

Faculty of Marine Engineering

Department of Marine Engineering

Examination for Officer in Charge of an Engineering Watch on Ships of 750kW Propulsion Power or More

ENGINEERING KNOWLEDGE – I (GENERAL)

TIME ALLOWED - THREE HOURS

Attempt SIX questions only as follows:

FOUR questions from Section A

ONE question from Section B

ONE question from Section C

Marks for each part of the question are shown in the brackets.

Pass mark 50 % of total AND also need to obtain the minimum of 8 Marks in each Section B and C.

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

Date: 2024.03.20

Pass marks: 50%

Section A

1. a. Describe the operation of a two – stage air compressor. (6 marks)
- b. What is Bumping Clearance? (2 marks)
- c. Explain why intercoolers and after coolers are fitted. (2 marks)
- d. State the safety features incorporated in the compressor and in the stating air system (4 marks)
- e. state FOUR safety features fitted in compressed air systems (2 marks)

2. With reference to ram type steering gears, explain how:
 - a. Shock loading is absorbed, [4 Marks]
 - b. Rudder position always corresponds to the helm position, [4 Marks]
 - c. Rudder 'drop' is accommodated, [4 Marks]
 - d. Steering gear can be operated upon failure of the bridge telemeter system [4 Marks]

3.

- a. State how and why lubricating oil deteriorates in main engine lubrication systems. [4 Marks]
- b. Describe simple shipboard tests to determine the degree of contamination. [3 Marks]
- c. Give a reason in each case, why each of the following conditions of lubricating oil is unacceptable:
- i. High acidity, [3 Marks]
 - ii. Significant fuel contamination, [3 Marks]
 - iii. Significant freshwater contamination. [3 Marks]

4.

- a) What is the purpose of introducing EEXI [4 marks]
- b) Which vessels are applicable for EEXI [3 marks]
- c) When EEXI and CII requirements are taking into effect [3 marks]
- d) Name four technologies used in marine engines to meet the EEXI requirements. [4 marks]
- e) State the MARPOL Annex number applicable to EEXI regulations [2 marks]

5.

- a) What are the basic types of auxiliary steam boilers used on board ship. [2 marks]
- b) Name the safety features incorporated on auxiliary boilers. [4 marks]
- c) State why it is important to maintain the water level within recommended limits during boiler operation. [4 marks]
- d) State the actions that you would take as a watch keeper if water level is not visible on a gauge glass during your watch. [4 marks]
- e) State the suitable temperature of feed water tank [2 marks]

6.

- a. State THREE modes of heat transfer. [2 Marks]
- b. Sketch a longitudinal cross section of a tubular heat exchanger detailing the fixtures and expansion of the tube nest arrangement. [7 Marks]
- c. Discuss the advantages and disadvantages of above in (Q5.b) compare with plate type heat exchanger. [7 Marks]

7.

- a. Sketch a 4-ram hydraulic steering gear system and briefly explain safe operation. [8 Marks]
- b. What is the indication of air in the steering system [2 Marks]
- c. What is the function of a hunting gear in steering gear on a ship (2 Marks)
- d. Describe the procedure of testing the ship's steering gear and associated equipment prior to departure from port. (4 marks)

Section B

8.

- a. Sketch a circuit diagram of an emergency power supply system suitable for a large tanker vessel, include in your diagram essential services supplied. [8 Marks]
- b. With reference to emergency generator discuss method of automatic starting and the time available for starting and connection of power to switch board. [8 Marks]

9. With reference to alkaline batteries used on board ship.

- a. Describe the operation of a battery cell and state the material used; [4 Marks]
- b. Describe how the cells are mounted to form a battery; [4 Marks]
- c. State the advantages and disadvantages compared with lead-acid batteries. [4 Marks]
- d. Explain the safety precautions to be observed during routine battery maintenance (4 marks)

Section C

10.

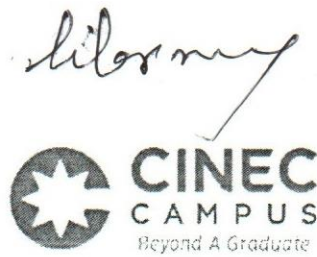
With reference to the prevention of hull corrosion briefly explain the following:

- a) Cathodic protection by sacrificial anodes (4 marks)
- b) Briefly explain protection provided by ICCP system (8 marks)
- c) State the purpose of shaft earthing system (2 marks)
- d) State the purpose of MGPS system (2 marks)

11.

With reference to large container carriers.

- a. Sketch a transverse section of a modern container carrier. [7 Marks]
- b. Describe the designs that have evolved to minimize the possibility of failures. [9 Marks]



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CLP
Ministry

Faculty of Marine Engineering
Department of Marine Engineering

Examination for Officer in Charge of an Engineering Watch on Ships of 750kW Propulsion Power or More

ENGINEERING KNOWLEDGE – II (Motor)

Time Allowed- Three Hours

Answer Six questions.

Marks for each part of the question are shown in the brackets. Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass.

Answers with clear sketches, diagrams, neat handwriting, and clear expression will get full marks.

Date: 2024.03.21

1.

With reference to large two stroke diesel engines.

- a) Explain the important checks needed for routine bedplate inspections (4 marks)
- b) Describe the function of the stuffing box in two-stroke engines (4 marks)
- c) Explain the role of tie rods in two-stroke propulsion engines, (2 marks)
- d) Outline the step-by-step procedure for scavenge inspection, (6 marks)

2.

- a) What are the two main NOx reduction technologies used in large slow speed engines. (2 Marks)
- b) Explain the operation of one of the above systems by using a simple sketch naming all the important parts. (12Marks)
- c) State the minimum temperature required to combine N2 and O2 in the combustion chamber to form NOx. (2 marks)

3.

- a). Describe, with the aid of sketches, how an auxiliary engine cylinder liner is calibrated. (6 marks)
- b). Describe, how liner calibration readings should be recorded. (4 marks)
- c) Describe why cylinder liners are honed and how it contributes to engine performance. (4 Marks)
- d) State cause of excessive cylinder liner and piston ring wear. (2 marks)

4.

With reference to an electronically controlled large slow speed engine.

- a. State 4 benefits of electronically controlled fuel injection (4 marks)
- b. Describe any cylinder lubrication system used in electronically controlled engine (6 marks)
- c. State the function of following controllers.
 - i. MPC (2marks)
 - ii. FCM-20 (2 marks)
 - iii. CCU (2 marks)

5.

With reference to main starting air compressors:

- a) State the reason for multi-staging. (2 marks)
- b) Explain why compressor lubricating oil consumption should be carefully monitored. (4 marks)
- c) State the factors effecting the volumetric efficiency. (4 marks)
- d) What safety devices are fitted to protect the compressor (2 marks)
- e) What is bumping clearance and explain how it effects the performance. (4 marks)

6.

With reference to the operation of a main engine:

- a) explain the checks to be made prior to putting the engine room in UMS mode. (9 Marks)
- b) In the event of failure of the engine monitoring and control equipment, explain how the machinery may be monitored and controlled safely and effectively (4 Marks)
- c) list SIX main engine parameters which should be recorded manually in the event of UMS failure (3 Marks)

7.

- a) Explain why air coolers are used in turbochargers and their importance. (2 marks)
- b) Discuss the potential issues of excessive air cooling in turbocharger systems and why it should be avoided. (2 marks)
- c) Describe how turbine glands are sealed in turbochargers, including the methods used for effective sealing. (2 marks)
- d) Explain how bearings in turbochargers are lubricated, emphasizing the methods and importance of proper lubrication. (4 marks)
- e) What is surging in turbochargers, and state, the impact, and preventive measures. (6 marks)

8.

- a). Describe the procedure for taking crankshaft deflection of a large slow speed engine, explaining all precautions that must be observed. (8 marks)
- b). Explain what action must be taken if readings be outside values recommended by the engine manufacturer? (4 marks)
- c) State the parameters influence the deflection readings. (4 marks)

9.

- a). During bunkering operation explain the responsibility of the engineer posted at the bunker manifold. (4 marks)
- b). After the bunkering operation state the mandatory entries to be made in the oil record book. (2 marks)
- c). What is 'Cappuccino' effect on bunkers received on board. How do you identify the above effect during bunkering and after receiving bunkers on board? (4 marks)
- d). What is pre bunker meeting (2 marks)
- e). How long the bunker sample to be kept on board (4 marks)

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MINISTRY OF PORTS, SHIPPING AND AVIATION

MERCHANT SHIPPING SECRETARIAT - SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH ON SHIPS OF 750kW
PROPULSION POWER OR MORE
ENGINEERING KNOWLEDGE- I (GENERAL)

111 Min 15

TIME ALLOWED - THREE HOURS

Attempt SIX questions only as follows:

FOUR questions from Section A

ONE question from Section B

ONE question from Section C

Marks for each part of the question are shown in the brackets

Pass mark 50 % of total **AND** also need to obtain the minimum of 8 Marks in each Section B and C.

Answers with clear sketches/diagrams, neat handwriting, and clear expression will get full marks.

1. Regarding onboard fixed firefighting systems:

- a) Draw a line diagram of a multi-bottle carbon dioxide fixed fire smothering Installation suitable for the Engine room and the Cargo Hold. (8 Marks)
- b) Outline the necessary steps to be taken before releasing CO₂ to the machinery space. (2 Marks)
- c) Discuss the safety inspections and routine maintenance required for the system described in (a). (6 Marks)

2.

- a) Detail the guidelines governing engineering watchkeeping on a motor ship. (6 Marks)
- b) Describe the occurrences triggering the slowdown and shutdown of a two-stroke slow-speed main diesel engine. (4 Marks)
- c) Detail in chronological order the specific actions to be undertaken by the engine room watchkeeper in the event of the slow-down and the shut-down activated on the main engine. (6 Marks)

3. Regarding plate-type heat exchangers used onboard ships:
- a) Produce a cross-sectional depiction, labeling all pertinent components, and indicating the flow direction of both fluid systems. (6 Marks)
 - b) State FOUR (04) advantages of a plate cooler over the shell and tube type. (4 Marks)
 - c) State the significant steps to be followed during of routine cleaning of a plate-type cooler. (6 Marks)
4. Regarding the Oil Centrifuges briefly explain:
- a) the difference between a Purifier and a Clarifier. (4 Marks)
 - b) the function of the purifier gravity disk. (2 Marks)
 - c) the method used to select the correct size of gravity disk. (4 Marks)
 - d) list down the advantages of the "ALCAP System" over the traditional centrifuge operation. (6 Marks)
- 5.
- a) Briefly explain the following heat treatment processes
 - i) Annealing (3 Marks)
 - ii) Tempering (3 Marks)
 - iii) Hardening (3 Marks)
 - b) List three (03) distinct parts that undergo each of the aforementioned heat treatment processes in the manufacturing of a large slow-speed engine. (3 Marks)
 - c) State the advantages of heat treatment of engine components. (4 Marks)
6. Regarding a vapor compression refrigeration system;
- a) Sketch a schematic of a refrigeration circuit, illustrating the positions of the main components and safety devices relative to each other within the system. (6 Marks)
 - b) Briefly explain the common method used to operate multiple cool rooms at different temperatures utilizing one refrigeration system. (8 Marks)
 - c) State two different methods being used to de-frost the evaporator. (2 Marks)

- 7.
- a) State the reasons leading to the deterioration of oil used in the main lubricating oil system of marine diesel engines. (4 Marks)
 - b) State the explicit indicators present in the lubricating oil system to identify deteriorated lubricating oil. (3 Marks)
 - c) Describe a simple test used on board a ship to determine the degree of contamination of water in the lubricating oil system. (3 Marks)
 - d) Provide a rationale for why the following scenarios are deemed unacceptable for the lubricating oil used in the systems:
 - i. fuel contamination, (3 Marks)
 - ii. considerable water contamination. (3 Marks)

SECTION B

8. Concerning an alkaline battery cell:
- a) Sketch a typical cell, stating the materials used; (6 Marks)
 - b) Describe the electrochemical process that takes place during the charge and discharge process. (4 Marks)
 - c) State the effects of overcharging. (2 Marks)
 - d) State the modern type of batteries considered for marine use as an option to the traditional batteries. (4 Marks)
9. Regarding testing and maintenance of large electric motors used on board ships, describe the following aspects:
- a) Describe the routine maintenance practices required to ensure reliable operation. (4 Marks)
 - b) Explain the procedure used to measure the insulation resistance. (4 Marks)
 - c) Specify the minimum acceptable value for insulation resistance applicable for various system voltage levels on board ship. (8 Marks)

SECTION C

10. State with reasons, the main purpose of EACH of the following on the ship's structure.
- a) Bulbous bow (4 Marks)
 - b). Flare (4 Marks)
 - c). Sheer (4 Marks)
 - d). Camber (4 Marks)
- 11.
- a). Describe with the aid of a sketch, the impressed current system suitable for use to protect the steel hull of the ship from corrosion. (6 Marks)
 - b). Compare the advantage between the sacrificial anodes and the impressed current system. (8 Marks)
 - c). State the various circumstances that requires ICCP system to be kept switched off. (2 Marks)