UNIT-9 SELF ASSESSMENT QUESTIONS

Q1: Differentiate between heat and temperature.

ASPECT	HEAT	TEMPERATURE
Definition	Energy that flows from a hotter object to a cooler one	Measure of the average kinetic energy of particles in a substance
Nature	Form of energy (in transit)	Physical quantity indicating hotness or coldness
Unit	Joule (J), calorie (cal)	Celsius (°C), Kelvin (K), Fahrenheit (°F)
Depends on	Mass, material, and temperature difference	Average motion of particles (independent of mass)
Flow	Always flows from hot to cold	Does not flow
Example	Heat from a flame warming your hand	Boiling water has a temperature of 100°C

Q2: Why we cannot tell temperature of a body by teaching it?

ANS:

We cannot tell the temperature of a body simply by touching it because our sense of touch is not always reliable. The feeling of hotness or coldness depends on the **rate of heat transfer** between our skin and the object, not the exact temperature.

For example:

- A metal object and a wooden object kept in the same room may have the same temperature.
- Metal feels colder because it transfers heat away from our hand faster than wood.

Q3: Explain different scales used in thermometers to measure the temperature

ANS:

1. Celsius Scale (°C)

- **Inventor:** Anders Celsius (1742)
- **Definition:** This scale is based on **the properties of liquid**.
  - Freezing point of water = 0°C
  - Boiling point of water = 100°C
- **Division:** The interval between freezing and boiling of water is divided into **100 equal parts**, hence it's called the centigrade scale.

- **Usage:** Widely used around the world for daily activities like weather reports, cooking, and body temperature measurement.
- **Advantages:** Easy to use because it relates to everyday experience of hot and cold.

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2. Fahrenheit Scale (°F)

- **Inventor:** Daniel Gabriel Fahrenheit (1724)
- **Definition:**
  - Freezing point of water = 32°F
  - Boiling point of water = 212°F
- **Division:** The difference between freezing and boiling of water is divided into **180 equal parts**.
- **Usage:** Commonly used in the United States for weather, cooking, and some industrial processes.
- **Advantages:** Provides finer subdivisions, which can be useful in some technical contexts.

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3. Kelvin Scale (K)

- **Inventor:** Lord Kelvin (William Thomson, 1848)
- **Definition:** Known as the **absolute temperature scale** because it starts at **absolute zero** (0 K), the theoretical point where all particle motion stops.
  - Freezing point of water = 273 K
  - Boiling point of water = 373 K
- **Division:** 1 K = 1°C in size, so the increment is the same as Celsius.
- **Usage:** Primarily used in **scientific research, physics, and chemistry**, where precise measurements of thermal energy are required.
- **Advantages:** Avoids negative numbers in calculations involving temperature, which is crucial for thermodynamic equations.

Q4: Define specific heat capacity.

ANS:

The **specific heat capacity**, c, of a material is defined as the amount of thermal energy required to raise the temperature of a unit mass of the material by 1 K or 1 ^{0}C.

$$C = \frac{\Delta Q}{m\,\Delta T}$$

UNIT

The SI unit of specific heat is $Jkg^{-1}k^{-1}$ or $J\ kg^{-1}\ {}^{0}C^{-1}$

Q5: Write down the factors on which specific heat capacity depends.

ANS:

FACTORS AFFECTING SPECIFIC HEAT CAPACITY

Nature of the Material

Different substances have different capacities to store heat.

Metals like copper and iron have low specific heat, while water has high specific heat.

Reason: Depends on the molecular structure and the type of bonding.

Phase of the Substance

Specific heat varies for **solid, liquid, and gas** forms of the same substance.

Example: Water has different specific heat in ice, liquid water, and steam.

Temperature

Specific heat is not strictly constant; it can change slightly with temperature.

Some materials store heat more efficiently at certain temperatures.

Q6: Write examples of specific heat capacity from daily life experience.

ANS

1. WATER

- **Observation:** Water takes a long time to heat up and a long time to cool down.
- **Reason:** Water has a **high specific heat capacity (~4.18 J/g°C)**, so it can store a lot of heat.
- **Example in daily life:**
  - Oceans and lakes warm up slowly during the day and cool slowly at night.
  - Hot water bottles retain heat for a long time.

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2. METALS

- **Observation:** Metals like iron, copper, and aluminum heat up and cool down quickly.
- **Reason:** Metals have **low specific heat capacity**, so small amounts of heat cause a large temperature change.

- **Example in daily life:**
  - Cooking utensils (pans, pots) heat up quickly on a stove.
  - Metal benches feel hot under the sun faster than wooden benches.

3. SAND

- **Observation:** Sand gets very hot in the sun and cools quickly at night.
- **Reason:** Sand has a **low specific heat capacity**, so it changes temperature easily.
- **Example:** Walking barefoot on the beach during the day vs. at night.

4. AIR

- **Observation:** Air warms and cools relatively quickly compared to water.
- **Reason:** Air has a **lower specific heat than water**.
- **Example:** Rooms heat up faster than lakes when exposed to sunlight.

Q7: Why does the temperature not increase when ice is heated at 0 ºC ?

ANS:

The Ice at 0 °C is at its **melting point**. When heat is supplied, it does **not increase kinetic energy** of molecules. In ice, water molecules are arranged in a **rigid lattice** held together by **hydrogen bonds**. Heating at 0 °C does **not increase the motion** of molecules significantly because the energy is **used to break these hydrogen bonds**, converting solid ice into liquid water at the same temperature.

Q8: Why does the temperature not increase when water is heated at 100 ºC? Explain.

ANS:

Water boils at 100 °C at 1 atmosphere pressure. At this temperature, adding heat does not increase the kinetic energy of the molecules (so temperature stays constant). Water molecules are polar and form hydrogen bonds with each other. Each molecule can form up to 4 hydrogen bonds with neighboring molecules. These bonds create a strong cohesive force, which requires a large amount of energy to overcome. During boiling: Heat energy is absorbed to break hydrogen bonds, allowing water molecules to escape as vapor. Temperature does not rise until all liquid water has been converted into gas.

Q9: Define evaporation and factors influencing evaporation process.

ANS:

DEFINITION OF EVAPORATION

Evaporation is the process by which a liquid change into a vapor (gas) at a temperature below its boiling point.

FACTORS INFLUENCING EVAPORATION PROCESS

1. **temperature**
   rate of evaporation will increase with the temperature.
2. **Area of the exposed surface**
   When the exposed area is large, the liquid molecules have more opportunities to leave the surface of the liquid. Hence a greater exposed surface area increases the rate of evaporation.
3. **Humidity of the surrounding air**
   Humidity is a measure of the amount of water vapor in the air. If the humidity is high, there is a lot of water vapor in the air and liquid vaporization is suppressed. The more humid surrounding air, the slower is the rate of evaporation.
4. **Motion of the air**
   Wet clothes dry faster on a windy day than on a still day. The motion of the air carries away the water vapor formed by evaporation, and brings drier air in contact with the wet clothes surface. These speeds up the rate of evaporation.
5. **Pressure**
   The lower the external pressure, the higher the rate of evaporation.

Q10: Differentiate between boiling and evaporation.

ANS:

Evaporation	Boiling
1· It takes place without supply having external heat source.	1· It only takes place without on supply external heat source.
2· It occurs at any temperature below boiling point.	2· It occurs only at certain temperature called "Boiling point".
3· It causes cooling.	3· It do not causes cooling.
4· It is relatively slow.	4· It is relatively fast.
5· It takes place only at the liquid surface.	5· It takes place throughout the liquid.
6· No formation of bubbles.	6· Bubbles are formed.

Q11: What is the freezing point of ethanol in Celsius scale?

ANS

The ethanol freezes at approximately **−114 degrees Celsius**.

Q12: What is the reason for expansion of solids on heating?

ANS

Solids expand on heating because the particles (atoms or molecules) gain **kinetic energy**.

Explanation

- In a solid, particles are tightly packed and vibrate about their fixed positions.
- When the solid is heated, these particles vibrate more rapidly and with greater amplitude.
- Due to the increased vibration, the average distance between particles increases slightly.
- As a result, the solid expands.

Q13: Explain two types of thermal expansion.

ANS:

There are mainly **two types of thermal expansion**:

1. Linear Expansion

It is the increase in the **length** of a solid when its temperature rises.

$$\Delta L = \alpha L \Delta T$$

where "alpha" (α) is a constant known as coefficient of linear expansion of the solid rod.

2. Volume Expansion

It is the increase in the **volume** of a substance when heated.

$$\Delta V = \beta V \Delta T$$

where "beta" (β) is a constant known as coefficient of volume expansion of the solid.

Q14: What is the relation between α and β ?

ANS:

RELATION BETWEEN LINEAR AND VOLUME EXPANSION

The relation between **linear expansion** and **volume expansion** for solids is **Coefficient of volume expansion** = three times **Coefficient of linear expansion**

$$\beta = 3\alpha$$