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**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, 23 March 2021**

**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. With reference to diesel engine crankshafts:
  - (a) explain the causes and effects of *torsional vibration*; (4)
  - (b) explain the term *critical speed*, stating why the engine should not be continuously operated at this speed; (6)
  - (c) explain the term *fatigue cracking*, stating, with reasons, TWO factors which have an influence on the likelihood of fatigue cracking. (6)
  
- ✓ 2. (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)
  
- ✓ 3. With reference to turbocharger systems:
  - (a) describe how performance of the system is monitored and how the information gathered is used to assess performance; (8)
  - (b) describe the arrangements for maintaining the systems in good condition. (8)
  
- ✓ 4. With reference to diesel engine SO<sub>x</sub> exhaust gas cleaning and pollution control:
  - (a) state, with reasons, which system parameters are monitored, explaining where the monitoring devices are located, how the data is stored and how data is made available to regulatory authorities; (10)
  - ✓(b) state how pollution of sea water can be caused by the use of SO<sub>x</sub> exhaust gas cleaning systems, explaining how such pollution is prevented. (6)
  
- ✓ 5. (a) Describe, with the aid of a sketch, the lubrication systems for a crosshead engine, explaining the properties required for the lubricating oil in each system. (10)
- (b) Describe a system which may be used to ensure that the cylinder lubricating oil properties are available for a crosshead engine when changing between fuels (including between fuel oil and gas), stating why it is not desirable to use the same cylinder LO for high and low sulphur fuels (including gas). (6)

- ✓ 6. (a) Write the Chief Engineer Officer's Standing Instructions for the actions to be taken by the watchkeeping engineer in the event of failure of the engine room control monitoring and alarm system. (8)
- (b) State the procedure to be followed in the event of repeated activation of an oil mist detector alarm. (8)
- ✓ 7. (a) Explain why top bracing is used for large crosshead engines. (4)
- (b) Describe, with the aid of a sketch, a hydraulic top bracing unit for a large crosshead engine indicating where the top bracing is fitted and how it operates. (6)
- (c) Write instructions for the checking of a large crosshead engine hydraulic top bracing system and a holding down system. (6)
- ✓ 8. 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)
- ✓ 9. (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)