

**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, 18 July 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. Write a report to the Superintendent Engineer regarding a number of cases of severe damage to medium speed engine exhaust valves in the previous 12 months. The report must outline the probable cause of the damage and must suggest future steps to avoid similar incidents. (16)

2. With reference to turbocharger systems:
 - (a) describe, with the aid of a sketch, a turbocharger jet assist system, explaining how it operates and why it is used; (10)
 - (b) describe, with the aid of a sketch, a waste-gate and bypass system, explaining why such an arrangement is fitted. (6)

3. With reference to marine diesel engine Selective Catalytic Reduction (SCR):
 - (a) explain, with the aid of a graph, the influence that fuel sulphur content has on the operation of an SCR unit; (4)
 - (b) explain how the operation of a turbocharger system can have a detrimental effect on the unit when burning fuels with higher sulphur content; (4)
 - (c) describe, with the aid of a sketch, a system which maintains good engine performance of the turbocharger system and good NO_x reduction when burning fuels with higher sulphur content, explaining how conflicting conditions are met. (8)

4.
 - (a) Sketch a diesel engine high pressure common rail fuel system, labelling the MAIN parts. (8)
 - (b) Describe how the common rail system sketched in part (a) operates, explaining how fuel injection timing is controlled. (8)

5.
 - (a) Describe the procedure for entry into, and inspection of, the inside of a starting air receiver, stating the types of defects which may be present with their possible causes. (12)
 - (b) Describe the procedure of closing up the air receiver and the initial pressurisation to working pressure. (4)

6. With reference to fatigue of engineering components:
- (a) draw an S/N curve for steel, showing the Fatigue Limit and two representative stress-cycle conditions on the graph; (4)
 - (b) explain how a component is designed to avoid fatigue failure, using the S/N curve drawn in part (a); (4)
 - (c) explain how poor maintenance and incorrect machinery operation can result in fatigue failure even though a component is designed to operate below the fatigue limit. (8)
7. (a) Describe, with the aid of a sketch, the lubrication systems of a crosshead type slow speed 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)
8. (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)
9. Write a procedure for the actions to be taken in the event of an engine oil mist detector alarm being activated, stating the reasons for EACH action. The procedure must cover the period from activation of the alarm to return of the engine to normal operation. (16)