



DIRECTORATE OF MERCHANT SHIPPING
GOVERNMENT OF SRI LANKA
CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : NAVIGATION
DATE : 28.06.2024

Time allowed **THREE hours**

Total marks : 180

ANSWER ALL QUESTIONS

Pass marks : 70%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **not** allowed.

- 1) A vessel is expected to depart Port Elizabeth, South Africa to arrive at Melbourne, Australia. Master intend to follow composite great circle track with a limiting latitude 42° S.

Departure position off Port Elizabeth:	$34^{\circ} 05' S$	$26^{\circ} 00' E$
Landfall position off Melbourne:	$39^{\circ} 00' S$	$143^{\circ} 50' E$

- a) Draw a suitable sketch to derive your calculations.

(06 marks)

- b) Pilotage distance Port Elizabeth berth to Departure point is 48 miles and landfall to Melbourne berth is 89 miles. Calculate total distance berth to berth on passage plan.

(24 marks)

- 2) Vessel awaiting at anchor at Prince Rupert with a draft of 22 meters, height of the mast is 40 meters above the keel and height of the bridge is 17 meters. Master intends to cross the bridge keeping 1 meter clearance above the Masthead. Extracts from tide tables for Prince Rupert for 14th March 2014 are as follows:

0313 – 5.8 m
0931 – 0.8 m
1523 – 6.0 m
2146 – 0.9 m

MHWS -6.6 m
MHWN-5.2 m
MLWN - 2.5m
MLWS - 1.2 m

- a) Draw a systemic diagram with given details.

(10 marks)

- b) Find the earliest possible time on 14th March 2014 with falling tide to cross under the Bridge keeping 1 meter clearance from Masthead.

(20 marks)

- 3) The master receives a request from the Australian maritime rescue coordination centre (MRCC) to assist in a search for an overdue fishing vessel. Currently there are four vessels on scene engaged in a parallel track search pattern.
- a) Explain OSC duties relevant to Search and Rescue.
(05 marks)
 - b) With clear diagrams describe Expanding square search pattern and Parallel search pattern with 2 vessels.
(05 marks)
 - c) At 0700 hrs 20th July 2016 ,OSC bears 143° (T) at a distance of 175 miles from your vessel. The OSC is currently steering 280°(T) at 15 knots . Determine the course to steer and the ETA on station if own vessel proceed at a speed of 20 knots. (Use Data sheet – 2)
(20 marks)
- 4)
- a) State the factors to be considered by a master when selecting optimum route for an ocean passage.
(10 marks)
 - b) Briefly describe;
 - i. Least time route
 - ii. Least time with least damage route
 - iii. Least damage route
 - iv. Constant speed route
(20 marks)
- 5) Answer the following questions with regard to TRS:
- a) Explain the method of long range avoidance of a Tropical revolving storm with the aid of a sketch showing the Imminent Danger area and Probable Danger Area.
(10 marks)
 - b) Vessel on a passage Pusan, South Korea to Keelung,Taiwan may encounter the Effects of Tropical Revolving Storm “**KROSA** “heading NNW at a speed of 10 kts. On the Data Sheet – 3 provided, show the usual path for such a TRS.
(05 marks)
 - c) Describe the alternative routes that could be taken by the master to keep the vessel safe and explain how each could keep the vessel clear of the worst of storm.
(15 marks)

6)

a) Compile;

- i. Masters Standing orders; and
- ii. Night orders for transitting Malacca strait.

(15 marks)

b) Describe the difference between Master's Standing Orders and Night Orders.

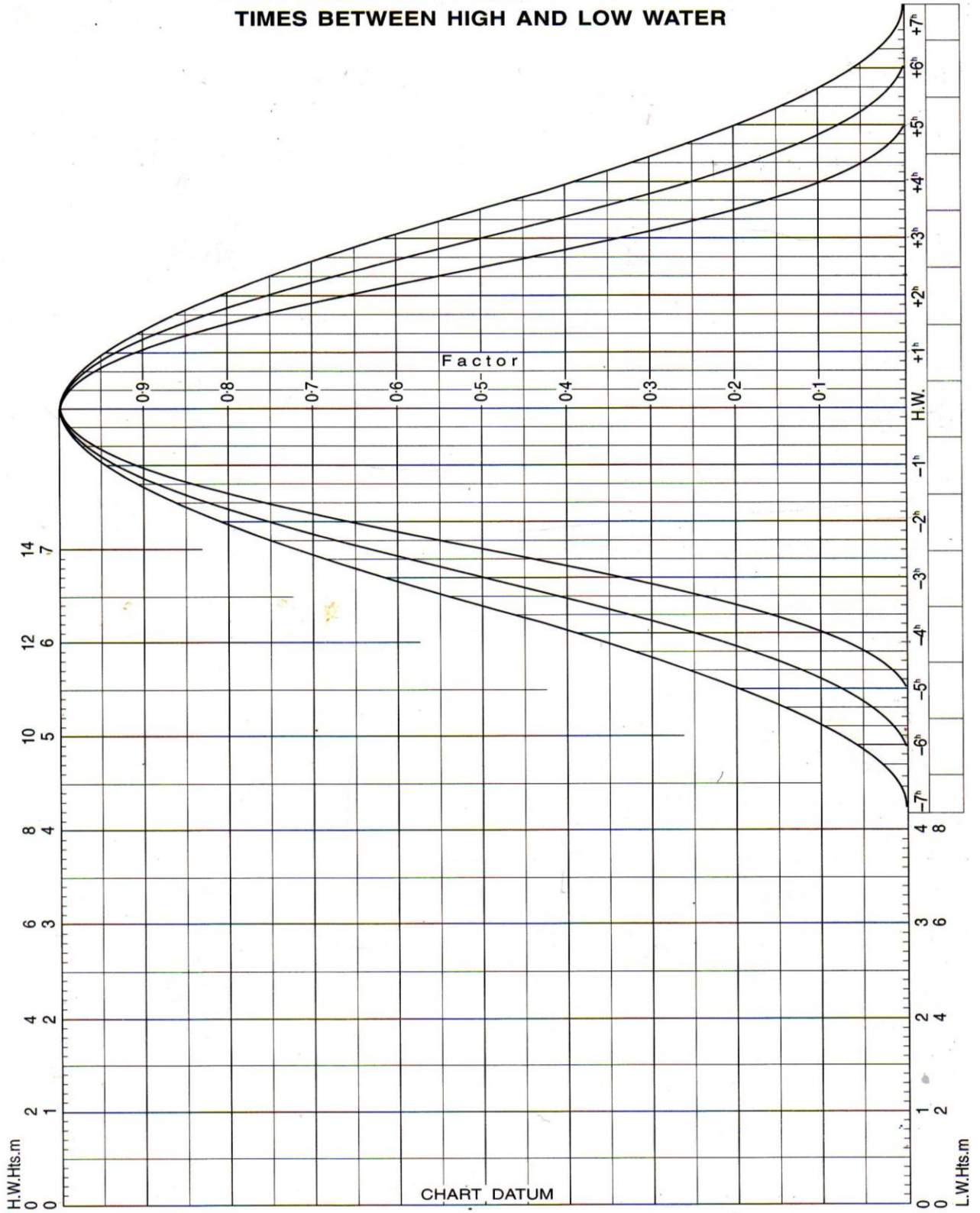
(05 Marks)

c) Describe 2 Ship reporting systems you have participated and advantages for a vessel using Ship reporting systems.

(10 marks)

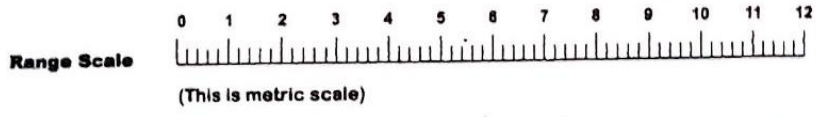
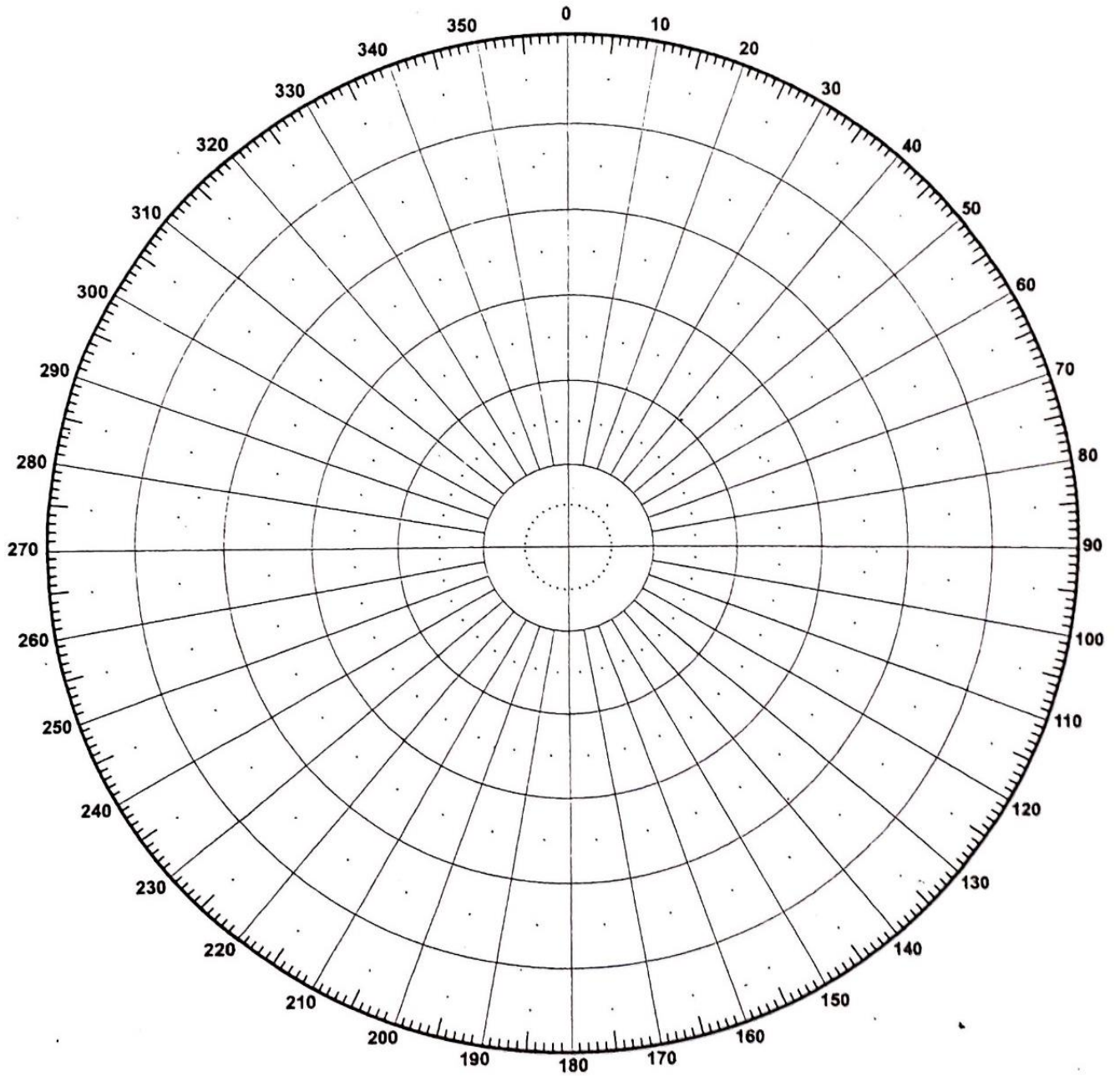
DATA SHEET -1

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



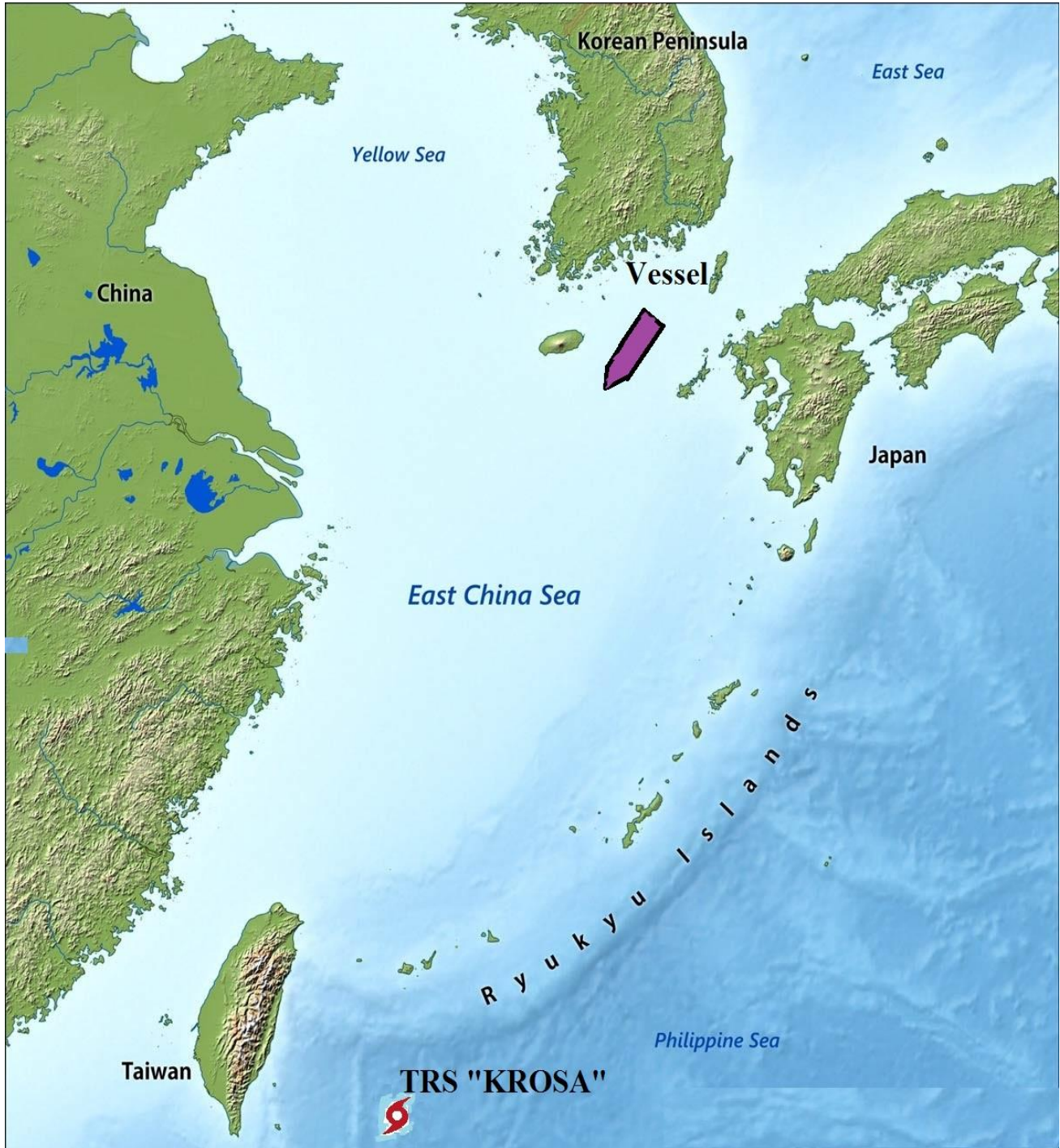
DATA SHEET -2

RADAR PLOTTING SHEET



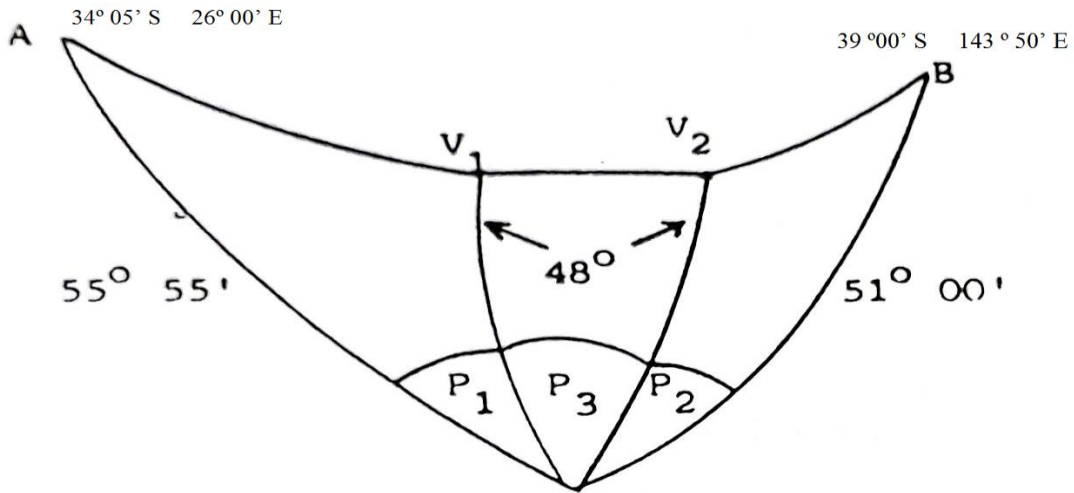
Signature of Candidate _____

DATA SHEET -3

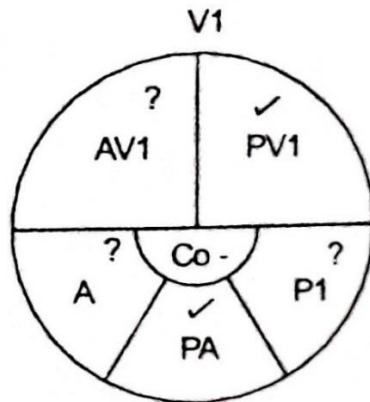


Answer Sheet ;

1). a).



b). Considering PAV1 triangle using Napier rule;



For distance : $\cos AV1 = \sin \text{lat } A / \sin \text{lat } V1$

For course : $\sin A = \cos \text{lat } V1 / \cos \text{lat } A$

For d'long : $\cos P1 = \tan \text{lat } A / \tan \text{lat } V1$

Same way considering PBV2 triangle distance, course and d'long to be derived.

V1 to V2 distance using plane sailing. $\text{Dep} = \text{D'long} \times \cos \text{lat}$.

AV1 Distance = **1987.4 nm**

BV2 Distance = **1191.8 nm**

P1 = **41.282 °** P2 = **25.926 °** P3 = **50.633 °**

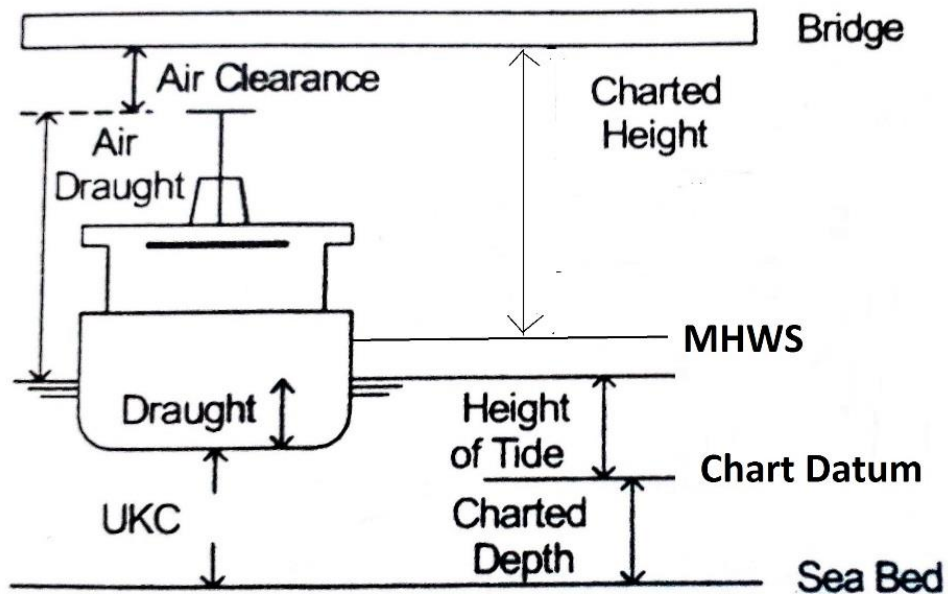
V1 to V2 distance = **2257 nm**

Total Distance = AV1 + V1V2 + V2B = **1987.4 + 1191.8 + 2257 = 5436.2**

Pilotage distance = 48+89 = **137 nm**

Total distance of passage berth to berth = 5573.2 nm

1) a).



b).

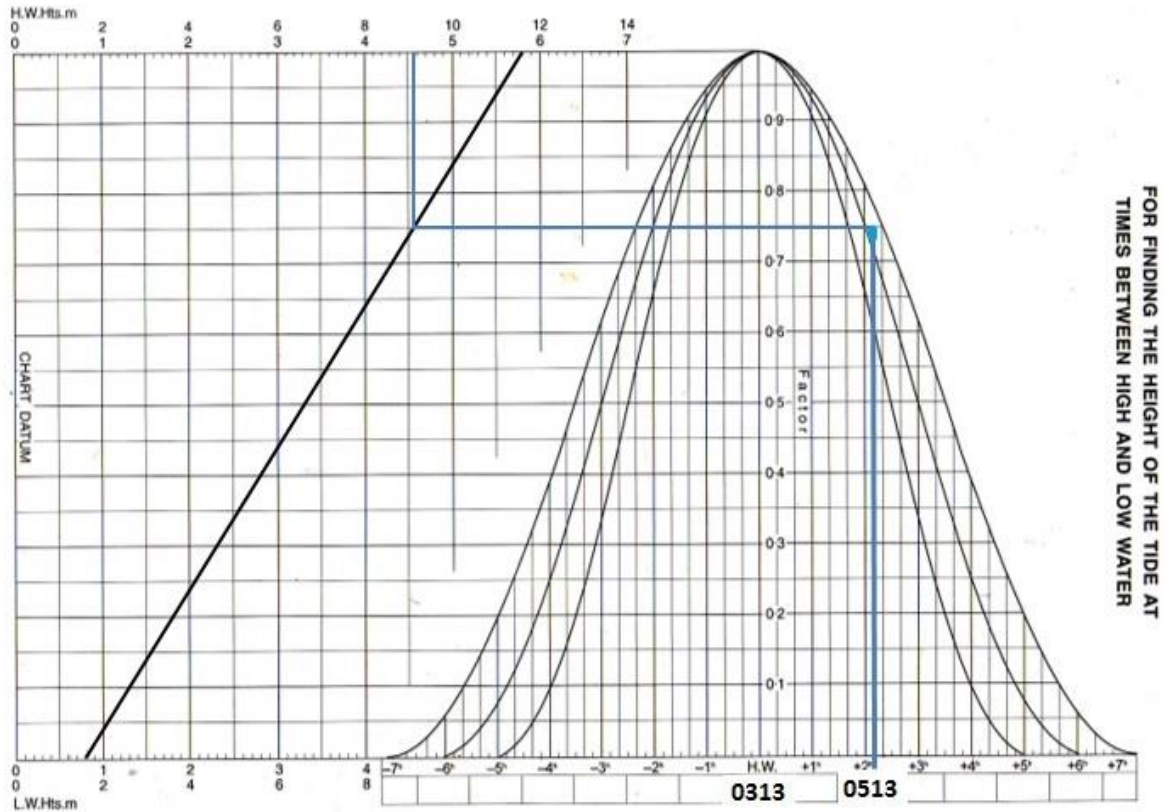
Height of Mast	40 m
Draft of the ship	22 m
Height of Mast above water	18 m
Clearance above the Mast	1 m
Total height above the water level required	19 m
Charted height of bridge	17 m
Height of tide below MHWS required	2 m
MHWS at Prince Rupert	6.6 m
Height of tide required	4.6 m

Or candidate can show

Air Draft + Air Clearance = (MHWS + Charte Height) – Height of Tide

$$\begin{aligned}
 18 \text{ m} + 1 \text{ m} &= (6.6 \text{ m} + 17 \text{ m}) - \text{Height of Tide} \\
 \text{Height of Tide} &= 4.6 \text{ m}
 \end{aligned}$$

Time to pass under the bridge at falling tide = 0523 on 14th March 2014.



3). a). **OSC Duties**

- 1.Co-ordinate operations of all SAR facilities on-scene.
- 2.Receive the search action plan or rescue plan from the SMC or plan the search or rescue operation, if no plan is otherwise available. (See Planning and Conducting the Search in this section.)
- 3.Modify the search action or rescue action plan as the situation on-scene dictates, keeping the SMC advised (do in consultation with the SMC when practicable.)
- 4.Co-ordinate on-scene communications.
- 5.Monitor the performance of other participating facilities.
- 6.Ensure operations are conducted safely, paying particular attention to maintaining safe separations among all facilities both surface and air.
- 7.Make periodic situation reports (SITREPs) to the SMC. The standard SITREP format may be found in appendix D. SITREPs should include but not be limited to:
 - o Weather and sea conditions
 - o The results of search to date
 - o Any actions taken
 - o Any future plans or recommendations

8. Maintain a detailed record of the operation:

- On-scene arrival and departure times of SAR facilities, other vessels and aircraft engaged in the operation
- Areas searched
- Track spacing used
- Sightings and leads reported
- Actions taken
- Results obtained

9. Advise the SMC to release facilities no longer required.

10. Report the number and names of survivors to the SMC.

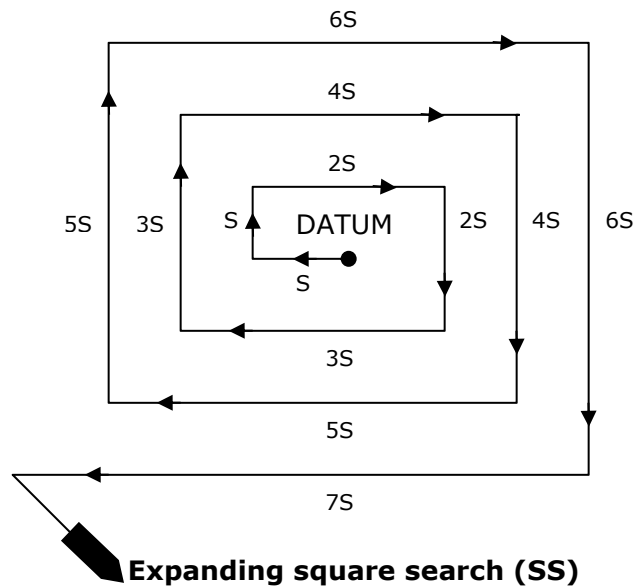
11. Provide the SMC with the names and designations of facilities with survivors aboard.

12. Report which survivors are in each facility.

13. Request additional SMC assistance when necessary (for example, medical evacuation of seriously injured survivors.)

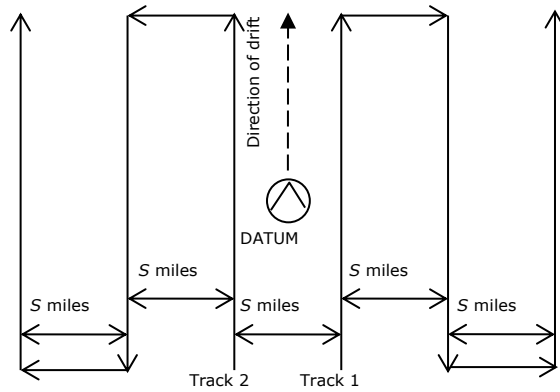
b). 1) **Expanding Square Search (SS)**

- Most effective when the location of the search object is known within relatively close limits.
- The commerce search point is always the datum position.
- Often appropriate for vessel or small boats to use when searching for persons in the water or other search objects with little or no leeway.
- Due to the small area involved, this procedure must not be used simultaneously by multiple aircraft at similar altitudes or by multiple vessels.
- Accurate navigate is required; the first leg is usually oriented directly into the wind to minimize navigational errors.



2). Parallel search pattern;

- Multiple vessels may be used as shown opposite:
 - Parallel sweep: for use by two ships.



PATTERN 2

Parallel track search – 2 ships

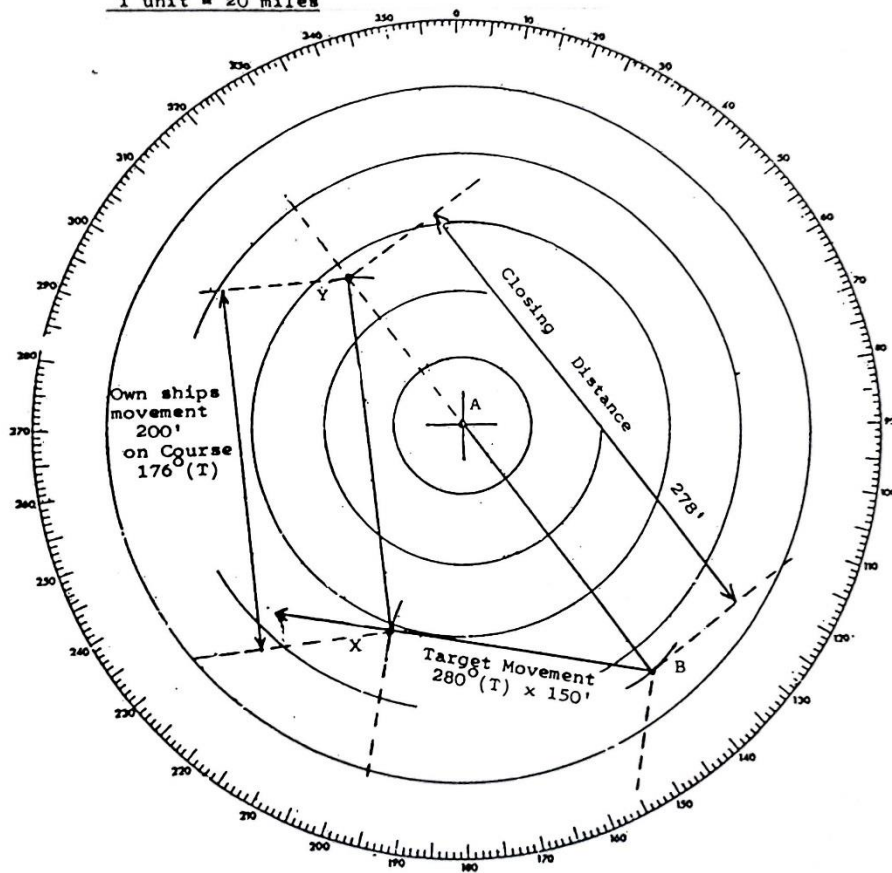
c).

10-hour period used

SCALE as shown

PLOTTING SHEET

1 unit = 20 miles



XY – is the course to steer to Rendezvous = 176° (T)

BY – is the closing distance = 278 nm

Effective speed = Closing distance / Time interval = $278/10 = 27.8$ kts

Time to Rendezvous = Total distance apart / Effective speed = $175/27.8 = 6.3$ hours.

ETA to Rendezvous = **1318 hrs 20th July 2016.**

4). a).

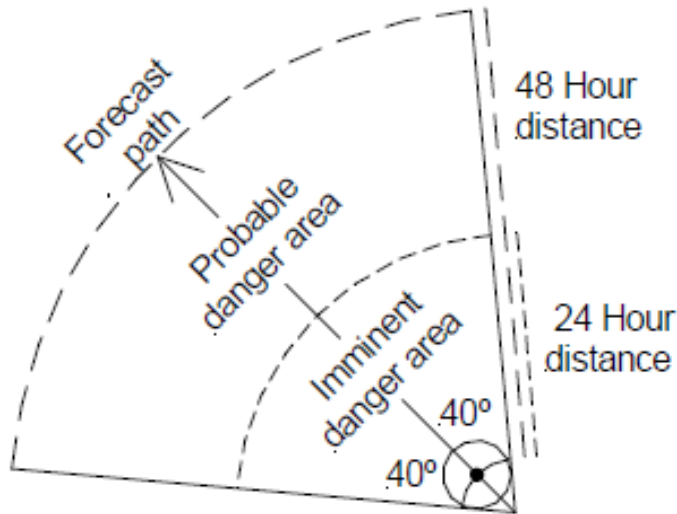
Factors to be considered are:

1. Displacement of the ship
2. Draught of the ship
3. Engine power of the ship
4. Ports to be called at
5. Least depth/shallow water along the route
6. Hazards along the route
7. Land, islands or reefs along the route
8. Load Line zones
9. Present and forecast weather, which affects (or may affect) the sea state and The swell may
10. require a reduction of the speed or may cause damage
11. Effects of reduced visibility on speed of progress (safe speed)
12. Navigational warnings or reports
13. War zones
14. Piracy attacks or other hostile activities

b)

- i. **Least time**: The objective being to reduce time on passage and is usually applicable to Tanker vessels. This type of vessel is less likely to sustain hull damage and will not suffer the possibility of cargo damage.
- ii. **Least time with Least Damage**: The objective with the option is to reduce and minimize damage costs. This objective is probably the most widely used by vessels engaging in weather routing service.
- iii. **Least Damage**: The objective being to sustain minimum damage, an option for vessels with particularly sensitive cargoes. e. g. livestock, vehicles etc.
- iv. **Constant Speed**: A requirement often stipulated by charter parties is that the vessel maintains a given speed throughout the period of passage.

5). a).



b). There are mainly 2 alternate paths. NNW direction or recurring to NE direction. Candidate should show the paths of the TRS.

- c). 1. Constantly monitor the weather conditions and movement of TRS
 2. Slow down or drift keep clear of probable danger area of TRS.
 3. Monitor movement of TRS , if moving NNW alter course to SE direction and keep Clear of TRS danger area.
 4. If TRS moving NE'y proceed SW course closer to China keep clear of TRS danger area.
 5. Each action to keep clear of TRS probable danger area and effect of actions to be constantly monitored.

6).

a). Standing orders ;

1. Conditions on which the Master is to be immediately called:-
 - a) Any doubt regarding ship's position
 - b) Any doubt regarding maintaining the course laid down on the chart.
 - c) Any doubt regarding navigational equipment malfunction or defect in steering gear or main ahead.
 - d) Deterioration of visibility or fog banks ahead.
 - e) Unusual sightings e.g. flares, single handed yachtmen etc.
 - f) High traffic density. The traffic conditions or movements of other vessels are giving cause for concern.
 - g) Failure to sight land, a navigation mark or to obtain soundings by the expected time.
 If land or a navigation mark is sighted or change in sounding occurs unexpectedly.
 If weather deteriorates or if there is any doubt regarding possible weather damage.

- h) At no time shall the bridge be left unattended. A relief officer to be called to the bridge if necessary.
- 2. A proper lookout shall be kept at all times. If necessary the O.O.W. shall summon assistance to the bridge.
- 3. When navigating with a pilot onboard. The O.O.W. will satisfy himself with regard to the courses steered, position of the vessel on the chart.
- 4. Use all possible means to fix the vessel frequently. When in soundings the anchor shall be ready for letting go with a crew member standing by.
- 5. The O.O.W. must comply with the Rule of the Road. Do not hesitate to The engines if necessary (Give notice if possible). Use sound signals if required.
- 6. The O.O.W. is responsible for the safe navigation of the vessel until the Master informs him that he has assumed responsibility.
- 7. Watch hand-over
 - (a) O.O.W. not to hand over the watch if relieving officer is not capable. Call me if in doubt.
 - (b) Allow time for obtaining night vision.
 - (c) The relieving officer to satisfy himself regarding:-
 - Night orders or other special instructions.
 - Position, course and speed of vessel
 - Weather, visibility, currents/tidal streams affecting vessel
 - The navigational situation e.g. position and movement of other vessels. Hazards likely to be encountered during the watch.
- 8. The relieving officer shall not take over the con until any manoeuvres are completed.
- 9. The O.O.W. shall make periodic checks of navigational equipment.
 - E.g.
 - i. The helmsman or auto pilot is steering the course laid down.
 - ii. The compass error to be checked at least once a watch and after a major alteration of course. Enter in compass record book. Frequently compare standard and steering repeaters.
 - iii. Check navigation lights.
- 10. The OOW is to familiarize himself with the operation of all Electronic Navigational Aids and be aware of their limitations. In clear weather the OOW should carryout radar plotting so that it becomes second nature.
- 11. The OOW must keep a correct log of courses and distances steered and times and positions of course alterations.
- 12. Ensure a good lookout is kept by the crew member.
- 13. In clear weather establish if risk of collision exists by taking compass bearings. Take early and substantial action to avoid close quarters situations.

(ii) Master's Night Orders

Generally includes following points:

- a) To comply with company and Master's standing orders.
- b) Follow the laid courses.
- c) Check and plot positions at required intervals.
- d) Keep proper look out and comply with ROR.
- e) Calling master at required position, if applicable.
- f) Anti piracy watch if required.
- g) Preparations before proceeding to pilot stations.

- h) Inform ETA.
- i) Slow down one hour (or as required for engine) before end of passage position.
- j) Call master at the marked position.
- k) Rigging pilot ladders in time.
- l) Stand by crews in time.
- m) Check the vessel's position frequently if at anchor.
- n) Calling master if in any doubt.

Master's Standing Orders The standing orders are a set of guidelines to ensure safe ship navigation and operations whether at sea or at port. Standing orders are to be followed at all times by the officer on duty and is duly signed by every officer on board, making them liable to adhere to the orders. That is to say that the standing orders are in-force and applicable at all times the ship is at sea, at port or at anchor.

Master's Night Orders The night orders are a supplement to the standing orders that come into force as the Master proceeds to take rest during the night. The standing orders are in force at all times whereas the night orders add specific points to the withstanding standing orders.