Exercises

A. Objective questions.

1. Write true or false.

a) False
b) False
c) True
d) True
e) False
f) False
g) True
h) False
i) True
j) True

2. Fill in blanks.

a) 1000 ml
b) Volume
c) kgm^{-3}
d) 1000
e) 1000
f) more
g) less
h) more
i) equal
j) zero

3. Match the following:

a) kgm^{-3} = density

b) no unit - [redacted] relative density

c) relative density - density bottle

d) iron - sinks in alcohol

e) wood - floats on water

4. Select the correct alternative.

a) mass = Density X volume

b) 800 kgm^{-3}

c) 48g

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

e) the density bottle will store 25 ml of any liquid in it.

f) The buoyant force on a body is equal to weight of liquid displaced by it.

g) equal to weight of wood piece.

h) Sink.

B. Short/Long Answer Questions.

1. Define term density of a substance.

Ans - Density of a substance is defined as 'mass per unit volume'.

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

2. Name SI unit of density. How is it related to $g\,cm^{-3}$?

Ans- SI unit of density is $kg\,m^{-3}$. CGS unit of density is $g\,cm^{-3}$

Relationship between SI and CGS units,

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

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

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

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

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

4. Arrange following substances in order of their increasing density: Iron, cork, brass, water, mercury.

Ans- cork, water, iron, brass, mercury.

5. How does density of a liquid/gas vary with temperature?

Ans- The density of water can also be affected by temperature. When comparing two samples of water with same salinity or mass, the water sample with higher temperature will have greater volume, and it will therefore be less dense.

6. A given quantity of a liquid is heated. which of

the following quantity will vary and how?

a) mass: does not change.

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

c) density: changes & decreases. $D = \frac{m}{V}$.

7. Describe an experiment to determine density of material of a coin.

Ans- Experiment - Let the mass of coin shown by beam balance = m (gram) = 50 g (say)

Vol. of coin

= Initial volume of water = V_1 = 40 ml (say)

Final Vol. of water

when coin is added in cylinder = V_2 = 50 ml (say)

Vol. of coin = $V_2 - V_1 = 50 - 40 = 10$ ml

D of material of coin = $D = \frac{m}{V} = \frac{50}{52-42} = \frac{50}{10}$

$= 5\ g\,cm^{-3}$

8. Describe an experiment to determine density of liquid.

Ans- Experiment -

a) mass of milk: wt. of empty 100 c.c beaker

$= M_1\ g = 70\ g$ (say)

Fill beaker (half) with milk and weight again

$= M_2\ g = 116\ g$ (say)

b) Vol. of milk: Transfer this milk to measuring cylinder and note Volume V = 40 c.c (say)

$$D = \frac{m}{V} = \frac{(m_2 - m_1)}{40\,c.c} = \frac{116 - 70}{40} = \frac{46}{40} = \frac{4.6}{4}$$
$$= 1.15\,g\,cm^{-3}$$

~~4. Which densit~~

9. What is a density bottle? How is it used to find density of a liquid?

Ans- Density bottle is a small glass bottle having a glass stopper at its neck. It is used to determine density of a liquid.

10. Define the term relative density of a substance.

Ans- It is the ratio of density of a substance to the density of water at 4°C.

11. What is the unit of relative density?

Ans- No units since it is a pure ratio.

12. Distinguish between density and relative density.

Ans- Density:

* Ratio of mass to volume. $D = \frac{m}{V}$
* Units are $g\,cm^{-3}$ or $kg\,m^{-3}$
* density in $kg\,m^{-3}$ = RD × 1000

Relative density

* Ratio of density of substance to density of water.

* It is a pure quantity and has no units.
* RD = Density in $g\ cm^{-3}$

RD = $\frac{\text{Density in } kg\ m^{-3}}{1000}$

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

Ans- 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.

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

Ans- If density of a body is less than density of liquid, the body will float on surface of liquid. If density of a body is more than 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 piece 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 / float on water?

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

Ans- D. of body A = 500 $kg\ m^{-3}$ = 500 × 0.5 = 0.5 $g\ cm^{-3}$

Body A will float on water.

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

Ans- D of Body B = 2520 kg m^{-3} = 2520 × 1/1000 = 2.52 g cm^{-3}

Body B will sink in water.

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

Ans- D of Body C = 1100 kg m^{-3} = 1100 × 1/1000 = 1.1 g cm^{-3}

Body C will sink in water.

d) Body D having density 0.85 gcm $^{-3}$

Ans- D of Body D = 0.85 g cm^{-3} < 1.0 g cm^{-3}

Body D will float on water.

17. What is law of floatation?

Ans- When a body floats in liquid, weight of liquid displaced by its immersed part = total weight of body is the law of floatation. Weight of floating body = weight of liquid displaced by its immersed part.

18. The density of water is 1.0 g cm^{-3}. Density of iron is 7.8 × 10^{-3} g cm^{-3}. Density of mercury is 13.6 g cm^{-3}.

a) Will a piece of iron float/sink in water?

Ans- D of iron = 7.8 × 10^{-3} g cm^{-3} = 0.0078 g cm^{3}

< 1.0 g cm^{3}

piece of iron will float in water.

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

Ans- D of mercury = 13.6 × 10^{-3} g cm^{-3}

D of iron = 7.8 × 10^{-3}

Piece of iron will float in mercury.

19. The diagram show a body floating in 3 different liquids. A, B, C at different levels.

a) In which liquid does the body experience greatest buoyant force?

Ans- Buoyant force is same in each case as the wt. of body is same in each case. Buoyant force = weight of liquid displaced by immersed part of body which balances wt. of the body.

b) Which liquid has least density?

Ans- Liquid A has least density as body immersed maximum.

c) Which liquid has highest density?

Ans- Liquid C has highest density as body immersed least.

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

Ans- When a body floats in liquid. The ~~total~~ wt. of the body = the weight of liquid displaced by its immersed part.

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

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

22. Explain why an iron needle sinks in water, but a ship made of iron floats on water.

Ans- Density of iron > density of water. weight of iron nail is more than wt. of water displaced by it and nail sinks. Iron ship is made in such a way that it displaces more wt. of water than its own weight.

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

Ans- Seawater has salt that increases its density while river water does not have salt. Sea water has more buoyant force than in river water. It is easier to swim in sea water than in river water.

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

Ans- Icebergs are dangerous for ships because it has huge masses of ice floating in sea with about 9/10 portion below water & only 1/10 portion of it above surface of water.

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

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

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

Ans- Submarine is a water tight boat which can travel under water like a ship. It relies on unique tanks that can be filled with water or air to adjust buoyancy. The tanks are filled with air to return to the surface.

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

Ans- 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 wt. of balloon and balloon stops rising further.

C. Numericals

1. The density of air is 1.28 g/l. Express it in:

a) g cm^3

= 1.28/1000 = 0.00128 g cm^{-3}

b) kg m

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

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

Ans- $10m \times 7m \times 5m = V_{350}\ m^3$

D of air $= 1.11\ kg\ m^{-3}$

$M = D \times V_{350} \times 1.11 = 388.5\ kg$

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

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

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

Ans- $D = \frac{m}{V} = \frac{438.6}{86} = 5.1\ g/cm^3$

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

a) CGS unit

$= D = \frac{m}{V} = \frac{150}{200} = 0.75\ g/cm^3$

b) SI unit

$= 0.75 \times 1000 = 750\ kg/m^3$

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

$= D = 0.8\ g/cm^3 = 0.8 \times 1000 = 800\ kg/m^3$

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

8. Calculate density of solid from following data:

Mass of solid = 72 g, initial vol. of water in measuring cylinder = 24 ml

Final vol. of water when solid is completely immersed in water = 42 ml.

Vol. 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 21.8 g, when filled completely with water is 41.8 g, when filled completely with liquid it is 40.6 g. Find:

a) Vol. of density bottle

= mass of water filling density bottle $= m_2 - m_1$

$= 41.8 - 21.8$

$= 20g$

Vol. of bottle = Vol. of water = 20 c.c. = 20 ml

b) R.D. of liquid

= mass of 20 c.c. of liquid $= 40.6 - 21.8 = 18.8\ g$

mass of 20 c.c. of water $= 20g$

$RD = \frac{18.8}{20} = \frac{1.88}{2} = 0.94$

10. Calculate D and RD of a brine solution. mass of empty D bottle $= 22g$, mass of bottle + water $= 50g$, mass of bottle + brine solution $= 54g$

Ans-

Mass of water $= m_2 - m_1 = 50 - 22 = 28g$

Mass of brine solution $= m_3 - m_1 = 54 - 22 = 32g$

D. of brine solution $= \frac{32}{28} = 1.14\ g/cm^3$

11. The mass of an empty density bottle is 30 g. It is 75 g when filled completely with water and 65 g when fil

= Mass of water $= m_2 - m_1 = 75 - 30 = 45\ g$

= Vol. of density bottle $= 45\ g$

= Mass of liquid $= m_3 - m_1 = 65 - 30 = 35\ g$

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

= R.D. of liquid $= \frac{35}{45} = \frac{7}{9} = 0.77$