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Subject * Thermodynimics

* Question # 1 *

System:-

"Part of universe under consideration."

e.g:- All the organ that work together for digestion.

Sorrounding:-

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

Adiabatic process:-

An adiabatic process is type of thermodynamics process which accur without transfering heat or mass between the system and its sorrounding.

isolated system:-

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

2)

Extensive property:-

It depends on extent mass/size of the system. It is an additive property. if we devide the system the properties of the system will be change. It is denoted by capital letters.

Question # 3

Given data:-

$m = 10kg$

$P_1 = 20 bar$

$v_1 = 1.0 m^2$

$P_2 = 100 bar$

Pv relation = $pv^{1.5}$ constt.

$T = ?$

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

$$= 2 MPa$$

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

from Steam tables:-

at 2 Mpa

$\hat{v}_f = 0.00012$, $\hat{v}_g = 0.0996$

Since $\hat{v}_1 > \hat{v}_2$ at 2 Mpa.

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

$$= \frac{0.2838\ MPa \cdot m^3}{1\ MPa} \left| \frac{1000\ kPa}{1\ kPa \cdot m^3} \right| \frac{1\ kJ}{}$$

$$= 283.8\ kJ/kg$$

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

(c) $q = ?$

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

at state 1, $P_1 = 2\ MPa$, $T_1 = 213.6^\circ C$

$u_1 = ?$

4)

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

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

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

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

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

5)

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

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

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

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

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

$$= \frac{-0.0632}{-0.5} (5.2474 - 3.1023)$$

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

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

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

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

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

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

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

$T = ?$

$T_2(^\circ C)$	$\hat{V}_2\ (m^3/kg)$
500	0.0328
T	0.0342
550	0.0356

$T_2 = 525.0^\circ C$

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

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

$\boxed{T = 213.6^\circ C}$

7) $T = 213.6\ C$

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$\hat{V} = ?$

$\hat{U} = ?$

$P = 7$ bar

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

Solution:-

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

$$2600 = 697.1 + x\ 2064.9$$

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

$$1902.9 = x(2064.9)$$

$$\frac{1902.9}{2064.9} = x$$

$$\boxed{x = 0.9221}$$

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

$$\hat{v} = (0.921)(0.2928)$$

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

8)

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

$$\hat{U} = 696.3 + (0.921)(2571.1 - 696.3)$$

$$\hat{U} = 696.3 + (0.921)(1874.8)$$

$$\hat{U} = 696.3 + 1726.6908$$

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