Chapter # 7

Density and Temperature

Q.1: Define density. Also write formula and unit?

Ans: Density: We define the density of the material as:

"Mass per unit volume of the substance is called its density." Mathematically:

Density = (Mass) / (Volume)

Its symbol is p:

p = m/V

Its S.I. unit is kilogram per cubic meter (kg/m^3).

Smaller unit to measure density is gram per cubic centimetre (g/cm^3). Density of liquids is usually measured in gram per millilitre (g/mL). It is a scalar quantity.

- Density of solids is greater than liquids and density of liquids is greater than gases.

Q# 2 How we find density of liquids ?

Ans: Density of liquids:

To measure the density of liquids, we need a graduated measuring cylinder to measure the volume of liquid, and a balance to measure the mass of liquids. We will measure the density of the liquid using the following steps:

1. Place the empty measuring cylinder on balance and measure its mass.

2. Add liquid to the measuring cylinder and measure its volume.

3. Subtract mass of the empty cylinder from the mass of the cylinder and liquid (measured in step2).

Mass of liquid = Mass of measuring cylinder and liquid- Mass of empty cylinder

4. Measure the volume of liquid from the measuring cylinder. 5. To calculate the density of the liquid, divide the mass of liquid by its volume.

Density of liquid = (Mass of liquid) / (Volume of liquid)

Q# 3 How we find density of regular Objects?

Ans: Density of Regularly Shaped Solids:

Ans: To find the density of regularly shaped solids (like solid cubes, solid cuboids, solid sphere etc.), we follow these steps:

1. Find the mass of the solid regular-shaped object using a balance.

2. Calculate the volume of the object using the formula according to the shape of the object.

For example, Volume of cuboid = Length x width x Height

Volume of cube = $(\text{side length})^3$

Volume of sphere = $4/3\ \pi\ r^3$

Density of solid = (Mass of solid) / (Volume of solid)

Q# 4 How we find density of Irregular objects?

Ans: Density of Irregular Shaped Object (Displacement Method):

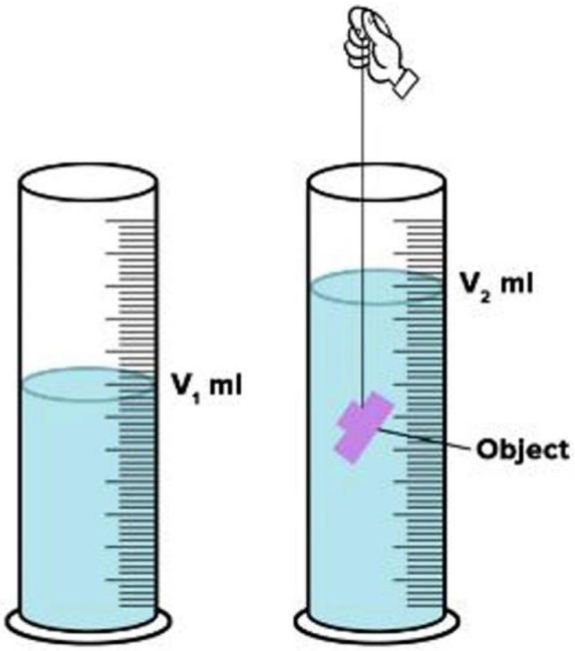
We can find the density of irregular-shaped solid objects like stones which can sink in the water. We need a graduated measuring cylinder to measure volume and a balance to measure the mass of the object. We will follow these steps to find its density:

1. Find the mass of the irregular shaped stone.

2. Add some water in the measuring cylinder and measure its initial volume (Vi).

3. Tie a thread with the irregular-shaped object, e.g., stone, and lower it in the measuring cylinder.

4. Water will rise (i.e., displace) in the measuring cylinder and measure the final volume (Vf). This final volume reading is the sum of the volume of water and the volume of the object.



5. Subtract the initial volume (Vi) from the final volume (Vf) to get the volume of the object

6. The volume of object = Vf- Vi

7. To find the density of the object, divide the mass of the object with its volume.

Density of solid =(Mass of solid) / (Volume of solid)

Q.5: How would you distinguish between solids, liquids, and gases based on the attractive force between particles and the motion of particles?

Ans. Matter exists in three fundamental states: solid, liquid, and gas. Matter consists of particles (atoms and molecules). Gaps between these particles are the main reason that divides matter into three states. Particles of matter apply an attractive force on each other.

Properties of Solids:

1. Solids are made up of particles (atoms or molecules).

2. There is a strong attractive force between particles.

3. Due to strong attractive force, particles of solids are closely packed and they have fixed lattice pattern. Solid particles cannot freely move like gas particles or slide past one another like liquid particles due to their fixed location. Solid particles can only vibrate about their mean position.

4. Solids have fix shape.

5. Solids have high density.

Properties of Liquids:

1. Liquid are also made up of particles (molecules).

2. The attractive force between particles is stronger than that of gases but weaker than that of solids.

3. The distance between particles in liquids is greater than that in solids due to an intermediate attractive force, yet they are still close together.

4. Liquid particles flow and glide over each other. Liquid particles keep changing their position.

5. Due to flowing particles, a liquid has no fix shape and can adopt the shape of the container.

6. A liquid has intermediate density (smaller than a solid and higher than a gas).

Properties of Gases:

1. Gas is also composed of particles (atoms and molecules).

2. There is a negligibly weak attractive force between gas particles.

3. Due to weak attractive force, the distance between particles is larger as compared to the size of the particles.

4. Particles are in constant random motion and they constantly collide with each other and with the walls of the container.

5. Forces between molecules are negligible, except during collisions.

6. Gas has no fixed shape and volume. The gas spreads out in the container and fills it, therefore its volume is equal to the volume of the container.

7. Gases are less dense than liquids and solids.

Q#6 Describe plasma as the fourth state of matter briefly.

Ans: Plasma: Plasma consists of positive ions, free electrons (negatively charged particles), and neutral atoms in a gaseous state.

Explanation:

(¡) Plasma exists at very high temperatures:

Usually, plasma exists at very high temperatures or at high pressure or both. By using a high electric and magnetic field, a substance can also be transformed into plasma.

(¡¡)Plasma in the universe:

There is a lot of plasma in the universe. Plasma is gas that is hot, bright, and highly ionized. These characteristics together make it different from gas. 99% of the visible universe is made up of plasma. That is why plasma is often called “the fourth state of matter”, along with solid, liquid, and gas.

(iii) Effect of temperature on K.E of gas:

When a gas is heated continuously, the kinetic energy (K.E) of gas molecules also continuously increases. Due to this, attractive molecular forces keep on decreasing as molecules go away from each other. The molecules and atoms start colliding. With each other powerfully. Due to it, electrons of the atoms are removed and atoms become positive ions. This ionic state of matter is called plasma. It can highly conduct current because it has free electrons and moving ions.

Q#7 Discuss the relationship between the motion of particles and the temperature of the substance.

Answers :

Particle Motion and Temperature Relationship:

- Water molecules move constantly, but their movement is usually too subtle to see without heat.
- Heating a substance causes visible water currents and faster particle movement.
  Effects of Heating:
- Decrease in Attractive Forces: Bonds may break (e.g., melting, boiling).
- Increased Particle Speed: Results in higher kinetic energy (K.E.) and temperature.

Temperature and Kinetic Energy:

- Temperature measures the hotness or coldness of a substance.
- Directly proportional to the average kinetic energy of particles.
- Heating increases particle speed and K.E., raising temperature.
- Cooling decreases particle speed and K.E., lowering temperature.

Absolute Zero:

- Continuous cooling leads to particles slowing down until they stop moving. Pressure.
- At absolute zero (0K or-273.15°C), particles have minimal kinetic energy and cannot exert.
- No heat energy is available to move particles.

Q# 8 Define and Explain the internal Energy of a substance.

Ans. INTERNAL ENERGY AND TEMPERATURE OF A SUBSTANCE:

The internal energy of a substance is the total energy possessed by the particles of the substance.

Internal Energy of a Substance:

- Total energy possessed by the particles of a substance.
- Comprises both kinetic and potential energy.

Components of Internal Energy:

- Potential Energy: Due to the attractive forces between particles.

- Kinetic Energy: Includes translational, rotational, and vibrational forms.
- For ideal gases, internal energy is due only to translational kinetic energy.

Relationship with Temperature:

- Temperature is directly proportional to the average kinetic energy of particles.
- Heating a substance increases the kinetic energy of particles.
- As result, internal energy of the substance also increases.

Implications of Internal Energy Changes:

- An increase in internal energy indicates a rise in temperature.
- This can result from added heat or other energy sources.

Q#9 Describe two different physical properties that vary with temperature and explain how these properties can be used to measure temperature.

Ans: Physical Properties Varying with Temperature for Measurement:

Expansion of Liquids:

- Most liquids expand uniformly upon heating, making them suitable thermometric materials. This property is used in liquid-in-glass thermometers (mercury or alcohol). Heat absorption causes liquid expansion, with the position indicating temperature.

Variation of Volume and Pressure (Gas Thermometers):

- Constant Volume: Pressure is directly proportional to temperature at constant volume (Gay-Lussac's law). Increased temperature leads to higher gas particle kinetic energy and pressure, enabling measurement.
- Constant Pressure: Volume is inversely proportional to temperature at constant pressure (Charles's law). Gas expansion pushes a piston, and volume change indicates temperature.
- Variation in Colour of Liquid Crystals: Liquid crystals change colour with temperature. Sealed in plastic strips or patches, they are touched to the body, and the colour change indicates the temperature.

Q.# 10 Discuss Fixed Points in the Calibration of Thermometer.

Importance of Fixed Points:

- Essential for accurate temperature measurement.
- Required for calibrating thermometers.
- Known as reference points: lower and upper reference points.

Types of Scales:

Celsius Scale:

- Lower reference point: 0°C (Melting point of ice).
- Upper reference point: 100°C (Boiling point of water).
- 100divisions between points.

Fahrenheit Scale:

- Lower reference point: 32°F.
- Upper reference point: 212°F.
- 180divisions between points.

Kelvin Scale:

- Lower reference point: 273 K.
- Upper reference point: 373 K. 100divisions between points.

Key Points:

- Fixed points must be accessible and reproducible.
- Essential for consistent and accurate temperature readings.

Q11. Explain sensitivity, range and linearity of the thermometer in detail.

SENSITIVITY OF A THERMOMETER:

- Sensitivity refers to a thermometer's ability to detect small changes in temperature.
- It is defined by the smallest variation in temperature that a thermometer can measure.
- For example, a thermometer with a sensitivity of 0.1°C can detect changes as small as 0.1°C.
- Another thermometer with a sensitivity of 1°C can only detect changes as large as 1°C and cannot measure smaller changes.
- Sensitivity is similar to the least count of a measuring instrument.
- Example: In a mercury thermometer, placing it in a glass of water at room temperature and then adding hot water will show a quick rise in the mercury level, indicating temperature change.

RANGE OF A THERMOMETER:

- The range is the span between the lowest and highest temperatures a thermometer can measure.
- Example: A clinical mercury thermometer can measure temperatures from 35°C to 42°C on the Celsius scale (94°F to 108°F on the Fahrenheit scale).

- Digital thermometers can measure a wide range, from very cold to very hot. In boiling water to measure 100°C (boiling point).

Q.12 : Explain the structure and function of liquid-in-glass thermometers and thermocouples.

Ans: **LIQUID-IN-GLASS THERMOMETERS:**

Structure:

- Consist of a long, thin glass tube with a bulb at one end.
- The bulb is filled with a liquid, commonly mercury or alcohol.
- The liquid expands and contracts with temperature changes.

Function:

- The thermometer works by measuring the expansion and contraction of the liquid inside the bulb.
- When placed in a warmer environment or in contact with a hot object, the liquid expands and rises in the tube, indicating a higher temperature.
- Conversely, when the temperature drops, the liquid contracts and falls, indicating a lower temperature.

Thermocouple

Structure:

- Consist of two different metal wires joined at one end to form a junction.
- The junction is the point where temperature measurement occurs.

Function:

- Thermocouples measure temperature based on the Seebeck effect.
- When the junction of the two metals is heated or cooled, it produces a voltage that is proportional to the temperature difference between the junction and the reference temperature.
- The voltage generated can be measured and converted into a temperature reading using standard conversion tables.

Q.13: Analyze how the structure of a liquid-in-glass thermometer can be modified to improve its performance. Give a detailed answer.

Ans: To improve the performance of a liquid-in-glass thermometer, modifications can be made to enhance its sensitivity, range, and linearity. Here are some key aspects:

- Nature of the Liquid Used:
    - Choice of Liquid: Selecting a liquid with a high coefficient of expansion, such as mercury or alcohol, improves sensitivity. These liquids expand and

contract more noticeably with temperature changes, allowing for more precise readings.

- Purity and Composition: Using pure liquids with consistent thermal expansion properties ensures more accurate measurements. Any impurities can affect the liquid's response to temperature changes.

Diameter of the Capillary Tube:

- Smaller Diameter: A smaller diameter tube increases the sensitivity of the thermometer. This is because a given volume of liquid expansion will result in a greater length of movement in a narrower tube, making it easier to detect small temperature changes.
- Uniform Bore: Ensuring the capillary tube has a uniform bore along its length is crucial for maintaining linearity and accuracy in readings.

3. Material of the Tube:

- Thermal Conductivity: The glass used should have low thermal conductivity to minimize heat exchange with the environment, which can affect readings.
- Transparency and Markings: Clear glass with distinct, precise markings improves readability. Using a coloured liquid or adding a contrasting background can make it easier to read the scale.

4. Bulb Design:

- Shape and Size: A larger bulb increases the volume of the liquid, which can enhance sensitivity by providing more liquid to expand and contract. However, the bulb's shape and size must balance sensitivity with response time and practical usage considerations. 5

5 Calibration and Scale:

- Accurate Calibration: Ensuring accurate calibration at known fixed points (e.g., ice point and steam point) helps maintain accuracy across the range.
- Extended Scale Range: Adjusting the scale to cover a broader temperature range allows the thermometer to be used in more diverse conditions. This can be achieved by selecting an appropriate liquid and adjusting the scale accordingly.

30 SLO Based important Short Questions

No.	Question	Answer
1.	Define density and its units.	Density is the mass per unit volume of a substance, symbolized as ρ. It is measured in kg/m³ (SI unit) or g/cm³.
2.	What is the formula for density?	The formula for density is ρ = m/V, where m is mass and V is volume.
3.	How does temperature affect the density of a material?	Density decreases as temperature increases because the substance expands, increasing its volume.
4.	What are the units for measuring the density of liquids?	The density of liquids is usually measured in grams per milliliter (g/mL).
5.	Why are solids generally denser than liquids and gases?	Solids have closely packed atoms, resulting in more matter in a fixed volume, making them denser.
6.	Describe the method to measure the density of a liquid.	Measure the liquid's mass using a balance and volume using a graduated cylinder, then divide mass by volume.
7.	How can the volume of a regularly shaped solid be determined?	For regularly shaped solids, use geometric form such as V = l × w × h for cuboids.
8.	Explain the displacement method for finding the volume of an irregular solid.	Submerge the object in water and measure the volume of water displaced, which equals the object's volume.
9.	What is the significance of the melting point in temperature scales?	The melting point is a fixed point used as a reference in scales like Celsius (0°C for ice).
10.	How does the choice of liquid in a	A liquid with a high coefficient of expansion, like

	thermometer affect its sensitivity?	alcohol, increases sensitivity by expanding more.
11.	Why is mercury commonly used in thermometers?	Mercury has a uniform thermal expansion and remains liquid over a wide temperature range.
12.	What is the SI unit for measuring temperature?	The SI unit for temperature is the Kelvin (K).
13.	How do liquids and gases differ in terms of density?	Liquids have higher densities than gases because their particles are more closely packed.
14.	What is absolute zero?	Absolute zero is -273.15°C, where molecular motion ceases entirely, representing the lowest possible temperature.
15.	Why is water not suitable for use in thermometers?	Water has a high vapor pressure and narrow freezing and boiling points, making it less ideal.
16.	Define internal energy.	Internal energy is the total energy of all the particles within a substance, including kinetic and potential energy.
17.	What factors affect the internal energy of a substance?	Temperature, state of matter, and the number of particles affect internal energy.
18.	Describe the plasma state of matter.	Plasma consists of ionized gas with free electrons and is found at high temperatures or pressures.
19.	How can the sensitivity of a thermometer be increased without changing its range?	Sensitivity can be increased by using a narrower capillary tube or a liquid with a higher expansio coefficient.
20.	What are the components of internal energy?	Internal energy includes kinetic energy (translational, rotational, vibrational) and potential energy.
21.	How does a thermocouple measure temperature?	A thermocouple generates a voltage proportional to the temperature difference between two junctions.
22.	Why is a thermocouple suitable for high	Thermocouples have a wide temperature range, fast

	temperatures?	response time, and are durable.
23.	What is the relationship between temperature and the average kinetic energy of particles?	Temperature is directly proportional to the average kinetic energy of particles.
24.	How does the expansion of liquids vary with temperature?	Most liquids expand uniformly upon heating, making them useful in thermometers.
25.	How is the volume of a gas affected by temperature at constant pressure?	The volume of a gas increases as temperature increases, according to Charles's law.
26.	What is the role of fixed points in thermometer calibration?	Fixed points, like the melting and boiling points of water, provide reference temperatures for accurate calibration.
27.	How does a liquid-in-glass thermometer function?	It measures temperature by the expansion and contraction of a liquid inside a glass tube.
28.	What is the Seebeck effect?	The Seebeck effect is the generation of a voltage due to a temperature difference across two different metals.
29.	Why is air less dense than solids and liquids?	Air particles are far apart, resulting in less matter per unit volume compared to solids and liquids.
30.	What happens to the density of water as temperature increases?	The density of water decreases as temperature increases due to thermal expansion.

Conceptual Questions

Q1: 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?

Ans: The liquid with a lower density of 1 g/mL will float on top of the liquid with a higher density of 1.2 g/mL. This is because objects with higher density sink in liquids with lower densities. Therefore, the liquid with float on top. A higher density (1.2 g/mL) will sink to the bottom, allowing the liquid with a lower density (1 g/mL) to float on top.

Q2: Write a method to find the volume and density of a human body?

Ans:

1. Measure the mass of the body (human body) using a scale in kilograms (Kg).

2. Submerge the body in a container filled with water. The volume of water displaced by the body is equal to the volume of the body. Measure the volume of water displaced using a graduated cylinder or by marking the water level before and after submerging the body.

3. Divide the mass of the body by its volume to calculate density.

Density = Mass/ Volume

Q# 3 How is plasma fourth state of matter. Give reason?

Ans: Plasma is often referred to as the fourth state of matter due to the following reasons.

1) Ionization: Atoms lose or gain electrons, resulting in a mixture of positively charged ions and free electrons. This process, known as ionization, is unlike gases, where atoms are neutral.

2) Electric conductivity: Plasma can conduct electricity because of the presence of free electrons. This property distinguishes it from gases, which are typically insulators.

3) Response to electric and magnetic field: Plasma responds strongly to electric and magnetic fields. These fields can influence the behaviour and movement of charged particles within the plasma.

4) Occurrence in nature: Naturally occur in phenomena such as lightning, auroras, and stars. Artificially generated in labs due to these distinct characteristics and behavior, plasma is considered a separate state of matter.

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

Ans: Water is not used in thermometers due to the following reasons:

1. Water has narrow freezing and boiling points.

2. Water has significant vapour pressure.

3. The thermal expansion of water is not linear and consistent as alcohol or mercury.

4. The density of water changes with temperature.

5. Water can be corrosive to certain materials used in thermometers.

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

Ans: The internal energy can increase without a change in temperature through processes such as compression or expansion in a closed system, chemical reactions, or by adding or removing heat while the system is performing work.

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

Ans: Fixed points on thermometer scales are necessary for calibration and accurate temperature measurement. Difficulties arise when setting these fixed points due to:

1. Uniformity
2. Precision
3. Standardization
4. Material properties
5. Environmental factors

Q.7: Mercury is replaced with alcohol in a liquid-in-glass thermometer. Discuss the possible change in sensitivity and range of the thermometer?

Ans: Alcohol typically expands more than mercury for a given rise in temperature. Therefore, the sensitivity of the thermometer, defined as the change in length per unit temperature change, would likely decrease when using alcohol instead of mercury. While sensitivity decreases, the increased expansion noticeable. Of alcohol may expand the readability of the thermometer, making small temperature changes more

Q.8: Why-273.15 °C temperature is called absolute zero? Can we achieve this temperature?

Ans: Absolute zero (-273.15 °C) is the lowest possible temperature where molecular motion ceases entirely. Theoretically, it is impossible to achieve this temperature because it would require removing all energy from a system, which is not feasible.

Q.9: Why is a thermocouple thermometer suitable for measuring high temperatures but a liquid in-glass thermometer is not?

Ans: A thermocouple thermometer is suitable for high temperatures due to the following reasons:

1. Wide temperature range

2. Fast response time

3. Durability

4. Compact design

In contrast, a liquid-in-glass thermometer is not suitable for high temperatures because:

i) It has a limited temperature range.
ii) It is fragile. I
iii) It has a slow response time.
iv) There is a risk of contamination.

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

Ans: The sensitivity of a liquid-in-glass thermometer can be changed without altering its temperature range by the following methods:

1. Bulb Size: Increasing or decreasing the bulb size can affect sensitivity. A larger bulb will increase sensitivity because it contains more liquid, allowing for more expansion.

2. Capillary Tube Diameter: A narrower tube will increase sensitivity because it requires less thermal energy to cause a noticeable expansion or contraction of the liquid column.

3. Liquid Selection: Using a different type of liquid with a higher coefficient of expansion than mercury, such as alcohol, can increase sensitivity.

4. Calibration: Adjusting the calibration of the thermometer by changing the markings on the scale can effectively change the perceived sensitivity.

Q.11: One student claims to have constructed a more sensitive liquid-in-glass thermometer. How can her claim be verified?

Ans: To verify the claim of constructing a more sensitive thermometer, the following steps can be taken:

1. **Review Design and Material**: Examine the design and materials used in the proposed thermometer.

2. **Theoretical Analysis:** Conduct a theoretical analysis of the proposed thermometer design. Calculate the expected sensitivity based on factors such as:
    - Bulb size
    - Capillary tube diameter
    - Thermal expansion of the liquid, etc.

Numerical Problems.

Q.1: Sarah has two objects, a wooden block and a metal ball, with the following properties:
a) The wooden block has a mas of 300 g and a volume of 150 cm^3.
b) The metal ball has a mass of 500 g and a volume of 50 cm^3.
Calculate the density of each object and determine which one is denser.

Ans. **a)** Given:-

Mass m = 300 g
Volume V = 150 cm^3
To Find Density ρ = ?

As we know that $\rho = \frac{m}{V}$

Putting values, we have $\rho = \frac{300}{150} =$ **2 g/mL**

b) Given:-

Mass m = 500 g
Volume V = 50 cm^3
To Find ρ = ?

As we know $\rho = \frac{m}{V}$

Putting values, we have $\rho = \frac{500}{15} =$ **10 g/mL**

The density of metal ball is high so it is deser.

Q.2: You have a container with 500 milliliters of cooking oil, and it has a mass of 450 grams. Calculate the density of the cooking oil in grams per milliliter (g/mL).

Ans. Given:-

Mass m = 500 g
Volume V = 450 cm^3
To Find ρ = ?

As we know $\rho = \frac{m}{V}$

Putting values, we have $\rho = \frac{500}{450} =$ **0.9 g/mL**

Q.3: A 70cm, 10cm 30cm plastic box has mass of 2500 g. Find the density of plastic.

Ans. Given:-

Mass m = 2500 g

Volume V = 70 x 10 x 30 = 21000 cm^3

To Find ρ = ?

As we know $\rho = \frac{m}{V}$

Putting values, we have $\rho = \frac{2500}{21000} = \frac{25}{210}$ **0.12 g/cm^3**

Q.4: Aluminum has a density of 2700 kg/m^3. Find the mass of a solid 25 cm diameter aluminum ball.

Ans. Given:-

Density ρ = 2700 g

Distance d = 25 cm

Radius r $= \frac{d}{2} = \frac{25}{2}$ 12.5 cm

Volume of sphere = $V = \frac{4}{3} \pi r^3$

$V = \frac{4}{3}$ 3.14 x $(12.5)^3$

$V = 1.33 \times 3.14 \times 1953 \times 10^{-6}$

V = = 8156 cm^3

To Find m = ?

As we know $\rho = \frac{m}{V}$

or $m = \rho V$

Putting values, we have $m = 2700 \times 8156 \times 10^{-6} =$ **22 kg**

Q.5: A cube of iron has a side length of 10 cm. What is volume of this cube? Mass of this iron cube is half kilogram. This cube has cavity inside it. Find the volume of the cavity.

Ans. Given:-

Volume of iron cube = V = $10^3 cm^3$ (as L = 10 cm)

Volume of cavity = V = $\frac{m}{} = \frac{500}{7.86} = 63.69 cm^3$

Volume of cavity = Volume of iron cube – Volume of cavity

Volume of cavity = 1000 – 63.69

Volume of cavity = 936.31 cm^3

So volume of cavity inside the iron cube is approximately 936.31 cm^3.

Q.6: Mass of an irregular shaped stone is 200 grams (g). When it is lowered in a measuring cylinder, it rises the water level from 40 mL to 73 mL. Find volume and density of this stone.

Ans. Given:-

Mass m = 200 g

Initial volume V_1 = 40 mL

Final volume V_2 = 73 mL

To Find ρ = ?

To Find V = ?

As we know $V = V_2 - V_1$

V = 73 – 40 = 33mL

As we know $\rho = \frac{m}{V}$

Putting values, we have $\rho = \frac{200}{33} =$ **6.1 g/mL**

Thus volume of stone is **33mL** and its density is **6.1 g/mL**.