Abdul Hadi CHEN 19111007:- 1

Q 1:-

System:-

The part of universe which is under observation is called system.

Surrounding:-

Everything in universe except systems is called surrounding of that system.

Adiabatic Process:-

An adiabatic process is a type of thermodynamics process which occurs without transferring heat or mass between the system and ~~ither~~ its surroundings.

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Isolated system:-

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

Extensive property:-

A property that depends on the amount of matter in a sample. Mass and voalume are examples of extensive properties.

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Solution:-

$P = 7$ bar.

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

$\hat{V} = 2$

$\hat{u} = ?$

$\hat{H} = H_f + x H_{fg}$

$2600 = 687.1 + x(2064.9)$

$x = \frac{1802.9}{2064.9} \Rightarrow x = 0.821.$

$\hat{V} = x V_g$

$\hat{V} = (0.821)(0.2728)$

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

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

$$= 686.3 + (0.921)(2571.1 - 686.3)$$

$$= (686.3) + (0.921)(1874.8)$$

$$= \underline{2420\ kJ/kg}$$

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Solution:-

$m = 10.0 kg$

$P_1 = 20 bar.$

$V_1 = 1.0 m^3$

$P_2 = 100 bar.$

PV relation $= PV^{1.5} = const.$

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

$= \cancel{200}\ 2 MPa.$

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

a) $T = ?$

from steam table at $P = 2MPa.$

$\hat{V}_L = 0.0012 m^3/kg$ $\hat{V}_v = 0.0996 m^3/kg.$

$\hat{V}_1 > \hat{V}_v$ at $2MPa.$

steam is superheated.

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

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

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

$$T = 213.6^\circ C.$$

b) $\hat{W} = ?$

$$P_2 = \frac{100 \text{ bar} \mid 100 \text{ kPa}}{\mid 1 \text{ bar}} = 10 \text{ MPa}.$$

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

$$\hat{V}_2^{1.5} = \left[\frac{P_1 V_1^{1.5}}{P_2} \right]^{1/1.5}$$

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

$$\hat{V}_2 = \underline{0.0342 \; m^3 kg}$$

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

$= 283.8 \text{ kJ/kg}$

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

c) $q = ?$

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

At state 1 $P_1 = 2 \text{ MPa}$, $T_1 = 213.6°C$.

~~u kg~~ U_1 (kJ/kg)	T (°C)
2600.3	212.4
u_1	213.6
2628.3	225

$U_1 = 2602.97 \text{ kJ/kg}$

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

u_2 (kJ/kg)	$\hat{v}_2$ m³/kg
3045.8	0.0328
$\hat{U}_2$	0.0342
3144.5	0.0356

$\hat{U}_2 = 3085.15 \text{ kJ/kg}$

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

$= (3035.15 - 2602.87)\ \frac{kJ}{kg}$

$\Delta\hat{U} = 442.18\ kJ/kg$

c) $Q = ?$

$\Delta\hat{U} = \hat{Q} + \hat{W}$

$\hat{Q} = \Delta\hat{U} - \hat{W}$

$\hat{Q} = (442.18 - 283.8)\ kJ/kg$

$\hat{Q} = 208.38\ \frac{kJ}{kg}$

$T = ?$

$T\ (^\circ C)$	$\hat{V}_2\ m^3/kg$
500	0.0328
T	0.0342
550	0.0356

$T_2 = 525.0\ ^\circ C$

→ It is Part of (a). Sorry Sir

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

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

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

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

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

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

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

$$= \boxed{283.8\ kJ/kg}$$

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