

## Physical Quantity and Measurement

**1. How can we define density?**

Ans. Density is the property of an object which depicts the amount of matter in a given volume.

Density of an object can be defined as the mass of an object in a given volume.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

**2. What is the SI unit of Density?**

Ans. The SI unit of Density is -  $\text{Kg/m}^3$

**3. Show how you will convert density from  $\text{kg/m}^3$  to  $\text{g/cm}^3$**

$$\begin{aligned}\text{Ans. } 1\text{kg/m}^3 &= 1000 \text{ gm} / (100 \text{ cm})^3 \\ &= 1/1000 \text{ gm/cm}^3 \\ &= 10^{-3} \text{ gm/cm}^3\end{aligned}$$

**4. Give an example where two substances have equal masses but have different volume**

Ans. When equal weights of rice and cotton are taken, the rice occupies less volume than the cotton.

**5. Give an example where equal volume of two substances but have different volume.**

Ans. when equal volumes of rice and cotton are taken, the rice weighs more than cotton.

**6. What is the meaning of the statement, the density of Lead is  $11.34 \text{ g/cm}^3$ ?**

Ans. The density of Lead is  $11.34 \text{ g/cm}^3$  means  
Lead has  $11.34\text{g}$  mass per unit  $\text{cm}^3$  volume.

**7. What is a density bottle?**

Ans. **Density bottle** which is also known as a Pycnometer, specific gravity **bottle**, or pycnometer is a measuring device used to calculate the **density** of the desired liquids. A **Density bottle** is commonly made with glass.

**8. How can we measure the density of Regular Solid?**

Ans. There are two steps involved in calculating the density of a regular solid.

- The mass of the regular solid is determined by using a beam balance or any other suitable type of balance.
- The volume of the regular solid is calculated using one of the following formulae.

**9. Which instrument is required to measure density of an irregular solid?**

Ans. Measuring Cylinder or Eureka Can.

**10. How can we measure density of irregular solid?**

Ans. A measuring Cylinder is an instrument used to measure volume of an irregular solid. In this method, water is poured into the cylinder and the reading taken as the initial volume.

Let it is  $V_1$ .

Now tie the solid with a thread and immerse in the cylinder. Thus the water level increases.

Now take the reading of the cylinder as final volume.

Let it is  $V_2$ .

So the volume of solid is

$$V = (V_2 - V_1)$$

Let the mass of the solid is  $M$

So the density is

$$D = \frac{M}{V}$$

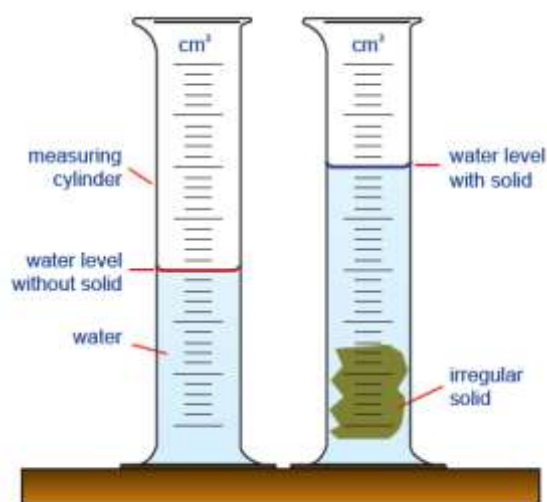


Fig. 4.3 Measuring the volume of an irregular solid

**11. How can we measure the density of an irregular solid with the help of Eureka Can?**

Ans, Eureka Can is called Displacement Vessel.

It is based on Archimedes' Principle. According to which the amount of water displaced by an object is equal to its volume.

First of all measure the mass of the irregular solid using beam balance.

Now, tie this irregular solid with a thread and drop it in the water in Eureka can, make sure that it does not touch the base of the can

Keep a small measuring beaker on the mouth of the Eureka can.

Now, after dropping the irregular solid the water flows from the Eureka can into measuring beaker through the pipe like structure.

Collect the water in the measuring beaker and measure its volume.



The volume this flowed water gives the volume of irregular solid.

Let the Volume is  $V$

And the mass of the Irregular solid is  $M$

So the Density of the solid is

$$D = \frac{M}{V}$$

**12. How can we measure density of Liquid using Graduated Gas Cylinder?**

Ans. Take a Graduated Gas Cylinder and take its mass through physical balance.

Let the mass is  $m_1$ .

Now take the cylinder with the liquid and measure the volume.

Let the volume is  $V$ .

Now then take the mass of the cylinder with liquid is  $m_2$ .

So the density can be determined by

$$D = \frac{m_2 - m_1}{V}$$

**13. How can we measure the density of Gas?**

Ans. Take a flask of volume V. Take the mass of the flask. Let it is  $m_1$ .  
Then using vacuum pump remove all the air from the flask and then take the mass of the flask. Let it is  $m_2$ .  
So the density can be determined by

$$D = \frac{m_2 - m_1}{V}$$

**14. What is Relative density?**

Ans. Relative Density of a substance is the ratio of its density to that of the water.

$$\text{Relative Density} = \frac{\text{Density of Substance}}{\text{Density of Water}}$$

$$\text{Now Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{So Relative Density} = \frac{\text{Mass of the substance}}{\text{Volume of the Substance}} \times \frac{\text{Volume of Water}}{\text{Mass of Water}}$$

**15. Why Relative Density has no unit?**

Ans. Relative Density is the ratio of two similar quantity. So that it has no Unit.

**16. With which instrument we can measure relative density?**

Ans. Relative Density Bottle.

**17. The density of an item is dependent on which factors?**

Ans. Some factors which can affect the density of an item.

- Physical State of Matter
- Temperature
- Pressure

**18. How the density of an item can changes with temperature?**

Ans. As the temperature of a substance of fix mass is increased the atoms gain energy and move far apart. This leads to the rise in the volume and the density decreases.

And due to decrease of temperature the volume of a substance decrease and the density increase.

**19. How the density of a substance change with the pressure.**

Ans. When pressure of any substance increase then atoms of any substance come closer and its volume decreases and the density increases. On the same way when the pressure of any substance decreases the atoms go far away and the volume increases. So that its density decreases.

**20. How does the density of a liquid change with a decrease in temperature?**

Ans. As the temperature increases, volumes of most of the liquids also increases and when the volume increases density decreases. Similarly, when temperature decreases, the volume of most liquids decreases which increases the density.

**21. Why any substance can float and sink?**

Ans. The substances that have a relative density of less than 1, (such as wood, cork and ice) float on water. These substances have -lower density than water, and thus have less mass packed in a given volume than water does.

The substances that have a relative density of more than 1, (such as lead, copper and iron, sink in water) sink in water. These substances have a higher density than water, and thus have more mass packed in a given volume than water does.

- 22. The density of water is  $1 \text{ g/cm}^3$  and the density of alcohol is  $0.79 \text{ g/cm}^3$ . Will ice with a density of  $0.9 \text{ g/cm}^3$  float on (i) water; (ii) alcohol?**

Ans. The Ice can float in water because its density ( $0.9 \text{ g/cm}^3$ ) is less than the density of water ( $1 \text{ g/cm}^3$ )

But Ice will sink in Alcohol. Because the density of Ice ( $0.9 \text{ g/cm}^3$ ) is less than that of Alcohol ( $0.79 \text{ g/cm}^3$ ).

- 23. The degree of immersion of Solid depends on which factors?**

Ans. The degree of immersion of a solid depends on the relative density of the liquid that it floats on.

- 24. What is Hydrometer?**

Ans. Hydrometer is a device based on principle of floatation to read the relative density of the liquid density.

- 25. What is Buoyant Force?**

**Or Describe Archimedes Principle**

Ans. The buoyant force or upthrust acting on an object is equal to the weight of the fluid (liquid or gas) that is displaced by the object.

This is known as the Archimedes principle.

- 26. Which forces are acting on a body when an object is sinking in any liquid?**

Ans. When an object sinks in any liquid, there are two forces that act on it.

- i. The weight of the object pushes the object into the liquid, displacing part of the liquid.
- ii. The buoyant force pushes the object up.

- 27. Explain the circumstances under which an object will float or sink in water.**

Ans. When an object sinks in any liquid, there are two forces that act on it.

- i. The weight of the object pushes the object into the liquid, displacing part of the liquid.
- ii. The buoyant force pushes the object up.

Now,

- When the weight of the object is more than the buoyant force pushing it up the resultant force pushes the object down. In this case, the object sinks in water. This happens when the density of the object is more than the density of the liquid.
- When the weight of the object is equal to the buoyant force pushing it up, the resultant force is zero. In this case, the object floats at the surface of the liquid This happens when the density of the object is equal to the density of the liquid.
- When the weight of the object is less than the buoyant force pushing it up, the resultant force pushes the object up. In this case, the object floats with part of the object above the surface of the liquid and part below it. This happens when the density of the object is less than the density of the liquid.

**28. Why a ship loaded with cargo submerges more in river water than sea water?**

Ans. The sea water has more density than river water. Ship which is made by steel or aluminium alloy is denser than water.

So when the loaded ship when submerged in river water it sinks more than sea water.

**29. Why the wax float on water?**

Ans. The relative density of wax is 0.93. And the density of water is 1. So the wax float on the water.

**30. Why hydrogen balloons rise up in air?**

Ans. The hydrogen filled balloons have lesser density than the components of gases present in the air. This is why the balloon rise up.

**31. Why Iron sink in water but float in Mercury?**

Ans. Water has a relative density of 1 while iron has a relative density of 7.8. Thus, any object made of solid iron will sink in water.

However, mercury has a relative density of 13.6. Thus, an object made of solid iron will float on mercury.

**32. Why only around 10% of an iceberg is visible above the surface of the water while 90% of the iceberg is under the surface?**

Ans. Only around 10% of an iceberg is visible above the surface of the water while 90% of the iceberg is under the surface.

This can be explained by the relative density of ice, which is approximately 0.9. Thus, the volume of 90% of the iceberg displaces a volume of water equal to the mass of the entire iceberg.

**33. How is a submarine made to dive under the surface of the water and then come up to the surface?**

Ans. When the submarine surfaces, compressed air flows from the air flasks into the ballast tanks and the water is forced out of the submarine until its overall density is less than the surrounding water (positive buoyancy) and the submarine rises.

When submarine wants to dive in water it fills water in the ballast tank. SO, the overall density of submarine increased and it dive into water.