$HC_6H_5CO_2 \rightleftharpoons H^+ + C_6H_5CO_2^-$

4. Benzoic acid, $HC_6H_5CO_2$, is an organic acid whose sodium salt, $NaC_6H_5CO_2$, has long been used as a safe food additive to protect beverages and many foods against harmful yeasts and bacteria. The acid is monoprotic. Write the equation for its K_a.

$HC_6H_5CO_{2(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + C_6H_5CO_2^-{}_{(aq)}$ (1)

$$K_a = \frac{[H_3O^+][C_6H_5CO_2^-]}{[HC_6H_5CO_2]}$$ (1)

5. The $[H^+]$ of a 0.10 M solution of cyanic acid (HCNO) is found to be 0.0010 M. Calculate the K_a for cyanic acid.

0.10 M 0.0010 M
$HCNO \leftrightarrow H^+ + CNO^-$

$$K_a = \frac{[H^+][CNO^-]}{[HCNO]}$$ (1)

$$= \frac{[0.0010\ M][0.0010\ M]}{[0.10\ M]}$$ (1)

$= 1.0 \times 10^{-5}$ (1)

6. If 1.22 grams of benzoic acid, $HC_6H_5CO_2$, is dissolved in 1.0 L of water, the $[H^+]$ is found to be 8.0×10^{-4} M. Calculate the K_a for benzoic acid.

$HC_6H_5CO_2 \rightleftharpoons H^+ + C_6H_5CO_2^-$

$HC_6H_5CO_2 \leftrightarrow H^+ + C_6H_5CO_2^-$

$\frac{1.22\ g}{122.32\ g} \cdot mol \times \frac{1}{1.0\ L} = 1.0 \times 10^{-2}\ mol/L$ (1)

$$K_a = \frac{[H^+][C_6H_5CO_2^-]}{[HC_6H_5CO_2]}$$ (1)

$$(1) = \frac{[8.0 \times 10^{-4}\ M]^2}{[1.0 \times 10^{-2}\ M]} = 6.4 \times 10^{-5}$$ (1)

7. A 0.0050 M solution of butyric acid, HC_4H_7, has a pH =4.0, calculate K_a.

$HC_4H_7O \leftrightarrow H^+ + C_4H_7O_2^-$ $pH = 4.0$ (1)
$[H^+] = 1 \times 10^{-4}\ mol/L$

$$K_a = \frac{[H^+][C_4H_7O_2^-]}{[HC_4H_7O]}$$ (1)

$$= \frac{[1.0 \times 10^{-4}\ M]^2}{[0.0050\ M]} = 2.0 \times 10^{-6}$$
(1) (1)

8. Determine the $[OH^-]$ and the $[H^+]$ of a 0.20 M solution of formic acid. The $K_a = 1.8 \times 10^{-4}$

$HCOOH \leftrightarrow H^+ + HCOO^-$

$$K_a = \frac{[H^+][HCOO^-]}{[HCOOH]}$$ (1)

$$1.8 \times 10^{-4} = \frac{[x][x]}{[0.20\ M]}$$ (1)

$[H^+] = 6.0 \times 10^{-3}\ mol/L$ (1)

$[H^+][OH^-] = 1.0 \times 10^{-14}$

$$[OH^-] = \frac{1.0 \times 10^{-14}}{6.0 \times 10^{-3}\ mol/L}$$ (1)

$= 1.7 \times 10^{-12}\ mol/L$

(17/16)