



GOVERNMENT OF KARNATAKA

DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

18TH CROSS, MALLESHWARAM, BENGALURU – 560 012

CHAPTER-WISE MULTIPLE-CHOICE QUESTIONS FOR COMPETITIVE EXAM

SUBJECT: PHYSICS

NAME OF THE CHAPTER: I PUC - MOTION IN A STRAIGHT LINE

SYNOPSIS

1: Classification of motion in straight line

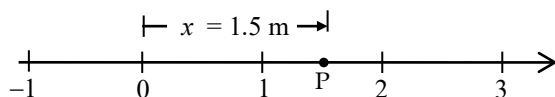
- Motion of bodies or particles occurring in a straight line is called **rectilinear motion**.
- Motion in a straight line that repeats itself at regular intervals is called **periodic motion**.

2: Particle and reference frame

- A point object equivalent of an enlarged object having mass but no extension is called **particle**.
- A coordinate axes system, an observer, a clock and a body/particle/object in motion constitute a reference frame.

3: Position, displacement and distance travelled

- Relative to the origin, the shortest distance to the location of the particle moving on the straight line is called its **position**.



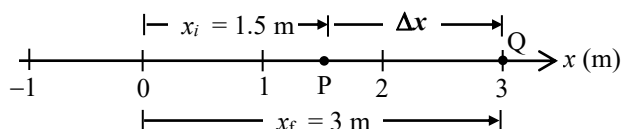
Eg: In the figure, the position of the particle is said to be $x = 1.5$ m.

- The change of the position of a particle is called **displacement**.
- If x_i and x_f are the initial and final positions of a particle, then the displacement is given by

$$\Delta x = x_f - x_i$$

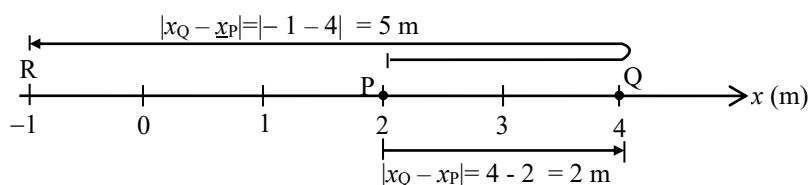
For example: the displacement of the particle in the following figure is

$$\Delta x = 3 - 1.5 = 1.5 \text{ m.}$$



- The total path length traversed by a particle during its motion in a straight line is called its **distance travelled**.

For example: If a particle is initially at $x = 2$ m, then moves to point $x = 4$ m and then finally comes back to $x = -1$ m, the total distance travelled is



In the example: the distance travelled here is $D = |x_Q - x_P| + |x_R - x_Q|$

Or $= |4 - 2| + |-1 - 4| = 7 \text{ m.}$

The displacement in the previous example is $\Delta x = -1 - 2 = -3 \text{ m.}$

The negative sign refers to the leftward direction of the displacement.

EXAMPLE 1

A car moving along an east – west straight road is initially spotted 200 m to the east, moving westward relative to a bus stop. It is then driven to a place 100 m to the west of the bus stop. The displacement and the distance travelled (in metre) by the car are respectively

(A) – 100, 100 (B) – 200, 200 (C) – 300, 300 (D) 300, 300

Ans (C)

Example Solved:

The displacement of the car is $\Delta x = -200 - 100 = -300 \text{ m}$

The distance travelled by the car is $D = |\Delta x| = 300 \text{ m}$

4: Average velocity and average speed

➤ If Δx is the displacement of a particle occurring in time Δt , the average velocity of the particle is

$$v_{av} = \frac{\Delta x}{\Delta t}$$

➤ The direction of the average velocity is always along the displacement.

➤ If D is the total distance travelled by a particle in time Δt , then average speed is

$$\bar{v} = \frac{D}{\Delta t}$$

➤ The average speed however, does not have any direction.

EXAMPLE 2

A cyclist rides on his bicycle from a place A to B along a straight line at a constant speed of 10 m/s for the first half of the distance and at 15 m/s during next half of the distance. If the cyclist finally comes back to the midpoint of A and B at a speed of 9 m/s, the average speed and average velocity of the cyclist for the entire journey are respectively

(A) 10.8 m/s, 3.6 m/s (B) 10.8 m/s, 10.8 m/s (C) 3.6 m/s, 3.6 m/s (D) 10.8 m/s, 0

Ans (A)

Example Solved:

Here, the total journey is divided into three equal parts of the distance:

So, the average speed of the journey is

$$\bar{v} = \frac{\text{tot distance}}{\text{total time}} = \frac{s + s + s}{t_1 + t_2 + t_3} = \frac{3s}{\frac{s}{v_1} + \frac{s}{v_2} + \frac{s}{v_3}} = \frac{3v_1v_2v_3}{v_1v_2 + v_2v_3 + v_1v_3}$$
$$\rightarrow \bar{v} = \frac{3 \times 10 \times 15 \times 9}{10 \times 15 + 15 \times 9 + 10 \times 9} = 10.8 \frac{\text{m}}{\text{s}}$$

The average velocity of the journey is

$$v_{av} = \frac{\text{tot displacement}}{\text{total time}} = \frac{s}{t_1 + t_2 + t_3} = \frac{s}{\frac{s}{v_1} + \frac{s}{v_2} + \frac{s}{v_3}} = \frac{v_1v_2v_3}{v_1v_2 + v_2v_3 + v_1v_3}$$
$$\rightarrow v_{av} = \bar{s} = \frac{10 \times 15 \times 9}{10 \times 15 + 15 \times 9 + 10 \times 9} = 3.6 \frac{\text{m}}{\text{s}}$$

5: Instantaneous velocity and instantaneous speed

➤ The time rate of change of the position of a particle is called its **instantaneous velocity / velocity**.

That is
$$v = \frac{dx}{dt}$$

The magnitude of this velocity is called **instantaneous speed**.

NOTE: If $x = t^n$, then $\frac{dx}{dt} = \frac{d}{dt}(t^n) = nt^{n-1}$

EXAMPLE 3

A body moving along the x axis changes its positions with time according to $x = 3 - 2t^3$; where x is in metre and t is in seconds. The instantaneous velocity and instantaneous speeds at $t = 1$ s are respectively
(A) 1 m/s, 1 m/s (B) 6 m/s, 6 m/s (C) -6 m/s, 6 m/s (D) 6 m/s, -6 m/s

Ans (C)

Example Solved:

The instantaneous velocity at any time t is the first time derivative of x

$$v = \frac{dx}{dt} = \frac{d}{dt}(3 - 2t^3) = \frac{d}{dt}(3) - \frac{d}{dt}(2t^3)$$

Or
$$v = 3 \frac{d}{dt}(1) - 2 \frac{d}{dt}(t^3) = 3 \times 0 - 2 \times 3t^2$$

Thus
$$v = -6t^2$$

At $t = 1$ s,
$$v = -6(1)^2 = -6 \frac{m}{s}$$

The instantaneous speed is the magnitude of this velocity

$$|v| = 6 \frac{m}{s}$$

6: Average acceleration and instantaneous acceleration

➤ If the velocities of a particle at initial time instant t_i and final time instant t_f are v_i and v_f respectively then the average acceleration of the particle is given by

$$\bar{a} = \frac{v_f - v_i}{t_f - t_i} = \frac{\Delta v}{\Delta t}$$

➤ The rate of change of velocity is called acceleration or instantaneous acceleration.

That is
$$a = \frac{dv}{dt}$$

EXAMPLE 4

The velocity of a particle moving along a straight line varies with time according to $v = 3t^2$; where v is in metre/second and t is in seconds. The average acceleration between $t = 2$ s and $t = 3$ s and instantaneous acceleration of the particle (both in m/s^2) at $t = 2$ s are respectively

(A) 15, 15 (B) 12, 15 (C) 15, 15 (D) 15, 12

Ans (C)

Example Solved:

The average acceleration between two time instants is

$$a_{av} = \frac{v_{fin} - v_{in}}{t_{fin} - t_{in}} = \frac{3(3)^2 - 3(2)^2}{3 - 2} = 15 \text{ ms}^{-2}$$

The instantaneous acceleration at any time instant is the first time derivative of the instantaneous velocity

$$a = \frac{dv}{dt} = \frac{d}{dt}(3t^2) = 3 \frac{d}{dt}(t^2) = 3 \times 2t = 6t$$

Thus, at $t = 2$ s,
$$a = 6(2) = 12 \text{ ms}^{-2}$$

7: Motion under constant or uniform acceleration

➤ If the acceleration of the particle moving in a straight line is constant/uniform, then

(i) $a = \text{constant}$.

If v_0 is the initial velocity, x is the displacement and v is the final velocity of a particle moving along a straight line with uniform acceleration a ,

➤ its velocity after time t is

(ii) $v = v_0 + at$

➤ its displacement after time t is

(iii) $x = v_0 t + \frac{1}{2} at^2$

➤ its velocity after displacement x is

(iv) $v^2 = v_0^2 + 2ax$

➤ its acceleration for two successive displacements x_1 and x_2 in identical

intervals t is

(v) $a = \frac{x_2 - x_1}{t^2}$

➤ its displacement in n^{th} second is

(vi) $x_n = v_0 + \frac{a}{2}(2n - 1)$

and finally

its average velocity is

(vii) $\bar{v} = \frac{v_0 + v}{2}$

EXAMPLE 6

A body starting with 10 m/s moves along a straight line with a constant acceleration. If its average velocity over the interval of first 5 s is 15 m/s, its velocity (in m/s) after 10 s from the start is

(A) 20

(B) 30

(C) 40

(D) 60

Ans (B)

Example Solved:

From the average velocity of the body $\bar{v} = \frac{v_0 + v}{2}$, we have

$$15 = \frac{10 + v}{2} \rightarrow v = 20 \frac{\text{m}}{\text{s}}$$

The acceleration of the body is $a = \frac{v - v_0}{t} = \frac{20 - 10}{5} = 2 \text{ m s}^{-2}$.

So, the velocity after $t = 10$ s from the start is $v = v_0 + at \rightarrow v = 10 + (2)(10) = 30 \frac{\text{m}}{\text{s}}$

EXAMPLE 7

A body moving along a straight line undergoes displacements 10 m and 18 m in the successive 2 s intervals. If the body starts from rest, its velocity (in m/s) after 5 s from the start is

(A) 2

(B) 5

(C) 10

(D) 20

Ans (C)

Example Solved:

The acceleration of the body is found using the formula $a = \frac{s_2 - s_1}{t^2} = \frac{18 - 10}{2^2} = 2 \text{ m s}^{-2}$

The velocity after 5 s from the start is $v = v_0 + at \rightarrow v = 0 + (2)(5) = 10 \frac{\text{m}}{\text{s}}$

EXAMPLE 8

A body starting from rest and moving along a straight line undergoes a displacement s in its n^{th} second of motion. Its average velocity after a time t is

(A) $\frac{st}{2n-1}$

(B) $\frac{st}{2n+1}$

(C) $\frac{2st}{2n-1}$

(D) $\frac{st}{4n-1}$

Ans (A)

Example Solved:

The acceleration of the body is found using the formula

$$s_n = v_0 + \frac{a}{2}(2n-1) \rightarrow s = 0 + \frac{a}{2}(2n-1) \rightarrow a = \frac{2s}{2n-1}$$

Velocity after time t, $v = v_0 + at = 0 + \left(\frac{2s}{2n-1}\right)t = \frac{2st}{2n-1}$

The average velocity in the first t second is

$$\bar{v} = \frac{v_0 + v}{2} = \frac{1}{2} \left(0 + \frac{2st}{2n-1} \right) = \frac{st}{2n-1}$$

8: Motion under gravity

➤ If a body falls under gravity near the surface of Earth, its acceleration

$$(i) a = -g = \text{constant. } (g = 9.8 \text{ m/s}^2 \approx 10 \text{ m/s}^2)$$

If v_0 is the initial velocity, y is the displacement and v is the final velocity of a body falling under gravity along a straight line,

- its velocity after time t is (ii) $v = v_0 - gt$
- its displacement after time t is (iii) $y = v_0 t - \frac{1}{2}gt^2$
- its velocity after displacement x is (iv) $v^2 = v_0^2 - 2gy$
- its displacement in n^{th} second is (vi) $y_n = v_0 - \frac{g}{2}(2n-1)$

EXAMPLE 9

A ball thrown from the top of a building of height H reaches its foot in time T. Then its initial velocity is

- (A) $\frac{gT}{2} - \frac{H}{T}$ (B) $\frac{gT}{2} + \frac{H}{T}$ (C) $\frac{H}{T} - \frac{gT}{2}$ (D) $\frac{gT^2}{2} - \frac{H}{T^2}$

Ans (A)

Example Solved:

The initial velocity of the ball is found using the formula

$$s = v_0 t - \frac{1}{2}gt^2 \rightarrow -H = v_0 T - \frac{1}{2}gT^2$$

Or $-\frac{H}{T} = v_0 - \frac{1}{2}gT \rightarrow v_0 = \frac{gT}{2} - \frac{H}{T}$

EXAMPLE 10

A cricket ball is hit so that it travels vertically upwards after being struck by the bat. A man observes that it takes 3 s for the ball to reach its maximum height. The maximum height it reaches is

- (A) 15 m (B) 45 m (C) 135 m (D) 180 m

Ans (B)

Example Solved:

The initial velocity of the ball is found using the formula

$$v = v_0 - gt \rightarrow 0 = v_0 - (10)(3) \rightarrow v_0 = 30 \text{ m/s}$$

The maximum height is found using

$$s = v_{av}t = \left(\frac{v_0 + v}{2}\right)t \rightarrow s = \left(\frac{30+0}{2}\right)(3) = 45 \text{ m}$$

9: Motion graphs

➤ If time t is plotted along the horizontal axis, position x of a particle is drawn along vertical axis, the resulting graph is said to be position time graph or $x - t$ graph.

➤ Some typical $x - t$ graphs are as shown:

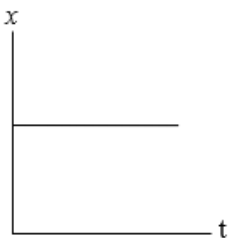


Fig (1): $x - t$ graph of a body at rest

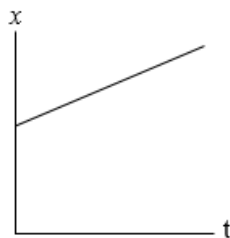


Fig (2): $x - t$ graph of a body moving at constant velocity

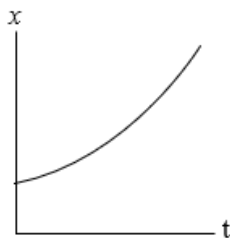


Fig (3): $x - t$ graph of a body moving with positive acceleration

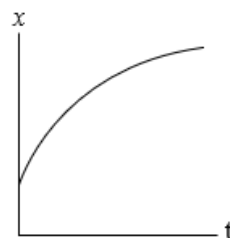


Fig (4): $x - t$ graph of a body moving with negative acceleration

➤ If time t is plotted along the horizontal axis, velocity v of a particle is drawn along vertical axis, the resulting graph is said to be velocity time graph or $v - t$ graph.

➤ Some typical $v - t$ graphs are as shown:

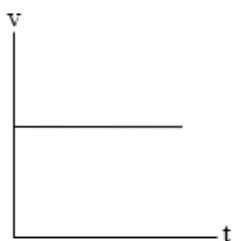


Fig (1): $v - t$ graph of a body moving with uniform velocity

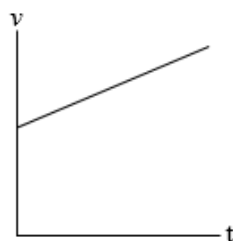


Fig (2): $v - t$ graph of a body moving at constant acceleration

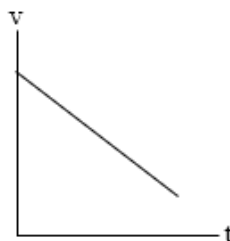


Fig (3): $v - t$ graph of a body moving with negative acceleration

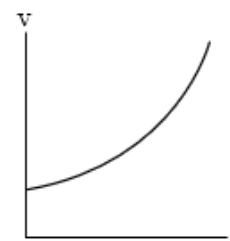


Fig (4): $v - t$ graph of a body moving with variable acceleration

➤ The slope of tangent of $x - t$ graph at a given time instant t , gives the velocity of that body at that instant.

➤ The area under the $v - t$ graph between time instants $t_1 \leq t \leq t_2$ gives the displacement of the body during that interval.

➤ The slope of $v - t$ graph at a given time instant t , gives the instantaneous acceleration at that instant.

➤ The area under the acceleration time graph between the time instants $t_1 \leq t \leq t_2$ gives the change of velocity of the body during that interval.

EXAMPLE 11

The velocity time graph of a body is as shown in the figure. The acceleration of the body and its displacement in first 4 s are respectively

(A) $+1.875 \text{ m/s}^2$, 25 m

(B) -1.875 m/s^2 , 15 m

(C) 12.5 m/s^2 and 1.25 m

(D) -1.25 m/s^2 , 1.25 m

Ans (B)

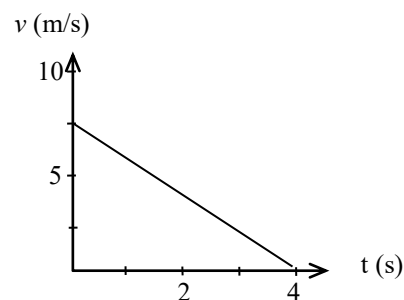
Example Solved:

The acceleration of the body is the slope of the $v - t$ graph:

$$a = \text{slope} = -\frac{7.5}{4} = -1.88 \text{ ms}^{-2}$$

The displacement in the first 4 s is

$$s = \text{area} = \frac{1}{2} \times 4 \times 7.5 = 15 \text{ m}$$

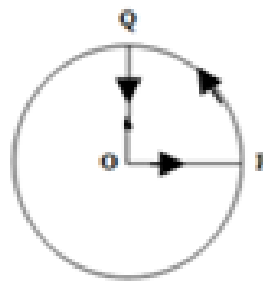


MOTION IN A STRAIGHT LINE - PRACTICE QUESTIONS

1. Identify the WRONG statement from the following.

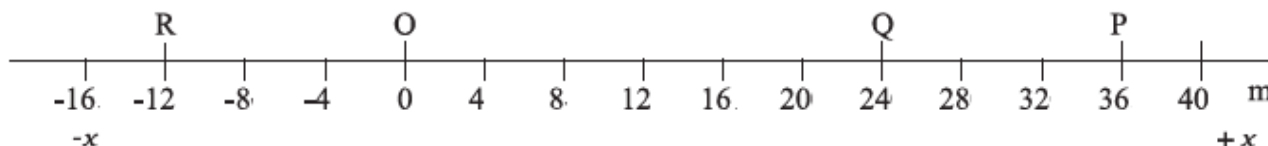
- (A) Average velocity of a body is defined as the ratio of displacement (Δx) of the body to the time interval (Δt) in which the displacement occurs.
- (B) Average speed of a body is defined as the ratio of total length of the path travelled by it to the total time taken for the motion.
- (C) Magnitude of the average velocity is always less than or equal to average speed.
- (D) Average speed can be positive, negative or zero for a particle in motion.

2. A cyclist starts from the centre O of a circular park of radius one kilometre, reaches the edge P of a park, then cycles along the circumference and returns to the centre along QO as shown in figure. If the round trip takes ten minutes, the net displacement and average speed of the cyclist (in metre and kilometre per hour) is



- (A) $21.4, \frac{\pi+4}{2}$ (B) 0, 21.4 (C) 0, 1 (D) $\frac{\pi+4}{2}, 0$

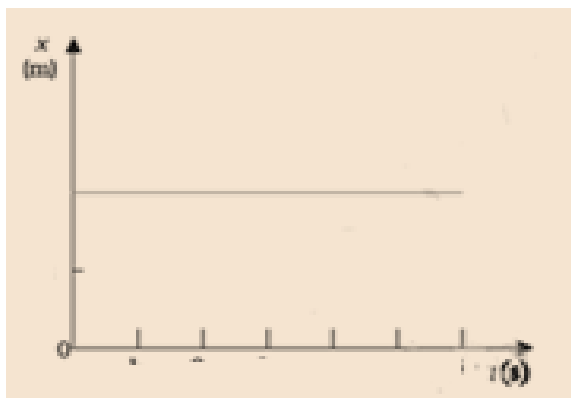
3. If a particle moves from Q to P and then to O on a straight path coinciding with X-axis as shown in the diagram in a time interval 0 to 6s, then its average velocity and average speed in the given time interval are respectively



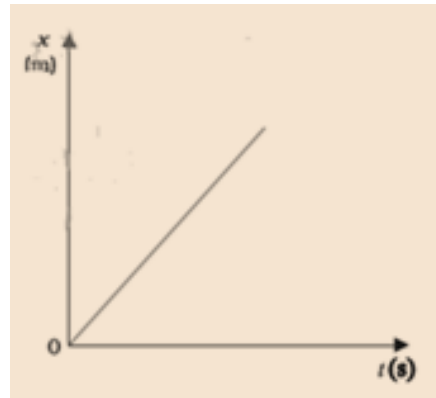
- (A) -4 m s^{-1} and 8 m s^{-1} (B) -6 m s^{-1} and 8 m s^{-1}
 (C) $+6 \text{ m s}^{-1}$ and 8 m s^{-1} (D) -4 m s^{-1} and 6 m s^{-1}

4. The position – time graphs of two particles M and N are (i) and (ii) respectively. Then

(i)



(ii)



- (A) M is moving uniformly along positive X-axis and N is at rest on positive X- axis.
- (B) M is moving non-uniformly along positive X-axis and N is at rest on positive X- axis.
- (C) M is at rest on positive X- axis and N is moving uniformly along positive X-axis.
- (D) M is at rest on positive X- axis and N is moving non-uniformly along positive X-axis.

5. Here are the two statements regarding position – time of a particle moving non-uniformly along positive X- axis.

Statement I : The slope of the line joining two different points of the graph over a time interval gives the average velocity of the particle in that interval.

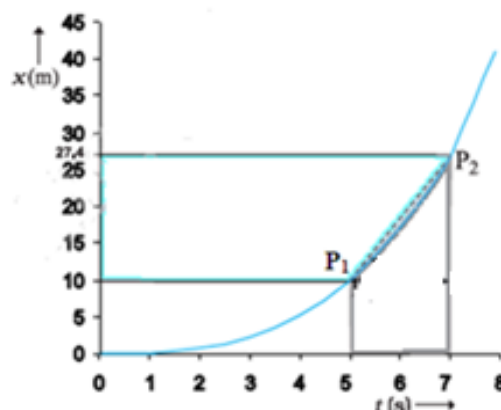
Statement II : The slope of the tangent drawn to the graph at a point corresponding to an instant gives the instantaneous velocity of the particle at that instant.

Choose the correct option from the following.

- (A) Both the statements are wrong. (B) Statement I is correct but the statement II is wrong.
(C) Both the statements are correct. (D) Statement I is wrong but the statement II is correct.

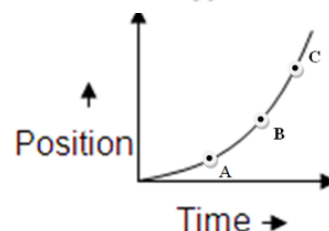
6. According to the given position-time graph, the average velocity of the body between $t = 5$ s to $t = 7$ s is

- (A) 3.9 ms^{-1}
(B) 8.7 ms^{-1}
(C) 18.7 ms^{-1}
(D) 5.3 ms^{-1}



7. v_A , v_B and v_C are the instantaneous velocities corresponding to the points A, B and C of the given position – time graph of a particle respectively. Then the correct option relating their values is

- (A) $v_A < v_B = v_C$ (B) $v_A < v_B < v_C$
(C) $v_A > v_B > v_C$ (D) $v_A > v_B = v_C$



8. The position of an object moving along X-axis varies with time according to the equation $x = 10 + 5t^2$ where, x is in 'm' and t is in 's'. The velocity at $t = 0$ s and $t = 4$ s are

- (A) 0 and 50 m s^{-1} (B) 0 and 40 m s^{-1}
(C) 10 and 50 m s^{-1} (D) 5 and 40 m s^{-1}

9. The position of an object moving along X-axis is varying with time according to the equation $x = 10 + 5t^2$ where, x is in 'm' and t is in 's'. Average velocity in the time interval $t = 1$ s to $t = 3$ s is

- (A) 20 m s^{-1} (B) 10 m s^{-1} (C) 35 m s^{-1} (D) 17.5 m s^{-1}

10. The position of an object moving along X-axis is varying with time according to the equation $x = 5 + 2t^3$ where, x is in 'm' and t is in 's'. Acceleration of the object at $t = 1$ s is

- (A) 10 m s^{-2} (B) 6 m s^{-2} (C) 5 m s^{-2} (D) 12 m s^{-2}

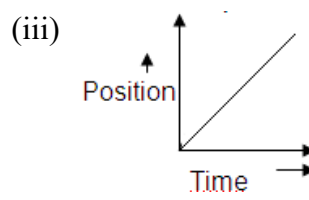
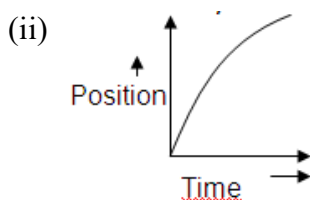
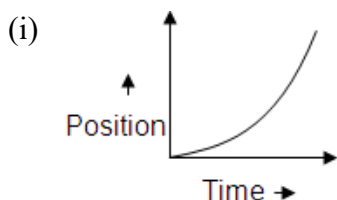
11. The positions of objects A, B and C moving along X axis are varying with time according to the equations $x_A = 10 + 5t^2$, $x_B = 3 + 5t$ and $x_C = 4 + 2t^3$ respectively where, x is in 'm' and t is in 's'. Then the objects A, B and C are moving with _____ respectively.

- (A) uniform acceleration, non-uniform velocity and non-uniform acceleration
(B) uniform acceleration, uniform velocity and non-uniform acceleration
(C) non-uniform acceleration, uniform velocity and uniform acceleration
(D) uniform negative acceleration, uniform velocity and non-uniform acceleration

12. A man walks on a straight road from his home to a market 2 km away with a speed of 4 kmph. Finding the market closed, he instantly turns and walks back home with a speed of 6 kmph. The magnitude of average velocity and average speed of the man over the interval of time 0 to 50 min are

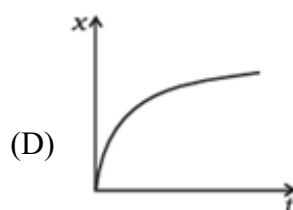
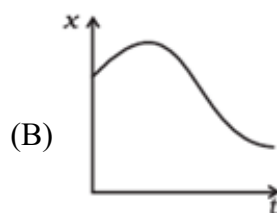
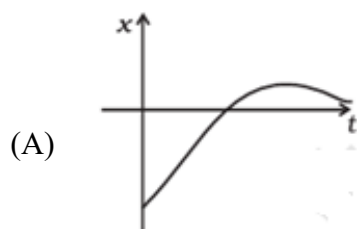
- (A) 0 and 2.4 kmph (B) 4.8 kmph and 4.8 kmph
(C) 0 and 5.0 kmph (D) 0 and 4.8 kmph

13. Three different position – time graphs are given below. The graphs correspond to bodies having _____ accelerations respectively.



- (A) positive, zero and negative (B) zero, positive and negative
(C) positive, negative and zero (D) negative, positive and zero

14. Among the four graphs, there is only one graph for which average velocity over the time interval (0, T) can vanish for a suitably chosen T. Which one is it?



15. In one-dimensional motion, instantaneous speed v satisfies $0 \leq v < v_0$.

- (A) The displacement in time T must always take non-negative values.
(B) The displacement x in time T satisfies $-v_0 T < x < v_0 T$.
(C) The acceleration is always a non-negative number.
(D) The motion has no turning points.

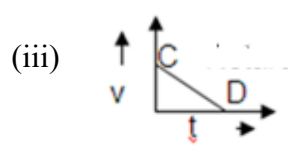
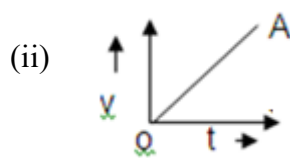
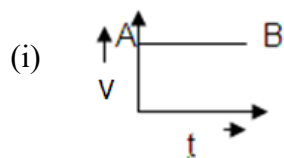
16. A vehicle travels half the distance L with speed V_1 and the other half with speed V_2 , then its average speed is

- (A) $\frac{V_1 + V_2}{2}$ (B) $\frac{2V_1 V_2}{V_1 + V_2}$ (C) $\frac{2V_1 V_2}{V_1 + V_2}$ (D) $\frac{L(V_1 + V_2)}{V_1 V_2}$

17. The displacement of a particle is given by $x = (t - 2)^2$ where x is in metres and t in seconds. The distance covered by the particle in first 4 seconds is

- (A) 4 m (B) 8 m (C) 12 m (D) 16 m

18. Three different velocity – time graphs are given below. The graphs correspond to bodies having _____ accelerations respectively.



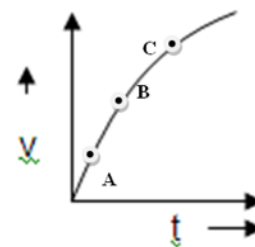
(A) positive, zero and negative

(B) zero, positive and negative

(C) positive, negative and zero

(D) negative, positive and zero

19. If a_A , a_B and a_C are the instantaneous accelerations corresponding to the points A, B and C of the given velocity – time graph respectively. Then the correct option relating their values is



(A) $a_A < a_B = a_C$

(B) $a_A < a_B < a_C$

(C) $a_A > a_B > a_C$

(D) $a_A > a_B = a_C$

20. If velocity v of a particle moving on a straight line as a function of time t is given as $v = 5 - t$ (m s^{-1}), then the distance covered by the particle in first 5 second is

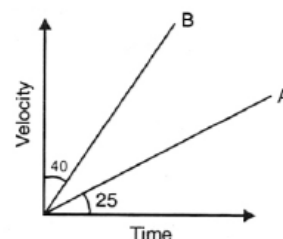
(A) 25 m

(B) 12.5 m

(C) 15 m

(D) 17 m

21. The velocity – time graph for two bodies A and B are shown. Then the acceleration of A and B are in the ratio



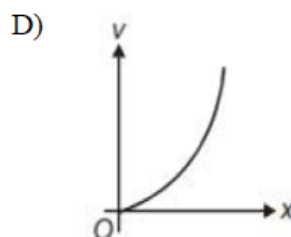
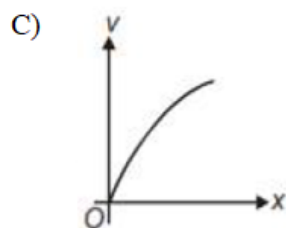
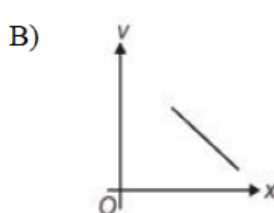
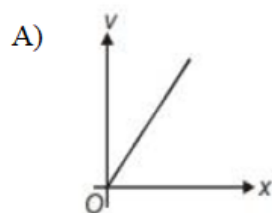
(A) $\frac{\tan 25}{\tan 40}$

(B) $\frac{\cos 25}{\cos 50}$

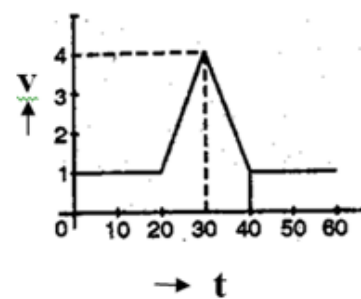
(C) $\frac{\tan 25}{\tan 50}$

(D) $\frac{\sin 25}{\sin 50}$

22. For a body moving with uniform acceleration along straight line with initial velocity zero, variation of its velocity(v)with position (x) is best represented by



23. Velocity-time(v - t) graph for a moving object is shown in figure. Total displacement of the object during the time interval when there is non-zero acceleration and retardation is



(A) 60 m

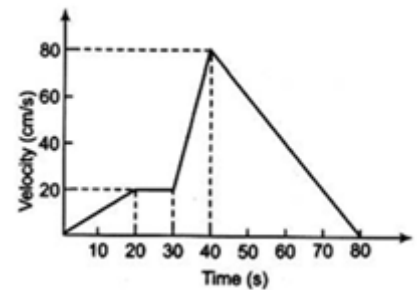
(B) 50 m

(C) 30 m

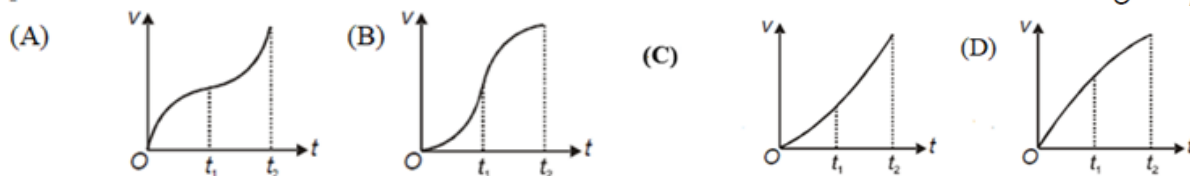
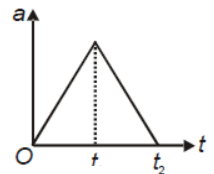
(D) 40 m

24. The velocity-time graph of moving object is given in figure. The maximum acceleration is

- (A) 1 cm/s^2
 (B) 2 cm/s^2
 (C) 3 cm/s^2
 (D) 6 cm/s^2



25. A particle starts moving from rest on a straight line its acceleration (a) versus time (t) is shown in the figure. Possible speed-time graph for the particle is



26. A lift is coming from 8th floor and is just about to stop at 4th floor. Taking ground floor as origin and positive direction upwards for all quantities, which one of the following is correct?

- (A) $x < 0, v < 0, a > 0$ (B) $x > 0, v < 0, a < 0$
 (C) $x > 0, v < 0, a > 0$ (D) $x > 0, v > 0, a < 0$

27. At a metro station, a girl walks up a stationary escalator in time t_1 . If she remains stationary on the escalator, then the escalator takes her up in time t_2 . The time taken by her to walk up on the moving escalator will be

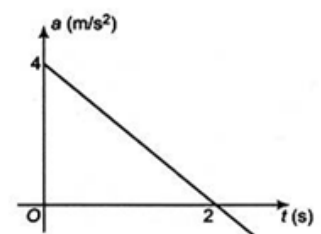
- (A) $\frac{t_1+t_2}{2}$ (B) $\frac{t_1 t_2}{t_2 - t_1}$ (C) $\frac{t_1 t_2}{t_2 + t_1}$ (D) $t_1 - t_2$

28. The acceleration 'a' in m s^{-2} of a particle is given by $a = 3t^2 + 2t + 1$, where t is the time. If the particle starts with a velocity $v = 2 \text{ m s}^{-1}$ at $t = 0$ then velocity at the end of 2 sec is

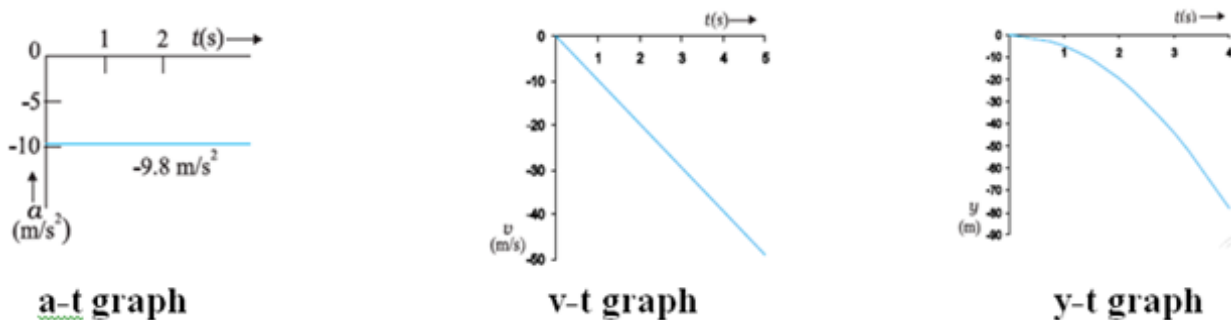
- (A) 12 m s^{-1} (B) 16 m s^{-1} (C) 27 m s^{-1} (D) 18 m s^{-1}

29. The acceleration – time (a – t) graph of a particle moving in a straight line is as shown in the figure. The velocity – time graph of the particle would be

- (A) a straight line (B) a circle
 (C) a parabola (D) an ellipse



30. The acceleration – time graph, velocity – time graph and displacement – time graph of a body are as shown. The three graphs correspond to



- (A) a body thrown vertically up. (B) a body falling freely under gravity.
 (C) a body thrown in horizontal direction. (D) a body thrown vertically down.

31. A car is moving along a straight-line with a speed of 126 km h^{-1} is brought to rest within a distance of 200 m. The magnitude of the acceleration of the car is:
- (A) 79.38 m s^{-2} (B) 30.6 m s^{-2} (C) 3.06 m s^{-2} (D) zero
32. When the brake of a car is applied, the car stops after travelling 100 m. If speed of car is halved and brakes produce same retarding acceleration, it stops after travelling a distance of:
- (A) 25 m (B) 50 m (C) 75 m (D) 100 m
33. A body moving along a straight line with a speed of 5 m/s acquires a speed of 15 m/s in 6 s. Assuming constant acceleration, the distance travelled by the body in 6 s is:
- (A) 120 m (B) 30 m (C) 90 m (D) 60 m
34. A body covers 16m in first 4 s and 32 m in the next 4 seconds while moving with constant acceleration. The velocity of the body at the end of 10 s is:
- (A) 14 m/s (B) 12 m/s (C) 10 m/s (D) 8 m/s
35. A bike moving with an initial velocity of 4 m/s accelerates at a constant rate of 2 m/s^2 . What is the distance travelled by the bike during the 5th second of its motion?
- (A) 9 m (B) 13 m (C) 14 m (D) 45 m
36. If an object covers 10 m in the 4th second and 30 m in the 8th second of motion, the acceleration of the object is:
- (A) 2.5 m/s^2 (B) 2.67 m/s^2 (C) 4 m/s^2 (D) 5 m/s^2
37. Moving with uniform acceleration, a body crosses a point A with a velocity 1 m/s and another point B with a velocity 7 m/s . The velocity of the object at the mid-point of AB is:
- (A) 3.5 m/s (B) 4 m/s (C) 5 m/s (D) 6 m/s
38. When a bullet hits a plank with a certain speed and emerges out, it loses 10% of its speed. How many planks are needed to stop the bullet?
- (A) 6 (B) 5 (C) 11 (D) 10
39. A car accelerates from rest at a constant rate α from some time, after which it decelerates at a constant rate β and comes to rest. If the total time elapsed is t , then the maximum velocity acquired by the car is:
- (A) $\frac{\alpha^2 + \beta^2}{\alpha\beta} t$ (B) $\frac{\alpha^2 - \beta^2}{\alpha\beta} t$ (C) $\frac{\alpha\beta}{\alpha + \beta} t$ (D) $\frac{1}{2} \left(\frac{\alpha\beta}{\alpha + \beta} \right) t^2$
40. A particle starts with a velocity of 2 m s^{-1} and moves in a straight line with a retardation of 0.1 m s^{-2} . The time at which the particle is 15 m from the initial position is:
- (A) 10 s only (B) 30 s only (C) 20 s (D) both 10 s and 30 s
41. The velocity of an object moving along a straight-line varies with time as $v = 5t + 4 \text{ m/s}$. The displacement of the object in first two seconds is ($g = 10 \text{ m/s}^2$):
- (A) 20 m (B) 18 m (C) 14 m (D) 13 m

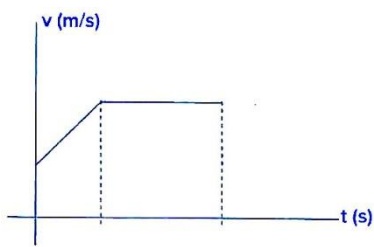
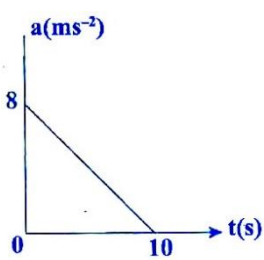
42. A stone is dropped from the top of a tower of height h . After 1 second, another stone is dropped from a window 20 m below the top. Both the stones reach the bottom simultaneously. The value of h is (Take $g = 10 \text{ m/s}^2$):
- (A) 31.25 m (B) 100 m (C) 120 m (D) 130 m
43. When dropped from a height h , a stone travels 35 m in the last second of its motion. The value of h is (take $g = 10 \text{ m/s}^2$):
- (A) 140 m (B) 80 m (C) 45 m (D) 120 m
44. From the top of a 400 m high cliff, a stone is dropped. Simultaneously another stone is thrown vertically up from the base with a speed of 50 m/s towards the first stone. The distance from the base where they would meet is ($g = 10 \text{ m/s}^2$):
- (A) 100 m (B) 320 m (C) 80 m (D) 240 m
45. A body is dropped from rest under the action of gravity. The distances covered by the body in the 1st, 2nd, and 3rd seconds are in the ratio of:
- (A) 1:3:5 (B) 1:4:9 (C) 1:2:3 (D) 1:1:1
46. An object is thrown vertically upwards from the roof of a building with an initial speed of 10 m/s. It hits the ground exactly 3 seconds later. Taking the upward direction as positive and the roof as the reference point, the displacement and the total distance travelled by the object are, respectively:
- (A) – 15 m and 15 m (B) – 45 m and 75 m (C) 15 m and 25 m (D) – 15 m and 25 m
47. Vertically thrown upwards from the ground, an object travels 5 m during the 3rd second of its upward motion. The total time of its motion is:
- (A) 3 seconds (B) 5 seconds (C) 6 seconds (D) 7 seconds
48. For a body thrown vertically upwards, the average velocity becomes zero in 3 seconds. The average speed of the body over the journey is:
- (A) 0 m/s (B) 7.5 m/s (C) 15 m/s (D) 30 m/s
49. An astronaut drops a small tool from a height of 5 metres on Earth, and it takes t seconds to hit the ground. If the same tool is dropped from the exact same height on Mars, where the gravitational pull is weaker (4 m/s^2 compared to Earth's 10 m/s^2), how long will the fall take on Mars expressed in terms of t ?
- (A) $1.6t$ (B) $0.4t$ (C) $2.5t$ (D) $0.625t$
50. Imagine dropping your smartphone from a height of 2 metres on Earth and doing the exact same thing inside a habitat on Mars. Knowing that Mars exerts a much weaker gravitational pull than Earth, how will the phone's drop on Mars compare?
- (A) It crashes down faster and hits harder. (B) It floats down slower and hits with less impact.
(C) It falls at the same rate but hits harder. (D) It falls faster but hits softer.
51. A professional archer shoots an arrow straight up into the air with a launch speed of 25 m/s. Due to gravity, the acceleration is 10 m/s^2 . How many seconds pass from the moment of launch until the falling arrow reaches a downward speed of 5 m/s?
- (A) 1 s (B) 2 s (C) 3 s (D) 4 s

52. A tennis player hits a ball straight upward into the air. If you ignore air resistance and analyze the ball's flight from the moment it leaves the racket until right before it is caught, which of the following statements is true about its motion?
- (A) The ball's velocity and acceleration vectors point in the same direction during the climb.
 (B) At the very peak of its flight, both the ball's velocity and acceleration drop to zero.
 (C) The downward gravitational acceleration remains constantly active at all points of the flight.
 (D) The ball maintains a non-zero velocity through every single moment of its trajectory.
53. A drone is climbing straight up at a steady rate of 15 m/s. At an altitude of 20 m, a loose bolt detaches from the drone and falls to the earth. Neglecting air resistance, find the final impact velocity of the bolt.
- (A) 15 m/s (B) 20 m/s (C) 25 m/s (D) 30 m/s
54. A race-track is straight. Two vehicles begin the race simultaneously from the same spot. Vehicle A has an initial velocity u_1 and a uniform acceleration a_1 . Vehicle B has an initial velocity u_2 and a uniform acceleration a_2 . If both vehicles tie at the finish line, the duration of the race is:
- (A) $\frac{u_2 - u_1}{a_1 - a_2}$ (B) $\frac{1}{2} \left(\frac{u_2 - u_1}{a_1 - a_2} \right)$ (C) $\frac{u_2 + u_1}{a_1 + a_2}$ (D) $2 \left(\frac{u_2 - u_1}{a_1 - a_2} \right)$
55. When an object is thrown upwards, it is at the same height at times t_1 and t_2 . The maximum height reached by the object is:
- (A) $\frac{1}{2} g(t_1^2 + t_2^2)$ (B) $\frac{1}{8} g(t_1 + t_2)^2$ (C) $\frac{1}{8} g(t_1^2 + t_2^2)$ (D) $\frac{1}{2} g(t_1 + t_2)^2$

KEY ANSWERS

1	2	3	4	5	6	7	8	9	10	11
D	B	A	C	C	B	B	B	A	D	B
12	13	14	15	16	17	18	19	20	21	22
D	C	B	B	C	B	B	C	B	C	C
23	24	25	26	27	28	29	30	31	32	33
B	D	B	C	C	B	C	B	C	A	D
34	35	36	37	38	39	40	41	42	43	44
B	B	D	C	A	C	D	B	A	B	C
45	46	47	48	49	50	51	52	53	54	55
A	D	C	B	A	B	C	C	C	D	B

PREVIOUS YEAR QUESTIONS (2020 onwards)

1. At a metro station, a girl walks up a stationary escalator in 20 s. If she remains stationary on the escalator, then the escalator takes her up in 30 s. The time taken by her to walk up on the moving escalator will be [KCET-2020]
 (A) 60 s (B) 12 s (C) 10 s (D) 25 s
2. Rain is falling vertically with a speed of 12 m s^{-1} . A woman rides a bicycle with a speed of 12 m s^{-1} in east to west direction. What is the direction in which she should hold her umbrella? [KCET-2020]
 (A) 45° towards East (B) 30° towards West
 (C) 45° towards West (D) 30° towards East
3. For a body moving along a straight line, the following v-t graph is obtained. According to the graph, the displacement during [KCET-2021]
 (A) uniform acceleration is greater than that during uniform motion
 (B) uniform acceleration is less than that during uniform motion
 (C) uniform acceleration is equal to that during uniform motion
 (D) uniform motion is zero
 
4. A particle starts from rest. Its acceleration 'a' versus time 't' is shown in the figure. The maximum speed of the particle will be [KCET-2021]
 (A) 80 m s^{-1}
 (B) 40 m s^{-1}
 (C) 18 m s^{-1}
 (D) 2 m s^{-1}

5. The displacement X (in metre) of a particle of mass m (in kg) moving in one dimension under the action of a force, is related to time 't' (in second) by, $t = \sqrt{X} + 3$. The displacement of the particle when its velocity is zero, will be [KCET-2022]
 (A) 6 m (B) 2 (C) 4 m (D) 0 m
6. A body is moving along a straight line with initial velocity v_0 . Its acceleration a is constant. After t seconds, its velocity becomes v. The average velocity of the body over the given time interval is [KCET-2023]
 (A) $\bar{v} = \frac{v^2 + v_0^2}{2at}$ (B) $\bar{v} = \frac{v^2 + v_0^2}{at}$ (C) $\bar{v} = \frac{v^2 - v_0^2}{2at}$ (D) $\bar{v} = \frac{v^2 - v_0^2}{at}$
7. An athlete runs along a circular track of diameter 80 m. The distance travelled and the magnitude of displacement of the athlete when he covers $\frac{3}{4}$ th of circle is (in m) [KCET-2024]
 (A) $60\pi, 40\sqrt{2}$ (B) $40\pi, 60\sqrt{2}$ (C) $120\pi, 80\sqrt{2}$ (D) $80\pi, 120\sqrt{2}$
8. Two stones begin to fall from rest from the same height, with the second stone starting to fall ' Δt ' seconds after the first falls from rest. The distance of separation between the two stones becomes 'H', ' t_0 ' seconds after the first stone starts its motion. Then t_0 is equal to [KCET-2025]
 (A) $\frac{H}{g\Delta t}$ (B) $\frac{H}{\Delta t} + \frac{\Delta t}{2g}$ (C) $\frac{H}{g\Delta t} - \frac{\Delta t}{2}$ (D) $\frac{H}{g\Delta t} + \frac{\Delta t}{2}$
9. A car covers the first half of the distance between two places at 40 km/h and another half at 50 km/h. The average speed of the car is [KCET-2026]
 (A) 45.00 km/h (B) 44.44 km/h (C) 43.14 km/h (D) 42.04 km/h

KEY ANSWERS

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