



# UK MARINE TRAINING CENTRE (UMTC)

SAI POOJA BUILDING, SHOP NO. 4, PLOT NO. 36, SECTOR - 34. KAMOTHE, NAVI  
MUMBAI - 410 209 MAHARASHTRA, INDIA.

EMAIL : [umtcindia1234@gmail.com](mailto:umtcindia1234@gmail.com) | PH : +91 9673855053, +91 7021406134

## JULY 2020

Attempt SIX questions only

Marks for each part question are shown in brackets

**Q1.** With reference to diesel engine crankshafts:

- (a) Explain the causes and effects of torsional vibrations; (4)
- (b) Explain the term *critical speed*, starting why the engine should not be continuously operated at this speed. (6)
- (c) Explain the term *fatigue cracking*, starting with reasons, TWO factors which have an influence on the likelihood of fatigue cracking. (6)

2013/MAR	2020/JUL/Q					
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**Q2.** With reference to failure of fuel injector nozzles due to burning:

- (a) state, with reasons, THREE possible causes; (6)
- (b) write a procedure to be used when investigating the cause of fuel injector nozzle burning; (6)
- (c) describe a system which should be operated in order to minimise the risk of future fuel injector nozzle burning. (4)

2016/MAR/Q9	2017/12/Q3	2020/JUL/Q2				
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**Q3. A.** Describe, with the aid of a sketch, a Selective Catalytic Reduction system, explaining the chemical reaction for reducing NO<sub>x</sub> and the control system requirements. (10)

**B.** State two engine-based systems for reducing marine diesel engine NO<sub>x</sub>, explaining how they reduce NO<sub>x</sub> level but also increase fuel consumption and CO<sub>2</sub> emissions. (6)

2019/JUL/Q8	2020/JUL/Q3					
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**Q4.** As chief engineer, write a report for the engineering superintendent regarding the checking of a bottom end bearing on a crosshead type main diesel engine, after a high temperature alarm was activated at sea, and the subsequent return to full service of the engine. (16)

2020/JUL/Q4						
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**Q5.** Explain with aid of sketches, the gas combustion process in a dual fuel medium speed main engine, operating with pilot injection. (10)

Explain exhaust is meant by exhaust gas recirculation and how this may be effective in reducing air pollution. (6)

2016/APR	2020/JUL/Q5					
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**Q6.** With reference to abnormal and excessive cylinder liner wear;

- (a) Explain how it may be caused, stating how it is detected; (6)
- (b) Explain the effects and consequences of excessive cylinder liner wear; (5)
- (c) Explain how abnormal cylinder liner wear may be prevented. (5)

2019/JUL /Q4	2020/JUL/Q6					
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**Q7.** As Chief Engineer write instructions for the checking of the engine Slow Turning System and subsequent monitoring of the engine Slow Turning System. The instruction must take account of problem areas which may be linked to the need for slow turning of an engine whilst selected for standby and prior to an actual start. (16)

2018/JUL/1	2020/JUL/Q7					
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**Q8.** With reference to two stroke, slow speed engines:

Explain what is meant by the term thermal stress and how this can cause cracking of the crownsurfaces; (4)

Sketch a cross section of a piston, labelling the MAIN components and indicating coolant flow; (8) State a cause of EACH of the following defects:

- (i) Burning of the crown upper surfaces; (2)
- (ii) Carbon deposits in the cooling spaces. (2)

2015/03-Q8	2016/12-Q8	2017/07-Q6	2017/10-Q8	2019/JUL-Q6	2020/JUL/Q8
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**Q9.** With reference to turbocharger systems:

Describe how performance of the system is monitored and how the information gathered is used to assess performance; (8)

Describe the arrangements for maintaining the systems in good condition. (8)

2019/JUL/Q1	2020/JUL/Q9				
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## October 2020

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Q1. (a) Sketch a main engine electronically controlled fuel injection system (6)

(b) Explain how fuel injector quantity and timing is changed in the fuel injection system sketched in part (a) (6)

(c) State why it may be necessary to change engine fuel timing (4)

2020/OCT/Q1						
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Q2. With reference to crankcase lubricating oil:

(a) Describe the causes and effects of bacterial attack; (6)

(b) Explain how bacterial attack may be detected; (4)

(c) Describe how a crankcase lubricating oil system may be returned to service following bacterial attack. (6)

2011/12-Q3	2014/12-Q7	2017/12-Q6	2018/OCT/3		
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Q3. Write a report to the superintendent engineer concerning an incident of turbocharger vibration and surging which occurred on a two stroke, direct drive, main propulsion engine during a normal passage in calm weather. The report must include information about the immediate action taken to prevent damage, the subsequent action to remedy the fault and recommendations to prevent subsequent future incidents. (16)

2018/OCT/3					
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Q4. (a) Explain with aid of sketches, the gas combustion process in a dual fuel medium speed main engine, operating with pilot injection. (10)

(b) Explain exhaust is meant by exhaust gas recirculation and how this may be effective in reducing air pollution. (6)

2020/JUL/Q5	2020/OCT/Q4				
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Q5. (a) draw a labelled sketch through a section of a crosshead tyope engine, showing the locationand fitting of tie rods. (4)

(b) Explain why tie rods are fitted in crosshead engines and are not required for trunk pistonengines. (6)

(c) As chief engineer officer, write instructions for the checking of tie rods fitted in an engine, stating the equipment to be used. (6)

2020/OCT/Q5							
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Q6. (a) Describe a procedure for cylinder liner calibration, indicating how the readings are recorded to allow for easy recognition of liner wear. (6)

(b) Describe TWO forms of abnormal cylinder liner wear, explaining how each is recognised. (6)

(c) Explain how abnormal cylinder liner wear may be prevented. (4)

2019/JUL/Q4	2020/OCT/Q6						
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Q7. (a) Explain why a diesel engine cylinder is supplied with excess air. (4)

(b) Explain why fuel droplet size produced during injection has to be within narrow limits in orderto enable good cylinder combustion to be achieved. (4)

(c) Explain how the desired fuel droplet size is produced by fuel injectors. (4)

(d) State why fuel injection timing has to be within narrow limits to enable economic engineoperation without bearing overload. (4)

2014/07-Q7	2015/12-Q5	2017/07-Q3	2020/OCT/7				
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Q8. With reference to diesel engine SOX 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 SOX exhaust gas cleaning systems, explaining how such pollution is prevented. (6)

2017/10-Q1	2017/12-Q9	2020/OCT/8					
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Q9. (a) Describe, with aid of sketch, a main engine fresh water cooling water system, incorporating HT and LT systems.

(b) Describe the charge air supply for a turbocharged engine, explaining the purpose of each mainpart.

2020/OCT/Q9						
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## December 2020

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Q1. 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)

2014/12-Q1	2017/07-Q1	2018/DEC/7	2019/MAR/1	2020/DEC/1		
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Q2. a. Describe, with the aid of a sketch, a main engine fuel oil circulating system incorporating the MGO and HFO service tanks, a fuel change over system, heating and viscosity control system and tank return system. (10)

b. Write instructions for changing the system described in part (a) of the question from MGO to HFO, indicating the checks to be made during the changeover. (6)

2018/DEC/8	2020/DEC/2					
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Q3. With reference to a Closed Loop engine exhaust gas SOX scrubber system:

- (a) Describe, with the aid of a sketch, such a system; (8)
- (b) State, with reasons, the fluid which is used for SOX scrubbing in this system; (4)
- (c) State how the effectiveness of the scrubbing fluid is maintained and how the sludge is removed and disposed of. (4)

2017/07-Q4	2019/MAR/3	2019/DEC/Q4	2020/DEC/3			
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Q4. Explain why multiple air inlet and exhaust valves are fitted to some medium speed diesel engines. (4)

Explain how the valve actuator (tappet) clearance is set for multiple valve installations. (4) Write a procedure for checking the valve operating mechanisms of a medium speed engine. (8)

2019/MAR/Q8	2019/OCT/Q3	2020/DEC/4			
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Q5. With reference to marine diesel engine selective catalytic reduction (SCR)

- Explain, with the aid of a graph, the influence that fuel sulphur content has on the operation of an SCR unit (4)
- Explain how the operation of a turbocharger system can have a detrimental effect on the engine when burning fuels with higher sulphur content (4)
- Describe, with the aid of a sketch, a system which maintains good engine performance of the turbocharger system and good NO<sub>x</sub> reduction when burning fuels with higher sulphur content, explaining how conflicting conditions are met (8)

2020/DEC/5					
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Q6. a. Describe, with the aid of a sketch a diesel engine fuel system which employs direct injection of liquid fuel into the cylinders. (12)

b. Explain the advantages of this type of fuel injection system compared with the use of gaseous fuel in the form of gas. (4)

2018/JUL/Q4	2020/DEC/6				
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Q7. (a) Explain why charge air coolers are fitted to turbocharged diesel engines, stating the possible effects on engine operation and performance if they are not maintained in good condition. (6)

(b) As Chief Engineer Officer, write instructions for the routine in-service checking of charge air cooler performance and cleanliness together with the checking of condensate draining. (6)

(c) State, with reasons, the possible consequences if condensate is not drained from the charge air cooler. (4)

2015/MAR	2016/JUL	2016/12-Q5	2018/JUL/5	2020/DEC/7	
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Q8. 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



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fatigue failure even though a component is designed to operate below the fatigue limit (8)

2020/DEC/8					
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Q9. A. Describe how crosshead bearing and guide clearances can be checked. (6)

b. Describe, with the aid of a sketch, the procedure for checking the condition of a crosshead engine bottom end bearing. (10)

2019/MAR/Q6	2019/OCT/Q7	2020/DEC/9			
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