

O-II

• (1) $pH = 5 \Rightarrow [H^+] = 10^{-5} M ; VL$

$pH = 3 \Rightarrow [H^+] = 10^{-3} M : VL$

$$\text{finally } [H^+] = \frac{10^{-5}V + 10^{-3}V}{V+V}$$
$$= \frac{10^{-5} + 10^{-3}}{2} \approx \frac{10^{-3}}{2} M$$

$$pH = 3 + \log 2 = 3.3$$

• (2)

$$pH = 2 \Rightarrow [H^+] = 10^{-2} M = M_1$$

$$pH = 3 \Rightarrow [H^+] = 10^{-3} M = M_2$$

$$\begin{aligned} \text{moles of HCl removed} &= n_{H^+}(\text{initial}) - n_{H^+}(\text{final}) \\ &= 10^{-2} \times 1 - 10^{-3} \times 1 \\ &= 9 \times 10^{-3} = 0.009 \end{aligned}$$

• (3.)

$$(A) K_{sp} = S^2 \Rightarrow S = \sqrt{8 \times 10^{-37}}$$

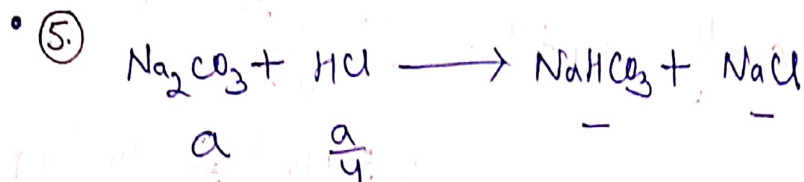
$$(B) K_{sp} = S^2 \Rightarrow S = \sqrt{7 \times 10^{-16}}$$

$$(C) K_{sp} = 108 S^5 \Rightarrow S = \left(\frac{K_{sp}}{108} \right)^{1/5}$$

$$(D) K_{sp} = 27 S^5 \Rightarrow S = \left(\frac{K_{sp}}{27} \right)^{1/5} \Rightarrow \text{Maximum}$$

• ④ $[\text{common ion}] \uparrow \Rightarrow \text{solubility} \downarrow$

max. concn. of common ion, $(\text{Br}^-) = 0.2$ in 0.1 M CaBr_2



$$\text{pH} = \text{pK}_a + \log\left(\frac{\text{S/A}}{\text{A/A}}\right) = 11 + \log\left(\frac{3a/4}{(a/4)}\right)$$

$$\text{pH} = 11 + \log 3$$

• ⑥

	HIn (Red)	In^- (Blue)	pH
1.)	80	20	$\text{pK}_{\text{In}} + \log\left(\frac{20}{80}\right)$
2.)	20	80	$\text{pK}_{\text{In}} + \log\left(\frac{80}{20}\right)$

$$\Delta \text{pH} = 2 \log 4 = 4 \log 2 = 4 \times 0.3 = 1.2$$

• ⑦

$$[\text{OH}^-] = 10^{-7} + 10^{-7} = 2 \times 10^{-7} \Rightarrow \text{pOH} = 7 - \log 2$$

$$\text{pH} = 7 + \log 2 = 7.3$$

But Due to ^{from H₂O} common ion effect (without common ion effect) $\Rightarrow [\text{OH}^-] < 2 \times 10^{-7}$
Hence $\text{pH} < 7.3$

• ⑧

On increasing dilution (volume) concentration of H^+ ~~and~~ ion decrease, although moles increase ~~but~~ but volume increase more.

$$\text{Concn.} = \frac{\text{moles}}{\text{Volume}} \propto \frac{\sqrt{V}}{V} \propto \frac{1}{\sqrt{V}}$$

(for dilute soln.)

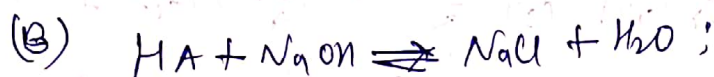
9. (A) $[OH^-] = \sqrt{K_b \cdot C} = \sqrt{10^{-5} \times 0.1} = 10^{-3} M$

(B) $pOH = 3$; $pH = 14 - 3 = 11$

(C) Salt of S.A. & W.B. is acidic solution.

(D) for phenolphthalein indicator can be used when strong base is present.

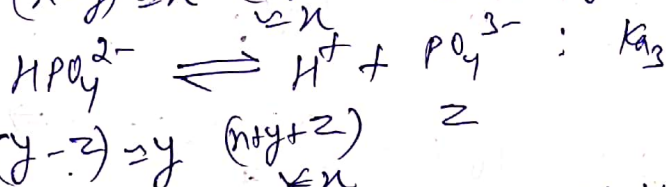
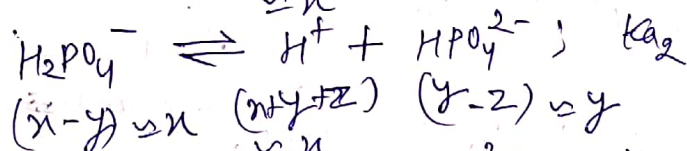
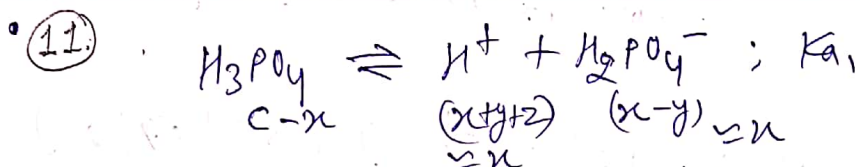
10. (A) $K_{eq} = K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{2 \times 10^{-6}} = 5 \times 10^{-9}$



$K_{eq} = \frac{1}{K_h} = \frac{K_a}{K_w} = \frac{2 \times 10^{-6}}{10^{-14}} = 2 \times 10^8$

(C) $[H^+] = \sqrt{K_a \cdot C} = \sqrt{2 \times 10^{-6} \times 0.1} = \sqrt{20} \times 10^{-4}$

$pH = 4 - \frac{1}{2} \log 20 = 3.35$



(as $K_{a1} \gg K_{a2} \gg K_{a3} \Rightarrow x \gg y \gg z$)

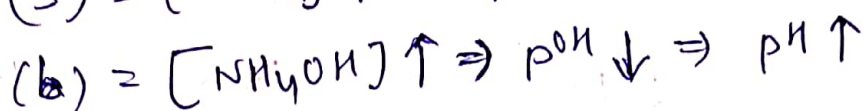
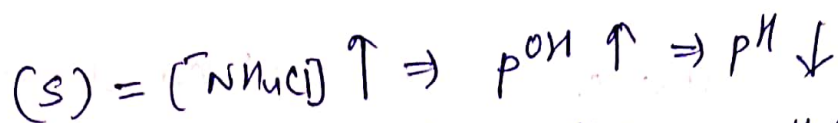
(A) $[H^+] = [H_2PO_4^-] = x$

(B) $K_{a1} = \frac{x^2}{[H_3PO_4]} \Rightarrow x = [H^+] = \sqrt{K_1 [H_3PO_4]}$

(C) $K_2 = \frac{x \cdot y}{x} = y = [HPO_4^{2-}]$ (D) $[PO_4^{3-}] = z$

• (12.) (A) No effect of dilution on pH of buffer

(B), (C) & (D) :- $pH = pK_b + \log\left(\frac{s}{b}\right)$



• (13.) when equal volumes are mixed concn. of each ion will be half of initial

for ppt. of $AgCl$,

$$Q_{sp} = [Ag^+][Cl^-] > K_{sp} = 1.8 \times 10^{-10}$$

$$(A) Q_{sp} = \frac{10^{-4}}{2} \times \frac{10^{-4}}{2} = 2.5 \times 10^{-9} > K_{sp}$$

• (14.) $C = \frac{8 \times 1000}{80 \times 100} = 1 M$

as $\frac{K_a}{C} < 10^{-3} \Rightarrow [H^+] = \sqrt{K_a \cdot C} = 10^{-2} M$
 $\Rightarrow pH = 2$



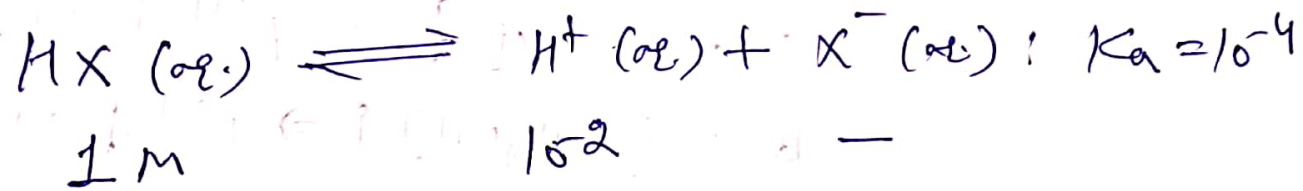
0.1 moles \times 0.1 = $\frac{M_1 V_1}{M_2 V_2}$
 \times \times 0.25

0.1 moles at equivalence point

(Salt of W.A & S.B.) $C = \frac{0.1}{\frac{100}{1000} + 0.4} = \frac{1}{5} = 0.2 M$
 $pH = 7 + \frac{1}{2} pK_a + \frac{1}{2} \log C = 8.65$

• (16.) Mixing of S.A (HCl) & W.A (HX)

$$[HCl] = \frac{10^{-3}}{(100/1000)} = 10^{-2} M$$



$$(1-x) \approx 1 \quad (10^{-2} + x) \quad x$$

$$K_a = 10^{-4} = \frac{(10^{-2} + x) x}{1}$$

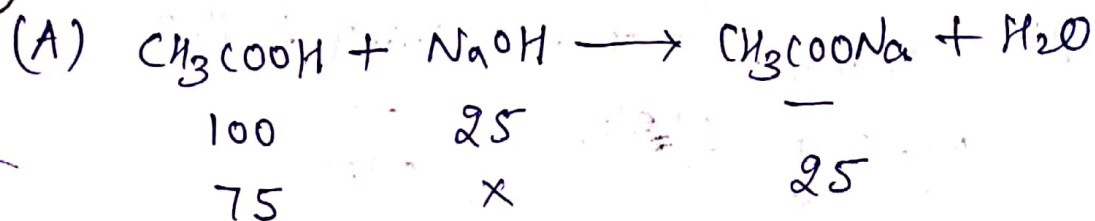
$$10^{-4} = 10^{-2}x + x^2$$

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

$$x = 0.62 \times 10^{-2}$$

$$[H^+] = 10^{-2} + x = 1.62 \times 10^{-2} M$$

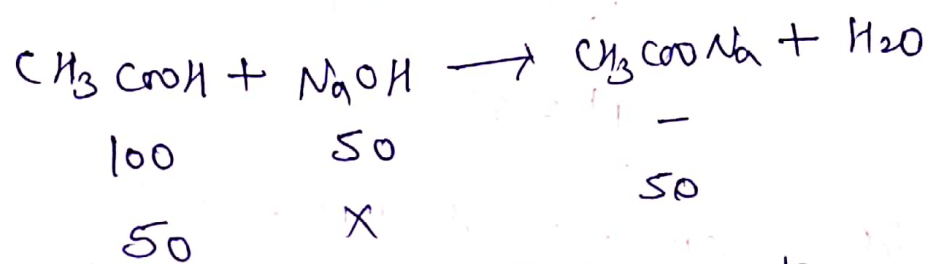
17.



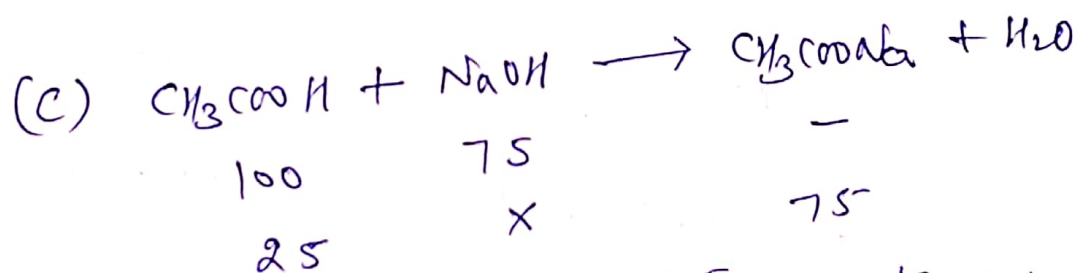
$$\text{pH} = \text{pK}_a + \log \left(\frac{S}{A} \right) = \text{pK}_a + \log \left(\frac{25}{75} \right)$$

$$= \text{pK}_a - \log 3$$

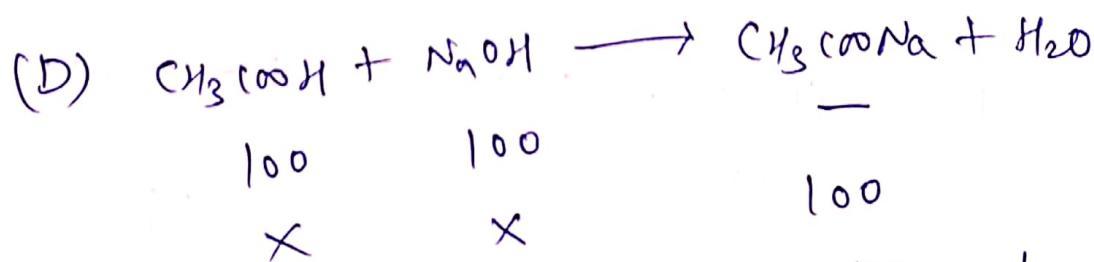
(B)



$$\text{pH} = \text{pK}_a + \log \left(\frac{50}{50} \right) = \text{pK}_a$$



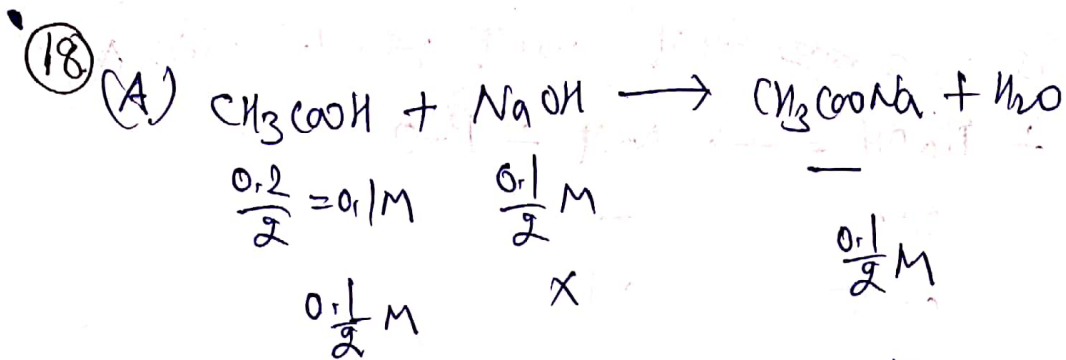
$$\text{pH} = \text{pK}_a + \log \left(\frac{75}{25} \right) = \text{pK}_a + \log 3$$



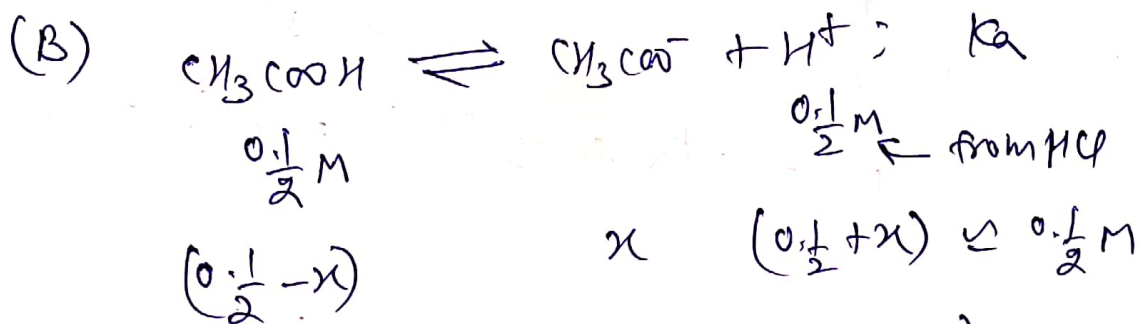
$$C = \frac{100}{200} = \frac{1}{2} \text{M}$$

$$\text{pH} = 7 + \frac{1}{2} \text{pK}_a + \frac{1}{2} \log C$$

$$= \frac{1}{2} [\text{pK}_w + \text{pK}_a - \log 2]$$

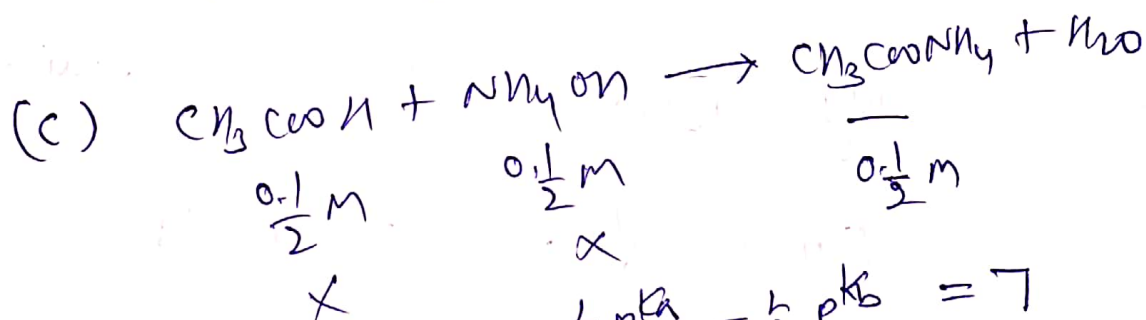


$$\text{pH} = \text{pK}_a + \log\left(\frac{\text{S/A}}{1}\right) = \text{pK}_a = 5$$



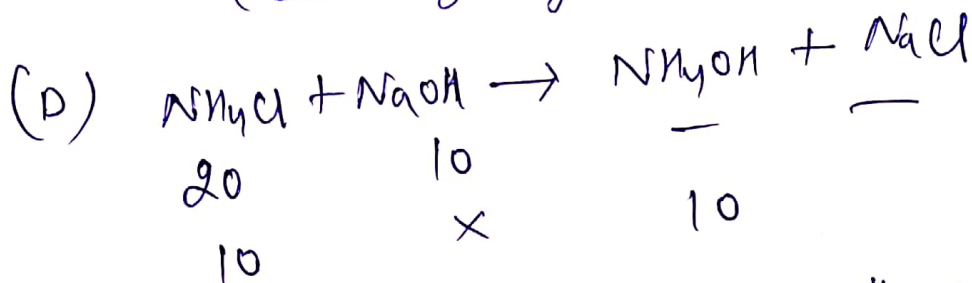
(x is negligible as $\frac{K_a}{C} \leq 10^{-3}$)

$$[\text{H}^+] = 0.1 \text{ M} \Rightarrow \text{pH} = 1 + \log 2 = 1.3$$



$$\text{pH} = 7 + \frac{1}{2}\text{pK}_a - \frac{1}{2}\text{pK}_b = 7$$

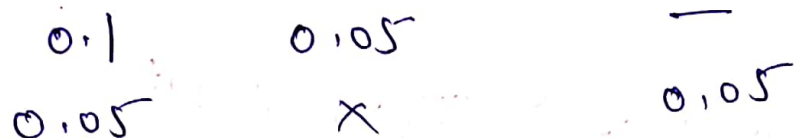
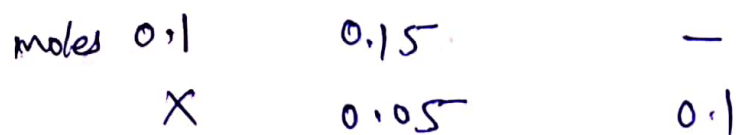
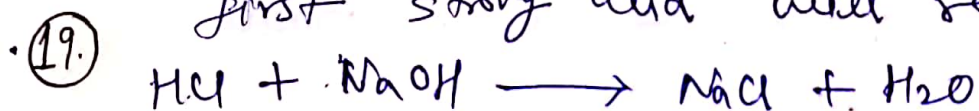
(Salt hydrolysis)



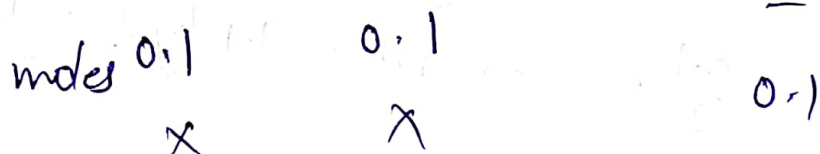
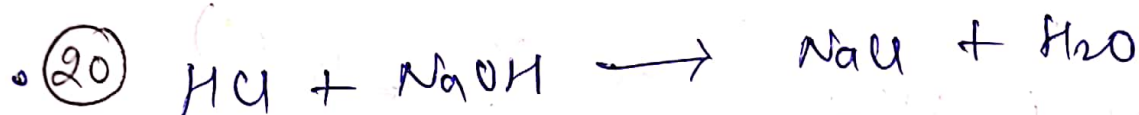
$$\text{pOH} = \text{pK}_b = 5 \Rightarrow \text{pH} = 9$$

as $[\text{NH}_4\text{OH}] = [\text{NH}_4\text{Cl}] \Rightarrow$ Buffer capacity is maximum.

first strong acid will react with NaOH



$$\text{pH} = \text{pKa} + \log\left(\frac{\text{S}}{\text{A}}\right) = \text{pKa} = 5$$



only CH_3COOH remain in soln. with $C = \frac{0.2}{2} = 0.1\text{M}$

$$[\text{H}^+] = \sqrt{K_a \cdot C} = 10^{-3}\text{M}$$

$$\text{pH} = 3$$