# 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, 12 December 2023**

**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. As Chief Engineer Officer write a report to the company superintendent engineer concerning bacterial attack of lubricating oil in the sumps of the main engine and one of the generator engines. The report should explain how the attack was detected, damage found in the engines, investigations into the possible cause of the attack, how the immediate problem was resolved and how future incidents may be prevented. (16)

2. (a) Describe with the aid of sketches the operation of a four-stroke dual fuel engine, explaining how the correct amount of gaseous and liquid fuels are supplied to the cylinders to meet the power requirement and how the cylinder charge is ignited. (10)

   (b) State, with reasons, three problems associated with the burning of gaseous fuels in a diesel engine, indicating how these problems may be overcome. (6)

3. (a) Describe, with the aid of a sketch, the lubrication systems of a crosshead type diesel engine. (8)

   (b) Explain the properties required by the lubricating oil in each of the systems described in part (a), stating how these properties compare with those of a lubricating oil used in the crankcase of a trunk piston type diesel engine. (8)

4. (a) Describe, with the aid of a sketch, either a diesel engine Open Loop SOx scrubber system or a Closed Loop SOx scrubber system. (10)

   (b) Explain what systems need to be monitored in order to ensure that the scrubber system meets all IMO regulations. (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. With reference to slow speed diesel engine turbocharging:

(a) explain why electrically driven scavenge air blowers are fitted; (4)

(b) describe how a turbocharger may be disabled to allow for operation of the main engine in the event of failure of the turbocharger rotor; (8)

(c) describe the procedure for running an engine in the event of a turbocharger not being operational. (4)

7. With reference to poor ignition quality fuel:

(a) explain how it can affect combustion in BOTH slow speed and medium speed diesel engines; (8)

(b) explain how the effects on BOTH diesel engine types in part (a) can be reduced. (8)

8. (a) With the aid of a sketch, explain how and why thermal stress occurs in cylinder liners of an operating diesel engine. (10)

(b) With the aid of a sketch, explain how cylinder liner thermal stress can be minimised. (6)

9. With reference to oil fired boilers:

(a) describe, with the aid of a sketch, the fuel system including the pilot ignition system; (6)

(b) explain how the boiler whose fuel system is described in part (a) is flashed up from cold on diesel oil and changed over to heavy fuel operation; (6)

(c) explain how the air and fuel supplies are controlled together in order to produce optimum combustion at all loads. (4)