CERTIFICATE OF COMPETENCY EXAMINATION

EXAMINATIONS ADMINISTERED BY
QUALIFICATIONS SCOTLAND
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY

SMALL VESSEL CHIEF ENGINEER <3000 GT, UNLIMITED

058-01 - APPLIED MARINE ENGINEERING

FRIDAY, 12 June 2026

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; 2 (4)

   (b) state, with reasons, THREE suitable materials. 3 (6)

2. Detail the changes in the properties of steel by the addition of EACH of the following elements:

   (a) nickel; 1 (2)

   (b) chromium; 1 (2)

   (c) molybdenum; 1 (2)

   (d) silicon; 1 (2)

   (e) manganese. 1 (2)

3. With reference to manufacturing components from aluminium:

   (a) explain why it may be necessary to anneal aluminium; 2 (2)

   (b) describe the problems encountered when working with annealed aluminium; 3 (4)

   (c) describe how it could be annealed on board a vessel. 4 (4)

4. (a) Describe how a Brinell hardness test is carried out. 3 (3)

   (b) With reference to a ball race bearing, explain EACH of the following terms:

   (i) brinelling; 2 (2)

   (ii) false brinelling. 2 (2)

   (c) Explain how false brinelling can be reduced in practice. 2 (3)

5. Describe FIVE different welding processes that could be utilised on board a vessel, to join TWO overlapping sections of mild steel. (10)

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6. A vessel has been laid up for a considerable time with shore power connected. Routine underwater hull inspections reveal an unusually high deterioration rate of the vessel's anodes. Assuming the dockside wiring, shore power connections and bonding systems are all in good condition and correctly connected:

(a) explain how this may occur; 5 (8)

(b) state TWO devices that should be fitted to prevent this situation occurring. 2 (2)

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; 2 (3)

(b) describe how the sensing element is constructed, explaining why it is called a PT100 probe; 2 (4)

(c) explain why these probes typically have three or four wires to connect them to the temperature indicating device. 2 (3)

8. (a) State the reasons for fitting a pneumatic process valve with EACH of the following:

(i) a volume booster; 2 (2)

(ii) a feedback positioner. 2 (2)

(b) State, with reasons, the type of actuator fitted to the process valves for EACH of the following systems:

(i) a fuel supply system in which the valve must not move on loss of power to the control system; 2 (3)

(ii) a lubrication oil cooling system in which the valve diverts the oil through a cooler. 2 (3)

2 (2)

9. (a) State the relationship between *proportional band* and *gain*.

(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 (2)

(ii) Describe what happens when the flow out is increased. 1 (2)

(iii) Describe the effect of increasing the controller gain with respect to the steady state tank level when the outflow is increased. 1 (2)

(iv) Describe how the introduction of Integral action would affect this system. 1 (2)

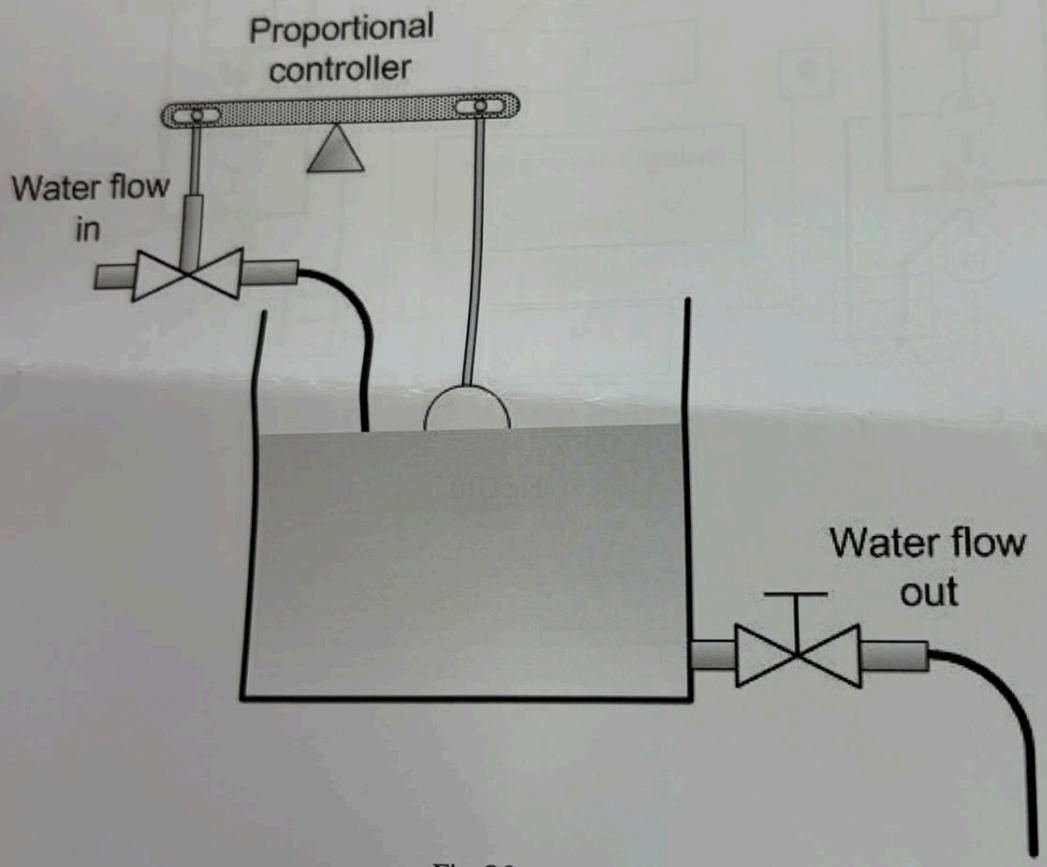

Fig Q9

10. In the Hydraulic Control System shown in the figure, identify components A, B, C, D, E, F, G, H, J and K from their symbols. (10)

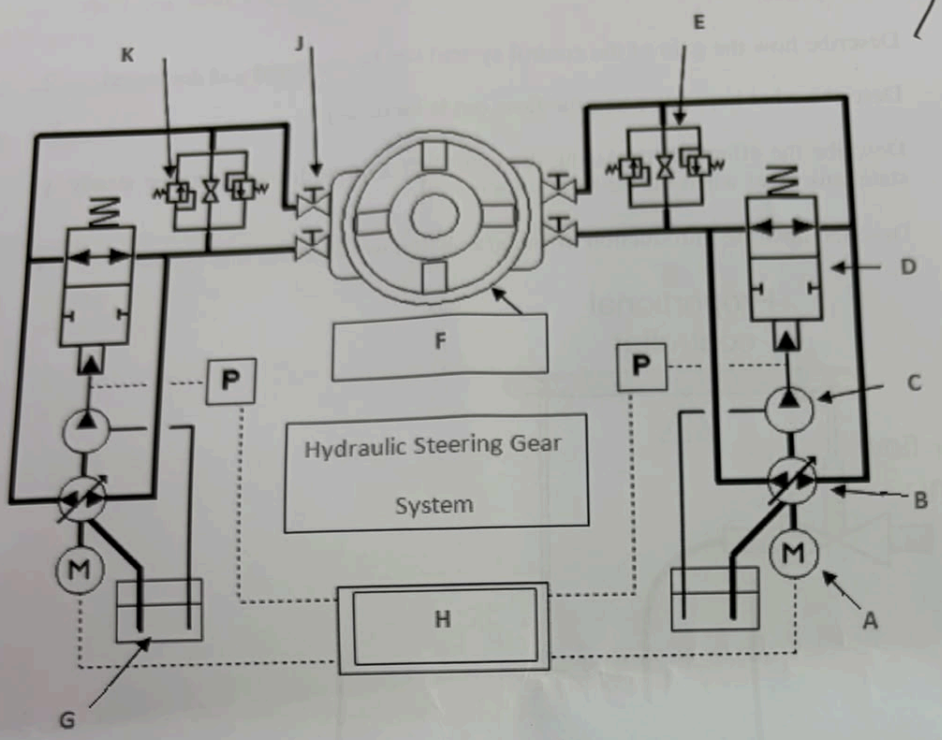

Fig Q10