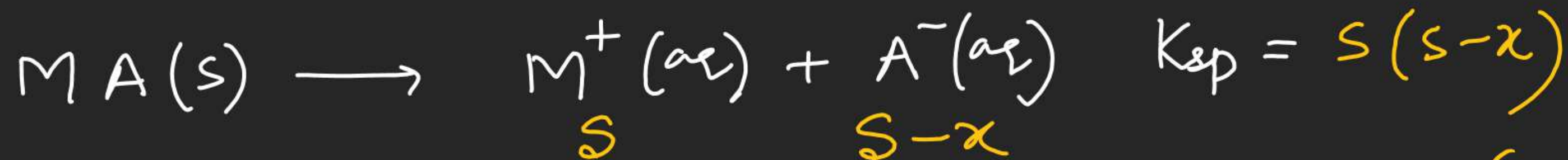


# Effect of hydrolysis on solubility:-

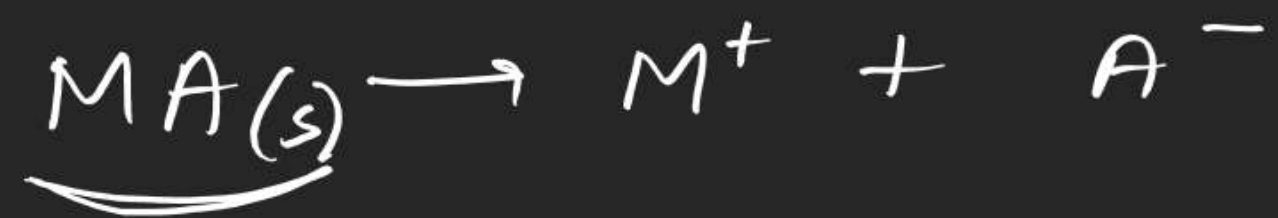


$S-x$

$x$

→ in this question pH of the solution will be given.  
and given pH will be due to a Buffer.

e.g pH = 8       $[OH^-] = 10^{-6} \neq x$



$$K_{sp} = [M^+][A^-] \quad \text{--- ①}$$



$$\frac{K_w}{K_a} = \frac{[HA][OH^-]}{[A^-]} \quad \text{--- ②}$$

$$[M^+] = S = [A^-] + [HA] \quad \text{--- ③}$$

by eq ②

$$S = [A^-] \left\{ 1 + \frac{K_w}{K_a [OH^-]} \right\}$$

by eq ①

$$K_{sp} = S \cdot \frac{S}{\left\{ 1 + \frac{K_w}{K_a [OH^-]} \right\}}$$

$$S = \sqrt{K_{sp} \left[ 1 + \frac{[H^+]}{K_a} \right]}$$

Q.30J-Adv

$$pH=7$$

$$pH=2$$

$$S=10^{-4}$$

$$10^{-3}$$

$$S = \sqrt{K_{sp} \left[ 1 + \frac{[H^+]}{K_a} \right]}$$

$$10^{-2} = \frac{(10^{-4})^2}{(10^{-3})^2} = \frac{\cancel{K_{sp}} \left[ 1 + \frac{10^{-7}}{K_a} \right]}{\cancel{K_{sp}} \left[ 1 + \frac{10^{-2}}{K_a} \right]}$$

$$\frac{10^{-4}}{K_a} = 1 + \frac{10^{-7}}{\cancel{K_a}}$$

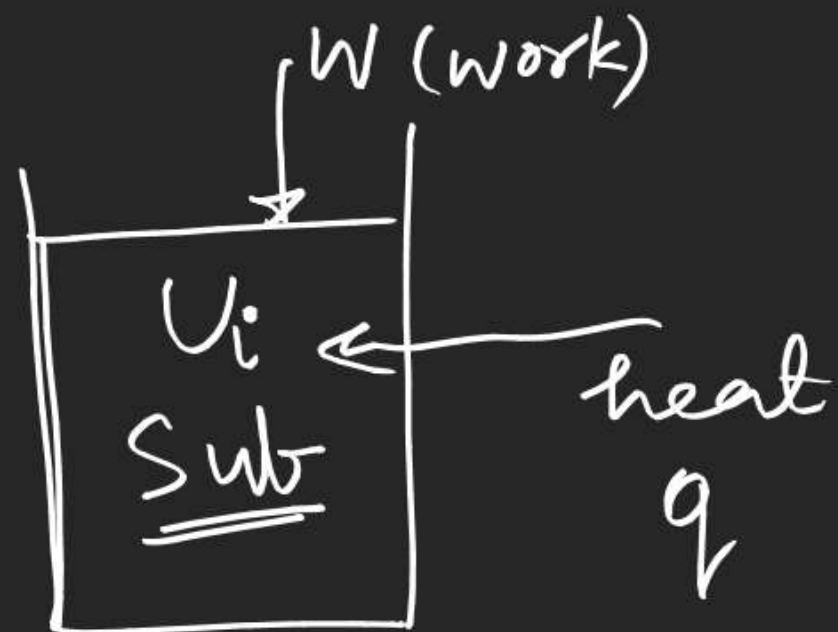
$$\underline{K_a = 10^{-4}}$$



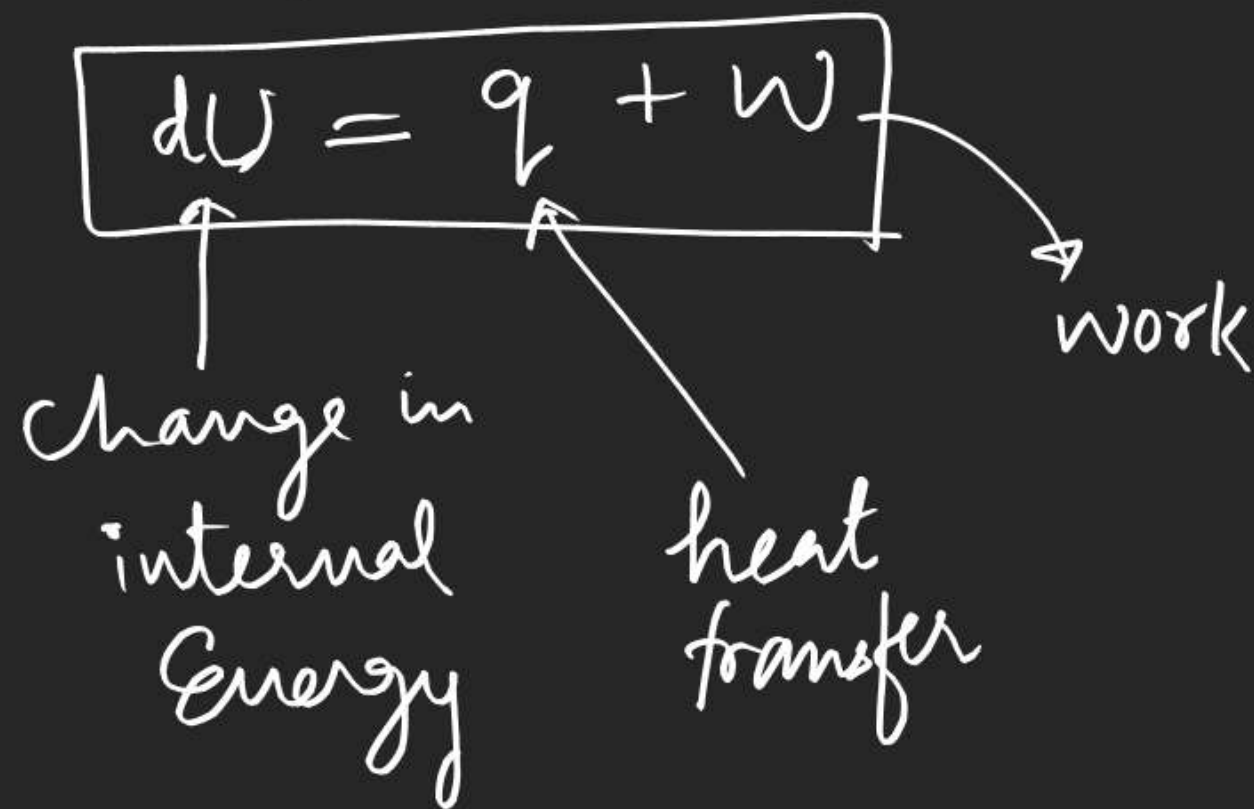
# Thermodynamics

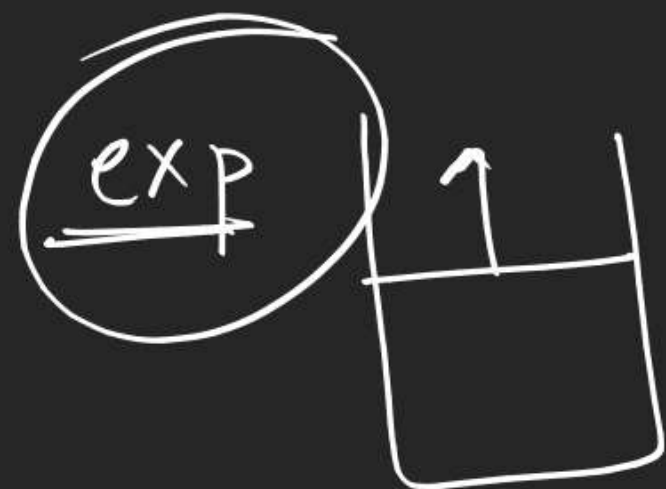
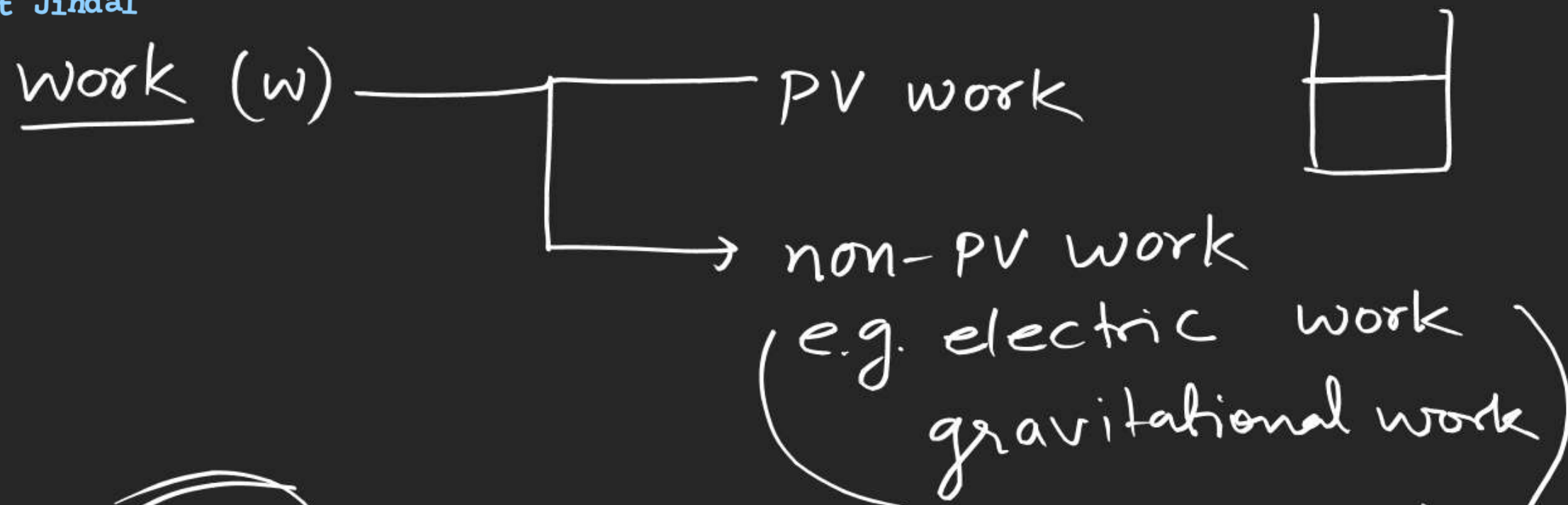
This chapter mainly deals with feasibility of a change (like chemical rxn, phase change etc)  
With the help of 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> Law of T.D.

1<sup>st</sup> law of T.D:  $\rightarrow$  Total energy of universe is constant.



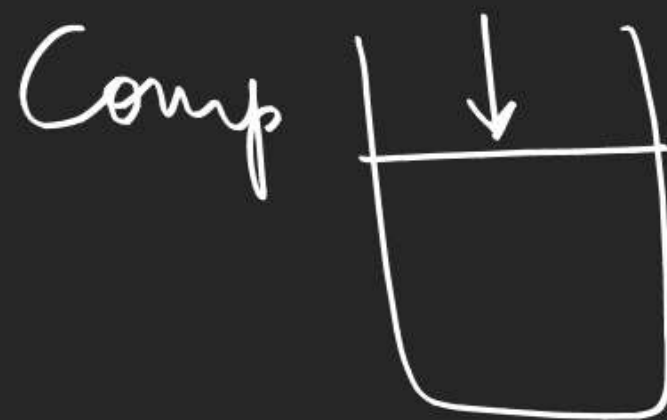
$$U_f = U_i + q + w$$





work done by the system = 50 kJ

$w = -50 \text{ kJ}$

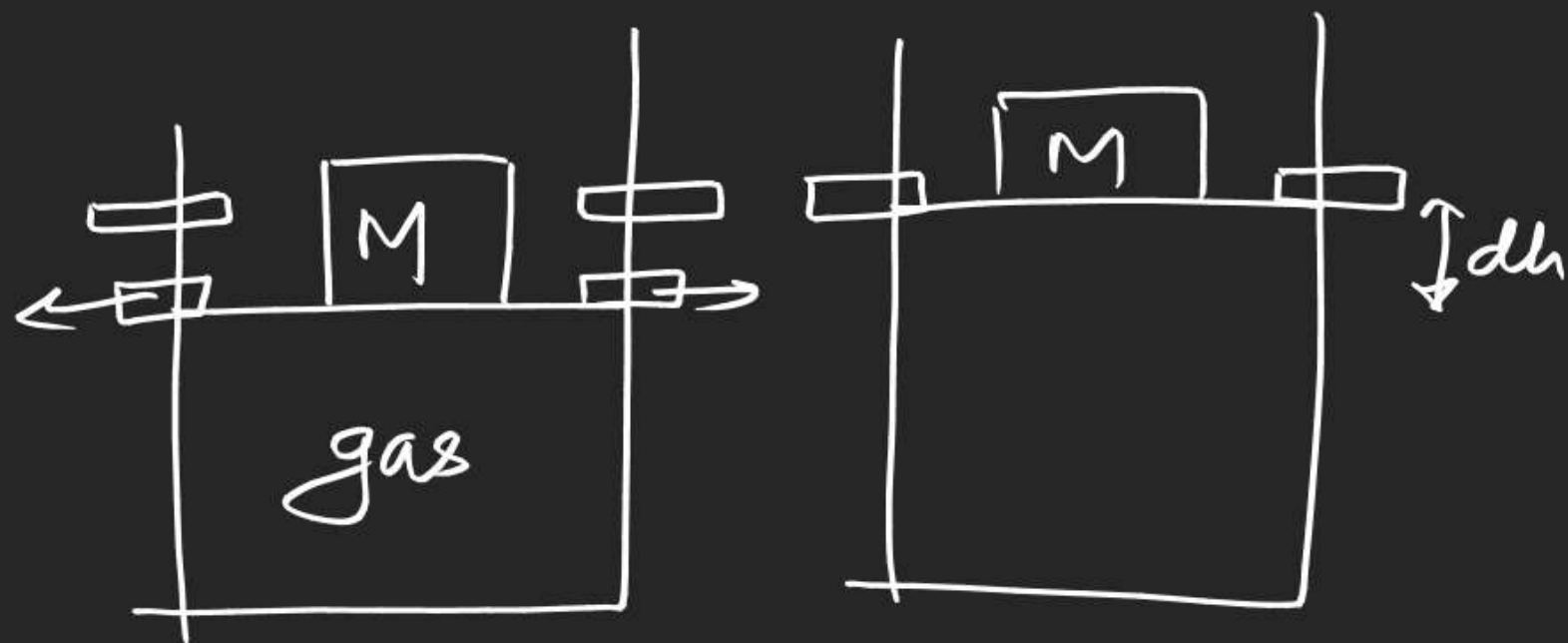


$w = -100 \text{ kJ}$

work done by the system = 100 kJ

$w = 150 \text{ kJ}$

work done on the system = 150 kJ



$$|W| = \text{Change in PE}$$

$$= \frac{Mg}{A} (dh \times A)$$

$$|W| = P_{\text{ext}} dV$$

As per sign convention

$$W = - P_{\text{ext}} dV$$

$$W = - \int P_{\text{ext}} dV$$



Q. find 'w' for an ideal gas undergoing an expansion from 2 lit to 4 lit against.

① constant external pressure  $10^5 \text{ Pa}$ .

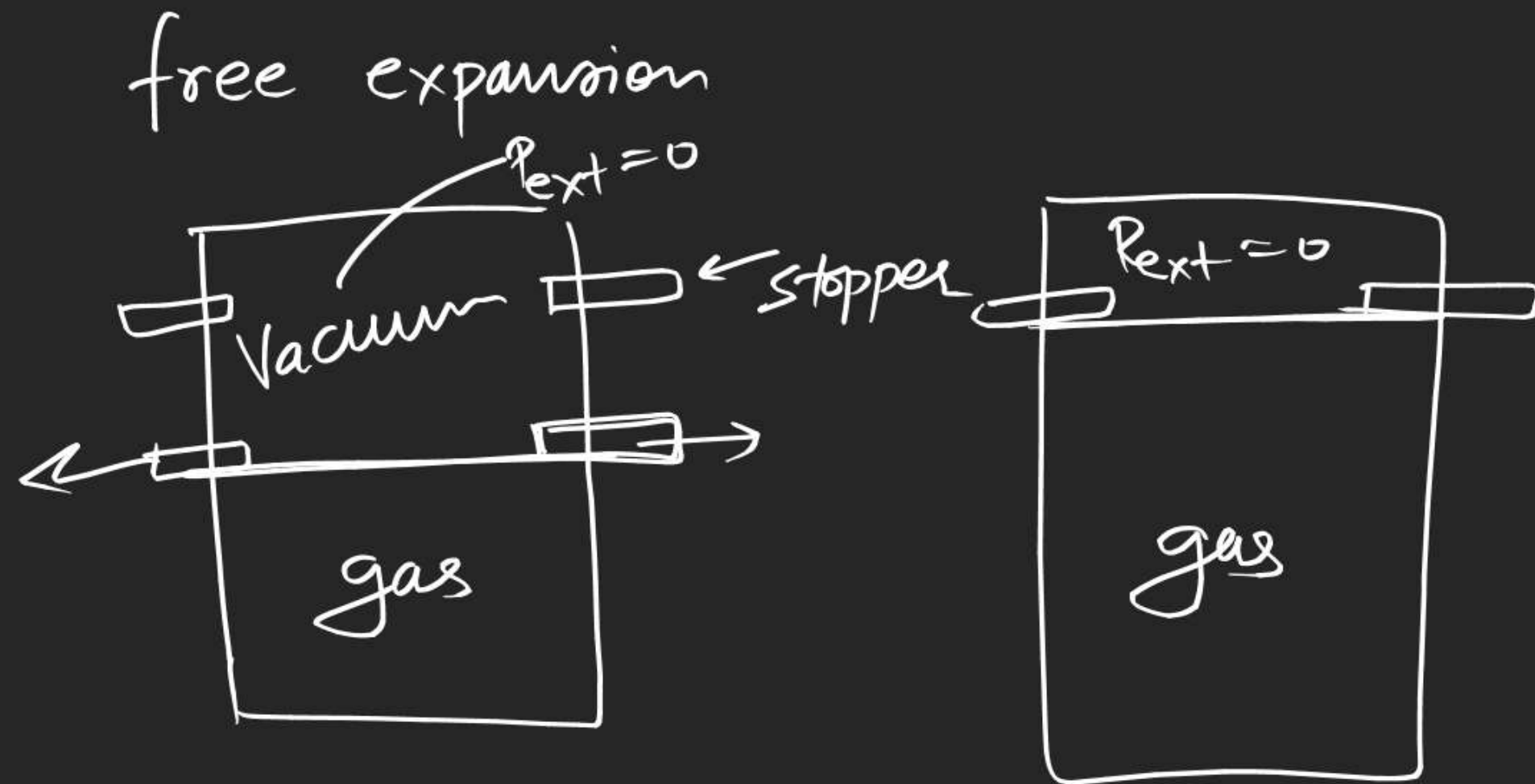
② variable external pressure  $= [10 + 2V(\text{lit}^{-1})] \text{ bar}$

Sol<sup>n</sup>

$$\begin{aligned}
 W &= -P_{\text{ext}} \int dV \\
 &= -P_{\text{ext}} (V_2 - V_1) \\
 &= -10^5 \text{ Pa} (4 - 2) \times 10^{-3} \text{ m}^3 \\
 &= -100 \times 2 \text{ J} \\
 &= -200 \text{ J}
 \end{aligned}$$

$$\begin{aligned}
 W &= - \int (10 + 2V) \cdot dV \\
 &= - \left[ 10V + 2 \frac{V^2}{2} \right]_2^4 \\
 &= - \left[ 10(4 - 2) + (16 - 4) \right] \text{ bar.lit} \\
 &= - [20 + 12] \times 100 \\
 &= -3200 \text{ J}
 \end{aligned}$$





$$W = -0(V_2 - V_1)$$
$$= 0$$

Heat ( $q$  or  $Q$ )

$$Q = -50 \text{ kJ}$$

heat given by system = 50 kJ

$$Q = 50 \text{ kJ}$$

heat is given to the system = 50 kJ

Molar heat capacity (C) :- Amount of heat required to raise the temperature of 1 mol substance by 1 Kelvin.

molar  $\rightarrow$  J/mol/K

Specific heat  $\Rightarrow$  J/gm/K

heat capacity  $\Rightarrow$  J/K

1 mol

$q \rightarrow dT$

$dT \rightarrow q$

1 Kelvin  $\rightarrow$

$$\boxed{\frac{q}{dT} = C}$$

$$q = C dT$$

for 'n' moles

$$q = n C dT$$

$$\boxed{Q = \int n C dT}$$

Substance should not undergo any chemical & phase change

# characteristics of molar heat capacity

① It is temperature dependent.

As  $T \uparrow$   $C \uparrow$

② It is process dependent

at constant volume

$$C = C_v$$

" " pressure

$$C = C_p$$

③ for ideal gas  $C_p = C_v + R$

④ for solid & liq  $C_p \approx C_v = C$

$$Q_v = \int n C_v dT$$

$$Q_p = \int n C_p dT$$



<u>for ideal gas</u>	$C_v$	$C_p$	$\gamma = C_p/C_v$
Monoatomic (He, Ar, Ne)	$\frac{3}{2}R$	$\frac{5}{2}R$	$\frac{5}{3} = 1.66$
diatomic ( $H_2$ , $N_2$ , $O_2$ )	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{7}{5} = 1.4$
triatomic (linear) ( $CO_2$ )	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{7}{5} = 1.4$
triatomic (non-linear) ( $H_2O$ , $SO_2$ )	$3R$	$4R$	$\frac{4}{3} = 1.33$

$$Q = \int nC dT$$
$$= \int mS dT$$

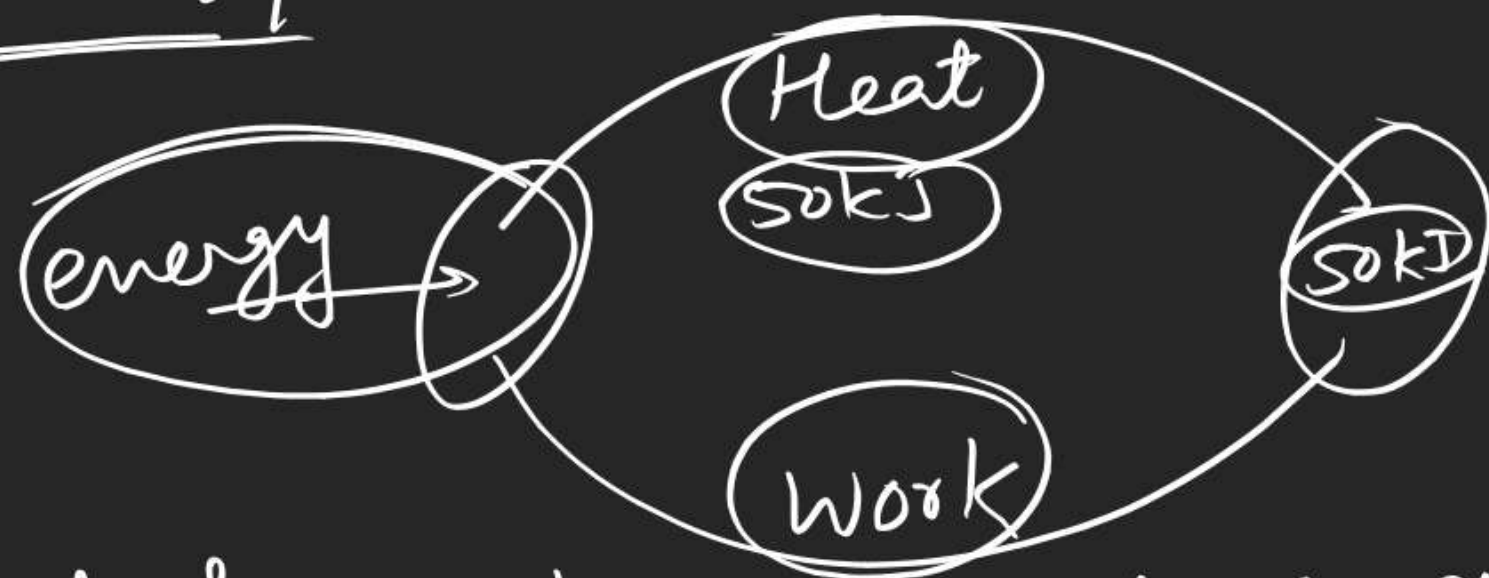
$$nC = mS = \text{heat capacity}$$

$\uparrow$   $\uparrow$

molar specific heat capacity  
heat heat  
capacity (J/gm/K)  
(J/mol/K)

# Energy

Energy      heat      work       $\Rightarrow$  heat and work are energy.



- $\Rightarrow$  heat & work are mode of energy transfer
- $\Rightarrow$  heat = energy transfer due to temperature difference
- $\Rightarrow$  Work = energy transfer due to some force.

$$W = - \int p_{\text{ext}} dv$$

$\downarrow$   
 J

$\downarrow$   
 Pa

$\downarrow$   
 m<sup>3</sup>

atm. lit

atm

lit

bar. lit

bar

lit

$$\left[ \begin{aligned} 1 \text{ atm. lit} &= 1.01325 \times 10^5 \text{ Pa} \times 10^{-3} \text{ m}^3 \\ &= 101.325 \text{ J} \end{aligned} \right.$$

$$\left[ \begin{aligned} 1 \text{ bar. lit} &= 10^5 \text{ Pa} \times 10^{-3} \text{ m}^3 \\ &= 100 \text{ J} \end{aligned} \right.$$

