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# MERCHANT SHIPPING SECRETARIAT
## GOVERNMENT OF SRI LANKA
## CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : Engine and control systems
DATE : 29 Feb 2024

Time allowed **THREE** hours | Total marks : 96
Answer **8 questions** including mandatory **question no 10** | Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **NOT** allowed.

1.

a) Sketch and describe the four-stroke timing diagram of a Diesel engine and explain the term of overlap (08 marks)

b) Explain the term of "Uniflow" scavenge and its advantages. (04 marks)

2.

a) Briefly explain the three boiler mountings and their importance. (06 marks)

b) Why it is necessary to clean /water wash Exhaust Gas Boiler tubes frequently? (02 marks)

c) Explain the reasons, why Boiler water to be treated. (04 marks)

3.

a) Explain the two types of Turbo charging systems in marine use. (04 marks)

b) What is Turbo charger Surging and how does it occur? (02 marks)

c) Briefly sketch and describe the Scavenging methods. (06 marks)

4.

a) Draw and explain a positive displacement pump. (06 marks)

b) What is the use of centrifugal pump onboard and its advantages? (03 marks)

c) What are the problems occurring in Ballast pumps during Ballast operation and how do you overcome the said faults? (03 marks)

5.

a) Sketch and describe the Refrigeration cycle. (08 marks)

b) Explain the purpose of Receiver, Drier, Solenoids and Control unit reference to the Ship's refrigeration plant. (04 marks)

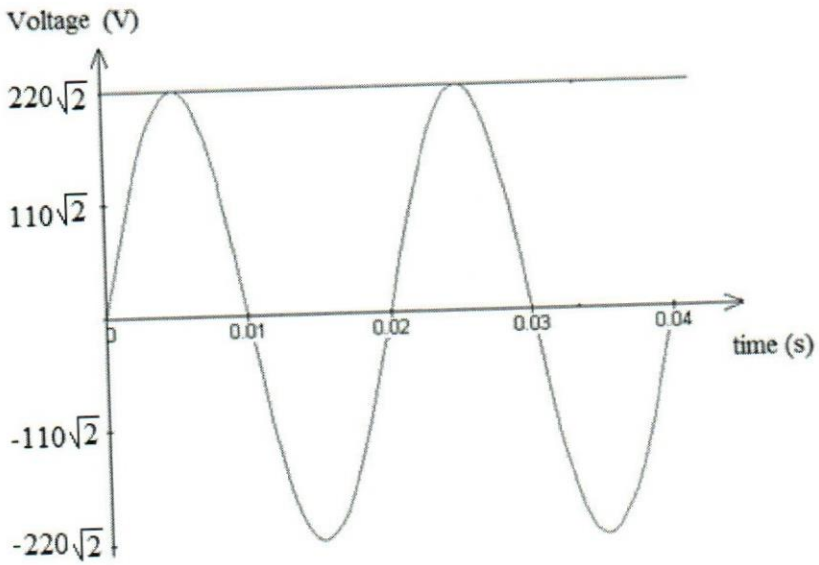
6.

a) What are the reasons to have a crank case explosion? (04 marks)

b) What are the actions to be taken when there is a crank case explosion? (04 marks)

c) What actions to be taken after a scavenge fire? (04 marks)

7. i) The graph below shows how a sinusoidal alternating voltage varies with time, when voltage source is connected across a device.

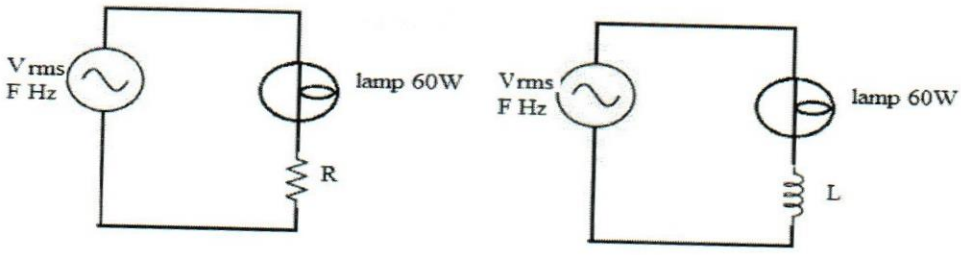



With the aid of above diagram determine

a) Vrms. (02 marks)

b) Frequency (F) (02 marks)

ii) A 100V, 60W lamp is to be operated on above power supply.




Find the value of

a) Non-inductive resistance (02 marks)

b) Pure inductance in series with the lamp so that the lamp is not over run. (03 marks)

c) Which would be preferable in above two methods? (03 marks)

8.

a) Sketch and describe the main engine cooling water system and explain how cooling water inlet temperature control. (08 marks)

b) Why cooling water treatment to be done? (01 mark)

c) What are the main purposes of the system oil in the large 2 stroke engine? (03 marks)

9.

a) Draw and explain the fresh water generator system (Evaporator). (08 marks)

b) How to prepare potable water from evaporated fresh water? (04 marks)

10. Following card areas were obtained from power cards taken from a 5 cylinder slow speed diesel engine.

| **Cyl number** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| **Area in mm2** | **1530** | **1500** | **1590** | **1510** | **930** |

Card length : 110 mm
Diameter of the cylinder : 980 mm
Piston stroke : 2100 mm
Spring constant : 85 KN/m2 per mm
RPM : 120

a) Calculate the total power (Indicated power) developed by the engine. (10 marks)

b) What will be the consequences, if engine continue to operate in this condition? (02 marks)

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**CERTIFICATE OF COMPETENCY EXAMINATION**

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : Leadership and team working skills
DATE : 29th February 2024 Time : 1300 hrs

Time allowed **THREE** hours Total marks : 100
**ANSWER ALL QUESTIONS** Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **NOT** allowed.

1) Your company has handpicked you to relieve the Chief Officer aboard a particular ship which has got severely neglected due to poor maintenance with in the past 8 (eight) months as per ship's technical superintendent's condition reports.

   Explain your approach technics and style you may consider to be the most effective in order to bring the vessel back to a good operational condition with minimum time?

   (20 marks)

2) a) Identify the potential hazards in an onboard working environment?
   b) Identify the characteristics of effective warning signs.

   (10 marks each)

3) Explain the use of equity theory to motivate seafarers onboard.

   (20 marks)

4) (a) What are the main components of a decision?

   (10 marks)

   (b) Briefly explain the 3 main decision making conditions.

   (10 marks)

5) IMO has identified 'Management factor' as one of the categories of fatigue onboard vessels. From a Chief Officers point of view, describe the 'Management factor' and state what you can do to mitigate the impacts of the said factor to reduce seafarer fatigue onboard.

   (20 marks)

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**CERTIFICATE OF COMPETENCY EXAMINATION**

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : Meteorology
DATE : 28th February 2024

Time allowed **THREE** hours | Total marks : 180
**ANSWER ALL QUESTIONS** | Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **NOT** allowed.

1) World is divided in to three climatic zones and each zone is having its inherent type of weather. In relation to torrid zone cyclonic patterns answer following questions.
   a) General tendency of the tropical cyclones is to recurve at some stage of the movement of the cyclone. Briefly explain why TRS generally re-curve.

      (07 Marks)

   b) Weather information of cyclones are important tools for mariner to take early and substantial actions in avoiding tropical cyclone. Briefly explain environmental conditions supports formation of tropical cyclones.

      (08 Marks)

   c) Affective avoiding actions of tropical cyclones may depend on various factors. Briefly explain general avoiding actions for N/H and S/H for following conditions.
      i. If vessel lies in dangerous quadrant,
      ii. If vessel lies in the path of the TRS
      iii. If vessel lies in the Navigable semi circle.

      (15 Marks)

2) Mariner's knowledge relating to ocean currents will help in many aspects when transiting different areas in different seasons. In relation to ocean currents briefly explain following questions with examples.
   a) Drift Current
   b) Gradient Current
   c) Upwelling current
   d) Warm current
   e) Cold Current
   f) Seasonal Current

   (05 Marks each)

3) A busy shipping lane is located in Atlantic Ocean below the New Foundland Island. Vessels en-route from east coast of North America to Europe very often use this route. But during certain times of the year this area is known to have floating ice bergs.

a) Briefly describe why this area is well known for ice bergs. (Your answer must contain the origination of ice bergs, the path and currents involved.)

(10 marks)

b) State the geographical limits of ice bergs in this area.

(05 marks)

c) Banks of New Foundland often have restricted visibility. Briefly explain the causes for the formation of fog in this area.

(05 marks)

d) A master receives an Ice Report (Annex - I) when sailing to New Foundland. As per the Ice Report, state the ice condition prevailing in the position 49°00'N, 052°00'W.

(10 marks)

4) Surface wind is one of the main considerations in voyage planning, with reference to wind answer following.

a) Generally, wind will blow across the isobars and deflected by coriolis force. But in some situations, wind blow parallel to isobars. Explain with suitable sketches the types of wind which blow parallel to isobars.

(15 marks)

b) The general circulation of earth's atmosphere is modified due to large land masses and surface wind pattern may alter due to various factors. With regards to surface wind explain what is meant by periodical wind and local wind including examples for both categories.

(15 marks)

5)

a) Over the earth surface it is noticeable different areas of the world are having different climatic conditions. Explain with suitable sketches why surface temperature varies over the earth surface.

(15 marks)

b) Much of weather related conditions could be explained by evaluating atmospheric stability conditions at the local geographical area. In relation to atmospheric stability briefly explain Stable, Unstable and Conditional atmospheric stability with suitable sketches.

(15 marks)

6) In mid-latitude navigation, mariners should have substantial knowledge of weather associated in mid- latitudes. Frontal and frontal depressions greatly vary by its characteristics compared to tropical cyclones. Answer the following questions in relating to fronts and frontal depressions:

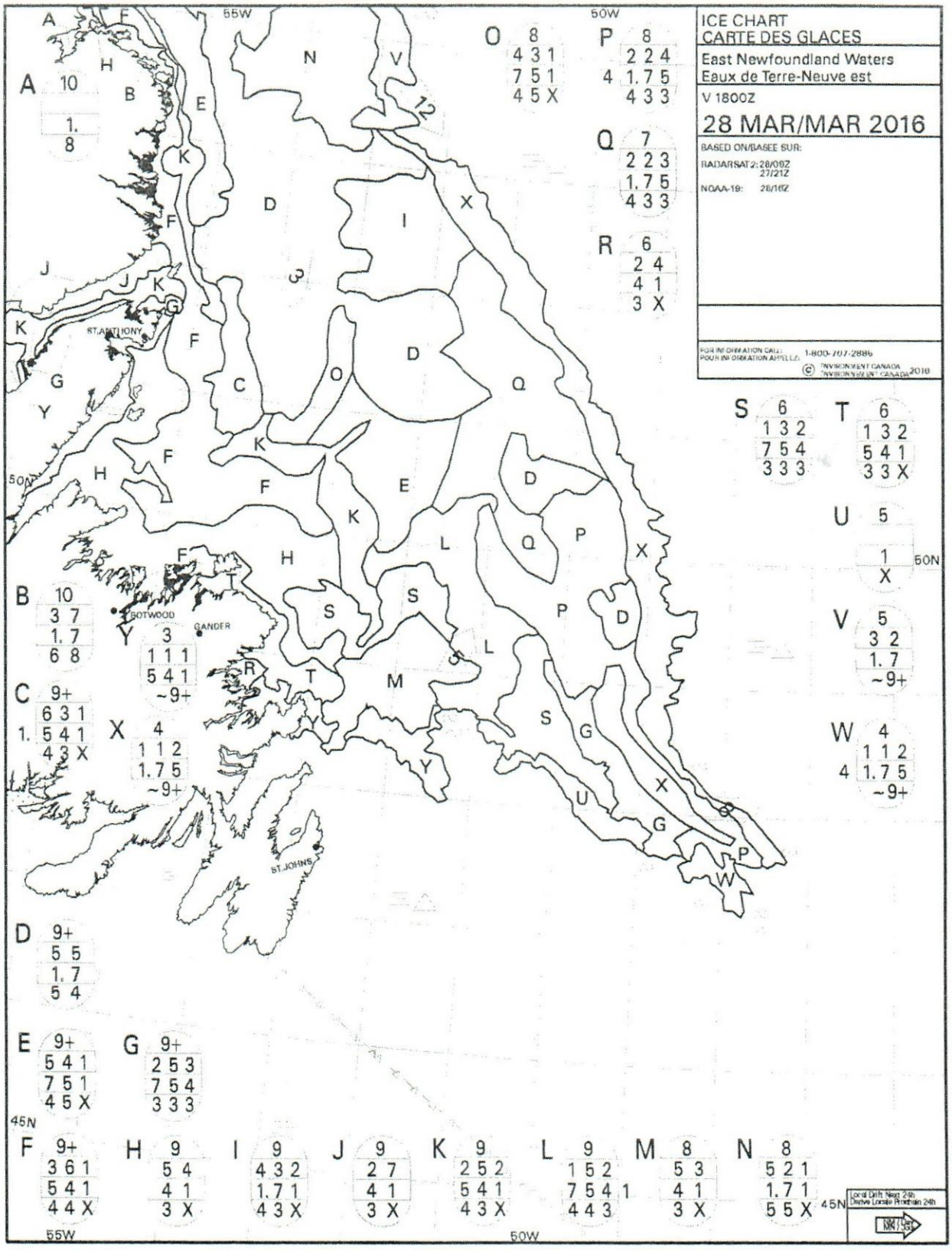
a) Briefly explain properties of air masses and factors effecting properties of an air mass.

(15 marks)

b) Briefly explain Cold front, Warm front and weather associated with each condition with suitable sketches including symbols used in weather map for each condition.

(15 marks)

Annex - I


ICE CHART
CARTE DES GLACES
East Newfoundland Waters
Eaux de Terre-Neuve est
V 1800Z
28 MAR/MAR 2016
BASED ON/BASEE SUR:
RADARSAT-2: 28/09Z 27/21Z
NOAA-19: 28/16Z
FOR INFORMATION CALL: 1-800-707-2886
POUR INFORMATION APPELEZ:
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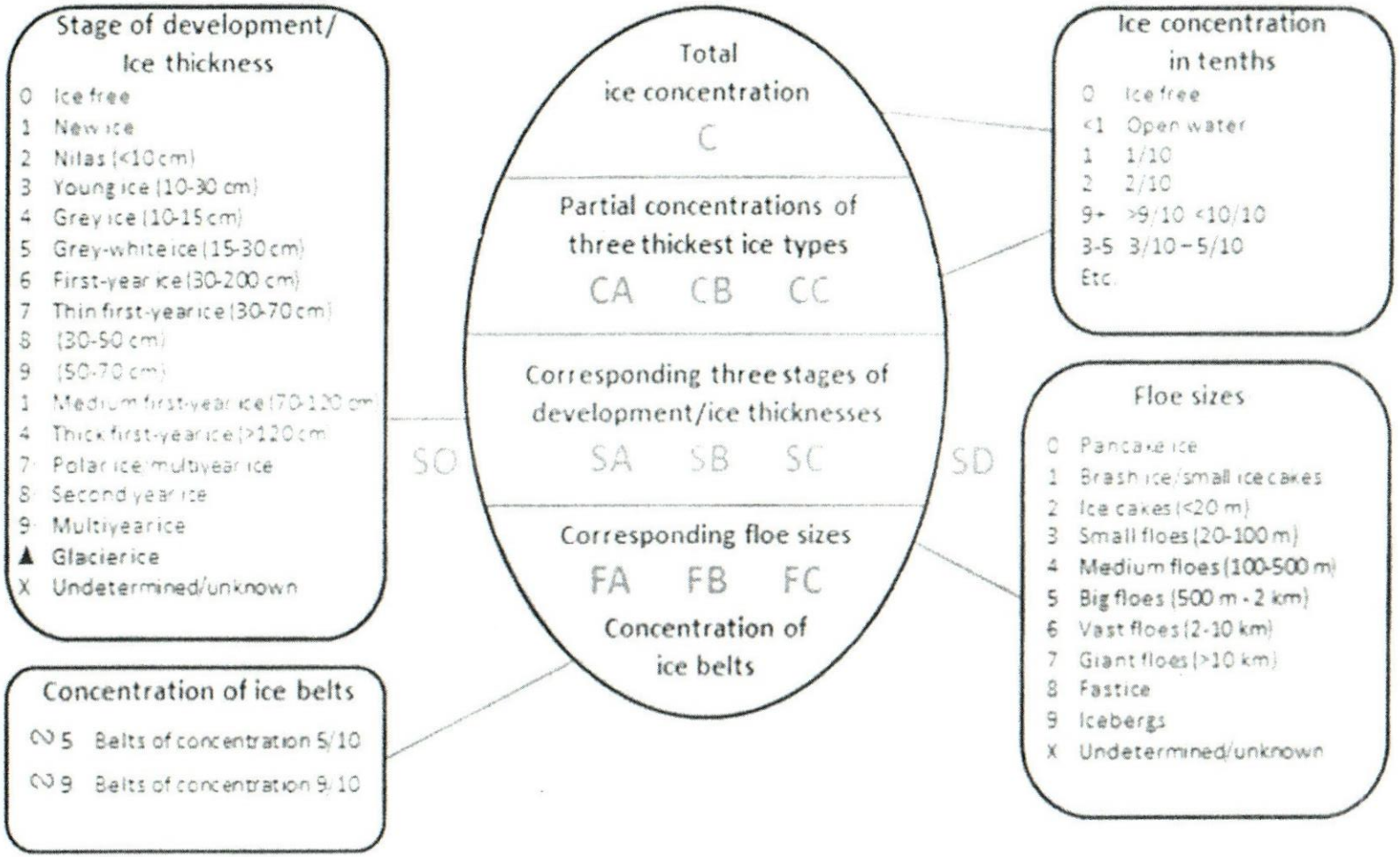
55W
50W
50N
45N
60N
ST. ANTHONY
BOTWOOD
GANDER
ST. JOHNS
A 10 / 1. / 8
B 10 / 3 7 / 1. 7 / 6 8
C 9+ / 6 3 1 / 1. 5 4 1 / 4 3 X
D 9+ / 5 5 / 1. 7 / 5 4
E 9+ / 5 4 1 / 7 5 1 / 4 5 X
F 9+ / 3 6 1 / 5 4 1 / 4 4 X
G 9+ / 2 5 3 / 7 5 4 / 3 3 3
H 9 / 5 4 / 4 1 / 3 X
I 9 / 4 3 2 / 1. 7 1 / 4 3 X
J 9 / 2 7 / 4 1 / 3 X
K 9 / 2 5 2 / 5 4 1 / 4 3 X
L 9 / 1 5 2 / 7 5 4 1 / 4 4 3
M 8 / 5 3 / 4 1 / 3 X
N 8 / 5 2 1 / 1. 7 1 / 5 5 X
O 8 / 4 3 1 / 7 5 1 / 4 5 X
P 8 / 2 2 4 / 4 1. 7 5 / 4 3 3
Q 7 / 2 2 3 / 1. 7 5 / 4 3 3
R 6 / 2 4 / 4 1 / 3 X
S 6 / 1 3 2 / 7 5 4 / 3 3 3
T 6 / 1 3 2 / 5 4 1 / 3 3 X
U 5 / 1 / X
V 5 / 3 2 / 1. 7 / ~9+
W 4 / 1 1 2 / 4 1. 7 5 / ~9+
X 4 / 1 1 2 / 1. 7 5 / ~9+
Y 3 / 1 1 1 / 5 4 1 / ~9+
Local Drift Next 24h
Dérive Locale Prochain 24h




The ice egg may be supplemented by 2 figures:

SO Sporadic (<1/10 concentration) occurences of ice, thicker than indicated inside the egg, may be indicated here

SO When all partial ice concentrations inside the egg total considerably less than the total ice concentration C, the stage of development of the predominant of the remaining thinner ice types may be indicated here

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# MERCHANT SHIPPING SECRETARIAT
## GOVERNMENT OF SRI LANKA
## CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : Electronic Navigation Systems
DATE : 28th February 2024

Time allowed **THREE** hours — Total marks : 130
**ANSWER ALL QUESTIONS** — Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **NOT** allowed.

1) Mechanical Gyro compass has been used on merchant vessels for decades as a direction finding equipment. Gyro compass has been made using the inherent mature of a precession of free Gyroscope.
   a) Using precession describe how a liquid ballistic control Gyro compass control its North end.

   (10 marks)

   b) With a suitable diagram, explain the forces activating at the north end in following locations of it.
      i) Maximum drifted position at East
      ii) Maximum tilted up position
      iii) Maximum drifted position at West

   (05 marks each)

2) IMO has issued a circular on performance requirement of a Gyro compass.
   a) List at least ten of the requirements

   (10 marks)

   b) FOC may be the future direction finding equipment
      i) With a sketch of a block diagram and fiber optic ring describe fully how to find north using Fiber Optic Gyro compass

   (15 marks)

3) Explain effect of DOP with reference to GPS system.

   (25 marks)

4) With aid of a diagram show the internal parts and the instruments connected to AIS.

   (25 marks)

5) Answer the following questions with regards to Standard Magnetic Compass:

a) Indicate in sketched curves, the deviations per its respective coefficient as given below (You may request for graph paper):

COEF = DEV

A = $+2^0$ E

B = (-) $3^0$ W

C = $+2^0$ E

D = (-)$4^0$ W

E = $+4^0$ E

(7 marks)

b) Under SOLAS chaper-5 Reg.19, what are the requirements for Magnetic standard compasses relevant record books?

(05 marks)

c) List down 12 items to what you should focus on during your supervision and verification to your utmost satisfaction when your ship's compass is to be tuned by an approved / licensed adjuster to optimum levels with special emphasis to heeling error?

(5 marks)

d) Show in a basic sketch the correcting system of the Healing Error.

(5 marks)

e) Write short notes on the following:

i. Gauzing Error
ii. Retentive Error
iii. Secular Change
iv. Transient Changes
v. Lunar Changes
vi. Irregular Disturbance
vii. Local Disturbance (magnetic Anomalies)
viii. Actinic Line

(8 marks)

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**CERTIFICATE OF COMPETENCY EXAMINATION**

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : Ship Construction
DATE : 27th February 2024

Time allowed **THREE** hours — Total marks : 120
**ANSWER ANY SIX QUESTIONS** — Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **NOT** allowed.

1) Due to pitching and pounding fore end of the vessel should be extra stiffened to withstand strong impacts.
   a) Sketch the fore end construction of a ship.
   (10 marks)
   b) With the aid of sketch above (a) state how panting and pounding regions are strengthened.
   (10 marks)

2)
   a) Sketch FOUR types of rolled steel sections commonly employed to stiffen plating
   (08 marks)
   b) State where in ship's structure the rolled sections in (a) would be employed
   (04 marks)
   c) What are the types of framing systems used in construction of vessels and discuss the important features related to such framing systems.
   (08 marks)

3)
   a) In relation to a ship survey, list the main survey schemes for Safety related certificates.
   (05 marks)
   b) What is the requirement of dry dock survey.
   (05 marks)
   c) Explain what EDD program is and how you plan for IWS.
   (10 marks)

4)

a) Sketch and describe a transverse midship section of a bulk carrier constructed on a combined framing system indicating it's salient features.

(11 marks)

b) Ship designers often say that the bulk carrier is a rational structure with minimal amount of waste. Justify the above comment with reasons.

(09 marks)

5)

a) In relation to a watertight doors below the water line;

i. Describe the methods adopted to achieve the strength at a watertight door opening.

(05marks)

ii. What maintenance and inspections are carried out on above (i) doors.

(03marks)

b) Explain the following terms;

i. Sheer strake
ii. Bilge strake
iii. Keel
iv. Bilge keel

(03 marks each)

6)

a) Name steel materials used in strength members such as ship structure and hull plating.

(04 marks)

b) Discuss the advantages of using such material in relation to their properties of strength.

(08 marks)

c) Indicate;

i. the main attractions of Aluminum in preference to mild in ship construction.

(04 marks)

ii. the disadvantages of use of Aluminum.

(04 marks)

7)

a) Name types of rudders.

(03 marks)

b) What is meant by the term "Balanced Rudder"

(03 marks)

c) What is the Lifting of Rudder and how it is compensated.

(06 marks)

d) Sketch and name a rudder pintle bearing arrangement indicating important details

(08 marks)

8) With reference to corrosion on ship's hull;

a) Describe two ways of preventing corrosion.

(04 marks)

b) What is cathodic protection, explain with a corrosion cell.

(04 marks)

c) Sketch and describe an impressed current system employed in a commercial vessel in order to control corrosion.

(12 marks)

9) Briefly explain the purpose of following features included in a ship's structure. You may use suitable sketches where necessary.

a) Double bottom tank
b) Duct keel
c) Longitudinal girders and shell plating
d) Solid floors and bracket floors.
e) Collision bulk head

(04 marks each)