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Q#1

→ Define the following.

i) **System**:- Anything which are kept in consideration is called system.

ii) **Surroundings**:- Everything external to the system is known as surroundings.

iii) **Adiabetic Process**:- An adiabetic process is a a type of thermodynamic process which occurs without transferring heat or mass b/w the system and its surroundings.

iv) **Isolated System**:- In an isolated system, neither mass not energy transfer takes place b/w the system and its surroundings.

Example:- i) Thermos flask
ii) The universe

v) **Extensive Property**:- An extensive property is a physical quantity whose value is proportional to the size of the system it describes, or to the quantity of matter in the system.

Example:- The mass of a sample is an extensive ~~property~~ quantity; it depends on the amout of substance.

Q#2

→ Compute specific volume and specific internal energy of steam at 7 bar and specific enthalpy 2600 kJ/kg.

→ Data Given:-

$P = 7$ bar

$\hat{h} = 2600$ kJ/kg

→ Required:-

$x = ?$

$\hat{V} = ?$

$u = ?$

→ Sol:-

i) $\hat{h} = h_f + x h_{fg}$

$$2600 = 697.1 + x(2064.9)$$

$$2600 - 697.1 = x(2064.9)$$

$$1902 = x(2064.9)$$

$$\frac{1902}{2064.9} = x$$

$$\boxed{x = 0.921}$$

Muhammad Tabish Javed
Chen- 19111028

ii) $\hat{V} = v_f + x\, v_{fg}$

$= 0.001108 + (0.921)(0.273 - 0.001108)$

$= 0.001108 + (0.921)(0.271892)$

$= 0.001108 + 0.25041$

$$\boxed{\hat{V} = 0.2515 \ m^3/kg}$$

iii) $\hat{U} = u_f + x\, u_{fg}$

$= 696.3 + (0.921)(2571.1 - 696.3)$

$= 696.3 + (0.921)(1874.8)$

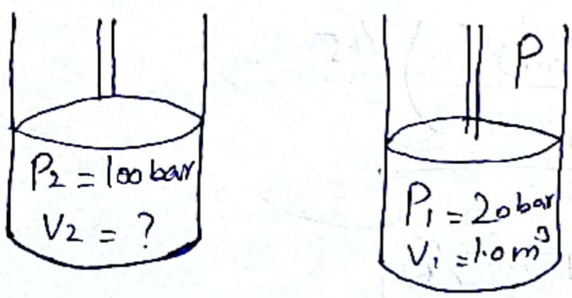
$= 696.3 + 1726.6908$

$$\boxed{\hat{U} = 2420 \ kJ/kg}$$

Q#3

→ Consider a piston-cylinder assembly containing ------- process is given by $Pv^{1.5}$ = constant

Calculate the work done and heat transferred during this process.



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Given:-

Mass $= m = 10\ kg$

Find:-

Work done $= ?$

Heat transfer $= ?$

$\rightarrow \quad P\hat{V}^{1.5} =$ constant

As, $P_1\hat{V}^{1.5} = P_1\hat{V}_1^{1.5} = P_2\hat{V}_2^{1.5}$

Now, we have to find

Specific value $= \hat{V}_1 = ?$

$$\hat{V}_1 = \frac{V_1}{m} = \frac{1}{0.1} \Rightarrow \boxed{0.1\ m^3/kg}$$

Now, $P_1\hat{V}_1^{1.5} = P_2\hat{V}_2^{1.5}$

$$\hat{V}_2^{1.5} = \frac{P_1\hat{V}_1^{1.5}}{P_2}$$

$$\hat{V}_2 = \left(\frac{P_1\hat{V}_1^{1.5}}{P_2}\right)^{1/1.5}$$

$$\hat{V}_2 = \left(\frac{2 \times (0.1)^{1.5}}{10}\right)^{1/1.5}$$

$$\boxed{\hat{V}_2 = 0.0341\ m^3/kg}$$

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Now,

$$\hat{w} = -\int_{0.1}^{0.0342} P d\hat{v}$$

$$= -\int_{0.1}^{0.0342} \frac{P_1 \hat{V}_1^{1.5}}{\hat{V}^{1.5}} d\hat{v}$$

$$= 2 P_1 \hat{V}_1^{1.5} \left[\frac{1}{\hat{V}_2^{0.5}} - \frac{1}{\hat{V}_1^{0.5}} \right]_{0.1}^{0.0342}$$

$$\boxed{\hat{w} = 284 \text{ kJ/kg}}$$

Now,

Apply 1st Law

$$\boxed{q = \Delta U - w}$$

$$U_1 = 2600.3 \text{ kJ/kg}$$

For U_2,

$$\frac{U_2 - U(T=500)}{U(T=550) - U(T=550)} = \frac{V_2 - V(500^\circ C)}{V(T=550) - V(T=500)}$$

$$U_2 = U(T=500^\circ C) + [U(T=500)\} - U(T=500)]$$

$$U_2 = \left[\frac{V_2 - V(T=500)}{V(T=550) - V(T=500)} \right]$$

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$$u_2 = 3045.8 + [3144.5 - 3045.8)\left[\frac{0.0342 - 0.03279}{0.03564 - 0.03279}\right]$$

$$\boxed{u_2 = 3094.6 \ kJ/kg}$$

$$q = \Delta u - w \Rightarrow (u_2 - u_1) - w$$

$$\boxed{q = 210 \ KJ/kg}$$

~~Since, the value of 'q' is positive, heat transfer from the system to the surroundings. (d) to find T_2, we must~~

So, the final answer is

$$\boxed{\hat{w} = 284 \ kJ/kg}$$

and

$$\boxed{q = 210 \ kJ/kg}$$