

Board – ICSE

Class – 8th

Topic – Physical quantities and measurement

1. Define the term density of a substance.

Answer:

Density of a substance is defined as “Mass per Unit volume”.

$$\text{Density [d]} = \frac{\text{Mass of substance}}{\text{Volume of substance}} = \frac{M}{V}$$

2. How does the density of a liquid (or gas) vary with temperature?

Answer:

Most of the liquids increase in volume with increase in temperature, but water shows anomalous behaviour. Water has maximum volume at 4°C and maximum density at 4°C. Actually, when volume increases density decreases and when volume decreases the density increases.

But water when cooled from a high temperature, contracts upto 4°C because volume decreases and expands when cooled further below 4°C and hence density of water increases when it is cooled upto 4°C while decreases when cooled further below 4°C. In other words, the density of water is maximum at 4°C equal to 1 g cm⁻³ or 1000 kg m⁻³.

3. A given quantity of a liquid is heated. Which of the following quantity will vary and how? (a) mass, (b) volume and (c) density

Answer:

When a given quantity of liquid is heated

(a) Mass : does not change.

(b) Volume: changes and increases with rise in temperature.

(c) Density : Changes and decreases.

Density = Mass / volume

4. Describe an experiment to determine the density of a liquid.

Answer:

To determine the density of a liquid $D = M / V$

We need to find (i) the vol. of liquid say milk, (ii) mass of liquid.

EXPERIMENT:

(i) To find the mass of milk:

wt. of empty 100 c.c beaker = M_1 g = 70 g (say)

Fill the beaker (half) with milk and weigh again= M_2 g = 116 g (say)

(ii) To find the vol. of milk:

Transfer this milk into measuring cylinder and note the volume $V = 40$ c.c (say)

$$\begin{aligned} \therefore \text{Density of milk} = D &= \frac{M}{V} = \frac{(M_2 - M_1)}{40 \text{ c.c}} \\ &= \frac{(116 - 70)}{40} = \frac{46}{40} = \frac{4.6}{4} = 1.15 \text{ g cm}^{-3} \end{aligned}$$

5. Explain the meaning of the statement 'relative density of aluminium is 2.7'

Answer:

The statement 'Relative density of aluminium is 2.7'.

A piece of aluminium of any volume has mass 2.7 times that of an equal volume of water. i.e. Aluminium is 2.7 times heavier than water.

6. The density of water is 1.0 g cm^{-3} . The density of iron is $7.8 \times 10^3 \text{ g cm}^{-3}$. The density of mercury is 13.6 g cm^{-3} .

Answer the following:

(a) Will a piece of iron float or sink in water ?

(b) Will a piece of iron float or sink in mercury ?

Answer:

Density of water 1.0 g cm^{-3}

(a) Density of piece of iron = $7.8 \times 10^3 \text{ g cm}^{-3}$

$$7.8 \times 10^{-3} = \frac{7.8}{1000} = 0.0078 \text{ g cm}^3 < 1.0 \text{ cm}^3$$

\therefore Density of piece of iron is less than density of water.

Hence, piece of iron will float in water.

(b) Density of piece of iron = 7.8×10^3

Density of mercury is $13.6 \times 10^3 \text{ g cm}^{-3}$

Since $7.8 \times 10^3 < 13.6 \times 10^3$

\therefore Density of piece of iron is LESS than density of mercury

\therefore Piece of iron will float in mercury

7. It is easier to swim in sea water than in river water. Explain the reason.

Answer:

Density of sea water is greater than density of river water, [because of impurities]

(i) In each case the weight of water displaced will be equal to the weight of the man.

\therefore Ratio of weight of sea water and river water displaced by man is 1: 1.

(ii) With smaller portion of man's body submerged in sea water, the wt. of sea water

displaced is equal to the total weight of body. While to displace the same weight of river water, a larger portion of the body will have to be submerged in water.

∴ It is easier for man to swim in sea water.

8. Icebergs floating on sea water are dangerous for ships. Explain the reason.

Answer:

Icebergs are very dangerous for ships as icebergs are huge masses of ice floating in sea [density of ice being 0.917 g cm^{-3}]

with about 9/10 portion below water and only 1/10 portion of it above surface of water.

9. What is a submarine? How can it be made to dive in water and come to the surface of water?

Answer:

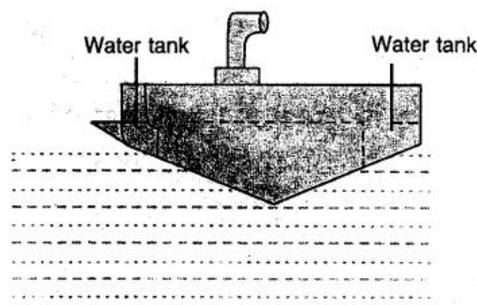
SUBMARINE: Submarine is a water-tight boat which can travel under water like a ship.

It is provided with water tanks. When submarine is to dive, water is filled in water tanks and it is made heavier and average density of submarine becomes greater than the density of sea water and it sinks. To make the submarine rise to the surface of water, water tanks are emptied and average density of submarine becomes less than the density of sea water and it rises to surface of water.

10. A balloon filled with hydrogen rises in air. Explain the reason.

Answer:

A balloon filled with hydrogen rises to a certain height as it displaces more wt. of air than wt. of balloon but as it rises higher density of air decreases there and upthrust becomes less and ultimately upthrust becomes equal to the weight of balloon and balloon stops rising further.



While submarine is underwater soldiers can see the enemy activities through periscope.

11. Name the S.I. unit of density. How is it related to g cm^{-3} ?

Answer:

S.I. unit of density is kg m^{-3} In C.GS. system unit of mass is g and unit of volume is cm^3 , so

CGS unit of density is g cm^{-3} (gram per cubic centimetre)

Relationship between S.I. and C.GS. units

$$1 \text{ kg m}^{-3} = \frac{1 \text{ kg}}{1 \text{ m}^3} = \frac{1000\text{g}}{(100 \text{ cm})^3}$$

$$= \frac{1}{1000} \text{ g cm}^{-3}$$

Thus,

$$1 \text{ kg m}^{-3} = 10^{-3} \text{ g. cm}^{-3}$$

$$\text{or } 1 \text{ g cm}^{-3} = 1000 \text{ kg m}^{-3}$$

12. Describe an experiment to determine the density of the material of a coin.

Answer:

Density = Mass / volume

To find the density of the material of a coin, we need to find its

- (i) Mass—by common beam balance and
- (ii) Its volume by measuring cylinder.

Measure the mass of coin.

EXPERIMENT - Let the mass of coin shown by beam balance = M (gram) = 50 g (say)

Measure the vol. of coin.

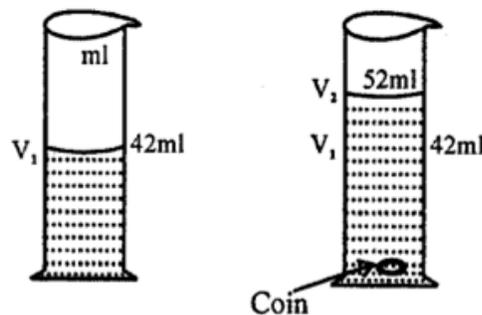
Initial volume of water = $V_1 = 40 \text{ ml}$ (say)

Final volume of water

When coin is added in the cylinder = $V_2 = 50 \text{ ml}$ (say)

Then vol. of coin = $V_2 - V_1 = 50 - 40 = 10 \text{ ml}$

$$\text{Density of material of coin} = D = \frac{M}{V} = \frac{50}{52 - 42} = \frac{50}{10} = 5 \text{ g cm}^{-3}$$



13. Define the term relative density of a substance.

Answer:

RELATIVE DENSITY: "is the ratio of density of a substance to the density of water at 4° C."

Or

RELATIVE DENSITY “is the ratio of mass of the substance to the mass of an equal volume of water at 4° C.”

14. Distinguish between density and relative density.

Answer:

Density	Relative density
(i) It is ratio of mass to volume. $D = \frac{\text{Mass}}{\text{Volume}} = \frac{M}{V}$ (ii) Units are g cm^{-3} or kg m^{-3} (iii) Density in $\text{kg m}^{-3} = \text{R.D} \times 1000$	(i) It is the ratio of density of substance to density of water. (ii) It is a pure quantity. It has no units. (iii) $\text{R.D} = \text{Density in } \text{g cm}^{-3}$ $\text{R.D} = \frac{\text{Density in } \text{kg m}^{-3}}{1000}$

15. Which of the following will sink or float on water? (Density of water = 1 g cm^{-3})

- (a) body A having density 500 kg m^{-3}
- (b) body B having density 2520 kg m^{-3}
- (c) body C having density 1100 kg m^{-3}
- (d) body D having density 0.85 g m^{-3}

Answer:

Density of water = 1 g cm^{-3}

(a) Density of body A = $500 \text{ kg m}^{-3} = 500 = 0.5 = 0.5 \text{ g cm}^{-3}$

Density of body A is less than density of water hence A will float on water

(b) Density of body B = $2520 \text{ kg m}^{-3} = 2520 \times 1/1000 = 2.52 \text{ g cm}^{-3}$

Density of body B is more than density of water and hence B will sink in water

(c) Density of body C = $1100 \text{ kg m}^{-3} = 1100 \times 1/1000 = 1.1 \text{ g cm}^{-3}$ is greater than water.

Hence, body C will sink in water.

(d) Density of body D = $0.85 \text{ g cm}^{-3} < 1.0 \text{ g cm}^{-3}$

Density of body D is less than the density of water hence body D will float on water