Chemistry 30

Unit 5: Acids & Bases

Practice Set 1 Answers: 1-1 to 1-6 What are Acids & Bases?

1. List four characteristic properties of acids and four characteristic properties of bases.

Acids	Bases
sour taste	bitter taste
turn litmus paper red	turn litmus paper blue
react with active metals to produce $H_2(g)$	slippery feel
form electrolytic solutions	form electrolytic solutions

2. Fill in the chart below by providing simple definitions.

	Acid	Base
Arrhenius's Definition	produce hydrogen ions in solution	produce hydroxide ions in solution
Brønsted-Lowry Definitions	proton donors	proton acceptors

3. a. Write the correct symbol for the hydrogen ion: **H^+**

   b. Write the correct symbol for a hydronium ion: **H_3O^+**

4. Define the term ***amphiprotic.***

   A substance that can act as an acid in some reactions and as a base in other reactions.

5. Write balanced equations for the:

   a. Dissociation of calcium hydroxide, $Ca(OH)_2$

   $Ca(OH)_2 \rightarrow Ca^{2+}(aq) + 2\ OH^-(aq)$

   b. Ionization of nitric acid, HNO_3

   $HNO_3 \rightarrow H^+(aq) + NO_3^-(aq)$

6. Write the equation for the ionization of nitric acid, HNO_3, showing the formation of the hydronium ion.

$HNO_3 + H_2O(l) \rightarrow H_3O^+(aq) + NO_3^-(aq)$

7. Identify the hydrogen-ion donor & acceptor (present on the reactant side of each equation) in each of the following reactions:

		H^+ donor (the acid)	**H^+ acceptor (the base)**
a.	$HNO_3\ (l) + H_2O(l) \rightarrow H_3O^+\ (aq) + NO_3^-\ (aq)$	HNO_3	H_2O
b.	$C_2H_5NH_2\ (l) + H_2O(l) \rightarrow C_2H_5NH_3^+\ (aq) + OH^-(aq)$	H_2O	$C_2H_5NH_2$
c.	$CH_3CO_2\ H(l) + H_2O(l) \rightarrow CH_3CO_2^-(aq) + H_3O^+(aq)$	$CH_3CO_2\ H$	H_2O

8. For each acid listed in question 7, identify it's conjugate base.

	Acid (Reactant side of equation)	**Conjugate Base**
a.	HNO_3	NO_3^-
b.	H_2O	OH^-
c.	$CH_3CO_2\ H$	$CH_3CO_2^-$

Conjugate bases differ from their acids by having one less hydrogen.

9. Write the formulas for the conjugate base of each of the following acids.

Conjugate bases have one less hydrogen then their acids. Losing a hydrogen ion (a proton) will increase the negative charge by a value of 1. Be careful to include all charges!

a. H_2SO_3 **HSO_3^-**

b. HCO_3^- **CO_3^{2-}**

c. NH_4^+ **NH_3**

10. Write the formulas for the conjugate acid of each of the following bases.

Conjugate acids will have one more hydrogen than their base, and the charge will increase the positive charge by one.

a. H_2O **H_3O^+**

b. CO_3^{2-} **HCO_3^{1-}**

c. PH_3 **PH_4^+**

11. Which of the following would you expect to act as Brønsted-Lowry bases:

a) Br^- b) Li^+ c) H_3PO_4 d) NH_4^+ e) H_2O f) NH_2^-

The bases are the substances that could combine with a H^+. They are Br^-, H_2O, and NH_2^-

12. For each of the following reactions, identify the Brønsted-Lowry acid and Brønsted-Lowry base on the reactant side of the equation, and the conjugate acid and conjugate base on the product side.

a. $HSO_4^-(aq) + CO_3^{2-}(aq) \rightarrow SO_4^{2-}(aq) + HCO_3^-(aq)$

acid | **base** | **conjugate base** | **conjugate acid**

b. $HCO_3^-(aq) + OH^-(aq) \rightarrow CO_3^{2-}(aq) + H_2O(l)$

acid | **base** | **conjugate base** | **conjugate acid**

13. Consider the following two reactions. In which reaction does $H_2PO_4^-$ act as a base? In which does it act as an acid?

		Is $H_2PO_4^-$ an acid or base?
a.	$H_2PO_4^-(aq) + H_2O(l) \rightarrow H_3PO_4(aq) + OH^-(aq)$	a base because it accepts another H^+ to form H_3PO_4
b.	$H_2PO_4^-(aq) + H_2O(l) \rightarrow HPO_4^{2-}(aq) + H_3O^+(aq)$	an acid because it donates a H^+