

**CERTIFICATE OF COMPETENCY EXAMINATION**

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

**SMALL VESSEL CHIEF ENGINEER <3000 GT, UNLIMITED**

**058-01 - APPLIED MARINE ENGINEERING**

**FRIDAY, 17 November 2023**

**1400-1600 hrs**

Examination paper inserts:

Notes for the guidance of candidates:

1. Candidates should note that 100 marks are allocated to this paper. To pass candidates must achieve 50 marks.
2. Non-programmable calculators may be used
3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook

**APPLIED MARINE ENGINEERING**

Attempt ALL questions

Marks for each part question are shown in brackets

1. With reference to ship's side valves:
- (a) state why grey cast iron is not a suitable material; ✓ (4)
  - (b) state, with reasons, THREE suitable materials. ✓ (6)
2. (a) Explain how the properties of steel are modified by its carbon content. (2)
- (b) Explain EACH of the following terms:
- (i) annealing; ✓ (3)
  - (ii) normalising; ✓ (3)
  - (iii) hardening. ✓ (2)
3. Explain EACH of the following terms:
- (a) ductile cast iron; ✓ (2)
  - (b) tensile stress; ✓ (2)
  - (c) work hardening; ✓ (2)
  - (d) shear stress; ✓ (2)
  - (e) Young's modulus. ✓ (2)
4. 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)

5. (a) With reference to fretting corrosion:
- (i) explain the process; ✓ (3)
  - (ii) state a common cause; ✓ (1)
  - (iii) state how it is normally detected. ✓ (1)
- (b) With reference to pitting corrosion:
- (i) explain the term *pitting corrosion*; ✓ (1)
  - (ii) state TWO common causes; ✓ (2)
  - (iii) explain why it is considered to be dangerous. ✓ (2)
6. With reference to the production of glass reinforced plastic (GRP) hulls:
- (a) describe the process of resin infusion moulding for the production of a hull; ✓ (4)
  - (b) state the advantages of resin infusion moulding with respect to traditional methods of construction; ✓ (3)
  - (c) explain how this process can virtually eliminate the onset of osmosis in the hull. ✓ (3)
7. With reference to capacitance probe sensors:
- (a) describe, with the aid of a sketch, how a capacitance probe produces an output which can be used to measure the liquid level in a tank. ✓ (7)
  - (b) state TWO different uses of this device on a vessel; ✓ (2)
  - (c) state ONE disadvantage of this type of probe. ✓ (1)
8. With reference to an impeller type flowmeter, describe how an output is produced and processed to provide EACH of the following:
- (a) an analogue output in litres per minute; ✓ (5)
  - (b) a digital output in litres per minute. ✓ (5)
9. With reference to *Discontinuous* or *On Off* control systems:
- (a) sketch the response of a basic heater control, showing temperature against time and labelling the key points; (4) 2  
0
  - (b) state THREE methods of improving the accuracy/speed of response. (6)



10. (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)