

# **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, 02 July 2021**

**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 meaning of the term *alloy*, stating why they are used. (3)  
(b) Describe the changes in the mechanical properties of steel with increasing amounts of carbon. (4)  
(c) List SIX common alloying elements used in the production of steel. (3)
  
2. Describe the heat treatment process EACH of the following components would undergo, stating the reasons for EACH of the processes:  
(a) crankshaft; (4)  
(b) valve spring; (3)  
(c) used copper washer. (3)
  
3. 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)
  
4. 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)
  
5. With reference to TIG welding:  
(a) describe the process; (3)  
(b) explain why an ac current is preferred when welding aluminium; (2)  
(c) explain the advantages compared to other methods. (5)

6. (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)
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)
  - (c) explain why these probes typically have three or four wires to connect them to the temperature indicating device. (3)

8. 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)

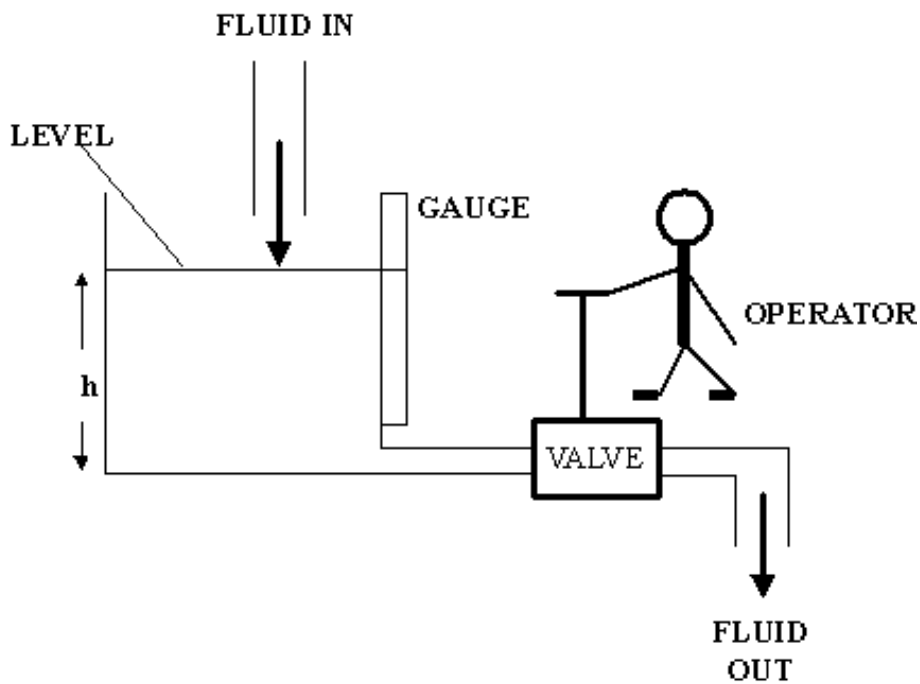


Fig Q8

9. With reference to engine governors, explain EACH of the following terms:

- (a) sensitivity; (2)
- (b) hunting; (2)
- (c) speed droop; (2)
- (d) stability; (2)
- (e) isochronous governing. (2)

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)

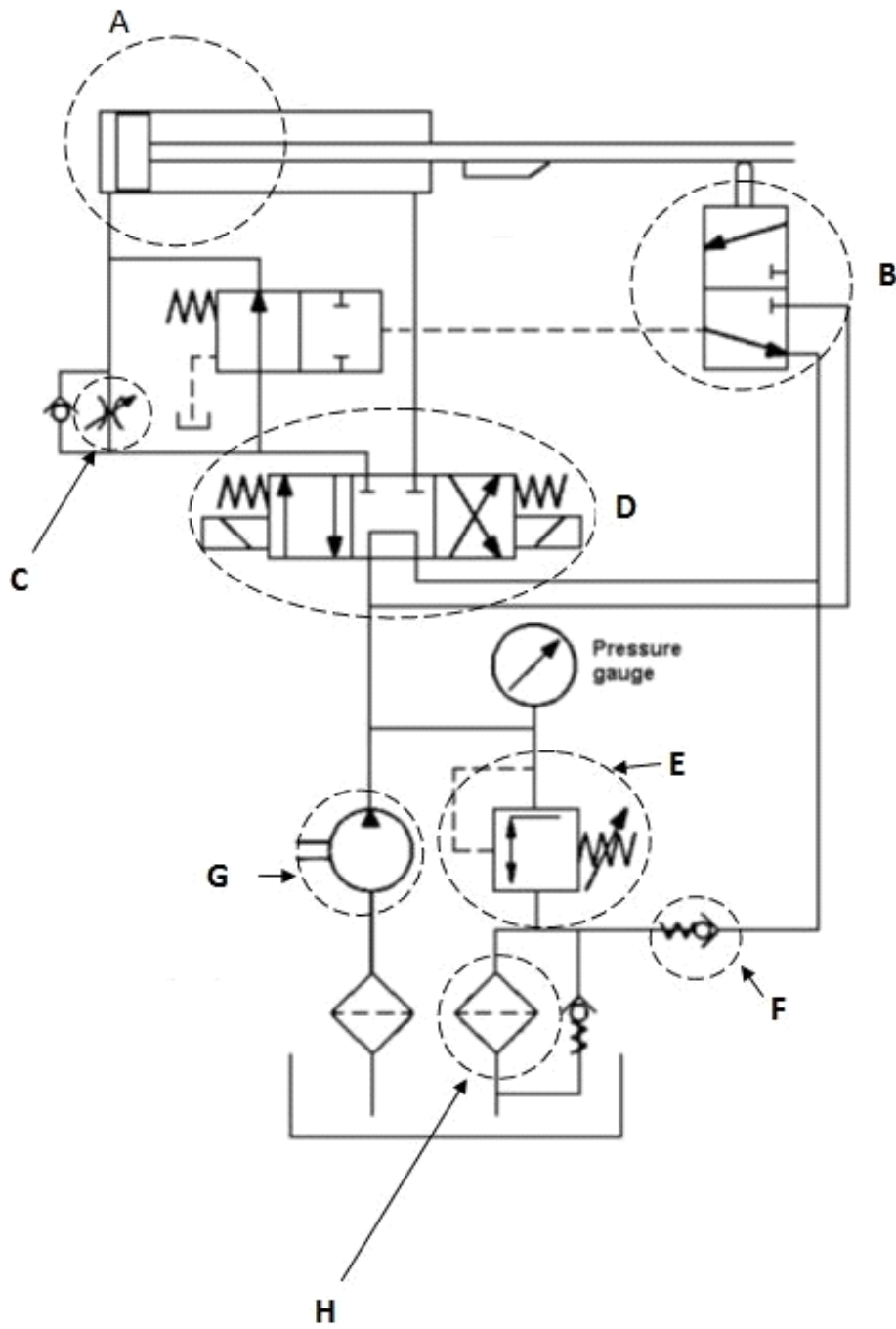


Fig Q10