CLASS 1	EK MOTOR

SENIOR MARINE EXAMINATIONS

Past Papers

CLASS1

EK MOTOR

CLASS	1	DECEMBER	2007

ENGINEERING KNOWLEDGE – MOTOR

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

1. Write a report to the engineering superintendent regarding the failure of a main crosshead engine fuel pump cam and follower where the damage was so severe that the normal pump lifting equipment could not be immediately fitted. 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 restarting. (16)

2. Write a procedure for changing the entire main and auxiliary engine fuel oil supply and treatment system from Heavy Fuel Oil (HFO) to Low Sulphur Heavy Fuel Oil (LSHFO) in preparation for the vessel entering a Sulphur Emission Control Area (SECA), indicating the approximate times of EACH action prior to entering the SECA. (16)

3. (a) Explain the purpose of a lubricating oil system backflush filter. (4)

   (b) Describe a lubricating oil system backflushing filter, explaining how it operates. (12)

4. With reference to cylinder liner scuffing:

   (a) explain how it is caused, stating how it is detected; (6)

   (b) explain the effects of cylinder liner scuffing: (4)

   (c) explain how minor scuffing may be treated in order to avoid the need for liner replacement. (6)

5. (a) Explain how a diesel generator is prepared and selected as a standby generator, stating how the selection for standby duty is made. (8)

   (b) Write a procedure for checking a diesel generator engine after it has been shut down following a period of operation and before it is returned to standby duty. (8)

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6. With reference to turbochargers:

   (a) explain how the operating performance of a turbocharger system may be monitored; (8)

   (b) state, with reasons, FOUR factors which adversely affect the operating performance of a turbocharger. (8)

7. (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)

8. (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 Q8(b) may be corrected. (6)

9. (a) Explain why multiple air inlet and exhaust valves are fitted to some medium speed diesel engines. (4)

   (b) Explain how the valve actuator (tappet) clearance is set for multiple valve installations. (4)

   (c) Write a procedure for checking the valve operating mechanisms of a medium speed engine. (8)

CLASS	1	OCTOBER	2007

ENGINEERING KNOWLEDGE – MOTOR

Attempt SIX questions only

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1. (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 or quickly resolved. (6)

2. With reference to main engine crankshafts:

   (a) explain the term *axial vibration*; (4)

   (b) describe, with the aid of a sketch, how axial vibration may be controlled; (6)

   (c) (i) state which bearing would be most at risk due to the effects of axial vibration; (2)

   (ii) describe how damage to the bearing stated in Q2(c)(i) may be repaired. (4)

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

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

4. (a) Describe, with the aid of a sketch, the camshaft chain drive for a large slow speed two stroke engine, incorporating a chain tensioning wheel and primary and secondary balance weights. (6)

   (b) Explain how chain slackness is caused, stating its effect on engine operation. (4)

   (c) Explain how chain tension is adjusted. (6)

5. A significant number of machinery failures are due to poor maintenance techniques. State, with reasons, the possible consequences of poor maintenance techniques on EACH of the following:

   (a) main engine lubricating oil self cleaning filters; (4)

   (b) cylinder liner honing; (4)

   (c) auxiliary engine bottom end bearing overhaul; (4)

   (d) fitting of piston compression and oil control rings. (4)

6. (a) Explain why variable exhaust valve closing can be advantageous in the operation of large slow speed main engines. (8)

   (b) Explain, with the aid of a sketch, how variable exhaust valve closing is achieved. (6)

   (c) Explain how high impact is avoided as the valve closes. (2)

7. (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)

8. With reference to a large slow speed engine which is to be run under local control:

   (a) describe the change over to local engine side control and the watchkeeping system, to ensure safe, efficient operation of the engine and machinery space; (10)

   (b) describe how an emergency full astern manoeuvre is carried out. (6)

9. (a) State, with reasons, a suitable operating pressure range for an auxiliary boiler which is required for heavy fuel oil heating. (6)

   (b) With reference to safety valve easing gear, explain EACH of the following:

      (i) how it works; (3)

      (ii) how the valves operate independently of the gear; (4)

      (iii) when easing gear should be used. (3)

CLASS	1	JULY	2007

ENGINEERING KNOWLEDGE – MOTOR

Attempt SIX questions only

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Marks for each part question are shown in brackets

1. (a) Describe the procedure for taking crankshaft deflections. (4)

   (b) Explain why crankshaft deflections are not necessarily a useful means of indicating main bearing weardown. (4)

   (c) Describe the procedure for checking a main bearing clearance. (8)

2. (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. (5)

   (b) State, with reasons, the possible causes of a high exhaust temperature on a single cylinder of a main propulsion engine. (6)

   (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)

3. With reference to Heavy Fuel Oil (HFO):

   (a) state, with reasons, the effect on the engine of burning fuel which is off specification with relation to EACH of the following:

      (i) density; (2)

      (ii) viscosity; (2)

      (iii) sulphur; (2)

      (iv) aluminium/Silicon content (2)

   (b) explain what system adjustments are required to enable the fuel to be burned, for EACH of the off specification parameters mentioned in Q3(a). (8)

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4. (a) Describe, with the aid of sketches, a cylinder lubrication system which enables the cylinder lubricant to be delivered to the cylinder in appropriate quantities and at a time when the piston is passing the cylinder lubricant injection points. (8)

   (b) Explain how the quantity of lubricant injected at each cylinder lubricant injector point may be varied in the system described in Q4(a). (4)

   (c) Outline the considerations when determining the quantity of cylinder lubricant injected. (4)

5. (a) Explain why the rotation of exhaust valves is considered useful for diesel engines burning HFO. (4)

   (b) Describe, with the aid of sketches, a device used for producing valve rotation in valves fitted to medium speed engines. (8)

   (c) Explain why multiple valves are fitted to some medium speed engine. (4)

6. (a) Describe, with the aid of sketches, a lifting device used for lifting pistons from a slow speed main engine, explaining how it is attached to the piston. (5)

   (b) State the risks that may be associated with lifting a piston using the device described in Q6(a). (5)

   (c) Describe the arrangements which must be in place to ensure that all lifting equipment has a current test certificate and is fit for operation. (6)

7. With reference to main engine turbochargers:

   (a) state, with reasons, why the air side and gas sides of a turbocharger should be maintained in a clean condition at all times; (6)

   (b) explain how the performance of a turbocharger can be checked during operation; (5)

   (c) describe a procedure for cleaning the gas side of a turbocharger during operation. (5)

8. (a) Sketch a compressed air system for supplying starting air and control/safety air to the main engine. (6)

   (b) State, with reasons, why control air should be dried before being supplied to user outlets. (4)

   (c) Describe a device used for drying air which is to be used for control systems. (6)

9. With reference to boilers and steam systems:

(a) explain the term *water hammer*, stating how it is caused and describing the possible consequences of *water hammer*; (4)

(b) explain how *water hammer* can be avoided; (4)

(c) explain why cold water should not be pumped into a hot but empty waste heat economiser; (4)

(d) describe the procedure for blowing down an auxiliary boiler positioned in the funnel uptake. (4)

CLASS	1	MARCH	2007

ENGINEERING KNOWLEDGE – MOTOR

Attempt SIX questions only

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1. Some large slow speed engine manufacturers have replaced large diameter single tie rods with smaller twin tie rods.

   (a) Explain, with the aid of sketches, each configuration. (8)

   (b) Explain the advantages claimed for the smaller tie rods. (4)

   (c) State when tie rod tensions should be checked, describing the action that should be taken to allow the ship to proceed safely if a broken tie rod cannot be repaired right away. (4)

2. (a) Describe, with the aid of a sketch, the construction of a large slow speed main engine semi-built crankshaft throw, labelling the main features. (8)

   (b) In the event of a crankshaft throw slip of 4°, explain EACH of the following:

   (i) how this affects the operation of the engine; (4)

   (ii) the action that should be taken to allow the ship to proceed safely to a repair port. (4)

3. With reference to the repeated failure of foundation bolts at the free end of a medium speed main engine:

   (a) outline possible causes for these failures; (6)

   (b) describe the actions to be taken to determine the cause; (6)

   (c) describe future actions to avoid further failures. (4)

4. With reference to air start systems for main engines:

   (a) sketch an air start system; (10)

   (b) describe TWO causes of cylinder air start line explosions. (6)

5. (a) Describe, with the aid of a sketch, the operating system for an hydraulically operated exhaust valve, fitted with an air spring, for a large slow speed main engine. (10)

   (b) Compare the closing action of a valve controlled by a rocker arm and coil spring with the closing action of an hydraulic valve with air spring, explaining how impact closing is avoided in EACH case. (6)

6. (a) Describe, with the aid of a sketch, how the fuel and exhaust valves of a large slow speed main engine may be operated without a camshaft. (8)

   (b) Explain how the engine described in Q6(a) may be operated at 10% of its service speed while maintaining good cylinder load balance and combustion. (6)

   (c) State the protection system that must be installed to safeguard the power supply to main engine electronic control systems. (2)

7. (a) Describe THREE types of vibration associated with large slow speed main engines, explaining how EACH type affects the engine. (8)

   (b) (i) Sketch a resiliently mounted main engine and gear box, showing how they are connected to the intermediate shaft. (6)

   (ii) Describe the regular checks which should be carried out on the chocks. (2)

8. (a) Describe, with the aid of a sketch, an hydraulic isochronous governor suitable for a main engine. (7)

   (b) Describe how the governor described in Q8(a) reacts to a load increase. (6)

   (c) State what adjustment to the governor described in Q8(a) will cause it to be slow in response to a load change, or will prevent it from settling on the set speed. (3)

9. (a) Explain how fires may occur in main engine exhaust gas economisers. (4)

   (b) Explain how the risk of fires may be minimised when operating the main engine. (4)

   (c) Describe the procedure for dealing with a fire in an exhaust gas economiser. (8)