# 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 (°C) or degrees Fahrenheit (°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 Jkg<sup>-1</sup>°C<sup>-1</sup> 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:

- In cold countries, fishes and other aquatic animals can survive in the ponds even though the surface has frozen to ice.
- 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:

- 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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