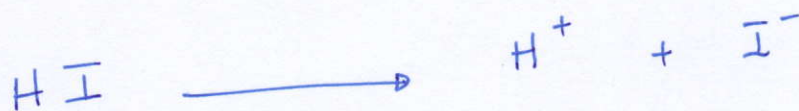


# Chapter 14 - Acids and Bases

14.54



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

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

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

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

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

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

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

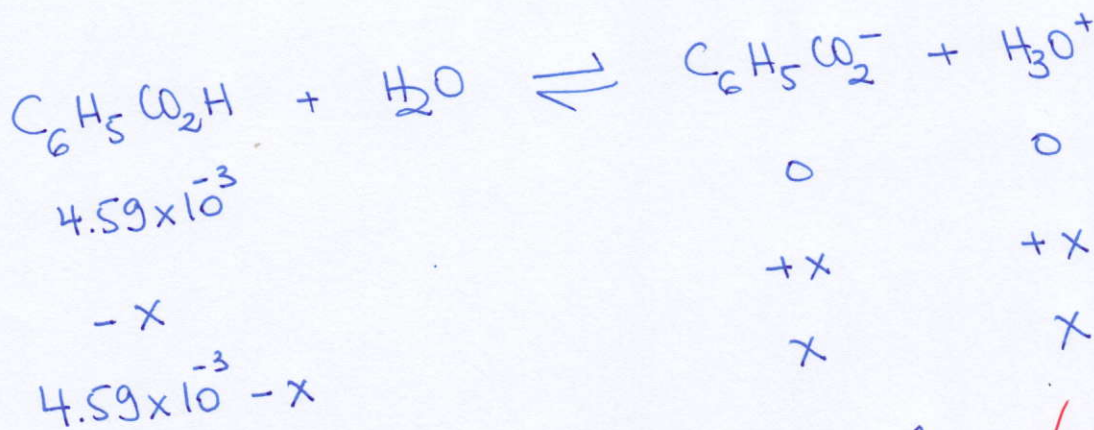
$$[\text{H}^+] = \frac{n_{\text{H}^+}}{V_t} = \frac{1.75 \times 10^{-2}}{0.2} = 8.75 \times 10^{-2} \text{ M}$$

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

14.66

0.56 g Benzoic Acid,  $(BA)$   $C_6H_5CO_2H$ ,  $MW = 122.12$  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  $4.59 \times 10^{-3}$

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

By comparing  $x$  to the initial concentration of BA

$$\frac{5.42 \times 10^{-4}}{4.59 \times 10^{-3}} = 0.118 = 11.8\%$$

approximation not acceptable

$$\Rightarrow \frac{x^2}{4.59 \times 10^{-3} - x} = K_a = 6.4 \times 10^{-5}$$

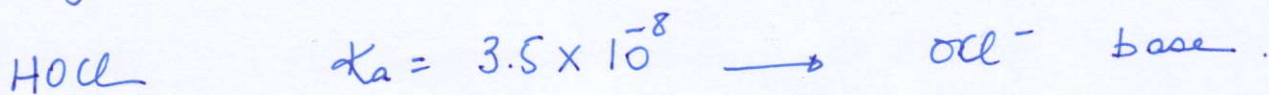
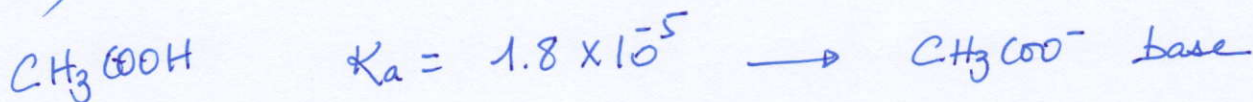
Solve as quadratic eq.

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

$$x_2 = -5.75 \times 10^{-4}$$



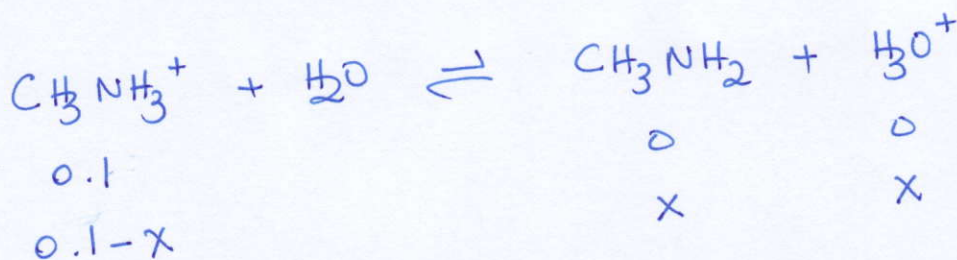
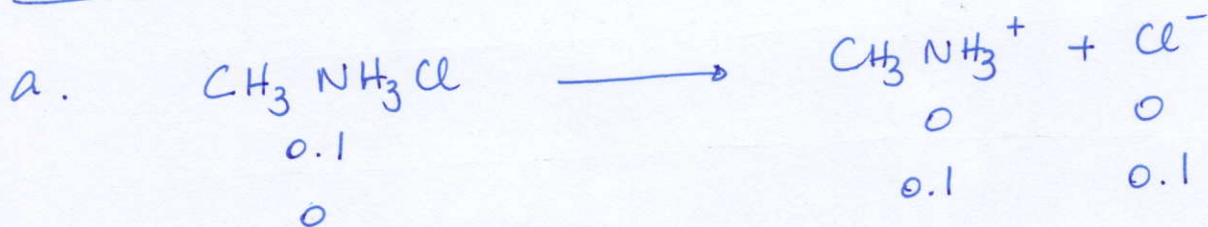
14.113



Larger  $K_a \Rightarrow$  stronger acid  $\Rightarrow$  the conjugate base is weaker  $\Rightarrow$   $\text{CH}_3\text{COO}^-$  is a weaker base than  $\text{OCl}^-$ .

$\Rightarrow$   $\text{OCl}^-$  is the stronger base.

14.117



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

$$K_a = \frac{K_w}{K_b(\text{CH}_3\text{NH}_2)} = \frac{10^{-14}}{4.38 \times 10^{-4}} = 2.28 \times 10^{-11}$$

$$\Rightarrow \frac{x^2}{0.1} = 2.28 \times 10^{-11} \Rightarrow x = 1.51 \times 10^{-6}$$

app. accepted

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

14.119

NaCN

NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>

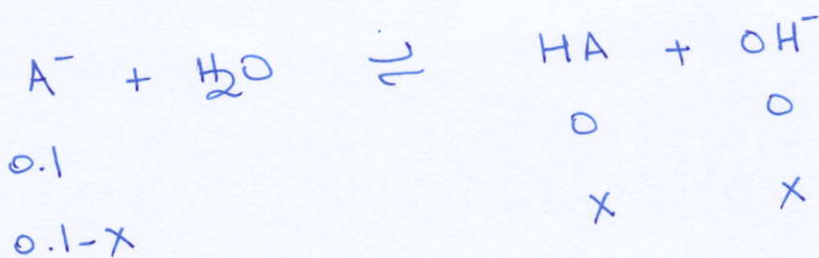
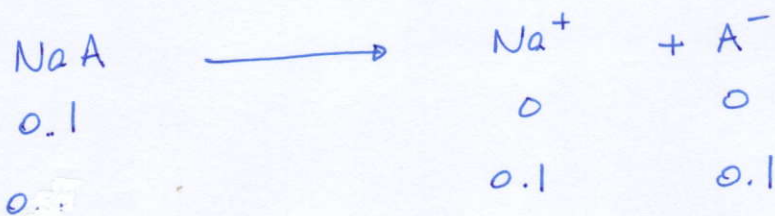
NaF

NaCl

NaOCl

the 5 salts are in the form NaA.

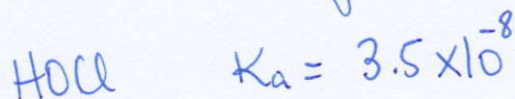
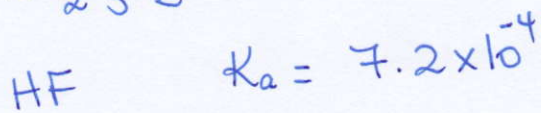
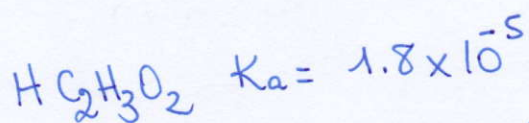
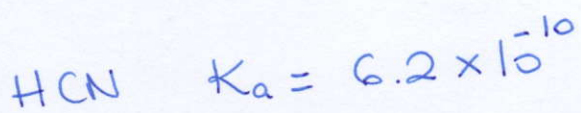
$$pH = 8.07 \Rightarrow [H_3O^+] = 10^{-8.07} \Rightarrow [OH^-] = \frac{10^{-14}}{10^{-8.07}} = 1.17 \times 10^{-6} M$$



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

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

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



} ⇒ the salt is NaF