

BIG CHEM: Unit 11 - Acids and Bases
Problem Set #11 - All your base are belong to us.

Due: Monday, April 7, 2008
Mr. Darlington

- Based on the article, "How Acid Rain Works," describe how acid rain works.
- Water and ionization**
 - Draw a diagram showing the result when one hydrogen (proton) is pulled off one water molecule and attached to another.
 - What are the formulas of the ions formed?
 - Write an equation showing the formation of the ions from two molecules of water:
The hydronium ion (H_3O^+) and the hydroxide ion (OH^-) are formed by the reaction between water molecules.
 - What would form from the reaction between hydronium and hydroxide ions? Write an equation showing the reaction.
- Determine if the following compounds are electrolytes, and therefore form an aqueous solution capable of conducting electricity.
 - $\text{C}_6\text{H}_{12}\text{O}_6$
 - CaCl_2
 - CCl_4
 - NaOH
 - C_5H_{12}
 - H_2SO_4
 - $\text{Ca}(\text{OH})_2$
 - LiOH
- Describe the difference between hydrogen chloride gas and hydrochloric acid.
- Describe the difference between the Arrhenius theory and the Brønsted-Lowry of acids and bases.
- According to Arrhenius theory, describe the difference between an Arrhenius acids and Arrhenius bases.
- Explain why magnesium hydroxide is an Arrhenius base but sodium hydroxide is not.
- Of the following compounds, pick the ones that are the Arrhenius acid or bases.
In addition, describe why the compounds you chose are Arrhenius acids or bases and the other compounds are not.

LiF	KOH
HBr	HBr
$\text{Mg}(\text{OH})_2$	NH_3
CH_3CHO	NaCl
- Explain why NaCl is not an acid despite the fact that it is an electrolyte.
- Describe the general properties of acids.
- Describe the general properties of bases.
- pH scale**
 - When the pH of a solution changes from a pH of 5 to a pH of 3, the hydronium ion concentration changes in that solution by how much? Give specific numbers.
 - As an aqueous solution's pH changed from 7 to 11, describe how the hydronium and hydroxide ion concentration change. Give specific numbers.
 - Which of the following pH values indicates the highest concentration of hydronium ions in a solution: 1, 2, 3, or 4. Explain.
 - Which 0.1 molar solution has a pH greater than 7? $\text{C}_6\text{H}_{12}\text{O}_6$, CH_3COOH , KCl or KOH . Explain.
- Indicators**
 - A student dissolves a substance in water, tests the resulting solution and observes that red litmus paper turns blue.
Based on this result, what can the student determine about the solution?
 - A solution of pH 11 is first tested with phenolphthalein and then with litmus. What is the color of each indicator of this solution?
 - According to Reference Table M, what is the color of the indicator methyl orange in a solution that has a pH of 2?
 - Describe the effect on red litmus paper of an Arrhenius base.
 - The pH of a solution is 9. What effect does the solution have on phenolphthalein? Is the solution alkaline or acidic?
- What is the pH in each of the following cases?
 - $[\text{H}_3\text{O}^+] = 10^{-12} \text{ M}$?
 - $[\text{H}_3\text{O}^+] = 10^{-2} \text{ M}$?
 - $[\text{H}_3\text{O}^+] = 10^{-7} \text{ M}$?
 - $[\text{H}_3\text{O}^+] = 10^{-5} \text{ M}$?
 - $[\text{H}_3\text{O}^+] = 10^{-14} \text{ M}$?
 - $[\text{H}_3\text{O}^+] = 10^{-3} \text{ M}$?
- What is the concentration of hydronium in each of the following cases?
 - $[\text{OH}^-] = 10^{-12} \text{ M}$?
 - $[\text{OH}^-] = 10^{-2} \text{ M}$?

- c $[\text{OH}^-] = 10^{-7} \text{ M}$?
- d $[\text{OH}^-] = 10^{-5} \text{ M}$?
- e $[\text{OH}^-] = 10^{-14} \text{ M}$?
- f $[\text{OH}^-] = 10^{-3} \text{ M}$?

16 What is the pH in each of the following cases:

- a $[\text{OH}^-] = 10^{-12} \text{ M}$?
- b $[\text{OH}^-] = 10^{-2} \text{ M}$?
- c $[\text{OH}^-] = 10^{-7} \text{ M}$?
- d $[\text{OH}^-] = 10^{-5} \text{ M}$?
- e $[\text{OH}^-] = 10^{-14} \text{ M}$?
- f $[\text{OH}^-] = 10^{-3} \text{ M}$?

17 **Neutralization Reactions**

- a Complete and balance each of the acid base neutralizations below. Identify the spectator ions.
- b $\text{H}_2\text{SO}_4 + \text{Mg}(\text{OH})_2$
- c $\text{HNO}_3 + \text{Al}(\text{OH})_3$
- d $\text{H}_3\text{PO}_4 + \text{Ca}(\text{OH})_2$
- e $\text{HI} + \text{KOH}$
- f $\text{HBr} + \text{Ba}(\text{OH})_2$

18 The definition of neutralization is a reaction between an acid and a base to produce a salt and water. Where does the salt come from in the neutralization reaction?

19 Where does the water come from in a neutralization reaction?

20 **Titration**

- a How much 6.0 M HNO_3 is needed to neutralize 39 mL of 2.0 M KOH ?
- b How much 3.0 M NaOH is needed to neutralize 30. mL of 0.75 M H_2SO_4 ?
- c What is the concentration of 20 mL of LiOH if it is neutralized by 60 mL of 4 M HCl ?
- d What is the concentration of 60 mL of H_3PO_4 if it is neutralized by 225 mL of 2 M $\text{Ba}(\text{OH})_2$?
- e How much 2 M HBr is needed to neutralize 380 mL of 0.1 M NH_4OH ?