NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

NAUTICAL SCIENCE: PAPER I

MARKING GUIDELINES

Time: 3 hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

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SECTION A PRACTICAL CHARTWORK

QUESTION 1

1.1

	Course	Cape Point Lt.	Slangkoppunt Lt.
Compass:	022° (C)	084° (C)	042° (C)
Deviation:	4° E	4° E	4° E
Magnetic:	026° (M)	088° (M)	046° (M)
Variation	26° W	26° W	26° W
True:	000° (T)	062° (T)	020° (T)

1.1 & 1.2

Criterion	Possible Score	Rating
1st 16:00 position fix (Brgs Cp Pt Lt: 062° (T) Slang 020° (T))	2	
2nd position on reporting point 1B – inbound (latitude: 34° 00,7' S longitude: 018° 15,1' E)	2	
Course to make good: 008° (T) & 15	1	
DR 16:30 at estimated speed 15,0 kn	1	
Current vector set/direction: 090° (T)	1	
Current vector rate/magnitude measurement: 0,75 miles	1	
Current vector set label: 090° (T)	--	--
Drift/rate label: 1,5 Kn 1,5	--	--
Speed over-the-ground: 7,6 M ÷ 0,5 T = **15,2** kn	1	
Course to make good: 008° (T)	--	--
Course to counter current: 003° (T)	1	
Leeway: – 5° (W'ly wind)	--	--
Course to steer: 358° (T)	1	
Variation: 26° W	--	--
Magnetic: 024° M	--	--
Deviation: 4° E	--	--
Comp Co: 020° C	1	
Course to make good: 030° (T) & 15	1	
Course to make good: 090° (T) & 15	1	
Arrival at correct destination – Pilot station	1	
Total	**15/15**	**/15**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt) **1** = **Good** (attempt mostly correct/accurate)		

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1.3 Passage Plan Information Table

Name of WP	Position of Way Point	Course to Next WP	Distance to Next WP	Speed in Knots	Time to Next WP
WP 1 16:00	– Start Position – Cape Pt Lt 062° (T) × 18,6' M 034° 30,01' S 018° 10,0' E	008° (T)	29,7 M	15	1h 59m
WP 2	Green Pt Lt 048° (T) × 9,9 M 034° 00,7' S 018° 15,1' E	030° (T)	9,7 M	15	0h 39m
WP 3	Green Pt Lt 121° (T) × 3,1 M 033° 52,5' S 018° 20,85' E	090° (T)	2,6 M	15	0h 10m
WP 4	– End Position – Green Pt Lt 180° (T) × 1,6 M 033° 52,5' S 018° 24,0' E	---	---	---	---
TOTALS / AVERAGES			42,0 M	15	2h 48m

Passage Plan Table Marking Rubric

Criterion ***…Check general accuracy (sample of ± 3) of:***	**Possible Score**	**Rating**
WPs GPS co-ordinates (latitudes)	1	
WPs GPS co-ordinates (longitudes)	1	
Courses	1	
General layout & presentation of table (column headings)	1	
Total	**4** / **4**	___ / **4**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt) **1** = **Acceptable** (attempt mostly correct/accurate)		

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QUESTION 2

2.1 Base Line Robben Island Light / Green Point Light: 346°/166°

Base Angle: 90° – 78° = 12°

Bearing (of Green Point Light) from Robben Is. Lt: 166° + 12° = 178°

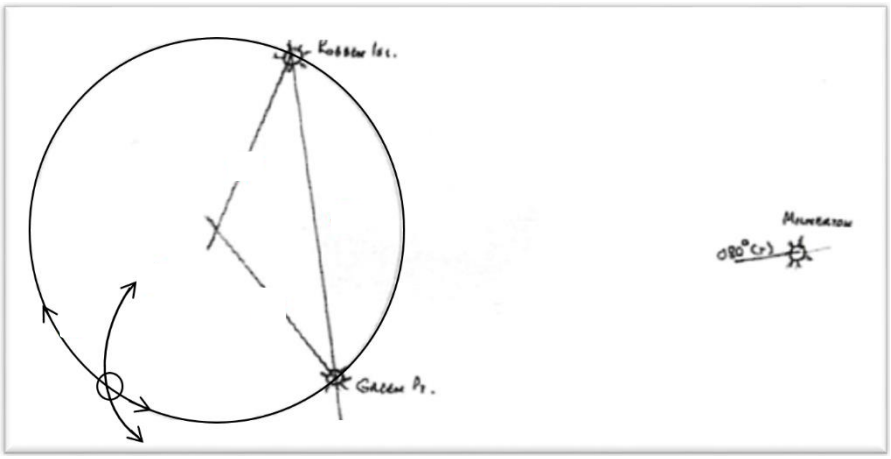
Bearing (of Robben Is. Lt) from Green Pt. Lt: 346° – 12° = 334°

$$\text{Range/Distance from Green Pt. Lt.} = \frac{\text{Height of Obj.} \times 1{,}86}{\text{VSA (in minutes)}}$$

$$= \frac{20 \times 1{,}86}{14{,}9'}$$

$$= 2{,}5 \text{ M}$$

HSA & VSA



Criterion	Possible Score	Rating
Triangle construct: base line	3	
side 1 toward observer's side of base line		
side 2 toward observer's side of base line		
Position plot: range (product of HSA triangle)	2	
range (product of VSA)		
Total	**5** / **5**	___ / **5**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt)		
1 = **Good** (attempt mostly correct/accurate)		

2.2 Anchor position Lat: 033° 54,1' S

Long: 018° 21,1' E

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QUESTION 3

3.1

		Bearings off Cape Point Light	
	Course	**10:00**	**11:00**
Compass	150°	070°	010°
Dev	0°	0°	0°
Magnetic	150°	070°	010°
Var	24°W	24°W	24°W
True	**126°**	**046°**	**346°**

Criterion	**Possible Score**	**Rating**
1st /10:00 Bearing off Cape Point Light: 046° (T)	1	
2nd /11:00 Bearing off Cape Point Light: 346° (T)	1	
Course to make good (corrected for Leeway): 126° (T) & 7	2	
DR at estimated speed 7,0 kn (7 M)	1	
Current vector set/direction: 270° (T)	1	
Current vector rate/magnitude measurement: 1,0 miles	1	
Current vector set label: 270° (T)	1	
Drift/rate label: 1,0 Kn 1,0	1	
Transfer of 1st bearing to current terminal point	1	
11:00 Position fix at intersection of bearing lines	2	
Total	**12 / 12**	**/ 12**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt) **1** = **Good** (attempt mostly correct/accurate)		

3.2 Position at 11:00 Cape Point Lt Brg 346° (T) × 7,1'
(Lat 34° 28,3' S Long 018° 31,9' E)

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QUESTION 4

4.1 Green Point lighthouse: **Fl. 10s 20m 25M**

- Colour of light: white;
- Class of light: flashing;
- Period/frequency is 10 seconds;
- Elevation of lighthouse is 20 metres above Height Datum/MHWS;
- Nominal luminous range of the light is 25 nautical miles;

4.2 Tidal stream: Direction **296°** (T)
Speed/rate/drift = **0,6** knots

4.3 Safe passage of Whittle Rock Cardinal Buoy is on the **East** side

4.4 **Bottom** corner's limits co-ordinates: 034° 34' 00" S 018° 09' 16" E

4.5 Variation for 2015 is 25° 21'W (increasing by 6' W), per annum

4.6 Count/number of Notices to Mariners in the year 2007: 4

4.7 Robben Island fog signal: horn (2) 30 s

4.8 Heights datum / MHWS

4.9 4.9.1 'Cy' = clay
4.9.2 'M' = mud

4.10 What is the meaning of the chart symbol?

4.10.1  wreck (over 200 m or unknown depth) considered <u>not</u> dangerous to surface navigation

4.10.2  foul area/ground <u>not</u> dangerous to surface navigation

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QUESTION 5 TIDES

5.1 HoT (predicted) = UKC + d – CD -**OR**- Draught = 4,20 m

= 2,5 + 4,2 – 5,4

= 1.3 m

Clearance = 2,50 m

Depth required = 6,70 m

Chart depth = 5,40 m

Height of tide = 1,30 m

07:00	1.25	Time Corr^{n} = $\frac{\text{Small HoT Difference}}{\text{Large HoT Difference}}$ × Difference in time
time	1.30	
08:00	1.38	= $\frac{0,05}{0,13}$ × 1˚ or $\frac{0,05}{0,13}$ × 0˚ 60’

= 0˚ 23’ 4,62”

= 0h 23m 4,62s ≈ 23m

07:00

\+ 00:23

Thus Time = **07:23 B**

5.2 ***Spring*** tides occur during ***new*** and ***full*** moon phases

Neap tides occur during ***first*** and ***last quarter*** moon phases

5.3 Centrifugal forces

5.4 A. mean sea level (MSL)
B. height datum
C. height of tide
D. drying height
E. under keel clearance (UKC) / depth below keel

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SECTION B ASTRO-NAVIGATION

QUESTION 6

6.1.1

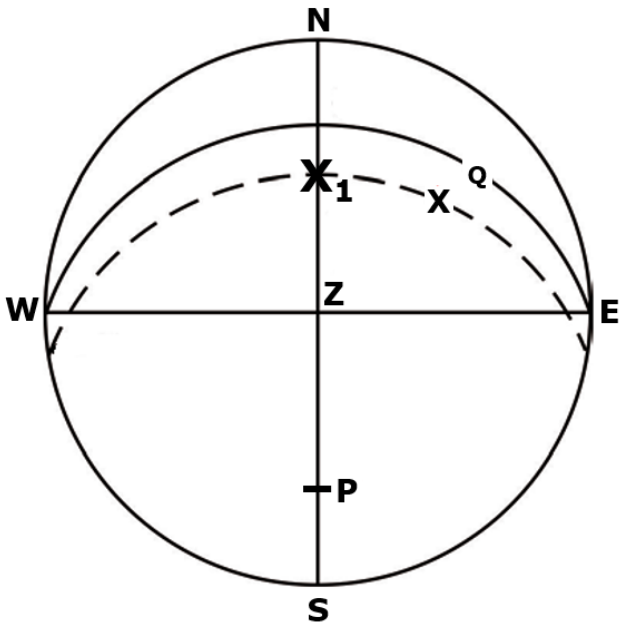
LMT Mer. Pass. 12 Aug 1987	12h 14m 00s	
LIT (011˚ 30' E)	00h 46m 00s	-
GMT Mer. Pass.	11h 28m 00s	
Zone (011˚ 30' E)	01h 00m 00s	+
Ship's Zone Time @ Mer. Pass.	12h 28m 00s	

6.1.2

Dec. (11:00)	S 13º 47,4'	*(Trend = **Decreasing**)*
'**d** ' Corrⁿ (28')	**-** 0,4'	*(d Corrⁿ = 0.8' × Minute 28' of GMT ÷ 60)*
Dec. (11:28)	S 13º 47,0'	

Sextant alt.	73º 11,7'	
I.E.	0,5'	+ (OFF)
Obs. Alt.	73º 12,2'	
Dip (He: 12m)	6,1'	–
App. Alt.	73º 06,1'	
Total corn	15,9'	+
True Alt.	73º 22,0'	
	- 90º 00,0'	
Zenith (ZX)	16º 38,0'	
Dec. (QX)	13º 47,0'	**S**
Latitude (QZ)	30º 25,0'	**S**

6.2



Q = Celestial Equator
X = Declination of the Sun
X_1 = Position of the Sun
Z = Zenith Position
P = Pole Elevated

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QUESTION 7

7.1 *(Local Mean Time = GMT ± Longitude)*

LMT (19 Aug 1987)	09h 52m	
LIT (015˚ 10,0' E)	01h 01m –	(01 00' 40")
GMT	08h 51m	
Zone (015˚ 10,0' E)	01h 00m +	
Ship's Zone Time	09h 51m	(3)

GHA (08:00)	299° 04,0'	
Incr.(51')	012° 45,0' +	*(Incr. = Mins & Secs of GMT **x** 15)*
GHA (08:51)	311° 49,0'	
Long. (015˚ 10,0' E)	015˚ 10,0' E +	
LHA	**326° 59,0'**	

Dec. (08:00)	N 12˚ 54,9'	*(Trend = **Decreasing**)*
'**d**' Corr^{n} (51')	**–** 0,7'	*(d Corr^{n} = 0.8' × Minute 51' of GMT ÷ 60)*
Dec. (08:51)	N 12˚ 54,2'	(3)

$$\text{Azimuth} = \text{Tan}^{-1}\left(\frac{\text{Sin - LHA}}{\text{Cos } \pm\text{Lat} \times \text{Tan } \pm\text{Dec} - \text{Sin } \pm\text{Lat} \times \text{Cos} - \text{LHA}}\right)$$

$$= \text{Tan}^{-1}\left(\frac{\text{Sin} - 326°\ 59{,}0'}{\text{Cos } -28° \times \text{Tan } +12°\ 54{,}2' - \text{Sin } -28° \times \text{Cos} - 326°\ 59{,}0'}\right)$$

= 42, 437°

= N 42° E

True Azimuth = 0° + 42°

= 042° (T)

-**OR**-

A = 0.819 N

B = 0.421 N

C = 1.240 N

Az = N 42 ½° E

042 ½° (T)

True Azimuth = 042° (T)
Obs. Comp. Brg. = 069° (C)
Comp. Error = 27° **W**
Compass Heading = 340° (C)
Compass Error = 27° (W) *(Error West = Subtract)*
True Heading = **313° (T)**

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7.2 Compass Error = Variation ± Deviation **–** OR **–**

Comp Error - Variation = Deviation

27° W – 23° W =

+4° W =

4° W =

T 313°

V 23° W

M 336°

D 4° W

C 340°

7.3 In the Southern hemisphere, the months of the year for the:

7.3.1 shortest day: **June**

7.3.2 shortest night: **December**

Total: 150 marks

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MARKSHEET **Exam Number:** _____

SECTION A PRACTICAL CHARTWORK

1.1

Criterion	Possible Score	Rating
Conversion of Compass Co. 1st and 2nd bearings to True	6	
Total	**6 / 6**	**___ / 6**

1.1 & 1.2

Criterion	Possible Score	Rating
1st 16:00 position fix (Brgs Cp Pt Lt: 062° (T) ✓ Slang 020° (T) ✓)	2	
2nd position on reporting point 1B - inbound (latitude: 34° 00,7' S ✓ longitude: 018° 15,1' E ✓)	2	
Course to make good: 008° (T) & 15	1	
DR 16:30 at estimated speed 15,0 kn ✓	1	
Current vector set/direction: 090° (T) ✓	1	
Current vector rate/magnitude measurement: 0,75 miles ✓	1	
Current vector set label: 090° (T)	--	--
Drift/rate label: 1,5 Kn 1,5	--	--
Speed over-the-ground: 7,6 M ÷ 0,5 T = **15,2** kn ✓	1	
Course to make good: 008° (T)	--	--
Course to counter current: 003° (T) ✓	1	
Leeway: – 5° (W'ly wind)	--	--
Course to steer: 358° (T) ✓	1	
Variation: 26° W	--	--
Magnetic: 024° M	--	--
Deviation: 4° E	--	--
Comp Co: 020° C ✓	1	
Course to make good: 030° (T) & 15	1	
Course to make good: 090° (T) & 15	1	
Arrival at correct destination – Pilot station ✓	1	
Total	**15 / 15**	**___ / 15**
0 = Poor (zero / totally inappropriate / inaccurate attempt) **1 = Good** (attempt mostly correct/accurate)		

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1.3 **Passage Plan Information Table**

Name of WP	Position of Way Point	Course to Next WP	Distance to Next WP	Speed in Knots	Time to Next WP
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TOTALS / AVERAGES			42,0 M	15	2h 48m

Passage Plan Table Marking Rubric

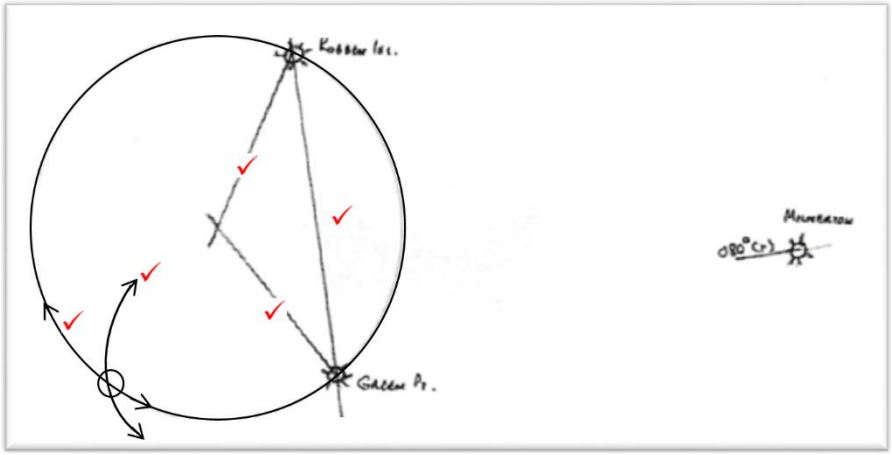
Criterion ***…Check general accuracy (sample of ± 3) of:***	**Possible Score**	**Rating**
WPs GPS co-ordinates (latitudes) ✓	1	
WPs GPS co-ordinates (longitudes) ✓	1	
Courses ✓	1	
General layout & presentation of table (column headings) ✓	1	
Total	**4** / **4**	___ / **4**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt) **1** = **Acceptable** (attempt mostly correct/accurate)		

(4)

[25]

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2.1 HSA & VSA



Criterion		Possible Score	Rating
Triangle construct:	base line ✓ side 1 toward observer's side of base line ✓ side 2 toward observer's side of base line ✓	3	
Position plot:	range (product of HSA triangle) ✓ range (product of VSA) ✓	2	
Total		**5** **5**	___ **5**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt) **1** = **Good** (attempt mostly correct/accurate)			

3.1

Criterion	Possible Score	Rating
1st /10:00 Bearing off Cape Point Light: 046° (T) ✓	1	
2nd /11:00 Bearing off Cape Point Light: 346° (T) ✓	1	
Course to make good (corrected for Leeway): 126° (T) & ✓ 7	2	
DR at estimated speed 7,0 kn (7 M) ✓	1	
Current vector set/direction: 270° (T) ✓	1	
Current vector rate/magnitude measurement: 1,0 miles ✓	1	
Current vector set label: 270° (T) ✓	1	
Drift/rate label: 1,0 Kn 1,0	1	
Transfer of 1st bearing to current terminal point ✓	1	
11:00 Position fix at intersection of bearing lines ✓ ✓	2	
Total	**12** **12**	___ **12**
0 = **Poor** (zero / totally inappropriate / inaccurate attempt) **1** = **Good** (attempt mostly correct/accurate)		

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