Name :- Ahmed Umar Rafiq

Registration No:- Chen19111002

Department :- BS Chemical Engineering.

Paper :- Chemical Engineering Thermodynamic.

Date :- 27-Nov-2020.

KFUEIT.

Q#3]. Solution:-

$m = 10\ kg$

$P_1 = 20\ bar$

$V_1 = 1\ m^3$

$P_2 = 100\ bar$

Pv relation = $Pv^{1.5} = constant.$

a) $\hat{W} = ?$

$$P_2 = \frac{100\ bar \mid 100\ kPa}{1\ bar} = 10,000\ kPa = 10\ MPa.$$

$\hat{v}_2 = ?$

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

$$\hat{v}_2 = \left(\frac{P_1 v_1^{1.5}}{P_2}\right)^{1/1.5}$$

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

Ahmed Umar Rafiq

Chen 19111002

$$\hat{v}_2 = (0.2 \times (0.1)^{1.5})^{\frac{1}{1.5}} \ m^3/kg.$$

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

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

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

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

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

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

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

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

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

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

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

Ahmed Umar Rafiq
Chen19111002

b) $q_v = ?$

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

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	213.6
2628.3	225

$$u_1 = 2602.97\ kJ/kg$$

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

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

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

$$\Delta \hat{u} = \hat{u}_2 - \hat{u}_1$$
$$= (3095.15 - 2602.97)\ kJ/kg$$
$$\Delta \hat{u} = 492.18\ kJ/kg$$

Ahmed ...

Chen 19111002

(—)

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

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

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

$$\boxed{\hat{q} = 208.38\ \frac{kJ}{kg}}$$ Ans

(←→)

Q#2).

Data Given:-

$P = 7\ bar$

$h = 260\ kJ/kg.$

Required :-

$x = ?$

$\hat{v} = ?$

$\hat{u} = ?$

Solution:-

① $\hat{h} = h_f + x \cdot h_{fg}$

$2600 = 697.1 + x(2064.9)$

$2600 - 697.1 = x(2064.9)$

$\Rightarrow 1902.9 = x(2064.9)$

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

$$\boxed{x = 0.921}$$

Ahmed Umar Rafiq
Chen19111002

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

$= 0.001108 + (0.921)(0.273 - 0.001108)$

$= 0.001108 + (0.921)(0.271892)$

$= 0.001108 + 0.25041.$

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

(3) $\hat{u} = u_f + x \cdot u_{fg}$.

$= 698.3 + (0.921)(2571.1 - 698.3)$

$= 696.3 + (0.921)(1874.8)$

$= 696.3 + 1726.6908$

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

So

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

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

Answer.

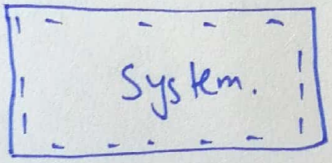
Ahmed Umar Rafiq
Chen 19111002
(—)

Q#1

Solution

1) System:-

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



2) Surroundings:

The part of the universe other than the system is called surroundings.

3) Adiabatic process:-

No (~~mass or~~)[x] heat energy transfer through boundries of the system.

~~Ahem~~

Ahmed Umar Rafiq

Chen 19111002.

(—)

4) Isolated Process:-

No mass or heat energy transfer with the environment.

5) Extensive Property:-

Depend the mass of the system.

e.g = Mass, volume, internal energy, Enthalpy, Entropy.