1 Measurement

In this chapter, you will learn about:

- mass and weight
- difference between mass and weight
- beam balance and spring balance
- density
- determining density of solids
- relative density
- determining relative density of liquids
- floating and sinking of a substance
- variation of density of gases and liquids with temperature
- convection currents

Introduction

In physics, you take measurements of many different lengths. The length of a piece of wire, the height of liquid in a tube and the distance moved by an object are some examples. In Class 6, you have already learned about the meaning of measurement, importance of measurement, need for standard units and basic measurements. In this chapter, you will learn about mass, weight and their differences, instruments used to measure mass and weight, and density.

Mass and weight

Most of the people find weight and mass similar. But in physics, these are two totally different concepts.

Key definition

Mass of a body is the quantity of matter present in a body regardless of its volume or any force acting on it.

The SI unit of mass is kilogram and it is denoted by kg. Mass of any given substance is a constant quantity and does not change with the change in position or location. Mass is measured by using a physical balance or a beam balance.

Weight of a body is the magnitude of force acting on the body due to gravitation, i.e., the gravitational pull acting on the body.

Key definition

Weight is the force exerted on an object due to gravitation.

The definition itself concludes that weight is not constant, but changes according to the gravitational force acting on the body. The weight is generally measured in kilogram-force (kgf) or gram-force (gf). SI unit of weight is newton (N). Weight is measured with the help of a spring balance. Table 1.1 shows differences between mass and weight.

Do you know that gravitational force on the Moon is one-sixth of the gravitational force on the Earth? The gravitational pull exerted on the body on the Moon is six times less than the gravitational pull exerted on the body when it is on the Earth. Thus, the weight of a person on the Moon becomes one-sixth of his/her weight on the Earth. But mass on the Moon remains same as it does not depend upon gravitational force. In fact, mass is a constant quantity, it does not change with change in position or location.

Key point

Mass is a constant quantity, whereas weight depends upon the gravitational pull acting on the body.

Table 1.1 Differences between mass and weight

Mass	Weight
It is the amount of matter present in a body.	It is the magnitude of force acting on a body due to gravitation.
It is a constant quantity and does not change with change in position or location of body.	It is not constant and depends upon acceleration due to gravity and changes from place to place.
Its SI unit is kilogram (kg).	Its SI unit is newton (N).
It is measured using physical balance or beam balance.	It is measured using a spring balance.
It can never be zero.	It can be zero if no force of gravity is acting on the body.

FACT! Your weight in space will be zero.

Measurement of mass

You have already learnt that beam balance and physical balance are used to measure mass of a body. Let us study about them in detail.

Beam balance

Mass of an object is measured by comparing it with some standard mass. These masses are known as **weights** (please note that these weights are different from the term 'weight' you have learnt earlier in this chapter). You might have seen a beam balance at some grocery shop (Figure 1.1). Beam balance consists of a straight rod of metal. This metal rod is supported at its centre with the help of an iron loop. Two pans of equal masses are suspended at the rod's ends at equal distances. The pans are suspended with the help of strings or iron chains of equal length and mass. A pointer is fixed at the centre of the beam between the iron loop. When both the pans are empty or loaded with equal mass, the metal rod is horizontal and the pointer points vertically up, towards the centre of the iron loop.

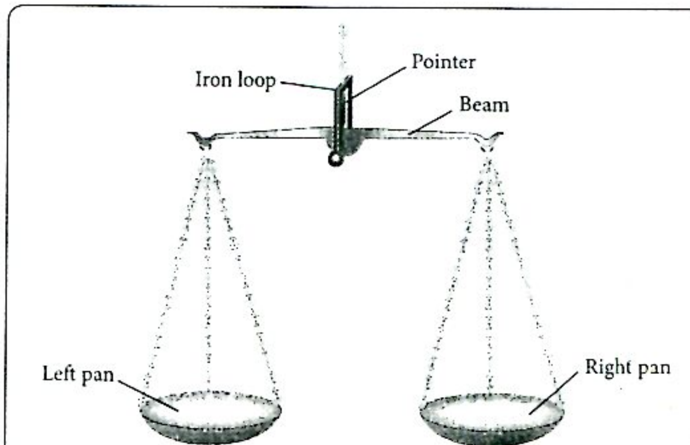


Figure 1.1 Beam balance

To measure the mass of an object, it is kept on one pan of the beam balance and known masses are kept on the other pan. The known masses are adjusted in the pan till the pointer points vertically up. Then the values of known masses are added up to find out the mass of the object.

Conditions to find accurate measurement are as follows.

- Both the pans should have same mass.
- Pans should be suspended at equal distance from the centre of the beam.
- When nothing is placed on both the pans, beam should be horizontal and pointer should point vertically upward.

Physical balance

Physical balance is used in laboratories or jewellery shops. They can accurately measure the mass up to a milligram. It works on the same principle as that of beam balance. Figure 1.2 shows a physical balance.

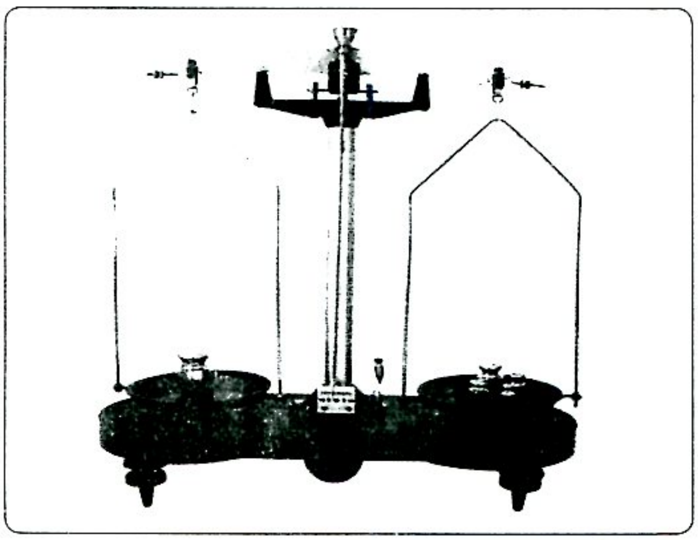


Figure 1.2 Physical balance

Measurement of weight

Weight of an object is measured by using a spring balance. It utilises the relationship between the applied load and the deformation of the spring. A spring balance consists of a spring fixed on one end and the other end is attached to a hook where an object can be suspended to know its weight. Let us study about the spring balance in detail.

Spring balance

A spring balance is used to measure the weight of an object (Figure 1.3). It works on the principle that a spring will extend the same amount as that of weight of the object. If more weight is attached to the spring, it will stretch more. It consists of a spring which is enclosed in a metallic case. This metallic case has a slit through which spring is visible. The upper end of the spring is fixed and a pointer is attached to its lower end. The metallic case also has a scale next to the slit.

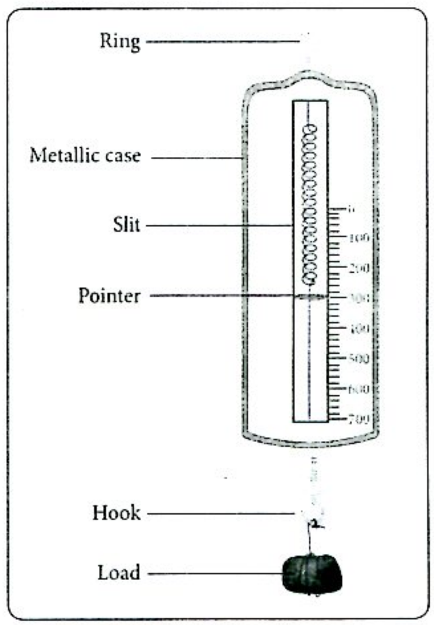


Figure 1.3 Spring balance

At the end of the scale a hook is present where an object can be attached to measure its weight. When there is no weight on the hook the pointer points to 0 kgf. If some weight is attached to the hook then spring will extend and the pointer will point to some value on the scale. This value will be the weight of the object attached to the hook.

Conditions to find accurate measurement using a spring balance are as follows.

- When no weight is attached to the hook, the pointer should point to 0 kgf.
- Read the position of the pointer through the scale accurately.

Checkpoint

A Answer the following questions.

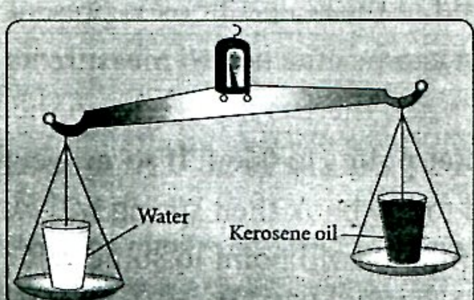
1. What is mass?
2. Define weight.
3. What are the SI units of mass and weight?
4. How are mass and weight measured?
5. Which quantity is measured using a spring balance?
6. How is a spring balance different from a beam balance?
7. What is the principle of a spring balance?

Density

Before learning about density, let us first perform an activity.

Activity 1.1

Take two glasses having same size and mass. Fill one glass with water and other with kerosene oil. Remember that equal amount of water and kerosene oil should be kept in the respective glasses. Now using a beam balance compare the masses of both the glasses. What do you observe? Which of the glass has more mass? Can you explain why do both the liquids have different masses when equal volume has been taken?



Comparison of masses having equal volume

In the Activity 1.1, you have noticed that mass of water is more than the mass of kerosene oil. But the volume of both water and kerosene oil is same. Can you explain this? Let us revise the definition of mass now. You have already studied in this chapter that mass is the amount of matter contained in an object. So you can now conclude that matter contained in one glass of water is more than that of one glass of kerosene oil. This is because the matter in water is more closely packed than in kerosene oil. Hence, water is denser than kerosene oil.

Key point

If more mass is packed into the same volume then the substance becomes denser.

Now can you tell that will two objects having same mass have same volume? To find out the answer let us compare volumes of equal masses of two different substances, such as iron and cotton.

Activity 1.2

Take 1 kg of iron and 1 kg of cotton. Do both of them have same volume?

No, 1 kg of cotton occupies more space than that of 1 kg of iron. Hence, it can be concluded that objects having equal masses need not have equal volumes.

Key definition

Density of an object is defined as the mass per unit volume of that object.

If V is the volume of an object and M is its mass then density D of the object is calculated by the following formula.

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

The SI unit of density is kg/m³ or kg m⁻³ and CGS unit is g/cm³ or g cm⁻³. So from the above formula you can conclude that if you know the mass and the volume of a substance, you can easily calculate the density of that substance. Table 1.2 shows the density of some common substances.

Table 1.2 The density of some common substances

Substance	Density in kg/m³
Ice	920
Water (fresh water)	1000
Air	1.20
Steel	7900
Aluminium	2700
Copper	8940
Gold	19320
Iron	7800
Lead	11350

Density of aluminium is 2700 kg/m³, i.e., 2700 kg of aluminium occupies volume of 1 m³. Now let us do some numericals.

Example 1

Find the density of a substance whose mass is 1000 kg and occupies 5 m³ of space.

Solution

$$\text{Mass} = 1000 \text{ kg}$$

$$\text{Volume} = 5 \text{ m}^3$$

$$\text{Density} = ?$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{1000}{5} = 200 \text{ kg/m}^3$$

Example 2

Calculate the volume of 2700 kg of aluminium, given that the density of aluminium is 2.7 g/cm³.

Solution

$$\text{Mass} = 2700 \text{ kg}$$

$$\text{Density} = 2.7 \text{ g/m}^3 = 2700 \text{ kg/m}^3$$

$$\text{Volume} = ?$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$= \frac{2700}{2700} = 1 \text{ m}^3$$

Determining the density of a solid

As you already know that to determine the density of a substance you need to know the mass and the volume of that substance. For regular solids, such as a cube or cuboid, the volume can be determined by using the formulae, (side)³ and $l \times b \times h$, respectively. Then density is calculated by the formula, $D = \frac{M}{V}$.

For an irregularly shaped solid, such as a pebble, you cannot use any formula to determine volume. This is because they do not have definite sides. Its volume can be easily determined by the displacement method, using a liquid. Water is poured into a measuring cylinder until the cylinder is about half full. The volume of the water is measured (say V_1) and then the pebble (irregular shaped solid) tied with thread is lowered gently into it (Figure 1.4). When the pebble is completely immersed the volume of the water is read again (say V_2). The volume of the pebble is the amount of water displaced by the pebble, found by subtracting the first reading from the second ($V_2 - V_1$). Now the density of the pebble is the amount of water displaced by the pebble calculated by the following formula.

$$D = \frac{M}{V_2 - V_1}$$

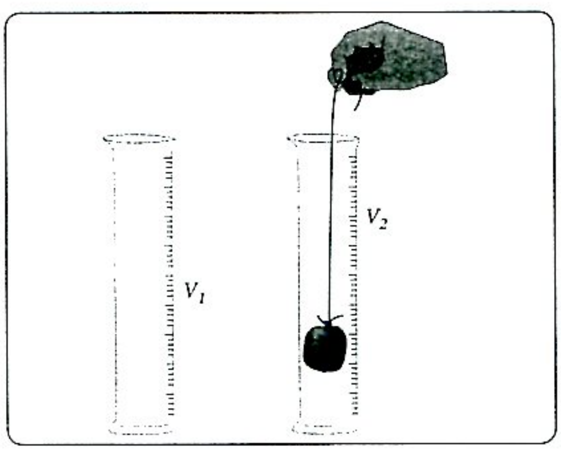


Figure 1.4 Measuring volume of an irregular-shaped solid

Relative density

Relative density (RD) is the density of the substance with respect to the density of water. Relative density is also known as **specific gravity**.

$$\text{RD} = \frac{\text{Density of substance}}{\text{Density of water at 4 °C}}$$

Density of aluminium is 2700 kg/m^3 and that of water is 1000 kg/m^3. Hence the relative density of aluminium is 2.7. Remember that relative density has no unit. Actual density of a substance can be easily calculated by multiplying the relative density of the substance with the density of water, i.e.,

$$\text{Density of a substance} = \text{RD of the substance} \times 1000\ \text{kg/m}^3$$

Determination of relative density of a liquid

Relative density of a liquid can be determined by using a relative density bottle which is also known as **specific gravity bottle.** It is a small glass bottle with a stopper which has a fine hole (Figure 1.5). Firstly, weigh the specific gravity bottle using a physical balance. Remember bottle should be empty and dry. Suppose the mass of the empty bottle is M_1. Now fill the bottle completely with water and apply stopper to the bottle. As soon as stopper is inserted excess water overflow through the hole present in the stopper. This ensures that specific gravity bottle always contains same volume of liquid. Now weigh the bottle

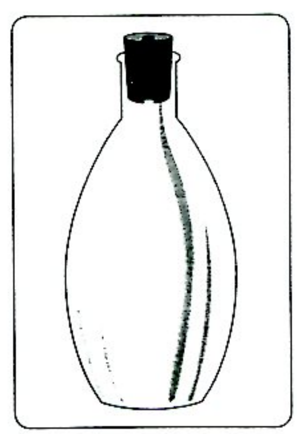


Figure 1.5 Specific gravity bottle

again. Note down the mass of the bottle completely filled with water, say M_2. Now again fill the bottle with some liquid other than water whose relative density has to be determined. Again insert the stopper and let the excess of liquid overflow through the hole present in the stopper. Now again weigh the liquid. Now note down the mass of the liquid, say M_3.

You already know that,

$$RD = \frac{\text{Density of substance}}{\text{Density of water at 4 °C}}$$

If the volume of the liquid and water is same,

$$RD = \frac{\text{Mass of substance}}{\text{Mass of water}}$$

Mass of liquid = Mass of bottle filled with liquid – Mass of empty bottle

$$= M_3 - M_1$$

Mass of water = Mass of bottle filled with water – Mass of empty bottle

$$= M_2 - M_1$$

Thus,

$$RD = \frac{M_3 - M_1}{M_2 - M_1}$$

Example 3

A relative density bottle weighs 25 g. When completely filled with water it weighs 55 g. When filled with a liquid it weighs 49 g. Find the relative density of the liquid.

Solution

$$M_1 = 25 \text{ g}$$

$$M_2 = 55 \text{ g}$$

$$M_3 = 49 \text{ g}$$

Mass of liquid = $M_3 - M_1 = 49 - 25 = 24$ g

Mass of water = $M_2 - M_1 = 55 - 25 = 30$ g

$$RD = \frac{\text{Mass of liquid}}{\text{Mass of water}}$$

$$RD = \frac{24\text{ g}}{30\text{ g}} = 0.8$$

Floating and sinking

When a piece of wood is placed in water the wood floats. This is due to the difference in the densities of the wood and the water. When two substances are put together the less dense substance floats above the denser substance. For example, put some water in a container and now put some oil in the same container. You will see that oil starts floating on the water and does not mix with water. This happens because density of oil is less than that of water and hence it floats over the water.

Key point

When a substance is placed over a liquid, it will float only if the density of the substance is less than the liquid, otherwise it will sink.

In case of water, substances with densities less than 1 g cm^{-3} will float on water. Whereas, substances with densities more than 1 g cm^{-3} will sink in water. Many substances, such as wood, vegetable oil, petrol, kerosene oil, etc., which are less dense than water float on water. Whereas substances, such as iron, aluminium, steel, stone, etc., which are denser than the water sink in the water.

FACT!

Ice floats on water because the density of ice is less than that of water.

Variation of density of gases and liquids with temperature

Generally all the substances expand on heating. (You will study about the expansion of substances on heating in Chapter 4.) You already know that density of a substance is mass per unit volume. If volume of the substance increases, then its density will decrease. All substances expand on heating and contract on cooling. In case of solids, the increase in volume is very small so solids do not show much variation in density on heating. But this is not the case with liquids and gases. Liquids and gases both expand to a great amount. This results in significant change in volume. Volume increases when the gases and liquids are heated up and decreases when the gases and liquids are cooled down. Hence, this concludes that density of gases and liquids decreases when they are heated up and increases when they are cooled down.

Key point

When a liquid or a gas is heated its density decreases and when cooled, its density increases.

A fluid expands on absorbing heat. On expansion its density decreases and it becomes light. Hence, hot fluid being less dense and lighter rises up and cold fluid being comparatively more dense and heavy moves down to take the hot fluid's place (Figure 1.6). This process is called **convection**. You will study more about this process in Chapter 4. It keeps repeating over and over again and sets up **convection currents**.

Key definition

The constant upward and downward circulation of fluid carrying thermal energy from the heat source to the other portions of the fluid is called convection currents.

This causes ocean currents, sea and land breezes, etc.

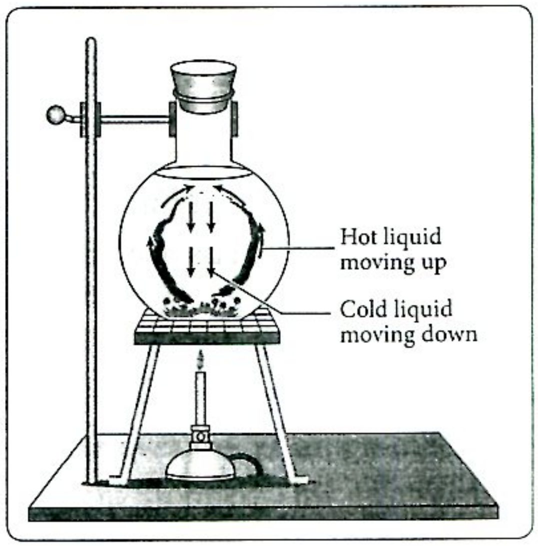


Figure 1.6 Convection current in liquid

Checkpoint

A Answer the following questions.

1. Define density.
2. Name the bottle used to measure relative density of liquids.
3. A big block of wood floats in water whereas a small iron nail sinks. Explain.
4. What is specific gravity bottle?
5. Define convection current.

Key ideas

- Mass and weight are two different concepts.
- Mass of a body is the quantity of matter present in a body regardless of its volume or any force acting on it.
- Weight of a body is the magnitude of force acting on the body due to gravitation.
- Beam balance and physical balance are used to measure mass of a body.
- Weight of an object is measured by a spring balance.
- Density of an object is defined as the mass per unit volume of that object.

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

- Relative density is the density of the substance with respect to the density of water.

  $$RD = \frac{\text{Density of substance}}{\text{Density of water at } 4\,^{\circ}\text{C}}$$

- Relative density of a liquid can be determined using relative density bottle.
- When two substances are put together the less dense substance floats above denser substance.
- When a liquid or a gas is heated its density decreases and when cooled, its density increases.
- The constant upward and downward circulation of fluid carrying thermal energy from the heat source to the other portions of the fluid is called convection currents.

Key words

Convection current cyclic movement of fluids due to difference in density as a result of change in temperature

Density mass contained in unit volume of a substance

Mass the amount of matter an object has

Relative density density of a substance with respect to the density of water

Weight magnitude of force acting on a body due to gravitation

Exercise

A Fill in the blanks.

1 SI unit of mass is ________________.

2 The force of ________________ acting upon the body is known as weight.

3 ________________ is used to measure weight.

4 A substance having relative density 4 will ______________ in/on water.

5 When a substance is heated, its density ______________.

B Match the following.

1 Temperature	a mass
2 Quantity of matter	b relative density
3 Relative density bottle	c convection currents
4 Spring balance	d floats on water
5 Ice	e weight

C State whether the following statements are True or False.

1 Mass of a body changes with change in position or location.

2 Two substances of same mass can have different densities.

3 A body of density 2.5 g m^{-3} will sink in water.

4 When a substance is heated its density increases.

5 Convection currents occur due to variation in densities of cold and hot fluids.

D Choose the correct option.

1 Weight of a body

a remains same b changes with temperature

c changes with place d none of the above.

2 Density of a body is represented by the expression

a $D = \frac{V}{M}$ b $D = \frac{1}{M} \times M$

c $D = M \times V$ d $D = \frac{M}{V}$.

3 Which of the following is not a unit of density?

a m/s b g/cm^3

c kg/m^3 d $g\ cm^{-3}$

4 When water is heated, it expands and

a moves downward b rises upward

c remains at same place d none of these.

E Give one word or one sentence answer.

1 Define weight of a body.

2 What is relation between kgf and N?

3 Which instrument is used to measure mass?

4 Name the instruments used to measure weight.

5 List any two units of mass.

F Answer the following questions in short.

1. State two units of density.
2. What is the effect of temperature on density?
3. How are g/ml and kg/m^3, the units of density related?
4. Describe the use of spring balance.
5. Differentiate between mass and weight.
6. How are kg and g related?
7. Define relative density.

G Answer the following questions in detail.

1. Explain how temperature increase leads to setting up of convection currents in fluids.
2. Why does a small iron nail sinks in water and huge iron ship floats?
3. Explain how temperature affects density.
4. Explain the formation of sea breeze and land breeze.
5. How do you measure relative density of a liquid in the lab?

H Solve the following numericals.

1. Calculate the mass of aluminium which occupies a volume of $250\ cm^3$. Density of aluminium is $2700\ kg\ m^{-3}$.
2. The density of air is $0.00128\ g\ cm^{-3}$. Express it in $kg\ m^{-3}$.
3. An empty RD bottle has a mass of 30.5 g. When filled with water, its mass was found to be 60.5 g. When filled with a liquid, its mass was 53.5 g. What is the RD of the liquid?
4. What will be the volume of 200 g of liquid with density 0.5 g/ml?
5. What is the mass of $3\ m^3$ solid block which has density of $3\ kg/m^3$?

Brain teasers

A How high can you throw different types of balls, like a golf ball, a basketball and a football? Would one of them be denser than the others? Do factors like mass, shape and volume influence the density?

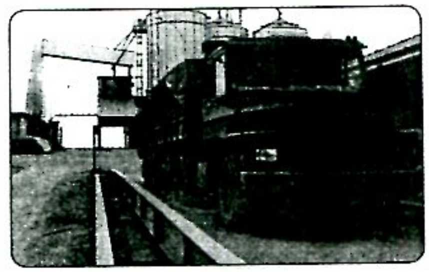
B If the side of cube is increased by a unit then find out what is the increase in the volume and density.

C If a mixture of oil and water is kept in a glass then explain a method to separate water from the oil.

Project idea

Fill a glass with water to half full. Now pour olive oil into the water. Continue pouring till you get a 1 cm thick layer of oil over the water. Sprinkle the salt on the top of the oil. Observe what happens. You will see that the layer of oil sinks in water and then return to the top after some time. Discuss the reason of such behaviour with the other students in your class.

Know your science



Weighbridge

Weighbridges, also known as truck scale, are used to weigh the entire vehicles and their contents. These are large scales usually mounted permanently on a concrete foundation. Weighbridges play a vital role in today's agricultural industries, providing valuable weight data for incoming and outgoing vehicles at farms, mills and terminals, as well as for bulk loading activities.The load carried by the vehicle can be calculated by finding the difference between the empty and the loaded vehicle.

2 Motion and its types

In this chapter, you will learn about:

- state of rest and motion
- how rest and motion are relative
- types of motion
- simple pendulum
- uniform and non-uniform motion
- scalar and vector quantities
- distance and displacement
- speed, velocity and acceleration
- first equation of motion
- acceleration due to gravity

Introduction

Look around your classroom and try to identify objects which are at rest. Look at the pencil on your desk or the blackboard in front of you. Are they moving? Observe the traffic on a nearby road and identify the objects in motion and at rest. If you are being asked that are you at rest or in motion, what will you say? Most of you will say that you are at rest, but do you know that everything on the Earth is moving at enormous speed? Yes, it is very much true as all of us are on the Earth which is revolving around the Sun at a speed of 30 km/s. The solar system is also moving around the Milky Way galaxy at the speed of 250 km/s. So technically, all of us are moving, but then why you do not feel the movement? This is because all these motions are constant.

Rest and motion

Before discussing rest and motion, let us discuss about frame of reference. When you observe a body that does not change its position with change of time, you almost unknowingly refer to a second body which is near the first one (Figure 2.1). The second body should be a fixed

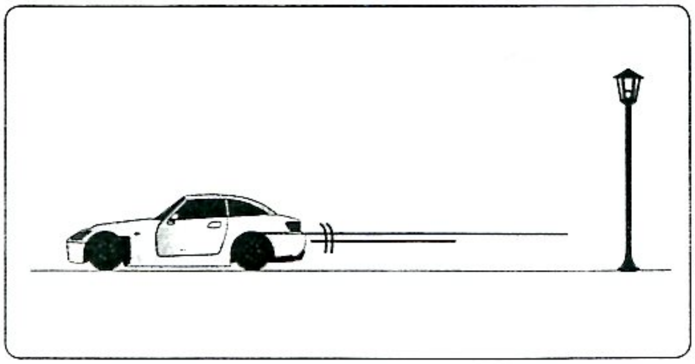


Figure 2.1 A car is in motion with reference to a stationary lamppost

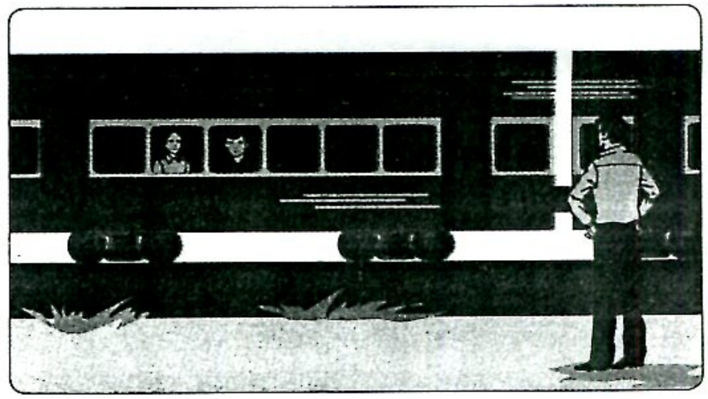


Figure 2.2 Rest and motion are relative

one, it may be a building, a tree, a lamppost, a prominent spot on a road or a fixed star in the sky. This second body is called a **reference body** or a **frame of reference**.

A body is at rest if the distance between the body and some reference point (frame of reference) is not changing.

A body is in motion if the distance between that body and some reference point (frame of reference) is changing.

Key point

A person is moving away from you if the distance between you and the person is increasing. Similarly, a person is moving towards you if the distance between you and the person is decreasing.

Rest and motion are relative

For a particular frame of reference, a body may be at rest, but for some other frame of reference, the same body may be in motion. Let us understand this concept through an example.

Consider two persons sitting in a moving train. For each of them the other is at rest while the train itself is in motion. Therefore, you may say that a person seated in a moving train is at rest. But would this statement be the same when they are viewed by a person on the ground? A person on the ground sees the train along with both the persons and objects in it in motion. For him the two persons are in motion. Therefore, this statement needs to be modified, a person seated in a moving train is at rest in relation to any other person (body) in the same train, but is in motion in relation to any other person (body) outside the train (Figure 2.2).

Similarly, the person on the road is at rest with reference to any other person on the road and is in motion with reference to a person viewing him from the moving train.

Kinds of motion

Various objects move in different ways. Based on those various ways, motion can be classified as translatory (linear) motion, vibratory or oscillatory motion, rotatory motion and random motion. To understand the kinds of motion, a body can be viewed as being made up of a number of tiny particles. Based on this concept let us now discuss various kinds of motions.

Translatory motion

The motion of an object is said to be translatory, if the position of the object is changing with respect to a fixed point or object with time. All the particles of a body executing translatory motion move in the same direction traversing parallel paths, i.e., all the particles of a body move through the same distance in the same direction in a fixed interval of time.

The path traversed by the body in executing translatory motion may be linear, circular, curved or any irregular shape. Examples of such motions are ball thrown by the cricketer, man running on the ground, etc. The motions will result in a change in location unless in the case where the body returns to its original position.

Translatory motion is broadly classified into two types.

Rectilinear: When a body moves along a straight line, its motion is called rectilinear motion. A car moving along a straight road is an example of rectilinear motion (Figure 2.3 a).

Curvilinear: When a body moves along a curved path, its motion is called curvilinear motion. A car moving along a curved road is an example of curvilinear motion (Figure 2.3 b).

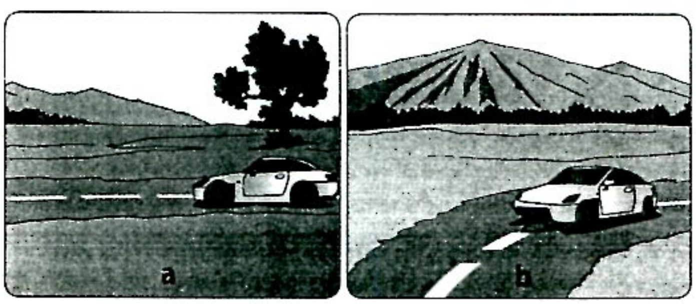


Figure 2.3 **a** Rectilinear and **b** curvilinear motion

Rotatory motion

The motion of an object is said to be rotatory if the motion of all the particles of the body is circular (i.e., along a circular path) with respect to an imaginary line called the **axis of rotation**. This happens when an object spins. The axis of rotation may be internal or external to the body. The centre of the circular path that each particle traces lies on the axis of rotation. A spinning top, wheel of a moving vehicle, hands of a clock, moving fan, rotation of the Earth, etc., are few examples of rotatory motion (Figure 2.4).

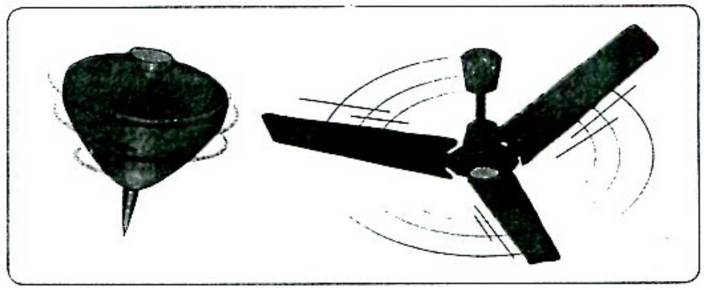


Figure 2.4 Rotatory motion

A rotatory motion is different from a translatory motion because in a rotatory motion different parts of the object move through different distances during same time.

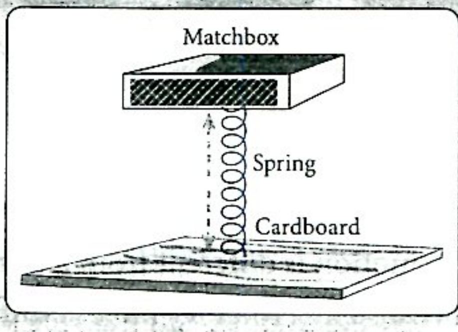
Oscillatory motion

Oscillatory motion is repetitive and fluctuates between two locations. The to-and-fro motion of an object about a fixed point is called oscillatory motion. In case of oscillatory motion, a body as a whole moves back and forth. For example, the motion of the swing is oscillatory motion as it moves back and forth about a mean position (Figure 2.5). Similarly, the motion of a pendulum is also an oscillatory motion.

Figure 2.5 Oscillatory motion

Activity 2.1

Fix one end of a spring on a piece of cardboard. On its other end, stick a small matchbox as shown in the figure below. Press the matchbox a little and then leave it. Observe the motion of the matchbox. Is it executing a to-and-fro motion? Here matchbox executes oscillatory motion.



Oscillatory motion of spring

Bodies executing multiple motions

Some of the bodies in motion may be executing two or more types of motion at the same time. Few examples of such motion are as follows.

- A running vehicle executes both translatory as well as rotational motion. The wheels of vehicles execute rotational motion, the axis of rotation being the axle of the vehicle. The vehicle itself executes translatory motion in moving from one place to another (Figure 2.6).
- The Earth executes both translatory as well as rotational motion. While spinning on its axis it executes rotatory motion and while moving on its orbit around the Sun (revolution) it is executing translatory motion.
- A spinning billiard ball executes both translatory as well as rotational motion. While spinning it is executing rotational motion and while moving from its original location it is executing translatory motion.

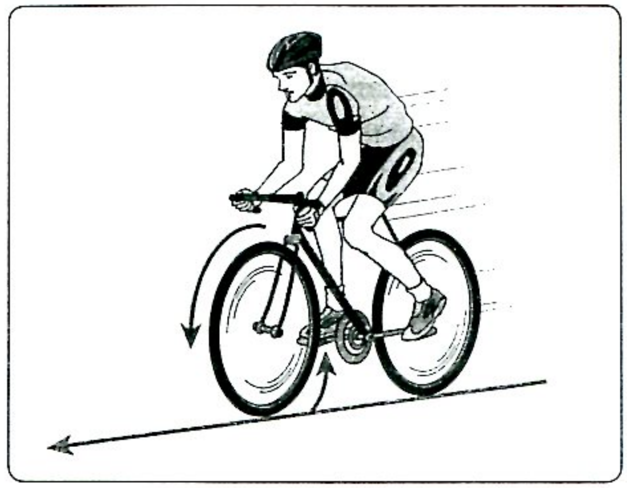


Figure 2.6 Translatory and rotational motion

Other categories of motion

Circular motion: A motion in which the body traverses a circular path is called circular motion. This is a kind of translatory motion where the body reaches the initial position each time it completes traversing the circle. Each particle of a body, executing rotational motion, executes circular motion. Giant wheel, a stone tied to a rope and swung in air, etc., are some examples of circular motion (Figure 2.7).

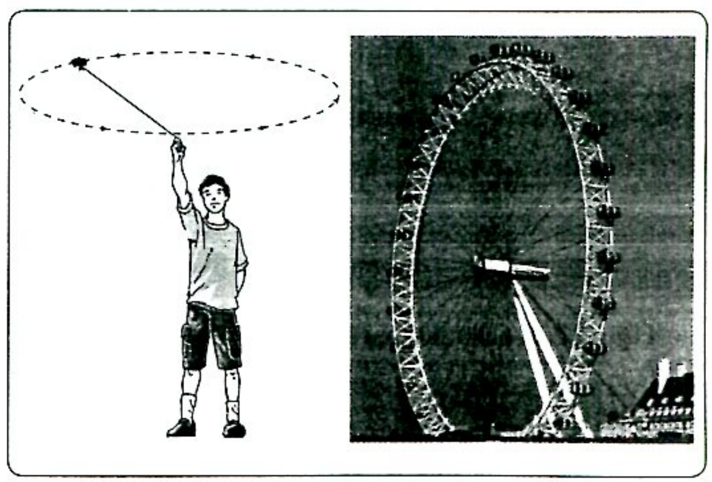


Figure 2.7 Circular motion

Periodic motion: Any motion that repeats itself at regular interval of time is called periodic motion. Clock pendulum, pulse, heartbeat, motion of planets around the Sun, etc., complete their motion in a fixed time and then repeat the motion. The Earth completes its one revolution in 365 ¼ days and then starts another revolution (Figure 2.8). These are few common examples of periodic motion.

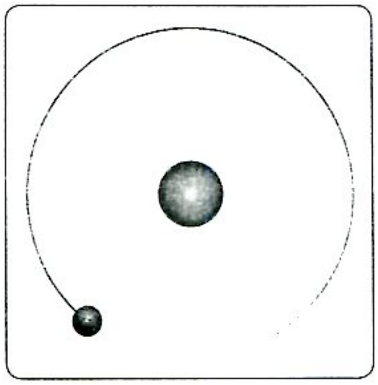


Figure 2.8 Periodic motion

Vibratory motion: When a certain part of a body moves to and fro about its mean position in a definite style, then the motion is called vibratory motion. Strings of musical instruments, like guitar, sitar and veena, etc., moves to and fro motion when plucked and hence, show vibratory motion (Figure 2.9). During this motion there is a change in shape and size of the body. Vibratory motion is a type of oscillatory motion.

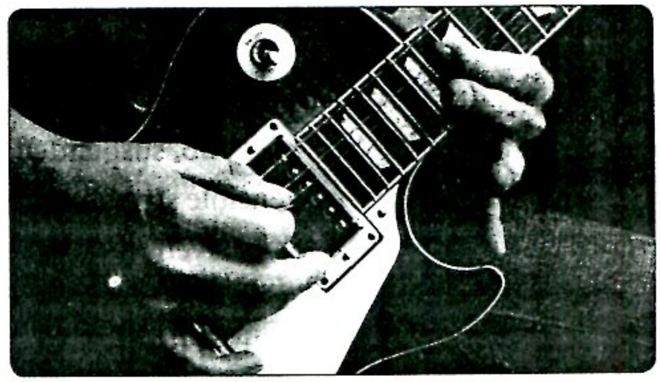


Figure 2.9 Vibratory motion

Random motion: A body which suddenly changes its nature of motion from one kind to another kind is said to have random motion (Figure 2.10). When a balloon filled with air is left then it executes random motion as the air expels. A mosquito in the air and a bird also shows random motion.

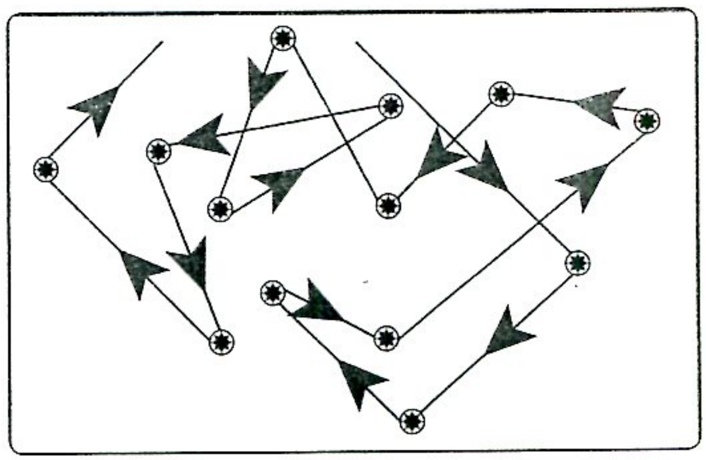


Figure 2.10 Random motion

Checkpoint

A Identify the nature of motion of the following objects.

1 Ant
2 Arrow
3 Bullet
4 Compact disc
5 Electron
6 Fan blade
7 Honeybee
8 Housefly
9 Library book
10 Ocean current
11 Pencil
12 Satellite
13 Stapler
14 Typewriter key
15 Washing machine
16 Weather balloon