भारत सरकार / GOVERNMENT OF INDIA
पत्तन, पोत परिवहन और जलमार्ग मंत्रालय
MINISTRY OF PORTS, SHIPPING AND WATERWAYS
समुद्रीय प्रशासन महानिदेशालय, मुंबई
DIRECTORATE GENERAL OF MARITIME ADMINISTRATION, MUMBAI

MARINE ENGINEERING OFFICER – CLASS IV PART A
SUBJECT: HEAT ENGINES
October 2026

Max Marks: 100 / Pass Marks: 50

Instructions for the exam would be provided in answer sheet

1. A solid originally at temperature T_1 is kept in an evacuated chamber at a temperature $T_2 > T_1$. The rate of increase of temperature of the body is proportional to:
   A. $T_2^3 - T_1^3$
   B. $T_2^4 - T_1^4$
   C. $T_2^2 - T_1^2$
   D. $T_2 - T_1$

2. A room air conditioner has a coefficient of performance 2.5 on a hot day and uses 1200W of electric power. Calculate the quantity of heat that the air conditioner removes from the room in 1 minute.
   A. 1800 KJ
   B. 18.0 KJ
   C. 1.80 KJ
   D. 180 KJ

3. A Styrofoam box used to keep drinks cold at picnic has a total wall area of 0.80 m^2 and the wall thickness 2.0 cm. It is filled with ice, water and cans of cola at 0°C. What is the rate of heat flow (H) into the box if the temperature of the outside wall is 30 °C? Also, calculate how much ice melts in one day (M)?
   A. 3200 gm
   B. 320 gm
   C. 3.2 gm
   D. 32 kg

4. A steel tank is completely filled with 2.80 m^3 of ethanol when both the tank and the ethanol are at temperature of 32 °C. The tank and its contents are then cooled to 18 °C. Calculate the additional volume of ethanol that can be added into the tank? Assume that beta e = 75* 10^{-5} /K and beta s = 3.6*10^{-5} / K.
   A. 30.8 L
   B. -28.0L
   C. 28.0 L
   D. -30.8 L

5. A composite wall is 1.0 m long and 1.5 m high. It consists of an outer steel plate 1.5 cm and an inner layer of plywood of thickness 2.5 cm. If the rate of heat transfer is 450 kJ per hour across the wall, calculate the temperature drop across the outer and inner faces of the wall (in °C). Assume that the thermal conductivity of the steel is 16 and the plywood is 0.13 W/mK respectively.
   A. 2.62 C
   B. 1.61 C
   C. 26.2 C
   D. 16.1 C

6. A four-stroke diesel engine has L/D ratio of 0.60. The mean effective pressure is found to be 0.8 MPa. The engine produces indicated power of 40 HP while it is running at 3000 RPM. Find the dimensions of the engine.
   A. 9.87 CM
   B. 87.7 CM
   C. 8.77 CM
   D. 6.83 CM

7. A wall is 6.5 m long, 3.1 m high and 30 cm thick. The inner surface of the wall is at 24 °C while the outer surface is at a lower temperature. If the heat transfer through the wall is 3937 kJ per hour and the thermal conductivity of the wall is 0.88 W/mK, calculate the temperature (in °C) of the outer surface.
   A. 5.5
   B. 0.55
   C. 0.055
   D. 55

8. A four-stroke diesel engine has L/D ratio of 1.20. The mean effective pressure is found to be 0.9 MPa .The engine produces indicated power of 50 HP while it is running at 2800 RPM. Find the dimensions of the engine.
   A. 14.74 MM
   B. 14.75 CM
   C. 12.29 CM
   D. 13.64 CM

9. A tank 2.5m x 2.5m x 2.5m is made of steel and has a 21 cm thick wall. It contains water at 80 °C. The air around the tank is at 21 degree C. Assume that the thermal conductivity of steel is 43 W/mK, the heat transfer coefficient of water is 2.6 kW/m^{2k} and that of air is 24.0 W/m^{2k}. Calculate the overall heat transfer coefficient (W/m^{2K}) from water to air.
   A. 15.31
   B. 21.31
   C. 9.1
   D. 20.04

10. Suppose a room air conditioner has a coefficient of performance 2.5 on a hot day and uses 1200W of electric power. Calculate the quantity of heat that the air conditioner delivers to the outside atmosphere in one minute.
   A. 25.2 MJ
   B. 25.2 J
   C. 25.2 KJ
   D. 2.52 KJ

11. A composite wall is 6 m long and 3.2 m high. It consists of an outer metallic plate 2.1 cm, a layer of liquid Freon of 8 cm and a plywood layer of 4.5 cm. If the temperature drop across the outer and inner faces of the wall is 20 °C, calculate the heat transfer per hour (in kJ) through the wall. Assume that the thermal conductivity of the metal is 64, the liquid Freon is 0.07 and plywood is 0.13 W/mK respectively.
   A. 928.2 MJ
   B. 92.82 KJ
   C. 92.82 MJ
   D. 928.2 KJ

12. 1.9 kgs of water at 20 °C is poured into a vessel containing 0.60 kg of ice. The result is a mixture of ice and water at 0 °C. If the final mass of ice in the vessel is 0.16 kg, calculate the initial temperature of the ice. Assume that: Water equivalent of vessel = 0.05 kg. Specific heat of ice = 2.04 kJ/kgK, Latent heat of fusion = 335 kJ/kg, Specific heat of water = 4.2 kJ/kgK
   A. -13.4C
   B. -1.34 C
   C. 6.7 C
   D. -6.7 C

13. Assume that a freezer has a coefficient of performance of 2.40. The freezer is used to convert 2.0 kg of water at 30 °C to 2.0 kg of ice at -10 °C in one hour. How much electrical energy is consumed by the freezer during this hour? Assume that c_w = 4.190 kJ/kg K, L_f = 334 kJ/kg and c_{ice} = 2.01 kJ/kg K.
   A. 3998J
   B. 39.98 KJ
   C. 399.8 KJ
   D. 399800J

14. A composite wall is 8 m long and 4.2 m high. It consists of an outer steel plate 3 cm, a layer of corkboard of 9 cm and a wood layer of 6 cm. If the temperature drop across the outer and inner faces of the wall is 24 °C, calculate the heat transfer per minute (in kJ) through the wall. Assume that the thermal conductivity of the steel is 16, the corkboard is 0.043 and the wood is 0.16 W/mK respectively.
   A. 195.9 KJ
   B. 19.59 MJ
   C. 1.959 KJ
   D. 19.59 KJ

15. A composite wall is 0.5 m long and 1.2 m high. It consists of an outer steel plate 1 cm and an inner layer of wood of thickness 2 cm. If the temperature drop across the outer and inner faces of the wall is 25 °C, calculate the temperature drop across the steel plate (in °C). Assume that the thermal conductivity of the steel is 16 and the wood is 0.16 W/mK respectively.
   A. 0.124
   B. 12.4
   C. 0.012
   D. 124

16. Assume a window air-conditioner unit absorbs 90 kJ of heat per minute from the room being cooled and in the same time period deposits 150 kJ of heat into the outside atmosphere. Calculate Energy Efficiency Rating (EER) of the unit.
   A. 0.511
   B. 5.11
   C. 0.23
   D. 2.3

17. The mass of an iron calorimeter is 0.42 kg. It contains 0.75 kg of water at 25 °C. If the specific heat of iron is 0.46 kJ/kg K and the specific heat of water is 4.2 kJ/kg K, calculate the heat required (in kJ) to raise the temperature of the water by 12 °C.
    A. 979.6 KJ
    B. 401.2 KJ
    C. 4.012 KJ
    D. 40.12 KJ

18. Suppose a freezer has a coefficient of performance of 2.40. The freezer is to convert 3 kg of water at 25 °C to 3kg of ice at - 10 °C in one hour. How much wasted heat is rejected to the room in which the freezer sits? For water, c_w = 4.19 kJ/kg.K and L_f = 334 kJ/kg; For ice, c_{ice} = 2.01 kJ/kg K.
    A. 19.5 MJ
    B. 195.02 KJ
    C. 1950.2 KJ
    D. 19502 KJ

19. A composite wall is 1.2 m long and 2.0 m high. It consists of an outer steel plate 1.5 cm and an inner layer of plywood of unknown thickness. If the rate of heat transfer is 408 kJ per hour across the wall, and the temperature drop across the outer and inner faces of the wall is 21 °C, calculate the thickness (in cm) of the plywood layer. Assume that the thermal conductivity of the steel is 16 and the plywood is 0.13 W/mK respectively.
    A. 0.577
    B. 57.7
    C. 5.77
    D. 577

20. Suppose a freezer has a coefficient of performance of 2.40. The freezer is to convert 3 kg of water at 25 °C to 3 kg of ice at - 10 °C in one hour. What is the magnitude of heat that must be removed from the water at 25 °C to convert it to ice at - 10 °C?
    A. 1376.6 MJ
    B. 137.66 KJ
    C. 13.76 MJ
    D. 1376.6 KJ

21. Assume that a freezer has a coefficient of performance of 3.0. The freezer is used to convert 2.5 kg of water at 25 °C to 2.5 kg of ice at -22 °C in one hour. How much electrical energy is consumed by the freezer during this hour? Assume that c_w = 4.190 kJ/kg K, L_f = 334 kJ/kg and c_{ice} = 2.01 kJ/kg K.
    A. 402.5 KJ
    B. 402.5 MJ
    C. 40.25 KJ
    D. 4025KJ

22. Suppose a room air conditioner has a coefficient of performance 3.0 on a hot day and uses 900W of electric power. Calculate the quantity of heat that the air conditioner delivers to the outside atmosphere in one minute.
    A. 216 J
    B. 216 KJ
    C. 2.16 KJ
    D. 21.6 KJ

23. A tank 3m x 3m x 3m is made of steel and has an 18 cm thick wall. It contains water at 90 °C. The air around the tank is at 25 °C. Assume that the thermal conductivity of steel is 43 W/mK, the heat transfer coefficient of water is 3.0kW/m^2k and that of air is 25.0 W/m^{2k}. Calculate the overall heat transfer coefficient (W/m^{2K}) from water to air.
    A. 22.46
    B. 15.72
    C. 22.1
    D. 7.9

24. The coefficient of area expansions, (deltaA/A)/T, of a rectangular sheet of the solid is (in terms of coefficient of linear expansion alpha):
    A. alpha/2
    B. 2alpha
    C. alpha/4
    D. 4alpha

25. A physics student wants to cool 0.25 kg of Cola (mostly water), initially at 25 °C, by adding ice initially at 20 °C. How much ice should he add so that the final temperature will be 0 °C with all ice melted if the heat capacity of container may be neglected.
    A. 69.6 gm
    B. 6.96 gm
    C. 69.6 KG
    D. 6.96kg

भारत सरकार / GOVERNMENT OF INDIA
पत्तन, पोत परिवहन और जलमार्ग मंत्रालय
MINISTRY OF PORTS, SHIPPING AND WATERWAYS
समुद्रीय प्रशासन महानिदेशालय, मुंबई
DIRECTORATE GENERAL OF MARITIME ADMINISTRATION, MUMBAI

MARINE ENGINEERING OFFICER CLASS IV-A
SUBJECT: APPLIED MECHANICS

Max Marks: 100 / Pass Marks: 50

Instructions for the exam would be provided in answer sheet

---

1. A runner runs 1.75 laps around a circular track in a time of 70 seconds. The diameter of the track is 70m. The magnitude of the runner's average velocity is,(**π** =3.14)
   A. 5.495m/s
   B. 2.355m/s
   C. 3.14m/s
   D. 0.71m/s

2. A ball of mass 400 grams has a constant velocity of 45 Kmph when it reverses direction. The change in momentum in Kg m/sec will be,
   A. 18 Kg m/s
   B. 5 Kg m/s
   C. 0 Kg m/s
   D. 10 Kg m/s

3. A 10 kg object is travelling at a speed of 30 m/sec on a frictionless road. The magnitude of the retarding force that should be applied on the object to stop it within a distance of 10m is,
   A. 300N
   B. 100N
   C. 450N
   D. 4.5KN

4. A body with an initial momentum of 23.1 kg m/sec , collides and it's momentum changes to 42.9 kgm/sec in 5 seconds. The force exerted on the body due to collision will be
   A. 4.62N
   B. 3.96N
   C. 8.58N
   D. 13.3N

5. The Centrifugal force exerted by a stone of mass 200g tied from a 5m long string rotating at 3 revolutions per sec is, (**π** = 3.1412)
   A. 35.52N
   B. 355.2N
   C. 18.84rad/sec
   D. 94.23 N

6. A constant force of 4N is applied to a body of mass 8 kg, initially at rest. The velocity of the body after 10 seconds will be,
   A. 0.5m/s
   B. 50m/s
   C. 5m/s
   D. 40m/s

7. Kinetic Energy is represented by the formula:
   A. (mv)/2
   B. mv^2
   C. (mv^2)/2
   D. mv

8. A cricket ball is thrown at a speed of 40 m/sec in a direction 45degree above the horizontal. Assume that g = 9.8 m/sec^2, the maximum height that the ball reaches, correct to one decimal is,
A. 40.8m
B. 40.82m
C. 40.816m
D. 40.8163m

9. A ball is thrown vertically upwards with a velocity of 45 m/sec from the top of a tower having height of 50m. In return it misses the tower and falls down. The time (t) that elapses from the instant that the ball was thrown until it passes the edge of the tower on its way down and the velocity (v) with which the ball hits the ground will be, Assume g = 10 m/sec^2.
A. t= 4.5secs and v=45m/s
B. t=55 secs and v=9m/s
C. t= 9secs and v=55m/s
D. t=4.5 secs and v=55m/s

10. A bullet of mass 60 grams travelling at 520m/s strikes a freely suspended block of mass 18Kg and gets embedded in it. The velocity with which the block begins to swing is,
A. 1.73m/s
B. 520m/s
C. 0 m/s
D. None of the above

11. The tension in a cable tied horizontally to an 8kg cart is 64N. Starting from rest, the time taken by the cart to attain a speed of 92 m/sec assuming negligible friction will be
A. 8 secs
B. 11.5 secs
C. 92m/s
D. 1.4375 secs

12. An auto travels at a rate of 45kmph for 6minutes, then at 60kmph for 6minutes and finally at 30kmph for 8minutes. The total distance travelled (D) in Km and the average speed(S) in kmph will be,
A. D=15.4 Km and S=43.5Kmph
B. D=14.5km and S=43.5Kmph
C. D=14.5Km and S=4.35 Kmph
D. D=145Km and S=43.5 Kmph

13. The tangential velocity of an object attached to a string of length 2m that rotates at 7 rotations per second will be,
A. 44rad/sec
B. 88m/sec
C. 14m/s
D. None of the above

14. A certain force acts on a body of mass 1kg causes a particular acceleration. When the same force is applied to a body of mass X, the acceleration produced is 2m/sec2. The total acceleration produced when this force acts on these two bodies tied together is 1.5m/sec2. The value of X will be,
A. 3kg
B. 3N
C. 1Kg
D. 1N

15. The frequency of rotation of a body of mass 8g, tied to a string of length 2m, if the centrifugal force generated due to rotation is 100N, will be,
A. f=16 Hz
B. f=12.6 Hz
C. f=6.25 Hz
D. None of the above

16. Two balls were dropped from different heights. One is dropped 2secs later but they both strike the ground at the same time.If the difference in their heights is 78m, the height from which the second ball was dropped was,
(Assume g = 10m/sec^2)
A. 12.5m
B. 45m
C. 60m
D. 75m

17. A spring of spring constant 100N/m is fixed at one end and a mass 25kg sliding horizontally at 3m/s is attached to its free end. The maximum compression of the spring when this mass strikes it will be,
A. 2.25m
B. 2m
C. 1.5m
D. 1m

18. A ball is dropped from the top of a building. The ball takes 0.5sec to pass the 3m length of a window some distance from the top of the building. The distance of the top of the window from the point the ball was dropped is,
(Assume g = 10 m/sec^2)
A. 8.5m
B. 0.6125m
C. 3m
D. 10m

19. A truck starts from rest and moves with a constant acceleration of 4.5m/sec^2. Its velocity (V) and distance (D) travelled after 15 seconds will be,
A. V=6.75m/s and D=506.25m
B. V=6.75m/s and D=50.625m
C. V=67.5m/s and D=5.0625m
D. V=67.5m/s and D=506.25m

20. A ball is dropped from the top of a building. It takes 0.5seconds to pass the 3m length of a window some distance from the top of the building. The speed of the ball as it passes the top of the window is, (Assume g = 10 m/sec^2)
A. 6m/s
B. 3.5m/s
C. 8.5m/s
D. None of the above

21. Two cars (A and B) start from rest at the same time and same point. Car-A moves north accelerating at 3 m/sec^2 for 6 seconds and then moves at a uniform velocity. Car-B moves south accelerating at 4 m/sec^2 for 5 seconds and then moves at a uniform velocity. At some point in time, the distance between them is measured to be 1074 m. The time that has passed since the two cars started moving will be,
A. 26 secs
B. 25 secs
C. 51 secs
D. 31 secs

22. A body falls freely from rest. The distance(H) it falls in 5seconds and its speed (V)after falling for 60m will be,
(Assume g=10m/sec^2)
A. H=12.5m and V=34.64m/s
B. H=34.64m and V=125m/s
C. H=125m and V=34.64m/s
D. H=60m and V=34.64m/s

23. An object is moving along straight line with its displacement given by equation $X(t) = t^3 - 4t^2 + 17t + 60$, where displacement is in meters and t in seconds. The displacement of the object when the acceleration is zero will be,
A. X=74m
B. X=78m
C. X=60m
D. X= 0m

24. The potential energy possessed by a body of weight 50N lifted to a height of 20m is
A. 9.800 J
B. 98.00 J
C. 980.0J
D. 9800 J

25. A cricket ball is thrown at a speed of 28 m/sec in a direction 30degree above the horizontal. Assuming g = 9.8 m/sec^2, the time taken by the ball to return to ground corrected to two decimal places is,
A. 2.657 sec
B. 1.43 sec to go up and 1.43 sec to come down
C. 1.5 sec to go up and 1.5 sec to come down
D. None of the above

भारत सरकार / GOVERNMENT OF INDIA

पत्तन, पोत परिवहन और जलमार्ग मंत्रालय

MINISTRY OF PORTS, SHIPPING AND WATERWAYS

समुद्रीय प्रशासन महानिदेशालय, मुंबई

DIRECTORATE GENERAL OF MARITIME ADMINISTRATION, MUMBAI

MARINE ENGINEERING OFFICER – CLASS IV PART A

SUBJECT: MATHEMATICS

Max Marks: 100 / Pass Marks: 50

Instructions for the exam would be provided in answer sheet

1. In a class, 80 boys and 60 girls participated in an examination. 20 percent of the boys and 50 percent of the girls pass. How many students failed the exam?
   A. 90 students
   B. 92 students
   C. 96 students
   D. 94 students

2. Chandan walked diagonally across a rectangular field of 3 by 8 kms. If he had walked along the sides, he would have walked a greater distance. Calculate the distance he saved by walking across as opposed to walking along the sides?
   A. 2.56 kms
   B. 2.36 kms
   C. 2.46 kms
   D. 2.26 kms

3. Aryan, Rishi and Wilson started a business with an investment of 900, 700 and 600 respectively. At the end of one year, the total profit is 300. What is Rishi's share of the profit?
   A. 89 rupees
   B. 95 rupees
   C. 97 rupees
   D. 92 rupees

4. A person X observes a flag post of height 15m at an angle of elevation of 60 degree. Another person Y observes the same post at an angle of 45degree from a direction opposite to person X. Find the distance (in m) between the two people. Your answer should be correct to two decimals.
   A. 18.44
   B. 23.66
   C. 27.33
   D. 31.55

5. In a class, 70 boys and 110 girls participated in an examination. 50 percent of the boys and 50 percent of the students passed the examination. What percent of the girls failed the exam?
   A. 44 percent
   B. 48 percent
   C. 50 percent
   D. 46 percent

6. In the equation, (x - 3) + (5/(x-2)) = ((x + 3)/2) one of the values that x can take is 4. Find the other.
   A. 7 or 4
   B. 2 or 7
   C. 4 or 7
   D. 7 or 2

7. In a class, 50 boys and 60 girls participated in an examination. 40 percent of the boys and 40 percent of the students passed the examination. How many girls passed the exam?
   A. 28 girls
   B. 24 girls
   C. 30 girls
   D. 26 girls

8. For a particular car, assume that in the range of 50-90 km per hour, the fuel consumption will be directly proportional to the speed of the car. The car consumes 6.00 litres of fuel per hour when travelling at 75 km per hour. On Sunday, the car makes a round trip from one city to another and back. The car travelled at 60km per hour during the onward trip and 90 km per hour during the return trip. If the total fuel consumed in the round trip was 20 litres, what is the distance between the two cities?
   A. 121
   B. 141
   C. 132
   D. 125

9. In a particular match, Akash scored 110 runs which included 4 boundaries and 6 sixes. What percent of his score did he make by running between the wickets?
   A. 50%
   B. 53%
   C. 56%
   D. 59%

10. Rani walks from one end of a street to the other end at a speed of 12 kms per hour. If the street is 700 meters long, how much time does she take?
   A. 200 seconds
   B. 190 seconds
   C. 180 seconds
   D. 210 seconds

11. In a class, 50 boys and 60 girls participated in an examination. 40 percent of the boys and 70 percent of the girls pass. What percentage of the total students failed the exam?
   A. 39 percent
   B. 36 percent
   C. 44 percent
   D. 33 percent

12. A force of 1200 N compresses a spring from its natural length of 18 cm to a length of 16 cm. Calculate the work is done in compressing it from 16 cm to 14 cm.
   A. 4800
   B. 1200
   C. 3600
   D. 6000

13. Nikhil is 5 times as efficient as Newton. Nikhil and Newton can work together and complete a task in 14 days. How long will Newton take to complete the work by himself?
   A. 87 days
   B. 86 days
   C. 85 days
   D. 84 days

14. Madhu walked diagonally across a circular field of radius 42 meters. If she had walked along the edge of the field, she would have walked a greater distance. Calculate the distance she saved by walking across as opposed to walking along the edge?
   A. 45.8 meters
   B. 49.0 meters
   C. 46.6 meters
   D. 47.9 meters

15. Two trains leave from the same point diverging from each other at 45 degree. After the first train travels for 32km, the distance between the two trains is 28km. Find the distance that the second train has covered from the starting point (in km). Assume that the second train is faster than the first. Your answer should be correct to one decimal.
    A. 39.13
    B. 44.33
    C. 47.55
    D. 33.31

16. Solve the equation $5\cos^2 x-9\sin x-3=0$. Find value of x in degrees. Your answer should be correct to two decimals.
    A. 14.21
    B. 12.23
    C. 11.53
    D. 13.18

17. Find the second moment of area of a rectangle of width 10 and depth 5 about its centroid. Your answer should be correct to two decimals.
    A. 104.17
    B. 105.11
    C. 106.21
    D. 107.13

18. Nisha walked diagonally across from one side to the other side of a circular field of radius 500 meters. If she had along the perimeter of the field, she would have walked a greater distance. Calculate the actual distance she saved.
    A. 540 meters
    B. 610 meters
    C. 570 meters
    D. 590 meters

19. The velocity v of a body after time t is given by the expression $v=3t^2-10t$. If distance s=20 when t=3 sec, the distance s in terms of t can be written as at^p+bt^q+c where p>q. Find the values of a, b, c, p and q respectively.
    A. 2,-6,32,4,3
    B. 3,-7,28,2,4
    C. 1,-5,38,3,2
    D. 4,-2,42,1,5

20. A car covers a certain distance at a speed of 50 km/hr in 13 minutes. To cover the same distance in 29 minutes, it must travel at a speed of:
    A. 22 km/hr
    B. 19 km/hr
    C. 28 km/hr
    D. 29 km/hr

21. A train with a length of 350 metres crosses a tree in 10 seconds. At what speed is the train running?
    A. 35 km/hr
    B. 108 km/hr
    C. 144 km/hr
    D. 126 km/hr

22. If the equation of a circle is in the form $x^2 + y^2+ 2gx+2fy + c = 0$, and the circle is passing through the points (2,-1), (1,1) and (3,2), find values of g, f and c.
    A. -2.5, -0.5 ,4
    B. -1.5, -0.4 ,5
    C. -3.4, -0.2, 7
    D. -4.5, -0.3, 6

23. The distance s moved by a body in time t is given by the expression $s= 16t-4t^2+5$ meters. Find the distance moved by the body when the velocity is zero. Your answer should be correct to one decimal.
    A. 27
    B. 21
    C. 19
    D. 31

24. Solve the equation $5\sin^2x-9\cos x-3=0$. Find value of x in degrees. Your answer should be correct to two decimals.
    A. 68.45
    B. 72.63
    C. 82.23
    D. 78.46

25. Solve the equation $5\cos^2x-13\cos x+6=0$. Find value of x in degrees. Your answer should be correct to two decimals.
    A. 60.23
    B. 53.13
    C. 56.33
    D. 63.37

			Sr. No. 27X26-2
	EXAMINATION OF MARINE ENGINEER OFFICER		
	Grade: MEO – Class-IV Part A		
	Subject: **ENGINEERING DRAWING**		
(India 2026)	**(Time allowed – 4 Hours)**		**Total Marks: 100**

NB:

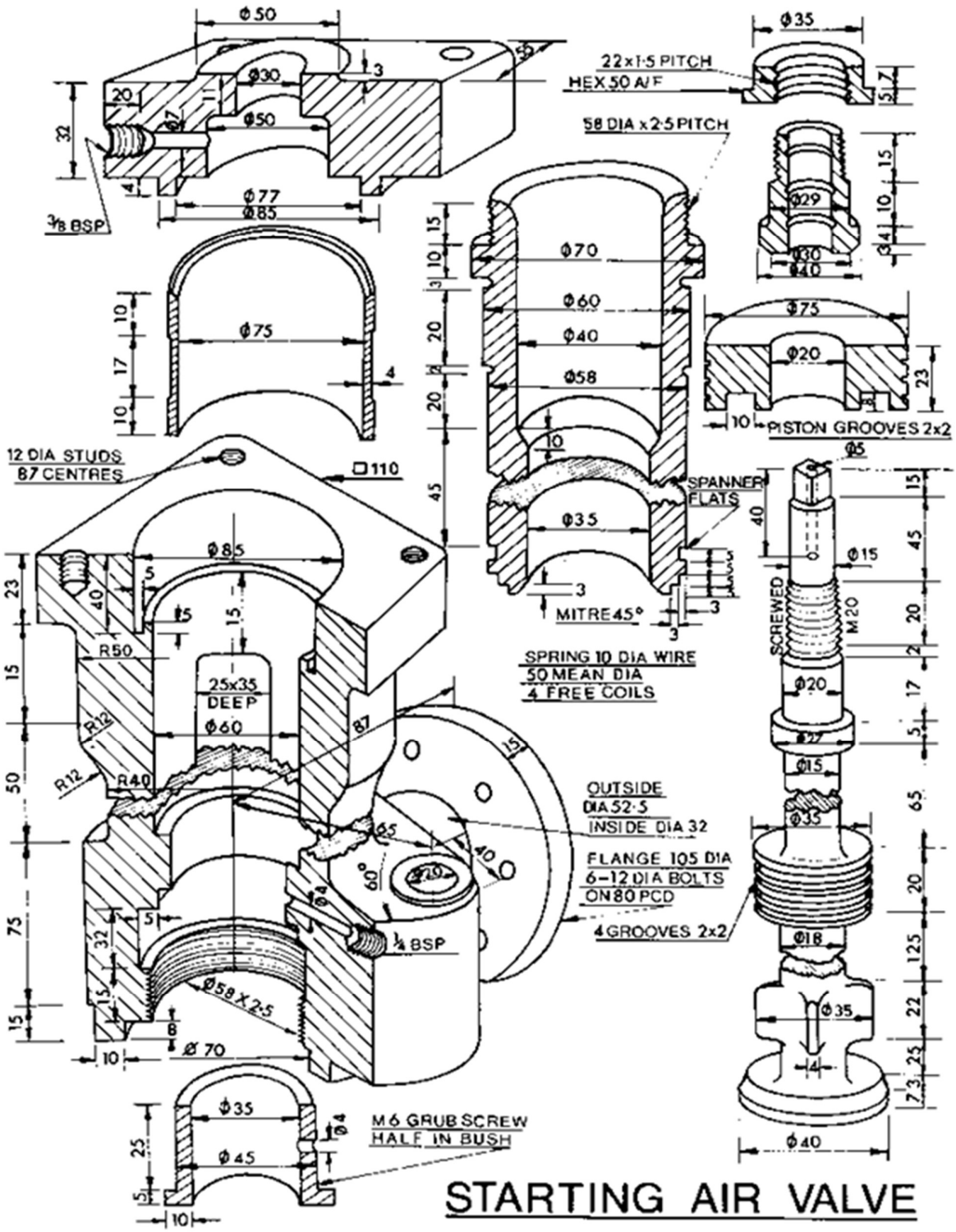
(1) All Questions are Compulsory
(2) The Scale used must ensure uniform distribution and coverage of the Drawing sheet.
(3) Neatness in Drawing carries weightage.

STARTING AIR VALVE

DRAW:

(i)	Sectional elevation through inlet branch showing all parts assembled.	(40)
(ii)	End elevation	(40)
(iii)	Sectional plan through vent in valve body.	(20)

----------xxxxxxxxxxxxxxxxxxxxx----------



STARTING AIR VALVE

Sr. No. 23X2026-1

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER

Grade: MEO Class IV

Function: Controlling the Operation of the Ship & Care for Persons on Board at Operational Level

Subject: **SHIP CONSTRUCTION AND STABILITY**

(Time allowed :3 hours) Total Marks: 100

Note:
1) Answer **SIX** Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be striked off by (**X**) at the end of each question.

1 For a ship the center of buoyancy and the metacenter are in the line of action of the buoyant force _____.
(a) only when there is positive stability
(b) only when there is negative stability
(c) only when there is neutral stability
(d) at all times
Justify your answer. [16]

2 Explain the meaning and purpose of EACH of the following terms:
(a) Duct keel (b) Margin line
(c) Sheer (d) Round of Bilge [4x4]

3 (a) Describe the types of welding joints and the advantages of welding over riveting in ship construction. [8]

(b) With a diagram briefly explain different types of rudders. [8]

4 With reference to bilge keels:
(a) Describe how the design and method of attachment reduces the possibility of damage to the shell plate; [8]
(b) State what testing must be carried out. [4]
(c) Explain why the bilge keels do not extend the full length of the vessel. [4]

5 With reference to large bulk carriers:
(a) Sketch a cross section of a bulk carrier through the mid-ship; [8]
(b) Explain the design features that have evolved to minimise the possibility of failure. [8]

6 (a) Define angle of loll. [6]

(b) A box barge 60 m long and 10m wide floats at an even keel draught of 4 m. It has a compartment amidships 12 m long. Calculate the new draught if this compartment is laid open to the sea when: (i)μ is 100% (ii)μ is 85% (iii)μ is 60% [10]

7 (a) What do you understand by 'coffin' plate? [6]

(b) A ship displacing 10000 tonne and travelling at 16 knots has a fuel consumption of 41 tonne per day. Calculate the consumption per day if the displacement is increased to 13750 tonne and the speed is increased to 17 knots. Within this speed range, fuel consumption per day varies as $(\text{speed})^{3.8}$. [10]

8 A ship with a displacement of 8,200 tonnes and a length of 90 m is floating in sea water with a density of 1.024 t/m^3. The half-ordinates of the waterplane area at equal intervals are: 0, 2.61, 3.68, 4.74, 5.84, 7.00, 7.30, 6.47, 5.35, 4.26, 3.16, 1.88, and 0 m. Calculate: [16]

(i) Calculate the Waterplane Area using Simpson's First Rule.

(ii) Calculate the TPC (Tonnes per Centimetre Immersion) in sea water.

(iii) Find the change in mean draught when the ship moves from sea water of density 1.024 t/m^3 into river water with a density of 1.005 t/m^3.

9 (a) What are the water pressure loads on the ship's hull? [6]

(b) A ship of 5,000 tonnes displacement has a KM of 6.2 m and a KG of 5.5 m. It has a rectangular double-bottom tank of length 16 m and breadth 10 m, which is partially filled with diesel oil (Relative Density = 0.88). Calculate (a) The Free Surface Correction (FSC) or virtual rise in KG. (b) The final GM of the ship. [10]

Sr. No. 23X26-2

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER

Grade: MEO Class IV

Function: Controlling the Operation of the Ship & Care for Persons on Board at Operational Level

Subject: **SHIP SAFETY AND ENVIRONMENTAL PROTECTION**

(Time allowed :2 hours) Total Marks: 100

Note:
1) Answer **FIVE** Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be striked off by (X) at the end of each question.

1	(a)	Explain the purpose of a Enclosed space permit.	[6]
	(b)	State the different types of work permit used on ships and their utility.	[6]
	(c)	Prepare a checklist for issuance of Enclosed space permit.	[8]
2		Write short notes on following: (a) Immersion suit (b) TPA (c) Anti-exposure suit (d) EEBD	[5x4]
3	(a)	Name the gases usually found inside enclosed spaces.	[6]
	(b)	What instruments are used in detecting /checking the gases which are present?	[6]
	(c)	What is the minimum level of oxygen required for entry into enclosed space.	[2]
	(d)	With a simple diagram, explain the working of oxygen content meter.	[6]
4	(a)	What is a Fire control plan(F.C.P.)? What information does it provide?	[5]
	(b)	State 5 nos. graphic symbols shown in the plan and state the language in which the plan is drafted.	[5]
	(c)	Mention the locations at which the FCP is displayed?	[5]
	(d)	How does the FCP aid the shore fire fighting team? Where do they find the ship's FCP?	[5]
5		Write short notes on following with respect to lifeboats: (a) Marking on lifeboat (b) Signalling and communication equipment (c) Centrifugal brakes (d) Safeties provided on lifeboat davit	[5x4]
6	(a)	Explain the function of IMO as one of UN specialised agencies.	[6]
	(b)	Briefly explain the structure of IMO including the main committees.	[7]
	(c)	Explain the process of adopting a convention at IMO.	[7]

7 (a) Sketch and explain the operation of the Quick Closing Valve? [10]

(b) What do you understand by the Emergency Shutdown System? Explain the operation in an emergency. [10]

8 Using a simple sketch, describe the fire main of a ship with which you are familiar. Include in your answer :

(a) the number and type of pumps [5]

(b) material of the piping [5]

(c) significance of the drain valve [5]

(d) location of the international shore coupling [5]

Sr. No. 22X26-1

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER
Grade: MEO Class IV
Function: Marine Engineering at Operational Level

Subject:MARINE ENGINEERING KNOWLEDGE (GENERAL)

(Time allowed :3 hours) Total Marks: 100

Note:
1) Answer SIX Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be strike off by (X) at the end of each question.

1 In an automatic backflushing filter (e.g. for fuel oil or lube oil), what normally initiates a cleaning cycle?

(a) A high differential pressure across the filter, or a preset timer interval, whichever occurs first [16]

(b) Manual opening of the drain cock by the engineer on watch

(c) A rise in oil temperature at the filter outlet

(d) A drop in the oil level of the service tank

Briefly discuss the operation of an automatic backflushing filter and justify the correct option you chose from the above four.

2 Clean and dry control air is essential for efficient,troublefree operation of a ship's pneumatic ' control air system.

(a) Sketch and describe a low pressure control air systems used on board ships,showing various arrangements to deal with dust,oil and moisture.as well as safety systems. [8]

(b) Explain using a line diagram, arrangement provided, to reduce the air pressure to 7/ 8 bars, required for control air system. [8]

3 Describe with the aid of suitable graph, the discharge characteristics of a centrifugal pump. Explain why it does not require a relief valve. [16]

4 Give an outline sketch of Heavy F.O. setting tank heating system and briefly explain the system. Sketch only the low pressure steam inlet upto condensate collection tank. [16]

5 The auxiliary boiler of a ship periodically needs feed water and the rate of feed is gradually increasing everyday, without an increase in demand. Suggest some causes for such a happening. [16]

6 Write short notes on the following :

(a) Need to ensure that D.O. service tanks are not heated beyond a certain temperature. [4]

(b) Importance of the level of the F.W. compensating tank for jacket cooling of main engines as an indicator of impending trouble. [4]

(c) Need to check remote stop of all F.O. installations regularly. [4]

(d) Neccessity for a proper check of all engine room parameters before taking over of watch. [4]

7 (a) What are the Safety Devices fitted to an Air Compressor? [4]

(b) What is the Purpose of the Scum Valve on a Boiler? [4]

(c) What is the Function of an Evaporator in a Refrigeration System? [4]

(d) Regarding the Emergency Bilge Injection Valve, what is its relevant size compared to the Main Sea Water Injection Valve? [4]

8 (a) Describe the constructional features of plate type fresh water generator and its operational procedures for fresh water generation. [6]

(b) State the temperatures and pressures at salient points. [4]

(c) State some of the advantages and limitations that exist in using a plate type heat exchanger. [6]

9 (a) Whils't on 'seawatch' you observe that the Oil Mist detector(OMD) in the engine room has triggered an alarm; and in feeling the crankcase doors on the bottom platform, you find that the unit in question feels warmer than the rest.What pre-emptive action will you take as Watch-keeper to bring the situation under control. [10]

(b) Draw a simple line diagram of a 'OMD' and explain it's working. [6]

Sr. No. 22X26-2

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER
Grade: MEO Class IV
Function: Marine Engineering at Operational Level

Subject:MARINE ENGINEERING KNOWLEDGE (MOTOR)

(Time allowed :3 hours) Total Marks: 100

Note:
1) Answer **SIX** Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be strike off by (**X**) at the end of each question.

1 A very sudden rise in pressure during combustion accompanied by a metallic, hammer like sound is called knocking of the unit or detonation and usually occurs
(a) Near the end of the pressure rise after ignition of fuel charge
(b) Just before the fuel charge is about to ignite
(c) Immediately after the unit reaches peak pressure and before ignition of fuel
(d) At any stage of the combustion process.
State the correct answer and explain why the other reasons given are not justified. [16]

2 (a) List and explain the desirable properties of lubricating oil for different application such as for main engine, auxiliary engine and for cyliner lubrication. [8]

(b) Sketch an auxiliary engine lubricating oil circuit. [8]

3 With reference to turbochargers :

(a) Explain the term surging, stating how it occurs, its effect on the turbocharger and how it can be avoided; [8]

(b) Describe the procedures for cleaning EACH of the following and explain the precautions which should be taken: [8]

(i) Suction air (ii) Turbine blades and nozzle ring

4 Write short notes on: [4x4]

(a) control air dryer (b) crankcase door

(c) auxiliary engine overspeed trip (d) fuel oil leak off alarm

5 A large marine diesel main propulsion engines, speed fluctuates all the time during the voyage. Make written statements to the chief engineer explaining the observation of various engine parameters, during the voyage which could be indication of some fault, causing engine speed fluctuation. [16]

6	(a)	What are the advantages of a thin shell bearing?	[4]
	(b)	What are the typical bearing failures? Discuss at least four bearing failures.	[8]
	(c)	Why is periodic analysis of the lubricating oil important?	[4]
7	(a)	Why tie-rods are provided on a 2-stroke main engine?	[6]
	(b)	Why tie rods are placed close to the centerline of the crankshaft?	[5]
	(c)	What is a tie rod pinch screw? And what is its purpose?	[5]
8		Explain briefly how the different moving parts of a main engine are subjected to various stresses. Name the stresses and justify by stating how they originate.	[16]
9		Indicator cards have shown that one cylinder is high in power although the maximum pressure is low. State the associated effects that this might have on the various instruments of the engine and give a detailed description of the method of rectifying the defect. If this abnormality were not remedied, what might be the subsequent effects on the operation of the engine? State the type of engine to which your answer refers.	[16]

Sr. No. 21X26-3

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER

Grade: MEO Class IV

Function: Marine Engineering at Operational Level

Subject:MARINE ENGINEERING KNOWLEDGE (STEAM)

(Time allowed :3 hours) Total Marks: 100

Note:

1) Answer **SIX** Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be striked off by (**X**) at the end of each question.

1		With reference to main propulsion steam turbine:	
	(a)	What are the symptoms and causes of high temperature of turbine, reduction gear and shaft bearings?	[8]
	(b)	What actions are taken in case of hot bearings as above?	[8]
2	(a)	Sketch and describe a double evaporation water tube boiler showing the circulation of water and steam.	[10]
	(b)	What are the advantages and disadvantages of a Double evaporation boiler over a single evaporation boiler?	[6]
3	(a)	What are the dangers of fuel accumulation in boiler furnaces?	[8]
	(b)	What are the causes for fuel accumulation in the boiler furnace?	[8]
4		Give a description of an automatic sootblower system for a water-tube boiler. Show on a diagram the layout of the system and the order of operation you would expect the blowers to follow.	[16]
5		Describe in detail how you would blow down a boiler and open it up for internal inspection. Explain why boilers are often blown down over board and not run down to bilges. State why regular blow down and freshening of the contents of a boiler is essential.	[16]

6 With reference to an auxiliary steam installation:

(a) Explain the term water hammer indicating possible effects on the system. [4]

(b) State how the risk of water hammer may be avoided. [4]

(c) State, with reasons, why the testing and treatment of boiler water is essential. [4]

(d) State, with reasons, how boiler problems may be minimized if no water treatment is immediately available and a steam supply must be maintained. [4]

7 (a) Sketch and describe a remote water level sensor using DP cell. [8]

(b) What is the purpose of equalising valve ? [4]

(c) How are the Low level, High Level alarms tested? [4]

8 Write short notes on the following:

(a) flame eye working principle (b) safety interlocks in an auxiliary boiler [16]

(c) consequence of a failed water level controller

9 Sketch and describe a boiler water level controller of the float operated type. State the reasons for having this mechanism on the boiler and using the controller and boiler for analogy explain the following terms. [16]

(a) Detecting element

(b) Servo motor

(c) Desired value

Sr. No. 26X26-2

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER

Grade: MEO Class IV

Function: Electrical, Electronics & Control Engineering at Operational Level

Subject: **MARINE ELECTRO TECHNOLOGY**

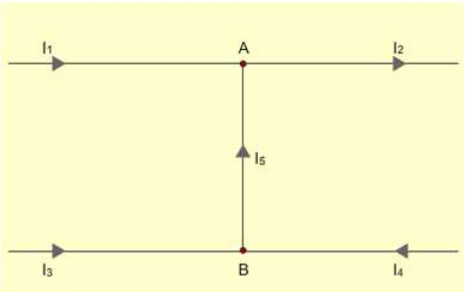
(Time allowed :3 hours) Total Marks: 100

Note:
1) Answer **SIX** Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be striked off by (**X**) at the end of each question.

1		Differentiate between squirrel cage and wound rotor motors, of the three phase a.c. induction type, in respect of the following: (a) rotor construction; (b) torque characteristics; (c) speed variation.	[16]
2		If the motor terminal markings are unknown how would you identify the start, run and common terminal connections.	[16]
3	(a)	Sketch and describe the working of a Lead -Acid battery.	[12]
	(b)	What routine maintenance is carried out on these batteries?	[4]
4		Draw the wiring diagram of a fluorescent tube lighting and explain the function of choke, starter, condenser, across starter. What is the purpose of the coating inside of the tube with fluorescent powder?	[16]
5	(a)	How protection is provided for electrical **short circuit**.	[4]
	(b)	Describe the construction and operation of **HRC fuses**.	[8]
	(c)	What are the advantages of HRC fuses.	[4]

6 (a) Explain Kirchoff's current law. [6]

(b) In the given circuit, find the current value I_2 . [10]



7 (a) Compare constant current method and constant voltage method of charging batteries. [6]

(b) The filament of a 230V lamp takes a current of 0.261A when working at its normal temperature of 2000º C. The temperature coefficient of the tungsten filament material can be taken as 0.005 º C^{-1} at 0º C. Find the approximate current which flows at the instant of switching on the supply to the cold lamp, which can be considered to be at a room temperature of 20º C. [10]

8 (a) Define work, Power and Efficiency. [6]

(b) A shunt motor has an armature resistance of 0.2 ohms and with an armature current of 120 amperes runs at 750 r.p.m. off a 400-volt supply. Calculate the speed and armature current of the motor if the flux per pole is reduced to 75 per cent of its initial value, the total torque remaining unaltered. [10]

9 (a) Explain what do you understand by the term 'transducer'? [6]

(b) An inductance coil has a resistance of 19.5Ω and when connected to a 220V, 50Hz supply, the current passing is 10A. Find the inductance of the coil. [10]

Sr. No. 26X26-1

India (2026)

EXAMINATION OF MARINE ENGINEER OFFICER

Grade: MEO Class IV

Function: Maintenance & Repair at Operational Level

Subject: **MARINE ENGINEERING PRACTICE**

(Time allowed :3 hours) Total Marks: 100

Note:
1) Answer **SIX** Questions only.
2) All Questions carry equal marks
3) Neatness in handwriting and clarity in expression carries weightage
4) Illustration of an Answer with clear sketches/diagrams carries weightage.
5) Start answering from the backside of the front cover page.
6) Blank pages whether full or half, to be striked off by (**X**) at the end of each question.

1 Describe the examination you will carry out on the following parts of an air compressor: [4x4]

(a) Suction and delivery valves and seats (b) Relief valves and bursting discs
(c) Coolers and cooling passages (d) Piston and piston rings

2 The exhaust temperature of an auxiliary diesel engine is found to be excessive and uneven at normal load, with dark exhaust at the funnel.
Describe the following:

(a) an investigation into the situation; [5]
(b) the procedure to remedy the immediate problems, so identified; [6]
(c) any further action that might be considered necessary. [5]

3 A centrifugal pump has been opened up due to abnormal noise:

(a) List the checks you will carry out on the various components; [4]
(b) Name the parts which may require replacement; [4]
(c) Checks to be carried out after assembly; [4]
(d) Operational parameters, which may be required to be compared with manufacturers test record. [4]

4 With reference to auxiliary boilers;

(a) Briefly describe the maintenance procedures for oil burning equipment. [5]
(b) Explain the need for, and the use of, soot blowers. [5]
(c) Describe how a boiler should be taken out of service. [6]

5 An air cooler of a large two stroke marine diesel engine is showing poor performance. Suggest some measures you would initiate to rectify the problem and improve the performance. [16]

6 Briefly explain the following; [4x4]

(a) How would you know a Refrigeration system is 'undercharged'?

(b) What should you do to ensure that there is no water leakage into the engine cylinder before preparing main engine for sea?

(c) What would be the probable cause of a rise in the level of the lub oil sump tank of a main engine?

(d) How does the valve rotator as fitted on an exhaust valve of aux.engine work?

7 With reference to Steering Gear & Hydraulic Power Rotary pumps:

(a) Explain how the reserve of fluid in the system is checked and how make–up is achieved. [5]

(b) Describe how a steering system is tested prior to leaving port with reference to SOLAS. [5]

(c) Explain how tests are made for leaks, and air and other gases are bled from the system. [6]

8 (a) What are some key components of a heat exchanger that you would examine closely during a maintenance check? [8]

(b) How is leakage detected in plate-type and shell-and-tube heat exchangers? [8]

9 With reference to stuffing box of a two stroke main engine explain following:-

(a) With a neat sketch, describe the construction of a piston rod stuffing box. [8]

(b) Explain how stuffing box condition affects crankcase oil quality and why this is important to engine reliability. [8]