

Chemical Reactions

Chm.2.2.2 - Students should be able to determine if a chemical reaction has occurred based on the following criteria:

- Precipitate formation (tie to solubility rules)
- Product testing - Know the tests for some common products such as oxygen, water, hydrogen and carbon dioxide: burning splint for oxygen, hydrogen or carbon dioxide, and lime water for carbon dioxide. Include knowledge and application of appropriate safety precautions.
- Color Change – Distinguish between color change as a result of chemical reaction, and a change in color intensity as a result of dilution.

Chm.2.2.3 - Write and balance chemical equations predicting product(s) in a reaction using the reference tables.

- Identify acid-base neutralization as double replacement.
- Write and balance ionic equations.
- Write and balance net ionic equations for double replacement reactions.
- Recognize that hydrocarbons (C,H molecule) and other molecules containing C, H, and O burn completely in oxygen to produce CO₂ and water vapor.
- Use reference table rules to predict products for all types of reactions to show the conservation of mass.
- Use activity series to predict whether a single replacement reaction will take place.
- Use the solubility rules to determine the precipitate in a double replacement reaction if a reaction occurs.

Students should be able to:

1. Identify a reaction by type.
2. Identify and apply the four indicators of a chemical reaction.
3. Color Change – Distinguish between color change as a result of chemical reaction, and a change in color intensity as a result of dilution.
4. Predict and write formulas using the reference tables to write a complete chemical equation.
5. Identify the physical states of reactants or products in a chemical equation.(optional)
6. Balance chemical equations using the law of conservation of mass.
7. Predict product(s) in a reaction using the reference tables.
8. Use activity series to predict whether a single replacement reaction will take place.
9. Use the solubility rules to determine the precipitate in a double replacement reaction if a reaction occurs.
10. Recognize a precipitate as an insoluble substance as listed in the solubility rules.
11. Identify acid-base neutralization as double replacement.
12. Recognize that hydrocarbons (C,H molecule) and other molecules containing C, H, and O burn completely in oxygen to produce CO₂ and water vapor.
13. Write and balance ionic equations.
14. Write and balance net ionic equations.
15. Identify the spectator ions in a double replacement reaction.
16. Product testing - Know the tests for some common products such as oxygen, water, hydrogen and carbon dioxide. (tests to know: burning splint for Oxygen, Hydrogen and Carbon Dioxide (include knowledge of safety precautions) lime water for Carbon Dioxide).

Unit 4 Objectives Checklist – Chemical Reactions

Objective	Was this covered in class?	Have I met this objective?
1. Identify a reaction by type.		
2. Identify and apply the four indicators of a chemical reaction.		
3. Color Change – Distinguish between color change as a result of chemical reaction, and a change in color intensity as a result of dilution.		
4. Predict and write formulas using the reference tables to write a complete chemical equation		
5. Identify the physical states of reactants or products in a chemical equation.(optional)		
6. Balance chemical equations using the law of conservation of mass.		
7. Predict product(s) in a reaction using the reference tables.		
8. Use activity series to predict whether a single replacement reaction will take place.		
9. Use the solubility rules to determine the precipitate in a double replacement reaction if a reaction occurs.		
10. Recognize a precipitate as an insoluble substance as listed in the solubility rules.		
11. Identify acid-base neutralization as double replacement.		
12. Recognize that hydrocarbons (C,H molecule) and other molecules containing C, H, and O burn completely in oxygen to produce CO ₂ and water vapor.		
13. Write and balance ionic equations.		
14. Write and balance net ionic equations.		
15. Identify the spectator ions in a double replacement reaction.		
16. Product testing - Know the tests for some common products such as oxygen, water, hydrogen and carbon dioxide. (tests to know: burning splint for Oxygen, Hydrogen and Carbon Dioxide (include knowledge of safety precautions) lime water for Carbon Dioxide).		

Assignment 1: Introduction

(Prentice Hall Chemistry Chapter 11)

1. What happens in a chemical change?
2. How can matter be changed from one form to another?
3. What is a chemical reaction?
4. What is a word equation?
5. What is a chemical equation?
6. What is a skeleton equation?
7. Define or explain each of the following:
 - a. +
 - b. \rightarrow
 - c. Reactants
 - d. Products
 - e. Coefficients
 - f. Balanced

8. Define or explain each of the following:

a. (g)	b. (l)	c. (s)
d. (aq)	e. (Δ)	f. $\xrightarrow{\quad}$

9. When writing a chemical equation, where are the conditions necessary for the reaction shown?
10. State the Law of Conservation of Mass.
11. To balance a chemical equation:
 - a. Write a skeleton equation that shows the correct chemical formula for reactants and products.
 - b. Determine the _____ of _____ of each type on each side of the equation.
 - c. Use _____ to balance the equation. _____ SHOULD NEVER BE CHANGED.
 - d. Make sure that you have the smallest possible whole number coefficients.

12. Explain and give an example to demonstrate how changing a subscript is different from changing a coefficient.
13. Why must the formulas for reactants and products be written correctly when writing and balancing chemical equations?
14. Give 3 examples of chemical reactions that occur around you on a daily basis.
- -
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15. What are the four indicators of chemical change? Give a one sentence description of each.
- -
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16. Describe the following types of reactions. Write a chemical equation that represents each type.
- combination or synthesis reaction
 - decomposition reaction
 - single replacement
 - double replacement
 - acid-base neutralization reaction
 - combustion reaction
17. Which of the above types of reactions are acid-base neutralization reactions categorized as?
18. What are hydrocarbons?
19. What are the common products when a hydrocarbon undergoes combustion?
20. How could a burning splint be used to observe the presence of each of the following gases:
- Oxygen
 - Hydrogen
 - Carbon Dioxide
21. There is another common test for the presence of carbon dioxide. It involves the use of a solution. Do some research to find the solution and explain how it is used. In your description be sure to include the chemical equation representing the chemical reaction involved.

Assignment 2: Physical vs. Chemical Properties

A physical property is observed with the senses and can be determined without destroying the object. For example, color, shape, mass, length, and odor are all examples of physical properties.

A chemical property indicates how a substance reacts with something else. The original substance is fundamentally changed in observing a chemical property. For example, the ability of iron to rust is a chemical property. The iron has reacted with oxygen, and the original iron metal is changed. It now exists as iron oxide, a different substance.

A. Practice

Classify the following properties as either chemical or physical by putting a check in the appropriate column.

	Physical Property	Chemical Property
1. Blue color		
2. Density		
3. Flammability		
4. Solubility		
5. Reacts with acid to form H ₂		
6. Supports combustion		
7. Sour taste		
8. Melting point		
9. Reacts with water to form a gas		
10. Reacts with a base to form water		
11. Hardness		
12. Boiling point		
13. Can neutralize a base		
14. Luster		
15. Odor		

B. Physical vs. Chemical Changes

In a physical change, the original substance still exists, it has only changed in form. In a chemical change, a new substance is produced. Energy changes always accompany chemical changes.

Classify the following as being a physical or chemical change.

1. Sodium hydroxide dissolves in water. _____
2. Hydrochloric acid reacts with potassium hydroxide to produce a salt, water and heat. _____
3. A pellet of sodium is sliced in two. _____
4. Water is heated and changed to steam. _____
5. Potassium chlorate decomposes to potassium chloride and oxygen gas. _____
6. Iron rusts. _____
7. When placed in H₂O, a sodium pellet catches on fire as hydrogen gas is liberated and sodium hydroxide forms. _____
8. Evaporation. _____

- 9. Ice melting. _____
- 10. Milk sours. _____
- 11. Sugar dissolves in water. _____
- 12. Wood rotting _____
- 13. Pancakes cooking on a griddle _____
- 14. Grass growing in a lawn _____
- 15. A tire is inflated with air. _____
- 16. Food is digested in the stomach. _____
- 17. Water is absorbed by a paper towel. _____

C. Chemical and Physical Properties

Indicate whether each of the following properties is chemical or physical.

- _____ 1. Sulfur is a bright yellow solid.
- _____ 2. Sulfur has a low melting point.
- _____ 3. Sulfur causes silver to tarnish.
- _____ 4. Aluminum is very malleable.
- _____ 5. Monuments made of copper corrode in acid rain.
- _____ 6. Copper is a good conductor of electricity.
- _____ 7. Iron fillings are magnetic.
- _____ 8. Bromine is a reddish brown liquid.
- _____ 9. Sodium is a very active metal.
- _____ 10. Alcohol is flammable.
- _____ 11. Sulfur dioxide smells like rotten eggs.
- _____ 12. Glass has a nonporous surface.
- _____ 13. Water is a very stable compound.
- _____ 14. Copper is a ductile metal.
- _____ 15. Sodium chloride is very soluble in water.
- _____ 16. The melting point of ice at 1 atm is 0°C.
- _____ 17. Iron rusts in air or water.
- _____ 18. Mercury is almost 14 times as dense as water.
- _____ 19. Sulfur is not a good conductor of heat or electricity.
- _____ 20. Iodine sublimates.

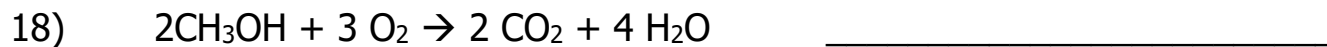
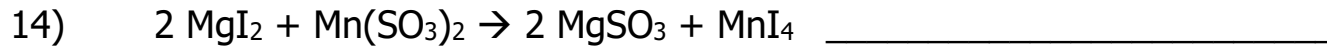
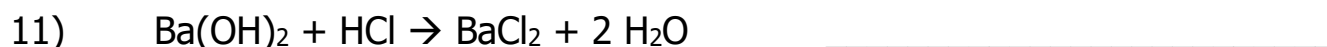
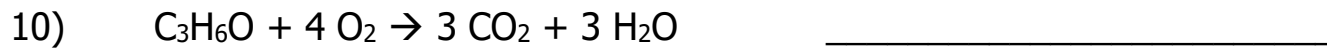
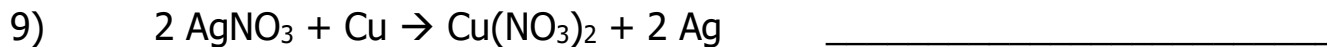
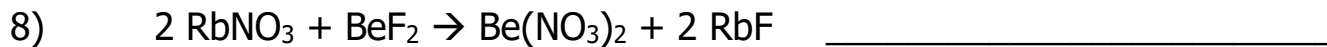
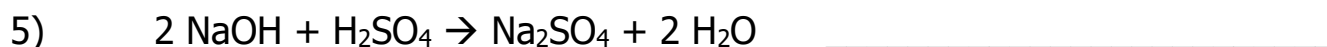
D. Chemical and Physical Changes

Identify the following changes as chemical or physical

- _____ 1. Lead reacts with sulfuric acid in a car battery.
- _____ 2. Gasoline burns in a car engine.
- _____ 3. Frost forms on a car window at night.
- _____ 4. Grass is covered with dew.
- _____ 5. Ice cream melts.
- _____ 6. Dynamite explodes.
- _____ 7. Moth balls sublime.
- _____ 8. Oxygen can be liquefied at high pressure and low temperature.
- _____ 9. Silver tableware is often tarnished.
- _____ 10. A steel needle can be magnetized.
- _____ 11. Sodium reacts with water to produce hydrogen gas and sodium hydroxide.
- _____ 12. Sugar dissolves in water.
- _____ 13. Sugar can be decomposed to carbon, carbon dioxide and water.
- _____ 14. Healing of a wound on your skin (a scrape for example)

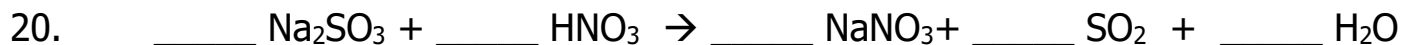
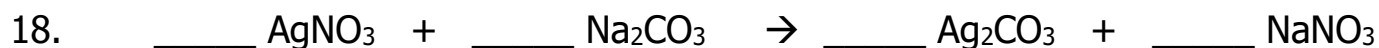
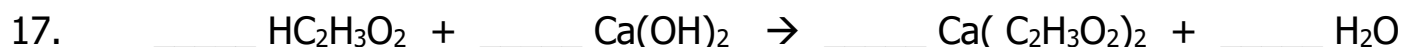
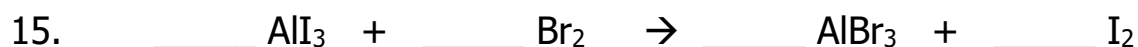
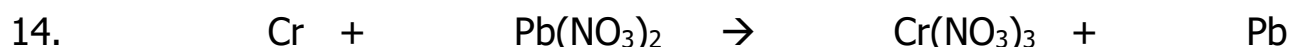
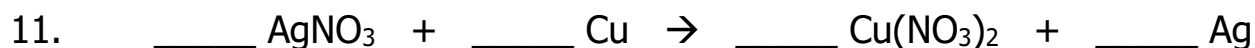
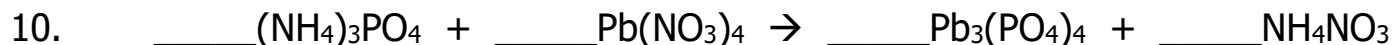
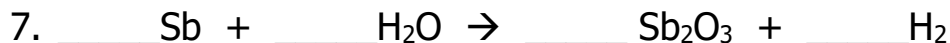
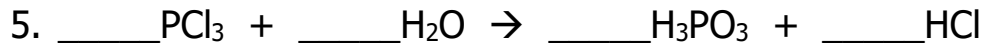
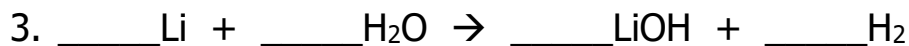
Assignment 3: Classification of Chemical Reactions

Classify the reactions below as synthesis, decomposition, single replacement, double replacement, acid-base neutralization, or combustion.



Assignment 4: Balancing Equations

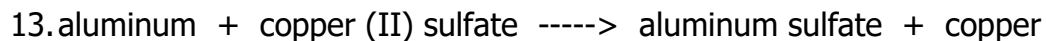
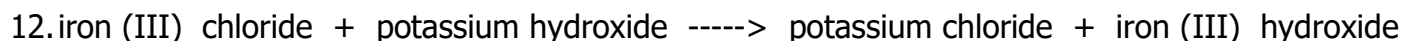
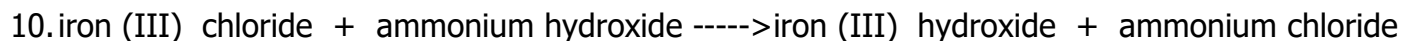
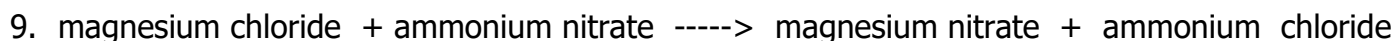
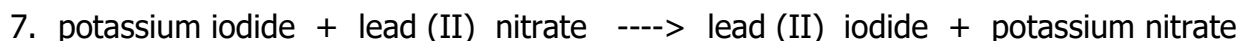
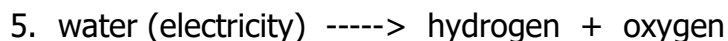
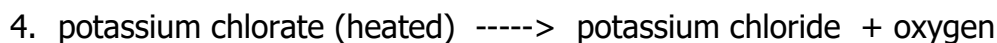
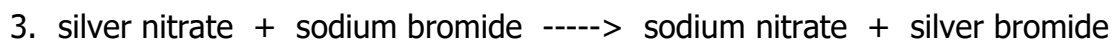
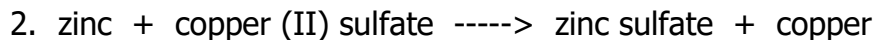
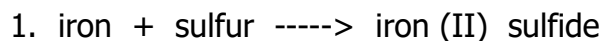
Examples - Balance the following equations with the smallest whole number coefficients.



21. $\text{AlI}_3 + \text{HgCl}_2 \rightarrow \text{AlCl}_3 + \text{HgI}_2$
22. $\text{SnCl}_4 + (\text{NH}_4)_2\text{S} \rightarrow \text{NH}_4\text{Cl} + \text{SnS}_2$
23. $\text{MnS} + \text{PbCl}_4 \rightarrow \text{MnCl}_2 + \text{PbS}_2$
24. $\text{Hg}_2(\text{NO}_3)_2 + \text{NaI} \rightarrow \text{Hg}_2\text{I}_2 + \text{NaNO}_3$
25. $\text{KOH} + \text{FeCl}_3 \rightarrow \text{KCl} + \text{Fe}(\text{OH})_3$
26. $\text{AgNO}_3 + \text{Al} \rightarrow \text{Al}(\text{NO}_3)_3 + \text{Ag}$
27. $\text{Mn} + \text{H}_3\text{PO}_4 \rightarrow \text{Mn}_3(\text{PO}_4)_2 + \text{H}_2$
28. $\text{CaBr}_2 + \text{KOH} \rightarrow \text{Ca}(\text{OH})_2 + \text{KBr}$
29. $\text{AgNO}_3 + \text{K}_3\text{PO}_4 \rightarrow \text{Ag}_3\text{PO}_4 + \text{KNO}_3$
30. $\text{Na}_3\text{PO}_4 + \text{ZnSO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{Zn}_3(\text{PO}_4)_2$
31. $\text{Ca}(\text{OH})_2 + \text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$
32. $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
33. $\text{C}_2\text{H}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
34. $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
35. $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
36. $\text{C}_5\text{H}_{10}\text{O} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
37. $\text{N}_2\text{O} \rightarrow \text{O}_2 + \text{N}_2$
38. $\text{Li} + \text{N}_2 \rightarrow \text{Li}_3\text{N}$
39. $\text{FeCl}_2 + \text{Cl}_2 \rightarrow \text{FeCl}_3$
40. $\text{P}_4 + \text{Cl}_2 \rightarrow \text{PCl}_5$

Assignment 5: Writing Balanced Equations

Write and balance a chemical equation to represent each of the following chemical reactions. Identify each reaction type.



Assignment 6: Synthesis Reactions

Complete the word equation. Then write and balance a chemical equation for the reactions describe below.

1. lithium + oxygen ----->

2. calcium + iodine ----->

3. potassium + sulfur ----->

4. strontium + bromine ----->

5. magnesium + phosphorus ----->

6. potassium + nitrogen ----->

7. beryllium + oxygen ----->

8. cesium + sulfur ----->

9. silver + bromine ----->

10. zinc + oxygen ----->

Assignment 7: Decomposition Reactions

Complete the word equation. Then write and balance a chemical equation for the reactions describe below.

1. lithium carbonate ----->
2. sodium oxide ----->
3. silver fluoride ----->
4. aluminum hydroxide ----->
5. calcium bromide ----->
6. nickel (IV) oxide ----->
7. gallium (III) carbonate ----->
8. strontium chlorate ----->
9. silver hydroxide ----->
10. magnesium chloride ----->

Assignment 8: Single Replacement Reactions

Complete the word equation. Then write and balance a chemical equation for the reactions describe below.

1. potassium + water ----->
2. magnesium + calcium phosphide ----->
3. zinc + sodium bicarbonate ----->
4. zinc + lead (II) nitrate ----->
5. potassium + barium acetate ----->
6. aluminum + mercury (II) nitrate ----->
7. fluorine + sodium chloride ----->
8. calcium + cadmium (II) nitrate ----->
9. lithium + water ----->
10. strontium + water ----->

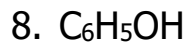
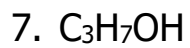
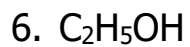
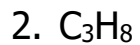
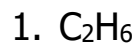
Assignment 9: Double Replacement Reactions

Complete the word equation. Then write and balance a chemical equation for the reactions describe below.

1. sodium phosphate + zinc sulfate ----->
2. barium acetate + sodium sulfide ----->
3. potassium carbonate + aluminum chloride ----->
4. mercury (II) nitrate + sodium iodide ----->
5. silver nitrate + sodium carbonate ----->
6. ammonium phosphate + sodium hydroxide ----->
7. potassium fluoride + magnesium sulfate ----->
8. barium chloride + sodium sulfate ----->
9. lead (II) nitrate + magnesium iodide ----->
10. sodium phosphate + ammonium sulfate ----->

Assignment 10: Combustion Reactions.

Write and balance a chemical equation for the reactions describe below.



Assignment 11: Chemical Reactions Review

Complete the word equation. Then write and balance a chemical equation for the reactions describe below. Identify each reaction.

1. aluminum + hydrochloric acid
2. calcium hydroxide + nitric acid
3. magnesium + zinc nitrate
4. mercury + oxygen -----> mercury (II) product
5. zinc chloride + hydrogen sulfide
6. silver chloride + sodium nitrate
7. sodium chlorate (heated)
8. barium nitrate + sodium chromate
9. sodium bromide + silver nitrate
10. calcium phosphate + aluminum sulfate
11. zinc carbonate (heated)
12. ethanol (C₂H₅OH) + oxygen
13. iron + oxygen -----> iron (III) product
14. lead (II) nitrate + potassium chromate
15. isopropyl alcohol (C₃H₇OH) burning

Assignment 12: Writing Balanced Equations from Descriptions

Write balanced chemical equations to correspond to each of the following descriptions. Include all physical states and reaction conditions if given.

1. During a single replacement reaction, aluminum metal reacts with aqueous sulfuric acid produce an aqueous solution of aluminum sulfate and hydrogen gas.
2. When solid potassium nitrate is heated it decomposes to form solid potassium nitrite and oxygen gas.
3. When lithium metal combines with fluorine gas in a synthesis or combination reaction, solid lithium fluoride is formed.
4. When solid barium carbonate is heated it decomposes into solid barium oxide and carbon dioxide gas.
5. When solid mercury (II) sulfide is heated it decomposes into liquid mercury and solid sulfur.
6. The surface of aluminum metal undergoes a combination reaction with oxygen in the air to form solid aluminum oxide.
7. During a single replacement reaction aluminum metal reacts with aqueous hydrochloric acid to produce an aqueous solution of aluminum chloride and hydrogen gas.
8. During a double replacement reaction aqueous solutions of potassium iodide and lead (II) nitrate combine to form an aqueous solution of potassium nitrate and the precipitate lead (II) iodide.
9. When the alcohol methanol, CH_3OH , undergoes combustion with oxygen in the air, carbon dioxide gas and water vapor is formed.