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Applications of First Law of Thermodynamics

(i) On Isothermal process :-

When a change in pressure & Volume of a substance takes place but the temp. remains constant, the change is said to be isothermal. In an isothermal change the temp. is kept constant by adding or taking it away from the substance. As there is no change in temp., ∴ no change in internal energy.

∴ $dU = 0$

According to 1st Law of Thermodynamics $dQ = dU + \delta W$

$\delta Q = 0 + \delta W$

or $dQ = \delta W$

By Boyle's law $pV = \text{const.}$

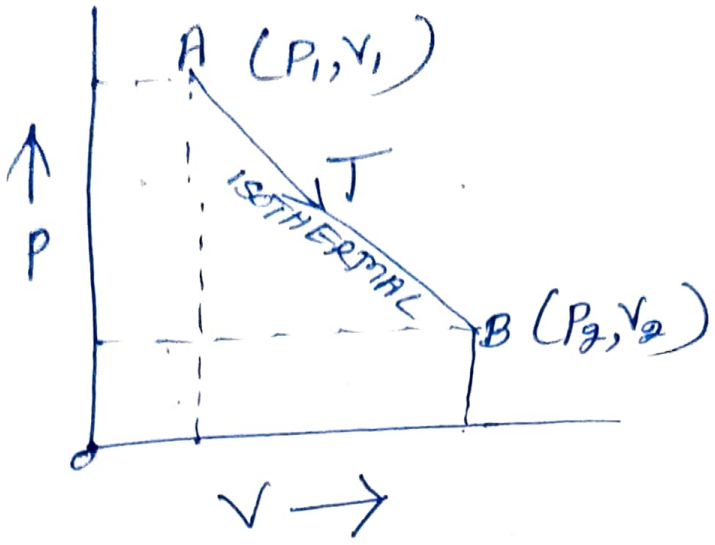

fig ①

$\therefore PV = RT = \text{constant}$ (for 1 gm molecule of gas)

For n gram molecules of a gas,

$$PV = nRT$$

For idial gas

$$U_2 - U_1 = 0$$

$\therefore$ From 1st Law of thermodynamics

$$Q = W$$

i.e. In an isothermal process the heat supplied to an ideal gas is equal to the work done by the Gas.

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(ii) Adiabatic process

$$\delta Q = 0$$

According to the first law of thermodynamics

$$\delta Q = dU + \delta W$$

$$0 = \delta U + \delta W$$

$$\delta U = -\delta W$$

∴ In an adiabatic process increase or (decrease) in internal energy = External work done on or by the gas.

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