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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, 18 March 2024

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. 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)

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 oil filled stern tubes:

   describe, with the aid of a sketch, the principle of operation of a combination seal, which incorporates a wrapped bellows radial face seal and a lip seal. (10)

4. With reference to Marine Growth Prevention Systems, which incorporate impressed current anodes fitted in the sea boxes or sea strainers of main seawater cooling water systems:

   (a) explain how the system protects steel pipework against marine growth and corrosion; (6)

   (b) explain how the effectiveness of the system can be ascertained; (2)

   (c) state the advantages this system has over one which makes use of biocides. (2)

5. (a) Describe an oily water separator bilge content dischage monitoring system that ensures that the oil discharge content is below the recommended maximum and that logs and retains data. (8)

(b) State TWO additional measures that can be taken to ensure that no illegal pumping overboard can take place. (2)

6. With reference to tunnel type bow thrusters:

(a) explain why some vessels are fitted with more than one bow thruster; (2)

(b) discuss the options available in terms of prime mover and transmission systems. (8)

7. 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 how the entire fresh water system can be made free from bacteria; (3)

(d) state an acceptable residual value in the fresh water tanks to ensure the correct concentration of treatment in the system. (1)

8. List TEN checks that a Chief Engineer Officer should make prior to a Port State Control inspection of the engine room and its equipment. (10)

Section B

9. (a) Explain the term *power factor.* (2)

(b) Explain why it is detrimental to have a low power factor. (2)

(c) Explain, with the aid of phasor diagrams, how a synchronous motor may be used to assist in power factor correction. (6)

10. (a) Sketch a cross section through an a.c. induction motor. (5)

(b) Describe the construction of the a.c induction motor sketched in part (a). (5)

11. With reference to a.c switchboards:

(a) state, with reasons, the protective devices that are fitted; (5)

(b) state why a breaker may fail to open under prolonged low voltage conditions; (2)

(c) explain the actions to be taken should a main generator circuit breaker stay connected despite repeated efforts to trip it off the board. (3)

Section C

12. (a) List FIVE of the nine hazard classes of Dangerous Goods as stated in the International Maritime Dangerous Goods (IMDG) code. (5)

(b) State the documentation that must accompany any hazardous shipment, explaining the purpose of this documentation. (5)

13. With reference to structural fire protection in passenger ship accommodation spaces:

(a) define the meaning of Class A bulkheads, stating the requirements; (4)

(b) explain how the integrity of the bulkhead is retained, with respect to ventilation trunkings, where Class A bulkheads have to be penetrated. (2)

(c) discuss the design of ventilation systems with respect to the location and isolation of air conditioning units, supply and exhaust fans, to prevent the spread of smoke and fire. (4)

14. During sea trials, extensive noise measurements are taken in accordance with the *Code of Practice for Noise Levels in Ships.*

(a) State and explain the unit of sound measurement. (2)

(b) State the noise level above which personnel are required to wear ear protection. (1)

(c) Explain how a ship's crew may be made aware of the hazards posed by exposure to excessive noise. (2)

(d) Explain how the noise levels can be reduced in the design of EACH of the following:

(i) diesel generators; (3)

(ii) ventilation fans and trunkings. (2)