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**DIRECTORATE OF MERCHANT SHIPPING
GOVERNMENT OF SRI LANKA**

CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF
500 GT OR MORE (UNLIMITED)

SUBJECT : MATHEMATICS

DATE : 14.Dec.2023

Time allowed THREE hours

Total marks : 100

Answer all questions

Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required.

1)

a) Define irrational numbers (2 marks)

b) Express with positive indices $4x^{-\frac{1}{2}} \times 3\sqrt{x^{-1}}$ (4 marks)

c) Solve $\log_5 x + 3\log_x 5 = 4$. (6 marks)

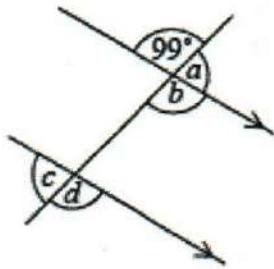
d) In spherical triangle DEF, $d = 112^\circ 3'$, $E = 113^\circ 23'$ and $F = 90^\circ$. Calculate D, e and f. (8 marks)

2)

a) Show that $x - 2$ is a factor of the polynomial $x^3 - 3x^2 - 4x + 12$, find the other factor. (5 marks)

b) Find the equation of a hyperbola if the standard equation whose conjugate axis 5 and the distance between foci is 13 (5 marks)

c) Find the size of the each of the angles marked with letters in the diagram below



(4 marks)

- d) The distance to a tower of height 25 m from point B is 40 m. If points A and B lie on a straight line leading to the tower and the angle of elevation to the top of the tower from point B is twice the angle of elevation from point A, determine the distance from point A to point B. (6 marks)

3)

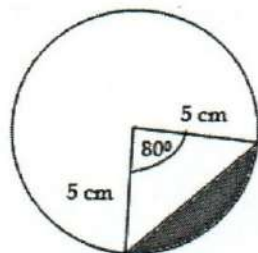
- a) Find 'K' such that line $4x - ky + 4 = 0$ and $8x + 2ky + 5 = 0$ are perpendicular. (4 marks)

(4 marks)

- b) Prove $\tan A \sin A + \cos A = \sec A$ (4 marks)

(4 marks)

- c) Find the shaded area



(4 marks)

- d) A map has a scale of 1:200000. The distance between the two towns is 60km. how far is the town on the map? (4 marks)

(4 marks)

- e) Simplify $a^2c - (2a^2c - 4a^2c + 8a^2c) - 7a^2c$ (4 marks)

(4 marks)

4)

- a) Construct the triangle ABC where $AB=6$ cm, $BC=4$ cm, $\widehat{ABC}=75^\circ$ and draw circum-circle. Find the radius of it. (6 marks)

(6 marks)

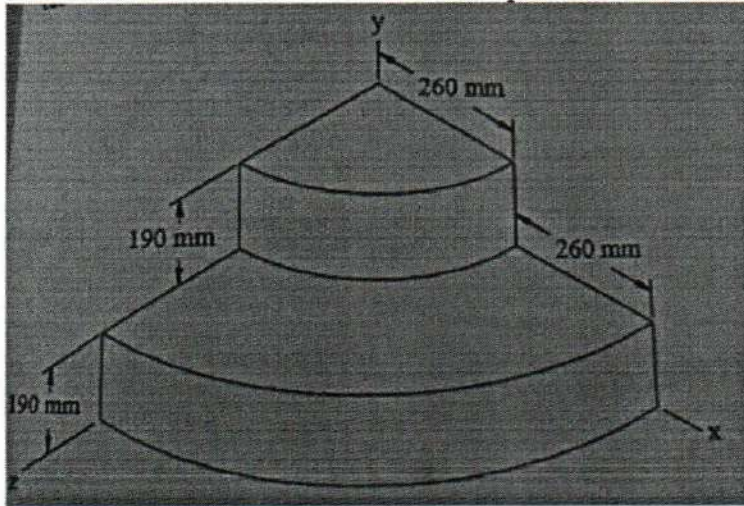
- b) Divide $(5x^4 - 3x^2 - 5)$ by $(x - 1)$ (4 marks)

(4 marks)

- c) Factorize $x^2 - 17x - 84$ (4 marks)

(4 marks)

- d) The concrete steps shown are in the shape of a quarter circle. Determine the total number of cubic meters of concrete required to construct the steps



(6 marks)

5)

- a) Find the area under the graph $y = \frac{1}{1+x^2}$ from 0 to 1 using 3/8 Simpson's rule

(8 marks)

- b) ABCDOE is a regular hexagon with O as origin. The position vector of A is a and the position vector of B is b . Find the following in terms of a and b

i) the position vector of C

ii) \overrightarrow{OE}

(6 marks)

- c) Draw the graph of $y = x^2 + 2x + 3$

(6 marks)

6)

- a) In spherical triangle LMN, $M = 44^\circ 16.0'$, $L = 90^\circ$ and $m = 39^\circ 37'$. Calculate l and n .

(8 marks)

- b) Find General solution

$$\sin \theta = \frac{1}{2}$$

(4 marks)

- c) The table below shows the amount of time a group of students spent revising for an end of year exam and the score they achieved in the exam. Draw a scatter graph to represent the above information. Find the relationship between the amount of time a group of students spent revising for an end of year exam and the score they achieved in the exam.

Hours of revision	0	2	5	6	8	10	13	14	15	16
Exam score	20	28	23	85	32	63	52	60	58	68

(8 marks)



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**MERCHANT SHIPPING SECRETARIAT
GOVERNMENT OF SRI LANKA
CERTIFICATE OF COMPETENCY EXAMINATION**



GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF
500 GT OR MORE (UNLIMITED)

SUBJECT : METEOROLOGY

DATE : 14th Dec 2023

Time:

Time allowed **THREE hours**

Total marks : 120

ANSWER ALL QUESTIONS

Pass marks : 50%

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) Define the followings.

- i) TRS
- ii) Path
- iii) Track
- iv) Dangerous Quadrant
- v) Navigable Semicircle

(20 marks)

b) Describe the warning signs of an approaching TRS

(10 marks)

2. a) Describes the characteristics and location of the,

- i) Doldrums
- ii) Trade Winds
- iii) Horse Latitudes
- iv) Westerlies

(20 marks)

b) Briefly explain about the NAVTEX (Navigational Telex) system.

(10 marks)

3. a) Define "Depressions"

(08 marks)

b) Briefly describe the followings,

- i) Frontolysis
- ii) Frontogenesis
- iii) Line Squall
- iv) Occlusion
- v) Warm & Cold Occlusion

(10 marks)

c) Explain the Formation of Frontal Depression

(12 marks)

4. Solar radiation is the fundamental energy driving our climate system, and nearly all climatic and biologic processes on Earth are dependent on solar input. Energy from the sun is essential for many processes on Earth including warming of the surface, evaporation, photosynthesis, and atmospheric circulation.

- a) Explains with the suitable diagram the how effect on insolation
 - i) variation in Latitude
 - ii) variation in the sun's declination (10 marks)
- b) Briefly explains the Greenhouse effect (10 marks)
- c) Why cloudy nights are warmer than clear nights (10 marks)

- 5. a) Explains the method of estimating the strength of the wind from the appearance of the sea surface, using the Beaufort wind scale (18 marks)
- b) Lists the factors, other than the wind speed, which affect the appearance of the sea surface (06 marks)
- c) Explains the differences between apparent and true wind. (06 marks)

- 6. a) Name the things that effect Air Pressure. (06 marks)
- b) Explain how atmospheric pressure decreases with height above sea level. (06 marks)
- c) Define followings,
 - i) Humidity
 - ii) Barometric Tendency (08 marks)
- d) Give an explanations for Smog and Orographic fog (Hill Fog). (10 marks)



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CERTIFICATE OF COMPETENCY EXAMINATION



GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF
500 GT OR MORE (UNLIMITED)
SUBJECT : BASIC MANAGEMENT
DATE : 13.12.2023

Time allowed THREE hours

Total marks : 100

Answer all questions

Pass marks : 50%

You may draw sketches wherever required.

1. What are the objectives of the following Conventions:

- a. STCW
- b. SOLAS
- c. MARPOL
- d. MLC

(20 marks)

2. Explain briefly the obligations of a port State and a flag State.

(20 marks)

3. As an operational level officer, briefly explain your emergency response to following situations.

- a) Dangerous cargo leak reported on deck
- b) Crew member is seriously injured
- c) Reporting of a smoke coming out from a cargo hold
- d) Grounding

(20 marks)

4. Explain the role of the Recognised Organisation with reference to statutory survey and certification?

(20 marks)

5. Describe the risk assessment process and its impact on safety management on board a ship.

(20 marks)



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CERTIFICATE OF COMPETENCY EXAMINATION



GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF
500 GT OR MORE (UNLIMITED)

SUBJECT : APPLIED SCIENCE

DATE : 12.Dec.2023

Time allowed THREE hours

Total marks : 120

Answer any SIX (6) questions

Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required.

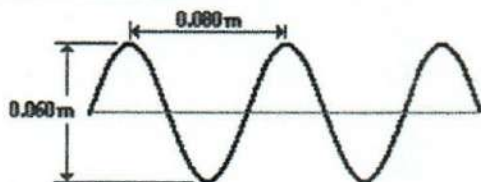
Constants to be use - $g = 9.8ms^{-2}$, $G = 6.67 \times 10^{-11} N m^2kg^{-2}$

1.

- a. A baseball is popped straight up into the air and has a hang-time of 6.25 s. Determine the height to which the ball rises before it reaches its peak. (4 marks)

- b. State Newton's first law (3 marks)

- c. A wave travelling in the positive x direction has a frequency of 25.0 Hz as in the figure below. Find the

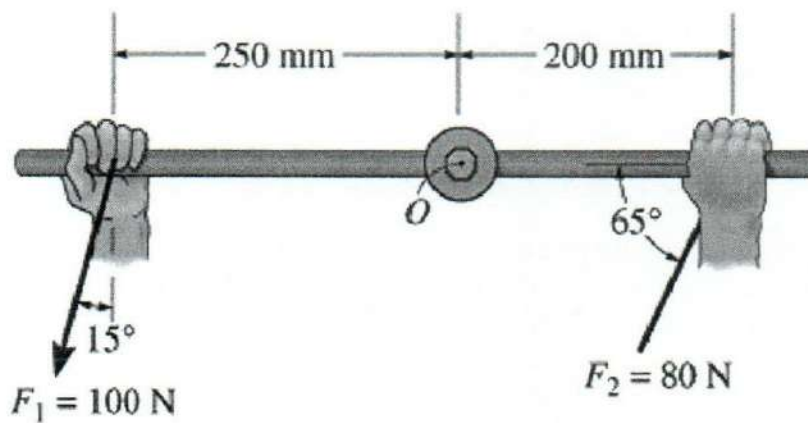


- i. Amplitude
 - ii. Wavelength
 - iii. Period
 - iv. Speed of the wave
- (5 marks)
- d. The focal length of a concave mirror is 3.0 cm. If an object 1.2 cm high stands 4.5 cm from the mirror, determine the characteristics of the image (whether it is real or virtual, upright or inverted) and find:
- i. the size of the image
 - ii. its distance from the mirror
 - iii. state its characteristics

(8 marks)

2.

- a. Find the kinetic energy of a wheel rotating at 4 rad/s given the mass is 3 kg and the radius of gyration is 0.2 m (4 marks)
- b. A vessel accelerates from a velocity of 1 m/s at a rate of 0.2 m/s² for 30 seconds. Using a velocity - time graph calculates the distance travelled (5 marks)
- c. The wrench is used to loosen the bolt. Determine the moment of each force about the bolt's axis passing through point O.



(4 marks)

- d. What are the general properties of electromagnetic radiation? (3 marks)
- e. If Fe (Iron), Cu (Copper) and Zn (Zinc) metals exposed to electrolyte and electrical contact, explain which metal get corroded.

Galvanic Series

Zn

Fe

Cu

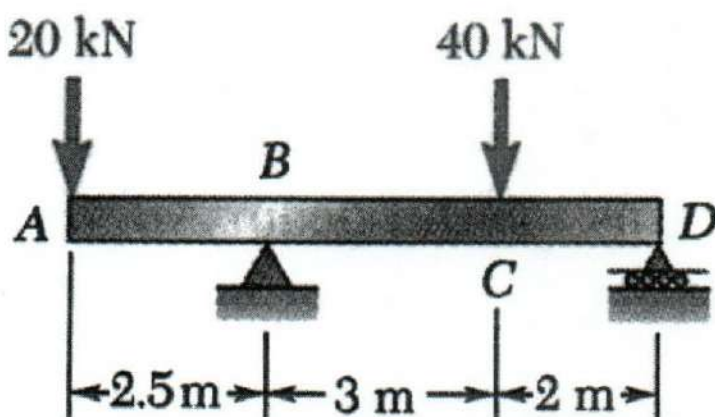
(4 marks)

3.

- a. A 7 kg mass is being pulled towards the right with a rope that has a tension of 70 N at an angle of 42 degrees to the x-axis. If the surface is frictionless, what acceleration will the mass develop?

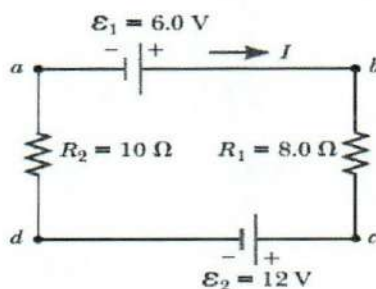
(4 marks)

- b. Draw the shear and bending moment diagrams for the beam shown in the Figure



(8 marks)

- c. Define Humidity (3 marks)
- d. A single-loop circuit contains two resistors and two batteries as shown in Figure (Neglect the internal resistances of the batteries.) Find the current in the circuit.



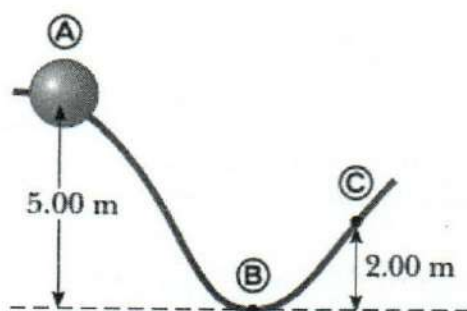
(5 marks)

4.

- a. A student pulls a vacuum cleaner with a force of 40 N at an angle of 28° to the horizontal. The vacuum cleaner moves 2 m to the right. Find the work done. (4 marks)
- b. Young's modulus for brass is $8.96 \times 10^{11} \text{ Pa}$. A 120-N weight is attached to an 8-m length of brass wire; find the increase in length. The diameter is 1.5 mm. (4 marks)

6.

- a. A 0.400 kg bead slides on a curved wire, starting from rest at point A in Figure. If the wire is frictionless, find the speed of the bead
- at B
 - at C

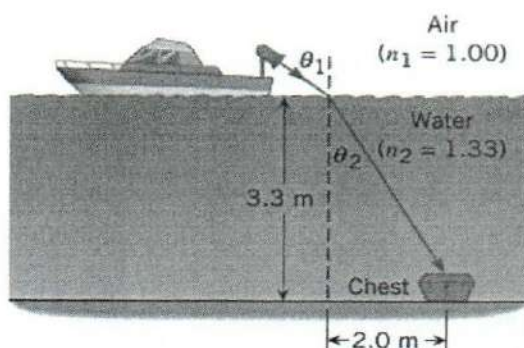


(5 marks)

- b. An SUV with mass 1.80×10^3 kg is traveling eastbound at 15.0 m/s, while a compact car with mass 9.00×10^2 kg is traveling westbound at 15.0 m/s. The cars collide head-on, becoming entangled. Find the speed of the entangled cars after the collision. (4 marks)
- c. A certain machine moves a load of 300 N through a distance of 0.2 m by using an effort of 15 N. If the effort moves through a distance of 5 m. calculate
- The Mechanical Advantage
 - The Velocity Ratio
 - The machine's efficiency

(6 marks)

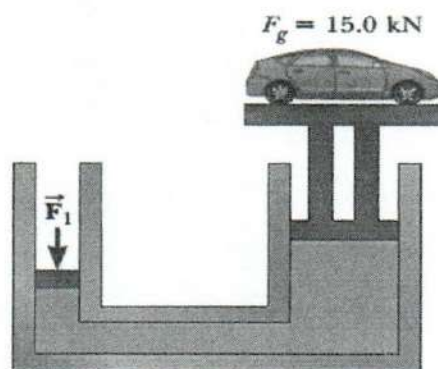
d. Find θ_1 .



(5 marks)

7.

- A Pitot tube is an instrument used to measure airspeed of an aircraft. Calculate the change in pressure read by the instrument if the airspeed is 105 m/s. [Take the density of air at these conditions as 0.95 kg/m^3] (4 marks)
- 6.2 liters of an ideal gas are contained at 3.0 atm and 37°C . How many moles of this gas are present? ($R = 0.082 \text{ L atm / mol K}$) (4 marks)
- John went to pick up his kid at the school. He was traveling about 20 m/s when the release bell went off at 350 Hz. What frequency does John hear? (The speed of sound in the air is 343 m/s) (4 marks)
- State Archimedes' principle (4 marks)
- The small piston of a hydraulic lift has a cross-sectional area of 3.00 cm^2 , and its large piston has a cross-sectional area of 200 cm^2 . What downward force of magnitude F_1 must be applied to the small piston for the lift to raise a load whose weight is $F_g = 15.0 \text{ kN}$?



(4 marks)



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CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF
500 GT OR MORE (UNLIMITED)

SUBJECT : BRIDGE EQUIPMENT

DATE : 12.Dec.2023



Time allowed THREE hours

Total marks : 120

Answer all SIX (6) questions

Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required.

Instructions to candidate

- Answer all questions
- Time : 1300hrs to 1600hrs (03hours)
- Total marks : 120
- Pass Mark : 50%
- Electronic devices capable of storing and retrieving are **not** allowed

1. a) Explain the function of Bridge Navigation Watch Alarm system (BNWAS) Fitted on Bridge. (10 marks)
- b) With respect to a Sextant explain
 - i. What is meant by Interaction between screws?
 - ii. Why it is preferred to find the value of "Index Error" using the Sun? (05 marks each)
2. With reference to Navtex;
 - i. explain how it operates and the purpose of it. (08 marks)
 - ii. Describe how the appropriate stations are selected by the operator. (04 marks)
 - iii. list the types of messages available, highlighting the ones that cannot be blocked by the operator and giving the reasons for it. (08 marks)
3. a) Describe the following segments in the GPS system
 - (i) Space segment (ii) Control Segment (06 Marks)
- b) Explain the function of the DGPS (08 Marks)
- c) Briefly describes the Enhance Loran system (06 Marks)

4. With regard to Autopilot system;
- a) Explain the effectiveness of the following controls on the Autopilot system;
 - i. weather
 - ii. off course alarm(03 marks each)
 - b) what is meant by Non Follow Up steering mode? (05 marks)
 - c) Explain the sequins of steps to be followed when switching over from manual steering to autopilot. (09 marks)
5. a) Define the terms,
- (i) Variation (ii) Deviation (iii) Angle of Dip (06 Marks)
 - b) Discuss the advantages and disadvantages of Wet card compass (05 Marks)
 - c) Explain the following properties of free gyroscope
 - (i) Gyroscope Inertia (Rigidity in the space)
 - (ii) Precession
 - (iii) Three degree of Freedom(03Marks each)
6. With regard to the Echo Sounder used for depth measurement,
- a) Discuss the advantages and disadvantages of Single and Duel Transducers. (08 marks)
 - b) Briefly explain the followings;
 - i. The purpose of having Transmission Mark / Zero mark.
 - ii. Separation Error.
 - iii. Aeration.(04 marks each)



DIRECTORATE OF MERCHANT SHIPPING
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CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF 500
 GT OR MORE (UNLIMITED)
 SUBJECT : GENERAL SHIP KNOWLEDGE
 DATE : 11.Dec.2023

Time : 0900 to 1200 hrs

Time allowed **THREE hours**

Total marks : 150

ANSWER ALL QUESTIONS

Pass marks : 50%

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) Briefly explain the uses of Simpson's Rules in ship's stability.

(05marks)

b) The breadths of a ship's water plane 180 m long, at equal intervals from aft, are:

1.5, 7.8, 11.5, 13.4, 14.1, 15.7, 13.0, 11.1, 7.3 & 0 meters

Find the following;

i. The water-plane area of the vessel

ii. FWA, if the displacement at this draft is 8500 t in sea water

(20 marks)

2) a) Define followings

i. Dead weight

ii. Metacentric Height

(04 marks each)

b) A ship of 15400 t displacement, KG 6.5m carries out cargo operation as follow;

2000t	loaded	KG-5.8m
1100t	loaded	KG-4.8m
900t	loaded	KG-7.0m

She then discharges 600 tonnes of ballast that was at KG 0.8 m, Find how much deck cargo at KG 10m can be loaded so that the KG of ship does not exceed 7 m.

(17 mark)

- 3) a) State the stability criteria which required to be maintained by the Load Line regulations to ensure the seaworthiness of a vessel. (12 marks)
- b) Sketch an unstable vessel (a vessel in an unstable equilibrium) heeled to a small angle (not up to the angle of loll). The sketch should clearly indicate the positions of G, B, M & Z and also show the action of different forces. (08 marks)
- c) Describe the possible actions to be taken in case of correcting a vessel which is in an angle of loll. (05 marks)
- 4) A vessel arrives at river Thames with a displacement of 12000 t and a draught of 5.77 m. The water density at the entrance to the Hugli River is 1.020. She is to cross a bar up the river before entering Calcutta port. The depth at the bar is 6.0 m and relative density of the water is 1.005. If her TPC is 25, find the minimum quantity of cargo to off load at the entrance to the Hugli River so that she may cross the bar with an UKC of 0.5 m. (25 marks)
- 5) a) With an aid of labelled sketches describe the following;
- i. Longitudinally Framed double bottom tank (10 marks)
 - ii. Transversely Framed double bottom tank (10 marks)
- b) Briefly explain the safety precautions to be taken during welding. (5 marks)
- 6) a) Describe different types of marine paints and their usage to prevent corrosion on board ships. (08 marks)
- b) Describe briefly how a ship is designed to withstand longitudinal stress. (08 marks)
- c) Sketch and explain types of welding faults. (09 marks)



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CERTIFICATE OF COMPETENCY EXAMINATION**



GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF 500
GT OR MORE (UNLIMITED)

SUBJECT : ENGINEERING KNOWLEDGE

DATE : 11.12.2023

Time : 3 hrs

Time allowed **THREE hours**

Total marks : 96

ANSWER ANY SIX QUESTIONS

Pass marks : 50%

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.

- (i) Explain the different between two stroke and four stroke cycle of a diesel engine. (08 marks)
- (ii) List down the four stroke of a diesel engine. (08 Marks)

2.

- (i) Explain the meaning of water tube and smoke tube boilers. (04 marks)
- (ii) Name three equipment powered by steam other than heating purpose. (06 marks)
- (iii) List most important boiler mountings (06 Marks)

3. Make short notes on following equipment.

- (i) Emergency generator (06marks)
- (ii) Incinerator (4marks)
- (iii) Emergency fire pump (06marks)

4.

- (i) Draw a basic lay out (using block diagram) of a ships electrical power distribution system (10 Marks)

(ii) What is the different between alternating current (AC) and direct current (DC) (04 Marks)

(iii) What is the meaning of frequency of an AC power supply? (02 Marks)

5.

(i) Make a detailed sketch of a lube oil system of a marine diesel engine. (10 marks)

(ii) Name three main functions of lubricating oil. (6 marks)

6.

(i) What are the basic requirement for steering system. (8 Marks)

(ii) List down the indication and alarms in the steering system. (08 Marks)

7.

(i) What is the deferent between centrifugal pump and positive displacement pump. (6marks)

(ii) What is meant by priming of a centrifugal pump? (4 marks)

(ii) How do you know when a centrifugal pump is experiencing early stage of cavitation (6 marks)

8. What are the main causes for the following problems in a main engine?

a. Scavenge fire

b. Uptake fire

c. Starting air-line explosion

d. Crank case explosion. (4 marks each)

9.

(i) Name the equipment available on board in order to meet the "MARPOL" requirements. (6 marks)

(ii) Make a detail sketch of a hydraulic winch operation mechanism. (10 marks)

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CERTIFICATE OF COMPETENCY EXAMINATION**

GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF 500
GT OR MORE (UNLIMITED)
SUBJECT : COASTAL NAVIGATION
DATE : 24.10.2023 Time : 0900 to 1200 hrs

Time allowed **THREE hours** Total marks : 100
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) Answer the following questions with reference to the Data sheet – 1.
 - a) It shows four tracks, state, with reasons, the tracks that comply and the tracks that do not comply with Rule 10 of International Collision Regulations. (10 marks)
 - b) Identify the symbols 1, 2, 3, 4, 5, 6 and 7 in accordance with the BA 5011. (10 marks)

- 2)
 - a) Discuss the reliability of the tidal predictions contained in the Admiralty Tide Tables, giving reasons for discrepancies between predicted tidal heights and actual tidal heights. (04 marks)
 - b) A vessel is to sail from Vancouver Harbour, British Colombia, on the 20th March. The Master instructs the OOW to determine the available time window on the morning high water tide, 20th March, that the vessel may cross a shoal.
Charted depth of shoal 9.5 m
Sailing draught fwd 11.1 m
Sailing draught aft 11.9 m
It is the Company requirement that a minimum under keel clearance of 10% of the maximum draught is required.
Find each of the following:
 - i) The earliest time that the vessel may cross the shoal (in the morning)
 - ii) The latest time that the vessel may cross the shoal (in the morning)(08 marks each)

- 3) On completion of an ocean passage, a ship is to enter restricted navigational waters in restricted visibility condition.
- State the factors to be considered when determining the bridge composition when entering to the above waters. (02 marks)
 - How do you ensure efficient bridge resource management throughout these waters as the OOW. (10 marks)
 - If your primary means of navigation is ECDIS, explain the method of verifying the ship position by other means. (08 marks)
- 4) You are on a product tanker coming from Tokyo, Japan to "Western Petroleum A" anchorage ($1^{\circ}14.45'$ N, $103^{\circ}47.8'$ E), Singapore. The vessel entered Singapore strait during morning and the 0800 hrs GPS position observed to be $01^{\circ}16.3'$ N, $104^{\circ}04.7'$ E. The maximum draught of the vessel is 12.5 m, length overall is 190 m and her engine speed is 18 knts. She is equipped as required by the international regulations for her size and type. Calculate the following:
- Plot the position at 0800 hrs. (01 marks)
 - Plan the passage from the 0800 hrs position up to the above mentioned position in "Western Petroleum A". All the required information and the warnings shall be marked on the chart. (10 marks)
 - Port authority wants you to arrive at the anchoring position at 1000 hrs. Calculate the speed that must be maintained to arrive at the anchoring point at 1000 hrs. (02 marks)
 - While proceeding at the above calculated speed, she experiences a southerly current at the rate of 2 knts between longitudes $104^{\circ}00'$ E and $103^{\circ}56'$ E. Calculate the course to steer between these longitudes counteracting the current. (05 marks)
 - She drops her stbd anchor heading 045° (T) at 1015 hrs exactly at the position given above. At 1030 hrs, chief officer reports that she is brought-up with 5 shackles on the water. Draw the vessel's swinging circle. (02 marks)

- 5) A container vessel bound for Tanjung Pagar Terminal is proceeding along the East bound traffic lane to receive pilot at Eastern Boarding A. The vessel draws 10 m and capable of making 18 knots speed.
- a) At 1030 hrs she observes a horizontal sextant angle of 50° between buffalo Rock isolated danger buoy ($01^{\circ} 09.9' N$, $103^{\circ} 48.15' E$) and Karang Banteng pillar buoy with Racon 'K' ($01^{\circ} 09.5' N$, $103^{\circ} 48.83' E$). At the same time Karang Banteng pillar buoy bore $085^{\circ} (T)$. Fix the vessel's position at 1030 hrs. (05 marks)
- b) While following the East bound lane, vessel steered $064^{\circ} (T)$ at 16 knots. At 1045 hrs the vessel observed the GPS position as $01^{\circ} 11.7' N$, $103^{\circ} 52' E$. fix the position of the vessel at 1045 hrs. (05 marks)
- c) Find the set and drift experienced in above (b). (05 marks)
- d) What would be your course to steer if set and drift was known before to make good $064^{\circ} (T)$. (05 marks)

CANADA - VANCOUVER

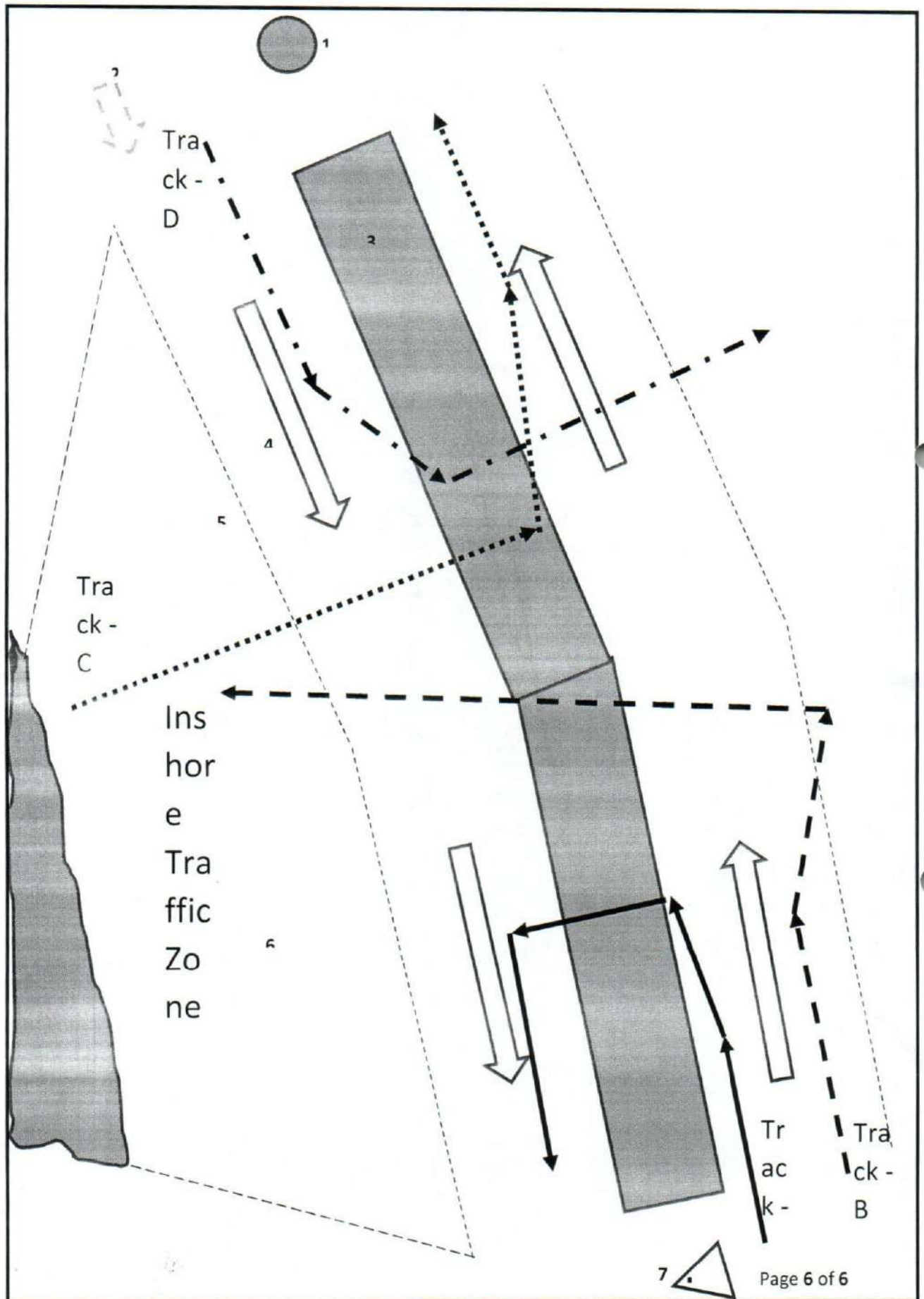
LAT 49°17'N LONG 123°07'W

TIME ZONE +0800

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

JANUARY				FEBRUARY				MARCH			
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
1 0305	3.7	16 0155	3.6	1 0430	4.2	16 0400	4.4	1 0345	4.2	16 0325	4.5
SA 0735	3.2	0625	3.0	0940	3.5	0910	3.4	0925	3.3	0915	3.0
1315	4.3	SU 1225	4.6	TU 1340	4.0	W 1345	4.2	W 1310	3.7	TH 1350	3.8
2050	1.3	2000	1.2	2135	1.1	2125	0.6	2055	1.4	2100	1.0
2 0405	4.0	17 0315	4.0	2 0505	4.4	17 0445	4.6	2 0425	4.3	17 0410	4.6
0850	3.4	0750	3.3	1025	3.5	1010	3.3	1005	3.2	1005	2.8
SU 1350	4.2	M 1310	4.5	W 1430	4.0	TH 1450	4.2	TH 1415	3.7	F 1510	3.9
2130	1.1	2055	0.8	2215	1.0	2215	0.5	2140	1.3	2155	1.0
3 0455	4.2	18 0420	4.3	3 0540	4.5	18 0530	4.7	3 0500	4.4	18 0450	4.6
0950	3.5	0905	3.4	1105	3.4	1100	3.1	1040	3.1	1050	2.5
M 1425	4.2	TU 1400	4.5	TH 1520	4.0	F 1600	4.3	F 1520	3.8	SA 1615	4.0
2205	1.0	2145	0.5	2255	0.9	2305	0.5	2225	1.2	2245	1.1
4 0535	4.4	19 0510	4.6	4 0615	4.6	19 0605	4.8	4 0530	4.4	19 0525	4.6
1040	3.5	1010	3.5	1140	3.3	1150	2.8	1115	2.9	1130	2.2
TU 1505	4.1	W 1455	4.5	F 1610	4.0	SA 1700	4.3	SA 1610	3.9	SU 1710	4.1
2245	0.8	2235	0.3	2330	0.8	O 2350	0.6	2300	1.1	O 2330	1.3
5 0610	4.6	20 0555	4.8	5 0645	4.6	20 0640	4.8	5 0555	4.5	20 0555	4.6
1120	3.5	1105	3.4	1215	3.2	1235	2.6	1145	2.7	1210	1.9
W 1540	4.1	TH 1550	4.5	SA 1655	4.1	SU 1755	4.2	SU 1655	4.0	M 1800	4.1
2315	0.8	O 2320	0.2	●				● 2340	1.2		
6 0645	4.6	21 0635	4.9	6 0005	0.8	21 0030	0.9	6 0620	4.5	21 0010	1.6
1200	3.5	1200	3.3	0710	4.6	0715	4.8	1220	2.5	0625	4.6
TH 1615	4.1	F 1650	4.5	SU 1250	3.1	M 1320	2.3	M 1745	4.1	TU 1250	1.7
● 2350	0.7			1740	4.1	1845	4.1			1850	4.1
7 0715	4.7	22 0010	0.2	7 0035	0.9	22 0110	1.2	7 0015	1.3	22 0050	1.9
1235	3.4	0715	5.0	0735	4.6	0745	4.8	0645	4.5	0655	4.5
F 1655	4.1	SA 1255	3.1	M 1330	2.9	TU 1405	2.1	TU 1255	2.2	W 1330	1.5
		1745	4.3	1825	4.0	1940	4.0	1830	4.1	1940	4.1
8 0025	0.7	23 0050	0.4	8 0110	1.1	23 0150	1.6	8 0050	1.5	23 0125	2.2
0745	4.7	0755	5.0	0805	4.6	0820	4.7	0715	4.5	0725	4.4
SA 1315	3.4	SU 1345	2.9	TU 1410	2.7	W 1455	1.9	W 1335	2.0	TH 1410	1.4
1735	4.0	1845	4.1	1915	3.9	2040	3.8	1920	4.1	2035	4.1
9 0055	0.8	24 0135	0.7	9 0145	1.4	24 0230	2.1	9 0125	1.8	24 0205	2.8
0815	4.7	0835	5.0	0830	4.6	0850	4.5	0740	4.5	0750	4.2
SU 1400	3.3	M 1440	2.7	W 1455	2.4	TH 1540	1.8	TH 1415	1.7	F 1450	1.4
1815	3.9	1940	3.9	2010	3.8	2145	3.7	2015	4.0	2135	4.0
10 0130	0.9	25 0215	1.1	10 0225	1.7	25 0310	2.5	10 0205	2.2	25 0250	2.9
0645	4.7	0910	4.9	0905	4.6	0920	4.3	0815	4.5	0815	4.0
M 1445	3.1	TU 1535	2.4	TH 1540	2.2	F 1630	1.7	F 1500	1.5	SA 1530	1.4
1905	3.7	2045	3.7	2110	3.7	2310	3.7	2120	4.0	2240	4.0
11 0205	1.2	26 0255	1.6	11 0305	2.1	26 0355	3.0	11 0255	2.6	26 0345	3.2
0920	4.7	0945	4.8	0935	4.6	0950	4.1	0845	4.4	0840	3.8
TU 1535	2.9	W 1635	2.2	F 1630	1.9	SA 1720	1.7	SA 1550	1.3	SU 1610	1.5
2000	3.6	2200	3.5	2230	3.6			2235	4.0	2350	4.0
12 0240	1.4	27 0340	2.2	12 0355	2.5	27 0035	3.8	12 0350	2.9	27 0505	3.9
0950	4.7	1020	4.6	1010	4.5	0505	3.3	0925	4.2	0915	3.7
W 1630	2.7	TH 1730	2.0	SA 1730	1.6	SU 1020	4.0	SU 1645	1.2	M 1700	1.5
2110	3.4	2335	3.4			1810	1.6				
13 0325	1.8	28 0425	2.7	13 0005	3.7	28 0155	3.9	13 0000	4.1	28 0055	4.1
1025	4.7	1055	4.4	0455	3.0	0655	3.4	0505	3.2	0700	3.3
TH 1725	2.4	F 1825	1.8	SU 1050	4.4	M 1105	3.8	M 1010	4.1	TU 1005	3.5
2230	3.3			1825	1.3	1910	1.5	1745	1.1	1755	1.6
14 0410	2.2	29 0115	3.5	14 0145	3.9	29 0255	4.1	14 0125	4.2	29 0155	4.2
1105	4.6	0535	3.1	0620	3.3	0830	3.4	0640	3.3	0820	3.2
F 1815	2.0	SA 1130	4.3	M 1140	4.3	TU 1200	3.7	TU 1110	3.9	W 1115	3.4
		1915	1.6	1925	1.1	2005	1.5	1850	1.1	1900	1.7
15 0010	3.4	30 0240	3.8	15 0300	4.2	30 0300	4.2	15 0230	4.4	30 0245	4.2
0510	2.6	0705	3.4	0750	3.4	0750	3.4	0810	3.2	0905	3.0
SA 1140	4.6	SU 1210	4.1	TU 1235	4.2	TU 1235	4.2	W 1225	3.8	TH 1245	3.3
1910	1.6	2005	1.4	2025	0.8			2000	1.0	2000	1.6
31 0340	4.0	31 0340	4.0					31 0325	4.3	31 0325	4.3
0835	3.5	0835	3.5					0940	2.8	0940	2.8
M 1255	4.0	M 1255	4.0					F 1410	3.4	F 1410	3.4
2050	1.3	2050	1.3					2055	1.6	2055	1.6

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

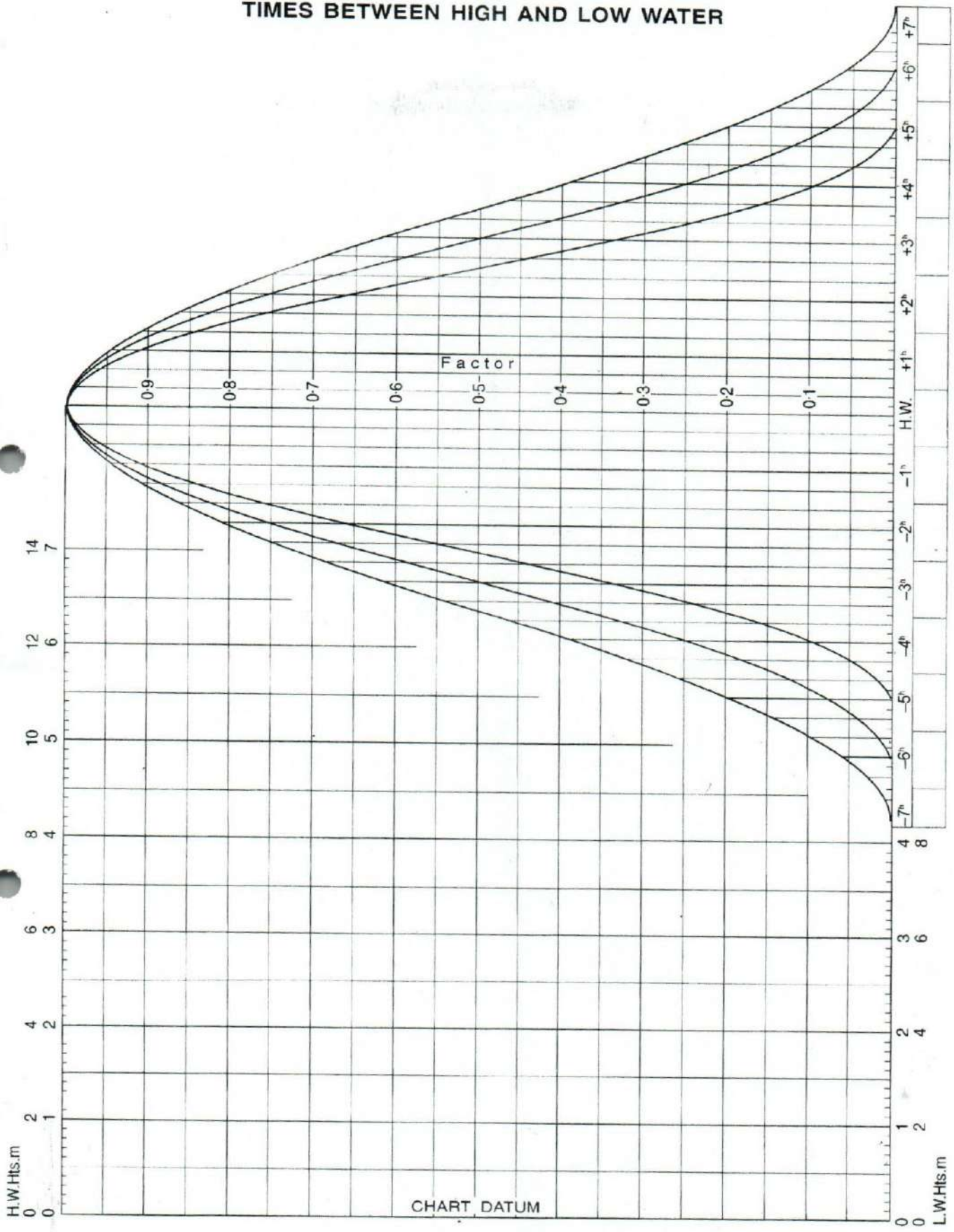


CHART DATUM

5) A container vessel bound for Tanjung Pagar Terminal is proceeding along the East bound traffic lane to receive pilot at Eastern Boarding A. The vessel draws 10 m and capable of making 18 knots speed.

a) At 1030 hrs she observes a horizontal sextant angle of 50° between buffalo Rock isolated danger buoy ($01^{\circ} 09.9' N$, $103^{\circ} 48.15' E$) and Karang Banteng pillar buoy with Racon 'K' ($01^{\circ} 09.5' N$, $103^{\circ} 48.83' E$). At the same time Karang Banteng pillar buoy bore 085° (T). Fix the vessel's position at 1030 hrs.

(05 marks)

b) While following the East bound lane, vessel steered 064° (T) at 16 knots. At 1045 hrs the vessel observed the GPS position as $01^{\circ} 11.7' N$, $103^{\circ} 52' E$. fix the position of the vessel at 1045 hrs.

(05 marks)

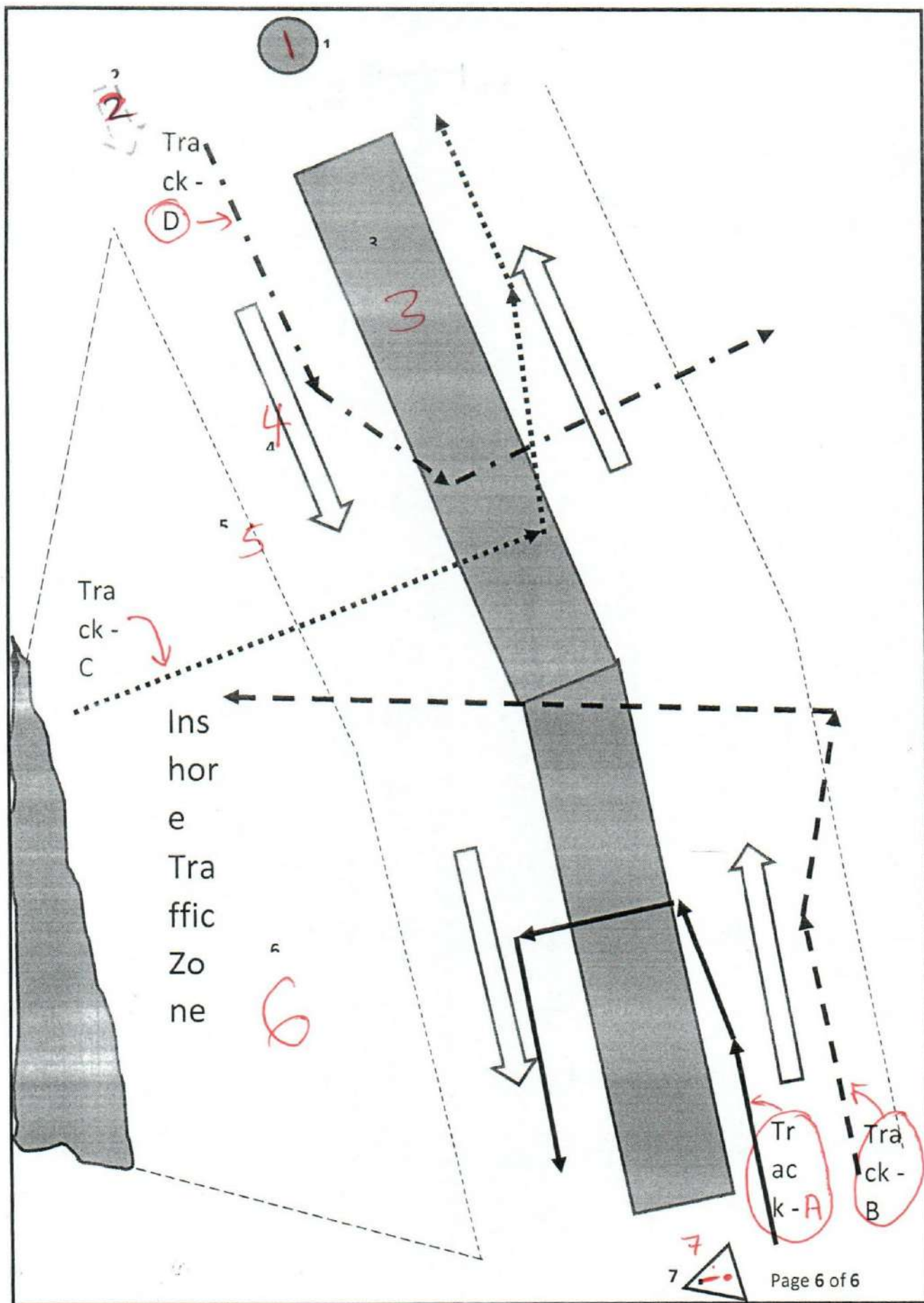
c) Find the set and drift experienced in above (b).

(05 marks)

d) What would be your course to steer if set and drift was known before to make good 064° (T).

(05 marks)

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CANADA - VANCOUVER

LAT 49°17'N LONG 123°07'W

TIME ZONE +0800

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

JANUARY				FEBRUARY				MARCH			
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
1 0305 3.7		16 0155 3.6		1 0430 4.2		16 0400 4.4		1 0345 4.2		16 0325 4.5	
0735 3.2		0625 3.0		0940 3.5		0910 3.4		0925 3.3		0915 3.0	
SA 1315 4.3		SU 1225 4.6		TU 1340 4.0		W 1345 4.2		W 1310 3.7		TH 1350 3.8	
2050 1.3		2000 1.2		2135 1.1		2125 0.8		2025 1.4		2100 1.0	
2 0405 4.0		17 0315 4.0		2 0505 4.4		17 0445 4.6		2 0425 4.3		17 0410 4.6	
0850 3.4		0750 3.3		1025 3.5		1010 3.3		1005 3.2		1005 2.8	
SU 1350 4.2		M 1310 4.5		W 1430 4.0		TH 1450 4.2		TH 1415 3.7		F 1510 3.9	
2130 1.1		2055 0.8		2215 1.0		2215 0.5		2140 1.3		2155 1.0	
3 0455 4.2		18 0420 4.3		3 0540 4.5		18 0530 4.7		3 0500 4.4		18 0450 4.6	
0950 3.5		0905 3.4		1105 3.4		1100 3.1		1040 3.1		1050 2.5	
M 1425 4.2		TU 1400 4.5		TH 1520 4.0		F 1600 4.3		F 1520 3.8		SA 1615 4.0	
2205 1.0		2145 0.5		2255 0.9		2305 0.5		2225 1.2		2245 1.1	
4 0535 4.4		19 0510 4.6		4 0615 4.6		19 0605 4.8		4 0530 4.4		19 0525 4.6	
1040 3.5		1010 3.5		1140 3.3		1120 2.8		1115 2.9		1130 2.2	
TU 1505 4.1		W 1455 4.5		F 1610 4.0		SA 1700 4.3		SA 1610 3.9		SU 1710 4.1	
2245 0.8		2235 0.3		2330 0.8		O 2350 0.6		2300 1.1		O 2330 1.3	
5 0610 4.6		20 0555 4.8		5 0645 4.6		20 0640 4.8		5 0555 4.5		20 0555 4.6	
1120 3.5		1105 3.4		1215 3.2		1235 2.6		1145 2.7		1210 1.9	
W 1540 4.1		TH 1550 4.5		SA 1655 4.1		SU 1755 4.2		SU 1655 4.0		M 1800 4.1	
2315 0.8		O 2320 0.2		●				● 2340 1.2			
6 0645 4.6		21 0635 4.9		6 0005 0.8		21 0030 0.9		6 0620 4.5		21 0010 1.6	
1200 3.5		1200 3.3		0710 4.6		0715 4.8		1220 2.5		0625 4.6	
TH 1615 4.1		F 1650 4.5		SU 1250 3.1		M 1320 2.5		M 1745 4.1		TU 1250 1.7	
● 2350 0.7				1740 4.1		1845 4.1				1850 4.1	
7 0715 4.7		22 0010 0.2		7 0035 0.9		22 0110 1.2		7 0015 1.3		22 0050 1.9	
1235 3.4		0715 5.0		0735 4.6		0745 4.8		0645 4.5		0655 4.5	
F 1655 4.1		SA 1255 3.1		M 1330 2.9		TU 1405 2.1		TU 1255 2.2		W 1330 1.5	
		1745 4.3		1825 4.0		1940 4.0		1830 4.1		1940 4.1	
8 0025 0.7		23 0050 0.4		8 0110 1.1		23 0150 1.6		8 0050 1.5		23 0125 2.2	
0745 4.7		0755 5.0		0805 4.6		0820 4.7		0715 4.5		0725 4.4	
SA 1315 3.4		SU 1345 2.9		TU 1410 2.7		W 1455 1.9		W 1335 2.0		TH 1410 1.4	
1735 4.0		1845 4.1		1915 3.9		2040 3.8		1920 4.1		2035 4.1	
9 0055 0.8		24 0135 0.7		9 0145 1.1		24 0230 2.1		9 0125 1.8		24 0205 2.6	
0815 4.7		0835 5.0		0830 4.6		0850 4.5		0740 4.5		0750 4.2	
SU 1400 3.3		M 1440 2.7		W 1455 2.4		TH 1540 1.8		TH 1415 1.7		F 1450 1.4	
1815 3.9		1940 3.9		2010 3.8		2145 3.7		2015 4.0		2135 4.0	
10 0130 0.9		25 0215 1.1		10 0225 1.7		25 0310 2.5		10 0205 2.2		25 0250 2.9	
0845 4.7		0910 4.9		0905 4.6		0920 4.3		0815 4.5		0815 4.0	
M 1445 3.1		TU 1535 2.4		TH 1540 2.2		F 1630 1.7		F 1500 1.5		SA 1530 1.4	
1905 3.7		2045 3.7		2110 3.7		2310 3.7		2120 4.0		2240 4.0	
11 0205 1.2		26 0255 1.6		11 0305 2.1		26 0355 3.0		11 0255 2.6		26 0345 3.2	
0920 4.7		0945 4.8		0935 4.6		0950 4.1		0845 4.4		0840 3.8	
TU 1535 2.9		W 1635 2.2		F 1630 1.9		SA 1720 1.7		SA 1550 1.3		SU 1610 1.5	
2000 3.6		2200 3.5		2230 3.6				2235 4.0		2350 4.0	
12 0240 1.4		27 0340 2.2		12 0355 2.5		27 0035 3.8		12 0350 2.9		27 0505 3.3	
0950 4.7		1020 4.6		1010 4.5		0505 3.3		0925 4.2		0915 3.7	
W 1630 2.7		TH 1730 2.0		SA 1730 1.6		SU 1020 4.0		SU 1645 1.2		M 1700 1.5	
2110 3.4		2335 3.4				1810 1.6					
13 0325 1.8		28 0425 2.7		13 0005 3.7		28 0155 3.9		13 0000 4.1		28 0055 4.1	
1025 4.7		1055 4.4		0455 3.0		0655 3.4		0505 3.2		0700 3.3	
TH 1725 2.4		F 1825 1.8		SU 1050 4.4		M 1105 3.8		M 1010 4.1		TU 1005 3.5	
2230 3.3				1825 1.3		1910 1.5		1745 1.1		1755 1.6	
14 0410 2.2		29 0115 3.5		14 0145 3.9		29 0255 4.1		14 0125 4.2		29 0155 4.2	
1105 4.6		0535 3.1		0620 3.3		0830 3.4		0640 3.3		0820 3.2	
F 1815 2.0		SA 1130 4.3		M 1140 4.3		TU 1200 3.7		TU 1110 3.5		W 1115 3.1	
		1915 1.6		1925 1.1		2005 1.5		1850 1.1		1900 1.7	
15 0010 3.4		30 0240 3.8		15 0300 4.2		30 0250 4.4		15 0250 4.4		30 0245 4.2	
0510 2.6		0705 3.4		0750 3.4		0810 3.2		0810 3.2		0905 3.0	
SA 1140 4.6		SU 1210 4.1		TU 1235 4.2		W 1225 3.8		W 1225 3.8		TH 1245 3.3	
1910 1.6		2005 1.4		2025 0.8		2000 1.0		2000 1.0		2000 1.6	
		31 0340 4.0								31 0325 4.3	
		0835 3.5								0940 2.8	
		M 1255 4.0								F 1410 3.4	
		2050 1.3								2055 1.6	