# SSC JE Mains 2022

Mechanical Engineering

# Most Expected Questions

## SET-10


| SUBSCRIPTION FEATURES | CIVIL MAHA PACK |
|---|---|
| All Live Classes | Yes |
| All Test Series | Yes |
| All Mock Video Solutions | Yes |
| All Revision Batches | Yes |
| All Recorded Videos | Yes |
| All eBooks | Yes |
| Personality Development | Yes |
| Spoken English | Yes |

Y२०१ –


**Q Explain the boiler classification 15 marks**

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## Classification of boilers

1. Depending upon to the position of water and flue gases :
   - (a) Smoke tube or fire tube boilers
   - (b) Water tube boilers
2. Depending upon to the position furnace :
   - (a) Internally fired boilers
   - (b) Externally fired boilers
3. Depending upon the position of axis of the boiler:
   - (a) Vertical boilers
   - (b) Horizontal boilers

Ex

14

(4) A/c to pressure L.P.B $P < 25$ bar

M.P.B → $20 < P < 80$

H.P.B $P > 80$ bar

Subcritical Boiler 180 to 221.2 bar

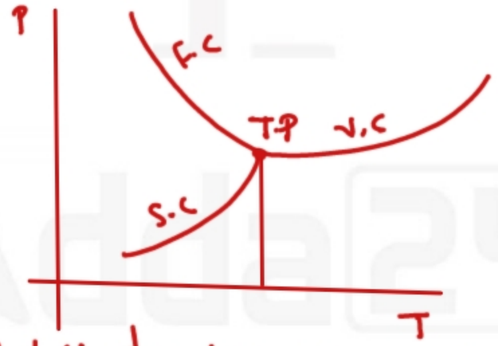
Super critical $P > 221.2$ bar

Q→ Difference

| Water Tube Boiler | Fire tube Boiler |
|---|---|
| i) The water circulates inside the tubes which are surrounded by the hot flue gases from the furnace. | i) The hot gases from furnace passes through the tubes which are surrounded by water. |
| ii) It generates steam at a higher pressure up to 165 bar. to 221 bar | ii) It can generate steam only up to 24.5 bar. |
| iii) The rate of generation of steam is high, up to 450 tons/hrs | iii) The rate of generation of steam is low, up to 9 tons/hrs |
| iv) Its overall efficiency 90% | iv) Its overall efficiency is only 75% |
| v) Its operating cost is high | v) Its operating cost is less |
| vi) The bursting chance of water tube boiler is more | vi) The bursting chance of fire tube boiler is less |
| vii) It is used for large power plant | vii) It is not suitable for large power plants |
| viii) Examples:<br>• Babcock and Wilcox boiler<br>• Stirling boiler<br>• La-Mont boiler<br>• Benson boiler<br>• Loeffler boiler<br>• Yarrow boiler | viii) Examples:<br>• Simple vertical boiler<br>• Cochran boiler<br>• Lancashire boiler<br>• Cornish boiler<br>• Scotch boiler<br>• Locomotive boiler<br>• Velcon boiler |

15 marks

## Q The Clausius-Clapeyron Equation 15 marks




used to find LH during phase change at different Saturation pressure and temp


$$\left(\frac{\partial P}{\partial T}\right)_v = \left(\frac{\partial S}{\partial V}\right)_T$$

$$\frac{dP}{dT} = \frac{LH}{T_{sat}(V_2 - V_1)}$$

$$ds = \int \frac{dQ}{T}$$

$$ds = \frac{\int dQ}{T_{sat}} = \frac{LH}{T_{sat}}$$

$$dP = \frac{LH\, dT}{T(V_2 - V_1)}$$

$$\int dP = \frac{LH}{(V_2 - V_1)} \int \frac{dT}{T}$$

$$(P_2 - P_1) = \frac{LH}{(V_2 - V_1)} \ln\left(\frac{T_2}{T_1}\right)$$

Q A system receives 50 kJ of heat while expanding with volume change of 0.14 m3 against an atmosphere of 1.2 × 105 N/m2. A mass of 90 kg in the surroundings is also lifted through a distance of 5.5 m. (i) Calculate the change in energy of the system. (ii) The system is returned to its initial volume by an adiabatic process which requires 110 kJ of work. Find the change in energy of the system. (iii) For the combined processes of (i) and (ii), calculate the change in energy of the system 30 Marks

Solⁿ: $Q = 50kJ$ $\Delta V = 0.14$ $m = 90kg$ $P = 1.2\times10^5 N/m^2$ $h = 5.5$

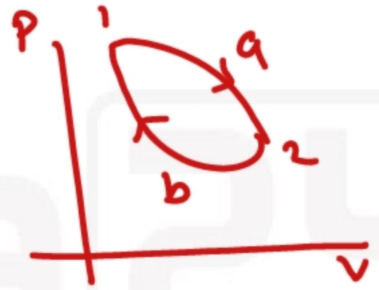
$Q = \Delta U + \Delta K + \Delta P.E + W$ (Q, ΔK, ΔP.E = 0)

(i) $Q = (\Delta U) + W + E_P$

$50 = \Delta U + P(V_2 - V_1) + mgh$

$50\times10^3 = \Delta U + 1.2\times10^5 \times 0.14 + 90\times9.8\times5.5$

$(\Delta U) = 28.31\times10^3 Joule = 28.13 KJ$




(ii) $dQ = 0$ $\quad Q = \Delta U + (\Delta P.E) + W$

$\Delta U = -(\Delta P.E + W) = -(mgh + 110\times10^3)$

$\Delta U = \underline{-81.82 KJ}$