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Q No. 3

$m = 10.0\ kg$

$P_1 = 20\ bar$

$V_1 = 1.0\ m^3$

$P_2 = 100\ bar$

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

a) $\hat{w} = ?$

$$P = \frac{100\ bar \mid 100\ kpa}{\mid 1\ bar} = 10.\ MPa$$

$\hat{v}_2 = ?$

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

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

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

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

$$= (0.0 \times 0.0316)^{1/1.5} = (0.2 \times 0.0316)^{0.667}$$

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

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

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

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

$$P = \frac{0.0632}{\hat{v}_2^{1.5}}\ MPa$$

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

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

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

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

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

b) $q = ?$

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

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

$u_1 = ?$

$u_1 = (kJ/kg)$	$T(^\circ C)$
2600.3	212.4
u_1	213.6
2628.3	225

(3

$u_1 = 2602.96 \text{ kJ/kg}$ $\hat{v}_2 = 0.0342 \text{ m}^3/\text{kg}$

At state 2, $P_2 = 10 \text{MPa}$

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

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

$$\Rightarrow \Delta\hat{u} = \hat{u}_2 - \hat{u}_1$$

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

$$\Delta\hat{u} = 492.18 \text{ kJ/kg}$$

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

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

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

$$\times\ \hat{q} = 492.38 \frac{kJ}{kg}$$

$$\hat{q}_1 = 208.38 \text{ kJ/kg}$$

Q. No. 2

$P = 7 bar$

$h = 2600\ kJ/kg$

$v = ?$

$\hat{v} = ?$

$\hat{u} = ?$

Sol

(1) $\hat{h} = h_f + x.h_{fg}$

$2600 = 697.1 + x(2064.9)$

$2600 - 697.1 = x(2064.9)$

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

$x = 0.921$

(2) $\hat{v} = v_f + x.v_{fg}$

$= 0.001108 + (0.921)(0.0273 - 0.001108)$

$= 0.001108 + (0.921)(0.271892)$

$= 0.001108 + 0.25041$

$= 0.2515\ m^3/kg$

(3) $\hat{u} = u_f + xu_{fg}$

$= 696.3 + (0.921)(2571.1 - 696.3)$

$= 6963 + (0.921)(1874.8)$

$= 6963 + 1726.6908$

$= 2420\ kJ/kg$

(4) So,

$\hat{v} = 0.2515\ m^3/kg$

$\hat{u} = 2420\ kJ/kg$

Q. No. 1

1) System

System refers to the subject matter of analysis. Thermodynamic system or system refer to definite quantity of matter, enclosed by a boundary on which we focus our attention for thermodynamic analysis.

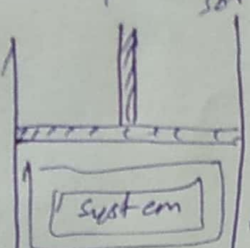

Fig. 0.1

2) Surroundings

This part of the universe other than the system is called surroundings. As shown Fig 0.1.

3) ~~Ad~~ Adiabatic process

No heat transfer through bondries of the system.

4) Isolated process

No mass or heat energy transfer with environment.

5) Extensive property

Depend upon the mass of system e.g mass, volume, internal energy Enthalpy, Entropy.

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