Characterstics of eqlbm state

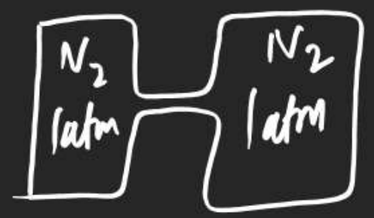
1.) At equilibrium conc of reactants and products become constant.

2. It is a dynamic eqlbm

3. forward rate of Rxn = backward Rate of rxn ($r_f = r_b$)

Static

dynamic



$A \longrightarrow B$

$A \Longleftrightarrow B$

$A \rightleftharpoons B$

$A = B$

$A \# B$

Law of chemical eqlbm (or Law of mass action)

Instantaneous rate of a rxn is directly proportional to the product of active masses of reactant raised to the power some numbers which are equal to the stoichiometric coeff.

$$aA + bB \rightarrow cC$$

$$r_f \propto (a_A)^a (a_B)^b \qquad r_b \propto (a_C)^c$$

Active mass can be replaced by

1. for gases :→ either by molar conc or by partial pressure
2. for ions/solute :→ by molar conc.
3. for solid/pure liq/solvent : active masses are constant (independent of mass) and are merged with proportionality constant.

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$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

✓ $r_f \propto [N_2][H_2]^3$ $\quad r_b \propto [NH_3]^2$

✓ $r_f \propto (P_{N_2})(P_{H_2})^3$ $\quad r_b \propto P_{NH_3}^2$

$$C(s) + O_2(g) \rightarrow CO_2(g)$$

$r_f \propto (a_C)(a_{O_2})$ $\quad r_b \propto (a_{CO_2})$

$r_f \propto (a_{O_2})$

$$\Longrightarrow I_2(aq) + I^-(aq) \rightarrow I_3^-(aq)$$

$r_f \propto [I_2][I^-]$ $\quad r_b \propto [I_3^-]$

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$$a\,A(g) + b\,B(g) \longrightarrow c\,C(g)$$

$r_f \propto [A]^a[B]^b$ $\qquad$ $r_b \propto [C]^c$

$r_f = k_f[A]^a[B]^b$ $\qquad$ $r_b = k_b[C]^c$

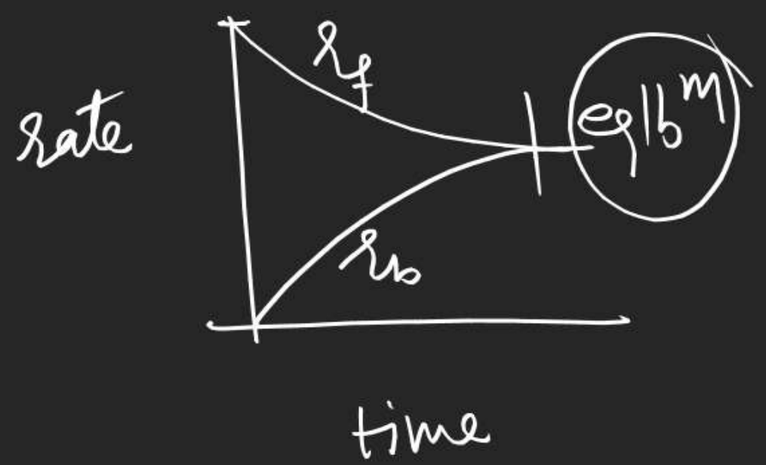
k_f: forward rate constant (for a given rxn rate constant depends only temperature)

k_b: backward rate constant

at equilibrium

$$r_f = r_b$$

$$k_f[A]^a[B]^b = k_b[C]^c$$



$$K_{eq} = \frac{k_f}{k_b} = \frac{[C]^c}{[A]^a[B]^b}$$

Characteristics of equilibrium constant:→

1. For a given reaction K_{eq} depends only on temperature.
2. It is independent of size & shape of container, moles of reactant taken etc.
3. It's value depends on representation of Rxn on paper.

(1) $A \longrightarrow B \quad K_1$

$$K_1 = \frac{[B]}{[A]}$$

$2A \longrightarrow 2B \quad K_2 = K_1^2$

$$K_2 = \frac{[B]^2}{[A]^2} = K_1^2$$

$y = x$

$y^2 = x^2$

$\frac{[A]}{[B]}$

(11)

$A \longrightarrow B \quad K_1$

$B \longrightarrow A \quad K_2$

$$K_1 = \frac{[B]}{[A]}$$

$$K_2 = \frac{[A]}{[B]} = \frac{1}{K_1}$$

$A \longrightarrow B + C \quad K = 10$

$B + C \longrightarrow A \quad \frac{1}{10} = K'$

(iii)

$A \longrightarrow B \quad K_1$ $\qquad$ $C \longrightarrow D \quad K_2$

$$K_1 = \frac{[B]}{[A]} \qquad K_2 = \frac{[D]}{[C]}$$

$$A + C \longrightarrow B + D \quad K$$

$$= \frac{[B][D]}{[A][C]}$$

$$K = K_1 K_2$$

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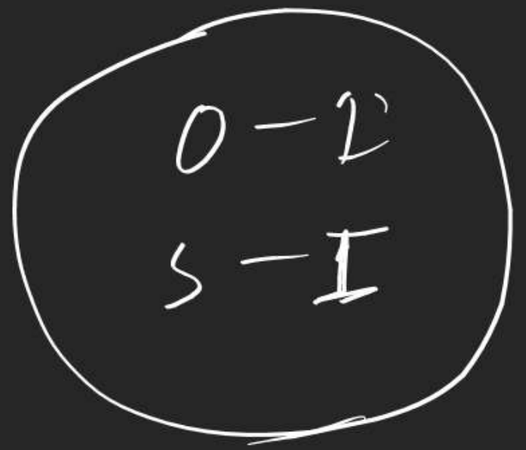

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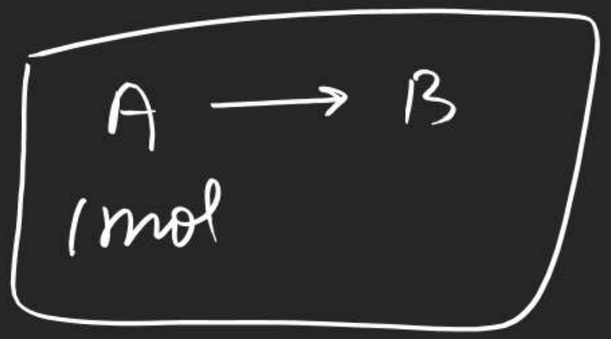
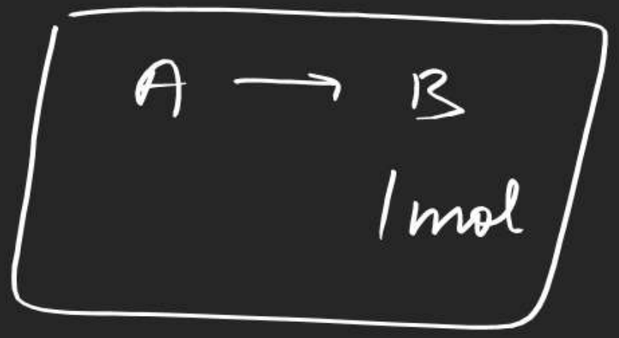
$$y = 3x + 2$$

$$x = \frac{y-2}{3}$$

$$x = \frac{1}{3}y - \frac{2}{3}$$

(4) Eqlb^m can be achieved from any direction





(5) Eqlb^m can be achieved in closed container only

100

$\frac{10}{100} \times 100$

$\frac{10}{100} = \alpha$

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S – II 1 – 5

J-Adv last 8 questions (20 – 27)

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$2I^- \longrightarrow I_2$ (2)

$ClO_3^- \longrightarrow Cl^-$ (6)

$6H^+ / 6HSO_4^-$ $6I^- + ClO_3^- \longrightarrow 3I_2 + Cl^- + 3H_2O$

$+ 6H_2SO_4$ $+ 6HSO_4^-$

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(21) $KMnO_4 + \overset{+2}{Na_2S_2O_3} \longrightarrow Mn^{2+} + \overset{+6}{SO_4^{2-}}$

(4) → x mol

$8 \times 3 = x \times 4$

(23) $S_8 + HNO_3 \longrightarrow H_2SO_4 + NO_2 + H_2O$

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(25) n moles in 250 ml $\quad [Fe^{2+}] = \frac{n}{250} \times 1000$

$= \underline{4n}$

eq of Fe^{2+} = eq of $KMnO_4$

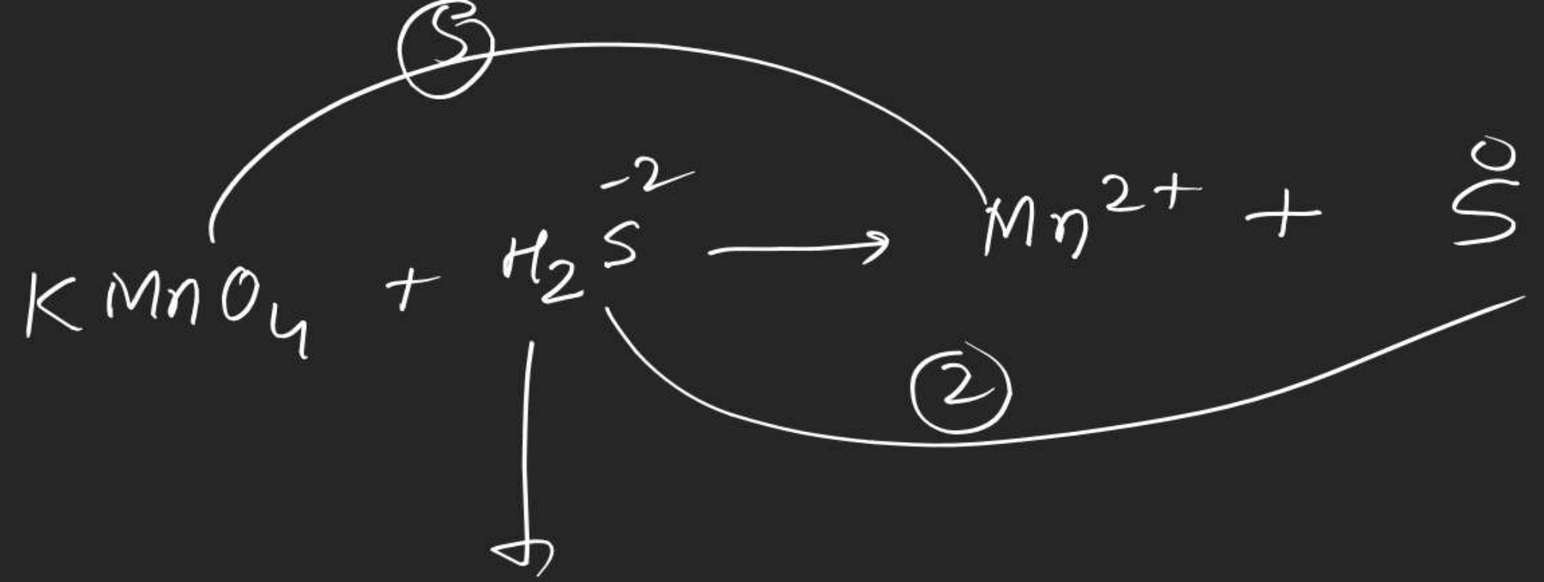
$1 \times 4n \times \frac{25}{2} = \cancel{12.5} \times 0.03 \times 5$

$Fe^{2+} \longrightarrow Fe^{3+}$

$n = \frac{15}{8} \times 10^{-2}$

$\% Fe = \frac{\frac{15}{8} \times 10^{-2} \times 56}{5.6} \times 100$

(27)



$n \times 5 = 5 \times 2$