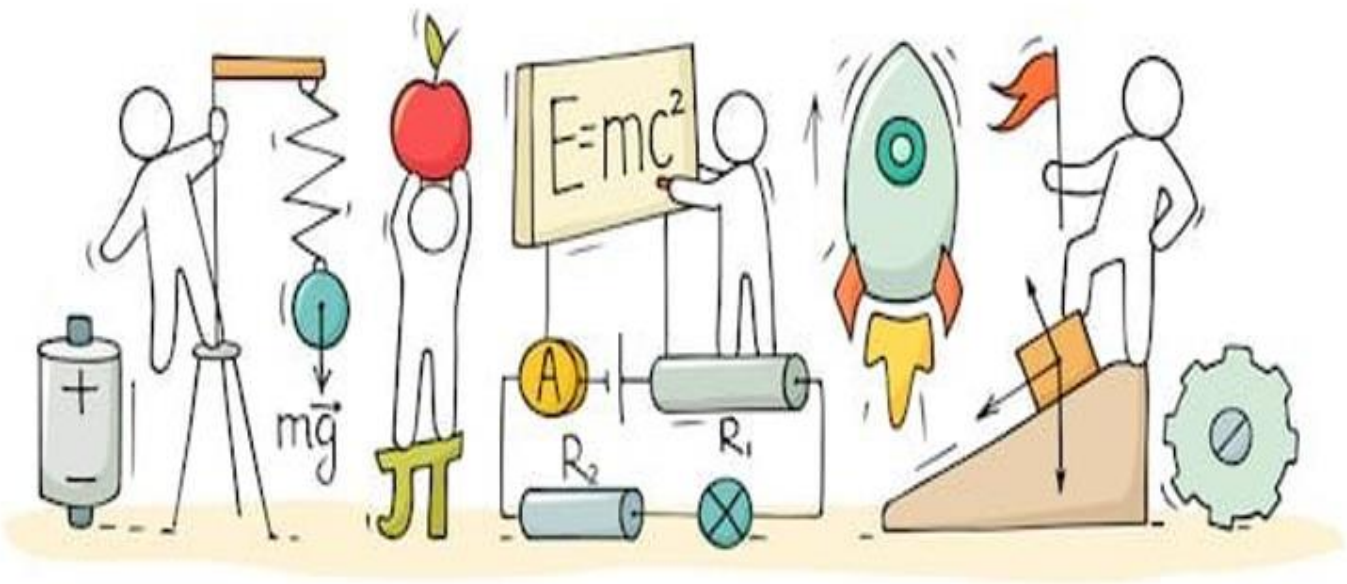
SCIENCE

Chapter 10: Motion and Measurement of Distances



Motion and Measurement of Distances

Story of Transport

- Man learnt to domesticate animals and ride them for hunting and to move from one place to another.

- The wheel was invented around 3,500 BC. This led to the discovery of the modern transport system.
- By using horses and wheels, the early man discovered the chariot which was the cheapest mode of road transport.
- Early man hollowed tree trunks and used them to cross rivers and streams. This gave rise to waterways.
- Slowly, the modern transport system was developed further.

Measurement In Daily Life

- Measurement is a method that enables us to identify the quantity of anything.
- In measurement, we compare the unknown quantity of an object to the known fixed quantity of an object of the same kind, which leads us to measure the quantity of the unknown object.
- The known fixed quantity in a measurement is called a unit. For example, the length of cloth is 10 metres, so the unit of measurement here is a metre.
- The quantity equals the product of numerical value and the unit. It is written mathematically as:
- Quantity = Numerical Value x Unit

Measurement

- Measurement means the comparison of an unknown quantity with some known quantity. This known fixed quantity is called a unit.
- The result of a measurement is expressed in two parts:
  i. A number.
  ii. A unit of measurement.
- The units of measurement used in ancient times were: Length of the foot, width of the finger, cubit and hand span.
- Measurements done with body parts of different human beings differed because of differing sizes of the body part.
- Therefore, for the sake of uniformity, the International System of Units (SI units) was adopted as the most widely used system of measurement.

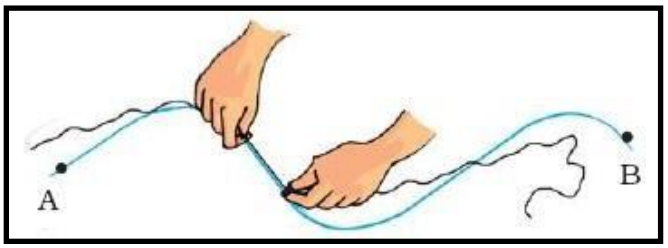
Measurement of Length

- The SI unit of length is metre.
- Each metre (m) is divided into 100 equal divisions called centimetre (cm).
- Each centimetre has 10 equal divisions called millimetre (mm).
- Thus,

  1 m = 100 cm

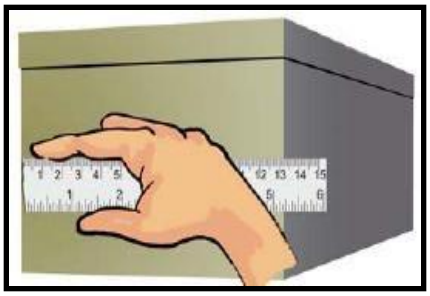
  1 cm = 10 mm

  1 km = 1000 m
- The length of a straight line is measured by a metre scale or a measuring tape.
- The length of a curved line can be measured using a thread.

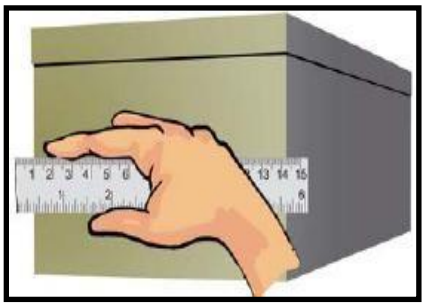


Precautions while Measuring Lengths using a Metre Scale

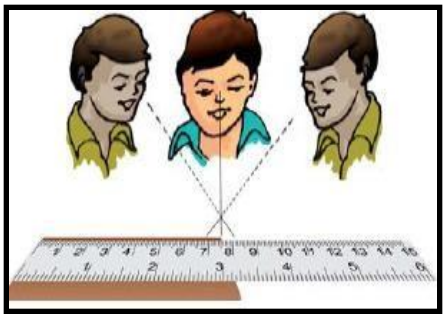
- Place the scale in contact with the object along its length.



- If the zero mark is not clear, use any other full mark of the scale and then subtract the reading of this mark from the reading at the other end. The difference is the length of the object.

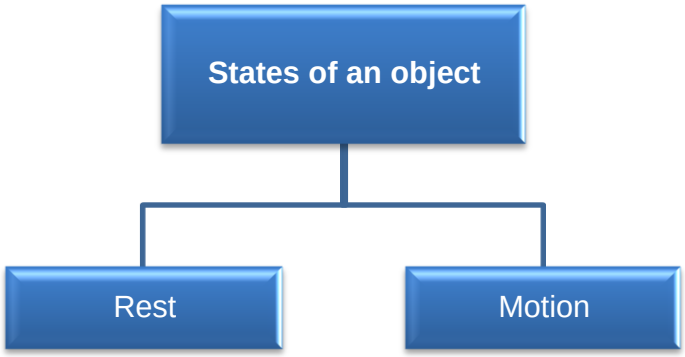


- Your eye must be exactly in front of the point from where the measurement is to be taken.



Motion

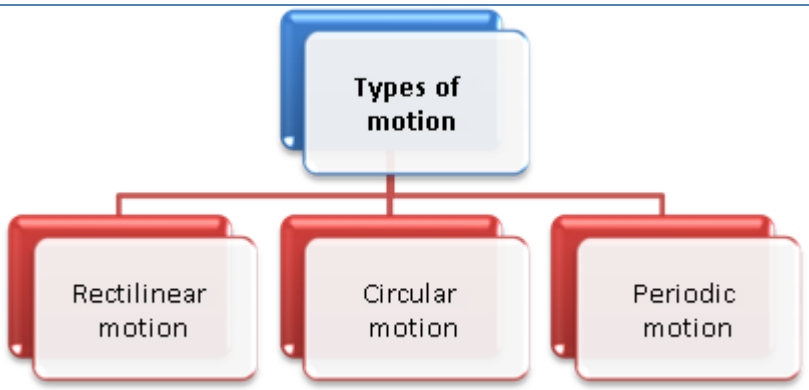
- Motion refers to the change in the position of an object with respect to time.
- Objects are at rest or in motion.



- There are two states of an object:

Rest	Motion
When the body does not change its position with respect to time, then it is said to be at rest, or it is said to be motionless or stationary.	When the body changes its position with respect to time, then it is said to be in motion.
Example: Chairs of the dining table, a flower vase, the table and the blackboard are all at rest.	Example: The blades of a rotating fan, the hands of a working wall clock, a moving car, a spinning top and satellites are all in motion.

Types of Motion



Rectilinear Motion

- Rectilinear motion is the motion of an object which moves in a straight line.
- Examples: A train moving on a track, a parade and coins tossed in the air.

Circular Motion

- Circular motion is the motion in which an object moves continuously at a fixed distance from a fixed point.

- It is a motion in which the body traverses a circular path.
- Examples: The hands of a clock, a merry-go-round, the blades of a fan, the wheels of a moving vehicle, satellites and a spinning top.

Periodic Motion

- Periodic motion is the motion which repeats itself at regular intervals of time.
- Examples: The pendulum of a wall clock, the bells in a church, a bouncing ball, a vibrating string and a swinging cradle.

Combinations of different types of Motion

- A moving car which moves straight on the road displays rectilinear motion, but at the same time, the wheels of the car which are moving in circles display circular motion. So, a moving car displays both, rectilinear and circular motions.
- In a sewing machine, the needle is in periodic motion, whereas the wheels of the sewing machine are in circular motion. So, a sewing machine displays both, circular and periodic motions.

Physical Quantities

- The quantities that can be measured are called physical quantities. For measuring the physical quantities, we require magnitude and a fixed unit. For example, If the distance from London to Reading is 275 km, so the magnitude is 275 and its unit is km here.
- The specific physical quantities that cannot be expressed in any other quantity are called fundamental physical quantities. Some fundamental physical quantities are mass, length, time and temperature.

Traditional Units of Measurement:

In ancient times, people use their hands, arms and feet to measure the quantities. These methods still use in the present time. The units that we measure through these methods are yards, cubit and handspan.

- **Yard:** The distance between the endpoint of an outstretched arm to the tip of the nose.
- **Cubit:** The distance between the elbow to the tip of the middle finger.
- **Foot:** Measurement of the quantity by a barefoot of an adult person.
- **Handspan:** The measurement of a quantity by the tip of the thumb to the tip of the little finger when the palm is outstretched.

These methods are not reliable because different people have different body shapes and sizes. However, if these methods apply individually then they can be effective. For example, tailors use the handspan method to measure the arm of the customers to make the sleeves.

Standard Units of Measurement:

- The standard units of measurement introduced to measure accurate quantity of any object.
- In 1960, the General Council of Weights and Measures organized where all the scientists gathered to decide the uniform system of units acceptable all over the world.
- The standard system unit is called the SI system ('Systeme International d'Unites' in French). Table 1 shows the SI units of fundamental quantities.

A few other SI systems are:

- CGS (Centimetre for length, Gram for mass and Second for time),
- MKS (Metre for length, Kilogram for mass and Second for time),
- FPS (Foot for length, Pound for mass and Second for time).
- The measurement of smaller quantities is called submultiples of units. They represent with the factor of 1/10, 1/100 and 1/1000, etc.
- The measurement of larger quantities is called multiples of units. They represent with the factor 10, 100 and 1000, etc.
- Both multiples and submultiples have prefixes and symbol.

Table 2 shows the prefixes of multiples and submultiples.

Prefixes	Symbol	Submultiples/Multiples
deci	d	Submultiple: 1/10
centi	c	Submultiple: 1/100
milli	m	Submultiple: 1/1000
Kilo	k	Multiple: 1000
Hecto	h	Multiple: 100
Mega	M	Multiple: 10000

Correct Measurement Of Length

We use suitable instruments to measure the quantity of an object.

Measuring Length

- The measurement of length concerns the length, width, thickness, height and distance of any object.
- There are several instruments used to measure the length. For example, a ruler, metre rod and a measuring tape, etc.
- A ruler has units of centimetre and millimetre. It is used to measure smaller quantities (Figure 2).

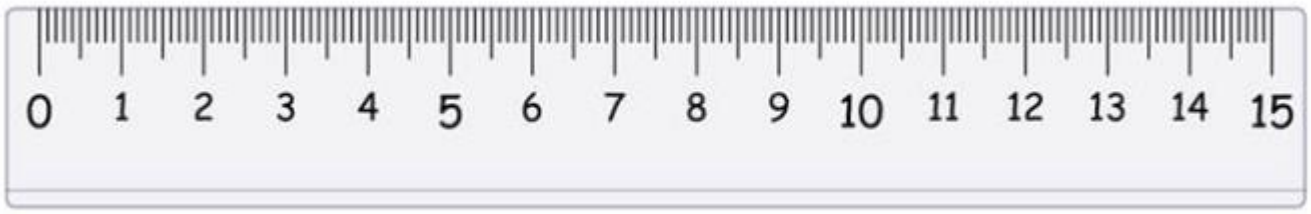
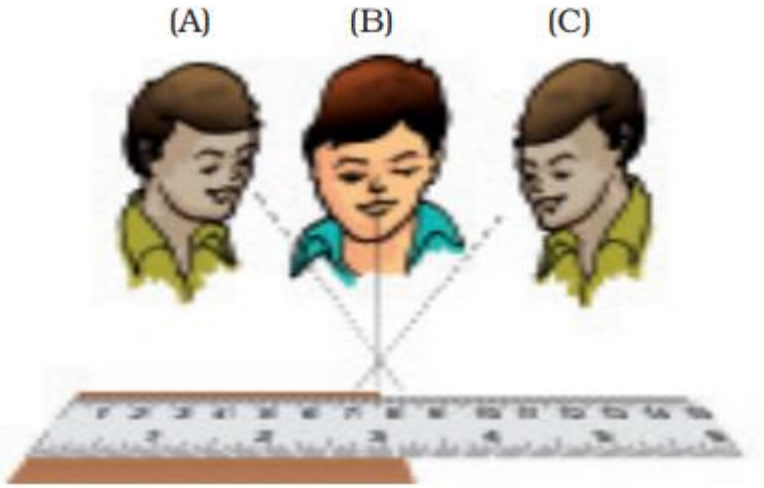


Figure 2: A ruler.

A metre rod is used by tailors to measure the length of the cloth. The unit of metre rod is fixed to one metre(Figure 3).

Figure 3: A metre rod.

- Correct way to use a ruler/scale
- The following steps we need to follow while measuring anything by a ruler/scale:-
- Place the scale exactly at the tip of the object.
- Do not observe the object at different angles while measuring because this causes parallax error (Figure 4).



CHAPTER - 10 MOTION AND MEASUREMENT OF DISTANCES

Motion and Measurement of Distances

- Transportation modes
  - Land
    - Cycle
    - Bus
  - Air
    - Aeroplane
    - Helicopter
  - Water
    - Ship
    - Boat
- Motion Types
  - Circular — Objects motion along a circular path
  - Periodic — Objects motion repeats after a regular time intervals
  - Rectilinear — Objects motion in a straight line
- Change in position of an object with time motion
- Length measurement
  - SI unit-Metre
    - 1m=100cm
    - 1cm=10mm

Table : objects at rest and in motion

Objects at rest	Objects in motion
House	A flying bird
Table	Second's hand of the clock
Clock	Motion of train

Important Questions

Multiple Choice Questions:

Question 1. Which is a standard unit of measurement?

(a) Angul (finger)

(b) Mutthi (fist)

(c) Step

(d) Inch

Question 2. What is the SI unit of length?

(a) Metre

(b) Centimetre

(c) Kilometre

(d) All of these

Question 3. 4 kilometres are equal to

(a) 4,00,000 metre

(b) 40,000 metre

(c) 4,00p metre

(d) 400 metre

Question 4. 15 cm are equal to

(a) 150 mm

(b) 15 mm

(c) 1.5 mm

(d) 0.15 mm

Question 5. Which is a correct relationship?

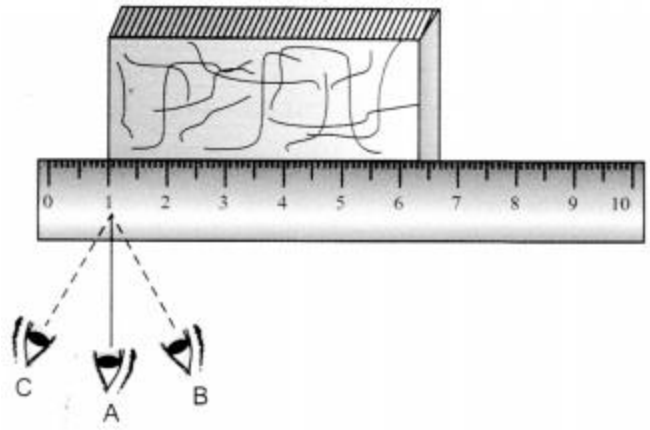
(a) 1 m = 100 cm

(b) 1 cm = 100 mm

(c) 1 km = 100 m

(d) all of these

Question 6. In the following figure, the proper way of reading scale is



(a) C

(b) B

(c) A

(d) Any way can be choosen

Question 7. An example of rectilinear motion is

(a) apple falling from a tree

(b) motion of a car on road

(c) a spinning top

(d) both (a) and (b)

Question 8. Which is an example of a periodic motion?

(a) Oscillation of a pendulum

(b) Motion of a bus on road

(c) A spinning top

(d) A stone dropped from a certain height

Question 9. What kind of motion is executed by a pendulum of a wall clock?

(a) Oscillatory motion

(b) Vibratory motion

(c) Circular motion

(d) Linear motion

Question 10. One metre is equal to ……. millimetre.

(a) 10

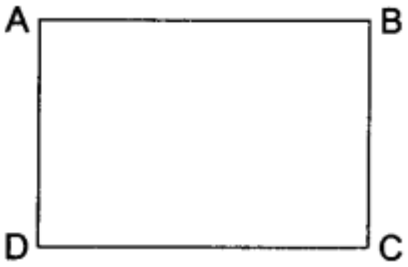
(b) 1000

(c) 100

(d) 10000

Very Short Question:

1. Are senses reliable for accurate measurement?
2. Why can hand span and arm length not be used as standard units of length?
3. How many centimetres are there in 1 m?
4. Name the measuring device which can be used for measuring the girth of a tree.
5. Give one example of linear motion.
6. Give an example of circular motion.
7. Name the types of motion in which a body moves along a straight path
8. Find the length and breadth of given rectangle in mm and cm.



9. Give the unit for measuring the following:

(a) Distance between Delhi and Jaipur.

(b) Thickness of a coin.

(c) Length of your eraser.

(d) Length of your shoe lace.

10. Name the device used to measure the following:

(a) Size of your shoulder.

(b) Size of your wrist.

(c) Your height.

(d) Your weight.

(e) Cloth for curtain.

(f) Circumference of round table.

Short Questions:

1. State two precautions to be observed while measuring length with the help of a metre scale.
2. Define rest and motion.
3. Define the term standard unit.
4. How can a measured length be expressed?

5. Give one example each of the following types of motion:

(a) Linear

(b) Translation

(c) Circular

(d) Periodic.

Long Questions:

1. Why do we need standard unit for measurement?

2. What type of motion do the following objects have?

(a) the galloping of a horse

(b) the needle of a sewing machine

(c) the movements of a mosquito

(d) the blades of an electric fan

(e) the smoke from a lighted dhoopbatti

(f) wheels of moving car.

3. Give two examples for each of the following motions:

(i) Linear motion

(ii) Spinning motion

(iii) Oscillatory motion

(iv) Periodic motion

(v) Vibrational motion

(vi) Circular motion

(vii) Random motion

Answer Key-

Multiple Choice Answers:

1. (d) Inch
2. (a) Metre
3. (c) 4,00p metre
4. (a) 150 mm
5. (d) all of these
6. (c) A
7. (d) both (a) and (b)

8. (a) Oscillation of a pendulum

9. (a) Oscillatory motion

10. (b) 1000

Very Short Answers:

1. Answer: Our senses are not reliable for accurate measurement.
2. Answer: because these vary from person to person.
3. Answer: 100 cm.
4. Answer: Measuring tape.
5. Answer: Motion of stone falling from a certain height.
6. Answer: Motion of arms of watch.
7. Answer: Rectilinear or linear motion.
8. Answer: Using measuring scale (15 cm scale), Length AB = 3 cm and breadth BC = 2 cm.

   AB = 3 × 10 = 30 mm

   BC = 2 × 10 = 20 mm.
9. Answer:

   (a) Kilometre

   (b) Millimetre

   (c) Centimetre

   (d) Centimetre
10. Answer:

    (a) Measuring tape

    (b) Measuring tape

    (c) Measuring tape

    (d) Weighing balance

    (e) Metre scale or measuring tape

    (f) A long thread or measuring tape.

Short Answer:

1. Answer: Two precautions are:

   (i) The initial point of distance must coincide with the zero reading of metre scale.

   (ii) The eye should be kept in line with the point of measurement.
2. Answer: The objects which do not change their positions with time are said to be at rest. The objects which change their positions with time are said to be in motion.

3. Answer: The unit that could be used everywhere as a basic unit of measurement is called a standard unit.
4. Answer: Each measurement has:

   (i) A number describing the numerical value.

   (ii) The unit in which that quantity is measured.
5. Answer:

Types of motion	Example
(a) Linear	motion of stone falling
(b) Translatory	buses
(c) Circular	ceiling fan
(d) Periodic	pendulum of clock

Long Answer:

1. Answer: We need standard unit for measurement to make our judgement more reliable and accurate. For proper dealing, measurement should be same for everybody. Thus there should be uniformity in measurement. For the sake of uniformity we need a common set of units of measurement, which are called standard units. Nowadays SI units are used in science and technology almost universally.
2. Answer:

   (a) The galloping of a horse: Linear motion.

   (b) The needle of a sewing machine: Periodic motion.

   (c) Movement of a mosquito: Random motion.

   (d) Blade of an electric fan: Circular motion.

   (e) The smoke from a lighted dhoopbatti: Random motion.

   (f) Wheels of moving car: Linear motion and Rotational motion.
3. Answer:

   (i) Linear motion: (a) Rolling of ball on ground, (b) Moving of bicycle on road,

   (ii) Spinning motion: (a) Rotating fan, (b) Wheel of sewing machine.

   (iii) Oscillatory motion: (a) Pendulum of clock, (b) Motion of a child on a swing,

   (iv) Periodic motion: (a) Pendulum of clock, (b) Motion of a swing, heartbeat.

   (v) Vibrational motion: (a) String of a guitar, (b) Surface of drums.

(vi) Circular motion: (a) Rotation of fan, (b) Bicycle wheel.

(vii) Random motion: (a) Motion of football players, (b) Movement of mosquito.