

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, 13 June 2025

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">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 used3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer. |
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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 aluminium as a hull material:
- explain how pure aluminium differs from marine grade aluminium; (4)
 - explain THREE significant problems associated with aluminium during construction and in service. (6) (3)
2. (a) Define the term *stainless steel*, making reference the percentage quantities of its TWO main constituents. (4)
- (b) With reference to EACH of the following grades of stainless steel, list ONE of its unique properties and a common use that utilises this property:
- ferritic; - Soft, heat conductor, Exhaust (Kettle wear) (2)
 - austenitic; - hard (316) - Ship Side Valve - (Corrosion resistant) (2)
 - martensitic. - hard Wearing (Pumps, Turbines) (2)
3. (a) Describe how a Brinell hardness test is carried out. (3)
- (b) With reference to a ball race bearing, explain EACH of the following terms:
- brinelling; (2)
 - false brinelling. (2) (7)
- (c) Explain how false brinelling can be reduced in practice. (3)
4. Describe FIVE different welding processes that could be utilised on board a vessel, to join TWO overlapping sections of mild steel. (10) (5)
5. With reference to Impressed Current Cathodic Protection of a vessel's hull:
- explain why it may be required; (2)
 - describe, with the aid of a sketch, the key points of installation; (5) (5)
 - describe its operating principle. (3) (8)

6. With reference to osmosis in glass reinforced plastic (GRP) hulls:

- (a) explain the process of osmosis and the method by which osmotic blisters occur in service; (6)
- (b) describe a procedure for the local treatment of a single blister. (4) ①/6

7. With reference to a PT100 probe (resistance thermometer):

- (a) explain the principle of operation by which it is able to give a temperature measurement; (3)
- (b) describe how the sensing element is constructed, explaining why it is called a PT100 probe; (4) ①/7
- (c) explain why these probes typically have three or four wires to connect them to the temperature indicating device. (3)

8. With reference to a thermistor:

- (a) state the materials used in their construction, the principle of operation and the reason for their use on vessels; (4) ②
- (b) state the temperature range over which they are able to operate; (1) ③
- (c) state, with reasons, FIVE applications where thermistors may be found on board a vessel. (5)

- 9/ (a) State the relationship between *proportional band* and *gain*. (2)
- (b) The figure shows the level in a water tank is being controlled by a float and lever proportional system.
- (i) Describe how the gain of the control system can be increased and decreased. (2)
 - (ii) Describe what happens when the flow out is increased. (2)
 - (iii) Describe the effect of increasing the controller gain with respect to the steady state tank level when the outflow is increased. (2)
 - (iv) Describe how the introduction of Integral action would affect this system. (2)

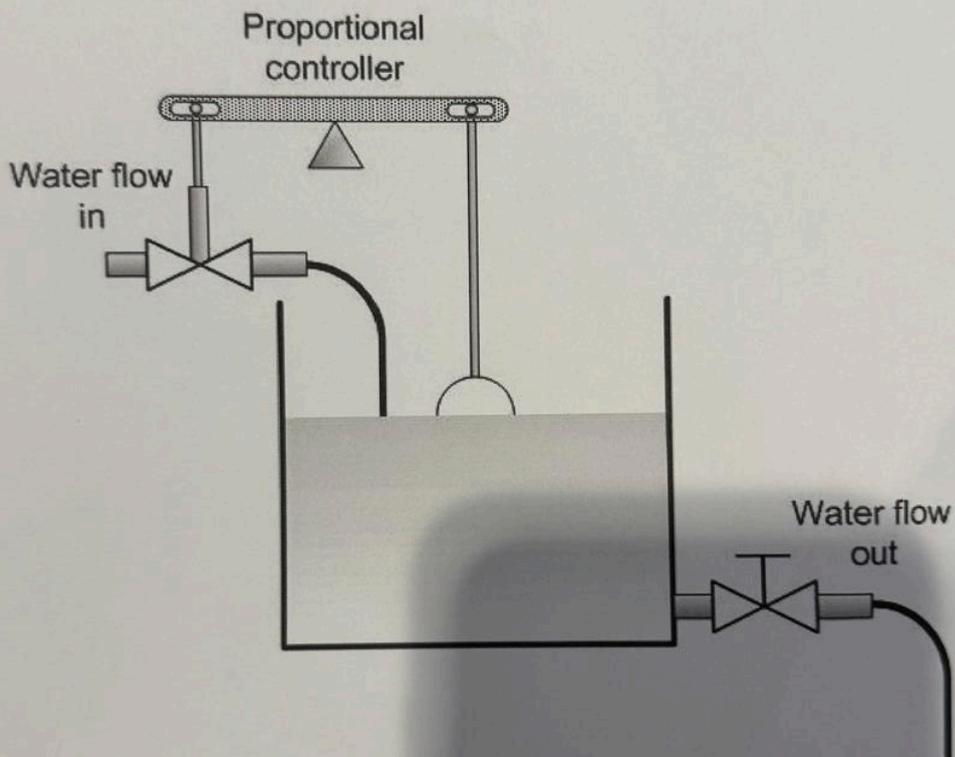


Fig Q9

- 10/ (a) Explain the term *failsafe* in a control system, stating TWO examples where this term is applied. (4)
- (b) Explain the term *failset* in a control system, stating TWO examples where this term is applied. (4)
- (c) State what is meant by a 4:3 control valve. (2)

7/8

6/8