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Subject chemical engineering thermodynamics

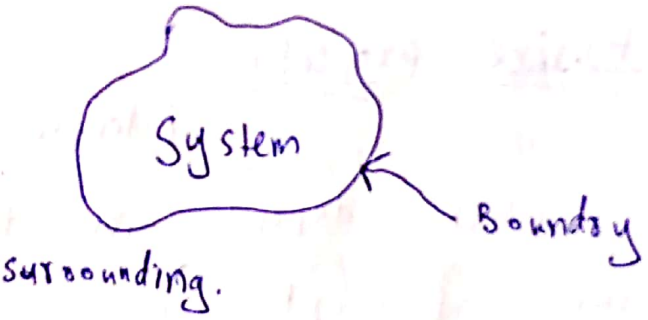
Qno1:-

System:-

A system is defined as the quantity of matter or region in space chosen for the thermodynamic study. or any thing which is under process is system

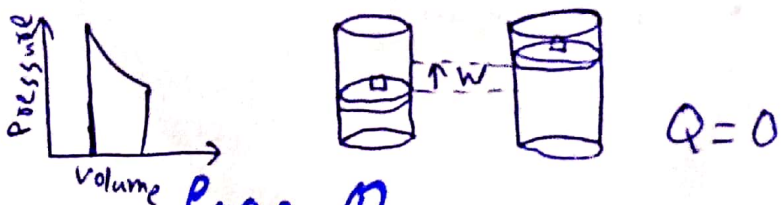
Surrounding:-

The mass or region outside the system is called surrounding.




Adiabatic Process:-

An adiabatic process is a type of thermodynamic process which occurs without transferring heat or mass between the system and surrounding.



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## Isolated system:-

An Isolated system does not exchange energy or matter with its surrounding.

### Example:-

A thermoflask is the best example of an isolated system.


## Extensive property:-

Extensive properties are those which depend upon the mass. An extensive property is a property of matter that changes as the ammount of matter change.

### Example:-

a) energy, E
b) Ehthalpy, H.
c) heat capacity.

# Qno2:-

## Given data:-

Pressure = P = 7 bar

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

## To find:-

Specific volume = ? = $\hat{V}$

specific Internal energy = $\hat{U}$ = ?

## Solution:-

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

$2600 = 697.1 + x(2064.9)$

$2600 - 697.1 = x(2064.9)$

$(2064.9)\ x = 1902.9$

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

$x = 0.9215458$

$\hat{V} = v_f + x v_{fg}$

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

$= 0.001108 + (0.921)(0.271892)$

$= 0.001108 + 0.25041$

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

$\hat{u} = u_f + x u_{fg}$

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

$= 696.3 + (0.921)(1874.8)$

$= 696.3 + 1726.6908$

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

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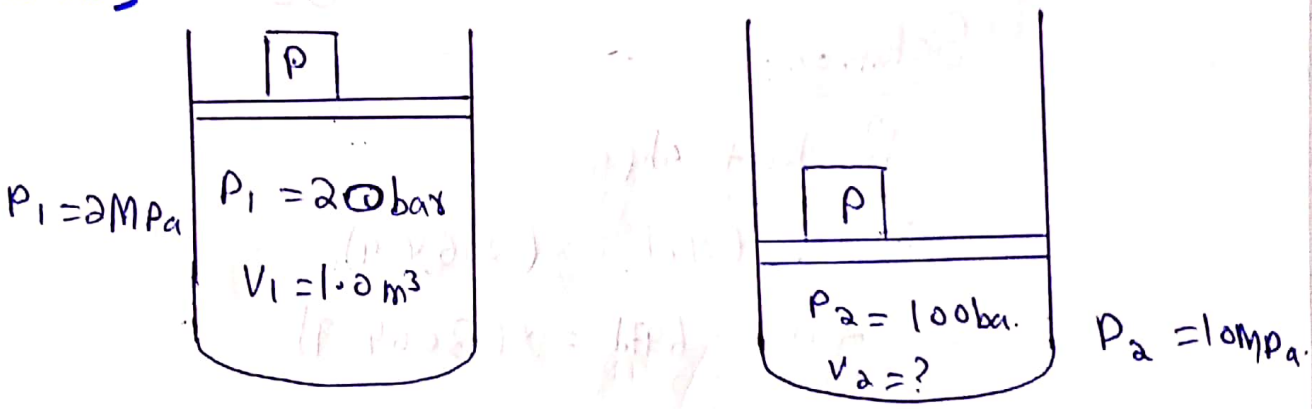
Q no3.




Mass of the water = 10. kg.

**To find :-**

work done = ?

Heat tranfer = ?

$P \hat{v}^{1.5} = \text{constant}$

we know that

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

Now we need to find the Specific volum $= \hat{v} = ?$

$$\hat{v}_1 = \frac{V_1}{m} = \frac{1}{0.1}$$

$$\boxed{\hat{v}_1 = 0.1 m^3/kg}$$

Now,

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

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

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

$$\hat{v}_2 = \left( \frac{2 \times (0.1)^{1.5}}{10} \right)^{1/1.5}$$

$$\hat{v}_2 = \left( \frac{0.0632}{10} \right)^{1/1.5}$$

$$\boxed{\hat{v}_2 = 0.0341 m^3/kg}$$

As,

$$\hat{w} = -\int_a^b P \, d\hat{v}$$

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by putting the values

$$\hat{W} = -\int_{0.1}^{0.0342} \frac{P_1 \hat{V}_1^{1.5}}{\hat{V}^{1.5}} d\hat{V}$$

$$= 2 P_1 \hat{V}_1^{1.5} \left[ \frac{1}{\hat{V}_2^{0.5}} - \frac{1}{\hat{V}_1^{0.5}} \right]_{0.1}^{0.0342}$$

$$= 2(2)(1.0)^{1.5} \left[ \frac{1}{(0.0341)^{0.5}} - \frac{1}{1.0^{0.5}} \right]$$

$$\hat{W} = 2(2\,MPa)(1.0)^{1.5} [5.41 - 3.16] \longrightarrow (i)$$

$$= \frac{2 \mid 2MPa \mid (m^3)^{1.5} \mid 10^6\,Pa \mid N}{\mid (kg)^{1.5} \mid 1MPa \mid Pa\,m^2} \times (0.1)^{1.5} \left(2.25\right) \left(\frac{kg^{0.5}}{m^3}\right)$$

$$= 283372$$

$$\hat{W} = 283.3\,kJ/kg$$

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heat transfer = q = ?

As we know

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

$$q = \Delta \hat{u} - \hat{w} \longrightarrow (1)$$

first calculat $\Delta \hat{u}$

from steam table.

at $P = 2 mpa$, $\hat{u}_1 = 2600$.

for $u_2$.

$$\frac{u_2 - u(T=500)}{u(T=550) - u(T=550)} = \frac{v_2 - v(500°C)}{v(T=550 - v(T=500)}$$

$$u_2 = u(T=500°C) + [u(T_2 500)] - u(T=500)$$

$$= \left[ \frac{v_2 - v(T=500)}{v(T=550) - v(T=500)} \right]$$

$$= 3045.8 + [3145.5 - 3045.8)$$

$$\therefore \left[ \frac{0.0342 - 0.03279}{0.03564 - 0.03279} \right]$$

$$u_2 = 3094.6.$$

$$q = (3094.6 - 2600) - 283.3$$

$$\boxed{q = 211.3}$$