

**CERTIFICATES OF COMPETENCY IN THE MERCHANT
NAVY - MARINE ENGINEER OFFICER**

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

040-13 - ENGINEERING KNOWLEDGE - MOTOR

TUESDAY, 29 March 2022

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) Explain, with the aid of a sketch, Thermal Stress, stating how thermal stress is induced in the cylinder liner when the engine is operating. (8)
- (b) Explain why thermal stress may be damaging to an engine cylinder. (4)
- (c) Explain how thermal stress may be avoided in an operating engine without reducing engine power output. (4)
3. (a) Describe, with the aid of a sketch, an external system for reducing engine NOx emissions, explaining the chemistry of the process. (8)
- (b) Explain why Urea is used in the Selective Catalytic Reduction process instead of ammonia. (4)
- (c) Explain why the exhaust gas quality must be monitored before and after the Selective Catalytic Reduction unit, stating how such monitoring influences operation of the SCR unit. (4)
4. (a) State, with reasons, SIX points which should be covered in a risk assessment for the replacement of a crosshead main engine fuel injection pump in port. (6)
- (b) Write instructions for the replacement of a crosshead main engine fuel injection pump. (10)
5. With reference to an engine air starting system:
- (a) explain why a slow turning system is fitted; (4)
- (b) state, with reasons, when a slow turning system operates; (2)
- (c) describe, with the aid of a sketch, an air starting system, explaining how the slow turning system operates. (10)

6. 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)
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- (a) State, with reasons, THREE properties required of a cylinder lubricant for a main engine operating on HFO. (6)
 - (b) Describe, with the aid of sketches, an electronically controlled cylinder lubrication system, stating how the timing and quantity of cylinder lubricant is regulated and set. (10)
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- With reference to LNG diesel engine installations:
- (a) describe, with the aid of a sketch, a Gas Valve Unit, explaining its purpose and indicating where it is located in the gas train; (8)
 - (b) explain why ventilation and inert gas systems must be installed with the engine fuel gas system; (4)
 - (c) state why pilot injection must be provided when burning fuel gas, explaining how a pilot injection system operates. (4)
9. With reference to waste heat steam generation systems:
- (a) describe, with the aid of a sketch, the economiser circulation system; (5)
 - (b) explain how the economiser circulation pumps are kept cool; (3)
 - (c) describe how the boiler water is maintained in a condition which minimises scale formation and system corrosion. (8)