

**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, 27 March 2023

0915-1215 hrs

Examination paper inserts:

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. (a) Explain EACH of the following metallurgical failure mechanisms:
 - (i) fretting; (3)
 - (ii) fretting corrosion. (3)
- (b) State TWO shipboard examples where fretting may occur. (2)
- (c) State TWO shipboard examples where fretting corrosion may occur. (2)

2. ✓ (a) Describe, with the aid of a sketch, a temperature measuring instrument that uses the principle of operation of a change in resistance with the application of heat. (6)
- (b) Describe how the instrument sketched in part (a) is tested and calibrated. (4)

3. ✓ With reference to stern tube bearings:
 - (a) explain why white metal lined bearings are susceptible to failure; (5)
 - (b) outline the merits of non metallic bearings. (5)

4. ✓ (a) Describe a vacuum sewage system. (5)
- (b) List the advantages of the system described in part (a). (4)
- (c) State why untreated sewage should not be allowed to stagnate. (1)

5. ✓ With reference to centrifugal separators used for oily bilge duty:
 - (a) explain why centrifugal oily water separators are superior to those which rely on gravity; (3)
 - (b) describe, with the aid of a sketch, how flow over the centrifugal separator plates can break down emulsions by encouraging flocculation of particles and coalescence of droplets; (5)
 - (c) state how the bilge overboard control valve can only operated by the Chief Engineer; (1)
 - (d) state a value of overboard parts per million oil content that may be set which is below the generally recommended value. (1)

6. ✓ (a) Sketch a single stage flash evaporator, labelling the component parts and showing the directions of flow. (5)
- (b) Explain the term *flash evaporation*. (2)
- (c) State the regulations governing the operation of an evaporator if the distilled water is intended for human consumption. (3)
7. (a) In deck machinery hydraulic systems, state the functions of the hydraulic oil reservoir, making reference to the volume of the hydraulic fluid in the system. (6)
- (b) State FOUR reasons for machinery tripping out on high oil temperature during operation. (4)
8. ✓ With reference to fixed CO₂ smothering systems for ships machinery spaces:
- (a) State the safety procedure that the Chief Engineer Officer should adopt with respect to maintenance being carried out on the system by contractors whilst the vessel is in port. (3)
- (b) State the procedure prior to the safe release of CO₂ into the machinery space in the event of a fire. (4)
- (c) Describe the factors that should be considered prior to re-entry of the machinery spaces after the release of CO₂ gas. (3)

Section B

- 9. (a) Sketch a circuit diagram of a self excited a.c. generator. (5)
- (b) Describe the operation of the circuit sketched in part (a). (5)

10. With reference to the protection of High Voltage electric a.c. motors:
- (a) state the type of fuses that are fitted and how they prevent single phasing; (3)
 - (b) describe the operation of EACH of the following direct temperature sensors:
 - (i) resistance temperature device; (3)
 - (ii) thermistor. (4)

11. (a) Explain the meaning of EACH of the following types of electrical safety equipment:
- (i) intrinsically safe; (2)
 - (ii) flameproof; (2)
 - (iii) increased safety. (2)
- (b) State the electrical tests for equipment in hazardous areas, describing the safety precautions. (4)

Section C

12. ✓ With reference to double bottom fuel tanks:

- (a) explain why weighted cocks are fitted to the tank sounding pipes; (2)
- (b) explain the purpose of air pipes; (2)
- (c) state the design features incorporated on air pipe vents with respect to EACH of the following:
 - (i) heavy weather; (2)
 - (ii) fire; (2)
 - (iii) bunkering. (2)

13. ✓ (a) With reference to bilge keels:

- (i) describe, with the aid of a sketch, how the design and method of attachment reduces the possibility of damage to the shell plate; (5)
- (ii) state what testing must be carried out. (2)
- (b) Explain why the bilge keels do not extend the full length of the vessel. (3)

14. ✓ With reference to large fixed bladed propellers:

- (a) describe, with the aid of a sketch, EACH of the following:
 - (i) the effect of hull fouling; (3)
 - (ii) operation in clean hull, ballast condition. (3)
- (b) explain why fitting a *light propeller* may be beneficial. (4)