NAME _____ PREF ____ SECTION SC_____ DATE _____

EXPERIMENT 14: PREPARATION AND PROPERTIES OF AMMONIA

Equipment: 3 test tubes (1 must be dry; used as a collection tube), 'swivel' clamp, ring stand, one-hole rubber stopper, delivery tube, beaker.
Materials: pinch of $(NH_4)_2SO_4$, pinch of $Ca(OH)_2$, H_2O, 20% NaOH, red litmus paper, pH paper

SAFETY WARNING: NaOH IS A HAZARD TO LIVING CELLS.
WASH WITH WATER IMMEDIATELY AFTER CONTACT.

In this experiment you will learn about ammonia and its properties.

A. Mix a pinch of ammonium sulfate $(NH_4)_2SO_4$ with a pinch of calcium hydroxide $Ca(OH)_2$. Add a drop of water and rub the mixture in the palm of your hand. Note the odor of any gas given off by waving your hand across the mixture towards your nose. **CAUTION: Don't get too close!!!**

1. Describe the odor. _____

1a. Describe any feeling. _____

2. Complete the equation: $(NH_4)_2SO_4 + Ca(OH)_2 =$ __NH_3 + _____ + _____

B. Fit a test tube with a one-hole rubber stopper and a delivery tube. Fill 1/6 of the test tube with powdered NH_4Cl. Add a 20% solution of NaOH until the test-tube is 1/4 full. Clamp the test tube in a slightly slanting position so that the delivery tube points upward. Place a dry test tube over the delivery tube to collect the ammonia by downward displacement of air. Heat the mixture VERY GENTLY. Place a piece of moist red litmus paper at the mouth of the inverted collection tube; a change in color indicates the collection tube is filled with ammonia. **BE SURE TO WORK UNDER THE HOOD!!!**

3. Complete the equation: $NH_4Cl + NaOH =$ _____ + _____ + _____

C. Collect a test tube-ful of ammonia. Keep the tube in the inverted position and close it off with your thumb. Hold it in that position in a beaker filled with water and remove your thumb from the opening. Jiggle the test tube gently.

4. Describe what happens. _____

5. Explain. _____

D. Go back to your set-up from Part B. Rotate the test tube in the clamp so that the delivery tube points down. Adjust the height of the clamp so that the delivery tube is in a test tube half-filled with water. The end of the delivery tube must be 1/4 inch below the surface of the water in the second test tube. Apply heat to the reaction mixture for three minutes. When the time is up, **FIRST REMOVE THE SECOND TEST TUBE AND THEN REMOVE THE HEAT!!!** (Why? _____

_____).

Test the solution in the second test tube with pH paper. pH = ____

6. What ion must be present in excess in the solution? _____

7. Write an equation for the reaction (between water and ammonia) to show the formation of these ions.

_____

E. Gently boil the solution prepared in Part D for a few minutes testing the vapors produced with red litmus every minute. Test the remaining liquid with red litmus paper.

8. What happens to the ammonia in solution as a result of heating? _____

_____

9. Write an equation to show this change. _____

10. Compare this reaction with the reaction in Part D. _____

_____

F. **Teacher Demonstration: The Ammonia Fountain**

Fit a one liter round bottom flask with a one hole stopper holding a piece of glass tubing tapered at one end. The tapered end should reach to within 1/2 inch of the bottom of the flask, and the other end should extend 12 inches beyond the stopper. Add 10 mL. concentrated aqueous ammonia to the flask. Put the stopper assembly in firmly, and heat the solution in the flask until the ammonia gas comes out rapidly. Immediately invert the flask, and let the tubing dip well down into a one liter beaker filled with water containing a few drops of phenolphthalein or red litmus solution.

11. Describe what happens. _____

_____

12. What causes the "fountain" effect in this demonstration? _____

_____

13. What causes the change in color? _____ Write an equation to illustrate your answer. _____

SUMMARY QUESTIONS

14. Why is ammonia gas more soluble in water than oxygen or hydrogen gas? _____

_____

15. Would you expect to be able to make a successful HCl Fountain? _____ Explain. _____

_____

_____

16. What is a coordinate covalent bond? _____
Re-write your equation for Question 7 using electron-dot diagrams. Identify the coordinate covalent bond.

CONCLUSIONS:

Ammonia gas dissolves readily in water because its molecules are strong _____.

The ammonia molecule can remove a _____ from a water molecule and hold it with a _____ _____ bond. In addition to molecules of ammonia and water, aqueous solutions of ammonia gas contain _____ and _____ ions.