NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

NAUTICAL SCIENCE: PAPER I

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 6 pages and an Annexure Booklet of 9 pages (i–ix). Please check that your question paper is complete.
2. Answer **ALL** the questions in Sections A and B.
3. Begin the answer to each new question on a new page.
4. Chronologically order/arrange and number the answers correctly according to the order/sequence and numbering system used in this question paper.
5. Clearly show ALL calculations and diagrams used in the determination of answers in answer book and/or chart accordingly.
6. The use of an approved scientific calculator (non-programmable and non-graphical) is permitted. Alphanumeric calculators and dictionaries are **NOT** permitted.
7. Nautical tables may be used.
8. Use Magnetic Variation 24° W unless otherwise stated, and the attached Deviation Card – Annexure 1, throughout.
9. It is in your own interest to write legibly and to present your work neatly.

REQUIREMENTS

Drawing instruments
Chart SAN 3002

ANNEXURES

Annexure 1 – Examination Notes and Deviation Card
Annexure 2 – Predicted Hourly Heights – Knysna - December 2007
Annexure 3 – Altitude Correction Tables
Annexure 4 – Conversion of Arc to Time
Annexure 5 – Nautical Almanac – 1987 February 12, 13, 14
Annexure 6 – Nautical Almanac – 1987 August 17, 18, 19
Annexure 7 – Increments and Corrections 28^m, 29^m
Annexure 8 – Increments and Corrections 50^m, 51^m
Annexure 9 – Graph Paper

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SECTION A PRACTICAL CHARTWORK

QUESTION 1

A vessel is approaching Cape Town from the south steering a compass course 022° (C) at an estimated speed of 15,0 knots.

At 16:00 the vessel's position is fixed with Cape Point Light bearing 084° (C) and Slangkoppunt Light bearing 042° (C).

Use Magnetic Variation 26° W.

1.1 Determine the compass course to steer from the 16:00 position to the second WP at the beginning of the Traffic Separation Scheme approaching Cape Town, given that:

- Estimated speed through the water is 15 knots
- Current is estimated to be setting 090° (T) at 1,5 knots
- Estimated leeway from a Westerly wind is 5°. (6)

1.2 Clearly lay off on the chart the required details of WPs, courses, and speeds from the 16:00 position to safely reach Table Bay pilot rendezvous position – north of Green Point lighthouse accordingly. (15)

1.3 Prepare and present the details of the passage in table format. Restrict the information in the table to the following aspects:

- WP Name
- WP Position (GPS coordinates – latitude & longitude)
- Course (4)

[25]

QUESTION 2

Your vessel is at anchor west of Green Point, and the following observations were made:

- The horizontal sextant angle (HSA) between Green Point Light and Robben Island Light is 78°;
- The vertical sextant angle (VSA) of Green Point Lt. is 0° 14,9'.

Range = 1.86 × Height of Object (in meters) ÷ VSA (in minutes)

2.1 Determine and plot the anchor position comprising the said ranges. (13)

2.2 State the GPS coordinates of the vessel's anchor position on your answer book. (2)

[15]

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QUESTION 3

A vessel steering 150° (C) observed at 10:00 Cape Point Light bearing 070° (C). At 11:00 Cape Point Light was again observed bearing 010° (C). The vessel maintained a course 150° (C) and engine speed of 7 knots throughout. The current was known to set 270° (T) at 1,0 knot.

3.1 Determine and plot the vessel's position at 11:00. (18)

3.2 State the established ship's position as a bearing and range in reference to Cape Point Light. (2)

[20]

QUESTION 4

With reference to Chart SAN 3002:

4.1 Describe the characteristics of Green Point Light: Fl 10s. 20m 25M. (5)

4.2 From the 'Tidal Streams' table, what is the direction and rate of the tidal stream south-east of Cape Point Light in approximate position: 34° 23,4' S 018° 32,8' E five hours before HW Neaps? (2)

4.3 Your North-bound vessel is navigating in thick fog in the vicinity of Whittle Rock Cardinal Buoy in False Bay. Which is the safe side to pass the buoy? (2)

4.4 What are the bottom corner's limits GPS co-ordinates? (2)

4.5 What is the variation to apply to the true bearing in the year 2015 on the compass rose in False Bay? (2)

4.6 How many Notices to Mariners affected the chart in the year 2007? (1)

4.7 What is the audio or fog signal of Robben Island in Table Bay? (1)

4.8 Heights of objects (lighthouses, overhead bridges, mountains, etc.) on the chart are measured from which plane of reference? (1)

4.9 Describe the nature of the seabed symbolised by the abbreviation:

4.9.1 'Cy'

4.9.2 'M' (1 × 2 = 2)

4.10 What is the meaning of the chart symbol?

4.10.1 

4.10.2  (1 × 2 = 2)

[20]

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QUESTION 5

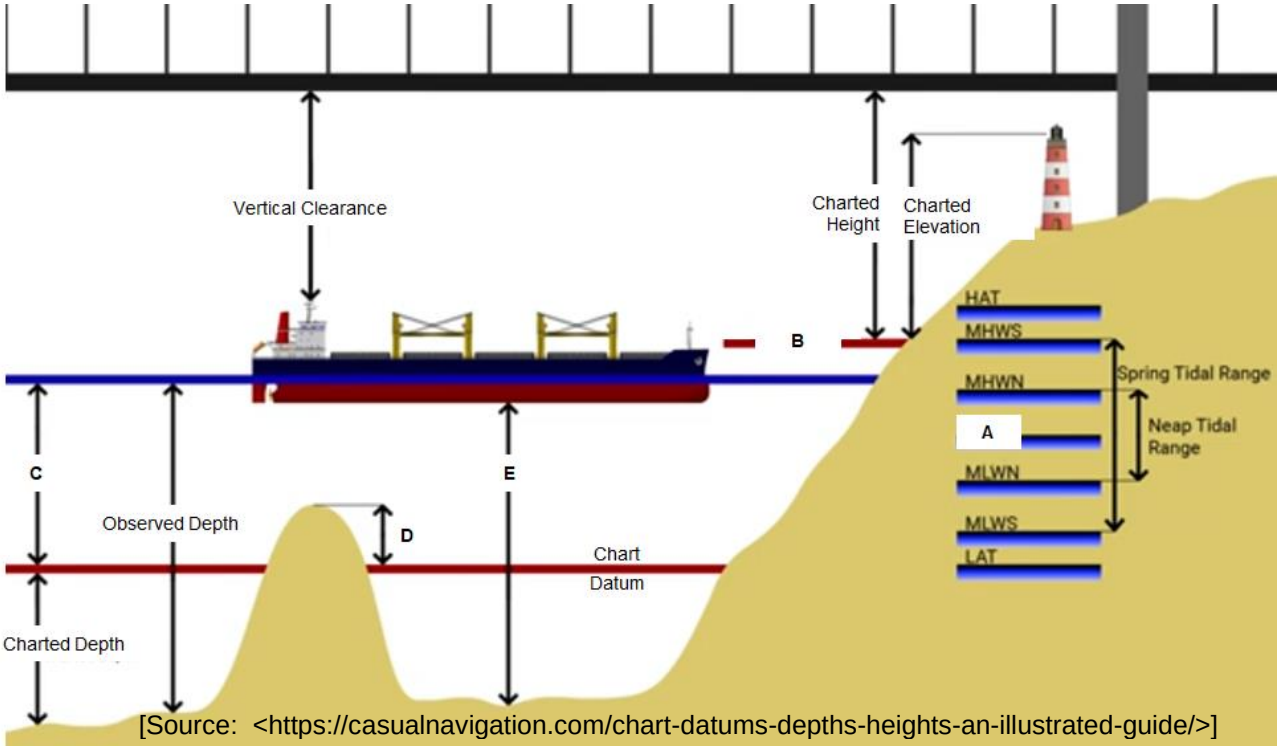
5.1 Your vessel is due to sail from Knysna on the rising tide during the morning of 1 December 2007. The channel depth through Knysna Heads is 5,4 m. You are required to have a minimum clearance at all times of 2,5 m beneath the keel. The draught of your vessel is 4,2 m.

By way of interpolation, determine the earliest time to cross the Heads on the rising tide? (10)

5.2 When do spring and neap tides occur? (4)

5.3 The moon – sun gravitational forces on Earth are one of the two tide-causing forces. What is the name of the other force? (1)

5.4 The diagram below illustrates typical tidal level information. Complete the labels for A–E in your answer book.



[Source: <https://casualnavigation.com/chart-datums-depths-heights-an-illustrated-guide/>]

(5)

[20]

100 marks

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SECTION B ASTRO-NAVIGATION

QUESTION 6

On 12 February 1987 in DR position 30º 00' S 011º 30' E, the lower limb of the sun was observed at meridian passage, to the north of the observer, with a sextant altitude of 73º 11,7'. Index error of the sextant 0,5' off the arc, height of eye is 12 metres.

LIT = Longitude ÷ 15
d.Corrn = (Minutes of GMT ÷ 60) × d. Value
Latitude = Zenith Distance + Declination
Latitude = Declination – Zenith Distance
Latitude = Zenith Distance – Declination

6.1 Determine:

6.1.1 the GMT, and ship's zone time of meridian passage of the sun. (5)

6.1.2 the latitude of the observer at meridian passage. (15)

6.2 By means of a rational horizon sketch on the plane of the celestial horizon, show, inter alia:

- cardinal points,
- observer's meridian (NS),
- zenith position (Z),
- elevated pole (P),
- celestial equator (Q),
- sun's declination (X),
- position of the sun (X_1). (5)

[25]

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QUESTION 7

On 19 August 1987 at 09:52 LMT in DR position 28° 00' S 015° 10' E the Sun was observed to bear 069° (C) when the vessel was heading 340° (C).

LIT = Longitude ÷ 15
Incr = Minutes and Seconds of GMT × 15
d.Corrn = (Minutes of GMT ÷ 60) × d. Value
$Z = \tan^{-1}((\sin(LHA) \div (\cos(L) \times \tan(d) - (\sin(L) \times \cos(LHA))$

$A = \tan(L) \div \tan(LHA)$
$B = \tan(d) \div \sin(LHA)$
$Z = \tan^{-1}(1 \div C \times \cos(L))$

7.1 What is the true heading of the vessel at this time? (18)

7.2 If the magnetic variation is 23° W, what is the deviation of the compass for this heading? (5)

7.3 In the Southern Hemisphere, during which months of the year do

7.3.1 the shortest day; and (1)

7.3.2 the shortest night occur? (1)
[25]

50 marks

Total: 150 marks

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