

Chapter 7

Density and Temperature

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Short Questions

1. Two liquids A and B have densities 1 g/mL and 1.2 g/mL respectively. When both liquids are poured into a container, one liquid floats on top of the other. Which liquid is on top, and why?

• **Answer:**

Liquid A (density 1 g/mL) floats on top of liquid B (density 1.2 g/mL). This happens because liquids with lower density float on liquids with higher density due to buoyancy.

2. Write a method to find the volume and density of a human body.

• **Answer:**

To find the **volume** of a human body:

1. Submerge the person in water in a container.
2. Measure the volume of water displaced (equal to body volume).

To find **density**:

1. Use the formula: $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$ Density = Volume / Mass
2. Measure the person's mass using a scale and divide it by the measured volume.

3. How is plasma the fourth state of matter? Give a reason.

• **Answer:**

Plasma is the fourth state of matter because it consists of ionized gas particles (atoms lose electrons). It is formed at extremely high temperatures, where gases become electrically charged. Examples include the Sun and lightning.

4. Why is water not used in liquid-in-glass thermometers?

• **Answer:**

Water is not used because:

1. It freezes at 0°C and boils at 100°C , limiting its temperature range.
 2. It does not expand uniformly with temperature changes.
 3. It sticks to the glass, making readings less accurate.
-

5. Can we increase internal energy of a substance without increasing its temperature?

- **Answer:**

Yes, internal energy can increase without raising temperature during **phase changes**. For example, when ice melts or water boils, energy is used to change the state (solid to liquid or liquid to gas) rather than increasing temperature.

6. Why are fixed-point scales required for thermometers? What difficulties are there when setting fixed points for thermometer scales?

- **Answer:**

Fixed points (e.g., melting and boiling points of water) ensure accurate and standardized calibration of thermometers.

Difficulties:

1. Impurities in substances can alter fixed points.
 2. Atmospheric pressure variations affect boiling/melting points.
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7. Mercury is replaced with alcohol in liquid-in-glass thermometers. Discuss the possible change in sensitivity and range of the thermometer.

- **Answer:**

- **Sensitivity:** Alcohol expands more than mercury for the same temperature change, making the thermometer more sensitive.
 - **Range:** Alcohol freezes at a lower temperature than mercury, increasing the range for colder temperatures but not suitable for very high temperatures due to its low boiling point.
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8. Why is -273.15°C called absolute zero? Can we achieve this temperature?

- **Answer:**

-273.15°C is called **absolute zero** because it is the lowest possible temperature where all molecular motion theoretically stops. It cannot be achieved practically, as quantum mechanics limits how closely we can reach this state.

9. Why is a thermocouple thermometer suitable to measure high temperatures but not a liquid-in-glass thermometer?

- **Answer:**

A thermocouple thermometer can measure high temperatures because:

1. It uses metal junctions that can withstand extreme heat.

2. It provides quick and accurate readings. Liquid-in-glass thermometers are unsuitable because:
 3. Liquids like mercury or alcohol boil at lower temperatures.
 4. Glass can crack under high heat.
-

10. Can we increase the sensitivity of a liquid-in-glass thermometer without changing its range?

- **Answer:**

Yes, sensitivity can be increased by:

1. Using a liquid with a higher expansion rate (like alcohol).
 2. Reducing the diameter of the thermometer bore to show more noticeable changes in liquid column height.
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11. One student claims to have constructed a more sensitive liquid-in-glass thermometer. How can her claim be verified?

- **Answer:**

Her claim can be verified by:

1. Comparing the thermometer's readings with a standard thermometer for small temperature changes.
2. Observing if the liquid column in her thermometer shows larger movements for minor temperature changes.

Long Questions

1. Define density. Describe methods to determine densities of regular and irregular-shaped solids, liquids, and gases.

Definition of Density:

Density is defined as the amount of mass per unit volume of a substance. It tells us how compact or concentrated matter is within a given space. Mathematically, it is expressed as:

$$\text{Density}(\rho) = \frac{\text{Mass (m)}}{\text{Volume (V)}} \quad \rho = \frac{m}{V}$$

- **SI Unit:** kg/m^3
- **Common Units:** g/cm^3 or g/mL
For water, the density is approximately 1 g/mL , which is often used as a reference.

Methods to Determine Density:

1. For Regular-Shaped Solids:

- **Example:** Cubes, spheres, cylinders.
- **Procedure:**
 1. Measure the mass of the object using a digital balance.
 2. Calculate the volume using geometric formulas:
 - **Cube:** $V = \text{side}^3$
 - **Sphere:** $V = \frac{4}{3} \pi r^3$
 - **Cylinder:** $V = \pi r^2 h$
 3. Divide the mass by the calculated volume to find density.
- **Example Calculation:** A cube has a mass of 10 g and a side length of 2 cm .
Volume: $V = 2^3 = 8 \text{ cm}^3$
Density: $\rho = \frac{10}{8} = 1.25 \text{ g/cm}^3$

2. For Irregular-Shaped Solids:

- **Example:** Rocks, stones.
- **Procedure (Water Displacement Method):**
 1. Measure the mass of the object using a balance.

2. Fill a measuring cylinder with water and record the initial water level.
3. Submerge the object fully in the water and record the new water level.
4. The difference in water levels gives the volume of the object.
5. Calculate density using $\rho = \frac{m}{V}$ $\rho = \frac{m}{V}$.

○ **Example Calculation:** A rock weighs 200 g and displaces water from 50 mL to 80 mL:
 Volume: $80 - 50 = 30$ mL
 Density: $\rho = \frac{200}{30} = 6.67$ g/mL

3. For Liquids:

○ Procedure:

1. Measure the mass of an empty container using a balance.
2. Add a known volume of the liquid to the container and measure the total mass.
3. Subtract the mass of the empty container to get the mass of the liquid.
4. Calculate density using $\rho = \frac{m}{V}$ $\rho = \frac{m}{V}$.

○ **Example Calculation:** A beaker weighs 100 g empty and 150 g with 50 mL of liquid:
 Mass of liquid: $150 - 100 = 50$ g
 Density: $\rho = \frac{50}{50} = 1$ g/mL

4. For Gases:

○ Procedure:

1. Trap a known volume of gas in a container.
2. Measure the mass of the container with and without the gas.
3. Subtract the two values to get the mass of the gas.
4. Use $\rho = \frac{m}{V}$ to calculate density.

○ **Example Calculation:** A gas has a mass of 0.5 g and occupies 1 L:
 Density: $\rho = \frac{0.5}{1} = 0.5$ g/L

2. How would you distinguish between solids, liquids, and gases on the basis of attractive forces between particles and the motion of particles?

Distinguishing Between Solids, Liquids, and Gases:

1. Solids:

- **Attractive Forces:**

- Strongest among the three states.
- Particles are tightly packed and held in fixed positions due to strong intermolecular forces.

- **Motion of Particles:**

- Particles vibrate but do not move freely.
- They maintain a fixed shape and volume.

- **Examples:** Ice, metal, wood.

2. Liquids:

- **Attractive Forces:**

- Moderate strength, weaker than solids but stronger than gases.
- Particles are close together but not in fixed positions.

- **Motion of Particles:**

- Particles move past each other, allowing liquids to flow and take the shape of their container.

- **Examples:** Water, oil, alcohol.

3. Gases:

- **Attractive Forces:**

- Negligible, as particles are far apart.
- Particles move independently without significant interaction.

- **Motion of Particles:**

- Particles move rapidly and randomly in all directions.
- Gases expand to fill their container.

- **Examples:** Oxygen, carbon dioxide, nitrogen.

Comparison Table:

Property	Solid	Liquid	Gas
Shape	Fixed	Takes the shape of container	No fixed shape

Volume	Fixed	Fixed	Expands to fill container
Attractive Forces	Strongest	Moderate	Weakest
Particle Motion	Vibrates in fixed positions	Moves freely within container	Moves rapidly in all directions

Examples:

- Ice (solid) melts into water (liquid) and evaporates into vapor (gas) when heated. This transformation shows how particle motion and intermolecular forces change with state.

3. Describe two different physical properties that vary with temperature and explain how these properties can be used to measure temperature.

1. Expansion of Liquids:

- **Property:** Liquids expand when heated and contract when cooled. The volume of a liquid changes predictably with temperature.
- **Application in Measuring Temperature:**
 - **Liquid-in-Glass Thermometers:**
 - Liquids like mercury or alcohol are used in thermometers.
 - When the liquid is heated, it expands and rises in a calibrated tube, showing the temperature.
 - **Examples:**
 - Mercury thermometers are used for medical and laboratory purposes.
 - Alcohol thermometers are used in colder regions due to alcohol's low freezing point.

2. Electrical Resistance:

- **Property:** The electrical resistance of a metal changes with temperature. When the temperature increases, the resistance of the metal wire also increases.
- **Application in Measuring Temperature:**
 - **Resistance Thermometers (RTDs):**
 - A metal wire (e.g., platinum or nickel) is used, and its resistance is measured.
 - The resistance is calibrated to provide an accurate temperature reading.
 - **Thermistors:**

- Semiconductor materials are used, whose resistance decreases as temperature increases.
 - **Examples:**
 - RTDs are used in industrial processes where high precision is needed.
 - Thermistors are used in home appliances like air conditioners.
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4. Describe the construction and working of different types of gas thermometers.

1. Constant Volume Gas Thermometer:

- **Construction:**
 - A gas-filled bulb connected to a pressure gauge through a tube.
 - The gas is confined in the bulb, and its volume remains constant.
 - The system is placed in a container for measuring temperature.
 - **Working:**
 - When the temperature increases, the gas particles move faster, increasing pressure.
 - The increase in pressure is measured on the pressure gauge.
 - The relationship between pressure and temperature follows the formula: $P \propto T$ or $P \propto T$
 - The thermometer is calibrated to directly show the temperature.
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2. Constant Pressure Gas Thermometer:

- **Construction:**
 - A gas-filled bulb connected to a column of liquid or a piston to maintain constant pressure.
 - The bulb is placed in a container to measure temperature.
 - **Working:**
 - When temperature increases, the gas expands, increasing its volume.
 - The volume change is measured, and the relationship is: $V \propto T$ or $V \propto T$
 - The thermometer is calibrated to convert volume changes into temperature readings.
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Advantages of Gas Thermometers:

1. Highly accurate and reliable.
2. Used as standard thermometers in laboratories.

3. Gases follow ideal gas laws, making their behavior predictable.

Disadvantages of Gas Thermometers:

1. Bulky and not portable.
 2. Cannot measure extremely low temperatures due to condensation of gases.
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5. Analyze how the structure of a liquid-in-glass thermometer can be modified to improve its performance.

Improvements in Sensitivity:

1. **Use Liquids with Higher Expansion Rates:**
 - Alcohol expands more than mercury, making temperature changes more noticeable.
 - Suitable for colder regions as alcohol does not freeze easily.
 2. **Reduce Bore Diameter:**
 - Narrower bores increase the rise of the liquid for small temperature changes.
 - This amplifies the liquid's response, making the thermometer more sensitive.
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Improvements in Range:

1. **Choose Appropriate Liquids:**
 - Mercury for high-temperature applications (boiling point 356°C).
 - Alcohol for low-temperature applications (freezing point -114°C).
 2. **Adjust Scale:**
 - Extend the thermometer tube to accommodate wider temperature ranges.
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Improvements in Durability:

1. **Use Reinforced Glass:**
 - Prevents breakage during handling or exposure to extreme conditions.
 2. **Seal the Tube Better:**
 - Ensures no leakage of liquid, especially for volatile liquids like alcohol.
-

Applications of Modified Liquid-in-Glass Thermometers:

1. Precision thermometers in laboratories.
2. Outdoor thermometers for extreme weather conditions.
3. Medical thermometers for accurate human body temperature readings.

Extera Short (Topic Wise)

7.1 Density

1. **What is density?**

Density is the mass of a substance per unit volume, indicating how compact the matter is within a given space.

2. **How is density calculated?**

Density is calculated using the formula: $\text{Density} = \text{Mass} \div \text{Volume}$.

3. **Why is density considered an intensive property?**

Density is intensive because it does not depend on the amount of substance present; it remains constant regardless of sample size.

4. **How does temperature affect the density of a substance?**

Generally, as temperature increases, substances expand, leading to a decrease in density; conversely, cooling a substance typically increases its density.

7.2 Measuring Densities of Different Substances

1. **How can the density of a regular-shaped solid be measured?**

Measure its mass using a balance and calculate its volume using geometric formulas; then, divide mass by volume to find density.

2. **What method is used to determine the density of an irregular-shaped solid?**

Use the water displacement method to find the object's volume, then divide its mass by this volume to calculate density.

3. **How is the density of a liquid typically measured?**

Measure the mass of a known volume of the liquid and divide the mass by the volume to determine density.

4. **What instrument is commonly used to measure the density of gases?**

A gas pycnometer or a specialized gas density meter is used to measure the density of gases.

7.3 States of Matter

1. **What are the three classical states of matter?**

Solid, liquid, and gas.

2. **How do particles behave in a solid state?**

Particles are closely packed in a fixed, orderly arrangement and vibrate in place.

3. **What characterizes the liquid state of matter?**

Particles are close together but can move past one another, allowing liquids to flow and take the shape of their container.

4. **How do gases differ from solids and liquids in terms of particle arrangement?**

Gas particles are far apart and move freely, filling the entire volume of their container.

7.4 Plasma as a Fourth State of Matter

1. **What is plasma?**

Plasma is an ionized gas consisting of free electrons and ions, making it electrically conductive.

2. **Where is plasma commonly found?**

Plasma is found in stars, including the sun, and in phenomena like lightning and neon signs.

3. **How is plasma different from the other states of matter?**

Unlike solids, liquids, and gases, plasma has free-moving charged particles, giving it unique electromagnetic properties.

4. **What conditions are necessary to form plasma?**

Extremely high temperatures or strong electromagnetic fields are required to ionize gas into plasma.

7.5 Relationship between the Motion of Particles and Temperature

1. **How does temperature affect particle motion in a substance?**

Increasing temperature increases particle kinetic energy, causing them to move faster; decreasing temperature slows them down.

2. **What happens to the particles in a solid as temperature increases?**

Particles vibrate more vigorously, which can lead to melting if the temperature reaches the substance's melting point.

3. **Why do gases expand when heated?**

Heating increases particle speed, causing them to collide more forcefully and spread apart, leading to expansion.

4. **How is temperature related to the kinetic energy of particles?**

Temperature is directly proportional to the average kinetic energy of particles in a substance.

7.6 Internal Energy and Temperature of a Substance

1. **What constitutes the internal energy of a substance?**

Internal energy is the total of all kinetic and potential energies of the particles within a substance.

2. **How does temperature influence the internal energy of a substance?**

An increase in temperature raises the kinetic energy of particles, thereby increasing the substance's internal energy.

3. **Can internal energy change without a change in temperature?**

Yes, during phase changes (e.g., melting or boiling), internal energy changes while temperature remains constant.

4. **What is the relationship between heat added to a substance and its internal energy?**

Adding heat increases internal energy, either by raising temperature or causing a phase change.

7.7 Variation in Physical Properties as a Tool for Measuring Temperature of a Substance

1. **How does the expansion of liquids assist in measuring temperature?**

Liquids expand uniformly with temperature, allowing thermometers to measure temperature based on liquid volume changes.

2. **Why is electrical resistance used in temperature measurement?**

The electrical resistance of materials changes predictably with temperature, enabling devices like resistance thermometers to measure temperature accurately.

3. **How do thermocouples utilize the Seebeck effect for temperature measurement?**

Thermocouples generate a voltage when there is a temperature difference between two different metals, which can be measured to determine temperature.

4. **What role does the color change in thermochromic materials play in temperature measurement?**

Thermochromic materials change color at specific temperatures, providing a visual indication of temperature changes.

7.8 Fixed Points in Calibration of a Thermometer

1. **What are fixed points in thermometer calibration?**

Fixed points are precise temperatures at which phase changes occur, such as the melting and boiling points of pure substances, used as reference standards.

2. **Why is the triple point of water significant in thermometer calibration?**

The triple point of water is a reproducible reference temperature where water coexists in solid, liquid, and gas phases, serving as a standard calibration point.

3. **How does using fixed points improve thermometer accuracy?**

Calibrating thermometers at known fixed points ensures their readings are accurate and consistent across different temperature ranges.

4. **What is the importance of the ice point in thermometer calibration?**

The ice point, 0°C , provides a reliable and reproducible fixed point for thermometer calibration.

7.9 Sensitivity, Range, and Linearity of Thermometers

1. **What is the sensitivity of a thermometer?**

Sensitivity refers to a thermometer's ability to detect small changes in temperature, measured by the change in its output for a small temperature variation.

2. **What is meant by the range of a thermometer?**

The range is the minimum and maximum temperatures a thermometer can accurately measure.

3. **Why is linearity important in thermometers?**

Linearity ensures that the thermometer's scale readings correspond proportionally to temperature changes, maintaining consistent accuracy across its range.

4. **How can the sensitivity of a liquid-in-glass thermometer be increased?**
By using liquids with higher expansion rates and a narrower bore for more noticeable movement in the liquid column.
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7.10 Structures and Functions of Liquid-in-Glass and Thermocouple Thermometers

1. **How does a liquid-in-glass thermometer work?**
It uses the expansion of a liquid (e.g., mercury or alcohol) within a narrow tube. The liquid's level changes with temperature and indicates the temperature on a calibrated scale.
 2. **What is the main principle behind thermocouple thermometers?**
Thermocouples operate on the Seebeck effect, where a voltage is generated at the junction of two different metals when exposed to a temperature difference.
 3. **What are the advantages of thermocouple thermometers?**
Thermocouples are durable, respond quickly, and can measure a wide range of temperatures, making them ideal for industrial applications.
 4. **Why are alcohol thermometers preferred in colder regions?**
Alcohol has a lower freezing point than mercury, allowing it to measure temperatures below -39°C , which mercury thermometers cannot.
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7.11 Effect of Structure of a Liquid-in-Glass Thermometer on Its Sensitivity, Range, and Linearity

1. **How does the diameter of the bore affect a thermometer's sensitivity?**
A narrower bore increases sensitivity, as small temperature changes cause a noticeable rise or fall in the liquid column.
2. **What role does the liquid's expansion rate play in determining sensitivity?**
Liquids with higher expansion rates (like alcohol) make thermometers more sensitive by amplifying the liquid's movement for small temperature changes.
3. **How can the range of a thermometer be extended?**
Using liquids with low freezing points (e.g., alcohol) or high boiling points (e.g., mercury) extends the thermometer's range.
4. **What structural modifications ensure a thermometer's linearity?**
Using a uniform capillary bore and calibrating the thermometer carefully ensures proportional changes in the liquid column correspond to temperature changes.

Long Questions (Topic Wise)

1. Define density and explain its importance. Discuss its applications in science and daily life.

Definition of Density:

Density is the mass per unit volume of a substance. It determines how compact a material is.

Mathematically:

$$\text{Density}(\rho) = \frac{\text{Mass (m)}}{\text{Volume (V)}} \quad \text{Density}(\rho) = \frac{\text{Mass (m)}}{\text{Volume (V)}}$$

- **SI Unit:** kg/m^3
- **Common Units:** g/cm^3 or g/mL

Importance of Density:

1. Helps in identifying substances based on their characteristic densities.
2. Plays a role in buoyancy and stability of objects in fluids.
3. Assists in designing structures, where lightweight materials are needed.

Applications of Density:

1. **Buoyancy:**
Substances with lower densities float on higher-density substances.
Example: Ice floats on water because its density is less than water.
2. **Material Identification:**
Comparing measured density with known values can identify materials like gold or aluminum.
3. **Design and Engineering:**
Engineers consider density to optimize weight and strength, such as in aircraft and bridges.
4. **Environmental Science:**
Density aids in predicting pollutant behavior in water and air.

2. Discuss the methods used to measure the densities of solids, liquids, and gases, including examples for each.

Measurement of Density:

1. For Regular-Shaped Solids:

- Use geometric formulas to calculate volume.
- Measure mass using a digital balance.
- Compute density using: $\rho = \frac{m}{V}$

Example: A cube with side 3 cm has a volume of $3^3 = 27 \text{ cm}^3$. If its mass is 54 g, its density is $\rho = \frac{54}{27} = 2 \text{ g/cm}^3$.

2. For Irregular-Shaped Solids:

- Measure the volume using water displacement.
- Measure the mass directly and calculate density. *Example:* A stone increases water from 50 mL to 80 mL (volume = 30 mL). If its mass is 60 g, $\rho = \frac{60}{30} = 2 \text{ g/mL}$.

3. For Liquids:

- Measure the mass of a container, then with the liquid. Subtract the container mass to get the liquid's mass.
- Measure the volume and compute density. *Example:* A beaker with 200 mL of liquid weighs 300 g. If the beaker weighs 100 g, the liquid's mass is 200 g. $\rho = \frac{200}{200} = 1 \text{ g/mL}$.

4. For Gases:

- Use a gas syringe to measure volume and mass indirectly. *Example:* A gas-filled container weighs 0.5 g more than an evacuated container. If the volume is 2 L, $\rho = \frac{0.5}{2} = 0.25 \text{ g/L}$.

3. Compare the three states of matter based on their particle arrangement, motion, and properties.

Solid:

1. Particles are closely packed in fixed positions.
2. Strong intermolecular forces keep particles in place.
3. Has a definite shape and volume.
4. Particles vibrate but do not move freely. *Example:* Ice, metals.

Liquid:

1. Particles are close but can move past one another.
2. Weaker intermolecular forces than solids.
3. Takes the shape of its container but has a fixed volume.
4. Particles move more freely than in solids. *Example:* Water, oil.

Gas:

1. Particles are far apart and move freely.
 2. Negligible intermolecular forces.
 3. No fixed shape or volume, gases expand to fill the container.
 4. Particles move rapidly and randomly. *Example:* Oxygen, nitrogen.
-

4. Explain plasma as the fourth state of matter. Discuss its properties and applications. What is Plasma?

Plasma is a state of matter consisting of free-moving ions and electrons. It forms when a gas is ionized at high temperatures or under strong electromagnetic fields.

Properties of Plasma:

1. Highly conductive due to free electrons.
2. Responds to electric and magnetic fields.
3. Exists at extremely high temperatures.

Examples of Plasma:

1. Stars, including the sun, are made of plasma.
2. Lightning and auroras are natural examples of plasma.
3. Plasma is used in fluorescent lights and neon signs.

Applications of Plasma:

1. **Energy Generation:** Used in nuclear fusion research for energy production.
 2. **Medical Devices:** Plasma sterilization is used in hospitals.
 3. **Electronics:** Plasma etching is essential in semiconductor manufacturing.
 4. **Space Science:** Understanding plasma helps in studying solar winds and cosmic phenomena.
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5. Analyze the structure and function of liquid-in-glass thermometers and thermocouple thermometers. Highlight their advantages and limitations.

Liquid-in-Glass Thermometers:

1. **Structure:**

- Contains a liquid (mercury or alcohol) inside a glass tube.
- The liquid expands or contracts with temperature changes, moving along a calibrated scale.

2. **Advantages:**

- Simple and inexpensive.
- Reliable for a wide range of temperatures.
- Alcohol thermometers work well in cold regions due to alcohol's low freezing point.

3. **Limitations:**

- Mercury is toxic and requires careful handling.
 - Alcohol thermometers are not suitable for high temperatures.
-

Thermocouple Thermometers:

1. Structure:

- Made of two different metals joined at one end (hot junction).
- The temperature difference between the hot and cold junction generates a voltage.

2. Advantages:

- Can measure very high temperatures.
- Durable and suitable for industrial use.
- Quick response to temperature changes.

3. Limitations:

- Requires calibration for precise measurements.
- Less accurate at low temperatures compared to other thermometers.

Comparison:

- Liquid-in-glass thermometers are ideal for general use, while thermocouples are better for industrial and high-temperature environments.

MCQs

1. What is the formula for density?

- A) Mass $\times$ Volume
- B) Mass $\div$ Volume
- C) Volume $\div$ Mass
- D) Mass + Volume

Answer: B) Mass $\div$ Volume

2. Which state of matter has a definite shape and volume?

- A) Solid
- B) Liquid
- C) Gas
- D) Plasma

Answer: A) Solid

3. What is plasma?

- A) A solid with high density
- B) A liquid with low viscosity
- C) An ionized gas with free electrons
- D) A type of crystal structure

Answer: C) An ionized gas with free electrons

4. How does temperature affect particle motion in a substance?

- A) Higher temperatures decrease particle motion
- B) Lower temperatures increase particle motion
- C) Higher temperatures increase particle motion
- D) Temperature has no effect on particle motion

Answer: C) Higher temperatures increase particle motion

5. What happens to the internal energy of a substance when its temperature increases?

- A) Internal energy decreases
- B) Internal energy increases
- C) Internal energy remains constant
- D) Internal energy becomes zero

Answer: B) Internal energy increases

6. Which property is commonly used to measure temperature?

- A) Color change
- B) Electrical resistance
- C) Magnetic susceptibility
- D) Density

Answer: B) Electrical resistance

7. What are fixed points in thermometer calibration?

- A) Arbitrary temperature values
- B) Temperatures at phase transitions of pure substances
- C) Average temperatures over time
- D) Points where thermometers are inaccurate

Answer: B) Temperatures at phase transitions of pure substances

8. What does the sensitivity of a thermometer refer to?

- A) Its ability to measure high temperatures
- B) Its response to small temperature changes
- C) Its durability under extreme conditions
- D) Its size and portability

Answer: B) Its response to small temperature changes

9. How can the range of a liquid-in-glass thermometer be extended?

- A) Using a liquid with a higher boiling point
- B) Widening the capillary tube
- C) Shortening the glass stem
- D) Using colored liquids

Answer: A) Using a liquid with a higher boiling point

10. What is the primary function of a thermocouple thermometer?

- A) Measuring electrical current
- B) Measuring temperature differences
- C) Measuring atmospheric pressure
- D) Measuring humidity levels

Answer: B) Measuring temperature differences

11. Which state of matter has particles that are free to move past one another but remain in close contact?

- A) Solid
- B) Liquid
- C) Gas

D) Plasma

Answer: B) Liquid

12. What is the SI unit of density?

A) kg/m^3

B) g/cm^3

C) kg/L

D) g/mL

Answer: A) kg/m^3

13. Which method is suitable for measuring the density of an irregularly shaped solid?

A) Using a ruler to measure dimensions

B) Water displacement method

C) Using a thermometer

D) Calculating mass only

Answer: B) Water displacement method

14. In which state of matter do particles have the highest kinetic energy?

A) Solid

B) Liquid

C) Gas

D) Plasma

Answer: D) Plasma

15. What happens to the particles of a substance as it is heated from a solid to a liquid?

A) They move closer together

B) They move further apart and move more freely

C) They remain in fixed positions

D) They stop moving

Answer: B) They move further apart and move more freely

16. What is internal energy?

A) The energy required to change the state of a substance

B) The total kinetic and potential energy of particles in a substance

C) The energy transferred between objects of different temperatures

D) The energy stored in chemical bonds

Answer: B) The total kinetic and potential energy of particles in a substance

17. How does a liquid-in-glass thermometer work?

- A) By measuring electrical resistance
- B) By detecting infrared radiation
- C) By expansion and contraction of a liquid in response to temperature changes
- D) By using a bimetallic strip

Answer: C) By expansion and contraction of a liquid in response to temperature changes

18. What is the triple point of water?

- A) The temperature at which water boils
- B) The temperature at which water freezes
- C) The temperature and pressure at which water coexists in solid, liquid, and gas phases
- D) The temperature at which water becomes plasma

Answer: C) The temperature and pressure at which water coexists in solid, liquid, and gas phases

19. Which factor does NOT affect the sensitivity of a liquid-in-glass thermometer?

- A) Diameter of the capillary tube
- B) Type of liquid used
- C) Length of the thermometer
- D) Thickness of the glass wall

Answer: C) Length of the thermometer

20. What is the main advantage of a thermocouple thermometer over a liquid-in-glass thermometer?

- A) Higher accuracy
- B) Ability to measure a wider range of temperatures
- C) Lower cost
- D) Easier to read

Answer: B) Ability to measure a wider range of temperatures

21. Which state of matter is characterized by having a definite volume but no definite shape?

- A) Solid
- B) Liquid
- C) Gas
- D) Plasma

Answer: B) Liquid

22. How does increasing temperature affect the density of most substances?

- A) Increases density
- B) Decreases density

- C) Has no effect on density
- D) Causes density to fluctuate

Answer: B) Decreases density

23. What is the primary characteristic of plasma that distinguishes it from other states of matter?

- A) High density
- B) Free-moving ions and electrons
- C) Fixed volume
- D) Strong intermolecular forces

Answer: B) Free-moving ions and electrons

24. How does the diameter of the bore affect the sensitivity of a liquid-in-glass thermometer?

- A) A wider bore decreases sensitivity
- B) A narrower bore increases sensitivity
- C) Diameter has no effect on sensitivity
- D) Both A and B

Answer: B) A narrower bore increases sensitivity