

Unit 9: Heat

Things to be Studied in this Unit

- Thermal energy, heat and temperature
- Anomalous expansion of water and its effect
- Effect of heat on volume
- Thermometer and its structure
- Thermometric liquids (Mercury and Alcohol)
- Types of thermometers and their uses
- Specific heat capacity
- Heat equation
- Simple numerical problems related to heat

Introduction

Heat is a form of energy that is transferred between two substances due to a temperature difference. It flows spontaneously from a hotter object to a colder one. Heat is measured in calories or joules. Heat is associated with the kinetic energy of atoms and molecules within a substance. It is what causes substances to change in temperature.

Temperature is a measure of the average kinetic energy of the particles (atoms or molecules) within a substance. It is measured in degrees Celsius ($^{\circ}\text{C}$) or degrees Fahrenheit ($^{\circ}\text{F}$) and kelvin (K).

Things to Know

- ❑ **Heat energy:** Heat energy of an object is the sum of the kinetic energy contained by the molecules of that object.
- ❑ **One calorie heat energy:** One calorie of heat energy is the quantity of heat required to raise the temperature of one gram of pure water by 1°C or 1K.
- ❑ **One joule heat energy:** One joule of heat energy can be defined as the amount of heat energy required to raise the temperature of an object of mass 1 kg and specific heat capacity of $1 \text{ J kg}^{-1} \text{ }^{\circ}\text{C}^{-1}$ by 1°C .
- ❑ **Anomalous expansion of water:** Generally, liquids expand on heating and contract on cooling. But a different behaviour is observed in the case of water. When water at 0°C is heated, it contracts until the temperature rises to 4°C . But expansion is observed after 4°C only. This unusual behaviour shown by water between 0°C and 4°C is called the anomalous expansion of water.
At 4°C , water has maximum density and minimum volume. This property of water is beneficial for aquatic animals in cold countries.
- ❑ **Advantages of anomalous expansion of water:**
 1. In cold countries, fishes and other aquatic animals can survive in the ponds even though the surface has frozen to ice.
 2. In cold countries, soft drink bottles can be stored below the frozen ice of the pond to prevent them from freezing.
- ❑ **Disadvantages of anomalous expansion of water:**
 1. Water pipes burst in cold countries due to expansion of water inside the pipe when the temperature of water falls below 4°C to 0°C .
 2. Fruits and vegetables get damaged during severe frost in cold countries.

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