

# **CERTIFICATES OF COMPETENCY FOR ENGINEERS (YACHT)**

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

**SMALL VESSEL CHIEF ENGINEER UNLIMITED**

**058-01 - APPLIED MARINE ENGINEERING**

**FRIDAY, 10 June 2022**

**1400-1600 hrs**

Examination paper inserts:

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Notes for the guidance of candidates:

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| <ol style="list-style-type: none"><li>1. Candidates should note that 100 marks are allocated to this paper. To pass candidates must achieve 50 marks.</li><li>2. Non-programmable calculators may be used</li><li>3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.</li></ol> |
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Materials to be supplied by examination centres:

Candidate's examination workbook
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## APPLIED MARINE ENGINEERING

Attempt ALL questions

Marks for each part question are shown in brackets

1. With reference to EACH of the following materials, list their percentage composition and a different application for EACH material on board, stating, with reasons, why they are suitable for this application:
  - (a) cupro-nickel; (2)
  - (b) aluminium bronze; (2)
  - (c) admiralty brass; (2)
  - (d) duralumin; (2)
  - (e) solder. (2)
  
2. Describe the heat treatment process EACH of the following components would undergo, stating the reasons for EACH of the processes:
  - (a) crankshaft; (4)
  - (b) valve spring; (3)
  - (c) used copper washer. (3)
  
3. With reference to stresses within engineering materials:
  - (a) explain EACH of the following terms
    - (i) tensile stress; (1)
    - (ii) shear stress; (1)
    - (iii) compressive stress; (1)
  - (b) list TWO components within a diesel engine that are subject to the effects of EACH of the three stresses listed in part (a); (6)
  - (c) state the component in a 4 stroke diesel engine that has a maximum recommended service life due to constant cyclic stress. (1)

4. Explain EACH of the following engineering terms, stating ONE material that exhibits EACH property:
- (a) brittleness; (2)
  - (b) ductility; (2)
  - (c) hardness; (2)
  - (d) malleability; (2)
  - (e) toughness. (2)
5. With reference to gas metal arc welding (MIG) of mild steel:
- (a) describe the process; (3)
  - (b) explain, with reasons, the surface preparation required; (3)
  - (c) list THREE advantages and ONE limitation. (4)
6. A drydock inspection of the stainless steel alloy propeller shafts has revealed serious pitting corrosion of the shafts in the region where the shafts pass through the stern tube. The stern tube arrangement consists of a shaft seal and a sea-water flooded stern tube with cutless bearing at the aft (sea) end.
- (a) Describe the possible reasons for this corrosion. (6)
  - (b) Describe the modifications that could be made to the stern tube arrangement to reduce the likelihood of future shaft corrosion. (4)
7. With reference to the production of glass reinforced plastic (GRP) hulls:
- (a) outline the properties of glass fibre and resin that make them suitable for the construction of a hull; (3)
  - (b) describe the traditional method for the layup of a GRP hull; (5)
  - (c) list FOUR disadvantages of GRP hulls in service. (2)
8. Describe, with the aid of a sketch, a method of measuring and remotely indicating EACH of the following:
- (a) temperature; (4)
  - (b) rate of flow. (6)

9. (a) Describe, with the aid of a control block diagram, how a governor maintains the speed of a diesel engine driving a generator. (6)
- (b) Describe the reasons for Integrating the error signal and the effect it has on the governor fuel rack. (4)
10. (a) Explain EACH of the following control terms:
- (i) proportional bandwidth; (2)
- (ii) integral action; (2)
- (iii) derivative action. (2)
- (b) Describe a 3-step method for tuning a PID controller. (4)