PHYSICAL QUANTITIES AND MEASUREMENT
NUMERICALS

Q.1: The density of air is 1.28 g litre^{-1}. Express it in :

a) g cm^{-3} b) kg m^{-3}

Solution:

a) Density of air = 1.28 g litre^{-1}

= $\frac{1.28}{1000}$ g cm^{-3}

= **0.00128 g cm^{-3}**

$\because$ 1 g litre^{-1} = $\frac{1}{1000}$ g cm^{-3} = 1 kg m^{-3}

b) Density of air = 1.28 g litre^{-1}

= **1.28 kg m^{-3}**

Q.2: The dimensions of a hall are 10 m x 7 m x 5 m. If the density of air is 1.11 kg m^{-3}, find the mass of the air in the hall.

Solution:

Length of hall, l = 10 m

Breadth of hall, b = 7 m

Height of hall, h = 5 m

Volume of hall, v = l x b x h

= 10 m x 7 m x 5 m

= **350 m^3**

Density of air = 1.11 kg m^{-3}

Mass of air in the hall = density x volume

= 1.11 kg m^{-3} x 350 m^3

= **388.5 kg**

Q.3: The density of Aluminium is 2.7 g cm^{-3}. Express it in kg m^{-3}.

Solution:

Density of Aluminium = 2.7 g cm^{-3}

= 2.7 x 1000 kg m^{-3}

= **2700 kg m^{-3}**

1 g cm^{-3} = 1000 kg m^{-3}

Q.4: The density of Alcohol is 600 kg m^{-3}. Express it in g cm^{-3}.

Solution:

Density of Alcohol = 600 kg m^{-3}

= $\frac{600kgm^{-3}}{1000}$

= **0.6 g cm^{-3}**

$\because$ 1 kg m^{-3} = $\frac{1}{1000}$ g cm^{-3}

Q.5: A piece of zinc of mass 438.6 g has a volume of 86 cm^3. Calculate the density of zinc.

Solution:

Mass of a piece of zinc = 438.6 g

Volume of a piece of zinc = 86 cm^3

Density of a piece of zinc = $\frac{mass}{volume}$

= $\frac{438.6g}{86cm^3}$

= **5.1 g cm^{-3}**

Q.6: A piece of wood mass 150 g has a volume of 200 cm^3. Find the density of wood in:

a) C.G.S. unit b) S.I. unit

Solution:

a) Mass of a piece of wood = 150 g

Volume of a piece of wood = 200 cm^3

Density (in C.G.S. unit) = $\frac{mass}{volume}$

= $\frac{150g}{200cm^3}$

= **0.75 g cm^{-3}**

b) Density (in C.G.S. unit) = 0.75 g cm^{-3}

Density (in S.I. unit) = 0.75 g cm^{-3} x 1000

= **750 kg m^{-3}**

1 g cm^{-3} = 1000 kg m^{-3}

Q.7: Calculate the volume of wood of mass 6000 kg if the density of wood is 0.8 g cm^{-3}.

Solution:

Mass of wood = 6000 kg

Density of wood = 0.8 g cm^{-3}

= 0.8 g cm^{-3} x 1000

= 800 kg m^{-3}

1 g cm^{-3} = 1000 kg m^{-3}

Volume of wood = $\frac{mass}{density}$

= $\frac{6000kg}{800kgm^{-3}}$

= **7.5 m^3**

Q.8: Calculate the density of a solid from the following data :

a) mass of solid = 72 g

b) Initial volume of water in measuring cylinder = 24 ml

c) Final volume of water when solid is completely immersed in water = 42 ml

Solution:

Mass of solid = 72 g

Initial volume of water in measuring cylinder, v_1 = 24 ml

Final volume of water when solid is completely immersed in water, v_2 = 42 ml

Volume of solid = $v_2 - v_1$

= 42 ml – 24 ml

= 18 ml

= 18 cm^3

1 ml = 1 cm^3

Density of solid = $\frac{mass}{volume}$

= $\frac{72g}{18cm^3}$

= 4 $g\ cm^{-3}$

Q.9: The mass of an empty density bottle is 21.8 g, when completely filled with water it is 41.8 g and when filled completely with liquid it is 40.6 g. Find :

a) the volume of the density bottle.

b) the relative density of liquid.

Solution:

Mass of an empty density bottle, m_1 = 21.8 g

Mass of density bottle + water, m_2 = 41.8 g

Mass of density bottle + liquid, m_3 = 40.6 g

$\therefore$ Mass of water, $m_2 - m_1$ = (41.8 – 21.8) g

= 20 g

$\therefore$ Mass of liquid, $m_3 - m_1$ = (40.6 – 21.8) g

= 18.8 g

a) Volume of the density bottle = $\frac{mass}{density}$

= $\frac{20g}{1gcm^3}$

Density of Water is 1 gcm^{-3} or 1000 kgm^{-3} at 4^0C

= 20 cm^3 or 20 ml.

b) Relative Density of liquid = (mass of liquid) ÷ (mass of equal volume of water)

$$= \frac{m_3 - m_1}{m_2 - m_1}$$

$$= \frac{18.8g}{20g}$$

= **0.94**

Q.10: Following the following observation, calculate the density and relative density of the brine solution. the volume of the density bottle.

Mass of empty density bottle = 22 g
Mass of bottle + water = 50 g
Mass of bottle + brine solution = 54 g

Solution:

Mass of an empty density bottle, m_1 = 22 g
Mass of density bottle + water, m_2 = 50 g
Mass of density bottle + brine solution, m_3 = 54 g
∴ Mass of water, $m_2 - m_1$ = (50 – 22) g
= 28 g
∴ Mass of brine solution, $m_3 - m_1$ = (54 – 22) g
= 32 g

∴ Volume of the density bottle/brine solution = $\frac{mass}{density}$

$$= \frac{28g}{1gcm^3}$$

= 28 cm^3 or 28 ml.

∴ Density of brine solution = $\frac{mass}{volume}$

$$= \frac{32g}{28cm^3}$$

= **1.14 g cm^{-3}**

∴ Relative Density of brine solution = (mass of liquid) ÷ (mass of equal volume of water)

$$= \frac{m_3 - m_1}{m_2 - m_1}$$

$$= \frac{32g}{28g}$$

= **1.14**

Q.11: **The mass of an empty density bottle is 30 g, it is 75 g when filled completely with water and 65 g when filled completely with a liquid it is 40.6 g. Find :**

a) the volume of the density bottle.

b) the density of liquid.

c) the relative density of liquid.

Solution:

Mass of an empty density bottle, m_1 = 30 g

Mass of water + density bottle, m_2 = 75 g

Mass of liquid + density bottle, m_3 = 65 g

$\therefore$ Mass of water, $m_2 - m_1$ = (75 – 30) g

= 45 g

$\therefore$ Mass of liquid, $m_3 - m_1$ = (65 – 30) g

= 35 g

a) Volume of the density bottle = $\frac{mass}{density}$

= $\frac{45g}{1gcm^3}$

= **45 cm^3 or 45 ml.**

b) Density of liquid = $\frac{mass}{volume}$

= $\frac{35g}{45cm^3}$

= **0.77 g cm^{-3}**

c) Relative Density of liquid = **(mass of liquid) ÷ (mass of equal volume of water)**

= $\frac{m_3 - m_1}{m_2 - m_1}$

= $\frac{35g}{45g}$

= **0.77**