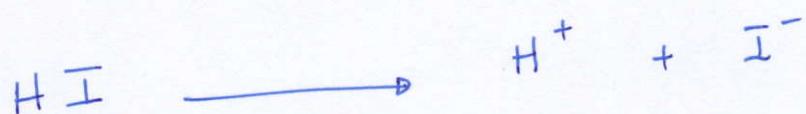
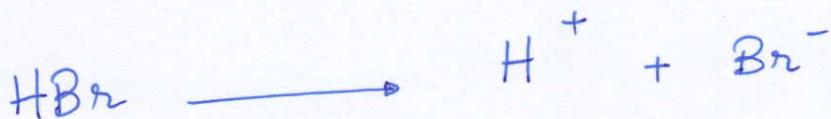


Chapter 14 - Acids and Bases

14.54



$$n_{\text{HBr}} = [\text{HBr}] \times V_{\text{HBr}} = 0.05 \times 0.05 = 2.5 \times 10^{-3} \text{ mol}$$

$$n_{\text{HI}} = [\text{HI}] \times V_{\text{HI}} = 0.1 \times 0.15 = 1.5 \times 10^{-2} \text{ mol}$$

$$\Rightarrow n_{\text{Br}^-} = 2.5 \times 10^{-3} \text{ mol}$$

$$n_{\text{I}^-} = 1.5 \times 10^{-2} \text{ mol}$$

$$n_{\text{H}^+} = n_{\text{H}^+_1} + n_{\text{H}^+_2} = 2.5 \times 10^{-3} + 1.5 \times 10^{-2} = 1.75 \times 10^{-2} \text{ mol}$$

$$\Rightarrow [\text{Br}^-] = \frac{n_{\text{Br}^-}}{V_t} = \frac{2.5 \times 10^{-3}}{0.2} = 1.25 \times 10^{-2} \text{ M}$$

$$[\text{I}^-] = \frac{n_{\text{I}^-}}{V_t} = \frac{1.5 \times 10^{-2}}{0.2} = 7.5 \times 10^{-2} \text{ M}$$

$$[\text{H}^+] = \frac{n_{\text{H}^+}}{V_t} = \frac{1.75 \times 10^{-2}}{0.2} = 8.75 \times 10^{-2} \text{ M}$$

$$[\text{OH}^-] = \frac{K_w}{[\text{H}^+]} = \frac{10^{-14}}{8.75 \times 10^{-2}} = 1.14 \times 10^{-13} \text{ M}$$

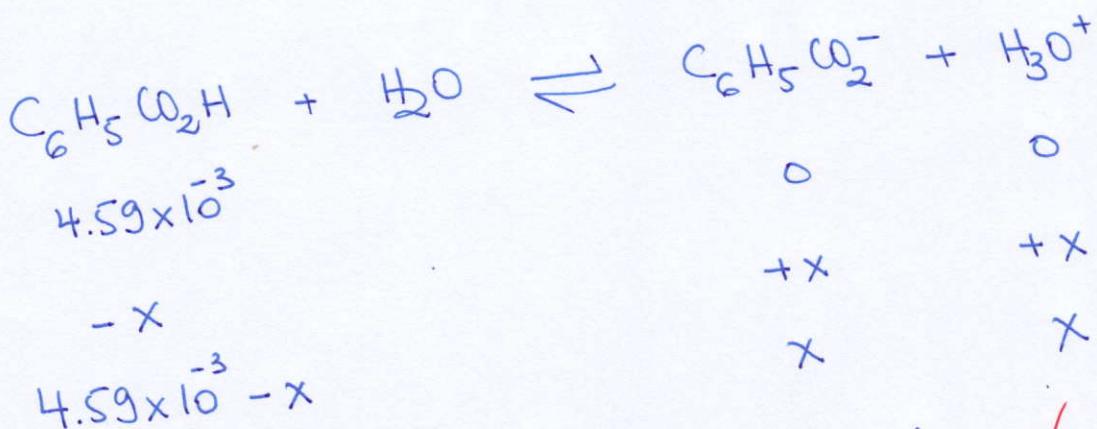
14.66

(BA)

0.56 g Benzoic Acid, $C_6H_5CO_2H$, MW = 122.12 g/mol

$$K_a = 6.4 \times 10^{-5}$$

$$\Rightarrow n_{BA} = \frac{0.56}{122.12} = 4.59 \times 10^{-3} \text{ mol} \Rightarrow [BA] = 4.59 \times 10^{-3} M$$



$$K_a = \frac{[C_6H_5CO_2^-][H_3O^+]}{[C_6H_5CO_2H]} = \frac{x^2}{4.59 \times 10^{-3} - x} \approx \frac{x^2}{4.59 \times 10^{-3}}$$

we consider
x is negligible
compared to
 4.59×10^{-3}

$$\Rightarrow x = 5.42 \times 10^{-4}$$

By comparing x to the initial concentration of BA

$$\frac{5.42 \times 10^{-4}}{4.59 \times 10^{-3}} = 0.118 = 11.8\% \quad \text{approximation not acceptable}$$

$$\Rightarrow \frac{x^2}{4.59 \times 10^{-3} - x} = K_a = 6.4 \times 10^{-5} \quad \text{Solve as quadratic eq.}$$

$$\Rightarrow x_1 = 5.11 \times 10^{-4}$$

$$\cancel{x_2 = -5.11 \times 10^{-4}}$$

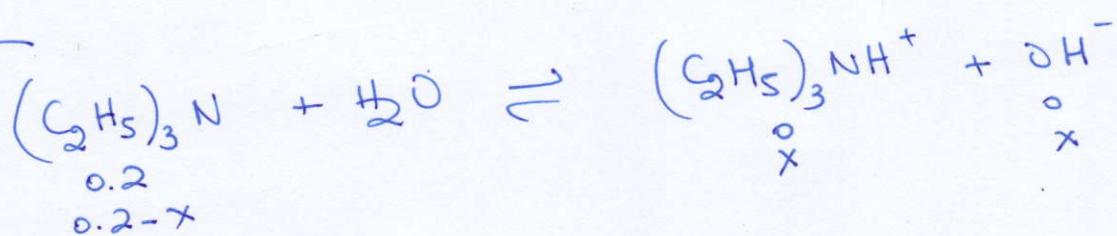
$$\Rightarrow [C_6H_5COO^-] = [H_3O^+] = 5.11 \times 10^{-4} M$$

$$[C_6H_5COOH] = 4.59 \times 10^{-3} - 5.11 \times 10^{-4} = 4.08 \times 10^{-3} M$$

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{10^{-14}}{5.11 \times 10^{-4}} = 1.96 \times 10^{-11} M$$

$$pH = -\log [H_3O^+] = 3.29$$

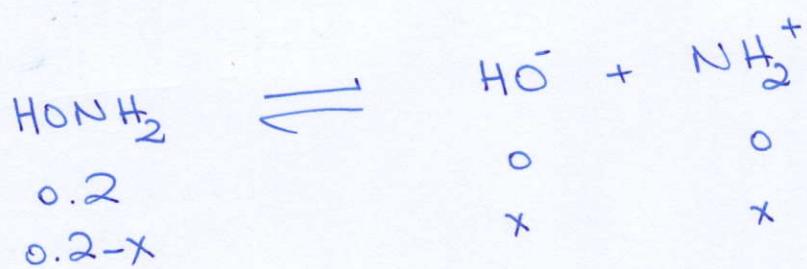
14.95



$$K_b = \frac{[(C_2H_5)_3NH^+] [OH^-]}{[(C_2H_5)_3N]} = \frac{x^2}{0.2-x} \approx \frac{x^2}{0.2}$$

$$\Rightarrow x = 8.94 \times 10^{-3} \quad (\text{app. accepted } 4.47\%)$$

$$\Rightarrow [OH^-] = 8.94 \times 10^{-3} M \quad [H^+] = 1.12 \times 10^{-12} M \quad pH = 11.95$$

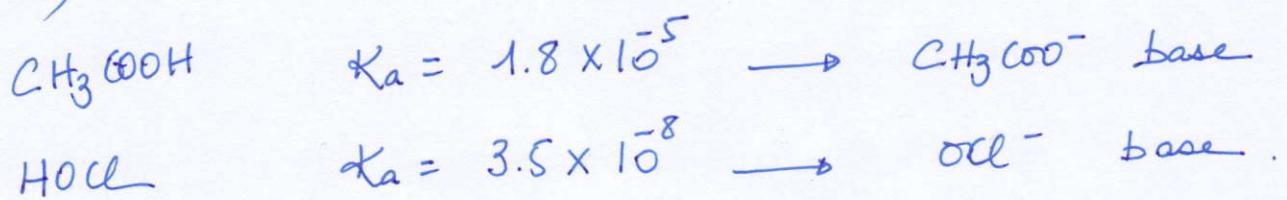


$$K_b = \frac{[OH^-] [NH_2^+]}{[HONH_2]} = \frac{x^2}{0.2-x} \approx \frac{x^2}{0.2}$$

$$\Rightarrow x = 4.69 \times 10^{-5} \quad (\text{app. accepted } 0.023\%)$$

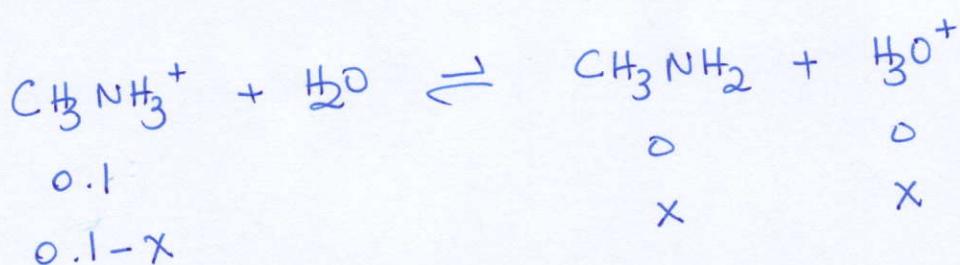
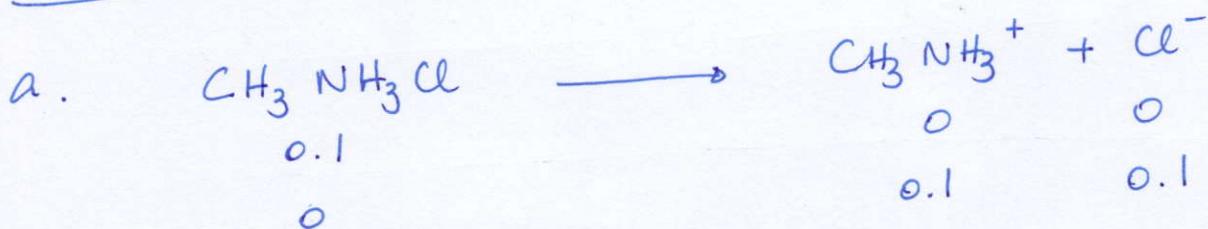
$$\Rightarrow [OH^-] = 4.69 \times 10^{-5} M \quad [H^+] = 2.13 \times 10^{-10} M \quad pH = 9.67$$

14.113



Larger $K_a \Rightarrow$ Stronger acid \Rightarrow the conjugate
 base is weaker \Rightarrow CH_3COO^- is a weaker base
 than OCl^- .
 $\Rightarrow \text{OCl}^-$ is the stronger base.

14.117



$$K_a = \frac{[\text{CH}_3\text{NH}_2][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{NH}_3^+]} = \frac{x^2}{0.1-x} \approx \frac{x^2}{0.1}$$

$$K_a = \frac{K_w}{K_b(\text{CH}_3\text{NH}_2)} = \frac{10^{-14}}{4.38 \times 10^{-6}} = 2.28 \times 10^{-11}$$

$$\Rightarrow \frac{x^2}{0.1} = 2.28 \times 10^{-11} \Rightarrow x = 1.51 \times 10^{-6} \quad \text{app. accepted}$$

$$\Rightarrow [\text{H}_3\text{O}^+] = 1.51 \times 10^{-6} \text{ M} \Rightarrow \text{pH} = 5.82$$

Na CN

Na $\text{C}_2\text{H}_3\text{O}_2$

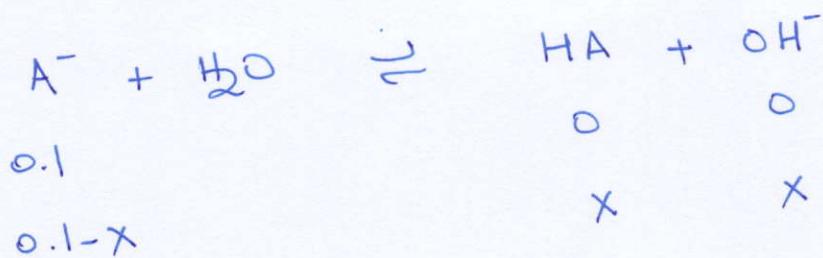
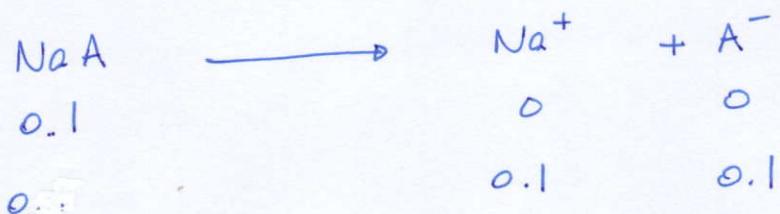
Na F

Na Cl

Na OCl

the 5 salts are in the form Na A .

$$\text{pH} = 8.07 \Rightarrow [\text{H}_3\text{O}^+] = 10^{-8.07} \Rightarrow [\text{OH}^-] = \frac{10^{-14}}{10^{-8.07}} = 1.17 \times 10^{-6} \text{ M}$$



$$K_b = \frac{[\text{HA}][\text{OH}^-]}{[\text{A}^-]} = \frac{[\text{OH}^-]^2}{[\text{A}^-]} = \frac{(1.17 \times 10^{-6})^2}{0.1} = 1.37 \times 10^{-11}$$

$$K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{1.37 \times 10^{-11}} = 7.3 \times 10^{-4}$$

Let us now compare the K_a calculated to what exists in the table 14.2 in your book.

$$\text{HCN} \quad K_a = 6.2 \times 10^{-10}$$

$$\text{H} \text{C}_2\text{H}_3\text{O}_2 \quad K_a = 1.8 \times 10^{-5}$$

$$\text{HF} \quad K_a = 7.2 \times 10^{-4}$$

HCl strong acid

$$\text{HOCl} \quad K_a = 3.5 \times 10^{-8}$$

\Rightarrow the salt is Na F