PHYSICAL QUANTITY AND MEASUREMENT

physical quantity and measurement

B 1) Density of a substance is defined as "Mass per unit volumn".

2) S.I unit of density is $kg\,m^{-3}$. In CGS system unit of mass is g and unit of volum is cm^3 so CGS unit of density is $g\,cm^{-3}$.

Relationship:-

$$1\,kgm^{-3} = \frac{1\,kg}{1m^3} = \frac{1000g}{(100cm)^2} = \frac{1}{1000}\,gcm^{-3}$$

thus, $1\,kgm^{-3} = 10^{-3}\,gcm^{-3}$

or $1\,gcm^{-3} = 1000\,kgm^{-3}$

3) The statement mean 1 cubic centimeter volume of brass has mass of 8.4g.

4) Cork = 0.25

Water = 1.0

Iron = 7.8

Brass = 8.4

mercury = 13.6

5) As the temprature increases volumn of most of the liquid also increases and when the volumn increases density decreases. Similarly when temprature decrease, the volumn of most liquids decreases which increases the density.

6) when a given quantity of a liquid is heated -

mass = does not change

Volumn = changes and increases with the rise in temperature.

density = changes and decreases.

7 Aim :- Determine the density of the material of a coin.

Materials required :- measuring cylinder, coin, beam balance and thread.

Procedure :- Step 1 - The mass of the ~~given~~ coin must be measured using a beam balance.

Step 2 :- A measuring cylinder filled partly with water is taken.

Step 3 - The level of water should be noted.

Step 4 - Now the coin should be tied with a thread and lowered into the measuring cylinder ~~it~~ ~~shown~~ carefully.

Step 5 - Difference in volume $= (V_2 - V_1)$ = volumn

Step 6 - Then the density should be calculated.

$$\text{Density} = \frac{\text{Mass}}{\text{Volumn}} = \frac{M}{V} \text{ g cm}^{-3}$$

if $M = 75\text{g}$, $V = 10\text{cm}^3$, then.

$$\text{Density} = \frac{75}{10\text{cm}^3} = 7.5\text{g cm}^{-3}$$

Observation and conclusion :- The density of coin = 7.5g cm^{-3}

8 Aim :- Determine the density of a liquid using a density bottle.

Materials required :- density Bottle, any liquid, beam balance.

Procedure :- Step 1 - The bottle must be ~~washed~~ washed and dried and then the mass of empty bottle must be measured using a beam balance. Let the mass be M_1 g

Step 2 - Then bottle ~~se~~ must be filled with water and a-

gain measured. Let it be M_2 g

Step 3 - The bottle must be emptied and dried and then filled with the liquid given (say milk). Let the mass be M_3 g

Step 4 - The mass of water must be calculated and the mass of liquid must be calculated.
As its known that the mas of water contained in bottle gives the volumn of bottle.

Step 5 - So, Mass of liquid = $M_3 - M_1$ g
and volum of liquid = $M_2 - M_1$
So Let $M_1 = 30g$, $M_2 = 60g$, $M_3 = 54g$
∴ density of the liquid will be = $\frac{(M_3 - M_1)g}{(M_2 - M_1)cm^3}$

$$= \frac{54 - 30\,g}{60 - 30\,cm^2}$$

$$= \frac{24\,g}{30\,cm^2} = 0.8\,g\,cm^{-3}$$

Observation and conclusion:- The density of liquid a is $0.8\,g\,cm^{-3}$.

a Density bottle is a small ~~gas~~ glass bottle having a gas stopper at its neck. The bottle can store a fixed volumn of a liquid. The stopper has a narrow hole through it. ~~Th~~ When the bottle is filled with liquid and stopper is inserted, the exess liquid rises through the hole and drains out. Thus the bottle will contain the same volum of liquid each time when it is filled. It is used to determine the density of liquid.

10 Relative density is the ratio of the density of a substance to the density of water at 4°c.

11 The Relative density doesn't have a unit because it is the ratio of two dimensionally same quantity.

12 Density of a substance is defined as "Mass per unit volumn. whereas Relative density is the ratio of the density of a substance to the density of water at 4°c.

13 The statement means a piece of aluminium of any volumn has mass 2.7 times that of an equal volumn of water.

14 The density of an object determines whether it will float or sink in another substance. ~~At An object will float or sink in another subst-~~ ance. An of object will float if the density of a body is less than the density of liquid. An object will sink if the density of a body is more than the density it is placed in.

15 Cork floats on water as the density of cork is less than the density of water.

Iron nail sinks in water as the density of iron nail is more than the density of water.

16 a) Density of body 'a' : $500 g kg m^{-3} = 500 = 0.5 g cm^{-3}$.

b) Density of body 'a' is less than density of water hence body 'a' will float on water.

b) Desil Density of body 'b' : $2520 \times \frac{1}{1000} = 2.52 g cm^{-3}$

Density of body 'b' is more than the density of water so the body 'b' will sink.

c) Dns Density of body 'c' = $1100 kg m^{-3} \times \frac{1}{1000} = 1.1 g m^{-3}$

Density of body 'c' is more than density of water and hence the body 'b' will sink

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

Density of body 'd' is ~~more~~ less than density of water so the body 'd' will float

17 When any oleject displaces a weight of water equal to its own weight, it floats. This is called the law of flotation.

18 ~~a)~~ The density of iron is $7.8\ g\ cm^{-3}$

The density of water is $1.0\ g\ cm^{-3}$

The density of ~~water is~~ mercury is $13.6\ cm^{-3}$

a) The piece of iron will sink in water as the density of iron is more than density of water.

b) The piece of iron will ~~sink~~ float in ~~water~~ mercury as the density of of iron is less that the density of mercury

19 a) The ~~Boyant~~ Buoyant force is same in each one.

b) The liquid has the least density is ~~fig 'a'~~ liquid 'A'.

C) The liquid has the highest density is liquid 'C'

20 ~~An object will float if the buoyancy buoyant force exerted on it by the fluid balances its weight~~

20 The Archimedes principle states that the ~~bo~~ buoyant force is the weight of the fluid displaced. So, for a floating oleject on a liquid, the weight of the displaced liquid is the weight of the object.

21 ~~Flotation of ice in water~~: A piece of ~~w~~ ice floats on water because the density of ~~water is~~ ice is $0.9\ g\ cm^{-3}$ is less that the density of water which is $1.0\ g\ cm^{-3}$

22 Iron needle sinks in water, but a ship made of iron ~~float~~ floats on water. because weight of iron nail is more than the weight of water displaced by it ~~and~~ but the ~~ship~~ iron ship is made in such a way that it displaces more weight of water than its own weight ~~and~~ secondly the ship is hollow and the empty space contain air ~~th~~ which makes the average density of ship less ~~that that of~~ than that of water.

23 It is easier for a person to swim in sea water than in river water. The reason is that sea water contain salt and so ~~the~~ its density is more than the density of river water. The weight of the man gets ~~b~~ balanced by the less immersed part of his body in the sea water as compared to that of river water

24 Icebergs are huge masses of ice floating in the sea with about 9/10 portion of ice below seawater it becomes difficult for the sailor to estimate the size of the iceberg increasing the danger of the ships colliding in them.

25 A stone is easier to ~~&~~ lift in water because to buoyant force of the water act on the stone which counter balances the ~~weight~~ weight of the stone acting downward and this makes the stone lighter. In the air, the gravity ~~pulls~~ tries to pull the stone downward and hence we hence we require more force to lift up the stone.

26 Submarine is a water-tight boat which can travel underwater like a ship. It is provided with water tanks. When the submarine is to ~~to~~ dive, water is filled is water tanks, it is made he-

avier and average density of submarines becomes greater than the density of seawater and it sinks. To make the submarine rise to the surface of the water, water tanks are emptied. This ~~man~~ makes the submarine ~~rise to the surface of the water~~ become less than the density of seawater and it rises to surface.

27 Hydrogen's density and weight is less than that of air. A balloon filled with ~~de~~ hydrogen rises to a certain height ~~at~~ as it displaces more weight of air than the weight of balloon but as it rises higher density of air decreases and upthrust becomes less and ultimately upthrust becomes equal to the weight of balloon and balloon stop rising further.

C1 Density = 1.28 g litre^{-1}

$= \frac{1.28}{1000} = 0.00128\ g\,cm^{-3}$

$= \frac{1.28}{1000} \times 1000 = 1.28\ kg\,m^{-3}$

2. The dimention of hall = 10m x 7m x 5m

$= 350\ m^3$

Mass = volumn x density (1.11)

$= 350 \times 1.11 = 388.5\ kg$

3 The density = $2.7\ g/cm^3$

in $kg/m^3 = \frac{27 \times 1000}{10} = 2700\ kg/m^3$

4 The density = $600\ kg\,m^{-3} = \frac{600}{1000} = 0.60\ g\,cm^{-3}$

9. Density of water is $1\ g\ cm^3$

a) ∴ volumn of density Bottle = weight of water in grams completely filling the bottle.

Volumn of density bottle.

mass of empty density bottle = 21.8 g

mass of ~~bbbb~~ bottle + water = 41.8 g

~~∴ mas~~ $= M_2 - M_1$

$= 41.8 - 21.8$

$= 20\ g$

But 1g of water has volume = 1cc

∴ Volumn of bottle = volumn of water = ~~20 cc~~ = 20 cc = 20 ml

b) Mass of 20 cc of liquid = 40.6 - 21.8

= 18.8 g

Mass of 20 cc of water = 20g

$R.D = \frac{\text{Mass of 20 cc of liquid}}{\text{Mass of 20 cc of water}} = \frac{18.8}{20} = \frac{1.88}{2} = 0.94.$

10 Mass of empty bottle(M_1) = 22g

Mass of bottle + water(M_2) = 50g

Mass of bottle + ~~Bbbbb~~ Brine solution (M_3) = 54g

Mass of water = $M_2 - M_1 = 28\ g$

Mass of Brine solution = $M_3 - M_1 = 32\ g$

Density = $\frac{32}{28} = 1.14\ g/cm^2$

11 a) Mass of empty density bottle = M_1 = 30g

Mass of Bottle + water = 75 g

mass of water = 75 - 30 = 45 g

Volumn of density bottle = mass of water = 45 g/ml

b) ~~Mass of empty density bottle = 30 g~~

~~Mass of bottle + water = 75 g~~

Mass of liquid x = ~~75~~ 65 - 30 g = 35 g

$$D = \frac{\text{Mass of liquid}}{\text{mass of water}} = \frac{35}{45} = 0.75\ g/cm^3$$

$$R.D = \frac{\text{Mass of 45 cc of ~~dis~~ liquid}}{\text{Mass of 45 cc of water}} = \frac{35}{45} = \frac{7}{9}$$