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# Ch-2
# Motion
## Exercise

A) Objective Questions

i) Write True or false

a) Two trains going in opposite directions with the same speed are at rest relative to each other. False

b) A ball is thrown vertically upwards. Its motion is uniform throughout. False

c) The motion of a train starting from one station and reaching at another station is non-uniform. True

d) A motion which repeats itself after a fixed interval of time is called periodic motion. True

e) A ball thrown by a boy from a roof-top has oscillatory motion. False

f) Mass has both magnitude and direction. False.

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g) Weight always acts vertically downwards.
True

h) Mass varies from place to place but weight does not. False

2) Fill in the blanks

a) Two boys cycling on the road with the same speed are at rest relative to each other.

b) The motion in a straight line is rectilinear motion.

c) One to and fro motion of a clock pendulum takes time = 2s

d) 36 km $h^{-1}$ = 10 m $s^{-1}$

e) Total distance travelled = average speed × total time taken.

f) The weight of a girl is 36 kgf. Her mass will be 36 kg.

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2) The weight of a body is measured using a spring balance.

3) Match the following

| Column A | Column B |
|---|---|
| a) Circular motion | i) a running fan |
| b) Periodic motion | ii) a car moving on market |
| c) Vibratory motion | iii) movement of the hands of a clock. |
| d) Rotatory motion | iv) motion of wire of a guitar. |
| e) Non-uniform motion | v) motion of pendulum of a clock. |

4) Select the correct alternative.

a) A book lying on a table is an example of :

i) a body at rest [✓] ii) a body in motion [ ]

iii) a body neither at rest nor in motion [ ]

iv) none of these

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b) The motion of a pendulum is:
i) rotatory [ ] ii) oscillatory [✓] iii) curvilinear [ ]
iv) rectilinear [ ]

c) A car moving on a straight road is an example of:
i) Rotatory motion [ ] ii) Rectilinear motion [✓]
iii) Oscillatory motion [ ] iv) Periodic motion [ ]

d) A ball falls down vertically. Its motion is:
i) Periodic [ ] ii) linear [✓]
iii) Circular [ ] iv) Vibratory [ ]

e) If a body covers equal distances in equal intervals of time, the motion is said to be:
i) Uniform [✓] ii) non-uniform [ ]
iii) oscillatory [ ] iv) Vibratory [ ]

f) A boy goes from his house to school by bus at a speed of 20 $km\,h^{-1}$ and returns back through the same route at a speed of 30 $km\,h^{-1}$. The average speed of his journey is:-

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i) 24 km h$^{-1}$ [✓] ii) 25 km h$^{-1}$ [ ]
iii) 30 km h$^{-1}$ [ ] iv) 20 km h$^{-1}$ [ ]

g) The earth attracts a body of mass 1kg with a force of 10N. The mass of a boy is 50kg. His weight will be :-
i) 50kg [ ] ii) 500N [✓] iii) 50N [ ] iv) 5N [ ]

B) Short / Long answer questions :-

1) Explain the meaning of the terms rest and motion.

Ans) Rest :- A body is said to be at rest if it does not change its position with respect to its immediate surroundings.
Motion :- A body is said to be in motion if it changes its position with respect to its immediate surroundings.

2) Comment on the statement 'rest and motion are relative terms'. Give an example.

Ans) Imagine you are sitting inside a moving bus. When you look outside you will observe that you are moving. Now look to the roof of the bus, you are at rest. Hence it is concluded

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that rest and motion are relative terms.

Q3) Fill in the blanks.

a) A person walking in a compartment of a stationary train is in motion relative to the compartment and is in motion relative to the platform.

b) A person sitting in a compartment of a moving train is at rest relative to the other person sitting by his side and is at rest relative to the platform.

4) Name the five different types of motion you know.

Ans) The different types of motion are:-
1) Translatory motion
2) Rotatory motion
3) Oscillatory motion
4) Vibratory motion
5) Periodic motion
6) Multiple motion
7) Random motion.

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Q5) What do you mean by translatory motion? Give one example.

Ans) If an object like a vehicle, moves in a line in such a way that every point of the object moves through the same distance in the same time, then the motion of the object is called translatory motion. Ex - The motion of an apple falling from a tree, the motion of a man walking on a road, the motion of a box when pushed from one corner of a room to the other, are all the translatory motion.

6) Explain the meanings of (i) rectilinear motion, and (ii) curvilinear motion. Give one example of each.

Ans) i) Rectilinear :- If the motion of a body is along a straight line, it is said to be the rectilinear or linear motion. Ex - The motion of bullet fired from a gun.

ii) Curvilinear :- If the motion of a body is along a curved path, it is said to be the curvilinear motion. Ex - the motion of a cycle while taking a turn on the road, a car moving along a curved path, a ball thrown by an

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athlete are in curvilinear motion.

7) What is rotatory motion ? Give two examples

Ans) Rotatory motion :- A body is said to be in a rotatory motion or a circular motion if it moves about a fixed axis without changing the radius of its motion. Ex - the blades of a fan, a spinning wheel.

8) What is meant by circular motion ? Give one example.

Ans) The motion of a body along a circular path is called circular motion. Ex - A girl is whirling a stone tied at the end of a string in a circular path.

9) How does a rotatorey motion differ from the circular motion?

Ans) In rotatory motion, the axis of rotation passes from a point in the body itself whereas in circular motion, the axis of revolution passes through a point outside the body. Thus, the motion of earth around the sun is the circular motion whereas the motion of earth about its own axis

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is the rotational motion.

9½ In the circular and rotatory motions, the distance of a point of a the body from a fixed point always remain same, whereas it is not same in curvilinear motion.

10½ Explain oscillatory motion by giving one example.

Ans½ Oscillatory motion :- The to and fro motion of a simple pendulum is an oscillatory motion.

ex - 1½ The motion of a swing, 2½ Piston of an engine.

11½ What is vibratory motion? Give one example.

Ans½ In vibratory motion, a part of the body always remains fixed and the rest part moves to and fro about it's mean position. During the vibratory motion, the shape and size of the body changes. Ex - when we breath, our chest expands and contracts. This motion is vibratory motion.

12½ Differentiate between periodic and non-periodic motions by giving an example of each.

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Ans) Periodic motion :- A motion which gets repeated after regular intervals of time is called a periodic motion. Ex- The earth moving around the sun takes 365 days to complete one revolution and this motion gets repeated after every 365 days.

Non-Periodic motion :- The motion which does not repeat itself after regular interval of time is called non-periodic motion. Ex- A footballer running on a field, application of brakes in a moving vehicle, a ball rolling down the ground gradually slows down and finally stops, motion of tides in the sea, etc.

14) Name the type of motion being performed by each of the following :-

a) Vehicle on a straight road :- Rectilinear
b) Blades of an electric fan in motion :- Rotatory
c) Pendulum of a wall clock :- Oscillatory & periodic
d) Smoke particles from chimney :- Non-periodic
e) Hands of a clock :- Uniform, Circular & periodic
f) Earth around the sun :- Rotatory, Circular & periodic
g) A spinning top :- Rotatory

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15) Give two examples to illustrate that a body can have two or more types of motion simultaneously.

Ans) Sometime a body can have more than one type of motion. Such a motion is called the mixed motion. Ex- i) The wheels of a moving train both the translatory as well as the rotatory motions as it moves from position A to position B while rotating.

ii) The earth rotates about its axis (rotatory motion) and at the same time it revolves around the sun in a curved path (curvilinear or circular motion) in a fixed time interval (periodic motion).

16) State the types of motion of the following:-

a) The needle of a sewing machine

Ans) Periodic motion

b) The wheel of a bicycle

Ans) Rotatory motion.

c) The drill machine

Ans) Mixed = Translatory and Rotatory motion.

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d) The carpenter's saw
Ans) mixed = Translatory and Oscillatory motion

17) Distinguish between uniform and non-uniform motions, giving an example of each.

Ans)

| Uniform motion | Non-uniform motion |
|---|---|
| 1) When a body covers equal distances in a straight line in equal intervals of time, however small these time intervals may be. | 1) When a body covers equal distances in equal intervals of time in a straight line. |
| 2) In this case direction of motion remains the same. | 2) In this case direction of motion changes. |
| 3) Ex - A body moving with a constant speed in a straight line has uniform motion. | 3) Ex - Circular motion is example of non-uniform motion. |

18) How do you determine the average speed of a body in non-uniform motion?

Ans) In a non-uniform motion, the average speed of a body is calculated by dividing the total distance travelled by the body, with the total time of its journey. Thus,

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Average speed = Total distance travelled by the body / Total time of journey.

19) Define the term weight and state its SI unit.

Ans) The weight of a body is the force with which earth attracts the body i.e the weight of a body is the force of gravity on it. The weight of a body is not constant, but it changes from places to place. It is represented by the symbol W. The SI unit of weight is newton (N)

20) How are the units of weight, kgf and newton related?

Ans) 1kgf = 10N

21) State three differences between mass and weight.

Ans) Mass

i) It is the quantity of matter contained in a body

ii) Its SI unit is Kilogram (kg)

iii) It is measured by a beam balance.

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## Weight

i) It is the force with which the earth attracts the body.
ii) Its SI unit is newton (N)
iii) It is measured by a spring balance.

22) which quantity : mass or weight, does not change by change of place?

Ans) The mass of a body is constant and it does not change by changing the position of the body.

23) State which of the quantities, mass or weight is always directed vertically downwards.

Ans) Mass is the quantity of matter contained in a body. Weight is the force with which the earth attracts the body. Weight is always directed vertically downwards.

C) Numericals

1) A car covers a distance of 160 km between two cities in 4 hr. What is the average speed of car?

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Ans) Distance = 160 km
Time = 4 h
Speed = $\frac{\text{Distance travelled}}{\text{Time Taken}}$
$= \frac{160\ km}{4\ h} = 40\ km\ h^{-1}$

2) A train travels a distance of 300 km with an average speed of 60 $km\ h^{-1}$. How much time does it take to cover the distance?

Ans) Speed = 60 $km\ h^{-1}$
Distance covered = 300 km
$\because$ speed = $\frac{\text{distance travelled}}{\text{Time taken}}$
$\therefore$ Time taken = $\frac{\text{distance travelled}}{\text{Speed}}$
$= \frac{300\ km}{60\ km\ h^{-1}} = 5\ h$

3) A boy travels with an average speed of 10 $m\ s^{-1}$ for 20 min. How much distance does he travel?

Ans) Average speed of boy = 10 $m\ s^{-1}$
Time taken = 20 min
Distance travelled = speed x Time taken

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Convert minutes into seconds
1 min = 60 sec
20 min = 20 × 60 = 1200 sec
Distance travelled = $10 m s^{-1}$ × 1200 sec
= 12000 m or 12 km.

4) A boy walks a distance 30 m in 1 min and another 30 m in 1.5 min. Describe the type of motion of the boy and find his average speed in $m s^{-1}$.

Ans) Total distance travelled in going and coming back
distance = 30 m + 30 m = 60 m
Total time taken = 1 min + 1.5 min = 2.5 min
= 2.5 × 60 s = 150 s

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time of travel}}$$

$$= \frac{60 m}{150 s} = 0.4 m s^{-1}$$

5) A cyclist travels a distance of 1 km in the first hour, 0.5 km in the second hour and 0.3 km in the third hour. Find the average speed of the cyclist in
i) $km h^{-1}$ ii) $m s^{-1}$

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Solution: Distance in first hour = 1km
distance in second hour = 0.5 km
distance in third hour = 0.3 km
Total time taken = 3hr
Total distance = 1 + 0.5 + 0.3 = 1.8 km
i) Average speed in $Kmh^{-1}$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time taken}} = \frac{1.8}{3} = 0.6\ kmh^{-1}$$

ii) Average speed in $ms^{-1}$
1km = 1000m
1.8 = 1.8 × 1000 m
= 1800m
1hour = 3600 seconds
3hour = 3600 × 3 = 10800s

$$S_{av} = \frac{D}{T} = \frac{1800}{10800} = 0.167\ ms^{-1}$$

6) A car travels with speed 30 $kmh^{-1}$ for 30min and then with speed 40 $kmh^{-1}$ for one hour. Find:-
a) the total distance travelled by the car.
b) the total time of travel, and
c) the average speed of car.

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Ans) Speed of car for first 30 min = 30 km h$^{-1}$
Speed of car for next 1 hour = 40 km h$^{-1}$
a) Total distance travelled by the car

1st car, speed = $\frac{\text{Distance}}{\text{Time}}$ ⇒ Distance = Speed × Time

(∵ 30 min = 0.5 h)

Distance = 30 × 0.5
= 15 km

2nd car speed = $\frac{D}{t}$ ⇒ D = S × t

Distance = 40 km h$^{-1}$ × 1 hr
= 40 km.

Add 1st car and 2nd car
Total distance = 15 km + 40 km = 55 km

b) Total time of travel = 0.5 hr + 1.0 hr = 1.5 hr

c) Average speed = $\frac{\text{distance travelled}}{\text{Total time taken}}$

= $\frac{55 \text{ km}}{1.5 \text{ hr}}$ = 36.67 km h$^{-1}$

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7) On earth the weight of a body of mass 1.0 kg is 10 N. What will be the weight of a boy of mass 37 kg in (a) kgf (b) N?

Ans) Weight of a body of mass 1.0 kg body = 10 N

a) Weight of a boy of mass = 37 kg

b) Weight of a boy of 37 kg in N will be
1 kgf = 10 N
∴ 37 kgf = 37 × 10 N
= 370 N

8) The weight of a body of mass 6.0 kg on moon is 10 N. If a boy of mass 30 kg goes from earth to the moon surface, what will be his (a) mass (b) weight

Ans) (a) Mass remains same it does not change.
So mass of boy 30 kg on earth = 30 kg on moon surface

(b) Weight of boy on moon becomes $\frac{1}{6}$
∴ 30 kg boy will weight $30 \times \frac{1}{6} = 5$ kg
1 kg = 10 N ⇒ 5 × 10 N = 50 N
∴ Weight of boy on moon surface = 50 N.