

**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, 14 December 2021**

**0915-1215 hrs**

Examination paper inserts:

[Empty rectangular box for 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. As Chief Engineer Officer, write a report to the engineering superintendent regarding the failure of a main engine cylinder liner due to cracking which resulted in water leakage from the cooling space into the cylinder. The report must explain how the defect was detected, the immediate action taken, the rectifying action taken to ensure that the engine could be operated and the checks made on the engine before and after restarting. (16)
  
2. (a) Describe, with the aid of sketches, the lubrication system for a turbocharger. (6)
- (b) Describe, with the aid of sketches, the replacement of a turbocharger bearing, stating the checks which must be made before the turbocharger is returned to service. (10)
  
3. With reference to diesel engine hybrid SO<sub>x</sub> scrubber systems:
  - (a) state the fluids used in the open and closed loops of the scrubber, explaining how these fluids are controlled to meet the scrubbing demand at different engine loads; (6)
  - (b) state the circumstances under which *Open Loop scrubbing* would be used and *Closed Loop scrubbing* would be used; (2)
  - (c) describe how the effective SO<sub>x</sub> neutralising effect of the fluid used in the closed loop system is maintained during long operating periods and how pollution of the sea is avoided. (8)
  
4. With reference to cylinder liner scuffing:
  - (a) explain how it is caused, stating the method of detection; (6)
  - (b) explain the effects of cylinder liner scuffing; (4)
  - (c) explain how minor scuffing may be treated in order to avoid the need for liner replacement. (6)
  
5. (a) Describe, with the aid of a sketch, a diesel engine air start system and the devices which are fitted to prevent or limit damage in the event of an explosion. (8)
- (b) Explain how an explosion in a diesel engine air start system might occur. (4)
- (c) As Chief Engineer Officer, outline the actions that should be taken to ensure that an explosion from the causes explained in part (b) may be avoided. (4)

6. (a) Explain why optimum fuel atomisation is required in a marine diesel engine cylinder and how it is achieved. (6)
- (b) Explain how optimum fuel droplet size is produced by a fuel injector. (6)
- (c) Explain how fuel injector nozzles are maintained in good condition. (4)
7. With reference to diesel engine lubricating oil and distillate fuel oil:
- (a) describe the causes and effects of microbial attack; (6)
- (b) explain how microbial attack may be detected; (4)
- (c) describe how an oil system may be returned to service following microbial attack. (6)
8. (a) With the aid of sketches, describe the operation of a dual fuel 4-stroke engine when operating on gas. (10)
- (b) For the engine described in part (a), explain how and when the fuels are supplied to the cylinders. (6)
9. With reference to boilers and steam generation systems:
- (a) explain the term *water hammer*, stating how it is caused and describing the possible consequences of it; (4)
- (b) explain how *water hammer* can be avoided; (4)
- (c) describe, with the aid of a sketch, how the boiler fuel system may be operated in port to comply with local emission control regulations. (8)