**	10·9	11·7	12·4	12·9	13·4	13·8	14·2	14·6	14·9	15·3	15·9	16·5	17·0	17·5	17·9	18·4	18·8	19·2	19·6	20·0	20·9	21·7	22·5
66	**20**	11·1	12·0	12·6	13·1	13·6	14·1	14·5	14·8	15·2	15·5	16·1	16·7	17·2	17·7	18·2	18·6	19·0	19·4	19·8	20·2	21·1	21·9	22·7
72	**22**	11·6	12·4	13·0	13·6	14·1	14·5	14·9	15·3	15·6	15·9	16·6	17·1	17·7	18·1	18·6	19·1	19·5	19·9	20·3	20·7	21·5	22·4	23·2
79	**24**	12·0	12·8	13·5	14·0	14·5	14·9	15·3	15·7	16·0	16·4	17·0	17·6	18·1	18·6	19·0	19·5	19·9	20·3	20·7	21·1	22·0	22·8	23·6
85	**26**	12·4	13·2	13·9	14·4	14·9	15·3	15·7	16·1	16·4	16·8	17·4	18·0	18·5	19·0	19·4	19·9	20·3	20·7	21·1	21·5	22·4	23·2	24·0
92	**28**	12·8	13·6	14·3	14·8	15·3	15·7	16·1	16·5	16·8	17·2	17·8	18·3	18·9	19·4	19·8	20·3	20·7	21·1	21·5	21·9	22·8	23·6	24·4
98	**30**	13·2	14·0	14·6	15·2	15·7	16·1	16·5	16·9	17·2	17·5	18·2	18·7	19·2	19·7	20·2	20·7	21·1	21·5	21·9	22·2	23·1	24·0	24·7
115	**35**	14·0	14·9	15·5	16·1	16·6	17·0	17·4	17·8	18·1	18·4	19·1	19·6	20·1	20·6	21·1	21·5	22·0	22·4	22·8	23·1	24·0	24·9	25·6
131	**40**	14·9	15·7	16·4	16·9	17·4	17·8	18·2	18·6	18·9	19·3	19·9	20·4	21·0	21·5	21·9	22·4	22·8	23·2	23·6	24·0	24·9	25·7	26·5
148	**45**	15·7	16·5	17·1	17·7	18·2	18·6	19·0	19·4	19·7	20·0	20·7	21·2	21·7	22·2	22·7	23·2	23·6	24·0	24·4	24·7	25·6	26·5	27·2
164	**50**	16·4	17·2	17·9	18·4	18·9	19·3	19·7	20·1	20·5	20·8	21·4	22·0	22·5	23·0	23·4	23·9	24·3	24·7	25·1	25·5	26·4	27·2	28·0
180	**55**	17·1	17·9	18·6	19·1	19·6	20·0	20·4	20·8	21·2	21·5	22·1	22·7	23·2	23·7	24·1	24·6	25·0	25·4	25·8	26·2	27·1	27·9	28·7
197	**60**	17·8	18·6	19·3	19·8	20·3	20·7	21·1	21·5	21·8	22·2	22·8	23·3	23·9	24·3	24·8	25·3	25·7	26·1	26·5	26·9	27·7	28·6	29·4
213	**65**	18·4	19·2	19·9	20·4	20·9	21·4	21·7	22·1	22·5	22·8	23·4	24·0	24·5	25·0	25·5	25·9	26·3	26·7	27·1	27·5	28·4	29·2	30·0
230	**70**	19·0	19·9	20·5	21·1	21·5	22·0	22·4	22·7	23·1	23·4	24·0	24·6	25·1	25·6	26·1	26·5	26·9	27·4	27·7	28·1	29·0	29·8	30·6
246	**75**	19·6	20·5	21·1	21·7	22·1	22·6	23·0	23·3	23·7	24·0	24·6	25·2	25·7	26·2	26·7	27·1	27·5	27·9	28·3	28·7	29·6	30·4	31·2
262	**80**	20·2	21·0	21·7	22·2	22·7	23·1	23·5	23·9	24·3	24·6	25·2	25·8	26·3	26·8	27·3	27·7	28·1	28·5	28·9	29·3	30·2	31·0	31·8
279	**85**	20·8	21·6	22·2	22·8	23·3	23·7	24·1	24·5	24·8	25·1	25·8	26·3	26·9	27·3	27·8	28·3	28·7	29·1	29·5	29·9	30·7	31·6	32·4
295	**90**	21·3	22·1	22·8	23·3	23·8	24·2	24·6	25·0	25·4	25·7	26·3	26·9	27·4	27·9	28·4	28·8	29·2	29·6	30·0	30·4	31·3	32·1	32·9
312	**95**	21·8	22·7	23·3	23·9	24·3	24·8	25·2	25·5	25·9	26·2	26·8	27·4	27·9	28·4	28·9	29·3	29·7	30·1	30·5	30·9	31·8	32·6	33·4
328	**100**	22·3	23·2	23·8	24·4	24·9	25·3	25·7	26·1	26·4	26·7	27·3	27·9	28·4	28·9	29·4	29·8	30·3	30·7	31·1	31·4	32·3	33·2	33·9
361	**110**	23·3	24·2	24·8	25·4	25·8	26·3	26·7	27·0	27·4	27·7	28·3	28·9	29·4	29·9	30·4	30·8	31·3	31·7	32·1	32·4	33·3	34·1	34·9
394	**120**	24·3	25·1	25·8	26·3	26·8	27·2	27·6	28·0	28·3	28·7	29·3	29·8	30·4	30·9	31·3	31·8	32·2	32·6	33·0	33·4	34·3	35·1	35·9
427	**130**	25·2	26·0	26·7	27·2	27·7	28·1	28·5	28·9	29·2	29·6	30·2	30·8	31·3	31·8	32·2	32·7	33·1	33·5	33·9	34·3	35·2	36·0	36·8
459	**140**	26·1	26·9	27·6	28·1	28·6	29·0	29·4	29·8	30·1	30·5	31·1	31·6	32·2	32·6	33·1	33·6	34·0	34·4	34·8	35·2	36·0	36·9	37·7
492	**150**	26·9	27·7	28·4	28·9	29·4	29·9	30·2	30·6	31·0	31·3	31·9	32·5	33·0	33·5	34·0	34·4	34·8	35·2	35·6	36·0	36·9	37·7	38·5
525	**160**	27·7	28·6	29·2	29·8	30·2	30·7	31·1	31·4	31·8	32·1	32·7	33·3	33·8	34·3	34·8	35·2	35·6	36·0	36·4	36·8	37·7	38·5	39·3
558	**170**	28·5	29·4	30·0	30·5	31·0	31·5	31·9	32·2	32·6	32·9	33·5	34·1	34·6	35·1	35·6	36·0	36·4	36·8	37·2	37·6	38·5	39·3	40·1
591	**180**	29·3	30·1	30·8	31·3	31·8	32·2	32·6	33·0	33·3	33·7	34·3	34·9	35·4	35·9	36·3	36·8	37·2	37·6	38·0	38·4	39·3	40·1	40·9
623	**190**	30·0	30·9	31·5	32·1	32·5	33·0	33·4	33·7	34·1	34·4	35·0	35·6	36·1	36·6	37·1	37·5	37·9	38·4	38·7	39·1	40·0	40·8	41·6
656	**200**	30·8	31·6	32·2	32·8	33·3	33·7	34·1	34·5	34·8	35·1	35·8	36·3	36·8	37·3	37·8	38·3	38·7	39·1	39·5	39·8	40·7	41·6	42·3
722	**220**	32·2	33·0	33·6	34·2	34·7	35·1	35·5	35·9	36·2	36·5	37·2	37·7	38·3	38·7	39·2	39·7	40·1	40·5	40·9	41·4	42·1	43·0	43·8
787	**240**	33·5	34·3	35·0	35·5	36·0	36·4	36·8	37·2	37·6	37·9	38·5	39·1	39·6	40·1	40·4	41·0	41·4	41·8	42·2	42·6	43·5	44·3	45·1
853	**260**	34·8	35·6	36·3	36·8	37·3	37·7	38·1	38·5	38·8	39·2	39·8	40·4	40·9	41·4	41·8	42·3	42·7	43·1	43·5	43·9	44·8	45·6	46·4
919	**280**	36·0	36·9	37·5	38·0	38·5	39·0	39·4	39·7	40·1	40·4	41·0	41·6	42·1	42·6	43·1	43·5	43·9	44·3	44·7	45·1	46·0	46·8	47·6
984	**300**	37·2	38·1	38·7	39·2	39·7	40·2	40·6	40·9	41·3	41·6	42·2	42·8	43·3	43·8	44·3	44·7	45·1	45·5	45·9	46·3	47·2	48·0	48·8
1050	**320**	38·4	39·2	39·9	40·4	40·9	41·3	41·7	42·1	42·4	42·8	43·4	43·9	44·5	45·0	45·4	45·9	46·3	46·7	47·1	47·5	48·3	49·2	50·0
1115	**340**	39·5	40·3	41·0	41·5	42·0	42·4	42·8	43·2	43·5	43·9	44·5	45·1	45·6	46·1	46·5	47·0	47·4	47·8	48·2	48·6	49·5	50·3	51·1
1181	**360**	40·6	41·4	42·1	42·6	43·1	43·5	43·9	44·3	44·6	45·0	45·6	46·1	46·7	47·2	47·6	48·1	48·5	48·9	49·3	49·7	50·6	51·4	52·2
1247	**380**	41·6	42·5	43·1	43·7	44·1	44·6	45·0	45·3	45·7	46·0	46·6	47·2	47·7	48·2	48·7	49·1	49·5	50·0	50·3	50·7	51·6	52·4	53·2
1312	**400**	42·7	43·5	44·1	44·7	45·2	45·6	46·0	46·4	46·7	47·0	47·7	48·2	48·7	49·2	49·7	50·1	50·6	51·0	51·4	51·7	52·6	53·5	54·2

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 01 DECEMBER 2021

0915 - 1215 hrs

Materials to be supplied by examination centres

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet (Version 3.0 March 2019) Nautical Almanac Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Datasheet Q1 Worksheet Q2(1) Gnomonic Chart Worksheet Q2(2) Mercator Chart Worksheet Q3 Radar Plotting Sheet

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.

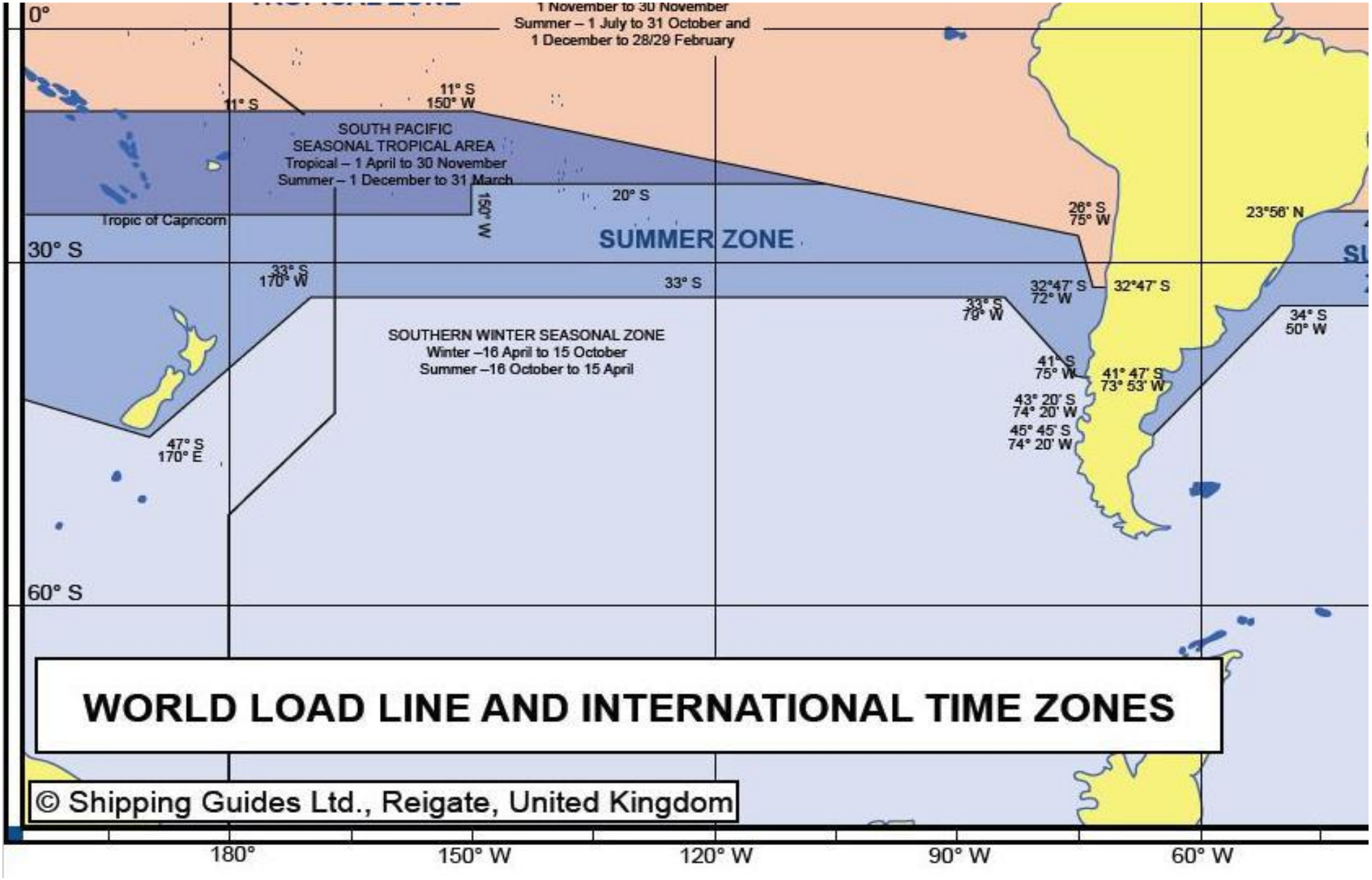
2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.

3. Non-programmable calculators may be used.

4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA


0°
1 November to 30 November
Summer – 1 July to 31 October and
1 December to 28/29 February
11° S
11° S
150° W
SOUTH PACIFIC
SEASONAL TROPICAL AREA
Tropical – 1 April to 30 November
Summer – 1 December to 31 March
20° S
150° W
Tropic of Capricorn
30° S
SUMMER ZONE
26° S
75° W
23°56' N
33° S
170° W
33° S
32°47' S
72° W
32°47' S
33° S
79° W
34° S
50° W
SOUTHERN WINTER SEASONAL ZONE
Winter –16 April to 15 October
Summer –16 October to 15 April
41° S
75° W
41° 47' S
73° 53' W
43° 20' S
74° 20' W
45° 45' S
74° 20' W
47° S
170° E
60° S
WORLD LOAD LINE AND INTERNATIONAL TIME ZONES
© Shipping Guides Ltd., Reigate, United Kingdom
180°
150° W
120° W
90° W
60° W

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer

All questions refer to a 30,000 gt general cargo ship undertaking a voyage from Auckland, New Zealand, to Puerto Montt, Chile. The ship will be loaded to the Summer displacement and will be at service speed 16.5 knots

1. The intended sea passage is:

   Auckland Pilot Station, coastal, 56 miles to waypoint 36°10'S 175°30'E;

   Rhumb Line to NW limit of 'Southern Winter Seasonal Zone';

   Parallel Sailing until the ship can enter the Southern Winter Seasonal Zone as soon as the Summer period applies;

   Great Circle to 41°30'S 74°30'W;

   Coastal, 40 miles, to Puerto Montt Pilot Station.

   (a) Assuming that UT applies to all Seasonal Loadline dates, with reference to Datasheet Q1, state the earliest time and date, UT, that the vessel can enter the Southern Winter Seasonal Zone. (5)

   (b) The ship is to disembark the Auckland Pilot at 0800 hours, Standard Time, 10th October. With reference to Datasheet Q1, calculate EACH of the following:

      (i) the distance to steam prior to commencing the Great Circle; (10)

      (ii) the position that the Great Circle can be commence; (20)

      (iii) the total distance of the passage. (10)

2. (a) With the aid of Worksheet Q2(1), plot, on Worksheet Q2(2), the intended ocean passage, as determined in Q1, from waypoint 36°10'S 175°30'E to waypoint 41°30'S 74°30'W. (20)

(b) Also on Worksheet Q2(2), sketch EACH of the following:

(i) the Peru (Humboldt) Current and the East Australian Current; (4)

(ii) the Sub Tropical Anticyclone (STAC); (2)

(iii) the prevailing air flow from the STAC that will affect the intended sea passage. (4)

(c) Outline the anticipated meteorological conditions of the ocean passage and how the prevailing wind and currents may affect the ETA at Puerto Montt Pilot Station. (15)

3. The fourth stage of the Voyage Plan, 'Monitoring', identifies that the primary means of position fixing will be by the ship's Global Navigation Satellite System, with Celestial Navigation as the secondary means.

(a) With regard to position monitoring, outline the accuracy, availability and possible errors of EACH of the following:

(i) GNSS; (7)

(ii) Celestial Navigation. (8)

(b) During the ocean passage, ship steering 090°T, at service speed, the OOW obtains the following stellar observations:

Star	Ship Time	CZD	TZD	Bearing
SUHAIL	1852 hours	12°19.5'	12°18.1'	129°T
SIRIUS	1900 hours	43°22.5'	43°22.9'	030°T
RIGEL	1903 hours	38°45.5'	38°46.0'	283°T
ALPHARD	1915 hours	83°22.6'	83°21.4'	185°T

The 1900 hours satellite position of 32°58.0'S 158°33.0'W was used for the observation calculations.

Using Worksheet Q3, or other suitable means, plot the FOUR positions lines to represent 1900 hours Ship Time. (16)

(c) Due to the inconsistencies within the FOUR stellar observations and with the satellite position, the OOW calls the Master to the bridge. The OOW informs the Master that heavy cloud cover limited the availability of stars for observation.

(i) State, giving reasons, the factors that the Master should consider when determining the ship's 1900 hours position. (8)

(ii) Based on the factors in Q3(c)(i), state, giving reasons, the ship's 1900 hours position. (4)

4. During the voyage the World Wide Navigation Warning Service (WWNWS) will be an important source of Maritime Safety Information.

(a) Define *Maritime Safety Information*, as outlined in the SOLAS convention. (4)

(b) State the obligations of the Master with regards to WWNWS. (6)

(c) Outline the main features of EACH of the following:

(i) Navarea warnings; (8)

(ii) Coastal Warnings; (8)

(iii) Local Warnings. (6)

(d) State the purpose of EACH of the following:

(i) International SafetyNET service; (3)

(ii) Navtex service. (2)

5. Due to a series of errors made by a junior officer, when undertaking celestial observations and calculating ETAs at voyage waypoints, the Master needs to explain the principle of world-wide time systems to the officer.

(a) Outline EACH of the following terms:

(i) Standard Time; (3)

(ii) Daylight Saving Time; (3)

(iii) Local Time in a port; (3)

(iv) Local Mean Time; (3)

(v) Zone Time; (3)

(vi) Longitude Into Time (Arc to time conversion). (3)

(b) To appraise whether the officer is now competent, the Master sets a test.

If the Local Time in Great Britain is 06:47:23, on the 3rd April, determine the following times at Eastport Pilot Station (44°54'N 66°59'W), Maine, USA:

(i) Universal Time; (3)

(ii) Standard Time; (3)

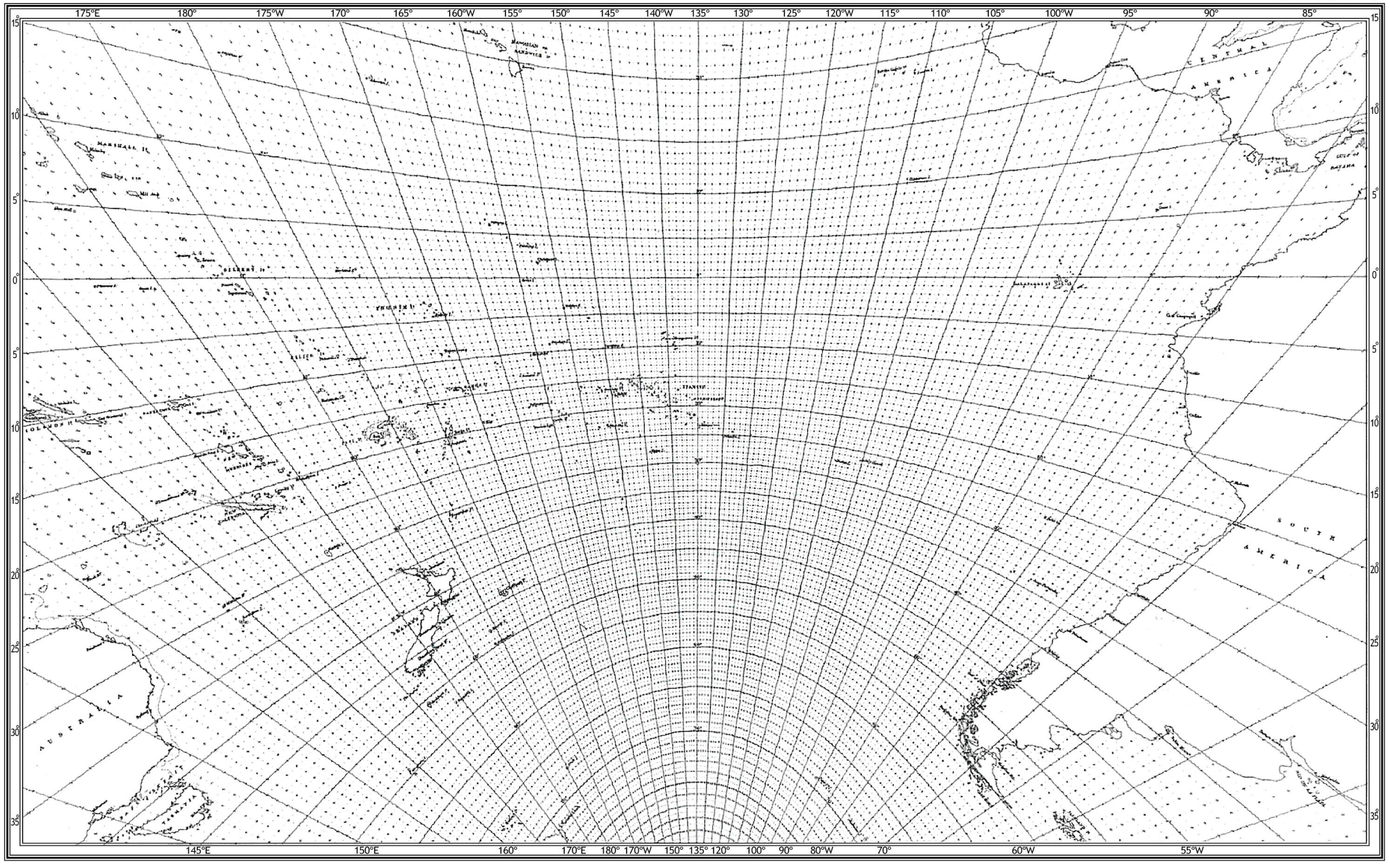
(iii) Local Time; (3)

(iv) Zone Time. (3)

GNOMONIC CHART FOR FACILITATING GREAT CIRCLE SAILING

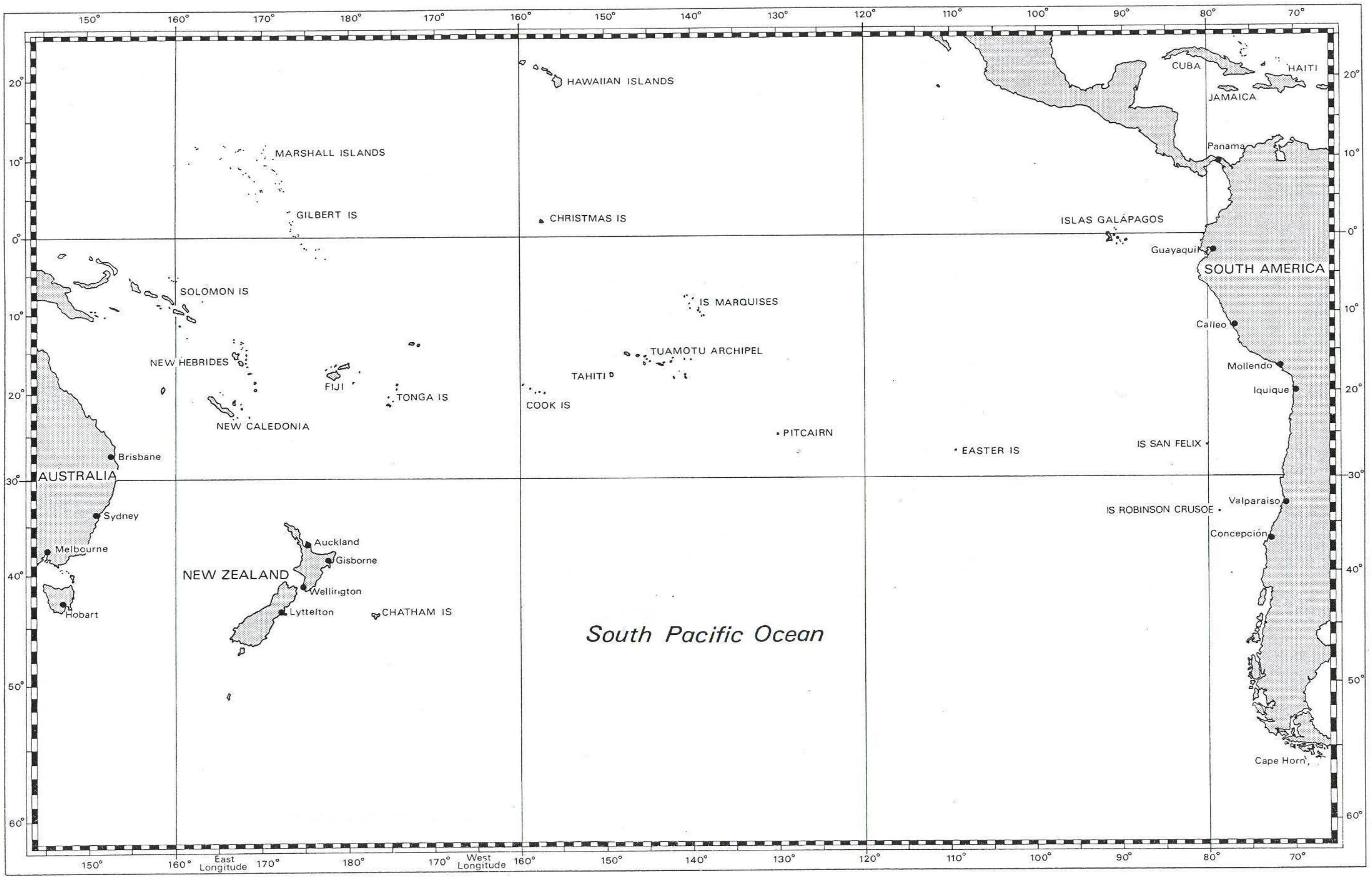
SOUTH PACIFIC AND SOUTHERN OCEANS

Chart T



Candidate's Name ……..……..

Examination Centre ……



Candidate's Name ……..……..

Examination Centre ……

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 23 MARCH 2022

0915 - 1215 hrs

Materials to be supplied by examination centres

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet (Version 3.0 March 2019) Nautical Almanac Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Worksheet Q3 Worksheet Q4 Radar Plotting Sheet Datasheet Q5 Worksheet Q5

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.

2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.

3. Non-programmable calculators may be used.

4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer

All questions refer to a car carrier, LOA 200 m, Service Speed 22.0 knots, on Time Charter between South Korea and Australia.

The Charterer has advised the Master that the forthcoming voyage will be from Daecheon Hang, S.Korea to Darwin, Northern Territories, and Brisbane, Queensland, Australia.

1. SOLAS Chapter V specifies the legal aspects regarding *Safe Navigation*.

   (a) Outline EACH of the following:

      (i) the Master's legal obligation regarding a Voyage Plan; (8)

      (ii) the FOUR specific requirements of a planned route. (8)

   (b) The Charterer advises the Master that, due to the urgency of the cargo delivery, he is to plan a passage of the shortest possible route, not to deviate whilst on passage and to maintain service speed at all times.

      Outline the Master's legal protection, as specified in SOLAS Chapter V, regarding non-compliance with the Charterer's instruction. (8)

   (c) It is intended to compile the Passage Plan using the ship's approved ECDIS equipment. However, full coverage of Indonesian waters is not available on the ship's Electronic Navigation Charts (ENC).

      Outline the key points of the current MCA guidance when operating approved ECDIS equipment in the Raster Chart Display System (RCDS) mode. (6)

   (d) Outline the purpose and details of CATZOC on Electronic Navigational Charts (ENC). (10)

2. The ship completes cargo operations at the port of Daecheon Hang, S.Korea (ATT Pacific and Atlantic Index No 7501) and is preparing to go to sea on the evening of the 24th July.

The departure drafts are noted as For'd 7.8 m and Aft 8.0 m.

Company policy requires a squat allowance of 10% of the departure draft and the Master has stated that a minimum UKC of 1.0 metre must be maintained at all times.

Immediately after the vessel clears the berth, the outbound pilotage involves a 40 minute transit of a dredged channel. Charted depth of dredged channel 5.6 m. The pilot advises that the vessel should enter the channel TWO hours before the evening High Water.

(a) Determine EACH of the following:

(i) the minimum height of tide required to pass through the channel; (5)

(ii) the intended time to clear the berth to meet the Pilot's advice. (5)

(b) During the pre-departure equipment tests, a fault is detected with the vessels steering system which needs to be rectified prior to leaving the berth.

Determine the latest time that the vessel can safely commence the channel transit on the subsequent ebb tide. (10)

(c) The vessel clears the port and commences the sea passage at 0230 hrs (South Korean Standard Time) on the 25th July.

To programme future port operations, the charterers require notification of the anticipated arrival times at the Australian ports.

The voyage plan indicates:	Daecheon Hang to Darwin	3113 miles;
	Darwin to Brisbane	2057 miles.

Port operations in Darwin are estimated to take 18 hours to complete.

Determine EACH of the following:

(i) the ETA Darwin (Standard Time); (8)

(ii) the ETA Brisbane (Standard Time). (8)

3. After departure from Daecheon Hang, meteorological warnings regarding the movement of a TRS have been received.

At 0600 hours on the 26th July, UT, information is received that the TRS is now in position 18°00'N 118°00'E. The storm is presently heading 040°T at 10 knots and has an area of influence of 250 miles.

0600/26 UT ship position 27°30'N 127°00'E, course 174°T at service speed.

(a) Calculate the bearing and distance of the TRS from the ship at 0600/26 UT. (8)

(b) Using Worksheet Q3, show EACH of the following:

(i) the ship positions at 0600/26 UT and DR position at 0600/27 UT; (4)

(ii) the TRS position at 0600/26 UT; (2)

(iii) the possible area of influence of the storm during the period 0600/26 to 0600/27 UT. (8)

(c) At 0700 hours on the 26th July, UT, the Master chairs a meeting with the Navigation Officers to debate the options available to manoeuvre the ship to safety.

State the factors to consider and the advisability for undertaking EACH of the following options:

(i) continue on passage; (6)

(ii) take shelter in the lee of Okinawa Island; (6)

(iii) steer due North; (6)

(iv) steer to pass North of Taiwan and enter Taiwan Strait; (6)

(v) pass North of Okinawa and then steer a SE'ly course. (6)

4. The planned track through Indonesian waters transits areas of numerous, low lying, islands. Terrestrial navigation aids are limited and unreliable. Precise and accurate navigation is required.

(a) Current Marine Guidance Notice gives recommendations regarding the use of electronic navigational aids.

(i) State the FIVE checks that are outlined when using radar for position fixing and monitoring. (10)

(ii) Outline the recommended method for ensuring that the radar display heading marker is correctly aligned with the heading of the ship. (8)

(b) The planned track, 180°T, will pass 5.0 miles west of an isolated shoal. At twilight, whilst approaching the area during good weather and clear visibility, the OOW obtains 3 positions by independent means.

The GNSS position shows the ship 0.2 miles to the west of the planned track.

The morning star position shows the ship 1.1 mile to the east of the planned track.

The radar position, obtained by long range scanning, shows the ship 1.6 miles to the west of the planned track.

State, giving reasons, which position a prudent navigator would assume to be the most relevant. (5)

(c) Parallel Indexing is to be used during a passage of restricted waters through an island chain.

An appropriate reference point, Bandu Island, has been identified and the nominated radar will be set on the 3 mile range scale.

The planned approach track is 167°T.

When Bandu Island is on the starboard beam, range 1.9 miles, the planned track is altered to 180°T.

When Bandu Island is bearing 283°T, range 1.9 miles, the planned track is altered to 205°T to clear the island chain.

(i) Using Worksheet Q4, draw the Parallel Index lines for the passage. (15)

(ii) Bandu Island first appears on the nominated radar bearing 210°T x 3.0'.

State the action required to resume the planned track. (4)

5. The passage from Darwin to Brisbane transits the Torres Strait.

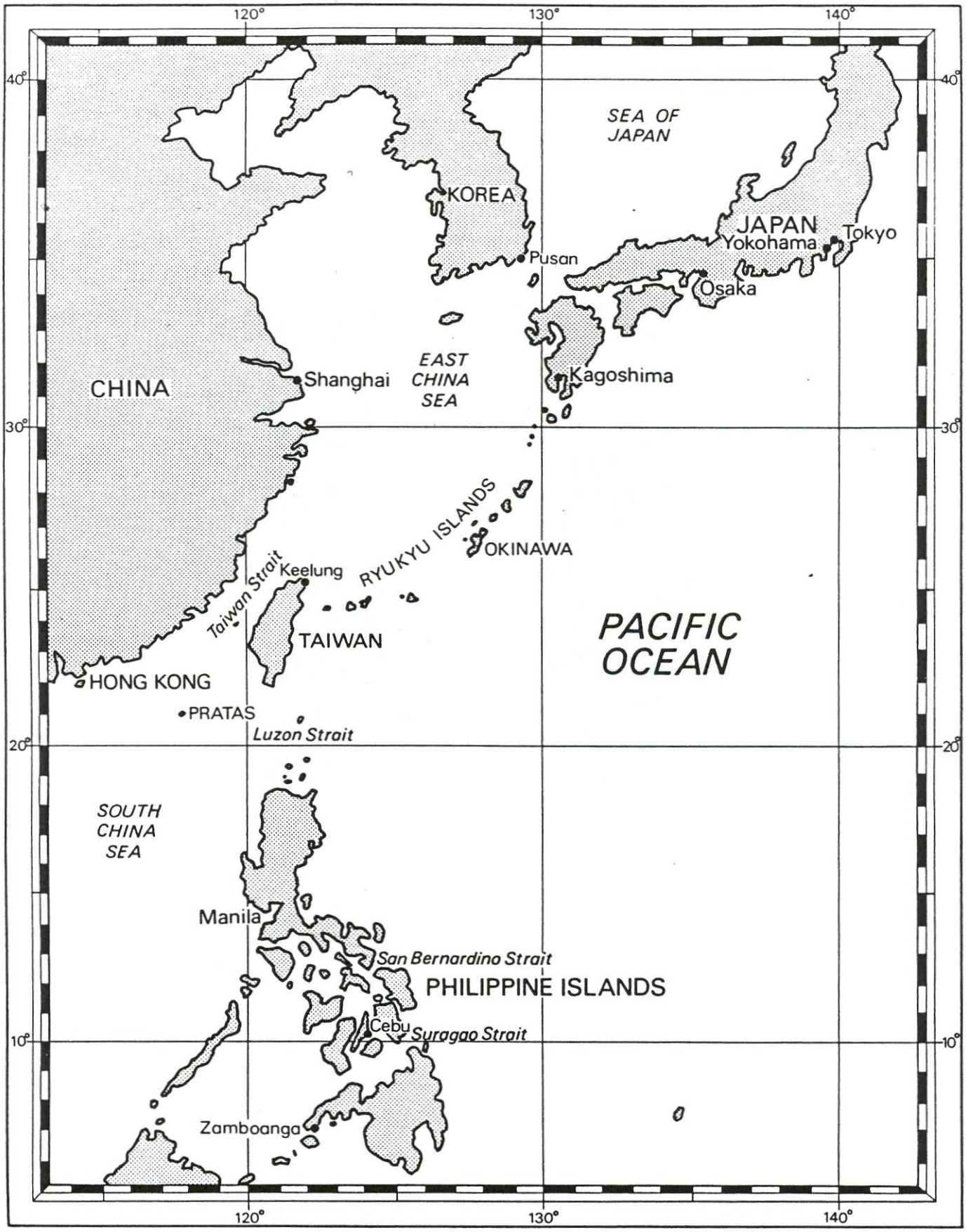
The Master requires to pass Hammond Rock lighthouse between sunrise and sunset and during a tidal stream not exceeding 3.0 knots.

(a) With reference to Datasheet Q5, determine the Standard Times of sunrise and sunset on the 2nd August, at Hammond Rock lighthouse. (10)

(b) Using Worksheet Q5, identify the time periods that meet the Master's requirements to pass Hammond Rock lighthouse. (20)

(This Worksheet must be returned with your answer book)

Chart M



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

G.M.T.	SUN G.H.A.	SUN Dec.	MOON G.H.A.	MOON v	MOON Dec.	MOON d	MOON H.P.
d h	° ′	° ′	° ′	′	° ′	′	′
1 00	178 25.7	N18 02.5	118 07.6	9.3	S 7 14.6	11.2	59.4
01	193 25.7	01.9	132 35.9	9.4	7 25.8	11.1	59.4
02	208 25.7	01.2	147 04.3	9.3	7 36.9	11.1	59.4
03	223 25.8	00.6	161 32.6	9.3	7 48.0	11.1	59.4
04	238 25.8	18 00.0	176 00.9	9.2	7 59.1	11.0	59.4
05	253 25.9	17 59.3	190 29.1	9.3	8 10.1	11.0	59.4
06	268 25.9	N17 58.7	204 57.4	9.2	S 8 21.1	10.9	59.4
07	283 25.9	58.1	219 25.6	9.1	8 32.0	10.8	59.4
08	298 26.0	57.5	233 53.7	9.2	8 42.8	10.8	59.4
S 09	313 26.0	56.8	248 21.9	9.1	8 53.6	10.8	59.4
U 10	328 26.1	56.2	262 50.0	9.0	9 04.4	10.7	59.4
N 11	343 26.1	55.6	277 18.0	9.1	9 15.1	10.7	59.4
D 12	358 26.1	N17 54.9	291 46.1	9.0	S 9 25.8	10.6	59.4
A 13	13 26.2	54.3	306 14.1	9.0	9 36.4	10.5	59.4
Y 14	28 26.2	53.7	320 42.1	8.9	9 46.9	10.5	59.4
15	43 26.3	53.0	335 10.0	8.9	9 57.4	10.4	59.4
16	58 26.3	52.4	349 37.9	8.9	10 07.8	10.3	59.4
17	73 26.3	51.7	4 05.8	8.8	10 18.1	10.3	59.4
18	88 26.4	N17 51.1	18 33.6	8.8	S10 28.4	10.2	59.4
19	103 26.4	50.5	33 01.4	8.8	10 38.6	10.2	59.4
20	118 26.5	49.8	47 29.2	8.8	10 48.8	10.1	59.4
21	133 26.5	49.2	61 57.0	8.7	10 58.9	10.0	59.4
22	148 26.5	48.6	76 24.7	8.6	11 08.9	10.0	59.4
23	163 26.6	47.9	90 52.3	8.7	11 18.9	9.9	59.4
2 00	178 26.6	N17 47.3	105 20.0	8.6	S11 28.8	9.8	59.4
01	193 26.7	46.6	119 47.6	8.5	11 38.6	9.8	59.4
02	208 26.7	46.0	134 15.1	8.5	11 48.4	9.6	59.4
03	223 26.8	45.4	148 42.6	8.5	11 58.0	9.6	59.4
04	238 26.8	44.7	163 10.1	8.5	12 07.6	9.6	59.4
05	253 26.8	44.1	177 37.6	8.4	12 17.2	9.4	59.4
06	268 26.9	N17 43.4	192 05.0	8.4	S12 26.6	9.4	59.4
07	283 26.9	42.8	206 32.4	8.3	12 36.0	9.3	59.3
08	298 27.0	42.1	220 59.7	8.3	12 45.3	9.2	59.3
M 09	313 27.0	41.5	235 27.0	8.3	12 54.5	9.2	59.3
O 10	328 27.1	40.8	249 54.3	8.2	13 03.7	9.0	59.3
N 11	343 27.1	40.2	264 21.5	8.2	13 12.7	9.0	59.3
D 12	358 27.2	N17 39.6	278 48.7	8.2	S13 21.7	8.9	59.3
A 13	13 27.2	38.9	293 15.9	8.1	13 30.6	8.8	59.3
Y 14	28 27.3	38.3	307 43.0	8.1	13 39.4	8.7	59.3
15	43 27.3	37.6	322 10.1	8.0	13 48.1	8.7	59.3
16	58 27.4	37.0	336 37.1	8.1	13 56.8	8.5	59.3
17	73 27.4	36.3	351 04.2	7.9	14 05.3	8.5	59.3
18	88 27.4	N17 35.7	5 31.1	8.0	S14 13.8	8.3	59.3
19	103 27.5	35.0	19 58.1	7.9	14 22.1	8.3	59.3
20	118 27.5	34.4	34 25.0	7.8	14 30.4	8.2	59.3
21	133 27.6	33.7	48 51.8	7.9	14 38.6	8.1	59.3
22	148 27.6	33.1	63 18.7	7.8	14 46.7	8.0	59.3
23	163 27.7	32.4	77 45.5	7.7	14 54.7	7.9	59.3
3 00	178 27.7	N17 31.8	92 12.2	7.7	S15 02.6	7.9	59.3
01	193 27.8	31.1	106 38.9	7.7	15 10.5	7.7	59.2
02	208 27.8	30.5	121 05.6	7.7	15 18.2	7.6	59.2
03	223 27.9	29.8	135 32.3	7.6	15 25.8	7.5	59.2
04	238 27.9	29.2	149 58.9	7.6	15 33.3	7.5	59.2
05	253 28.0	28.5	164 25.5	7.5	15 40.8	7.3	59.2
06	268 28.0	N17 27.8	178 52.0	7.5	S15 48.1	7.2	59.2
07	283 28.1	27.2	193 18.5	7.5	15 55.3	7.1	59.2
08	298 28.1	26.5	207 45.0	7.4	16 02.4	7.1	59.2
T 09	313 28.2	25.9	222 11.4	7.4	16 09.5	6.9	59.2
U 10	328 28.3	25.2	236 37.8	7.4	16 16.4	6.8	59.2
E 11	343 28.3	24.6	251 04.2	7.4	16 23.2	6.7	59.2
S 12	358 28.4	N17 23.9	265 30.6	7.3	S16 29.9	6.6	59.2
D 13	13 28.4	23.3	279 56.9	7.3	16 36.5	6.5	59.2
A 14	28 28.5	22.6	294 23.2	7.2	16 43.0	6.4	59.1
Y 15	43 28.5	21.9	308 49.4	7.2	16 49.4	6.3	59.1
16	58 28.6	21.3	323 15.6	7.2	16 55.7	6.2	59.1
17	73 28.6	20.6	337 41.8	7.2	17 01.9	6.1	59.1
18	88 28.7	N17 20.0	352 08.0	7.1	S17 08.0	6.0	59.1
19	103 28.7	19.3	6 34.1	7.1	17 14.0	5.8	59.1
20	118 28.8	18.6	21 00.2	7.1	17 19.8	5.8	59.1
21	133 28.8	18.0	35 26.3	7.0	17 25.6	5.6	59.1
22	148 28.9	17.3	49 52.3	7.1	17 31.2	5.5	59.1
23	163 29.0	16.6	64 18.4	7.0	17 36.7	5.4	59.1
	S.D. 15.8	d 0.6	S.D.	16.2		16.2	16.1

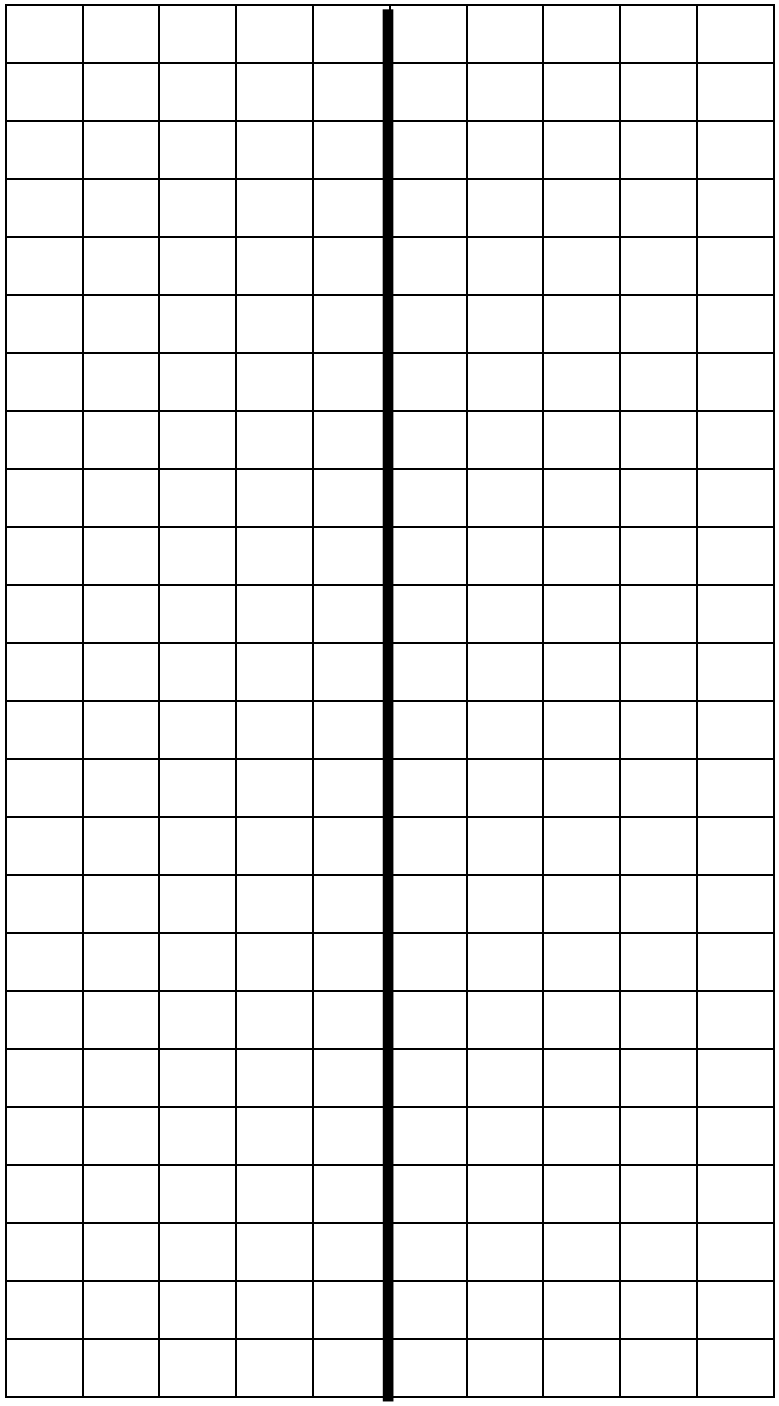
Lat.	Twilight Naut.	Twilight Civil	Sunrise	Moonrise 1	Moonrise 2	Moonrise 3	Moonrise 4
°	h m	h m	h m	h m	h m	h m	h m
N 72	▭	▭	▭	12 41	14 50	17 20	▬
N 70	////	////	01 35	12 25	14 21	16 19	18 17
68	////	////	02 20	12 13	13 59	15 44	17 21
66	////	00 37	02 49	12 02	13 42	15 19	16 47
64	////	01 45	03 11	11 54	13 28	15 00	16 23
62	////	02 19	03 28	11 46	13 17	14 44	16 04
60	00 33	02 43	03 43	11 40	13 07	14 31	15 48
N 58	01 35	03 02	03 55	11 34	12 59	14 20	15 34
56	02 06	03 17	04 05	11 29	12 51	14 10	15 23
54	02 29	03 31	04 15	11 25	12 44	14 01	15 13
52	02 47	03 42	04 23	11 21	12 39	13 54	15 04
50	03 01	03 52	04 30	11 17	12 33	13 47	14 56
45	03 30	04 13	04 46	11 10	12 22	13 32	14 39
N 40	03 52	04 29	04 59	11 03	12 12	13 20	14 25
35	04 09	04 42	05 10	10 58	12 04	13 10	14 13
30	04 23	04 54	05 19	10 53	11 57	13 01	14 03
20	04 45	05 12	05 36	10 44	11 45	12 45	13 45
N 10	05 02	05 28	05 50	10 37	11 34	12 32	13 30
0	05 16	05 41	06 03	10 30	11 24	12 19	13 16
S 10	05 28	05 54	06 16	10 24	11 14	12 07	13 02
20	05 40	06 06	06 29	10 16	11 04	11 54	12 47
30	05 51	06 19	06 45	10 08	10 52	11 39	12 29
35	05 56	06 27	06 54	10 04	10 45	11 30	12 19
40	06 02	06 35	07 04	09 59	10 37	11 20	12 08
45	06 09	06 44	07 16	09 53	10 28	11 08	11 54
S 50	06 16	06 55	07 30	09 45	10 18	10 55	11 38
52	06 19	07 00	07 37	09 42	10 13	10 48	11 30
54	06 22	07 05	07 44	09 39	10 07	10 41	11 22
56	06 26	07 11	07 52	09 35	10 01	10 33	11 12
58	06 29	07 17	08 02	09 30	09 54	10 24	11 01
S 60	06 33	07 24	08 12	09 25	09 47	10 14	10 49

Lat.	Sunset	Twilight Civil	Twilight Naut.	Moonset 1	Moonset 2	Moonset 3	Moonset 4
°	h m	h m	h m	h m	h m	h m	h m
N 72	▭	▭	▭	20 23	20 08	19 34	▬
N 70	22 31	////	////	20 41	20 38	20 36	20 37
68	21 48	////	////	20 55	21 01	21 12	21 33
66	21 20	23 21	////	21 07	21 19	21 37	22 07
64	20 59	22 23	////	21 17	21 34	21 57	22 32
62	20 42	21 50	////	21 25	21 46	22 13	22 51
60	20 28	21 27	23 26	21 33	21 57	22 27	23 07
N 58	20 16	21 09	22 33	21 39	22 06	22 39	23 21
56	20 05	20 53	22 03	21 45	22 14	22 49	23 33
54	19 56	20 40	21 41	21 50	22 21	22 58	23 43
52	19 48	20 29	21 24	21 55	22 27	23 06	23 52
50	19 41	20 19	21 09	21 59	22 33	23 13	24 00
45	19 25	19 59	20 41	22 08	22 46	23 29	24 18
N 40	19 13	19 43	20 20	22 16	22 56	23 41	24 32
35	19 02	19 30	20 03	22 22	23 05	23 52	24 44
30	18 53	19 18	19 49	22 28	23 13	24 02	00 02
20	18 37	19 00	19 28	22 38	23 27	24 18	00 18
N 10	18 23	18 45	19 11	22 47	23 39	24 33	00 33
0	18 10	18 31	18 57	22 56	23 50	24 46	00 46
S 10	17 57	18 19	18 44	23 04	24 01	00 01	01 00
20	17 43	18 06	18 33	23 13	24 14	00 14	01 14
30	17 28	17 53	18 22	23 23	24 27	00 27	01 31
35	17 19	17 46	18 16	23 29	24 35	00 35	01 40
40	17 09	17 38	18 10	23 36	24 44	00 44	01 51
45	16 57	17 29	18 04	23 44	24 55	00 55	02 04
S 50	16 43	17 18	17 57	23 53	25 08	01 08	02 20
52	16 36	17 13	17 54	23 58	25 14	01 14	02 27
54	16 29	17 08	17 51	24 03	00 03	01 21	02 35
56	16 21	17 02	17 48	24 08	00 08	01 28	02 45
58	16 11	16 56	17 44	24 14	00 14	01 37	02 55
S 60	16 01	16 49	17 40	24 21	00 21	01 47	03 07

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	
1	06 17	06 16	12 06	16 43	04 17	05	
2	06 14	06 11	12 06	17 37	05 10	06	◐
3	06 09	06 07	12 06	18 33	06 05	07	

TIDAL STREAM CURVE

Direction (-) Direction (+)



TIME
(HRS)

0

RATE (KNOTS)

Scale to be adjusted as required

Candidate's Name …… Examination Centre ……

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –
DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 06 JULY 2022

0915 - 1215 hrs

Materials to be supplied by examination centres

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet (Version 3.0 March 2019) Nautical Almanac Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Datasheet Q1 Worksheet Q5

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.
2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.
3. Non-programmable calculators may be used.
4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All questions relate to a 30,000 dwt Product Tanker on a single voyage charter from Namibe, Angola, to Charleston, U.S.A. The ship is chartered to complete the sea passages at its most economical speed 11.0 knots.

1. The planned ocean passage is by Rhumb Line, using waypoints:

Dep Namibe	15°10'S 12°00'E.
Arr Charleston	32°45'N 79°45'W.

(a) Calculate EACH of the following:

(i) the course of the Rhumb Line passage; (10)

(ii) the distance of the Rhumb Line passage. (5)

(b) To enable the maximum cargo to be loaded at Namibe, the Charterer requires the Master to ensure that the transit of the North Atlantic Seasonal Tropical Zone is completed prior to the commencement of the 'Summer' period.

With regard to the intended Rhumb Line passage and with reference to Datasheet Q1:

(i) state the date and time by which the transit of the North Atlantic Seasonal Tropical Zone must be completed; (5)

(ii) calculate the distance from the commencement of the ocean passage to clearing the North Atlantic Seasonal Tropical Zone; (10)

(iii) calculate the latest time, Angola Standard Time, to commence the ocean passage to meet the Charterers requirements. (10)

Note: Assume that UT applies to all Loadline times and dates.

2. The requirements for the carriage of nautical charts, publications and equipment are laid down by SOLAS Ch V, as detailed in relevant Statutory Instruments and current Marine Guidance Notices.

(a) State the THREE specified requirements relating to the scale and content of a navigational chart. (6)

(b) In addition to nautical charts, list the publications that are considered to satisfy the carriage requirements of UK Regulations. (14)

(c) One of the criteria of the carriage of radio equipment is the type of voyage that a ship undertakes. Outline the FOUR sea areas pertaining to the carriage of radio equipment. (12)

(d) List the items of GMDSS equipment that should be carried for the specified voyage. (8)

3. To check the Bridge navigational equipment, the OOW obtains a celestial observation of the SUN during the morning watch, 29th June, in calm, clear conditions.

Observation details:

GNSS position:	14º21'.3S 10º29'.6E.
Universal Time:	08:31:22.
Sextant Altitude of Sun's LL:	33º47'.8 at observed bearings 049ºG and 055ºC.
Height of eye:	10.3m.
Index Error:	0.1' Off the arc.
Variation:	8ºW.

(a) Calculate the intercept and bearing of the SUN. (25)

(b) Calculate the gyro compass error and the deviation of the magnetic compass. (10)

(c) State, with reasons, the apparent reliability of the GNSS at the time of the celestial observation. (5)

4. During the ocean passage warnings are received from the US National Hurricane Centre regarding the movement of a Tropical Revolving Storm (TRS).

(a) Sketch a plan view of a North Atlantic TRS, naming all the features of the storm and its movement. (10)

(b) State the on board meteorological and oceanographical indicators of a possible TRS. (8)

(c) The ship comes under the influence of the TRS and the Master needs to take action to safeguard the ship and personnel.

The following meteorological conditions are noted:

Wind NE Force 6.
Pressure falling slowly.
Swell from SSE.

The US National Hurricane Centre predict that the TRS will continue on its present course 300ºT and increase speed to 9.0 knots.

The ship is not navigationally restricted.

(i) Outline the relative position of the ship in relation to the TRS. (8)

(ii) Outline how a prudent Master should manoeuvre the ship in light of the predicted path of the TRS and the ship's relative position. (6)

(d) Subsequently, the OOW advises the Master that the air pressure is now showing a marked fall and the wind is now Force 8 and 'veering' rapidly.

(i) Outline the relative position of the ship in relation to the TRS. (4)

(ii) State, giving reasons, whether the action outlined in Q4(c)(ii) remains the most effective course of action. (4)

5. A section of the Charleston pilotage passage requires the ship to maintain a constant radius turn to port, to maintain position within the dredged channel. The Port Authority has positioned a beacon at the centre of the turn radius to assist in position monitoring. A Parallel Index is to be plotted, using the beacon as the reference point (PI Ref).

The planned passage is:

Approach track 325°T, ship speed 8.0 knots.

PI Ref abeam x 1.6 miles, commence the port turn of constant radius of 1.6' from the PI Ref.

PI Ref bearing 130°T x 1.6' complete port turn, required track 200°T, distance 2.0 miles to the required position off the berth.

The 'Wheel Over' position for the port turn is 1.5 cables prior to the commencement of the turn.

The ship will commence reducing speed at a distance of 8 cables prior to the required position off the berth.

The radar will be set on the 3 mile range, North Up, relative motion.

(a) Using Worksheet Q5:

(i) construct the required Parallel Indexing for the stated passage; (20)

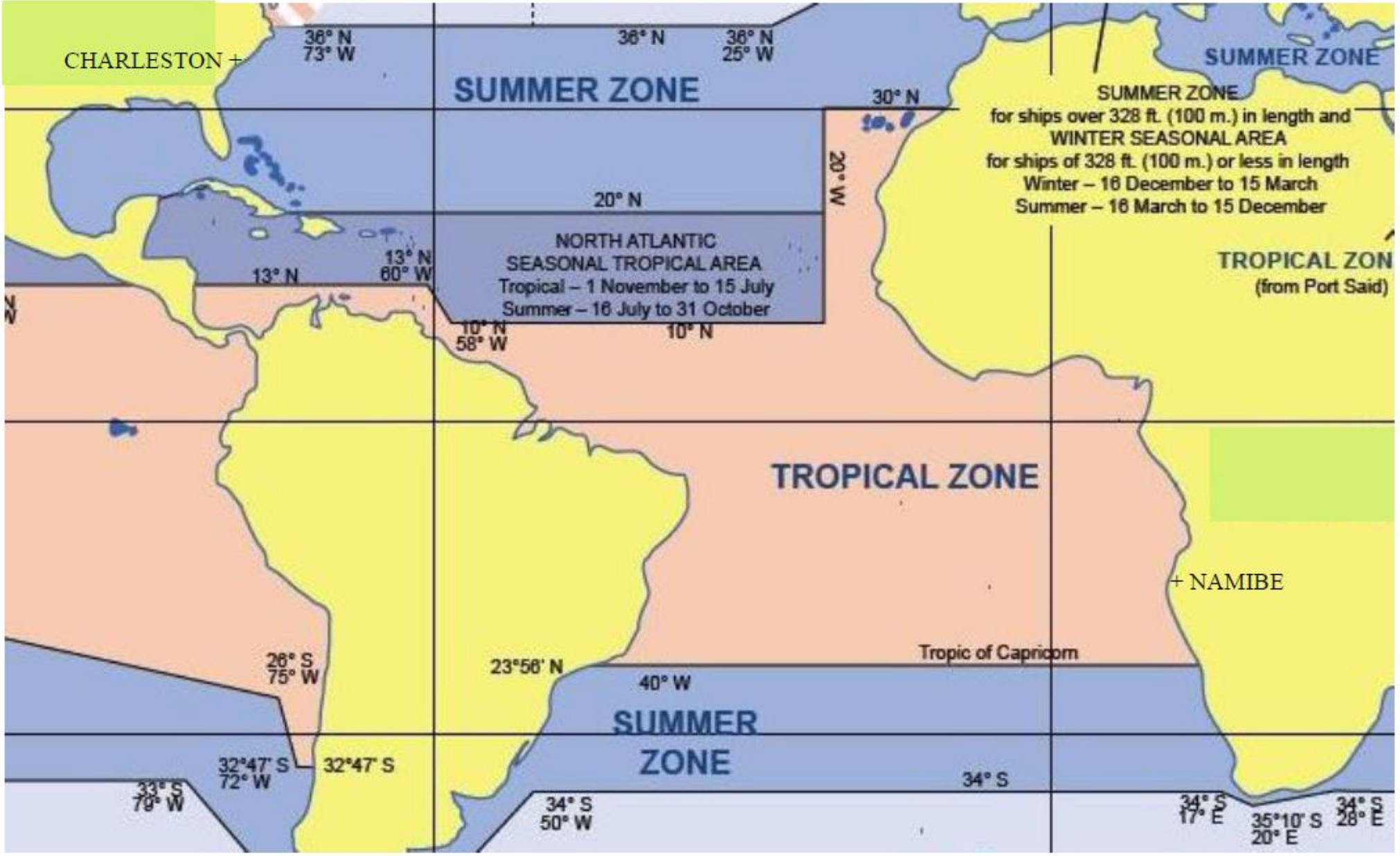
(ii) indicate the position of the beacon on the Parallel Indexing for the 'Wheel Over' position; (4)

(iii) indicate the position of the beacon on the Parallel Indexing for the commencement of the speed reduction. (4)

(b) During the port turn, the PI Ref is observed bearing 186°T x 1.7'.

Outline the required action to bring the ship back to the planned track as quickly as possible. (6)

(c) Explain why Parallel Indexing should not be the only method of monitoring the ship's position during the turn to port. (6)


CHARLESTON +
36° N
73° W
36° N
36° N
25° W
SUMMER ZONE
SUMMER ZONE
30° N
SUMMER ZONE
for ships over 328 ft. (100 m.) in length and
WINTER SEASONAL AREA
for ships of 328 ft. (100 m.) or less in length
Winter – 16 December to 15 March
Summer – 16 March to 15 December
20° W
20° N
NORTH ATLANTIC
SEASONAL TROPICAL AREA
Tropical – 1 November to 15 July
Summer – 16 July to 31 October
13° N
60° W
13° N
TROPICAL ZON
(from Port Said)
10° N
58° W
10° N
TROPICAL ZONE
+ NAMIBE
26° S
75° W
23°56' N
Tropic of Capricorn
40° W
SUMMER
ZONE
32°47' S
72° W
32°47' S
33° S
79° W
34° S
50° W
34° S
34° S
17° E
35°10' S
20° E
34° S
28° E

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –
DECK OFFICER

STCW 78 as amended CHIEF MATE/MASTER REG. II/2 (UNLIMITED)

032-73 - NAVIGATION

WEDNESDAY, 05 OCTOBER 2022

0915 - 1215 hrs

Materials to be supplied by examination centres

Candidate's examination workbook UK and Ireland Tide Tables (Edition Sept 2011) Navigation Formulae Datasheet (Version 3.0 March 2019) Nautical Almanac Nautical Tables Pacific and Atlantic Oceans Tide Tables (Edition Sept 2011)

Examination paper inserts:

Datasheet Q1 Worksheet Q2 Worksheet Q4 Datasheet Q5

Notes for the guidance of candidates:

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2. Candidates should note that 200 marks are allocated to this paper. To pass candidates must achieve 120 marks.

3. Non-programmable calculators may be used.

4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

NAVIGATION

Attempt ALL questions

Marks for each question are shown in brackets

All questions refer to a 50,000 gt bulk carrier, engaged on a 12 month time charter, trading between Africa and Australia. Service speed 16.2 knots, fuel consumption 45 tonnes per day.

1. The ship is presently loading at Maputo, Mozambique, and is to discharge at Geraldton, W. Australia. The ship will be loaded to the 'Summer' displacement. ETD Maputo 1600 hours, Standard Time, 8th April.

   A direct Great Circle route is being appraised, using waypoints:

Dep Maputo	26°40'S	33°00'E
Arr Geraldton	29°10'S	114°30'E

   (a) Calculate EACH of the following:

   (i) Initial course; (12)

   (ii) Distance; (8)

   (iii) Position of the vertex; (12)

   (b) The appraised direct Great Circle route transits through the Southern Winter Seasonal Zone.

   The distance from Maputo to the Southern Winter Seasonal Zone is 2050 miles and a further 580 miles will be within the Southern Winter Seasonal Zone.

   270 tonnes of fuel must be consumed to bring the ship to her 'Winter' loadline.

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

   (i) whether the intended direct Great Circle route is legally permissible for the ETD and 'Summer' displacement of the ship. (10)

   (ii) whether sufficient fuel would be consumed to permit a direct Great Circle route during the Southern Winter Seasonal Zone 'Winter' period. (8)

2. At 2030 hours, 17th April, a message is transmitted by a yacht, requesting urgent medical assistance. The message states the yacht position as 32°24'S 105°10'E and is making for Fremantle, Western Australia, course 090°T, speed 4.0 knots.

Own position 31°44'S 104°28'E.

(a) Calculate the bearing and distance of the yacht. (10)

(b) Whilst proceeding to give assistance, the Bridge team discuss the difficulty of visually locating a small yacht and consult The International Aeronautical and Maritime Search and Rescue Manual, Vol III, for guidance regarding lookouts.

State EACH of the following:

(i) the SIX factors affecting observer effectiveness; (6)

(ii) the recommended position of lookouts during the day; (2)

(iii) the recommended position of lookouts during the night. (4)

(c) Outline the function of the yacht's Search And Rescue Radar Transponder (SART) to aid location. (10)

(d) At 2324 hours radar contact is made with the yacht, bearing 135°T x 10.8'. Own ship immediately reduces to manoeuvring speed 12.0 knots.

To appraise the situation the Master decides to initially take station 1 mile on the port beam of the yacht.

The yacht will maintain her course and speed.

Due to the prevailing conditions the yacht lights are considered to be visible to a maximum range of 3.0 miles.

Using Worksheet Q2, or other suitable means, determine EACH of the following:

(i) course to the required position; (12)

(ii) relative bearing at which the yacht lights are predicted to be sighted. (6)

3. Australian medical officials have advised that the injured yachtsman should be hospitalised as a matter of urgency.

(a) Explain EACH of the relevant medical terms:

(i) Medico; (4)

(ii) Medevac. (2)

(b) The injured person has been transferred to own ship and own ship is now diverting to Fremantle. ETA 1900 hours, 19th April. A helicopter will be used to transfer the injured person to shore.

At 0800 hours, 18th April, the Master chairs a meeting with the Deck Officers and Chief Engineer to discuss aspects of the forthcoming ship/helicopter rendezvous.

State the topics to discuss at this meeting to prepare for the forthcoming rendezvous. (12)

(c) At 1815 hours, 19th April, initial communication is established with the helicopter.

Outline the information that should be exchanged between the ship and the helicopter prior to the commencement of the rendezvous operation. (12)

4. The ship is to transit the Prince of Wales Channel, Torres Strait.

The Admiralty Sailing Directions give warnings of "strong tidal flow" and "shallow water and numerous reefs in close proximity to the Traffic Scheme" in the channel.

The Admiralty Tide Tables give details of the rate and direction of the tidal streams.

(a) In preparation for the Torres Strait transit, using Worksheet Q4 or graph paper, construct a Tidal Stream Curve for the 28th August. (16)

(b) Outline EACH of the following:

(i) the function and presentation of the ECDIS 'Safety Contour' setting to assist in the transit; (7)

(ii) the function and presentation of the ECDIS 'Safety Depth' setting to assist in the transit. (7)

5. At 1500 hours, 28th June, during a Great Circle passage between Melbourne, Australia and Durban, S. Africa, the ship experiences a total failure of its Global Navigation Satellite System receiver whilst in position 51°00'S 110°30'E.

(a) Outline the difficulties of monitoring the ship's position for the remaining ocean passage without access to GNSS data. (10)

(b) The OOW undertakes stellar observations at evening twilight 28th June and calls the Master to the Bridge as the resulting observation plot does not clearly establish the ship's position.

Datasheet Q5 indicates the OOW's plot, based on the following details:

- DR 51°06'S 109°35'E;
- Ship steering 260°T at service speed;
- Position lines all run to 1645 hrs.

The star observations are:

Star	Ship Time	Intercept	Bearing
A	1640 hours	3.6' Towards	045°T
B	1645 hours	2.8' Away	031°T
C	1650 hours	1.9' Away	240°T
D	1654 hours	2.0' Towards	350°T

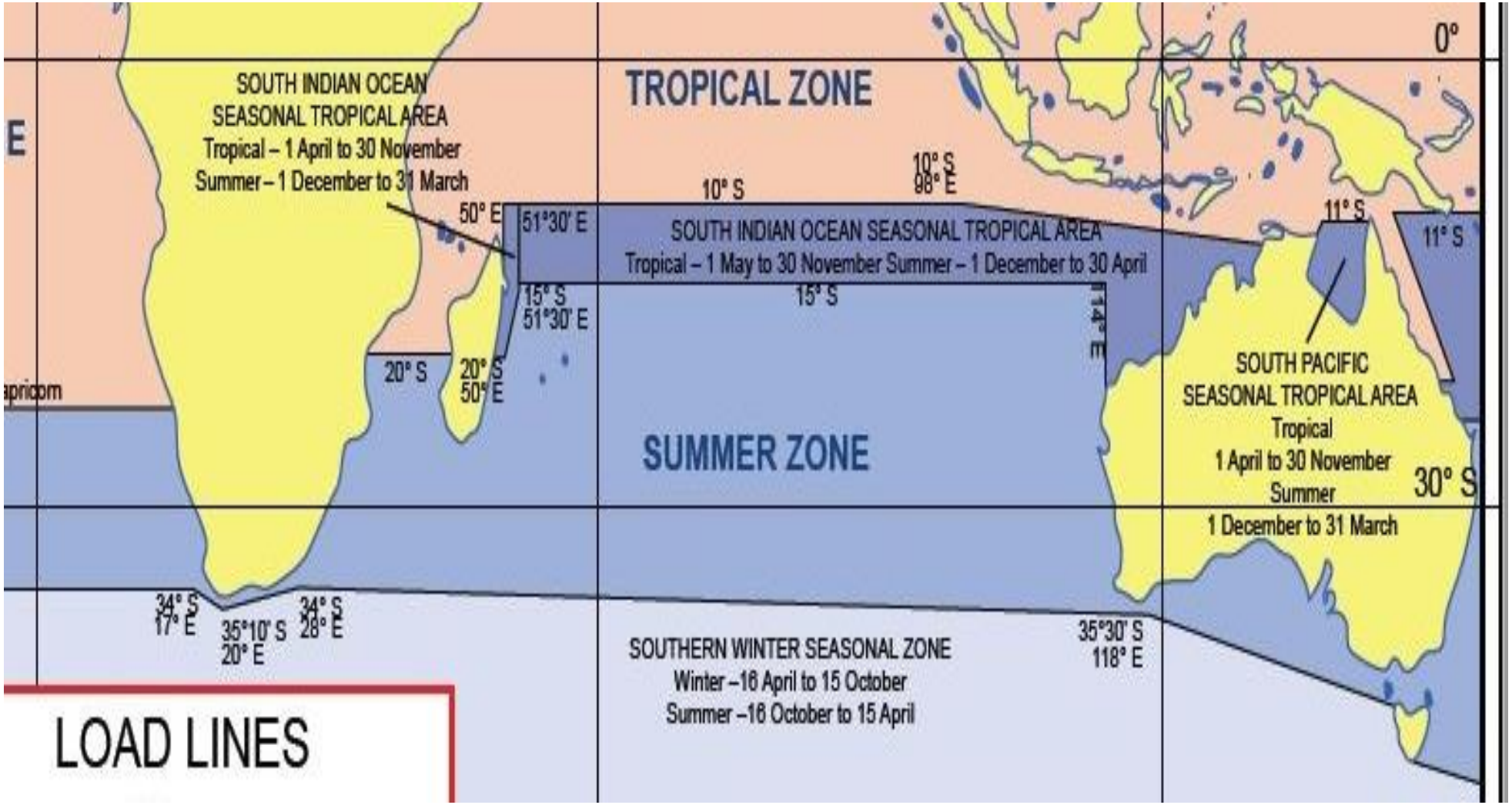
The OOW informs the Master that heavy cloud cover limited the star availability but all the stars observed were of a suitable altitude. Also, strong head winds, drizzle and a moderate swell were being experienced during the observation period.

Reworking the calculations and the plot confirm the OOW's initial results and no apparent errors were found.

(i) State, giving reasons, whether it would be appropriate to determine a Most Probable Position for the observation. (8)

(ii) Outline the factors to be taken into account when determining the 1645 hours position. (16)

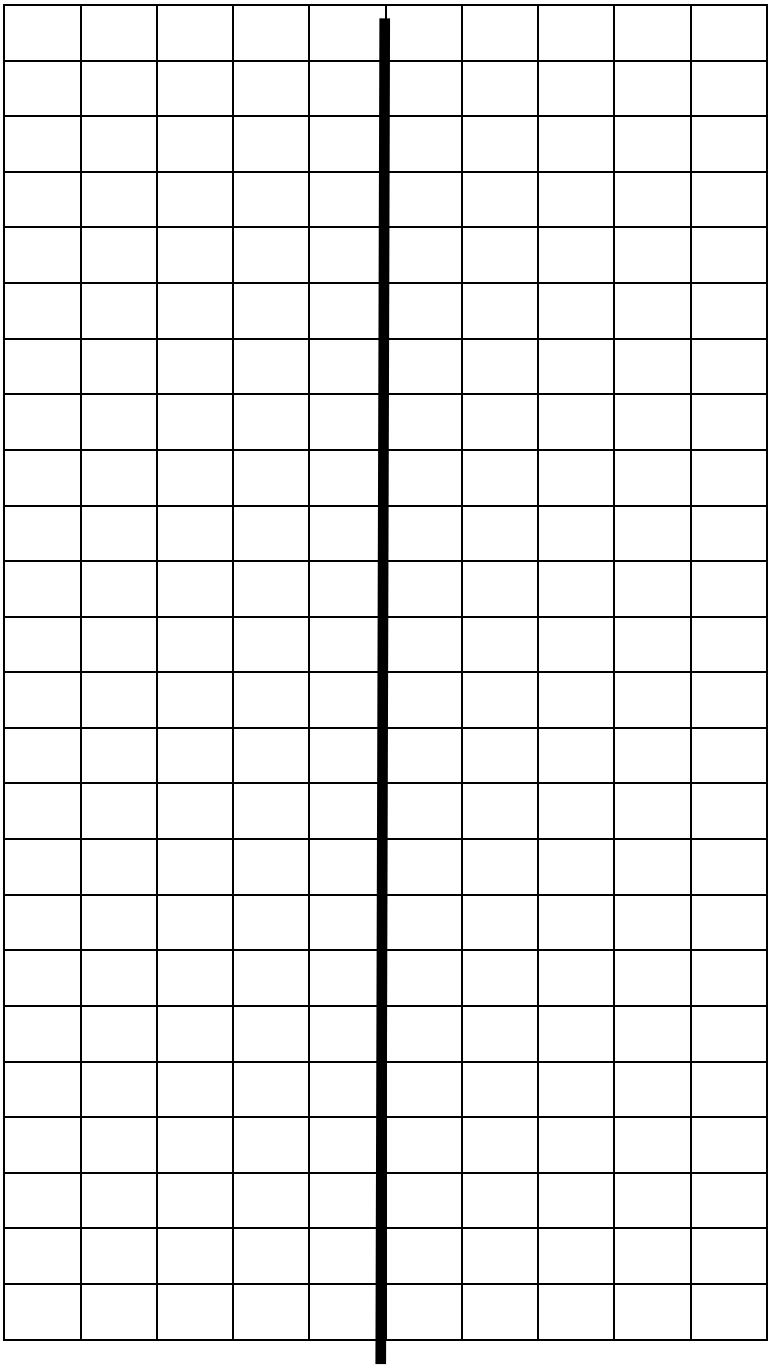
(iii) Determine the observed stellar position at 1645 hours. (6)


0°
TROPICAL ZONE
SOUTH INDIAN OCEAN
SEASONAL TROPICAL AREA
Tropical – 1 April to 30 November
Summer – 1 December to 31 March
10° S
10° S
98° E
11° S
11° S
50° E
51°30' E
SOUTH INDIAN OCEAN SEASONAL TROPICAL AREA
Tropical – 1 May to 30 November Summer – 1 December to 30 April
15° S
15° S
51°30' E
114° E
20° S
20°
50° E
SUMMER ZONE
SOUTH PACIFIC
SEASONAL TROPICAL AREA
Tropical
1 April to 30 November
Summer
1 December to 31 March
30° S
34° S
17° E
35°10' S
20° E
34° S
26° E
SOUTHERN WINTER SEASONAL ZONE
Winter –16 April to 15 October
Summer –16 October to 15 April
35°30' S
118° E
LOAD LINES

(This Worksheet must be returned with your answer book)

TIDAL STREAM CURVE

Direction (-) Direction (+)



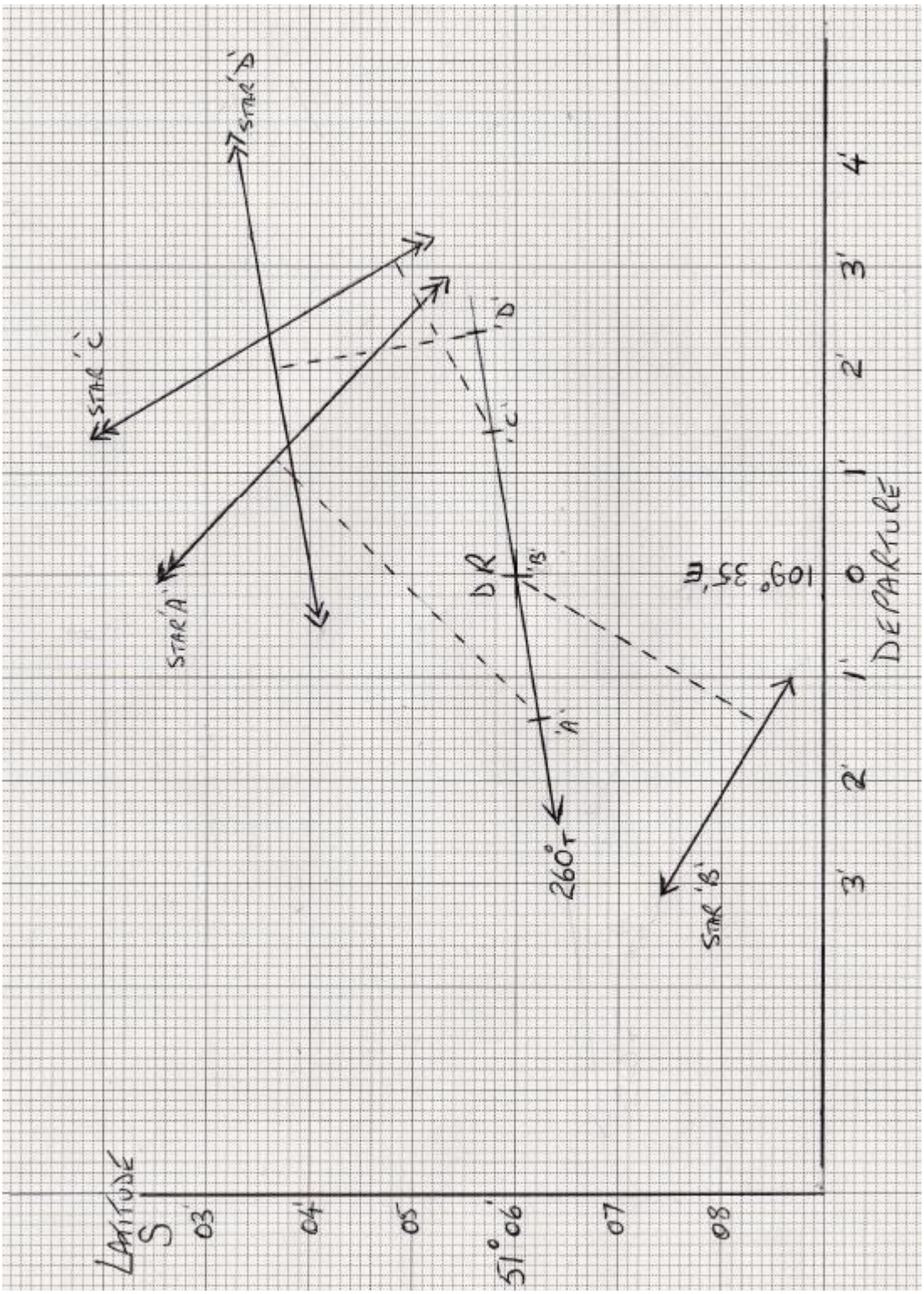
TIME
(HRS)

0

RATE (KNOTS)

Scale to be adjusted as required

Candidate's Name …… Examination Centre ……


LATITUDE
S
03
04
05
51° 06'
07
08
DEPARTURE
0
1'
2'
3'
4'
109° 35' E
DR
'A'
'B'
'C'
'D'
260° T
STAR 'A'
STAR 'B'
STAR 'C'
STAR 'D'