

Exercise 14.2a

Acid-Base Theories

Name: _____

Date: _____ Per: _____

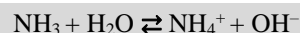
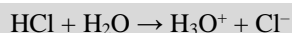
DIRECTIONS: Answer the following in the space provided.

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

	Acid	Base
Arrhenius Model:	<i>donates hydrogen ions (H⁺) in aqueous solution</i>	<i>donates hydroxide ions (OH⁻) in aqueous solution</i>
Brønsted-Lowry Model:	<i>donates protons (still H⁺) in a chemical reaction (not necessarily aqueous)</i>	<i>accepts protons (still H⁺) in a chemical reaction (not necessarily aqueous)</i>
Lewis Model:	<i>electron pair acceptor in chemical reaction</i>	<i>electron pair donor in reaction</i>

2. Acids may donate one or more hydrogen ions/protons when they ionize. An acid capable of donating only one of these particles is referred to as monoprotic, whereas acids that donate more than one are referred to as polyprotic. H₂SO₄ is considered a(n) diprotic acid because it donates two of these particles and H₃PO₃ is considered a(n) triprotic acid because it donates three.
3. Acids that donate multiple protons in solution do so one at a time in separate ionization reactions. Each ionization requires additional energy to remove the hydrogen ion because the anion produced from the previous ionization exerts a greater attraction on the remaining protons. This means that in each step, the acid becomes weaker (less able to be deprotonated).
4. For the following polyprotic acids, write the equations for each ionization step.

	H ₃ PO ₄	H ₂ CO ₃
Step 1	$H_3PO_4(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + H_2PO_4^-(aq)$	$H_2CO_3(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HCO_3^-(aq)$
Step 2	$H_2PO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HPO_4^{2-}(aq)$	$HCO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CO_3^{2-}(aq)$
Step 3	$HPO_4^{2-}(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + PO_4^{3-}(aq)$	



5. According to Arrhenius, HCl would be classified as a(n) acid because it is deprotonated by (or donates H⁺ to) in an aqueous solution (i.e., loses H⁺ to water). NH₃ would be classified as a(n) B-L base because it accepts hydrogen ions (protons) in a chemical reaction to produce OH⁻.
6. In the diagram at right, the Lewis acid is BF₃ and the Lewis base is NH₃.
- a. Explain why: In the reaction between BF₃ and NH₃, the electrons used to create the bond are donated by the NH₃ and accepted by the boron in BF₃.
7. Explain how H⁺ is a Lewis acid. Hydrogen has no electrons to contribute to a bond so can only accept electrons.

