Chapter 1

MEASUREMENT AND MOTION

Section-A
MEASUREMENT

KEY FACTS

1. **A Basic or Fundamental Quantity** is that which cannot be derived from another. Length, mass, time, electric current, temperature are five basic quantities.*

2. **A derived quantity** is that which can be obtained by combining of basic quantities using multiplication and division. Area, volume, density, velocity, force, etc., are derived quantities.

3. **SI Units.** The scientists, all over the world, have accepted a basic set of units for the measurement of physical quantities. This is called the S.I. system of units. The following table shows a list of physical quantities and their respective standard units.

Physical quantity	SI Unit	
	Name	Symbol
Length	metre	m
Area	square metre	m^2
Volume	cubic metre	m^3
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Current	ampere	A

4. **Prefixes used in S.I. Units**

A.	Name	Symbol	Submultiple	Example (1 metre is written as 1 m)
	deci	d	$\frac{1}{10} = 10^{-1} = 0.1$	decimetre (dm) $= \frac{1}{10}$ metre $= \frac{1}{10}$ m
	centi	c	$\frac{1}{100} = 10^{-2} = 0.01$	centimetre (cm) $= \frac{1}{100}$ m
	milli	m	$\frac{1}{1000} = 10^{-3} = 0.001$	millimetre (mm) $= \frac{1}{1000}$ m

* The remaining two basic quantities are *luminous intensity* and *amount of substance* with which we are not dealing in this book.

B.

Name	Symbol	Multiple	Example
deca	da	10 (10 times)	decametre (dam) = 10 m
hecto	h	100 (100 times)	hectometre (hm) = 100 m
kilo	k	1000 (1000 times)	kilometre (km) = 1000 m
mega	M	1000000 (10 lakh times)	megametre(Mm) = 1000000 m

5. The following units are used to measure objects, like very small bacteria, insects, viruses etc., micro (μ, pronounced as mu), nanometre (nm), Angstrom (Å) and picometre (pm).

   1 μm (micron or micrometre) = 1 millionth of a metre = $\dfrac{1}{1000000}$ m = 10^{-6} m

   1 nm (nanometre) = 10^{-9} m = one billionth of a metre = $\dfrac{1}{1000000000}$ m = 10^{-9} m

   1 Å (Angstrom) = 10^{-10} m

   1 pm (picometre) = 10^{-12} m.

6. The following units are used to measure very large distances like the distances between stars and planets etc.

   1 light year = 9.465×10^{15} m

   = 9.46 trillion km

   = **About 9.5 lakh crore metre**

   = 9,500,000,000,000 km

   1 Parsec = **3.2616 light years**

   1 light year is the distance a ray of light can travel in one year. If a star is 5 light years away from us, it means that this distance is equal to the distance travelled by light in 5 years. Thus the light from the star that reaches us today started from the star 5 year ago.

Question Bank-1(a)

1. Arrange the following lengths in the increasing magnitude.

   '1 metre, 1 megametre, 1 centimetre, 1 kilometre, 1 millimetre, 1 micrometre.'

2. If a woman has a mass of 45,000,000 mg, what is her mass in grams and kilograms?

3. Which SI units would you use for the following measurements?

   (a) the length of a swimming pool

   (b) the mass of the water in the pool

   (c) the time it takes a swimmer to swim a lap

4. Which of the following is the best estimate in metres of the height of a mountain?

   (a) 1 m   (b) 100 m   (c) 1 km   (d) 1 Mm

5. Ten metres is equal to

   (a) 100 cm   (b) 1,00,000 mm

   (c) 1,000 cm   (d) 1,000 μm

6. A certain bacterial cell has a diameter of 0.50 μm. The tip of a pin is about 1100 μm in diameter. How many of these bacterial cells would fit on the top of the pin?

7. **List an appropriate SI base unit (with a prefix as needed) for measuring the following.**

   (a) the time it takes to play a CD in your stereo

   (b) the mass of a SUV

   (c) the length of a soccer field

   (d) the diameter of a large pizza

(e) the distance between New Delhi and Jaipur

(f) your mass

(g) the length of your school auditorium

(h) your height

8. **Estimate the magnitude of the lengths in metres of each of the following:**

(a) a ladybug   (b) your leg

(c) your school building (d) a giraffe

9. **Express each of the following as indicated:**

(a) 3.5 dm expressed in mm

(b) 3 h 20 min expressed in seconds

(c) 0.59 km expressed in centimetres

(d) 380 μm in centimetres

(e) 0.592 mg expressed in grams

(f) 25 g expressed in micrograms

(g) 36 km/h expressed in metres per second

10. **What is the SI base unit for length?**

(a) inch   (b) foot

(c) metre   (d) kilometre

11. **A light year (ly) is a unit of distance defined as the distance light travels in one year. Numerically, 1 ly = 9 500 000 000 000 km. How many metres are in a light year?**

(a) 9.5×10^{10} m   (b) 9.5×10^{12} m

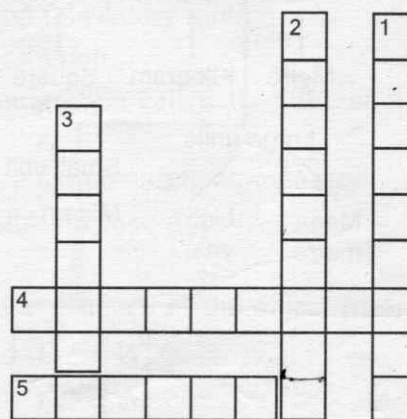(c) 9.5×10^{15} m   (d) 9.5×10^{18} m

12. **Ankit is measuring how fast bacteria grow in a dish by measuring the area that the bacteria cover. On day 1, the bacteria cover 0.35 cm². On day 2, they cover 0.70 cm². On day 3, they cover 1.40 cm². What is the best prediction for the area covered on day 4?**

(a) 1.50 cm²   (b) 3 cm²

(c) 2.80 cm²   (d) 2.90 cm².

13. **Create a concept map using the following words:**

> Measurement, SI units, Length, Mass, Time, Area, Volume, CGS units, Large units, Very small unit, megametre, micron, light year, metre, kilogram, cubic metre, centimetre, gram, cubic centimetre, square metre, square centimetre

14. **Solve the following crossword with the help of the given clues.**

ACROSS

4. 1 million (ten lakh) metres

5. one- millionth $\left(\dfrac{1}{10 \text{ lakh}}\right)$ of a metre

DOWN

1. Distance light travels in one year.

2. One billionth $\left(\dfrac{1}{100 \text{ crore}}\right)$ of a metre

3. A unit of distance used in astronomy. About $3\frac{1}{4}$ light years.

Answers

1. micrometre, millimetre, centimetre, metre, kilometre, megametre.

2. 45,000 g; 45 kg

3. (a) metres   (b) kilograms

(c) seconds

4. (c)   5. (c)

6. 2200 bacterial cells

(e) the distance between New Delhi and Jaipur

(f) your mass

(g) the length of your school auditorium

(h) your height

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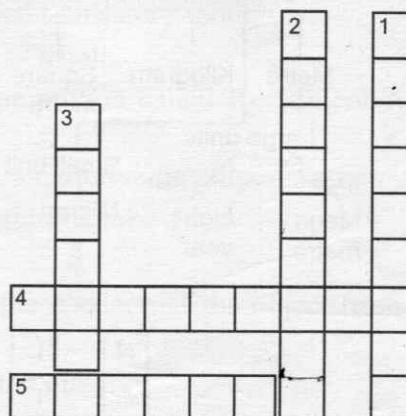(c) 9.5×10^{15} m   (d) 9.5×10^{18} m

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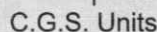
Answers

1. micrometre, millimetre, centimetre, metre, kilometre, megametre.

2. 45,000 g; 45 kg

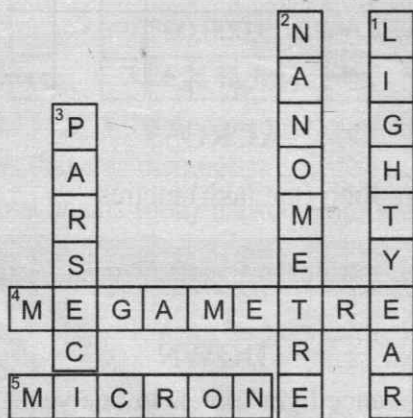3. (a) metres   (b) kilograms

(c) seconds

4. (c)   5. (c)

6. 2200 bacterial cells

7. (a) s or das   (b) kg   (c) m

   (d) cm or dm   (e) km   (f) kg

   (g) m   (h) cm, dm, or m.

8. (a) 1 cm = 0.01 m   (b) 1 m

   (c) 10 m or more   (d) 10 m

9. (a) 350 mm   (b) 12000 s   (c) 59000 cm

   (d) 0.038 cm   (e) 0.000592 g

   (f) 25×10^6 µg   (g) 10 m/s

10. (c)   11. (c)   12. (c)

13.

Measurement

- S.I. Units
  - Length — Metre
    - Large units
      - Mega metre
      - Light year
  - Mass — Kilogram
  - Area — Square metre
    - Small unit — Micron
  - Volume — Cubic metre
  - Time — second
- C.G.S. Units
  - Length — Centimetre
  - Mass — Gram
  - Area — Square Centimetre
  - Volume — Cubic Centimetre

14.

								²N		¹L
								A		I
		³P						N		G
		A						O		H
		R						M		T
		S						E		Y
⁴M	E	G	A	M	E	T	R	E		E
		C					R			A
⁵M	I	C	R	O	N	E	E			R

Section-B

MOTION

KEY FACTS

I. An object is said to be in motion if it changes its position with respect to other objects around it, when a force acts on it.

II. Different types of motion

1. **Translatory motion.** The type of motion in which the entire position of the object changes, that is, all its parts move simultaneously through the same distance is called translatory motion.

   Ex. Motion of a car, a bird, an aeroplane. All of them move as a unit.

   A translatory motion may be of two types — a straight line motion called **Rectilinear Motion** or a curved line motion called **Curvilinear Motion.**

   (i) **Rectilinear Motion**–Object moves in a straight line, *e.g.*, a car travelling along a straight road.

   (ii) **Curvilinear Motion**–When objects moving along a straight line take a curve.

   Ex. A car moving along a curve on the road.

2. **Circular Motion**–Object moves along a circular path and the distance of the object from the central point remains the same.

   Ex. (i) Movement of tip of the hand of a clock or watch on the dial.

   (ii) Motion of the blades of a ceiling fan when it is switched on.

3. **Rotational Motion**–When an object turns (or spins) about a fixed axis, it is called rotational motion.

   Ex. Spinning top, spinning of earth on its axis.

4. **Revolution**– An object moving around a circular path repeatedly.

   Ex. Blades of a moving fan, motion of handle of a sewing machine, Earth revolving round the sun.

5. **Oscillatory Motion**–An object passing through the same point while moving back and forth between two points.

   Ex. Motion of a swing, motion of the needle end of a sewing machine.

6. **Vibratory Motions**–Oscillatory motions which begin very fast and then slow down soon to position of rest. Vibrating objects produce sound.

   Ex. Plucked string of a sitar.

7. **Periodic Motion**–The motion which repeats itself after regular intervals of time.

   Ex. The motion of seconds' hand of a watch, the revolution of earth around the sun, swinging of a pendulum, Motion of pendulum of a "pendulum clock".

8. **Non-Periodic Motion**–Sudden movement without any regularity.

   Ex. Earthquake, storm, landslide.

9. **Mixed Motion**–More than one type of motion at the same time, *i.e.,* a combination of two or more motions.

   Ex. (i) Motion of earth → circular motion, periodic motion and rotational motion.

   (ii) A ball rolling on the gound → rotational motion and rectilinear motion.

Question Bank-1(b)

1. What are the similarities and differences between the motion of a bicycle and a ceiling fan that has been switched on.

2. **Fill in the blanks.**

   (i) Motion of a needle on a sewing machine is _____ motion.

   (ii) Motion of a wheel on a bicycle is _____ motion.

   (iii) The motion of a plucked string of a violin or sitar is _____ motion.

   (iv) A bird flying in the sky posseses _____ motion.

3. Motion of a screw while going into the wood is an example of

   (a) linear and spin motion

   (b) rotation and revolution

   (c) rotation and spin motion

   (d) rotation and linear motion

4. Motion of pendulum of a clock is an example of

   (a) rotational motion   (b) curvilinear motion

   (c) rectilinear motion   (d) periodic motion

5. Name the type of motion seen in the following:

   > **Word Bank**: *revolution, periodic motion, rotation, oscillatory motion, curvilinear motion, rectilinear motion.*

   (a) Earth rotating on its axis

   (b) Blades of a moving fan

   (c) Needle end of a sewing machine

   (d) A rocket fired into space

   (e) An apple falling from a tree

   (f) A car moving along a road

   (g) A car moving along a curve on the road

   (h) Motion of the branch of a tree moving to and fro.

6. Motion of earth has

   (a) circular motion   (b) periodic motion

   (c) rotational motion   (d) All the three types

7. **Match the following:**

   (i) A buzzing bee   (a) Time taken by the bob to complete one oscillation

   (ii) A bullet fired from a gun   (b) Rotatory

   (iii) Guitar string   (c) Vibratory

   (iv) Time period of a simple pendulum   (d) Periodic

   (v) Heart beat   (e) Random motion

   (vi) Potter's wheel   (f) Linear and rotatory

   (vii) A cricket ball bowled   (g) Linear

   (viii) A flying kite   (h) Curvilinear

8. Which part of the moving cycle undergoes rotatory motion ?

   (a) A

   (b) B

   (c) C

   (d) All of these

9. Praveen is drilling a hole in the wall. What type of motion is caused ?

   (a) rotatory

   (b) translatory

   (c) curvilinear

   (d) None

10. The motion of sea waves is

    (a) rectilinear   (b) curvilinear

    (c) oscillatory   (d) both a and c

11. When you play soccer, the motion described by the football is
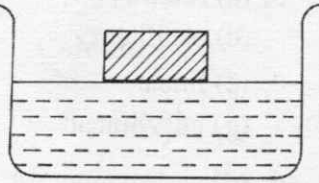
    (a) curvilinear

    (b) circular

    (c) oscillatory

    (d) non-uniform

12. Which of the following objects does not have more than one type of motion ?

    (a) screw   (b) rolling ball

    (c) scooter's wheel   (d) child on a seesaw

13. A cork is placed on the surface of water. A small stone is dropped in the water. As a result wave motion is produced on the surface of water and the cork starts moving. What kind of motion does the cork describe ?
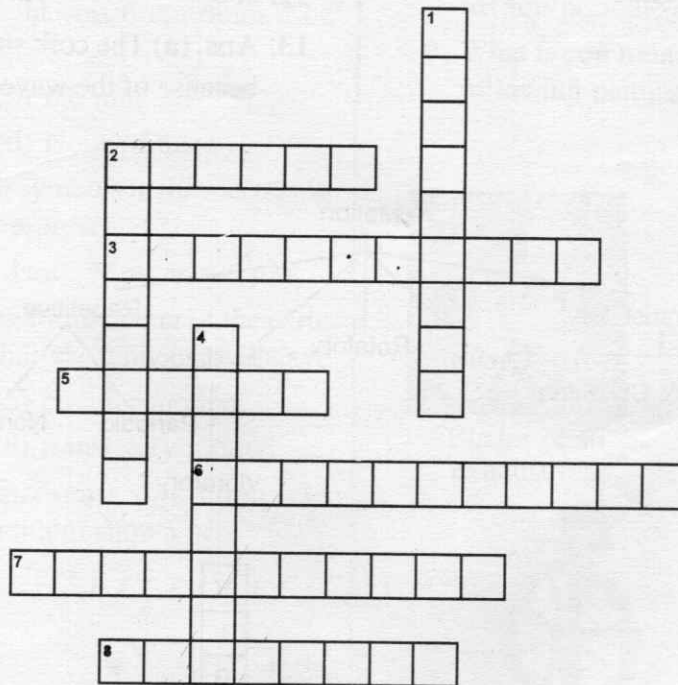
(a) periodic

(b) linear

(c) circular

(d) both periodic and circular

14. **Using the following words draw a concept map.**

Words : *Motion, Translatory, Circular, Rotatory, Oscillatory, Repetitive, Periodic, Non-periodic, Vibratory, Rectilinear, Curvilinear.*

15. **Solve the following crossword with the help of the given clues :**

ACROSS

2. Irregular motion such as motion of a ball during a game of hockey or football.

3. The motion in which all parts of the body travel through the same distance

5. Movement of a body

6. Motion of a body along a curved path.

7. Motion of a body like a pendulum

8. Occuring or appearing at intervals

DOWN

1. Motion of a plucked string of a sitar

2. Spinning of a body about a fixed axis

4. Motion of a girl sitting on a merry–go–round

Answers

1. *Similarities:* Wheel of a bicycle and ceiling fan (when on) both show circular motion

   Differences: Cycle moves in rectilinear motion while a ceiling fan does not have this kind of motion.

2. (i) Oscillatory

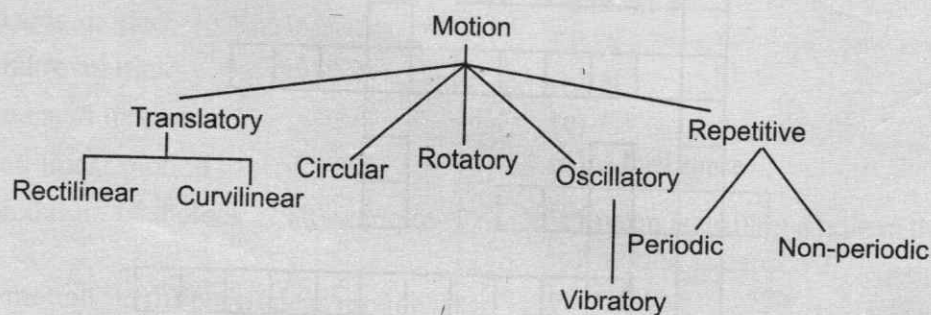   (ii) Both the circular (rotatory) and linear motion
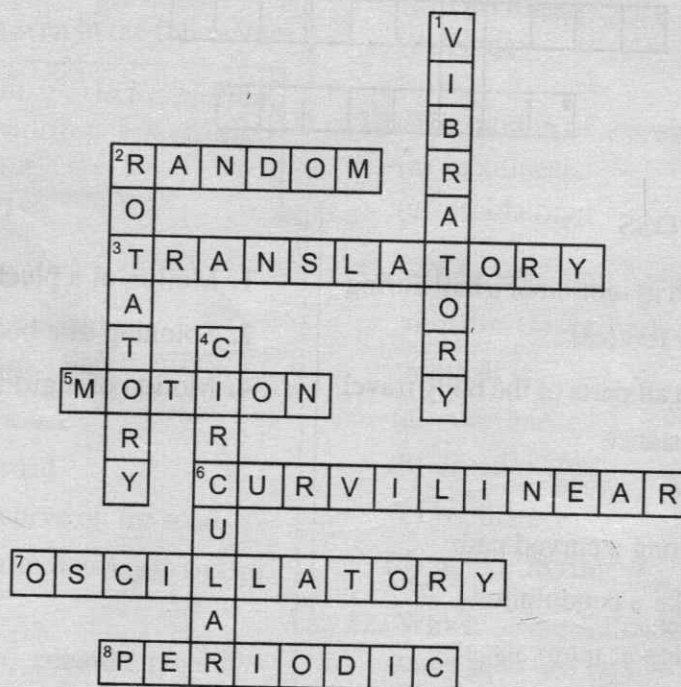
   (iii) Vibratory

   (iv) Random

3. (d)

4. (d)

5. (a) rotatory   (b) circular\rotator

   (c) oscillatory   (d) linear

   (e) linear   (f) linear

   (g) curvilinear   (h) oscillatory

6. (d)

7. (i) –e,   (ii) –f,   (iii) –c,   (iv) –a

   (v) –d,   (vi) –b,   (vii) –h,   (viii) –

8. (ii)   9. a, b   10. d

11. a, d   12. d

13. **Ans.** (a) The cork starts moving up and down because of the waves on the surface of water

14.

15.

Self Assessment Sheet-1(a)

1. Match the following

Column A	Column B
(i) dm	a. one hundredth $\left(\frac{1}{100}\right)$ part
(ii) mg	b. Megametre
(iii) kilo	c. One thousand (1000)
(iv) centi	d. milligram
(v) Mm	e. decimetre

2. One dozen coins were arranged one above the other. Their total height was 6 cm 6mm. The thickness of each coin is

(a) 6.4 mm   (b) 6.6 mm

(c) 5.5 mm   (d) None of these

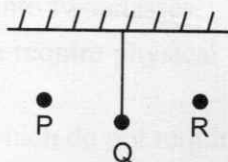3. Arrange the following symbols in the increasing order of lengths they represent.

dm cm m km dam Mm mm μm

4. If a tunnel is dug along the diameter of the earth and a ball is dropped into the tunnel, it will have

(a) linear motion   (b) circular motion

(c) oscillatory motion (d) translatory motion

5. Which of these represents one complete oscillation of the pendulum shown here.

(a) PQR

(b) PQQP

(c) QRRP

(d) PQR RQP

6. A satellite is orbiting the earth in such a manner that the satellite is always straight above India. It is at a height of about 36,000 km. Which of the following is true ?

(a) Its period of rotation is 24 hours.

(b) Its period of revolution is 24 hours.

(c) Its period of rotation is 48 hours.

(d) Its period of revolution is 48 hours.

7. **Answer true or false :**

(i) The SI unit of length is cm.

(ii) The motion of moon around the earth is circular.

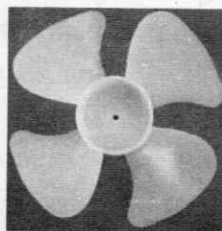(iii) The motion of the ball in a game of football is curvilinear.

(iv) The thickness of 80 turns of a wire is found to be 72 cm. The thickness of the wire is 9 cm.

(v) The motion of the seconds hand of a clock is rotational.

8. The motion of the arms of soldiers taking part in march past.

(a) circular

(b) oscillatory

(c) rotatory

(d) non-periodic

9. What is common to the motion exhibited in the following pictures.

Blades of an exhaust fan

A child on a merry go round

The motion of a spinning wheel

A couple taking 7 rounds in marriage

(a) All motions are translatory

(b) All motions are curvilinear

(c) All motions are rotatory

(d) All motions are circular

10. **Which one is odd man out ?**

(a) A car taking turn on a curved road

(b) Motion of a swing

(c) Motion of needle end of a sewing machine

(d) Motion of an engine piston

Answers

1. (i) –e, (ii) –d   (iii) –c   (iv) –a   (v) –b

2. (c)

3. μm , mm, cm, dm, m, dam, km, Mm

4. (c)   5. (d)   6. (b)

7. (i) False, the SI unit of length is metre
   (ii) True

   (iii) False. It is random motion
   (iv) False. It is 0.9 cm
   (v) True

8. (b)

9. All of them are examples of circular motion.

10. (a). It is curvilinear motion. The others are periodic motions.