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Question 1

System:-
A set of the things in which working or interset in it is called system.

Sourrounding:-
A part of which separate from the system is called surrounding.

Adiabatic process:-
An adiabatic process is a thermodynamic process, in which there is no heat transfer into or out of the system ($Q=0$). The system can be considered to be perfectly insulated.

Isolated system.
In the natural sciences an isolated system is a physical system without any external exchange - neither matter nor energy can enter or exist

but can only move around inside.

Extensive property:-

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

Question 2

Given data:-

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

$$P = 7 \, bar.$$

$$\hat{V} = ?$$

$$\hat{U} = ? \qquad x = ?$$

Solution:-

$$\hat{H} = (1-x)\, u_f + x\, u_g$$

$$2600 = (1-x)697 + x(2573)$$

$$2600 = 697 - 697x + 2573x$$

$$2600 = 697 + 1370x$$

$$x = \frac{2600 - 697}{1376}$$

$$\boxed{x = 0.921.}$$

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$\hat{V} = x \cdot V_g$

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

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

$\hat{U} = (1-x) U_f + x \cdot U_g$

$\hat{U} = (1 - 0.921) 697 + (0.921 \times 2573)$

$\hat{U} = 54.984 + 2369.733$

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

$x = 0.921, \quad \hat{V} = 0.2512 \ m^3/kg$

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

Question3

$m = 10kg$

$P_1 = 20bar$

$V_1 = 1.0m^3$

$P_2 = 100bar$

PV relation $= PV^{1.5} = constant$

a) $T = ?$

$P_1 = 20bar \left| \dfrac{100kPa}{1bar} \right. = 2000kPa$

$P_1 = 2 \ MPa$

$\hat{V}_1 = \dfrac{1m^3}{10kg} = 0.1 \ m^3/kg$

$P = 2 MPa$ From Steam table

$\hat{V}_1 = \cancel{1.0 m^3}$

$\hat{V}_l = 0.0012$, $\hat{V}_v = 0.0996$

since, $\hat{V}_l > \hat{V}_u$ at $P = 2 MPa$

the steam is superheated.

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

$$T = (225 - 212.4)\left(\frac{0.1 - 0.0996}{0.1038 - 0.0996}\right) + 212.4$$

$T = 213.6°C$

b) $\hat{W} = ?$

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

$P_2 = 10 MPa$

$\hat{V}_2 = ?$

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

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

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

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

$$\hat{V}_2 = (0.2 \times 0.0316)^{1/1.5} = (0.2 \times 0.0316)^{0.667}$$

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

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

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

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

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

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

$$= \frac{-0.0632}{-0.5} \left. \frac{1}{\hat{V}^{1.5}} \right|_{0.1}^{0.0342}$$

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

$$\hat{W} = \frac{0.2838\,MPa.m^3}{kg}\left|\frac{1000\,kPa}{1\,MPa}\right|\frac{1\,KN}{1\,kPa.m^2}$$

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

c) $q = ?$

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

At state 1, $P_1 = 2\,MPa$, $T_1 = 213.6°C$

$U_1 = ?$

U_1 (KJ/kg)	T (°C)
2600.3	212.4
U_1	213.4
2628.3	225

Then

$$U_1 = 2602.97\ KJ/kg$$

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

$\hat{U}_2$ (KJ/kg)	$\hat{V}$ (m^3/kg)
3045.8	0.0328
U_2	0.0342
3144.5	0.0356

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

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

$$\Delta \hat{U} = (3095.15 - 2602.97)\ KJ/kg$$

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

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

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

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

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

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