Motion And Measurement Of Distances 10

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INTRODUCTION

Long ago people faced many problems to go from one place to another. In earlier times there was no way to transport the things, except muscular energy of man and animal. They moved around on food. Later on, with the domestication of animals, such as horses, camels, oxen etc. humans learnt how to ride them and carry goods on their backs from one place to another.

Car

Bus

Scooter

Auto

Ship

Aeroplane

Means of transport

USE OF MEANS OF TRANSPORT IN EARLIER TIMES

The discovery of wheel was a great achievement in the modes of transport. Its design was being

improved for so many years. After this James Watt discovered steam engine. It is a new source of transport. The steam engine led to the development of automobiles. On water, motor boats, ships were used to transport. Until the beginning of the 19th century.

Electric trains, monorail, supersonic aeroplanes and spacecraft are some of the 20th century contributions.

Activity Time

Some means for moving from one place to another place are given below. Try to identify all means of transport and write the names of them :

_____ _____ _____

_____ _____ _____

DISTANCE KNOWLEDGE OF THE PEOPLE

People travelled from one place to another by means of transport. But they did not know how far they have travelled ?

How will you know whether you can walk all the way to your school or whether you will need to take a bus or a rickshaw to reach your school ?

It is often important to know how far a place is, so that we can have an idea how we are going to reach that place, by walk, take a bus or a train, an airplane, a ship or a space craft.

Sometimes, there are many objects whose length or width we need to know. Suppose somebody asks you, how tall you are ? You need to tell the length from the top of your head to the bottom of your feet.

To understand the concept of distance we should first know length of our desk.

Let us take a piece of a string. Make two knots on the ends of this string. We take the distance between the two knots or one string length. It is used to measure the width of the desk as shown in the figure. Also use it to measure the height of the desk.

Activity Time

Write the measurement of the given table :

S.No.	Measurement	No. of string length
1.	Length of the table	
2.	Height of the table	

CONCEPT OF MEASUREMENT

Measurement means the comparison of an unknown quantity with some known fixed quantity called unit. A measurement is always represented in two parts. First part is the number and second is the unit of measurement.

Thus, if the length of a table is S meters then S is the number and metre is the unit of length. The length of the object gives time of the length of the unit selected for measurement.

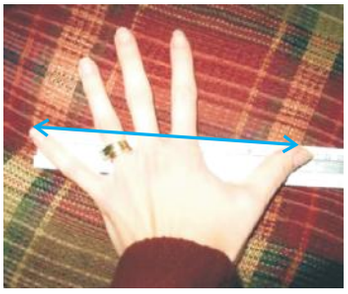
Thus, every measurement consists of a number and a unit. No measurement is complete unless both the number and the unit are mentioned.

UNITS OF MEASUREMENT

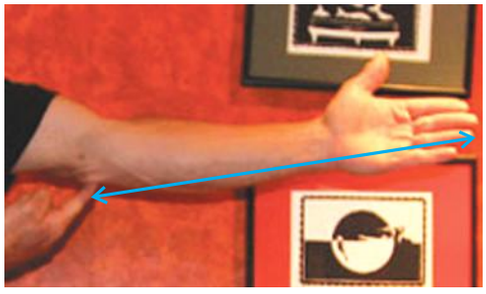
There are two units of measurement :

1. Artificial unit
2. Standard unit

1. In ancient times, the length of a hand, the width of a finger and the distance of a footstep were commonly used as different units of measurement.



Hand span



Length of hand

Footstep

2. **Standard units of measurements :** There are seven standard units in the SI system—

- The kilogram (kg) for mass.
- The second (s) for time.
- The kelvin (k) for temperature.
- The ampere (A) for electric current.

Do You Know ?

Two devices for measuring very small lengths are vernier callipers and micrometer screw gauge. Vernier callipers can measure the length as small as 0.1 mm. Micrometer screw gauge is even more accurate. It can measure the length as small as 0.01 mm. Both these instruments can be used to measure lengths (say a few centimeter) more accurately than a metre scale.

- The mole (mol) for the amount of a substance.
- The candela (cd) for luminous intensity.
- The metre (m) for distance.

WHAT IS MOTION?

The most obvious phenomenon in nature is motion. It will not be out of place to mention the famous statement made by Galileo about the state of motion.

According to Galileo : Everything in the physical world is in motion from the tiniest particles within an atoms to the largest galaxies of stars.

The motion of objects such as animals or people, the sun, the moon and the planets is an obvious phenomenon of nature.

Your surroundings contain many objects such as aeroplane, motorbike, blackboard, book, chair, hands of a clock, a big pen, birds in the sky, a house etc.

We see many things moving around us. A boy walking along a road, a man running, a racing car, a speeding truck, moving dogs are a few examples of things showing motion.

REST AND MOTION

When is a body said to be at rest or in motion ? The question seems quite interesting. Let us clearly understand the terms **rest** and **motion** of a body. A body is said to be at rest or in state of rest when it does not change its position with respect to any fixed point in its surroundings it is at rest or in a state of rest.

Some moving and stationary objects

TYPES OF MOTION

You may have observed the motion of a vehicle on a straight road. March part of soldiers in a parade, an electric fan revolves and the pendulum of a clock moves sideways etc.

The motion of most of the things you see around you can be classified under the following types :

Translatory Motion

Translatory motion is that in which all the particles of a body move through the same distance in the same time.

Imagine you walk 10 paces first along a straight line and then along a curved line. Do all parts of your body move through the same distance in both the cases ? Well answer is yes.

Some examples of translatory motion are, a car or a train moving along a road; a ball rolling down a ground, a girl sliding down a slope, firing of a bullet from a gun, a stone shot from a catapult etc.

The translatory motion is of four kinds :

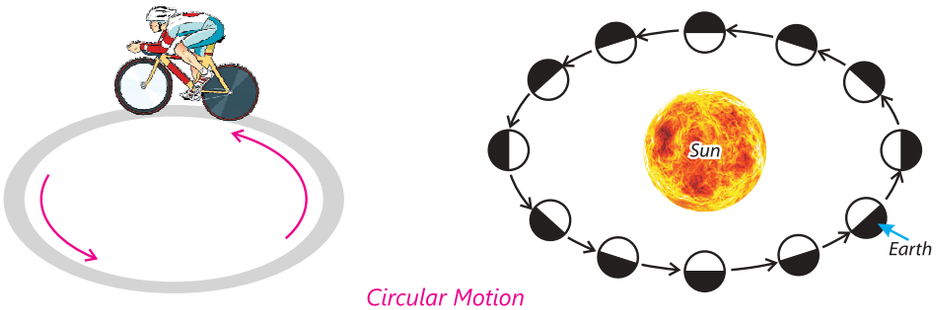
1. Linear motion
2. Circular motion
3. Rotatory motion
4. Oscillatory motion

1. **Linear motion :** When a body moves in a straight line is called linear motion for example a train moving on a straight rail track, its motion is called rectilinear motion or linear motion.

Linear motion

2. **Circular motion :** When a body moves along a curved line, the motion described by the body is called circular motion.

   The moon moves around the earth. The earth moves around the sun.



Circular Motion

3. **Rotatory Motion :** A motion in which a body moves about a fixed axis without changing its position is called the rotatory motion.

Rotatory Motion

4. **Oscillatory motion :** Oscillatory motion is that in which a body moves to and fro about its mean position.

The motion of such objects is called the oscillatory motion.

Which other things perform oscillatory motion in your surroundings ? The motion of a swing and the pendulum of a clock show oscillatory motion.



Oscillatory Motion

Some more examples of oscillatory motion are :

- Balance wheel of a clock
- Motion of a hanging bell
- The piston of a motor car.

Speed

Imagine two boys A and B are running a 200 m race. Let us imagine boy A finishes the race in 20 seconds and B finishes it in 25 seconds. Who ran faster ? Obviously the boy A. It is because the rate at which A was running was 200 metre/20 seconds = 10 metre/second where as the rate of running of boy B was 200 metre / 25 seconds = 8 metre/second.

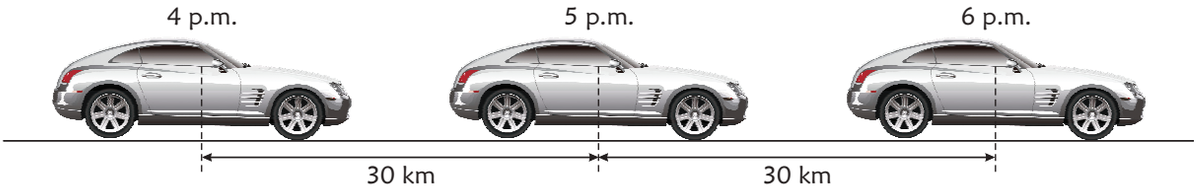
The rate of change of motion is called speed. You can find the speed of an object by dividing the distance it has travelled by the time. The standard unit of speed is metre/second. It is written m/s or ms^{-1} in symbol.

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}}$$

If the distance covered is small then, the speed is expressed in cm/sec. Similarly, if the distance covered is fairly large it is expressed in km/hour.

Types of Speed

Uniform speed : When a body covers an equal distance in equal intervals of time (however short the time intervals may be), the body is said to be moving with a uniform speed.

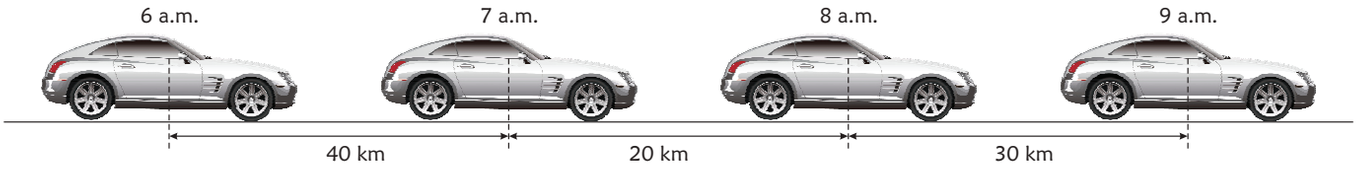


Uniform speed

Non-uniform speed : When a body covers unequal distances in equal intervals of time, the body is said to be moving with a non-uniform speed.

Mostly, objects do not cover long distances in a uniform speed, therefore, the speed is calculated as average speed.

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$



Non–uniform speed

Velocity

In order to understand velocity, let us consider the following example. If someone states that the speed of a machine M is 10 m/s, it is very clear that the machine will cover 10 m in one second.

However, there is one question which comes up in mind. As you have not seen the machine, you can always question, in which direction the machine will moe, i.e. whether it will move towards east or west etc, or whether it will rise up vertically or drill into the ground, etc. In other words, the statement "Speed of the machine M is 10 m/s" is not complete, as the direction is not specified.

Therefore, in a way the velocity is speed, but the direction is specified.

Hence "Velocity is the rate of change of motion in a specified direction".

Force

Everyday we do many actions. In these actions, we pull something, push it, throw it, or more likely, may beat it.

Pulling

Wringing

Pushing

Thus "A force is a push or pull exerted on an object that tends to start moving, stop moving, or change its motion." A force can change the shape of an object. The object always moves in the direction of the force applied.

Effects of Force

1. **Force can change the state of rest or motion :** If we apply a force on a hand cart, then it moves in the direction of force. It is not necessary everytime that force can cause motion. For example, if we push the wall, it does not move because the exerted force is not enough.
2. **Force can slow or stop the moving body :** Suppose your friend is cycling. If you pull the cycle back, the speed of the cycle will decrease, the force applied in the opposite direction slows the speed of the body.

3. **Force increases the speed :** Imagine a man is slowly pulling a hand cart. If you help him, it moves faster. Similarly, a horse cart moves faster if more force is exerted by the horse.
4. **Force can change the direction :** During the game of cricket, when the moving ball is hit by a bat, it changes its direction. Similarly, in the playground, a football player kicks the moving football to change its direction.

5. **Force can change the shape of the object :** A spring is hung on the wall. When we exert force to pull it, it gets stretched and the shape will change. Similarly, on pressing a ball it changes its shape.

Types of Forces

There are many types of force. Some of them are as follows :

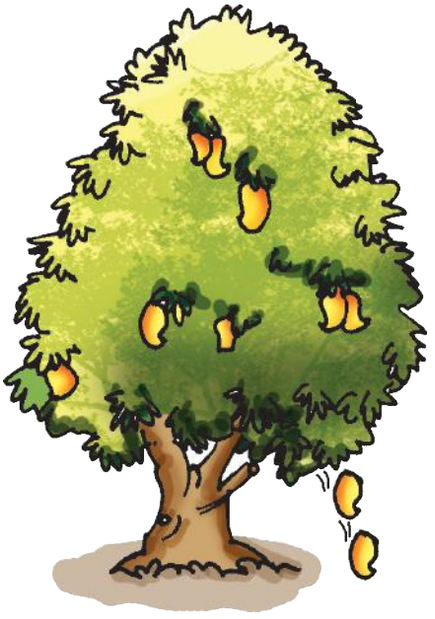
1. **Gravitational force :** Whenever an object is dropped, it always falls towards the ground. Why ?

It is because the pull exerted by the earth on the objects around it is towards its centre. The pull exerted by the earth on the objects is called the force of gravity or gravitational force.

When we throw an object vertically upward, the force of gravity of the earth at once starts acting on it. First, it slows down the object, then stops it and finally pulls it towards itself.

It is the force of gravity which gives weight to an object. Weight is basically the force of the earth.

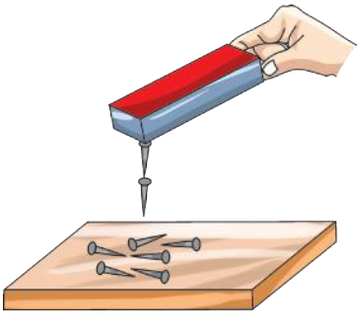
In the universe, each particle of matter attracts every other particle. It is the gravitational force which keeps the moon revolving round the earth. The planets too, experience gravitational force which keep them in their orbits.



Gravitational force

2. **Muscular force :** When we exert force by our arm or by the muscles of the body on some object, it is called the muscular force.
3. **Magnetic force :** The magnet can attract the metals like iron, nickel, cobalt, etc. The force exerted by a magnet is called the magnetic force.
4. **Electric force :** The force exerted by an electrostatic charge is called an electrostatic force.

Muscular force



Magnetic force

5. **Frictional force :** You must have experienced that applying brakes on a moving object, it moves a little on, and then stops on its own. The invisible force that brings an object to rest is called the frictional force. There are two types of friction :

(a) Sliding friction : When solid objects slide over each other, the sliding friction acts between their surface. For example, sliding a book across a table.

(b) Rolling friction : When an object such as a ball rolls over a surface rather than slides, it is called a rolling friction. Rolling friction tends to be less than the sliding friction.

Advantages of Friction

1. Writing and drawing is made possible because of the friction between the pen or pencil and the paper.
2. We are able to walk because friction prevents us from slipping.
3. Without friction, the wheel of vehicles will slip.
4. Without friction, belts would not be able to drive machines.
5. The brakes of the vehicles would not work without friction between the rim and the brake shoes.

Know the Keywords :

Measurement : Process that compares a given physical quantity with the accepted standard unit of that quantity.

Motion : State in which a given object keeps on changing its position, with time and with respect to its surroundings.

Rest : State in which a given object does not change its position with time and with respect to its surroundings.

Point to Remember

- Measurement means the comparison of an unknown quantity with some fixed quantity.
- Translatory motion is that in which all the particles of a body move through the same distance in the same time.
- Velocity is the rate of change of motion in a specified direction.
- Force is a push or pull exerted on an object that tends to start moving, stop moving, or change its motion.

EXERCISE TIME

A. Answer the following questions :

1. If you are sitting in a moving train are you at rest or in motion ?
2. Is your school at rest or in motion ?
3. What type of motion does the wheel of a bicycle perform ?
4. What type of force does an apple falling from a tree show ?

B. Write 'T' for true and 'F' for false statement :

1. Balance of a clock is a rotatory motion. ( )
2. The full form of S.I. is Standard Unit. ( )
3. Car is a translatory motion. ( )
4. Iron is a metal of magnetic force. ( )
5. Force can not change the direction. ( )
6. Force increases the speed. ( )

C. Explain the different types of motions. Explain each one briefly.

D. Explain in brief the statement. "Rest and motion are relative terms."

E. Explain the term Force and its effect.

F. What are the advantages of using S.I. unit?

G. Write the types of Forces.

H. What is speed? Write the formula and S.I. unit.

I. What is velocity?

J. Fill in the blanks :

1. _____ discovered steam engine.
2. The rate of change of motion is called_____.

3. Force can _____ or _____ the moving body.
4. Without _____, the wheel of vehicles will slip.
5. Pull or Push is called _____.

K. Differentiate between :

(i) Rest and motion

(ii) Rectilinear and circular motion

L. Tick (✓) the correct option :

1. Which of the following is not an example of oscillatory motion ?
   - (i) children sitting on a merry go round ◯
   - (ii) pendulum of a wall clock moving left and right ◯
   - (iii) a person sitting on a rocking chair ◯
2. Rectilinear and circular motions are a part of a _____ motion.
   - (i) rotatory ◯ (ii) translatory ◯ (iii) oscillatory ◯
3. Which of the following is not an example of linear motion ?
   - (i) motion of a cyclist on a straight plane ◯
   - (ii) motion of a freely falling stone ◯
   - (iii) motion of a runner during 1 km race ◯
4. A kite flying in the sky shows :
   - (i) linear motion ◯ (ii) translatory motion ◯ (iii) circular motion ◯

Creative Work

- **Using string and a scale, let each student measure the length of his/her legs, and hands. Prepare a bar graph of the leg's length measurements that have been obtained for the whole class.**
- **Visit a park near your house. Sit there on a swing. Name the type of motion and write a description of it in your rough note book.**