NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

NAUTICAL SCIENCE: PAPER II

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 7 pages. Please check that your question paper is complete.
2. Answer **ALL** the questions in the answer book provided.
3. Clearly show **ALL** calculations and diagrams which you have used in the determination of your answers.
4. Begin the answer to each new question on a new page.
5. The use of scientific calculators is permitted.
6. Alphanumeric calculators and dictionaries are **NOT** permitted.
7. If necessary, round off final courses correct to the nearest whole degree. Round off other final answers correct to three decimal places unless stated otherwise.
8. Nautical tables may be used.
9. It is in your own interest to write legibly and to present your work neatly.

SPECIAL REQUIREMENTS

Radar Plotting Sheet (to be submitted with your answer book)
Drawing Instruments

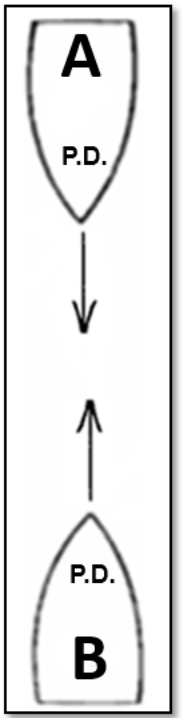
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SECTION A SEAMANSHIP

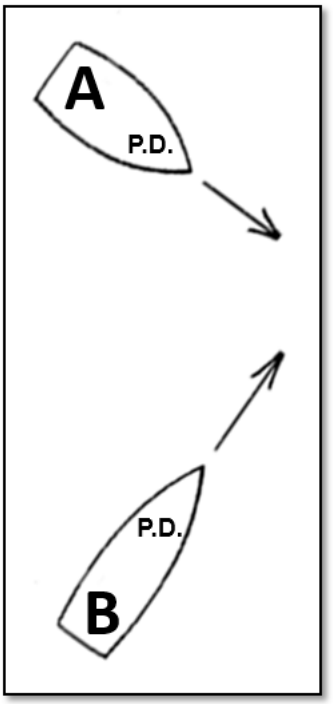
QUESTION 1

In compliance with the International Regulations for Preventing Collisions at Sea, 1972 as amended (hereinafter referred to as the COLREGs), answer the following question sets:

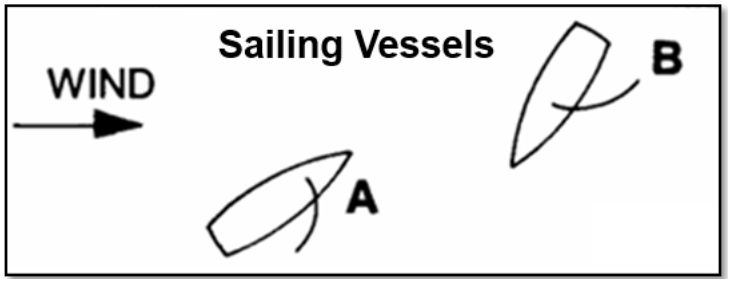
1.1 The following scenarios involve power-driven (PD) and sailing vessels underway in clear visibility and approaching each other so as to involve a risk of collision. In each case, identify the 'give-way' vessel AND describe the appropriate collision-avoidance manoeuvres to be executed by the 'give-way' vessel accordingly:



1.1.1



1.1.2



1.1.3

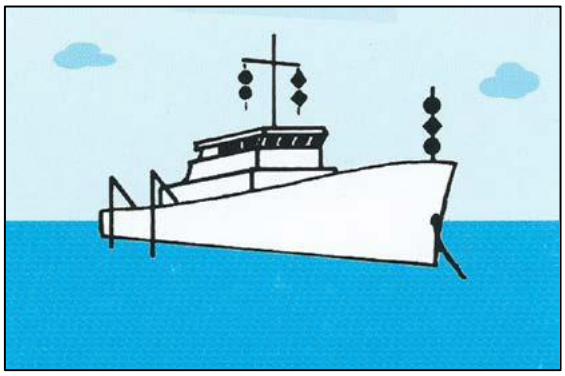
1.1.1 (3)

1.1.2 (4)

1.1.3 (3)

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1.2 From the bridge of your approaching vessel, the anchored contact is held visually dead ahead so as to involve a risk of collision. Its aspect and day signals are shown below.



1.2.1 Identify the specific underwater operation the contact is engaged in. (2)

1.2.2 Indicate the side on which another vessel may safely approach and/or pass the contact. (2)

1.2.3 Describe the contact's advertised manoeuvrability status while engaged in the specific operation. (2)

1.3 A pilot vessel is engaged in pilot duty.

1.3.1 Draw the night signal displayed by the pilot vessel, underway, viewed from ahead. (5)

1.3.2 Describe the identity sound signal of a pilot vessel engaged in pilot duty during restricted visibility. (2)

1.4 According to Rule 2a, list FOUR entities that would be held responsible and liable for the consequences of any neglect to comply with the COLREGs. (4)

1.5 Vessels may assume RAM status while engaged in particular maritime operations. List THREE such maritime operations. (3)

[30]

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QUESTION 2 'SOLAS'

2.1 List FIVE actions to be undertaken and/or initiated by the OOW on the bridge of a ship when a person falls overboard while underway during the daytime. Your answer must prioritise the most urgent actions. (5)

2.2 Outline FIVE typical pieces of equipment that should be carried aboard an SAR vessel during the preparation and/or execution of SAR operations. (5)

[10]

QUESTION 3 SHIP STABILITY

3.1 What does the term 'lightweight tonnage' of a vessel mean? (2)

3.2 When is a vessel said to 'list'? (1)

3.3 A seagoing vessel is subject to different forces and motions. A vessel's motion has six degrees of freedom. List any TWO degrees of freedom. (2)

3.4 Sketch the transverse section through a ship with a starboard heel, showing the positions of the centres of gravity and buoyancy, initial metacentre, and directions of the forces of gravity and buoyancy when the ship is in neutral equilibrium. (5)

3.5 The actual waterline of a vessel docked in a river port within the tropical region cuts its Plimsoll mark just below the fresh water line mark. Draw a simple line diagram showing the actual waterline, visible Plimsoll mark, deck line, and tropical fresh water statutory freeboard for the Plimsoll mark. (5)

3.6 Adding, removing or shifting weights within a ship affects the overall stability of a vessel. State how a vessel's overall stability would be affected in the following circumstances (answer INCREASE/DECREASE):

3.6.1 Top loading of cargo. (1)

3.6.2 Cargo lowered from a higher to a lower deck by a ship's own crane. (1)

3.6.3 Discharging of cargo. (1)

3.6.4 Cargo raised off a lower deck by a ship's own crane. (1)

3.7 What is the maritime term given to the water used specifically to make a ship steady? (1)

[20]

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QUESTION 4 RADAR

Your vessel is steering a course of 165° (T) at a reduced speed of 5 knots due to poor visibility of less than 1 000 m. You detect a radar target astern that you have been plotting with the following bearings and ranges:

TIME	BEARING	RANGE
20h00	255° (T)	10,0 M
20h15	255° (T)	7,0 M
20h30	255° (T)	4,0 M

4.1 Plot the target's movements on the radar plotting sheet provided. (5)

4.2 Prepare a full target report accordingly. Organise the target data in accordance with the common template here below:

Target Report	
Target Identity	(-)
Initial Bearing & Range	(1)
Relative Course	(-)
True Course	(1)
Speed	(2)
CPA Bearing	(1)
CPA Range	(2)
CPA Time	(3)

(10)

4.3 Based on your plot and assuming continued restricted visibility, determine the appropriate action your vessel should take to avoid collision with this target in accordance with COLREGs. (5)

[20]

QUESTION 5 SEA TRANSPORT

5.1 Briefly describe the general design features of the following sea-going vessels:

5.1.1 Dry bulk carriers (5)

5.1.2 Vehicle carriers (5)

[10]

90 marks

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SECTION B COMMUNICATIONS AND METEOROLOGY

QUESTION 6 MARITIME COMMUNICATION

6.1 Maritime distress communication existed well before the introduction of GMDSS. Outline the main improvements brought to bear on maritime distress communication by GMDSS. (3 × 1 = 3)

6.2 You are the OOW on board your vessel named 'SPONOPONO' with call sign ZSAR. Your vessel is in distress, having grounded on the northwest side of Seal Island. You are requiring immediate assistance. The weather conditions observed include a NW wind of force 7 and poor visibility.

6.2.1 Give an example of the most appropriate initial message(s) you would prepare for transmission over VHF radio in this regard. (11)

6.2.2 What are the frequency and channel numbers of the maritime distress radiotelephony on which the said distress would be transmitted? (2)

6.3 Give the single international meaning of the following signals:

6.3.1 '**A**' (flown at the dip) (2)

6.3.2 **National flag** (flown at half-mast) (2)

[20]

QUESTION 7 METEOROLOGY

7.1 By means of a weather station model, illustrate the following weather phenomenon:

- cloud cover: overcast
- wind direction: east
- most likely change of wind direction: back
- wind speed: 25 kn (4)

7.2 Draw the prescribed synoptic weather symbols to illustrate the established general direction of origin and movement of a mature occluded front in the Southern Hemisphere. Indicate the location of the warm and cold air sectors accordingly. (6)

7.3 Land and sea breezes are good examples of the small-scale formation and circulation of winds caused by localised temperature and pressure differences. Draw and label a cross profile of a typical sea breeze to illustrate the thermal circulation of wind. (10)

[20]

40 marks

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SECTION C SAILINGS

QUESTION 8

8.1 By means of the Mercator sailing method, find the course and distance between 13° 15' N, 072° 10' E and 22° 55' S, 009° 56' E.

Latitude	Meridional Parts
13° 15' N	796,82
22° 55' S	1404,09

Tan (course) = D.Long ÷ DMP
Distance = D.Lat ÷ cos (course) (15)

8.2 A vessel in position 045° 00' S, 050° 00' E steers a course of 090° (T) for a distance of 400 miles. Determine its destination position. (5)

20 marks

Total: 150 marks

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