

# **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, 18 November 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. (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:
  - (i) ferritic; (2)
  - (ii) austenitic; (2)
  - (iii) martensitic. (2)
  
2. With reference to manufacturing components from aluminium:
  - (a) explain why it may be necessary to anneal aluminium; (2)
  - (b) describe the problems encountered when working with annealed aluminium; (4)
  - (c) describe how it could be annealed on board a vessel. (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. With reference to the attachment of aluminium superstructures to a steel hull:
  - (a) explain why it is not normal practice to join the two components using conventional welding techniques; (2)
  - (b) state the particular problems associated with the aluminium superstructure where it is bonded to a steel hull; (2)
  - (c) outline the maintenance that should be carried out to ensure the continued structural integrity of the vessel; (2)
  - (d) sketch a typical transition joint that could be utilised to attach an aluminium superstructure to a steel hull. (4)

5. (a) Describe the problems associated with two dissimilar metals in contact in the presence of sea water. (4)
- (b) Describe THREE different methods that may be used to reduce the problems described in part (a). (6)
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)
7. (a) Explain, with the aid of a sketch, the design and operation of a thermocouple. (8)
- (b) State ONE limitation of the thermocouple, stating how this is overcome in practice. (2)
8. Explain EACH of the following control terms:
- (a) settling time; (2)
- (b) repeatability; (2)
- (c) dead zone; (2)
- (d) hysteresis; (2)
- (e) proportional bandwidth. (2)

9. The figure shows a tank filling with fluid at a variable rate, and an output regulated manually by an operator controlling a valve.

Explain, with the aid of a control block diagram, the control process taking place that enables the operator to maintain a constant tank level, 'h' for varying rates of fluid flow input.

*Note: fluid flow in will always be less than the maximum flow out with the valve full open.*

(10)

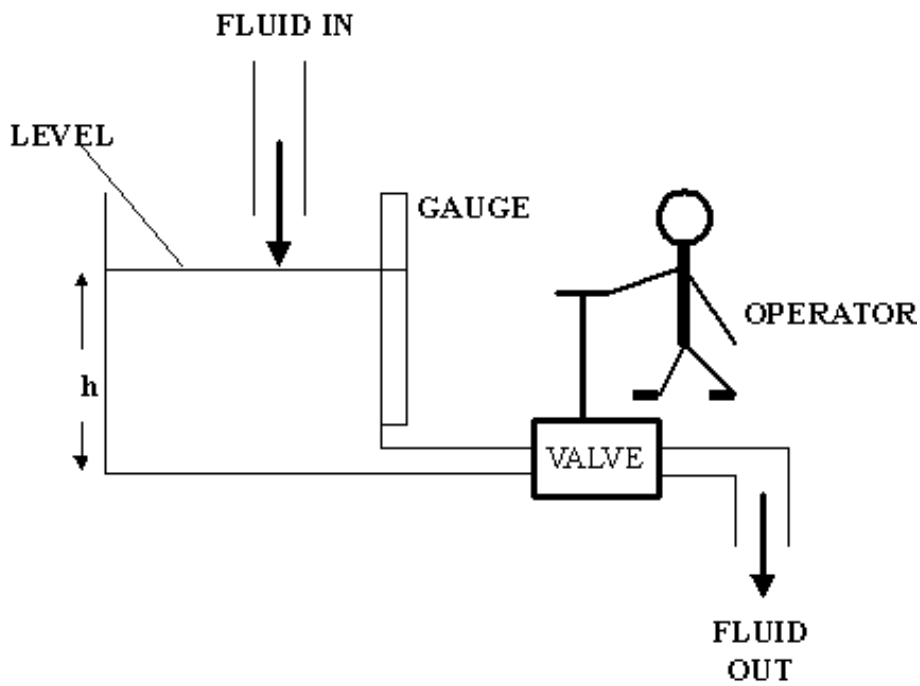


Fig Q9

10. (a) Identify components A, B, C, D, E, F, G and H shown in the figure. (8)
- (b) Explain the difference between a *strainer* and a *filter* in a hydraulic circuit. (2)

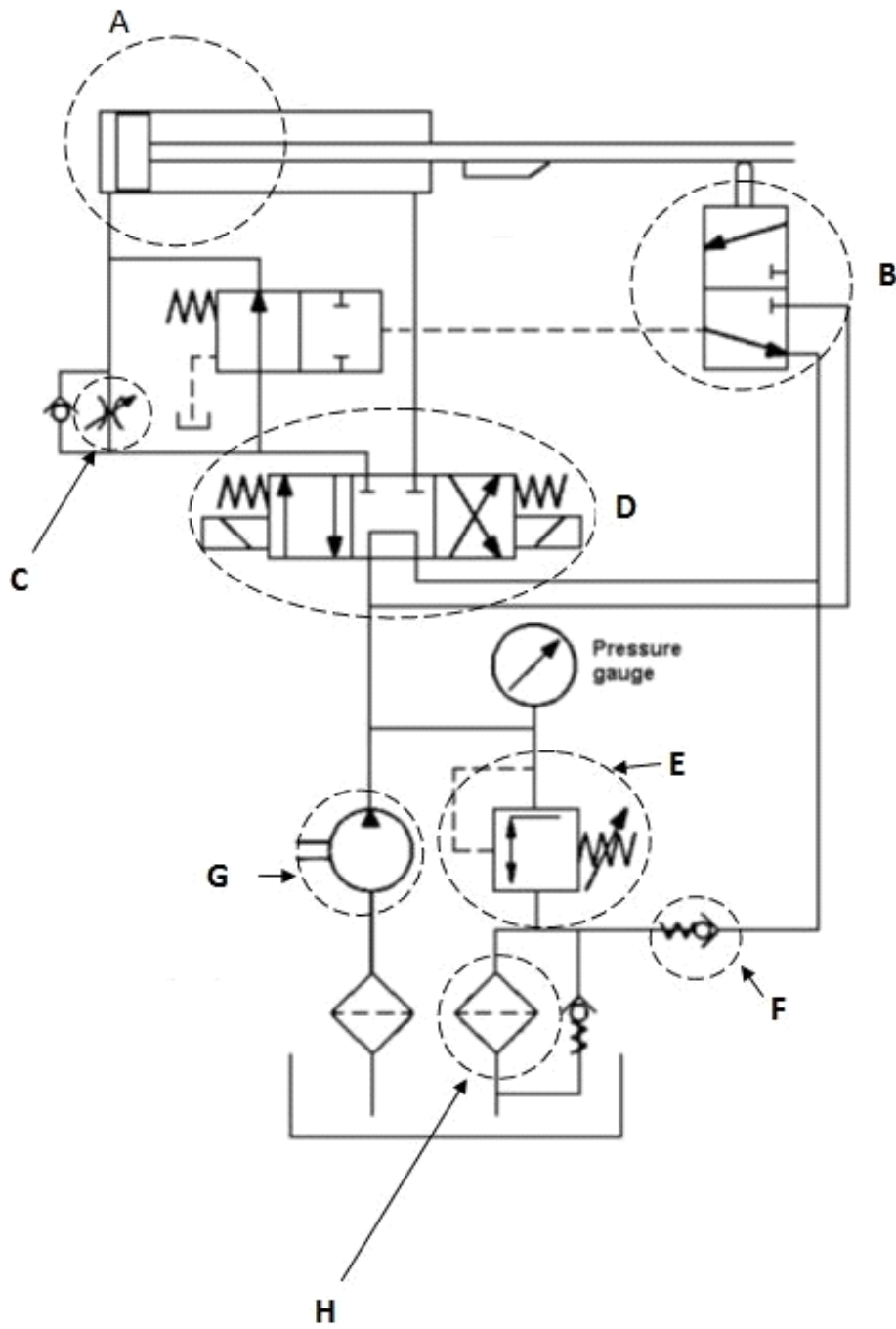


Fig Q10