="Chemical Engineering Thermodynamic."=

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="Question"= —— (i) ——

System:- Part of universe under considration is obsewation is called system. **eg.** All organ that work togather for digestion.

Surroundings:-

Every thing in universe except system is surrounding of the System.

Adiabetic process:-

A process which occur with out transfering heat and mass between the system and surrounding is known as adibetic.

Isolated system:-

In this type of system both mass and energy can not enter or leave the system.

Extensive property:-

Depend on extent mass/size of the system. It is an Additive property detobed by Capital letter.

"Question" — (2) —

Numerical:-

Data:- $P = 7\,bar$

$\hat{H} = 2600\,kJ/kg$

To find:- $\hat{V} = ?$

$\hat{U} = ?$

solution:-

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

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

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

$$x = \frac{1902.9}{2064.9} \qquad \boxed{x = 0.921}$$

$$\hat{V} = x v_g$$

$$= (0.921)(0.2728)$$

$$\boxed{\hat{V} = 0.2512\ m^3/kg}$$

$\hat{U} = U_f + x U_{fg}$

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

$= 696.3 + (0.921)(1874.8)$

$= 696.3 + 1726.6908$

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

"Question" — (3)

Numerical:-

Data:- $m = 10.0 kg$

$P_1 = 20 \, bar$

$V_1 = 1.0 \, m^3$

$P_2 = 100 \, bar$

Pv relation $= Pv^{1.5} = const$

Solution:- $T = ?$

$$P_1 = \frac{20bar \mid 100kPa}{\mid 1bar} = 2000kpa = 2Mpa$$

$$\hat{V}_1 = \frac{1.0m^3}{10kg} = 0.1 m^3/kg$$

At $P = 2Mpa$

$\hat{V}_1 = 0.0012$, $V_2 = 0.0996$

since $\hat{V}_1 > \hat{V}_2$ at $P = 2Mpa$

T(°C)	$\hat{v}$ (m^3/kg)
212.4	0.0996
T	0.1
225	0.1038

$$= \frac{0.2838\ MPa.m^3}{kg}\left|\frac{1000\,kPa}{1\,MPa}\right|\frac{1\,kN}{1\,kPa.m^3}$$

$$\boxed{\hat{W} = 2803.8\ kJ/kg}$$

$\hat{W} = ?$

$$P_2 = 100\,bar \left| \frac{100\,kPa}{1\,bar} \right. = 10{,}000\,kPa = 10\,MPa$$

$\hat{V}_2 = ?$

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

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

$$\hat{V}_2 = \left[\frac{2\,MPa}{}\left|\left(\frac{0.1\,m^3}{kg}\right)^{1.5}\right|\frac{1}{10\,MPa}\right]^{1/1.5}$$

$$\hat{V}_2 = (0.2 \times (0.1)^{1.5})^{1/1.5}\ m^3/kg$$

$$= (0.2 \times 0.0316)^{1/1.5} = (0.2 \times 0.0516)^{0.667}$$

$$\boxed{\hat{V}_2 = 0.0342\ m^3/kg}$$

$$P = 2\,Mpa \left(\frac{0.1\,m^3}{kg}\right)^{1.5} \left(\frac{kg}{\hat{v}\,m^3}\right)^{1.5}$$

$$P = \frac{0.0632\,Mpa}{\hat{v}^{1.5}}$$

$$\hat{w} = -\int_{0.1}^{0.0342} \frac{0.0632}{\hat{v}^{1.5}}\, d(\hat{v})$$

$$= \frac{-0.0632}{-0.5} \left. \frac{1}{\hat{v}^{0.5}} \right|_{0.1}^{0.0342}$$

$$= \frac{-0.0632}{-0.5} \left[\frac{1}{(0.0342)^{0.5}} - \frac{1}{(0.1)^{0.5}} \right]$$

$$= \frac{-0.0632}{-0.5} \left(524074 - 3.1023 \right)$$

$$= \frac{-0.1419\,Mpa}{-0.5} \left| \frac{.Mpa.m^3}{kg} \right| \frac{1000\,kpa}{1\,Mpa} \left| \frac{1\,kN}{1\,kpa\,m^2} \right.$$

6) $\Delta \hat{U} = \hat{U}_2 - \hat{U}_1$

$= (3095.15 - 2602.97)$ KJ/kg

$\Delta \hat{U} = \hat{q} + \hat{w}$

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

$\hat{q} = (492.18 - 283.8)$ KJ/kg

$\boxed{\hat{q} = 208.38 \text{ KJ/kg}}$

T=?

T_2(°C)	$\hat{V}_0$ (m^3/kg)
500	0.0328
T	0.0342
550	0.0356

$T_2 = 525.0°C$

$$y = \left[(y_2 - y_1)\left(\frac{x - x_1}{x_2 - x_1}\right)\right] + y_1$$

$$T = (225 - 212.4)\left(\frac{0.1 - 0.0996}{0.1058 - 0.0996}\right) + 212.4$$

$\boxed{T = 213.6°C}$

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u_1 (KJ/kg)	T (°C)
2600.3	212.4
u_1	213.6
2628.3	225

$$\boxed{u_1 = 2602.97 \text{ KJ/kg}}$$

At state 2, $P_2 = 10\,MPa$, $\hat{v}_2 = 0.0342\ m^3/kg$

$\hat{u}_2$ (KJ/kg)	$\hat{v}_2$ (m^3/kg)
3045.8	0.0328
$\hat{u}_2$	0.0342
3144.5	0.0356

$$\hat{u}_2 = 3095.15 \text{ KJ/kg}$$

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

$$P\hat{v}^{1.5} = P_1 \hat{v}_1^{1.5} \Longrightarrow P = \frac{P_1 v_1^{1.5}}{\hat{v}^{1.5}}$$