



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2008

NAUTICAL SCIENCE: PAPER II

MARKING GUIDELINES

Time: 3 hours

Marks: 150

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.

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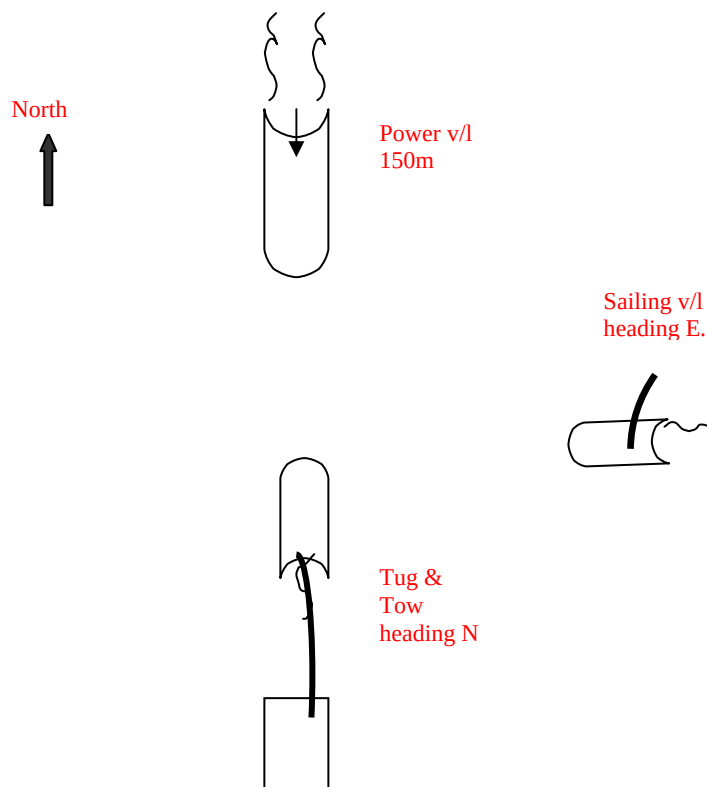
SECTION A SEAMANSHIP**QUESTION 1**

The following vessels are in clear weather and in close proximity to each other (so as to involve possible risk of collision):

- A tug and tow heading north;
- A power-driven vessel of length 150m heading south;
- A sailing vessel heading west and 4 points on the port bow of the vessel heading south.

- 1.1 What is the responsibility of each of the vessels so as to comply with the International Regulations for Preventing Collisions at Sea 1972 (as amended)? (10)
- 1.2 What should each of the vessels mentioned in the question above sound in fog (restricted visibility)? (6)
- 1.3 What sound signal shall each of the vessels mentioned in the question above sound in sight of one another (in clear visibility)? (6)
- 1.4 Draw the lights and shapes displayed by the tug and its tow (the overall length of the tug and tow is less than 200m) underway viewed from
 - (a) ahead;
 - (b) astern.

(8)
[30]

ANSWER QUESTION 1

1.1

- (a) The tug is showing no indication that she is constrained by her ability to manoeuvre. Hence she must keep clear of the sailing vessel (Rule 18 (a)). In the case of the power driven vessel ahead, as this is a head-on situation, the tug will give way to starboard (Rule 14).
The tug will make a bold alteration of course to starboard to keep clear of both vessels, and signal the alteration with one short blast of the whistle (Rule 34(a)).
- (b) The power driven vessel heading south will have the same responsibilities as the tug. She will, therefore, make a bold alteration to starboard to pass well ahead of the sailing vessel and clear of the tug on its port side. She will indicate her actions with one short blast on the whistle.
- (c) The sail vessel is the stand-on vessel, and will therefore maintain her course and speed. (10)

1.2**In fog:**

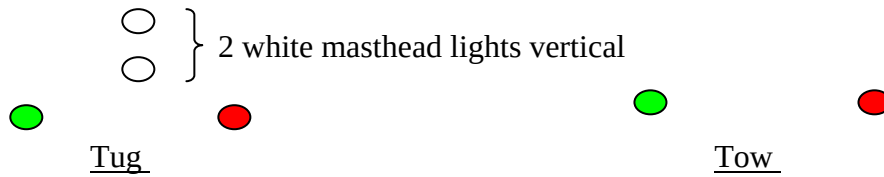
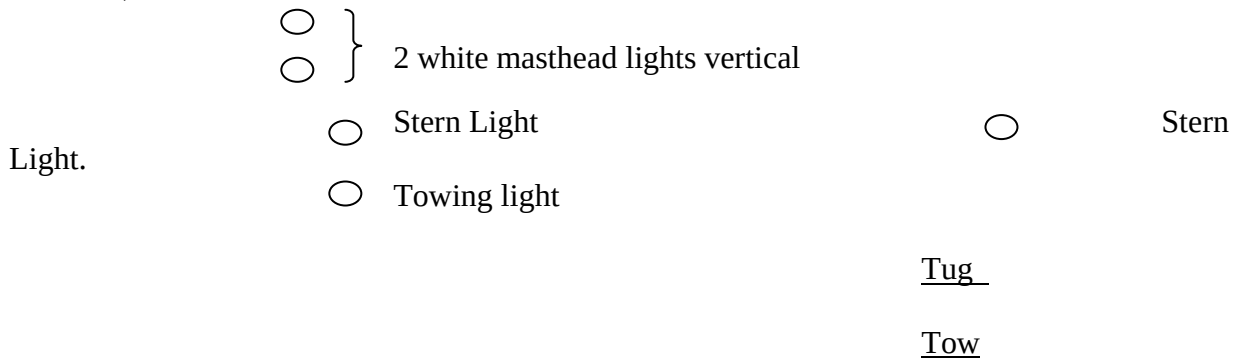
- (a) The tug will sound at intervals of not more than 2 minutes, 3 blasts in succession, namely 1 prolonged followed by 2 short blasts (Rule 35 (c)).
The vessel being towed, if manned, shall at intervals of not more than 2 minutes sound four blasts in succession, namely 1 prolonged followed by 3 short blasts. When practicable, this signal shall be made immediately after the signal of the towing vessel (Rule 35 (d)).
- (b) The power driven vessel making way shall sound at intervals of not more than 2 minutes 1 prolonged blast (Rule 35 (a)).
- (c) The sailing vessel will make the same signal as the tug above (Rule 35 (c)).
(3 x 2 = 6)

1.3 Clear visibility:

When altering course, a power driven vessel must indicate its actions as follows (Rule 34(a)):

- | | | |
|-----|---------------------------|-----------------|
| (a) | Alter course to starboard | 1 short blast; |
| (b) | Alter course to port | 2 short blasts; |
| (c) | Going astern | 3 short blasts. |

Rule 34 (d) may also be applicable, i.e. at least 5 short and rapid blasts on the whistle if any or either vessel fails to understand the intentions or actions of the other. (3 x 2 = 6)

1.4 a) Ahead:**b) Astern:**

(2 x 4 = 8)
[30]

QUESTION 2

List ten recognised signals used or exhibited to indicate your vessel is in distress and needs assistance.

[10]

ANSWER QUESTION 2

Distress signals (Annex IV):

- Gun or explosive fired at intervals of about 1 minute;
- Continuous sounding with any fog-signalling device;
- Rockets or shells, throwing red stars fired one at a time at short intervals;
- Morse code ••• - - - ••• (SOS) by radio or any other signaling mechanism;
- Spoken word 'Mayday' by radio;
- International code of signals for distress 'N C' (flags);
- A square flag with a ball or similar shape hoisted above or below it;
- Flames on deck from a burning drum or tar barrel;
- Rocket parachute flare or a hand flare showing a red light;
- Orange smoke signal;

- (k) Outstretched arms to each side repeatedly raised and lowered;
- (l) Radio telegraph alarm signal;
- (m) Radio telephone alarm signal;
- (n) Emergency position indicating radio beacon (EPIRB);
- (o) Orange coloured canvas with either a black square and circle, or appropriate symbol seen from the air.

(10 x 1 = 10)

[10]**QUESTION 3**

- 3.1 The hold of a ship is partly filled with bulk grain. During the loading the ship takes a list, and a quantity of grain shifts so that the surface of the grain remains parallel with the waterline.

Show the effect of this shift of grain on the ship's Centre of Gravity. Illustrate your answer with a cross section sketch of the ship clearly indicating the ship's keel and centre of gravity before and after the grain shift.

(15)

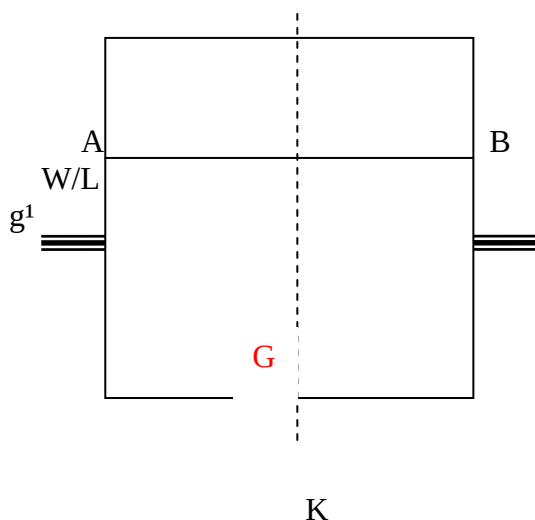
- 3.2 A ship of 20 000mt displacement has a $KG = 4,5\text{m}$. A container weighing 20,0mt in the lower hold has a $KG = 2,0\text{m}$. The container is then raised clear of the tank top and suspended by the ship's crane. The head of the crane's boom is 14,0m above the keel.

What is the new KG of the ship?

(10)

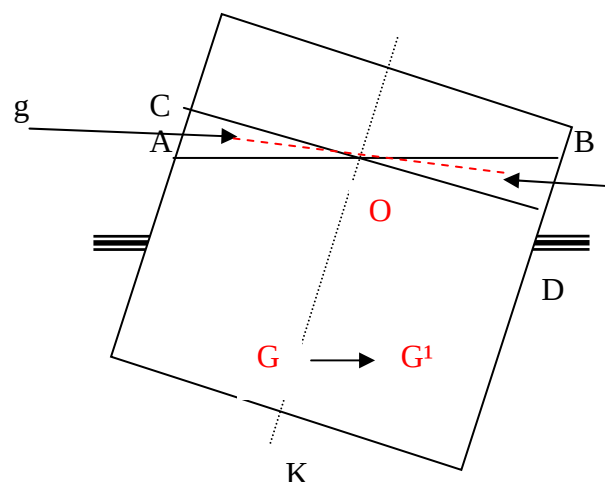
[25]**ANSWER QUESTION 3**

- 3.1 Before grain shift:



AB represents the level of the surface of the grain.

- After grain shift:



CD represents the level when inclined.

A wedge of grain AOC with its centre of gravity at 'g' has shifted to ODB with its centre of gravity at 'g¹'.

The ship's centre of gravity will shift from G to G¹, parallel to gg¹.

The distance $GG^1 = \frac{w \times d}{W}$ metres.

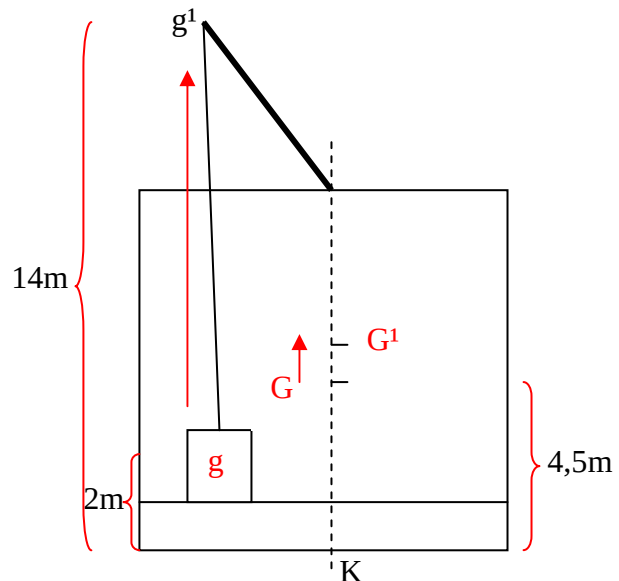
w = mass of wedge shifted.
d = distance gg¹
W = displacement of vessel.

(15)

3.2

$$\begin{aligned} GG^1 &= \frac{w \times d}{W} \text{ metres.} \\ &= \frac{20 \times 12}{20\,000} \\ &= 0,012 \text{ m} \end{aligned}$$

$$\begin{aligned} KG &= 4,5 \text{ m} \\ GG^1 &= 0,012 \\ KG^1 &= 4,512 \text{ m} \end{aligned}$$



(10)

[25]

QUESTION 4

Your power driven vessel is on a course 000° (T) at a speed of 12 knots. The visibility is below 1 n. mile.

The radar observation of an approaching target shows the following:

TIME	BEARING	RANGE
08H06	355° (T)	5,0 M
08h12	356° (T)	4,2 M
08h18	357° (T)	3,6 M

- 4.1 Make a suitable plot showing the target's relative course and speed **on the plotting sheet provided.** (4)
- 4.2 Determine the target's true course and speed. (4)
- 4.3 Determine the time and distance of the target's nearest point of approach; (assuming NO alteration of course or speed). (4)

- 4.4 What alteration of course would you require to make at 08h30 in order for the target's nearest point approach to be minimum 2,0M off your starboard side (assuming your vessel maintains speed of 12,0 knots and the target retains its present course and speed)? Demonstrate your answer on the plotting sheet. (6)
[18]

ANSWER QUESTION 4

- 4.1 See attached plotting sheet. (4)
- 4.2 Target's course = 015° (T) x 2 knots. (2 x 2 = 4)
- 4.3 CPA of target = 08h54, distance 0,4 miles. (2 x 2 = 4)
- 4.4 Required alter course for a CPA of 2,0 miles:
New course = 316° (T). (6)
Or 44° alteration to port.
[18]

RADAR PLOTTING SHEET

Date: Question 4
 Range: 6 miles
 Rings: 1 mile

Ship's Course: _____
 Ship's Speed: _____

Head Up ☐
 Course Up ☐
 North Up ☐

Contact ID: _____ Time of First Plot: _____ Initial Range: _____ Heading: _____ Speed: _____ CPA: _____ at _____	Contact ID: <u>QUEST 4</u> Time of First Plot: <u>08:06</u> Initial Range: <u>5.0</u> Heading: <u>015° (r)</u> Speed: <u>2.0 knots</u> CPA: <u>0.4</u> at <u>08:47</u>	Contact ID: _____ Time of First Plot: _____ Initial Range: _____ Heading: _____ Speed: _____ CPA: _____ at _____
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EXAMINATION NUMBER: _____

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QUESTION 5

List two commodities that would be either imported or exported at the following harbours and explain briefly (in one sentence) why they are shipped through that port:

- 5.1 Richards Bay; (3)
- 5.2 Durban; (3)
- 5.3 Cape Town; (3)
- 5.4 Saldanha Bay. (3)
- [12]**

95 marks

ANSWER QUESTION 5

- 5.1 Richards Bay:
- Coal exports, because of proximity of coal fields inland 250km;
 - Wood chips export from local soft wood forests;
 - Aluminium export from large smelter in Richards Bay;
 - Titanium exports from rich deposits of sand in the region;
 - Petcoke imports for the aluminium plant. (3)
- 5.2 Durban:
- Crude oil and petroleum products imported for local and inland refineries;
 - Containerised products imported & exported serving the local and inland industries;
 - Granite, coal & other minerals exported from mine sources inland;
 - Sugar export from local agriculture cane fields in KZN;
 - Citrus exports from local and inland agriculture;
 - Grain, SA is a net grain importer;
 - Mineral (e.g. copper) and agricultural (e.g. tobacco) from SADC exported through Durban;
 - Cars imported from Asia. (3)
- 5.3 Cape Town:
- Frozen fish exported and transshipped, sourced from S. Atlantic Ocean;
 - Fresh fruit (e.g. citrus & deciduous) exported from local and inland agriculture;
 - Wine from local vineyards exported;
 - Canned fruit and fish exported from local processing plants;
 - Containerised cargoes import and export through this hub port for the region & West Africa;
 - Grain imports for local and inland markets;
 - Tourism attraction bringing in seasonal cruise ships. (3)

5.4 Saldanha Bay:

- Iron ore exports sourced from large mines to the North;
- Granite and copper export sourced from local mines;
- Crude oil import into local strategic storage;
- Fish products from local processing plants.

(3)
[12]

95 marks

SECTION B COMMUNICATIONS AND METEOROLOGY**QUESTION 6**

- 6.1 Your vessel name is 'Madiba', call sign ZSTW, and you are 50 miles NNE of Richards Bay proceeding towards the port in heavy weather, strong gale force winds from the South, and you have reduced speed. You lose three containers washed off the main deck into the sea.

Give an example of the warning you would broadcast over radio of the navigation dangers of this cargo lost overboard.

(5)

- 6.2 Your vessel is at anchor at the inner anchorage of Richards Bay. Divers are inspecting your hull, and you have a cargo of explosives on board.

What two flags will you fly to indicate the above situation?

(4)

- 6.3 Your vessel, 'Madiba', call sign ZSTW, has broadcast a distress message because your vessel has broken down and drifting close to the beach. Subsequently your engine is restarted and your situation no longer requires assistance. What is one of the first things you should do? Give an example of your message.

(6)
[15]

ANSWER QUESTION 6

- 6.1 Safety signal:

'Securite securite securite

All ships all ships all ships

This is Zulu Siera Tango Whisky

Madiba Madiba Madiba

Lost overboard three (repeat three) 20 foot containers in the vicinity 50 miles north north east of Richards Bay.

Weather conditions strong gale force southerly wind. Visibility moderate.

Containers are semi-submerged and considered dangerous to navigation.

All ships to keep a good lookout and report sightings. – Out.'

(5)

- 6.2 'A' flag for the divers;

'B' flag for the hazardous or dangerous cargo.

(2 x 2 = 4)

- 6.3** Cancel the distress message.
 Urgency message cancelled:
 'Pan Pan Pan
 All ships all ships all ships
 This is Zulu Siera Tango Whisky
 Madiba Madiba Madiba
 Urgency message cancelled.
 No further assistance required. Repeat, no further assistance required. The vessel has
 regained power and proceeding on passage.
 Repeat, urgency message cancelled.
 This is Zulu Siera Tango Whisky – Out.'
- (6)
[15]

QUESTION 7

- 7.1 List any four of the principal cloud forms and describe the general characteristics of each one. (16)

ANSWER QUESTION 7.1

Cirrus (Ci) >6,000m.

Fibrous or feather-like appearance. No shadow because of extreme height. At this height moisture forms ice crystals.

Cirrostratus (Cs) >6,000m.

Thin whitish veil sometimes covering the entire sky. There is a halo effect of the sun or moon sufficiently visible to take a sight. The halo has an angular radius of $\pm 22^\circ$ around the sun or moon due to the effect of ice crystals on the light rays.

Cirrocumulus (Cc) >6,000m.

Typical 'mackerel' sky. Small flakes or globular masses arranged in rows or ripples. Colour white and consistent.

Altostratus (As) 2,000 – 6,000m.

Sheet cloud that may cover the entire sky. The colour appears darker than Cs because it is lower and thicker. Varies in density and patches. The sun or moon may be seen through lighter patches, but not sufficient to take a sight.

Alto cumulus (Ac) 2,000 – 6,000m.

Similar to Cc, but the masses or globules are larger. The middle or centre portions of the globules are darker, causing shadows.

Stratus (St) < 2,000m.

Formed by turbulence of the air masses close to the earth surface. Low sheet cloud resembling fog, but not reaching the surface. Appearance alternates between dark and lighter strips, with occasional breaks to reveal blue sky. In wind the cloud will demonstrate turbulence.

Stratocumulus (Sc) < 2,000m.

Formed by turbulence. Cloud layer resembling irregular masses or rolls of alternating degrees of darkness. Cover normally 100% or less. This is a softer more regular shape than Cu. Shows undulations or long rolls or waves.

Nimbostratus (Ns) < 2,000m.

Dense, shapeless and ragged layer of low cloud, usually 100% coverage. Shows strands of rain showers, but not reaching the surface.

Cumulus (Cu) < 2,000m.

Flat bases and round cauliflower-like tops of wooly appearance. Colour brilliant white with darker bases. They are formed by convection of the earth's air currents. If the tops reach sufficient height, the moisture content forms ice crystals which then fall rapidly to collide with the water drops, coming to the surface as rain.

Cumulonimbus (Cb) < 2,000m.

Large form of Cu built up to sufficient height for rain to fall. This is the 'shower' cloud. Reaching 6,000m they form flat tops or anvil shapes. This indicates extreme instability and turbulence. From these clouds it is possible to get hail as well as thunder and lightning.

(4 x 4 = 16)

-
- 7.2 What can be found by comparing the 'wet' and 'dry' bulb readings of a ship's hygrometer?

Having found the difference between the dry and wet bulb readings onboard a ship, state one use that can be made of this information.

(4)
[20]

35 marks

ANSWER QUESTION 7.2

7.2

Temperatures recorded from the wet and dry bulb thermometers are used to measure the relative humidity of the air, or 'Dew Point'.

This information can be used to determine the likelihood of fog.

It is also useful to determine whether or not to ventilate cargo, and the control of the humidity in cargo spaces as well as accommodation.

(4)
[20]

35 marks

SECTION C SAILINGS**QUESTION 8**

- 8.1 On a passage from New York to Cape Town your vessel's position is observed at Noon (GMT+1) on the 22nd October 2004 to be $29^{\circ} 32' S$ $12^{\circ} 58' E$. Calculate the course and distance to reach the next alter course position off Cape Town in Latitude $33^{\circ} 52' S$ and Longitude $18^{\circ} 18' E$. (10)
- 8.2 You are required to rendezvous with the Cape Town Pilot at 08h00 (SAST) on 23rd October. If the Pilot position is a further 6,0miles East from the alter course position in 8.1 above, what is the required speed in order to make that rendezvous? (5)
- [15]**

ANSWER QUESTION 8**8.1**

	D'Lat.	Mid. Lat.	D'Long.
Noon	$29^{\circ} 32,0' S$	$29^{\circ} 32,0' S$	$012^{\circ} 58,0' E$
A/c Position	$33^{\circ} 52,0' S$	$33^{\circ} 52,0' S$	$018^{\circ} 18,0' E$
Dif.	$4^{\circ} 20,0' S$	$63^{\circ} 24,0'$	$5^{\circ} 20,0' E$
Mid. Lat.	$260' S$	$21^{\circ} 27,0'$	$320' E$

Dep. =	D'Long x Cos M. Lat	Tan Course =	Dep ÷ D'Lat
=	$320 \times \cos 21^{\circ} 27,0'$	=	$297,836 \div 260$
Distance =	<u>297,836 miles</u>	Course =	S48,8E
		=	<u>$131\frac{1}{4}^{\circ} (T)$</u>

(10)

8.2

Noon to A/c position, distance	=	297,8 miles
A/c position to Pilot	=	<u>6,0</u>
Total distance to go	=	303,8 miles.
Noon @ GMT + 1h	=	22d 12h 00m
SAST is GMT + 2h	=	<u> 1 00</u>
Noon SAST	=	22d 13h 00m
Required ETA Pilot	=	<u>23 08 00</u>
Steaming time	=	<u> 0 19 00</u>
Distance	=	303,8
Required speed	=	<u>16,0 knots.</u>

(5)
[15]

QUESTION 9

Why is it necessary to use Mean Latitude when finding the Departure between two places using Plane Sailing?

(5)
[5]

20 marks

TOTAL FOR THIS PAPER: 150 MARKS

ANSWER QUESTION 9

9. We use the mean latitude in Plane Sailing calculations when the distance is greater than 600 miles (10° Latitude).

The reason is that the departure scale is different for each parallel of latitude due to the distortion of the curvature projected on a flat Mercator chart. This change in scale is relatively small for a small D.Lat, but will increase as the D.Lat increases.

(5)
[5]

20 marks

Total: 150 marks