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, 31 May 2024

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 carbon fibre:

   (a) describe how the base raw material is turned into a useable carbon fibre; (2)

   (b) describe how the fibres produced in part (a) are turned into a usable product; (2)

   (c) explain how its internal structure gives it its unique strength properties; (2)

   (d) list FOUR properties of carbon fibre that make it desirable for marine fabrication. (4)

2. With reference to the installation of copper pipes in engine cooling systems:

   (a) describe THREE possible causes for their premature failure; (6)

   (b) outline FOUR recommendations for the installation of copper pipes. (4)

3. With reference to fatigue failure of components:

   (a) describe how material fatigue testing is carried out in the laboratory; (2)

   (b) sketch the surface appearance of a fatigue fracture; (2)

   (c) describe the THREE stages of the failure; (3)

   (d) list the methods available on board to limit the possibility of fatigue failure to a propeller shaft. (3)

4. Describe, with the aid of sketches, FIVE defects that may be present on a weld produced using the covered electrode welding process. (10)

5. With reference to the cathodic protection of hull fittings:

   (a) explain how sacrificial anodes achieve this; (2)

   (b) state where sacrificial anodes would be fitted and why; (4)

   (c) describe an impressed current system, stating the principle on which it works. (4)

6. With reference to in service defects found in glass reinforced plastic (GRP) hulls:

   (a) state THREE possible causes of de-lamination; (3)

   (b) describe TWO methods of detecting de-lamination in service; (2)

   (c) describe TWO methods of repair to de-lamination on a sandwich construction hull; (2)

   (d) list THREE design problems that can lead to stress cracking. (3)

7. (a) Describe, with the aid of a sketch, how a Bourdon Tube can be utilised to measure temperature. (8)

   (b) State a typical application and location for this type of device. (2)

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

   (i) a volume booster; (2)

   (ii) a feedback positioner. (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; (3)

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

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)

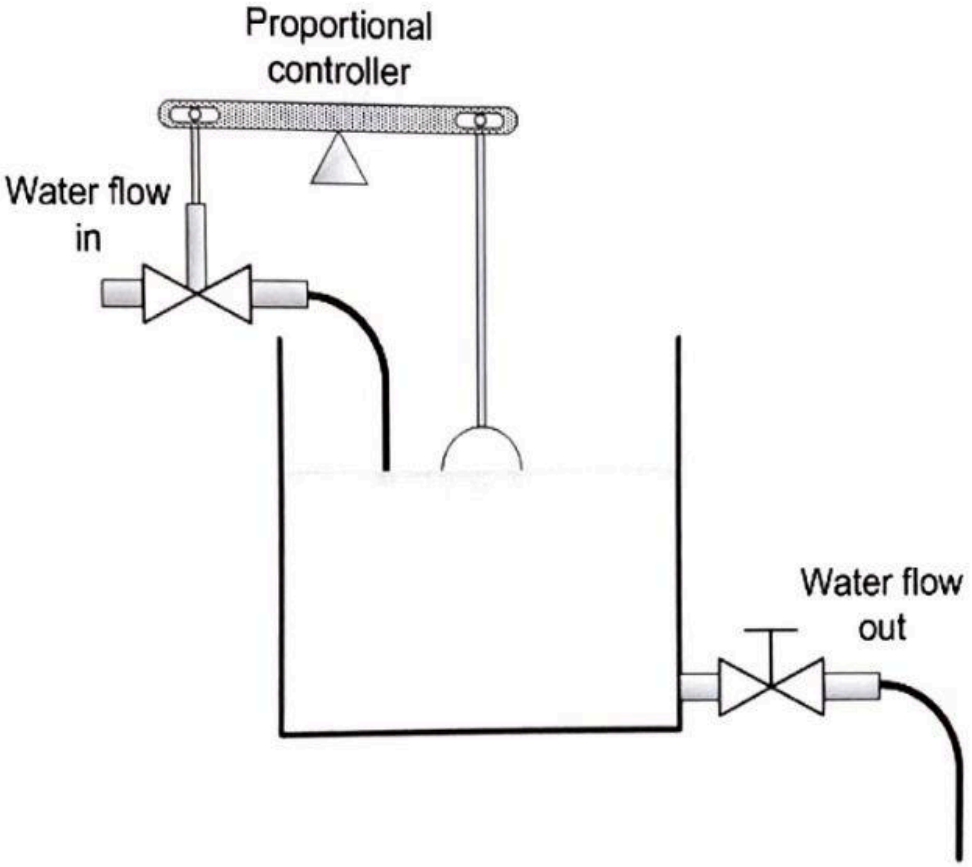

Fig Q9

10. 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)

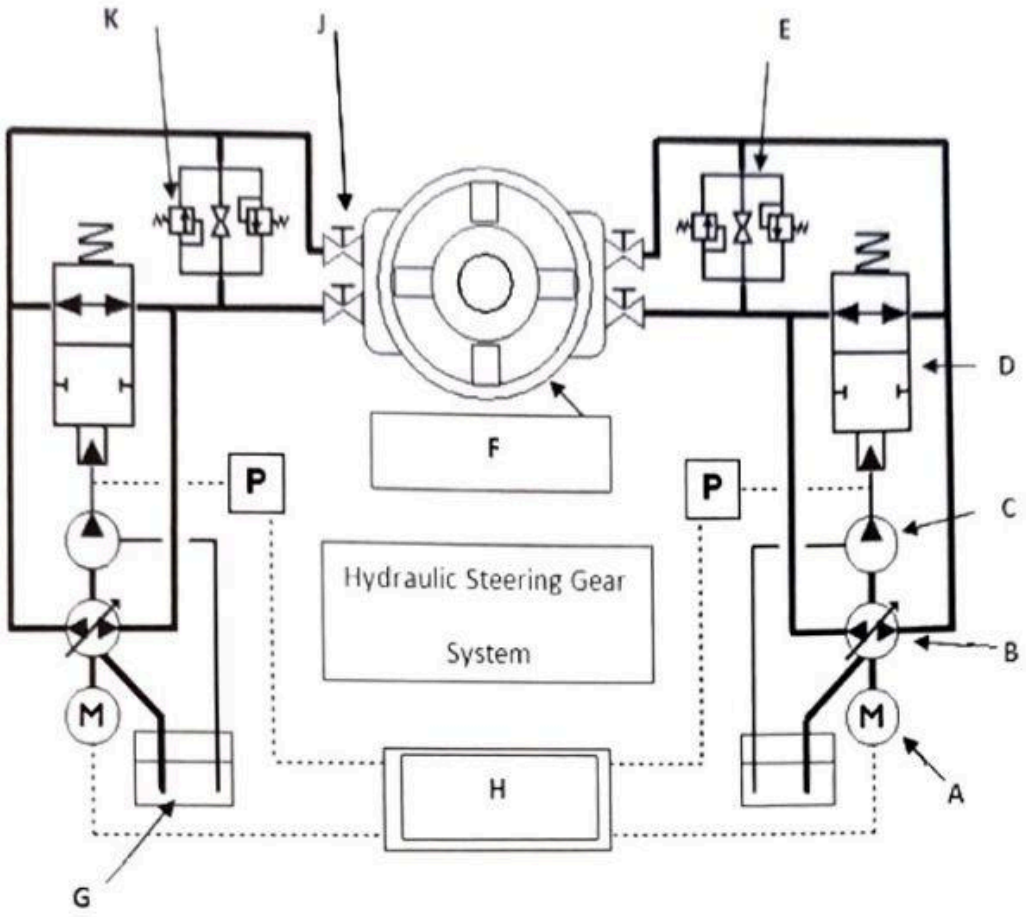

Fig Q10