

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, 04 March 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">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. (a) Outline THREE disadvantages of using aluminium in vessel construction. (3)
- (b) Outline THREE advantages of using steel in vessel construction. (3)
- (c) Outline FOUR conditions necessary in the preparation of steel surfaces prior to painting, to ensure a good surface finish. (4)

2. With reference to the case hardening of bearing journals:
 - (a) explain why this process may be carried out; (2)
 - (b) describe EACH of the following processes:
 - (i) induction hardening; (3)
 - (ii) nitriding; (3)
 - (c) explain why the processes described in part (b) are best suited to this application. (2)

3. (a) Explain EACH of the following terms:
 - (i) plasticity; (2)
 - (ii) sheer stress; (2)
 - (iii) Young's modulus; (2)
 - (iv) safety coefficient (factor of safety). (2)
- (b) State TWO factors that may influence the safety coefficient in operation. (2)

4. State, with reasons, a different welding/brazing/soldering process that is best suited to effect EACH of the following situations:
 - (a) joining two lengths of aluminium bronze seawater pipe, both pipes having the same diameter; (2)
 - (b) attaching a stainless steel handrail to a steel hull; (2)
 - (c) re-attach a section of broken flange on a cast iron pump casing; (2)
 - (d) attaching a brass flange onto a stainless steel pipe; (2)
 - (e) attaching a 1.0 mm steel section to 10 mm thick deckhead plate. (2)

5. A vessel has been laid up for a considerable time with shore power connected. Routine underwater hull inspections reveal an unusually high deterioration rate of the vessel's anodes. Assuming the dockside wiring, shore power connections and bonding systems are all in good condition and correctly connected:
- (a) explain how this may occur; (8)
 - (b) state TWO devices that should be fitted to prevent this situation occurring. (2)
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. Describe, with the aid of a sketch, a floatation device that produces an output signal to remotely control the liquid level in a tank. (10)
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) Describe, with the aid of a sketch, the principle and operation of a potentiometer. (6)
- (b) Explain how a potentiometer can be used to measure rotary movement. (4)
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)