Chem 130: Chemistry for Funeral Services
Problem Set 6: Due 3/7/06

Name: **KEY** Date: ____________

Each question is worth one point. Show your work wherever calculations are required.

1. What is pH? Why is it used for acids and bases?

pH is a way of representing the concentration of hydrogen ions (hydronium ions) in a solution. It is a negative logarithm. That represents dilute concentration with a much simpler number. It is used for acids and bases because they are defined by how much hydronium is produced in one of their solutions.

2. Write the equation for the auto-ionization of water. Explain what the equation describes. Why is pH 7 considered to be neutral?

$HOH + HOH \rightarrow H_3O^+ + OH^-$

This equation describes two water molecules colliding. The hydrogen on one is transferred to the oxygen on the other creating the hydronium ion and hydroxide ion. pH of 7 is considered neutral because it is the representation of the 1×10^{-7} molar concentration of each of these two ions in freshly distilled water.

3. How is a weak acid different from a strong acid? Give an example of each.

A weak acid only partially ionizes in solution. A strong acid completely or almost completely ionizes in solution. Vinegar (acetic acid) is an example of a weak acid. Hydrochloric acid is an example of a strong acid.

4. How is the definition of acid different in the Arrhenius theory than the Bronstead-Lowery theory? How is the definition of a base different in each theory?

Arrhenius: acids cause an increase of hydrogen ion (H^+) concentration in solutions; bases increase hydroxide ion (OH^-) concentration in solution.

Bronstead-Lowery: acids are proton donors while bases are proton acceptors. This theory is a bit more general in the way it treats bases.

5. Fill in the following chart.

Name of Acid	Conjugate Acid	Conjugate Base
Sulfuric	**H_2SO_4**	**SO_4^{-2}**
Hydrochloric	HCl	**Cl^-**
Acetic	**$HC_2H_3O_2$**	$C_2H_3O_2^-$
Phosphoric	H_3PO_4	**PO_4^{-3}**

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6. What is an amphoteric substance? Give an example.

An amphoteric substance can act as either an acid or a base. Water is the most common example. In the auto-ionization of water it can be seen that water is capable of donating or accepting protons.

7. Explain why a salt is produced in the reaction of acids with bases. How is hydrolysis related to acid/base reactions?

When an acid reacts with a base in a neutralization reaction, water is produced. The other half of the (commonly) double-replacement reaction "swaps" the acid's anion and the base's cation. The resulting compound is a salt.

8. What is the difference between deliquescence and efflorescence? Give an example of each.

Some hydrates can absorb water from the air to the point where they begin to dissolve. Such hydrates are deliquescent and are said to undergo deliquescence. Other hydrates give up their waters of hydration very easily to the atmosphere. That process is called efflorescence. Calcium chloride with two waters of hydration undergoes efflorescence. Sodium carbonate with ten waters of hydration undergoes efflorescence.

9. Write the chemical formulas, complete and balance the following equations. Give the names for all of the products. All of the reactions take place in aqueous solutions.

Sodium hydroxide + Phosphoric acid $\rightarrow$ **Na_3PO_4 + 3 HOH**
3 NaOH **H_3PO_4** **sodium phosphate + water**

Ammonia + Water $\rightarrow$ **NH_4^+ + OH^-**
NH_3 **HOH** **ammonium ion + hydroxide ion**

Plaster of Paris + Water $\rightarrow$ **2 $CaSO_4 \cdot 2\,H_2O$**
$(CaSO_4)_2 \cdot H_2O$ **HOH** **gypsum**

10. Fill in the following chart.

Name	Formula
Sodium bicarbonate	**Na_2CO_3**
Sulfuric acid	H_2SO_4
Magnesium chloride	**$MgCl_2$**
Potassium hydroxide	KOH
Hydrochloric Acid	**HCl**
Perchloric Acid	$HClO_4$
Calcium hydroxide	**$Ca(OH)_2$**
Nitrous Acid	HNO_2