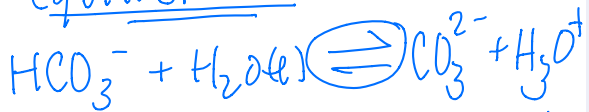


Solutions Lesson 6 Answers to Questions 5-11

Sections 8.3-8.4 Questions

1. Strong acids completely ionize in water
 $\text{HCl} + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{Cl}^- + \text{H}_3\text{O}^+$
 weak acids form equilibriums.



2. Soluble metal hydroxides are strong bases because they dissociate in water to produce 100% OH^- ions
 $\text{BOH} \rightleftharpoons \text{B}^+ + \text{OH}^-$

3. Weak bases (like weak acids) do not 100% ionize (form equilibriums)
 $\text{NH}_3 + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$

Understanding Concepts

- Distinguish between a strong and weak acid using the concept of reaction with water.
- What class of substances are strong bases? Explain their properties.
- What are the properties of a weak base? Explain these properties.
- Write appropriate chemical equations to explain the acidic or basic properties of each of the following substances added to water.
 - hydrogen bromide (acidic) $\text{HBr} + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_3\text{O}^+ + \text{Br}^-$
 - potassium hydroxide (basic) $\text{KOH} \rightarrow \text{K}^+ + \text{OH}^-$
 - benzoic acid, $\text{HC}_7\text{H}_5\text{O}_2(\text{aq})$ (acidic) $\text{HC}_7\text{H}_5\text{O}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{C}_7\text{H}_5\text{O}_2^-$
 - sodium sulfide (basic) $\text{S}^{2-} + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{HS}^- + \text{OH}^-$
- Theories in science develop over a period of time. Illustrate this development by writing theoretical definitions of an acid using the following concepts. Begin your answer with, "According to [name of concept], acids are substances that..."
 - the Arrhenius concept \rightarrow produce H^+ ions, produce OH^- ions
 - the revised Arrhenius concept \rightarrow produce H_3O^+ ions, \uparrow (OH^-)
 - the Brønsted-Lowry concept \rightarrow acid is a proton donor, proton acceptor
- Repeat question 5, defining bases. Refer to both strong and weak bases in your answer.
- According to the Brønsted-Lowry concept, what happens in an acid-base reaction? $\text{acid donates } \text{H}^+, \text{ base accepts } \text{H}^+$
- Use the Brønsted-Lowry definitions to identify each of the reactants in the following equations as acids or bases.
 - $\text{HCO}_3^-(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{HS}^-(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$
 ACID + BASE \rightarrow BASE + ACID
 - $\text{H}_2\text{CO}_3(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 ACID + BASE \rightarrow BASE + ACID
- Complete the following chemical equations to predict the acid-base reaction products.
 - $\text{HSO}_4^-(\text{aq}) + \text{PO}_4^{3-}(\text{aq}) \rightarrow \text{SO}_4^{2-}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq})$
 ACID + BASE \rightarrow BASE + ACID
 - $\text{H}_3\text{O}^+(\text{aq}) + \text{HPO}_4^{2-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{H}_2\text{PO}_4^-(\text{aq})$
 ACID + BASE \rightarrow BASE + ACID
- Some ions can form more than one conjugate acid-base pair. List the two conjugate acid-base pairs involving a hydrogen carbonate ion.

$$\text{HCO}_3^- + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CO}_3^{2-} + \text{H}_3\text{O}^+; \text{HCO}_3^- + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{CO}_3 + \text{OH}^-$$
- Identify the two acid-base conjugate pairs in each of the following reactions.
 - $\text{H}_3\text{O}^+(\text{aq}) + \text{HSO}_3^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{H}_2\text{SO}_3(\text{aq})$
 ACID + BASE \rightarrow BASE + ACID
 - $\text{OH}^-(\text{aq}) + \text{HSO}_3^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{SO}_3^{2-}(\text{aq})$
 BASE + ACID \rightarrow ACID + BASE

Applying Inquiry Skills

- Baking soda is a common chemical but its chemical properties are difficult for chemists to explain and predict. Baking soda is amphoteric and forms a basic solution. List some of the chemical properties of baking soda and indicate why some of these properties are difficult to explain and predict. Follow the links for Nelson Chemistry 11, 8.4.

GO TO www.science.nelson.com

Making Connections

- Common kitchen-variety baking soda has so many uses that it has entire books written about it. Use references to gather a list of uses for baking soda. Identify the uses that involve acid-base reactions.