



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2022

NAUTICAL SCIENCE: PAPER II

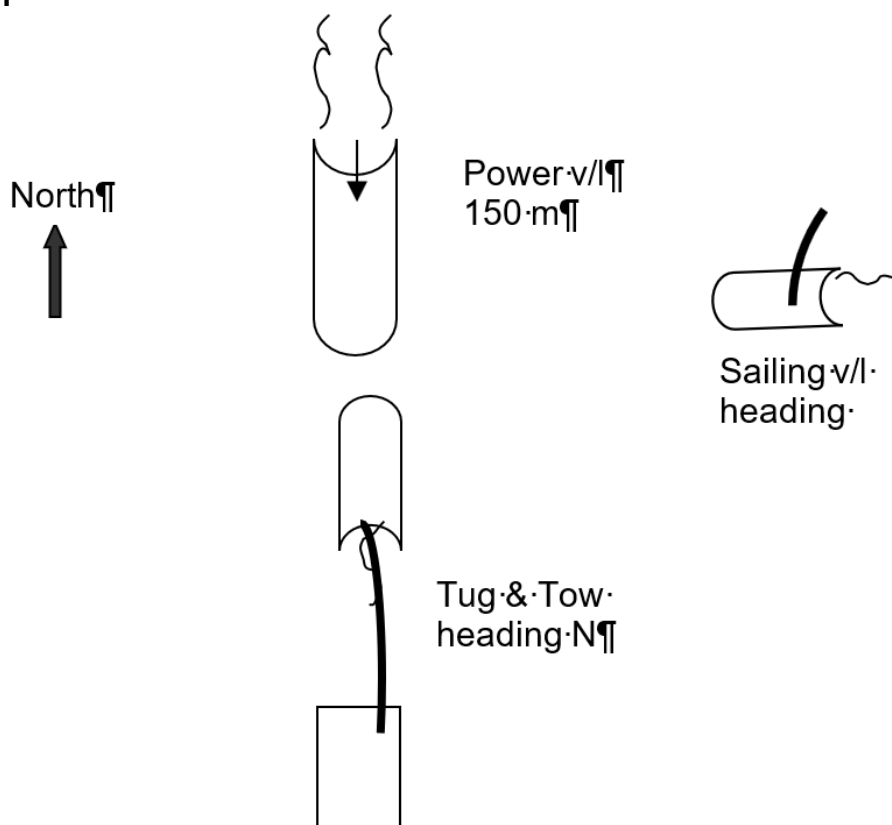
MARKING GUIDELINES

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.

SECTION A SEAMANSHIP**QUESTION 1**

- 1.1 The tug is showing no indication that she is restricted 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)).

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.

The sail vessel is the stand-on vessel and will therefore maintain her course and speed.

- 1.2 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)).

The power-driven vessel making way shall sound at intervals of not more than 2 minutes 1 prolonged blast (Rule 35 (a)).

The sailing vessel will make the same signal as the tug above (Rule 35 (c)).

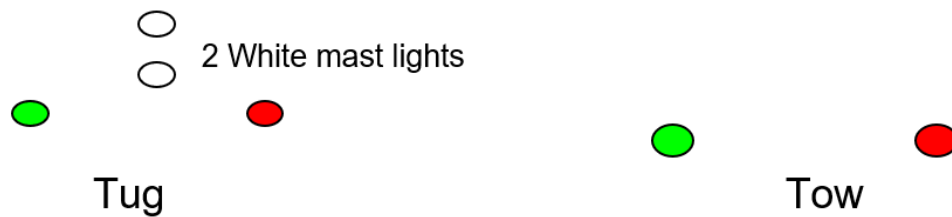
1.3 Clear visibility

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

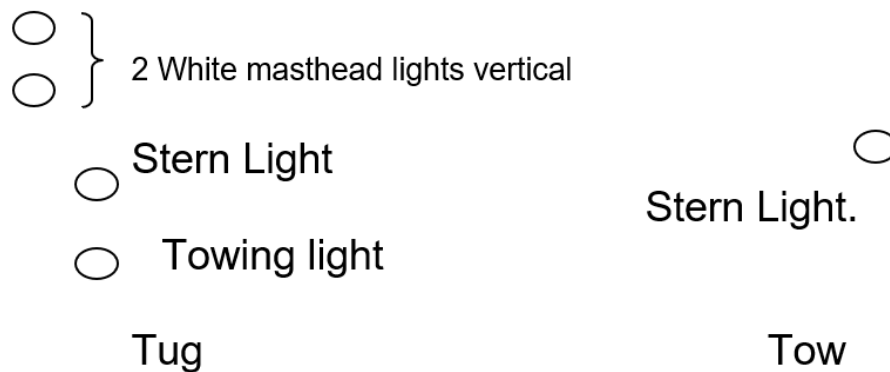
- | | | |
|-----|---------------------------|-----------------|
| (a) | Alter course to starboard | 1 short blast; |
| (b) | Alter course to port | 2 short blasts; |
| (c) | Going astern | 3 short blasts. |

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.

1.4 (a) Seen from ahead:



(b) Seen from astern:

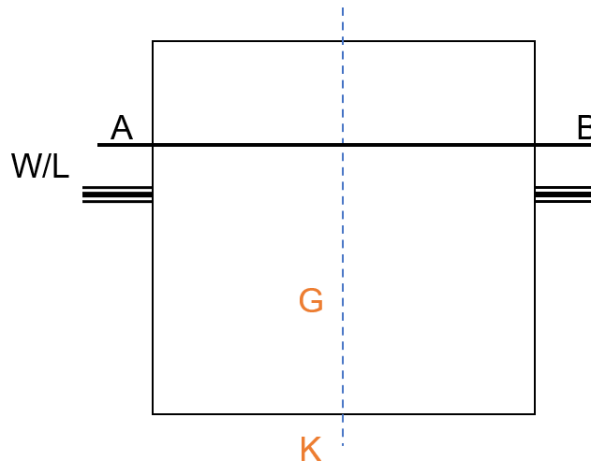


QUESTION 2

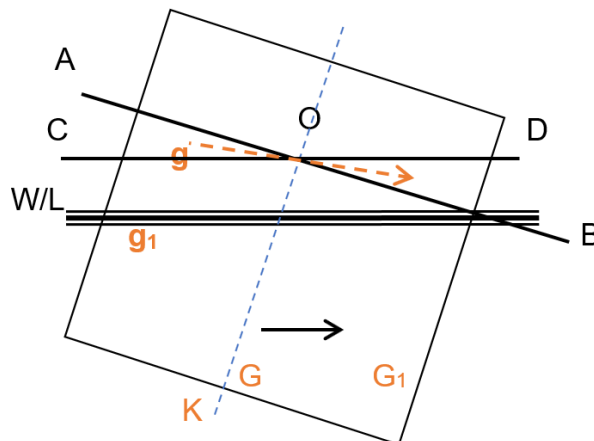
Distress signals (Annex IV):

1. Gun or explosive fired at intervals of about 1 minute;
2. Continuous sounding with any fog-signaling device;
3. Rockets or shells, throwing red stars fired at a time at short intervals;
4. A signal made by any signaling device consisting of the group Morse code **•••---•••** (SOS);
5. Spoken word "Mayday" by radio;
6. International code of signals for distress "N C" (flags);
7. A square flag with a ball or similar shape hoisted above or below it;
8. Flames on deck from a burning drum or tar barrel;
9. Rocket parachute flare or a hand flare showing a red light;
10. Orange smoke signal;
11. Outstretched arms to each side repeatedly raised and lowered;
12. A distress alert by means of DSC transmission:
 - (i) Vhf Chan 70 or
 - (ii) MF/HF on the frequencies 2 187,5 kHz, 4 207,5 kHz, 6 312 kHz, 12 577 kHz or 16 804,5 kHz;
13. Radio telephone alarm signal;
14. Emergency position indicating radio beacon (EPIRB);
15. Orange coloured canvas with either a black square and circle, or appropriate symbol seen from the air.

Answer may contain any ten of the above listed.

QUESTION 3**3.1 Before the grain shift:**

AB represents the level of grain in the hold.

After the grain shifts:

CD represents the surface level of the grain 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'.

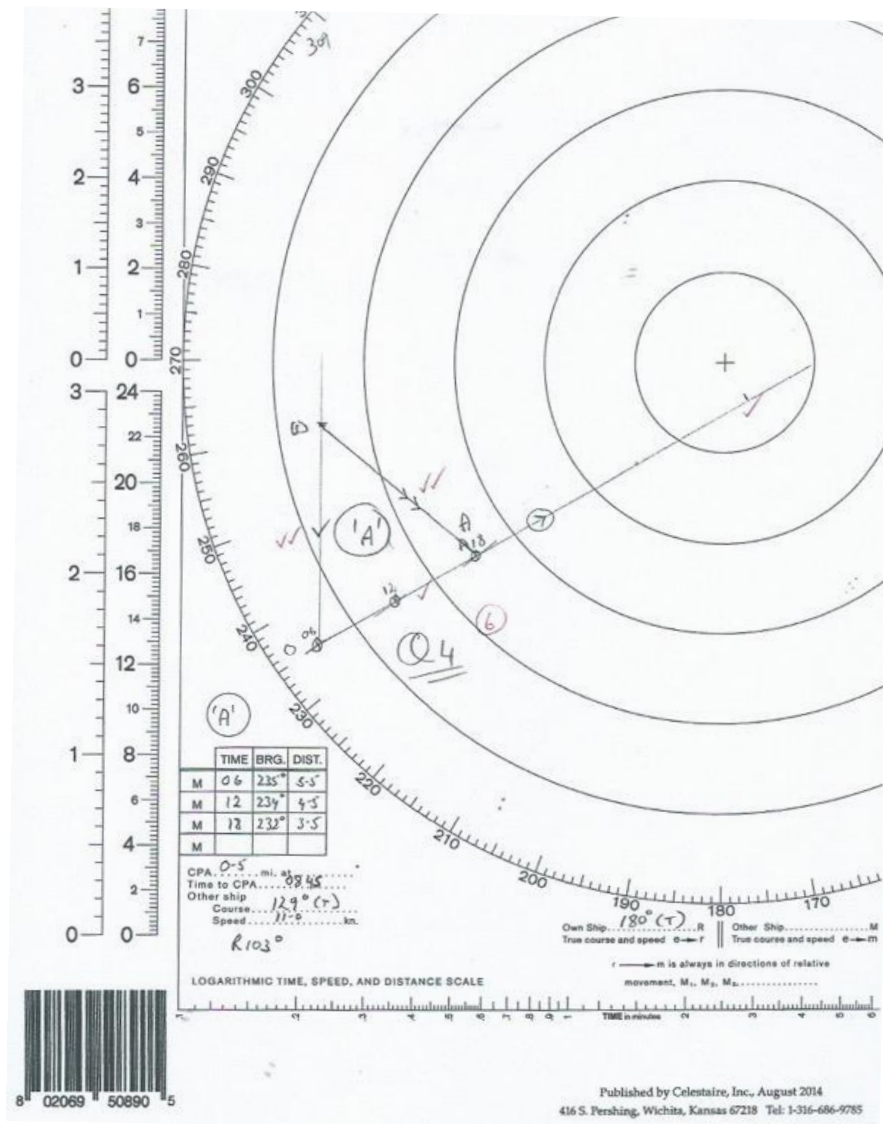
The ship's centre of gravity will shift from G to G₁, parallel to gg₁.

The distance $GG_1 = (w \times d) / W$ metres
 w = mass of wedge shifted
 d = distance gg₁
 W = displacement of vessel

- 3.2 When a body is completely or partially immersed in a liquid, it experiences an upthrust equal to the mass of liquid displaced. There is an apparent loss of mass, termed Buoyancy force.

QUESTION 4

4.1



4.2 Target's Course 129° (T), Speed 11,0 knots.

4.3 CPA 0,5 miles at about 08:39.
Aspect R78° (not required in this question but optional)4.4 Action of own vessel:
Reduce speed to minimum, maintaining steerage, and continue to plot the target and navigate with caution, until the target is clear.

QUESTION 5

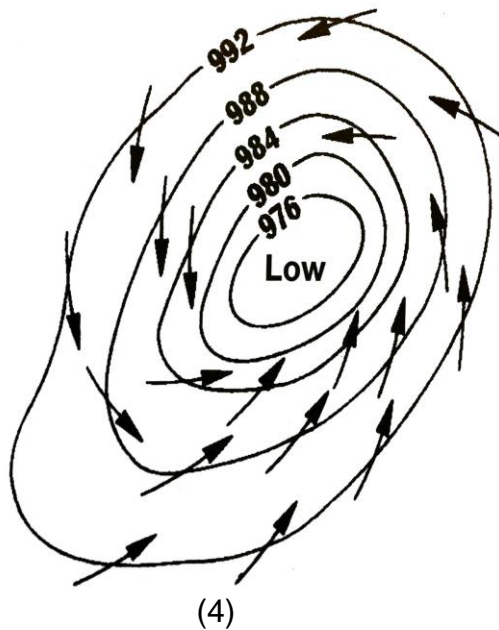
- Dry bulk carrier at Saldanha Bay:
 - Iron ore exports
 - Proximity of the Sishen mine and its rail link.
- Naval vessels in Simon's Town:
 - SA Navy base
 - NATO base
 - Navy dockyard repairs
- Rig supply boats at Mossel Bay:
 - Offshore oil and gas fields on S coast
 - PetroSA (Mosgas) refinery at Mossel Bay
 - Single buoy mooring (SBM) at Mossel Bay
- Tankers at Durban:
 - SAPREF and ENREF refineries at Durban
 - SBM off Durban
 - Pipeline to Gauteng and NATREF
 - Proximity of strategic oil storage
 - Import oil
- Dry bulk carriers at Richards Bay:
 - Coal exports
 - Coal imports
 - Titanium sand exports
 - Wood chip exports

SECTION B COMMUNICATIONS AND METEOROLOGY**QUESTION 6**

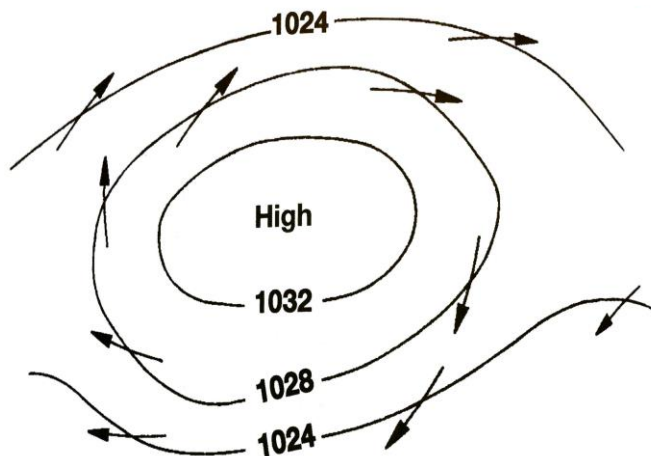
- 6.1 Distress call:
"Mayday, Mayday, Mayday,
This is the vessel AGULHAS, AGULHAS, AGULHAS."
- Followed by the distress message:
"Mayday;
Agulhas / ZULU SIERRA SIERRA TANGO (ZSST);
Position Latitude 34° 15' S, Longitude 22° 10' E, Cape Point bearing 000° × 10 miles;
Vessel is on fire;
Require immediate assistance;
Weather – wind SE force 5, visibility good;
OVER."
- 6.2 Flag = FOXTROT
- 6.3 The ensign or national flag of the vessel's registration flown from the flagstaff at the stern.

QUESTION 7**7.1 Depression:**

A depression is an area of low pressure surrounded by relatively high pressure. The isobars around it are circular or oval shaped. The horizontal circulation of the wind around the centre of the low is anti-clockwise and inwards in the northern hemisphere. The lower the central pressure and the closer the isobars, the stronger the winds accompanied by adverse weather. Lows move from west to east. They are generally associated with cloudy, unsettled weather and strong winds.

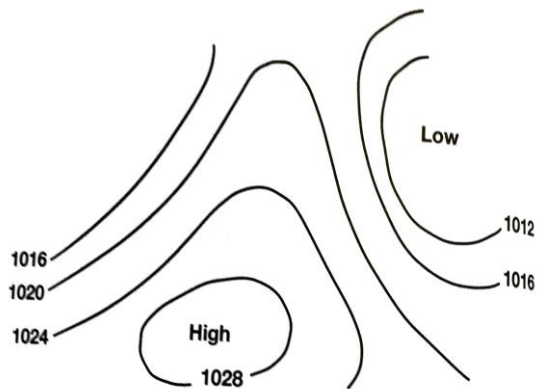
**Anti-cyclone:**

An anti-cyclone is an area of relatively high pressure surrounded by areas of much lower pressure. The isobars around the centre are more or less circular. The horizontal circulation of the wind is anti-clockwise and outwards from the centre in the southern hemisphere. Highs are generally associated with light winds and fine sunny weather, but sometimes overcast and gloomy weather prevails. They move very slowly, but like depressions in an easterly direction. Radiation fog often forms over the land at night and affects harbours and coastal areas.

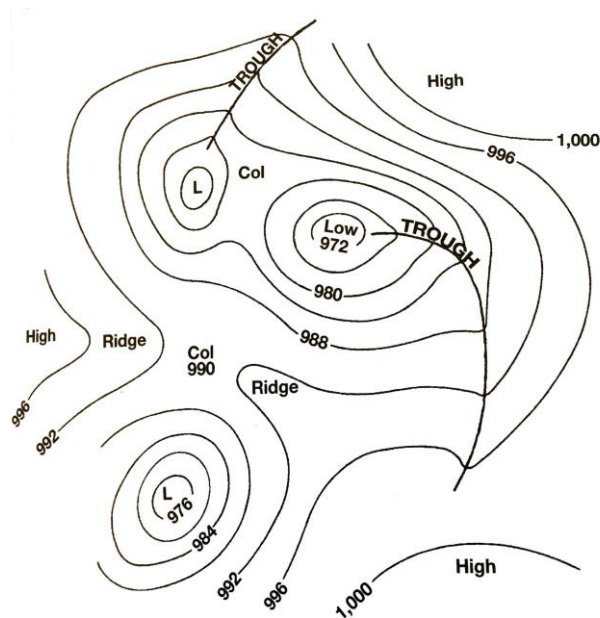


High pressure ridge:

This is also known as a "wedge". It is an extension of an anti-cyclone and it may extend in any direction from its parent. Generically it may be associated with fair anti-cyclone type weather. If the curvature along the axis of a ridge is small, the ridge is known as a flat ridge and tends to be faster moving than one in which the curvature is great.

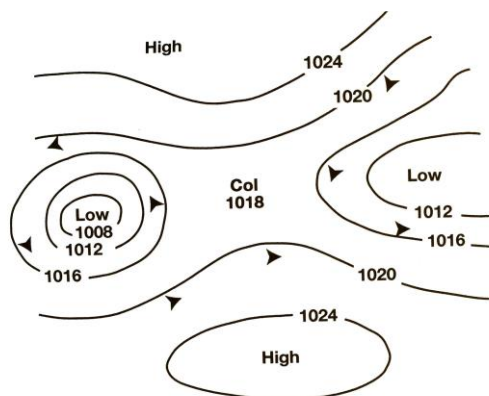
**Low pressure trough:**

Sometimes called a V-shaped depression, this is an extension of a depression into a high-pressure area. It nearly always points towards the equator. The trough may be frontal, in which case there is a marked change in the direction of the isobars on the trough line, or non-frontal, where the isobars are well rounded. Frontal troughs may be associated with warm, cold, secondary cold or occluded fronts and the weather changes will be similar to those associated with these fronts.

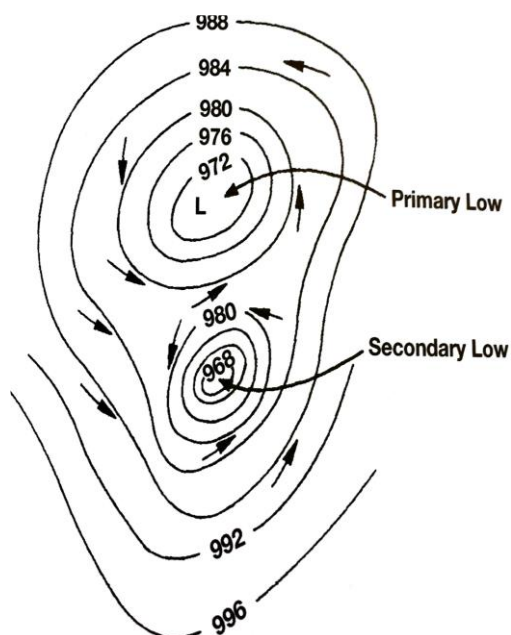


Col:

When two anti-cyclone systems and two depression systems are diametrically opposed there is an area in the centre of the four systems which cannot be considered as a high pressure or a low-pressure area. This area is known as a Col and the pressure is lower than around the high pressures and higher than around the low pressures. In a Col the pressure gradients are small, giving light variable winds. In general, the relative humidity is high and there may be fog, or there may be thunderstorms.

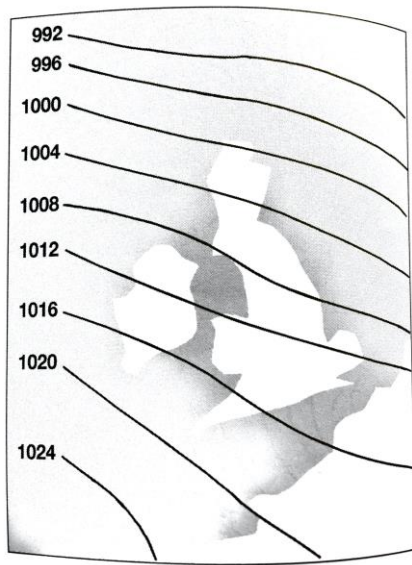
**Secondary low or secondary depression:**

This appears as a bulge or distortion to the primary depression, usually on the equatorial side of the centre. It travels with the main wind flow clockwise around the primary depression. Usually, the winds on the sides of the secondary nearest the primary are light, but on the other side away from the main depression the winds are generally strong (in winter could rise to severe gales) relative to most of the rest of the region affected. In summer a secondary may have a weaker wind circulation and be associated with thunderstorms and rain.



Straight isobars:

The isobars run in more or less parallel straight lines across a large area. Usually, the outlying area of a large and distant depression or anticyclone.



Answer should contain any four of the above seven systems.

The barograph is used to record the air pressure changes over a period of one week. This will indicate the characteristic and tendency of the change of barometric pressure over a period.

On an international voyage where typhoons and tropical revolving storms may be encountered, the barograph will give a clear indication of the barometric trends to help the navigator establish the ship's proximity and relation with such storms.

The barograph will clearly indicate the rate of fall or rise of pressure, indicating the approach of a depression or anti-cyclone.

SECTION C SAILINGS**QUESTION 8**

Plane sailing is used for small distances of less than 600 miles.

Mercator sailing is used for greater distances using the difference in meridional parts (DMP) for the two latitudes.

The reason for this is because the meridians are projected on a flat Mercator chart as perpendicular to the lines of latitude, when in fact they should converge. Therefore, the scale on a Mercator chart is increasingly distorted moving away from the Equator.

QUESTION 9

9.1

Latitude**Longitude**

33° 15,0' S

028° 00,0' E

34° 00,0' S026° 00,0' E

D. Lat.

0° 45,0' S

D. Long.

2° 00,0' W

Mean Lat.

33° 37,5'

Plane Sailing

$$\begin{aligned}
 \text{Dep.} &= \text{D. Long} \times \text{Cos. Mean Lat.} \\
 &= 120 \times \text{Cos. } 33^\circ 37,5' \\
 &= 99,931
 \end{aligned}$$

$$\begin{aligned}
 \text{Tan Course} &= \text{Dep.} / \text{D. Lat} \\
 &= 99,931 / 45 \\
 \text{Course} &= 2,2207 \\
 &= \text{S } 65,75 \text{ W} \\
 &= 245 \frac{3}{4}^\circ
 \end{aligned}$$

$$\begin{aligned}
 \text{Distance} &= \text{D. Lat} / \text{Cos. Course} \\
 &= 45 / \text{Cos } 65,75 \\
 &= 109,6 \text{ miles} \\
 &= 45 / \text{Cos. } 65,825 \\
 &= 109,6 \text{ miles}
 \end{aligned}$$

9.2 109,6 miles at 12 knots

$$\begin{aligned}
 \text{Steaming time} &= 09^{\text{h}} 08^{\text{m}} \\
 1 \text{ March} &= 18 \quad 00.. \\
 \text{ETA 2 March} &= 03^{\text{h}} 08^{\text{m}}
 \end{aligned}$$

Total: 150 marks