CH 223 – Worksheet 1

1. Give the conjugate acid or base of the following: a) CN^-, b) HPO_4^{2-}, c) HIO_3 d) NH_4^+, e) $C_2H_5NH_2$

a) HCN c) IO_3^- e) $C_2H_5NH_3^+$

b) PO_4^{2-} d) NH_3

2. Predict whether aqueous solutions of the following substances are acidic, basic, or neutral: a) $CrBr_3$, b) LiI, c) K_3PO_4, d) KCN e) NH_4^+

basic basic basic acidic

acidic small charged metal

3. Briefly define the following terms:

Common-Ion Effect: When a common ion is added to a system at equilibrium there will be a shift in products & reactants CH_3COOH & KCH_3COO^- the common ion is CH_3COO^-

Brønsted-Lowry acid and base: acid donates H^+ $\Rightarrow HClO_4 \rightarrow H^+ + ClO_4^-$

base accepts H^+ $\Rightarrow NH_3 \rightarrow NH_4^+ + OH^-$

A Strong acid: dissociates completely, example HNO_3

4. Calculate the pH of the following acid solutions: a) 0.00835 M HNO_3, b) 0.525 g of $HClO_4$ in 575 mL of solution, c) 0.0842 M $Ca(OH)_2$ M.

a) HNO_3 strong acid

$pH = -\log[H^+] = -\log(0.00835)$

$= 2.07$

b) $HClO_4$ strong acid $MM = 100.459 \frac{g}{mol}$

$(0.525\,g)\left(\frac{1\,mol}{100.459\,g}\right) = 0.00523\,mol$

$[HClO_4] = \frac{0.00525\,mol}{0.575\,L} = 9.1 \times 10^{-3} \frac{mol}{L}$

$\therefore pH = -\log(9.1 \times 10^{-3}) = 2.04$

c) $Ca(OH)_2$ strong base

$\therefore$ Assume it all dissolves then $pOH = -\log[OH^-] = -\log(2 \cdot 0.0842) = 0.774$

$pH = 14 - 0.774 = 13.2$

5. Calculate the molar concentration of OH^- ions in 0.5 M solution of hypobromite ion BrO^-, $K_a = 2.5.0 \times 10^{-9}$. What is the pH of the solution?

$BrO^-(aq) \rightleftharpoons HBrO + OH^-$ $\quad K_a \cdot K_b = K_w \therefore K_b = \frac{1.0 \times 10^{-14}}{2.5 \times 10^{-9}} = 4.0 \times 10^{-6}$

	0.5 M	0	0
	$-x$	$+x$	$+x$
	$0.5 - x$	x	x

relatively small ↓

$K_b = \frac{[HBrO][OH^-]}{[BrO^-]} = \frac{x^2}{0.5 - x} = 4.0 \times 10^{-6}$

relatively large

$x = \sqrt{(0.5 - x)(4.0 \times 10^{-6})} = 2.0 \times 10^{-6}$

$\% \text{ ionization} = \frac{2.0 \times 10^{-6}}{0.5} \times 100\% = 5.2 \times 10^{-4}\%$

$\therefore pOH = -\log[OH^-] = -\log(2.0 \times 10^{-6}) = 5.70$

$\therefore pH = 14 - 5.70 = 8.30$