Types of Chemical Reactions Lab

Research questions

This is a self-designed lab that will allow you to learn about different types of chemical reactions by analyzing each reaction type, choosing a few reactions to carry out in lab, evaluating the suitability of each reaction chosen to demonstrate the particular reaction type by predicting the products, and observing and describing the reaction as it is carried out in lab. Write a research question for each of the 5 reaction types. Your hypotheses will be the predicted products.

Lab book setup: Details are in the Checklist

Table of Contents – page 3, fill it in now.
Chemical Data Table including reactants AND expected products – info is online (L)
Safety (L)
Title (R)
Name, Date, Co: partner in upper right hand corner of RH page
Purpose (R)
Introduction – see checklist (R)
Materials list (also submit the day before the lab) (R)
- will you need each reactant as a solid or in a solution?

Procedure: write this after you have determined how you will do each reaction. (R)
- must be so complete that another person could duplicate it exactly.
- ***your reactions, their equations, and your proposed procedure must be approved and initialed before you will be permitted to begin lab work.***

Data table: a place for you to record the observations that confirm the reaction took place. (L)
Analysis of Data - see below (L or R)
Conclusion – see criteria sheet (L or R)

Hints (that you are required to use):

- Think SIMPLE. The best examples are not necessarily the most complex.
- Look through the examples in your notes, text, and worksheet on reaction prediction. Google will give you seemingly spectacular reactions that A) will not meet the specification you need, or B) will take lots of time to set up.
- Choose at least 2 examples of single and double replacement reactions. Choose 1 example each of decomposition, synthesis, and combustion reactions.
  - Each example must be of a different "subtype" - for example, instead of choosing 2 gas-forming double replacement reactions, choose one gas-forming and one precipitate-forming.
- All reactions will be done on a microscale or at least small scale. Use the least amount or reagents possible.
- Write a balanced equation for each BEFORE deciding to use it. Predict the products using what you know about reaction types. Investigate the properties of each of the products for solubility, etc.
- Be sure the products will be detectable, so that you can verify that your intended reaction probably took place.
- Use a solubility chart and an activity series to help you choose reactants and write the equations.
- Be sure to have an alternate reaction in case a chemical you planned is unexpectedly unavailable, or in case one of your reactions does not show the desired result.
- Litmus paper or pH paper will tell you if a solution is an acid or a base.

Available Chemicals (plan for alternates in case this list changes)

Acetic acid, dilute
Aluminum metal
Aluminum chloride
Aluminum sulfate
Ammonium carbonate
Ammonium chloride
Ammonium phosphate
Ammonium sulfate
Barium chloride
Barium hydroxide
Barium nitrate
Barium sulfate
Calcium carbonate
Calcium chloride
Calcium hydroxide
Calcium metal
Calcium oxide
Calcium sulfate
Cobalt chloride*
Copper metal
Copper (II) carbonate
Copper (II) chloride
Copper (II) sulfate
Distilled water
Ethanol
Hydrochloric acid, dilute
Hydrogen peroxide
Iron metal
Iron (III) chloride
Iron (II) sulfate
Iron (III) sulfate
Isopropanol
Lead nitrate*
Lithium chloride
Magnesium carbonate
Magnesium chloride
Magnesium hydroxide
Magnesium metal
Magnesium nitrate
Magnesium oxide
Magnesium sulfate
Methane
Nitric acid, dilute
Phosphoric acid, dilute
Potassium acetate
Potassium bromide
Potassium carbonate
Potassium chloride
Potassium ferricyanide*
Potassium ferrocyanide*
Potassium hydroxide
Potassium nitrate
Potassium phosphate
Potassium thiocyanate*
Silver nitrate
Silver oxide
Sodium acetate
Sodium bicarbonate
Magnesium bromide
Sodium bromide
Sodium carbonate
Sodium chloride
Sodium iodide
Sodium hydroxide
Sodium nitrate
Sodium phosphate
Sodium sulfate
Sodium sulfite
Sodium thiosulfate
Sulfur flowers
Sulfuric acid, dilute
Tin metal
Wood splints

Chemicals with an asterisk* beside their name require special disposal methods; If you choose these substances, ask.

Introduction Checklist

____ 1. Describe the problem you are solving, the question you are attempting to answer as the goal of the experiment, or the purpose of the experiment.

- State the problem, question or purpose.
- Why is this problem important?

____ 2. Define key terms needed.

- A copied textbook definition is not appropriate. Work your terms into a descriptive paragraph..
  - Chemical reaction
  - Reactant
  - Product
  - Law of conservation of matter

____ 3. Background information should provide explanations of key concepts and information to answer the questions below. The reader may not know as much as you do. Explain briefly each concept needed to understand the lab as you answer the questions.

- How is the law of conservation of matter demonstrated in this lab?
  - What is true of the atoms present before and after the reaction takes place?
  - Why must equations be balanced?
- What are the 5 reaction types? Briefly describe how to identify each type of reaction.
  - How are the subtypes of each reaction type useful to you in this lab? *Examples are not needed here* – the reactions you chose and describe in the next section will be the examples.
- Describe specifically what you expect to see in each reaction that will tell you each type of reaction has taken place. *You will need to be able to predict and describe the products you expect.*
- Include a short description of your procedure.

Example: bubbles will be evidence that carbon dioxide was produced.

_____ 4. What do you expect to observe or measure that will show you have solved the problem or answered your question? Get specific here! ***Do these steps for each reaction you will use.***

- Describe briefly each reaction you will do with a ***word equation***.
- Tell the ***reaction type***. Use the ***subtypes*** to *predict the product*.
- Write the ***balanced chemical equations*** for each reaction you choose.
  - Include ***(s) (l) (aq) (g)***
  - *Include a description of how you will know the reaction has taken place.*

Example: Write the following for each reaction you will do.

Reaction 1: Magnesium Hydroxide decomposes to yield magnesium oxide and water vapor

Decomposition; metal hydroxides, when heated, decompose into metal oxides and water.

$$Mg(OH)_{2\,(s)} \rightarrow MgO_{(s)} + H_2O_{(g)} \quad \textit{(balanced)}$$

We will see a white powder, which is likely MgO, in the test tube. The mass will be less than the mass of $Mg(OH)_2$, suggesting that H_2O was given off during heating.

___ 5. Your hypothesis for this lab will be the predicted products in step 4, above.

MSDS Chemical Data Table and Safety

_____1. Make a chemical data table that includes the chemical name, formula, molar mass, appearance (this will be very important) flammability, solubility, hazards, for each reactant AND product.

____ 2. List safety precautions and PPE you will take.

Materials:

____ 1. List the materials you will use for each reaction, separately.

- Specify sizes and amounts. Remember to use the smallest possible amount of each chemical.

Procedure:

_____ 1. Write a separate procedure for each reaction. Include:

- A balanced equation (yes, again!)
- Draw a macro model, showing physical states.
- Write in, below the macro model diagram, the appearance and a verbal description of each reactant and product.
- Include amounts and enough detail that another person could duplicate your work exactly.

Collection of Data Checklist:

___ 1. Data is in a table

___ 2. Appearance of reactants and products are described in sufficient detail to identify them, including (s) (l) (g) (aq)

Analysis of Data Checklist:

____1. Discussion of results for each reaction, individually:

- What did you observe to show that the expected reactions took place?
- Draw a particle model for each reaction.

___2. Error Analysis:

- Define experimental error and list all possible experimental errors.
- What didn't work well, so you changed it for the nest trial?
- What specifically were you limited by?
  - Describe measuring tools or other equipment that limited your research?
- Were your next attempts more successful? Why? Explain.

Lab Report Conclusion Criteria:

____1. Restate your purpose.

____ 2. State *each* reaction you carried out, as a chemical equation.

- Describe how you know you got the products you predicted. Explain.
- Did the products you actually got agree with the predictions you made? Explain.

___ 3. Were you able to verify the reaction types? Make a statement telling as much, or why not.