

## Balancing Chemical Equations Lab; SC2a,b; SC1d



In today's lab you will be conducting a series of chemical reactions. A chemical reaction is a process that is usually characterized by a chemical change in which the starting materials (reactants) are different from the products. Chemical reactions tend to involve the motion of electrons, leading to the formation and breaking of chemical bonds. There are several different types of chemical reactions. Let's review the main types of chemical reactions. In a synthesis reaction two or more chemical species combine to form a more complex product, such as  $A + B \rightarrow AB$ . While in a decomposition reaction a compound is broken into smaller chemical species, as indicated by  $AB \rightarrow A + B$ . A single displacement reaction is characterized by one element being displaced from a compound by another element, for example  $A + BC \rightarrow AC + B$ . On the other hand, in a double displacement reaction two compounds exchange bonds or ions in order to form different compounds, which can be shown as  $AB + CD \rightarrow AD + CB$ . An acid-base reaction is a specific type of double displacement reaction that occurs between an acid and a base. The  $H^+$  ion in the acid reacts with the  $OH^-$  ion in the base to form water and an ionic salt:  $HA + BOH \rightarrow H_2O + BA$ . In an oxidation-reduction or redox reaction the oxidation numbers of atoms are changed. Redox reactions may involve the transfer of electrons between chemical species. A combustion reaction is a special type of redox reaction in which a combustible material combines with an oxidizer to form oxidized products and generate heat (exothermic reaction). Usually in a combustion reaction, oxygen combines with another compound to form carbon dioxide and water. The purpose of this lab is to observe several types of chemical reactions and to document the physical and chemical changes that occur.

### Part 1: Synthesis Reaction ( $A + B \rightarrow AB$ )

1). Add a few copper shot to an aluminum weighing dish or a dish constructed from aluminum foil. 2). Construct a ring stand with ring and wire gauze, just as we have done in the past. 3). Light the Bunsen burner and adjust so that the flame is just below, but not touching, the gauze. 4). Heat the copper for five minutes. Observe carefully and record qualitative data on changes that you observe as the copper reacts with the oxygen in the air. 5). Remove from heat using crucible tongs and thoroughly observe the final product. You may choose to use a stereoscope for closer observation.

Q1. Record all qualitative data here. Be sure to note whether a stereoscope was used and be thorough.

Q2. Write the chemical reaction for this synthesis reaction. Did this reaction involve  $Cu^{1+}$  or  $Cu^{2+}$ ?

### Part 2: Decomposition Reaction ( $AB \rightarrow A + B$ )

1). Add enough sucrose ( $C_{12}H_{22}O_{11}$ ) to lightly cover the bottom of a dish constructed from aluminum foil. 2). Heat the sugar and note any changes. When the boiling ceases, turn off the burner and observe the product. 3). After about three minutes, remove and discard the foil.

Q3. Record all qualitative data here. Be sure to note whether a stereoscope was used and be thorough.

Q4. What products do you believe were formed during this reaction? Write the balanced equation.

### Part 3: Single Replacement Reaction ( $A + BC \rightarrow AC + B$ )

1). Obtain a small (~5mm) piece of magnesium ribbon. You may need to use scissors to cut a small piece, unless they are pre-cut for you. 2). Place the magnesium in an aluminum weighing dish. 3). Add enough 1M HCl to cover the ribbon. 4). Carefully observe the reaction and record your qualitative data below.

Q5. Record all qualitative data here.

Q6. What products do you believe were formed during this reaction? Write the balanced equation.

#### Part 4: Double Replacement Reaction (AB + CD → AD + CB)

1). Add a small amount of sodium carbonate solution to a test tube. 2). Add a small amount of calcium chloride solution until a noticeable reaction occurs. 3). Carefully observe the reaction and record your qualitative data below.

Q7. Record all qualitative data here.

Q8. What products do you believe were formed during this reaction? Write the balanced equation.

#### Part 5: Unknown Reaction (??)

1). Design your own experiment to determine reaction types. 2). Choose from the elements and compounds listed in the below table. You will need to determine how you will react the substances (mixing, heat, etc.). 3). Choose one substance from column A and *the corresponding item* from column B. Note that the two silver nitrate experiments must be conducting in test tubes, while the remaining reactions can be conducting in aluminum dishes. It is recommended that you add the substance from column B to the substance in column A.

Q9. Record the qualitative data for each reaction conducted here. You may decide to collaborate with other groups to assimilate this information.

Q10. Write the balanced chemical reaction for each of the above reactions.

A	B
Copper	Silver nitrate
Hydrogen peroxide	Heat
Zinc	Hydrochloric acid
Sodium chloride	Silver nitrate
Sodium hydroxide	Hydrochloric acid

#### Part 6: Redox Reaction (combustion demonstration)

1). This will be conducted as a demonstration due the extreme exothermic nature of this type of reaction.

Q11. Record the qualitative data for this reaction.

Q12. Write the balanced equation for this reaction.

#### Post Lab Analysis:

1). Balance the following four chemical equations and determine the specific type of reaction for each.

2). Write formulaic descriptions for each reaction using IUPAC nomenclature.

A).  $\text{___ LiNO}_3 + \text{___ CaBr}_2 \rightarrow \text{___ Ca(NO}_3)_2 + \text{___ LiBr}$  Type of reaction \_\_\_\_\_

B).  $\text{___ AgNO}_3 + \text{___ Li} \rightarrow \text{___ LiNO}_3 + \text{___ Ag}$  Type of reaction \_\_\_\_\_

C).  $\text{___ Si(OH)}_4 + \text{___ NaBr} \rightarrow \text{___ SiBr}_4 + \text{___ NaOH}$  Type of reaction \_\_\_\_\_

D).  $\text{___ NaCN} + \text{___ CuCO}_3 \rightarrow \text{___ Na}_2\text{CO}_3 + \text{___ Cu(CN)}_2$  Type of reaction \_\_\_\_\_