KINEMATICS

Learning Objectives :

- ♦ Rest and motion,kinds of motion.
- ♦ We will investigate the words used to describe the motion of objects.The hope is to gain a comfortable foundation with the language that is used throughout the study of mechanics. We will study the terms such as scalars, vectors, distance, displacement, speed, velocity and acceleration.
- ♦ How to describe straight-line motion in terms of average velocity,instantaneous velocity, average acceleration and instantaneous acceleration etc.
- ♦ How to solve problems involving straight-line motion with uniform acceleration.

Real time application:

- Φ What distance must an airliner travel down a runway before reaching takeoff speed? When you throw a baseball straight up in the air, how high does it go? When a glass slips from your hand, how much time do you have to catch it before it hits the floor? This kind of all questions are answered.
- Φ Usefull to sketch the time tables for buses,trains,etc.
- Φ Usefull in Engineering works.
- Φ Usefull in finding height of a building,height of a bridge from water level etc.
- Φ Without motion there will be no vehicle,no river,no wind can flow etc i.e.we can not expect our life without these.

♣ **Important formulae :**

1. $\text{Speed} = \dfrac{\text{Distance travelled}}{\text{Time taken}}$.

2. $\text{Average speed} = \dfrac{\text{total distance}}{\text{total time.}}$

3. If a body travels first half of the distance with a speed V_1 and second half of the distance with a speed V_2 then average speed is given by $V_{avg} = \dfrac{2V_1V_2}{v_1+v_2}$

4. If v_1 and v_2 are the speeds of a body during the first half and second half times then average speed $= \dfrac{v_1+v_2}{2}$.

5. If a body travels first 1/3 rd of the distance with a speed V_1 and next 1/3 rd of the distance with a speed V_2 and remaining 1/3 rd of the distance with a speed V_3 then the average speed is given by $V = \dfrac{3v_1v_2v_3}{v_1v_2+v_2v_3+v_3v_1}$

6. Velocity($\vec{V}$) = $\frac{\text{Displacement}}{\text{time}} = \frac{\vec{s}}{t}$

9. V = u+at

7. *Average Velocity*(V) = $\frac{\textit{Total displacement}}{\textit{Total time.}}$

10. s = ut+$\frac{1}{2}$at^2

8. $\textit{Acceleration}\,(\overrightarrow{a}) = \frac{\vec{v}-\vec{u}}{t} = \frac{\textit{change in velocity}}{\textit{time.}}$

11. $v^2 - u^2 = 2as$

§§ ***Mechanics :***

The branch of physics which deals with the study of forces,motion and their relationship is called Mechanics.

The study of mechanics is divided into three parts.

i) Statics:

The branch of mechanics which deals with objects at rest is called statics.

ii) Kinematics:

The branch of mechanics which deals with the motion of objects without considering the cause of motion is called kinematics.

iii) Dynamics:

The branch of mechanics which deals with the cause of motion is called dynamics.

§§ ***Rest and Motion :***

Rest: A body is said to be at rest if it does not change it's position with respect to surroundings.

Eg: A book on a table.

Motion: A body is said to be in motion if it changes it's position with time with respect to surroundings.

Eg: a moving car with respect to earth frame.

§§ **Rest and Motion are relative :**

Absolute = Something that does not depend on anything else.

Relative = Something that is dependent on other things.

Whenever we express the state of a body to be at rest or in motion, we are expressing the state with respect to (in relation to) some other body which we identify as the frame of reference.

§§ **Kinds of Motion :**

Based on different classification we define the following

1) 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. All the particles of a body excuting translatory motion move in the same direction traversing parallel paths.

Eg: A car moving in a straight line.

2) Rotatory Motion

The motion of an object is said to be rotatory if the motion of all the particles of 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 center of the circular path that each particle traces lies on the "axis of rotation".

Eg:1) A spinning Top

2) The Wheel of a moving vehicle

3) The hands of a clock

3) 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.

Eg:1) An Oscillating Table Fan

2) The Pendulum of a wall clock

3) A Swinging Cradle

4) Opening and Closing the door of a refrigerator.

4) 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.

Eg: Each particle of a body executing rotatory motion executes circular motion.

5) Periodic Motion

Any Motion that repeats itself at regular intervals of time is called periodic motion.

Eg:1) A bouncing ball

2) A Vibrating spring

3) Every body executing circular motion can be said to be executing periodic motion

4) Every body executing oscillatory motion can be said to be executing periodic motion.

6) Random Motion

Irregular Motion of bodies changing the nature of motion frequently is called Random Motion.

Eg:1) Motion of Football player on the ground.

2) Motion of house flies.

7) One dimensional motion : If just one coordinate is sufficient to specify the position of the particle completely then its motion is called one dimensional motion.

8) Two dimensional motion : If two coordinates are sufficient to specify the position of the particle completely then its motion is called two dimensional motion.

9) Three dimensional motion : If three coordinates are sufficient to specify the position of the particle completely then its motion is called dimensional motion

§§ ***Scalars:***

The physical quantities which have only magnitude but not direction are called scalars.

Ex: Mass, length, distance, time, area, volume, density, work etc.

§§ ***Vectors:***

The physical quantities which have both magnitude and direction are called vectors.

Ex: Displacement, velocity, acceleration, force etc.

§§ ***Distance:***

The length of the curve along which the body moves is called a distance.It is scalar quantity.

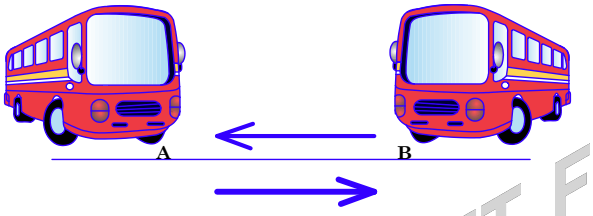
Units : cm (In C.G.S. System); m(In S.I. System)

§§ ***Displacement:***

The shortest pathlength between the initial and final positions of a body is called displacement. It is a vector quantity.

Examples 1:

Suppose a bus starting from station A travels 15000 m to reach stationB then the distance covered by the bus is 15000 m. Now if the bus returns to the station A then distance covered is 15000 m and the total distance covered by the bus during the trip from A to B and then back to A from B is 15000 m + 15000 m = 30000 m.

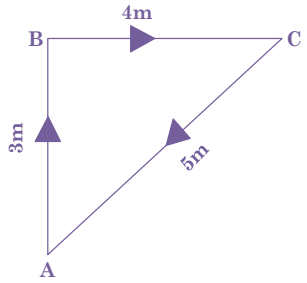


A bus moving from A to B and again from B to A

But the displacement when the bus moves from A to B and then from B to A is zero.

Examples 2:

Suppose a person moves 3 meters from A to B and 4 meters from B to C as shown in the figure. The total distance traveled by him is 7 meters and he is displaced only by 5 m which is the shortest distance between his initial position and final position.

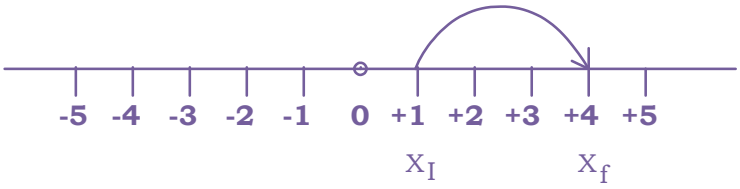


Examples 3:

Now let us consider an object changing its position, with respect to a fixed point called the origin 0. x_i and x_f are the initial position and final position of the object. Then the displacement of the object = $x_f - x_i$.

Case 1

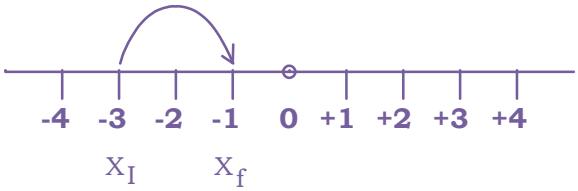
Suppose the object is moving from +1 to +4, then displacement = $x_f - x_i$ = +4 – (+1) = +3



DISPLACEMENT CASE-1

Case 2

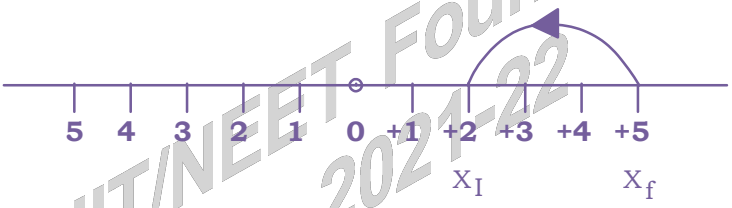
If the object is moving from -3 to -1 then displacement = $x_f - x_i = -1 - (-3) = 2$



DISPLACEMENT CASE - 2

Case 3

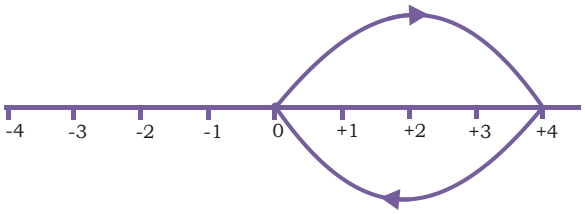
If the object is moving from +5 to +2 then displacement = $x_f - x_i = +2 - (+5) = -3$.



DISPLACEMENT CASE-3

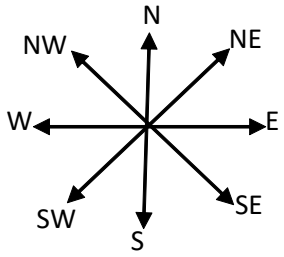
Case 4

If the object follows the path as shown in the figure then the final position and the initial position is the same i.e., the displacement is zero.



§§ ***Getting Direction :***

On the Earth the directions parallel to the ground which are



assumed to be flat are called as horizontal directions.North, East,West & south directions are horizontal and they are represented on paper as in side figure.The direction exactlly midway between N and E is called NE. Similarly NW, SW & SE.If the directions don't fall exactly midway then they won't be represented as NE, NW, SE, SW & SE. They are represented as in the following example.

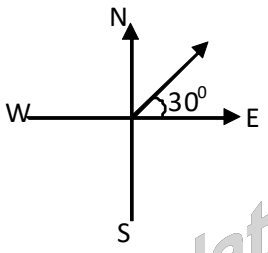
EXAMPLE

Example-1:

The direction represented in the given figure is

Sol:

30^0 due N of E or 60^0 due E of N

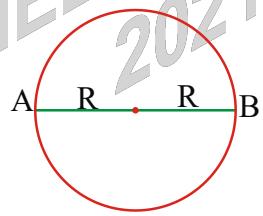


Example-2:

An athlete completes one round of a circular track of radius R in 40 s. What will be his displacement at the end of 2 min 20 s?

Sol:

The time = 2 min 20s = 140s



In 40 seconds athlete completes = 1 round

In 140 seconds athlete will completes

$= \frac{140}{40}$ round =3.5 rounds

The displacement in 3 rounds = 0

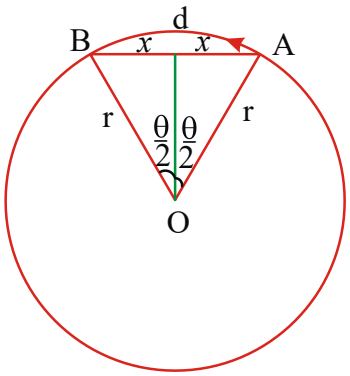
So net displacement =2R

Example-3:

If an object turns through an angle θ along a circular path of radius r from point A to poinB then

i) distance $d = r\theta$

ii)displacement $2x = 2r\sin(\theta/2)\left[\because \sin\frac{\theta}{2} = \frac{x}{r}\right]$



Example-4:

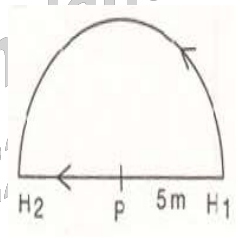
A horse is tied to a rope of length 5 m and the other end of the rope is tied to a pole. find the diplacement and the distance travelled by the horse in the following cases.

i) When the horse makes half revolution along a circular path.

ii) When it makes one full revolution

iii) when it makes 3/4 th of the revolution

sol: i) Half revolution along the circular path.



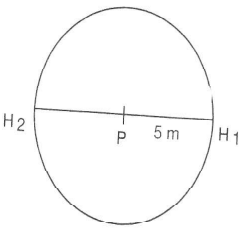
Distance travelled by the horse = $= \frac{2\pi r}{2} = \pi r = \pi \times 5 = 5\pi\ m.$

Displacement of the horse = diameter of the circular path,

$\overrightarrow{H_1 H_2}$ 10 m from H_1 to H_2

ii) When the horse makes full revolution

Distance travelled by the horse = circumference



of the circular path

$= 2\pi r = 2\pi \times 5 = 10\pi\ m$

Displacement of the horse = zero

iii) When the horse makes 3/4 th of the rrevolution

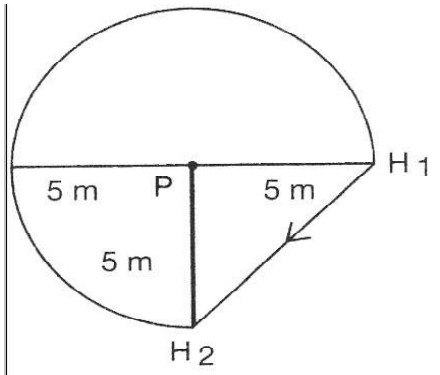


FIGURE 2.5

Distance travelled by the horse = 3/4 th of the circumference of the circle

$= \frac{3}{4}(2\pi)$

$= \frac{3}{2} \times \pi \times 5 = \frac{15}{2}\pi = 7.5\pi \ m.$

Displacement of the horse = $\overrightarrow{H_1 H_2}$

$|\overrightarrow{H_1 H_2}|$ = shortest distance between H_1 and H_2

$= \sqrt{5^2 + 5^2} = \sqrt{25+25} = \sqrt{50}$

$= 5\sqrt{2}$ m along H_1 to H_2

TEACHING TASK

I) *Single correct answer questions :*

1. A student walks 1kilometer due east and 1kilometer due south. Then she runs 2 kilometers due west.The magnitude of the student's resultant displacement is

A) 3.4 km B) 1.4 km C) 4km D) 0 km

2. If a person could fly nonstop around the equator of the earth and reaches back at initial point then displacement of person is ...

A) 2π radius of the earth B) 2π square of radius of the earth
C) diameter of earth D) 0

3. A person walks 3m towards east and then 4m towards north. Find the displacement of the person.

A) 5m B) 10m C) 15m D) 7m

4. A boy walks 12m towards west and then 5m towards south. Find the displacement of the boy.

A) 17m B) 13 m C) 8m D) 12m

5. A car travels 10km towards south and then 24km towards east. Find the displacement of the car.

A)15m B) 9m C) 34m D) 26m

6. A train travels 60km towards north and then 80km towards west. Find the displacement of the car.

A) 180km B) 100km C) 240km D) 208km

7. Statement of a scalar just consists of its magnitude along with a proper algebraic sign. Among the following the quantity which is not a scalar?

A) 20 kg B) 15 m C) 40 s D) 13 m due north

8. Among the following the quantity which one is a scalar?

A) 18m due west B) 20 m due south C) 30 m D) 23 m due north

9. Mohini walks 100m towards west then turns and walks back the way she came 20m. What distance she travelled? What is her displacement?

A) 80m, 120m B) 120m, 80m C) 120m,100m D) 100m, 120m

10. An Olympic runner is running totally 1600m circle track during a race. What are the distance and displacement he covered?

A) 1600m, 0m. B)40m,1600m C) 6400m,0m D) 1600m,64m

11. A shopper walks forward 20 m turns right and walks 5 m then turns left and walks in the original direction 10m there after turns left again for 5m. What is the distance she covered? What is her displacement?

A) 20m, 10m B) 30m, 20m C) 30m,40m D) 40m, 30m

12. Some hikers travel 2 km north turns toward the west and travel 4km turns towards the south and travel 6 km then finally travel east for 4 km. What is their distance? What is their displacement

A) 5m,20m B) 10m, 8m C) 16m, 4km D) 4m, 16m

II) <u>Multi correct answer questions :</u>

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which* ***ONE or MORE*** *is correct. Choose the correct options.*

13. Rakesh drives his bike 7 kilometer north.He stops for lunch and then drives 5 kilometer east. Then choose the correct

a) Totally he covered a distance of 12 km

b) his displacement is 8.6 km

c) finally he travelling towards west

A) Only a, b B) Only b, c C) Onlny a, c D) all a, b, c

14. Abdul walks to the pizza place for lunch. He walks 1 km east then 1 km south and then 1 km east again. Then choose the correct

a) Toally he covered a distance of 3 km

b) His displacement is $\sqrt{5}$ km

c) his displacement after travelling 1 km south is $\sqrt{2}$ km

A) Only a, b B) Only b, c C) Onlny a, c D) all a, b, c

III) Fill in the blanks :

15. A person starts from his house to office and is back again to his house.Then the displacement is.....

16. A person moves 3 m due north then turns towards east and moves again 4 m.The displacement of person is.....

17. An object is moving round in a circular path. It completes one revolution and goes back to its starting point. The _____ is zero but the _____ travelled is the circumference of the circular path.

IV) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*
  *If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows :*

18. A person is running in the circular path of radius 'r' then

Column - I	**Column - II**
a) after one complete revolution	1) distance = $2\pi r$, displacement = 0
b) after half revolution	2) distance = π r, displacement = 2r
c) after one fourth revolution	3) distance = π r/2, displacement = $\sqrt{2}$ r
d)after three by fourth of revolution	4) distance = 3π r/2, displacement = $\sqrt{2}$ r

A) a-1, b-2, c-3, d-4 B) a-1, b-2, c-4, d-2
C) a-2, b-1, c-3, d-4 D) a-1, b-3, c-2, d-4

V) Comprehension type questions :

19. An athlete running in a circular track of radius 70 m.Calculate his distance and displacement for

a) one revolution b) two revolutions c) half revolution
d) one fourth revolution e) three by fourth revolution.

VI) Solve the following :

20. On his fishing trip Justin takes the boat 12km south.The fish aren't biting so he goes 4km west.He follows a school of fish 1km north.What distance did he cover?What was his displacement?

21. Preston goes on a camel safari in Africa.He travels 5km north then 3 km east and then 1km north again.What distance did he cover?What was his displacement?

22. Naresh travels 8 m east then 4 m north.What distance did he cover?What was his displacement?

IV) Higher order thinking skills (HOTS) :

23. Stephen buys a new moped.He travels 3 km south and then 4 km east.How far does he need to go to get back to where he started in a shortest way?

24. A man is facing south.He turns 135^0 in the anti clock wise direcion and then 180^0 in clockwise direction.Which direction is he facing now?

25. An athlete completes one round of a circular track of radius R in 40 sec.What will be his displacement at the end of 2 min.20 sec?

26. A body moves from one corner of an equilateral triangle of side 10 cm to the same corner along the sides.Then the distance and displacement are respectively?

27. A body is moving along the circumference of a circle of radius 'R' and completes half of the revolution.The ratio of its displacement to distance is?

KEY

ΦΦ TEACHING TASK :

1)A 2)D 3)A 4)B 5)D 6)B 7)D 8)C 9)B 10)A 11)D
12)C 13)A 14)D 15)zero 16) 5 m 17)displacement,distance 18)A
19) a) 440 m,0 m b) 880 m,0 m c) 220 m,140 m d) 110 m,140 m e) 330 m, 140 m 20)11.6 m 21)9 km,6.7 km 22)8.94 m 23)5 km
24)SE 25)2R 26)30 cm,0 cm 27) 2: π

LEARNER'S TASK

BEGINNERS (Level - I)

I) Single correct option questions :

1. The position of a body changes w.r.t surroundings with time then the body is said to be in the state of.....with the same surroundings
A) rest B) motion C) neither in motion nor in rest D) none

2. A wooden bench lying in the corner of a garden is an example of
A) A body in motion B) A body in rest
C) body neither in state of rest nor motion D) none of these.

3. A person sitting in a speeding bus is at rest w.r.t
A) trees B) fields C) buildings D) other passengers

4. Distance is
A) always positive B) always -ve
C) may be +ve as well as -ve D) is neither +ve nor -ve.

5. A displacement
A) always +ve B) always -ve
C) either +ve or -ve or zero D) neither +ve nor -ve.

6. Choose the correct one
A) displacement > distance B) displacement < distance
C) displacement $\geq$ distance D) displacement $\leq$ distance

7. The ratio of distance travelled to displacement is
A) 1 B) ≤ 1 C) ≥ 1 D) <1

8. The S.I unit of displacement
A) m B) cm C) ft D) km

9. The ratio of C.G.S to S.I units of distance is
A) 1:100 B) 100:1 C) 1:1 D) 50:1

10. A physical quantity which has both magnitude and direction is called
A) scale B) vector C) both A and B D) none of these

11. If the distance covered by a particle is zero, what can you say about its displacement
A) It may (or) may not be zero B) It cannot be zero
C) It is negative D) It must be zero

12. If the displacement of a particle is zero distance covered by it
A) May (or) may not be zero B) Must be zero
C) it is negative D) All are true

13. In the following a physical quantity consisting of only magnitude is
A) Displacement B) force C) velocity D) Density

14. A scalar consists of
A) direction B) magnitude C) direction & magnitude D) None

15. Choose the wrong statement.
A) temperature is a vector B) current is a scalar
C) electric charge is a scalar D) both B and C

16. Anitha runs 2 m south then turns back and runs 3 m north. Distance and displacement are.
A) 2m,3m B) 5m, 1m C) 4m, 1m D) 1m,5m

17. Jayanth runs exactly 2 laps around 400 m track, then distance and displacement are.
A) 200m, 0 B) 500m, 0m C) 800 m, zero D) 700m,0m

18. A snail crawls 4 ft south then turns east and crawls 6 ft, then distance and displacement are.
A) 11ft,2.7ft B) 10 ft, 7.2 ft C)12 ft, 1ft D) 9ft,2ft

19. Rashmi runs 30 feet north, 30 feet west and then 30 feet south, then distance and displacement are.
A) 90ft,30ft B)80ft,20ft C) 90ft,22ft D) 90 ft, 40 ft

20. David walks 3 km north turns east and walks 4 km distance and displacement are.
A) 7km,5km B) 10km,5km C) 9km, 11km D) 5km,7km

21. John flies directly east for 20 km then turns to the north and flies for another 10 km, then distance and displacement are.
A) 30 km, 22km B) 30 km, 22.4 km C) 40 km, 22.4 km D) 3.0 km, 22.4 km

22. Cameron flies directly west for 13 km then turns to south and flies for another 30 km. He then flies east 13 km before landing at he airport.
A) 56 km, 3 km B) 66 km, 30 km C) 56 km, 30 km D)56 km, 3.0 k

23. Meghana runs north for 37 meters then turns east and runs for another 10 meters and then stops then distance and displacement are.
A) 47 m, $\sqrt{1496}$ m B) 48 m, $\sqrt{1496}$ m
C) 487 m, $\sqrt{1496}$ m D)4.7m, $\sqrt{1496}$ m

ACHIEVERS (Level - II)

I) Solve the following :

1. A particle moves along a straight line. At some time it is at x = 20 m. After some time it is at x = 35 m. Find the displacement during the interval.

2. A body is moving along a circular path of Radius 'R' what will be the distance travelled and displacement of the body when it completes one revolution ?

3. A body is moving along a circular path of Radius 'r' what will be the distance travelled and displacement when it completes half a revolution ?

4. If on a round trip you travel 6 km and then arive back home.

a) what distance you have travelled ? b) what is your final displacement ?

5. A body thrown vertically upwards reaches a maximum height h. If then returns to the ground. Calculate the distance and the displacement ?

6. A body travels a distance of 15 m. from P to Q and then moves a distance of 20 m. At right angles to P Q. Calculate the total distance travelled and displacement.

7. An ant travels a distance of 4 m from A to B and moves a distance of 3m at right angles to AB. Find its resultant displacement ?

8. A particle moves 3m north then 4 m east and finally 6 m south. Calculate its distance travelled and displacement.

EXPLORERS (Level - III)

I) Multiple option type :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options.*

1. The examples for random motion

a) marching of soldiers b) the tip of hands of a clock
c) movement of people in bazaar d) motion of flies and mosquitoes

A) a,b and c B) c and d C) a,c and d D) b and d

2. The distance between Sahithi's home and Anuhya's home is 1425 m.This distance is equal to

a) 142.5 km b) 1.425 km c) 1425 x 10^2 cm d) 14.25 km

A) a and b B) a and d C) b and c D) a,b and c

3. If a body completes half revolution in a circular path of radius R then

a) distance is π R b) displacement is 2R c) distance is 2R d) displacement is π R

A) a and b B) a and c C) a,c and d D) b and c

II) Fill in the blanks ;

4. distance is a..... quantity

5. displacement is a.....quantity

6. The SI unit for measuring distance .....

III) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions*

have to be appropriately bubbled as illustrated in the following example.

If the correct matches are A-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4 × 4 matrix should be as follows:

	Column - I	Column - II
7.	a) Distance	1) force
	b) Displacement	2) work
	c) vector	3) shortest path
	d) scalar	4) path covered

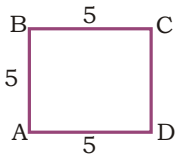
A) a - 1, b - , c - 3, d - 4 B) a - 4, b -3, c -1, d - 2

C) a - 1, b - 4, c - 3, d - 2 D) a - 2, b - 1, c - 4, d - 3

IV) Comprehension Type :

◆ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

8. A boy walks along the square path ABCD each of side 5m. Then



i) Along the path ABC distance travelled by a boy is

A) 5 m B)10 m C) 15 D) 20 m

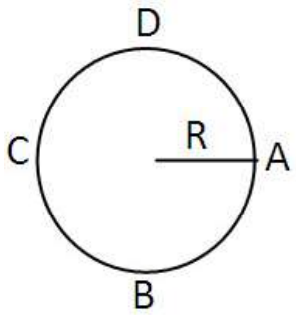
ii) Along the path CDA displacement covered by a boy

A) 5 m B) $10\sqrt{2}$ m C) $5\sqrt{2}$ m D) 10 m

iii) Total distance covered by a boy along the path ABCDA

A) 0 m B)5 m C) 10 m D) 20 m

9. Consider an ant moving along the circumference of circle or radius R m.



i) find distance and displacement from A to B

A) $\frac{\pi R}{4}, 2R$ B) $\frac{\pi R}{2}, \sqrt{2}R$ C) D) 0,0

ii) find distance and displacement from A to c

A) π R,2R B) 2R, π R C) π R,0 D) 0,2R

iii) find distance and displacement from A to D

A) $\frac{\pi R}{4}, 2R$ B) $\frac{3\pi R}{2}, \sqrt{2}R$ C) $\sqrt{2}R, \frac{\pi R}{2}$ D) 0,0

KEY

ΦΦ TEACHING TASK :

- **BEGINNERS :** 1)A 2)B 3)D 4)A 5)C 6)D 7)C 8)A 9)A 10)B 11)D 12)A 13)D 14)B 15)A 16)B 17)C 18)B 19)A 20)A 38)B 39)C 40)A 30)15 m
- **ACHIEVERS :** 31) $2\Pi R, 0$ 32) $\Pi r, 2r$ 33) 6km,0 km 34)2 h, 0 35)35m, 25 m 36)5m 37)13 m, 5m
- **EXPLORERS : I)**21)B 22)C, 23)A, **II)** 24) Scalar 25)Vector 26)meter **III)** 27) B **IV)** 28) i) B ii) C iii) D 29) i) B ii) A iii) B

§§ ***Speed:*** The distance travelled by the body in unit time is called its speed.

$$\text{Speed (V)} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

* speed is a scalar quantity.
* it is represented by v or u

units: CGS Unit : cm/s, SI unit: m/s,

§§ ***Uniform speed:*** If a body travels equal distances in equal intervals of time then it is said to be moving with uniform speed.

Eg: motion of ball on a frictionless plane surface.

§§ ***Non - uniform speed:*** If a body travels unequal distances in equal intervals of time (or) equal distance in unequal intervals of time the body is said to be travelling with non uniform (or) variable speed.

§§ **Instantaneous speed :** The speed of a body at any instant known as the instantaneous speed.speedometer of vehicle measures the instantaneous speed.

§§ ***Velocity:*** The rate of displacement (or) displacement per unit time is called velocity.

$$\therefore \text{Velocity } \left(\vec{v}\right) = \frac{Displacement}{time} = \frac{\vec{S}}{t}$$

* velocity is a vector quantity.

units: CGS Unit : cm/s, SI unit: m/s,

Note:

* The velocity of a body can be zero, negative or positive.
* The numerical value of velocity of a body can be equal to speed only if the body is moving along a straight line in the same direction.
* The velocity of a body can never be greater than the speed of that body.

§§ ***Uniform velocity:***

If a body travels equal displacements in equal intervals of time then the body is said to be travelling with uniform velocity.

§§ ***Non - uniform (or) variable velocity:***

If a body covers cover unequal displacements in equal intervals of time then it is said to be travelling with variable velocity.

TEACHING TASK

I) Single correct answer questions:

1. A body moves with a speed of 36 km/h. What is its speed in m/s.
A) 10 m/s B) 20 m/s C) 30 m/s D) 40 m/s

2. A man moves with a speed of 15 m/s. Express his speed in km/hr.
A) 34 km/h B) 54 km/h C) 36 km/h D) 18 km/h

3. An athlete runs in a circular path of radius 14 m, 10 times in 10 minutes. Calculate the speed.
A)1.6 m/s B) 1.26 m/s C)1.36 m/s D) 1.46 m/s

4. The train 'A' travelled a distance of 120 km in 3 hours where as another train 'B' travelled a distance of 180 km in 4 hours. Which train travelled faster ?
A) train A B) both trains C) train B D) none

5. Calculate the distance travelled by a car moving with a speed 35 km/h in 12 minutes.
A) 15 km B) 7 km C) 14 km D) 9km

6. Imagine two boys Ramu and Somu running a 300 m race. Let as imagine that Ramu finishes the race in 15 sec and somu finishes 30sec. Who run faster ?
A) Ramu B) somu C)equal speed D) nonE

II) Multiple option type:

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options.*

7. A scooterist covers a distance of 3 kilometers in 5 minutes. This speed equal to
a) 1000 cm/s b) 10 m/s c) 36 km/h
A) a, b only correct B) a, c only correct C) b, c only correct D) all a, b, c correct

8. Ahmed is moving in his car with a velocity of 45 km/h. Then he will cover a distance of
a) 45 km in one hour b) 750 m in one minute c) 12.5 m in one sec
A) a, b only correct B) a, c only correct C) b, c only correct D) all a, b, c correct

III) Fill in the blanks:

9. 1 km/h = ... m/s.
10. The speedometer of a vehicle measures .....
11. 15 m/s = ... km/h
12. 1 m/s = ... cm/s.
13. 1 km/min = ... m/s.

IV) Match the following:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows :*

14. A body moving in circular path of radius 7 m completes half rotation in 2 sec, then its

a) distance traveled	1) 11 m/s
b) displacement	2) 22m
c) speed	3) 7 m/s
d) velcoity	4) 14 m

A) a - 1, b - 2, c - 3, d - 4 B) a - 4, b -3, c -1, d - 2

C) a - 1, b - 4, c - 3, d - 2 D) a - 2, b - 4, c - 1, d - 3

V) Comprehension type:

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

15. In a wall clock length of seconds arm is 7 cm, minutes arm is 5 cm, hours arm is 3.5 cm

i) speed of seconds arm is

A) $\frac{11}{15}$ cm/s B) $\frac{7}{5}$ cm/s C) $\frac{10}{7}$ cm/s D) none

ii) Speed of minutes arm is

A) $\frac{11}{15}$ cm/s B) $\frac{11}{378}$ cm/s C) $\frac{11}{180}$ cm/s D) none

ii) Speed of hours arm is

A) $\frac{11}{15}$ cm/s B) $\frac{11}{378}$ cm/s C) $\frac{11}{21600}$ cm/s D) none

VI) *Solve the following:*

16. A Randy Johnson fastball is thrown with a velocity of 41.5 m/s, How long does it take the ball to reach the plate that is 18.44 meters from the pitcher's mound?

17. A bicyclist has an average velocity of 35 km/hr. How far will she travel in 6 hrs?

18. How long will it take you to complete a 135 mile trip if your velocity is 45 mph?

VII) Higher order thinking skills (HOTS)

19. A car covers a distance of 600 m in 2 minutes whereas a train covers a distance of 75 km in 50 minutes. Find the ratio of their speed

A) 1 : 5 B) 5 : 1 C) 1 : 2 D) 2 : 1

20. A bus covers a certain distance in 60 minutes if it runs at a speed of 60 km/hr. What must be the speed of the bus in order to reduce the time of journey by 40 minutes? A) 90 kmph B) 80 km/h C) 70 km/h D) 60 km/h

21. A person crosses a 600cm long bridge in 5cmin. What is his speed in kmph?

A) 7.2 B) 6 C) 5 D) 4.5

22. How far would you travel moving at 12m/s for 3min?

A) 160 m B) 2160m C) 612 m D) 123 m

KEY

ΦΦ TEACHING TASK :

1) A 2) B 3) D 4) C 5) B 6) A 7) D 8) D 9) 5/18
10) instantaneous speed 11) 54 12) 100 13) 50/3 14) D
15) i) A ii) B iii) C 16) 0.444sec 17) 210km 18) 3hr 19) A 20) A
21) A 22) B

LEARNER'S TASK

I) Single correct answer questions :

1. A speed is
A) always +ve B) always -ve C) may be +ve or -ve D) neither +ve nor -ve

2. When the distance travelled by a body is directly proportional to time the body is said to have
A) zero velocity B) zero speed C) uniform sped D) none of these

3. If the distances covered by an object are very large then speed can be expressed in
A) m/s B) cm/s C) km/h D) none

4. In 12 minutes a car whose speed is 35 km/h travels a distance of
A) 7 km B) 3.5 km C) 14 km D) 28 km

5. 1km/h = ... m/s
A) 5/18 B) 18/5 C) 9/5 D) 5/9

6. Velocity is
A) always +Ve B) always -ve C) may be +ve as well as -ve D) neither +ve nor -ve

7. Which of the following is a scalar quantity
A) displacement B) distance C) velocity D) all the above

8. A body starts from rest then its
A) initial velocity is zero B) final velocity is zero C) distance is zero D) none

9. The S.I unit of velocity
A) cm/s B) m/s C) no units D) cm/s^2

10. Select the in correct relation

A) speed = $\frac{\text{distance}}{\text{time}}$ B) velocity = $\frac{\text{displacement}}{\text{distance}}$

C) displacement = velocity x time D) $\frac{velocity}{displacement}$ = time

11. Given the distance between earth and sun is $1.6x10^8$ km and velocity of light is $4x10^5$ km/sec. Find time taken for sunlight to reach the earth is
A) 400 s B) 700 s C) 500 s D) 600 s

12. A bullet is shot from a gun with a velocity of 120 m/s. How long will it take the bullet to strike the target that is 200 meters away?
A) 2 sec B) 6.7 sec C) 5 sec D)A:1.67sec

13. A car covered a distance of 30km in 2.5 hours. What is the speed of the car?

A) 12 kmph b) 30 km/h C) 2.5 km/h D) 25 km/h

14. An aeroplane travels with a speed of 195m/s for 5 hours. What is the total distance traveled?

A) 3510 km B) 1530 km C) 5103 km D) 150 km

15. Ron walks 22.5 km in 5 hours.Find his speed

A) 5 km/h B) 22.5 km/h C) 20 km/h D) 4.5 km/hr

16. A train covers 168 km in 4 hours. Find its speed

A) 4 km/h B) 164 km/h C) 42 km/h D) 24 km/h

17. Mom pushes a stroller up and down the mall with an average speed of 6m/s. How far will she go in 30 min?

A) 1080m B) 2160m C) 612 m D) 123 m

18. If the mom in problem 33 stops to sit on a bench located 20m to the east of her starting place what was her average velocity during her 30min walk?

A) 0.90 m/s B) 0.80 m/s C) 0.70 m/s D) 0.011m/s

19. George walks to a friend's house. He walks 750 meters North then realizes he walked too far. He turns around and walks 250 meter towards South. The entire walk takes him 20 seconds. What is his speed?

A) 50 m/s B) 80 m/s C) 70 m/s D) 60 m/s

ACHIEVERS (Level - II)

Solve the following :

1. Convert 54km/h into m/s

2. A car moves with a velocity of 6m/s. Express the same in km/h.

3. A car urns in a race a distance of 22km along a circular path and reaches a diametrically opposite end in 3 minutes 20 seconds. Calculate the velocity of car ?

EXPLORERS (Level - III)

I) Multiple option type :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which* ***ONE or MORE*** *is correct. Choose the correct options*

1. Two friends Nithin and Jethin want to have a running race. Nithin can run 300 m in 15 sec where as Jethin can run 600 m in one minute.

a) Nithin will win the race b) Jethin will win the race

c) Nithin will loose the race d) Jethin will loose the race

A) only a, d are correct B) only b, c are correct

C) only a, b are correct D) only c, d are correct

2. Arrange the following speeds in decreasing order.

a) An athlete running with a speed of 10m/s

b) A bicycle moving with a speed of 20 m/min

c) A scooter moving with a speed of 30 km/h

A) a > b >c B) a > b = c C) a =b > c D) a = b= c

3. The information about fastest trains in India is given below. Then choose the correct

i) Gatimaan Express (travels between New Delhi-Agra) takes a travel time of 75 minutes to cover 200 km journey.

ii) Shatabdi Express (travels between New Delhi- Bhopal) takes a travel time of 60 min to cover 150 km journey.

iii) Rajdhani Express (travels between Mumbai- New Delhi) takes a travel time of 120 min to cover 280 km journey.

a) Gatimaan Express is the fastest compared to remaining trains

b) Shatabdi express travels faster than Rajadhani express

c) Rajdhani express has least speed in the given trains

A) only a, b B) only b, c C) only a, c D) all a, b, c

II) Fill in the blanks :

1. The rate at which the distance covered by the body is called ....

2. The rate of change of displacement of body is called.....

3. The SI unit of velocity is.....

4. The C.G.S unit of speed is .....

5. 1m/s=.....kmph

6. 20cm/s=.....m/s

7. 3m/s =..... .....kmph

8. 18kmph =.....m/s

III) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in* ***Column– I*** *have to be matched with statements (p, q, r, s) in* ***Column–II****. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

  *If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

1.

Column A	**Column B**
a) distance	1) m^2/s
b) velocity	2) m
c) $\frac{\text{speed}}{\text{distance}}$	3) s^{-1}
d) velocity x displacement	4) m/s

A) a - 1, b - 2, c - 3, d - 4 B) a - 4, b -3, c -1, d - 2

C) a - 1, b - 4, c - 3, d - 2 D) a - 2, b - 4, c - 1, d - 3

IV) Comprehension type:

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

1. Apara and Pranathi start from home at the same time and travel by different routes to school. Aparna's house is at a distance of 150m from the school while Pranathi's house is at 200 m from the school. Both reach the school at the same time.

i) Who travelled faster?

A) Pranathi B) aparna C) both equal D) none

ii) The difference of distance between Aparna's house to school and Pranathi's house to school?

A) 10 m B) 50 m C) 150 m D) 200 m

iii) Whose house is near to school?

A) Pranathi B) aparna C) both equal D) none

KEY

ΦΦ LEARNER'S TASK :

- **BEGINNERS :** 1) A 2) C 3) C 4) A 5) A 6) C 7) B 8) A 9) B 10) D 11) A 12) A 13) A 14) A 15) D 16) A 17) D 18) A
- **ACHIEVERS :** 1) 15 m/s 2) 21.6km/h 3) 110m/s
- **EXPLORERS : I)** 16) C 17) A 18) A 19) D **II)** 20) Speed 21) velocity 22) m/s 23) cm/s 24) 18/5 25) 0.2 26) 10.827) 5 **III)** 28) D **IV)** 29) i) A ii) B iii) B

§§ *Average speed:*

The ratio of the total distance travelled to the total time of travel is called average speed.

Average speed = $\frac{Total\ distance}{total\ time}$

Note:

a) It a particle travels a distance s_1 with a speed v_1 in a time t_1, a distance s_2 with a speed v_2 in a time t_2 and a distance s_3 with a speed v_3 in time t_3 then,

Total distance travelled = $s_1+s_2+s_3$,

Total time = $t_1+t_2+t_3$.

i) $V_{avg} = \frac{s_1+s_2+s_3}{t_1+t_2+t_3}$ ii) $V_{avg} = \frac{v_1t_1+v_2t_2+v_3t_3}{t_1+t_2+t_3}$ iii) $V_{avg} = \frac{s_1+s_2+s_3}{\frac{s_1}{v_1}+\frac{s_2}{v_2}+\frac{s_3}{v_3}}$

b) If a body travels first half of the distance with a speed v_1 and second half of the distance with a speed v_2, then $V_{avg} = \frac{2v_1v_2}{v_1+v_2}$

c) If a body travels with a speed v_1 for first half of time and with a speed v_2 for second half of time, then $V_{avg} = \frac{v_1+v_2}{2}$

§§ ***Average velocity:***

The ratio of total displacement to the total interval of time of a body is called average velocity.

$\therefore$ Average Velocity $(V) = \frac{\text{Total displacement}}{\text{Total time}}$

$V_{avg} = \frac{x_f - x_i}{t_f - t_i}$ Where x_i = Initial Distance, x_f = Final distance,

t_i = Initial time, t_f= Final time, V = Final Velocity.

EXAMPLE

Example-5:

A motor vehicle travelled the first third of a distance 's' at a speed of $V_1 = 10$ kmph, the second one third at a speed of $V_2 = 20$ kmph and the last one third at a speed of $V_3 = 60$ kmph. Determine the mean speed of the vehicle over the entire distances.

Sol: $V_{mean} = \frac{s_1 + s_2 + s_3}{t_1 + t_2 + t_3}$, $V_{mean} = \frac{\frac{s}{3} + \frac{s}{3} + \frac{s}{3}}{\frac{s}{3v_1} + \frac{s}{3v_2} + \frac{s}{3v_3}}$ $\therefore t = \frac{s}{v}$

$= \frac{s}{\frac{s}{3}\left[\frac{1}{10} + \frac{1}{20} + \frac{1}{60}\right]}$ $= \frac{3}{\frac{6+3+1}{60}}$ = $\frac{180}{10} = 18$ $\therefore V_{mean} = 18 Kmph$

Example-6:

A motorist drives north for 35.0 minutes at 85.0 Km/h and then stops for 15.0 minutes. He next continues north travelling 130 km in 2hours a) What is his total displacement? b) What is his average velocity?

Sol: *a)* Distance travelled in 35min $(S_1) = 85 \times \frac{35}{60} = 49.6\, km$

Distance travelled in 2 hrs (S_2)= 130km

Total displacement = $S_1 + S_2 = 130 + 49.6 = 179.6\, km$

b) $V_{avg} = \frac{S_1 + S_2}{t_1 + t_2}$ $= \frac{49.6 + 130}{\frac{35}{60} + 2} = 63.4\, kmph$

Example-7:

A particle is at x = +5m at t = 0s, x = -7m at t = 6 s and x = +2m at t = 10s. Find the average velocity of the particle during the intervals

(a) t = 0s to t = 6s (b) t = 6s to t = 10s (c) t = 0s to t = 10s.

Sol: From the definition of average velocity

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

a) the average velocity between the times t = 0 to t =6s

$x_1 = +5m, t_1 = 0, x_2 = -7m, t_2 = 6s$

Hence $\bar{v}_1 = \frac{x_2 - x_1}{t_2 - t_1} = \frac{-7-5}{6-0} = -2ms^{-1}$

b) The average velocity between the times $t_2 = 6s$ to $t_3 = 10s$ is

$$\bar{v}_2 = \frac{x_3 - x_2}{t_3 - t_2} = \frac{2-(-7)}{10-6} = \frac{9}{4} = 2.25ms^{-1}$$

c) The average velocity between times $t_1 = 0$ to $t_3 = 10s$ is

$$\bar{v}_3 = \frac{x_3 - x_1}{t_3 - t_1} = \frac{2-5}{10-0} = -0.3ms^{-1}$$

TEACHING TASK

I) Single correct answer questions:

1. A car travels first 30 km at a uniform speed of 40 km/h and the next 30 km at a uniform speed of 20 km/hr. Find its average speed.

A) 25.6 km/h B) 26.2 km/h C) 26.6 km/h D) 22.6 km/h

2. A train travels 60 km/h for 0.52 h 30 km/h for the next 0.24 h and finally 70 km/h for the next 0.71 h What is the average speed of the train?

A)52.9 km/h B) 59.9 km/h C) 55.9 km/h D) 51.9 km/h

3. A body covers 15 m in first second, 25 m in 2nd second and 35 m in 3rd second. What is the average speed of the body ?

A) 15 m/s B) 35 m/s C) 20 m/s D) 25 m/s

4. A train travels the first 100 km at a speed of 50 km/h between Delhi and Agra (the distance between Delhi and Agra is 200 km). How much fast must the train travel in the next 100 km so as to maintain an average speed of 70 km/h for the whole journey ?

A) 115.6 km/h B) 116.6 km/h C) 106.6 km/h D) 16.6 km/h

5. A car is moving along a circular track covering its one complete round of 225 m in 5 sec. Its average velocity is

A) 15m/s B) 0 m/s C) 10 m/s D) 15 km/s

6. If a car covers first $\frac{2}{5}^{th}$ of the total distance with a speed v_1 and the remaining $\frac{3}{5}^{th}$ of the total distance with a speed v_2 then its average speed is

A) $\frac{5v_1}{3v_1 + 2v_2}$ B) $\frac{5v_1v_2}{2v_1 + 3v_2}$ C) $\frac{5v_2}{3v_1 + 2v_2}$ D) $\frac{5v_1v_2}{3v_1 + 2v_2}$

7. A particle is moving along its straight line with different velocities 20 kmph in 5 sec, 40 kmph in 10 sec, 60 kmph in 15 sec. Find its average velocity will be

A) 46.6 kmph B) 36.6 kmph C)48.6 kmph D) 52.5 kmph

II) *Multiple option type:*

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

8. A car travels a distance of 200km from Delhi to Ambla towards North in 5 hours, returns to Delhi in same time.Then choose the correct

a) average speed of car is 40 km/h

b) total time taken to return back to Delhi is 10 hours

c) average velocity of the car is zero

A) only a, b B) only a, c C) only a, c D) all a, b, c

III) Fill in the blanks:

9. If a body travels first half of the distance with a speed v_1 and second half of the distance with a speed v_2 then average speed = ...

10. If a body travels first half of the total time with a speed v_1 and second half of the time with a speed v_2 then average speed = ...

11. Average velocity of earth in completing one rotation around sun is .....

IV) Match the following:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

  *If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

12. If a body covers the first x % of the total distance with velocity v_1 and the remaining (100 - x) % of the distance with velocity v_2, then

a] If x = 20 1] $V_{avg} = \frac{2v_1v_2}{v_1+v_2}$

b] If x = 30 2] $V_{avg} = \frac{10v_1v_2}{6v_1+4v_2}$

c] If x = 40 3] $V_{avg} = \frac{10v_1v_2}{7v_1+3v_2}$

d] If x = 50 4] $V_{avg} = \frac{10v_1v_2}{8v_1+2v_2}$

A) a-1, b-2, c-3, d-4 B) a-2, b-1, c-4, d-3

C) a-4, b-3, c-2, d-1 D) a-4, b-3, c-1, d-2

V) Comprehension type :

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

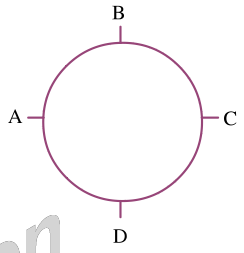
13. A person is moving along a circular path of radius r with uniform speed as shown in the figure. He completes one revolution in four seconds.

i) Average speed along AB is

A) πr B) $\frac{\pi r}{2}$ C) $\frac{\pi r}{3}$ D) $\frac{\pi r}{4}$

ii) Average speed along AC is

A) πr B) $\frac{\pi r}{2}$ C) $\frac{\pi r}{3}$ D) $\frac{\pi r}{4}$



iii) Average speed for one complete revolution is

A) πr B) $\frac{\pi r}{2}$ C) $\frac{\pi r}{3}$ D) $\frac{\pi r}{4}$

VI) Solve the following:

14. A car is moving with initial velocity of 20 m/s and it reaches its destiny at 50 m/s. Calculate its average velocity.

15. In 1988 Summer Olympic Games, Florence Griffith-Joyner set the women's world record in the 100 meter dash. She completed the race in 10.48 seconds. What was her average velocity?

16. How far will you travel if you walk for 6 hrs at an average velocity of 4 km/hr?

VII) Higher order thinking skills (HOTS)

17. A person runs 4.0 km in 32 minutes then 2.0 km in 22 minutes and finally 1.0 km in 16 minutes. Find average speed of him in km per minute?

A) 36 B) 18 C) 0.1 D) 10

18. A train travels 120 km in 2 hours and 30 minutes. What is its average speed?

A) 36 km/h B) 48 km/h C) 56 km/h D) 84 km/h

19. A plane's average speed between two cities is 600 km/hr. If the trip takes 2.5 hrs. how far does the plane fly?

A) 1500km B) 600km C) 2500km D) 3000km

KEY

ΦΦ TEACHING TASK :

1) C 2) B 3) D 4) B 5) B 6) A 7) A 8) D 9) $(2v_1v_2)/(v_1+v_2)$
10) $(v_1+v_2)/2$ 11) zero 12) C 13) i) D ii) B iii) B 14) 35 m/s
15) 9.54m/s 16) 24km 17) C 18) B 19) A

LEARNER'S TASK

BEGINNERS (Level - I)

I) Choose the correct option :

1. The numerical ratio of average velocity and average speed.

A) always less than one B) always equal to one

C) always more than one D) equal or less than one

2. An ant covers 2cm, 1.5cm , 2.5cm, 3cm in one second each.Find average speed of it.....

A) 3m/s B) 2.5 m/s C) 1.5m/s D) none

3. A car covers 40km in 1 hr and then 10 km in 15min then car moving with

A) variable speed B) uniform speed C) average speed D) none

4. 36kmph =..... m/min

A) 10 B) 129.6 C) 600 D) 100

5. A cyclist moving in circular path of radius 200m covers half revolution in 5min. its average speed is.....m/s

A) 44/21 B) 4/3 C) 88/7 D) 2/3

6. The magnitude of average velocity is equal to average speed when a particle moves

A) in a curved path B) in the same direction

C) with constant speed D) with constant speed

7. A car completes one lap around a circular track of radius 50 meters. The time it takes to complete the lap is 1.2 minutes. What is the total distance covered?

A) 4.66m/s B) 4.26m/s C) 4.36m/s D)3.36m/s

8. In the above question what is the average speed of the car in meters per second?

A) 0.694 B) 0.56 C) 0.51 D)0.88

9. A family leaves from New York City and is flying to Los Angles which is 2800miles away. It takes 3.25 hours to fly from New York to O'Hare International Airport in Chicago IL. There they have a one hour layover and fly to Los Angles in 2.75 hours. What is the average speed of the whole travel?

A) 30 mph B) 40 mph C) 50 mph D) 60 mph

10. A car travels 300.0 m East then 400.0 m West. If it takes 18.0 seconds to do this. what is the car's average speed and average velocity?

A) 38.18 m/s, 5.55m/s B) 38.88 m/s, 5.55m/s

C) 38.88 m/s, 5.05m/s D) 30.88 m/s, 5.55m/s

11. A runner runs for 1.00 hour at an average speed of 2.00 m/s. How far does she run during this time?

A) 120m B) 12m C) 1.20m D) Both a&c

12. A car travels a distance of 30 miles for 2 hrs and 45 miles for next 3 hrs.Calculate its average speed.

A) 15mph B) 1.5mph C) 5mph D) 10mph

13. A body moves 30 m at a uniform speed of 20 m/s and next 30 m at a uniform

speed of 12 m/s. Calculate its average speed.

A) 15 m/s B) 12 m/s C) 10 m/s D) 20m/s

14. A car covers 30 km at a uniform speed of 60 km/h and the next 30 km at a uniform speed of 40 km/h. Find the total time taken and the average speed ?

A) 70 minutes, 48 km/h B) 75 minutes, 48 km/h

C) 75 minutes, 40 km/h D) 25 minutes, 48 km/h

15. A train travels some distance with a speed of 30 km/h and returns with a speed of 45 km/h. Calculate the average speed of the train.

A) 36 km/h B) 18 km/h C) 56 km/h D) 24 km/h

16. Sam is driving along the highway towards Saint John. He travels 150km in 3.00hrs. What is his average speed for his trip?

A) 50 km/h B) 18 km/h

C) 56 km/h D) 24 km/h

17. A vehicle travels 2345 m [W] in 315 s towards the evening sun. What is its average velocity? (7.4 m/s [W])

A) 8m/s B) 7.4 m/s C) 8m/s D) 6m/s

ACHIEVERS (Level - II)

Solve the following :

1. Hari is practicing for a running race. For 1st 1/2 hour he runs 0.25 miles and for the next 1/2 hour he runs for 0.2 miles. Calculate the average speed?

2. A car moves from A to B at a speed of 50 km/hr and comes back from B to A at a speed of 30 km/hr. Find its average speed during the journey.

3. A car covers a distance of 60 km in 3 hours. However, for the first 40 km it travels 16 km/hr. At what speed must it travel for the rest of the distance in order to complete the journey on time?

4. Calculate the average velocity at a particular time interval of a particle if it is moves 5 m at 2 s and 15 m at 4s along x-axis?

EXPLORERS (Level - III)

I) Multiple option type:

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

1. Consider the motion of the tip of the minute hand of a clock. In one hour

a) The displacement is zero b) The distance covered is zero

c) average speed is zero d) average velocity is zero.

A) only a,b correct B) only a,c correct

C) only a, d correct D) all a, b, c, d are correct

2. When a body completes certain journey, then choose the correct

a) its distance can be zero b) its displacement can be zero

c) its average speed can be zerod) its average velocity can be zero

A) only a, b B) only a, c C) only b, c D) only b, d

3. When a body moves form one place to another place, choose the correct

a) its distance can be equal to or greater than displacement

b) its average speed can be equal to or greater than average velocity

A) only a B) only b C) both a, b D) both are wrong

II) Fill in the blanks:

4. Car moving on circular track its average velocity after one round.....

5. The ratio of total displacement to the total interval of time of a body is .....called

6. The ratio of the total distance travelled to the total time of travel is called .....

7. SI unit of average speed or average velocity is .....

8. If average speed is zero then average velocity is .....

III) Match the following:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

  *If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

1. A car is running in a circular track of radius R, and takes a time T to complete each 1 / 4 th of the distance.

a) after one rotation average speed is	1) zero
b) after one rotation average velocity is	2) π R / 2T
c) after half rotation average velocity is	3) $\sqrt{2}$ R / T
d) after 1/4 th rotation average velocity is	4) R / T

A) a-2, b-1, c-4, d-3 B) a-1, b-2, c-3, d-4

C) a-4, b-3, c-2, d-1 D) a-2, b-3, c-4, d-1

2. If a body covers the first x % of the total time with velocity v_1 and the remaining (100 - x) % of the time with velocity v_2, then

a] If x = 20 1] $V_{avg} = \frac{v_1 + v_2}{2}$

b] If x = 30 2] $V_{avg} = \frac{4v_1 + 6v_2}{10}$

c] If x = 40 3] $V_{avg} = \frac{3v_1 + 7v_2}{10}$

d] If x = 50 4] $V_{avg} = \frac{2v_1 + 8v_2}{10}$

A) a-1, b-2, c-3, d-4 B) a-2, b-1, c-4, d-3

C) a-4, b-3, c-2, d-1 D) a-4, b-3, c-1, d-2

IV) Comprehension type:

♦ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

1. If a particle moves along a straight line distance of 29 m in time of 5 sec and a distance 55m in time of 14 sec.Then

i) Total distance traveled by the particle

A) 29 m B) 55 m C) 84 m D) 14 m

ii) Total time taken by the particle is

A) 5 sec B) 14 sec C) 19 sec D) 29 sec.

iii) The average velocity of a particle is

A) 2.89 m/sec B) 4.42 m/s C) 9.82 m/s D) zero

2. Mr.Bean travelled 240 km in 4 hours by train and then travelled 120 km in 3 hours by car and 3 km in 1/2 hour by cycle. Then

i) Speed of train is

A) 20 kmph B) 40 kmph C) 60 kmph D) 80 kmph

ii) Speed of car is

A) 20 kmph B) 40 kmph C) 60 kmph D) 80 kmph

iii) Speed of bicycle is

A) 6 kmph B) 8 kmph C) 10 kmph D) 12 kmph

iv) Total distance travelled by Mr. Bean is

A) 240 km B) 120 km C) 3 km D) 363 km

v) Mr.Bean travelled for a total time of

A) 3.5 hr B) 5.5 hr C) 7.5 hr D) 9.5 hr

vi) Average speed of Mr.Been for the total trip is

A) 48.4 km/hr B) 52.3 km/h C) 56.7 km/h D) zero

KEY

ΦΦ TEACHING TASK :

☐ **BEGINNERS :** 1) D 2) A 3) B 4) C 5) A 6) B 7) C 8) A 9) B 10) B 11) D 12) A 13) A 14) B 15) A 32) A 33) B

☐ **BEGINNERS :** 28) 0.45mph 29) 37.5 km/hr 30) 40 km/hr 31) 5 m/s

☐ **BEGINNERS : I)** 16) C 17) D 18) C, **II)** 19) zero 20) average velocity 21) average speed 22) m/s 23) zero **III)** 24) A 25) C **IV)** 26) i) C ii) C iii) B 27) i)C ii) B iii) A iv) D v) C vi) A

§§ ***Acceleration:*** The change in velocity per unit time (OR) The rate of change of velocity of a body is called Acceleration.

$$\text{Acceleration} = \frac{change\ velocity}{time}$$

Units: m/s² (S.I system), cm/s² (C.G.S system)

The velocity of the car increases continuously with respect to time says that the car accelerates.The increase in velocity per unit time is called acceleration.

The velocity of the car decreases continuously with respect to time says that the car decelerates or retards.

The decrease in velocity per unit time is called deceleration or retardation.

Negative acceleration is called Retardation or Deceleration.

§§ ***Accelerations are of two types:***

i) Positive acceleration: If body's velocity increases gradually then it said to possesses positive acceleration.

Example: A freely falling body.

ii) Negative acceleration (or) Deceleration (or) Retardation:

If body's velocity decreases gradually then it said to possesses retardation.

Ex: A vertically projected body.

§§ ***Equations of motion :***

The relation between v, u,a and s for a body moving with uniform acceleration in a straight path are well known to us. Equations which relate these quantities are known as equations of motion.

The equations of motion are

i) $V = u+at$

ii) $s = ut+\frac{1}{2}at^2$

iii) $v^2- u^2 = 2as$

where $u \rightarrow$ Initial Velocity

$v \rightarrow$ Final Velocity

$t \rightarrow$ time

$a \rightarrow$ uniform acceleration

$S \rightarrow$ Distance travelled

EXAMPLE

Example-8:

If a sports car at rest accelerates uniformly to a speed of 144 km h^{-1} in 5 s then find distance travelled by it ?

Sol : $u = 0, v = 144 km\ h^{-1} = 144 \times \frac{5}{18} m\ s^{-1} = 40 m s^{-1}, t = 5\ s$

$a = \frac{v-u}{t} = \frac{40}{5} = 8 m\ s^{-2}, \quad s = \frac{1}{2} \times 8 \times (5)^2 = 100 m$

Example-9:

The driver of a car moving with a velocity of 54 km h^{-1} applies brakes to decrease its velocity to 36 km h^{-1} .If the retardation produced by the brakes is 2m s^{-2}, arange the following steps in a sequential order to calculate the distance travelled by the car.

Sol: $u = 54\,km\ h^{-1} = 54 \times \frac{5}{18} = 15 m\ s^{-1}, v = 36 km\ h^{-1} = 36 \times \frac{5}{18} = 10\, m\, s^{-1}, a = -2.0\, m\ s^{-1}$

$U \sin g\, v^2 - u^2 = 2as(a) \Rightarrow s = \frac{v^2 - u^2}{-2a}(c) \Rightarrow s = \frac{100 - 225}{-2a}(c)$

$\Rightarrow s = 125/4 = 31.25 m(d)$

Example-10:

A bike starting from rest picks up a velocity of 72 km h^{-1} over a distance of 40m.Calculate its acceleration.

Sol : Given, u = 0, v = 72 km h^{-1} $= 72 \times \frac{5}{18} = 20 ms^{-1}$, s = 40m

using $v^2 - u^2 = 2as \Rightarrow (20)^2 - 0 = 2a \times 40 \Rightarrow a = \frac{400}{2 \times 40} = 5\, m\, s^{-2}$

Example-11:

A car moving along a straight road with a speed of 72 km h^{-1} is brought to rest within 3 s after the application of brakes. Calculate the deceleration produced by the brakes.

Sol:

Initial velocity 'u' =72 km h^{-1} = $72 \times \frac{5}{18} = 20\ ms^{-1}$

Final velocity , v=0 m s^{-1},

$\frac{v-u}{t} = a \Rightarrow \frac{0-20}{3} = a \Rightarrow deceleration = 6.67 ms^{-2}$

TEACHING TASK

I) Choose the correct answer :

1. A train starting initially with a speed of 36 km/h picks up a velocity of 108 km/h in half minute. Calculate its acceleration in m/s^2.

A) 0.66 m/s^2 B) 0.76 m/s^2 C) 0.86 m/s^2 D) 0.96 m/s^2

2. A motor cyclist has 8sec to stop his motor cycle which is travelling at 50 km/h.What i s his retardation ?

A) 1.4 m/s^2 B) 1.74 m/s^2 C) 1.04 m/s^2 D) 2.74 m/s^2

3. A scooter acquires a velocity of 36 km/h in 10seconds just after the start. Calculate the acceleration of the scooter.

A) 7m/s^2 B) 4m/s^2 C) 3m/s^2 D) 1m/s^2

4. A bus increases its speed from 36km/h to 72km/h in 10seconds. Calculate its acceleration.

A) 7m/s^2 B) 4m/s^2 C) 3m/s^2 D) 1m/s^2

5. If a Ferrari with an initial velocity of 10 m/s accelerates at a rate of 50 ms^{-2} for 3 s, what will be its final velocity?

A) 150m/s B) 100 m/s C) 120 m/s D) 160 m/s

6. Josh rolled a bowling ball down a lane in 2.5 s. The ball traveled at a constant acceleration of 1.8 m/s^2 down the lane and was traveling at a speed of 7.6 m/s by the time it reached the pins at the end of the lane. How fast was the ball going when it left Tim's hand?

A) 1.2 m/s B) 3 m/s C) 3.1 m/s D) 4.1 m/s

7. An aeroplane accelerates down on a runway at 3.20 m/s^2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before takeoff.

A) 1720m B) 1270m C) 1050m D) 1500m

8. A car starts from rest and accelerates uniformly over a time of 5.21 seconds for a distance of 110 m. Determine the acceleration of the car.

A) 6.4m/s^2 B) 7.1m/s^2 C) 8.1 m/s^2 D) 7.4m/s^2

9. A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds. Determine the acceleration of the car and the distance traveled.

A) 73.8m B) 79.8m C) 98.7m D) 89.7m

10. Rocket-powered sleds are used to test the human response to acceleration. If a rocket-powered sled is accelerated to a speed of 444 m/s in 1.83 seconds then what is the acceleration and distance that the sled travel?

A) 406m B) 306m C) 206m D) 604m

II) *Multiple option type:*

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

11. A body starting from rest and moving with uniform acceleration of 5 m/s^2. Then choose the correct

a) its initial velocity is zero

b) its velocity will increase with time

c) its velocity at the end of 5 sec is 25 m/s

d) its velocity at the end of 10 sec is 250 m/s

A) only a, b, c B) only b, c, d C) only a, c, d D) all a, b, c, d

12. A person running at 20 m/s speeds up to 60 m/s in 4 seconds. Then choose the correct

a) his initial velocity is 20 m/s b) his final velocity is 60 m/s

c) his acceleration is 10 m/s^2 d) his velocity will be 120 km/h in next 6 sec

A) only a, b, c B) only b, c, d C) only a, c, d D) all a, b, c, d

III) Fill in the blanks:

13. The velocity of the body decreasing gradually is said to be in.....

14. The S.I unit of deceleration is .....

15. Another name for deceleration is.....

IV) Match the following:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

  *If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4*

matrix should be as follows:

16.

Column A		Column B	
a)	u = 10m/s, v = 0m/s, t =1s	1)	a = 2m/s^2
b)	u = 5m/s, v = 5m/s, t =5s	2)	a = -10m/s^2
c)	u = 0m/s, v = 10m/s, t=5s	3)	a = -0.5m/s^2
d)	u = 2m/s, v = 1m/s, t=2s	4)	a = 0m/s^2

A. a-2, b-4, c-1, d-3 B. a-2, b-3, c-4, d-1

C. a-3, b-2, c-1, d-4 D. a-3, b-4, c-1, d-2

V) Comprehension type :

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

17. Acceleration is ratio between change in velocity and time

i) The velocity of car changes from 18 km/h to 72 km/h in 30 s the acceleration in km/h^2 is

A) 648 B) 6480 C) 64800 D) 648000

ii) The change in velocity of motor bike is 54 km/h in one minute the acceleration in km/h^2 is

A) 324 B) 3240 C) 32400 D) 324000

iii) A speeding car changes its velocity from 108 km/h to 36 km/h in 4s the deceleration in m/s^2.

A) 6 B) 5 C) 4 D) 3

VI) Solve the following :

18. A bullet is moving at a speed of 367 m/s when it embeds into a lump of moist clay. The bullet penetrates for a distance of 0.0621 m. Determine the acceleration of the bullet while moving into the clay. (Assume a uniform acceleration.)

19. A stone is dropped into a deep well and is heard to hit the water 3.41 s after being dropped. Determine the depth of the well.

20. A plane has a takeoff speed of 88.3 m/s and requires 1365 m to reach that speed. Determine the acceleration of the plane and the time required to reach this speed.

VII) Higher order thinking skills (HOTS) :

21. A bike accelerates uniformly from rest to a speed of 7.10 m/s over a distance of 35.4 m. Determine the acceleration of the bike.

A) 0.8m/s^2 B) 7.1m/s^2 C) 0.712 m/s^2 D) 7.4m/s^2

22. An engineer is designing the runway for an airport. Of the planes that will use the airport, the lowest acceleration rate is likely to be 3 m/s^2. The takeoff speed for this plane will be 65 m/s. Assuming this minimum acceleration and what is the minimum allowed length for the runway?

A) 738m B) 798m C) 987m D) 704m

KEY

ΦΦ TEACHING TASK :

1) A 2) B 3) D 4) D 5)D 6)C 7) A 8)C 9)B 10) A 11)C

12) D, 13)Acceleration 14)ms^{-2} 15) retardation 16) A 17) i)B ii) B iii) B

18) -1.08x10^6 m /s^2 19) 57 m 20) 30.8 s 21) C 22) D

LEARNER'S TASK

BEGINNERS (Level - I)

I) Single correct answer questions :

1. Relation between change in velocity, acceleration and time is
A) v = u - at B) v - u = at C) v = at - u D) v - at = 0

2. The S.I unit of deceleration
A) m/min^2 B) m/s^2 C) cm/s^2 D) ft/s^2

3. The rate of change of velocity is known as
A) speed B) displacement C) acceleration D) none of these

4. The value of g is
A) 980 m/s^2 B) 9.8 m/s^2 C) 980 cm/s^2 D) 0.98 m/s^2

5. A body moves with a uniform velocity. Among the following the correct statement is A) Its velocity is zero B) Its speed is zero
C) Its acceleration is zero D) Both 1 & 2 are correct

6. If a particle is in uniform motion along its straight line then its acceleration is A) zero B) increases C) decreases D) constant

7. Unit of acceleration is
A) N/s^2 B) cm/s^2 C) m/s D) cm/s

8. Choose the correct statements:
A) a body having constant speed can have varying velocity
B) a body can posses zero acceleration with non-zero velocity
C) If velocity is constant,acceleration is uniform and motion is non-uniform.
D) If velocity is not constant,acceleration and motion are non-uniform.

9. Acceleration of a body can be due to
A) change in magnitude of velocity of the body
B) change in direction of velocity of the body
C) change in magnitude of velocity but not in direction
D) change in direction of velocity but not in magnitude

10. What is the relation between S.I and C.G.S units of acceleration?
A) 1:100 B) 100:1 C) 200:1 D)1:200

11. Find the ratio between C.G.S and S.I units of speed ?
A) 1:100 B) 100:1 C) 200:1 D)1:200

12. A car traveling at 22.4 m/s skids to a stop in 2.55 s. Determine the skidding distance of the car (assume uniform acceleration).
A) 40.6m B) 30.6m C) 20.6m D) 28.6m

13. A kangaroo is capable of jumping to a height of 2.62 m. Determine the takeoff speed of the kangaroo.
A) 1.2 m/s B) 7.17 m/s C) 3.1 m/s D) 4.1 m/s

ACHIEVERS(Level - II)

I) Solve the following :

1. How far does a plane fly in 15 s while its velocity is changing from 145 m/s to 75 m/s at a uniform rate of acceleration?

2. A skater is moving at 1.6m/s and then accelerates at 4m/s^2 for 4 sec. How far did he travel during that motion?

3. A car is moving 12 m/s and coasts up a hill with a uniform acceleration of –1.0 m/s^2. How far has it traveled after 6.0 s?

4. A plane travels 500 m while being accelerated uniformly from rest at the rate of 5.0 m/s^2. What final velocity does it attain?

5. A race car can be slowed with a constant acceleration of –11 m/s2. If the car is going 55 m/s, how many meters will it take to stop?

6. The observation deck of tall skyscraper 370 m above the street. Determine the time required for a penny to free fall from the deck to the street below.

EXPLORERS (Level - III)

I) Multiple option type :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

1. Acceleration of a body can be

a) positive b) negative c) zero

A) only a, b correct B) only a, c correct

C) only b, c correct D) all a, b, c are correct

2. A train strating from rest, attains a velocity of 75 km/h in 5 minutes. Assuming that the acceleration is uniform, Choose the correct option

a) The acceleration of the train is 5/72 ms^{-2}

b) The distance travelled by the train while it attained the velocity is 25/4km

c) The acceleration of the train is 1/20 ms^{-2}

d) The distance travelled by the train while it attained the velocity is 2 km

A)a,b B)a,d C)b,c D)none

II) Fill in the blanks :

1. Velocity is a ..... quantity

2. Speed in a given direction is called .....

3. ..... and ..... are relative terms

4. Acceleration of a body moving with increasing velocity is .....

5. Acceleration of a body moving with decreasing velocity is .....

6. Initial velocity of a body starting from rest is .....

7. Final velocity of a body coming to rest is .....

III) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I***

*have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

1.

Column – I	***Column – II***
a) distance	1) m
b) speed	2) s
c) acceleration	3) m/s
d) time	4) m/s^2

A) a - 1, b - 2, c - 3, d - 4 B) a - 1, b - 3, c - 4, d - 2

C) a - 1, b - 4, c - 3, d - 2 D) a - 2, b - 1, c - 4, d - 3

2.

Column – I	***Column – II***
a) velocity	1) $\frac{\vec{S}_{Total}}{t_{Total}}$
b) speed	2) $\frac{\vec{v}-\vec{u}}{t}$
c) acceleration	3) $\frac{\vec{S}}{t}$
d) average velocity	4) $\frac{S}{t}$

A) a - 1, b - 2, c - 3, d - 4 B) a - 2, b - 3, c - 1, d - 4

C) a - 3, b - 4, c - 2, d - 1 D) a - 4, b - 3, c - 1, d - 2

V) Comprehension type :

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

1. A train starts from rest and moves with a constant acceleration of 2.0 m/s^2 for half a minute.The breakes are then applied and the train comes to rest in one minute.

i) Find the total distance moved by the train.

A) 2.7 km B) 2.2 km C) 4.1 km D) 1.7 km

ii) Find the maximum speed attained by the train.

A) 60 m/s B) 80 m/s C) 50 m/s D) 30 m/s

iii) Find the position(s) of the train at half the maximum speed.

A) 225m B) 200 m C) 250 m D) 180 m

2. A cyclist who starts from the top of a hill accelerates uniformly with 0.5 m/s^2 to reach the foot with a velocity of 54 kmph.

i) He reaches the foot of the hill in .....s.

A) 30s B) 20s C) 10s D) 15s

ii) Find the velocities of the cyclist at the end of 5 s

A) 1.5m/s B) 2.5m/s C) 3m/s D) 5m/s

iii) Find the ratio of velocities of cyclist at the end of the 21sts and 7ths.

A) 3:2 B) 1:3 C) 3:1 D) 2:3

iv) Find the ratio of velocities of cyclist 6 s after the start to that of 6 s before reaching the foot of the hill.

A) 1:1 B) 1:2 C) 1:3 D) 1:4

RESEARCHERS (Level - IV)

I) Single correct answer questions :

1. What statement best describes the given figure ? [NSO-2011]

A) The earth is rotating around the sun B) The sun is rotating around the Earth

C) The Earth is revolving around the sun D) The sun is revolving around the Earth

2. In circular motion the,..... [NSO-2014]

A) direction of motion is fixed B) direction of motion changes continuously

C) velocity constant D) none

3. Consider the motion of the tip of the minute hand of clock. In on hour. [NSO - 2014]

A) The distance covered zero B) the displacement is zero

C) the average speed is zero C) none

4. Which of the following is example of vibratory motion ? [NSO - 2009]

A) a car moving along a circular track B) a freely falling stone

B) motion of the string of violin D) motion of the planet around the sun

5. Which of the following is example of periodic motion? [NSO - 2008]

A) A car taking a turn on a curved road B) A crane fling over a water pond

C) A lift moving down D) march past of soldiers

6. A passenger in a moving train is at .....w.r.t ground and is at..... with other passenger in same train. [NSO - 2009]

a) Motion,motion B)rest,rest C) motion, rest D) rest, motion

7. If a body travels half the distance with velocity v_1 and the next half with velocity v_2.ts average velocity will be given by. [NSO - 2008]

8. An artificial satellite is moving in circular orbit of 4225.km.find its speed if it takes 24hr to revolve around the earth. [NSO - 2012]

A) 30.7km/s B) 5.67km/s C) 6.14km/s D)1.57km/s

9. The length of a square field is 6 *m*. Parul ran 6 rounds around the field. The total distance that she covered, is ..... [NSO - 2008]

A) 216 *m* B) 144 *m* C) 176 *m* D) 186 *m*

10. Two simple pendulums P and Q are given. P completes 20 oscillations in 32 sec and Q completes 30 oscillations in 45 sec. Which pendulum is faster ? [NSO - 2008]

A) P B) Q C) both have same time period D) data insufficiently

11. Two boys P and Q are running along the same path. P is 10 m ahead of Q initialy.However, Q catches up with P. after running 50 m. Assuming that both boys are running at a constant speed. What is the ratio of the speeds of P and Q ?

A) 6 : 5 B) 5 : 6 C) 4 : 1 D) 4 : 5 [NSO - 2014]

12. Sonic vibrations were sent down from a return after 2 seconds. What is the depth of the sea. If the speed of sound in water is 1.5 kms^{-1} ? [NSO - 2012]

A) 150 m B) 3 m C) 1.5 m D) 750 m

13. A car driver took a total of two hours to make a journey of 75 km. He had a coffee break of half an hour and spend a quarter of an hour stationary in a traffic jam. What was his average speed during the journey ? [NSO - 2012]

A) 38 kms^{-1} B) 50 kms^{-1} C) 60 kms^{-1} D) 75 kms^{-1}

14. Talking one light year equal to 9.4 X 10^{15} m and one day equal to 86400 s, what will be the speed of light in light year per day if the speed of light in ms^{-1} is 3 X 10^{8} ? [NSO - 2012]

A) 2.75 X 10^{-3} ly day^{-1} B) 3.75 X 10^{-3} ly day^{-1}

C) 2.75 X 10^{3} ly day^{-1} D) 3.75 X 10^{-3} ly day^{-1}

15. The ultrasonic waves take 4 second to travel from the ship to the bottom of the sea and back to the ship (in the form of an echo). What is the depth of the sea ? [NSO - 2009]

A) 3000 m B) 2000 m C) 1000 m D) 500 m

16. A taxi driver noted reading on the odometer fitted in vehicle as 1050 km, when he started the journey. After 30 minutes drive, he noted that the odometer reading was1086 km. What is the average speed of the taxi ? [NSO - 2009]

A) 20 m/s B) 25 m/s C) 30 m/s D) 40

17. How long does it take for the earth to rotate on its axis seven times ? [NSO - 2010]

A) One day B) One week C) One month D) One year

KEY

ΦΦ LEARNER'S TASK :

- **BEGINNERS :** 1) B 2) B 3) C 4) B 5) C 6) A 7) B 8) A 9) A 10) A 11) A 12) D 13) B
- **ACHIEVERS :** 1) 1650m 2) 9.6m 3)54m 4) 71m/s 5) 138m 6) 8.69 s
- **EXPLORERS : I)** 1) D 2) A **II)** 14) vector 15) velocity 16) rest & motion 17) positive acceleration 18) negative acceleration 19) zero 20) zero **III)** 21) B 22) C **IV)** 23) i) A ii) A iii) A 24) i) A ii) B iii) C iv) D
- **RESEARCHERS :** 1) C 2) B 3) B 4) C 5) D 6) C 7) $V_{avg} = (2v_1v_2)/(v_1+v_2)$, 8) A 9) B 10) B 11) D 12) C 13) C 14) A 15) A 16) A 17) B