

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

## Lab 8.4 - Neutralization

\*Make complete and accurate observations during the lab. Observations include such things as...what is happening; for any chemicals, the color, appearance, phase (solid, liquid, gas), and odor (but **NEVER** taste) ; temperature if requested; etc.\*

Procedure	Observations
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\_\_\_\_1. Obtain **about** 20 mL of 1.0 M sodium hydroxide, NaOH, solution in a 50 mL beaker.

Observe: \_\_\_\_\_

\_\_\_\_2. Pour **exactly** 15.0 mL into a graduated cylinder.

\_\_\_\_3. Pour this 15.0 mL into an evaporating dish.

\_\_\_\_4. Rinse the graduated cylinder well.

\_\_\_\_5. Pour out the rest of the beaker and rinse it well.

\_\_\_\_6. Obtain **about** 25 mL of 1.0 M hydrochloric acid, HCl, solution in a 50 mL beaker.

Observe: \_\_\_\_\_

\_\_\_\_7. Pour **exactly** 20.0 mL into a graduated cylinder.

\_\_\_\_8. Pour out the rest of the beaker and rinse it well.

\_\_\_\_9. Using a graduated pipette, take **exactly** 12.0 mL of hydrochloric acid, HCl, solution from the graduated cylinder, and put it into the evaporating dish with the sodium hydroxide, NaOH, solution.

\_\_\_\_10. Your graduated cylinder should have 8.0 mL left in it.

\_\_\_\_11. Stir the solution in the evaporating dish with a clean stirring rod.

\_\_\_\_12. Feel the underside of the evaporating dish: \_\_\_\_\_

\_\_\_\_13. Observe the color of the solution in the evaporating dish: \_\_\_\_\_

\_\_\_\_14. **Slowly, drop by drop**, with constant stirring, add the hydrochloric acid, HCl, solution from the graduated cylinder to the sodium hydroxide, NaOH, solution in the evaporating dish,

until a distinct change takes place: \_\_\_\_\_

\_\_\_\_15. Squirt the rest of the hydrochloric acid, HCl, solution from the dropper back into the graduated cylinder.

- \_\_\_\_ 16. Remembering that you started with 20.0 mL of the hydrochloric acid, HCl, solution, how many milliliters did you use to cause the change in the sodium hydroxide, NaOH, solution in the evaporating dish: \_\_\_\_\_
- \_\_\_\_ 17. Rinse your dropper.
- \_\_\_\_ 18. Using your dropper, take some of the solution from the evaporating dish and squirt it onto a watch dish.
- \_\_\_\_ 19. Take the watch glass to a drying location specified by your teacher.

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## Day # 2

- \_\_\_\_ 20. Observe the contents of your watch glass when dry: \_\_\_\_\_
- \_\_\_\_ 21. Add a small amount of distilled water to the watch glass to dissolve the substance.
- \_\_\_\_ 22. Test the solution in the watch glass with red and blue litmus paper:
- Red litmus paper: \_\_\_\_\_
- Blue litmus paper: \_\_\_\_\_
- \_\_\_\_ 23. Rinse all glassware used, wipe down your lab area, wash your hands, then remove your safety goggles and have a seat.

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## Questions

1. **Neutralization is when enough acid is added to a base to cause it to lose its properties (or visa-versa).**

In your lab, did the:

A) acid neutralize the base, or B) base neutralize the acid

2. The product of a neutralization is a salt and water. The equation can be generalized as:

**BASE + ACID -----> SALT + WATER**

In a similar manner to the word equations which we have done, write the word equation for the reaction done in this lab:

\_\_\_\_\_  
3. What color is phenolphthalein indicator in a neutral solution ? \_\_\_\_\_

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## Review Questions

4. What does "M" represent in different solutions ? \_\_\_\_\_
5. What pH numbers represent acids ? \_\_\_\_\_
6. What pH numbers represent bases ? \_\_\_\_\_
7. What pH number is neutral ? \_\_\_\_\_

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## Exercise 8-B: All Types of Word Equations

1. silver + sulfur -----> \_\_\_\_\_

2. potassium hydroxide + acetic acid -----> \_\_\_\_\_

\_\_\_\_\_

3. iron sulfide -----> \_\_\_\_\_

4. sodium carbonate + hydrochloric acid -----> \_\_\_\_\_

\_\_\_\_\_

5. silver sulfate + barium nitrate -----> \_\_\_\_\_

\_\_\_\_\_

6. aluminum + sulfuric acid -----> \_\_\_\_\_

7. sodium phosphate + chloric acid -----> \_\_\_\_\_

\_\_\_\_\_

8. calcium + oxygen -----> \_\_\_\_\_

9. barium hydroxide + sulfurous acid -----> \_\_\_\_\_

\_\_\_\_\_

10. nitrogen hydride -----> \_\_\_\_\_

11. magnesium carbonate + hydrosulfuric acid -----> \_\_\_\_\_

\_\_\_\_\_

12. zinc bromide + copper silfide -----> \_\_\_\_\_

\_\_\_\_\_

13. magnesium sulfate + nitric acid -----> \_\_\_\_\_

\_\_\_\_\_

14. calcium hydroxide + hydrosulfuric acid -----> \_\_\_\_\_

\_\_\_\_\_

15. nickel + fluorine -----> \_\_\_\_\_

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## Exercise 8-A: Bases + Acids Word Equations

When you combine a base with an acid, you will get a salt and water. The general form for these equations are:

Base	+	acid	----->	salt	+	water
(2 words - "hydroxide")	+	("acid" in name)	----->	(2 words)	+	(H <sub>2</sub> O)

**Ex. sodium hydroxide + hydrochloric acid -----> sodium chloride + H<sub>2</sub>O**

Try the following:

1. sodium hydroxide + nitric acid ----> \_\_\_\_\_
2. calcium hydroxide + acetic acid ----> \_\_\_\_\_
3. barium hydroxide + hydrochloric acid ----> \_\_\_\_\_
4. magnesium hydroxide + sulfuric acid ----> \_\_\_\_\_
5. potassium hydroxide + phosphoric acid ----> \_\_\_\_\_
6. sodium hydroxide + hydrochloric acid ----> \_\_\_\_\_
7. potassium hydroxide + nitric acid ----> \_\_\_\_\_
8. calcium hydroxide + hydriodic acid ----> \_\_\_\_\_
9. sodium hydroxide + hydroiodic acid ----> \_\_\_\_\_
10. lithium hydroxide + carbonic acid ----> \_\_\_\_\_
11. magnesium hydroxide + chlorous acid ----> \_\_\_\_\_
12. calcium hydroxide + chloric acid ----> \_\_\_\_\_
13. sodium hydroxide + perchloric acid ----> \_\_\_\_\_
14. potassium hydroxide + hydrobromic acid ----> \_\_\_\_\_
15. barium hydroxide + citric acid ----> \_\_\_\_\_
16. aluminum hydroxide + hydrofluoric acid ----> \_\_\_\_\_
17. sodium hydroxide + sulfurous acid ----> \_\_\_\_\_
18. potassium hydroxide + hypochlorous acid ----> \_\_\_\_\_

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## Exercise 8-C: Neutralization Calculations

When a base neutralizes an acid, or visa versa, the amount of solution needed to accomplish this neutralization can be calculated. The formula for is:

$$(\text{Concentration of base})(\# \text{ OH groups})(\text{Volume of base}) =$$
$$(\text{Concentration of acid})(\# \text{ H groups})(\text{Volume of acid})$$

or it can be abbreviated:

Base		Acid
(M) (# OH) (Vol)	=	(M) (# H) (Vol)

An example:

If you have 15 mL of 2.0 M sodium hydroxide, NaOH, how many milliliters of 3.0 M hydrochloric acid, HCl, do you need to neutralize it ?

$$(2.0)(1)(15) = (3.0)(1)(X)$$
$$30 = 3X$$
$$10 \text{ mL} = X$$

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To receive full credit, you must include the set up (the first line of the example's answer and the answer. The in between steps are not necessary for credit. Now you try:

1. If you have 50 mL of 6.0 M sodium hydroxide, NaOH, how many milliliters of 2.0 M hydrochloric acid, HCl, do you need to neutralize it ?

2. How many milliliters of 6.0 M hydrochloric acid, HCl, do you need to neutralize 80 mL of 1.5 M calcium hydroxide,  $\text{Ca}(\text{OH})_2$  ?

3. If you have 33 mL of 4.0 M sulfuric acid,  $\text{H}_2\text{SO}_4$ , how many milliliters of 2.5 M sodium hydroxide,  $\text{NaOH}$ , do you need to neutralize it ?

4. How many milliliters of 1.2 M barium hydroxide,  $\text{Ba}(\text{OH})_2$ , do you need to neutralize 206 mL of 0.66 M sulfuric acid,  $\text{H}_2\text{SO}_4$  ?

5. If you have 43 mL of 0.82 M aluminum hydroxide,  $\text{Al}(\text{OH})_3$ , how many milliliters of 3.3 M hydrochloric acid,  $\text{HCl}$ , do you need to neutralize it ?

6. How many milliliters of 2.6 M sodium hydroxide,  $\text{NaOH}$ , do you need to neutralize 51 mL of 1.4 M phosphoric acid,  $\text{H}_3\text{PO}_4$  ?

7. If you have 125 mL of 0.83 M phosphoric acid,  $\text{H}_3\text{PO}_4$ , how many milliliters of 5.6 M aluminum hydroxide,  $\text{Al}(\text{OH})_3$ , do you need to neutralize it ?

8. If you have 45 mL of 6.3 M sodium hydroxide, NaOH, what is the concentration of 33 mL of hydrochloric acid, HCl, which neutralized it ?

9. What is the concentration of 100 mL of hydrochloric acid, HCl, which neutralizes 46 mL of 0.95 M calcium hydroxide,  $\text{Ca(OH)}_2$  ?

10. If you have 72 mL of 3.7 M sulfuric acid,  $\text{H}_2\text{SO}_4$ , what is the concentration of 82 mL of sodium hydroxide, NaOH, which neutralized it ?

11. What is the concentration of 75 mL of barium hydroxide,  $\text{Ba(OH)}_2$ , which neutralizes 105 mL of 0.65 M sulfuric acid,  $\text{H}_2\text{SO}_4$  ?

12. If you have 28 mL of 0.44 M aluminum hydroxide,  $\text{Al(OH)}_3$ , what is the concentration of 42 mL of hydrochloric acid, HCl, which neutralized it ?

13. What is the concentration of 66.1 mL of sodium hydroxide, NaOH, which neutralizes 36 mL of 2.1 M phosphoric acid,  $\text{H}_3\text{PO}_4$  ?

14. If you have 92 mL of 1.44 M phosphoric acid,  $\text{H}_3\text{PO}_4$ , what is the concentration of 38 mL of aluminum hydroxide,  $\text{Al}(\text{OH})_3$ , which neutralized it ?