5 (c)

$0.1 \, M \, Ba(OH)_2$

$10^{-3}M \, Ba(OH)_2$

$[OH^-] = 2 \times 10^{-3}$

$pOH = 3 - \log 2$

$pOH = 2.7$

$pH = 11.3$

5 (d)

$10^{-8} M$

$10^{-14} = (10^{-8} + x)(x)$

$[H^+] = 10^{-8} + x$

$\boxed{9.5 \times 10^{-8}}$

⑦ $pH = 6.95$

$C + x = [H^+] = 10^{-6.95}$

$H_2O \longrightarrow H^+ + OH^-$

$(C+x)(x) = 10^{-14}$

8 (f) (g)   WA → SA
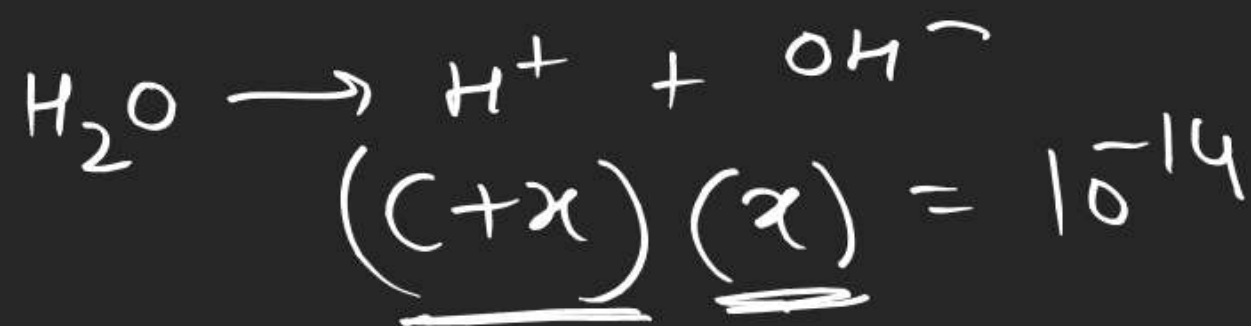
1M $\frac{1}{100}$ M

$$K_a = \frac{C\alpha^2}{1-\alpha}$$

$$K_a = \frac{x^2}{c-x}$$

$10-5$
10^{-5}
10^{-5}

pH = 10   pOH = 4

$$K_b = 10^{-5} = \frac{(10^{-4})^2}{C - 10^{-4}}$$

$$C - 10^{-4} = 10^{-3}$$

$$C = 10^{-3} + 10^{-4}$$

$$= 1.1 \times 10^{-3}$$

pH of a solution containing more than one acid or base :→

Case-I   SA + SA

$[HCl] = C_1$ $[H^+] = C_1 + C_2$

$[HNO_3] = C_2$

find $[H^+]$ of a solution made by mixing

V_1 ml C_1 M HCl + V_2 ml C_2 M HNO_3
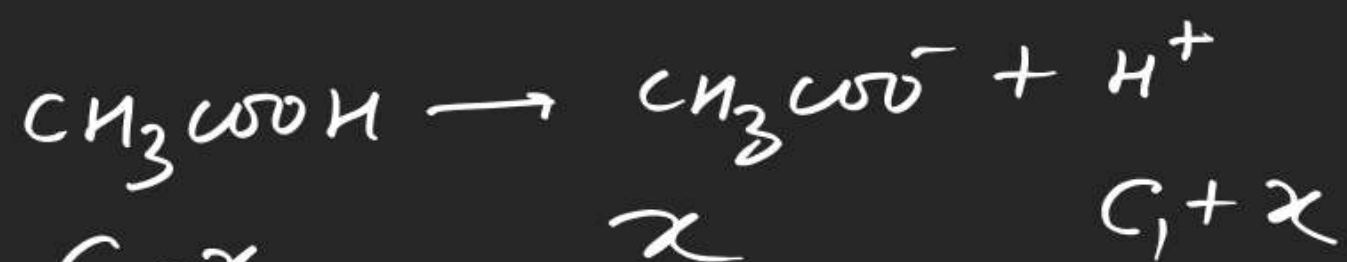
$$[H^+] = \frac{V_1 C_1 + V_2 C_2}{V_1 + V_2}$$

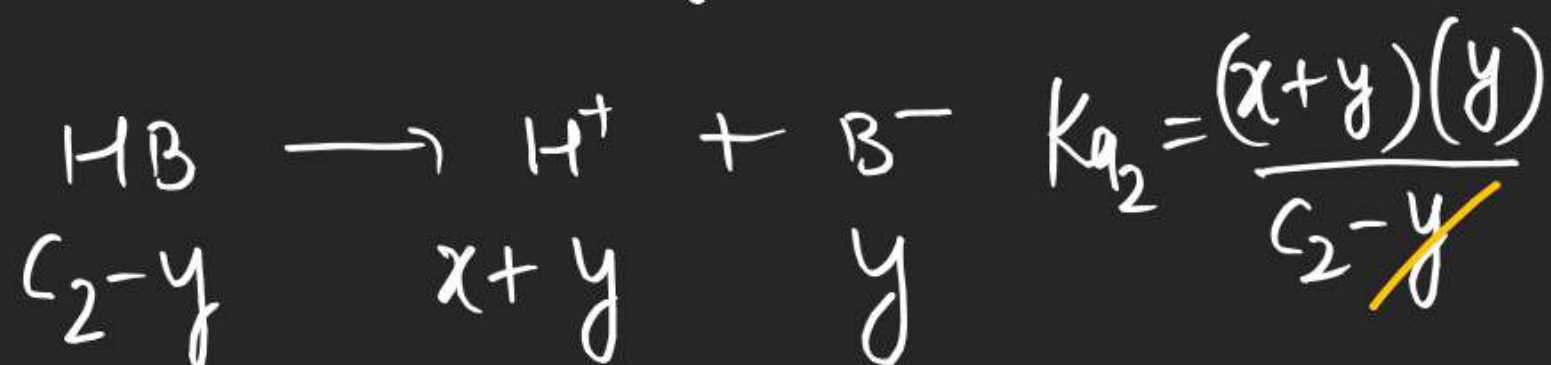$$[HCl] = \frac{V_1 C_1}{V_1 + V_2}$$ $$[HNO_3] = \frac{V_2 C_2}{V_1 + V_2}$$

Case-II $\underline{SA + WA}$

$[HCl] = C_1$ $[CH_3COOH] = C_2$

$CH_3COOH \longrightarrow CH_3COO^- + H^+$

$C_2 - x$ x $C_1 + x$

$K_a = \dfrac{(x)(C_1 + x)}{(C_2 - x)}$

$\boxed{\sqrt{\dfrac{K_a}{C_2}}}$

Case-III $WA + WA$

$HA \longrightarrow H^+ + A^-$ $Ka_1 = \dfrac{(x+y)(x)}{C_1 - x}$

$C_1 - x$ $x+y$ x

$HB \longrightarrow H^+ + B^-$ $Ka_2 = \dfrac{(x+y)(y)}{C_2 - y}$

$C_2 - y$ $x+y$ y
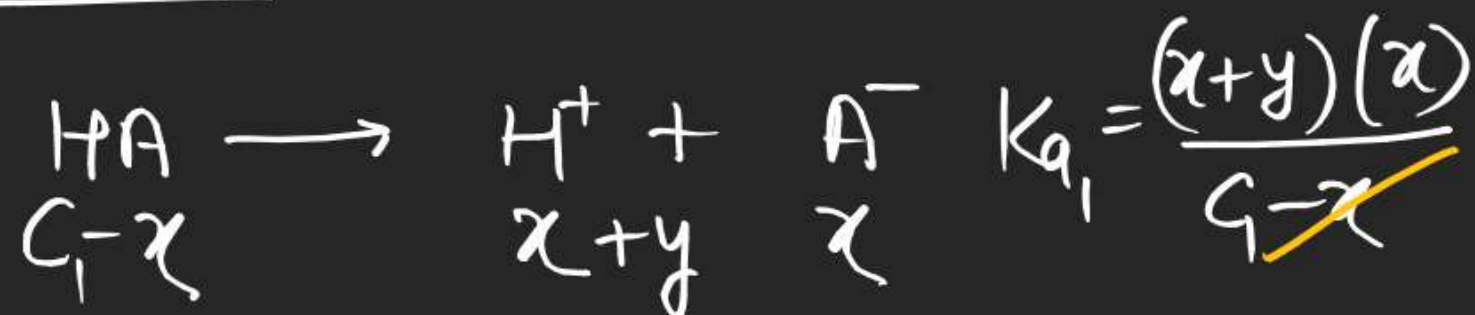
$Ka_1 C_1 = (x+y)(x)$

$Ka_2 C_2 = (x+y)(y)$

$$\sqrt{Ka_1 C_1 + Ka_2 C_2} = (x+y) = [H^+]$$

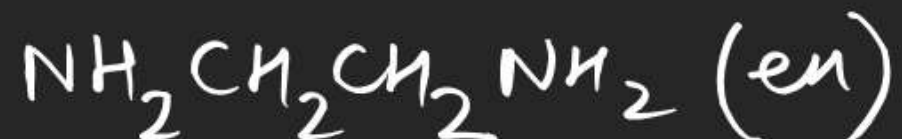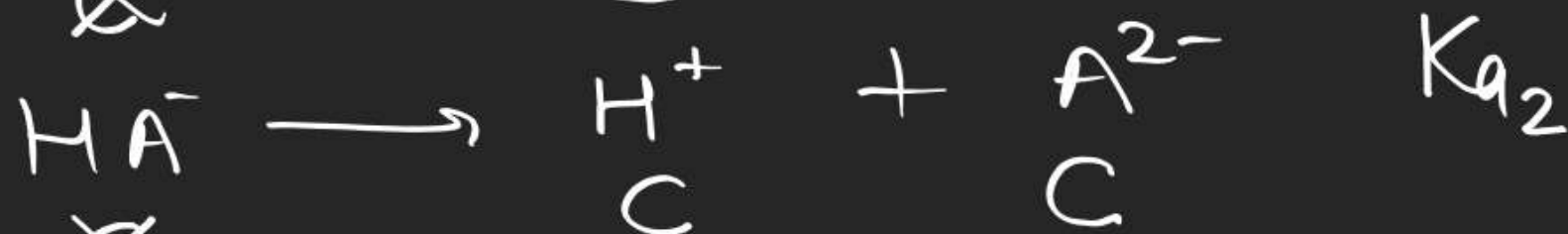(4) **pH of a solution containing polyprotic acid or polyhydroxic base**

e.g H_2S $Ba(OH)_2$

H_2CO_3 $Fe(OH)_3$

H_3PO_4

H_3PO_3 $NH_2CH_2CH_2NH_2$ (en)

$H_2C_2O_4$

H_2SO_4

$$H_2A \longrightarrow \boxed{H^+} + \boxed{HA^-} \quad Ka_1$$

$$\cancel{} \quad\quad C \quad\quad \cancel{C}$$

$$\begin{array}{cc} Ka_1 (H_2A) \\ Ka_2 (H_2A) \equiv Ka (HA^-) \end{array}$$

$$HA^- \longrightarrow H^+ + A^{2-} \quad Ka_2$$

$$\cancel{} \quad\quad C \quad\quad C$$

Case-I if Ka_1 & $Ka_2 \gg 1$

$$[H_2A] = C$$

$$[H^+] = 2C$$

Case-II if $Ka_1 \gg 1$ but not Ka_2

$$HA^- \longrightarrow H^+ + A^{2-}$$

$$C-x \quad\quad C+x \quad\quad x$$
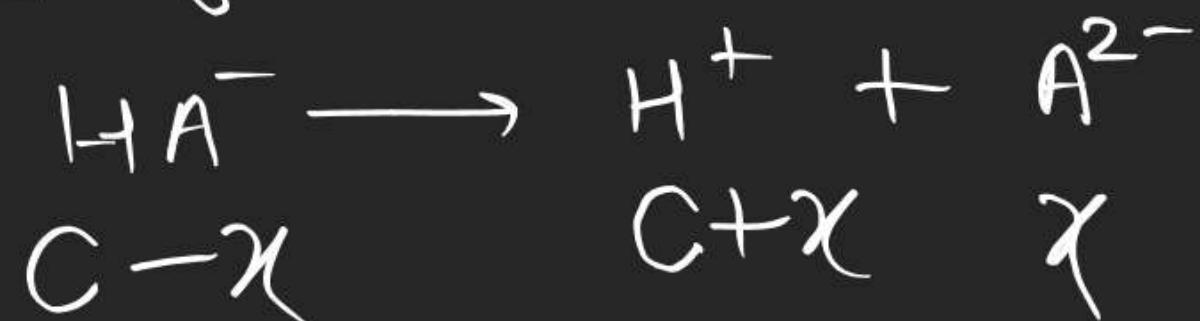
$$Ka_2 = \frac{(C+x)(x)}{C-x}$$

$\underline{\text{Case-III}}$ if Ka_1 & $Ka_2 < 1$

$$H_2A \longrightarrow H^+ + HA^-$$
$$C-x \qquad\quad x+y \qquad x-y$$

$$Ka_1 = \frac{(x+y)(x-y)}{c-x} = \frac{x^2}{c-x}$$

$$HA^- \longrightarrow H^+ + \boxed{A^{2-}}$$
$$x-y \qquad\quad x+y \qquad y$$
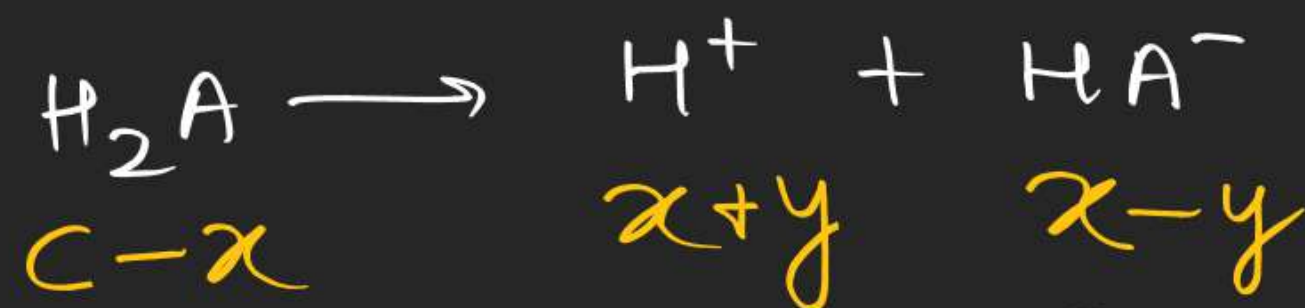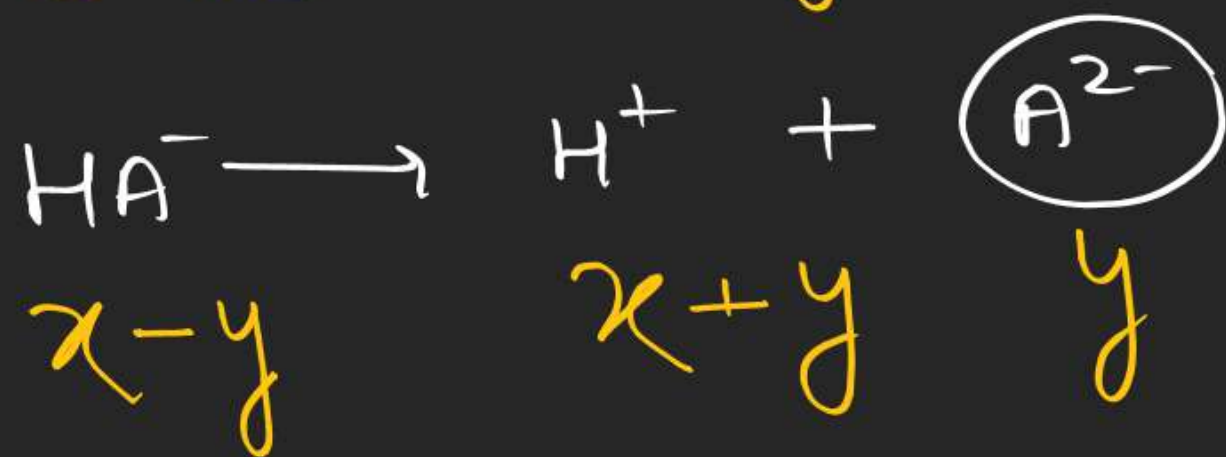
$$Ka_2 = \frac{(x+y)(y)}{x-y} = y$$

$$Ka_1 \gg Ka_2 \gg Ka_3$$

$$x \gg y \gg z$$

Q. find $[H^+]$, $[H_2PO_4^-]$, $[HPO_4^{2-}]$ & $[PO_4^{3-}]$ in 1 M H_3PO_4 sol^n. Ka. (H_3PO_4) = 10^{-4} 10^{-7}, 10^{-11}

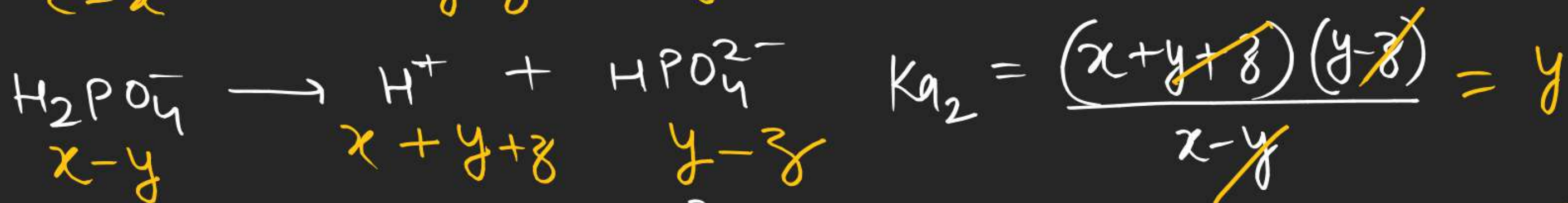$$H_3PO_4 \longrightarrow H^+ + H_2PO_4^-$$
$$c-x \qquad\qquad x+y+z \quad x-y$$

$$Ka_1 = \frac{(x+y+z)(x-y)}{c-x} = \frac{x^2}{c-x}$$

$$H_2PO_4^- \longrightarrow H^+ + HPO_4^{2-}$$
$$x-y \qquad\qquad x+y+z \quad y-z$$

$$Ka_2 = \frac{(x+y+z)(y-z)}{x-y} = y$$

$$HPO_4^{2-} \longrightarrow H^+ + PO_4^{3-}$$
$$y-z \qquad\qquad x+y+z \quad z$$

$$Ka_3 = \frac{(x+y+z)(z)}{y-z} = \frac{x \cdot z}{y}$$

$$\boxed{x = 10^{-2} \qquad y = 10^{-7} \qquad z = 10^{-16}}$$

$$NH_3 + H_2O \longrightarrow NH_4^+ + OH^- \quad K_b = \frac{x^2}{c-x}$$

$$\underset{c-x}{}$$

$$\underset{x}{NH_4^+} \quad \underset{x}{OH^-}$$

$$NH_4OH \longrightarrow NH_4^+ + OH^- \quad K_b = \frac{x^2}{c-x}$$

$$\underset{c-x}{} \quad \underset{x}{} \quad \underset{x}{}$$

$$en + H_2O \longrightarrow enH^+ + OH^- \quad K_{b_1}$$

$$\underset{c-x}{} \quad \underset{x-y}{} \quad \underset{x+y}{}$$

$$enH^+ + H_2O \longrightarrow enH_2^{2+} + OH^- \quad K_{b_2}$$

$$\underset{x-y}{} \quad \underset{y}{} \quad \underset{x+y}{}$$

Nishant Jindal
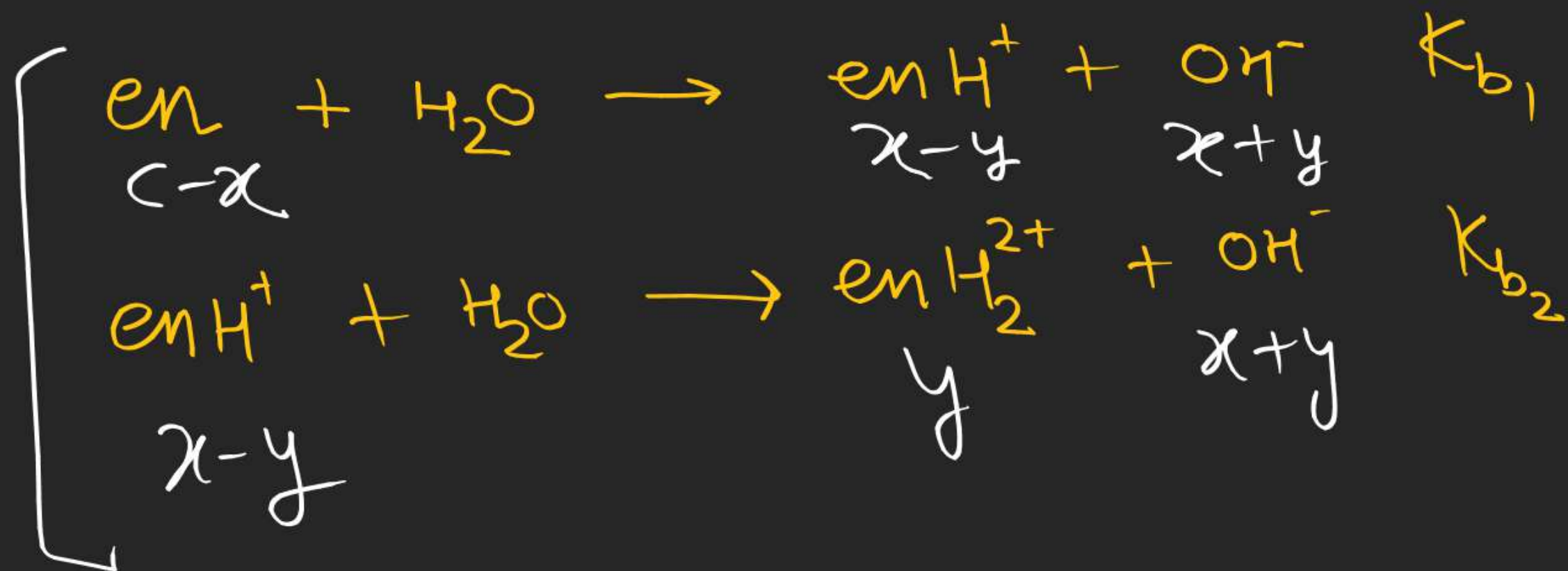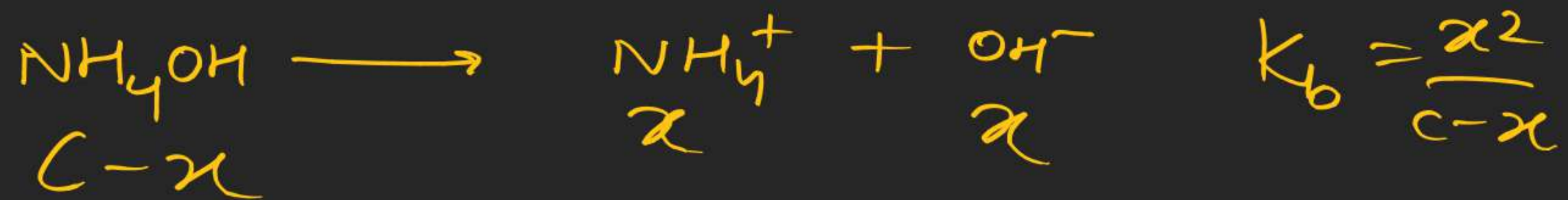
S-I   1-4
       15 - 23

O-I   1 - 10

J- Adv
Kinetic 9 - 17

(37) k_i

(38) k

(40)

(47)   (A) ✓ $rate = k\,[Cl_2][H_2S]$

(B) $rate = k\,[Cl_2][HS^-]$

$$\dfrac{[H^+][HS^-]}{[H_2S]} = K_{eq}$$

(32)

$$\text{Rate} = k [A]^n$$

$$\frac{1 = \cancel{k}\left(\frac{95}{100} \times 3\cancel{6}3\right)^n}{0.5 = \cancel{k}\left(\frac{2}{3} \times 3\cancel{6}3\right)^n}$$