CH 223 – Worksheet 1

1. Give the conjugate acid or base of the following: a) CN⁻, b) HPO₄²⁻, c) HIO₃, d) NH₄⁺, e) C₂H₅NH₂
   a) HCN               c) FO³⁻ e) C₂H₅NH₃⁺
   b) PO₄³⁻              d) NH₃

2. Predict whether aqueous solutions of the following substances are acidic, basic, or neutral: a) CrBr₃, b) Li⁺, c) K₃PO₄, d) KClO₄. e) NH₄⁺
   acidic basic basic basic acidic

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:
   CH₃COON & KCl: CH₃COO⁻ – the common ion is CH₃COO⁻

   Bronsted-Lowry acid and base:
   acid donates H⁺ ⇒ HClO₄ → H⁺ + ClO₄⁻
   base accepts H⁺ ⇒ NH₃ + H⁺ ⇒ NH₄⁺ + OH⁻

   A Strong acid: dissociates completely; example HNO₃

4. Calculate the pH of the following acid solutions: a) 0.00835 M HNO₃, b) 0.525 g of HClO₄ in 575 mL of solution, c) 0.0842 M Ca(OH)₂ M.
   a) HNO₃ strong acid
   pH = -log[H⁺] = -log(0.00835) = 2.04

   b) HClO₄ strong acid
   M = 100.459 g mol⁻¹
   (0.525 g) (1 mol / 100.459 g) = 0.00525 mol L⁻¹
   [HClO₄] = 0.00525 mol L⁻¹
   pH = -log(0.00525) = 2.04

   c) Ca(OH)₂ strong base

   Assume it all dissolves then \[ \text{pOH} = -\log(9.1 \times 10^{-3}) = 2.04 \]

5. Calculate the molar concentration of OH⁻ ions in 0.5 M solution of hypobromite ion BrO⁻, \[ K_b = 2.5 \times 10^{-9} \]. What is the pH of the solution?

   \[ K_a' = K_w \quad K_b = \frac{1.0 \times 10^{-14}}{2.5 \times 10^{-9}} = 4.0 \times 10^{-6} \]

   \[ K_b = \frac{[HBrO][OH⁻]}{[BrO⁻]} \]

   \[ [HBrO][OH⁻] = 4.0 \times 10^{-6} \]

   \[ x = \frac{[HBrO]}{[BrO⁻]} = 0.5 \times 0.5 \]

   \[ x = \frac{4.0 \times 10^{-6}}{0.5} = 8.0 \times 10^{-7} \]

   \[ \text{pH} = 14 - \log(8.0 \times 10^{-7}) = 13.2 \]