CERTIFICATE OF COMPETENCY EXAMINATION

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY

MANAGEMENT ENGINEER (UNLIMITED)

040-12 - ENGINEERING KNOWLEDGE - GENERAL

MONDAY, 14 July 2025

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, with the aid of a graph, EACH of the following types of ferrous material failure, stating ONE practical example of EACH:

   (a) creep; (5)

   (b) fatigue. (5)

2. Describe, with the aid of a sketch, the principle of operation of a capacitance electrode level measuring transmitter. (10)

3. (a) State,with reasons, FOUR causes of vibration in main propulsion transmission systems. (8)

   (b) State the effects of vibration if allowed to continue without any intervention. (2)

4. With reference to centrifugal pumps:

   (a) explain the function of EACH of the following:

      (i) the impeller; (2)

      (ii) the volute; (2)

   (b) state why some pumps may have EACH of the following:

      (i) a double entry impeller: (2)

      (ii) a diffuser ring; (2)

      (iii) more than one impeller. (2)

5. Describe, with the aid of a block diagram, a compensated control system for an active fin stabilisation unit. (10)

6. (a) With reference to a vapour compression refrigeration plant, explain why EACH of the following conditions are desirable:

(i) superheating at the compressor suction; (3)

(ii) undercooling at the condenser outlet. (3)

(b) Describe, with the aid of a Pressure-Enthalpy diagram, how the evaporator cooling load is affected by the conditions stated in part (a). (4)

7. With reference to air recievers:

(a) explain why air receivers are prone to corrosion; (3)

(b) state how corrosion can be prevented; (3)

(c) if significant corrosion is detected during a regular inspection, explain how the air receiver may still be safely used in service until a permanent repair can be effected. (4)

8. Accidents have occurred due to premature or accidental release of CO_2 into the machinery spaces.

(a) State the safety procedures that the Chief Engineer Officer should adopt with respect to maintenance being carried out on the system by shore contractors. (3)

(b) Explain why the Chief Engineer Officer and ship's staff should still have to check on work carried out by shore contractors. (2)

(c) State how the liquid levels in the CO_2 bottles may be checked in situ and how often this test should be carried out. (2)

(d) Explain why ship's general service air should not be used for blowing through and testing CO_2 operating lines and suggest a suitable alternative. (3)

Section B

9. Describe, with the aid of a block diagram, the operation of a load sensing electronic governor controller for an a.c. generator. (10)

10. (a) State the consequences of using direct on line starters for comparatively large sized a.c. induction motors. (2)

(b) Describe, with the aid of a sketch, an electronic soft starting system that may be used for large sized a.c. induction motors. (8)

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) skech 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 ship construction:

(a) explain why conventional liquid carriers are divided by longitudinal bulkheads; (3)

(b) explain why ore carriers may be fitted with wing tanks; (3)

(c) state, other than the carriage of liquids, the purpose of double bottom tanks in dry cargo ships; (1)

(d) state THREE reasons for transverse watertight bulkheads in ship construction. (3)

14 (a) State, with reasons, the potential hazards that may be present in EACH of the following spaces:

(i) oily bilge tanks; (2)

(ii) ballast tanks; (2)

(iii) chain lockers. (2)

(b) State the guidance to be followed before making an entry into an enclosed space. (4)