# Exercise 14.3a

## Acid-Base Theories and Reactions

Name: _____

Date: _____ Per: _____

***DIRECTIONS: Answer the following in the space provided.***

1. Summarize the three main acid-base theories in the table below:

| | Acid | Base |
|---|---|---|
| Arhennius Model: | | |
| Brønsted-Lowry Model: | | |
| Lewis Model: | | |

2. Acids may donate one or more _____ when they ionize. An acid capable of donating only one of these particles is referred to as _____ , whereas acids that donate more than one are referred to as _____ . $H_2SO_4$ is considered a(n) _____ acid because it donates _____ of these particles and $H_3PO_3$ is considered a(n) _____ acid because it donates _____.

3. Acids that donate multiple protons in solution do so _____. Each ionization requires additional _____ because the anion produced from the previous ionization exerts a greater _____ on the remaining protons. This means that in each step, the acid becomes _____.

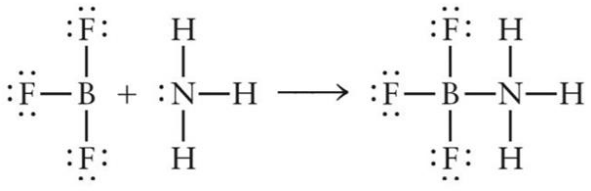
4. For the following polyprotic acids, write the equations for each ionization step.

| | $H_3PO_4$ | $H_2CO_3$ |
|---|---|---|
| Step 1 | | |
| Step 2 | | |
| Step 3 | | |

$HCl + H_2O \rightarrow H_3O^+ + Cl^-$ $NH_3 + H_2O \rightleftarrows NH_4^+ + OH^-$

5. According to Arrhenius, HCl would be classified as a(n) _____ because _____ _____. $NH_3$ would be classified as a(n) _____ because _____ _____.

6. In the diagram at right, the Lewis acid is _____ and the Lewis base is _____.



   a. Explain why: _____ _____ _____ _____

7. Explain how $H^+$ is a Lewis acid. _____ _____

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8. A(n) _____ is a substance that produces ions in water making a solution that is electrically conductive.

9. When a hydrogen atom ionizes to form $H^+$ the resulting particle is a(n) _____.

10. An ionic compound that forms from an acid-base neutralization reaction is a(n) _____.

11. A conjugate acid-base pair varies in formula by _____. When an acid loses a(n) _____, the residual ion is its _____. Strong acids always have _____ conjugate bases, while weak acids have _____conjugate bases.

12. The formula $H_3O^+$ represents the _____ ion.

13. Water is _____, which means it can act as an acid or a base. Often in acid-base systems the formula for water is written as "HOH" to clearly illustrate its ability to ionize into _____ ions and _____ ions.

14. Label the conjugate acid-base pairs of the following:

    a. $NH_3(aq) + H_2O(l) \rightleftarrows NH_4^+(aq) + OH^-(aq)$

    b. $HNO_2(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + NO_2^-(aq)$

    c. $HCN(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + CN^-(aq)$

    d. $NH_3(aq) + HCl(aq) \rightleftarrows NH_4^+(aq) + Cl^-(aq)$

    e. $PO_4^{3-}(aq) + HNO_3(aq) \rightleftarrows NO_3^-(aq) + HPO_4^{2-}(aq)$

    f. $HF(aq) + HSO_3^-(aq) \rightleftarrows F^-(aq) + H_2SO_3(aq)$

15. Write balanced chemical equations for the neutralization reactions below:

    a. HI and LiOH: _____

    b. NaOH and HF: _____

    c. $H_2SO_3$ and $Sr(OH)_2$: _____

    d. $Ca(OH)_2$ and $H_3PO_3$: _____

    e. Hydrobromic acid and barium hydroxide: _____

    f. Aluminum hydroxide and nitric acid: _____

    g. Sulfuric acid and manganese (III) hydroxide: _____

    h. Nitric acid and calcium bicarbonate: _____