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Thermodynamics

Question No 2

Given data:-

Pressure = P = 7 bar

Specific Enthalpy = $\hat{H}$ = 2600 KJ/Kg

To Find:-

Specific volume = ? = $\hat{v}$

Specific Internal Energy = $\hat{u}$ = ?

Solution:-

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

$2600 = 697.1 + x(2064.9)$

$2600 - 697.1 = x(2064.9)$

$x = \frac{1902.9}{2064.9}$

$\boxed{x = 0.921}$

(ii) $\hat{v} = v_f + x v_{fg}$

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

$= 0.001108 + (0.921)(0.271892)$

$= 0.001108 + 0.25041$

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

$$\hat{u} = u_f + x u_{fg}$$
$$= 696.3 + (0.921)(2571.1 - 696.3)$$
$$= 696.3 + 1726.69$$
$$\hat{u} = 2420 \text{ KJ/kg}$$

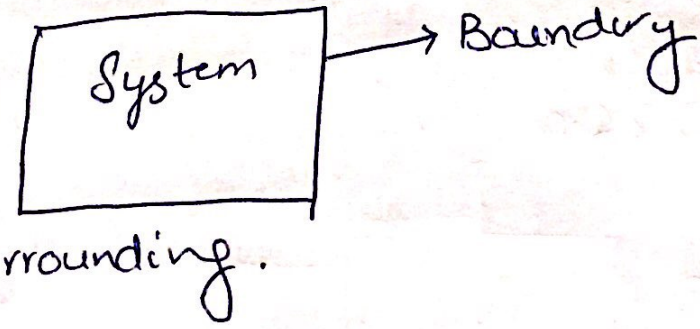
Question No 1

System:-

A system is defined as the quantity of matter or region in space chosen for the thermodynamics study or any thing which is under process in system.

Surrounding:-

The mass or region outside the system is called surrounding.



Isolated System:.

An isolated System does not exchange energy or matter with its surrounding.

Example:.

Thermal Flask is the best example of isolated System.

Extensive Property:-

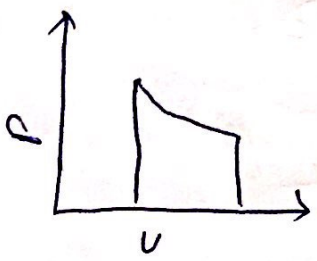
Extensive property are those which depends upone the mass. An extansive property is a property of matter that changes as the amount of matter change.

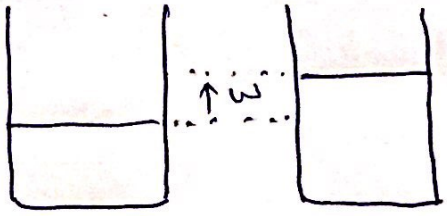
Example:.

Energy
Enthapy.

Adiabatic Process:.

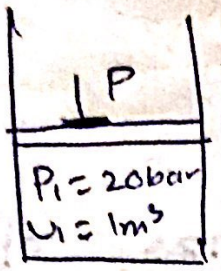
An adiabatic process is a type of thermodynamics process which occurs with out transfering heat or mass between the system and surrounding.



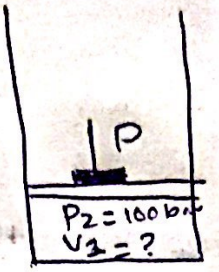


$Q = 0.$

Question No 3



$P_1 = 2MPa$



$P_2 = 10MPa$

Mass of water = m = 10 kg

$\therefore$ 1 bar = 10^5 bar

1 MPa = 10 bar

To Find:

Work = w = ?

heat Transfer = q = ?

Solution:

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

Now we have to find Specific Volume = $\hat{V}_1 = ?$

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

Now

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

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

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

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

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

Now

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

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

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

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

Apply 1st Law of Thermodynamics.

$$q = \Delta u - w$$

$$u_1 = 2600.3 \ \frac{kJ}{kg}$$

$$\frac{u_2 - u_1 (T_1 = 500^\circ C)}{u (T = 550^\circ C) - u (T = 500^\circ C)} = \frac{v_2 - v (T = 500^\circ C)}{v (T = 550^\circ C) - v (T = 500^\circ C)}$$

Solving for u_2

$$u_2 = u\,(T=500^{\circ}C) + [u\,(T_2\,500)] - u\,(T=500)$$

$$= \left[\frac{v_2 - v\,(T=500)}{v\,(T=580) - v(T=500)}\right]$$

$$= 3045.8 + [31445.5 - 3045.8]\left[\frac{0.0342 - 0.0327}{0.0356 - 0.03279}\right]$$

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

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

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