1st Law of Thermodynamics

I^{st} Law For a Closed System:

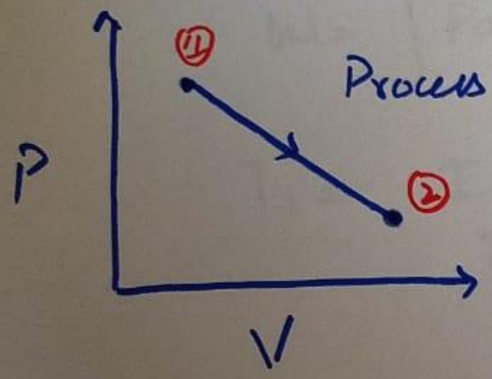
Examples: Sun, Piston Cylinder arrangement without valves

Thermodynamic Cycle:

=> Set of processes so arrayed that the same initial and final state are the same points

-> The change in a thermodynamic property is zero in a thermodynamic cycle

=> Initial and Final state are same.

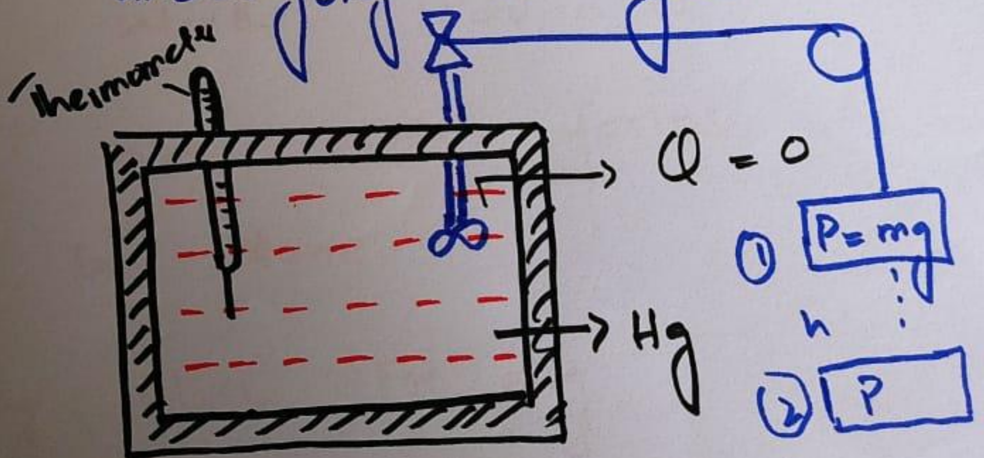


Thermodynamic Process

I^{st} Law For a Closed system undergoing a cycle

Joule's Experiment

Conservation of Energy Proof



Fluid = Mercury

Adiabatic Wall

Rigid

$\Delta V = 0$

$V = C$

$$W = \int P dV \quad = 0$$

$T_1 =$ Initial temperature of Hg

$T_1 = T_{atm}$ (atmospheric temperature)

Displacement work $\int P dV = 0$

But there are other forms of work that can be done

Stirring work For e.g

$$W = mgh$$

3

Shaft Work $W = \tau\theta$

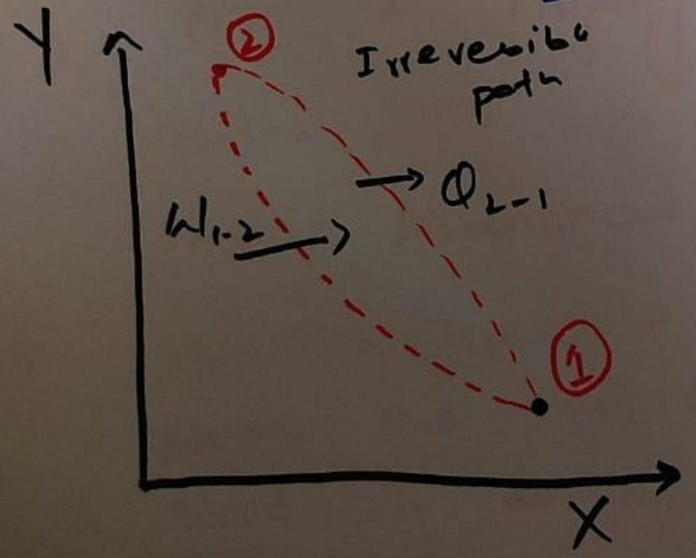
$$\boxed{W = mgh = \tau\theta}$$

Work done on the system

Final temperature $= T_2$

$T_2 > T_1$

Mechanical Work gave rise in K.E of the system which in turn has increased the temperature of the system.



(4

Remember:

=> Stirring Work is a rapid / spontaneous process.

=> That is why b/w Final and initial states are not in equilibrium.

=> Intermediate states are not in equilibrium

=> Irreversible Process

=> On a Property Diagram Irreversible paths are represented in dotted lines / Discontinuous lines

=> In a irreversible process intermediate states are not easily determined because there is no equilibrium.

Joule did this experiment with different setups. By changing fluids, Mechanical work setups, Electric work setups.

He found out the amount of work he puts into a system it is recieved back in the amount of heat. Irrespective of process either reversible & irreversible.

$$W_{1-2} \propto Q_{2-1}$$ ✓

$$Q_{1-2} \propto W_{2-1}$$ (Not exact amount)

6

The concept of high grade energy & Low grade energy was devised.

$$\Sigma W \propto \Sigma Q$$

$$\oint dW = \oint dQ$$

$$Work_{net} = Q_{net}$$ In a cycle.

$$\boxed{\oint dW = \oint dQ}$$ Only valid for a cycle

(7