

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, 09 March 2018

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. Non-programmable calculators may be used.2. 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 EACH of the following materials, list their percentage composition and a different application for EACH material on board, stating, with reasons, why they are suitable for this application:
 - (a) cupro-nickel; (2)
 - (b) aluminium bronze; (2)
 - (c) admiralty brass; (2)
 - (d) duralumin; (2)
 - (e) solder. (2)

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 stresses within engineering materials:
 - (a) explain EACH of the following terms
 - (i) tensile stress; (1)
 - (ii) shear stress; (1)
 - (iii) compressive stress; (1)
 - (b) list TWO components within a diesel engine that are subject to the effects of EACH of the three stresses listed in part (a); (6)
 - (c) state the component in a 4 stroke diesel engine that has a maximum recommended service life due to constant cyclic stress. (1)

4. With reference to gas metal arc welding (MIG) of mild steel:
 - (a) describe the process; (3)
 - (b) explain, with reasons, the surface preparation required; (3)
 - (c) list THREE advantages and ONE limitation. (4)

5. With reference to marine corrosion:
 - (a) list EIGHT factors that influence the rate of corrosion for an unprotected metal surface; (4)
 - (b) explain the process of galvanic corrosion; (4)
 - (c) state TWO major factors influencing the severity of galvanic corrosion. (2)

6. With reference to hot docking:
 - (a) explain how this occurs, stating its effects; (6)
 - (b) describe the operation of TWO devices that will prevent this occurring. (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. With reference to capacitance probe sensors:
 - (a) describe, with the aid of a sketch, how a capacitance probe produces an output which can be used to measure the liquid level in a tank. (7)
 - (b) state TWO different uses of this device on a vessel; (2)
 - (c) state ONE disadvantage of this type of probe. (1)

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)

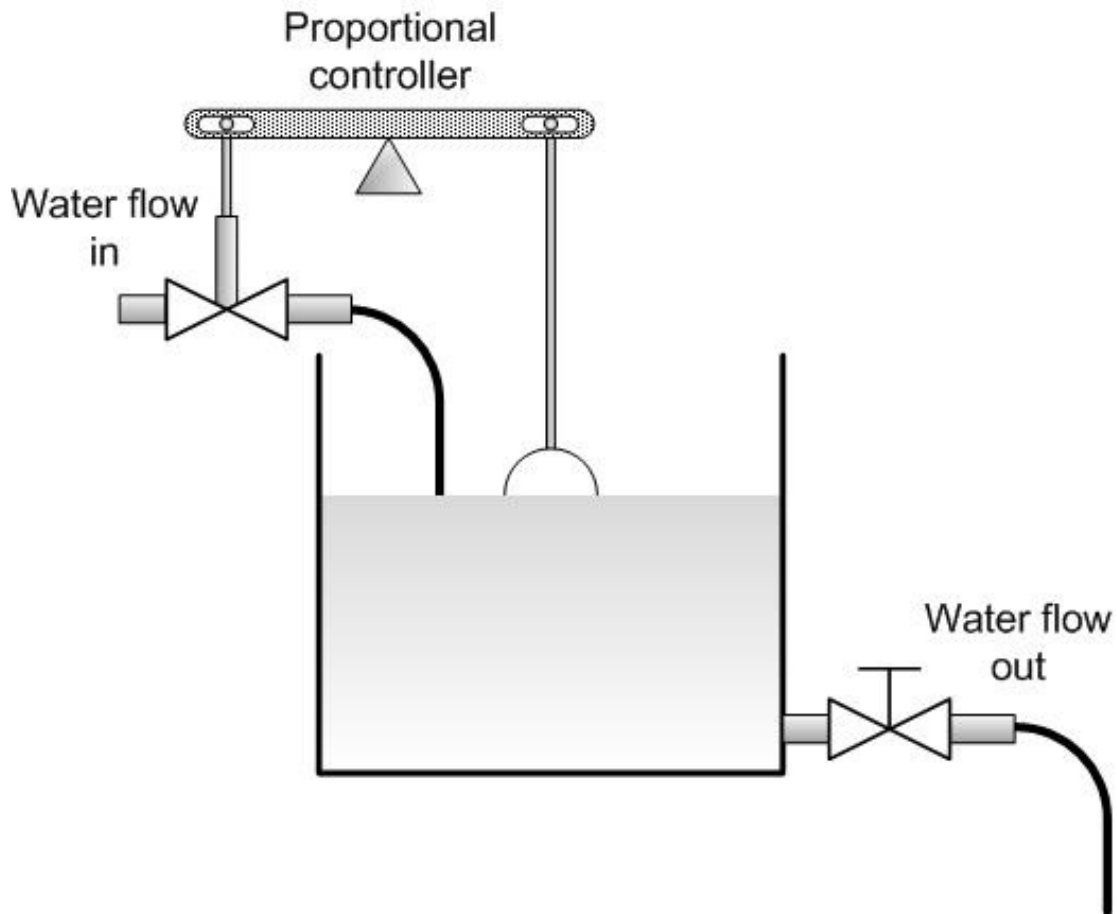


Fig Q9

10. (a) Define EACH of the following terms:
- (i) cascade control; (4)
- (ii) split range control. (3)
- (b) Describe possible problems associated with *split range control* used for the control of a main engine cooling system. (3)