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⇒ Mid Term Exam

Q#1

i) System:-

A system is the set of substances and energy that is being studied. So, for example, reactions are occuring in a jar, everything inside the jar is the system, and everything outside the jar is the surroundings.

ii) Surroundings:-

Everything in the universe surrounding a thermodynamic system. The surrounding is everything else that is not ~~def~~ the system defined.

3) Adiabatic process:-

In thermodynamics, an adiabatic process is a type of thermodynamics process which occurs without transfering heat or mass between the system and its surroundings.

4) Isolated System:-

An Isolated system is either of the following: a physical system so far removed from other systems that it does not interact with them. A thermos flask is the best example of an isolated system.

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Q#2

Solution:-

As pressure is given 07 bar

From steam tables:-

specific enthalpy of liquid $= \hat{h}_f = 697 \frac{kJ}{kg}$

change in specific enthalpy $= \Delta \hat{h}_{fg} = 2067 \frac{kJ}{kg}$

specific enthalpy of steam given $= \hat{h} = 2600 \frac{kJ}{kg}$

For dryness fraction:-

$$x = \frac{h_g - h_f}{h_{fg}} = \frac{2600 - 697}{2067} = 0.921$$

dryness fraction, $x = 0.921$

Specific Volume:-

$$\hat{V} = x\hat{V}_g = 0.921 \times 0.2728$$

$$= 0.2515 \ m^3/kg$$

Specific Internal Energy:-

$$\hat{U} = (1-x)\hat{U}_f + x\hat{U}_g$$

$$= (1-0921)696 + (0.921)(2573)$$

$$= 55 + 2365$$

$$= 2420 \ kJ/kg$$

Q#3

Soln:-

$m = 10.0kg$

$P_1 = 20bar$

$V_1 = 1.0m^3$

$P_2 = 100bar$

$PV^{1.5} = constant$

Work = $\hat{w}$ = ?

Heat = $\hat{q}$ = ?

$$\hat{w} = -\int P_E \, d\hat{v}$$

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

$$\hat{v}_2 = \left(\frac{P_1 v_1}{P_2}\right)^{1/1.5}$$

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

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

$$= 0.0342\ m^3/kg$$

$$\hat{w} = -\int_{0.1}^{0.0342} P_E \, d\hat{v} = -\int_{0.1}^{0.0342} P_E \, d\hat{v} \longrightarrow (1)$$

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

$$P = \frac{P_1 \hat{v}_1^{1.5}}{\hat{v}^{1.5}} = \frac{2\ MPa \left|\left(\frac{0.1\ m^3}{kg}\right)\right.^{1.5} \left|\left(\frac{kg}{\hat{v}\ m^3}\right)\right.^{1.5}}{}$$

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

Now put value of P in eqn. (1)

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

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

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

$$\hat{w} = 0.2830\ MPa\ m^3/kg$$

$$= \frac{0.2830\ MPa\ m^3}{kg}\left|\frac{1000\ kPa}{1\ MPa}\right|\left|\frac{K-N}{kPa\cdot m^2}\right.$$

$$\hat{w} = 285\ KJ/kg$$

Heat :-

$$\hat{q} = ?$$

As

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

$$\hat{q} = \Delta\hat{U} - \hat{w} \longrightarrow (2)$$

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

$$P_1 = 2\ MPa$$

By Linear Interpolation, find T_1

At 2 MPa, $\hat{V}_l = 0.0012\ m^3/kg$, $\hat{V}_v = 0.0996\ m^3/kg$

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

By linear Interpolation

$T_1 = 213.6^\circ C$

$P_1 = 2\ MPa$, $T_1 = 213.6^\circ C$, $\hat{U}_1 = ?$

U_1 (KJ/kg)	T(C)
2600.3	212.4
U_1	213.6
2628.3	225

By linear Interpolation

$\hat{U}_1 = 2602.97\ KJ/kg$

$P_2 = 10\ MPa$, $\hat{V}_2 = 0.0342\ m^3/kg$

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

By linear Interpolation b/w $\hat{U}$ & $\hat{V}$

$\hat{U}_2 = 3095.15\ KJ/kg$

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

$= (3095.15 - 2602.97)\ KJ/kg$

$\Delta\hat{U} = 429.18\ KJ/kg$

Put the values of $\Delta\hat{U}$ & $\hat{w}$ in eq. (2)

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

$$= (492.18 - 283.8)\ kJ/kg$$

$$\hat{q} = 208.38\ kJ/kg.$$

Q#1

(v) Extensive property:-

An Extensive property is a property of matter that changes as the amount of matter changes. Like other physical properties, an extensive property may be observed and measured without chemical change occuring.