



GOVERNMENT OF KARNATAKA  
DEPARTMENT OF FACTORIES, BOILERS, INDUSTRIAL SAFETY AND HEALTH  
BOILER OPERATION ENGINEERS EXAMINATION - 2023

SUBJECT: BOILER PAPER-1

REGISTER NUMBER

23 B O E

MAXIMUM MARKS: 100

TIME: 3 HOURS

A. Choose the Correct answer

24x1 = 24 Marks

- Which of the following is a high-pressure boiler?  
a. Lancashire boiler b. Cochran boiler c) Benson boiler d. all the above
- The critical pressure at which the latent heat of evaporation is zero is  
a. 225.65 kg/cm<sup>2</sup> b. 232.65kg/cm<sup>2</sup> c. 215.65 kg/cm<sup>2</sup> d. none of the above
- 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
- Which of the following is not a water tube boiler?  
a. Sterling boiler b. Cornish boiler c. Loeffler boiler d. Lamount boiler
- Dry saturated steam at very low pressure (5-10 kg/cm<sup>2</sup>) when throttled to the atmosphere will become  
a. Wet b. Superheated c. Remain dry saturated d. None of the above
- Furnace is situated outside in the case of a  
a. Locomotive boiler b. Cochran boiler c. Babcock and Wilcox boiler d. Cornish boiler
- Water at a pressure of 4Kg/cm<sup>2</sup> 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
- Saturation temperature of steam with increase in pressure increases  
a. Linearly b. Rapidly first then slowly c. Slowly first then rapidly d. Inversely
- Coke is produced by  
a. Pulverizing coal in an inert atmosphere  
b. Heating wood in a limited supply of air at temperatures below 300°C  
c. Strongly heating coal continuously for about 48 hours in the absence of air in a closed vessel d. None of the above
- In the bituminous coal carbon percentage is  
a. 76-85% b. 70-75% c. 70-73% d. 90-95%
- In a throttling process  
a. steam temperature remains constant b. steam pressure remains constant  
c. steam enthalpy remains constant d. steam entropy remains constant
- 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°K temperature  
 c. Of leakages                      d. Of non-availability of ideal substance
16. For burning of 1 Kg of carbon to CO<sub>2</sub> 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 is a water tube boiler  
 b. Cornish boiler is water tube boiler and Lancashire boiler is fire tube 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 flat surfaces under pressure 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. a. parallel flow and counterflow heat exchanger ✓  
 b. LMTD and effectiveness of heat exchangers ✓

**II. Answer the following**

3x2 = 6 Marks



1. If the lifting pressure of a safety valve is  $180 \text{ kg/cm}^2$  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. Explain the 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? ✓

5x4 = 20 Marks

**D. Answer the following (Any 5)**

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  $40 \times 10^4 \text{ Kgcm}$ . 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? *Wet preservation, dry* ✓
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 dry saturated 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  $100^\circ\text{C}$  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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