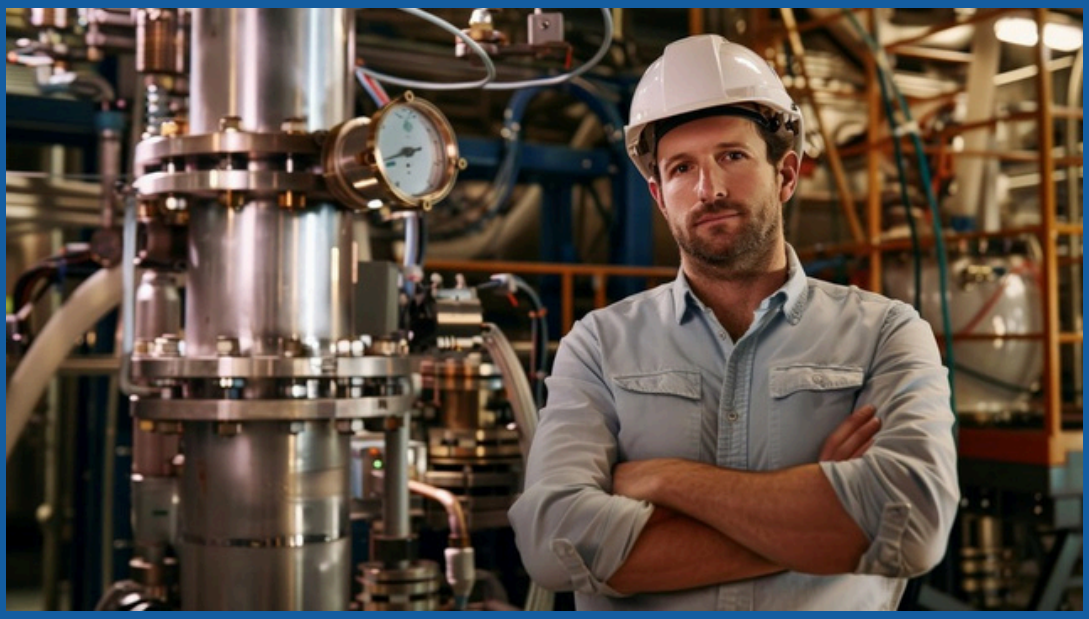
Study Material For Boiler Operation Engineer (BOE) Exams



Theory, Numerical Problems, MCQs and Boiler Drawing Problems from BOE Exams

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GOVERNMENT OF KARNATAKA

DEPARTMENT OF FACTORIES, BOILERS, INDUSTRIAL SAFETY AND HEALTH

BOILER OPERATION ENGINEERS EXAMINATION - 2023

SUBJECT: BOILER PAPER-1

MAXIMUM MARKS: 100 **TIME: 3 HOURS**

A. Choose the Correct answer **24x1 = 24 Marks**

1. Which of the following is a high-pressure boiler?
   a. Lancashire boiler b. Cochran boiler c) Benson boiler d. all the above
2. The critical pressure at which the latent heat of evaporation is zero is
   a. 225.65 kg/cm^2 b. 232.65kg/cm^2 c. 215.65 kg/cm^2 d. none of the above
3. Gradually increasing temperature of the gases at the input to the chimney for a given steam output is an indication of
   a. Higher effectiveness of the boiler b. Low calorific value of coal being burnt
   c. Fouling of heat transfer surfaces d. all the above
4. Which of the following is not a water tube boiler?
   a. Sterling boiler b. Cornish boiler c. Loeffler boiler d. Lamount boiler
5. Dry saturated steam at very low pressure (5-10 kg/cm^2) when throttled to the atmosphere will become
   a. Wet b. Superheated c. Remain dry saturated d. None of the above
6. Furnace is situated outside in the case of a
   a. Locomotive boiler b. Cochran boiler c. Babcock and Wilcox boiler d. Cornish boiler
7. Water at a pressure of 4Kg/cm^2 and 160°C temperature when exposed to the atmosphere will
   a. boil b. flash i.e. get converted into steam c. remains as it was d. cool down
8. Saturation temperature of steam with increase in pressure increases
   a. Linearly b. Rapidly first then slowly c. Slowly first then rapidly d. Inversely
9. Coke is produced by
   a. Pulverizing coal in an inert atmosphere
   b. Heating wood in a limited supply of air at temperatures below 300^{0}C
   c. Strongly heating coal continuously for about 48 hours in the absence of air in a closed vessel d. None of the above
10. In the bituminous coal carbon percentage is
    a. 76-85% b. 70-75% c. 70-73% d. 90-95%
11. In a throttling process
    a. steam temperature remains constant b. steam pressure remains constant
    c. steam enthalpy remains constant d. steam entropy remains constant
12. In an experiment to determine the dryness fraction of steam, The mass of water separated was 1.2 Kg in 15 minutes and the mass of steam passed out in same time was 4.8 kg. The dryness fraction is
    a. 0.4 b. 0.25 c. 0.5 d. 0.8

13. Pick-up the wrong statement at critical condition of steam

a. Latent heat is zero b. Liquid directly becomes steam
c. Specific volume of liquid and steam is the same d. This is the maximum pressure limit

14. Increase of pressure of a liquid

a. Lowers the boiling point b. Raises the boiling point
c. Does not affect the boiling point d. Reduces its volume

15.100% efficiency of a thermal cycle cannot be achieved because

a. Of frictional losses b. It is not possible to achieve $0^{o}K$ temperature
c. Of leakages d. Of non-availability of ideal substance

16. For burning of 1 Kg of carbon to CO_2 as per chemically correct combustion, the amount of oxygen required is

a. 1 Kg b. 4/3 Kg c. 8/3 Kg d. 2 Kg

17. The diameter of tubes for a natural circulation boiler as compared to controlled circulation boiler.

a. More b. Less c. Same d. Could be less or more depending upon other factors

18. Pick up the correct statement

a. Cornish boiler is a fire tube boiler and Lancashire boiler isa water tube boiler
b. Cornish boiler is water tube boiler and Lancashire boiler is firetube boiler
c. Cornish boiler has 2 fire tubes and Lancashire boiler has one fire tube
d. Cornish boiler has one fire tube and Lancashire boiler has two fire tubes

19. Boiler stays are used mainly for

a. Taking care of shear failure b. Preventing flatsurfaces underpressure from tearing apart
c. Taking care of failure in compression d. Providing foundation for boiler

20. In which of the boilers, the draught in the furnace is produced by utilizing steam from boiler?

a. Lancashire boiler b. Locomotive boiler
c. Babcock& Wilcox boiler d. Cochran boiler

21. In a recuperative air preheater, heat is transferred

a. From metal wall from one medium to another
b. From heating an intermediate material and then heating air from this material
c. By direct mixing d. None of the above

22. Oxygen content in atmospheric air on a weight basis is

a. 21% b. 23% c. 30% d. 40%

23. Condition of steam in the boiler drum is

a. Dry b. Wet c. Superheated d. None of the above

24. Over-fire burning is a phenomenon of

a. Supply of excess air
b. Burning of CO and un-burnt in the upper zone of the furnace by supplying more air
c. Fuel bed firing d. Supply of excess coal

B I. Write short notes on the following **5x2 = 10 Marks**

1. Nucleate boiling and film boiling
2. Recuperative air preheater and regenerative air preheater
3. Natural circulation boiler and once through boiler
4. Control methods for varying the outputs of ID fans and FD fans
5. parallel flow and counterflow heat exchanger
6. LMTD and effectiveness of heat exchangers

II. Answer the following **3x2 = 6 Marks**

1. If the lifting pressure of a safety valve is 180 kg /cm^2 and if the blow down of this safety valve is 5%, at what pressure it will get reseated?
2. For a triangular prism if the base of the triangle is 30 cms, the height of triangle is 40cms and length of the prism is 60 cms, find out the volume of the prism in litres.
3. A shaft of 10cms in diameter, 2 meters long is subjected to a torque of 80,000 kgcm. Calculate the maximum stress

C. Answer the following (Any 5) **5x3 = 15 Marks**

1. What are the different types of safety valves? Explain spring loaded safety valve
2. What are the reasons for explosion in boiler and what actions are required to prevent them?
3. What is a calorifier? What are the different types of calorifiers?
4. Explainthe steam accumulator.
5. (a) Explain the surface condenser and jet condenser along with sketch
   (b) How leaking tubes of surface condenser are identified?
6. What is a fluidized bed combustion boiler and what are its advantages?

D. Answer the following (Any 5) **5x4= 20 Marks**

1. Explain cyclone combustion, flame combustion and rapid combustion
2. (a) What are the different types of FD fans and PA fans used in boilers?
   (b) What is stalling of fans?
3. What are the fuels that can be used in a power boiler? Give their calorific values
4. What is a butterfly valve? What are its applications?
5. Explain stoichiometric air and excess air
6. A 220 mm (depth) x 120 mm (width) rectangular beam is subjected to a maximum bending moment of 40x10^{4}Kgcm. Determine
   a) Maximum stress in the beam
   b) The value of longitudinal stress at a distance of 50 mm from the top surface of the beam.

E. Answer the following **5x5= 25 Marks**

1. With a sketch explain the working of Ljungstrom tri-sector airpreheater.
2. What is preservation of boiler? How and why it is done?
3. (a) What is combustion? What are the requirements of combustion?
   (b) What are the chemical reactions involved in fuel combustion?
4. If one ball of coal of 250 c.c. volume breaks in to small 250 pcs. of ball having a volume of 1 c.c. of each ball, calculate how many times the surface area exposed to heat for combustion will increase?
5. A boiler consumes 224 tons of coal to produce 1864 tons of steam per day. The steam is drysaturated at 90 atm absolute. Calculate the boiler thermal efficiency and the equivalent evaporation per ton of coal if the calorific value of coal is 5400 Kcal/Kg and the specific enthalpy of feed water being 101.0 Kcal/Kg of water. The specific enthalpy of dry saturated steam at 90 atm abs is 646.5 Kcal/kg. The latent heat of dry saturated steam at 100^{0}C is 539 Kcal/Kg.

Or

What are the sources of heat losses of boiler? Explain in brief any 2 sources of heat loss.

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SUBJECT: BOILER PAPER-2 **REGISTER NUMBER**

MAXIMUM MARKS: 100 **TIME:3 HOURS**

I. **Choose the correct answer against each question.** **25 X 1 = 25marks**

1) The purpose of fins on convector tube is,
   a) Make it Lighter b) Strengthen the tube c) Increase heat transfer d) Prevent Rupture
2) The size of the boiler tube is specified by
   a) Outside diameter b) Inside diameter & thickness c) Outside diameter & thickness
   d) Mean diameter & thickness
3) The Rankine efficiency is
   a) 10-20% b) 20-30% c) 35-45% d) 60-75%
4) The ratio of work done per cycle to the swept volume in case of air compressor is called
   a) Compressor efficiency b) Compression ratio
   c) Mean effective pressure d) Compression index
5) The power required for an induced draught fan as compared to forced draught fan in a boiler of the same capacity is,
   a) Same b) More c) Less d) Depends on fuel fired
6) The short term over heating usually exhibits
   a) Thin lip longitudinal rupture b) Thick lip longitudinal rupture
   c) Traverse cracks d) Severe pitting
7) The percentage of carbon in medium carbon steel is
   a) 0 to 0.05 % b) 0.05 to 0.3 % c) 0.3 to 0.6 % d) 0.6 to 2.1%
8) Young's modulus of perfectly rigid body is
   a) Zero b) Unity c) 10 d) Infinity
9) Which of the following boiler is most suitable to meet fluctuating steam demand
   a) Locomotive boiler b) Lancashire boiler
   c) Babcock & Wilcox boiler d) Cornish boiler
10) The air pressure at the fuel bed is reduced below that of atmosphere by means of a fan placed at or near the bottom of the chimney to produce draught, such draught is called as
   a) Natural Draught b)Forced draught c)Induced draught d)Balanced draught
11) The vacuum obtained in a condenser depends on
   a) Type of condenser used b)Quantity of steam admitted
   c) Pressure of cooling water d)Temperature of cooling water
12) The standard value of atmospheric pressure at sea level is
   a) 10.13 bar b) 1.013 bar c) 101.3 bar c) 0.1013 bar
13) The modulus of elasticity of mild steel is approximately
   a) 80kn/mm^2 b) 100kn/mm^2 c) 110 kn/mm^2 d) 210 kn/mm^2
14) Efficiency of thermal cycle increases by
   a) Regeneration b) Reheating of steam
   c) Regeneration and Reheating of steam d) Cooling of steam

15) Air leaking into the condenser reduces
   a) Turbine output b) Cooling capacity
   c) Life of the condenser d) All of the above
16) Chances of sediments depositing inside the surface of water tubes is less due to-
   a) High working pressure
   b) Low working pressure
   c) Natural circulation boiler
   d) Forced circulation
17) Creep failures in boiler tubes are detected with
   a) Changes in tube wall thickness
   b) Severe bulging of tube
   c) Microstructure examination
   d) Traverse cracking of tube walls
18) The ideal position of an economizer in a boiler is
   a) After FD fan in Combustion air path
   b) After APH in Flue gas path
   c) Before APH in flue gas path
   a) Before ID fan in Flue gas path
19) Super heater tubes are made of
   a) Low carbon steel
   b) Medium carbon steel
   c) Alloy steel
   d) Wrought Iron
20) _____ is used to transport fine fuel particles from coal mill to boiler floor at different elevations as per the demand.
   a) Seal air b) Primary air c) Secondary air d) Tertiary air
21) The following is not a boiler accessory
   a) Steam Stop Valve b) Economizer c) Super heater d) Air preheater
22) Change in length of the steel bar depends on
   a) Change in Temperature b) Original length
   c) Co-efficient of thermal expansion d) All of the above
23) Which of the following has minimum molecular mass?
   a) Oxygen b) Hydrogen c) Nitrogen d) Water
24) Isothermal compression in air compressors is not practical because
   a) It does not increase pressure much
   b) It required big cylinder
   c) Compressor has to run at very low speed to achieve it
   d) It is not efficient
25) ESP's are used to collect _____ from flue gases
   a) Carbon Monoxide b) Nitrogen Oxide (NOx)
   c) Sulphur Oxide (Sox) d) Fine ash

II. Write true or false against each statements given below **10 X 1 = 10marks**

1) Hooks law holds good up to plastic limit
2) The latent heat of steam decreases with increase in pressure
3) The liquid used in pressure gauge should have very low surface tension
4) With natural draught the fuel consumption in a boiler can be reduced
5) $2m^3$ of hydrogen require 1 m3 of oxygen and produces 2 m^3 of water

6) In a convergent nozzle the cross section increases continuously from entrance to exit
7) A good fuel should have a low ignition point
8) A beam supported on more than two supports is called continuous beam
9) The saturated pressure & saturated temperature meet at critical point
10) When a shaft is subjected to torsion, the shear stress induced will be maximum at centre and zero at the circumference

III. Answer any 10 questions from the following **10 X 2 = 20 marks**

1) What is the effect of adding nickel to the alloy steel?
2) Explain boiler accessories and list the major accessories.
3) Define IBR "Steam pipe"?
4) Explain steam trap & its significance?
5) Explain "caustic embrittlement"?
6) Explain the terms "Specific steam consumption & Heat rate"?
7) Explain carry over in the boiler?
8) List the probable reasons for incomplete combustion of fuel?
9) List four causes for heavy black smoke while fuel oil is fired?
10) List any three probable causes for high bed temperature & any three effects?
11) List the positive & negative effects of excess air?
12) Explain coal grindability index?

IV. Answer any 5 (five) questions from the following : **5X4=20 marks**

1. Write down the steps involved in chemical cleaning of the water touched surface of the water tube boilers.
2. What are the merits and demerits of stoker firing over pulverized firing system?
3. How do you specify the Boilers? What are the various circuits involved in Boilers?
4. Why is necessary for boiler blow down? Explain its effect on boiler efficiency.
5. What are the important methods of the NDE (any five)?
6. What are the salient features of Supercritical Boiler?
7. Explain the term Regeneration?
8. Name the four major circuits in steam power plant?

V. Answer any 5 (five) questions from the following : **5X5= 25 marks**

1. What is the purpose of ESP and Explain the working principle in brief?
2. Define forced draft and induced draft cooling towers? List out the Advantages & disadvantages?
3. Why "Intermittent blow down" and "Continuous blow down" operated in a boiler?
4. Write five advantages of CFBC boilers over AFBC boilers.
5. Discuss need of providing excess air for combustion. What is the disadvantage of providing too much of excess air?
6. Explain the requirements for steam piping layout and drainage system.
7. Name any two types of draught systems? Why the balanced draught system is preferred than other draught system?
8. Under which regulation of IBR 1950 Remnant Life Assessment (RLA) study are carried out and List out the tests required to be carried out during Remnant Life Assessment study of boilers operating above 400 $^{\circ}$C steam temperature.

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Subject: DRAWING PAPER-3 REGISTER NUMBER:

Maximum Marks: 100 Duration: 3 Hours

Q1.Name the below givenPiping and Instrumentation DiagramValve symbols.

a) **(12 Marks)**

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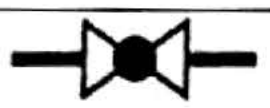
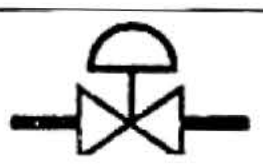
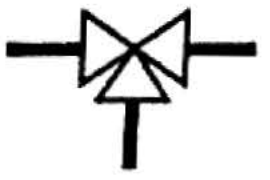
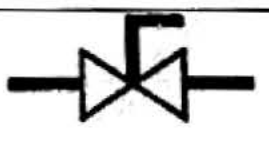
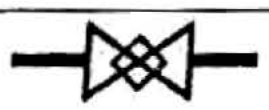
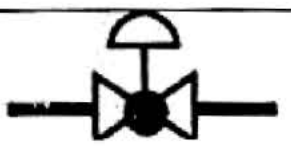
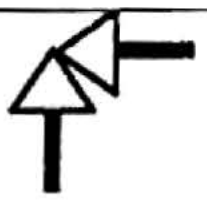
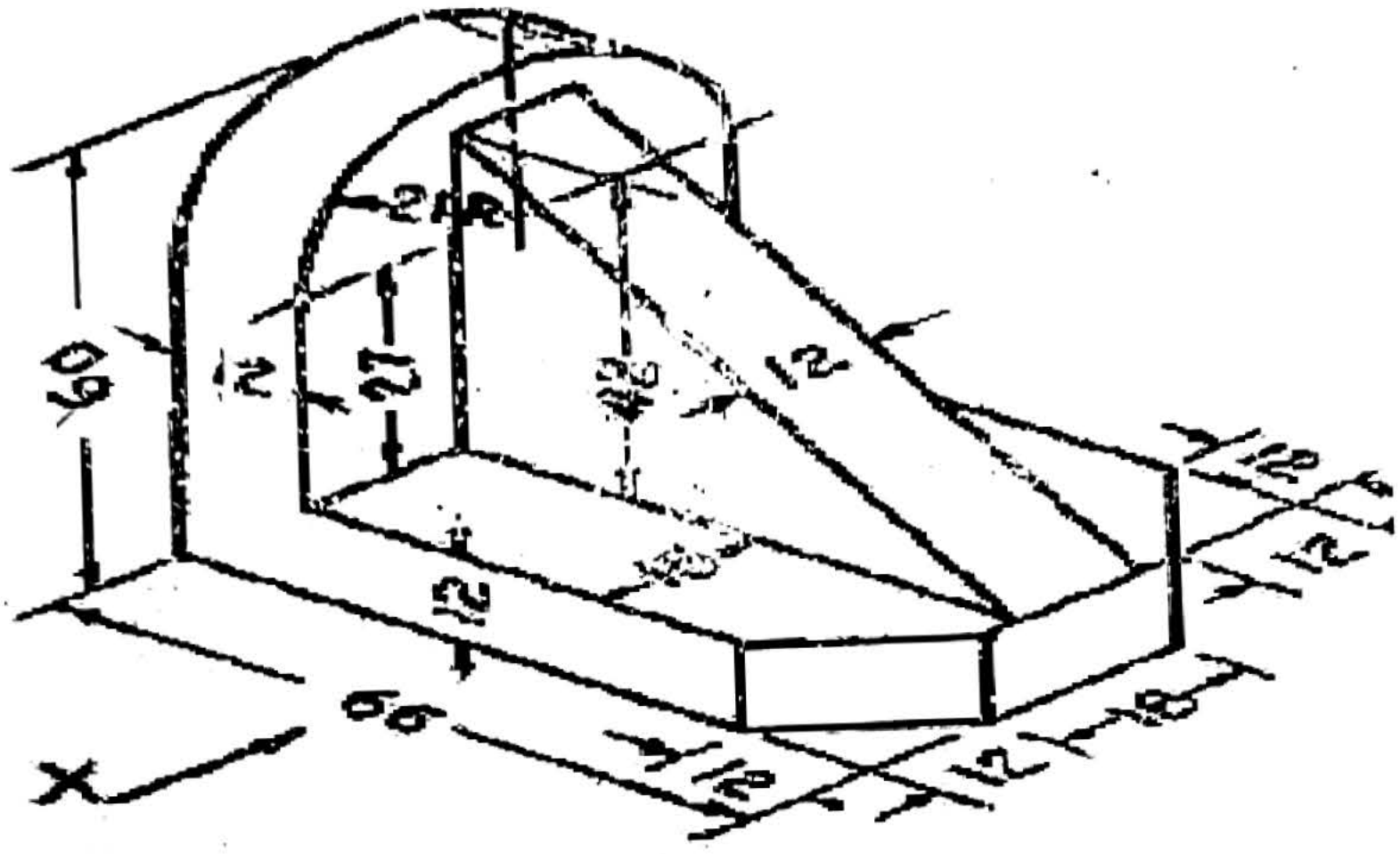
2)		8)	
3)		9)	
4)		10)	
5)		11)	
6)		12)	

b) Draw any 8 welding symbols. **(8X1= 8 Marks)**

Q2. Draw first angle projection orthographic views for any 01 isometric view of an object is given below. **(12 Marks)**

a) **Object -1**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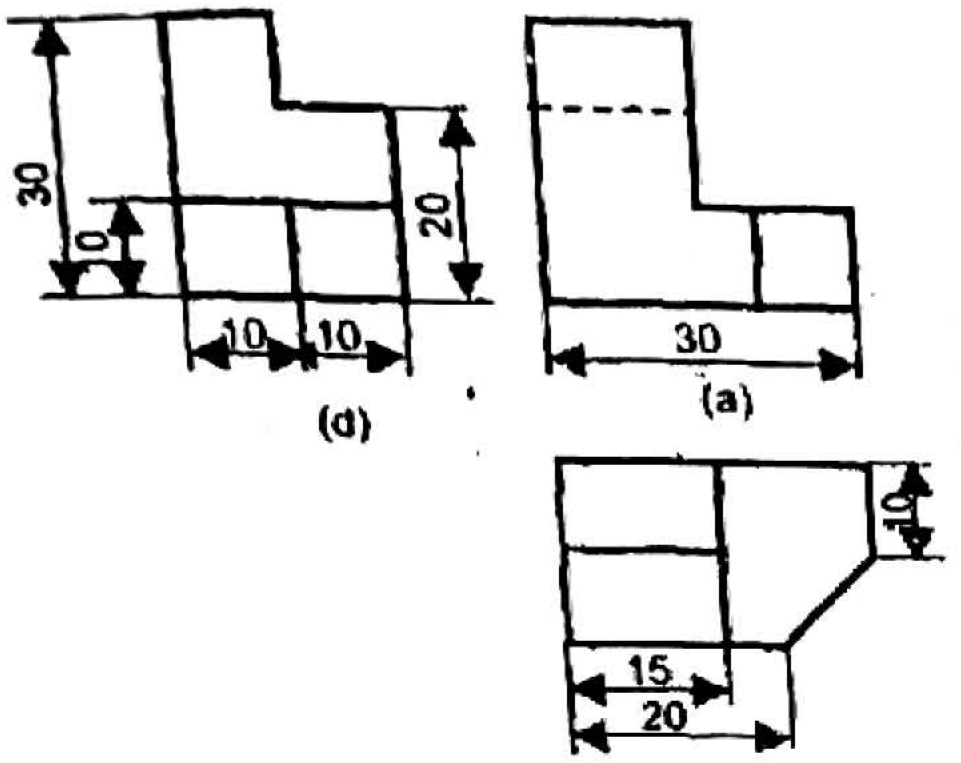
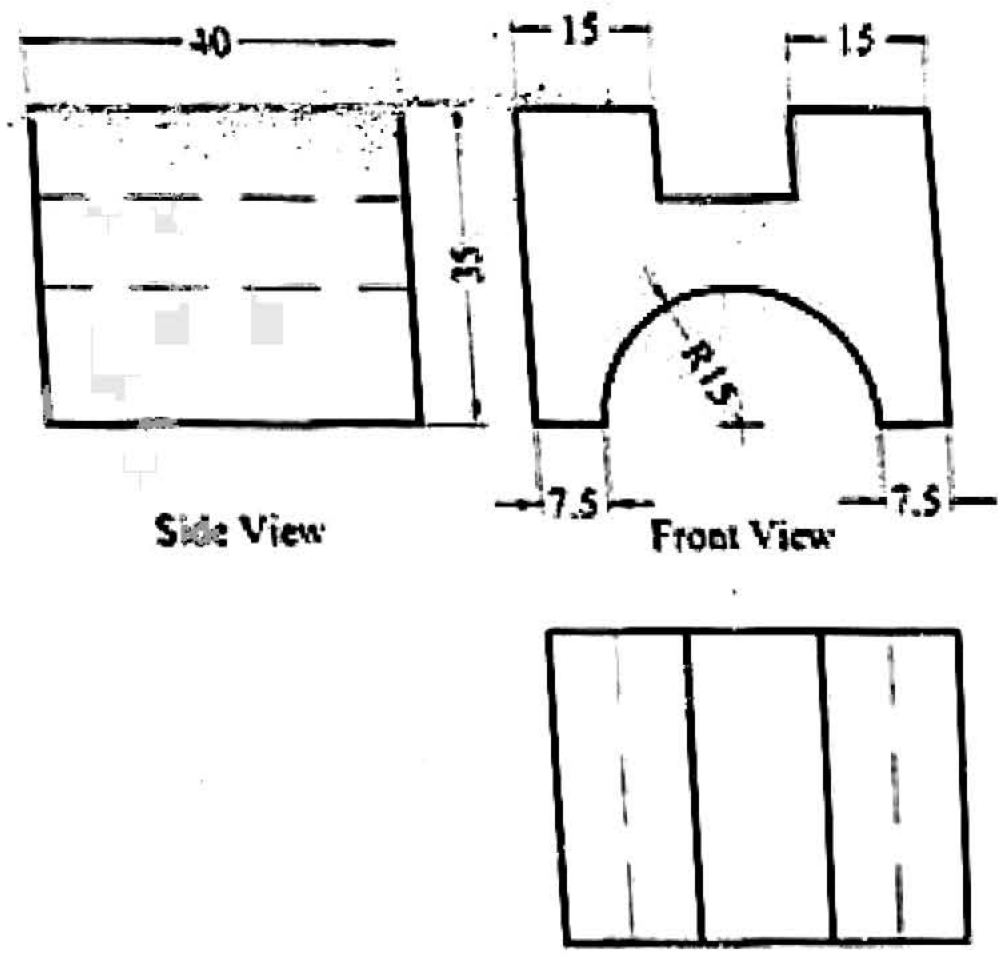
Q3. Draw an isometric view from the any 01 set of orthographic views shown below.
(18 Marks)

a) Orthographic view set – 1 (Third angle projection)



b) Orthographic views set – 2 (First angle projection)



Q4. Draw neat free hand sketches with lebels for any 2 of the following systems:
(2X10= 20 Marks)

a) Longitudinal section drawing of Attemperator.

b) Draw neat sketch of gauge galss, showing its internals.

c) Details of the Natural circulation of boiler circuit from Boiler Feed Pump to saturated steam outlet tubes.

Q5. Draw neat free hand sketch of the Main steam stop valve and lebel the important parts. **(10 Marks)**

Q6. Draw general arrangement single line drawing of a water and steam system of the PF fired boiler showing Economizer inlet valve to main steam stop valve all main systems. **(20 Marks)**

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