Assignment 03 - Science
Lesson 9 - Heat

Temperature

- Temperature can be specified as a fundamental property of any material object.
- Temperature is measure of the mean kinetic energy possessed by the particles that form an object.

Measuring temperature

- The device used to measure the temperature is known as a thermometer.

Q: Who invented the world's first thermometer?

various types of thermometers

1. Glass mercury thermometer
2. glass alcohol thermometer
3. digital thermometer

1. Glass Mercury thermometer

This thermometer is constructed by connecting a narrow glass tube to a bulb containing Mercury.

- When the temperature rises, the Mercury in the bulb expands and moves up along the narrow tube.
- The temperature can be read from the scale marked on the tube according to the length of the Mercury column.
- The reasons for using mercury in thermometers are,

1. Mercury is a good thermal conductor
2. Mercury is a liquid over a broad range of temperatures (from -39^0C to 357^0C)
3. Mercury has a uniform expansion over a broad range of temperatures.

Q: Draw the figure 9.4
Q: State a reason for using of Glass Mercury thermometers is on the decline?

2. Glass alcohol thermometer

This is constructed by connecting a narrow glass tube to a bulb containing ethyl alcohol. (ethanol).

- The reasons for using ethyl alcohol in thermometers are,

  1. Melting point of Ethanol is -115^0C and it suitable for measuring low temperatures much below 0^0C.
  2. Ethanol has a high expansion relative to most other liquids.
  3. Ethanol has a uniform expansion with temperature.

Q: What is done to see the alcohol column of the thermometer clearly? Give reasons.

3. Digital thermometer

- Digital thermometers from which the temperature can be read directly also commonly used today.
- An electrical property such as the resistance which depends on the temperature is used instead of the expansion cost by an increase in temperature.

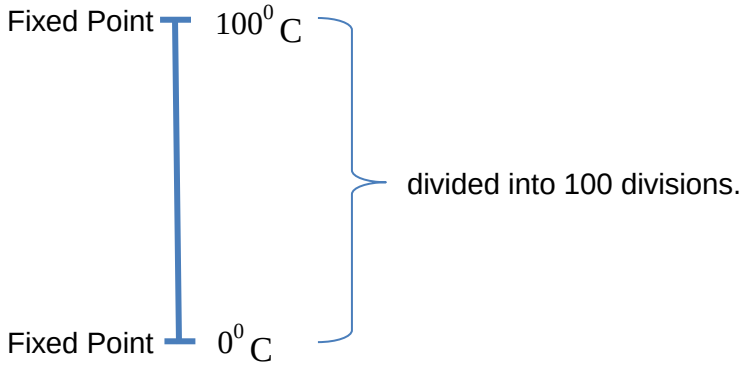
Temperature scales

1. Celsius scale
2. Fahrenheit scale
3. Kelvin scale

- The Definite temperatures used in forming a temperature scale are known as fixed points.
- The melting point of ice (temperature at which pure ice melts into liquid water under the pressure of 1 atmosphere) is taken as one fixed point.
- The boiling Point of water (temperature at which water vapor rises into steam under the pressure of 1 atmosphere) is taken as the other fixed point.

1. Celsius scale

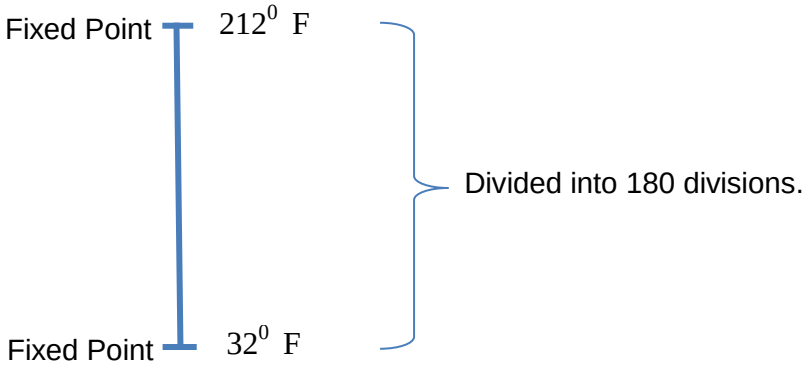
- This scale was introduced by Anderse Celsius.
- The melting point of ice is 0^0 C.
- The boiling point of water is 100^0 C.



- For this scale, the temperature range between the two fixed points is divided into 100 divisions.

2. Fahrenheit scale

- This is introduced by Gabriel Fahrenheit.
- The melting point of ice is 32^0 F
- The boiling point of water is 212^0 F.
- For this scale, the temperature ranges between the two fixed points are divided into 180 divisions.



3. Kelvin scale

- This scale was introduced by the British scientist Lord Kelvin.
- There is minimum value to the temperature that any object can reach is known as the absolute zero temperature.
- The temperature of an object is a measure of the mean kinetic energy of the particles that constitutes the object.
- The temperature of the object decreases when the kinetic energy of the particles decreases.
- When the kinetic energy of all the particles becomes zero, the temperature of the object reaches the absolute zero. This is the absolute zero temperature.

According to the Celsius scale:

Absolute zero = -273.15^0C

The Kelvin scale is defined so that its zero (0K) is at the absolute zero temperature.

1K = 1^0 C

The melting point of ice	= 0^0 C	= 273.15K (approximately 273 K)
The boiling point of water	= 100^0 C	= 373.15 K (approximately 373 K)

Q: What is the International unit of measuring temperature?

Relationship between Celsius and Kelvin scales

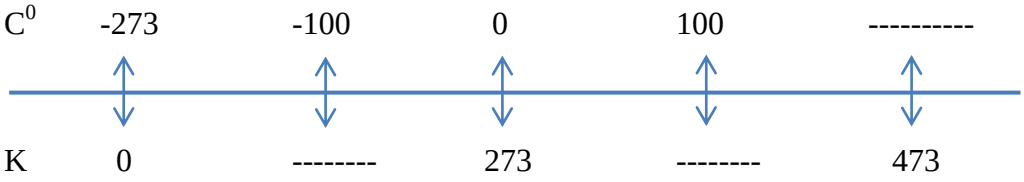
To convert a temperature measured in Celsius into Kelvin scale, add 273.

Example: - 50^0 C into Kelvin scale
50+ 273= 323 K

To convert a temperature measured in kelvin into Celsius scale, subtract 273.

Example: - 390 K into Celsius scale
390-273 = 117^0C

Q: Fill in the blanks in the following chart.



Q: Do the exercise 9.1.

Heat

The energy transfers from one object to another as a result of the temperature difference existing between the two object is known as the ----------.
The scientist ---------- has first described heat as a form of energy. The scientist ---------- experimentally investigated about heat.

Q: Draw the figure 9.8

Observation: The temperature of the water in the Apparatus (a) ----------
The temperature of the water in the Apparatus (b) ----------gradually.
Conclusion: the temperature of water in the vessel b ---------- .this happened because ---------- transferred from the candle flame to the water and so the temperature of water has risen as a result of it.

Heat transfer

Write the activity 9.1 to investigate what happens when we put a heated piece of iron into a cold water vessel.

Q: Write the observation and conclusion.

Thermal equilibrium

As heat flows out from the iron block, its temperature gradually a decrease. After a while, the temperature of the water and the iron block become equal. After reaching this common temperature, heat does not flow to the water from the iron block or to the iron block from the water. This state is called thermal equilibrium.

Q: What is the International unit for measuring heat?

Heat capacity of an object

The amount of heat required to increase the temperature of an object by 1 unit is known as the heat capacity of the object.

The factors that affecting for heat capacity are,

1. The substance that the object is made of
2. The mass

Q: Name the international unit of measuring heat capacity.
Q: Draw the diagram of activity 9.2.

Observation: in the Apparatus 1& 2, the temperatures are different as they are different substances even though the masses of water and coconut oil are same. In the Apparatus 1 & 3 temperatures are different as their masses are different.
Conclusion: Heat capacity of an object depends on the substance that the object is made of and its mass.

Specific heat capacity

The amount of heat required to increase the temperature of a unit mass of a given substance by 1 Degree is known as the specific heat capacity of the substance.

Q: what is the unit of specific heat capacity?
Q: what is the relationship between the heat capacity and the specific heat capacity?
Q: write an equation for this.
Q: copied on the table 9.1

Finding the quantity of heat

When a substance absorbs or releases heat its temperature changes. In order to find the quantity of heat flow, the following relation can be established.

Quantity of heat =Q (J)
Mass = m (kg)
Specific heat capacity = C (J kg^{-1} K^{-1}/ 0 C^{-1})
Temperature change = Θ (K / ^{0}C)

$$Q = m\ c\ \Theta$$

Example: Find the amount of heat required to increase the temperature of 2 kg of iron from 25 ^{0}C to 65^{0}C. The specific heat capacity of iron is 460 J $kg^{-1}K^{-1}$

$Q = m\ c\ \Theta$
$Q = 2kg * 460\ Jkg^{-1}\ K^{-1} * (65-25)\ K$
$=2 * 460 * 40$
$=36800\ J$

Q: Do the exercise 9.2

Change of state of matter

The conversion of the state of a substance from solid, liquid or gas into another state is known as a change of state.

Q: Give some examples for change of state

Melting point

The temperature at which a solid substance that has been heated changes state from the solid state to the liquid state is known as its melting point.
The melting point depends on the pressure.

Example: the melting point of ice is 0 ^{0} C

Freezing point

The temperature at which a liquid substance that is being cooled changes the state from the Liquid state to the solid state is known as its freezing point.
The freezing point depends on the pressure.

Example: freezing point of water is 0 ^{0} C

The melting point and the freezing point of a given substance have the same value.

Boiling point

The temperature at which liquid starts to boil (that is the temperature at which the liquid turns to Vapor by forming Bubbles inside the liquid) is known as its boiling point.

Example: the boiling point of water is 100^0 C.

Q: Copy down table 9.3

Latent heat

Atoms of substances that exist as solids at room temperature cause some amount of kinetic energy.
When heat is supplied, this kinetic energy increases gradually and along with it the temperature of the substance increases.
When heat is continuously supplied, at a certain point the kinetic energy of the atoms becomes large enough to break the bonds between the atoms and allow the atoms to move freely.
This is the point that the substance changes state from the solid state to the liquid state.

At the point that the change of state takes place, the heat supplied is spent on breaking the bonds between molecules and therefore, the temperature of the substance does not increase.
When the change of state of all atoms is complete, the heat supplied is spent again on increasing the temperature of the system.

The heat absorbed by the system without changing its temperature while the change of state is taking place is known as the latent heat.

Instances of latent heat

1. Latent heat of fusion
2. Latent heat of vaporization
3. Specific latent heat of fusion
4. Specific latent of vaporization

1. Latent heat of fusion

Q: Draw figure 9.12.

Conversion of a solid into liquid is known as fusion and the heat absorbed in the conversion of ice at 0^0 C into water at 0^0 C is known as the latent heat of fusion. (this heat is spent on doing work against the intermolecular attractive forces and the temperature does not change until all the solid ice becomes liquid water.)

2. latent heat of vaporization

Q: Draw the figure 9.13

The heat absorbed in the conversion of liquid water at 100^0 C into steam at 100^0 C is known as the latent heat of vaporization. (This heat is spent on doing work against the intermolecular attractive forces and the temperature does not change until all the water becomes steam.)

3. specific latent heat of fusion

Q: Draw the figure 9.14

The amount of heat required to change the state of unit mass of a solid substance at its melting point into the liquid state is known as the specific latent heat of fusion of the substance.
The amount of latent heat that has to be supplied in order to convert 1 kilogram of ice at 0^0 C into liquid water at the same temperature is known as the specific latent heat of fusion of ice. The value is 3.36* 10 5 J.

4. specific latent heat of vaporization

Q: Draw the figure 9.15

The amount of heat required to change the state of unit mass of a solid substance at its boiling point into the gas state is known as the specific latent heat of vaporization of the substance.
The amount of latent heat required in order to convert 1 kg of water at 100^0 C into steam at the same temperature is known as the specific latent heat of vaporization of water. This value is 2.26 * 10 6 J.

Q: What is vaporization?
Q: What is evaporation?
Q: Give some examples for evaporation?
Q: Explain why Bubbles are formed in a boiling liquid?