Notes

3). Calculation of final temperature in reversible and Irreversible adiabatic expansion or Compression :-

Since, $\Delta U = -P\Delta V$

or $\Delta U = C_V \Delta T$

$\therefore C_V \Delta T = -P\Delta V$

for infinitisimally small quantity -

$$C_V dT = -PdV = -RT\frac{dV}{V}$$

or, $$C_V \frac{dT}{T} = -R\frac{dV}{V}$$

or, $$C_V\, d(\ln T) = -R\, d(\ln V)$$

for two temperatures T_1 & T_2 when corresponding volumes V_1 & V_2.

$$C_V \ln\left(\frac{T_2}{T_1}\right) = -R \ln\frac{V_2}{V_1} = R\ln\frac{V_1}{V_2}$$

or $$\ln\left(\frac{T_2}{T_1}\right) = \left(\frac{R}{C_V}\right)\ln\frac{V_1}{V_2}$$

Notes

We know that —

$$C_p - C_v = R$$

& $$C_p / C_v = \gamma$$

$$\ln \frac{T_2}{T_1} = (\gamma - 1) \ln \frac{V_1}{V_2}$$

$$\ln \frac{T_2}{T_1} = \ln \left(\frac{V_1}{V_2}\right)^{\gamma - 1}$$

or $$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma - 1}$$

or $$\boxed{T_2 = T_1 \left(\frac{V_1}{V_2}\right)^{\gamma - 1}}$$

* Limitation of 1st law of Thermodynam-
-es :-

1). The 1st law establishes definite relationship between heat absorb and the work performed by a system in a given process. But it puts no restriction on the direction of flow of heat.

2). A/c to 1st law, the energy of an isolated system remains constant during a specified change of state. But it does not tell whether a specified change i.e. whether it is feasible.

3). A/c to 1st law, energy of one form can be converted into an equivalent amount of energy of another form. But it doesnot tell that heat energy cannot be completly converted into an equivalent amount of work.