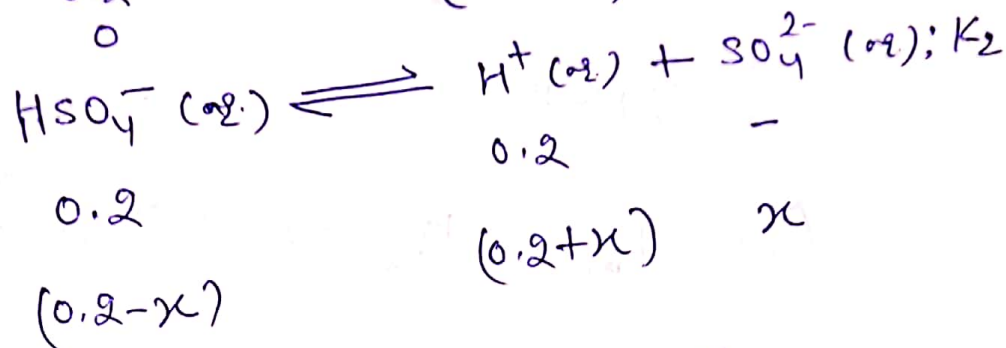
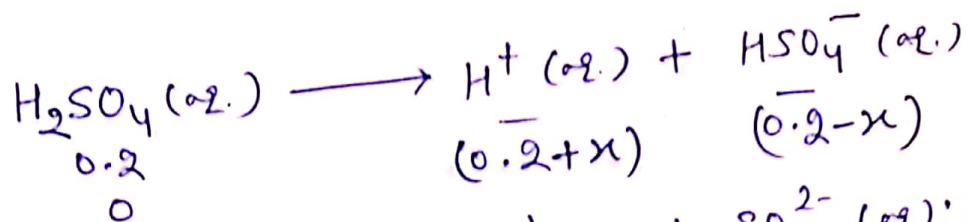


S-II

①



$$K_2 = 10^{-2} = \frac{(0.2+x) x}{(0.2-x)}$$

$$0.2 \times 10^{-2} - 10^{-2} x = 0.2x + x^2$$

$$x^2 + 0.21x - 2 \times 10^{-3} = 0$$

$$x = 9.13 \times 10^{-3} \text{ M}$$

$$\Rightarrow [\text{SO}_4^{2-}] = x = 9.13 \times 10^{-3} \text{ M}$$

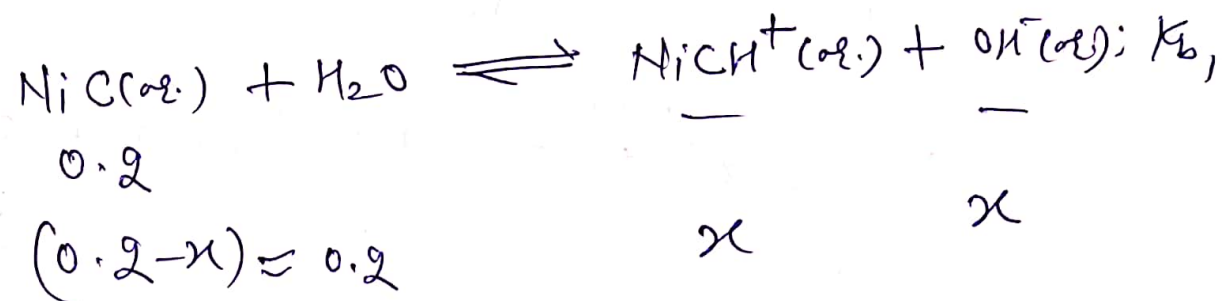
$$[\text{H}_2\text{SO}_4] \approx 0$$

$$[\text{H}^+] = 0.2 + x = 0.209 \text{ M}$$

$$[\text{HSO}_4^-] = 0.2 - x = 0.191 \text{ M}$$

②

as $K_{b1} \gg K_{b2} \Rightarrow \text{OH}^-$ is given by I step only



$$\left[\because \frac{K_{b1}}{0.2} < 10^{-3} \Rightarrow (0.2-x) \approx 0.2 \right]$$

$$K_{b1} = \frac{x^2}{0.2}$$

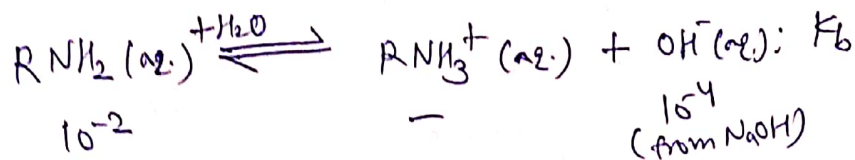
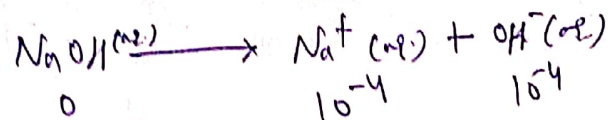
$$[\text{OH}^-] = x = \sqrt{K_{b1} \times 0.2} = \sqrt{16 \times 10^{-8}}$$

$$= 4 \times 10^{-4} \text{ M}$$

$$\text{pOH} = 4 - \log 4$$

$$\text{pH} = 14 - \text{pOH} = 10 + \log 4 = 10.6$$

③



$$(10^{-2} - x) \approx 10^{-2} \quad x \quad (10^{-4} + x)$$

$$\left[\because \frac{K_b}{10^{-2}} < 10^{-3} \Rightarrow (10^{-2} - x) \approx 10^{-2} \right]$$

$$K_b = 2 \times 10^{-6} = \frac{x(10^{-4} + x)}{10^{-2}}$$

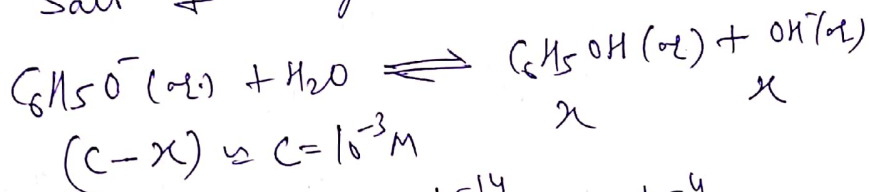
$$2 \times 10^{-8} = 10^{-4}x + x^2$$

$$x^2 + 10^{-4}x - 2 \times 10^{-8} = 0$$

$$x = 10^{-4} \text{ M}$$

$$[\text{OH}^-] = 10^{-4} + x = 2 \times 10^{-4} \text{ M}$$

④ Salt of strong base & weak acid



$$(C - x) \approx C = 10^{-3} \text{ M}$$

$$K_b = \frac{10^{-14}}{K_a} = \frac{10^{-14}}{0.6 \times 10^{-10}} = \frac{10^{-4}}{0.6}$$

$$\frac{10^{-4}}{0.6} = \frac{x^2}{10^{-3}}$$

$$[\text{OH}^-] = x = \sqrt{\frac{10^{-4} \times 10^{-3}}{0.6}} = \frac{10^{-3}}{\sqrt{6}}$$

$$\text{pOH} = 3 + \frac{1}{2} \log 6$$

$$\text{pH} = 14 - \text{pOH} = 11 - \frac{1}{2} \log 6 = 10.52$$

• ⑤ ~~all~~ all salts having amphiprotic anion

so.

$$(i) \underline{\text{NaHCO}_3} \Rightarrow \text{pH} = \frac{\text{p}K_{a1} + \text{p}K_{a2}}{2}$$

$$= \frac{7 - \log 4.2 + 11 - \log 4.8}{2}$$

$$= 8.35$$

$$(ii) \underline{\text{Na}_2\text{HPO}_4} :- \text{pH} = \frac{\text{p}K_{a2} + \text{p}K_{a3}}{2}$$

$$= \frac{8 - \log 6.2 + 12}{2}$$

$$= 9.6$$

$$(iii) \underline{\text{NaH}_2\text{PO}_4} :- \text{pH} = \frac{\text{p}K_{a1} + \text{p}K_{a2}}{2}$$

$$= \frac{3 - \log 7.5 + 8 - \log 6.2}{2}$$

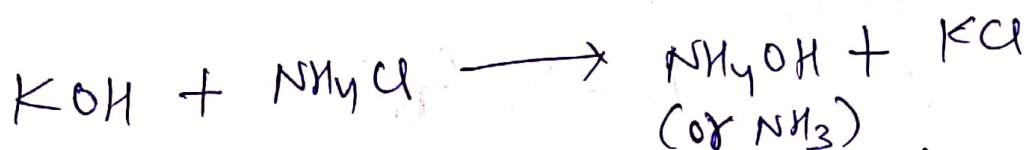
$$= 4.66$$

$$\bullet \textcircled{6} \quad pOH = pK_b + \log \frac{[NH_4Cl]}{[NH_3]}$$

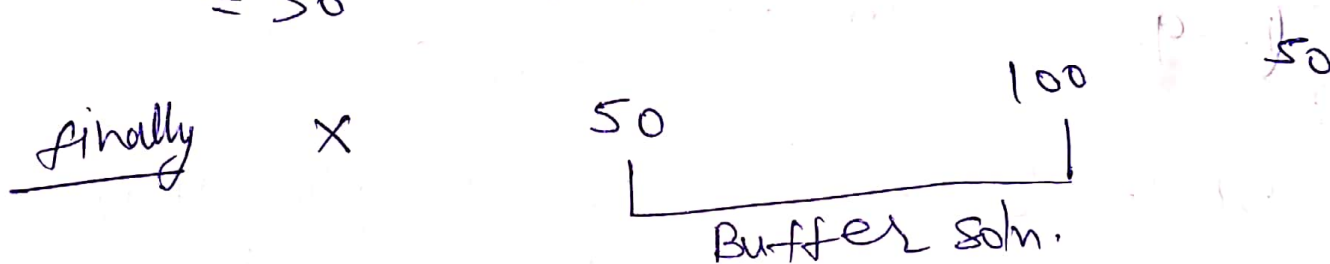
$$(14-9) = 5 - \log 2 + \log \left(\frac{[NH_4Cl]}{0.25} \right)$$

$$\Rightarrow \frac{[NH_4Cl]}{0.25} = 2 \Rightarrow [NH_4Cl] = 0.5 M$$

When KOH is added to buffer



<u>initially</u>	(500×0.1) $= 50$	(200×0.5) $= 100$	(200×0.25) $= 50$	$-$ -11
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$$\text{New } pOH = pK_b + \log \left(\frac{5}{10} \right)$$

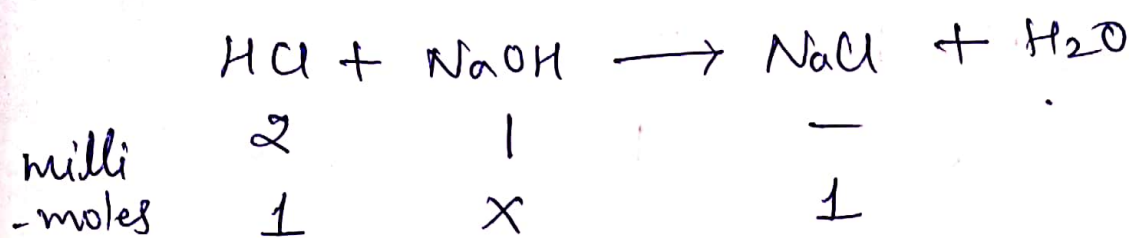
$$= 5 - \log 2 + \log \left(\frac{50}{100} \right)$$

$$= 5 - 2 \log 2$$

$$\text{New } pH = 14 - pOH = 9 + 2 \log 2$$

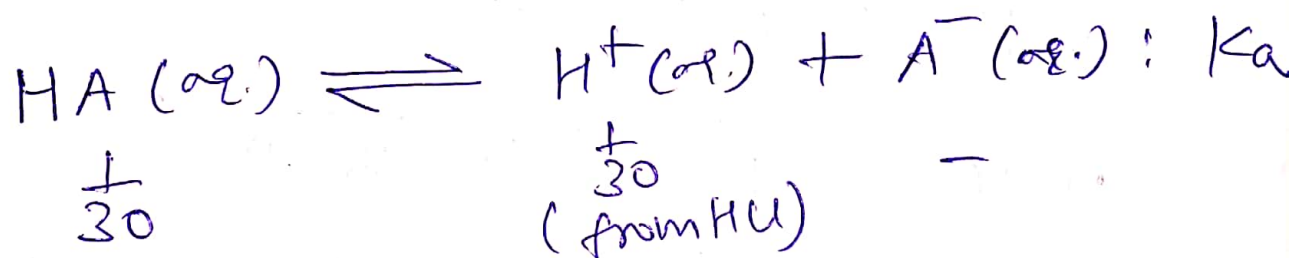
$$= \underline{\underline{9.6}}$$

- (7) I S.A. & S.B. react so



$$\text{After rxn } [\text{HCl}] = \frac{1}{10+10+10} = \frac{1}{30} \text{ M}$$

$$\text{Finally } [\text{HA}] = \frac{0.1 \times 10}{10+10+10} = \frac{1}{30} \text{ M}$$

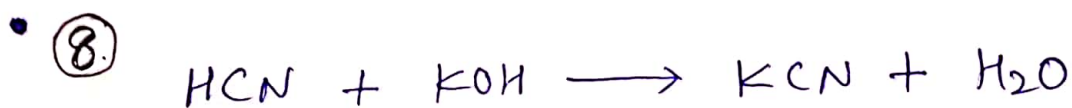


$$\left(\frac{1}{30} - x\right) \approx \frac{1}{30} \quad \left(\frac{1}{30} + x\right) \approx \frac{1}{30} + x$$

$$[x \text{ is negligible as } \frac{K_a}{C} < 10^{-3}]$$

$$K_a = 10^{-5} = \frac{\frac{1}{30} \cdot (\text{A}^-)}{\frac{1}{30}}$$

$$[\text{A}^-] = \underline{\underline{10^{-5} \text{ M}}}$$



$$1.50 \times 0.5$$

$$= 75$$

X

$$V_2 \times 1.5$$

$$= 75$$

X

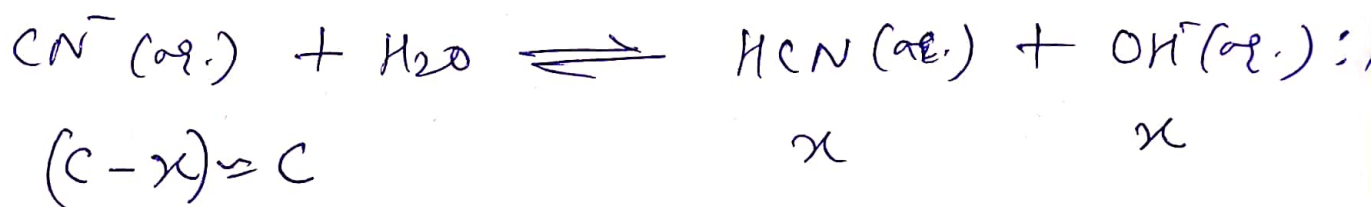
—

75 millimoles

$$\text{Concn. (G)} = \frac{75}{150 + V_2} = \frac{75}{200}$$

$$= 3.75 \times 10^{-1} \text{ M}$$

Salt formed (KCN) undergo hydrolysis

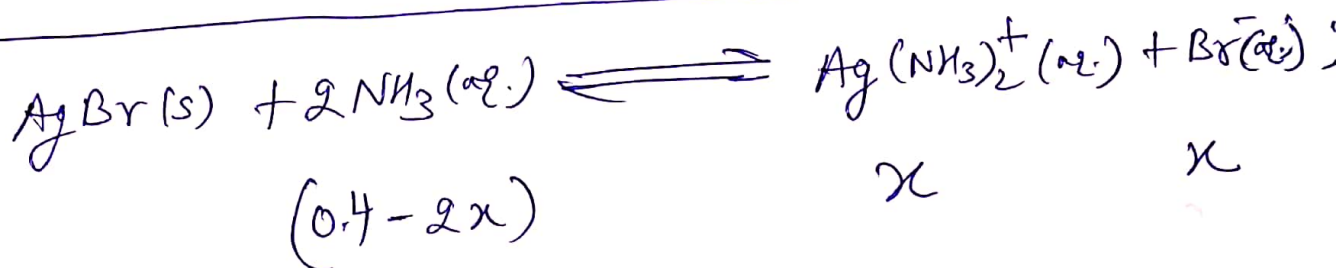
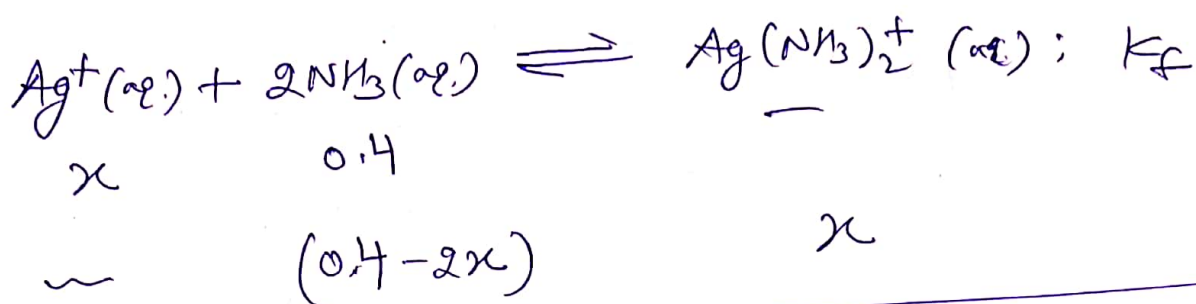
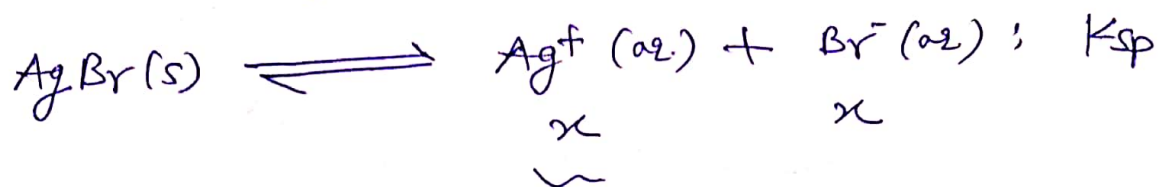


$$K_h = \frac{10^{-14}}{K_a} = \frac{x^2}{C-x} = \frac{x^2}{C}$$

$$x = [\text{HCN}] = \sqrt{\frac{10^{-14}}{3.75 \times 10^{-9}} \times 3.75 \times 10^{-1}}$$

$$= \underline{\underline{10^{-3} \text{ M}}}$$

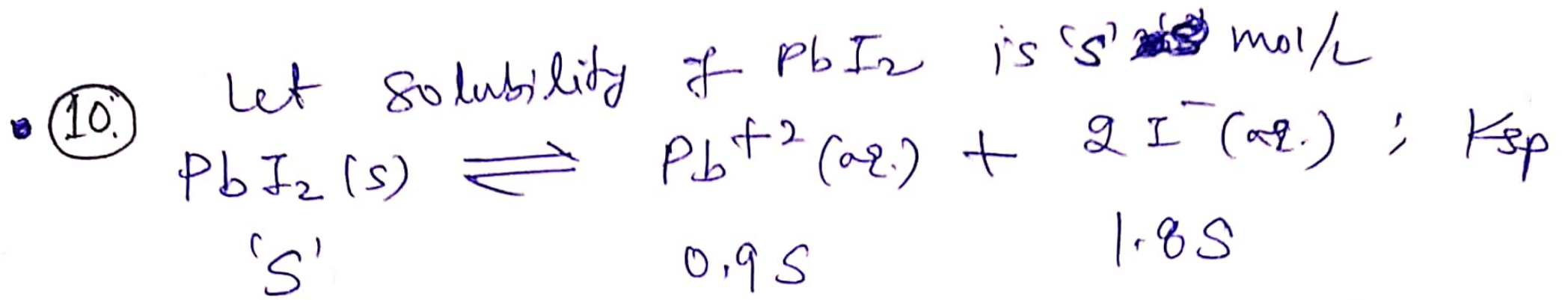
- ⑨ Let solubility of AgBr is 'x' mol/L



$$K_{sp} \times K_f = \frac{x^2}{(0.4 - 2x)^2}$$

$$\sqrt{K_{sp} \times K_f} = \frac{x}{0.4 - 2x}$$

$$x = 2.8 \times 10^{-3} \text{ M}$$



$$K_{sp} = [\text{Pb}^{+2}] [\text{I}^{-}]^2$$

$$1.4 \times 10^{-8} = (0.9S) (1.8S)^2$$

$$S = \left(\frac{1.4 \times 10^{-8}}{0.9 \times (1.8)^2} \right)^{1/3}$$

$$= 1.68 \times 10^{-3} \text{ M}$$