CHEMISTRY CHECK-LIST / SCORE SHEET
Unit 6

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Vocabulary List

- Boiling point elevation
- Freezing point depression
- Henry's law
- Immiscible
- Miscible
- Molality (*m*)
- Molarity (*M*)
- Saturated solution
- Solubility
- Unsaturated solution

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Vocabulary List

- Acid
- Amphoteric
- Base
- Buffer
- End point
- Equivalence point
- Hydronium ion (H_3O^+)
- Neutralization reaction
- pH
- Titration

Worksheet (Molarity)

1. Calculate the molarity, M, of the following solutions:
   a. 3.0 moles of NaCl are dissolved in 1 liter of solution.

   b. 0.5 moles of MgF_2 are dissolved in 2 liters of solution.

   c. 3 moles of NaOH are dissolved in 0.25 liters of solution.

2. How many liters of a 4.0 M $CaCl_2$ solution would contain 2 moles of $CaCl_2$?

3. How many liters of a 0.5 M $CaCl_2$ solution would contain 3.5 moles of $CaCl_2$?

4. How many liters of a 2.5 M $CaCl_2$ solution would contain 1.0 mole of $CaCl_2$?

5. How many moles of KCl are there in 2 liters of a 3.0 M solution?

6. What is the molarity, M, of a solution in which 116 grams of KF are dissolved in 2 liters of solution?

7. How many grams of KF are in 2 liters of a 3.0 M solution of KF? What is the [$CaF_{2(aq)}$] of a solution when 39 g of CaF_2 are dissolved in enough water to make 2200 mL of solution? ([ ] is how chemists say concentration or molarity)

8. How many grams of NH_3 are dissolved in 85 mL of a 0.75 M solution?

Worksheet: Concentration (Dilutions)

1. 25 mL of 5.6 M HCl are placed in a volumetric flask. The flask is filled to 250 mL with water. What is the molarity of the new solution?

2. 5.6 mL of NaOH are added to a flask and the flask is filled with water to the 200 mL mark. The concentration of the new solution is found to be .098 M. What was the initial molarity of the solution before the dilution was completed?

3. A chemist has 300 mL of a 2.5 M KCl solution. The solution is diluted by **adding** 1.2 L of water to the original volume. What is the [KCl] of the diluted solution?

4. A chemist has 2 liters of a 3.2 M hydrochloric acid solution. If the solution is left out in the room and enough water evaporates so that there is only 1.2 liters of solution left, what is the final molarity of this concentrated acid?

5. When a chemist **adds** 1.0 L of water to 3.0 liters of a 0.8 M HF solution, what is the new concentration of the total HF solution?

6. How much water will a chemist need **to add** to 200 mL of a 3.3 M KCl solution if they want to make a 1.0 M solution of KCl?

Worksheet: Colligative Properties Worksheet

1. Define each of the following vocabulary terms
   - **colligative property**
   - **boiling point elevation**
   - **freezing point depression**
   - **Molality**

2. What is the molality when 3.54 grams of glucose (C6H12O6) is dissolved in 400 grams of water?

3. How many kilograms of water must be added to 15.0 g of oxalic acid, $H_2C_2O_4$, to prepare a 0.025 *m* solution?

4. When 200.5 grams of sucrose ($C_{12}H_{22}O_{11}$) is dissolved into 100.0 grams of water, what is the freezing point?

5. Determine the freezing points of each of these 0.50 *m* aqueous solutions:
   a. K_2SO_4

   b. $CsNO_3$

SYNTHESIS OF A FROZEN COLLOID
and
THE EFFECT of a SOLUTE on the FREEZING POINT of a SOLUTION

In this lab you will be synthesizing a frozen colloid commonly known as ice cream. You will also be investigating the effect of a solute on the freezing point of this solution. You have probably made home made ice cream before but, have you ever wondered why you needed to mix rock salt in with the ice to make it freeze. Try making it without the salt!

Salt has a definite effect on the freezing process of the ice cream, it lowers the freezing point of water (ice slurry) by 1.86 degrees celsius per molal. You will determine the molality of your salt slurry for this lab using the formula(s) that you have learned . Don't forget that NaCl is an ionic compound and molality will depend on the number of ions present in the solution.

Procedure:

1. Obtain two plastic zip-lock bags from your teacher
   - -1 one gallon bag (re-usable, do not throw away.)
   - -1 quart size bag (throw out after consuming contents)
2. Measure out 1 cup of liquid ice cream mixture and pour it into the small bag and seal tightly. Be sure to remove all air.
3. Place 4 cups of ice cubes into the gallon bag and determine it's mass by measuring the volume after it melts in a large graduated cylinder. <u>**DO NOT WEIGH ON A BALANCE!**</u>
4. Weigh out__ grams of NaCl (rock salt) and place in the bag with the ice cubes. Your teacher will assign you an amount. Record the number of grams!
5. Knead the small bag inside the large bag with the ice.
6. Continue to knead until your mixture is frozen. This may take several minutes. Record the total time it took to form this product. (Start to finish)
7. Once it is frozen, measure the ice slurry temperature then you should remove the small bag of product. <u>**Measure the volume of ice slurry. Then dump the slurry down the sink.**</u> You may now consume this frozen colloid it you wish
8. Rinse out the large bag and turn it into your teacher.

Questions:

1. What is the molality of your ice mixture?
2. Compare your molality to those of your classmates. Does the molality make a difference in the freezing rate of the ice cream?
3. Calculate the freezing point of the salt solution in this experiment based on your molality.
4. What other factors could be affecting the freezing point of our solution?
5. How does the calculated freezing point from question 3 compare to the temperature you recorded in step 7?

pH and pOH Worksheet

Name________________________

Date ______________

1. Calculate the pH and pOH of solutions having the following concentration:
   a. 0.00010 mole H_3O^+ per liter. pH = ________ pOH = ________
   b. 0.010 mole OH^- per liter. pH = ________ pOH = ________
   c. 1.0×10^{-5} mole OH^- per liter. pH = ________ pOH = ________
   d. 1.0×10^{-2} mole H_3O^+ per liter. pH = ________ pOH = ________

2. Calculate the $[H_3O^+]$ of the following solutions:
   a. pH = 3.0 $[H_3O^+]$ = ________
   b. pH = 6.0 $[H_3O^+]$ = ________
   c. pOH - 12.0 $[H_3O^+]$ = ________

3. Calculate the $[OH^-]$ of the following solutions:
   a. pOH = 11.0 $[OH^-]$ = ________
   b. pH = 4.0 $[OH^-]$ = ________
   c. pOH = 8.0 $[OH^-]$ = ________

4. Calculate the pH and pOH of solutions having the following concentratioin. Assume 100% ionization. Remember that 1 mole of H_2SO_4 produces 2 moles of H_3O^+ ion.
   a. 0.0025 M NaOH pH = ________ pOH = ________
   b. 0.0025 M H_2SO_4 pH = ________ pOH = ________
   c. 0.075 M H_2SO_4 pH = ________ pOH = ________
   d. 0.048 M HCl pH = ________ pOH = ________
   e. 0.032 M KOH pH = ________ pOH = ________
   f. 0.00017 M NaOH pH = ________ pOH = ________

5. Calculate the $[H_3O^+]$ and $[OH]^-$ of the following solutions:
   a. pH = 2.500 $[H_3O^+]$ = ________ $[OH^-]$ = ________
   b. pOH = 5.800 $[H_3O^+]$ = ________ $[OH^-]$ = ________
   c. pOH = 3.200 $[H_3O^+]$ = ________ $[OH^-]$ = ________
   d. pH = 4.700 $[H_3O^+]$ = ________ $[OH^-]$ = ________
   e. pH = 9.600 $[H_3O^+]$ = ________ $[OH^-]$ = ________
   f. pOH = 10.300 $[H_3O^+]$ = ________ $[OH^-]$ = ________

6. The approximate pH of some common substances is listed. Calculate the pOH, the $[H_3O^+]$ and the $[OH]^-$
   a. Viengar 2.8 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   b. Orange 3.5 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   c. Rainwater 6.2 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   d. Seawater 8.5 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   e. Soft drink 3.0 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   f. Tomato 4.2 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   g. Egg 7.8 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____
   f. Milk of magnesia 10.5 pOH = _____ $[H_3O^+]$ = _____ $[OH^-]$ = _____

Worksheet: Neutralization and Titration Name_______________

1. Give the word equation for the neutralization reaction of an acid and a base.

2. Complete these equations:

   $HCl + LiOH \rightarrow$

   $HC_2H_3O_2 + Mg(OH)_2 \rightarrow$

3. A _________________ is a laboratory method used to determine the concentration of an acid or a _________________ in solution by performing a _________________ reaction with a standard solution.
4. At the ________________ of the titration, the indicator changes color, which indicates neutralization. Once neutralized, moles of _________________ and moles of _________________ are equal.
5. In a titration of HCl with NaOH, 100.0 mL of the base was required to neutralize 20.0 mL of 5.0 M HCl. What is the molarity of the NaOH? (Be sure to write the neutralization reaction.)

6. In a titration of H_2SO_4 with NaOH, 60.0 mL of 0.020 M NaOH was needed to neutralize 15.0 mL of H_2SO_4. What is the molarity of the acid? (Be sure to write the neutralization reaction.)

7. If 10.0 mL of 0.300 M KOH are required to neutralize 30.0 mL of gastric juice (HCl), what is the molarity of the gastric juice?

ACID/BASE TITRATION

Titration is a laboratory procedure which involves the addition of measured amounts of a known solution of an acid or a base to a solution of a base or acid to measure concentration. This process involves the careful observation of changes in the pH of the titrated solution. For an accurate determination of the endpoint of this procedure, graphical analysis of the addition process is required. The resulting graph is called a titration curve.

In this experiment, the endpoint or equivalence point will be determined for four different sets of titration pairs. The four different pairs will involve the titration of:

1. Strong acid versus strong base
2. Weak acid versus strong base
3. Weak acid versus weak base
4. Strong acid versus weak base

UNIVERSAL INDICATOR COLORS

pH	
4 =	Pink
5 =	Orange
6 =	Yellow
7 =	Yellow/Green
8 =	Blue/Green
9 =	Blue
10 =	Violet

The titration procedure that you will use not only allows the determination of the endpoint, but also gives some insight into the mechanism of acid base interaction.

PROCEDURE:

1. Obtain a 24 well tray. Clean and dry. Fill each well about 3/4 full of each solution as indicated below.

   A-6 acetic acid (weak acid) CH_3C00H

   B-6 ammonium hydroxide (weak base) NH_4OH

   C-6 hydrochloric acid (strong acid) HCl

   D-6 sodium hydroxide (strong base) NaOH

2. Locate a 15 ml dropping bottle of universal indicator solution. Obtain a color chart. Your teacher will explain the use of the indicator in prelab.

3. Now you are ready to start the experiment. Make sure that you clean your pipets after each use. Place 10 drops of hydrochloric acid into well A-1. Use the 24 well tray. Clean your pipet. Add 5 drops of water and 1 drop of universal indicator.

4. Compare the color of the acid solution to the universal standard. What is the pH of the acid solution? Record the following information in a data table for the remainder of the experiment, using the following headings:

   Drops of Titrant Added
   Color of Solution in Well
   pH

5. CLEAN YOUR PIPET. Add a drop of sodium hydroxide to well A-1 stirring constantly. Record the information as above. Repeat this process until the pH of the well reaches at least 10.

6. Graph the results of this experiment with pH on the vertical axis and number of drops of 0.1 M NaOH on the horizontal axis. Connect the points with curved line. There should be two plateaus in your curve. Extend the plateaus with your ruler. Now with the ruler, draw a vertical line that is parallel with the Y-axis that connects the two plateau lines. Measure the distance of the vertical that connects the horizontal lines.

   Locate the mid point of this distance and mark it on the titration curve. This represents the end point or equivalence point of the titration. The title of this graph is strong acid/strong base.

7. Repeat the procedure for the other three combinations.