

Phase Changes

Why?

Most substances go through a phase change when heated or cooled. Molecules of a substance are held together in either the solid, liquid, or gaseous phase by intermolecular forces. It is necessary to discuss what is occurring at the molecular level in order to explain how an ice cube is melted or how water is boiled.

Learning Objectives

- To determine what is occurring on the molecular level during a phase change

Success Criteria

- Students will be able to construct their own heating or cooling curve when given the temperatures at which phase changes occur.

New Concepts

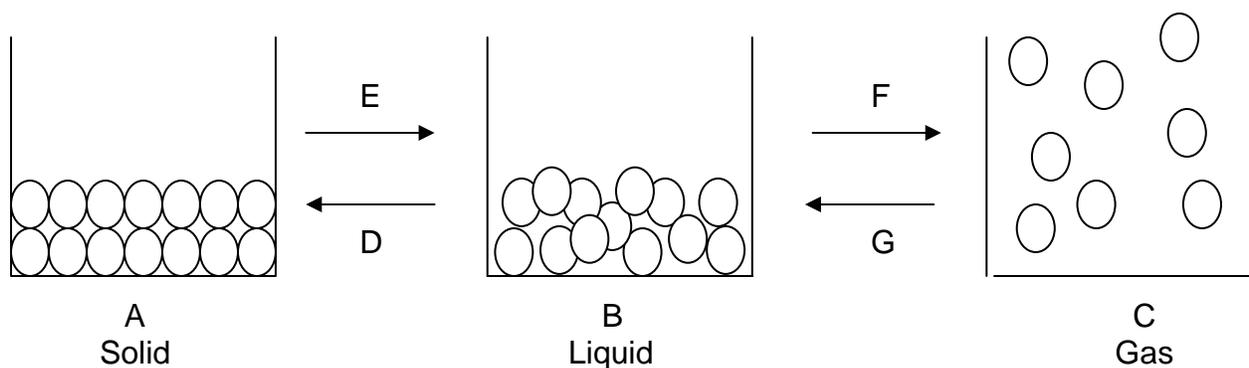
- Heating / cooling curves

Prerequisites

- Temperature (average kinetic energy)
- Phases of matter: solid, liquid, gas
- Molecules
- Endothermic
- Exothermic

Vocabulary

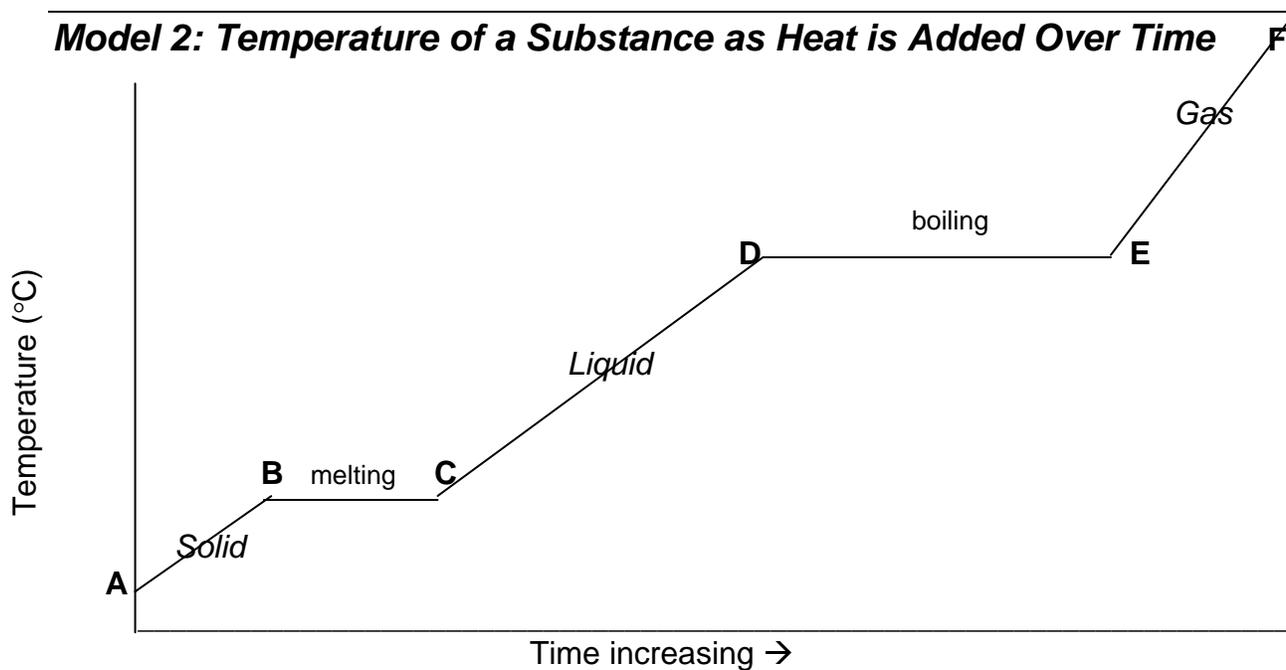
- Fusion (melting)
- Solidification
- Condensation
- Boiling
- Vaporization
- Kinetic energy
- Boiling

Model 1: Representations of Molecules in Three Phases**Task**

Label each arrow (D, E, F, G) in Model 1 with the appropriate phase change (fusion/melting, solidification/freezing, boiling, condensation).

Key Questions

1. Which arrows in Model 1 indicate the addition of energy?
2. Which term, endothermic or exothermic, is used to describe the situation when energy is added into a system from the surroundings?
3. Which arrows in Model 1 indicate the release of energy?
4. Which term, endothermic or exothermic, is used to describe the situation when energy is released into the surroundings by the system?



Key Questions

1. What is plotted on the x-axis and what is plotted on the y-axis of the graph in Model 2?
2. During which line segments does temperature increase?
3. During which line segments is there no change in temperature?
4. If this substance were water, at what temperature would segment B – C occur?
5. If this substance were water, at what temperature would segment D – E occur?

6. On the molecular level, why is energy added in order to complete an endothermic phase change? (Refer to both Models in your answer.)

7. On the molecular level, why is energy released to complete an exothermic phase change? (Refer to both Models in your answer.)

8. Comparing segments B – C and D – E, what information is conveyed by the observation that segment D – E is longer?

Exercise

A sample of a mythical substance is cooled from a temperature of 250°C to 10°C in two hours. The boiling point of the substance is 175°C and the melting point is 22°C .

Using this information, draw a cooling curve for the sample.

On the curve clearly label the following items in the appropriate locations (use arrows as needed to indicate direction or exact location on the curve. Some terms may be used more than once, as needed.):

Solid	Freezing Point	Melting Point
Liquid	Fusion	Direction of endothermic changes
Gas	Solidification	Direction of exothermic changes
Condensation	KE changing	
Boiling	KE not changing	