

Lab: Exothermic and Endothermic Reactions

Introduction

Every day, you experience various chemical and physical changes in which heat energy is either released (exothermic change).

If you have used “Drano” to unclog a drain, you should have noticed the great amount of heat released as the Drano mixed with the backed-up water. This is an exothermic reaction.

Perhaps you have tested the wind direction by wetting your finger and holding it up to the wind. The side of your finger that feels cold indicates the direction from which the wind is coming. This is an endothermic reaction.

Can all physical and chemical changes be categorized as an endothermic and exothermic reaction?

In this experiment, you will explore various physical and chemical changes. For each change, you will decide whether heat energy was released, was absorbed, or there was no change.

Prelab Assignment

1. From the Introduction, formulate a problem statement.
2. From the procedure,
 - (a) state the manipulated and responding variables;
 - (b) list some controlled variables;
 - (c) list the equipment and materials necessary.
3. Prepare an observation table.

Safety

Wear safety goggles

Hydrochloric acid and sodium hydroxide are corrosive. Avoid skin contact. Flush any contacted area with running water for several minutes. If a chemical comes in contact with your eyes, hold your eyelids open and flush your eyes under a gentle stream of water for 20 minutes. Call for assistance.

Some of the chemicals are caustic and can burn the skin. Avoid skin contact. Keep your hands away from your face. Wash your hands thoroughly at the end of the experiment.

Dispose of the solutions as directed by your teacher.

Procedure

For each step measure the temperature of the substance before and after adding a second substance to it. Record the temperature change as either an increase in temperature, a decrease in temperature, or no change. Remember to clean the thermometer and the stirring rod after each time they are used.

1. Dip a cotton ball in rubbing alcohol, propan-2-ol, and touch it to the back of your hand.
2. Half-fill a tt with water, add an ice cube and stir the contents.
3. Half-fill a tt with water, with tweezers add a piece of Drano tablet, stir the contents.
4. Half-fill a tt with water, add ~ half a spatula of $\text{NH}_4\text{Cl}_{(s)}$, **stir the contents.**
5. One-third fill a tt with water, add an equal amount of propan-2-ol, stir the contents.

6. One-third fill a tt with water, add an equal amount of $\text{NaOH}_{(\text{aq})}$, stir the contents.
7. One-third fill a tt with water, add an equal amount of $\text{HCl}_{(\text{aq})}$, stir the contents.
8. One-third fill a tt with $\text{NaOH}_{(\text{aq})}$, add an equal amount of $\text{HCl}_{(\text{aq})}$, a little at a time, stir the contents.
9. Dip a cotton ball in after-bath splash. Rub the after-bath splash on the back of your hand.
10. Half-fill a tt with water, add ~ half a spatula of $\text{NaNO}_{3(\text{s})}$, stir the contents.
11. Half-fill a tt with water, add a small lump of $\text{CaCO}_{3(\text{s})}$, stir the contents.
12. One-third fill a tt with $\text{HCl}_{(\text{aq})}$, add a small piece of $\text{CaCO}_{3(\text{s})}$, stir the contents.
13. One-third fill a tt with water, add ~ half a spatula of $\text{NH}_4\text{NO}_{3(\text{s})}$, stir the contents.
14. One third fill a tt with $\text{HCl}_{(\text{aq})}$, add a small piece of zinc metal, stir the contents.

Data Processing and Presentation

1. Present your results in a suitable data table.
2. Summarize your results in an appropriate table.
3. In which reactions was there a drop in temperature?
4. In which reactions was there a rise in temperature?
5. Were there any reactions where there was no change in temperature?
6. Which reactions involved physical changes only?
7. Which reactions involved chemical changes?
8. Write balanced thermo-chemical equations for each chemical change observed in this experiment. Include the phase of each substance. Write the net ionic equations for these reactions.
9. Write a definition of endothermic, (**endergonic**) reactions.
10. Write a definition of exothermic, (**exergonic**) reactions.
11. Which reactions were endothermic?
12. Which reactions were exothermic?
13. Why did reactions in Procedure 1 and 9 feel cold?
14. Cold packs and hot packs are available for a variety of medical uses. Which of the solid chemicals used in the reactions above could be employed for each of these purposes?
15. Consider the following reactions. Identify each one as either endothermic or exothermic.
 - a) A flame is brought near the wick of an alcohol burner. The wick absorbs the heat energy from the flame.
 - b) The wick bursts into flames and emits energy.
 - c) The energy from the burning wick vaporizes the fuel below the wick.
 - d) The vaporized fuel bursts into flames to produce heat and light.
16. Three beakers are placed in a row. The left beaker contains a mixture of ice and water, the middle beaker contains water at room temperature, and the right beaker contains warm water. Place your left hand in the left beaker and your right hand in the right beaker. Leave your hands there for a few minutes. Remove both hands simultaneously and place them in the middle beaker. The left hand will feel warm, the right hand will feel cold. Why? Explain.

Conclusion and Evaluation

Give a valid conclusion based on the correct interpretation of the results, with an appropriate explanation.