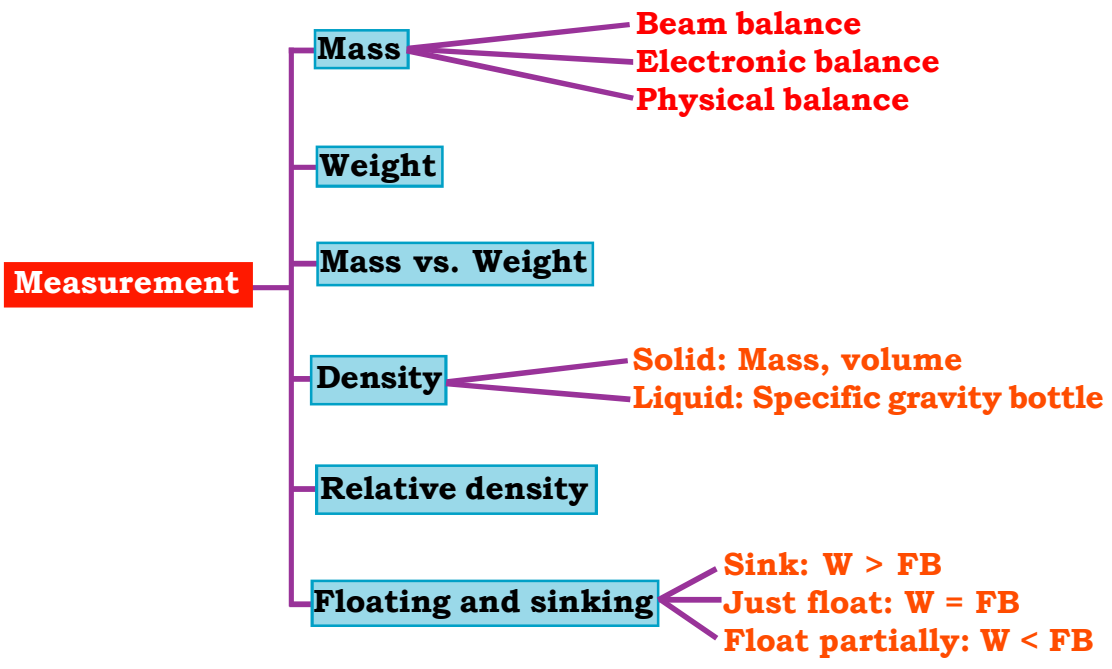
1 MEASUREMENT

Isaac Newton (January 4, 1643 to March 31, 1727) was a physicist and mathematician who developed the principles of modern physics, including the laws of motion, and is credited as one of the great minds of the 17th century Scientific Revolution. In 1687, he published his most acclaimed work, Philosophiae Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy), which has been called the single most influential book on physics. In 1705, he was knighted by Queen Anne of England, making him Sir Isaac Newton.

CONCEPT MAP



Concept 1

Measurement:

A measurement is the action of measuring something, or some amount of stuff. So it is important to measure certain things right, distance, time, and accuracy are all great things to measure. By measuring these things or in other words, by taking these measurements we can better understand the world around us. Measurements can also allow us to make decisions based on the outcome of the measurement. By this reasoning measurements are extremely important because they shape the way we think and interact every day.

Mass:

- Mass is the quantity of matter which a body contains. This is the same wherever the body is.
- There are three states of matter: solid, liquid and gas - all of these contain atoms and/or molecules that make up the mass of the object.

Unit: Kilograms (kg) in the SI system.

Constant: Mass remains the same everywhere, whether on Earth, the Moon, or in space.

Measured by: A beam balance or an electronic balance.

Knowledge Box

Measurement is the key to understanding the universe! It helps us quantify everything—from the size of an atom to the distance between galaxies.

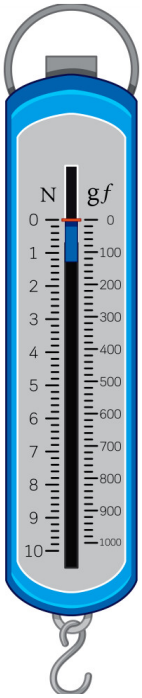
Example: If my mass was 65 kg. This would be true wherever I went in the universe. Just because I travelled to the moon wouldn't make the number of atoms and molecules in my body change... it would be the same... just as my dress-size would! My mass would remain at 65 kg.

Misconception :

Misconception: Bigger objects always have greater measurements!
Correction: Measurement depends on what you're measuring! A cotton ball may be bigger than a metal nail but weighs much less!

Mass Always Stays the Same!!

Weight:



- The force that acts on the mass of an object because of gravity is called its weight.
- Weight is the force of gravity acting on a mass that is positioned in a gravitational field. This changes with the strength of the gravitational field.
- There is an equation that links mass to weight in a gravitational field:

Formula: Weight=Mass × Gravity

$$w = mg$$

w = the weight (in newton)

m = the mass of the object (in kilogram)

g = the gravitational field strength at the position where the mass is placed.

Unit: Newtons (N).

Changes with location: Weight depends on gravitational acceleration, which varies from planet to planet.

Measured by: A spring balance.

- On Earth g = 9.8 m/s^2. Therefore, my weight is 9.8 x 65 = 637 Newtons.
- This is only true while I stay on Earth.

On the moon, I would be very light and jumping would be very easy. This is because g = 1.67 m/s^2. Therefore my weight on the moon is 1.67 × 65 = 108.55 Newtons. I would weigh a sixth of what I did on Earth, but it wouldn't mean I was any thinner.. I'd still have all those atoms and molecules that make up my mass!

Fun Facts

Did you know that the **heaviest** living thing on Earth is *not* an elephant or a blue whale? It's actually a tree! 🌳
The **Pando Tree** in Utah, USA, weighs around **6,000 tonnes!**

Difference Between Mass and Weight:

Aspect	Mass	Weight
Definition	Amount of matter in an object.	Gravitational force acting on an object
Symbol	M	W or F_a
Formula	-(mass is intrinsic)	W = m × g (mass × gravity)
Unit(SI)	Kilogram (kg)	Newton (N)
Measurement Tool	Beam balance or electronic balance	Spring balance
Constant or Variable	Constant everywhere in the universe	Changes depending on gravity
Gravity's Effect	Unaffected by gravity	Directly depends on gravitational pull
Example	A 5 kg object is 5 kg everywhere.	The 5 kg object weight 49 N on Earth, but nearly about 8 N only on the Moon.

In short:

- **Mass** tells you how much matter something has.
- **Weight** tells you how strongly gravity is pulling on that matter.

Examples:

Joey weighs 28 kgs

A bag of 5 kgs of apples

Difference between mass and weight

An object's **mass** is the **quantity of matter** in that object.

For an object of 1 kg
Mass on earth = 1 kg
Mass in space = 1kg
Mass on moon = 1kg

An object's **weight** is how hard **gravity is pulling on it.**

For an object of 1 kg
Weight on earth = 1 kg
Weight in space = 0kg
Weight on moon = 0.0166 kg

CLASSROOM DISCUSSION QUESTIONS CDQ 01

1. What is the fundamental difference between mass and weight?

(A) Mass is measured in newtons, while weight is measured in kilograms

(B) Mass changes depending on location, while weight remains constant

(C) Mass is the same everywhere, while weight varies depending on the gravitational field

(D) None of the above

2. Which of the following statements accurately describes mass?

(A) Mass is the force exerted on an object due to gravity

(B) Mass is the same on Earth and the Moon

(C) Mass is measured in newtons

(D) Mass varies depending on the strength of the gravitational field

3. What is the equation that links mass to weight in a gravitational field?

(A) $w = mv$ (B) $w = mg$

(C) $w = kv$ (D) $w = mg^2$

4. What is the gravitational field strength on Earth typically denoted by?

(A) g=9.8 N/kg (B) g=6.67 N/kg

(C) g=10 N/kg (D) g=1.67 N/kg

5. On Earth, what would be the weight of an object with a mass of 50 kg? ($g = 10 m/s^2$)

(A) 50 N (B) 500 N

(C) 5 N (D) 10 N

6. How does weight change when an object is taken to the Moon?

(A) Weight increases

(B) Weight decreases

(C) Weight remains the same

(D) Weight becomes zero

7. What is the primary factor influencing weight?

(A) Volume (B) Density

(C) Mass (D) Height

8. Why does an object weigh less on the Moon compared to Earth?

(A) The gravitational field on the Moon is weaker than on Earth

(B) The gravitational field on the Moon is stronger than on Earth

(C) The mass of the object changes on the Moon

(D) The gravitational constant on the Moon is higher than on Earth

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

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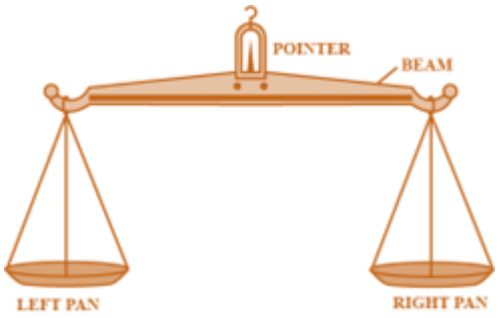
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

Concept 2

Measurement of Mass:

Beam balance:

We measure mass of an object by comparing it with a standard mass. Normally, we use a beam balance to measure mass. The commonly used beam balance is shown in Figure. This balance consists of a horizontal beam supported at its centre with two similar pans suspended at equal distances from the centre of the beam.



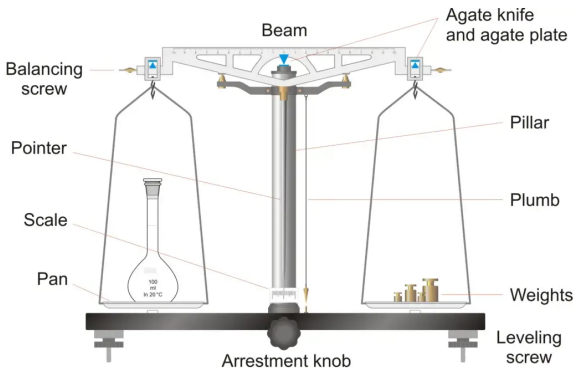
Beam balance

Standard weight stones

The object to be weighed is placed on one of the pans. The standard weights are then placed on the other pan till both the pans are balanced and the beam is horizontal once again. The mass of the object is equal to the sum total of the standard weights used.

Physical Balance:

Physical Balance and its Parts: A physical balance is used when a greater degree of accuracy is required. For example, for finding the mass of a piece of gold or diamond. Also a physical balance is used in school laboratories for finding relative-density, masses etc. A physical balance is enclosed in a glass case so that air current does not affect the measurement.



The main parts of a physical balance are:

1. Levelling screws 2. Plumb line 3. Pans

4. Pointer 5. Arrestment knob 6. Balancing screws

Levelling screws: Adjustment of these screws make the base of the balance horizontal.

Plumb line: Indicates whether the balance is horizontal. In the horizontal position of the balance, the plumb line remains aligned with the pointed end of the knob fixed to the pillar.

Pans: The object to be weighed is placed in the left pan. The weights are placed in the right pan with the help of forceps.

When the balance is not in use, the pillar supporting the beam is lowered and the pans rest on wooden supports.

Pointer: When the balance is in the horizontal position, the pointer remains on the central zero mark of the scale.

Arrestment knob: Turning the knob raises the beam. The pans are also raised from their support and the pointer swings equally on either side of the central zero mark on the scale.

The object and weights are then placed in their respective pans.

Balancing screws: Adjustment of the balancing screws ensures that the pointer swings equally on either side of the zero mark.

For measuring mass of an object in the laboratory you are provided with a weight box which contains masses of 1g, 2g, 5g, 10g, 20g, 50g and 100g. For more accurate measurements, milligram weights are also provided.

A physical weight box.

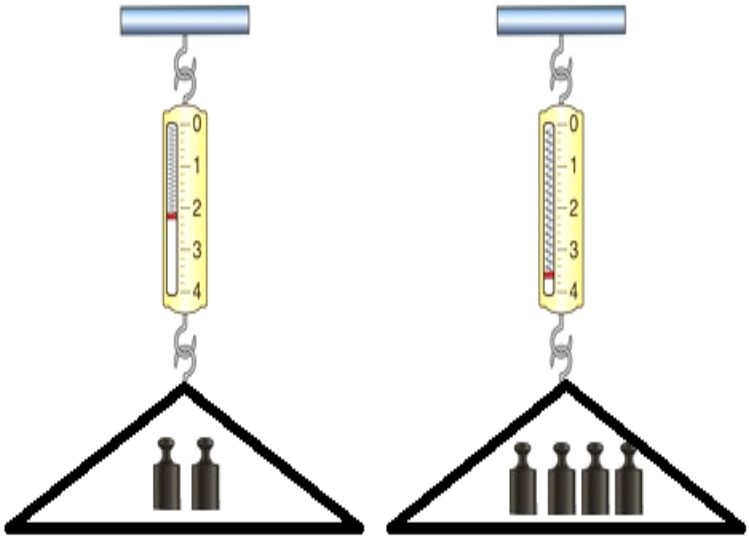
A body whose mas is to be measured is kept in the left hand pan of the balance and equivalent weights are placed on right hand pan so that the beam should be horizontal. Total weights in the right pan are counted and this is the mass of the given body.

Spring balance:

A spring balance is used to measure the weight of a body at a given place. It consists of a steel spring enclosed in a metallic case. The body to be weighed is attached to the lower end of the spring balance. A pointer is attached to the lower end of the spring balance. It rest again the scale graduated on the case.

Misconception :

Misconception: You can measure weight using a weighing scale!
Correction: A weighing scale measures mass! A spring balance measures weight!



Measurement of weight of an object with a spring balance:

i) We check that when there is no load on the pan, the pointer reads zero.

ii) When the body to be weighed is placed on the pan, the spring gets elongated due to the weight of the body.

iii) The position of the pointer on the scale thus gives the weight of the body.

Tast to the student

Guess the Mass"

Take three mystery objects (e.g., a chalk piece, an eraser, and a notebook).

Ask students to guess their mass before weighing them on a digital scale.

Compare their predictions with the actual readings!

CLASSROOM DISCUSSION QUESTIONS CDQ 02

1. **Which of the following is used for measuring mass with high accuracy in school laboratories?**
   (A) Spring balance
   (B) Physical balance
   (C) Beam balance
   (D) None of these
2. **What is the function of the levelling screws in a physical balance?**
   (A) To measure the mass of an object
   (B) To ensure the pointer is at the zero mark
   (C) To make the base of the balance horizontal
   (D) To adjust the weights in the pans
3. **What is the purpose of the plumb line in a physical balance?**
   (A) To measure small masses
   (B) To indicate whether the balance is horizontal
   (C) To support the pans
   (D) To adjust the weights
4. **In a physical balance, what does the adjustment knob do?**
   (A) Raises the beam and pans from their support
   (B) Adjusts the plumb line
   (C) Balances the screws
   (D) Measures the weight directly
5. **What is the role of the balancing screws in a physical balance?**
   (A) To measure the mass of objects
   (B) To align the plumb line
   (C) To ensure the pointer swings equally on either side of the zero mark
   (D) To support the pans
6. **How is the mass of an object determined using a beam balance?**
   (A) By comparing it with a standard mass
   (B) By using the adjustment knob
   (C) By reading the pointer's position
   (D) By elongating a spring
7. **What should be checked first when measuring weight with a spring balance?**
   (A) The mass of the weights
   (B) The horizontal position of the balance
   (C) That the pointer reads zero with no load
   (D) The elongation of the spring
8. **What happens to the spring in a spring balance when a body is placed on the pan?**
   (A) It contracts
   (B) It remains the same
   (C) It elongates
   (D) It measures the mass directly

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

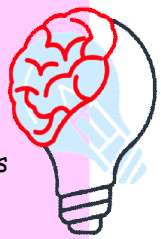
Concept 3

Density:

Objects of the same size may have different masses, and objects of the same mass may have different sizes. This is because different kinds of material have different densities. Density is the property of a body that tells about the arrangement of molecules in a given material.

It is defined as mass per unit volume. If a body of mass M units has a volume of V units, then:

Knowledge Box



Density tells us how **"packed"** the matter in an object is. It is the **mass per unit volume** of a substance.

Denser objects feel "heavier" even if they are small. For example, a small iron cube is **denser** than a large sponge!

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} \Rightarrow D = \frac{M}{V}$$

The SI unit for density is kgm^{-3}

Its CGS unit is gcm^{-3}.

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

$\Rightarrow$ 1 CGS unit of density = 1000 SI units of density

If the density of water in the CGS system is $1gcm^{-3}$, then it is $1000\ kgm^{-3}$ in SI system.

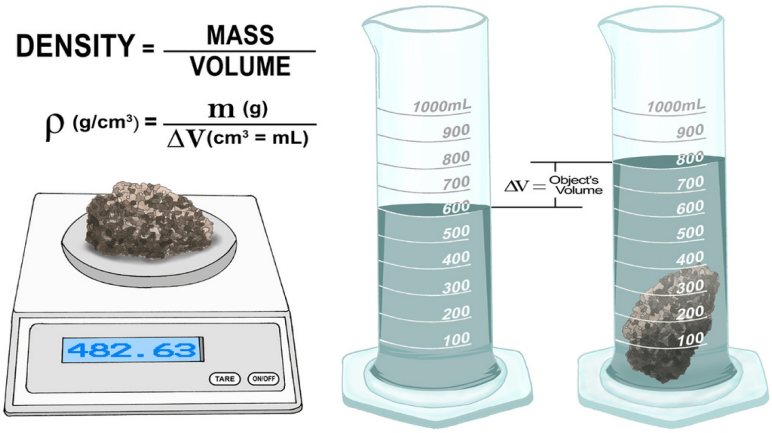
The density of an object can be found experimentally by measuring its mass and volume. Its mass can be measured with a physical balance, while its volume can be measured using a measuring cylinder. The density can be calculated on the basis of these two quantities. A specific gravity bottle can be used to find the density of a liquid.

Determination of Density of a Solid by Using a Measuring Cylinder:

To find the density of a solid its mass and volume are required. The mass (M) of the solid is determined using a physical balance. To find the volume of the solid, a measuring cylinder with a fixed volume of water is taken and the volume of water is noted. Let the volume of water be V_1. The solid is tied to a string and is lowered into the measuring cylinder such that it is completely immersed in water. The new level of

water (V_2) is noted. The difference in the levels of water $V = V_2 - V_1$ gives the volume of the solid. Knowing the mass and volume of the solid, the density of the solid can be determined using the formula $D = \frac{M}{V}$.

DETERMINATION OF UNKNOWN DENSITY



Determination of Density of a Liquid Using a Specific Gravity Bottle:

The specific gravity bottle or the density bottle is a small glass bottle having a close fitting ground glass stopper at its neck. The stopper has a small capillary tube.

When the bottle is completely filled with a liquid, excess liquid rises through the capillary tube and drains out, which ensures that equal volumes of different liquids fill the bottle.

First, a clean empty density bottle with stopper is weighed in a physical balance and its mass (m_1) is determined. Then it is filled with distilled water and the stopper is inserted. The bottle is wiped from outside so that it is dry. Its mass (m_2) is measured using a physical balance. Next, the water is poured off and the bottle is dried. Now the bottle is filled with the given liquid and its mass is measured (m_3). The density of the liquid is calculated as follows:

Misconception :

Misconception: Bigger objects always have more density!
Correction: Density is not about size; it's about mass per unit volume. A small metal ball can have more density than a big cotton pillow!

Mass of empty bottle = m_1

Mass of empty bottle + water = m_2

Mass of empty bottle + liquid = m_3

Mass of only water = $m_2 - m_1$

Volume of 1 g of water = 1 cm^3

Volume of water = $(m_2 - m_1)$ cm^3

Volume of liquid = Volume of water = $(m_2 - m_1)$ cm^3

Mass of only liquid = $m_3 - m_1$

Density of liquid

= Mass of liquid/Volume of liquid = $m_3 - m_1/(m_2 - m_1)$.

This will be in g/cm^3.

The density of liquids and gases changes with change in temperature. With the rise in temperature, the density decreases and vice versa. The convection currents in liquids and gases are formed due to the decrease in their density with the rise in temperature.

Relative density:

The density of a substance is compared with the density of water, which gives a number called the relative density of the substance.

$$\text{Relative density of a substance} = \frac{\text{density of a substance}}{\text{density of water}}$$

It is just a number, with no unit.

Let us consider the density of iron is 7,800 kg/m^3.

$$\text{Then, The Relative density of iron} = \frac{7800}{1000} = 7.8$$

It means that a certain volume of iron has 7.8 times the mass of the same volume of water.

Determination of Relative Density of a Liquid:

The relative density of a liquid is determined by using a relative density bottle. It is a small bottle made of glass. It has a stopper with a fine hole. This bottle is used for finding the mass of equal volumes of liquids.

Density Bottles

CLASSROOM DISCUSSION QUESTIONS CDQ 03

1. What is the formula for calculating density?

(A) Density = Volume/Mass

(B) Density = Mass/Volume

(C) Density = Mass × Volume

(D) Density = Mass – Volume

2. What is the SI unit of density?

(A) g cm^{-3} (B) kg m^{-3}

(C) g m^{-3} (D) kg cm^{-3}

3. How is the volume of a solid determined using a measuring cylinder?

(A) By weighing it on a physical balance

(B) By measuring the increase in water level when the solid is immersed

(C) By calculating its dimensions

(D) By using a specific gravity bottle

4. What happens to the density of liquids and gases with an increase in temperature?

(A) Density increases

(B) Density decreases

(C) Density remains the same

(D) Density fluctuates

5. What is the relative density of iron if its density is 7800kgm^{-3} and the density of water is 1000 kg m^{-3}?

(A) 7.8

(B) 78

(C) 0.78

(D) 780

6. Why is a specific gravity bottle used to determine the density of a liquid?

(A) It measures the mass directly

(B) It ensures equal volumes of different liquids fill the bottle

(C) It measures the volume directly

(D) It is more accurate than a physical balance

7. In the CGS system, what is the density of water?

(A) 1 g cm^{-3}

(B) 1000 kg m^{-3}

(C) 1 kg cm^{-3}

(D) 1000 g m^{-3}

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

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6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

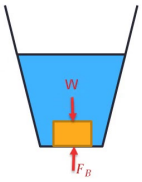
Concept 4

Floating and Sinking:

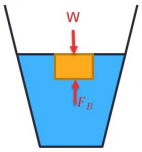
Why do Body Sink or Float In Liquids?

As we have seen above that if a piece of cork is placed in water, it rises and floats on the surface of water. But a piece of stone or a piece of iron sinks down in the water. However, the buoyant force acts on both the cork and the stone. Then why does the cork float and the stone sink down?

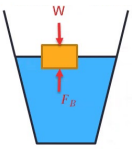
You known that when a body is immersed in a liquid, two forces act on it, first the weight of the body, say W, acting downward and the buoyant force, say F_B acting upwards. Hence, the body will move in the direction of the resultant of these two opposite forces. We have the following three conditions:



1. The weight of the body is greater than the buoyant force. If the weight W of the body is greater than the buoyant force F_B, the body will sink downward.



2. The weight of the body is equal to the buoyant force. If the weight W of the body is equal to the buoyant force F_B. The body will just float below the surface of the liquid as in Figure. In this case the weight of displaced fluid is equal to the weight of the body.



3. The weight of the body is less than buoyant force. If the weight W of the body is less than to the buoyant force F_B, that is upthrust is more than the weight of the body and hence, body will float partially immersed in the liquid.

Therefore, when

1. $W > F_B$ – The body sinks down.
2. $W = F_B$ – The body just floats below the surface of the liquid.
3. $W < F_B$ – The body floats partially immersed.

Principle of Floatation:

Thus, by the conditions of floating and sinking of a body we conclude that, a body will float in a liquid if the weight of the liquid displaced by it, is equal to its own weight. This is called the principle of floatation.

Suppose, a body of volume V is floating in a liquid of density d. Let the volume of displaced liquid is v and density of the body is D.

Thus, Mass of the body = Volume × Density = V×D

$\therefore$ Weight of the body = (mass × gravity) = (V×D)×g

Mass of displaced liquid = (volume × density) = (v×d)

Weight of displaced liquid = (mass × gravity) = (v×d) × g

Now, according to the principle of floatation,

Weight of the body = weight of the liquid displaced

$V \times D \times g = v \times d \times g$

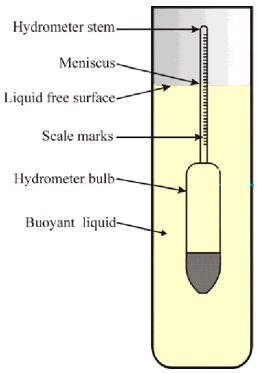
i.e., $V \times D = v \times d$

or $\frac{V}{v} = \frac{d}{D}$

$$\frac{\text{Volume of Floating Body}}{\text{Volume of Displaced Liquid}} = \frac{\text{Density of Liquid}}{\text{Density of Body}}$$

Some Applications of Principle of Floatation:

1. **Why ships keep afloat while a nail of iron sinks.** The volume of displaced seawater by a ship is more because the base of a ship is larger compared to a nail and, hence, the buoyant force increases and becomes equal to the weight of the ship. Thus, a ship floats in the seawater. In case of a nail, the volume of displaced water is less and, therefore, the upthrust is less than the weight of the nail. This is why a nail sinks down.



2. **Hydrometer.** The hydrometer is a device based on principle of floatation to read the density of the liquid. Some special hydrometers are designed to test whether a battery is fully charged or whether milk is pure or not.

3. **Icebergs float in seawater.** Large pieces or blocks of ice floating in seawater are called icebergs. The density of ice is about 0.9 g/cm^3, a little less than the density of seawater which is about 1.02g/cm^3, Therefore, an iceberg floats in seawater.

CLASSROOM DISCUSSION QUESTIONS CDQ 04

1. **What are the two forces acting on a body when it is immersed in a liquid?**
   (A) Weight and pressure
   (B) Buoyant force and pressure
   (C) Weight and buoyant force
   (D) Upthrust and pressure

2. **According to the principle of floatation, a body will float in a liquid if:**
   (A) The weight of the liquid displaced is greater than the weight of the body
   (B) The weight of the body is equal to the weight of the liquid displaced
   (C) The volume of the liquid displaced is equal to the volume of the body
   (D) The density of the liquid is greater than the density of the body

3. **Why does a piece of iron sink in water while a ship floats?**
   (A) The volume of water displaced by the ship is less than that displaced by the iron
   (B) The density of iron is less than the density of water
   (C) The buoyant force on the ship is greater due to its larger volume of displaced water
   (D) The weight of the ship is less than the weight of the iron

4. **What condition will make a body float just below the surface of the liquid?**
   (A) Weight of the body is greater than the buoyant force
   (B) Weight of the body is equal to the buoyant force
   (C) Weight of the body is less than the buoyant force
   (D) Weight of the body is zero

5. **An iceberg floats in seawater because:**
   (A) The density of ice is equal to the density of seawater
   (B) The density of ice is greater than the density of seawater
   (C) The density of ice is less than the density of seawater
   (D) The volume of seawater displaced by the iceberg is less than its volume

6. **Which of the following devices is based on the principle of floatation to read the density of a liquid?**
   (A) Barometer
   (B) Hydrometer
   (C) Thermometer
   (D) Hygrometer

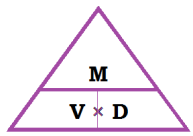
MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

C.D.F. (Concepts, Definitions and Formulae)

1. The mass is the measure of quantity of matter contained in the body.
2. The gravitational pull acting on a body is called weight of the body. OR

   The force with which the body is attracted towards the earth is called the weight of the body.
3. The SI unit of mass is kilogram (kg).
4. The SI unit of weight is newton (N).
5. Beam balance is used to measure mass of body.
6. A physical balance is used to measure the weight of a body at a given place.
7. The density of a substance is defined as the mass per unit volume of that substance.
8. The SI unit of density is kg/m^3.
9. The density of gases and liquids varies with the change in temperature.
10. The relative density (R.D.) of a substance is defined as the ratio of the density of the substance to the density of water.
11. The variations in the density of gases and liquids with temperature result convection currents in liquids and gases.
12. A hydrometer is a device used to measure density of liquids.
13. Density = $\frac{\text{mass}}{\text{volume}}$
14. Volume = $\frac{\text{mass}}{\text{density}}$



To find the one you want, cover up that letter in the triangle and the remaining letters show you the formula.

15. Mass = volume × density
16. Density of water = 1,000 kg/m^3 = 1 g/cm^3.
17. Relative density = $\frac{\text{density of substance}}{\text{demsity of water}} = \frac{\text{mass of substance}}{\text{mass of same volume of water}}$

Advanced Worksheet

LEVEL 1

Single Correct Answer Type (S.C.A.T.):

1. How is density defined?

(A) Volume per mass
(B) Mass per unit volume
(C) Mass per density
(D) Density per mass

2. The SI unit of mass is:

(A) Newton (B) Kilogram
(C) Newton/kg (D) Gram

3. The SI unit of weight is:

(A) Kilogram (B) Newton
(C) Newton metre (D) Kilometre

4. The SI unit of density is:

(A) Gram/metre^3
(B) Kilogram/metre^3
(C) Gram/cm^3
(D) Kg/cm^3

5. What instrument can be used to find the density of a liquid?

(A) Physical balance
(B) Measuring cylinder
(C) Specific gravity bottle
(D) Thermometer

6. What would be the weight of an object with mass 500 grams (Let g = 10m/s^2)

(A) 5N (B) 500N
(C) 50N (D) 0.5N

7. The process of heat transfer for that involves the movement of a liquid or a gas is called.

(A) Convection (B) Conduction
(C) Radiation (D) None

8. When a substance is heated its density:

(A) Increases
(B) Decreases
(C) Remains same
(D) None of these

9. When a gas is heated, it expands and becomes:

(A) Lighter (B) Heavier
(C) No change (D) None

10. The convection currents in air are formed due to:

(A) Variation in temperature
(B) Variation in mass
(C) Variation in weight
(D) None of these

11. The mass is a:

(A) Scalar quantity
(B) Vector quantity
(C) Absolute quantity
(D) None of these

12. The mass is measured by:

(A) A beam balance
(B) A spring balance
(C) Micro balance
(D) None of these

13. A hydrometer is used to measure:

(A) Density (B) Mass
(C) Weight (D) R.D.

14. We use a beam balance to measure:

(A) Weight (B) mass

(C) Force (D) Body

15. The density of aluminium is 2.7g/cm^3. Its density in kg/m^3 is:

(A) 27 kg/m^3

(B) 2700 kg/m^3

(C) 270 kg//m^3

(D) 27000 kg/m^3

16. To determine the density of a solid, we have to determine its:

(A) Mass and area

(B) Weight and area

(C) Mass and volume

(D) Weight and volume

17. When a fluid is heated, it expands and becomes:

(A) Lighter

(B) Heavier

(C) No change

(D) None of these

18. A body of density 5.34 g/cm^3 in water (density 1.0 g/cm^3) will:

(A) Float (B) Sink

(C) Rise (D) None

19. What happens to the spring in a spring balance when a body is placed on the pan?

(A) It contracts

(B) It remains the same

(C) It elongates

(D) It measures the mass directly

20. _____ Is a fundamental quantity which is measured using a beam balance.

(A) Mass (B) Density

(C) Weight (D) Amount

21. The _____ of a body reduces at very high altitudes.

(A) Length (B) Weight

(C) Mass (D) Force

22. The reference standard for a kilogram is the one kilogram mass of ____.

(A) A platinum - iridium alloy

(B) Brass

(C) A platinum - silver alloy

(D) A silver - iridium alloy

23. Which one is a scalar quantity amongst the following?

(A) Weight

(B) Mass

(C) Force

(D) Displacement

24. The instrument used for measuring weight is _____.

(A) Physical balance

(B) Micrometre

(C) Spring balance

(D) Beam balance

25. The physical factors to which density is related are _____.

(A) Mass and weight

(B) Mass and volume

(C) Weight and volume

(D) Mass and area

26. Water has maximum density at _____.

(A) 0^{0}C (B) 4^{0}C

(C) 100^{0}C (D) 10^{0}C

27. The factor on which the working of a spring balance depends is ____.

(A) Speed of wind

(B) Tides

(C) Earth's gravitational force

(D) Direction of wind

28. The units used to measure fundamental quantities are called _____ units.

(A) Fundamental (B) Basic
(C) Vector (D) Scientific

29. Kilogram-force is the non-SI unit of _____.

(A) Weight
(B) Density
(C) Energy
(D) Relative density

30. The symbol used to denote density is _____.

(A) Ω (B) α
(C) ρ (D) μ

LEVEL 2

Multi Correct Answer Type (M.C.A.T.):

31. Which of the following statements are TRUE?

(A) The quantity of matter contained in a body is called its mass

(B) The gravitational pull acting on a body is called its weight

(C) The mass remains constant at all places

(D) The SI Unit of mass is newton

32. Which of the following statements are FALSE?

(A) Physical balance is used to measure weight of a body

(B) The SI unit of relative density is g/cm^3

(C) The density of water is less than the density of wood

(D) The wood or a cork floats in water.

33. Which of the following statements are FALSE?

(A) Equal masses of iron and common salt have same volume

(B) The density of water is 1g/cm^3 in the SI unit

(C) The SI unit of relative density is g/cm^3

(D) Multiplying relative density by 100, we get density of the liquid in kg/m^3

Comprehension Passage Type (C.P.T.):

PASSAGE - I

A body in a liquid is acted upon by its weight and upward buoyant force. If weight is more, it sinks, if equal it floats; if buoyannt force is more, it floats partially. This is known as the principle of floatation.

34. What principle explains floating and sinking of an object in liquids.

(A) Newton's law

(B) Pascal's principle

(C) Principle of floatation

(D) None of the above

35. Which force acts upward on a body in a liquid?

(A) Weight

(B) Buoyant force

(C) Friction

(D) Air pressure

36. What happens if the weight of the body is greater than the buoyant force?

(A) It floats

(B) It sinks

(C) It stays in mid-air

(D) It evaporates

PASSAGE - II

Mass is the amount of matter in an object and is measured in kilograms (kg), while weight is the force of gravity acting on an object and is measured in newtons (N). Mass remains the same everywhere, but weight changes with gravity.

37. What is mass?

(A) The force of gravity acting on an object

(B) The quantity of matter in a body

(C) The density of an object

(D) The volume of an object

38. In which units is mass typically measured?

(A) Newtons (N)

(B) Kilograms (kg)

(C) Meters per second (m/s)

(D) Liters (L)

39. How does mass differ from weight?

(A) Mass changes with location, weight does not

(B) Weight changes with location, mass does not

(C) Mass is measured in newtons, weight is measured in kilograms

(D) Mass is a force, weight is a quantity of matter

LEVEL 3

Matrix Matching Type (M.M.T.):

SET-I

Column I

40. Mass

41. Weight

42. Relative Density

43. Purity Of Milk

Column II

(A) Hydrometer

(B) Physical balance

(C) Weighing Machine

(D) No units

(E) Spring balance

SET-II

Column I

44. Which instrument is used to measure mass?

45. What is the instrument used to measure weight?

46. What is the difference between mass and weight?

47. What principle explains why objects float or sink?

Column II

(A) Beam balance

(B) Spring balance

(C) Mass is a quantity of matter in the body, weight is a force of gravity on mass

(D) Principle of floatation

Assertion Reason Type (A.R.T.):

(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, Reason (R) is false.

(D) Assertion (A) is false, Reason (R) is true.

48. Assertion (A): Density is defined as the mass per unit volume of a substance.

Reason (R): The S.I unit of density is kg.

49. Assertion(A): The S.I unit of density is kg/m^3.

Reason(R): Density determines whether an object will float or sink in a fluid.

50. Assertion(A): Spring balance measures weight by the extension of a spring proportional to the applied force.

Reason(R): Pans attached to the spring balance provide support for the object being weighed.

51. Assertion(A): Objects float when the weight of the displaced fluid is equal to the weight of the object.

Reason(R): The principle of floatation explains why ships and boats can stay afloat in water.

52. Assertion(A): Relative density compares the density of a substance to the density of a reference substance.

Reason(R): Specific gravity bottle is used to measure the relative density of liquids.

Statement Type (S.T.):

(A) Both statements are true

(B) Both statements are false

(C) Statement I is true, but Statement II is false

(D) Statement I is false, but Statement II is true

53. Statement I: Mass is a scalar quantity.

Statement II: Weight is a measure of the gravitational force acting on an object.

54. Statement I: The SI unit of mass is the kilogram (kg).

Statement II: Mass and weight are two different quantities representing the same concept.

55. Statement I: A beam balance is a type of physical balance used to measure mass.

Statement II: Spring balance measures weight by utilizing Hooke's Law.

Integer Type Questions (I.T.Q.):

56. How many grams are in a kilogram?

57. On a spring balance, if an object weighs 500 grams, how many kilograms does it weight?

58. What is the mass of an object if it has a weight of 98 Newtons?

59. What is the volume of a liquid if it occupies 500 millilitres in a measuring cylinder?

60. If the density of an object is 2 grams per cubic centimetre, what is its mass if it occupies a volume of 10 cubic centimetres?

Comparing Mass and Weight

Objective:

To demonstrate the difference between mass and weight and understand how they are measured.

Materials Needed:

i) Spring balance or weighing scale
ii) Various objects with different masses (e.g., books, fruits, toys)
iii) Measuring tape or ruler
iv) Notebook and pen for recording observations

Procedure:

Begin by discussing the concepts of mass and weight with the participants, explaining that mass refers to the amount of matter in an object, while weight is the force exerted on an object due to gravity.

Set up the spring balance or weighing scale in a clear and accessible location.

Select one of the objects and measure its mass using the spring balance or weighing scale. Record the mass in grams or kilograms.

Use the measuring tape or ruler to measure the dimensions (length, width, and height) of the object. Record these measurements.

Calculate the volume of the object by multiplying its length, width, and height.

Discuss the concept of density with the participants, explaining that density is the mass per unit volume of an object.

Calculate the density of the object by dividing its mass by its volume. Record this value.

Repeat steps 3-7 for several other objects with different masses.

Discuss the differences observed in the measurements of mass, weight, and density for the various objects.

Ask the participants to predict the weight of each object on the moon, where gravity is weaker than on Earth.

Conclude the experiment by emphasizing the difference between mass and weight and the importance of understanding these concepts in scientific measurements.

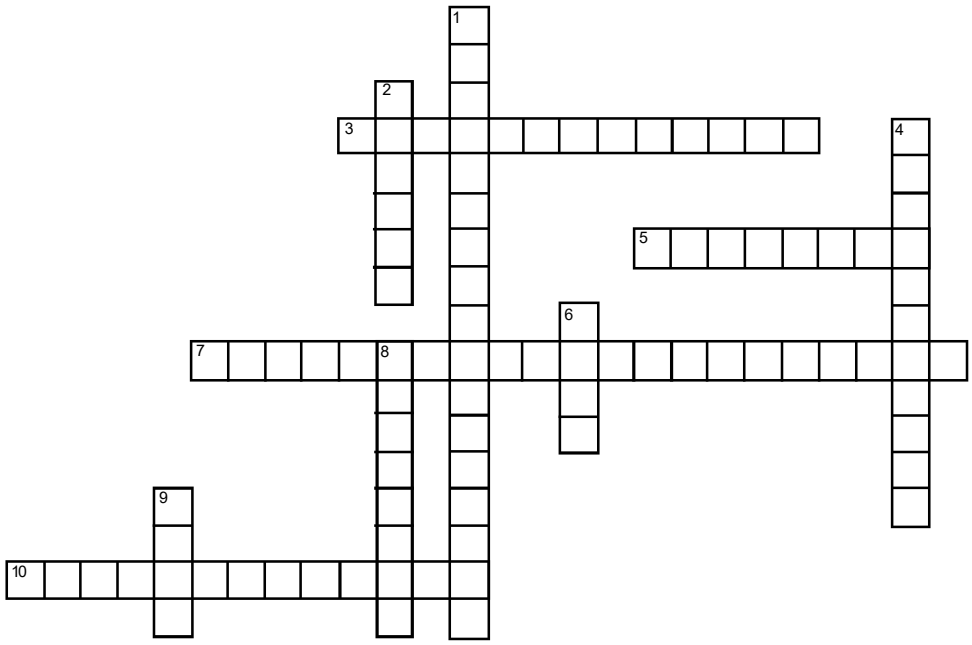
Note:

Ensure safety precautions are followed, especially when handling heavy objects or using measuring tools.

Measurement Mania

Exploring Mass, Weight, and Density

Test Your Knowledge with this Fun Crossword Puzzle!



ACROSS

3. Container to measure liquid volume

5. Unit of measurement for mass

7. An instrument to compare densities

10. Tool to measure weight

DOWN

1. Measurement tool for liquids

2. Force exerted on an object due togravity

4. Device to measure mass

6. The amount of matter in an object

8. What objects do in fluids based ontheir density

9. The parts of a balance where objectsare placed