

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, 10 December 2024

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. (a) Describe, with the aid of a sketch, the arrangement of the gas and liquid fuel systems at the cylinder of a dual fuel 4-stroke engine, stating the input and output signals at the controller. (12)
- (b) Describe the arrangement of the gas fuel piping system used for a 4-stroke dual fuel engine, stating the safety features incorporated. (4)

2. As Chief Engineer Officer, write a report to the engineering superintendent regarding failure of a four-stroke main engine, to complete a slow turning procedure and the discovery of water around a cylinder head gasket after the failed slow turning attempt.

The report must outline possible causes of the problem and the steps taken to identify the exact cause. The report must also explain the measures taken to rectify the defect(s) and the steps taken to prevent similar future incidents. (16)

3. (a) Explain why an engine may fail to start on air when the start air receiver is fully charged and the air receiver outlet to the engine is open. (10)
- (b) Describe how problems with air starting systems may be avoided. (6)

4. (a) State, with reasons, the properties required of a lubricating oil for a trunk piston type, medium speed engine, indicating why some properties differ from those required of a lubricating oil used in the crankcase of a crosshead diesel engine. (6)
- (b) Describe, with the aid of a sketch, the lubrication system of a trunk piston medium speed engine, explaining how impurities in the lubricating oil are removed. (10)

5. (a) Explain how the build up of residue in the scavenge space of a large slow speed two stroke engine is minimised by design, operation and maintenance. (10)
- (b) Explain the possible damage which could be caused by a scavenge fire. (6)

6. (a) Explain how diesel engine cylinder performance is checked. (4)
- (b) Sketch an indicator diagram showing good cylinder combustion and on the same indicator diagram show combustion defects due to EACH of the following:
- (i) early fuel injection; (2)
 - (ii) late fuel injection; (2)
 - (iii) poor fuel atomisation. (2)
- (c) Explain how the cylinder combustion defects drawn in (b) may be corrected. (6)
7. (a) Write a procedure for the action a duty engineer should take on being called to the engine room during a UMS period in the event of an engine slowdown due to a high cylinder exhaust temperature on the main propulsion engine. (6)
- (b) State, with reasons, the possible causes of a high exhaust temperature on a single cylinder of a main propulsion engine. (5)
- (c) Explain why a defect resulting in a high exhaust temperature on one cylinder can cause engine damage if the engine is not slowed down when the fault initially occurs. (5)
8. (a) With reference to an engine cylinder liner explain the term "Thermal Stress", indicating how and why it occurs during operation of an engine. (4)
- (b) Explain how the upper part of a cylinder liner is subjected to fatigue during engine operation. (4)
- (c) Explain how thermal stress and fatigue combine and can lead to failure of a cylinder liner during engine operation. (4)
- (d) Describe how an engine should be effectively operated in order to minimise the risk of failure due to the combined effects of fatigue and thermal stress. (4)
9. With reference to diesel engine SO_x 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_x exhaust gas cleaning systems, explaining how such pollution is prevented. (6)