

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, 26 May 2023

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 carbon fibre used in marine construction:
 - (a) describe the properties that make it suitable for EACH of the following:
 - (i) hull construction; (2)
 - (ii) mast construction; (2)
 - (b) explain its undesirable properties for the applications in part (a); (3)
 - (c) explain the safety considerations necessary when working with carbon fibre. (3)

2. With reference to the heat treatment of steel:
 - (a) explain which steels this process is best suited to; (2)
 - (b) explain EACH of the following processes, making reference to mechanical properties and internal structure:
 - (i) hardening; (4)
 - (ii) tempering. (4)

3. With reference to the hull of a vessel:
 - (a) define the term *fatigue*; (3)
 - (b) describe how fatigue stress occurs whilst in a seaway; (3)
 - (c) state the effect of fatigue on the hull material. (4)

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. (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 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)
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. (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)

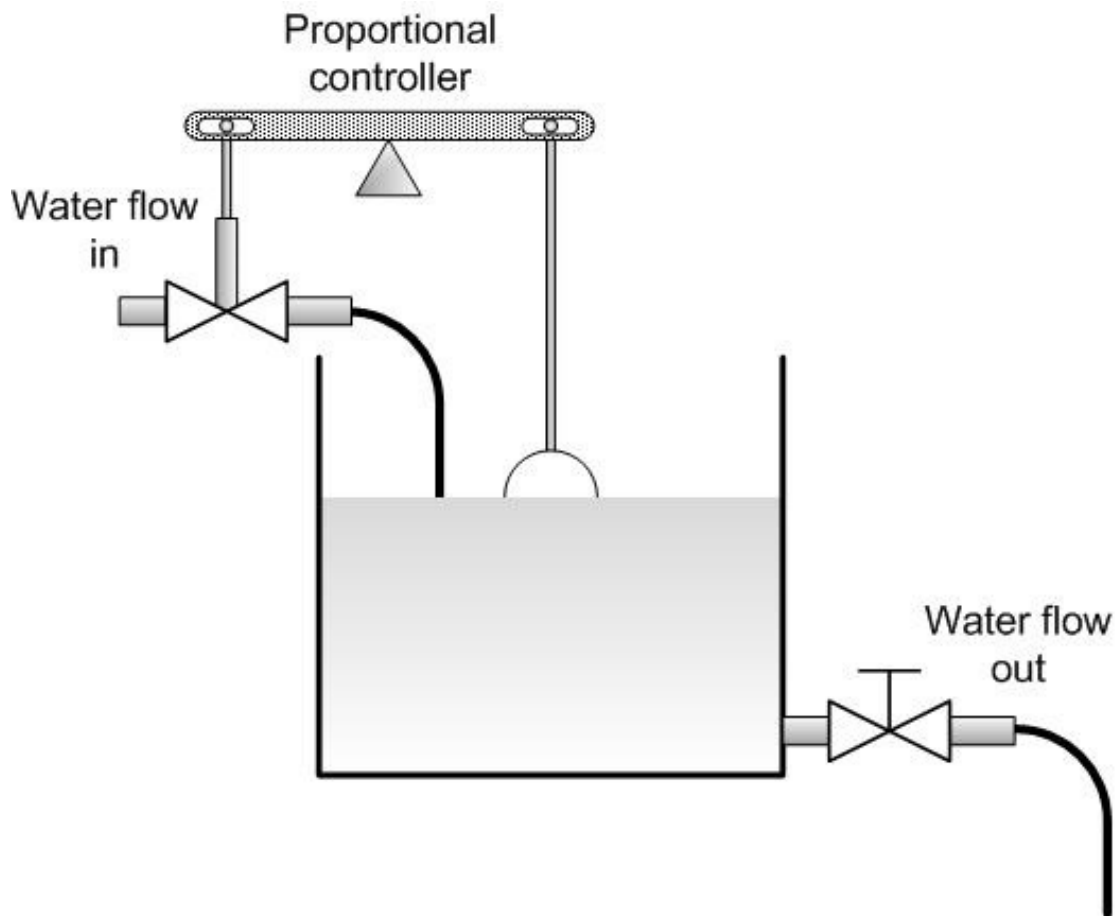


Fig Q8

9. (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)

10. On passage at full sea speed, a high jacket water temperature alarm goes off. The header tank is full, there are no leaks in the systems, both the HT and SW pumps are running and in good condition, however the temperature is continuing to rise.

(a) State the immediate course of action that should be taken, explaining why. (2)

(b) From the information on the supplied system diagram, shown in the figure below, describe THREE possible actions that may bring the plant back to within normal operating parameters. (8)

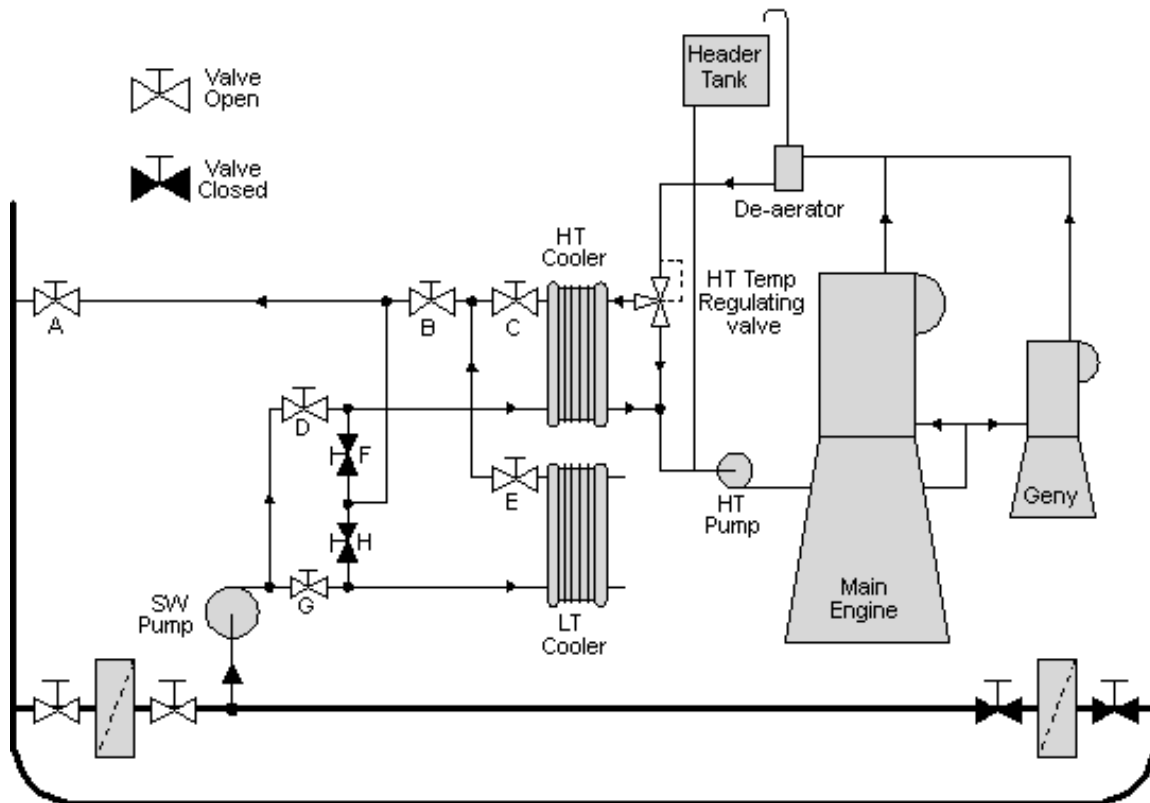


Fig Q10