HW 8/8/2021

Test Yourself

A. 1) a. Equal volumes of two different substances have equal masses. False

b. The density of a piece of brass will change by changing its size or shape. False

c. The density of a liquid decreases with increase in its temperature. True

d. Relative density of water is 1.0. True

e. Relative density of a substance is expressed in $g\,cm^{-3}$. False

f. When a body is immersed in a liquid, the buoyant force experienced by the body is equal to the volume of the liquid displaced by it. False

g. A body experiences the same buoyant force while floating in water or alcohol. True

h. A body experiences the same buoyant force when it floats or sinks in water. False

i. A body floats in a liquid when its weight becomes equal to the

weight of the liquid displaced by its submerged part. True

j. A body while floating, sinks deeper in a liquid of low density than in a liquid of high density. True

2) a. 1 kg is the mass of 1000 ml of water at 4°C.

b. Mass = density × volume

c. The S.I unit of density is $kg\ m^{-3}$

d. Density of water is 1000 $kg\ m^{-3}$.

e. $1\ g\ cm^{-3} = 1000\ kg\ m^{-3}$.

f. The density of a body which sinks in water is more than 1000 $kg\ m^{-3}$.

g. A body sinks in a liquid A, but floats in a liquid B. The density of liquid A is less than the density of liquid B.

h. A body X sinks in water, but a body Y floats on water. The density of the body X is more than the density of body Y.

i. The buoyant force experienced by a body when floating in salt-water is

equal that when floating in pure water.

3)

Colum A		Colum B
a) $Kg\ m^{-3}$	—	iv) density
b) No unit	—	i) relative density
c) Relative density	—	v) density bottle
d) Iron	—	ii) sinks in alcohol
e) Wood	—	iii) floats on water

4) a) The correct relation is
ii. Mass = Density × Volume

b) The relative density of alcohol is 0.8. Its density is
ii. $800 Kg\ m^{-3}$

c) A block of density $0.8\ gcm^{-3}$ has a volume of $60\ cm^3$. The mass of block is
iii) 48g

d) The density of aluminium is $2.7g\ cm^{-3}$ and that of brass $8.4g\ cm^{-3}$. The correct statement is:

ii. The mass of a certain volume of brass is more than the mass of equal volume of aluminium.

f) The correct statement is :
iii. The buoyant force on a body is equal to the weight of the liquid displaced by it.

g) A piece of wood floats on water. The buoyant force on wood will be :
iii. equal to the weight of the wood piece.

h) The weight of a body is more than the buoyant force experienced by it, due to a liquid. The body will :
i. sink

B) 1) Define the term density of a substance.

Ans- Density of substance is defined as "Mass per Unit Volume".

$$\text{Density} = \frac{\text{Mass of substance}}{\text{Volume of the substance}}$$

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

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

Ans- S.I unit of density is $kg\ m^{-3}$. In C.G.S. system 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.G.S units

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

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

Thus,

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

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

3) The density of brass is $8.4\ g\ cm^{-3}$. What do you mean by this statement?

Ans- This statement means one cubic centimetre volume of brass has mass of 8.4g.

4) Arrange the following substances in order of their increasing density:
Iron, Cork, Brass, Water, Mercury.

Ans- Cork, Water, Iron, Brass, Mercury

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

Ans- 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 blow 4°C. In other words, the density of water is maximum at 4°C equal to $1 g\ cm^3$ or $1000\ Kg\ m^3$.

14) How does the density of a body and that of a liquid determine whether the body will float or sink into that liquid?

Ans- If the density of a body is LESS than the density of LIQUID, the body will FLOAT on the surface of liquid. If the density of a body is MORE than the density of liquid, the body will SINK in a liquid.

15) A cork piece floats on water surface while an iron nail sinks in it. Explain the reason.

Ans- Cork floats on water means density of cork is less than density of water. Iron nail sinks in water means density of iron nail is more than density of water.

16) Which of the following will sink or float on water?

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

a) Body A having density $500 kg\ m^{-3}$.

Density of body A = $500 kg\ m^{-3}$

= $0.5 g\ cm^{-3}$

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

b) Body B having density $2520 kg\ m^{-3}$

Density of body B = $2520 kg\ m^{-3}$

= $2520 \times 1/1000 = 2.52 g\ cm^{-3}$.

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

c) Body C having density $1100 kg\ m^{-3}$.

Density of body C = $1100 kg\ m^{-3}$

= $1100 \times 1/1000 = 1.1 g\ cm^{-3}$

This is greater than water.

Hence, body C will sink in water.

d) Body D having density $0.85 g\ cm^{-3}$.

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

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

17) State the law of floatation?

Ans- When a body floats in a liquid, the weight of the liquid displaced by its immersed part is equal to the total weight of the body. This is the law of floatation, i.e. while floating. weight of the floating body = weight of the liquid displaced by its immersed part.

20) For a floating body, how is its weight related to the buoyant force?

Ans- When a body floats in a liquid. The weight of the liquid displaced by its immersed part is equal to the total weight of the body.

21) Why does a piece of ice float on water?

Ans- Floatation of ice on water: Density of $0.9 g cm^{-3}$ is less than density of water $1 g cm^{-3}$. Hence, ice floats on water.

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

Ans- Density of sea water is greater than density of river water.

* In each case the weight of water displaced will be equal to the weight of the man.

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

* With smaller portion of man's body submerged in sea water, the weight 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.

25) Explain why it is easier to lift a stone under water than in air.

Ans- In water, the stone experience a buoyant force which counter balances the weight of the stone acting downward and this makes the stone lighter and thus easier to lift the stone in water.

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

Ans- A ballon filled with hydrogen rises to a certain height as it displaces more weight of air than weight 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.

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

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

Ans- a) The density of air is 1.28g/litre
It is in $g cm^{-3} = \frac{1.28}{1000} = 0.00128 g cm^{-3}$

b) 1.28g g/litre $= \frac{1.28}{1000} \times 1000 = 1.28 kg m^{-3}$

2) The dimensions of a hall are 10m X 7m X 5m. If the density of air is $1.11 kg m^{-3}$ find the mass of air in the hall.

Ans- The dimensions of hall 10m X 7m X 5m
i.e. $350 m^3$ = Volume
Density $= 1.11 kg\ m^{-3}$

3) The density of aluminium is $2.7 g cm^{-3}$. Express it in $kg\ m^{-3}$.

Ans- Density of aluminium $= 2.7 g/cm^3$

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

4) The density of alcohol is $600 kg m^{-3}$. Express it in $g\ cm^{-3}$.

Ans- Density of alcohol $= 600 kg/m^3$

$In\ g/cm^3 = \frac{600}{1000} = 0.60 g/cm^{-3}$

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

Ans- Mass of Zinc = 438.6g

Volume = 86 cm^3

Density = $\frac{M}{V} = \frac{438.6}{86} = 5.1 g/cm^{-3}$

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

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

a) Mass of wood = 150g

Volume of wood = 200 cm^3

Density = $\frac{M}{V} = \frac{150}{200} = 0.75 g/cm^3$

b) In S.I. system = 0.75×1000

= 750 kg/m^{-3}

7) Calculate the volume of wood of mass 6000 kg if the density of wood is 0.8 $g\,cm^{-3}$.

Mass = 6000kg

D = 0.8 g/cm^3

= $0.8 g/cm^{-3} \times 1000 = 800 kg/m^{-3}$

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

Volume $= \frac{M}{D} = \frac{6000}{800} = 7.5\ m^3$

8) Calculate the density of a solid from the following data:

a) Mass of solid = 72g

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

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

Mass of solid = 72g

Initial volume of water = V_1 = 24ml

Final volume of water = V_2 = 42ml

Volume of solid = $V_2 - V_1 = 42 - 24 = 18\ cm^3$

$D = \frac{M}{V} = \frac{72}{18} = 4.0\ g\ cm^{-3}$

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

a) The volume of density bottle

b) The relative density of liquid

a) Volume of density bottle:
Mass of empty density bottle = M_1 = 21.8g
Mass + water = M_2 = 41.8g
Mass of water completely fill the density bottle = $M_2 - M_1$ = 41.8 - 21.8 = 20g (1g of water = 1cc)
∴ Volume of density bottle = 20cc = 20ml
b) Mass of 20 ml of liquid = 40.6 - 21.8 = 18.8g
Mass of water = 20g

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

$$= \frac{1.88}{20} = 0.94$$

10) From the following observations, calculate the density and relative density of a brine solution.
Mass of empty density bottle = 22g
Mass of bottle + water = 50g
Mass of bottle + brine solution = 54g

Ans- Mass of empty bottle = M_1 = 22g
Mass of bottle + water = M_2 = 50g
Mass + brine + brine solution = M_3 = 54g
Mass of water = $M_2 - M_1$ = 50 - 22 = 28g
Mass of brine solution = $M_3 - M_1$ = 54 - 22 = 32g

$$\text{Density of brine} = \frac{32}{28} = 1.14\ g/cm^{-3}$$

Relative density $= \frac{32}{28} = 1.14$

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

a) Volume of density bottle.

Mass of water $= 75 - 30 = 45g$

Volume of density bottle = Mass of water

$= 45g = 45ml$

b) Density of liquid.

Mass of liquid $= 65 - 30 = 35g$

$D = \frac{\text{Mass of liquid}}{\text{Mass of water}} = \frac{35}{45} = 0.77 g/cm^{-3}$

c) Relative density of liquid.

Mass of water $= 75 - 30 = 45g$

Volume of water $= 45cc$

Mass of liquid $= 65 - 30 = 35g$

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

$= \frac{35^{7}}{45_{9}} = \frac{7}{9} = 0.77$

X