

02.

POWER PLANT ENGINEERING

1. Steam Power Plant

1. Thermal power plant works on

- (a) Carnot cycle (b) Joule cycle
 (c) Rankine cycle (d) Otto cycle

GPSC AMVI 2020

GPSC AMVI (ME) 24-12-2016

GPSC AMVI (Auto) 24-12-2016

Mizoram PSC 2015 (Paper-1)

SSC JE (Exam date : 26.08.2015) Shift-1

Ans. (c) : Thermal power plant works on Rankine cycle.

Cycle	Application
Carnot cycle	It is used for comparison of other cycles.
Rankine cycle	Thermal power plant
Joule cycle	Gas Turbine
Otto cycle	Petrol engine
Diesel cycle	Low speed diesel engine
Bell Colleman cycle	Air Refrigerator

2. Rankine cycle has:

- (a) two isochoric and two isobaric processes
 (b) two isothermal and two isobaric processes
 (c) two isentropic and two isobaric processes
 (d) two adiabatic and two isobaric processes

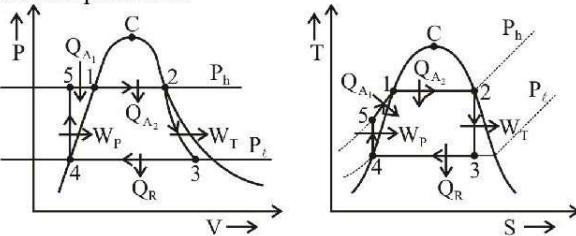
SSC JE 11-12-2020

SSC JE 27.09.2020 (Shift-1)

SSC JE 27.09.2019 (Shift-2)

ISRO SDSC 08.04.2018

Ans. (c) : Rankine cycle has two isentropic and two isobaric processes.



5-1-2 → Heat addition at constant pressure in boiler

2-3 → Isentropic work done by turbine

3-4 → Heat rejection at constant pressure in condenser

4-5 → Isentropic pump work

• Steam power plant is based on Rankine cycle.

3. In cooling tower, water is cooled by the process of:

- (a) Condensation (b) Fusion
 (c) Evaporation (d) Sublimation

NPCIL 03.06.2018

SSC JE 24.01.2018, 27.01.2018 (10:15 am)

SSC JE 3 March 2017 (Shift-1)

Ans : (c) A cooling tower is a special heat exchanger in which air and water are brought into direct contact with each other in order to reduce the water's temperature.

- The purpose of cooling tower is to cool relatively warm water by contacting with unsaturated air. The evaporation of water mainly provides cooling.

4. Bleeding in turbine means-

- (a) Leakage of steam
 (b) Steam doing no useful work
 (c) Extracting steam for pre-heating feed water
 (d) Removal of condenser steam

Arunanchal Pradesh PSC JE 2020

SSC JE 2014 (Evening)

MP Engineer JE Paper II 2011

Ans. (c) Bleeding is the process of extracting live steam from certain point and utilizing heat of this steam in raising the temperature of water entering in to boiler.
 • For this purpose feed water heater (FWH) is used.

5. Expansion of steam in Rankine cycle is assumed to be _____.

- (a) isentropic (b) polytropic
 (c) isothermal (d) hyperbolic

SSC JE 28-10-2020 (3 to 5 pm)

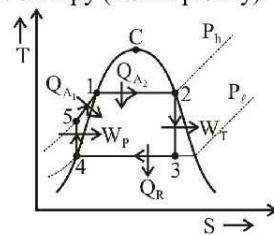
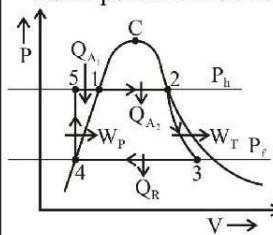
MPSC AMVI 2001

MPSC AMVI 2003

Ans. (a) : Expansion of steam in Rankine cycle is assumed to be isentropic process.

Rankine Cycle–Rankine cycle is an ideal cycle for steam power plant. It has four processes– Two isobaric & two rev. adiabatic or isentropic processes.

- Heat addition & rejection in Rankine cycle is at constant pressure & compression & expansion of steam perform at constant entropy (isentropically).



Processes–

(2-3) = Isentropic expansion (Turbine)

(3-4) = Isobaric heat rejection (Condenser)

(4-5) = Isentropic compression (Pump)

(5-1-2) = Isobaric heat addition (Boiler)

6. Between Rankine and Carnot cycles, which of the following is not a difference?

- (a) Carnot cycle is theoretical whereas Rankine cycle is practical

- (b) Carnot cycle uses air whereas Rankine cycle uses water as a working substance
- (c) Carnot cycle exchanges heat at constant temperature whereas Rankine cycle exchanges heat at constant pressure
- (d) Carnot cycle is ideal for vapor power cycles whereas Rankine cycle is ideal for heat engines

UPSSSC JE 19.12.2021

Ans. (d) : Carnot cycle and Rankine cycle both are theoretical cycles, but Carnot cycle has highest efficiency compared to other cycles. So this cycle is considered as ideal cycle and used for the comparison of efficiency other cycles.

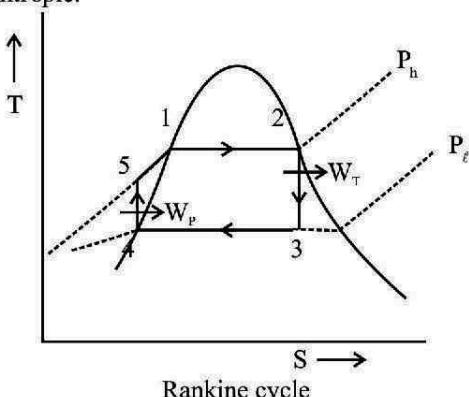
- So as compared to Carnot cycle, we can consider to Rankine cycle as practical.
- Carnot cycle uses air, whereas Rankine cycle uses water as a working substance, so in Rankine cycle, we are found a vapour dome.
- Carnot cycle exchanges heat at constant temperature ($T = C$), whereas Rankine cycle exchanges heat at constant pressure.
- Carnot cycle is ideal cycle for all other cycles (Ex-Gas power, heat engines, gas negative, vapour power cycle all) whereas Rankine cycle is ideal for vapour power cycles only.

7. Which process efficiency is stated in terms of the thermal efficiency of a steam turbine determined using the Rankine cycle model?

- (a) Isenthalpic
- (b) Isentropic
- (c) Hydraulic
- (d) Volumetric

UPSSSC JE 19.12.2021

Ans. (b) : Using the Rankine cycle, the thermal efficiency of the steam turbines is determined in terms of isentropic.



5 - 1 - 2 → Boiler → Heat addition at constant pressure.

2 - 3 → Turbine → Isentropic expansion of steam

3 - 4 → Condenser → Heat rejection at constant pressure

4 - 5 → Pump → Isentropic compression of water

Efficiency of Rankine cycle –

$$\eta_R = \frac{W_{\text{net}}}{Q_A} = \frac{W_T - W_P}{Q_A} = \frac{(h_2 - h_3) - (h_5 - h_4)}{h_2 - h_5}$$

8. In steam power cycle, the process of removing non-condensable gases is called

- (a) scavenging process
- (b) deaeration process
- (c) exhaust process
- (d) condensation process

**RSMSSB JEN (Diploma) 21.08.2016 Shift-II
ESE-2019**

Ans. (b)

- ⇒ The process of removing non-condensable gases in steam power cycle is called deaeration and is done in deaerator.
- ⇒ Scavenging process is the process of removing exhaust gases and replacing with fresh gases.
- Exhaust process is the removal of burn out gasses.
- Condensation process is conversion of steam to liquid form.

9. A power plant, which uses a gas turbine following by steam turbine for power generation, is called
- (a) Topping cycle
 - (b) Bottoming cycle
 - (c) Brayton cycle
 - (d) Combined cycle

**SSC JE 20-03-2021 Shift-II
ESE-1993**

Ans. (d) : A power plant, which uses a gas turbine following by steam turbine for power generation, is called combined cycle.

10. A regenerative steam cycle renders

- (a) increased work output per unit mass of steam
- (b) decrease work output per unit mass of steam
- (c) increased thermal efficiency
- (d) decreased work output per unit mass of steam as well as increased thermal efficiency

**SSC JE 27.10.2020 (Shift-1)
ESE-1993**

Ans. (d) : A regenerative steam cycle renders decreased work output per unit mass of steam as well as increased thermal efficiency.

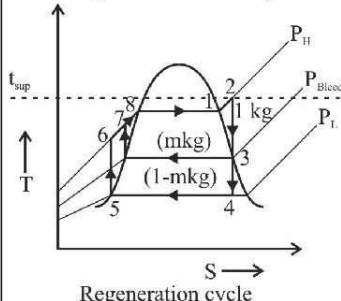
- A steam turbine cycle in which the condensate or feed water is heated to a temperature that is much higher than that corresponding to saturation at the exhaust pressure by means of steam that has been bled from the turbine at points intermediate between the throttle and exhaust.

11. Regenerative heating the thermal efficiency of a Rankine cycle.

- (a) does not affect
- (b) decreases
- (c) may increase or decrease
- (d) increases

**SSC JE 27-09-2019 (Shift-2)
SSC JE 27-10-2020 (Shift-1)**

Ans. (d) : Regenerative heating increases the thermal efficiency of Rankine's cycle.



- In regenerative cycle, extract live steam (Bleeding) from certain point and utilizing heat of this steam in raising the temperature of water entering in to boiler. For this purpose feed water heater (FWH) is used.

$$\eta_R = \frac{W_{net}}{Q_A}$$

- In regenerative cycle, $Q_A \downarrow$

So, $\eta_R \uparrow$

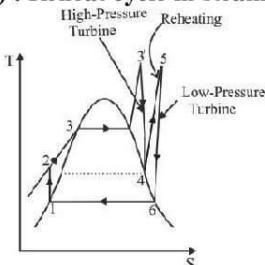
Note— Rankine efficiency would approach Carnot cycle efficiency by providing a series of regenerative feed heater.

12. The reheat cycle in steam power plant is mainly adopted to:

- increase moisture content in low pressure stages to a safe value
- decrease moisture content in low pressure stage to a safe value
- decrease the capacity of condenser
- recover the waste heat boiler

UPRVUNL JE 2016 (Shift-II)
ESE-1998

Ans. (b) : Reheat cycle in steam power plant -



3' - 4 : Isentropic expansion of steam (In high pressure turbine)

4 - 5 : Reheating of steam at constant pressure (In reheater)

5 - 6 : Isentropic expansion of steam (In low pressure turbine)

6 - 1 : Condensation at constant pressure (In condenser)

2 - 3 - 3' : Heat addition to water at constant pressure (In boiler)

* The reheat cycle in steam power plant is mainly adopted to decrease moisture content in low pressure stage to a safe value

13. The work output from the turbine in case of a Rankine cycle is given by:

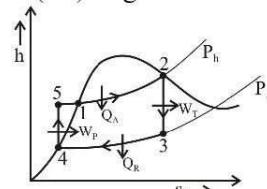
- enthalpy change between inlet and outlet
- entropy change between inlet and outlet
- pressure change between inlet and outlet
- temperature change between inlet and outlet

SSC JE 27-10-2020 (Shift-1)

SSC JE 27-09-2019 (Shift-2)

Ans. (a) : The work output from the turbine in case of a Rankine cycle is given by enthalpy change between inlet and outlet.

Rankine cycle on (h-s) diagram—



$$W_{Turbine} = (h_2 - h_3), W_{Pump} = (h_5 - h_4), Q_A = (h_2 - h_5)$$

$$\text{Net work output} = W_T - W_P = (h_2 - h_3) - (h_5 - h_4)$$

$$\eta_R = \frac{W_{net}}{Q_A} = \frac{W_T - W_P}{Q_A}$$

$$\text{Work ratio, } r_w = \frac{W_{net}}{W_T} = \frac{W_T - W_P}{W_T}$$

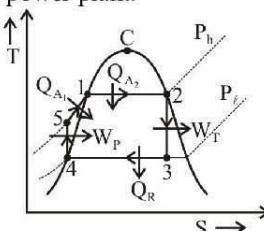
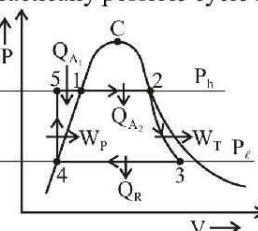
14. For a steam power plant _____ cycle is recommended.

- Brayton
- Carnot
- Rankine
- Otto

SSC JE 28-10-2020 (3 to 5 pm)

MPSC AMVI 2004

Ans. (c) : Rankine cycle is recommended for a steam power plant. Because it is most efficient cycle & practically possible cycle for power plant.



- This cycle has two isobaric (heat addition & rejection) & two isentropic (compression & expansion) process.

$$\eta_{th} = \frac{W_{net}}{Q_A}$$

$$r_w = \frac{W_{net}}{W_T}$$

Where, $W_{net} = W_T - W_P$

$$Q_A = Q_{A_1} + Q_{A_2}$$

Note-

- Brayton cycle → For gas turbine or gas power plant.
- Otto cycle → For S.I. engine.

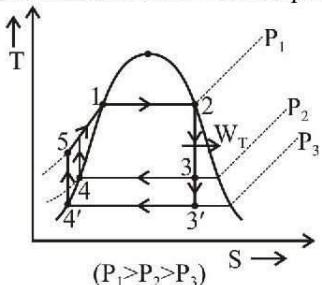
15. An increase in the efficiency of Rankine cycle can be expected with _____.

- increase in exhaust pressure
- increase in temperature of heat rejection

- (c) decrease in exhaust pressure
 (d) decrease in temperature of heat addition

**SSC JE 28-10-2020 (3 to 5 pm)
 UPSSSC JE 2016**

Ans. (c) : An increase in the efficiency of Rankine cycle can be expected with decrease in exhaust pressure.



Method of improving Rankine cycle efficiency (η_R)—

1. By increasing boiler pressure (P_b)
2. By increasing superheat temperature (t_{sup})
3. By decreasing condenser or exhaust pressure (P_L)

16. In thermal power plants, the deaerator is used mainly to

- (a) remove air from condenser
- (b) increase free water temperature
- (c) reduce steam pressure
- (d) remove dissolved gases from feed water

**ISRO VSSC 25-02-2018
 ESE-1996**

Ans. (d) : In thermal power plants, the deaerator is used mainly to remove dissolved gases from feed water.

- Deaerator contains two sections— deaeration section and feed tank section. Steam is supplied in both section. It is done by heating water to its boiling temperature.

17. The overall efficiency of thermal power plant is

- (a) Boiler efficiency, turbine efficiency and generator efficiency
- (b) Boiler efficiency, turbine efficiency, generator efficiency and gas cycle efficiency
- (c) Carnot cycle efficiency
- (d) Regenerative cycle efficiency

SSC JE 2 March 2017 Shift-I

MP Sub Engineer 5 April 2016 Evening

Ans. (a) The overall efficiency of thermal power plant is boiler efficiency, turbine efficiency and generator efficiency

Overall efficiency of TPP, $(\eta_0) = \eta_b \times \eta_T \times \eta_G$

where η_b = Boiler efficiency

η_T = Turbine efficiency

η_G = Generator efficiency

Boiler efficiency -

$$\eta_b = \frac{\text{Used heat to produce steam}}{\text{Heat supplied by fuel}}$$

$$\eta_b = \frac{\dot{m}(h_2 - h_1)}{\dot{m}_f \times C.V.}$$

18. The ratio of isentropic heat drop to the heat supplied is called

- (a) Rankine efficiency (b) Stage efficiency
- (c) Reheat factor (d) Internal efficiency

**MP Engineer JE Paper II 2011
 ESE-2000**

Ans. (a) The ratio of isentropic heat drop to the heat supplied is called Rankine efficiency.

• Stage efficiency = $\frac{\text{WD/kg of steam by stage}}{\text{heat drop/kg of steam in stage}}$

• Reheat factor = $\frac{\text{Cummulative heat drop}}{\text{Isentropic heat drop}}$

19. What is the effect of bleeding

- (a) It decreases the power developed by the turbine
- (b) The boiler is supplied with hot water
- (c) It increases thermodynamic efficiency of turbine
- (d) All of the above

Himachal SSC JE 2018

MP Engineer JE Paper II 2011

Ans. (d) Bleeding is the process of extracting live steam from certain point and utilizing heat of this steam in raising the temperature of water in the boiler.

Due to bleeding,

$$W_T \downarrow, W_p = C, W_{net} \downarrow$$

But $\eta_{th} \uparrow$ due to $Q_A \downarrow$

So, we can say, power developed by the turbine decrease, and thermodynamic efficiency also increase.

Note—option 'c' is given by the 'commission'.

20. The performance of a steam cycle in a power plant is compared with a standard process of

- (a) Carnot cycle
- (b) Air standard cycle
- (c) Constant pressure cycle
- (d) Rankine cycle

HPCL Engineer 12.08.2021 Shift-I

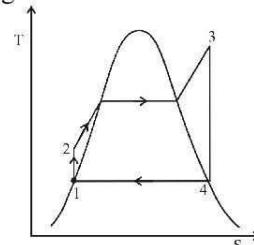
Ans. (d) : The performance of a steam cycle in a power plant is compared with a standard process of Rankine cycle

21. Rankine Cycle efficiency of a steam power plant may be in the range of

- (a) 5-10% (b) 35-45%
- (c) 70-80% (d) >90%

ISRO TA 14.07.2021

Ans. (b) : Rankine cycle efficiency of steam power plant in the range of 35-45%.

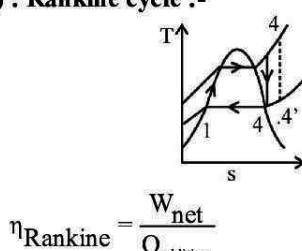


Rankine cycle is a reversible cycle that has two constant pressure and two isentropic processes.
 Process 1-2 – Isentropic compression
 Process 2-3 – Isobaric heat addition
 Process 3-4 – Isentropic expansion
 Process 4-1 – Isobaric heat rejection

- 22.** In Rankine cycle, increase in superheating temperature at constant pressure results in:
- increase in thermal efficiency
 - decrease in the quality of the steam leaving the turbine
 - decrease in thermal efficiency
 - decrease in mean temperature of heat addition in cycle

NRL GET 23.09.2021 Shift-II

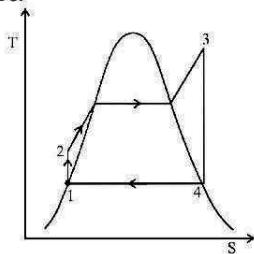
Ans. (a) : Rankine cycle :-



- 23.** In the Rankine cycle, the heat is added _____
 (a) isothermally (b) at constant volume
 (c) at constant pressure (d) adiabatically

MPSC AMVI 20.11.2021 (Mains)

Ans. (c) : In the Rankine cycle, the heat is added at constant pressure.



Rankine cycle is a reversible cycle that has two constant pressure and two isentropic processes.
 Process 1-2 – Isentropic compression
 Process 2-3 – Isobaric heat addition
 Process 3-4 – Isentropic expansion
 Process 4-1 – Isobaric heat rejection

- 24.** The moisture content of steam at the turbine exit of a steam power plant operating on the Rankine cycle can be decreased by:
- decreasing boiler pressure
 - increasing boiler pressure
 - reheating steam
 - super cooling steam

SSC JE 22-03-2021 Shift-II

Ans. (c) : The various advantage of reheating are as follow—
 (i) It increases dryness fraction of steam at exhaust so that blade erosion due to impact of water particle is reduced.

- It increases thermal efficiency.
- It increase the work done per kg of steam and this result in reduced size of boiler.

So, the moisture content of steam at the turbine exit of a steam power plant operating on the Rankine cycle can be decreased by reheating steam.

- 25.** Which of the following helps to increase efficiency of the Rankine cycle ?
- Increasing average temperature at which heat is reject from the working fluid
 - Increasing average temperature at which heat is transferred to the working fluid
 - Increasing the condenser pressure
 - Operating at constant temperature

SSC JE 2021

Ans. (b) : Methods to increase the efficiency of the Rankine cycle—

- Increase the average temperature at which heat is transferred to the working fluid in the boiler.
- Decrease the average temperature at which heat is rejected from the working fluid in the condenser.
- Lowering the condenser pressure
- Superheating the steam to high temperature.
- Increasing the boiler pressure.

- 26.** Which is the most practical fluid for the Rankine cycle ?

- Fuel
- Air
- Air-fuel mixture
- Water

SSC JE 2021

Ans. (d) : The efficiency of the Rankine cycle is limited by the high heat of vaporization by the fluid. The fluid must be cycled through and reused constantly. Therefore, water is the most practical fluid for this cycle.

- 27. Boilers in the Rankine cycle are used :**

- to allow expansion of steam
- to store working fluid
- for steam generation
- to maintain heat in the process

SSC JE 2021

Ans. (c) : Boilers in the Rankine cycle are used for steam generation in coal fired power plant or nuclear reactor.

- 28. The Rankine cycle is an ideal cycle for vapour power plants because :**

- it does not allow isentropic expansion
- steam is not condensed in the condenser
- it includes reversible processes
- water enters the pump at unsaturated state

SSC JE 2021

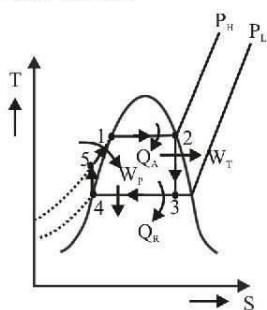
Ans. (c) : The Rankine cycle is an ideal cycle for vapour power plants because, it includes reversible processes.

The following four reversible processes-

- (Turbine) \Rightarrow Isentropic expansion of steam
- (Condenser) \Rightarrow Heat rejection by steam at constant pressure

4-5 (Pump) \Rightarrow Isentropic compression of water
(5-1-2) (Boiler) \Rightarrow Heat addition to water at constant pressure.

5-1-2 $\begin{cases} \nearrow (5-1) : \text{Sensible heat} \\ \searrow (1-2) : \text{Latent heat} \end{cases}$



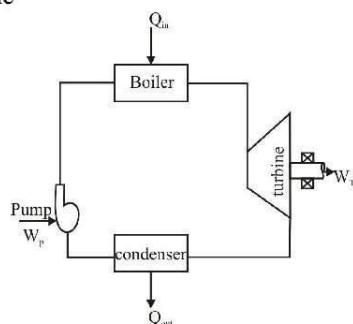
29. Which of the following is NOT a part of the Rankine cycle ?

- (a) Compressor
- (b) Turbine
- (c) Pump
- (d) Boiler

SSC JE 22-03-2021 Shift-II

Ans. (a) : Rankine cycle is used in steam power plant for power generation which consists.

- (1) Boiler
- (2) Water feed pump
- (3) Condenser
- (4) Turbine



• Compressor is not a part of this cycle.

30. The efficiency of superheat rankine cycle is higher than that of simple rankine cycle because.

- (a) The enthalpy of main steam is higher for superheat cycle.
- (b) The mean temperature of heat addition is higher for superheat cycle.
- (c) The temperature of steam in condenser is high.
- (d) The quality of steam in low condenser is low.

JPSC AE 23.10.2021 Paper-I

Ans. (b) : The efficiency of superheat rankine cycle is higher than that of simple rankine cycle because the mean temperature of heat addition is higher for superheat cycle.

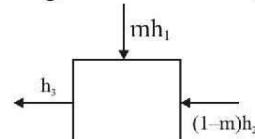
$$\uparrow \eta = 1 - \frac{T_a}{T_{add}} \uparrow$$

31. Consider an actual regenerative rankine cycle with one open feed water heater for each kg steam entering the turbine, if 'm' kg steam with a specific enthalpy 'h_1', is bled from the turbine and specific enthalpy of liquid water entering is 'h_2', then 'h_3', specific enthalpy of saturated liquid leaving the heater is equals to

- (a) $mh_1 - (h_2 - h_1)$
- (b) $h_1 - m(h_2 - h_1)$
- (c) $h_2 - m(h_2 - h_1)$
- (d) $mh_2 - (h_2 - h_1)$

JPSC AE 23.10.2021 Paper-I

Ans. (c) : Actual regenerative rankine cycle



For conservation of energy

$$\begin{aligned} h_3 &= mh_1 + (1-m)h_2 \\ &= mh_1 + h_2 - mh_2 \end{aligned}$$

$$h_3 = h_2 - m(h_2 - h_1)$$

32. For a given set of operating pressure limit of rankine cycle, the highest efficiency occurs for

- (a) Saturated cycle
- (b) Superheated cycle
- (c) Reheat cycle
- (d) Regenerative cycle

JPSC AE 23.10.2021 Paper-I

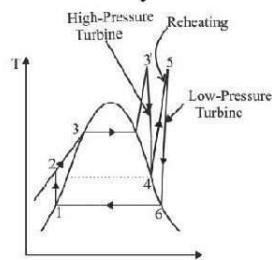
Ans. (d) : For a given set of operating pressure limit of rankine cycle, the highest efficiency occurs for regenerative cycle because heat addition to cycle is reduced and here is no change in work done.

33. The main advantages of a reheat rankine cycle is

- (a) reduced moisture content in LP side of turbine
- (b) increased efficiency
- (c) reduced load on condenser
- (d) reduced load on pump

JPSC AE 23.10.2021 Paper-I

Ans. (a) : Reheat Rankine cycle Advantage-



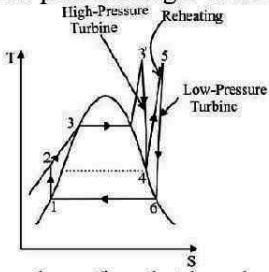
- (i) Mean temperature of heat addition increases.
- (ii) Turbine work output increase
- (iii) Dryness fraction at lower stage increase i.e. moisture content in LP side of turbine decrease.
- (iv) Efficiency of plant increases 4-5%

34. In an ideal steam power cycle with same inlet pressure the low dryness fraction of steam in the last stage of expansion process can be

- (a) Providing regeneration
- (b) Providing reheating
- (c) Reduce superheat
- (d) Lowering condenser pressure

JPSC AE 23.10.2021 Paper-I

Ans. (b) : The reheat cycle has been developed to take advantage of the increased efficiency with higher pressures, and yet avoid excessive moisture (improve in quality) in the low pressure stages of turbine.



We can see from above fig., that by reheating the steam, the dryness fraction at exit of turbine is improved during the reheating. So we can assume that the dryness fraction for reheating is more than simple Rankine cycle process ($x_6 > x_4$).

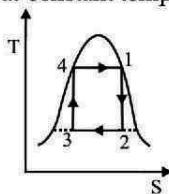
Therefore, in the Rankine cycle process with reheating the dryness of fraction is avoided.

35. During which of the following process does the heat rejection takes place in Carnot vapour cycle?

- (a) Constant volume
- (b) Constant pressure
- (c) Constant temperature
- (d) Constant entropy

JPSC AE 23.10.2021 Paper-I

Ans. (c) : Heat rejection and heat addition takes place in Carnot vapour cycle at constant temperature.



36. The reheat cycle in steam power plant is employed mainly to

- (a) Improve thermal efficiency
- (b) Recover waste heat from boiler
- (c) Improve steam quality at turbine exit
- (d) Reduce condenser heat loss in the plant

Arunanchal Pradesh PSC JE 2020

Ans. (c) : The reheat cycle in steam power plant is employed mainly to improve steam quality at turbine exist.

37. If the thermal efficiencies of mercury and steam cycles are respectively η_1 and η_2 , then the overall efficiency of a Binary cycle can be expressed as:

- (a) $\eta_1 + \eta_2 - \eta_1\eta_2$
- (b) $\eta_1 + \eta_2 + \eta_1\eta_2$
- (c) $\eta_1 - \eta_2$
- (d) $\eta_1 + \eta_2$

SSC JE 27-10-2020 (Shift-3)

Ans. (a) : Binary vapour cycle is the combination of two cycle—

- (i) High temperature cycle (Working fluid \Rightarrow Mercury)
- (ii) Low temperature cycle (Working fluid \Rightarrow Water)

$$\eta_0 = 1 - (1 - \eta_1)(1 - \eta_2)$$

$$\therefore \quad \boxed{\eta_0 = \eta_1 + \eta_2 - \eta_1\eta_2}$$

38. Rankine cycle efficiency is _____ than/as Carnot cycle efficiency if both work under the same operating temperatures.

- (a) less
- (b) Can be less or more
- (c) more
- (d) Same

SSC JE 11-12-2020

Ans. (a) : The efficiency of Rankine cycle is always less than the efficiency of Carnot cycle even both are operating same temperature limits.

- If the infinite regenerator is applied the Rankine cycle, its efficiency is almost equal to the efficiency of Carnot cycle.

39. In a good steam power plant, the Rankine cycle efficiency is in the range of:

- (a) 15 - 25%
- (b) 65 - 75%
- (c) 35 - 45%
- (d) 75 - 85%

Punjab PSC JE 19.12.2021

SSC JE 27-10-2020 (Shift-1)

Ans. (c) :

- Steam power plant is operated on Rankine cycle.
- It's efficiency varies from 35% to 45%.
- Efficiency of internal combustion engine 35-40%.
- It's efficiency more with respect to other all steam engine.

40. Which of the following statement is INCORRECT with respect to a reheat cycle?

- (a) Steam rate increases
- (b) Net work done increases
- (c) Turbine work increases
- (d) Work ratio increases

SSC JE 27-10-2020 (Shift-3)

Ans. (a) : In a reheat cycle—

- (i) Steam rate decreases
- (ii) Net work done increases, because
Pump work $W_p = \text{Constant}$ and $W_T \uparrow$
So, $W_{net} \uparrow$
- (iii) Turbine work increases
- (iv) Work ratio increases, because
 $W_{net} \uparrow$
So, $r_w = \frac{W_{net}}{W_T} = 1 - \frac{W_p}{W_T} \uparrow$
 $\Rightarrow r_w \uparrow$

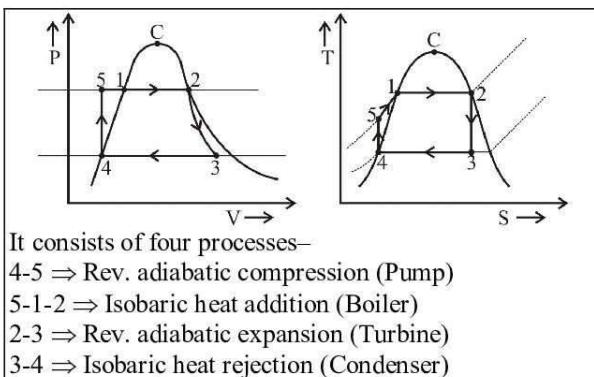
41. _____ process is NOT involved in Rankine cycle.

- (a) Constant pressure heat addition
- (b) Isentropic compression
- (c) Isentropic expansion
- (d) Constant volume heat addition

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (d) : Constant volume heat addition process is not involved in Rankine cycle.

- * Rankine cycle is also known as vapour power cycle.
- * It is mostly used in steam power plant.



- 42. Which of the following statements is true?**
- Rankine efficiency is higher than Carnot efficiency.
 - Rankine efficiency is lower than Carnot efficiency.
 - Rankine efficiency cannot be compared with Carnot efficiency.
 - Rankine efficiency is equal to Carnot efficiency.

SSC JE 27-10-2020 (Shift-3)

Ans. (b) : Rankine efficiency is lower than Carnot efficiency because in Carnot cycle heat is added at constant temperature. Due to this mean temperature (T_m) of heat addition is increased.

- Carnot cycle is the Bench-mark for the efficiency in the engine field.

- 43. In a regenerative Rankine cycle, the steam extracted from the steam turbine is used to**
- Preheat the combustion air
 - Preheat the fuel
 - Preheat the boiler feedwater
 - Reheat the steam

Arunanchal Pradesh PSC JE 2020

Ans. (c) : In a regenerative Rankine cycle, the steam extracted from the steam turbine is used to preheat the boiler feed water.

- 44. The process of draining steam for heating the feedwater is known as—**
- Cooling
 - Bleeding
 - Reheating of steam
 - Governing

RRB JE CBT-II 31.08.2019 IIInd Shift

Ans : (b) Bleeding is the process of extracting live steam from certain point & utilizing heat of this steam in raising the temperature of water entering into boiler.
 * For this purpose feed water heater (FWH) is used.

- 45. What happens on bleeding steam to reheat feed water to boiler ?**
- It does not affect the thermal efficiency of the cycle
 - It drops the thermal efficiency of the cycle
 - It improves the thermal efficiency of the cycle
 - It may improve or drop the thermal efficiency of the cycle based on point of extraction of steam

HPCL JE 20-04-2019

Ans. (c) : The effect of bleeding steam to reheat feed water to boiler -

- It improves the thermal efficiency of the cycle.
- The boiler is supplied with a hot water.
- A small amount of work is lost by the turbine, which decreases the power developed.

- 46. In a Ranking cycle, the work done by turbine during expansion of steam is 8 kJ while the work required for pump to feedback the water into the boiler is 6 kJ. Determine the work ratio.**
- 0.9
 - 0.25
 - 0.34
 - 0.75

DSSSB JE 16-11-2019 (4.30-6.30)

Ans. (b) : Given, In a Rankine cycle,
 $W_T = 8 \text{ kJ}$, $W_p = 6 \text{ kW}$

$$\text{Work ratio } (r_w) = \frac{W_{\text{net}}}{W_T} = \frac{W_T - W_p}{W_T} \\ = \frac{8 - 6}{8} = \frac{2}{8} \\ \therefore r_w = 0.25$$

- 47. In Rankine Cycle the work output from turbine is given by**

- Change of internal energy between inlet & outlet
- Change of enthalpy between inlet & outlet
- Change of entropy between inlet & outlet
- Change of temperature between inlet & outlet

Mizoram PSC 2019 (Paper-2)

Ans. (b) : In Rankine cycle the work output from turbine is given by change of enthalpy between inlet and outlet.

i.e. $\text{Work output} = h_1 - h_2$

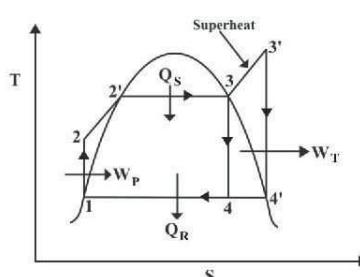
- 48. Identify the incorrect statement, from the following options related to the below statement:**

Superheated steam is used in a Rankine power cycle

- because it increases work output of the cycle for same pressure limit
- to reduce the work of pumping
- because it increases cycle efficiency for same pressure limit
- because steam at the exit of turbine will be less wet, preventing erosion of turbine blades

SSC JE 25-09-2019 (Shift-2)

Ans. (b) :



By using superheated steam in Rankine power cycle–

1. Pump work will be constant
2. Turbine work will be increases
3. An increase in the superheat at constant pressure increases the mean temperature of heat addition and hence increase the net work output and cycle efficiency.
4. The quality of steam at the exit of turbine is improved resulting in reduced erosion of the turbine blade.

- 49. For the same maximum and minimum temperatures, the Rankine cycle has:**
- (a) higher specific work output than that of the Carnot cycle
 - (b) equal efficiency to that of the Carnot cycle
 - (c) more efficiency than that of the Carnot cycle
 - (d) lower specific work output than that of the Carnot cycle

SSC JE 27-09-2019 (Shift-1)

Ans. (a) : For the same maximum and minimum temperatures, the Rankine cycle has higher specific work output than that of the Carnot cycle.

- 50. The internal irreversibility of Rankine cycle is caused by**
1. fluid friction
 2. throttling
 3. mixing

Select the correct answer using the code given below.

- | | |
|------------------|------------------|
| (a) 1 and 2 only | (b) 1 and 3 only |
| (c) 2 and 3 only | (d) 1, 2 and 3 |

ESE-2019

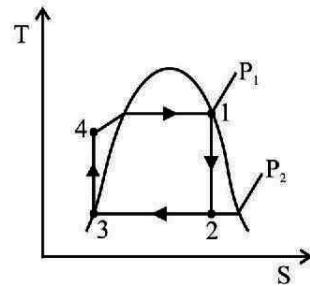
Ans. (d) : Internal irreversibility of Rankine cycle is caused by fluid friction, throttling and mixing due to fluid friction. The expansion and compression process are not reversible and entropy of the fluid in both increases.

- 51. The efficiency of superheat Rankine cycle is higher than that of simple Rankine cycle because**
- (a) the enthalpy of main steam is higher for superheat cycle
 - (b) the mean temperature of heat addition is higher for superheat cycle
 - (c) the temperature of steam in the condenser is high
 - (d) the quality of steam in the condenser is low

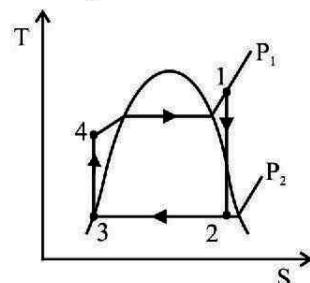
ESE-2019

Ans. (b) : The efficiency of superheat Rankine cycle is higher than that of simple Rankine cycle because the mean temperature of heat addition is higher for superheat cycle.

• Simple Rankine cycle–



Superheat Rankine cycle



- 52. Which one of the following methods is more effective to improve the efficiency of the Rankine cycle used in thermal power plant?**

- (a) Increasing the condenser temperature
- (b) Decreasing the condenser temperature
- (c) Decreasing the boiler temperature
- (d) Increasing the boiler temperature

ESE-2018

Ans. (b) : The efficiency of the Rankine cycle with decreasing the condenser temperature will allow more expansion of the steam in the turbine therefore the work output will increase which will increase the efficiency of the turbine.

- 53. The expansion of steam in a steam turbine in a simple Rankine cycle is _____.**

- (a) an isothermal process
- (b) a reversible adiabatic process
- (c) an adiabatic process
- (d) an isobaric process

CSEB AE 2018

Ans. (b) : The expansion of steam in a steam turbine in a simple Rankine cycle is a reversible adiabatic process.

- 54. The correct order of the components in a Rankine cycle is:**

- (a) Condenser – Pump – Boiler – Turbine
- (b) Pump – Condenser – Boiler – Turbine
- (c) Boiler – Turbine – Pump – Condenser
- (d) Turbine – Condenser – Boiler – Pump

CSEB AE 2018

60. In steam power plants, the pump handles liquid which has a very small specific volume and the turbine handles vapour whose volume is many times larger. Therefore work output of turbine isthe work input to pump.

- Many times larger than
- Many times smaller than
- Equal to
- None of these

MPSC AMVI 2017

Ans. (a) : In steam power plants, the pressure rise in the pump is equal to the pressure drop in the turbine (neglecting pressure loss in other components). The pump handles liquid, whose specific volume is very small and the turbine handles vapour, whose specific volume is many times larger.

From the equation, $W = -\int_1^2 v dp$

So, if $v \uparrow \Rightarrow W \uparrow$ and $v \uparrow \uparrow \uparrow$ then $W \uparrow \uparrow \uparrow$

Therefore, work output of turbine is many times larger than the work input to pump.

61. In a heat engine cycle, which of the following process occurs ?

- heat is transferred from furnace to boiler
- work is produced in turbine rotor
- steam is condensed in condenser
- all of the above

Nagaland PSC (JE) 2017 (Paper-2)

Ans. (d) : In a Heat engine cycle following processes occurs—

- Heat is transferred from furnace to boiler
- Work is produced in turbine rotor.
- Steam is condensed in condenser

62. Filling or decking in a cooling tower increases the rate of heat transfer by providing ____.

- increased flow of water
- increased flow of air
- increased flow of water and air
- a large amount of wetted surface

SSC JE 3 March 2017 Shift-I

Ans. (d) : In cooling tower, water can be cooled by evaporation process. Filling or decking in a cooling tower increases the rate of heat transfer by providing a large amount of wetted surface area because increase wetted surface area allow for maximum contact between the air and water, which allows for greater evaporation rates.

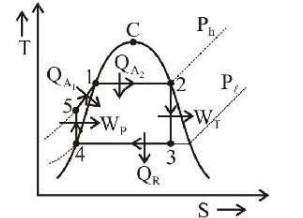
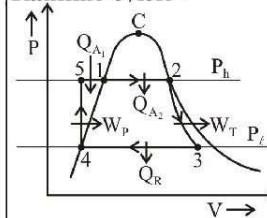
63. The expansion of steam in a nozzle follows

- Carnot cycle
- Rankine cycle
- Joule cycle
- Stirling cycle

Vizag JET 2017

Ans. (b) : The expansion of steam in a nozzle follows Rankine cycle.

Rankine cycle—



64. Steam is the most common working fluid used in vapour power cycles because out of its –

- Availability
- Low cost
- High enthalpy of vapourisation
- All of above

MPSC AMVI 2017

Ans. (d) : Steam is the most common working fluid used in vapour power cycles because out of its availability, low cost and high enthalpy of vapourisation.

65. Rankine cycle efficiency of good steam power plant may be in the range of :

- 10% to 15%
- 35% to 40%
- 70% to 80%
- 90% to 95%

MPSC AMVI 2017

Ans. (b) : Rankine cycle efficiency of a good steam power plant may be in the range of 35 to 45%. A simple Rankine cycle operates the boiler at 3MPa with an outlet temperature of 3500C and the condenser at 50 kPa.

66. Consider the following statements in respect of regenerative Rankine cycle:

1. Regeneration increases the efficiency of the cycle.
2. The boiler capacity is increased for a given output.
3. The capacity of the condenser is reduced.

Which of the above statements are correct?

- 1, 2 and 3
- 1 and 2 only
- 1 and 3 only
- 2 and 3 only

ESE-2017

Ans. (a) :

- The amount of heat added at low temperature is reduced therefore the mean effective temperature of heat addition is increased and cycle efficiency is increased.
- The boiler capacity is increased for a given output. The amount of steam which does not get fully expanded in the turbine leads to same reduction in the work output but the amount of steam returning to the work output is to remain constant then the boiler, capacity has to be increased.
- The capacity of the condenser is reduced because a small fraction of the steam is not reaching the condenser now.

67. Isentropic efficiency of turbine is given as :

- Actual work output / Isentropic work output
- Isentropic work input/Actual work input
- Actual work output x Isentropic work output
- Isentropic work input x Actual work input.

RSMSSB JEN 16.10.2016 (Degree)

Ans. (a) : Isentropic efficiency of turbine is the ratio of the actual work output of the turbine to the isentropic work output.

68. The vacuum obtainable in a condenser is dependent upon
- capacity of ejector
 - quantity of steam to be handled
 - capacity of ejector or quantity of steam to be handled
 - temperature of cooling water

MP Sub Engineer 4th April 2016 Evening

Ans. (d) The vacuum obtainable in a condenser is dependent upon temperature of cooling water.

69. A closed vessel heat exchanger in which steam coming from turbine is condensed using supply of cooling water at atmospheric pressure, is called :
- Steam Engine
 - Heat Exchanger
 - Condenser
 - None of these

Mizoram PSC 2016 (Paper-2)

Ans. (c) : A steam condenser is a closed vessel into which the steam is exhausted and condensed after doing work in an engine cylinder or turbine. It has following two objects –

- The primary object is to maintain a low pressure (below atm.) so as to obtain the maximum possible energy from steam and thus to secure a high efficiency.
- The secondary object is to supply pure feed water to the hot well, from where it is pumped back to the boiler.

70. In the Rankine cycle the lower limit on the condenser pressure is due to the:

- expansion limit in turbine
- condenser size
- air leakage into the condenser
- temperature of the cooling water

UPRVUNL JE 2016 (Shift-I)

Ans. (d) : In the Rankine cycle the lower limit on the condenser pressure is due to the temperature of the cooling water. The overall effect of lowering the condenser pressure is an increase in the thermal effecting of the cycle.

71. Which is the example for external combustion engine?

- Petrol Engine
- Diesel Engine
- Steam Engine
- None of the above

Karnataka PSC RTO 10.07.2016

Ans. (c) : A steam engine is one type of external combustion engine. In a steam engine, fuel such as coal is burned in the combustion chamber. This heat turns water in a boiler to steam.

72. Thermal efficiency of thermal power plant is of the order of

- 15%
- 20%
- 30%
- 45%

UPSSSC JE 2015

Ans. (c) : Thermal power plant works on Rankine cycle.
 * It is located at a site where coal, water and transportation facilities are available easily.
 * The overall efficiency of a thermal power plants is least compared to other plants and is of the order of 30-32%.

73. The function of condenser in thermal power plant is
- To act as reservoir to receive steam from turbine
 - To condense steam into condensate to be reused again
 - To create vacuum
 - All the above

UPSSSC JE 2015

Ans. (d) : Condenser is a device in a steam power plant in which steam condenses and heat released by steam is absorbed by water.

- The condensation of steam in a close vessel produces a partial vacuum due to great reduction in the volume of low pressure steam.
- The condensate water is fed back to the boiler to reuse in the boiler by the pump.

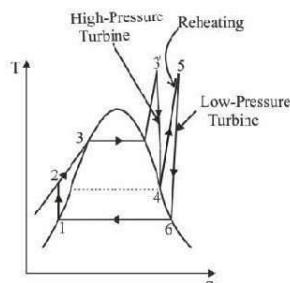
74. If a re-heater is added to a Rankine Cycle, then usually:

- the net work and efficiency decreases
- the net work remains same and efficiency increases
- the net work increases and efficiency remains same
- the net work and efficiency increases

SSC JE 2015

Ans. (d) : If a re-heater is added to a Rankine- cycles then usually the net work and efficiency increases. Since,

$$W_T = W_{HPT} + W_{LPT} \quad & W_{net} = W_T - W_P \\ (Q_A)_{Total} = (Q_A)_{Boiler} + (Q_A)_{Reheater}$$



$$r_w = \frac{W_{net}}{W_T}$$

if $W_{net} \uparrow \Rightarrow r_w \uparrow$

But η_{RH} may be increase, decrease or constant depending on heat adding.

75. For the same maximum temperature in the cycle, the average temperature of heat addition of a Rankine cycle compared to that of Carnot cycle is-

- not related
- same
- lower
- higher

SSC JE 2015

Ans. : (c) According to Carnot theorem, "No heat engine operating in a cycle between two given thermal reservoirs, with fixed temperatures, can be more efficient than a reversible engine operating between the same thermal reservoirs."

* So at any condition, the average temperature, of heat addition of a Rankine cycle compared to that of Carnot cycle is lower.

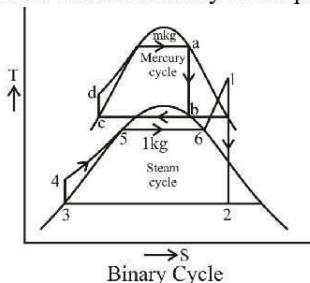
76. Power cycle which is actually a combination of two cycles, one in high temperature region and the other in low temperature region is called.

- (a) Dual cycle (b) Duplicated cycle
 (c) Twin cycle (d) Binary cycle

MPSC AMVI 2013

Ans. (d) : A binary vapour cycle is defined in thermodynamic as a power cycle that is a combination of two cycles, one in a high temperature region and the other in a lower temperature region.

- In the binary cycle (two-fluid), two cycles with different working fluids are coupled in series.
- The heat rejected by one being utilized by another cycle so the overall efficiency of the plant increases.



The overall efficiency of two cycle coupled in series is

$$\eta = \eta_1 + \eta_2 - \eta_1\eta_2$$

77. We can increase the efficiency of Rankine cycle by-

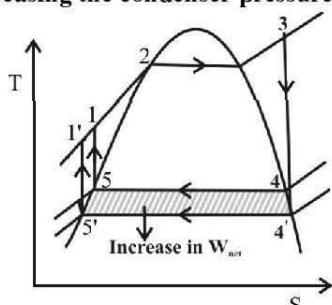
- (a) Lowering condenser pressure
 (b) Superheating steam to high temperature
 (c) Increasing boiler pressure
 (d) All the above

MPSC AMVI 2013

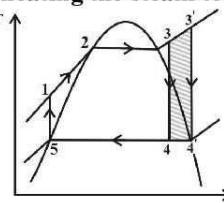
Ans. (d) : Thermal efficiency of ranking cycle is improved by-

- By increasing boiler pressure (P_h)
- By increasing superheat temperature (t_{sup})
- By decreasing condenser (exhaust pressure (P_L))

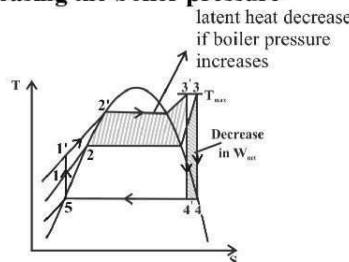
1- Decreasing the condenser pressure-



2- Superheating the steam to high temperature



3- Increasing the boiler pressure-



78. Production of more than one useful form of energy from the same energy source is called-

- (a) Cogeneration (b) Coordination
 (c) Corporation (d) Co-operation

MPSC AMVI 2013

Ans. (a) : Cogeneration is the production of more than one useful form of energy (Such as process heat and electric power) from the same energy source.

79. Consider the following statements :

Assertion (A) : Use of higher steam pressures in power plants has increased pollution.

Reason (R) : High capacity steam plant burns more quantity of fuel.

Now select your answer according to the coding scheme given below :

- Both (A) and (R) are true and (R) is the correct explanation of (A)
- Both (A) and (R) are true, but (R) is not the correct explanation of (A)
- (A) is true, but (R) is false
- (A) is false, but (R) is true

TNPSC 2012 (Paper-4)

Ans. (d) : High capacity steam plant burns more quantity of fuel to produce more steam at high rate.

80. For a given set of operating pressure limits of a Rankine cycle, the highest efficiency occurs for:

- (a) Saturated cycle (b) Superheated cycle
 (c) Reheat cycle (d) Regenerative cycle

Arunachal Pradesh PSC Boiler Inspector 2012

Ans. (d) : For given operating pressure limits in a Rankine cycle, the highest efficiency occurs for Regenerative cycle. It is because mean temperature of heat addition increases in the regenerative cycle.

81. The reheat factor in steam turbine depends on:

- Exit pressure only
- Stage efficiency only
- Initial pressure and temperature only
- All the above

Arunachal Pradesh PSC Boiler Inspector 2012

Ans. (d) : The reheat factor in steam turbine depends on exit pressure, stage efficiency and initial pressure and temperature.

$$\bullet \text{ Reheat factor} = \frac{\text{Cumulative heat drop}}{\text{Adiabatic heat drop}}$$

• Advantage of Reheating of steam turbine –

- It increase the work done through the turbine
- It reduces the erosion of the blades, because of increase in dryness fraction of steam at exhaust.

82. Which one of the following statements is correct?

- (a) Efficiency of the Carnot cycle for thermal power plant is high and work ratio is also high in comparison to the Rankine cycle.
- (b) Efficiency of the Carnot cycle is high and work ratio is low in comparison to the Rankine cycle.
- (c) Efficiency of the Carnot cycle is low and work ratio is also low in comparison to the Rankine cycle.
- (d) Both the cycle have same efficiencies and work ratio.

ESE-2007

Ans. (b) : The specific work output for the Rankine cycle is more than the Carnot cycle for the same maximum and minimum temperature.

Also, the work ratio is defined as the ratio of net work to the work done in the turbine.

$$r_w = \frac{W_{net}}{W_T} = \frac{W_T - W_C}{W_T}$$

- This work ratio is low for the Carnot cycle.
- Efficiency of the Carnot cycle is high and work ratio is low in comparison to the Rankine cycle.

83. When is the greatest economy obtained regenerative feed heating cycle?

- (a) Steam is extracted from only one suitable points of a steam turbine
- (b) Steam is extracted only from the last stage of a steam turbine
- (c) Steam is extracted only from the first stage of a steam turbine
- (d) Steam is extracted from several places in different stages of steam turbines

ESE-2006

Ans. (d) : When is the greatest economy obtained regenerative feed heating cycle steam is extracted from several places in different stages of steam turbines.

84. The ideal cycle on which steam engine works is—

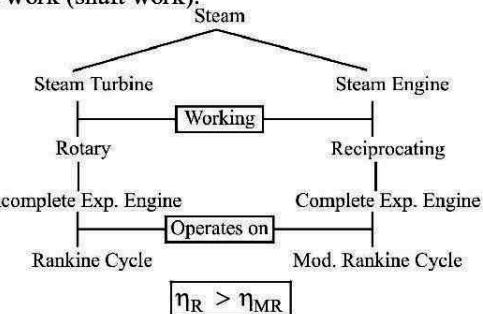
- | | |
|------------------|-------------------|
| (a) Carnot cycle | (b) Rankine cycle |
| (c) Otto cycle | (d) Joule cycle |

MPSC AMVI 2005

Ans. (b) : The ideal cycle on which steam engine works is Modified Rankine cycle.

- There is no given option of Modified Rankine cycle, so we assume Rankine cycle.

- A steam engine is a heat engine that continuously converts heat (energy released by burning of fuel) in to work (shaft work).



85. In condensing steam engine.....

- (a) The pressure is more than atmospheric pressure
- (b) The pressure is below atmospheric pressure
- (c) The pressure is equal to atmospheric pressure
- (d) The complete vacuum exists in condenser

MPSC AMVI 2004

Ans. (b) : Condensing the steam from a high volume gas to a low volume liquid causes a significant pressure drop at the exhaust.

- The case of the decrease in the average temperature at which energy is rejected, requires a decrease in the pressure inside condenser. So, condenser pressure is below atmospheric pressure.

86. The main advantage of a reheat Rankine cycle is

- (a) reduced moisture content in L.P. side of turbine
- (b) increased efficiency
- (c) reduced load on condenser
- (d) reduced load on pump

ESE-2002

Ans. (a) : The main advantage of a reheat Rankine cycle is reduced moisture content in L.P. side of turbine.

- The main advantage of the reheat cycle is that it increases the dryness fraction of steam at condenser inlet thus making it possible to use higher boiler pressure. It also increase the net-work output thus decreasing the mass flow rate of steam required for the same power output.

87. Consider the following statements:

The efficiency of the vapour power Rankine cycle can increased by

1. Increasing the temperature of the working fluid at which heat is added.
2. Increasing the pressure of the working fluid at which heat is added.
3. Decreasing the temperature of the working fluid at which heat is rejected.

Which of these statements is/are correct?

- | | |
|-------------|----------------|
| (a) 2 and 3 | (b) 1 alone |
| (c) 1 and 2 | (d) 1, 2 and 3 |

ESE-1999

Ans. (d) : The efficiency of the vapour power Rankine cycle can be increased by—

- Increasing the temperature of the working fluid at which heat is added
- Increasing the pressure of the working fluid at which heat is added
- Decreasing the temperature of the working fluid at which heat is rejected.

88. Every attempt is made to convert different sources of energy into electricity because—

- (a) Electricity is convenient to use
- (b) Its conversion efficiency is very high
- (c) It can be easily and efficiently transmitted over a great distance
- (d) All the above

MPSC AMVI 1998

Ans. (d) : Every attempt is made to convert different sources of energy into electricity because—

- Electricity is convenient to use.
- Its conversion efficiency is very high.
- It can be easily and efficiently transmitted over a great distance.

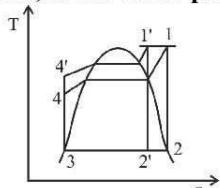
89. The specific steam consumption is expressed as....

- | | |
|--------------|-------------|
| (a) kg/kJ.s | (b) kg/kWh |
| (c) kg/hr/kJ | (d) kg/s/kJ |

MPSC AMVI 1998

Ans. (b) : Specific steam consumption is defined as the steam consumed by a locomotive's cylinders per unit output of power. It is typically measured in kg/kWh or kg/kJ.

90. In a Rankine cycle, with the maximum steam temperature being fixed from metallurgical consideration, as the boiler pressure increases

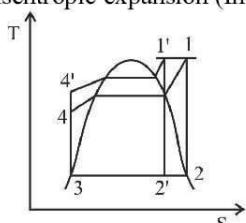


- (a) the condenser load will increase
- (b) the quality of turbine exhaust will decrease
- (c) the quality of turbine exhaust will increase
- (d) the quality of turbine exhaust will remain unchanged

ESE-1997

Ans. (b) : 1-2-3-4-1 is normal Rankine cycle process.

Process 1-2 → Isentropic expansion (In turbine)



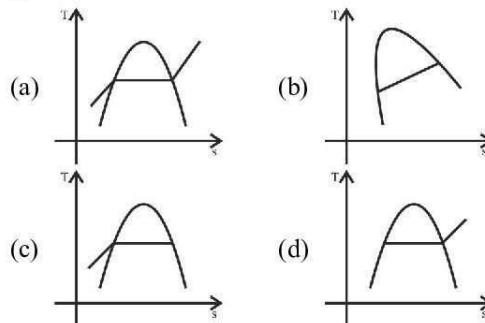
Process 2-3 → Constant pressure heat rejection (In condenser)

Process 3-4 → Isentropic compression (In pump)
Process 4-1 → Constant pressure heat addition (In boiler)

1'-2'-3,4'-1' is a Rankine cycle when the boiler pressure increased

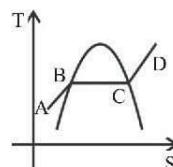
- As the maximum steam temperature is fixed because of the metallurgical condition and the boiler pressure is increased.
- We can conclude from the Rankine cycle that the quality of turbine exhaust will decrease i.e. from 2 to 2'

91. The conversion of water from 40°C to steam at 200°C at a pressure of 1 bar is best represented as



ESE-1994

Ans. (a) :



- The conversion of water from 40°C to steam at 200°C at a pressure of 1 bar is best represented as above TS diagram

AB line represents

- 40°C water to 100°C saturated water at 1 atm.

BC line represents

- * 100°C saturated water convert into 100°C dry saturated steam at 1 atm.

CD line represents

- * 100°C dry saturated steam to 200°C super heated steam at 1 atm.

92. In a steam power plant, feed water heater is a heat exchanger to preheat feedwater by

- (a) leave steam from steam generator
- (b) hot flue gases coming out of the boiler furnace
- (c) hot air from air preheater
- (d) extracting steam from turbine

ESE-1992

Ans. (d) : In a steam power plant, feed water heater is a heat exchanger to preheat feed water by extracting steam from turbine. This process is known as bleeding of turbine.

Feed water heater- A feed water heater is a power plant component used to pre-heat water delivered to steam generating boiler.

- 93. In the bottom cycle of cogeneration, low grade waste heat is used for**
- processing
 - power generation
 - feed water heating
 - none of the above
- ESE-1992

Ans. (b) : In the bottom cycle of cogeneration, low grade waste heat is used for power generation.
A bottoming cycle is a thermodynamic cycle which generates electricity from waste heat.

2. Boiler Mountings & Accessories

- 94. A device used to put off fire in the furnace of the boiler when the level of the water in the boiler fails to an unsafe limit.**
- Economiser
 - Fusible plug
 - Superheater
 - Blow off cock

Karnataka PSC AE (WRD) 31.07.2021

SSC JE 11.12.2020

SSC JE 27.10.2020 (Shift-I)

SSC JE 27-09-2019 (Shift-1)

SSC JE 27.10.2020 (Shift-III)

Mizoram PSC 2019 (Paper-2)

ISRO LPSC 04.03.2018

UPRVUNL JE 2016 (Shift-I)

Mizoram PSC 2015 (Paper-1)

SSC JE 2014 (Evening)

TSPSC AE 2015

Ans. (b) : Fusible plug—

- It is used to extinguish the fire inside the boiler when the water level inside the boiler falls to an unsafe level and prevent an explosion.
- It also prevents the damage that may happen due to the explosion.

- 95. Locomotive type of boiler is—**

- horizontal multi-tubular water tube boiler
- water wall enclosed furnace type
- vertical tubular fire tube type
- horizontal multi-tubular fire tube type

SSC JE 27.10.2020 (Shift-3)

SSC JE 27.10.2020 (Shift-1)

Himachal SSC JE 2018

SSC JE 24.01.2018 (3:15 pm)

UPRVUNL JE 2016 (Shift-2)

SSC JE 2007

Ans. : (d) Locomotive type of boiler is horizontal multitubular fire tube type.

Locomotive boiler –

Pressure – 10 – 20 bar

Capacity – 2 – 4 tonn/hr

Note—No long chimney is used, artificial draught is achieved by steam jet.

- 96. The Benson boiler has—**

- no steam drum
- a vertical steam drum
- an horizontal steam drum
- two drums—one for water and another for steam

JPSC AE 23.10.2021 Paper-I

SSC JE 23.03.2021 (Shift-II)

SSC JE 23.03.3021 (Shift-III)
SSC JE 28.1.2020 (Shift-III)
SSC JE 25.01.2018 (10:15 am)
SSC JE 2015
ESE-1999

Ans. : (a) Benson boiler is a modern high pressure, forced circulation, artificial draught, water tube boiler.
* It is invented by " Mark Benson" in 1923.
* This boiler has no steam drum due to very high pressure, upto or more than critical pressure as we know At critical pressure, latent heat (Δh)=0
Then no required any water steam separator (like drum)

- 97. Which of the following is a water tube boiler?**

- Cochran boiler
- Lancashire boiler
- Babcock Wilcox boiler
- Locomotive boiler

SSC JE 27.10.2020 (Shift-III)

ISRO LPSC 04-03-2018

CSEB AE 2018

SSC JE 03.03.2017 (Shift-I)

Karnataka PSC JE 09.09.2017

UPSSSC JE 2015

DMRC 27.07.2013

PSPCL JE 2012

Ans : (c) Water Tube Boiler—In this boiler the water is contained inside the tubes (called water tubes) which are surrounded by flames and hot gases from outside.

Examples—Babcock and Wilcox boiler, Stirling boiler, La-Mont boiler, Benson boiler, Yarrow boiler and Loeffler boiler etc.

Fire Tube Boiler—In this boiler, the flames and hot gases produced by combustion of fuel, pass through the tubes, which are surrounded by water.

Examples—Cochran boiler, Lancashire boiler, Cornish boiler, Scotch marine boiler, Locomotive boiler, Simple vertical boiler and Velcon boiler.

- 98. In a boiler, the device in which the waste heat of flue gases is utilised for heating feed water is called a/an:**

- superheater
- injector
- economiser
- air preheater

SSC JE 27-09-2019 (Shift-2)

SSC JE 27-09-2019 (Shift-1)

WBPSC 2018

RRB JE [Exam Date : 04-01-2015 (Yellow Paper)]

TNPSC 2012

ESE-1999

Ans. (c) : Economiser is a boiler accessory in which the waste heat of flue gases is utilised for heating feed water. It improves boiler efficiency, by 15 to 20% of coal saving.

Super heater is used to increase temperature of saturated steam without raising its pressure or at constant pressure.

Air preheater is used for raising the temperature of air before it supply to the furnace, it absorbs heat from flue gases which is passing through chimney. It reduce fuel consumption and increase thermal efficiency of Boiler.

* The function of an **injector** is to feed water into the boiler. It is also used where the space is not available for the installation of feed pump.

99. The draught in locomotive boilers is produced by

- (a) Chimney
- (b) Centrifugal fan
- (c) Steam jet
- (d) Locomotion

SSC JE 22-03-2021 Shift-II

SSC JE 11.12.2020

SSC JE 27.09.2019 (Shift-1)

ESE-2011, 2003

Ans. (c) : The draught in locomotive boiler is produced by steam jet.

• Locomotive boiler is a multi-tubular horizontal, internally fired and mobile boiler. The principle feature of this boiler is to produce steam at a very high rate.

100. What can you say about a water tube boiler's efficiency when compared to a fire tube boiler with equal features?

- (a) Fire tubes has higher efficiency than water tube
- (b) Water tube has higher efficiency than fire tube
- (c) Both have the same efficiency
- (d) Cannot be quantified

UPSSSC JE 19.12.2021

Ans. (b) : In water-tube boiler, water is flowing through tubes which are surrounded by flue gases. These boilers are mostly high pressured.

• It have higher heat transfer area and higher pressure as compared to fire tube boilers with equal features. So, these water tube boilers have higher efficiency than fire tube boilers.

i.e. $P \uparrow \Rightarrow W_T \uparrow$ and

Utilization of heat is more, so

$$\eta_{WT} > \eta_{FT}$$

101. The device used to empty the boiler, when required and to discharge the mud, scale of sediments which are accumulated at the bottom of the boiler is known as

- (a) Safety valve
- (b) Stop valve
- (c) Fusible valve
- (d) Blow off cock

SSC JE 27.10.2020 (Shift I)

SSC JE 25.09.2019 (Shift II)

HPSSC JE 2018

UPRVUNL JE 2015

SSC JE 2011

Ans. (d) : The device used to empty the boiler, when required and to discharge the mud, scale of sediments which are accumulated at the bottom of the boiler is known as blow off cock.

102. Which one of the following is a boiler mounting?

- (a) Fusible plug
- (b) Super heater
- (c) Economiser
- (d) Chimney

Punjab PSC JE 19.12.2021

MRPL Tech. Asst. Trainee 2021

HPCL JE 2019

NPCIL 08.11.2019 (9-11 am)

DMRC 2014 (Paper-I)

Ans : (a) Boiler mounting- Boiler mountings are a set of safety device installed for the safe operation of a boiler.

Example:

1. Water level indicator
2. Safety valve
3. Pressure gauge
4. Steam stop valve
5. Feed check valve
6. Man hole
7. Fusible plug

103. Lancashire boiler is :

- (a) stationary fire tube boiler
- (b) internally fire tube boiler
- (c) horizontal boiler
- (d) All of these

Punjab PSC JE 19.12.2021

HPSSC JE 2018

Mizoram PSC 2015 (Paper-I)

SSC JE 2011, 2008

Ans. (d) : Characteristic of Lancashire boiler :-

H-FT-NC-ND-IF-2T-LP-S-MP

where,

H = Horizontal

FT = Fire Tube

NC = Natural Draught

IF = Internal Fired

LP = Low Pressure

S = Stationary

MP = Multipass

2T = Two Tube

104. A device used to increase the temperature of saturated steam without raising its pressure is called

- (a) fusible plug
- (b) blow off cock
- (c) economiser
- (d) superheater

UPSSSC JE 2016

UPRVUNL JE 2016 (Shift-II)

SSC JE 2014 (MORNING)

UPSSSC JE 2015

Ans. : (d) A device used to increase the temperature of saturated steam without raising its pressure is called super heater.

* Super heater takes heat from the flue gases.

* It is located in the path of flue gases between boiler & economiser.

* It increases the overall efficiency of cycle.

* It reduces the moisture content in last stage of turbine and thus increase the work output.

- 105. Which one of the following boiler accessories does not need "Flue-gas" for its operation?**
- (a) Economiser (b) Pre-heater
 (c) Injector (d) Super heater

SSC JE 11.12.2020

UPRVUNL JE 2016 (Shift-I)

ESE-2007

Ans. (c) : Flue-gas is needed for the operation of following boiler accessories –

- Economiser
- Pre - heater
- Super heater

Injector - Flue gas does not need for the operation of injector. The function of an injector is to feed water into the boiler. Its commonly employed for vertical and locomotive boiler and does not find its applications in large capacity high pressure boiler.

- 106. In a water-tube boiler, the flue gas flows through the following accessories :**

1. Superheater
2. ID Fan
3. Air heater
4. Economiser

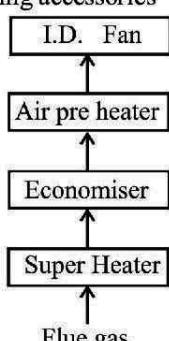
Which of the following gives the correct sequence of the flue gas through these accessories?

- | | |
|----------------|----------------|
| (a) 3, 1, 4, 2 | (b) 1, 4, 3, 2 |
| (c) 1, 3, 2, 4 | (d) 1, 2, 3, 4 |

SSC JE 2012

ESE-2001, 1997

Ans. : (b) In a water tube boiler the flue gas flows through the following accessories –



- 107. Which statement represents the steady flow energy equation for a boiler?**

- (a) $h_1 + \frac{V_1^2}{2gJ} = h_2 + \frac{V_2^2}{2gJ}$
- (b) $Q = h_2 - h_1$
- (c) $h_1 + \frac{V_1^2}{2gJ} + Q = h_2 + \frac{V_2^2}{2gJ}$
- (d) $W = h_2 - h_1 + Q$

SSC JE 24. 1. 2018 (10.15 am)

SSC JE 25. 1. 2018 (3.15 pm)

SSC JE 25. 1. 2018 (10.15 am)

Ans. (b) We know that SFEE

$$m_1 \left(h_1 + \frac{V_1^2}{2} + gz_1 \right) + Q = m_2 \left(h_2 + \frac{V_2^2}{2} + gz_2 \right) + W$$

For Boiler-

$$W = 0, z_1 = z_2, V_1 \approx V_2$$

h_1, h_2 = enthalpies at inlet and outlet.

$$\text{Then, } h_1 + Q = h_2$$

$$Q = h_2 - h_1$$

- 108. What is the primary function of a steam trap in a boiler?**

- (a) Recover heat from exit gases
- (b) Increase temperature of steam above saturated temperature
- (c) Separate the water particles from the steam
- (d) Drain off condensed water accumulating in the steam pipelines

SSC JE 11.12.2020

SSC JE 3 March 2017 Shift-I

TNPSC 2012 (Paper-4)

Ans. (d) In boiler, primary function of steam trap is to drain off condensed water accumulating in the steam pipelines. A steam trap is a device used to discharge condensates and non-condensable gases with a negligible consumption or loss of live steam.

- 109. A closed vessel made of high quality steel in which steam is generated from water by the application of heat, is known as**

- (a) Steam nozzle
- (b) Steam Generator (or) a boiler
- (c) Steam Jet Draught
- (d) None of these

SSC JE 27-09-2019 (Shift-2)

RRB JE 30.08.2019 (Shift-I)

Mizoram PSC 2016 (Paper-2)

Ans. (b) : A closed vessel made of high quality steel in which steam is generated from water by the application of heat is known as steam generator or a boiler.

- 110. Equivalent evaporation of a boiler is defined with respect to generation of steam from & at**

-
- (a) 20°C
 - (b) 100°C
 - (c) 150°C
 - (d) Any of these

SSC JE 27-09-2019 (Shift-2)

SSC JE 25.1.2018 (10.15 am)

ISRO IPRC 21-04-2018

Ans. (b) : Equivalent evaporation of a boiler is defined with respect to generation of steam from & at 100°C. It is the quantity at 100°C, which changed in the dry & saturated steam at 100°C temperature & normal atmospheric pressure.

$$\text{Equivalent evaporation (E)} = \frac{m_e(h - h_{f1})}{2257}$$

Where, m_e = Mass of vapourised water

h = Total heat of steam (kJ/kg)

h_{f1} = Latent heat of feed water (kJ/kg)

- 111. is the platform in a furnace upon which fuel is burnt.**
- (a) Shell
 - (b) Grate
 - (c) Accessory
 - (d) Blow off cock
- SSC JE 27.10.2020 (Shift-1)**
SSC JE 27.10.2020 (Shift-3)
SSC JE 27-09-2019 (Shift-2)
- Ans. (b) :** In boiler furnace grate is the plateform on which fuel is burnt.
- Boiler's accessories are those components which are installed either inside or outside of the boiler to increase the efficiency of the boiler and help in proper working of plant.
 - **Example :** Feed pump, injector, economiser, air preheater, super heater etc.
 - The function of blow off cock is to discharge mud and other sediments deposited in bottom of the boiler.
- 112. The steam capacity of Cochran boiler is :**
- (a) 2000 kg/hr
 - (b) 3000 kg/hr
 - (c) 4000 kg/hr
 - (d) 5000 kg/hr
- HPCL JE 07-11-2019 (Shift-2)**
NPCIL 07.11.2019
- Ans. (b) :** The steam capacity of Cochran boiler is 3000 kg/hr.
- ⇒ Cochran boiler is a multitubular vertical fire tube boiler having a number of horizontal fire tubes.
- ⇒ It is the modification of a simple vertical boiler.
- Characteristic of Cochran boiler :-**
- * Pressure ⇒ 7.5 – 10 bar
 - * Capacity ⇒ 2.5 to 3 t/hr
 - * Small floor area
 - * Favoured for small plants.
- 113. Which of the following is a type of high-pressure boiler?**
- (a) Locomotive boiler
 - (b) Lancashire boiler
 - (c) Velox boiler
 - (d) Cornish boiler
- SSC JE 27.10.2020 (Shift-1)**
SSC JE 27-09-2019 (Shift-2)
- Ans. (c) :** A steam generator or boiler is a thermal device used to generate steam at a desired pressure and temperature by transferring heat energy produced by burning coal, to water to produce steam.
- General Classification of boiler**
- (1) Fire tube boiler (Low pressure boiler)**
- (i) Simple vertical boiler
 - (ii) Cochran boiler
 - (iii) Scotch marine boiler
 - (iv) Locomotive boiler
- (2) Water tube boiler (High pressure boiler)**
- (i) Babcock & Wilcox boiler
 - (ii) La-mont boiler
 - (iii) Benson boiler
 - (iv) Loeffler boiler
 - (v) Stirling boiler
 - (vi) Velox boiler
- 114. A short chimney is provided for-**
- (a) Lancashire Boiler
 - (b) Babcock and Wilcox Boiler
 - (c) Locomotive Boiler
 - (d) Cochran Boiler
- MPSC AMVI 2003, 2001**
- Ans. (c) :** The chimney is the part of a steam power plant.
- A short chimney is provided for locomotive boiler because the use of artificial draught.
 - Since mobile, no long chimney, Artificial draught achieved by steam jet.
- 115. Which of the following is essential for boiler operation?**
- (a) Superheater
 - (b) Economiser
 - (c) Injector
 - (d) Safety valve
- ISRO IPRC 28-08-2016**
SSC JE 2014 (Morning)
- Ans. (d) :** Safety valve is essential for boiler operation. Because safety valve is a boiler mounting, and boiler mountings are the fitting, which are mounted on the boiler for its proper and safe functioning.
- Some important boiler mountings
- | | |
|--------------------------|---------------------|
| 1. Water level indicator | 2. Pressure gauge |
| 3. Safety valve | 4. Steam stop valve |
| 5. Blow-off-cock | 6. Feed check valve |
| 7. Fusible plug | |
- Boiler Accessories**—These are the devices which are used as integral parts of a boiler and help in running efficiently.
- Some important boiler accessories
- | | |
|---------------|------------------|
| 1. Feed pump | 2. Super heater |
| 3. Economiser | 4. Air preheater |
- 116. An air preheated is used –**
- (a) to raise temperature of feed water
 - (b) to avoid hazard
 - (c) to raise temperature of entering air
 - (d) to increase temperature of steam
- UPRVUNL JE 25.10.2021 (Shift-II)**
SSC JE 27.10.2020 (Shift-III)
UPRVUNL JE 2016 (Shift-II)
- Ans. (c) :** In power plant, function of air pre-heater is to raise temperature of entering air. The purpose of the air preheater is to recover the heat from the flue gas (Exhaust gases) from the boiler to improve boiler efficiency.
- 117. Fans used for mechanical draft (induced) are of _____ type**
- (a) axial flow type
 - (b) radial flow type
 - (c) centrifugal type
 - (d) propeller type
- HPSSC JE 07.03.2021**
ESE-1992
- Ans. (d) :** Fans used for mechanical draft (induced) cooling tower are propeller type.
- * In induced draft tower, the fan is placed at the top and above the eliminator such that atmospheric air is circulated from the top to the bottom.

- 118. The main advantage of the water tube boiler over the fire-tube boiler is**
- The water tube boiler can operate safely at higher pressure
 - Soot deposition in the tubes is avoided
 - Corrosion of the tubes is less
 - Fouling of the tubes is reduced

SSC JE 11.12.2020
ESE-2014

Ans. (a) : The main advantage of the water tube boiler over the fire-tube boiler is the water tube boiler can operate safely at higher pressure.

Fire tube boiler	Water tube boiler
1. They are low pressure boiler and the operating pressure is about 25 bar.	1. They are high pressure boilers and operating pressure is about 250 bar
2. Hot flue gases are present inside the tubes and water surrounds them	2. The water is present inside the tubes and hot flue gases surrounds them
3. The overall efficiency of this boiler is up to 75%	3. The overall efficiency is up to 90% with the economiser.
4. The rate of steam generation and quality of steam is very low	4. The rate of steam generation and quality of steam is better and suitable for given output
5. Water does not circulate in a definite direction	5. Water circulates in a well-defined direction

- 119. Performance of boiler is measured by**
- Amount of water supplied per hour
 - Steam produced in kg per kg of fuel burnt
 - Steam produced in kg/hr
 - All of above

HPSSC JE 23.12.2020

RSMSSB JEN (Diploma) 21.08.2016 Shift-II

Ans. (d) : Performance of boiler is measured by–
 (i) Amount of water supplied per hour.
 (ii) Steam produced in kg per kg of fuel burnt.
 (iii) Steam produced in kg/hr.

- 120. The evaporation of 15.653 kg of water per hour from and at 100°C is called**
- evaporative capacity
 - factor of evaporation
 - equivalent evaporation
 - one boiler h.p.

SSC JE 25. 1. 2018 (10.15 am)

Karnataka PSC JE 09-09-2017

Ans. (d) : The evaporation of 15.653 kg of water per hour from and at 100°C is called one boiler h.p.

- 121. Which of the following are boiler mountings?**
- fusible plug
 - blow off cock
 - steam trap
 - feed check valve

Select the answer using the codes given below:

- | | |
|----------------|----------------|
| (a) 1, 2 and 3 | (b) 2, 3 and 4 |
| (c) 1, 3 and 4 | (d) 1, 2 and 4 |

HPSSC JE 10.04.2021, 23.12.2020
ESE-2005

Ans. (d) : Boiler mountings–

- Water level indicator-2
- Pressure gauge-1
- Safety valves-2
- Steam stop valve-1
- Blow off cock-1
- Feed check valve-1
- Fusible plug

Boiler accessories–

- Feed water pump
- Injector
- Air pre-heater
- Super heater
- steam drier or separator
- economiser

- 122. The fusible plug in small boilers is located**

- in the drum
- in the fire tubes
- above steam dome
- over the combustion chamber

SSC JE 23-03-2021 Shift-II

SSC JE 27. 1. 2018 (10.15 pm)

Ans. (d) : The fusible plug in small boilers is located over the combustion chamber. It is used for the purpose of enhancing the safety during operation. It is made up of brass, bronze or gunmetal etc.

- 123. Cochran boiler is a :**

- Horizontal fire-tube boiler
- Horizontal water-tube boiler
- Vertical water-tube boiler
- Vertical fire-tube boiler

SSC JE 11.12.2020

SSC JE 2010

Ans. : (d) Cochran Boiler –

Cochran boiler is a modification of simple vertical boiler where heating surface has been increased by increasing number of fire tubes.

- * It is used for steam generation of low rate.
- * It is a fire tube boiler.

Characteristics of Cochran Boiler –

- * A vertical
- * Multi tubes
- * Fire tubes
- * Internally fired
- * Natural circulation boiler

- 124. _____ boiler involves circulation of water by natural convection.**

- Velox
- La-Mount
- Babcock-Wilcox
- Benson

SSC JE 28-10-2020 (3 to 5 pm)

SSC JE 2015

Ans. (c) : In Babcock-Wilcox boiler natural circulation of water involves.

Specifications-

- It is a water-tube boiler.
- It is externally-fired boiler.
- Moderate pressure boiler.
- Natural circulation of water.
- Inclined tubes (at 15° from horizontal) are used.
- Multipass tubes.
- Horizontal & stationary boiler.

125. Which of the following is NOT an accessory of a boiler?

- (a) Water pump for feeding
- (b) Condenser
- (c) Economiser
- (d) Air preheater

**SSC JE 11-12-2020
ESE-2009**

Ans. (b) : Condenser is a accessory of thermal power plant not of boiler. Condenser is a heat exchanger, is installed after turbine in a power plant to condense steam into the water.

- Steam is condensed into the water by condenser at constant pressure.
- Efficiency of thermal power plant is increased by using of condenser.

126. Economiser in boiler

- (a) Increases steam pressure
- (b) Increase steam flow
- (c) Decreases fuel consumption
- (d) Decreases steam pressure

**UPSSSC JE 2015
ESE-2011**

Ans. (c) : Economiser is a device built into a boiler to improve the economy of the boiler by decreasing fuel consumption.

Economiser also improves the efficiency of the boiler.

127. What salts of calcium and magnesium cause temporary hardness of boiler feed water?

- (a) Sulphites (b) Nitrates
- (c) Bicarbonates (d) Chlorides

**UPSSSC JE 2015
SSC JE 2014 (Morning)**

Ans. (c)

- The quality of water used for a boiler depends on the type of the boiler and also its capacity.
- All the modern boiler require the purest form of water.
- Temporary hardness, caused by the scale forming carbonates, is the result of decomposition of bicarbonates of calcium and magnesium.
- Permanent hardness is caused by chlorides, sulphates and nitrates, which are not decompose by boiling.

128. The number of flue tubes in a Cornish boiler is:

- (a) Three (b) Four
- (c) One (d) Two

**SSC JE 27-10-2020 (Shift-1)
SSC JE 27.09.2019 Shift-2)**

Ans. (c) : The number of flue tubes (fire tubes) in Cornish boiler is one.

The diameter (d) of flue tube in Cornish boiler may be about $\frac{3}{5}$ times that of shell.

$$d = \frac{3}{5} D$$

The diameter of Cornish boiler is generally 1m to 2m and its length varies from 5m to 7.5m.

Note- The number of flue tubes in Lancashire boiler is two.

$$d = \frac{2}{5} D$$

[For Lancashire boiler]

129. The function of feed check valve is used for

- (a) Regulate water supply in the boiler
- (b) Regulate the flow of steam
- (c) Put off the fire in the furnace
- (d) Indicate water level in the boiler

UPRVUNL JE 2015

SSC JE 2013

Ans. (a) : The function of feed check valve is used for regulate water supply in the boiler.

- To control the supply of water to the boiler and to prevent the escaping of water from the boiler when the pump pressure is less or pump is stopped, this device is used.

130. In a Lancashire boiler, the economiser is located

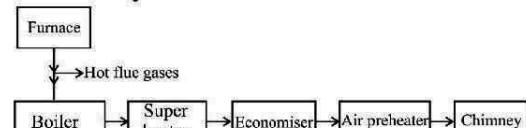
- (a) Before air preheater
- (b) After air preheater
- (c) Between feed pump and boiler
- (d) Not used

UPRVUNL JE 2016 (Shift-I)

UPRVUNL JE 2015

Ans. (a) : In a Lancashire boiler, the economizer is located before air preheater.

- Air preheater is installed between the economiser and chimney.



Block diagram of flue gases

131. For the same diameter and thickness of a tube fired tube boiler as compared to water tube boiler has

- (a) More heating surface
- (b) Less heating surface
- (c) Same heating surface
- (d) No heating surface

UPRVUNL JE 2015

DMRC 2014 (Paper-I)

Ans. (b) : For the same diameter and thickness of a tube fired tube boiler as compared to water tube boiler has less heating surface.

Fire tube boiler	Water tube boiler		
Hot gases inside the tube and water outside the tube	Water inside the tube and hot gases outside the tube	3. It's operating cost is low.	3. Its operating cost is high.
Operating pressure limited to 16 bar	Can work under high pressure 100 bar or above	4. It is not suitable for large power plants.	4. It is used for large power plants.

Note : - Option 'a' is given by commission.

132. Which one is the low-pressure steam generator?

- (a) Benson steam generator
- (b) Loeffler steam generator
- (c) Velox steam generator
- (d) None of these

**MPSC MVI 2003
MPSC AMVI 2001**

Ans. (d) : High Pressure Boilers –

- Babcox & wilcox Boiler
- Stirling Boiler
- La-mont Boiler
- Velox Boiler
- Loeffler boiler

Low Pressure Boilers –

- Cochran Boiler
- Locomotive Boiler
- Lancashire Boiler
- Cornish Boiler
- Scotch Marine Boiler

133. Lancashire boiler has _____ flue tube (s), where as Cornish boiler has _____ flue tube (s).

- (a) 1 : 2
- (b) 2 : 1
- (c) 2 : 2
- (d) 3 : 2

SSC JE 22-03-2021 Shift-II

Ans. (b) : Cornish Boiler –

- (i) No. of flue gas tube/Fire tube - 1
- (ii) Diameter of shell - 1.25 to 1.75 m
- (iii) Length of shell - 4 to 7m
- (iv) Max. Working pressure - 10.5 bar

Lancashire Boiler

- (i) No. of flue gas tube/Fire tube - 2
- (ii) Length of shell - 7 to 9m
- (iii) Maximum working pressure - 16 bar

134. _____ falls under the category of a water tube boiler.

- (a) Locomotive boiler (b) Cornish boiler
- (c) La-Mount boiler (d) Lancashire boiler

SSC JE 22-03-2021 Shift-II

Ans. (c) :

Fire tube Boiler	Water tube Boiler
1. The hot gases from furnace passes through the tubes which are surrounded by water.	1. The water circulates inside the tubes which are surrounded by the hot flue gases from the furnace.
2. It can generate steam only up to 24.5 bar.	2. It generated steam at a higher pressure greater than 80 bar

3. It's operating cost is low.	3. Its operating cost is high.
4. It is not suitable for large power plants.	4. It is used for large power plants.
6. Examples - Simple vertical boiler, Cochran boiler, Lancashire boiler, Locomotive boiler, Velcon boiler	Examples - 1. Babcock and Wilcox boiler 2. Stirling boiler 3. La-Mount boiler 4. Benson boiler 5. Loeffler boiler 6. Yarrow boiler

135. Which of the following statement is correct about a Benson boiler ?

- (a) Flue gases pass only in one direction
- (b) Air is sent through the same direction
- (c) There is not recirculation of water
- (d) Steam is sent out in multiple directions

SSC JE 22-03-2021 Shift-II

Ans. (c) : Characteristic of Benson Boiler -

- (i) It can be erected in a comparatively small floor area.
- (ii) There is no recirculation of water.
- (iii) Absence of the steam separating drum.
- (iv) The entire process of heating steam generation and superheating is done in a single continue tube.

136. The Babcock-Wilcox boiler is classified as a water tube boiler because:

- (a) it has a large reservoir of water at the bottom
- (b) water passes through the tube and hot gases around
- (c) water passes around the tubes having hot gases
- (d) water heater is mounted on the boiler itself

SSC JE 22-03-2021 Shift-II

Ans. (b) : The Babcock - Wilcox boiler is classified as a water tube boiler because water passes through the tube and hot flue gases around water tube. This boiler is used when pressure above 10 bar and steam generating capacity is required higher than 7000 kg/hr.

137. _____ is NOT a water tube boiler.

- (a) Stirling boiler
- (b) Scotch Marine boiler
- (c) Babcock - Wilcox boiler
- (d) Benson boiler

SSC JE 22-03-2021 Shift-II

Ans. (b) : In fire-tube boiler hot flue gases passes through tubes and water surround them.

Examples - Cornish Boiler, Lancashire Boiler, Locomotive Boiler, Cochran Boiler, Scotch marine Boiler, Immersion Boiler.

* In water tube boiler water passes through tubes and hot flue gasses surround them.

Example - Babcock & Wilcox Boiler, Stirling boiler, La-Mount boiler, Benson boiler, Yarrow boiler and Loeffler Boiler.

- 138. In the Rankine cycle, the fluid which enters the boiler is:**
- steam
 - mercury
 - water
 - oxygen

SSC JE 22-03-2021 Shift-II

Ans. (c) : In Rankine cycle the fluid which enters the boiler is water. Rankine cycle for a steam boiler would be a reversible cycle constant pressure heating process of water to form steam.

- 139. Fusible plug is generally made up of an alloy (gunmetal) which consists of copper tin and**
- aluminum
 - zinc
 - cast iron
 - manganese

SSC JE 22-03-2021 Shift-II

Ans. (b) : Fusible plug is very important safety device, which protects the fire tube boiler against overheating. It is located just above the furnace in the boiler. It generally (made up of an alloy (gunmetal)) which consists of copper, tin and zinc.

- 140. Which of the following is the most widely used fuel in boilers?**
- Wood
 - Oil
 - Pulverized coal
 - Anthracite coal

SSC JE 22-03-2021 Shift-II

Ans. (c) : Pulverized coal of bituminous is the most widely used fuel in boiler.

Note- Option (d) is given by commission.

- 141. Foaming is a phenomenon that occurs in the boiler feed water due to**
- manganese
 - Sodium chloride
 - oil
 - nitrogen peroxide

SSC JE 22-03-2021 Shift-II

Ans. (c) : Foaming is phenomenon, which is formation of a layer of froth or stable foam on the surface of water, that occurs in the boiler feed water due to foaming agent (such as oil, alkali).

- Use of anti-foaming agent such as castor oil. Anti foaming agents neutralize the effect of surface tension.

Note - Foaming is a cause of decreasing the boiler efficiency.

- 142. The equivalent evaporation (kg/hr) of a boiler providing 2000 kg/hr of steam with enthalpy content of 2426 kJ/kg from feed water at temperature 40°C (liquid enthalpy = 168 kJ/kg of vaporization of water at 100°C = 2258 kJ/kg) is**
- 2000
 - 2149
 - 1682
 - 1650

JPSC AE 23.10.2021 Paper-I

Ans. (a) : The equivalent evaporation

$$m_s(h - h_f) = \frac{2000(2426 - 168)}{2258} = 2258$$

$$= 2000 \text{ kg/hr.}$$

- 143. Boiler rating is usually defined in terms of**
- Maximum temperature of steam in Kelvin
 - Heat transfer area in m²
 - Heat transfer rate in kJ/hr
 - Steam output in kJ/hr

JPSC AE 23.10.2021 Paper-I

Ans. (d) : Boiler rating is usually defined in terms of steam output in kJ/hr

- 144. Which one of the following is a fire tube boiler?**

- Babcock and Wilcox boiler
- Locomotive boiler
- Stirling boiler
- Benson boiler

JPSC AE 23.10.2021 Paper-I

Ans. (b) : Water tube boiler-

- Babcock and Wilcox boiler
- Stirling boiler
- Benson boiler

Fire tube boiler-

- Simple vertical
- Cochran boiler
- Lancashire boiler
- Cornish boiler
- Locomotive boiler

- 145. Identify the requirement of a good boiler from the following options :**

- It should use maximum refractory material
- It should be able to produce steam at minimum pressure
- It should have more flexible joints
- It should be light in weight and compact

SSC JE 2021

Ans. (d) : A good boiler should have the following characteristics-

- The boiler should have maximum steam generation rate with minimum fuel consumption.
- It can be started and stopped quickly.
- It should be light in weight and compact.
- The joint should be leak proof.
- Its initial cost running and maintenance cost should not high.

- 146. How is a high - pressure boiler classified ?**

- When pressure > 50 bar
- When pressure > 80 bar
- When velocity of water is very low
- When it operates, high amount of steam is required for the operation of the cycle

SSC JE 2021

Ans. (b) : When pressure is above 80 bar then boiler is known as high pressure boiler.

- The high pressure boilers are widely used for power generation in thermal power plants.

Example: La-Mount boiler, Benson boiler, Loeffler boiler, Babcock and Wilcox boiler

- 147. In Lancashire boilers, the feed water tube is :**

- open channel type
- perforated
- thin conduit
- solid

SSC JE 2021

Ans. (b) : In Lancashire boilers, the feed water tube is perforated.

- Lancashire boiler is a stationary fire tube type, internally fired, horizontal and natural circulation boiler. It is used where working pressure and power required are moderate.

148. Which of the following is NOT a maintenance method of a boiler ?

- (a) Dry lay-up (b) Wet lay-up
- (c) Short-term lay-up (d) Chemical lay-up

SSC JE 2021

Ans. (d) : A steam boiler lay-up is a maintenance procedure that helps to prevent corrosion within the boiler on both the waterside and fireside when you plan to take the boiler out of service for an extended period of time.

Dry lay-up- Dry lay-up is recommended for boilers that will be out of service for 1 month or more.

Wet lay-up- For boiler that must be kept in an emergency standby mode, wet lay-up is recommended.

Short-term lay-up- You should perform the short-term lay-up if you plan to shut down your boiler for 5-10 days.

- Chemical lay-up is not a maintenance method of a boiler.

149. Which of the following statements is INCORRECT with respect to water tube boilers?

- (a) They are suitable for high steam pressure
- (b) They are suitable for large gas flows
- (c) They cannot handle high steam pressure
- (d) They are smaller and lesser in weight

SSC JE 2021

Ans. (c) : Advantages of water tube boiler –

- (1) They are comparatively smaller and lesser in weight therefore easy operation performed.
- (2) Can tolerate high steam pressure.
- (3) Rapid heat transmission.
- (4) Required less floor area for a given output
- (5) They are suitable for large gas flows.
- (6) Large evaporative capacity.

150. Which of the following is NOT a water-tube boiler ?

- (a) Stirling boiler (b) Cornish boiler
- (c) Loeffler boiler (d) La-Mount boiler

SSC JE 2021

Ans. (b) : Examples of water tube boilers are La-Mount, Benson, Stirling, Babcock and Wilcox and Loeffler boiler etc.

- Examples of fire tube boiler are Cornish boiler, Lancashire boiler, Cochran boiler, Locomotive boiler etc.

151. What is radiant heating in the context of boilers?

- (a) Heating process carried out using radiation effect
- (b) Heating done on radial tubes
- (c) Saturated steam is re-circulated and super-heated
- (d) Heating done on external walls only by reflecting radiant energy

SSC JE 2021

Ans. (a)

- Boiler is basically a closed vessel into which water is heated until the water is converted into steam at the required pressure.
- Superheated steam boilers evaporate the water and then further heat the steam in a superheater, causing the discharged steam temperature to be substantially above the boiling temperature at the boiler's operating pressure.
- Some superheaters are radiant type absorb heat by radiation heat transfer. This radiation type heat energy released by the boiler furnace along with convection heat transfer. This is called radiant heating.

152. A fusible plug must be used primarily for safety purposes in which of the following types of boilers ?

- (a) Oil-fired boiler
- (b) High - pressure boiler
- (c) Fire-tube boiler
- (d) Marine type boiler

SSC JE 2021

Ans. (c) : Function of fusible plug– It is very important safety device of a steam boiler, which protect the fire tube boiler against overheating.

- A fusible plug must be used primarily for safety purposes in fire-tube boiler.

153. Which of the following does NOT result in poor performance of boilers ?

- (a) Surface fouling (b) Poor combustion
- (c) Boiler mounting (d) Poor water quality

SSC JE 2021

Ans. (c) : Performance of the boiler, like efficiency and evaporation ratio reduces with time, due to poor combustion, surface fouling, poor water quality and poor operation.

154. _____ is used for pumping water into a boiler.

- (a) Rotor (b) Feed pump
- (c) Duplex pump (d) Economiser

SSC JE 22-03-2021 Shift-II

Ans. (b) : Feed pump or boiler feed pump is used for pumping water into a boiler. It is very common boiler accessory.

155. According to IBR regulations, boilers exceeding need regular inspection and certification :

- (a) capacity of more than 15 litres
- (b) capacity of more than 5 gallons
- (c) capacity lesser than 5 gallons
- (d) capacity of more than 50 gallons

SSC JE 2021

Ans. (b) : According to IBR regulations, boilers exceeding 22.75 litres (more than five gallons) need regular inspection and certification.

156. Forced circulation of water takes place in

- (a) Locomotive boiler
- (b) Babcock-Wilcox boiler
- (c) La-Mount boiler
- (d) Stirling boiler

HPSSC JE 10.04.2021

Ans. (c) : Forced circulation—If the circulation water take place with the help of an external pump, then its called a forced circulation boiler. Boiler with forced circulation of water—

- La-Mount
- Benson
- Velox

Boiler with the natural circulation of water—

- Lancashire boiler
- Babcock-Wilcox boiler
- Cochran boiler

157. Which of the following device is used for pumping water into the boiler and also for heating the feed water?

- | | |
|----------------|-----------------|
| (a) economiser | (b) feed pump |
| (c) injector | (d) duplex pump |

HPSSC JE 10.04.2021

Ans. (c) : Injector is a device which is used for pumping water into the boiler and also for heating, the feed water. It has no moving parts and water is supplied into the boiler by the action of steam flowing through nozzles.

158. Which of the following options is used for mixing air with fuel supply?

- | | |
|------------------|--------------------|
| (a) Fusible plug | (b) Chimney |
| (c) Booster fan | (d) Blowdown valve |

SSC JE 27-10-2020 (Shift-3)

Ans. (c) : Booster fan is used for mixing air with fuel supply.

159. _____ CANNOT be counted as a boiler mounting.

- | | |
|---------------------|-------------------|
| (a) Feed water pump | (b) Stop valve |
| (c) Fusible plug | (d) Blow-off cock |

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (a) : Feed water pump is a accessory device.

Mounting Devices of Boiler—Essential for safe operation of boiler.

- (i) Safety valve, (ii) Water-level-indicator,
- (iii) Pressure gauge, (iv) Fusible plug, (v) Blow off cock,
- (vi) Feed check valve, (vii) Steam stop valve,
- (viii) Man/mud/inspection hole

Accessories of Boiler—To increase efficiency of boiler.

- (i) Feed water pump, (ii) Economiser, (iii) Super heater,
- (iv) Air preheater, (v) Draught equipments.

160. _____ boiler is capable of generating a small quantity of steam per unit time at high pressure.

- | | |
|--------------------|---------------------|
| (a) Lancashire | (b) Locomotive |
| (c) Babcock-Wilcox | (d) Scottish marine |

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (c) • Babcock-Wilcox boiler is capable of generating a small quantity of steam per unit time at high pressure.

Note—In Babcox-Wilcox boiler water tubes are straight (inclined).

- Inclination of water tube = 15°
- Pressure = (10–100)bar
- Capacity = (2 – 200 t/hr)

161. Which type of pump is commonly used now a days to force water into the boiler?

- (a) Single-stage reciprocating pump
- (b) Duplex pump
- (c) Rotary pump
- (d) Centrifugal pump

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (d) : Centrifugal pump is commonly used to force water into the boiler. Because centrifugal pump supplies continuous & more discharge.

- Centrifugal pump increases less pressure of feed water so to get high pressure ratio multistage centrifugal pumps are used now a days.

162. Due to the turbidity of the water in boiler feed water, _____ is caused.

- | | |
|-------------------|---------------|
| (a) embrittlement | (b) corrosion |
| (c) sludge | (d) cracking |

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (c) : Due to the turbidity of water in boiler feed water, sludge is caused.

- Turbidity in the water is suspended insoluble matter including coarse particle's (mud, sediment, sand etc). That settled rapidly on standing.
- To clean the sludge man hole is provided to enter the man in the boiler after empty the water with the help of blow off cock.

163. Inside a boiler surface, scales are formed due to the presence of _____ in the boiler feed water.

- | |
|-------------------------|
| (a) Ca and Mg salts |
| (b) dissolved gases |
| (c) insoluble compounds |
| (d) oils |

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (a) : Scales are formed due to the presence of Ca & Mg salts in the boiler feed water inside a boiler surface.

- Blow-off-cock is used to empty the boiler when ever required.
- To discharge the mud, scale or sediments which are accumulated at the bottom of the boiler blow-off-cock is used.

164. While classifying the boilers into fire-tube and water-tube, mark out the odd one out of the options given below.

- | | |
|-----------------------|-----------------------|
| (a) Lancashire boiler | (b) Locomotive boiler |
| (c) Stirling boiler | (d) Cochran boiler |

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (c) : Stirling boiler is the odd one out of them because this boiler is a water tube boiler & rest are fire tube boilers.

- A separate mud drum used in this type of boiler.
- Tubes in stirling boiler are bent.

165. The approximate percentage of carbon in bituminous coal used as a fuel for boiler is _____.

- | | |
|------------|------------|
| (a) 10-20% | (b) 20-30% |
| (c) 40-50% | (d) 65-80% |

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (d) Bituminous type coal is used as a fuel in the boiler.

% of carbon in coal—

- Anthrasite → (92%–98%) Carbon
- Bituminous → (65%–80%) Carbon
- Lignite → (28%–30%) Carbon
- Pit → 28% Carbon

166. Which of the following is NOT a type of safety valve used for boilers?

- (a) Dead-weight type (b) Spring type
- (c) Sliding type (d) Lever type

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (c) : Sliding type is not a type of safety valve used for boilers.

Safety Valve—It's main function is to maintain the steam pressure inside the boiler. When pressure of steam more than the rated pressure (or design pressure) of boiler then it release the excessive internal pressure.

Type of safety valve—

- (i) Lever safety valve
 - (ii) Dead weight safety valve
 - (iii) High steam & low water safety valve
 - (iv) Spring loaded safety valve
- A steam boiler is usually provided two safety valve.
 - Safety valve is a mounting.

167. Which of the following is NOT applicable to fire-tube locomotive boilers?

- (a) They are mobile in nature
- (b) They are externally fired
- (c) They are placed horizontally
- (d) They are multi-tubular

SSC JE 28-10-2020 (3 to 5 pm)

Ans. (b) : Fire-tube locomotive boiler is a internal-fired boiler.

- In fire-tube boiler hot gases flow through inside the pipe (tube) & water around it.

Characteristics of locomotive boiler –

- (i) Horizontal, fire tube
- (ii) Multitubular, internal fired
- (iii) Natural circulation
- (iv) Low pressure & artificial draught
- (v) Mobile & single pass
- (vi) Best for fluctuated load
- (vii) Pressure – 10-20 bar
- Capacity – 2-4 Ton/hr

168. What is the minimum valley angle of an ash hopper used in a dry electrostatic precipitator?

- (a) 25° (b) 45°
- (c) 35° (d) 55°

SSC JE 27-10-2020 (Shift-3)

Ans. (d) : Electro static precipitator is a pollution control device. It prevents fly ash to go out with exhaust gas through chimney.

- The minimum valley angle of an ash hopper used in a dry electrostatic precipitator is 55° (or 60°).

169. Which of the following is determined by deploying multiple gauge glasses in boilers?

- (a) Level (b) Velocity
- (c) Pressure (d) Flow

SSC JE 27-10-2020 (Shift-3)

Ans. (a) : In boilers, the level is determined by deploying multiple gauge glasses.

Gauge glass—

- It is a water level indicator used in steam boilers to view the level of water in the boiler by the operator.
- A gauge glass shows the current level of water in the boiler.

170. What is the typical composition of the casting employed in oil-fired boilers?

- (a) 70% Ni and 30% Cr
- (b) 90% Ni and 10% Cr
- (c) 80% Ni and 20% Cr
- (d) 50% Ni and 50% Cr

SSC JE 27-10-2020 (Shift-3)

Ans. (d) : In oil-fired boilers, the typical composition of 50% Ni and 50% Cr of casting is employed.

- Ni and Cr are anticorrosion metals.

171. What is the range of length of a Cornish boiler?

- (a) 4 to 8 m (b) 1 to 2 m
- (c) 10 to 15 m (d) 15 to 50 m

SSC JE 27-10-2020 (Shift-3)

Ans. (a) : The cylindrical shell of Cornish boiler is about 1.25 meter to 1.75 meter in diameter and the length varies from 4 to 8 meters.

- For Cornish boiler,

$$d = \frac{3}{5} D$$

Where, d = Diameter of flue tube

D = Diameter of shell

172. Fusible plugs in boilers are made of:

- (a) brass (b) cast iron
- (c) titanium (d) steel

SSC JE 27-10-2020 (Shift-3)

Ans. (a) : Fusible plug in a boilers is a threaded metal cylinder which is made of generally brass (also bronze or gun metal).

- This is used to protect the boiler against damage due to overheating due to low water level.
- Fusible plug is located on the top of the combustion chamber.

173. Operating pressure for once through boiler is:

- (a) super-critical (b) critical
- (c) subcritical (d) subcritical and critical

SSC JE 11-12-2020

Ans. (a) : Operating pressure for once through boiler is super-critical.

- In this type boilers no any drum is used.
- Benson boiler is a once through boiler.

174. A closed container is termed as boiler if its volume exceeds _____ litres.
- 10
 - 22.75
 - 50
 - 100

SSC JE 11-12-2020

Ans. (b) : A closed container is termed as boiler if its volume exceeds 22.75 litres.

- * A boiler or steam generator is a device used to create steam by applying heat energy to water.
- Boilers are usually prepared by folding metal sheets with butt joints.

175. _____ boiler is an example of once-through boilers.
- Benson
 - La-Mount
 - Benson and La-Mount
 - Loeffler

SSC JE 11-12-2020

Ans. (a) : Benson boiler is a high pressure, drumless, water tube, supercritical and forced circular boiler. It is a once through boiler.

- La-Mount & Loeffler boiler is also a water tube boiler.

176. The most appropriate example of _____ boiler is Cornish boiler:

- multi-tubular
- water tube
- flue gas
- fire tube

SSC JE 11-12-2020

Ans. (d) : Cornish boiler is a fire tube boiler in which one flue gas tube is used.

For a Cornish boiler—

$$d = \frac{3}{5} D$$

Where, d = Diameter of tube

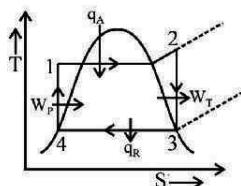
D = Diameter of shell or drum

- It is a natural circulation & low pressure boiler.

177. The power developed by a turbine in a certain steam power plant is 1206 kW. The heat supplied to boiler is 3500 kJ/kg. The heat rejected by steam to cooling water is 2900 kJ/kg. The feed pump work required to condensate back into the boiler is 6 kW. What will be mass flow rate of cycle?
- 0.002 kg/s
 - 0.00622 kg/s
 - 6.22 kg/s
 - 2 kg/s

SSC JE 27-10-2020 (Shift-3)

Ans. (d) :



$$W_T = 1206 \text{ kW}$$

$$W_P = 6 \text{ kW}$$

$$q_A = 3500 \text{ kJ/kg}, q_R = 2900 \text{ kJ/kg}$$

$$\dot{m} = ?$$

$$W_{net} = W_T - W_P = \dot{m}(q_A - q_R)$$

$$1206 - 6 = \dot{m}(3500 - 2900)$$

$$\dot{m} = 2 \text{ kg/s}$$

178. Which of the following fittings is mounted to put off fire in a boiler furnace when the water lever falls below the desired level?

- Feed check valve
- Fusible plug
- Safety valve
- Blowdown valve

Arunanchal Pradesh PSC JE 2020

Ans. (b) : Fusible plug is mounted to put off fire in a boiler furnace when the water level falls below the desired level

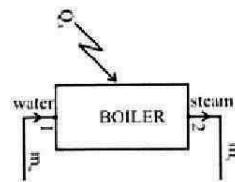
179. Boiler efficiency is :

- $\frac{\text{Mass of Steam} \times \text{Temp. of Steam}}{\text{Calorific Value of Fuel}}$
- $\frac{\text{Energy of Fuel} - \text{Energy of Steam}}{\text{Energy of Fuel}}$
- $\frac{\text{Mass of Steam}}{\text{Mass of Fuel}}$
- $\frac{\text{Energy of Steam}}{\text{Energy of Fuel}}$

RSMSSB JEN 26.12.2020 (Diploma)

Ans. (d) : Boiler efficiency (η_b) : - It is the ratio of heat utilized in raising steam to the heat supplied by fuel.

$$\eta_b = \frac{Q_u}{Q_A} = \frac{m_s(h_2 - h_1)}{m_f \times C.V.}$$



where

m_s = mass of steam

m_f = mass of fuel

C.V. = calorific value

h_2 = enthalpy of steam

h_1 = enthalpy of water

Q_u = Heat utilized in formation of steam

Q_A = Heat added into boiler by burning fuel.

180. Superheater is used in boiler to increase the :

- Temperature of feed-water for better efficiency
- None of these mentioned
- Temperature of saturated steam with increase in pressure
- Temperature of saturated steam without increase in pressure

RSMSSB JEN 26.12.2020 (Diploma)

Ans. (d) : Superheater is used in boiler to increase the temperature of saturated steam without increase in pressure.

Superheater : - The Superheater is a heat exchanger in which heat is transferred to the saturated steam to increase its temperature.

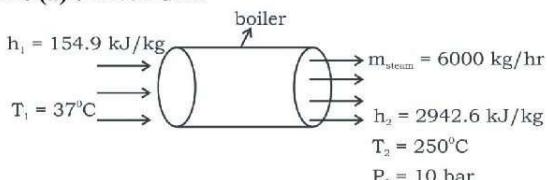
- * It raises the overall cycle efficiency.
- * In Addition, it reduces the moisture content in last stages of the turbine and thus increases the turbine internal efficiency.
- * It is located between boiler furnace and Economiser.

181. A boiler plant supplies 6000 kg/hr of steam at 10 bar and 250°C with enthalpy content 2942.6 kJ/kg from feed water at temperature 37°C (liquid enthalpy 154.9 kJ/kg). At this time, it uses 800 kg/hr of coal having a calorific value of 30,000 kJ/kg, then efficiency of boiler will be:

- (a) 69.7% (b) 49.7%
 (c) 79.7% (d) 59.7%

RSMSSB JEN 13.12.2020 (Diploma)

Ans. (a) : Given data



$$m_f = 800 \text{ kg/hr}$$

$$\text{calorific value } C = 30,000 \text{ kJ/kg}$$

$$\text{Boiler efficiency } (\eta_{\text{boiler}}) = \frac{\left(\begin{array}{l} \text{Actual heat obtained} \\ \text{from boiler} \end{array} \right)}{\left(\begin{array}{l} \text{calorific value of fuel} \\ \times \text{mass of fuel} \end{array} \right)}$$

$$\eta_{\text{boiler}} = \frac{m_{\text{steam}} (h_2 - h_1)}{m_f \times C}$$

$$= \frac{6000 \times (2942.6 - 154.9)}{800 \times 30,000}$$

$$\eta_{\text{boiler}} = 69.7\%$$

182. Lancashire Boiler is :

- (a) Vertical, fire tube boiler
 (b) Horizontal, water tube boiler
 (c) Vertical, water tube boiler
 (d) Horizontal, fire tube boiler

RSMSSB JEN 13.12.2020 (Diploma)

Ans. (d) : Lancashire boiler is a stationary. Internally horizontal fire tube boiler.

Lancashire boiler can be represented by H- FT – NC-ND – IF – LP – 2T – S-MP

Where H = Horizontal

FT = Fire tube

NC = Natural circulation

ND = Natural draught

IF = Internal fired

MP = Multi Pass

S = stationary

LP = Low pressure

2T = Two Tube

thermal efficiency = 80 to 90%

Length = 7 to 9 meter

Diameter = 2 to 3 meter

183. The capacity of boiler is defined as

- (a) The amount of water evaporated into steam in one hour
 (b) The maximum pressure at which steam can be produced in a boiler
 (c) The volume of steam produced per hour
 (d) The maximum temperature at which steam can be produced in a boiler

Arunanchal Pradesh PSC JE 2020

Ans. (a) : The capacity of a boiler is defined as the amount of water evaporated into steam in one hour.

184. The maximum working pressure in a Lancashire boiler is:

- (a) 28 bar (b) 30 bar
 (c) 24 bar (d) 16 bar

SSC JE 27-10-2020 (Shift-1)

Ans. (d) : Lancashire Boiler-

Horizontal – Fire tube – Natural circulation – Internal fired – 2 tube – Low pressure – Stationary – Multipass.

- Pressure – 16 Bar
- Capacity – (2-5) ton/hr

$$\bullet d = \frac{2}{5} D$$

Where, d = Diameter of fire tube
 D = Diameter of boiler shell

185. In a fire tube boiler, the operating pressure range is:

- (a) 21 to 25 bar (b) 16 to 20 bar
 (c) 30 to 35 bar (d) 26 to 29 bar

SSC JE 27-10-2020 (Shift-1)

Ans. (b) : In fire tube boiler, the operating pressure range is 16 to 20 bar.

In fire tube steam boiler, the flames and hot gases, produced by combustion of fuel, pass through the tubes (called multi tubes) which are surrounded by water.

186. Which of the following does NOT come under the forced circulation type of boilers?

- (a) Lancashire (b) Velox
 (c) Benson (d) La-Mount

SSC JE 27-10-2020 (Shift-1)

Ans. (a) : Lancashire boiler is not a forced circulation type boiler.

Forced Circulation Boiler—In this boiler the circulation of water by a centrifugal pump driven by some external power.

Use of forced circulation is made in high pressure boiler such as La-Mount boiler, Benson boiler, Loeffler boiler, Velox boiler etc.

Natural Circulation Boiler—In this boiler the circulation of water is done by natural convection currents which are setup during the heating of water.

Examples—Lancashire boiler, Cornish boiler, Cochran boiler etc.

187. The efficiency of a Cochran boiler is in the range of:

- (a) 90 - 95% (b) 20 - 25%
 (c) 70 - 75% (d) 40 - 45%

SSC JE 27-10-2020 (Shift-1)

Ans. (c) : The efficiency of a Cochran boiler is in the range of 70-75%.

Cochran boiler gives about 70% thermal efficiency with coal firing and about 75% thermal efficiency with oil firing.

Cochran boiler → Vertical boiler–Fire tube – Natural circulation – Natural draught – Internally fired – Multi tube – Low pressure – Single pass

Pressure = 7.5 – 10 bar

Capacity = 2.5 ton/hr

188. As per regulations, boilers should be fitted with safety valves.

- | | |
|-----------|----------|
| (a) three | (b) four |
| (c) two | (d) five |

SSC JE 27-10-2020 (Shift-1)

Ans. (c) :

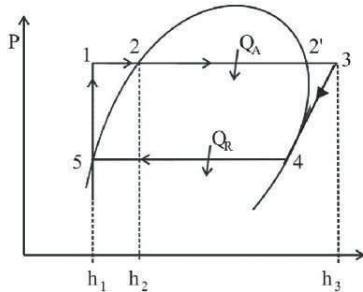
- As per regulations, boilers should be fitted with two safety valves.
- Safety valves are attached to the steam chest for preventing explosions due to excessive internal pressure of steam.
- The function of a safety valves is to blow off the steam when the pressure of steam inside the boiler exceeds the working pressure.

189. The enthalpies of feed-water and steam at exit of a boiler are 73 kJ/kg and 2800 kJ/kg respectively. Steam output 1128.5 kg/hr. The equivalent evaporation is:

- | | |
|-------------------|------------------|
| (a) 1301.4 kg/hr | (b) 1363.5 kg/hr |
| (c) 11 kg/kg fuel | (d) 900 kg/hr |

SSC JE 25-09-2019 (Shift-2)

Ans. (b) :



Given–

$$h_1 = 73 \text{ kJ/kg}$$

$$h_3 = 2800 \text{ kJ/kg}$$

Steam output

$$m_a = 1128.5 \text{ kg/hr}$$

$$L_o = \text{Latent heat of vapourisation} = 2257 \text{ kJ/kg}$$

Equivalent evaporation

$$\begin{aligned}\dot{m}_e &= \frac{\dot{m}_a (h_3 - h_1)}{L_o} \\ &= \frac{1128.5(2800 - 73)}{2257} \\ &= 1363.5 \text{ kg/hr}\end{aligned}$$

So, equivalent evaporation is 1363.5 kg/hr.

190. Factors influencing boiler efficiency are

- | | |
|-------------------|----------------------|
| (a) Fixed factors | (b) Variable factors |
| (c) Steam factors | (d) Both (a) & (b) |

Mizoram PSC 2019 (Paper-2)

Ans. (d) : The efficiency of a boiler depends on two types of factors – Fixed factors and Variable factors.

* Boiler designing, heat recovery equipments, etc. are fixed factor.

* Steam pressure, temperature, inlet-outlet condition etc. are variable factor.

191. Identify the incorrect statement, from the following options

In the La-Mount high pressure boiler

- | |
|---|
| (a) small diameter tubes with high fluid velocity are used to obtain high heat transfer rates |
| (b) radiant as well as convective evaporating tubes are used |
| (c) radiation is the only mode of heat transfer to the water tubes |
| (d) small diameter water tubes are used giving less weight and cost |

SSC JE 25-09-2019 (Shift-2)

Ans. (c) : La-Mount boiler is a high pressure steam boiler, employs forced circulation and it is water tube type boiler.

- In the La-Mount boiler radiation is not only mode of heat transfer to the water tubes.

192. Which statement from below is true about water tube boilers?

- | |
|--|
| (a) They are internally fired |
| (b) Their tubes are surrounded by water |
| (c) They can operate upto 100 bar steam pressure |
| (d) They are safer and simpler to operate than fire tube boilers |

SSC JE 25-09-2019 (Shift-2)

Ans. (c) : Water tube Boiler – In this type of boiler, tubes contain water and the hot gases produced by combustion of fuel, flow outside the tube. All water containing tubes is connected with steam-water drum in which steam formed and separates from water.

- They are externally fired.
- Their tube are surrounded by flue gases.
- They are required more skill and careful abstention for efficient and economic working.
- Can work under as high pressure as 100 bar or above
- Rate of steam production is higher.
- Water treatment is more necessary.

Examples– Babcock and Wilcox boiler, Stirling boiler, La-Mount boiler, Benson boiler, Loeffler boiler etc.

193. Conventionally, in a Babcock-Wilcox boiler, the circulation of water between the drum and the water-tubes is:

- | |
|--|
| (a) normally by natural circulation (thermosiphon) |
| (b) by a pump |
| (c) caused by gravity |
| (d) there is no circulation of water |

SSC JE 25-09-2019 (Shift-2)

Ans. (a) : The Babcock and Wilcox boiler is considered as a natural convection water tube boiler, in which the circulation is obtained due to difference in density values.

194. In a Lancashire boiler, the heat is transferred to the water by:

- (a) radiation from walls of furnace
- (b) blow-down
- (c) flue tubes immersed in the water
- (d) natural circulation of water between water tubes and drum

SSC JE 25-09-2019 (Shift-2)

Ans. (c) : Lancashire boiler—This boiler works on the basic principle of heat exchanger. It is basically a shell and tube type heat exchanger in which the flue gases flow through the tubes and the water flows through shell. The heat is transferred from flue gases to the water through convection.

* In a Lancashire boiler, the heat is transferred to the water by flue tubes immersed in the water.

195. A boiler 9 kg steam/kg of coal burnt, which has the calorific value 27 MJ/kg. The enthalpy of feed water and steam at the exit are 300 kJ/kg and 3000 kJ/kg respectively. Its efficiency is:

- | | |
|-----------|------------|
| (a) 55% | (b) 90% |
| (c) 94.2% | (d) 83.57% |

SSC JE 25-09-2019 (Shift-2)

Ans. (b) : Given, $m = 9 \text{ kg/kg}$ of coal

Calorific value (CV) = $27 \text{ MJ/kg} = 27000 \text{ kJ/kg}$.

$$h_1 = 300 \text{ kJ/kg}$$

$$h_2 = 3000 \text{ kJ/kg}$$

Work done per kg of coal burnt (W) = $m(h_2 - h_1)$

$$= 9(3000 - 300)$$

$$= 24300 \text{ kJ/kg of coal}$$

$$\text{Thermal efficiency } (\eta) = \frac{\text{Work done}}{\text{Heat Added (CV)}} \\ = \frac{24300}{27000} \times 100 = 90\%$$

196. Identify the incorrect statement, from the following options:

In an injector in a boiler

- (a) steam from the boiler is accelerated in a nozzle, which entrains feed-water due to the low pressure as its exit
- (b) the steam used is exhausted to atmosphere
- (c) steam is used to pump feed-water into the boiler
- (d) steam used in locomotive boilers

SSC JE 25-09-2019 (Shift-2)

Ans. (b) : In an injector in a boiler, the steam used is exhausted to atmosphere is the incorrect statement.

197. Identify the incorrect statement, from the following options:

Industrial steam generators that are used in sugar and paper industries or hospitals

- (a) can be pulverized coal fired
- (b) can operate with fluidized bed combustors using bales of bagasse
- (c) can be fluidized bed units for coal or rice husk
- (d) can be grate (stoker) fired units using coal or wood

SSC JE 25-09-2019 (Shift-2)

Ans. (b) : Industrial steam generators are used in process industries like, sugar, paper, jute etc. These are used in institutions like hospitals, commercial and residential building complexes.

- They are smaller in size. They can be pulverized coal-fired, fluidized bed or stoker fired units, with coal mostly as the fuel.
- They can not be operated with fluidized bed combustors using bales and bagasse.

198. The transport of heat by natural circulation of water does not take place in which boiler?

- (a) La-Mount boiler
- (b) Lancashire boiler
- (c) Cochran boiler
- (d) Babcock-Wilcox boiler

SSC JE 25-09-2019 (Shift-2)

Ans. (a) : Natural circulation boilers—In this boiler, water flow takes place naturally, by density difference of water. The flow of water and steam are set up due to density difference resulting from difference in temperature.

Example:—Lancashire, Babcock-Wilcox, Cochran boiler etc.

Forced circulation boilers—In this boiler, water flow takes place by a pump.

Example:—Benson, La-Mount, Velox boiler etc.

199. Which of the following is not true with regard to an economiser in a steam boiler?

- (a) It is used for recovery of heat from flue gases
- (b) It gives increased boiler efficiency
- (c) It preheats feed-water
- (d) It produces superheated steam

SSC JE 25-09-2019 (Shift-2)

Ans. (d) : Function of economiser—

1. It is used for recovery of heat from flue gases.
2. It gives increased boiler efficiency.
3. It preheats feed water.

* Super heater produces wet steam into super heated steam.

200. In a La-Mount boiler, the mass flow of water through the boiler circulation pump, compared to the rate of evaporation

- (a) thirty times
- (b) twenty-five times
- (c) ten times
- (d) forty times

SSC JE 27-09-2019 (Shift-1)

Ans. (c) : In a La-Mount boiler, the mass flow of water through the boiler circulation pump, compared to the rate of evaporation is ten times.

- 201. The pressure of steam produced in a supercritical boiler is in the range of:**
- (a) 100 bar to 130 bar
 - (b) 150 bar to 180 bar
 - (c) 180 bar to 190 bar
 - (d) 200 bar to 240 bar

SSC JE 27-09-2019 (Shift-1)

Ans. (d) : The pressure of steam produced in a supercritical boiler is in the range of 200 bar to 240 bar.

- Super-critical boiler must be without drum. But subcritical boiler may be with or without drum.

- 202. Natural draught is produced:**

- (a) By the use of mechanical fan & steam jet
- (b) By the use of chimney
- (c) By the use of mechanical fan
- (d) By the use of steam jet

SSC JE 27-09-2019 (Shift-1)

Ans. (b) : Natural draught—

- Natural draught is produced by the use of chimney.
- The draught produced by the chimney is due to density differences between the column of hot gases inside the chimney and cold air outside the chimney and also on the height of the chimney above the level of the furnace grate.

- 203. The furnace is situated outside the boiler shell in a case of a:**

- (a) Locomotive boiler
- (b) Cochran boiler
- (c) Babcock and Wilcox boiler
- (d) Cornish boiler

SSC JE 27-09-2019 (Shift-1)

Ans. (c) : Babcock and Wilcox boiler—

- This is a water tube boiler, used in steam power plant. In this type of boiler, water is circulated inside the tubes and hot gases flow over the tubes.
- The furnace is situated outside the boiler shell in case of a Babcock and Wilcox boiler.
- This is a horizontal drum axis, natural draught, natural circulation, multitubular, stationary, high pressure, solid fuel fired, externally fired water tube boiler.

- 204. Which boiler has a relatively large storage of steam and water?**

- (a) Cochran boiler
- (b) Simple vertical boiler
- (c) Lancashire boiler
- (d) Cornish boiler

SSC JE 27-09-2019 (Shift-1)

Ans. (c) : Lancashire boiler—

- Lancashire boiler has large storage of steam and water. The size is approximately from 7-9 meters in length and 2-3 meters in diameter.
- Lancashire boiler is a horizontal type and stationary fire tube boiler.
- This is an internally fired boiler because the furnace present inside the boiler. This boiler generates low pressure steam and it's a natural circulation boiler.

- 205. If m_w is the mass of water changing the enthalpy from h_1 to h_2 in a boiler and L is the latent heat of steam at 100°C. Then equivalent evaporation is defined in form**

- (a) $(m_w h_1 h_2)/L$
- (b) $[m_w(h_2 + L)]/h_1$
- (c) $[m_w(h_2 + h_1)]/L$
- (d) $[m_w(h_2 - h_1)]/L$

SSC JE 27-09-2019 (Shift-1)

Ans. (d) : Equivalent evaporation—It is defined as the amount of dry saturated steam produced from feed water at 100°C temperature and 1 atmospheric pressure. It is known as equivalent evaporation.

$$m_e \times L = m_w [h_2 - h_1]$$

$$m_e = \frac{m_w [h_2 - h_1]}{L} = \frac{m_w [h_2 - h_1]}{2257}$$

Note:- $\left(\frac{h_2 - h_1}{2257} \right)$ is known as factor of evaporation.

- 206. When the pressure inside the boiler drum exceeds the desired level, then which of the following devices blows off the excess steam from the boiler?**

- (a) Fusible plug
- (b) Blow-off cock
- (c) Safety valve
- (d) Stop valve

SSC JE 27-09-2019 (Shift-1)

Ans. (c) : Safety valve—

The safety valve is used to blow off the steam when the pressure of the steam inside the boiler exceeds the working pressure.

- 207. Usually, boiler rating is defined in terms of**

- (a) Calorific value of the fuel used for combustion
- (b) Heat transfer area in m^2
- (c) Rate of heat transfer in kJ/hr
- (d) Steam output in kg/hr

SSC JE 27-09-2019 (Shift-2)

Ans. (d) : Usually, boiler rating is defined in terms of steam output in kg/hr.

- 208. Which of the following is NOT a type of boiler mounting?**

- (a) Superheater
- (b) Feed check valve
- (c) Pressure gauge
- (d) Water level indicator

SSC JE 27-09-2019 (Shift-2)

Ans. (a) : Superheater is a boiler accessory not a boiler mounting, which superheat the steam above saturation temperature point without raising its pressure.

- 209. Which of the following is a boiler accessory?**

- (a) Blow-off cock valve
- (b) Steam stop valve
- (c) Safety valve
- (d) Air preheater

SSC JE 27-09-2019 (Shift-2)

Ans. (d) : Air preheater is a boiler accessory. Its function is to preheat the air before entering to the furnace by utilizing some of the energy left in the flue gases before exhausting them to atmosphere. It increases the plant efficiency about 1%.

* Steam stop valve, blow-off cock valve, safety valve are boiler mountings which are essential fitting for safe working of boiler.

- 210. Which of the following is a type of fire-tube boiler?**
- Stirling boiler
 - Yarrow boiler
 - Cochran boiler
 - Babcock and Wilcox boiler

SSC JE 27-09-2019 (Shift-2)

Ans. (c) : Cochran boiler is a type of fire tube boiler. It is a vertical, multitubular, internally fired boiler.

- 211. A boiler produces 1000 kg/hr steam with rise in enthalpy of steam of 2500 kJ/kg. The calorific value of coal used is 30000 kJ/kg and its consumption is 100 kg/hr. What would be the boiler efficiency?**
- 18.33%
 - 83.33%
 - 8.33%
 - 73.33%

SSC JE 27-09-2019 (Shift-2)

Ans. (b) : Given,

Quantity of steam generated

$$\text{per hour } (m_s) = 1000 \text{ kg/hr}$$

Quantity of fuel used

$$\text{per hour } (m_f) = 100 \text{ kg/hr}$$

Calorific value of fuel

$$(CV) = 30,000 \text{ kJ/kg}$$

Change in enthalpy of boiler steam

$$(\Delta h_s) = 2500 \text{ kJ/kg}$$

we know that,

$$\begin{aligned} \text{Boiler efficiency} &= \frac{\text{Heat supplied to water}}{\text{Heat supplied to boiler}} \\ &= \frac{m_s \times \Delta h_s}{m_f \times CV} \\ &= \frac{1000 \times 2500}{100 \times 30000} \times 100 \\ \eta_{\text{Boiler}} &= 83.33\% \end{aligned}$$

- 212. Which of the following is NOT a factor for selecting a type of a boiler for a particular application?**
- Fuel and water available
 - Steam generation rate
 - Floor area available
 - Climate of the region

SSC JE 27-09-2019 (Shift-2)

Ans. (d) : Factor to be considered for selecting a type of boiler for particular application—

- The working pressure and quality of steam required
- Steam generation rate
- Floor area available
- Fuel and water available
- Accessibility for repair and inspection.
- Comparative initial cost.
- The portable load factor.
- Erection facilities
- Operating and maintenance costs.

So, climate of the region is not a selection factor.

- 213. Which of the following statement is INCORRECT about fire tube boiler?**
- Load fluctuation cannot be handled.
 - These are operated at high pressure up to 250 bars.
 - The hot flue gases pass through the tubes and water surround them
 - They are bulky and difficult to transport

HPCL JE 20-04-2019

Ans. (b) : About fire tube boiler –

- Load fluctuation can not be handled.
- The hot flue gases pass through the tubes and water surround them.
- They are bulky and difficult to transport.
- Generally they are low pressure (less than 80 bar), natural circulation of water & natural draught.

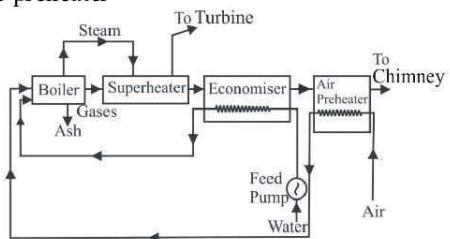
- 214. Which of the following is an accessory of boiler?**

- Feed pump
- Blow-off-cock
- Fusible plug
- Feed check valve

HPCL JE 20-04-2019

Ans. (a) : Boiler Accessories -

- Feed pump
- Super heater
- Economiser
- Air preheater



* Feed pump ⇒ Used to deliver of water to the boiler.

- 215. A thermal power station was designed to burn coal containing 12% ash. When the plant actually started operating, coal having 22% ash was made available. Which unit of the plant will need major modifications?**
- Water treatment plant
 - Pulverising unit
 - Ash handling unit
 - Cooling towers

CSL ET 2018 Shift-I

Ans. (c) : Ash handling unit

- 216. Which of the following boilers is suitable for a fluctuating demand of steam?**

- Stirling boiler
- Lancashire boiler
- Locomotive boiler
- Cornish boiler

CSEB JE 2018

Ans. (c) : Locomotive boiler is fire tube boiler. It is suitable for a fluctuating demand of steam. It is a multi tubular horizontal internally fired and mobile boiler. Locomotive boiler generally used in railways locomotive engine and in submarines.

- 217. The Babcock and Wilcox boiler has _____ water tubes.**

- horizontal
- unpredictable
- inclined
- vertical

Punjab PSC JE 19.12.2021 (E/M)

CSEB JE 2018

Ans. (c) : Babcock and Wilcox is water tube boiler. It has inclined water tube.

218. Which of the following is a Fire-Tube boiler?

- (a) Stirling boiler
- (b) Yarrow boiler
- (c) Cochran boiler
- (d) Babcock and Wilcox boiler

CSEB JE 2018

Ans. (c) : Fire tube boiler— In the fire tube boiler the hot gases are inside the tubes and water surrounds the tube.

Example –

- Simple vertical boiler
- Marine boiler
- Cochran boiler
- Cornish boiler
- Lancashire boiler
- Locomotive boiler

219. The flow rate of steam in water-tube boiler as compared with fire-tube boilers is _____.

- (a) less
- (b) the same
- (c) more
- (d) unpredictable

CSEB JE 2018

Ans. (c) : The flow rate of steam in water tube boiler as compared with fire tube boiler is more.

220. The closed vessel generating the steam is known as _____.

- (a) Steam Boiler
- (b) Steam Turbine
- (c) Steam injector
- (d) Steam Condenser

CSEB JE 2018

Ans. (a) : The closed vessel generating the steam is known as steam boiler or steam generator. Its function is to transfer the heat produced by the combustion of fuel to water and ultimately to generate steam.

221. The thermal efficiencies of the boilers are increased by using _____.

- (a) Economizer
- (b) Deaerators
- (c) Conectors
- (d) Radiators

CSEB AE 2018

Ans. (a) : Heat exchanger can be used for pre heating Boiler feed water called economizers of combustion air (air heater). Economizers typically increases the overall boiler efficiency by three to four %.

222. Scotch Marine boilers are a type of _____.

- (a) Fire-tube boilers
- (b) Mixed type boilers
- (c) Fluid type boilers
- (d) Water-tube boilers

CSEB AE 2018

Ans. (a) : Fire-Tube boiler— Since fire is inside the tubes and hence it is named as fire tube boiler. The heat from the hot gases is conducted through the walls of the tube to the water. The examples of the fire tube boiler are-Simple Vertical, Cochran, Lancashire, Cornish, Locomotive, Scotch Marine, and Velcon boiler.

223. Which one of the following is not a boiler accessory?

- (a) Pre-heater
- (b) Economizer
- (c) Spring loaded safety valve
- (d) Super heater

VIZAG JET 28-10-2018

Ans. (c) : Boiler accessories are used to enhance the efficiency of the boiler.

Some of boiler accessories are economiser, air preheater, superheater etc.

Mountings—Fusible plug, water level indicator, safety valve, spring loaded safety valve etc.

224. A safety valve mainly used with locomotive and marine boilers is :

- (a) lever safety valve
- (b) dead weight safety valve
- (c) high steam and low water safety valve
- (d) spring loaded safety valve

WBPSC 2018

Ans. (d) : A safety valve mainly used with locomotive and marine boilers is a spring loaded safety valve.

225. Feed water conditioning in thermal power plants is done to:

- (a) Reduce hardness and for removal of solids
- (b) Increase efficiency of thermal power plant
- (c) Increase heat transfer rate
- (d) Increase steam parameters

NPCIL 03.06.2018

Ans : (a) Feed water conditioning in thermal power plants is done to reduce hardness and for removal of solids because quality of steam depends upon feed water.

226. The diameter (in meter) of Cornish boiler is of the order of

- (a) 1 to 2
- (b) 1.5 to 2.5
- (c) 2 to 3
- (d) 2.5 to 3.5

SSC JE 23. 1. 2018 (3.15 pm)

Ans. (a) : The diameter of Cornish boiler is generally 1 m to 2m and its length varies from 5 m to 7.5m.
* Cornish boiler has only one flue tube.

227. Which of the following boilers is best suited to meet fluctuating demands?

- (a) Babock and wilcox
- (b) Locomotive
- (c) Lancashire
- (d) Cochran

SSC JE 23. 1. 2018 (3.15 pm)

Ans. (b) : Locomotive boiler is best suited to meet fluctuating demands of steam. Locomotive boiler is a horizontal drum axis, multitubular, natural circulation, artificial draught, medium pressure, fire tube boiler that has an internal fire furnace.

228. The shell of Cochran boiler is made hemispherical

- (a) to give maximum space and strength
- (b) to withstand the pressure of steam inside the boiler
- (c) Both (a) and (b)
- (d) None of these

HPSSC JE 2018

Ans. (c) : The shell of Cochran boiler is made hemispherical—

* To give maximum space and strength

* To withstand the pressure of steam inside the boiler

- 229. The diameter of tubes for natural circulation boiler as compared to controlled circulation boilers is**
- more
 - less
 - same
 - could be more or less depending on other factors

SSC JE 22.1.2018 (10.15 am)

Ans. (a) In natural circulation boiler, water circulation is done by natural convection.

e.g. Lancashire, Cochran, Rail engine boiler etc.

- The diameter of tube for natural circulation boiler as compared to controlled circulation boiler is more.

- 230. If H is the total heat of steam in kcal/kg and is the sensible heat of feed water in kcal/kg, then factor of evaporation is**

$$\begin{array}{ll} \text{(a)} \frac{(H-h)}{539} & \text{(b)} \frac{(H-h)}{427} \\ \text{(c)} \frac{(H-h)}{102} & \text{(d)} (H-h) 75 \end{array}$$

SSC JE 27.1.2018 (10.15 pm)

Ans. (a) : Factor of evaporation : It is the ratio of heat received by 1 kg of water under working condition to that received by 1 kg of water evaporated from and at 100°C

$$\text{Factor of evaporation} = \frac{H-h}{539}$$

where H = Total heat of steam in kcal/kg

h = sensible heat of feed water in kcal/kg

- 231. Pick up the correct statement as regards to Cornish boiler and Lancashire boiler**

- Cornish is fire tube and Lancashire is water tube
- Cornish is water tube and Lancashire is fire tube
- Cornish has two fire tubes and Lancashire has one
- Lancashire has two fire tubes and Cornish has one

SSC JE 27.1.2018 (10.15 pm)

Ans. (d) : The Cornish boiler has only one fire tube compared to the Lancashire boiler's two.

- 232. The equivalent evaporation of a boiler is a measure to compare**

- the given boiler with the model
- the two different boilers of the same make
- two different makes of boilers operating under the same operating conditions
- any type of boilers operating under any conditions

SSC JE 27.1.2018 (10.15 pm)

Ans. (d) : Equivalent evaporation of a boiler is a measure to compare any kind of boilers operating under any conditions.

- 233. What are the advantages of water tube boilers over fire tube boilers ?**

- Steam at higher pressures can be produced
 - More effective heat transfer
 - Sediment deposition is more
- A only
 - A and C only
 - A, B and C
 - A and B only

SSC JE 2 March 2017 Shift-I

Ans. (d) Advantage and disadvantage of water tube boilers over fire tube boiler-

Advantage:-

- Steam can be raised more quickly
- Steam at higher pressures can be produced
- Higher rate of evaporation
- Suitable for any type of fuel and method of firing
- More effective heat transfer
- Failure of water tube will not affect the working of boiler
- Easy maintenance
- Easy transportation

Disadvantage:-

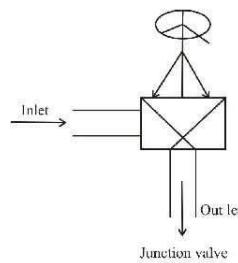
- Not suitable for ordinary water
- Not suitable for mobile application
- High initial cost
- Sediment deposition is more.

- 234. The valves mounted on the boilers which change the direction of flow of steam by 90° and valves fitted in the pipelines which allow the steam in the same direction are respectively called as**

- Stop valves and junction valves
- Junction valves and stop valves
- Junction valves and safety valves
- Feed safety valves and stop valves

SSC JE 2 March 2017 Shift-I

Ans. (b) The valve mounted on the boilers which change the direction of flow of steam by 90° is called junction valve and a valve which is fitted in pipelines allow the steam in the same direction is called stop valves.



- 235. Which of the following are boiler mountings and not boiler accessories ?**

- Pressure gauge
 - Air preheater
 - Superheater
- B and C only
 - A only
 - A, B and C
 - A and C only

SSC JE 2 March 2017 Shift-I

Ans. (b) Boiler mounting-These are the fittings which are mounted on the boiler for its proper and safe functioning.

Some of the important boiler mountings are as follows—

- 1- Water level indicator
- 2- Pressure gauge
- 3- Safety valves
- 4- Steam stop valve
- 5- Blow-off-cock
- 6- Feed check valve
- 7- Fusible plug

Boiler Accessories:- The device which is used to increase efficiency of boilers, called boiler accessories.

Some important accessories are as follows—

1. Air Preheater
2. Water Preheater (Economiser)
3. Super Heater
4. Feed Water Equipment
5. Draught Equipment

236. The height of the chimney in a steam power plant is governed by

- (a) Control of pollution
- (b) Draught to be produced
- (c) Flue gases
- (d) Type of boiler

ISRO SDSC 12-02-2017

Ans : (b) The height of the chimney in a steam power plant is governed by draught to be produced. This draught is produced by pressure difference between atmospheric air and hot gases in chimney.

Types of Draught-

- (1) Natural draught
- (2) Artificial draught

Natural Draught—It is produced by chimney.

Artificial or Forced Draught—It is produced by fan or steam jet.

237. Which of the following statements is/are correct about fire tube boilers ?

- (A) The hot products of combustion pass through the tubes which are surrounded by water.
- (B) Fire tube boilers have low initial cost.
- (C) Fire tube boilers are more likely to explosion.

Select the code for the correct answer from the options given below :

- (a) A only
- (b) B only
- (c) C only
- (d) All of the above

Karnataka PSC JE 09-09-2017

Ans. (d) : Characteristic of fire tube boilers :-

- The hot products of combustion pass through the tubes which are surrounded by water
- Fire tube boilers have low initial cost.
- Fire tube boilers are more likely to explosion.

Fire tube boiler example:- Cochran boiler, Lancashire boiler, Cornish boiler, Scotch marine boiler, locomotive boiler, velcon boiler etc.

238. Locomotive boiler is a

- (a) Single tube, horizontal, internally fired and stationary boiler
- (b) Single tube, vertical, externally fired and stationary boiler
- (c) Multitubular, horizontal, internally fired and mobile boiler
- (d) Multitubular, horizontal, externally fired and stationary boiler

Vizag JET 2017

Ans. (c) : Locomotive Boiler is a device that is used to create steam from water by using heat energy. This is a horizontal drum axis, multitubular, Natural Circulation, Artificial draft, forced circulation, Medium pressure, mobile boiler.

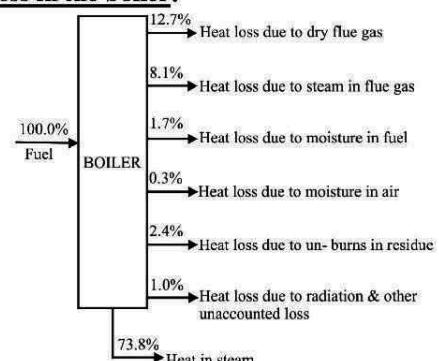
239. The heat loss in a boiler takes place in the form of _____.

- (a) heat carried away by flue gases
- (b) heat carried away by ash
- (c) moisture present in fuel and steam formed by combustion of hydrogen in fuel
- (d) All options are correct

SSC JE 3 March 2017 Shift-I

Ans. (d) Balancing total energy entering a boiler against the energy that leaves the boiler in different forms:

Heat loss in the boiler:-



240. A feed check valve is used in :

- (a) Boiler feeding water line
- (b) Over head water tanks in houses
- (c) Basement tank
- (d) None of the above

RSMSSB JEN 16.10.2016 (Degree)

Ans. (a) : The feed check valve is fitted in the water space of the boiler just below the normal water level of the water.

The function of the feed check valve is to control the supply of water to the boiler and prevents the back flow of water from the boiler.

241. Which of the following is a 'Natural Circulation' boiler?

- (a) Cochran
- (b) Benson
- (c) La-Mount
- (d) Velox

UPRVUNL JE 2016 (Shift-II)

Ans. (a) : Natural Circulation Boiler – In natural circulation steam boilers the circulation of water is done by convection currents, which are set up during the heating of water. In this boiler, water flow takes place natural, by density difference of water. The flow of water and steam are set up due to density difference resulting from difference in temperature.

Example - Lancashire, Cochran, Babcock and Wilcox boiler etc.

242. Water is feed to a boiler at 50°C , the enthalpy of vapourisation at atmospheric pressure in the boiler is 2400 kJ/kg , steam coming out from boiler is ($C_p = 4\text{ kJ/kgK}$, $\text{DC} = 0.7$).

- (a) 2160 kJ/kg
- (b) 1980 kJ/kg
- (c) 1940 kJ/kg
- (d) 1880 kJ/kg

UPRVUNL JE 2016 (Shift-II)

Ans. (d) : Given - $h_{fg} = 2400 \text{ kJ/kg}$
dryness fraction $x = 0.7$

$$t_1 = 50^{\circ}\text{C} \quad C_p = 4 \text{ kJ/kgK}$$

Temperature at atmospheric pressure

$$t_2 = 100^{\circ}\text{C}$$

$$\begin{aligned} h_f &= mC_p \Delta T \\ &= 1 \times 4 \times (100 - 50) \\ &= 200 \text{ kJ/kg} \end{aligned}$$

$$\begin{aligned} \text{Net heat} &= h_f + xh_{fg} \\ &= 200 + 0.7 \times 2400 \\ &= 1880 \text{ kJ/kg} \end{aligned}$$

243. Which of the following is accessory :

- (a) Safety valve
- (b) Pressure gauge
- (c) Water level indicator
- (d) Super heater

UPSSSC JE 2016

Ans. (d) : Boiler accessories –

- (1) Feed pump
- (2) Super heater
- (3) Economiser

Boiler mounting –

- (1) Water level indicator – 2
- (2) Pressure gauge – 1
- (3) Safety valve – 2
- (4) Feed check valve – 1
- (5) Blow off cock – 1
- (6) Steam stop valve – 1
- (7) Fusible plug
- (8) Man/mud/inspection hole

Boiler Auxiliaries –

- * Pulveriser
- * Burners
- * Dust collectors
- * Precipitators (ESP)

244. The steam temperature with increase in load in case of boiler fitted with radiation super heater –

- (a) Increases
- (b) Decreases
- (c) Remains Unaffected
- (d) First increase then decrease

UPSSSC JE 2016

Ans. (b) : The steam temperature with increase in load in case of boiler fitted with radiation super heater decreases.

245. The steam in boiler drum is always

- (a) Wet
- (b) Dry
- (c) Super heat
- (d) Wet or Dry

RSMSSB JEN (Diploma) 21.08.2016 Shift-II

Ans. (a) : The steam in boiler drum is always wet.

246. An Economizer is installed in a boiler primarily to

- (a) Super heat the steam
- (b) Reduce fuel consumption
- (c) Increase steam pressure
- (d) All of above

RSMSSB JEN (Diploma) 21.08.2016 Shift-II

Ans. (b) : Function of Economizer–It is a boiler accessory which saves energy by using the exhaust gases from the boiler to preheat the cold water used to fill it (the feed water).

It reduces fuel consumption also.

247. Ratio of heat absorbs by feed water to the heat supplied by fuel in a given time, is known as

- (a) Factor of Evaporation
- (b) Equivalent Evaporation
- (c) Boiler Efficiency
- (d) Power of a boiler

RSMSSB JEN (Diploma) 21.08.2016 Shift-II

Ans. (c) :

Boiler efficiency

$$= \frac{\text{Ratio of heat absorbs by feed water}}{\text{Heat supplied by fuel in given time}}$$

248. In a boiler, a fusible valve is located at

- (a) Bottom of drum
- (b) Bottom of fire tubes
- (c) Super heater drums
- (d) None of the above

RSMSSB JEN (Diploma) 21.08.2016 Shift-II

Ans. (a) : Fusible valve or plug is a boiler mounting, used to protect the boiler against damage due to overheating caused by low water level in the boiler.

A fusible valve is located at the bottom of drum and above the furnace.

249. The formation of scale boiler leads to _____

- (a) Decreases in efficiency of boiler
- (b) Increase in efficiency of boiler
- (c) Increase in heat transfer
- (d) Decreased in maintenance of boiler

Karnataka PSC RTO (Mech.) 10.07.2016

Ans. (a) : Efficiency of boiler is inversely proportional to the scale formation.

So, the formation of scale boiler leads to decreases in efficiency of boiler.

250. For supplying feed water to a boiler which of the following pump is not used

- (a) Steam injector
- (b) Reciprocating pump
- (c) Multistage centrifugal pump
- (d) Gear pump

UPRVUNL JE 2015

Ans. (d) : For supplying feed water to a boiler gear pump is not used.

- For supplying feed water to a boiler steam injector, reciprocating pump, multistage centrifugal pump are used.

251. In steam generators a stoker acts as one of the following devices. What is this device ?
(M.P. Sub Engineer 2015)

- Air preheating device
- Steam superheating device
- Air superheating device
- Fuel feeding device

Ans. (d) : A stoker is a mechanical system that feeds solid fuel like coal coke or anthracite into the furnace of steam boiler. There are two type of stoker fired,
(i) Overfeed stokers
(ii) Underfeed stokers

252. The basic job of feed water treatment in boilers is to overcome the problem of :

- corrosion
- scaling
- carry over
- all of these

Mizoram PSC 2015 (Paper-1)

Ans. (d) : The basic job of feed water treatment in boilers is to over come the problem of—

- * Corrosion
- * Carry over
- * Scaling

is situated inside the boiler.

253. Maximum heat is lost in a boiler due to

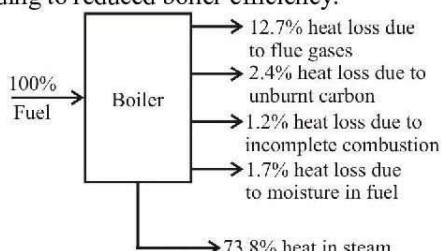
- Unburnt carbon
- Flue gases
- Incomplete combustion
- Moisture in fuel

UPRVUNL JE 2015

Ans. (b) : Maximum heat is lost in a boiler due to flue gases.

Dry flue gas loss—

- This accounts for major heat losses amongst all.
- If the flue gases leaving the boiler are at a high temperature than the temperature, for which it is designed, then most of the heat is getting wasted leading to reduced boiler efficiency.



254. In glass tube type water level indicator for a boiler one end of the tube is connected to water space and the other end is connected to

- Chimney
- Super heated steam outlet from super heater
- Steam space in drum
- Water space also

UPRVUNL JE 2015

Ans. (c) : In glass tube type water level indicator for a boiler one end of the tube is connected to water space and the other end is connected to steam space in drum.

Note : Option 'b' is given by commission.

255. Locomotive boiler produces steam at

- Medium rate
- Low rate
- Very high rate
- Very low rate

UPRVUNL JE 2015

Ans. (c) : Locomotive boiler produces steam at very high rate.

- It is a multi tubular horizontal internally fired and mobile boiler
- It consists of a shell or barrel having 1.5 meter diameter and 4 meters in length
- Pressure = 10-20 bar
- Capacity = (1 - 4) t/hr
- Since mobile, no long chimney, Artificial Draught achieved by steam jet.

256. If circulation of water in a boiler is made by pump, then it is known as

- Natural circulation boiler
- Forced circulation boiler
- Internally fired boiler
- Externally fired boiler

UPRVUNL JE 2015

Ans. (b) : If circulation of water in a boiler is made by pump then it is known as forced circulation boiler.

- In this type of steam boiler, the water circulation takes place with the help of centrifugal pump driven by some external power.
Here the circulation is forced by some external agency.
- Forced circulation is used in high pressure boiler such as La-Mount boiler, Loeffler boiler, Benson boiler etc.

257. Which of the following is a high pressure boiler?

- Lancashire boiler
- Cochran boiler
- Benson boiler
- All of the above

UPSSSC JE 2015

Ans. (c) : High pressure boiler (Pressure > 80 bar) –

- La-Mount Boiler
- Benson Boiler
- Loeffler Boiler
- Velox Boiler

Low pressure boiler (Pressure < 80 bar) –

- Cochran Boiler
- Cornish Boiler
- Lancashier Boiler
- Locomotive Boiler

258. Fusible plug for a steam boiler is an alloy consisting of bismuth, lead and

- Copper
- Tin
- Zinc
- Aluminium

UPSSSC JE 2015

Ans. (b) : Fusible plug for a steam boiler is an alloy consisting of bismuth, lead and tin. The purpose of the fusible plug is to prevent the damages due to overheating of boiler drum.

In a boiler it is fitted in the boiler drum above the crown of furnace.

259. Boiler accessories are used to ensure:

- (a) easy maintenance
- (b) improved performance
- (c) safe operation
- (d) automatic control

SSC JE 2015

Ans. : (b) Boiler accessories are used to ensure improved performance or to increase efficiency of boiler.

These are:-

- (i) Air Preheater
- (ii) Water Preheater (Economiser)
- (iii) Super Heater
- (iv) Feed Water Equipment
- (v) Draught Equipment

260. Which of the following is the boiler accessory?

- (a) Blow-off cock
- (b) Pressure gauge
- (c) Water level indicator
- (d) Economiser

TSPSC AE 2015

Ans. (d) : Boiler Accessories— Economiser, Air preheater superheater, feed water pump etc.

Boiler Mountings— Blow-off-cock, pressure gauge, water level indicator, steam stop valve, fusible plug etc.

261. For maximum discharge of hot gases through a chimney, the height of hot gas column producing draught is

- (a) Twice the height of chimney
- (b) Equal to the height of chimney
- (c) Half the height of chimney
- (d) None of the above

ESE-2015

Ans. (b) : For maximum discharge, the height of hot gas column producing the draught is equal to the height of the chimney

$$H' = H$$

- For maximum discharge, the draught pressure is given by $p = \frac{176.5H}{T_1}$ mm of water
- Velocity of flue gases, $V = \sqrt{2gH'} = 4.43\sqrt{H'}$

262. A super critical boiler consists of only economiser and superheater and it does not have an evaporator because

- (a) Water temperature can be raised to critical temperature in the economizer itself
- (b) High evaporation rate is achieved through forced circulation of water through tubes
- (c) Enthalpy of evaporation becomes zero at critical pressure or above that
- (d) Flue gas used to run rotary compressor to supply high pressure air to the furnace.

ESE-2014

Ans. (e) : A super critical boiler consists of only economizer and superheater and it does not have an evaporator because enthalpy of evaporation becomes zero at critical pressure or above.

- A large number of industrial boilers are designed to operate between working pressure ranging from 125 bar to 300 bar.
- When boiler operates at a pressure greater than 221 bar, it is called supercritical boiler.

263. The equivalent evaporation (kg/hr.) of a boiler producing 2000 kg/hr. of steam with enthalpy content of 2426 kJ/kg from feed water at temp. 40°C (liquid enthalpy = 168 kJ/kg; enthalpy of vapourisation of water at 100°C=2258 kJ/kg) is:

- | | |
|----------|----------|
| (a) 2149 | (b) 1682 |
| (c) 1649 | (d) 2000 |

SSC JE 2014 (Evening)

Ans. : (d) Given –

$$m_c = 2000 \text{ kg/hr}$$

$$h = 2426 \text{ kJ/kg}$$

$$h_f = 168 \text{ kJ/kg}$$

Equivalent evaporation

$$(E) = \frac{m_c(h - h_f)}{2258} = \frac{2000(2426 - 168)}{2258}$$

$$E = 2000 \text{ kg/hr}$$

264. Which one of the following components is not a boiler accessory?

- | | |
|---------------|------------------|
| (a) injector | (b) superheater |
| (c) feed pump | (d) safety valve |

Mizoram PSC 2014 (Paper-I)

Ans. (d) : The following are the important accessories of the boilers are—

- (i) Feed water pump
- (ii) Injector
- (iii) Economiser
- (iv) Air preheater
- (v) Super heater

265. The air pre-heater of a boiler is located between

- (a) Furnace and chimney
- (b) Furnace and economizer
- (c) Economiser and chimney
- (d) Superheater and furnace

ESE-2014

Ans. (c) : The air pre-heater of a boiler is located between economiser and chimney.

Furnace → Superheater → Economiser →

Air pre-heater → Chimney

Air pre-heater—An air preheater is to recover the heat from the boiler flue gas which increases the thermal efficiency of boiler by reducing the useful heat lost in the flue gas.

266. Maximum steam pressure (in bar) in a locomotive boiler is limited to

- | | |
|--------|--------|
| (a) 5 | (b) 10 |
| (c) 18 | (d) 25 |

SSC JE 2013

Ans. : (c) Locomotive boiler is a multi tubular horizontal internally fired and mobile boiler. The principle feature of this boiler is to produce steam at a very high rate.

* Maximum steam pressure in a locomotive boiler is limited to 18 bar.

267. Which one of the following components is not boiler mounting ?

- (a) Safety valve (b) Pressure gauge
(c) Feed pump (d) Stop valve

Arunachal Pradesh PSC Boiler Inspector 2012

Ans. (c) : Following boiler mounting components are given below :-

- (1) Safety valve
(2) Water Level Indicator
(3) Pressure gauge
(4) Fusible plug
(5) Blow off cock
(6) Steam stop valve
(7) Man/Mud/Inspection hole
(8) Feed check valve

* Feed pump is not boiler mounting.

268. The components of the boiler installed to increase the efficiency of the boiler plants are called as :

- (a) mountings (b) accessories
(c) feeders (d) tools

TNPSC 2012 (Paper-4)

Ans. (b) : The components of the boiler installed to increase the efficiency of the boiler plants are called as accessories.

Boiler accessories are –

- Economiser
- Super heater
- Air preheater
- Feed pump

269. Hot flue gases are passed through tubes which are immersed in water in the case of :

- (a) fire-tube boiler
(b) water-tube boiler
(c) natural draught boiler
(d) none of these

TNPSC 2012 (Paper-4)

Ans. (a) : A fire-tube boiler is a type of boiler in which hot gases are passed through one or more tubes which are immersed in water.

270. Which of the following form part(s) of boiler mountings ?

- I. Economiser
II. Feed check valve
III. Steam trap
IV. Superheater

Select the correct answer using the codes given below :

- (a) II only (b) I and III
(c) II, III and IV (d) All

TNPSC 2012 (Paper-4)

Ans. (a) : Boiler mountings–

- Water level indicator
- Blow - off - cock
- Safety valve
- Pressure gauge
- Steam stop valve
- Feed check valve
- Man hole

Boiler Accessories–

- Feed water pump
- Injector
- Economiser
- Super heater
- Steam trap
- Air pre heater

271. Safety valve used with locomotive boilers is operated by

- (a) Dead weight
(b) High steam and low water
(c) Lever
(d) Spring

SSC JE 2012

Ans. : (d) Generally safety valve used with locomotive boiler is controlled by spring.

* To release the excess steam when the pressure of steam inside the boiler exceeds safety valve are utilised.

272. The ratio of air required for complete combustion of carbon to carbon dioxide and that to carbon monoxide is

- (a) 2.0 (b) 4.0
(c) 1 (d) 0.5

SSC JE 2012

Ans. (a) : The ratio of air required for complete combustion of carbon to form carbon dioxide and air required for complete combustion of carbon to form carbon monoxide is 2.

273. The mass of coal consumption per kWh generation of power in a thermal power plant is of the order of :

- (a) 0.1 to 0.2 kg (b) 0.6 to 0.8 kg
(c) 1.0 to 1.2 kg (d) 2.0 to 2.2 kg

GPSC Motor Vehicle (Mech) 02-12-2012

Ans. (b) : Based on the CEA data in India the mass of coal consumption per kWh generation of power in a thermal power plant is of the order of 0.6 to 0.8 kg.

274. The steam in boiler drum is always

- (a) saturated (b) dry
(c) superheated (d) wet or dry

SSC JE 2011

Ans. : (d)

⇒ The steam in boiler drum is always wet or dry.
⇒ The temperature of wet steam or dry steam received by steam drum is increased by superheater.

275. An air preheater

- (a) increase evaporation capacity of a boiler
- (b) increase the efficiency of boiler
- (c) enables low grade fuel to be burnt
- (d) All of the above

MP Engineer JE Paper II 2011

Ans. (d) Air preheater is an accessory of boiler.
Function—To preheat the air which is coming in boiler for combustion with the help of exhaust gases.
Advantage—
 1. Increases evaporation capacity of a boiler.
 2. The boiler efficiency increases, by 2% for 35–40°C rise of incoming cold air.
 3. Enables low grade fuel to be burnt.

- 276. In modern steam generator, the correct path of gases from boiler furnace to chimney is**
- Boiler furnace, Economiser, Air preheater, Superheater and Chimney
 - Boiler furnace, Superheater, Air preheater, Economiser and Chimney
 - Boiler furnace, Air preheater, Superheater, Economiser and Chimney
 - Boiler furnace, Superheater, Economiser, Air preheater and Chimney

ESE-2011

Ans. (d) : Path of flue gases from boiler furnace to chimney—
 Boiler furnace → Superheater → Economiser → Air preheater → Chimney.

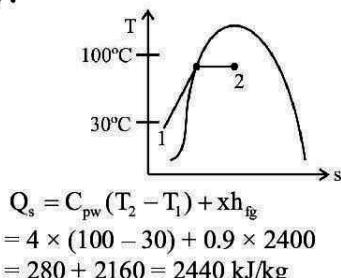
- 277. Water ($C_p = 4 \text{ kJ/kgK}$) is fed to a boiler at 30°C, the enthalpy of vaporization at atmospheric pressure in the boiler is 2400 kJ/kg; the steam coming from the boiler is 0.9 dry.**

What is the net heat supplied in the boiler?

- 2160 kJ/kg
- 2400 kJ/kg
- 2440 kJ/kg
- 2280 kJ/kg

ESE-2009

Ans. (c) :



- 278. Which one of following statements is correct?**
In a boiler, the air preheater is invariably located between:
- Forced draught fan and chimney
 - Forced draught fan and furnace
 - Economiser and feed pump
 - Condenser and feed pump

ESE-2009

Ans. (b) : In a boiler, the air preheater is invariably located between forced draught fan and furnace.

Air preheater—To preheat the air which is coming in boiler for combustion with the help of flue gases.

- Low grade and inferior fuel can be used.
- Improves combustion η with less soot, smoke and ash.

- 279. Which one of the following is correct?**

Water-tube boilers are preferred for

- high pressure and high output
- high pressure and low output
- low pressure and high output
- low pressure and low output

ESE-2008

Ans. (a) : Water-tube boilers are preferred for high pressure and high output.

Generally water tube boilers are high pressure boiler, forced circulation of water and forced draught.

Examples of water tube boiler—

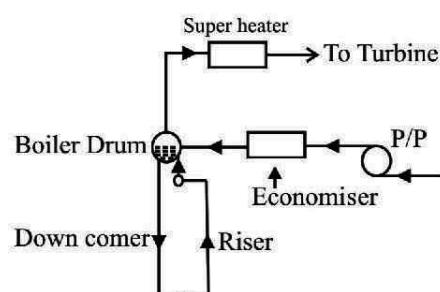
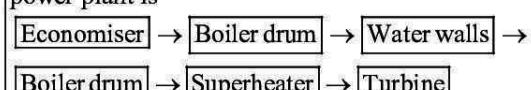
- Babcox and Wilcox boiler
- Stirling boiler
- Benson boiler
- La-Mount boiler
- Velox boiler
- Loeffler boiler

- 280. Which one of the following is the correct path of water flow through various components of boiler of a modern thermal power plant?**

- Economiser - boiler drum - water walls - boiler drum - superheater - turbine
- Economiser - water walls - boiler drum - superheater - turbine
- Economiser - water walls - boiler drum - turbine - superheater
- Economiser - turbine - superheater - water walls

ESE-2005

Ans. (a) : The correct path of water flow through various components of boiler of a modern thermal power plant is—



- 281. Which one of the following is the fire-tube boiler?**

- Babcock and Wilcox boiler
- Locomotive boiler
- Stirling boiler
- Bensoin boiler

ESE-2005

Ans. (b) : Locomotive boiler is the fire-tube boiler. Generally fire tube boiler are low pressure boilers, natural circulation of water and natural draught.

Example-

- Cochran boiler
- Locomotive boiler
- Lancashire boiler
- Cornish boiler

282. The correct gas flow path in a typical large modern natural circulation boiler is

- (a) Combustion chamber - Reheater - Superheater - Economiser - Air Preheater - I.D.fan - Electostatic precipitator - Stack
- (b) Combustion chamber - Superheater - Reheater - Economiser - Air Preheater - Electostatic precipitator - I.D.fan - Stack
- (c) Combustion chamber - Reheater - Superheater - Air Preheater - Economiser - Electostatic precipitator - I.D.fan - Stack
- (d) Combustion chamber - Superheater - Reheater - Economiser - Air Preheater - I.D.fan - Electostatic precipitator - Stack

ESE-2003

Ans. (b) : Correct flue gas flow path in a typical large modern natural circulation boiler is
 Combustion chamber → Superheater → Reheater → Economiser → Air Preheater → Electostatic precipitator → I.D.fan → Stack (Chimney).

283. Blowing down of boiler water is the process to

- (a) reduce the boiler pressure
- (b) increase the steam temperature
- (c) control the solids concentration in the boiler water
- (d) control the drum level

ESE-2002

Ans. (c) : Blowing down of boiler water is the process to control the solid concentration in the boiler water. Its purpose is to control boiler water parameters within prescribed limits to minimize scale, corrosion, carryover and other specific problems.

284. Which one of the following statements is not correct? In a fluidized-bed boiler

- (a) the combustion temperature are higher than those in the conventional boilers
- (b) inferior grade of coal can be used without slagging problems
- (c) the formation of NO_x is less rate than that in the conventional boilers
- (d) the volumetric heat release rates are higher than those in the conventional boilers

ESE-2001

Ans. (a) : Fluidized-bed boiler are the most common type of boiler recommended for biomass fuel, which is burned within a hot bed of inert particles, typically sand.

- In a fluidized-bed boiler the combustion temperature are higher not lower than those in the conventional boilers.

285. According to I.B.R. the thickness of boiler steel should not be less than

- | | |
|----------|----------|
| (a) 3 mm | (b) 5 mm |
| (c) 6 mm | (d) 7 mm |

WBPSC 2001

Ans. (d) : According to I.B.R. the thickness of boiler sheet should not be less than 7 mm.

- The factor of safety should not be less than 4.
- The thickness of the boiler shell is determined by the thin cylindrical formula, i.e.

$$t = \frac{P.D}{2\sigma_t \eta_e} + 1 \text{ mm as corrosion resistance.}$$

Where,

P = Steam pressure in boiler
 D = Internal diameter of boiler shell.
 σ_t = Permissible tensile stress

286. Once-through boiler will not have

- (a) Drums, headers and pumps
- (b) Drums, steam separators and pumps
- (c) Drums, headers and steam separators
- (d) Drums, headers, steam separators and pumps

ESE-1998

Ans. (c) : Once-through boiler will not have drums, headers and steam separators.

- The once through boiler works on the principle of critical point of water. Thus, as we go on increasing the pressure, the amount of latent heat required reduces and at critical point, there is no latent heat required as the water directly evaporates into steam.

287. For a steam power plant the steam is supplied with 2800 kJ/kg. It rejects heat 2000 kJ/kg. If it develops 750 kW of power, its steam consumption rate is.....

- | | |
|-----------------|-----------------|
| (a) 3.375 kg/hr | (b) 33.75 kg/hr |
| (c) 3375 kg/hr | (d) 337.5 kg/hr |

MPSC AMVI 1998

Ans. (c) :

Given-

$$\text{Power developed (P)} = 750 \text{ kW}$$

$$\text{Heat supplied (Q}_A\text{)} = 2800 \text{ kJ/kg.}$$

$$\text{Heat rejected (Q}_R\text{)} = 2000 \text{ kJ/kg}$$

$$\text{Steam Consumption rate } (\dot{m}_s) = \frac{P}{Q_A - Q_R}$$

$$\dot{m}_s = \frac{750}{800} \text{ kg/s} = \frac{750}{800} \times 3600 \text{ kg/hr}$$

$$= 3375 \text{ kg/hr}$$

288. Coal fired power plant boilers manufactured in India generally use:

- (a) Pulverised fuel combustion
- (b) Fluidized bed combustion
- (c) Circulating fluidized bed combustion
- (d) Moving stoker firing system

ESE-1997

Ans. (a) : Coal fired plant boilers manufactured in India generally used pulverised fuel combustion.

- Pulverised coal firing ensure complete combustion of coal, thus ensuring higher efficiency steam generators. It is predominately adopted in large coal-fired utility boilers. The finer the grinding of coal, the more efficient its combustion.

289. Induced draught fans of a large steam generator have

- (a) backward curved blades
- (b) forward curved blades
- (c) straight or radial blades
- (d) double curved blades

ESE-1996

Ans. (a) : Induced draught fans of a large steam generator have backward curved blades. When a fan is placed in the path of the flue gases before they enter the chimney the draught produced is known as induced draught fan.

290. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List-II
A. Babcock and Wilcox	1. Forced circulation
B. Lancashire	2. Fire tube
C. La-Mount	3. Water tube
D. Cochran	4. Vertical

Code:

A	B	C	D
(a) 1	2	3	4
(b) 2	3	4	1
(c) 3	2	1	4
(d) 2	4	1	3

ESE-1995

Ans. (c)

List-I	List-II
A. Babcock and Wilcox	3. Water tube
B. Lancashire	2. Fire tube
C. La-Mount	1. Forced circulation
D. Cochran	4. Vertical

291. Consider the following

- 1. Safety valve
- 2. Steam trap
- 3. Steam separator
- 4. Economiser

Among these boilers accessories would include

- (a) 1, 2 and 3
- (b) 2, 3 and 4
- (c) 1 and 4
- (d) 1, 2, 3 and 4

ESE-1994

Ans. (b) : Steam trap, steam separator, economiser are boiler accessories.

• Safety valve is a boiler mounting. The function of safety valve is to blow off the steam when the pressure of steam inside the boiler exceeds the working pressure. The following are the four types of safety valves:

- (a) Lever safety valve
- (b) Dead weight safety valve
- (c) High steam and low water safety valve and
- (d) Spring loaded safety valve

292. Once through boiler is named as such because

- (a) flue gas passes only in one direction
- (b) there is no recirculation of water
- (c) air is sent through the same direction
- (d) steam is sent out only in one direction

ESE-1993

Ans. (b) : Once through boiler is named as such because there is no recirculation of water.

The once through boiler works on the principle of critical point of water. Thus, as we go on increasing the pressure the amount of latent heat required reduces and at critical point, there is no latent heat required as the water directly evaporated into steam.

3. Fuels and Combustion

293. Bomb calorimeter is used to determine the calorific value of :

- (a) solid fuels
- (b) liquid fuels
- (c) both (a) and (b)
- (d) none of the above

SSC JE 23. 1. 2018 (10.15 am)

Nagaland PSC (JE) 2017 (Paper-2)

GPSC Motor Vehicle (Mech) 02-12-2012

Ans. (c)

- * Bomb calorimeter is used to determine the calorific value of solid and liquid fuels.
- * Calorimetric is the science of measuring quantities of heat, as distinct from "Temperature".
- * The instruments used for such measurements are known as calorimeters.
- * We are concerned only with oxygen bomb calorimeters, which are standard instruments for measuring calorific values of solid and liquid combustible samples.

294. Which of the following is not a non-conventional energy source?

- (a) Solar energy
- (b) Wind energy
- (c) Coal
- (d) Bio-gas

ISRO IPRC TECH. ASSTT. 28.08.2016

MPSC AMVI 2013, 2003

Ans. (c) : **Non-Conventional energy sources**— These non-conventional sources are also known as generally renewable sources of energy.

Ex-Bio energy, solar energy, wind energy, tidal energy.

Conventional energy sources—These sources of energy are generally known as non-renewable sources of energy and are available in limited quantity.

It's two type—

- (i) Commercial—Coal, Petroleum, Electricity.
- (ii) Non-commercial—fire wood, straw, dried dung.

Note— Hydro power plant energy source are conventional and also renewable energy source.

295. Which of the following is the most important commercial source of energy in India at present?

- (a) Solar energy
- (b) Oil
- (c) Coal
- (d) Uranium

MPSC AMVI 2003, 2001

Ans. (c) : The most important commercial source of energy in India at present is coal.

- Coal has a favour over other fuels as it can be converted into other forms of energy.

- 296.** The combustion analysis carried out by the Orsat Apparatus renders which of the following?
- The % composition by weight on the dry basis
 - the % composition by volume on the dry basis
 - the % composition by weight on the wet basis
 - none of the above

CPCB Scientist-B 08.09.2021

Ans. (b) :

- 297.** Considering the weight percentage, which of the following is determined by the proximate analysis of coal?
- Fixed carbon, Volatile matter, Moisture and Ash.
 - All solid and gaseous components.
 - All solid and gaseous components except volatile matter
 - Fixed carbon and volatile matter.

JPSC AE 23.10.2021 Paper-I

Ans. (a) : Proximate analysis is formally defined by a group of ASTM3 test method and is an assay of the moisture, volatile matter, fixed carbon and ash content of a coal sample. The moisture content is determined by the mass loss that a coal sample undergoes after it has been heated to 100°C under N₂ atmosphere.

- 298.** The solid fuel having the highest calorific value is
- wood
 - lignite
 - coke
 - anthracite

SSC JE 23. 1. 2018 (10.15 am)

Ans. (d) Anthracite (a solid fuel) has the highest calorific (HCV). It also has highest carbon content and energy density among all types of coal except graphite.

Types of Coal	C.V.
Anthracite	36000 kJ/kg
Bituminous	33500 kJ/kg
Lignite	25000 kJ/kg
Peat	23000 kJ/kg

- 299.** Calorific value of a fuel is based on
- 1 kg of fuel
 - 1 kg/m³ of fuel
 - 1 m³ of fuel
 - its specific volume

SSC JE 29. 1. 2018 (10.15 am)

Ans. (*) Calorific or heating value of fuel is defined as the energy liberated by the complete oxidation of unit of mass or volume of fuel. It is expressed in kJ/kg for solid and liquid fuel and for gas kJ/m³.

Note: No correct answer given by commission.

- 300.** The amount of heat generated per kg of fuel is known as
- Calorific value
 - Heat energy
 - Lower calorific value
 - Higher calorific value

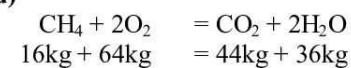
WBPSC 2018

Ans. (a) : Calorific Value—The energy contained in a fuel, determined by measuring the heat produced by the complete combustion of a specified quantity of it. This is now usually expressed in J/kg or J/m³.

- 301.** Quantity of oxygen required for complete combustion of 1kg of methane is
- 7 kg
 - 6 kg
 - 5 kg
 - 4 kg

ISRO LPSC 04-03-2018

Ans : (d)



$$1\text{kg CH}_4 + \frac{64}{16}\text{kg O}_2 = \frac{44}{16}\text{kg CO}_2 + \frac{36}{16}\text{kg H}_2\text{O}$$

$$1\text{kg CH}_4 + 4\text{kg O}_2 = \frac{11}{4}\text{kg CO}_2 + \frac{9}{4}\text{kg H}_2\text{O}$$

So, Quantity of oxygen required for complete combustion of 1 kg of methane (CH₄) is 4 kg.

During this reaction $\frac{11}{4}$ kg CO₂ and $\frac{9}{4}$ kg H₂O is produced.

- 302. Coke is produced by**

- pulverizing coal in inert atmosphere
- heating wood in limited supply of air at temperatures below 300°C
- strongly heating coal continuously for about 48 hours in the absence of air in a closed vessel
- binding the pulverized coal into briquettes

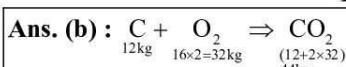
SSC JE 22.1. 2018 (10.15 am)

Ans. (c) Coke is produced by strongly heating coal continuously for about 48 hours in the absence of air in a closed vessel. Coke is used for boiler furnace due to its highly heating value.

- 303. For complete combustion of 1 kg of Carbon, the required Oxygen is**

- 8 kg of Oxygen
- 8/3 kg of Oxygen
- 3/8 kg of Oxygen
- None of the above

ISRO IPRC 10-12-2016



∴ For complete combustion of 12 kg of carbon. The required oxygen is 32 kg.

∴ For 1 kg of carbon required oxygen is $\frac{32}{12} = \frac{8}{3}$

So for complete combustion of 1 kg of carbon. The required oxygen is $\frac{8}{3}$ kg .

- 304. The coal is reduced to a fine powder with the help of grinding mill and then projected into the combustion chamber with the help of hot air current is known as**

- Pulverized fuel firing
- Manual fuel firing
- None- Pulverized fuel firing
- None of these

Mizoram PSC 2016 (Paper-2)

Ans. (a) : The coal is reduced to a fine powder with the help of grinding mill and then projected into the combustion chamber with the help of hot air current is known as pulverized fuel firing. Pulverizing is currently the favored method of preparing coal for burning. Pulverized coal can be introduced directly into the boiler for combustion.

305. A substance which produces a lot of heat on burning is called

- (a) oxidizing agent
- (b) biogas
- (c) biomass
- (d) fuel

GPSC AMVI (ME) 24-12-2016

Ans. (d) : The substance which produces a lot of heat on burning is called fuel.

Fuel – A fuel is any material that can be made to react with other substances so that it releases energy as heat energy or to be used for work.

Ex.– Petrol, Diesel, Natural gas, CNG, etc.

306. Another name for the coal used in power plant is–

- (a) Charcoal
- (b) Coke
- (c) Steam coal
- (d) Wet coal

RRB JE [Exam Date : 29-08-2015 (Shift-II)]

Ans : (c) Another name for the coal used in power plant is steam coal.

- Steam coal (Sometimes called thermal coal) is a high grade of coal used in electric power plants to generate steam to create electricity.

307. Calorific values of gaseous fuels is determined by

- (a) Bomb Calorimeter
- (b) Junker's Calorimeter
- (c) Separating Calorimeter
- (d) Throttling Calorimeter

TSPSC AE 2015

Ans. (b) : Calorific values of gaseous fuels is determined by- Junker's Calorimeter.

- Calorific value of the solid and liquid sample is determined by- Bomb calorimeter.
- Separating calorimeter is used to measure the probable values of dryness fraction of steam when steam is very wet.
- **Throttling calorimeter–** The principle of the throttling calorimeter is to throttle the wet steam so that it becomes superheated.

308. Which among the following circuits about the working of a steam power plant is not correct ?

- (a) Fuel and ash circuit
- (b) Air and flue gas circuit
- (c) Hot water and fuel circuit
- (d) Cooling water flow circuit

TNPSC 2012 (Paper-4)

Ans. (c) : The flow circuit of a thermal power plant consists of the following four main circuits–

1. Feed water and steam flow circuit
2. Coal and ash circuit
3. Air and gas circuit
4. Cooling water circuit.

309. In computing engine performance, the calorific value of fuel used is

- (a) H.C.V
- (b) L.C.V
- (c) The average of H.C.V and L.C.V
- (d) None of the above

GPSC Motor Vehicle (Auto) 02-12-2012

Ans. (a) : In computing engine performance. (like power, efficiency of fuel consumption etc.) the mostly calorific value of fuel used is H.C.V (High calorific value).

310. The calorific value of fuel is measured by

- (a) Viscometer
- (b) Thermometer
- (c) Calorimeter
- (d) Flow meter

GPSC Motor Vehicle (Auto) 02-12-2012

Ans. (c) : The calorific value of fuel is measured by calorimeter.

⇒ Calorimeter is used for measuring the heat developed during a mechanical, electrical or chemical reaction and for calculating the heat capacity of materials.

⇒ Calorific value is the amount of energy released when 1 kg of fuel burnt in the presence of oxygen. Its SI unit is kJ/kg.

311. The calorific value of diesel is about

- (a) 36.5 MJ/kg
- (b) 38.5 MJ/kg
- (c) 42.5 MJ/kg
- (d) 46.5 MJ/kg

GPSC Motor Vehicle (Auto) 02-12-2012

Ans. (d) : The calorific value of diesel is about 46.5 MJ/kg. Calorific value is defined as the amount of energy generated when a unit amount of substance is completely oxidized and it determined using the bomb calorimeter.

312. Energy available in fuels is stored as–

- (a) Heat energy
- (b) Chemical energy
- (c) Atomic energy
- (d) Explosive energy

MPSC AMVI 2011

Ans. (b) : Energy available in fuels is stored as chemical energy.

- Chemical energy is energy stored in the bonds of atoms and molecules. Batteries, Biomass, petroleum natural gas, are example of chemical energy.
- Chemical energy is converted to thermal energy when people burn wood in a fire place or burn gasoline in a car's engine.

313. The electro static precipitator are used for

- (a) Collection of solid particles
- (b) Collection of solid and liquid particles
- (c) Collection of liquid particles
- (d) Collection of gaseous compounds

WBPSC 2007

Ans. (a) : The electro static precipitator are used for collection of solid particles.

- An electrostatic precipitator is an air filtration device used primarily in the manufacturing, metal and mining industries. The device deploys an induced electro static charge to remove dust, smog and particulate matters from exhaust air/gas steams.

- 314. Match list-I with List-II and select the correct answer-**

List-I	List-II
A. Heavy water	1. Diesel Engine
B. Rankine cycle	2. Gas turbine
C. Fuel pump	3. Thermal power plant
D. Air compressor	4. Nuclear reactor

A	B	C	D
(a) 3	1	2	4
(b) 2	4	3	1
(c) 1	3	2	4
(d) 4	3	1	2

MPSC AMVI 2005

Ans. (d) :

- (A) Heavy water-(4) Nuclear reactor
- (B) Rankine cycle-(3) Thermal power plant
- (C) Fuel pump – (1) Diesel Engine
- (D) Air compressor – (2) Gas turbine

- 315. Consider the following statements—**

- (A): Efforts are made to harness non-conventional energy sources for power generation.
- (R): The conventional energy sources will be exhausted soon.

Now selected the answer from the following alternatives.

- (a) Both A and R are true, but R is not the correct reason for A
- (b) A is true, but R is false
- (c) R is true, but A is false
- (d) Both A and R are true and R is the correct reason for 1

MPSC AMVI 2005

Ans. (d) :

- Energy generated by using wind, solar energy, geothermal heat and biomass is known as a non-conventional energy sources. All these sources are renewable process of energy generation and do not cause environmental pollution.
- Conventional energy sources are generally referred to as fossil fuels, coal, natural gas and petroleum.
- These fossil fuels will be exhausted within a few centuries and can not be generated.
Ex- Coal, petroleum, etc.

- 316. Which calorific value of a fuel should be considered for calculation of thermal efficiency of a power plant?**

- (a) Lower calorific value
- (b) Higher calorific value
- (c) Gross heating value
- (d) None of the above

MPSC AMVI 2005

Ans. (a) : The calorific value of a fuel is the quantity of heat obtained per kilogram (solid or liquid) of fuel when burnt with an excess of oxygen in a calorimeter.

* If the H₂O is present in the products of as a vapour then the lower calorific value (LCV) is obtained. So for calculating thermal efficiency of a power plant the LCV is considered.

- 317. The fuel mostly used in steam boilers is –**

- (a) Peat
- (b) Coking bituminous coal
- (c) Non-coking bituminous coal
- (d) Brown coal

MPSC AMVI 2004

Ans. (c) : Non-Coking bituminous coal is the fuel mostly used in boiler.

- Coking coal (75-80% Carbon) used in steel industries and non-coking coal (carbon below 75%) used in thermal power plants for steam production.

- 318. Petroleum can be classified as—**

- (a) A renewable form of energy source
- (b) A non-renewable form of energy source
- (c) A non-conventional form energy source
- (d) None of the above

MPSC AMVI 2004

Ans. (b) : Petroleum is a conventional and non-renewable form of energy sources.

- 319. The Indian coal has an average ash content in the range of.....**

- (a) 20 to 30%
- (b) 8 to 10%
- (c) 5 to 10%
- (d) 50 to 60%

MPSC AMVI 1998

Ans. (a) : Ash content of coal produced in the country varies from 15% to 45% with majority of coal produced falls under 35% to 45% range. Average ash content of imported coal varies from 10% to 20%.

- The Indian coal has an average ash content in the range of 20 to 30%.

4. Steam Turbines

- 320. Compounding of a steam turbine is done to**

- (a) reduce the blade friction
- (b) balance the rotor
- (c) reduce the rotor speed
- (d) connect the shaft

SSC JE 22-03-2021 Shift-II

SSC JE 2013

MP Engineer JE Paper II 2011
ESE-1999, 1992

Ans. (c) : Compounding of steam turbine is done to reduce rotor speed as the rotor of steam turbine run at a very high speed (upto 30000 rpm) which have a number of disadvantages.

Methods of compounding—

- 1. Velocity compounding (Curtis turbine)
- 2. Pressure compounding (Rateau turbine)
- 3. Pressure velocity Compounding

- 321. For a single stage impulse turbine, having nozzle angle α , maximum blade efficiency under ideal condition is given by—**

- (a) $\frac{\cos \alpha}{2}$
- (b) $\frac{\cos^2 \alpha}{2}$
- (c) $\frac{\cos 2\alpha}{2}$
- (d) $\cos^2 \alpha$

UPSSSC JE 2015

SSC JE 2014 (Evening)

MP Engineer JE Paper II 2011

Ans. (d) For a single stage impulse turbine, in ideal condition,

$$\text{Maximum blade efficiency } \eta_{\max} = \cos^2 \alpha$$

$$\text{When, speed ratio } (\rho) = \frac{u}{u_1} = \frac{\cos \alpha}{2}$$

322. In impulse turbine, pressure on the two side of the moving blades-

- (a) Decreases
- (b) Increases
- (c) Remains same
- (d) May decrease or remain constant

Mizoram PSC 2019 (Paper-2)
UPSSSC JE 2015, SSC JE 2013

Ans. (c) : In impulse turbine the fluid is completely expanded in nozzle. Impulse turbine have the same pressure on the two sides of the rotor blades, whereas different pressure exists on the two sides of the moving blades of reaction turbine.

323. Curtis turbine is an example of

- (a) velocity compounded impulse steam turbine
- (b) pressure compounded impulse steam turbine
- (c) pressure-velocity compounded impulse steam turbine
- (d) reaction steam turbine

GSECL 23.02.2020 (Shift-2)
UPSSSC JE 2015, SSC JE 2011

Ans. : (a)

- ⇒ Curtis turbine is an example of velocity compounded impulse steam turbine.
- ⇒ The Rateau and Zolley turbines are the example of pressure compounded impulse turbine.
- ⇒ Simplest type of impulse turbine is De-laval turbine.
- ⇒ The simplest type of reaction turbine is Parson's turbine.

324. A single stage impulse turbine is also known as:

- (a) Curtis stage turbine (b) Reaction turbine
- (c) De-Laval turbine (d) Rateau turbine

SSC JE 2021, TSPSC AE 2015
TNPSC 2014 (Paper-4)

Ans. (c) : A single stage impulse turbine is also called the De-Laval turbine after its inventor. The turbine consists of single rotor to which impulse blades are attached.

- Simple single stage impulse turbine ⇒ De-Laval Turbine
- Pressure compounded impulse turbine ⇒ Rateau Turbine
- Velocity compounded impulse turbine ⇒ Curtis Turbine

325. In Parson's turbine if (α) is nozzle angle, then what is the maximum efficiency of the turbine?

- (a) $\frac{2 \cos \alpha}{(1 + \cos \alpha)}$
- (b) $\frac{2 \cos^2 \alpha}{(1 + \cos^2 \alpha)}$
- (c) $\frac{2 \cos^2 \alpha}{(1 - \cos \alpha)}$
- (d) $\frac{\cos^2 \alpha}{(1 + 2 \cos^2 \alpha)}$

SSC JE 2014 (Morning)
ESE-2004, 1999

Ans. (b) : The maximum efficiency of a parson's turbine is,

$$\eta_{\max} = \frac{2 \cos^2 \alpha}{(1 + \cos^2 \alpha)}$$

Where, α = Nozzle angle.

Note- The maximum efficiency of De-Laval turbine,

$$\eta_{\max} = \cos^2 \alpha$$

326. If the enthalpy drop in the moving blades and fixed blades of a steam turbine are 10 kJ/kg and 15 kJ/kg respectively, then the degree of reaction is

- (a) 67%
- (b) 60%
- (c) 40%
- (d) 33%

ISRO TA 14.07.2021
ESE-2009

Ans. (c) : Given that-

Enthalpy drop in moving blade (Δh_m) = 10 kJ/kg

Enthalpy drop in fixed blade (Δh_f) = 15 kJ/kg

Enthalpy drop in moving blade

$$DOR = \frac{\text{Enthalpy drop in moving blade}}{\text{Total Enthalpy drop}}$$

$$DOR = \frac{10}{10+15} = \frac{10}{25} = 0.4$$

$$DOR = 40\%$$

327. The process of maintaining the speed of a steam turbine constant for various load conditions is known as-

- (a) Reheating
- (b) Governing
- (c) Cooling
- (d) Bleeding

TSPSC AE 2015
RRB-JE 29.08.2019, 1st Shift

Ans. (b) : The process of maintaining the speed of steam turbine constant for various load conditions is known as governing.

→ Governing methods of steam turbines:-

- (i) Throttle control governing → $\eta \downarrow$, so used in small turbines (Impulse).
- (ii) Nozzle control Governing → $\eta \uparrow$, so used in large turbines (Impulse)
- (iii) By pass Governing → It is used in modern high pressure impulse turbine.

328. To maximum the work output at turbine, the specific volume of working fluid should be :

- (a) As small as possible
- (b) As large as possible
- (c) Constant as possible
- (d) None of the above

GPSC AMVI ME (24.12.2016)
UPSSSC JE 2016

Ans. (b) : To maximize the work output at turbine the specific volume of working fluid should be as large as possible.

$\because W = - \int v dp$
if $v \uparrow \uparrow \uparrow \Rightarrow W \uparrow \uparrow \uparrow$

- 329. In impulse turbine, the steam expands:**
- in the nozzle
 - in the blades
 - partially in nozzle, partially in blades
 - cannot say

UPRVUNL JE 2016 (Shift-I)
UPSSSC JE 2015

Ans. (a) : Impulse Turbine—

- In this type of turbine the steam is initially expanded in a nozzle.
- The high velocity jet of steam coming out of the nozzle is made to guide over a curved vane called blade.

- 330. If the enthalpy drop in the moving blades and fixed blades of a steam turbine is 10 kJ/kg and 15 kJ/kg respectively then the degree of reaction will be**

- 67%
- 60%
- 40%
- 33%

JPSC AE 23.10.2021 Paper-I

Ans. (c) : Degree of reaction

$$R = \frac{\Delta h_m}{\Delta h_m + \Delta h_f}$$

Where, h_m = For moving blade
 h_f = For fixed blade

$$R = \frac{10}{10+15} = 0.4$$

$$R = 40\%$$

- 331. Symmetrical blading is used in a turbine when its degree of reaction is**

- 25%
- 50%
- 75%
- 100%

JPSC AE 23.10.2021 Paper-I

Ans. (b) : Symmetrical blading is used in a turbine when its degree of reaction is 50%.

Under 50% reaction stage

$$\begin{array}{l|l} v_1 = v_{r1} & \theta = \beta \\ v_2 = v_{r2} & \alpha = \phi \end{array}$$

- 332. The advantage of Double Beat valve in steam engine are**

- Superheat steam may be used since there is an absence of sliding parts
 - The cylinder condensation is reduced since there is a separate valve for admission and exhaust
 - Low initial cost owing to completed casting
- Which of following are correct**
- 1 and 2 only
 - 1 and 3 only
 - 2 and 3 only
 - 1, 2 and 3 only

CPCB Scientist-B 08.09.2021

Ans. (a) : Advantage of double beat valve in steam engine are—

- Superheat steam may be used since there is absence of sliding parts.
- The cylinder condensation is reduced since there is a separate valve for admission and exhaust.

- 333. The steam engine has theoretical mean effective pressure is 5 bar and actual mean effective pressure is 4.5. The diagram factor will be:**
- 0.5
 - 0.9
 - 0.1
 - 0.11

CPCB Scientist-B 08.09.2021

Ans. (b) :

$$\text{Diagram factor} = \frac{\text{Actual mean effective pressure}}{\text{Hypothetical mean effective pressure}}$$

$$\frac{4.5}{5} = 0.9$$

- 334. Condensation can be prevented in steam engine by**

- Supply superheated steam
- Providing steam jacket around cylinder wall
- Decreasing speed

Which of following are most correct

- 1 and 2 only
- 1 and 3 only
- 2 and 3 only
- 1, 2 and 2 only

CPCB Scientist-B 08.09.2021

Ans. (a) : Condensation can be prevented in steam engine by

- Supply superheated steam
- Providing steam jacket around cylinder wall.

- 335. Select the most appropriate definition of a turbine from the following statements :**

- Turbine is a fluid machine
- It is device in which kinetic energy held by a fluid is converted to mechanical energy of a rotating member
- It is a device where potential energy is transferred to a fluid
- It is a device where mechanical energy from moving parts is transferred to a fluid

SSC JE 2021

Ans. (b) : A turbine is a rotating part which convert the kinetic energy of a working fluid into useful mechanical energy.

- 336. A Curtis stage; Rateau stage and a 50% reaction stage in a steam turbine are the example of**

- Different type of impulse turbine
- Different type of reaction turbine
- A simple impulse stage, a velocity compounded impulse stage and reaction stage
- A velocity compounded impulse stage, a simple stage and a reaction stage

JPSC AE 23.10.2021 Paper-I

Ans. (d) : Curtis stage- Velocity compounded impulse stage.

Rateau stage- Pressure compounded impulse turbine.
50% Reaction stage- A reaction stage.

- 337. Steam enters a De laval steam turbine with an inlet velocity of 30 m/s and leaves with an outlet velocity of 10 m/s. The work done by 1 kg of steam is**

- (a) 400 Nm
(c) 800 Nm

- (b) 600 Nm
(d) 1200 Nm

ISRO TA 14.07.2021

Ans. (a) : Workdone by steam in De-laval steam turbine
= Energy loss by steam

$$\begin{aligned} &= \frac{1}{2}mv_1^2 - \frac{1}{2}mv_2^2 \\ &= \frac{1}{2} \times 1 \times ((30)^2 - (10)^2) \\ &= \frac{1}{2}[900 - 100] \end{aligned}$$

$$W = 400 \text{ Nm}$$

338. In a back pressure turbine, the pressure of steam at turbine exhaust

- (a) Is below atmospheric
(b) Is atmospheric
(c) Is above atmospheric
(d) Can be at any pressure

Arunanchal Pradesh PSC JE 2020

Ans. (c) : In a back pressure turbine, the pressure of steam at turbine exhaust is above atmospheric pressure.

339. In a thermal power plant, deaerator is used to

- (a) Remove air from condenser
(b) increase feedwater temperature
(c) Reduce steam pressure
(d) Remove dissolved gases from feedwater

Arunanchal Pradesh PSC JE 2020

Ans. (d) : In a thermal power plant, deaerator is used to remove air from condenser.

340. All reaction turbine will have maximum efficiency if swirl velocity at the outlet will be equal to:

- (a) inlet swirl velocity
(b) zero
(c) runner outlet velocity
(d) runner inlet velocity

SSC JE 11-12-2020

Ans. (b) : All reaction turbine will have maximum efficiency if swirl velocity at the outlet will be equal to zero.

341. What is the maximum moisture content in a steam turbine exhaust?

- (a) 15%
(b) 25%
(c) 30%
(d) 20%

SSC JE 27-10-2020 (Shift-3)

Ans. (a) : In a steam turbine exhaust the maximum moisture content is 15%.

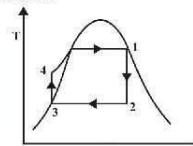
- Due to moisture, the chances of corrosion (or rusting) of turbine blades are high.
- To avoid these problems, the dryness fraction of steam in turbine in last stage of expansion should not be less than 0.88 generally.

342. If a dry saturated steam is admitted to a steam turbine following an isentropic process, at the exit of the turbine be a:

- (a) wet steam
(b) dry saturated steam
(c) liquid condensate
(d) superheated steam

SSC JE 25-09-2019 (Shift-2)

Ans. (a) : If a dry saturated steam is admitted to a steam turbine following an isentropic process, at the exit of the turbine be a wet steam.



1 ⇒ Dry saturated steam (admitted to a steam turbine)

2 ⇒ Wet steam (at exit of the turbine)

1-2 ⇒ Isentropic process

343. The degree of reaction for Parson's reaction turbine is

- (a) 70%
(c) 50%

- (b) 90%
(d) 30%

HPCL JE 20-04-2019

Ans. (c) : Parson's reaction turbine has the degree of reaction is 50% and the moving and fixed blades are symmetrical.

Degree of reaction (R) = $\frac{\text{Enthalpy drop in moving blade}}{\text{Total enthalpy drop}}$

$$R = \frac{(\Delta H)_{MB}}{(\Delta H)_{FB} + (\Delta H)_{MB}}$$

* R = 1, for pure reaction turbine because, $(\Delta H)_{FB} = 0$

* R = 0, for impulse turbine because, $(\Delta H)_{MB} = 0$

* R = 1/2, for Parson's reaction turbine because, $(\Delta H)_{FB} = (\Delta H)_{MB}$

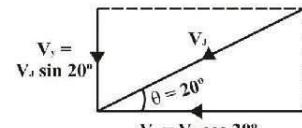
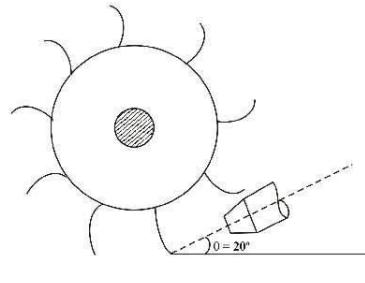
344. Steam is supplied at 500 m/s at a angle 20° tangent to the turbine wheel. The component of the jet velocity which contributes to the turbine work is:

- (a) $500 \tan 20^\circ$
(c) $500 \cos 20^\circ$

- (b) $500 \cosec 20^\circ$
(d) $500 \sin 20^\circ$

SSC JE 25-09-2019 (Shift-2)

Ans. (c) :



According to figure—

Component of the jet velocity (V_J),
 V_x contributes to steam turbine work

$$V_x = V_J \cos \theta$$

$$V_x = 500 \cos 20^\circ \text{ m/s} \quad (\because V_J = 500 \text{ m/s})$$

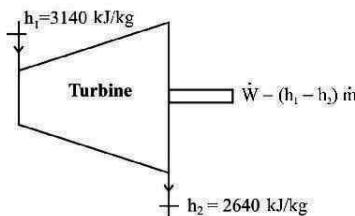
345. 0.5 kg/s of steam of enthalpy 3140 kJ/kg enters a steam turbine. It leaves the turbine with the enthalpy of 2640 kJ/kg. The turbine's power output is:

- (a) 102.5 kJ/s (b) 250 kW
 (c) 177 kW (d) 500 kW

SSC JE 25-09-2019 (Shift-2)

Ans. (b) : Given,

$$\begin{aligned} \dot{m} &= 0.5 \text{ kg/s}, \\ h_1 &= 3140 \text{ kJ/kg} \\ h_2 &= 2640 \text{ kJ/kg} \end{aligned}$$



We know that, for turbine work output (\dot{W}) = $\dot{m} \times$ (change in enthalpy in turbine)
 $= 0.5 \times (3140 - 2640) = 250 \text{ kW}$

346. The purpose of governing in the steam turbine is to :

- (a) maintain the speed of the turbine
 (b) reduce the effective heat drop
 (c) reheat the steam and improve its quality
 (d) completely balance against end thrust

HPSSC JE 2018

Ans. (a) : Steam turbine governing is the procedure of monitoring and controlling the flow rate of steam into the turbine with the objective of maintaining its speed of rotation as constant.

347. In an impulse reaction turbine, the enthalpy drop in fixed and moving blades are 20 kJ/kg and 40 kJ/kg respectively. Then the degree of reaction of stage is.

- (a) 0.33 (b) 0.5
 (c) 0.66 (d) 0.75

ISRO SDSC 08-04-2018

Ans. (c) : Given,

Enthalpy drop in fixed blade $(\Delta h)_f = 20 \text{ kJ/kg}$

Enthalpy drop in moving blade $(\Delta h)_m = 40 \text{ kJ/kg}$

$$\begin{aligned} \text{Degree of Reaction (DOR)} &= \frac{(\Delta h)_m}{(\Delta h)_m + (\Delta h)_f} \\ &= \frac{40}{40 + 20} = \frac{40}{60} = 0.66 \end{aligned}$$

348. In a cross compound steam engine

- (a) One high and one low pressure cylinders are set side by side, driving the same shaft, cranks being set 90° apart
 (b) Two cylinders are centred on the piston rod, the L.P. cylinder being placed nearest the crankshaft

- (c) Two cylinders are set at 90° , usually to save floor space
 (d) None of these

SSC JE 2 March 2017 Shift-I

Ans. (*) Two-cylinder compound engines are generally classified as—

1. Tandem type compound engines
2. Woolf type compound engines
3. Receiver type compound engines

Tandem type compound engine- The two cylinder (H.P. and L.P.) have a common piston rod working on same crank. (i.e. crank are at 0° to each other)

Woolf type compound engine:- Two cylinders (H.P. and L.P.) have different piston rods attached to two different cranks set of 180° to each other. These cranks are cast in the same crank shaft.

Receiver type compound engine:- Two cylinders (H.P. and L.P.) have different piston rods attached to two different cranks set at 90° to each other. These cranks are cast in the same crank shaft.

- The woolf type and receiver type compound engines are cross compound engine. In the cross-compound engine, the cylinders are provided side by side and each cylinder has a separate piston, which joints the rod and crank.

Note— Answer 'b' is given by commission.

349. Which of the following statements is correct regarding an impulse turbine ?

- (a) The steam is initially compressed in a nozzle from low pressure to high pressure
- (b) The steam is initially expanded in a nozzle from low pressure to high pressure
- (c) The steam is initially compressed in a nozzle from high pressure to low pressure
- (d) The steam is initially expanded in a nozzle from high pressure to low pressure

SSC JE 2 March 2017 Shift-I

Ans. (d) : Regarding an impulse turbine, the steam is initially expanded in a nozzle from high pressure to low pressure.

350. In a two stage gas turbine plant, reheating after first stage

- (a) decreases work ratio
- (b) Increases work ratio
- (c) Does not effect work ratio
- (d) None of the above

RSMSSB JE 21.08.2016 (Degree)

Ans. (b) : In a two stage gas turbine plant, reheating after first stage.

- (1) Increases work ratio
- (2) decreases thermal efficiency

351. The following are the method for compounding except

- (a) velocity compounding
- (b) pressure compounding
- (c) volume compounding
- (d) none of these

GPSC AMVI (ME) 24-12-2016

Ans. (c) : In power plants, high pressure and high temperature steam is used in order to increase their thermal efficiency. If the entire pressure drop is carried out in one stage only, then the velocity of steam is very high (30000 r.p.m). In order to reduce the rotor speed, various methods of compounding are employed. They are –

- Velocity compounding
- Pressure compounding
- Pressure -velocity compounding

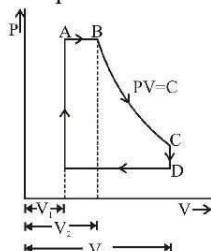
So, volume compounding is not a method of compounding.

352. The expansion ratio in steam engines is the ratio of

- Clearance volume to swept volume
- Swept volume to clearance volume
- Cut off volume to swept volume
- Swept volume to cut off volume

(MP Sub Engineer 5th April 2016 Morning)

Ans. (d) Expansion ratio—Ratio of swept volume to cut off volume is called expansion ratio.



$$\text{Expansion ratio} = \frac{\text{Swept volume}}{\text{Volume at cut off}} = \frac{V_3}{V_2}$$

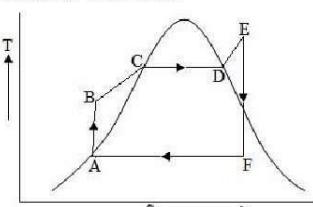
- Ratio of the clearance volume to swept volume is called clearance ratio.
- Ratio of cut off volume to clearance volume is called cut-off ratio.

353. During expansion in steam turbine, entropy

- Increase exponentially
- Decrease exponentially
- Increase linearly
- None of these

ISRO VSSC 28-08-2016

Ans : (d) During expansion in steam turbine, entropy remains constant.



Expansion occurs in process E to F in turbine (at $S = C$). EF is reversible adiabatic process, hence during the expansion entropy remains constant.

- In steam turbine heat addition & heat rejection process are at constant pressure while compression & expansion process are reversible adiabatic process i.e. constant entropy.

• Steam turbine worked on Rankine Cycle.

$(B - C - D) \Rightarrow$ Heat addition in boiler.

$(E - F) \Rightarrow$ Expansion of steam in turbine.

$(F - A) \Rightarrow$ Heat rejection in condenser.

$(A - B) \Rightarrow$ Pumping process in feed pump.

354. In a steam turbine, the critical pressure ratio for initial dry saturated steam is given by:

(MP Sub Engineer 5th April 2016 Morning)

- 0.545
- 0.577
- 0.585
- 0.595

Ans. (b) In a steam turbine the critical pressure ratio is

$$\text{given by } \left(\frac{2}{n+1} \right)^{\frac{n}{n-1}}$$

Critical pressure ratio Steam condition

0.577	Dry saturated steam
0.582	Wet steam
0.546	Super heated steam
0.528	Gas

355. A prime mover in which gradual changes in the momentum of a fluid are utilised to produce rotation of the mobile member is

- Electric Motor
- Turbine
- Diesel Engine
- None of these

Mizoram PSC 2016 (Paper-2)

Ans. (b) : Turbine is a prime mover in which gradual changes in the momentum of a fluid are utilised to produce rotation of the mobile member.

* High velocity steam impinges on moving curved vanes causes change in momentum & impulsive force produced on blades.

356. The D-slide valve is also known as :

- Inside admission valve
- Outside admission valve
- Piston slide valve
- None of the above

GPSC AMVI (Auto) 24-12-2016

Ans. (b) : The D-slide valve is also known as outside admission valve.

* **D-slide valve** – It moves in the steam chest with simple harmonic motion. Its function is to exhaust steam from the cylinder at proper moment.

357. The device in which the work is done by the fluid at the expense of its enthalpy is known as:

- Compressor
- Throttling device
- Turbine
- Heat exchanger

RRB SSE [Exam Date : 01-09-2015 (Shift-II)]

Ans : (c) In turbine, the work is done by the fluid at the expense of its enthalpy.

$$W_T = H_1 - H_2$$

- 358. The degree of reaction of a steam turbine is the ratio between the enthalpy drops in-**
- moving blades and that in the stage
 - moving blades and that in the nozzle
 - in the nozzle and that in the stage
 - in the nozzle and that is the moving blades

SSC JE 2015

Ans. : (a) The degree of reaction (R) of a steam turbine is the ratio between the enthalpy drops in moving blades and that in the stage.

$$R = \frac{(\Delta h)_{MB}}{(\Delta h)_{Stage}} = \frac{(\Delta h)_{MB}}{(\Delta h)_{FB} + (\Delta h)_{VB}}$$

- For pure reaction turbine, R=1
- For pure impulse turbine, R=0
- For impulse reaction turbine, $0 < R < 1$
- For Parson's reaction turbine, $R = \frac{1}{2}$

- 359. In a reaction turbine, the heat drop in fixed blade is 8 kJ/kg and total heat drop per stage is 20 kJ/Kg. The degree of reaction is**

- 40%
- 60%
- 66.7%
- 80%

SSC JE 2014 (MORNING)

Ans. : (b)

$$\text{Degree of reaction} = \frac{\text{Heat drop on moving blade}}{\text{Total heat drop}}$$

$$= \frac{12}{20} \times 100$$

$$\text{DOR} = 60\%$$

- 360. Which of the following does not relate to steam engine?**

- Crank shaft
- Cross head
- Steam chest
- Steam separator

SSC JE 2014 (MORNING)

Ans. : (d) Steam separator is not used in steam engine. It is used in steam boiler.

Parts of steam engine –

- Cylinder.
- Steam chest
- D-slide valve
- Inlet & exhaust ports.
- Piston
- Piston rod, (cross head, connecting rod.)
- Crankshaft, Eccentric
- Eccentric rod and valve rod
- Flywheel & Governor

- 361. If V_i be the inlet absolute velocity to blades, V_b be the tangential blade velocity and α be the nozzle angle, then for maximum blade efficiency for single-stage impulse turbine**

$$(a) \frac{V_b}{V_i} = \cos \alpha \quad (b) \frac{V_b}{V_i} = \frac{\cos \alpha}{2}$$

$$(c) \frac{V_b}{V_i} = \cos^2 \alpha \quad (d) \frac{V_b}{V_i} = \frac{\cos^2 \alpha}{2}$$

SSC JE 2014 (MORNING)

Ans. : (b)

The efficiency of a impulse turbine is maximum when,

$$\frac{V_b}{V_i} = \frac{\cos \alpha}{2}$$

& the efficiency of reaction turbine is maximum when,

$$\frac{V_b}{V_i} = \cos \alpha$$

- 362. A single-stage impulse turbine with a diameter of 120 cm runs at 3000 rpm. If the blade speed ratio is 0.42, the inlet velocity of steam will be :**

- 200 m/s
- 450 m/s
- 900 m/s
- 80 m/s

SSC JE 2014 (Evening)

Ans. : (b) Given,

Diameter, D = 120 cm = 1.2 m

Speed, N = 3000 r.p.m.

Blade speed ratio = 0.42

Blade velocity

$$V_b = \frac{\pi DN}{60} = \frac{\pi \times 1.2 \times 3000}{60} = 188.5 \text{ m/s}$$

Inlet velocity of steam

$$= \frac{\text{Blade Velocity}}{\text{Blade Speed Ratio}} = \frac{188.5}{0.42} = 448.80 \text{ m/s}$$

$$\approx 450 \text{ m/s}$$

- 363. The Parson's turbine is a :**

- Hydraulic turbine
- Steam turbine
- Gas turbine
- None of the above

PSPCL JE 2012

Ans. (b) : The Parson's turbine is a steam turbine.

- In a reaction turbine, the pressure is reduced in the fixed blade as well as in moving blade. The velocity of steam is increased in the fixed blades and reduced while passing through the moving blade. The simplest type of a reaction turbine is Parson's turbine.

- 364. Parson's turbine is :**

- simple reaction type turbine
- simple impulse type turbine
- velocity compounded turbine
- none of these

TNPSC 2012 (Paper-4)

Ans. (a) : A very widely used design has half degree of reaction or 50% reaction and this known as Parson's turbine.

- This consists of symmetrical stator and rotor blades.

- 365. Stage efficiency of steam turbine is equal to**

- Blade efficiency/Nozzle efficiency
- Nozzle efficiency/Blade efficiency
- Nozzle efficiency × Blade efficiency
- 1-Blade efficiency

MP Engineer JE Paper II 2011

Ans. (c) Stage efficiency – It is the ratio of work done on the blade per kg of steam to the total energy supplied or heat drop per stage per kg of steam.

For steam turbine,

$$\text{Nozzle efficiency } (\eta_N) = \frac{C_1^2}{2(\Delta h)}$$

$$\text{Blade or diagram efficiency } (\eta_b) = \frac{2(C_{w_1} \pm C_{w_2})C_b}{C_1^2}$$

$$\text{Stage efficiency } (\eta_s) = \frac{(C_{w_1} \pm C_{w_2})C_b}{\Delta h}$$

or $\eta_s = \eta_N \times \eta_b$

- Some times stage efficiency is also called overall efficiency.

366. The condition for maximum efficiency of reaction turbine is given by-

- (a) $V_b = V_1 \cos \alpha$ (b) $V_b = V_1^2 \cos \alpha$
 (c) $V_b = \frac{V_1 \cos \alpha}{2}$ (d) $V_b = \frac{V_1^2 \cos 2\alpha}{2}$

MP Engineer JE Paper II 2011

Ans. (a) The condition for maximum efficiency of reaction turbine is given by, $V_b = V_1 \cos \alpha$

and $\eta_{max} = \frac{2 \cos^2 \alpha}{1 + \cos^2 \alpha}$

For impulse turbine,

$$V_b = \frac{V_1 \cos \alpha}{2}$$

and $\eta_{max} = \cos^2 \alpha$

367. Willans line represents

- (a) Total steam consumption vs. power output with throttle governing
 (b) Total steam consumption vs. power output with cutoff governing
 (c) Behavior of supersaturated steam through nozzles
 (d) Condensation of steam while flowing through the turbine

ESE-2011

Ans. (a) : Willan's line represents total steam consumption vs. power with throttle governing.

368. Given,

η_s = stage efficiency

η_n = nozzle efficiency

η_b = blade efficiency

Which one of the following is correct?

- (a) $\eta_n = \eta_b \eta_s$ (b) $\eta_b = \eta_s \eta_n$
 (c) $\eta_b \times \eta_n \times \eta_s = 1$ (d) $\eta_s = \eta_b \eta_n$

ESE-2008

Ans. (d) : Stage efficiency of steam turbine is the ratio of the work done by the blades per kg of steam to the total energy supplied per stage per kg of steam.

and $\eta_{stage} = \eta_{nozzle} \times \eta_{blade}$

369. Blade erosion in steam turbines takes place

- (a) Due to high temperature steam
 (b) Due to droplets in steam
 (c) Due to high rotational speed
 (d) Due to high flow rate

ESE-2007

Ans. (b) : Blade erosion in steam turbines takes place due to droplets in steam.

Erosion of turbine blades results in rough, uneven surfaces that alter steam flow paths. This reduces turbine efficiency and can also limit capacity.

370. Throttle governing in steam turbines

- (a) Leads to significant pressure loss
 (b) Increases the efficiency
 (c) Increases heat losses
 (d) Decreases steam temperature

ESE-2007

Ans. (a) : Throttle governing in steam turbines leads to significant pressure loss.

In throttle governing, the steam admitted to the turbine is throttled so as to reduce the steam flow wherever there is a reduction of load, at the turbine. This is done by means of a balanced throttle valve which is operated by servomotor controlled by a centrifugal governor.

371. In an axial flow impulse turbine, energy transfer takes place due to

- (a) Change in relative kinetic energy
 (b) Change in absolute kinetic energy
 (c) Change in pressure energy
 (d) Change in energy because of centrifugal force

ESE-2006

Ans. (a) : In an axial flow impulse turbine, energy transfer takes place due to change in relative kinetic energy.

- In an impulse turbine, the pressure of steam is reduced in nozzle and remains constant while passing through the moving blade.

372. Which one of the following is the correct statement?

The degree of reaction of an impulse turbine

- (a) is less than zero
 (b) is greater than zero
 (c) is equal to zero
 (d) increases with steam velocity at the inlet

ESE-2005

Ans. (c) : Degree of reaction may also be defined as the ratio of enthalpy drop in the rotor to the enthalpy drop in a stage. i.e.

$$R = \frac{\text{Enthalpy drop in rotor}}{\text{Enthalpy drop in stage}}$$

- In the case of an impulse turbine, there is no change in the enthalpy in the rotor, so the degree of reaction is zero.

373. During cut-off governing of a steam engine, which one of the following parameter changes?

- (a) Speed
 (b) Steam pressure

- (c) Volume of steam supplied per stroke
 (d) Pressure and volume of steam supplied

MPSC AMVI 2005

Ans. (c) Cut-off governing—

- It is the method of controlling the engine output by varying the volume of intake steam.
- The volume of intake steam is varied by varying the cut-off point by a slide valve under the control of the centrifugal governor.

374. Which one of the following is the feature of pressure-compounding (Rateau staging)?

- (a) Low efficiency at low rotational speeds
 (b) High efficiency with low fluid velocity
 (c) High efficiency with high fluid velocity
 (d) Low efficiency at high rotational speeds

ESE-2004

Ans. (b) : The feature of pressure-compounding (Rateau staging) is high efficiency with low fluid velocity.

- It may be noted that by arranging a small pressure dropper stage, the velocity of steam entering the moving blades and hence the speed of rotor is reduced.
- The Rateau and Zoelly turbines are the example of pressure compounded turbine.

375. What is the value of the reheat factor in multi-stage turbine?

- (a) 1.03 to 1.04 (b) 1.10 to 1.20
 (c) 0.90 to 1.00 (d) 1.20 to 1.25

ESE-2004

Ans. (a) : The value of reheat factor in multistage turbine is 1.03 to 1.04.

The reheat factor is an important term used in multi-stage turbine which may be defined as the ratio of the cumulative heat drop to the isentropic heat drop.

$$\text{Reheat factor, RF} = \frac{\text{Cumulative heat drop}}{\text{Isentropic heat drop}}$$

376. Employing superheated steam in turbines leads to

- (a) Increase in erosion of blade
- (b) Decrease in erosion of blade
- (c) No erosion in blade
- (d) No change in erosion of blade

ESE-2003

Ans. (b) : Employing superheated steam in turbines leads to decrease in erosion of blade.

The erosion caused by wet steam flow reduces the efficiency of the last stage rotor blade of condensing steam turbines and makes their service life shorter.

377. The function of a governor of steam engine is to:

- (a) save steam
- (b) control the speed
- (c) provide safety to the people around
- (d) maintain constant load on the engine

MPSC AMVI 2001

Ans. (b) : The purpose of governing of a steam engine is to maintain the speed of engine fairly constant irrespective of load.

Function of a Governor in a steam turbine :-

- * A steam turbine governor is a component of the turbine control system that regulates rotational speed in response to changing load conditions.
- * The governor output signal manipulates the position of a steam inlet valve or nozzles which in turn regulates the steam flow to the turbine.

378. Consider the following statements regarding a 100% reaction turbine:

1. Change in absolute velocity of steam across the moving blades is zero.
2. Change in absolute velocity of steam across the moving blades is negative.
3. Enthalpy drop in fixed blades is zero.

Which of these statements is/are correct?

- | | |
|-------------|-------------|
| (a) 1 alone | (b) 2 alone |
| (c) 2 and 3 | (d) 1 and 3 |

ESE-2000

Ans. (d) : In a reaction turbine, the pressure is reduced in the fixed blades as well as in moving blades.

- Change in absolute velocity of steam across the moving blades is zero.
- Enthalpy drop in fixed blades is zero.

379. Which one of the following pairs is not correctly matched?

- (a) *Internal efficiency*: Product of stage of steam turbine efficiency and reheat factor
- (b) *Stage efficiency*: Ratio of adiabatic heat drop to the isentropic heat drop per stage of a turbine
- (c) *Dryness fraction*: Decreases due to reheating steam with in a stage
- (d) *Steam condensation*: Enhances blade erosion during expansion through the turbine

ESE-2000

Ans. (c) : *Dryness fraction*— "Ratio of mass of steam, to mass of steam & water mixture"

$$x = \frac{m_s}{m_s + m_w}$$

- $x = 0$ for saturated water
- $x = 1$ for saturated vapour
- $x = 0$ to 1 for wet steam

Note- When x is represented in percentage it is called quality of steam.

- * Due to reheating within a stage dryness fraction of steam increases.

380. The net result of pressure-velocity compounding of steam turbine is:

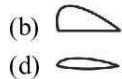
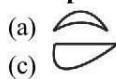
- (a) Less number of stages
- (b) Large turbine for a given pressure drop
- (c) Shorter turbine for a given pressure drop
- (d) Lower friction loss

ESE-1997

Ans. (b) : The net result of pressure-velocity compounding of steam turbine is large turbine for a given pressure drop.

- In a pressure - velocity compounding of an impulse turbine both the previous two method are utilised the total pressure drop at the steam is divided into stages and velocity obtained in each stage it is also called compounded.

381. Which one of the following sketches represents an impulse turbine blade?



(a)

(b)

(c)

(d)

ESE-1995

Ans. (a) : In impulse steam turbine there are some fixed nozzles and moving blades are present on a disc mounted on a shaft. Moving blades are in symmetrical order (option 'a'). The steam enters the turbine casing with some pressure. After that, it passes through one or more no. of fixed nozzles into the turbine.

- The relative velocity of steam at the outlet of the moving blades is same as the inlet to the blades.

382. The outward radial flow turbine in which there are two rotors rotating in opposite direction is known as

- 50% reaction radial turbine
- cantilever turbine
- Ljungstrom turbine
- pass-out turbine

ESE-1994

Ans. (c) : Ljungstrom turbine is steam turbine in which flow is in radial direction from inside to the outside and consists of two halves that rotate against each other.

383. In an ideal impulse turbine, the

- absolute velocity at the inlet of moving blade is equal to that at an outlet
- relative velocity at the inlet of moving blade is equal to that at an outlet
- axial velocity at the inlet is equal to that at the outlet
- whirl velocity at the inlet is equal to that at the outlet

ESE-1993

Ans. (b) : In an ideal impulse turbine, the relative velocity at the inlet of moving blade is equal to than an outlet.

$$\text{Blade efficiency}(\eta) = \frac{\text{Work done by moving blade}}{\text{Available energy}}$$

384. Match the following

List-I	List-II
A. De Laval Turbin	1. Simple impulse turbine
B. Rateau Turbine	2. Pressure Compounded steam turbine
C. Curtis Turbine	3. Velocity compounded steam turbine
D. Parson Turbine	4. Simple reaction steam turbine

Codes:

A	B	C	D
(a) 1	2	3	4
(b) 2	3	4	1
(c) 3	4	1	2
(d) 4	3	2	1

ESE-1992

Ans. (a) :

De Laval Turbine \Rightarrow Simple impulse turbine
Rateau Turbine \Rightarrow Pressure compounded steam turbine
Curtis Turbine \Rightarrow velocity compounded steam turbine
Parson Turbine \Rightarrow Simple reaction steam turbine

Degree of reaction (R_d) for –

- Impulse turbine, $R_d = 0$
- Pure 100% reaction turbine (Hero's turbine), $R_d = 1$
- Parson's turbine, $R_d = \frac{1}{2}$

385. A device which is used to drain off water from steam pipes without escape of steam is called

- Steam separator
- Steam trap
- Pressure reducing valve
- Injector

Ans. (b) : A device which is used to drain off water from steam pipes without escape of steam is called Steam trap.

5. Steam Nozzles

386. Steam nozzle converts :

- Heat energy of steam into kinetic energy
- Heat energy of steam into potential energy
- Kinetic energy into heat energy
- Potential energy into kinetic energy

SSC JE 22-03-2021 Shift-II

SSC JE 27.10.2020 (Shift-I)

SSC JE 4 March 2017 Shift-I

Vizag JET 2017

BSSC WRD JE 2016

GPSC AMVI ME 24.12.2016

TSPSC AE 2015

UPSSSC JE 2016

SSC JE 2015

SSC JE 27-10-2020 (Shift-1)

Vizag JET 2017

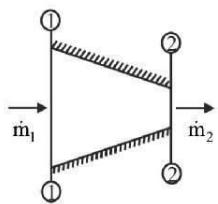
TSPSC AE 2015

Ans. (a) : * Steam nozzle is an insulated passage of varying cross sectional area through which heat energy (Enthalpy) of steam is converted into kinetic energy.

* Steam nozzle converts heat energy of steam into kinetic energy.

Apply SFEE ($\dot{m}_1 = \dot{m}_2$) equation–

$$H_1 + \frac{C_1^2}{2} + Z_1 + Q = H_2 + \frac{C_2^2}{2} + Z_2 + W$$

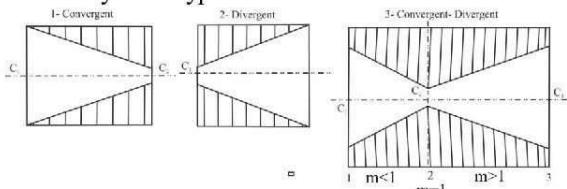


Assume, $Z_1 = Z_2$, $Q = 0$, $W = 0$,
 $C_1 \ll C_2$, $C_1 = 0$

$$\therefore H_1 - H_2 = \frac{C_2^2}{2} \Rightarrow \Delta H = \frac{C_2^2}{2} = KE$$

$$C_2 = \sqrt{2000(\Delta H)} \text{ m/s}$$

It is mainly three types:-



387. The pressure ratio known as critical pressure ratio for maximum discharge through the nozzle is given by:

$$(a) \frac{p_2}{p_1} = \left(\frac{2}{n+1} \right)^{\frac{n}{n-1}}$$

$$(b) \frac{p_2}{p_1} = \left(\frac{2}{n+1} \right)^{\frac{n-1}{n}}$$

$$(c) \frac{p_2}{p_1} = \left(\frac{n+1}{2} \right)^{\frac{n}{n-1}}$$

$$(d) \frac{p_2}{p_1} = \left(\frac{n+1}{2} \right)^{\frac{n-1}{n}}$$

**SSC JE 11-12-2020
UPSSSC JE 2015**

**SSC JE 2014 (Evening)
ESE-2000**

Ans. (a) : For maximum discharge-

$$(1) \text{ Critical pressure ratio, } \frac{p_2}{p_1} = \left(\frac{2}{n+1} \right)^{\frac{n}{n-1}}$$

$$(2) \text{ Critical temperature ratio, } \left(\frac{T_c}{T_1} \right) = \frac{2}{n+1}$$

$n = 1.3$ (For superheated steam)

$n = 1.135$ (For dry saturated steam)

$n < 1.135$ (For wet steam)

Where, $p_c \rightarrow$ Critical pressure

$p_1 \rightarrow$ Inlet pressure

$T_c \rightarrow$ Critical temperature

$T_1 \rightarrow$ Inlet temperature

$n \rightarrow$ Adiabatic index

388. The steam flow through a nozzle may be assumed as a/an:

- (a) isentropic flow
- (b) isothermal flow
- (c) convergent flow
- (d) divergent flow

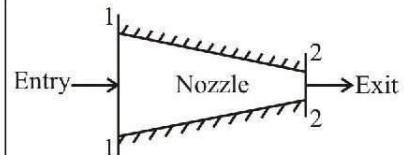
SSC JE 27-10-2020 (Shift-1)

ISRO SDSC 12.02.2017

SSC JE 4 March 217 (Shift-2)

Ans. (a) : The steam flow through a nozzle may be assumed as isentropic flow. (i.e. $\partial Q = 0$).

- * Nozzle is not a work transfer device, i.e. $W_N = 0$.
- * Mass flow rate is constant as per conservation of mass, $\dot{m}_1 = \dot{m}_2$



Note-Nozzle is a passage or duct of gradually varying cross sectional area, in which heat energy (pressure energy) of fluid is converted in to kinetic energy of fluid.

$$C_2 = 44.7\sqrt{\Delta h} \text{ m/s} \quad (\Delta h = \text{kJ/kg})$$

389. A nozzle is said to be choked when

- (a) It discharges flow into the atmosphere
- (b) It gets plugged
- (c) Flow-through it becomes zero and exit pressure is zero
- (d) Flow through it is maximum and exit pressure is critical pressure

MRPL Tech. Asst. Trainee 2021

ISRO IPRC TECH. ASSTT. 28.08.2016

SSC JE 2012

Ans. : (d) A nozzle is said to be choked, when the condition for maximum mass discharge through nozzle or choked flow condition.

Critical pressure ratio (CPR) –

$$\frac{p_2}{p_1} = \left(\frac{2}{n+1} \right)^{\frac{n}{n-1}}$$

$p_2 = p_c$ & $p_2/p_1 = p_c/p_1 = \text{CPR}$
when discharge is maximum

390. The mass flow through a convergent-divergent nozzle is maximum when the pressure at:

- (a) Exit is equal to the critical pressure
- (b) Exit is less than atmospheric pressure
- (c) Throat is equal to the exit pressure
- (d) Throat is equal to the critical pressure

NPCIL 03.06.2018

DMRC 2014 (Paper-I)

Ans. : (d) The mass flow through the convergent-divergent nozzle is maximum if the pressure at the throat is equal to the critical pressure.

Critical pressure ratio for maximum flow

$$= \frac{P_2}{P_1} = \left(\frac{2}{n+1} \right)^{\frac{n}{n-1}}$$