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CHEN19111049
Chemical Engineering 3rd semister.

System:-
A system "Everything under consideratiatic". Everything is called universe. The part of universe in which we intrested called our system.

Sourrounding:-
When we left the system from our universe the remaining universe is called sourrounding. A boundry (Imaginary and real) seprate the system and sourrounding.

Adibatic process:-
When at least one thermodynamic property of a system change it means

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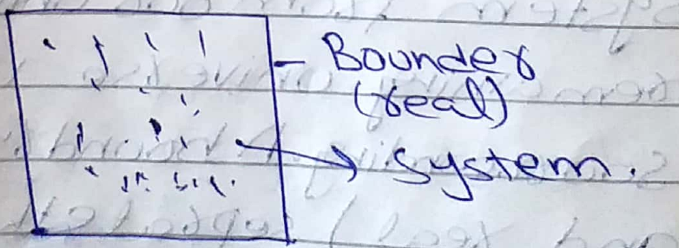
the state of a system change, So, the system undergoes the process.

Inadiabatic process the heat remain constant.

Q=0 (when the system undergoes from state 1 to state 2 Q remain same).

Isolated system:-

A system in which no mass or no energy inter the system. Our system called Isolated.



$m \neq 0$

$(E)\ Q \neq 0$

Extensive property:-

An extensive property is a physical quantity whose

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value is propotional to the size of the system it describes, or to the quantity of matter in the system. For example:- the mass of a sample is an extensive quantity. it depends on the ammount of substance.

QNo:2

Given data:-

$P = 7$ bar

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

$\hat{V} = ?$

$\hat{U} = ?$

$x = ?$

$\hat{h} = \hat{h}_f + \hat{x}\,\hat{h}_{gf}$

$$2600\frac{KJ}{kg} - 697\frac{KJ}{kg} = x(2067)\frac{KJ}{kg}$$

$$\frac{1903\,\cancel{KJ}}{\cancel{kg}} \Big| \frac{kg}{2067\,\cancel{KJ}}$$

$x = 0.92065$

$x = 0.921$

$\hat{V} = x\,\hat{V}g$

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$0.921(0.2728) m^3/kg$

$\hat{v} = 0.2511 \frac{m^3}{kg}$

Now we calculate internal energy.

$\hat{U} = \hat{U}_f + x \hat{U}_{gf}$

$\hat{U} = 696 \frac{kJ}{kg} + 0.921(2573 - 696) \frac{kJ}{kg}$

$\hat{U} = 696 \frac{kJ}{kg} + 0.921(1877) \frac{kJ}{kg}$

$\hat{U} = 696 \frac{kJ}{kg} + 1728.717 \frac{kJ}{kg}$

$\hat{U} = 2424.717 \frac{kJ}{kg}$

QNo:3

$m = 10.0 kg$

$P_1 = 20 bar$

$V_1 = 1.0 m^2$

$P_2 = 100 bar$

Pv relation $= Pv^5 = const$

(i) $T = ?$

$P_1 = \frac{20 bar | 100 kPa}{| 1 bar} = 2000 kPa$

$= 2 MPa$

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

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$$\hat{W} = \int_{0.1}^{0.0342} P_E d\hat{V} = -\int_{0.1}^{0.0342} P d\hat{V}$$

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

$$P = \left(2MPa\left(\frac{0.1 m^3}{kg}\right)^{1.5}\right)\left(\frac{kg}{\hat{V} m^3}\right)^{1.5}$$

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

$$\hat{W} = -\int_{0.1}^{0.0342} \frac{0.0632}{\hat{V}^{1.5}} d\hat{V}$$

$$= \frac{-0.0632}{-0.5} \left| \frac{1}{\hat{V}^{0.5}} \right|_{0.1}^{0.342}$$

$$= \frac{-0.0632}{-0.5}\left[\frac{1}{0.342^{1.5}} - \frac{1}{0.1^{1.5}}\right]$$

$$= \frac{0.2838 MPa\, m^3}{kg}\left|\frac{1000 kPa}{1 MPa}\right|\frac{1 kN}{1 kPa \cdot m^2}$$

$$= 283.8 kJ/kg$$

$$\hat{W} = 283.8 kJ/kg$$

(c) $q = ?$

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

state 1, $P_1 = 2MPa$, $T = 213.6°C$.

$U_1 = ?$

U_1 (kJ/kg)	T (°C)
2600.3	212.4
U_1	213.6

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From stream tables, at P= MPa
$\hat{v}_1 = 0.0012$, $\hat{v}_0 = 0.0996$
Since, $\hat{v}_1 > \hat{v}_v$ at P= MPa,
the stream is superheated.

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

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

$$T = (225 - 212.4)\left(\frac{0.1 - 0.0996}{0.1058 - 0.996}\right) + 212.4$$

T = 213.6°C.

(b) $c\hat{U} = ?$

$$P_2 = \frac{100\ bar}{} \left| \frac{100\,kPa}{1\ bar} \right. = 10.000\,kPa = 10\,MPa.$$

$\hat{V}_2 = ?$

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

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

$$\hat{v}_t = \left(0.2 \times (0.1)^{1.5}\right)^{1/1.5} \ m^3/kg.$$

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

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

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2625.3 225

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

At state 2, $P_2 = 10MPa$, $\hat{V}_2 = 0.342 \frac{m^3}{kg}$

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

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

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

$= (3095.15 - 2602.97) \frac{kJ}{kg}$

$\Delta \hat{U} = 492.18$ kJ/kg

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

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

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

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