

CERTIFICATE OF COMPETENCY EXAMINATION

**EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY
MANAGEMENT ENGINEER (UNLIMITED)**

040-13 - ENGINEERING KNOWLEDGE - MOTOR

TUESDAY, 15 July 2025

0915-1215 hrs

Examination paper inserts:

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Notes for the guidance of candidates:

Candidates should note that 96 marks are allocated to this paper. To pass candidates must achieve 48 marks.

Materials to be supplied by examination centres:

Candidate's examination workbook

ENGINEERING KNOWLEDGE - MOTOR

Attempt SIX questions only

Marks for each part question are shown in brackets

1. Write a report to the engineering superintendent regarding the failure at sea of a crosshead main engine bottom end bearing. The report must explain how the defect was detected, the immediate action taken to prevent further engine damage, the subsequent action taken to ensure that the vessel was able to continue on passage to the next port, probable cause of the bearing failure and other checks made on the engine. (16)

2. (a) Describe, with the aid of a sketch, a system for burning gaseous fuel in a two-stroke diesel engine, indicating safety features fitted and explaining why the gas has to be injected into the cylinder rather than mixed with the combustion air outside of the cylinders. (12)
- (b) Define the term *Methane Slip*, explaining how it occurs and why it is undesirable. (4)

3. (a) Explain the possible causes and actions to be taken in the event of a high exhaust temperature on a 4-stroke generator engine at :
 - (i) a single cylinder; (3)
 - (ii) more than one cylinder. (3)
- (b) Explain why multiple air inlet and exhaust valves are fitted to highly rated 4-stroke engines. (4)
- (c) Describe an arrangement for operating multiple valves from a single cam, explaining how the "tappet" clearance is set for both valves. (6)

4. (a) State, with reasons, SIX points that should be covered by a risk assessment for the inspection of a main engine crosshead bearing. (6)
- (b) State how it can be ensured that the lifting equipment used for the inspection of a crosshead bearing is fit for the purpose intended. (4)
- (c) List THREE defects which might be detected during inspection of a crosshead pin and bearing, stating the probable cause of such defects. (6)

5. With reference to main slow speed engine safety systems:

- (a) list FOUR engine operating parameters which will initiate an automatic engine *slowdown*, indicating in EACH case why an automatic *slowdown* is necessary; (8)
- (b) list TWO engine operating parameters which will initiate an automatic engine *shutdown*, indicating in EACH case why an automatic *shutdown* is necessary; (4)
- (c) explain how the operation of EACH shutdown listed on part (b) may be tested. (4)

- 6.
- (a) Explain why a diesel engine cylinder is supplied with excess air. (4)
 - (b) Explain why fuel droplet size produced during injection has to be within narrow limits in order to enable good cylinder combustion to be achieved. (4)
 - (c) Explain how the desired fuel droplet size is produced by fuel injectors. (4)
 - (d) State why fuel injection timing has to be controlled within narrow limits to enable economic engine operation without bearing overload. (4)

7. With reference to engine fuel injector nozzle cooling:

- (a) explain why fuel injector nozzle cooling is necessary; (4)
- (b) describe, with the aid of a sketch, the operation of a nozzle cooling system for a generator engine; (8)
- (c) explain how fuel injector nozzles are cooled on engines which are not fitted with a separate nozzle cooling system. (4)

- 8.
- (a) Explain why crankshaft deflections are taken. (4)
 - (b) Write a procedure for the taking of main engine crankshaft deflections. (8)
 - (c) Explain the action to be taken if some crankshaft deflection readings are outside acceptable limits. (4)

9. (a) Sketch an exhaust gas steam generation system in which the exhaust gas economiser comprises of a steam generation unit and a water/steam drum; there is no exhaust gas bypass arrangement but the steam system has a steam dump condenser. The sketch must show the exhaust gas flow as well as the feed water and steam flows. Soot blowing arrangements and the steam dump condenser system must be included. The Steam drum, which is supplied with feed water, is located above the exhaust gas economiser.

(8)

(b) Describe the operation of the steam generation system sketched in the answer to part (a). The description must explain how the steam pressure is regulated and how the feed water system operates to maintain water flow through the economiser steam generation unit.

(8)