Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Chemistry Unit 8 –Reaction Prediction**

|  |  |  |  |
| --- | --- | --- | --- |
| Objective | Learning Opportunities | Suggested Due Date | Date Completed |
| 8.1 Predict the Products of Single Replacement Reactions | * Review Podcast 7.2A The Basic 4 Types of Reactions
* Podcast 7.4
* #13-14 pg. 331; #15-16 pg. 332; #17 pg. 334; #18-19 pg. 335
* Related Reactivities of Metals DEMO
 | 01/15 and 01/16 |  |
| 8.2 Determine if a Substance is Oxidized or Reduced | * Podcast 7.2B – Special Types of Reactions
 | 01/17 |  |
| 8.3 Predict the Products of Acid-Base Reactions and Combustion Reactions | * Podcast 7.4
* Predicting Products of Reactions Based on Reaction Type
 | 01/21 |  |
| 8.4 Predict Solubility and Precipitate Formation in Double Replacement Reactions. | * Podcast 7.5A and Podcast 7.5 B
* Read p. 342 – 344, Answer #30-35
* Drip-Drop Lab (Molecular Equations)
 | 01/22 – 01/23  |  |
| 8.5 Recognize Spectator Ions in Complete Ionic Equations and Write the Net Ionic Equation | * Solubility Rules Quiz
* Copper-to-Copper Pre-Lab (Composition Notebook)
 | 01/24 |  |
|  Unit 8 Test | * Copper-to-Copper Lab
* Unit 8 Test Review
* Unit 8 Test JAN 31st
 | 01/27 – 01/30  |  |

****



**Related Reactivities of Metals Lab**

|  |
| --- |
| **Data Table** |
| Metal | Cu(NO3)2Cu2+ | Mg(NO3)2Mg2+ | Zn(NO3)2Zn2+ | AgNO3Ag+ |
| Cu |  |  |  |  |
| Mg |  |  |  |  |
| Zn |  |  |  |  |
| Ag |  |  |  |  |

**Analysis Questions**

1. Which metal reacted with the most solutions?
2. Which metal reacted with the fewest solutions?
3. With which of the solutions (of any) would you expect silver metal to react, if it were available to be tested? Fill your prediction in on the data table.
4. List the metals (including silver) in order, placing the most reactive metal first (the one reacting with the most solutions) and the least reactive metal last (the one reacting with the fewest solutions.
	* 1. 3)
		2. 4)
5. Refer to your “metal activity series” list in questions #4. Write a brief explanation of why the outside surface of a penny is made of copper instead of zinc.
6. a. Which of the four metals mentioned in this lab activity might be an even better choice

than copper for the outside of a penny? Why?

* 1. Why do you think that metal is not used for the coating of the outside of a penny?
1. Given your new knowledge about the relative chemical activities of these four metals:
	1. Which metal is *most* likely to be found in an uncombined or “free” state in nature?
	2. Which metal is *least* likely to be found chemically uncombined with other elements?
2. Reconsider the procedure for this lab.
	1. Would it have been possible to eliminate one or more of the metal-solution combinations and still obtain all the information needed to create the chemical activity ratings for the metals?
	2. If so, which combination(s) and why?

**An Introduction to Oxidation and Reduction**

**Oxidation and Reduction Movie Questions**

**Reduction**

1. Where did the term reduction come from?
2. What are two ways (or processes) to reduce metal ions?
3. Write the definition of reduction that makes the most sense to you.

**Oxidation**

1. Name two examples of oxidation.
2. Write the definition of oxidation that makes the most sense to you.

**Redox**

1. What does GER LEO stand for?
2. T/F Oxidation and reduction reactions take place together most of the time.
3. In the zinc and copper example, what was being reduced and what was being oxidized?
4. What is a reducing agent?
5. What happened with the silver tree? (wait for the copper wire demonstration before answering?

**Predicting Products of Reactions Based on Reaction Type**

**Work together with a partner to predict the products of the reactions given below. First identify the TYPE of reaction, then if the reaction occurs, complete the balanced equation. If it does not occur, write “NR” for “no reaction.”**

PARTNER A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. MgCO­3 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Na2CO3 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Cu + AlCl3 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. Ba(NO3)2+ Na 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. AlBr3 + Cl2 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11. Al2S3 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. MgF2 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15. Na + N2 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

17. Al + O2 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

19. Li + H2O 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 PARTNER B \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. MgCl2 $→$

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Sn(CO3)2 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Al(OH)3 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 8. Na + HCl 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 10. NaOH + Cu 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Zn + AlCl3 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Li2O 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. K3N 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Rb + O2 🡪

Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Mg + N2 🡪

 Type of Rxn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**11.3 Reactions in Aqueous Solution**

Read pages 342 – 344. Answer the following questions using complete sentences.

1. What does the symbol (aq) represent?
2. What is a complete ionic equation? Give an example
3. When ions do not change on both sides of the equation what should you do?
4. Define a spectator ion
5. What is a net ionic equation? Give an example.
6. What is a precipitate?
7. What are the general rules for solubility of ionic compounds?
8. Look at Table 11.3. Re-write these solubility rules into your own words.
9. Answer Questions 30 – 35 on page 344 on your own paper.

**Steps for Solving Net Ionic Equations**

1. Determine for each particle if it is written as an ion or molecule
2. For ions, write down the charge plus the number of ions determined from the formula
3. Write ionic equation for all substances
4. Cancel out like terms

EXAMPLE:

AgNO3 (aq) + NaCl (aq) AgCl (s) + NaNO3 (aq)

1. Use your solubility rules to determine what will break into ions and what will remain as a compound. Rule number 4 says that chlorides are soluble except when paired with Silver, Lead, or Mercury

Ag++ NO3-+ Na+ + Cl- AgCl (s) + Na+ + NO3-

1. Cancel out the spectator ions (the ones that don’t change on both sides)

Ag+ + Cl- AgCl (net ionic equation)

**Predicting Products of Reactions for**

**Double and Single Replacement Reactions**

**Work together with a partner to predict the products of the reactions given below. If a precipitate forms and reaction occurs, complete the balanced equation. If no precipitate forms and a reaction does not occur, write “NR” for “no reaction.”**

PARTNER A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. HCl + Mg 🡪
2. H2SO4 + Zn 🡪
3. MgCl2 + Al 🡪
4. ZnCl2 + Al 🡪
5. CaCl2 + Br2 🡪
6. AlBr3 + F2 🡪

PARTNER B \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Na2SO4 + BaCl2 🡪

1. HCl + AgNO3 🡪
2. NH4Cl + Mg(OH)2 🡪
3. NaOH + H3PO4 🡪
4. Na2S + AlCl3 🡪
5. Ca(NO3)2 + Ag2SO4 🡪

A Series of Copper Reactions

PLEASE complete the pre-lab in your lab notebook and get a stamp from your teacher BEFORE you begin this lab.

Purpose: In this experiment, you will perform a series of chemical reactions beginning with a weighed amount of copper metal. You will then recover the copper metal in the final reaction and determine the percent recovery. Since one of the basic laws of chemistry is the Law of Conservations of Mass, you should end up with the same weight of copper as you started with.

Reactions:

Cu + Cu(NO3)2 🡪 Cu(OH)2  🡪 CuO 🡪 CuCl2  🡪 Cu

Procedure:

1. **Copper (II) Nitrate from Copper**

Weight approximately 1 gram of metallic copper to 0.01 g into a 150 ml beaker and record the mass of the copper. Place the beaker on a ring stand under the hood. **CAREFULLY AND SLOWLY** add 10 ml of concentrated nitric acid (HNO3). Brown nitrogen dioxide gas (NO2) will be released, leaving a blue solution of copper nitrate. The brown NO2 is **HAZARDOUS**. If the copper does not completely dissolve, slight warming and additional acid may be required. Cool the solution to room temperature.

**The balanced reaction is:**

**Cu + 4 HNO3 🡪 Cu (NO3)2  + 2 NO2 + 2 H2O**

1. **Preparation of Copper (II) Hydroxide**

Dilute the cooled copper nitrate solution from Part A with 50ml of water. **Cautiously** add about 30ml of 6 M NaOH to produce a precipitate of copper hydroxide. The reaction is complete when no further precipitate of copper hydroxide is formed as drops of 6 M NaOH solution are added to the surface of the liquid in the beaker. The solution should test basic with litmus paper. (Use a stirring rod to transfer a small drop of solution to the litmus paper. Base turns red litmus to blue.) Add more sodium hydroxide solution if necessary. **Write the balanced equation for this reaction.**

1. **Preparation of Copper (II) Oxide**

Bring the solution of copper hydroxide up to a total volume of about 100ml with distilled water. (The volume may already exceed 100ml.) Gently simmer the solution for about five minutes with constant stirring. A black precipitate of copper (II) oxide will form as the copper hydroxide decomposes. If the precipitate does not settle, heat a bit longer. Allow the precipitate to settle and carefully decant the clear liquid being careful to lose as little of the precipitate as possible. Add about 100ml hot distilled water and repeat decantation. **Write a balanced chemical reaction for this reaction.**

1. **Preparation of Copper (II) Chloride**

Dissolve the copper by adding 15ml of 6 M hydrochloric acid (HCl) to the precipitate. Additional 1 ml amounts of HCl may be required to dissolve all the precipitate. **Write a balanced chemical equation describing this process.**

1. **Recovery of Copper Metal**

Add at least 1 gram of zinc foil to the solution to replace the copper. Stir the solution to increase the reaction rate. When all the copper has been replaced, the solution will be colorless. Remove the remaining zinc foil and scrape any copper film off into the beaker. Recover the copper metal by decanting off the liquid. Wash the copper metal with 50 ml of distilled water, stir, allow to settle and decant. Repeat with another 50 ml of water. Transfer the copper to a dry, weighed, evaporating dish using as little water as possible. Allow the copper to settle and decant most of the water. Dry the copper completely in a drying oven at 80˚C Weigh the dish and dry copper metal. **Write a balanced chemical equation for this final reaction and calculate the percent of copper recovered.**

# **Safety Alerts**

1. All solutions contain nitric acid which is very corrosive to skin and eyes. Wash spills off yourself with LOTS of water. Neutralize spills on the lab table with baking soda.
2. Solutions are toxic; so wash your hands before you leave the lab.
3. Sodium hydroxide is a strong base and is hazardous to skin and eyes. If you get any on yourself, wash off with large amounts of water. Neutralize spills on the counter with vinegar.
4. You will be using solutions with high concentrations of sulfuric and nitric acids and sodium hydroxide, both of which are highly damaging to skin and eyes. Be careful when handling them. If you spill any on yourself, wash off with lots of water. Neutralize sulfuric acid spills on the counter with baking soda, and neutralize potassium hydroxide spills with vinegar (dilute acetic acid).
5. When zinc dissolves in sodium hydroxide solution, hydrogen gas is produced. Make sure that no flames are present. This step should be performed in a fume hood.
6. Wear Chemical Splash Goggles and a Chemical-Resistant Apron.

**Prelab Questions**: Please draw safety symbols next to each step in your procedure to summarize that hazards to watch for as you complete each part of the lab. For a listing of safety symbols, please refer p. R80 in the back of your textbook. Feel free to design your own safety icon as well.

**Post-Lab Questions:**

1. Write the word equation for each of the 5 reactions.
2. Write a balanced chemical equation for each of the 5 reactions.
3. Write a net ionic equation for each of the 5 reactions.
4. Identify the type of reaction for each of the 5 reactions.**Chemistry Lab Report Rubric**

**A Series of Copper Reactions**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |
| --- | --- | --- |
| **Table of Contents** | **Points Earned** | **Points Possible** |
| * Includes the title, page numbers, and date of experiment
 |  | 2 |
| **Title** |  |  |
| * Capitalized appropriately, relates to the experiments, underlined at the top of the lab report
 |  | 1 |
| **Problem Statement** |  |  |
| * Testable and clearly stated
 |  | 2 |
| **Variables** |  |  |
| * Independent, Dependent, Control, at least 3 constants
 |  | 6 |
| **Hypothesis** |  |  |
| * States what you are doing, what you predict will happen, and why you think that will happen. If…Then…Because
 |  | 2 |
| **Materials** |  |  |
| * A list of all materials used in the experiment
 |  | 1 |
| **Procedure** |  |  |
| * Write a complete, **DETAILED** procedure.
 |  | 3 |
| **Data** |  |  |
| * Organized table that shows the data you have collected during the experiment
	+ - Include an appropriate title
		- Clearly organize and label data columns and rows
		- Units are clearly identified
		- Accuracy of data is appropriate to measuring equipment or instruments
		- Data from multiple trials is clearly shown
		- Data and table lines are neat and presentable (USE A RULER)
 |  | 3 |
| **Analysis** |  |  |
| * Calculate Percent Yield for your own trial and for the class average
 |  | 2 |
| Questions: 1. Word Equations (5)
2. Balanced Chemical Equations (5)
3. Net Ionic Equations (5)
4. Identify Reaction Type (5)
 |  | 20 |
| **Conclusion** |  |  |
| * Written in paragraph form (minimum of 3 paragraphs)
 |  | 1 |
| * Support or refute your hypothesis. Give reasons why. USE YOUR DATA!
 |  | 5 |
| * Discuss any EXPERIMENTAL error you may have had in the experiment.
 |  | 4 |
| * Discuss how to change the design to fix the errors. What further questions or investigations does this lead to?
 |  | 4 |
| **Discussion/Reflection** |  |  |
| * Discuss what you learned from this experiment and how it relates to what we are learning in class (Law of Conservation of Mass, Types of Reactions, Balancing Equations, Net Ionic Equations, etc) and applications in the real world (mining, medicine, technology, etc).
 |  | 4 |
| **Total Points** |  | 60 |

# **Net Ionic Equation Worksheet**

Write balanced net ionic equations for each of the following reactions. Assume all reactions occur in aqueous solution.

1. NaCl(aq) + Pb(NO3)2(aq) → PbCl2(s) + NaNO3(aq)

2. Na2CO3(aq) + FeCl2(aq) → FeCO3(s) + NaCl(aq)

3. Mg(OH)2(aq) + HCl(aq) → MgCl2(aq) + H2O(l)

4. K2(C2O4)(aq) + CaCl2(aq) → KCl(aq) + Ca(C2O4)(s)

5. (NH4)3PO4(aq) + Zn(NO3)2(aq) → NH4NO3( ) + Zn3(PO4)2( )

6. LiOH(aq) + VCl3(aq) → LiCl( ) + V(OH)3( )

7. Na2CO3(aq) + HCl(aq) → NaCl( ) + CO2( ) + H2O( )

8. Mg(NO3)2(aq) + Na2CrO4(aq) → NaNO3( ) + MgCrO4( )

9. FeCl3(aq) + Mg(s) → MgCl2(aq) + Fe(s)

10 Zr(OH)4(s) + HNO3(aq) → Zr(NO3)4( ) + H2O( )

11. Na2SO3(s) + HCl(aq) → NaCl( ) + H2O( ) + SO2(g)

12. BaBr2(aq) + Na2SO4(aq) →

13. AgNO3(aq) + MgI2(aq) →

14. (NH4)2C2O4(aq) + Al(ClO4)3(aq) →

15. Ni(NO3)2(aq) + NaOH(aq) →

**Unit 8 Reaction Prediction Test Review**

1. What do (s), (l), (aq), and (g) stand for in a chemical reaction?
2. The activity series of metals is utilized to predict the products for which type of reaction?
3. Looking at the solubility chart and rules, which salts will form a precipitate?
4. Write the net ionic equation for Pb(NO3)2 (aq) + NH4Cl (aq) 🡪 PbCl2 (s) + NH4NO3 (aq).
5. Predict the products for C2H6 + O2 🡪
6. Predict the products for Ca + Mg(NO3)2 🡪
7. Predict the products for H2SO4 + NaOH 🡪
8. Using the equation CS2 + O2 🡪 CO2 + SO2
	1. Balance the equation.
	2. What type of reaction is this?

For those of you paying attention, you may make a 3x5 hand written note card for the test.

1. Using the equation Sn + HF 🡪 SnF2 + H2:
	1. Balance the equation.
	2. What type of reaction is this?
2. In Step B of the Series of Copper Reactions Lab, sodium hydroxide is combined with copper(II) nitrate. Write the balanced equation for this reaction, the complete ionic equation, and the net ionic equation. BE READY TO DO THE SAME FOR ANY STEP IN THE LAB!