Government of the People's Republic of Bangladesh

Department of Shipping

Sample Written/Oral Question Bank

Marine Engineer Officer Class 2 and 1 Combined

Motor Engineering Knowledge

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1.0 Internal Combustion Engines

1.1 Engine Performance

1.With respect to the piston of large two stroke engine explain followings;

i)Mechanical load consideration (2)

ii)Effect of gas pressure (1)

iii)Effect of inertia (1)

iv)Thermal load consideration (2)

v)The external and internal contouring of the piston (2)

vi)Diametrical clearance of pistons (2)

2. Indicator cards provide a valuable means of determining engine power and evaluation of engine condition. Give details of the following-

(a) The information required for power calculation. (3)

(b) The information required for engine evaluation. (3)

(c) A method of its presentation with all the necessary information for forwarding it to the superintendent. (4)

3. (a) State what is indicating diagram & why they are taken for. (3)

(b) Define Power card and Out of phase card.(4)

(c) With modern system of Power calculation Piezo-Electric methods are widely used. Explain the type of transducer and principle of operation of the transducer. (3)

4.(a) Explain how power balance between the cylinders in main engine is achieved (4)

(b) State what effect lack of balance has on the engine performance and condition (3)

(c) Suggest how power balance can be roughly assessed under running conditions(3)

5. (a) Explain what is Engine Balancing.(3)

(b) Describe how cylinder balance is checked on a slow speed engine.(4)

(b) Explain how cylinder power balance is restored. (3)

6.(a) Explain the necessities of Checking a slow speed engine performance.(3)
(b) State the procedures to check an ideal performance for a slow speed engine. (4)
(c) Explain why a CAPA (computer aided performance analysis) is useful for assessing engine condition. (3)

7.(a)Explain how power balance between the cylinders in main engine is achieved (4)
(b)State what effect lack of balance has on the engine performance and condition (3)
(c)Suggest how power balance can be roughly assessed under running conditions (3)

8.(a) After taking a slow speed performance explain how will you analysis the performance. (4)
(b) What determines the FO consumption has been increased from the analysis.(3)
(c) What information can be obtained from a “load diagram”.(3)

9.You have joined a vessel nearly four years of age. There is another sister vessel having similar liner service under the same charterer. It has been monitored that your vessel is consuming more fuel as compared to the vessels designed consumption and also compared to the sister vessel. Briefly write down a detailed report to your vessel superintendent the steps you have taken to asses the probable causes and your suggestions to correcting the defect. (10)

10. With reference to engine layout and load diagram
(a) Sketch the load diagram of a two-stroke diesel engine with variable injection timing (VIT) stating the description of each line. (6)
(b) Explain the meaning of ‘propeller design point’ (PD) and how it is used in layout diagram. (4)

11. With reference to engine layout and load diagram
(a) Explain the following limits on the diesel engine with the aid of a sketch;
i) Limits for continuous operation (3)
ii) Limits for overload operation (3)

(b) Explain the meaning of ‘sea margin’, ‘propeller margin’ & ‘light running margin’ in determining the engine power.

12. (a) With reference to large two-stroke diesel engine maneuvering system explain the following-

i) Governor fuel limiter. (2)

ii) Scavenge pressure fuel limiter. (2)

iii) Torque limiter. (2)

iv) HPS pressure limiter (Cam less Engine only) (2)

(b) Why excess air of 30-40% is required for complete combustion in a diesel engine. (2)

13. As C/E you have noticed a trend of increase in exhaust temp of one of the cylinder of the engine: (Previous batch)

(a) Explain how you guide to your engineers in identifying the abnormalities?

(b) State corrective measures to be taken under- I) normal sea condition II) abnormal sea condition.

14. Explain with suitable diagrams how the following abnormality can be identified in a large propulsion engine

(a) Hull fouling and engine overloading

(b) Fuel pump wear

(c) Piston ring wear

(d) T/C gas side fouling

15. Explain the effect on the engine performance if it is operated with

(a) High P-max

(b) Low P-max

16.(a) Explain, with the aid of a graph, a large 2 stroke diesel engine load diagram, labelling the operating and limit lines.
(b) On the graph sketched in part (a), with the vessel fully ballasted, at constant load and in calm weather, mark point 'x' to show the position if the hull was clean and point 'y' to show the position if the hull was fouled.

1.2 Engine Components

1.2.1 Bedplate

1.With regard to main engine structure give reasoned opinion as to the validity of the following statements;
(a) By designing the welded areas of modern bedplate away from the high stress areas, constructional and operational problems reduced. (3)
(b) For steel chocked engine, the use of longer more resilient bolt is quite widespread.(3)
(c) Tightening of tie bolts within prescribed limits is simply to avoid overstressing the bolts (2)
(d) engine seating must be of at least equal stiffness and rigidity to its structure. (2)

2. (a) State with reasons the causes of cracking in bedplate transverse girders.(4)
(b) State how the likelihood of cracking can be minimized. (3)
(c) State what actions should be taken if a crack is detected in a transverse girder but facilities are not available for immediate repair. (3)

3. With regard to main engine structure:
a) Identify with reasons the areas of bedplate which are most likely to crack during operation. (3)
b) What action should be taken in the event of a), for the sake of safe operation? (4)
c) Suggest the steps to be taken to prevent above cracking. (3)

4. With respect to large modern marine engine bedplate of composite structure;
(a) Draw a simple sketch and describe the basic construction of bedplate.(7)
(b) Why composite structures are preferable over all in cast or fabricated structure.(3)

5. (a) Compare the merits and demerits of cast and fabricated construction for frames and structural parts. (6)
(b)Describe the areas that need special attention while carrying out inspection on a bed-plate of a long stroke engine. (4)

6. (a) Sketch a cross sectional view of large modern engine bedplate. (3)
(b) Explain why composite construction preferred for large engine bedplates. (4)
(c) Explain the possible causes of cracking in a bedplate. (3)

7. With reference to fretting between engine structural components:
(a) Describe how it may be identified;(6)
(b)Outline possible remedies available to ships staff.(4)

8. With reference to large slow speed diesel engines: . .
(a) Describe with the aid of sketches. the transverse girder supporting the crankshaft. (6)
(b) Identify where cracking may occur in the transverse girder, explaining possible reasons for the development of this type of fault. (4)

9. With reference to large slow speed diesel engines:
a. Describe with the aid of sketches, the complete supporting arrangement for the crankshaft and the bed plate. (5)
b. As Chief Engineer describe to a member of your staff the procedure for inspecting the bedplate, stating the defects which may be found together with possible causes.(5)

10.(a) Explain the requirements of bedplate for a slow speed diesel engine?(3)
(b) Discuss the force acting on bedplate? (3)
(c) Explain the characteristics of a bedplate?(4)

11.(a) Sketch & describe the construction of a single plate fabricated bedplate.(5)
(b) Sketch & describe the construction of a double plate.(4)
(c) Discuss the various materials used for the construction of bedplate.(1)

12.(a) Explain the types of fault generally found on a bedplate (3)
(b) Identify the areas on the bedplate that one prone to failure (2)
(c) Identify the areas on the bedplate that one prone to crack (2)
(d) Explain the causes failure of enact on the respective area identified on the bedplate (3)

13.(a) Discuss the methods used to repair a crack on bedplate (5)
(b) Discuss the areas that require special attention during inspection of a bedplate.(5)

14. With reference to fatigue of engineering components of marine diesel engine:
(a) Explain the influence of stress level and cyclical frequency on expected operating life;
(b) Explain the influence of material defects on the safe operating life of an engineering component; and
(c) State the factors which influence the possibility of fatigue cracking of a bedplate transverse girder and explain how the risk of such cracking can be minimize.

15. With reference to fatigue cracking:
(a) describe, with the aid of an S/N curve, the relationship between applied stress and the number of applied stress fluctuations in fatigue crack propagation;
(b) define the term Stress Raiser, giving examples and explaining the influence of a stress raiser on the propagation of a fatigue crack;
(c) define the term Fatigue Limit, explaining, with examples, how poor maintenance and

poor machine operation can result in fatigue crack propagation even though a component has been designed to avoid fatigue cracking.

1.2.2 Tie bolt

1.With reference to tie bolts in large main propulsion engines
(a) Explain the functional purpose. (4)
(b)What are the consequences of running engine with a broken tie bolt. (2)
(c)What immediate action to be undertaken in case of (b)? (2)
(d)State the procedure of tightening. (2)

2. (a)Describe with the help of simple sketch how main engine tie bolts are tightened in place by hydraulic tensioning device. (6)
(b). Explain with reason the detrimental effects of running engine for a prolonged period with slack tie bolts. (4)

3.With respect to large modern two stroke engines;
(a) Explain the function of tie bolts. (2)
(b) State the main causes of tie bolt failure. (3)
(c) Describe the tightening procedure of tie bolts. (3)
d) Explain why some engine builder incorporated jack bolts for main journal bearings.(2)

4. (a) Explain why tightening of main engine tie bolts to within prescribed limits is important. (5)
(b) Describe how tightening is carried out. (5)

5.(a) Sketch a slow speed marine diesel engine tie bolt and explain the purpose of this tie bolt fitted to the engine
(b) Sketch and explain the correct method of fitting a new tie bolt.(5)
(c) Sketch and explain the correct method of checking tie bolt.(5)

1.2.3 Holding down arrangement

1. During recent months, it has been necessary to frequently re-tighten some main engine holding down bolts as the steel chalks have become loose.
(a) Explain possible reasons for this. (4)
(b) State with reasons why re-chocking using a different material might reduce the incidence. (3)
(c) Explain the possible consequences if the situation is allowed to continue unchecked. (3)

2. With reference to main engine holding down studs/bolts:
(a)Explain the causes of persistent slackening. (2)
(b)State with reasons the likely consequences of such slackening. (2)
(c)Describe how future incidents of slackening might be minimized. (6)

3. (a) Explain the main factors which result in fatigue failure of holding down bolts. (5)
(b) Describe the design features of bolts in modern engines, which result in higher fatigue strength. (3)
(c) How are the bolts maintained and when they need special attention? (2)

4.(a) Sketch a main engine holding down arrangement employing hydraulically tightened long resilient bolts. (6)
(b) Suggest with reasons, which one or more of the following conditions are likely to contribute most to persistent breakage / slackening of ‘holding down bolts’:
(i) over tightened holding down bolts (2)
(ii) crankshaft misalignment (2)

5.(a) Sketch and describe the design features of holding down arrangement.
(b) Why epoxy resin (nonmetallic) chocking has great potential for development comparing its advantages and disadvantages to metallic chocks.(5)
(c) Explain how an epoxy resin chock is fitted on the bedplate.(5)

1.2.4 Crankshaft

1. a) Describe with the aid of simple sketches the principal differences between fully-built semi- built and one-piece crankshafts. (4)
b) State followings;
i) crankshaft materials (2)
ii) purpose of reference marks at the interface of the shrink fits (2)
iii) factors which could cause overstressing of a crankshaft (2)

2. (a) Explain why solid forged (one piece) crankshafts are sensitive to misalignment and require special attention.(6)
(b) Describe the correct procedure of taking crankshaft deflection readings. (4)

3. (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. (6)
(b) The action that should be taken to allow the ship to proceed safely to the repair port. (4)

4.(a) Describe the damage that may have occurred to a large slow speed main engine, propeller and shafting, which stopped abruptly due to the vessel grounding (6).
(b) Checks that must be made before attempting to operate the engine (4).

5. With reference to fatigue in crankshafts:
(a) Explain why larger shafts are more susceptible to fatigue failure than their smaller counterparts; (6)
(b) Outline how identifying its and final stages. (4)

6.(a) Explain why crankshaft deflections are taken. (4)
(b)Describe the precautions which must be taken to ensure that crankshaft deflection readings are as accurate as possible. (3)
(c) Explain the action to be taken if some crankshaft deflection readings are outside acceptable limits. (3)

7.Explain each of the following:
(a) Why wear down in main bearings is critical to the condition of the crankshaft and propeller shaft system (4)
(b) Why total reliance is placed on frictional grip in conventional built up crankshafts;(3)
(c) Why oil holes are given large fillets in crankpins and journals. (3)

8. With reference to crankshaft
(a) Identify with reason areas on a crankshaft that are prone to failure.(2)
(b) Describe with sketches the procedure in checking crankshaft alignment .(5)
(c) Explain how the crankshaft deflection results are interpreted and how the accuracy of the readings are checked.(3)

9.With reference to crankshaft
(a) Explain the causes, and effects of slipping in a crankshaft.(3)
(b) Discuss how a slipped crankshaft could be repaired.(4)
(c) Discuss the factors contributing to failure on a crankshaft.(3)

10. With reference to a large crankshaft :-
(a) Describe how crankshaft deflections are measured;
(b) State how the measurement can be checked for accuracy;
(c) What is the significance of crankshaft deflection measurement? and
(d) State four reasons for abnormal crankshaft deflection to occur.

11. (a) Explain why crankshaft deflections are taken.
(b) Write a procedure for the taking of main engine crankshaft deflections.
(c) Explain the action to be taken if some crankshaft deflection readings are outside acceptable limits.

1.2.5 Bearings, Connecting Rod & Cross Head

1. Discuss the validity of EACH of the following statements with respect to large slow speed diesel engines:
(a) Bearing clearances obtained by taking leads are fundamentally more accurate than those obtained with the use of feelers. (3)
(b) Bearing wear down can be measured by taking deflections. (2)
(c) A timing chain should be renewed when its slackness causes late fuel injection and exhaust valve operation. (2)
(d) Timing chain slackness is solely due to stretch of the link plates. (3)

2. (a) Explain why on large two stroke diesel engines, the top end bearing is more prone to failure than the bottom end.(5)
(b) Sketch and describe a crosshead designed to prevent or minimize bearing edge loading. (5)

3.(a) Explain why bottom end bolts particularly in medium speed engines are prone to failure under normal condition.(6)
(b)Explain how this tendency can be minimized by proper maintenance. (4)

4. The design of the bottom end bolt for medium speed four stroke engine is precise, so that even though a fatigue life exists, a designated life can be assigned to them;
a) Explain why bottom end bolts will ultimately fail under normal operating condition. (4)
b) Describe with the aid of a sketch the main design points of bottom end bolts.(6)

5.(a) Describe with the help of sketch a crosshead bearing arrangement where load concentrations are greatly reduced. (4)
(b) Draw a simple diagram showing the lubricating oil passage to the crosshead bearing and guide arrangement. (4)

6. (a) State with reasons, possible causes of crosshead bearing failures. (5)
(b) Explain why crosshead (Gudgeon pin) lubrication of 4 stroke engine is less critical than 2 stroke engine crosshead (5)

7.With respect to large modern two stroke engines;
a) State the problems associated with the loading and lubrication of crosshead bearings. (4)
(b) Describe with the aid of sketch a crosshead bearing arrangement designed to minimize loading during periods of cylinder peak pressure. (5)

8. While surveying a bottom end bearing under an Approved Planned Maintenance Scheme (APMS) damage is discovered on the bearing surface. As Chief Engineer Officer, write a report to the company office detailing the damage and the action taken.(10)

9. (a) As Chief Engineer Officer appointed to an older vessel with a medium speed main engine which has no maintenance records, describe the inspection of the spare connecting rod which may have been previously used in the main engine. (5)
(b) Sketch a connecting rod bottom end bolt, indicating its main features and explaining why the bolt must be replaced after a set number of running hours. (5)

10. With reference to the bottom end bolts for medium speed four stroke engines:
(a) Explain why bottom end bolts will ultimately fail under normal operating conditions (4)

(b) Describe the features incorporated into bottom end bolt design to inhibit failure (6)

11.(a) Describe how bottom end bolt failure is either aggravated or inhibited during maintenance (5)
(b) Describe with the aid of sketch, the features incorporated into bolt design to inhibit failure.(5)

12. (a)With reference to large two-stroke diesel engine bearing geometry explain with the aid of sketch the significance of following designs -
i) Tangential run out of oil groove. (2)
ii) Bore relief with tangential run out. (2)
iii) Axial oil grooves and oil wedges. (2)
(b) What are the differences between thick shell and thin shell bearing? (2)
(c) What is spark erosion and how it can be avoided? (2)

13. The Vessel which you are about to join as a Chief engineer has recently suffered top end bearing failure.
(a) State with reasons, the information and documents you would require in order enabling to assess the cause of such failure (4).
(b) State with reasons the possible causes of Top end bearing failure.(3)
(c) The procedure you would institute in order to minimize the risk of future failure.(3)

14. (a) Describe the procedure for X-head bearing survey/ which half of the bearing would you give particular attention? (2)
(b) Discuss possible defects that can expect. (2)
(c) How these defects can be minimized with correct operation and maintenance. (2)
(d) Two checks carried out after maintenance. (2)
(e) What factors limits the load on X-head. (2)

15.During crankcase Inspection, you find metallic debris on the floor of a particular unit. Further investigation reveals the unit crank pin bearing has wiped and badly scored
(a) Explain how you would operate engine to reach safe port.(5)
(b) What factors influence the speed limitation in part (a).(5)

16. (a) Describe procedure for crosshead bearing survey without dismantling and with dismantling the bearing. (4)
(b) Discuss possible defects that can be expected and how these defects can be minimized with correct operation and maintenance. (4)
(c) Discuss two checks that are carried out after overhauling of crosshead bearing to confirm correct operation of the overhauled bearing. (2)

17. Describe how clearances should be taken in the following bearings of marine engine
(a) Cross head bearing (2)
(b) Gudgeon pin bearing (2)
(c) Bottom end bearing (2)
(d) Main bearing and (2)
(e) Thrust bearing (2)

18. 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. (10)

19.Write a report to the engineeering superintendent regarding the failure at sea of a crosshead main engine bottom end bearing. The report must explain how the defect was detected, the immediate action taken to prevent further engine damage, the subsequent action taken to ensure that the vessel was able to continue on passage to the next port, probable cause of the bearing failure and other checks made on the engine. (10)

1.2.6 Stuffing Box

1. With reference to crankcase diaphragm glands:
(a) Explain why effectiveness deteriorates in service (2)
(b) Describe the procedure for renewal of parts so that efficiency is restored (4)
(c) Describe how effectiveness is restored if spares are unavailable; (4)

2. (a) Sketch a cross section through a piston rod stuffing box (6)
(b) Describe, with the aid of sketches, the function of, and difference between sealing rings and scraper rings. (4)

1.2.7 Piston

1. (a) Inspection of a piston indicates that cracking and burning on the upper part of the crown.
(i) Explain the possible reasons for this. (2)
(ii) State how future incidents might be avoided. (2)
(b) State the reasons for cracking in piston ring grooves.(2)
(c) State with reasons, the standing instructions you, would issue regarding safety procedures for the lifting of main engine pistons. (4)

2. With reference to the Piston for medium speed and high speed engines:
(a) State the properties required for piston materials.(3)
(b) Describe the materials used for piston. (3)
(c) Sketch and describe a composite trunk piston used for medium speed highly rated engines. (4)

3.With reference to the Piston for medium speed and high speed engines:
(a)State the properties required for piston materials. (3)
(b)Describe the materials used for piston. (3)

(c)Sketch and composite trunk piston used for medium speed highly rated engines. (4)

4.With respect to piston rings state the possible consequences of followings;
(2 X10)
a) Piston rings that are too tight in the piston grooves
b) Piston rings that are too slack in the piston grooves
c) Fouling of piston rings
d) Corrosion of piston rings
e) Bearing surfaces that are in poor condition

5. With reference to a piston which has been removed from a liner of a main engine:
(a) Describe FOUR defects which may be found during Inspection of the piston, indicating their location and possible cause:(5)
(b) Outline the factors which would determine whether the piston and liner are suitable for continued use. (5)

6.With reference to large slow speed diesel engines:
(a) Describe a method used for the manufacture of piston rings (4)
(b) Describe how new piston rings are fitted (3)
(c) Explain the procedure for bedding in of new piston rings (3)

7. Engine builders have steel pistons available to replace aluminum alloy pistons for medium speed engines. As Chief Engineer Officer, write a letter to the company superintendent commenting on the problems experienced with the aluminum alloy pistons currently fitted and justify a replacement program. (10)

8.Comment on the validity of EACH of the following statements:
(a) Piston crown thickness is governed solely by mechanical stress considerations (5)
(b) Hard rings and hard liners give the best combination for minimum wear (5)

9.With reference to piston and piston rings, identify the cause, effect and remedy of the following: (10)

(a) slack piston ring in grooves

(b) fouled piston rings

(c) corrosion on piston ring

(d) Worn piston grooves

(e) poor condition of bearing surfaces

10.With reference to piston and piston rings

(a) Discuss with sketches piston ring clearances and explain the methods used to check the clearances.(4)

(b) Explain the consequences on running an engine with incorrect ring clearances.(3)

(c) Discuss how do you know the piston rings are working satisfactory in an engine.(3)

11.With reference to piston

(a) Describe the procedure to overhaul a piston.(5)

(b) Explain the causes of piston running hot and the immediate steps to be taken in such situation.(2)

(c) Identify the causes and remedies associated with faults on piston.(3)

12. Write a report to the superintendent engineer concerning an incident of cracking which was discovered in one piston of a main diesel engine and the subsequent discovery of cracking in another piston of the same engine. The report must include information about the immediate action taken to prevent further damage to the engine, the subsequent action to remedy the fault and recommendations to prevent subsequent future similar incidents.

13. With reference to two stroke, slow speed engine pistons:

(a) explain what is meant by the term thermal stress and how this can cause cracking of crown surfaces;

(b) sketch a cross-section of a piston, labelling the main components and indicating

coolant flow;
(c) state a cause of EACH of the following defects:
(i) burning of the crown upper surfaces;
(ii) carbon deposits in the cooling spaces.

1.2.8 Cylinder Liner

1. With reference to piston ring and liner wear:
(a) State, with reasons, the causes of abnormal forms of wear known as cloverleafing and scuffing (micro seizure) (4)
(b)Explain how cylinder lubrication in terms of quantity and quality can influence wear; (3)
(c) Describe the procedure for determining whether piston rings are suitable for Use. (3)

2. (a) As Second Engineer describe the procedure involved in the complete inspection of a cylinder liner and piston assembly, indicating areas of significant interest.
(b) Explain with reason possible faults which might be found. (3)
(c) Suggest how such faults might be avoided. (4)

3. (a) Write a report to the engineering superintendent regarding the replacement at sea of a cracked main engine cylinder liner. The report must explain how the defect was detected, the immediate action taken to prevent further damage, the replacement of the cylinder liner, probable cause of the cracking and other checks made on the engine. (10)

4. (a) Describe the procedure for replacing a crosshead engine cylinder liner (10)

5.(a) Describe, with the aid of sketches, a timed cylinder lubrication system (6)

(b) Explain how the system operates (4)

6. With reference to a large slow speed diesel engine;
(a) Describe a cylinder liner (6)
(b) Explain why thickness is a compromise to deal with different types of stress (4)

7. With reference to cylinder lubrication, state EACH of the following:
(a) The indications that the correct quantity of oil is being used (4)
(b) The consequences of both excessive and insufficient lubrication (2)
(c) The difficulties of achieving correctly timed Injection (2)
(d) The desirable qualities for cylinder oil when residual heavy fuel Is being used.(2)

8. With reference to liner wear
(a) Explain the meaning of wear rate of liner.(3)
(b) Explain clover-leafing in cylinder liner wear.(3)
(c) Discuss the causes and remedy of excessive wear on liner.(4)

9. With reference to cylinder liner
(a) Sketch and describe procedure in the overhauling and renewal of liner.(5)
(b) Explain the procedures adopted in the inspection of cylinder liner.(3)
(c) Identify the causes and remedies associated with cylinder liner faults.(2)

10. With reference to Liner of a large diesel engine:
(a) Discuss the procedure for inspecting liner. (6)
(b) Discuss likely faults that can occur (areas prone to defects). (2)
(c) Prevention of faults developing or aggravating in service. (2)

11. (a) Explain how cylinder liner wear is measured and recorded for reference in future. Discuss method of determining if cylinder liner has reached the end of useful life. (5)
(b) Discuss the effect of fuel quality on wear rate of a liner and the preventive measure to minimize wear. (5)

12. (a) With the aid of simple diagram, describe the main design features of a modern cylinder lubricator system. (5)
(b) Why correct timing of cylinder oil injection is critical to reduce adhesive and corrosive wear. (2)
(c) how correct quantity and timing of cylinder oil injection is ensured. (3)

13.Describe FOUR defects which may be found during a piston/liner inspection via cylinder scavenge ports, explaining the possible causes and the action which should be taken to prevent their re-occurence.

14. As Chief Engineer Officer, write a report to the engineering superintendent regarding the failure of a main engine cylinder liner due to cracking which resulted in water leakage from the cooling space into the cylinder. 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 and after restarting.

1.2.9 Cylinder Head

1. With reference to cylinder head (4 X 2.5)
(a) Explain bore cooling of modern cylinder head
(b) Explain the stresses acting on cylinder head
(c) Describe the inspection and maintenance of cylinder head
(d) Describe the causes and remedies of faults associated with cylinder head

2. (a) Draw a simple diagram of cylinder relief valve suitable for large engines. State how excessive pressure can occur in cylinders and why it needs to be limited. (5)
(b) Suggest how a relief valve might persistently lift during maneuvering and how the situation can be corrected. Suggest with reasons conditions under which lifting of relief valve is considered serious . (5)

3. Write a report for the engineering superintendent regarding the replacement at sea of a damaged main engine cylinder cover. The report must explain how the problem was detected, the likely cause of the damage and the action which has been instituted to prevent further incidents of this type.

1.2.10 Exhaust Valve

1. (a) Describe using sketches an exhaust valve which employ air springing instead of coil springs.(5)
(b) Explain how air springing functions. (3)
(c) State the advantages of air springing. (2)

2. Explains the possible causes, effects and remedies of the following common problems associated with poppet exhaust valves; (5 X 2)

i) Overheating
ii) High temperature corrosion
iii) Failure to reseat
iv) Impact damage
v) Abrasive damage

3. (a) Describe with the aid of a sketch, a main engine exhaust valve which is hydraulically operated and designed to enable the valves to rotate during service. (4)
(b) Explain why valve rotation is considered to be desirables.(3)
(c) State the materials used for the seat and the valve described.(3)

4.(a) Describe a mechanism whereby the exhaust valve of a medium speed engine can be rotated during operations (rotocap) (6)
(b) Describe the effect of wrong adjustment of tappet in a medium speed engine. (4)

5. With respect to exhaust valves explain the reason for the following modifications;

(a) Nickel based alloy steel (nimonic) for valve heads and stems. (2)

(b) Stellite deposit on valve faces.(2)

(c) Rotocap or vane rotators for valves. (2)

(d) bore cooling for valve seats. (2)

(e) modern engines air springs are used (2)

6. Over a period of weeks since you joined a ship as Chief Engineer a number of exhaust valves and fuel injector nozzles have had to be replaced due to burning.

(a) Explain possible reasons for such incidents. (4)

(b) Describe the investigation procedure you would adopt in order to determine the actual cause of the problem. (4)

(c) State the Information you would record for future use. (2)

7. With reference to exhaust valves, identify the causes and effects of following faults:

(a) burning of exhaust valves in all cylinders (2)

(b) burning of exhaust valve in one cylinder (2)

(c) valve bouncing (2)

(d) exhaust-valve not fully closing (2)

(e) slackness of valves in spindles. (2)

8.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;

(b) cylinder liner honing;

(c) auxiliary engine bottom end bearing overhaul;

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

9. (a) Explain why variable exhaust valve closing can be advantageous in the operation of large slow speed main engines.
(b) Explain, with the aid of a sketch, how variable exhaust valve closing is achieved.
(c) Explain how high impact is avoided as the valve closes.

10. (a) Describe, with the aid of sketches, the procedure for lifting a cylinder cover from a slow speed crosshead engine, explaining how the lifting gear is attached to the cover.
(b) State the risks that may be associated with lifting a cylinder cover using the procedure described in part (a).
(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.

11.(a) Describe, with the aid of sketches, the procedure for cutting out and "hanging-up" an engine cylinder of a two-stroke crosshead engine in the event of complete failure of the crosshead pin such that the crosshead pin cannot be operated and no replacement is immediately available.
(b) State, with reasons, the factors which may inhibit starting and limit the operating speed of the engine with a cylinder cut out.

1.2.11 Camshaft & Chain Drive

1.(a) Sketch a section of a camshaft roller chain to show pin, bush, roller and link plates (4)
(b) Indicate the surfaces which are affected by wear. (2)
(c) State the procedure how to check the elongation of a timing chain (2)
(d) State why it important to renew a timing chain at the limit of elongation (2)

2. (a) With the aid of simple sketch, show the assembly of a single chain link and state the components it consists of. (4)
(b) Describe the advantages of chain drive. (3)
(c) Describe the possible consequence of running engine with badly worn or

adjusted chain.(3)

3.With respect to chain drive:

(a) Describe with sketch the procedure in checking wear in chain drive.(3)

(b) Describe with sketch the effect of stretch in chain drive on engine performance.(3)

(c) Describe with sketch how correct tension is restored in chain drive and how tightness is achieved.(4)

4.(a) Describe how camshaft timing is checked and adjusted after chain tensioning.(3)

(b) Describe the type of bearing used in a camshaft and chain drive system.(3)

(c) Describe the routine inspection to be carried out on chain drive.(4)

5. (a) Describe the routine inspection to be carried out for various components of chain drive. (5)

(b) With a detailed sketch of a chain link, indicate the points of failure generally occur.(2)

6. (a) Discuss the type of bearings are commonly employed for camshaft in large engines. (3)

(b) Explain the effect of worn camshaft bearing and loose camshaft bearing bolts in large engine. (3)

(c) Explain why angular position of camshaft requires regular checking & adjustment.(4)

7. (a) Why chain deteriorates (wear & elongates) in service (2)

(b) Explain with indicator diagram the effect of chain deterioration (slack chain) on engine performance (3)

(c) Discuss method of assessing percentage increase in length, and why limit is placed on elongation. (2)

(d) How deterioration is checked and corrected. (3)

8. With reference to the survey of diesel main propulsion machinery by the Classification Society:

(a) explain how classification societies have reduced the need for attendance by the surveyor; (2)
(b) describe how a planned maintenance scheme may be used in conjunction with CSM; (4)
(c) describe TWO programmes that are approved by the classification societies so that physically opening the machinery is not necessary on every occasion. (4)

9. With reference to the use of camshaft chain drive systems on diesel engines:
(a) describe the inspection process and the possible defects that may be found; (8)
(b) describe how correct chain tension is maintained, stating the effects of incorrect tension. (8)

1.3 Lube Oils

1.Lubricating oil performance is of such importance for engine performance that oil has to be considered an integrated engine component right from the design stage or even earlier, at concept stage. State in particular for medium speed trunk piston diesel engines with specific output operating on poor quality heavy fuels;
(a) the complex task of lubricating oil (4)
(b) a lubricating oil testing program is to be instituted for certain properties and conditions which need to be analyzed (6)

2. Lubricating oil performance is of such importance for engine performance that oil has to be considered an integrated engine component:
(a) State how lube oil can deteriorate in service (4)
(b) How the above can be prevented? (2)
(c) State at least three on board tests to ascertain lube oil condition (2)
(d) Explain the significance of lube oil ‘laboratory analysis report. (2)

3. With regard to lubrication:
(a) Explain hydrodynamic, hydrostatic, boundary and squeeze film lubrication. (4)

(b) State four contaminants and their adverse effect on the properties of lube oil. (4)
(c) In case of water contamination in crank case oil, state your action. (2)

4.(a) Describe the characteristics of liner lubricating oil of large engines burning heavy fuel oil.(4)
(b)Describe the characteristics of lubricating oil of medium speed engines burning heavy fuel oil. (3)
(c) Draw a simple diagram of lubricating oil quill used for a large engines and provide a brief description. (3)

5.(a) Describe the characteristics of liner lubrication of large engines burning heavy fuel (5)
(b) Describe the characteristics of lube oil of medium speed engines burning heavy fuel (3)
(c) Draw a simple sketch of lubricating oil quill used for a large engines (2)

6.(a) Explain briefly the properties required of a crankcase lubricating oil which is to be used for a highly rated medium speed trunk piston engine.(4)
(b) State the properties and conditions would need to be analyzed by shore lab for above oil on regular basis under a oil testing program. (4)
(c) What benefits would be achieved from this regular test program. (2)

7. Given below is medium speed trunk type main engine system oil analysis report, with reference to each parameters of this report- (4 X2.5)
(a) Is there sufficient additive reserve in circulation oil to protect the engine?
(b) Analyze the condition of this oil from used oil test results for each parameter by comparing with SAE30 new oil
(c) Discuss the effect of continued usage of this oil in the system without taking any corrective measure
(d) What lube oil system adjustment and treatment is required for continued usage of this oil and safe operation of the engine

Lubricating oil analysis report

Report Nr.	5555555		
Sample landed	25/09/05	Sample reported	30/09/05
Equipment:	Main Engine		
Model	4 stroke medium speed		
Rating:	7200KW at 500 RPM		
Engine running hours	75650 hrs		
Oil consumption	40 ltr/day		
Lubricating oil	SAE 30		
Oil volume in the system	5000 ltrs		
Sampling point	Engine inlet		

Parameters	Used oil Results	SAE 30 New oil
Viscosity @ 40°C	140	106
Density @ 15°C	0.965	0.95
Flashpoint °C	140	240
Water %	0.5	0
Nature of water	Trace of chloride	
Ash %	4.2	4
Base Number	23	30
Pentane/Heptane insolubles	3	
Toluene/Benzene insolubles	1.5	

8.With reference to engine system oil

(a) Discuss four contaminants commonly found in engine system oil and their adverse effect of function of oil.

(b) Source of these contaminants and how they detected.

(c) Corrective measures to be taken in case of contamination with contaminants identified in (a)

9. With reference to micro bacterial infestation:

(a) List the E/R systems that may be affected by this type of contamination (2)

(b) Explain the condition required for bacteria to evolve (3)

(c) Describe how the presence of microbial contamination can be detected. (2)

(d) Describe the action to be taken after microbial contamination is detected. (3)

10. a) State three operational circumstances that may enable water to enter LO system.(2)
b) Describe two tests that may be carried out to determine the presence of water. (4)
c) Describe a quantative test to ascertain the degree of water in lubricating oil. (2)
d) State three methods of extracting water contained in lubricating oil. (2)

11. (a) State, with reasons, THREE properties required of a cylinder lubricant for a main engine operating on HFO. (4)
(b) Describe, with the aid of sketches, an electronically controlled cylinder lubrication system, stating how the timing and quantity of cylinder lubricant is regulated and set. (6)

12. A slow speed diesel engine crankcase lubricating oil analysis report indicates a substantial presence of fresh water, metal particles and a reduction of BOTH alkalinity and anti-oxidant reserve.
Explain the possible causes of EACH of these changes, and how they may be found.

1.4 Fuel Oils

1. There has been significant changes in the properties of marine bunker fuels with a trend towards heavier fuels. The net effect with regard to bunker fuels is that the trend towards heavier fuel will continue.
(a) Describe the operational consideration when burning residual fuels. (6)
(b)) State with reason that fuel atomization has a major effect on ignition performance. (4)

2. With respect to marine fuel oil bunkers and recently implemented annex VI explain:
a) The sampling procedure to avoid a dispute. (4)
b) Sampling and preservation to comply annex vi. (2)
c) Documentation to be followed. (2)
d) Safe management before putting in service for consumption. (2)

3.(a) Describe five important point of specification for a residual fuel oil. (3)
(b) Why fuel oil laboratory analysis report is significant? (3)
(c) What is the influence of a poor-quality fuel on the environment as well on the machineries? (4)

4. With reference to marine fuel oil, write short notes on:
(a) Ignition quality (4)
(b) Sodium and vanadium (2)
(c) Sulphur. (2)
(d) Pour point. (2)

5. (a) Explain the term fuel ignition quality indicate how a fuel's chemical structure influences its value. (4)
(b) State, with reasons, the possible consequences of operating an engine on a fuel with a lower ignition quality than that for which it is timed. (2)
(c)(i) Explain how an engine might be adjusted to burn fuel of different ignition quality. (2)
(ii) State what checks can be carried out in order to determine that the engine is operating correctly. (2)

6. (a) With reference to the combustion of fuel briefly define the term ignition delay (3).
(b) Explain the operational parameters which will significantly reduce ignition delay (3).
(c) Describe the effect on combustion of followings:
(i) Low CCAI rating (2)
(ii) High CCAI rating (2)

7. Efficient combustion is achieved when the fuel has been thoroughly burnt in the time available. Describe the effect of followings to achieve efficient combustion (5 X 2)
i) Atomization
ii) Penetration

iii) Nozzle hole size
iv) Air turbulence
v) Ample excess air

8. Efficient combustion is achieved when the fuel has been thoroughly burnt in the time available. Explain the effect of (2.5 X4)
(a) Poor penetration
(b) Over penetration
(c) Slack needle
(d) Fuel impingement

9. With reference to marine fuel oil discuss
(a) how a fuel with poor ignition quality effects engine operation. (3)
(b) How C/E can interpret ignition quality of fuel from the fuel analysis report. (3)
(c) Operational measures to deal with fuel with poor ignition quality. (4)

10. (a) What problems are likely to take place with fuel oil containing very low Sulphur?(4)
(b) What are "Catalytic Fines"? What are the likely consequences on engine performance, if "Cat Fines" reach engine components during operation? (6)

11. While operating in heavy weather the main engine loses power and misfires. Investigation shows considerable quantities of water in the fuel.
(a) As Chief Engineer Officer explain the immediate actions which should be taken to ensure safe operation of the ship.
(b) State, with reasons, the possible sources of water entering the fuel storage, handling and supply system.
(c) As Chief Engineer Officer write the standing orders that would be issued with respect to operation of the fuel storage, handling and supply system.

12. (a) Describe, with the aid of a sketch, a main engine fuel oil circulating system incorporating the MGO and HFO service tanks, a fuel oil change-over system, heating and viscosity control system and tank return system.
(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.

13. As Chief Engineer write instructions for the main and auxiliary engine fuel change-over procedures to be followed when a vessel is due to move into an Emission Control Area. Approximate times must be mentioned to ensure that the vessel does not infringe any regulations and the instructions must mention steps required to avoid cross-contamination of fuel in service tanks, where MGO is carried as the low sulphur fuel.

1.5 Fuel Injection

1. (a) With reference to 'slow steaming nozzles' as applied to main engine fuel injectors, state with reasons when and why they would be used. (3)
(b) State with reasons the engine adjustments required when changing to a fuel having a different ignition quality. Explain the consequences of not making such Adjustments (4)
(c) State the procedures, which should be adopted, to ensure that main engine fuel injectors are maintained in a good operative order indicating what routine check should be made. (3)

2) With respect to fuel injection system:
a) Explain the basic points observed during a timing check. (4)
b) What are the important check(s) to carry out on completion (a) ? (2)
c) Explain following influence-
I)High CCAI value. (2)
ii) Restricted nozzle cooling. (2)

3) With reference to fuel injection:

a) Explain the concept of VIT and Super VIT. (4)

b) State the advantages and disadvantages of the VIT. (2)

c) Explain the phenomena of controlling VIT, with a fuel pump type of your choice. (4)

4. With respect to main engine fuel pump;

a) Explain the need of incorporation variable injection timing (VIT) and the achievement (5)

in respect to the performance at all load ranges, Describe with simple sketches how VIT is incorporated in port controlled fuel pump. (5)

5. (a) What is VIT? (2)

(b) With respect to VIT, elucidate the need for its coming into being and explain how it aids to achieve optimum performance at all load range of a diesel engine (6)

(c) Draw a simple sketch of a Fuel Injection Pump showing arrangement for VIT (2)

6. (a) Why variable injection timing incorporated in fuel system. (2)

(b) Describe, with the aid of sketches, a main engine fuel injection pump capable of variable injection timing.(8)

7. Efficient combustion is achieved when the fuel has been thoroughly burnt in the time Available. Describe the effect of followings to achieve efficient combustion: (2 X5)

(a) Atomization

(b) Penetration

(c) Nozzle hole size

(d) Air turbulence

(e) Ample excess air

8. (a) What is ignition delay? (2)

(b) With respect to VIT, elucidate the need for its coming into being and explain how it aids to achieve optimum performance at all load range of a diesel engine (6)
(c) Draw a simple sketch of a Fuel Injection Pump showing arrangement for VIT (2)

9. With respect to main engine fuel pump;
(a)Explain the need of incorporation variable injection timing (VIT) and the achievement (6)
(b) With respect to the performance at all load ranges, describe with simple sketches how VIT is incorporated in:
(i) Port controlled fuel pump (2)
(ii) valve controlled fuel pump (2)

10. With reference to electronic fuel injection systems used in modern large two-stroke diesel engines,
(a) Sketch a schematic diagram for fuel injection using common rail system (e.g. Sulzer RT-Flex) (5)
(b) Describe briefly how the engine computer system controls the delivery from the common rail to the individual cylinders via the volumetric injection control system based on the above diagram. (5)

11.Discussed the common faults which could arise in fuel pump. (5 X2)
(a) Plunger/Barrel wear.
(b) Excess leakage of fuel in to cam shaft system.
(c) Cavitations damage
(d) Wear of discharge valve.
(e) Fuel pump seizure.

12.With the aid of suitable sketches describe how timing is checked for valve control type fuel pump. (10)

13. (a) State, with reasons, SIX points which should be covered in a risk assessment for the replacement of a crosshead main engine fuel injection pump in port.
(b) Write instructions for the replacement of a crosshead main engine fuel injection pump.

14. (a) State, with reasons, SIX points which should be covered in a risk assessment for the replacement of a crosshead main engine fuel injection pump in port.
(b) Write instructions for the replacement of a crosshead main engine fuel injection pump.

1.6 Scavenging and Supercharging:

1. With regard to pulse turbocharging explain the reason for followings.
(a) Exhaust grouping and turbocharger arrangement (4)
(b) Pulse converter and multi pulse pressure operation (3)
(c) With respect to turbocharger state with reasons the following operational problems associated with gradual decrease in scavenge air pressure (3)

2. During normal engine operation a turbocharger rapidly loses speed and the speed reduction is accompanied by appreciable noise.
(a) State with reason the possible causes. (2)
(b) Explain in detail how the engine might be safely operated if the damage caused by this incident is such that the turbocharger cannot function. (6)
(c) State with reasons the factors which may limit engine operating speed with the turbocharger out of operation. (2)

3.With regard to turbocharger state the followings:
(a) Procedure of cleaning turbine side. (3)
(b) Phenomena of surging and reasons for same, in practice (3)
(c) Cooling water casing got holed, how to run turbocharger? (4)

4. With reference to turbocharger:

(a) State the advantages and disadvantages of sleeve type bearing. (3)

(b) Explain the causes of a turbocharger vibration. (3)

(c) In a pulse operation system, how do you run the engine with a defective turbocharger? (4)

5. With respect to main engine turbocharger:

(a) Observed during round, revolution indicator not working- what immediate action should be taken? (2)

(b) Issue a set of relevant standing instruction to the engineers. (4)

(c)How the turbocharger is maintained in good order- state in brief. (4)

6. With reference to the surging of turbo-chargers:

(a) Explain the phenomenon of surging (4)

(b) Give FOUR examples of defects likely to cause surging (4)

(c) Explain the principles used when matching the turbo-charger with a diesel engine.(2)

7.With reference to turbo chargers;

a) Describe the procedure for cleaning; (10)

i) the gas side ii) the air side

8. (a) Sketch an arrangement for fixing turbochargers blades to the blade disc. (3)

(b)Describe the routine maintenance to be carried out on the following components of a turbocharger.

i) Lubricating oil for ball bearings (3)

ii)Turbine blades (4)

9.(a) With respect to pulse turbocharging explain why exhaust grouping is necessary.(5)

(b) Why pulse converter is fitted with some engines (5)

10. With reference to scavenging and turbocharging
(a) Explain how an explosion may occur in the exhaust manifold of a large slow speed diesel engine, stating how this may cause failure of the turbocharger. (4)
(b) Describe with the aid of a sketch how a turbocharger may be disabled to allow for operation of a main engine in the event of failure of one turbocharger in a two-stroke main engine with multiple turbocharger. (6)

11. With reference to diesel engine safety,
(a) The scavenge fire alarm was activated and indications of a scavenge fire were noticed while your vessel is underway. As a chief engineer, describe with reason your necessary immediate sequential course of actions to effectively handle the situation. (5)
(b) Describe your actions as a chief engineer to safeguard against the risk of crankcase explosion in case the oil mist detector becomes inoperative. (5)

12 (a). Describe how a complete inspection of a main engine T/C may be carried out indicating, with reasons, the area required close attention.(5)
(b). Describe with a suitable sketch how air & gas tightness rotor casing is achieved.(5)

13. With respect to T/C-
(a) State how service performance checks are undertaken for each of the following: (5)
i. Gas side
ii. Blower side
iii. Suction filter
iv. After cooler
(b) State with reasons the action required to maintain satisfactory performance of each of the following: (5)
i) The turbine side
ii) The blower side

14. With reference to slow speed diesel engines

(a) explain why electrically driven scavenge air blowers are fitted to engines even though turbochargers are fitted.
(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.
(c) describe the procedure for operating an engine in the event of a turbocharger not being operational.

15. With reference to slow speed diesel engine turbocharging:
(a) explain why water separators are fitted;
(b) describe how an engine may be operated in the event of a charge air cooler being damaged beyond immediate repair;
(c) describe how an engine may be operated in the event of a turbocharger bearing failure which cannot be repaired immediately.

16. Write a report for the engineering superintendent regarding the replacement at sea of bearings on one of the main engine turbochargers. The report must explain how the bearing defects were detected, the likely cause of the damage and the action which has been implemented to prevent further incidents of this type.

1.7 Starting and Reversing

1) With respect to large modern diesel engine starting and reversing system using roller guide with reversing mechanism or reversing servo mechanism, describe;
(a) describe with the aid of sketches an arrangement for running direction interlock. (5)
(b) During maneuvering it has been experienced that the control air system has failed. As Chief Engineer you need to perform emergency operation of the engine. State the procedures for emergency operation. (5)

3. (a) What are the causes of a starting air line explosion? (2)

(b) During maneuvering observed a starting air line getting hot and giving smoke, what immediate action would you take as a chief engineer? (4)
(c) What precautions should be taken to avoid future occurrence? (4)

4. Draw a ‘Local’ or ‘Emergency’ maneuvering system of slow speed engine.(10)

5.(a) What are the reasons engine fails to start on air? (3)
(b) What are the reasons engine start on air but fails to fire?(3)
(c) If engine fails to start from ECR then how to start engine.(3)

6. (a) With a suitable sketch describe the operation of a large starting air valve. (5)
(b) Identify with reasons the defects to which the valve is most prone to encounter during operation. (2)
(c) State the indications of leaky starting air valve. (1)
(d) Explain the consequence of permitting a leaking starting air valve to operate in this condition for an extended period of time. (1)
(e) Discuss how the leakage can be largely avoided in practice. (1)

7.As Chief Engineer, write instructions for the checking of the engine slow turning system and subsequent routine 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. (10)

8. Describe, with the aid of a sketch, an open loop system for reducing SOx emissions from engine exhaust gas, explaining how the system operates whilst the vessel is in open waters. (10)

9. Describe, with the aid of a sketch, a closed loop scrubber system for removing SOx from engine exhaust gas, explaining the operation of this unit and stating when it would be used. (10)

10.(a) Describe, with the aid of a sketch, either a diesel engine Open Loop SOx scrubber system or a Closed Loop SOx scrubber system.
(b) Explain what systems need to be monitored in order to ensure that the scrubber system meets all IMO regulations.

11. With reference to main engine safety systems:
(a) state, with reasons, THREE engine operating parameters which should initiate an automatic slowdown if engine operation is outside of set value conditions;
(b) describe how the operation of each slowdown listed in part (a) may be tested;
(c) list two engine operating parameters which should initiate an automatic engine shutdown, in EACH case explaining why this parameter MUST shut down the engine.

12. (a) Explain how the emergency diesel generator is prepared and selected for automatic operation so that it will start and connect to the switchboard in the event of a blackout.
(b) Write a procedure for manual starting and running of the emergency generator, indicating how frequently this procedure should be carried out and stating which operating parameters should be checked.
(c) State the procedure for testing the emergency generator automatic start.

13. (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.
(b) Describe how problems with air starting systems may be avoided.

14. 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.

15. With reference to a Closed Loop engine exhaust gas SOx scrubber system:
(a) describe, with the aid of a sketch, such a system;
(b) state, with reasons, the fluid which is used for SOx scrubbing in this system;
(c) state how the effectiveness of the scrubbing fluid is maintained and how the sludge is removed and disposed of.

16. (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.
(b) Explain how an explosion in a diesel engine air start system might occur.
(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.

1.8 Cooling System

1. (a) State with reasons the factors which contribute to corrosion in diesel engine cooling water system. (3)
(b) Explain with reasons, under what circumstances rate of corrosion is increased. (3)
(c) Considering the merits and demerits, discuss the various types of inhibitors used to prevent and control corrosion. (4)

2. (a) Discuss the importance of cooling water treatment for a large marine diesel engine. (2)
(b) Explain the attention (care & maintenance) required by cooling water system in service (2)
(c) Explain why the load-controlled cooling system has been adopted in some modem large propulsion engine burning heavy fuel oil. (2)
(d) With a suitable diagram describe the operation of such cooling system. (4)

3. (a) State with reasons the factors which contribute to excessive scaling in diesel engine cooling water system. (4)
(b) Explain the effect of excessive scaling on engine performance. (3)
(c) State how such scaling is prevented and controlled (3)

1.9 Diesel Engine Control

1.With respect to a ship operating in UMS mode, explain how safety is ensured in the following cases:
(a) Leaking high pressure fuel oil pipe. (4)
(b) Explosive mist in crankcase. (4)
(c) Scavenge fire in a main engine unit. (4)
(d) Loss of power in engine room alarm system. (4)

2.(a) During a maneuvering observed M/E governor not working, as chief engineer what would be your immediate action? (4)
(b) What precaution should be taken, to avoid same in future? (4)
(c) What are the checks should be carried out from emergency engine control console? (4)

3. While during a maneuvering found engine turns on air but do not start on fuel:
(a)State as chief engineer, what immediate action should be taken. (4)
(b)What could be the possible causes for above? (4)
(c)State the items- requirements of operation from emergency control console.(2)

4. In engine rooms that are operated under UMS conditions, describe with the aid of sketches how the following are monitored:
(a) The perforation of a high pressure fuel pipe. (3)
(b) The immense possibility of a scavenge fire. (3)

(c) Condition that may be conducive to a crankcase explosion. (4)

5. (a) State with reasons the main indications of a piston running hot. (3)
(b) State with reasons the immediate steps to be taken if piston runs hot.(4)
(c) Explain the likely causes of piston running hot. (3)

6.The exhaust temperatures of a main propulsion engine are found to excessive and uneven at normal load, with the exhaust dark at the funnel, outline:
(a) An investigation of the situation (4)
(b) The procedure to alleviate the immediate problem (3)
(c) Any further actions that might be necessary (3)

7. (a) With respect to VIT, explain the need for its coming into being and explain how it aids to achieve optimum performance at all load range of a diesel engine. (5)
(b) With simple sketch explain a Fuel Injection Pump controlled by valves (5)

8. With reference to hydraulic governor, Define followings; (2.5 X 4)
(i) droop
(ii) dead band
(iii) stability
(iv) sensitivity

9. Sketch and describe the principle of operation of a hydraulic governor with compensating needle valve.(10)

10. a) Sketch & describe a mechanical overspeed trip. (4)
b) Describes two functions performed by a governor. (2)
c) Explain the function of a flywheel. (2)
d) Explain what is meant by speed droop. (2)

11. With respect to large modern marine diesel engine, briefly explain;

(a) How thermal stress is induced in diesel engine components. (6)
(b) How temperature rise is controlled in diesel engine. (10)

12. The exhaust temperatures of a main propulsion engine are found to excessive and uneven at normal load, with the exhaust dark at the funnel, outline:
(a) An investigation of the situation (6)
(b) The procedure to alleviate the immediate problem (2)
(c) Any further actions that might be necessary (2)

13. With reference to the local control of a main engine following failure of the automatic control system, explain how the engine can be monitored and controlled.

14. (a) Write the Chief Engineer Officer's Standing Instructions for the actions to be taken by the watchkeeping engineer in the event of failure of the engine room monitoring and alarm system.
(b) State the procedure to be followed in the event of repeated activation of an oil mist detector alarm.

1.10 Hazards in Engine Operation

1)With respect to the emission from diesel engines;
(a) State the effect of atmospheric pollution by;
(i) Oxides of nitrogen (NOx) (3)
(ii) Oxides of Sulphur (Sox) (3)
(ii)state the formation of NOx and Sulphur acids in a diesel engine system (4)

2. (a) Explain in detail the process leading to a crankcase explosion. (3)
(b) State how the effect of a crankcase explosion may be minimized. (2)
(c) State with reasons three devices, which may be incorporated in an engine system to minimize the risk of a crankcase explosion occurring. (2)

(d) State the action to be taken in the event of one of the warning devices being activated. (3)

3. (a) Show in a sketch the location of cracking in crank shaft, with reasons. (3)
(b) State how the likelihood of cracking can be minimized. (3)
(c)State what actions should be taken if a crack is detected in a crank shaft but facilities are not available for immediate repair. (4)

4. With reference to crankcase explosion;
(a) Describe the operating principle of a crankcase mist detector and how the device can be tested. (7)
(b) State three alternative indications of overheating or existence of conditions that might result in a crankcase explosion. (3)

5. With respect to “Scavenge fire” Describe: (5 X2)
a) Causes of scavenge fire
b) Symptoms/indication
c) Action to be taken
d) Inspection Criteria after extinguishing fire.
e) How such occurrence can be prevented?

6. With respect to “Starting air system explosion”:
(a) Explain how explosion may occur (5)
(b) Discuss how explosion can be avoided (3)
(c) Discuss safety devices fitted to limit damage from explosion (2)

7. As Chief Engineer Officer, write instructions for the actions to be taken in the event of a high temperature scavenge alarm being activated during a period of UMS operation, stating the reasons for EACH action.

8. (a) List TWO automatic main engine slowdown parameters, stating why EACH is applied to an engine.
(b) List TWO automatic main engine shutdown parameters, stating why EACH is applied to an engine.
(c) Explain how EACH of the parameters listed in part (a) and part (b) are tested for the correct operation.

9.(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.
(b) State, with reasons, the possible causes of a high exhaust temperature on a single cylinder of a main propulsion engine.
(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.

1.12 Balancing, Vibration and Noise

1.(a) State the various mechanical loads from one or more sources that the diesel engine components are subjected to.(2)
(b) Describe followings;
i) Static balance (2)
ii)Dynamic balance (2)
c) Primary and secondary imbalance (4)

2. (a) Sketch and Explain the purpose of top bracing and how is it adjusted ? (4)
(b) Describe followings: (3 X2)
i) Barred speed
ii)Torsional vibration damper
iii)Damping and detuning.

3. (a) Explain the reason for providing top bracing to a large marine diesel engine (2)
(b) Sketch and describe a top bracing arrangement (5)
(c) Describe regular maintenance for top bracing. (3)

4. With reference to torsional vibrations in a main propulsion installation based on medium speed engines, gearbox and controllable pitch propeller:
(a) Explain how the vibrations may be caused;
(b) State the possible effects and damage that could result;
(c) Discuss the methods employed to minimise the potential problems associated with torsional vibration; and
(d) Describe how the natural frequency of the system could be modified.

5.(a) Define the term Torsional Vibration with respect to an engine crankshaft, stating the effect that high levels can have on an engine crankshaft. (6)
(b) Explain how engine deterioration influences the risk of Torsional Vibration, stating what can be done to minimise that risk. (4)
(c) Explain TWO possible reasons for the activation of a Torsional Vibration alarm after an engine has been started if there had been no previous history of such an alarm and if no maintenance had been undertaken on the engine whilst it was stopped. (6)

6. Following the failure of the engine monitoring and alarm systems, explain the checks that will have to be made and how the engine room will be operated without these systems. (10)

7.(a) Describe, with the aid of a sketch, a hydraulic top bracing for a large 2 stroke diesel engine. (08)
(b) State the advantage of the hydraulic type over the friction type top bracing. (2)

8. (a) Explain, with the aid of sketches, the purpose of balance weights fitted to the crankshaft of a medium speed engine.
(b) Describe the maintenance checks required for detachable balance weights.
(c) Explain why composite pistons may be fitted to medium speed engines, stating the reasons for the materials used.

1.13 Compressed Air Systems

1. With reference to main air reservoirs explain:
(a) How the size and capacity is determined. (5)
(b) Why the certain internal areas are susceptible to wastage? (5)

2. With reference to large starting air receivers:
(a) Explain where corrosion is likely to occur and state why it occurs in these reasons (3)
(b) State how the incidence of corrosion in air receivers might be minimized. (3)
(c) If serious corrosion in detected in a starting air receiver and that receive must be used, explain how you as C/E, would determine the max pressure to which the receiver should be subjected. (3)
(d) State the further action a C/E must take upon discovering such air receiver corrosion. (4)

3. In respect to starting a diesel engine.
(a) Sketch a timing diagram showing crank angles related to the top and the bottom dead center for the period of admission of starting air and opening of the exhaust.(5)
(b) Explain how starting is ensured at any crank angle. (5)

4. (a) Sketch and describes the principles of operation of a starting air distributor. (8)
(b) Names the safety features incorporated in starting air lines. (2)

5. (a) Explain why two stage air compressors are used in preference to a single stage for main air systems. (2)
(b) State why intercoolers are fitted. (2)
(c) State the effect of intercooler fouling. (2)
(d) State with reasons what safety devices are fitted. (4)

6. Enumerate all the fittings provided on an air receiver. Explain for what purpose they are provided and how they are fitted.(10)

7. What precautions are needed to be taken when (4 X 2.5)
(a) filling
(b) emptying
(c) opening up
(d) cleaning the air bottle

8. (a) Draw a simple sketch of compressed air receiver showing the mountings and state the capacity requirements and safety features incorporated with such receivers.(10)

9. With respect to reciprocating air compressor, state with reason; (2.5 X 4)
(a) clearance volume needs to be as small as possible
(b) suction and discharge valves are of the plate type
(c) valves are often a source of trouble
(d) the plate valves are spring loaded

10. (a)Explain how and why the performances of reciprocating air compressors tend to "fall off" in service.(4)
(b)State how "fall off" is identified and to what extent permissible before correction.(2)
(c) Describe how optimum performance is restored (4)

11. Suggest with reasons why the following practices in air compressor operation should be encouraged. (10)
(a) maintaining the finest “bump” clearance in all stages;
(b) annealing bursting disc of the inter-cooler at regular intervals;
(c) restricting cylinder lubrication to absolute minimum; and
(d) regular cleaning of intake air filters

12. With reference to main starting air reservoirs:
(a) state, with reasons, FOUR safety devices fitted;
(b) write a procedure in order to prepare a reservoir for internal inspection;
(c) describe an internal inspection, stating TWO defects which may be found and the possible causes of such defects.

1.14 Electronic Injection

1.With reference to diesel engines without camshafts, describe, with the aid of a sketch, how the fuel injection and exhaust valve systems operate and are controlled.(10)

2.(a) Sketch a common rail fuel system for a marine diesel engine. (5)
(b) Describe how the common rail fuel system sketched in Q5(a) operates. (5)

3. (a) Sketch a block diagram of ME Engine control system.(6)
(b) Describe briefly the followings.(4)
i.EICU
ii.ECU
iii.ACU
iv.CCU

4. With reference to ME engine
a) Draw a block diagram of hydraulic system.(5)

b) Describe briefly the purpose of the following.(6)

I. Engine driven hydraulic pump

II. Engine start up pump

III.FIVA

IV. Accumulator

5. With reference to ME engine, sketch and describe cylinder lubricator.(10)

6. With reference to ME engine describe following

(a)Adaptive cylinder oil control (ACC) (5)

(b)Emergency cylinder lubrication (6)

7. With respect to ME engine sketch and describe ME fuel pressure booster. (10)

8. As Chief Engineer write a report to the engineering superintendent regarding the failure of a high pressure fuel pump unit on an electronically controlled engine. The report must explain the nature of the failure, how the failure was detected, and the immediate action taken. The report must also explain the actions taken to replace the pump and the steps taken to minimise the risk of future similar fuel pump failures. (10)

9.With reference to electronically controlled engines:

(a) describe how fuel injection quantity and timing is adjusted;

(b) describe how the exhaust valve timing may be varied;

(c) describe how starting air valves are regulated.

1.15 Duel Fuel Engines

1. With reference to LNG diesel engine installations:

(a) describe, with the aid of a sketch, a Gas Valve Unit, explaining its purpose and indicating where it is located in the gas train; (8)

(b) explain why ventilation and inert gas systems must be installed with the engine fuel

gas system; (4)
(c) state why pilot injection must be provided when burning fuel gas, explaining how a pilot injection system operates. (4)

2. 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)

3. (a) Describe, with the aid of a sketch, a Selective Catalytic NOx Reduction system, explaining the chemical reaction for reducing NOx and the control system requirements. (10)
(b) State two engine based systems for reducing marine diesel engine NOx, explaining how they reduce NOx level but also increase fuel consumption and CO2 emissions.

4. (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.

5. (a) Describe, with the aid of a sketch, a cylinder arrangement for a dual fuel 2-stroke engine, explaining how the gaseous fuel is delivered to the cylinder and ignited.
(b) Explain the term Methane Slip in reference to a dual fuel engine, stating why it occurs and the effect on the atmosphere.

2.0 Auxiliary Boilers

2.1 Boiler Mountings:

1.(a) describe the method of setting the safety valves of an exhaust gas boiler at sea. (4)
(b) State the limit in terms of percentage above max design working pressure, for setting safety valve (3)
(c) State the formality necessary when the Chief Engineer sets the safety valves (2)
(d) explain why you would not carry out an accumulation of pressure test on an exhaust gas boiler. (1)

2. With reference to exhaust gas boiler
(a) State the safety valve setting pressure (3)
(b)What inspection should be carried out during survey(s) (3)
(c) How the safety valve to be adjusted ? (4)

3. With reference to safety valves fitted on auxiliary boilers,
(a) Sketch and label an improved high lift safety valve showing salient clearances. (8)
(b) Explain how the lifting force is improved in this design. (2)

4. With reference to BOILER SAFTEY VALVE (4 X2.5)
(a) During overhauling what are the parts require special attention, justify with simple sketches.
(b) State the occupational/common problems encountered during service for the boiler safety valves.
(c) What are the likely causes for damage of such safety v/v.
(d) How will you repair a damage safety v/v

5. With reference to Full Lift safety valve:
(a) Sketch and describe important clearances and parts that would require attention during survey. (5)
(b) Discuss operational problems with above safety valves (3)
(c) Discuss routine checks during operation. (2)

2.2 Corrosion in Boilers and Water Treatment

1.(a) As chief engineer describe the procedures involved in the complete inspection of an auxiliary smoke tube boiler indicating areas of significant interest. (6)
(b) State the possible faults which might be found (2)
(c) Suggest how internal corrosion may be prevented. (2)

2. With reference to feed and boiler water:
(a) Explain why regular attention is required (5)
(b) Discuss the consequence if attention is neglected (5)

2.3 Boiler Operations

1. (a) What are the causes of an uptake fire? (6)
(b) State as chief engineer, what relevant action would you take? (2)
(c) State what precautions should be taken, to prevent same in future. (2)

2. With reference to EGE discuss:
(a) problems with EGE operation. (3)
(b) Precautions against EGE fire (3)
(c) procedures to "dry run" the EGE in case of tube failure. (4)

3. (a) What is “pinch point” (2)
(b) What are the factor to achieve the pinch point (3)
(c) As a C/E how would you achieve pinch point in waste heat recovery system. (5)

4. As a chief engineer prepare standing order (procedure) to be carried out in case of
a) High water level alarm (2)
b) Low water level alarm including water not visible in gauge glass (2)
(c) Ruptured boiler tube (2)
(d) include how above occurrences can be avoided. (4)

5. With reference to boilers and steam generation systems:
(a) explain the term water hammer, stating how it is caused and describing the possible consequences of it;
(b) explain how water hammer can be avoided;
(c) describe, with the aid of a sketch, how the boiler fuel system may be operated in port to comply with local emission control regulations.

2.4 Boiler Survey and Maintenance

1. As chief engineer describe the procedures involved in the complete inspection of an auxiliary smoke tube boiler indicating areas of significant interest. (6)
(a) State the possible faults which might be found (2)
(b) Suggest how internal corrosion may be prevented. (2)

2. With respect to an auxiliary boiler:
(a)State the significance of maintaining feed water temperature. (2)
(b) System observed with oil contamination, how to be remedied? (2)
(c) Explain the procedure of tube repair. (4)
(d) State the blow off pressure of safety valve. (2)

3.(a) Describe the method of scatting the safety valves of an exhaust gas boiler at sea. (4)
(b) State the limit in terms of percentage above maximum design working pressure for setting safe values.(2)

(c) State the formality necessary when the chief engineer sets the safety valve. (4)

4. (a) Explain why a composite boiler might be preferred to an alternatively fired boiler. (3)
(b)Describes in general terms the safeguards necessary with composite boilers. (4) .
(c) Explains the possible causes of deformation of heating surfaces in a boiler. (3)

5.(a) Describe with the aid of a block diagram, an auxiliary boiler burner control System (6)
(b) Explain how the system operates during start-up (4)

6. Describe the fireside inspection of the tubes and the tube plate of an auxiliary fire tube boiler and the detail the possible faults encountered (10)

7. What are the hazards associated with followings in Boiler water. What are the action to be taken if detected :
(a) Oil (3)
(b) Chloride content high (3)
(c) Why it is necessary to keep Oxygen out of Boiler and describe how this is done mechanically & chemically. (4)

8.(a) Discuss the actions to be taken in the event of gross oil contamination in the boiler.(5)
(b)What precaution would you take while putting the boiler into operation after oil contamination is rectified? (5)

9. With reference to survey of boilers:
(a) Discuss class regulation for frequency of boiler survey (2)
(b) Discuss boiler mountings and parts that require attention during internal and external examination (3)

(c) Describe method of boiler safety valve pressure setting (3)
(d) State the regulations for boiler safety valve. (2)

2.5 Exhaust Gas Heat Recovery System

1. Describe, with the aid of a sketch, a waste heat recovery system for electrical generation using main engine exhaust gas in combined gas/steam turbine systems. (10)

2. Describe the operation of the waste heat recovery system described in part (a) whilst the associated main engine is running. (10)

3.With reference to an economiser:
(a) write a procedure for the cleaning of the gas side of an economiser when the associated main engine is:
(i) running;
(ii) stopped.
(b) write a procedure for operation of the main engine when the associated economiser cannot be operated due to tube failure.

4. (a) Describe, with the aid of a sketch, the water/steam circulation system for the waste heat recovery system.
(b) Explain how economiser circulation pumps are maintained in a cool condition to allow for prolonged operation without problem.
(c) Describe how a waste heat recovery system steam pressure is maintained and the system operated when the associated diesel engine plant is operating on EACH of the following:
(i) low engine load;
(ii) low steam demand.

5. (a) Explain the action to be taken to ensure that the main engine may be operated in the event of an exhaust gas economiser developing a serious leak which cannot immediately be repaired.
(b) Describe how the heat transfer surfaces of an economiser are maintained in a clean condition.
(c) Explain the action which should be taken in the event of a fire in the economiser.

6. (a) Describe, with the aid of a sketch, a waste heat steam generating system incorporating separate oil fired boiler and diesel engine exhaust gas heat recovery unit (economiser).
(b) Explain how the system described in part (a) operates to ensure that the correct steam pressure is maintained during variations in engine load and steam consumption.