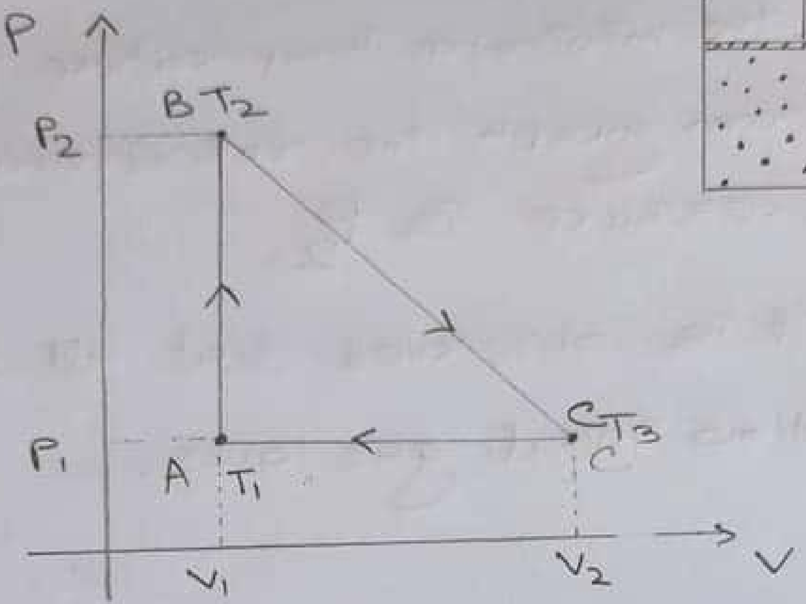

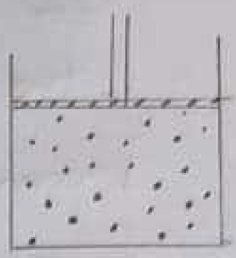

Amount of gas is fixed i.e

amount of gas = "n" moles

In line AB, volume remains constant.

$dV = 0$

According to Gay Lussac Law,

$$P \propto T$$

Thus $T_1 < T_2$.

In line AC, pressure remains constant

$dP = 0$.

According to Charles law,

$$V \propto T$$

Thus $T_1 < T_3$.

So,

the minimum temperature is T_1.

From graph the maximum pressure is P_2.

It is observed that all the lines follow ideal gas laws.

Ans: to the Qs no: (a)

$A \longrightarrow B$; It is an isochoric process

Thus $dV = 0$

We know,

$$dW = PdV$$

$$W = \int dW = \int_{V_1}^{V_1} PdV$$

$$= P\,[V]_{V_1}^{V_1}$$

$$= P(V_1 - V_1)$$

$$= P.0 = 0\,J.$$

So, work done from T_1 to T_2 is $0\,J$

(Ans).

Ans: to the Q-no: (b)

From 'a' we got work done from T_1 to T_2 is 0 J. $W = 0$.

Applying 1st law of thermodynamics, we know,

$$dQ = dU + dW.$$

$$\therefore Q = U + W.$$

$$\therefore Q = U \quad [\because \text{since } W = 0]$$

Again, for constant volume,

$$dQ = nC_v dT \quad [\because C_v = \text{specific heat at constant volume}]$$

or, $Q = \int dQ$

$$= \int nC_v dT$$

$$= nC_v \int_{T_1}^{T_2} dT$$

$$= n\frac{f}{2}R[T]_{T_1}^{T_2} = \frac{nRf}{2}(T_2 - T_1)$$

Since $Q = U$, then

$$U = \frac{nRf}{2}(T_2 - T_1)$$

$$\therefore Q = U = \frac{nRf}{2}(T_2 - T_1) \text{ (Ans)}.$$

So, from T_1 to T_2, absorbed heat and and change in internal energy is $\frac{nRf}{2}(T_2 - T_1)$.

Ans: to the Q. no: (c)

We know, for a closed loop, sum of the change in internal energies equals to zero.

Therefore,

$$U_{AB} + U_{BC} + U_{CA} = 0.$$

$$\text{or, } U_{BC} = -(U_{AB} + U_{CA})$$

$$\text{or, } U_{BC} = -\{nC_v(T_2 - T_1) + nC_v(T_1 - T_3)\}$$

$$\text{or, } U_{BC} = -nC_v(T_2 - T_3)$$

$$\text{or, } U_{BC} = nC_v(T_3 - T_2)$$

$$\therefore U_{BC} = n\frac{f}{2}R\,(T_3 - T_2)$$

Now,

Area under the P-V graph denotes the work done.

So, the work done would be.

$$W_{BC} = \int dW$$

Area under the curve is a trapezium.

$$\text{Area} = \frac{1}{2}(P_1 + P_2)(V_2 - V_1)$$

$$\therefore W_{BC} = \frac{1}{2}(P_1 + P_2)(V_2 - V_1)$$

Now,

$$Q_{BC} = U_{BC} + W_{BC}.$$

$$= \frac{nfR}{2}(T_3 - T_2) + \frac{1}{2}(P_1 + P_2)(V_2 - V_1)$$

So, from T_2 to T_3, absorbed heat is

$$\frac{nfR}{2}(T_3-T_2)+\frac{1}{2}(P_1+P_2)(V_2-V_1)$$

and change in internal energy is $\frac{nfR}{2}(T_3-T_2)$.