

**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, 19 July 2022

0915-1215 hrs

Examination paper inserts:

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 for the engineering superintendent regarding the replacement of the fuel injectors of multiple main engine units due to severe erosion of the nozzle holes and burning of the injector tips. The report must explain how the defects were detected, the likely cause of the damage and the action which has been implemented to prevent further incidents of this type. (16)

2. (a) Explain fatigue cracking, stating its causes and propagation. (8)
(b) Explain how the risk of fatigue cracking of cylinder head holding studs is liable to be increased by poor maintenance and engine overload. (8)

3. With reference to diesel engine NO_x emissions and control:
(a) explain how exhaust gas recirculation and direct water injection reduce engine NO_x emissions but result in increased specific CO₂ emissions; (6)
(b) describe, with the aid of a sketch, a Selective Catalytic Reduction system, stating, with reasons, the monitoring and control systems required. (10)

4. (a) Describe a procedure for cylinder liner calibration, indicating how the readings are recorded to allow for easy recognition of liner wear. (6)
(b) Describe TWO forms of abnormal cylinder liner wear, explaining how EACH is recognised. (6)
(c) Explain how abnormal cylinder liner wear may be prevented. (4)

5. (a) Discuss the dangers associated with a main engine starting air system, explaining how these dangers are mitigated. (9)
(b) State, with reasons, THREE causes of an engine failing to fire on fuel after successfully turning over on starting air. (3)
(c) Explain how the engine is transferred to local (engine side) control in the event of failure of the main engine remote control system. (4)

6. (a) Sketch a main engine electronically controlled fuel injection system. (6)
- (b) Explain how fuel injector quantity and timing is changed in the fuel injection system sketched in part (a). (6)
- (c) State why it may be necessary to change engine fuel injection timing. (4)
7. (a) Describe, with the aid of a sketch, a main engine fresh water cooling water system, incorporating HT and LT systems. (10)
- (b) Describe the charge air supply system for a turbocharged engine, explaining the purpose of each main part. (6)
8. (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)
9. With reference to an economiser:
- (a) write a procedure for the cleaning of the gas side of an economiser when the associated main engine is:
- (i) running; (5)
- (ii) stopped. (5)
- (b) write a procedure for operation of the main engine when the associated economiser cannot be operated due to tube failure. (6)