Work done during an Adiabatic Process.

The system is thermally insulated from surroundings in adiabatic Process. The gas expands from volume V_1 & V_2 as shown by indicator diagram in following figure.

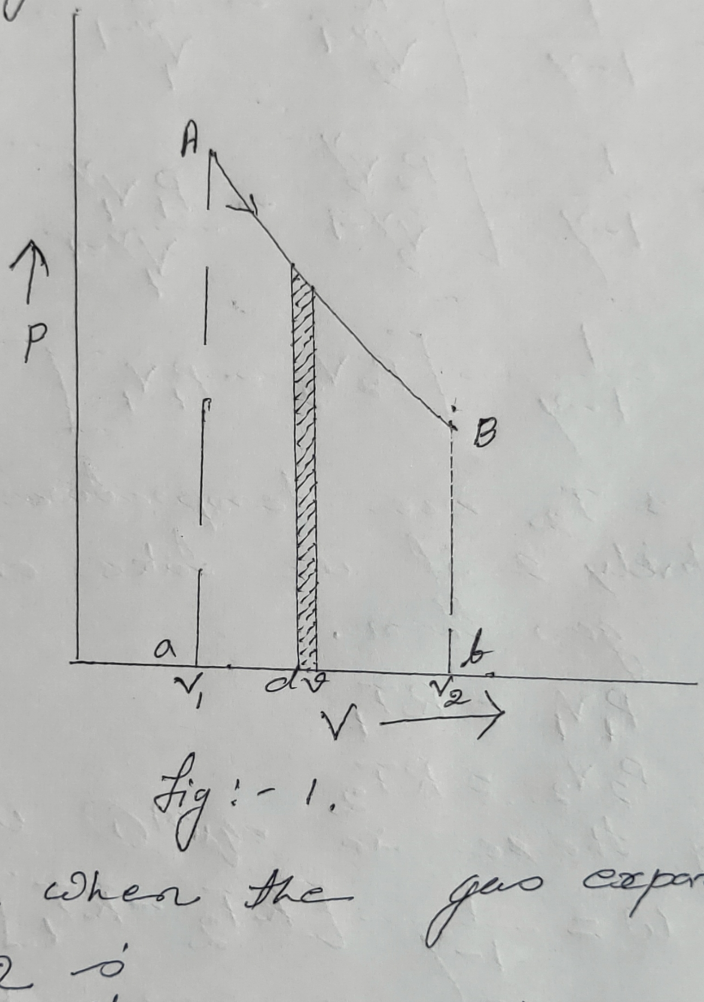

fig :- 1.

Work done when the gas expands from V_1 to V_2 is

$$\omega = \int_{V_1}^{V_2} p\,dV = \text{Area ABba}$$

During an adiabatic process.

$$PV^\gamma = \text{constant} = K$$

$$\text{or } P = \frac{K}{V^\gamma}$$

$\because P = \frac{K}{V^{\gamma}}$, $\therefore \omega = K \cdot \int_{V_1}^{V_2} \frac{dV}{V^{\gamma}}$

$$\therefore \omega = \frac{K}{1-\gamma}\left[\frac{1}{V_2^{\gamma-1}} - \frac{1}{V_1^{\gamma-1}}\right]$$

Since A & B lie on same adiabatic

$$P_1V_1^{\gamma} = P_2V_2^{\gamma} = K$$

$$\omega = \frac{1}{1-\gamma}\left[\frac{K}{V_2^{\gamma-1}} - \frac{K}{V_1^{\gamma-1}}\right]$$

$$= \frac{1}{1-\gamma}\left[\frac{P_2V_2^{\gamma}}{V_2^{\gamma-1}} - \frac{P_1V_1^{\gamma}}{V_1^{\gamma-1}}\right]$$

$$\omega = \frac{1}{1-\gamma}\left[P_2V_2 - P_1V_1\right] \quad \text{——} \quad (1)$$

If T_1 & T_2 are temprature at A & B respectively & if we take one gram molecule of the gas then,

$$P_1V_1 = RT_1$$
$$P_2V_2 = RT_2$$

putting these in eqn (1) we get:-

$$\omega = \frac{1}{1-\gamma}\left[RT_2 - RT_1\right]$$

$$\omega = \frac{R}{1-\gamma}\left[T_2 - \cancel{T}_1\right] = \frac{R}{1-\gamma}\left[T_2 - T_1\right]$$

Hence $\omega = \frac{R}{\gamma-1}\left[T_1 - T_2\right]$ —— (2)

Hence work done in this process depends only upon the initial & final temperatures T_1 & T_2. Thus the work done along any adiabatic betn ~~any~~ two isothermals is independent of the particular adiabatic. —x—