

**CERTIFICATES OF COMPETENCY IN THE MERCHANT
NAVY - MARINE ENGINEER OFFICER**

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY
MANAGEMENT ENGINEER (UNLIMITED)

040-12 - ENGINEERING KNOWLEDGE - GENERAL

MONDAY, 28 March 2022

0915-1215 hrs

Examination paper inserts:

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Notes for the guidance of candidates:

Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass AND also obtain a minimum 40% in Sections A, B and C of the paper.

Materials to be supplied by examination centres:

Candidate's examination workbook

ENGINEERING KNOWLEDGE - GENERAL

Attempt TEN questions only as follows:

SIX questions from section A

TWO questions from section B

TWO questions from section C

Marks for each part question are shown in brackets

Section A

1. State, with reasons, the materials used in EACH of the following components of a centrifugal pump for sea water circulating duties:
 - (a) casing; (2)
 - (b) impeller; (2)
 - (c) shaft; (2)
 - (d) wear rings; (2)
 - (e) mechanical seal. (2)

2. With reference to steels used in shipbuilding and marine engineering:
 - (a) describe EACH of the following types of failure;
 - (i) brittle failure; (2)
 - (ii) ductile failure. (2)
 - (b) Explain the term *ductile to brittle transition* stating the factor that determines ductile to brittle transition. (2)
 - (c) Describe a test to determine the value of brittle fracture of a specimen test piece. (4)

3. With reference to machinery condition monitoring systems:
 - (a) state what is meant by machinery condition monitoring; (2)
 - (b) state the means available for gathering data; (3)
 - (c) describe how the data is used to indicate machinery condition trends; (3)
 - (d) explain the relevance of machinery condition monitoring to approved planned maintenance systems. (2)

4. State the inspections, instructions and maintenance that should be carried out on main sea water pipelines, strainers and ship's side valves to minimise the risks of engine room flooding. (10)

5. With reference to centrifugal pumps:

- (a) explain the principle of operation of a centrifugal pump; (4)
- (b) explain why centrifugal pumps are not self priming; (2)
- (c) state why some pumps may have EACH of the following:
 - (i) a double entry impeller; (2)
 - (ii) more than one impeller. (2)

6. With reference to bacteria harmful to humans in drinking and washing water:

- (a) state the constraints placed on the installation and use of systems for shipboard production of fresh water; (3)
- (b) state the maintenance and treatment recommended for fresh water tanks; (3)
- (c) describe the principle of operation of a steriliser that uses silver ions. (4)

7. With reference to air compressors for general service use:

- (a) explain the principle of operation of a screw type compressor (4)
- (b) explain the advantages of screw compressors over reciprocating compressors in terms of running and maintenance. (6)

8. Explain the legal, administrative and technical responsibilities of a Chief Engineer Officer. (10)

Section B

9. (a) Sketch a circuit showing how the emergency generator is started, connected to the emergency busbars and how the main busbars are disconnected in the event of a blackout. (6)
- (b) Explain how an emergency generator can be tested to ensure that it is capable of satisfactorily delivering the rated power. (4)
10. Describe how the starting torque of electric induction motors may be improved by using EACH of the following:
- (a) wound rotor; (5)
- (b) double cage. (5)
11. With reference to lithium-ion batteries:
- (a) explain why this type of battery has been adopted for shipboard use; (4)
- (b) state ONE advantage and ONE disadvantage of lithium-ion batteries; (2)
- (c) define EACH of the following terms:
- (i) *cell drift*; (2)
- (ii) *thermal runaway*. (2)

Section C

12. With reference to the construction of refrigerated spaces:
- (a) state suitable materials that can be used for insulating refrigerated spaces; (2)
 - (b) state the properties that an insulating material should possess; (3)
 - (c) sketch a section through a wall of a cold storage space detailing how the insulation is attached to the ship's structure. (5)
13. With reference to roll reduction systems:
- (a) explain the principle of operation of bilge keels, stating their advantages; (4)
 - (b) describe TWO other methods of roll reduction, stating the advantages and disadvantages of EACH system. (6)
14. With reference to the structure of a large passenger ship, describe the requirement for preventing the spread of fire and smoke. (10)