Homework - Worksheet

(3)

$NaOH_{(aq)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$

4.33 mol/L 4.33 mol/L

$26\,g\ NaOH \times \frac{1\ mol\ NaOH}{40.00\,g\ NaOH} = 0.65\ mol\ NaOH$

pH = ?

pOH = ?

$C = \frac{n}{V} = \frac{0.65\ mol}{0.150\ L} = 4.33\ mol/L$

$pOH = -\log[OH^-_{(aq)}]$

$pOH = -\log[4.33]$

$pOH = -0.64$

$pH + pOH = 14.00$

$pH = 14.00 - (-0.64)$

$pH = 14.64$

$pH < 7$ ACIDIC

$pH > 7$ BASIC

$pH = 7$ NEUTRAL

$pH = 11.5$

$V = 500.\text{mL}$

$pH + pOH = 14.00$

$pOH = 14.00 - 11.5$

$\boxed{pOH = 2.5}$

$[OH^-_{(aq)}] = 10^{-pOH}$

$[OH^-_{(aq)}] = 10^{-2.5}$

$[OH^-_{(aq)}] = 3.16 \times 10^{-3}\text{M}$

$$KOH_{(aq)} \longrightarrow K^+_{(aq)} + OH^-_{(aq)}$$

$3.16 \times 10^{-3}\text{M}$ $\qquad$ $3.16 \times 10^{-3}\text{M}$

$$\frac{3.16 \times 10^{-3}\ \text{mol KOH}}{1\ \text{L KOH}} \times 0.500\ \text{L KOH} \times \frac{56.11\ \text{g KOH}}{1\ \text{mol KOH}}$$

$$= \boxed{0.09\ \text{g KOH}}$$

Ionization Constants for Acids

Strong acids - ionizes quantitatively in water to form hydronium ions

$$HCl_{(aq)} + H_2O_{(l)} \longrightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$$

Weak acids - ionizes partially in water to form hydronium ions

$$CH_3COOH_{(aq)} + H_2O_{(l)} \longleftrightarrow H_3O^+_{(aq)} + CH_3COO^-_{(aq)}$$

To describe the equilibrium of acids in water, the equilibrium law is used to calculate the acid ionization constant, K_a.

$$CH_3COOH_{(aq)} + H_2O_{(l)} \longleftrightarrow H_3O^+_{(aq)} + CH_3COO^-_{(aq)}$$

$$K = \frac{[H_3O^+_{(aq)}][CH_3COO^-_{(aq)}]}{[CH_3COOH_{(aq)}][H_2O_{(l)}]}$$

$$K[H_2O_{(l)}] = \frac{[H_3O^+_{(aq)}][CH_3COO^-_{(aq)}]}{[CH_3COOH_{(aq)}]}$$

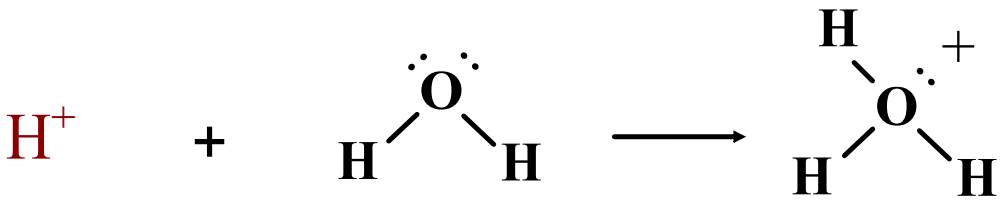
$$K_a = \frac{[H_3O^+_{(aq)}][CH_3COO^-_{(aq)}]}{[CH_3COOH_{(aq)}]}$$

$$H_2O_{(l)} \rightleftharpoons H^+ + OH^-$$

$$K = \frac{[H^+][OH^-]}{[H_2O]}$$

$$K[H_2O] = [H^+][OH^-]$$

$$K_w = [H^+][OH^-]$$



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

$$[H_3O^+] = 10^{-pH}$$

$$[H_3O^+][OH^-] = 1.0 \times 10^{-14}$$

Ex. Predict the hydronium ion concentration, and pH of a 1.0 mol/L nitrous acid solution at equilibrium.

$$HNO_{2(aq)} + H_2O_{(l)} \rightleftharpoons NO_{2(aq)}^- + H_3O_{(aq)}^+$$

1.0 mol/L

$$K_a = \frac{[NO_{2(aq)}^-][H_3O_{(aq)}^+]}{[HNO_{2(aq)}]}, \quad [NO_{2(aq)}^-] = [H_3O_{(aq)}^+]$$

$$K_a = \frac{[H_3O_{(aq)}^+]^2}{[HNO_{2(aq)}]}$$

$$[H_3O_{(aq)}^+] = \sqrt{K_a [HNO_{2(aq)}]}$$

$$[H_3O_{(aq)}^+] = \sqrt{(7.2 \times 10^{-4})[1.0]}$$

$$[H_3O_{(aq)}^+] = 0.027\ M$$

$$pH = -\log[H_3O_{(aq)}^+]$$

Worksheet