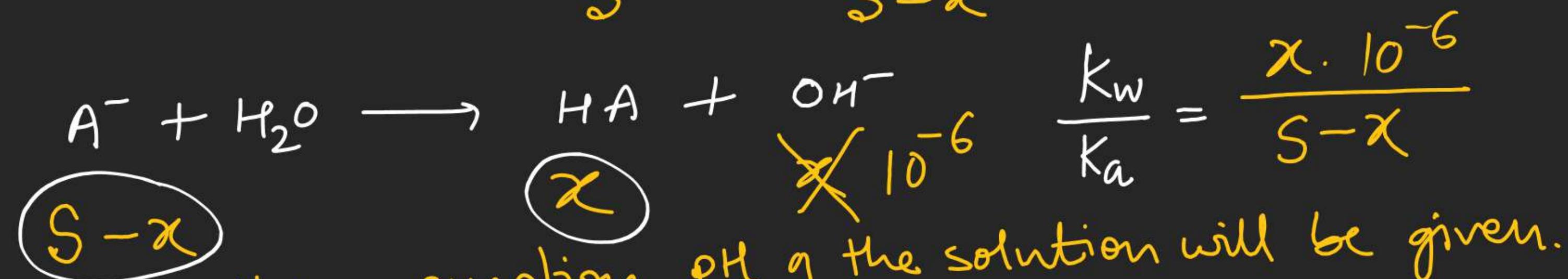
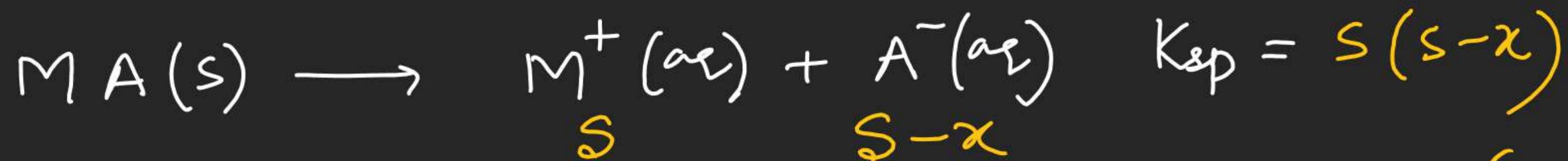


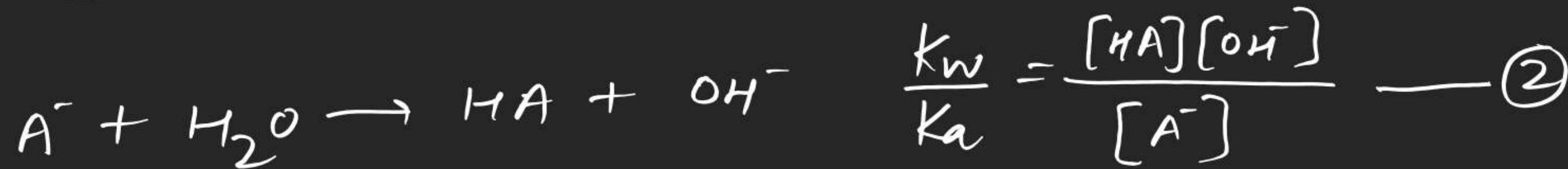
# Effect of hydrolysis on solubility :-



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

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

---



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

*by eq ①*

$$\cancel{\frac{[M^+]}{S}} \quad S = \left( \frac{[A^-]}{S} \right) \left\{ 1 + \frac{K_w}{K_a[OH^-]} \right\}$$

*by eq ②*

*by eq ①*

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

*S =*

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

Q. 30J-Adv

$$\text{pH} = 7$$

$$\text{pH} = 2$$

$$S = 10^{-4} \quad 10^{-3}$$

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

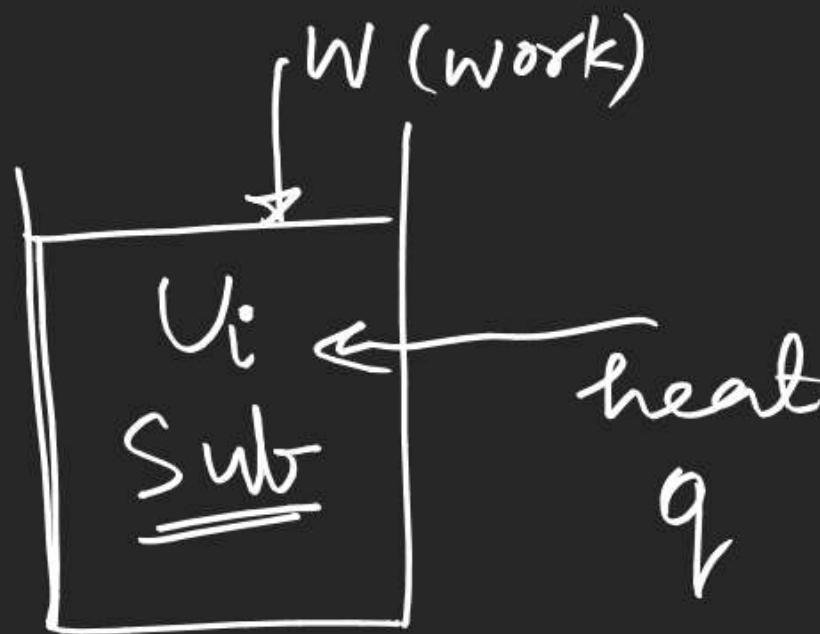
$$10^{-2} = \frac{(10^{-4})^2}{(10^{-3})^2} = \frac{\cancel{K_{\text{sp}}} \left( 1 + \frac{10^{-7}}{K_a} \right)}{\cancel{K_{\text{sp}}} \left( 1 + \frac{10^{-2}}{K_a} \right)}$$

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

## Thermodynamics

This chapter mainly deals with feasibility of a change (like chemical rxn, phase change etc) with the help of  ${}^1$ st,  ${}^2$ nd &  ${}^3$ rd law of T.D.

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



$$U_f = U_i + q + w$$

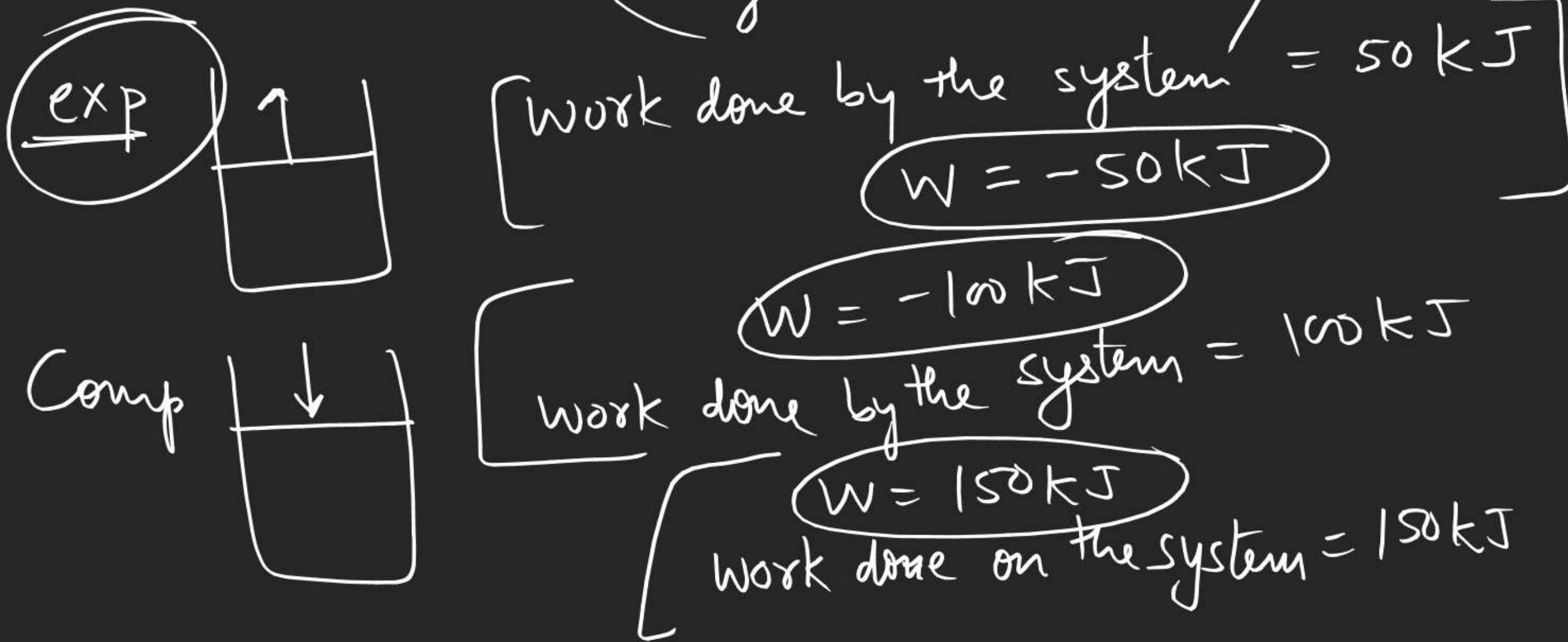
$$dU = q + w$$

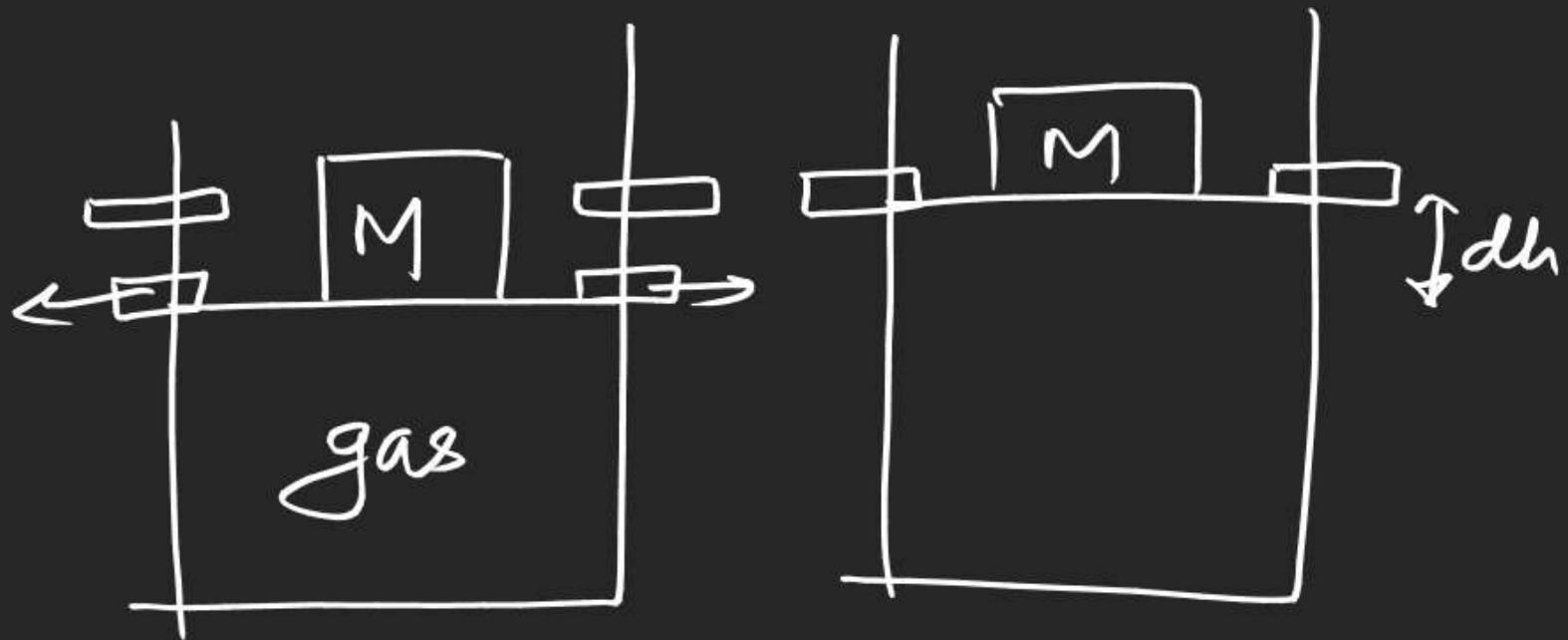
Diagram illustrating the first law of Thermodynamics:

- The equation  $dU = q + w$  shows the change in internal energy ( $dU$ ) as the sum of heat transfer ( $q$ ) and work ( $w$ ).
- The term  $q$  is labeled "heat transfer".
- The term  $w$  is labeled "work".
- The term  $dU$  is labeled "Change in internal Energy".



(e.g. electric work  
gravitational work)





$$|W| = \frac{\text{Change in}}{P \epsilon} = \frac{Mg}{A} (dh \times A)$$

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

As per sign convention

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

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

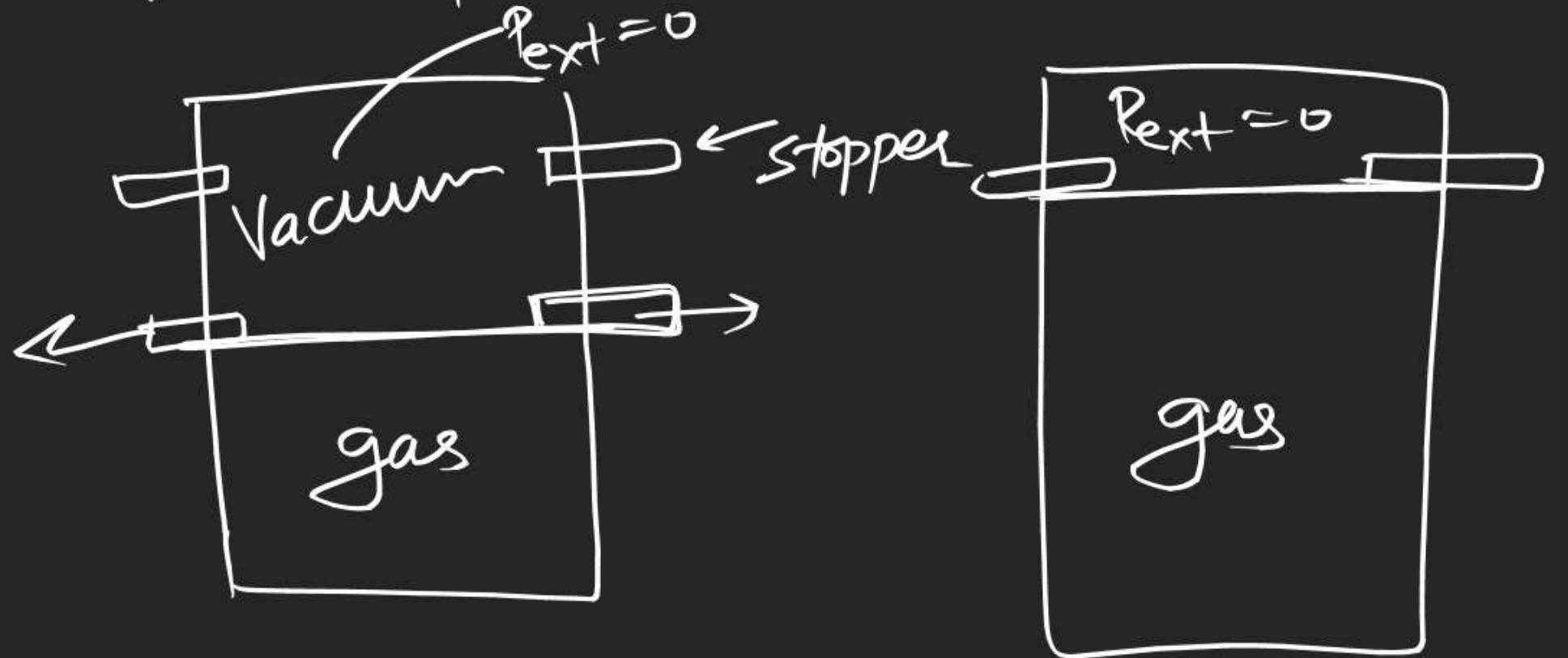
Q. find 'w' for an ideal gas undergoing  
an expansion from 2 lit to 4 lit against

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

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

$$\begin{aligned}
 \underline{\underline{\text{Sol}}} \quad w &= -P_{\text{ext}} \int dV \\
 &= -P_{\text{ext}} (V_2 - V_1) \\
 &= -10^5 \text{ Pa} (4-2) \times 10^{-3} \text{ m}^3 \\
 &= -100 \times 2 \text{ J} \\
 &= -200 \text{ J}
 \end{aligned}
 \quad \left| \begin{aligned}
 w &= - \int (10 + 2V) \cdot dV \\
 &= - \left[ 10V + 2 \frac{V^2}{2} \right] \\
 &= - \left[ 10(4-2) + (16-4) \right] \text{ bar.lit} \\
 &= -[20+12] \times 100 \\
 &= -3200 \text{ J}
 \end{aligned} \right.$$

free expansion



$$\begin{aligned} W &= -P(V_2 - V_1) \\ &= 0 \end{aligned}$$

Heat ( $q$  or  $Q$ )

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

heat given by system =  $50 \text{ kJ}$

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

heat is given to the system =  $50 \text{ kJ}$

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

molar  $\rightarrow \text{J/mol/K}$

specific heat  $\Rightarrow \text{J/gm/K}$ .

heat capacity  $\Rightarrow \text{J/K}$

$$\begin{array}{c} \text{1mol} \\ q \longrightarrow dT \\ dT \longrightarrow q \\ 1 \text{ Kelvin} \longrightarrow \boxed{\frac{q}{dT} = C} \end{array}$$

$$\begin{aligned} q &= C dT \\ \text{for 'n' moles} \\ q &= n C dT \end{aligned}$$

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

Substance  
Should not  
undergo any  
chemical &  
phase change

# Characteristics of molar heat capacity

① It is temperature dependent.

$$\text{As } T \uparrow \quad C \uparrow$$

② It is process dependent

$$\begin{array}{ll} \text{at constant volume} & C = C_V \\ \text{pressure} & C = C_P \\ \text{"} & \end{array}$$

③ for ideal gas  $C_P = C_V + R$

④ for solid & liquid  $C_P \approx C_V = C$

$$Q_V = \int n C_V dT$$

$$Q_P = \int n C_P dT$$

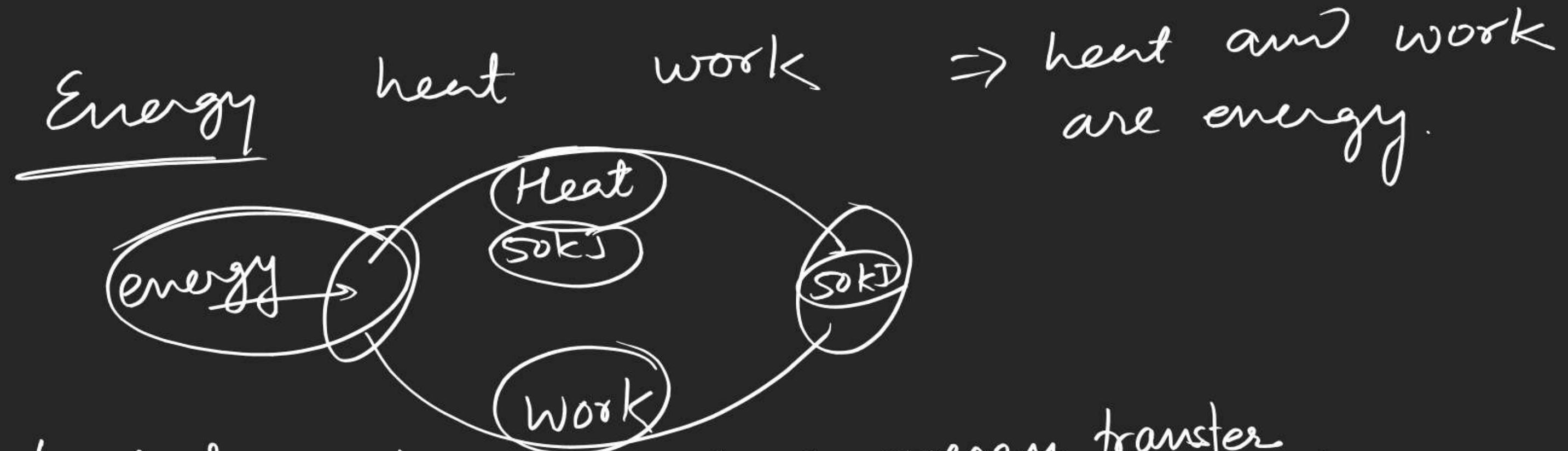
for ideal gas

	$C_V$	$C_P$	$\gamma = C_P/C_V$
Monoatomic (He, Ar, Ne)	$\frac{3}{2}R$	$\frac{5}{2}R$	$\frac{5}{3} = 1.66$
diatomic (H <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> )	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{7}{5} = 1.4$
triaxionic (linear) (CO <sub>2</sub> )	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{7}{5} = 1.4$
triaxionic (non-linear) (H <sub>2</sub> O, SO <sub>2</sub> )	$3R$	$4R$	$\frac{4}{3} = 1.33$

$$Q = \int n C dT$$
$$= \int m S dT$$

$$n C = m S = \begin{array}{l} \text{heat capacity} \\ \uparrow \\ \text{molar heat capacity} \\ \left( \frac{\text{J/mol}}{\text{K}} \right) \end{array}$$
$$\begin{array}{l} \text{heat capacity} \\ \uparrow \\ \text{specific heat} \\ \left( \frac{\text{J/gm}}{\text{K}} \right) \end{array}$$

# Energy



- ⇒ heat & work are mode of energy transfer.
- ⇒ heat = energy transfer due to temperature difference
- ⇒ work = energy transfer due to some force.

⇒ heat and work  
are energy.

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

↓                    ↓  
 J                    Pa                    m³

atm. lit	atm	lit
bar. lit	bar	lit

$$\begin{cases} 
 W_{\text{atm. lit}} = 1.01325 \times 10^5 \text{ Pa} \times 10^{-3} \text{ m}^3 \\ 
 = 101.325 \text{ J}
 \end{cases}$$

$$\begin{cases} 
 W_{\text{bar. lit}} = 10^5 \text{ Pa} \times 10^{-3} \text{ m}^3 \\ 
 = 100 \text{ J}
 \end{cases}$$

