

Student Investigation Sheet

Reactions in Solution

Most common reactions that occur in aqueous solutions can be classified into three main types: acid-base reactions, precipitation reactions, and oxidation-reduction reactions. You have encountered acid-base and precipitation reactions already, and you will encounter oxidation-reduction reactions at some point in this course. In this investigation, you will perform several different reactions in aqueous solutions, and observe changes in color and the formation of precipitants. You will use your observations to distinguish between the different types of reactions.

Safety Precautions:

- Handle the chemicals in this investigation with care, since several of them are toxic and corrosive. In particular, HCl and NaOH are corrosive to the skin and tissues.
- Read the MSDS sheets for each chemical you use.
- Report any chemical spills to the teacher, who will clean them up.
- Follow all general lab safety rules, wear closed-toe shoes, do not eat or drink anything in the lab.
- Never leave the lab area unattended with chemicals sitting out.
- Wear safety equipment including goggles, gloves, and lab aprons.
- Follow all instructions for disposal and cleaning of chemicals and glassware.
- Do not try to clean up any broken glass. Instead, report it to your teacher.

Objective(s):

In this investigation, you will distinguish between acid-base reactions, precipitation reactions, and oxidation-reduction reactions.

Materials:

Per student group:

- test tube rack
 - 4 to 8 small test tubes
 - small stirring rod
 - about 10 mL of each of the following chemicals, all in 0.1 M aqueous solutions: MgSO_4 , $\text{Ba}(\text{NO}_3)_2$, Na_2SO_4 , Na_2CO_3 , HCl , NaOH
 - (optional) solid copper and zinc
- MSDS sheets for all of the chemicals listed above
 - dropper
 - wash bottle containing distilled water
 - paper towels
 - safety goggles, one pair per student
 - lab apron, one per student
 - disposable gloves, one pair per student

Directions:

Use the following charts to help you plan your investigation. Before carrying out each reaction, predict the products, write a balanced chemical reaction, and predict whether or not there will be a precipitate or a gas formed.

	Na_2CO_3	Na_2SO_4	NaOH
MgSO_4			
$\text{Ba}(\text{NO}_3)_2$			
HCl			

	HCl
Cu (solid)	
Zn (solid)	

Safety Concerns

Identify any safety equipment and concerns that need to be observed in this lab.

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Key Question

What is the question you want to answer?

Directions: Write the question for the investigation. The question should be specific and investigable.

Key Components

- Specific (one general thought, does not combine two or more questions)
- Is able to be investigated

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Hypothesis

What do you predict will be the result of the investigation?	
	<i>Directions:</i> Develop a claim about what you think is going to happen.
	<u><i>Key Components</i></u> <ul style="list-style-type: none">• Expresses a cause-and-effect relationship• Is testable• Incorporates prior knowledge

Plan

How will you investigate the question?	
	<p><i>Directions:</i> Describe the plan that you will use to study your question and analyze your hypothesis.</p>
	<p><u><i>Key Components</i></u></p> <ul style="list-style-type: none">• Plan is easily repeatable by others• Plan describes the use of materials• Plan is in a logical order

Data

What evidence was gathered during the investigation?	
	<p><i>Directions:</i> Record all of the evidence that has been collected. Use graphic organizers, tables, and graphs when appropriate.</p>
	<p><u><i>Key Components</i></u></p> <ul style="list-style-type: none">• Data (from an investigation and/or other sources, such as observations, reading material, archived data, etc.)• Appropriate (data applies directly to the question)• Sufficient (uses enough data to completely answer the question and determine a finding on the hypothesis)

Conclusion

What did you learn from this investigation?	
	<p><i>Directions:</i> Develop a conclusion for your investigation. The conclusion should contain clear thoughts and proper vocabulary. This section focuses on the answer to your question. It should support or refute the hypothesis by using logical reasoning to link the hypothesis to the data.</p>
	<p><u><i>Key Components</i></u></p> <ul style="list-style-type: none">• Use precise and accurate language• Use scientific vocabulary• Provide clear logical thoughts• Use evidence and reasoning to support or refute the hypothesis

Analysis and Conclusions

1. For each type of reaction, write the balanced chemical equations for two examples that you observed in the investigation:

Acid-base reactions:

Precipitation reactions:

(if carried out) Oxidation-reduction reactions:

Additional Questions

1. Define each type of reaction:

Acid-base reactions:

Precipitation reactions:

2. Differentiate between acid-base and precipitation reactions. How are they similar? How are they different?

3. If you studied oxidation-reduction reactions in the investigation, explain how they are similar to and different from acid-base and precipitation reactions.