

Chemistry Lab: The Physical States of Matter and Physical Change.

Background:

Matter can exist in three **physical** states: Solid, Liquid, and Gas. **Solid** is matter that has a definite mass, definite shape, and definite volume. **Liquid** is matter that has a definite mass, definite volume, but no definite shape. **Gas** is matter that has definite mass, no definite volume, and no definite shape.

Solid particles are packed so closely together they are **incompressible**. They expand only slightly when heated. Liquid particles are packed less tightly. They are able to move past each other and almost incompressible, expand when heated. Liquids flow and take the shape of their containers. Gas particles are spaced far apart. They move freely and are **compressible**. They also expand infinitely to take the shape and volume of a container. A **gas** exits in that physical state at room temperature. **Vapor** refers to gases that are liquids or solids at room temperature, but have been heated to their **boiling points**.

A **physical change** alters a substance without changing its composition. The change between the states of matter is a physical change. Increasing or decreasing the temperature causes this change. When heated, the atoms and molecules of matter gain kinetic energy. The particles move faster and further apart until the speed of the particle reach certain critical points. These are the **melting points, and boiling points** of the substances. When melting, forces between the molecules can no longer hold them as tightly as a solid and the state becomes a liquid. When boiling, the forces between the molecules can no longer hold them together as a liquid and a gas is formed. When cooling the opposite occurs. As the temperature of a gas is lowered, particles lose kinetic energy and become closer until **condensation** occurs and a liquid is formed. When the temperature of a liquid is lowered the particles move closer until **freezing** occurs and a solid is formed. Boiling and condensation occur at the same temperature but one gain temperature and kinetic energy while the other loses both. Melting and freezing occur at the same temperature, but one gain temperature and kinetic energy, while the other loses both.

Goal

The goal of this experiment is to observe a substance (water) in it's three physical states: solid, liquid, and gas and to determine the points at which it changes from one state to another.

Equipment

400 ml beaker, Ice, Water, Hot plate, Temperature probe, Computer, Stirring rod

Procedure

1. Make a **hypothesis** for your experiment. Make this hypothesis in the form of a prediction of the outcome of this experiment.
2. Place this hypothesis at the beginning of your lab report under the "Purpose" section. Highlight the hypothesis.
3. Turn on the hotplate. Set on high.
4. Fill a 400-ml beaker to the 100-ml mark with ice
5. Add water to make a "slush".
6. Place the thermometer into the beaker. (Do not place beaker on hot plate, yet).
7. Record the temperature of the ice and water for 3 minutes. Record at 30 second intervals. (Do not place beaker on hot plate, yet).
8. Stir with stirring rod. Do not stir with thermometer.
9. At 3 minutes place the beaker on the hot plate with the thermometer still in the ice water. Do not stop recording at 30 second intervals.
10. Continue to observe and record until the water has been **boiling for 5 minutes**.
11. Make a table of time (.5 min) vs. temperature (°C).

Analyzing the Data

1. Using your data make a graph by hand of the curve in your notebook. Label all parts of the graph correctly.
2. Place a copy of the table in your notebook.

Questions

1. According to your data, at what temperature did it change from a solid to a liquid? Describe the graph.
2. According to your data, at what temperature did it change from a liquid to a gas? Describe the graph.
3. What is the difference between a physical change and a chemical change?