

**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, 22 March 2021

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. Describe EACH of the following properties of materials:

- (a) strength; (2)
- (b) hardness; (2)
- (c) ductility; (2)
- (d) toughness; (2)
- (e) brittleness. (2)

2. (a) Describe, with the aid of a Strain versus Time diagram, how a creep test is carried out to determine the strain rate of the material under test. (6)
- (b) Explain EACH of the stages sketched in the diagram in part (a). (4)

3. (a) Sketch an annotated block diagram of a closed loop control circuit. (5)
- (b) Describe how the control loop sketched in Q(a) operates. (5)

4. (a) Define *propeller slip*, explaining how it is calculated. (2)
- (b) State, with reasons, FOUR conditions which will affect the *propeller slip*. (8)

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 be 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. With reference to heat exchangers, describe how EACH of the following design aspects promote heat transfer:

- (a) material selection; (5)
- (b) flow patterns; (3)
- (c) extended surface areas. (2)

7. Sketch a hydraulic circuit for a FOUR ram steering gear that allows FIVE different ram combinations to be used, identifying EACH ram and valve combination. (10)

8. With reference to fixed installations for machinery space fires:

- (a) sketch a CO₂ bottled system; (5)
- (b) explain how the system sketched in part (a) is protected from overpressure; (2)
- (c) describe the periodic maintenance required. (3)

Section B

9. (a) Describe, with the aid of a sketch, the constructional details of a squirrel cage rotor as fitted in an induction motor. (7)
- (b) Explain why some rotors have a double cage. (3)
10. With reference to large electrical transformers on board ships:
- (a) state where these transformers may be used; (1)
- (b) state a typical efficiency range for a transformer; (1)
- (c) state the regulations pertaining to transformers; (3)
- (d) state the protective devices that are fitted; (2)
- (e) describe the maintenance requirements. (3)
11. (a) Explain the principle of operation of an insulation resistance test, stating why the test is carried out on a regular basis. (6)
- (b) Describe how EACH of the following electrical tests is carried out:
- (i) resistance; (2)
- (ii) continuity. (2)

12. (a) Describe the SIX degrees of motion that a ship at sea moves in when encountering heavy weather. (6)
- (b) Describe the constructional details that are designed to resist the forces exerted on a ship by the motions described in Q(a). (4)
13. With reference to the structure of a large passenger ship, describe the requirement for preventing the spread of fire and smoke. (10)
14. (a) With reference to the overhaul of a ship side valve in dry dock explain, as Chief Engineer Officer, what information should be given to the docking company prior to work commencing. (5)
- (b) Describe how the valves would be overhauled stating the precautions to be taken before returning the ship to service. (5)