REVIEW QUESTIONS
Chapter 10

1. For each reaction shown below, determine the Brønsted-Lowry acid and base and their conjugates:

A) $H_3BO_3 + H_2O \rightleftharpoons H_3O^+ + H_2BO_3^-$

**acid** **base** **acid** **base**

B) $HCO_3^- + OH^- \rightleftharpoons H_2O + CO_3^{2-}$

**acid** **base** **acid** **base**

C) $CN^- + H_2O \rightleftharpoons HCN + OH^-$

**base** **acid** **acid** **base**

2. Identify the Brønsted-Lowry acid for each base shown below:

a) $NO_3^-$ **$HNO_3$** b) $OH^-$ **$H_2O$**

c) $SO_4^{2-}$ **$HSO_4^-$** d) $CH_3O^-$ **$CH_3OH$**

e) $O^{2-}$ **$OH^-$** f) $HPO_4^{2-}$ **$H_2PO_4^-$**

3. Identify the Brønsted-Lowry base for each acid shown below:

a) $NH_3$ **$NH_2^-$** b) $H_2SO_4$ **$HSO_4^-$**

c) $HS^-$ **$S^{2-}$** d) HClO **$ClO^-$**

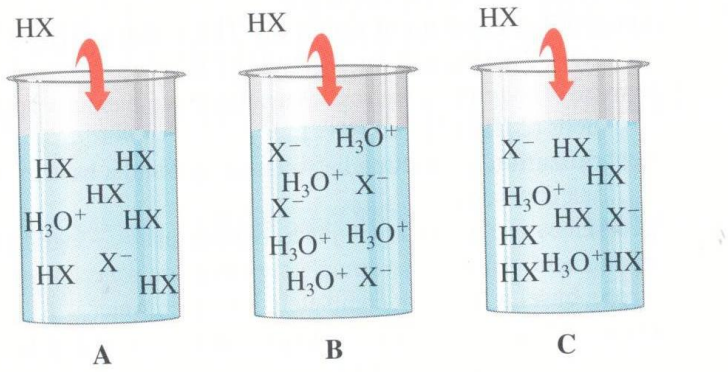
e) $HNO_2$ **$NO_2^-$** f) $H_2O$ **$OH^-$**

4. Each diagram below represents an acid solution with the formula HX. For each solution, determine if it is a strong acid or a weak acid.

**A) Weak acid (mostly molecules)**

**B) Strong acid (only ions)**

**C) Weak acid (mostly molecules)**




5. Complete the missing information in the table below:

| $[H_3O^+]$ | $[OH^-]$ | Acidic/Basic |
|---|---|---|
| $1.0 \times 10^{-12}$ | **$1.0 \times 10^{-2}$** | **Basic** |
| $3.8 \times 10^{-4}$ | **$2.6 \times 10^{-11}$** | **Acidic** |
| **$2.4 \times 10^{-11}$** | $4.2 \times 10^{-4}$ | **Basic** |
| **$1.0 \times 10^{-5}$** | $1.0 \times 10^{-9}$ | **Acidic** |
| $6.5 \times 10^{-8}$ | **$1.5 \times 10^{-7}$** | **Basic** |

**Sample calculations:**

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{1.0 \times 10^{-14}}{3.8 \times 10^{-4}} = 2.6 \times 10^{-11}$$

$$[H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1.0 \times 10^{-14}}{4.2 \times 10^{-4}} = 2.4 \times 10^{-11}$$

6. Identify each of the substances below as **strong electrolyte**, **weak electrolyte** or **non-electrolyte**:

a) KCl **strong electrolytes** b) $HNO_3$ **strong electrolyte**

c) $CH_3OH$ **non-electrolytes** d) HF **weak electrolyte**

e) $H_3PO_4$ **weak electrolytes**

7. What are the $[H_3O^+]$ and $[OH^-]$ for a solution with the following pH values?

a) 4.10

$$[H_3O^+] = \text{antilog}\,(-4.10) = 7.9 \times 10^{-5}\ M$$

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{1.0 \times 10^{-14}}{7.9 \times 10^{-5}} = 1.3 \times 10^{-10} M$$

b) 9.80

$$[H_3O^+] = \text{antilog}\,(-9.80) = 1.6 \times 10^{-10}\ M$$

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{1.0 \times 10^{-14}}{1.6 \times 10^{-10}} = 6.3 \times 10^{-5} M$$

8. What is the pH of a solution that contains 1.54 g of $HNO_3$ in 0.500 L of solution?

$$[H_3O^+] = [HNO_3] = 1.54\ g \times \frac{1\ mol}{63.01\ g} \times \frac{1}{0.500\ L} = 0.0489\ M$$

$$pH = -\log(0.0489) = 1.311 \quad \text{(3 sig figs)}$$

9. What is the pH of a solution prepared by dissolving 1.00 g of $Ca(OH)_2$ in enough water to make 875 mL of solution?

$$[OH^-] = 2\,[Ca(OH)_2] = 1.00\ g \times \frac{1\ mol}{74.03\ g} \times \frac{1}{0.875\ L} = 0.0154\ M$$

$$[H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1.0 \times 10^{-14}}{0.0154} = 6.49 \times 10^{-13} M$$

$$pH = -\log(6.49 \times 10^{-13}) = 12.188 \quad \text{(3 sig figs)}$$

**Alternately**

$$[OH^-] = 0.0154\ M$$

$$pOH = -\log(0.0154) = 1.812$$

$$pH = 14.000 - 1.812 = 12.188 \quad \text{(3 sig figs)}$$