Worksheet #3,4

STRONG BASE

④

KOH

V = 500.mL

pH = 11.5

m = ?

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

$3.16\times10^{-3}M$ $3.16\times10^{-3}M$

$pH + pOH = 14.0$

$pOH = 14.0 - 11.5$

$pOH = 2.5$

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

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

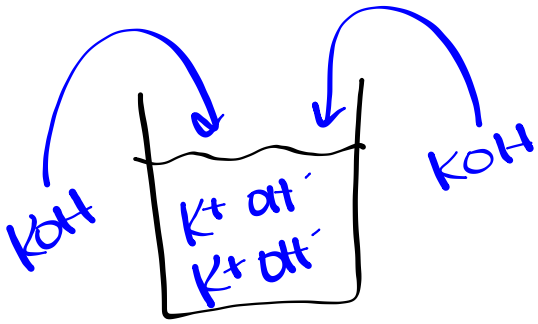
$[OH^-_{(aq)}] = 3.16\times10^{-3}M$

$C = \frac{n}{V}$

$n = (3.16\times10^{-3}mol/L)(0.500L)$

$n = 1.58\times10^{-3}mol$

$1.58\times10^{-3}mol\ KOH \times \frac{56.11g\ KOH}{1\ mol\ KOH} = \boxed{0.09g\ KOH}$


KOH
K+ OH-
K+ OH-
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

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

H^+

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

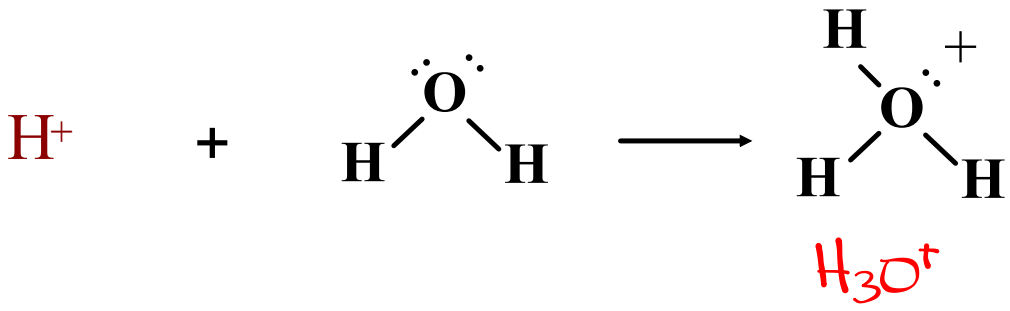
$$CH_3COOH_{(aq)} + H_2O_{(l)} \longleftrightarrow H_3O^+_{(aq)} + CH_3COO^-_{(aq)}$$

0.050M

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

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

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



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

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

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

WATER EQM

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

$K = \dfrac{[H^+_{(aq)}][OH^-_{(aq)}]}{[H_2O_{(l)}]}$

$K[H_2O_{(l)}] = [H^+_{(aq)}][OH^-_{(aq)}]$

$K_w = [H^+_{(aq)}][OH^-_{(aq)}]$

1.0×10^{-14}

WEAK ACID

$HA_{(aq)} + H_2O_{(l)} \rightleftharpoons A^-_{(aq)} + H_3O^+_{(aq)}$

$K = \dfrac{[A^-_{(aq)}][H_3O^+_{(aq)}]}{[HA_{(aq)}][H_2O_{(l)}]}$

$K[H_2O_{(l)}] = \dfrac{[A^-_{(aq)}][H_3O^+_{(aq)}]}{[HA_{(aq)}]}$

$K_a = \dfrac{[A^-_{(aq)}][H_3O^+_{(aq)}]}{[HA_{(aq)}]}$

specific for acid

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

WEAK ACID $HA + H_2O \rightleftharpoons A^- + H_3O^+$

$HNO_{2(aq)} + H_2O_{(l)} \rightleftharpoons NO_{2(aq)}^- + H_3O^+_{(aq)}$

1.0 M

$K_a = \frac{[NO_{2(aq)}^-][H_3O^+_{(aq)}]}{[HNO_{2(aq)}]}$, $[NO_{2(aq)}^-] = [H_3O^+_{(aq)}]$

$K_a = \frac{[H_3O^+_{(aq)}]^2}{[HNO_{2(aq)}]}$

$7.2 \times 10^{-4} = \frac{[H_3O^+_{(aq)}]^2}{[1.0]}$

$[H_3O^+_{(aq)}] = \sqrt{(7.2 \times 10^{-4})[1.0]}$

$[H_3O^+_{(aq)}] = 2.7 \times 10^{-2} M$

$pH = -\log[H_3O^+_{(aq)}]$

$pH = -\log[2.7 \times 10^{-2}]$

pH = 1.57

Homework

Worksheet

The pH of a 0.25 mol/L carbonic acid solution at equilibrium is found to be 3.48. Calculate the K_a.

Calculate the pH of a 0.410 mol/L solution of phosphoric acid.