3.Motion In a Straight Line

Physics Smart Booklet

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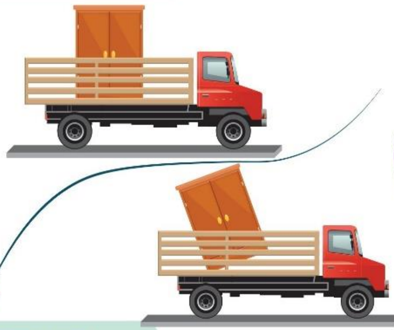
MOTION IN A STRAIGHT LINE

MOTION & FRAME OF REFERENCE



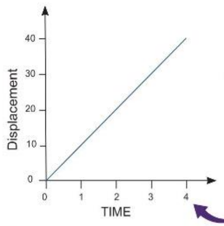
MOTION

Change in position of an object with respect to time is defined as Motion

FRAME OF REFERENCE

The point from which observer takes it's observation is called frame of reference.

Example:- Analysing lift moving upwards from ground. Observer on ground is inertial frame. Image of inertial frame

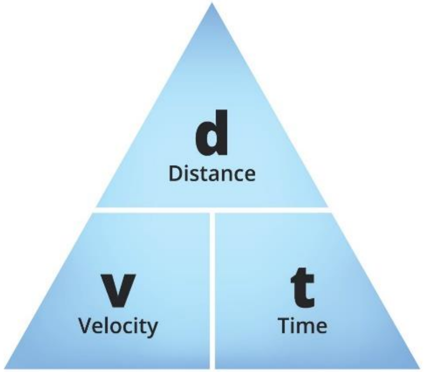


INERTIAL FRAME

- If net external force on system is non – zero frame is non – inertial
- It is accelerating frame.
- Frame velocity increases or decreases

NON-INERTIAL FRAME

- If net external force on system is non – zero frame is non – inertial
- It is accelerating frame.
- Frame velocity increases or decreases



$v = d : t$

$t = d : v$

$d = v \cdot t$

MOTION PARAMETERS

DISTANCE

- Actual path length covered by a moving object in a given interval of time.
- Always positive

DISPLACEMENT

- Shortest distance between the initial position and final position of moving object in a given interval of time.
- can be positive, negative or zero

SPEED

- Ratio of path length to the corresponding time by an object
- Always positive

VELOCITY

- The rate of change of distance of body with respect to time is defined as velocity
- Can be positive, negative or zero

AVERAGE SPEED

Average speed is defined as total distance travelled in total time

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

AVERAGE VELOCITY

Change in position or displacement divided by time intervals in which displacement occurs

$$\text{Average Velocity} = \frac{\Delta x}{\Delta t}$$

ACCELERATION

Measure of change in velocity of an object per unit time

$$a = \frac{\Delta x}{\Delta t}$$

UNIFORM MOTION & GRAPHS

- When a moving object cover equal distance in equal time intervals. It is said to be in uniform motion.
- Speed is constant.
- Acceleration is zero

CASE.1

$$\text{Average Speed} = \frac{2V_1V_2}{V_1+V_2}$$

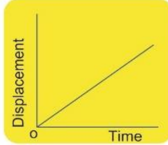
When object travels distance 'd' with velocity v_1 and next distance 'd' with velocity v_2

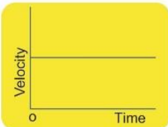
CASE.2

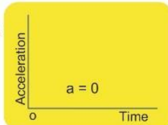
$$\text{Average Speed} = \frac{V_1+V_2}{2}$$

When object travels 't' interval with V1 and next 't' with V2

$$\text{Average Speed} = \frac{d_1+\dots\dots+d_n}{t_1+\dots\dots+t_n} = \frac{d_1+\dots\dots+d_n}{d_1/V_1+\dots\dots+d_n/V_n} = \frac{V_1t_1+\dots\dots+V_nt_n}{t_1+\dots\dots+t_n}$$







UNIFORM ACCELERATED MOTION

When a body moves along a straight line and velocity changes by equal amount in equal interval of time. Motion is uniformly accelerated motion

MOTION EQUATIONS

If acceleration is constant

(1) V = U + at

(2) $S = ut + \frac{1}{2}at^2$

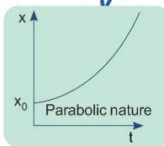
(3) V2 – U2 = 2as

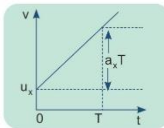
CALCULUS METHOD

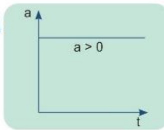
(i) $v = \frac{dx}{dt}$

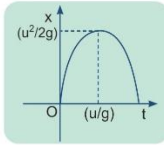
(ii) $a = v\frac{dv}{dt}$

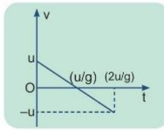
(iii) $a = \frac{dv}{dt}$

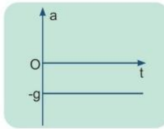












When ball is dropped from a height then it accelerates towards earth with constant acceleration.

Analysis of this motion of an object is motion under gravity

- $a_y = g = 9.8\ m/s^2$
- V = U + ayt
- $s = ut + \frac{1}{2}ayt^2$
- V² – U² = 2ays

Taking downward direction as 'positive'

Time of flight $T = \frac{2u}{g}$

Maximum Height $H_{max} = \frac{u^2}{2g}$

Time to drop $T = \sqrt{\frac{2h}{g}}$

Velocity after dropping $V = \sqrt{2gh}$

RELATIVE MOTION

- The Comparison between the motion of single object with respect to another inertial or non – inertial frame.
- This Analysis is of relative motion of an object.

Relative Uniform Motion

(1) a12 = 0

(2) In this case

$$V_{12} = \frac{S_{12}}{t}$$

V12 = Relative Velocity

S12 = Relative displacement

Relative Uniformly Accelerated Motion

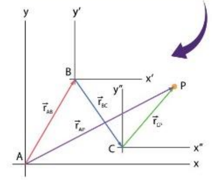
(1) $a_{12} \neq 0$

(2) In this case

$$V_{12} = u_{12} + a_{12}t$$

$$S_{12} = u_{12}t + \frac{1}{2}a_{12}t^2$$

$$V_{12}^2 - u_{12}^2 = 2a_{12}S_{12}$$



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Motion in a Straight Line

1. 'Kinematics' deals with description of motion, without referring to cause of motion.
2. Motion in one dimension is also called motion along a straight line and rectilinear motion.
3. Particle: The 'particle' is a physical concept represented by a mathematical concept 'point'. A particle ideally means a point mass. But in practice, a particle need not be a tiny object. For example, in a journey of a bus from Kurnool to Hyderabad, the bus can comfortably be considered as a point as its size is much smaller when compared to the distance between Kurnool and Hyderabad. (i.e., 210 km)
4. Frame of reference: To describe motion, the observer must define a 'frame of reference' relative to which the motion is analyzed. A set of coordinate axes (and a clock) attached to the object(s) at rest relative to the observer is called 'a reference frame'. In our discussion in this chapter, our frame of reference is the earth unless otherwise mentioned.
   Inertial and non-inertial frames of reference: A reference frame at rest or moving with constant velocity (with respect to objects of motion) is called an 'inertial frame of reference'. A frame of reference which and x_2 = final position.
5. Distance travelled – The length of actual path traversed by a particle is called distance travelled. It is a scalar.
6. Displacement – The magnitude straight line path from initial point to final point is called 'displacement'. It is a vector quantity. Its direction is from initial point to final point.
   If we consider a particle moving on X-axis its displacement is given by
   $$S = (x_2 - x_1)$$
   where x_1 = initial position and x_2 = final position.
   If a particle moves along a straight line in one direction, then distance travelled and magnitude of displacement are equal. In all other cases, distance travelled is more than the magnitude of displacement. Displacement of a particle can be zero positive or negative. But distance travelled cannot be zero (once the motion starts) or negative i.e., distance travelled is always positive.
7. The average velocity during a certain time interval is given by the ratio of its displacement to the time interval. Consider a particle moving on X-axis. Say, it is at x_1 (when $t = t_1$) and at x_2 (when $t = t_2$) then average velocity is given by $v_{avg} = \frac{(x_2 - x_1)}{(t_2 - t_1)} = \frac{\Delta x}{\Delta t}$
   The instantaneous velocity at a certain time is given by $V = \underset{\Delta t \to 0}{\mathrm{Lt}} \frac{(x_2 - x_1)}{(t_2 - t_1)} = \underset{\Delta t \to 0}{\mathrm{Lt}} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$
   So, 'the instantaneous velocity is the time rate of change of displacement'. Velocity is a vector and its SI unit is metre per second (= m s^{-1}).
8. If the velocity remains constant (both in magnitude and in direction) the motion is said to be 'uniform'. In uniform motion the instantaneous velocity and average velocity are equal. In uniform motion the distance travelled and magnitude of displacement are equal. If the direction of velocity or magnitude of velocity or both change, we say that the particle has variable velocity and is in 'non-uniform motion'. Whenever you come across the term 'velocity' in our discussion, it indicates 'instantaneous velocity'.
9. The average speed during a certain time interval is the ratio of distance travelled by the particle to that time interval.
   So, $\text{Average speed} = \frac{\text{total distance travelled}}{\text{time taken to cover that distance}}$
   In uniform motion, the speed and magnitude of velocity are equal. If a particle has constant speed, it does not imply that its velocity is constant. But if we say a particle has constant velocity, it implies that it has constant speed also. Speed is a scalar. Speed cannot be negative.
10. The average acceleration during a certain time interval is given by the ratio of the change in velocity to the time interval.
   $$a_{avg} = \frac{\text{change in velocity}}{\text{time taken}} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{\Delta v}{\Delta t}$$
   Instantaneous acceleration is the time rate of change of velocity. It is given by

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

Acceleration is a vector. Its SI unit is m s^{-2}. In uniform motion, acceleration is zero.

11. Acceleration, $a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$

Also, $a = v\frac{dv}{dx}\left[\because\ v = \frac{dx}{dt}\right]$

12. Uniformly accelerated rectilinear motion:

A particle is moving along a straight line and its acceleration is constant. Then the following equations can be used.

$$v = u + at$$

$$S = ut + \frac{1}{2}at^2$$

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

$S_{n^{th}} = u + a\left(n - \frac{1}{2}\right)$ where u = initial velocity, v = final velocity, a = acceleration,

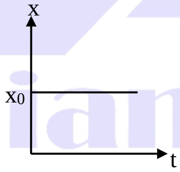
t = time, S = displacement and $S_{n^{th}}$ = displacement in n^{th} second.

13. Graphs for rectilinear motion

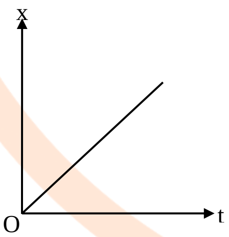
Position-time (x-t) graphs:

Note: The slope of position-time graph gives velocity of particle.

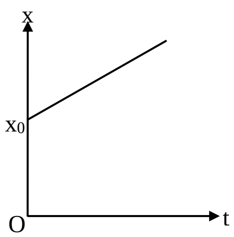
(i) Particle is at rest:



(ii) Particle is in uniform motion i.e., moving with constant velocity.



At t = 0, particle is at x = 0

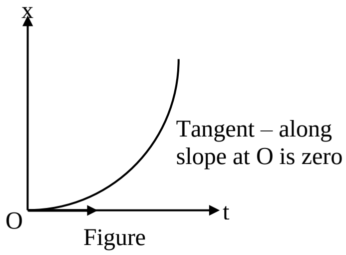


At t = 0, particle is at $x = x_0$

(iii) Particle is moving with constant acceleration: Here $x = ut + \frac{1}{2}at^2$. So x-t graph is a parabola

Figure (a) Initial velocity, u = 0 and particle is at x = 0 when t = 0

[The slope of curve at origin is zero]



Figure

Figure (b) Initial velocity, u ≠ 0 and particle is at x = 0, when t = 0 [Then slope of curve at origin is not zero]

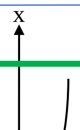
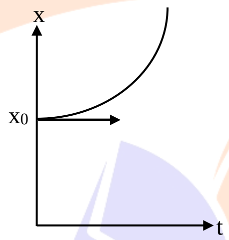
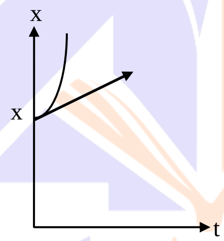


Figure (c) Initial velocity, u = 0 and particle is at $x = x_0$ when t = 0 [Slope of curve at $x = x_0$ is zero]



Figure

Figure (d) Initial velocity, $u \neq 0$ and particle is at $x = x_0$ when t = 0 [The slope of curve at $x = x_0$ is not zero]



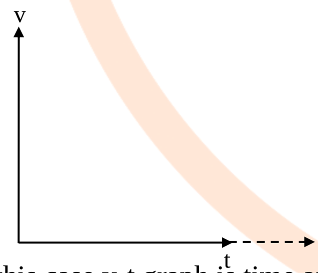
Figure

Velocity-time (v-t) graphs

Note: (i) The slope of v-t graph gives acceleration

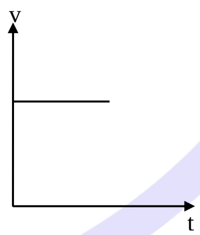
(ii) The area under v-t graph gives displacement.

(i) Particle is at rest



In this case v-t graph is time axis itself

(ii) Particle is in uniform motion



In this case acceleration of the particle is a = 0

(iii) Particle is moving with constant acceleration

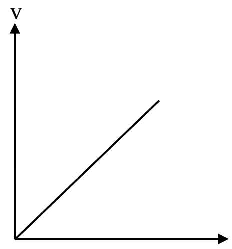


Figure (a) Initial velocity, u = 0

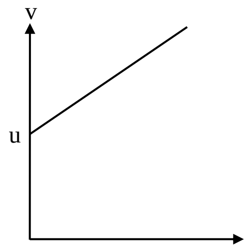


Figure (b) Initial velocity, $u \neq 0$

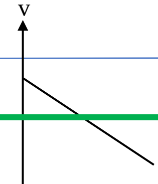
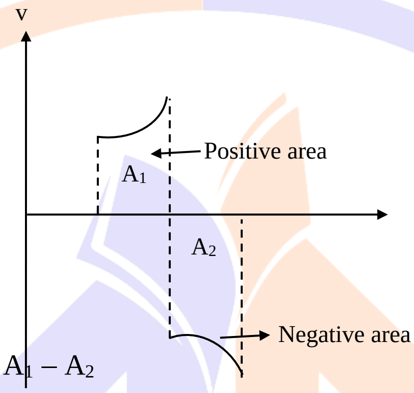


Figure (c) Uniformly retarded motion

(iv) In a v-t graph positive area gives positive displacement and negative area gives negative displacement.



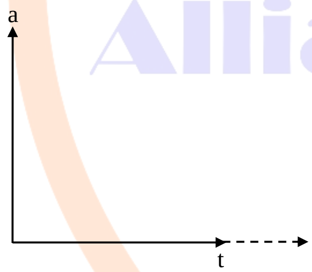
Total displacement = $(+A_1) + (-A_2) = A_1 - A_2$

Total distance travelled = $A_1 + A_2$

Acceleration – time (a-t) graphs

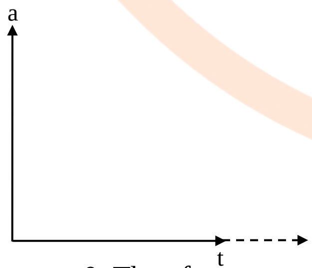
Note: The area under a-t graph gives change in velocity

(i) Particle is at rest



In this case a = 0. Therefore a-t graph is time axis itself.

(ii) Particle is in uniform motion



In this case a = 0. Therefore a-t graph is time axis itself.

14. We know that $a = v\frac{dv}{dS}$ [where S = displacement]

$$\therefore \frac{dv}{ds} = \frac{a}{v} \Rightarrow \text{slope of } v-s \text{ graph} = \frac{\text{acceleration}}{\text{velocity}} = \left(\frac{a}{v}\right)$$

Also, slope of v^2-s graph = 2(acceleration) = 2a

If area under acceleration-displacement graph (a-s graph) is A, then final velocity is given by the formula, $v = \sqrt{u^2 + 2A}$, where u = initial velocity of the particle.

15. Vertical motion under the action of gravity

Here, u = initial velocity, v = final velocity, t = time taken, g = acceleration due to gravity, s = displacement and $S_{n^{th}}$ = displacement in n[th] second.

For a freely falling body (with zero initial velocity), the equations of motion are

$v = gt$

$S = \frac{1}{2}gt^2$

$v^2 = 2\,gS$

$S_{n^{th}} = g\left(n - \frac{1}{2}\right)$

In case of a body projected vertically upwards (with initial velocity, u), the equations of motion are

Velocity after a time t is $v = u - gt$

$S = ut - \frac{1}{2}gt^2$

$v^2 - u^2 = -2gS$

$S_{n^{th}} = u - g\left(n - \frac{1}{2}\right)$

Maximum height attained is $h_{max} = \frac{u^2}{2g}$

Time of ascent is $t_a = \frac{u}{g}$

Time of descent is $t_d = \frac{u}{g}$

Also, $t_a = t_d = \sqrt{\frac{2h_{max}}{g}}$

If a body is projected vertically upwards with an initial velocity 'u' from the top of a tower of height h and time taken by the body to reach ground is 't', then

$$h = \frac{1}{2}gt^2 - ut$$

The above equation can also be used in case of a body dropped from a raising balloon, when its speed is 'u' and when it is at a height 'h' from the ground.

Relative velocity

If absolute velocity of body A is $\vec{v}_A$ and absolute velocity of body B is $\vec{v}_B$, then velocity of A with respect to B (i.e., velocity of A as observed by B) is given by

$$\vec{v}_{AB} = \vec{v}_A - \vec{v}_B$$

Similarly, acceleration of A respect with to B is given by

$$\vec{a}_{AB} = \vec{a}_A - \vec{a}_B$$

where $\vec{a}_A$ = acceleration of A; $\vec{a}_B$ = acceleration of B

we should be cautious while using above two equations and remember that they relate vectors.

Note: $\vec{v}_A, \vec{v}_B, \vec{a}_A$ and $\vec{a}_B$ in the above equations are relative to ground.

Illustrations

1. A man is running on a circular track of radius $\frac{700}{22}$ m. The magnitudes of his displacement and distance travelled by him respectively, when he completes one revolution are

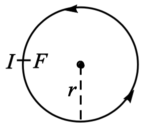
(A) 0, 200 m (B) 200 m, − 200 m (C) 200 m, 0 (D) 0, 0

Ans (A)

Suppose he starts at point I (see figure). After he completes one revolution, he reaches the same point I.

i.e., initial position (I) and final position (F) are same.

So, magnitude of his displacement = 0 m



Distance travelled by him = $2\pi r = 2\times\frac{22}{7}\times\frac{700}{22} = 200$ m

2. A disc, sliding on an inclined plane, is found to have its position (measured from the top of the plane) at any instant given by $x = 3t^2 + 1$, where x is in metre and t in second. Its average velocity in the time interval between 2 s to 2.1 s is

(A) 10.2 ms^{-1} (B) 15.5 ms^{-1} (C) 12.3 ms^{-1} (D) 9.7 ms^{-1}

Ans (C)

Let $t_1 = 2$ s, $t_2 = 2.1$ s

$x_1 = 3(2)^2 + 1 = 13$ m ;

$x_2 = 3(2.1)^2 + 1 = 14.23$ m

$\therefore\ v_{avg} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{14.23 - 13}{2.1 - 2} = 12.3\ ms^{-1}$

3. A car is stopped at a traffic light. It then travels along a straight road so that its distance from the traffic light is given by $x(t) = bt^2 - ct^3$, where $b = 2.40\ ms^{-2}$ and $c = 0.120\ ms^{-3}$. The instantaneous velocity of the car at $t = 5.0$ s is

(A) 5 ms^{-1} (B) 10 ms^{-1}

(C) 12 ms^{-1} (D) 15 ms^{-1}

Ans (D)

Given: $x = bt^2 - ct^3$, where $b = 2.4\ ms^{-2}$ and $c = 0.12\ ms^{-3}$.

Instantaneous velocity is $v = \frac{dx}{dt} = 2bt - 3ct^2$

$(v)_{at\ t = 5s} = 2(2.4)(5) - 3(0.12)(5)^2 = 15\ ms^{-1}$

4. Velocity of a car as function of time is given by $v_x(t) = \alpha + \beta t^2$, where $\alpha = 3.00\ ms^{-1}$ and $\beta = 0.100\ ms^{-3}$. The average acceleration for the time interval $t = 0$ to $t = 5$ s is

(A) 1 ms^{-2} (B) 0.5 ms^{-2} (C) 0.75 ms^{-2} (D) 1.25 ms^{-2}

Ans (B)

$v_x(t) = \alpha + \beta t^2$ (given)

Here $t_1 = 0$ and $t_2 = 5$ s

$\therefore\ v_1 = 3 + (0.1)(0)^2 = 3\ ms^{-1}$ and $v_2 = 3 + (0.1)(5)^2 = 5.5\ ms^{-1}$

Average acceleration $= \frac{v_2 - v_1}{t_2 - t_1} = \frac{5.5 - 3}{5 - 0} = 0.5\ ms^{-2}$

5. A particle is moving along x-axis whose acceleration is given by $a = 3x - 4$, where x is the position of the particle. At $t = 0$, the particle is at rest at $x = \frac{4}{3}$ m. The distance travelled by the particle in 5 s is

(A) 2 m (B) 5 m (C) 6 m (D) zero

Ans (D)

At $t = 0$, $x = \frac{4}{3}$ and $v = 0$ (given)

At $x = \frac{4}{3}$m, $a = 3\left(\frac{4}{3}\right) - 4 = 0$

$\therefore$ At $t = 0$, the velocity of the particle is zero and also its acceleration is zero. So it always remains at $x = \frac{4}{3}$.

Therefore, distance travelled is zero for any time interval.

6. Mark the incorrect statement among the following.

(i) A particle can have zero velocity and non-zero acceleration.

(ii) A particle can have zero displacement and non-zero velocity.
(iii) A particle can have zero acceleration and non-zero velocity.
(iv) A particle can have zero displacement and non-zero average velocity.

(A) (i) (B) (ii) (C) (iii) (D) (iv)

(1) (i) (2) (ii) (3) (iii) (4) (iv)

Ans (D)

For a vertically projected body at maximum height statement (i) is possible. When the same body reaches point of projection statement (ii) is possible. Statement (iii) is possible in case of uniform motion.

7. A man walks to the market which is at a distance of 6 km with a speed of 2.5 km h^{-1} and walks back with a speed of 4 km h^{-1}. His average speed for the round trip is nearly.

(A) 3 km h^{-1} (B) 4 km h^{-1} (C) 2.5 km h^{-1} (D) 6 km h^{-1}

Ans (A)

$$t_1 = \frac{6}{2.5} = 2.4\text{ h}\ ;\ t_2 = \frac{6}{4} = 1.5\text{h}$$

Total time = 2.4 + 1.5 = 3.9 h ;

Total distance = 6 + 6 = 12 km

$$\therefore \text{ Average speed} = \frac{12}{3.9} = \frac{120}{39} = \frac{40}{13}\text{ km h}^{-1}$$

8. At the instant a traffic light turns green, a car that has been waiting at an junction starts ahead with a constant acceleration of 3.2 ms^{-2}. At the same instant, a truck, travelling with a constant speed of 20 ms^{-1}, overtakes and passes the car.

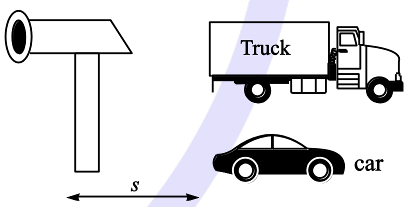
The distance from the starting point at which the car overtakes the truck is

(A) 200 m (B) 250 m (C) 300 m (D) 225 m

Ans (B)

For car: $u_c = 0$; $a_c = 3.2$ ms^{-2}

For truck: (constant) velocity, $v_t = 20$ ms^{-1}



Let the car overtake the truck at a distance s from the junction. Time taken by both of them will be same i.e., t(say).

$$s_c = u_c t + \frac{1}{2}a_c t^2 \Rightarrow s = 0 + \frac{1}{2}\times 3.2t^2 = 1.6t^2$$

$$s_t = v_t \times t \Rightarrow s = 20t$$

As $s_c = s_t = s$, $1.6\,t^2 = 20\,t \Rightarrow t = \frac{20}{1.6} = 12.5\text{ s}$

$\therefore$ $s = 20 \times 12.5 = 250$ m

9. A particle having an initial velocity u moves with a constant acceleration a for a time t. The displacement of the particle in the last one second is

(A) $u + a(t-1)$ (B) $u + \frac{a}{2}\left(t - \frac{1}{2}\right)$ (C) $u + 2a\left(t - \frac{1}{2}\right)$ (D) $u + a\left(t - \frac{1}{2}\right)$

Ans (D)

Given: initial velocity = u, acceleration = a, time = t

$$s_{n^{th}} = u + a\left(n - \frac{1}{2}\right) \Rightarrow s_{n^{th}} = u + a\left(t - \frac{1}{2}\right) \quad [n^{th}\text{ second is } t^{th}\text{ second here}]$$

10. A car starts from rest and moves with constant acceleration. The ratio of the distance covered in n^{th} second to that covered in n seconds is

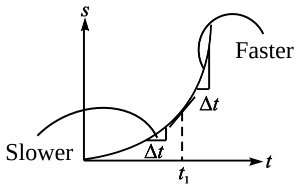
(A) $\frac{2n+1}{n^2}$ (B) $\frac{n^2}{2n+1}$ (C) $\frac{2n-1}{n^2}$ (D) $\frac{n^2}{2n-1}$

Ans (C)

$u = 0,\ t = n\ ;\ \therefore s_{n^{th}} = a\left(n - \frac{1}{2}\right)$ and $s = \frac{1}{2}an^2$

$$\frac{s_{n^{th}}}{s} = \frac{a\left(n-\frac{1}{2}\right)}{(1/2)an^2} = \left[\frac{2n-1}{n^2}\right]$$

11. Figure shows the displacement-time graph of a particle moving on a straight line.



The signs of velocity and acceleration of particle respectively at time t_1 are

(A) +ve, –ve (B) +ve, +ve

(C) –ve, +ve (D) –ve, –ve

Ans (B)

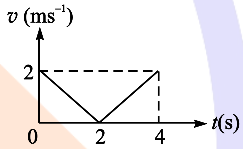
At time t_1, the tangent of s-t graph has positive slope. Therefore, the velocity is +ve. Also if we compare velocities before and after t_1, we observe that velocity after t_1 is more than velocity before t_1 [see figure]. The displacement in Δt after t_1 is more than the displacement for the same time interval Δt before t_1. So velocity is increasing and thus acceleration should also be positive.

$\therefore$ At $t_1 \to v$ is +ve ; a is +ve.

12. A bird flies for 4 s with a velocity of $|t - 2|$ ms^{-1} in a straight line, where t is in second. The distance travelled by it is

(A) 4 m (B) 2 m (C) 6 m (D) 5 m

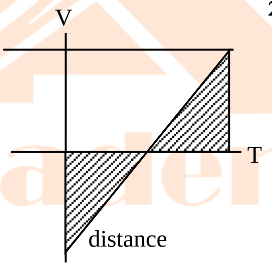
Ans (A)



The velocity-time graph is shown in the figure.

The distance travelled (here it is displacement) is area under

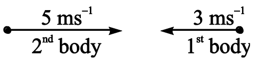
v-t graph $= \frac{1}{2}\times 2\times 2 + \frac{1}{2}\times 2\times 2 = 4$ m



13. Two bodies are moving with speeds 3 ms^{-1} and 5 ms^{-1}, The relative velocity of 1st body w.r.t second body if 1st body is moving leftwards and 2nd body right wards is

(A) 8 ms^{-1} leftwards (B) 2 ms^{-1} leftwards (C) 2 ms^{-1} rightwards (D) 8 ms^{-1} rightwards

Ans (A)



Let left direction is + ve and right direction – ve

$\vec{v}_{12} = \vec{v}_1 - \vec{v}_2 = (3) - (-5) = +8\ \text{ms}^{-1}$ i.e., velocity of 1st body w.r.t. 2nd one is 8 ms^{-1} leftwards.

14. A ball is dropped from rest. If it takes one second to cross the last 20 m before hitting the ground. The height from which it was dropped is

(A) 31.6 m (B) 40 m (C) 22.2 m (D) 43.7 m

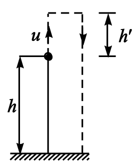
Ans (A)

$$S_{n^{th}} = 20\text{ m};\ \therefore g\left(n - \frac{1}{2}\right) = 20 \Rightarrow n = \frac{20}{9.8} + \frac{1}{2}$$

$$s = \frac{1}{2}gn^2 = \frac{1}{2}(9.8)\left(\frac{2.0}{9.8} + \frac{1}{2}\right)^2 = 31.6\text{ m}$$

$\Rightarrow$ height, $h = 31.6$ m

15. From the top of a building of height 27.3 m, a man throws a ball upwards, which strikes the ground after 16 s. The speed of ball with which it was thrown up is



(A) 63.5 ms^{-1} (B) 70.8 ms^{-1}

(C) 76.8 ms^{-1} (D) 80 ms^{-1}

Ans (C)

$h = \frac{1}{2}gt^2 - ut \Rightarrow 27.3m$

$27.3 = \frac{1}{2} \times 9.8 \times 16^2 - u(16) \Rightarrow u = 76.8\ ms^{-1}$

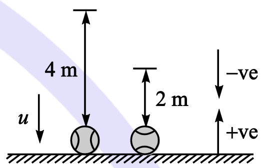
16. A tennis ball is dropped on to the floor from a height of 4 m. It rebounds to a height of 2 m. If the ball is in contact with the floor for 12×10^{-3} s, its average acceleration during the contact is (g = 9.8 ms^{-2}).
(A) 0 (B) 1260 ms^{-2} (C) 980 ms^{-2} (D) 600 ms^{-2}
Ans (B)

$v^2 = u^2 + 2as,\ u = 0 \qquad v^2 = 2as \text{ or } v = \sqrt{2as}$

$u = \sqrt{2 \times 9.8 \times 4} = -8.85\ ms^{-1}$

$v = \sqrt{2 \times 9.8 \times 2} = +6.26\ ms^{-1}$

$t = 12 \times 10^{-3} s$



Average acceleration $= \frac{v - u}{t} = \frac{(6.26) - (-8.85)}{12 \times 10^{-3}}$

a = + 1260 ms^{-2}

17. The acceleration of a particle varies with time according to the relation $a = 6t + 6\ ms^{-2}$. The velocity as a function of time is [Given: particle starts from origin at $t = 0$ with velocity 2 ms^{-1}].
(A) $v = t^3 + 3t^2 + 2t$ (B) $v = 3t^2 + 6t + 2$ (C) $v = 3t^3 + 6t^2 + 4$ (D) $v = t^2 + 4t + 6$
Ans (B)
a = 6t + 6 At t = 0, x = 0 and v = 2 ms^{-1} given

$\frac{dv}{dt} = 6t + 6;\ \int_2^v dv = \int_0^t (6t + 6)\,dt$

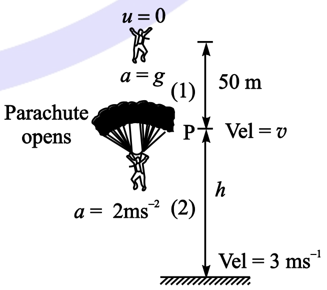
$\Rightarrow v - 2 = \left[\frac{6t^2}{2} + 6t\right]_0^t$

$v - 2 = 3t^2 + 6t \Rightarrow v = 3t^2 + 6t + 2$

18. A parachutist after bailing out falls through 50 m without friction. When parachute opens, it decelerates at 2 ms^{-2}. He reaches the ground with a speed of 3 ms^{-1}. The height at which he bailed out is nearly
[g = 10 ms^{-2}]
(A) 225 m (B) 256 m (C) 298 m (D) 327 m
Ans (C)
The journey is divided into two parts (1) and (2) (See figure)

(1) $v^2 - 0 = 2g \times 50\ [\because v^2 - u^2 = 2as]$

$v = \sqrt{1000} = 10\sqrt{10}\ ms^{-1}$



(2) $3^2 - v^2 = 2(-2)(h)\quad [\because v^2 - u^2 = 2as]$

$h = \frac{9 - v^2}{-4} = \frac{9 - 1000}{-4} = \frac{991}{4} = 247.75\ m$

∴ Height at which he bailed out is = h + 50
= 247.75 + 50 = 297.75 m

19. An elevator whose floor to the ceiling distance is 2.50 m, starts ascending with a constant acceleration of 1.25 ms^{-2}. One second after the start, a bolt begins falling from the ceiling of elevator. The free fall time of the bolt is [g = 10 ms^{-2}]
(A) $\frac{3}{2}$ s (B) 1 s (C) $\frac{2}{3}$ s (D) $\frac{3}{4}$ s
Ans (C)

After 1 s i.e., at the beginning of free fall, (initial) velocity of bolt is = $u + at = 0 + 1.25 \times 1 = 1.25\ ms^{-1}$

Acceleration of lift = $1.25\ ms^{-2}$ (upwards)

$= +1.25\ ms^{-2}$ and

Acceleration of bolt = $10\ ms^{-2}$ (downwards)

$= -10\ ms^{-2}$

Relative acceleration (of bolt w.r.t lift)

$= (-10) - (1.25) = -11.25\ ms^{-2}$

$s_r = -2.5$ m; $u_r = 0$ [$\because$ at the start of falling velocities of bolt and lift are equal]

$$s_r = u_r t + \frac{1}{2}a_r t^2 \Rightarrow -2.5 = 0 + \frac{1}{2}(-11.25)t^2 \Rightarrow t = \frac{2}{3}s$$

NCERT LINE BY LINE QUESTIONS

1. Choose the correct statement [NCERT Pg. 42]

(1) Area under velocity-time graph gives the distance travelled

(2) Area under velocity-time graph gives the change in position

(3) Area under velocity-time graph gives average acceleration

(4) Area under velocity time graph gives change in acceleration

2. Choose the correct statement for one dimensional motion [NCERT Pg. 57]

(1) A constant speed in an interval must have non-zero acceleration in that interval
(2) With negative value of acceleration speed must decrease
(3) With negative value of acceleration speed may increase
(4) With positive value of acceleration speed must increase

3. A drunkard walking in a narrow lane takes 5 steps forward, 3 steps backward and then stay for 1 s and repeat the same process again and again. Each step is 1 m long and takes 1 s. The time taken by drunkard to fall in a pit 10 m away from start is [NCERT Pg. 56]

(1) 45 s (2) 27 s (3) 30 s (4) 31 S

4. The reaction time is the time interval in which a person [NCERT Pg. 51]

(1) Observe the things
(2) Think about the observations
(3) Observe the things and act
(4) Observe the things, think and act

5. A person driving a car with a speed of 72 km/h observes a boy crossing the road at a distance of 100 m from the car. Driver applies the brakes and retards the car with a retardation of 5 m/s^2 and is just able to avoid this accident. The reaction time of driver is [NCERT Pg. 51]

(1) 2.0 s (2) 2.4 s (3) 3.0 s (4) 2. 8 s

6. In any realistic condition (v -t) and (a - t) graph cannot have sharp kinks at some points. This implies that [NCERT Pg.47]

(1) Both velocity and acceleration can change abruptly at an instant
(2) Both velocity and acceleration cannot change abruptly at an instant
(3) Only velocity cannot change abruptly at an instant but acceleration can change
(4) Only acceleration cannot change abruptly at an instant but velocity can change

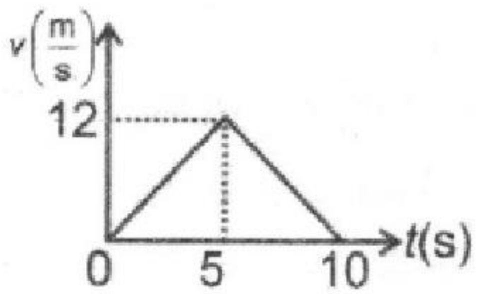
7. A ball is thrown vertically upward with a velocity of 20 m/s from the top of 160 m high building. The time taken by ball to hit the ground is [NCERT Pg. 48]

(1) 8S (2) 10S (3) 4 s (4) 6 s

8. In which of the following cases an object can be considered as point object? [NCERT Pg. 55]

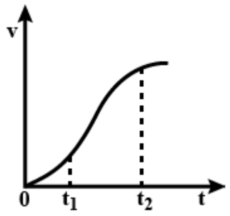
(1) Length of train in comparison to platform
(2) Length of engine in comparison to length of a small bridge
(3) A spinning cricket ball that turns sharply on hitting the pitch
(4) A -ailway carriage moving without jerks between two stations

9. The velocity time graph of a particle moving along a fixed direction is as shown in figure. The average velocity of particle between 5 s to 10 s is [NCERT Pg.60]



(1) 15.6m/s (2) 6.0 m/s (3) 8.9 m/s (4) 15.0 m/s

10. The velocity-time graph of a particle in one dimensional motion is as shown in figure. Which of the following relation is correct for describing the motion of particle over time interval t_1 to t_2? [NCERT Pg. 60]



1) $v_{t_2}^2 = v_{t_1}^2 + 2a_{average}(t_2 - t_1)$

2) $v_{t_2} = v_{t_1} + a_{average}(t_1 - t_2) + \frac{1}{2}a_{average}(t_2 - t_1)$

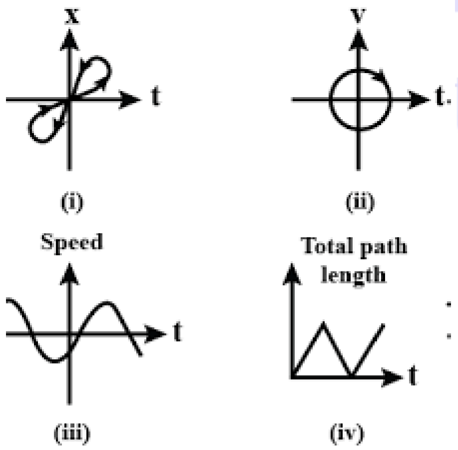
3) $v_{t_2} = v_{t_1} + a(t_1 - t_2)$

4) $a_{average} = \frac{v_{t_2} - v_{t_1}}{t_2 - t_1}$

11. A boy is standing on an open lift moving upwards with speed 10 m/s. The boy throws the ball with speed w.r.t. lift is 24.5 m/s. In how much time the ball returns to the hand of boy? (g= 10 m/s^2) [NCERT Pg. 59]

(1) 10s (2) 4.9 s (3) 7.5 s (4) 6 s

12. Which of the following graphs can represent one dimensional motion of a particle? [NCERT Pg. 57]



(1) i (2) ii (3) iii (4) iv

13. A man walks on a straight road from his home to market 2.0 km away with a speed of 4.0 km/h. The stays in the market for 30 minute for purchasing and returns to home with a speed of 6 km/h. The magnitude of average speed of whole journey is [NCERT Pg. 60]

(1) 4.0 km/h (2) 3.0 km/h (3) 4.5 km/h (4) 3.5 km/h

14. Two trains P and O of length 300 m and 500 m are moving on two parallel tracks each with a uniform speed of 72 km/h in the same direction, with Q ahead of P. The driver of train ***P*** decide to overtake train Q and accelerates by 2.0 m/s^2, if after 40 s the guard of P just brushes past the driver of Q, then the original distance between the trains is [NCERT Pg. 56]

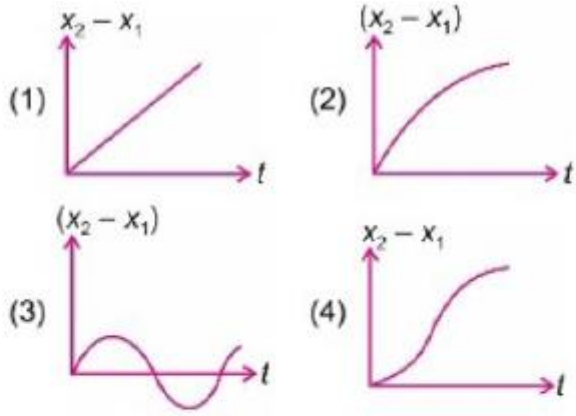
(1) 450 m (2) 650 m (3) 800 m (4) 1300 m

15. Two towns A and B are connected by a regular bus service with a bus leaving in either direction every T minutes. A man cycling with a speed of 20 km/h in the direction from A to B notices that a bus goes past him every 18 min in the direction of his motion and every 6 min in the

opposite direction. The speed with which (assumed constant) buses ply on road is [NCERT Pg. 56]

(1) 40 km/h (2) 60 km/h (3) 75 km/h (4) 80 km/h

16. Two stones are thrown up from the edge of a cliff 300 m high with initial speed of 10 m/s and 20 ***m/s***. Which of the following graph best represents the variation of relative position of second stone with respect to first stone till both the stones are in air? (neglect air resistance) g = 10 m/s² [NCERT Pg. 59]



17. Graphically derivative coefficient means or differential [NCERT Pg. 61)

(1) Angle made by the line joining two points on the curve with x-axis

(2) Slope of the tangent line at any point on the curve

(3) Area enclosed under the curve

(4) Both (1) and (3)

18. A police van moving on a highway with a speed of 30 km/h and a thiefs car speeding away in same direction with speed is 192 km/h. Thief in the car fires bullet on police van. If muzzle speed of bullet is 150 m/s, then the speed with which bullet hits the w.r.t. police van is [NCERT Pg. 58]

(1) 145 m/s (2) 130 m/s (3) 115 m/s (4) 105 m/s

19. The acceleration of a body starting from rest vanes with time as a = 2f + 3, where **t** is in second. The speed of body at **t = 2** s, is [NCERT Pg.63]

(1) 10 m/s (2) 12 m/s (3) 15 m/s (3) 18 m/s

20. The position of an object moving along x- axis is given by, $x = 10 + 15t + 5t^2$, where x is in meter and t is in second. The velocity of body at t = 3 s is (NCERT Pg. 45]

(1) 15 m/s (2) 30 m/s (3) 40 m/s (4) 45 m/s

NCERT BASED PRACTICE QUESTONS

1 A particle is said to be in motion if its position charges with

(a) Time (b) surrounding

(c) time and surrounding both (d) None of these

2 Displacement is

(a) path length (b) change in position

(c) scalar (d) all of above

3 If particle is in uniform motion then

(a) Its velocity is constant (b) Its acceleration is constant

(c) position of particle do not change (d) none of these

4 Which of the following can not be correct?

(a) $|speed| > |velocity|$ (b) $|speed| = |velocity|$

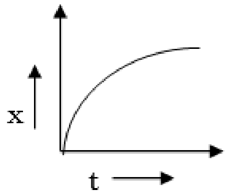
(c) $|distance| < |displacement|$ (d) $|distance| \geq |displacement|$

5 Kinematics equations are applicable when

(a) acceleration is constant (b) velocity is constant

(c) acceleration is nonumiform (d) always applicable

6 Displacement time graph of a particle is shown in figure this graph show



(a) constant velocity (b)constant acceleration
(c) constant retardation (d) Non uniform acceleration

7 In a straight line motion particle move half the distance with velocity v_1 and another half distance with velocity v_2 than average velocity of the particle is

(a) $\frac{2v_1v_2}{v_1+v_2}$ (b) $\frac{v_1+v_2}{2}$

(c) $\frac{v_1-v_2}{2}$ (d) none of these

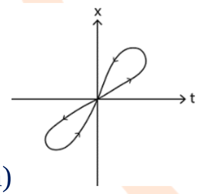
8 The position of an object moving along x – axis is given by $x = a + bt^2$ where a = 8.5 m and b = 2.5 m/s^2 and t is measured n seconds what is the average velocity between t = 2.05 and t = 4.05?

(a) 15 m/s (b) 10 m/s (c) 12 m/s (d) 5 m/s

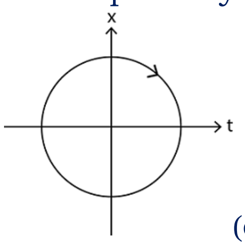
9 If velocity of a particle is zero at an instant then which of the following is correct
(a) acceleration must be zero (b) acceleration must be non zero
(c) acceleration may be zero or nonzero (d) None of these

10 Which of the following represent retarding motion
(a) $a > 0$. $\upsilon > 0$ (b) $a > 0$. $\upsilon < 0$ (c) $a < 0$. $\upsilon < 0$ (d) none of these

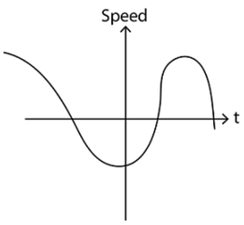
11 Which of the graph can not possibly represent one – dimensional motion of a particle?



(a)



(b)

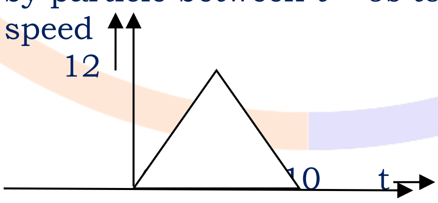


(c)

(d)All of the above

12 Speed time graph of a particle moving along a fixed direction is shown in fig the distance traversed by particle between t = os to 10 s is

(a) 60 m
(b) 30 m
(c) 120 m
(d) 80 m



13 A jet airplane travelling at the speed of 500 km h^{-1} ejects its products of combustion at the speed of 1500 km h^{-1} relative to the jet plane what is the speed of the latter with respect to an observer on the ground?

(a) 1000 km/h (b) 2000 km/h (c) 500 km/h (d) 250 km/h

14. A ball is thrown vertically upward with velocity 20 m/s from the top of a building the height of the point from where ball is thrown is 25.0m from the ground how long will it be before the ball hits the ground?

(a) 2s (b) 3s (c) 5 s (d) 4 s

15 If a car moving with velocity υ_0 is stopped by applying brakes. Then minimum stopping distance of the car is [if car retards uniformly]

(a) $\frac{\upsilon_0^2}{2a}$ (b) $\frac{\upsilon_0^2}{a}$ (c) $\frac{2\upsilon_0^2}{a}$ (d) $\frac{\upsilon_0}{a}$

16 If a particle is projected vertically upward with initial velocity υ then maximum height attained by the particle is

(a) $\frac{\upsilon^2}{2g}$ (b) $\frac{2\upsilon^2}{g}$ (c) $\frac{\upsilon^2}{g}$ (d) $\frac{\upsilon}{g}$

17 If a particle is projected vertically upward with initial velocity υ the time of flight of the particle is

(a) $\frac{\upsilon}{g}$ (b) $\frac{2\upsilon}{g}$ (c) $\frac{4\upsilon}{g}$ (d) $\frac{\upsilon}{2g}$

18 The area under the velocity time curve is

(a) displacement (b) acceleration (c) velocity (d) distance

19 If a particle start from rest the displacement of the particle in 1st 2nd and 3rd seconds is

(a) 1 : 3 : 5 (b) 1 : 2 : 3 (c) 1 : 4 : 9 (d) 1 : 4 : 8

20 A particle strated with initial velocity is move with acceleration a. What will be the average velocity of particle for time t

(a) ut + $\frac{1}{2}at^2$ (b) $\frac{u+at}{2}$ (c) u + $\frac{1}{2}at$ (d) u + at

21 A particle started with intial velocity u. Then the distance travelled by the particle in nth second is.

(a) u + $\frac{1}{2}a(2n-1)$ (b) un + $\frac{1}{2}an^2$

(c) u + $\frac{1}{2}an^2$ (d) none of these

22 An athletc completes one round of circular track of radius R in 40 seconds. What will be his displacement at the end of 2 minutes 20 seconds

(a) zero (b) 2R (c) 2π R (d) 7πR

23 The location of a particle has changed. What can we say about the displacement and the distance covered by the particle

(a) Both cannot be zero (b) one of the two may be zero

(c) Both must be zero

(d) If one is positive the other is negative and vice versa

24 A car travels a distance s on a straight line in two hours and then returns to the starting point in the next three hours. Its average velocity is

(a) $\frac{5}{5}$ (b) $\frac{25}{5}$ (c) $\frac{5}{2}+\frac{5}{3}$ (d) none of the above

25. When a particle move variable velocity. Which of the following statements are not correct

(i) Average speed = average velocity

(ii) Instantaneous speed = instantaneous velocity

(iii) Distance covered = magnitude of displacement

(a) i, ii, iii (b) i, ii (c) ii, iii (d) i, iii

26 The velocity of a body depends on time according to the equation $\upsilon = 20 + 0.1t^2$. The body is undergoing

(a) uniform acceleration (b) uniform retardation

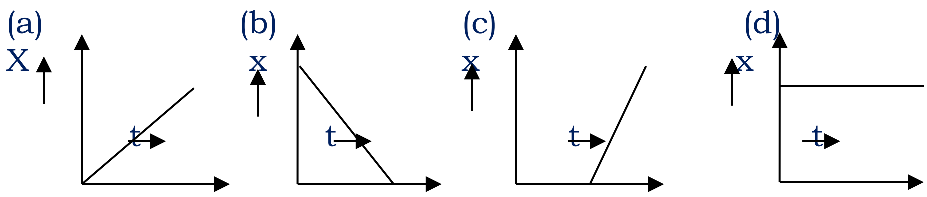
(c) Non-uniform acceleration (d) zero acceleration

27 The displacement of a body is given to be proportional to the cube of time elapsed. The magnitude of the acceleration of the body is

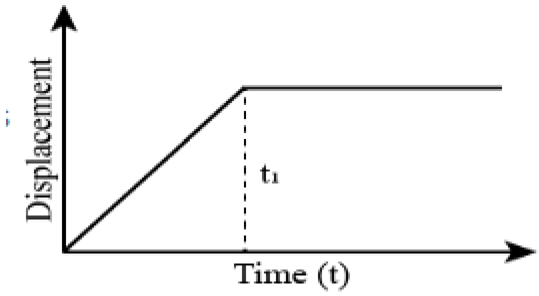
(a) Increasing with time (b) decreasing with time

(c) constant but not zero (d) zero

28 Which of the following can not be the distance time graph?

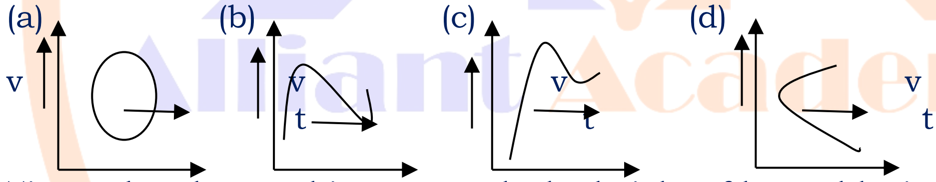


29 The x – t graph in figure



(a) constant velocity
(b) velocity of the body continuously charging
(c) Instantaneous velocity
(d) The body travels with constant speed upto time t_1 and then stops

30 Which of the following velocity time graphs is graphs is possible



31 Time taken by an object to reach the height of h_1 and h_2 is respectively t_1 and t_2 then the ratio of t_1 to t_2 is

(a) $h_1 : h_2$ (b) $\sqrt{h_1 : h_2}$ (c) $h_1 : 2h_2$ (d) $2h_1 : h_2$

32 Three particles A,B and C are thrown from the top of a tower with the same speed A is thrown straight up. B is thrown straight down and C is thrown horizontally. They hit the ground with speed $\upsilon_A . \upsilon_B and \upsilon_c$ respectively then.

(a) $\upsilon_A = \upsilon_B = \upsilon_c$ (b) $\upsilon_A > \upsilon_B > \upsilon_c$

(c) $\upsilon_A = \upsilon_B > \upsilon_c$ (d) $\upsilon_A > \upsilon_B = \upsilon_c$

33 A stone is dropped from a height h simultaneously another stone is thrown up from the ground which reaches a height 4h. Two stones cross each other after time

(a) $\sqrt{\frac{h}{8g}}$ (b) $\sqrt{8gh}$ (c) $\sqrt{2gh}$ (d) $\sqrt{\frac{h}{2g}}$

34 A particle when thrown moves such that it passes from same height at 2 and 10s, the height is

(a) g (b) 2g (c) 5g (d) 8g

TOPIC WISE PRACTICE QUESTIONS

Topic 1: Distance, Displacement, Speed and Velocity

1. A man leaves his house for a cycle ride. He comes back to his house after half-an-hour after covering a distance of one km. What is his average velocity for the ride ?

1) Zero 2) $2 km h^{-1}$ 3) $10 km s^{-1}$ 4) $\frac{1}{2} km s^{-1}$

2. The numerical ratio of average velocity to average speed is

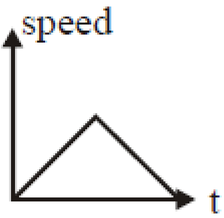
(1) always less than one (2) always equal to one

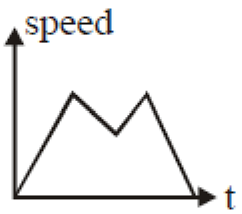
(3) always more than one (4) equal to or less than one

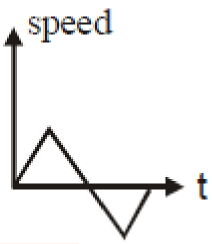
3. A body moves in a straight line along Y-axis. Its distance y (in metre) from the origin is given by y = 8t – 3t2. The average speed in the time interval from t = 0 second to t = 1 second is

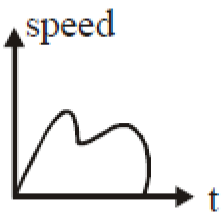
(1) – 4 ms^{-1} (2) zero 3) 5 ms^{-1} 4) 6 ms^{-1}

4. Which of the following speed time graphs is not possible?

1) 

2) 

3) 

4) 

5. A car travels from A to B at a speed of 20 km h^{-1} and returns at a speed of 30 km h^{-1}. The average speed of the car for the whole journey is

(1) 5 km h–1 (2) 24 km h–1 (3) 25 km h–1 (4) 50 km h–1

6. The location of a particle has changed. What can we say about the displacement and the distance covered by the particle?

(1) Neither can be zero (2) One may be zero

(3) Both may be zero (4) One is +ve, other is –ve

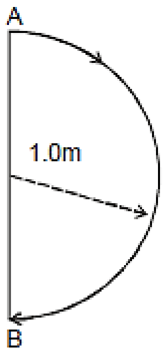
7. The displacement y (in metre) of a body varies with time t (in second) as $y = -\frac{2}{3}t^2 + 16t + 2$ How long does the body take to come to rest ?

(1) 8 s (2) 10 s (3) 12 s (4) 16 s

8. The displacement-time graphs of two particles A and B are straight lines making angles of 30° and 60° respectively with the time axis. If the velocity of A is vA and that of B is vB, the value of vA/vB is

(1) 1/2 (2) 1/ 3 (3) 3 (4) 1/3

9. In 1.0 s, a particle goes from point *A* to point *B*, moving in a semicircle of radius 1.0 m (see Figure). The magnitude of the average velocity is



1)3.14m/s 2) 2.0m/s 3) 1.0m/s 4) zero

10. A bird flies with a speed of 10 km/h and a car moves with uniform speed of 8 km/h. Both start from *B* towards *A* (*BA* = 40km) at the same instant. The bird having reached *A*, flies back immediately to meet the approaching car. As soon as it reaches the car, it flies back to *A*. The bird repeats this till both the car and the bird reach *A* simultaneously. The total distance flown by the bird is

(1) 80 km (2) 40 km (3) 50 km (4) 30 k m

11. An athlete completes one round of a circular track of radius R in 40 sec. What will be his displacement at the end of 3 min. 20 sec ?

(1) Zero (2) 2 R (3) 2 π R (4) 7 π R

12. A particle located at $x = 0$ at time $t = 0$, starts moving along with the positive x-direction with a velocity 'v' that varies as $v = \alpha\sqrt{x}$. The displacement of the particle varies with time as

(1) t^2 (2) t (3) $t^{1/2}$ (4) t^3

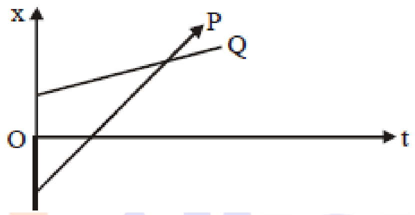
13. A point traversed half of the distance with a velocity v_0. The half of remaining part of the distance was covered with velocity v_1 & second half of remaining part by v_2 velocity. The mean velocity of the point, averaged over the whole time of motion is

1) $\frac{v_0+v_1+v_2}{3}$ 2) $\frac{2v_0+v_1+v_2}{3}$ 3) $\frac{v_0+2v_1+2v_2}{3}$ 4) $\frac{2v_0(v_1+v_2)}{(2v_0+v_1+v_2)}$

14. The displacement 'x' (in meter) of a particle of mass 'm' (in kg) moving in one dimension is related to time 't' (in sec) by $t=\sqrt{x}+3$. The displacement of the particle when its velocity is zero, will be

(1) 2 m (2) 4 m (3) zero (4) 6 m

15. The fig given shows the time-displacement curve of two particles P and Q. Which of the following statement is correct?



(1) Both P and Q move with uniform equal speed

(2) P is accelerated Q is retarded

(3) Both P and Q move with uniform speeds but the speed of P is more than the speed of Q

(4) Both P and Q move with uniform speeds but the speed of Q is more than the speed of P.

Topic 2: Uniformly Accelerated Motion

16. Which of the following decreases in motion along a straight line with constant retardation while the body is moving away from the origin?

(1) Speed (2) Acceleration (3) Displacement (4) None of these

17. A bullet fired into a wooden block loses half of its velocity after penetrating 60 cm. It comes to rest after penetrating a further distance of

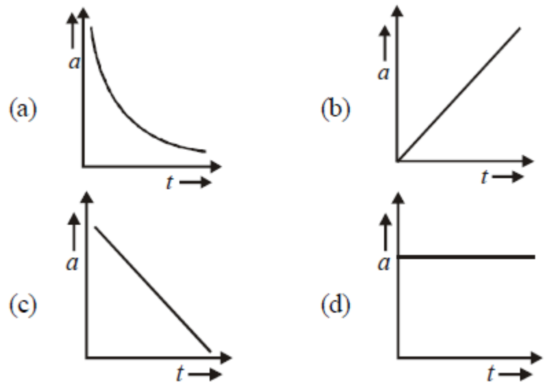
(1) 22 cm (2) 20 cm (3) 24 cm (4) 26 cm

18. The dependence of velocity of a body with time is given by the equation v = 20 + 0.1t2. The body is in

(1) uniform retardation (2) uniform acceleration

(3) non-uniform acceleration (4) zero acceleration.

19. The distance travelled by a body moving along a line in time t is proportional to t3. The acceleration-time (a, t) graph for the motion of the body will be



20. The velocity of a particle at an instant is 10 m/s. After 5 sec, the velocity of the particle is 20 m/s. Find the velocity at 3 seconds before from the instant when velocity of a particle is 10m/s.
(1) 8 m/s (2) 4 m/s (3) 6 m/s (4) 7 m/s

21. A particle experiences constant acceleration for 20 seconds after starting from rest. If it travels a distance s1 in the first 10 seconds and distance s2 in the next 10 seconds, then
1) $s_2 = s_1$ 2) $s_2 = 2s_1$ 3) $s_2 = 3s_1$ 4) $s_2 = 4s_1$

22. A body starts from rest from the origin with an acceleration of 6 m/s^2 along the x-axis and 8 m/s^2 along the y-axis. Its distance from the origin after 4 seconds will be
(1) 56 m (2) 64 m (3) 80 m (4) 128 m

23. The distance travelled by a particle starting from rest and moving with an acceleration $\frac{4}{3}\text{ms}^{-2}$, in the third second is:
(1) 6 m (2) 4 m (3) 10/3 m 4)19/3 m

24. The initial velocity of a particle is u (at t = 0) and the acceleration a is given by f t.
Which of the following relation is valid?
(1) v = u + ft^2 (2) v = u + f t^2/2 3)v = u + ft (4) v = u

25. An automobile travelling with a speed of 60 km/h, can apply brake to stop within a distance of 20m. If the car is going twice as fast i.e., 120 km/h, the stopping distance will be
(1) 60 m (2) 40 m (3) 20 m (4) 80 m

26. A body travels 2 m in the first two second and 2.20 m in the next 4 second with uniform deceleration. The velocity of the body at the end of 9 second is
1) -10ms^{-1} 2) -0.20ms^{-1} 3) $-0.40\,\text{ms}^{-1}$ 4) $-0.80\,\text{ms}^{-1}$

27. A particle accelerates from rest at a constant rate for some time and attains a velocity of 8 m/sec. Afterwards it decelerates with the constant rate and comes to rest. If the total time taken is 4 sec, the distance travelled is
(1) 32 m (2) 16 m (3) 4 m (4) 14 m

28. A bus starts moving with acceleration 2 m/s^2. A cyclist 96 m behind the bus starts simultaneously towards the bus at 20 m/s. After what time will he be able to overtake the bus?
(1) 4 sec (2) 8 sec (3) 18 sec (4) 16 sec

29. A metro train starts from rest and in 5 s achieves 108 km/h. After that it moves with constant velocity and comes to rest after travelling 45 m with uniform retardation. If total distance travelled is 395 m, find total time of travelling.
(1) 12.2 s (2) 15.3 s (3) 9 s (4) 17.2 s

30. A particle starting with certain initial velocity and uniform acceleration covers a distance of 12 m in first 3 seconds and a distance of 30 m in next 3 seconds. The initial velocity of the particle is
1) 3 ms^{-1} 2) 2.5 ms^{-1} 3) 2 ms^{-1} 4)1 ms^{-1}

31. A particle travels 10m in first 5 sec and 10m in next 3 sec. assuming constant acceleration, what is the distance travelled in next 2 sec?
(1) 8.3 m (2) 9.3 m (3) 10.3 m (4) 5.6 m

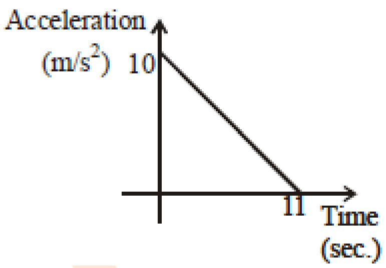
32. An NCC parade is going at a uniform speed of 6 km/h through a place under a berry tree on which a bird is sitting at a height of 12.1 m. At a particular instant the bird drops a berry. Which cadet (give the distance from the tree at the instant) will receive the berry on his uniform?
(1) 3.62 m (2) 4.12 m (3) 2.62 m (4) 5.32 m

33. A particle starts from rest and travel a distance x with uniform acceleration, then moves uniformly a distance 2x and finally comes to rest after moving further 5x with uniform retardation. The ratio of maximum speed to average speed is
1)5/2 2)5/3 3)7/4 4)7/5

34. A particle is moving in a straight line with initial velocity and uniform acceleration a. If the sum of the distance travelled in t^{th} and $(t + 1)^{th}$ seconds is 100 cm, then its velocity after *t* seconds, in cm/s, is
(1) 80 (2) 50 (3) 20 (4) 30

35. A car is moving along a straight road with a uniform acceleration. It passes through two points *P* and *Q* separated by a distance with velocity 30 km/h and 40 km/h respectively. The velocity of the car midway between *P* and *Q* is
(1) 33.3 km /h (2) $20\sqrt{2}$ km/h (3) $25\sqrt{2}$ km/h (4) 35 km/h

36. A body starts from rest at time t = 0, the acceleration time graph is shown in the figure. The maximum velocity attained by the body will be



(1) 110 m/s (2) 55 m/s (3) 650 m/s (4) 550 m/s

37. A car, moving with a speed of 50 km/hr, can be stopped by brakes after at least 6 m. If the same car is moving at a speed of 100 km/hr, the minimum stopping distance is
(1) 12 m (2) 18 m (3) 24 m (4) 6 m

38. A particle moves along a straight line such that its displacement at any time t is given by $s = t^3 - 6t^2 + 3t + 4$ metre. The velocity when the acceleration is zero is
1) 3 ms^{-1} 2)-12 ms^{-1} 3)42 ms^{-1} 4)-9 ms^{-1}

39. A particle moves along a straight line OX. At a time t (in second) the distance x (in metre) of the particle from O is given by $x = 40 + 12t - t^3$ How long would the particle travel before coming to rest?
(1) 40 m (2) 56 m (3) 16 m (4) 24 m

Topic 3: Motion Under Gravity

40. A body is thrown upwards and reaches its maximum height. At that position
(1) its acceleration is minimum (2) its velocity is zero and its acceleration is also zero
(3) its velocity is zero but its acceleration is maximum
(4) its velocity is zero and its acceleration is the acceleration due to gravity.

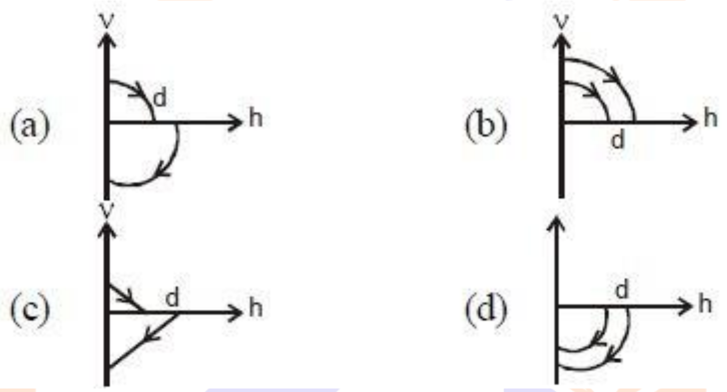
41. A man throws balls with the same speed vertically upwards one after the other at an interval of 2 seconds. What should be the speed of the throw so that more than two balls are in the sky at any time? $\left[\text{Given } g = 9.8 m/s^2\right]$

1) only with speed 19.6 m/s (2) more than 19.6 m/s
(3) at least 9.8 m/s (4) any speed less than 19.6 m/s

42. Two bodies of different masses m_a and m_b are dropped from two different heights a and b. The ratio of the time taken by the two to cover these distances is

1) a:b 2) b:a 3) $\sqrt{a}:\sqrt{b}$ 4) $a^2:b^2$

43. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height d/2. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as



44. A stone is dropped from a rising balloon at a height of 76 m above the ground and reaches the ground in 6s. What was the velocity of the balloon when the stone was dropped? Take g = 10 m/s^2

1) $\left(\frac{52}{3}\right) m/s$ upward 2) $\left(\frac{52}{3}\right) m/s$ downward 3) 3 m/s 4) 9.8 m/s

45. A boy standing at the top of a tower of 20m height drops a stone. Assuming g = 10ms^{-2}the velocity with which it hits the ground is

(1) 10.0 m/s (2) 20.0 m/s (3) 40.0 m/s (4) 5.0 m/s

46. What will be the ratio of the distances moved by a freely falling body from rest on 4th and 5th seconds of journey?

(1) 4 : 5 (2) 7 : 9 (3) 16 : 25 (4) 1 : 1

47. A ball dropped from a point A falls down vertically to C, through the midpoint B. The descending time from A to B and that from A to C are in the ratio

(1) 1 : 1 (2) 1 : 2 (3) 1 : 3 (4) 1: 2

48. A body dropped from top of a tower fall through 40 m during the last two seconds of its fall. The height of tower is $\left(g = 10 m/s^2\right)$

(1) 60 m (2) 45 m (3) 80 m (4) 50 m

49. A ball is dropped downwards, after 1 sec another ball is dropped downwards from the same0 point. What is the distance between them after 3 sec?

(1) 25 m (2) 20 m (3) 50 m (4) 9.8 m

50. A stone thrown vertically upwards with a speed of 5 m/sec attains a height H1. Another stone thrown upwards from the same point with a speed of 10 m/sec attains a height H2. The correct relation between H1 and H2 is

(1) H2 = 4H1 (2) H2 = 3H1 (3) H1 =2H2 (4) H1 = H2

51. From a 200 m high tower, one ball is thrown upwards with speed of 10 ms^{-1} and another is thrown vertically downwards at the same speeds simultaneously. The time difference of their reaching the ground will be nearest to
(1) 12 s (2) 6 s (3) 2 s (4) 1 s

52. Two stones are thrown from the top of a tower, one straight down with an initial speed u and the second straight up with the same speed u. When the two stones hit the ground, they will have speeds in the ratio
(1) 2 : 3 (2) 2 : 1 (3) 1 : 2 (4) 1 : 1

53. The water drops fall at regular intervals from a tap 5 m above the ground. The third drop is leaving the tap at an instant when the first drop touches the ground. How far above the ground is the second drop at that instant ? (Take g = 10 m/s^2)
(1) 1.25 m (2) 2.50 m (3) 3.75 m (4) 5.00 m

54. A ball is dropped from the top of a tower of height 100 m and at the same time another ball is projected vertically upwards from ground with a velocity 25 ms^{-1}. Then the distance from the top of the tower, at which the two balls meet is
(1) 68.4 m (2) 48.4 m (3) 18.4 m (4) 78.4 m

55. A stone falls freely from rest from a height h and it travels a distance $\frac{9h}{25}$ in the last second. The value of h is
(1) 145 m (2) 100 m (3) 122.5 m (4) 200 m

56. A body *A* is thrown vertically upward with the initial velocityv_1. Another body *B* is dropped from a height *h*. Find how the distance *x* between the bodies depends on the time *t* if the bodies begin to move simultaneously.
1) $x = h - v_1 t$ 2) $x = (h - v_1)t$ 3) $x = h - \frac{v_1}{t}$ 4) $x = \frac{h}{t} - v_1$

57. A juggler keeps on moving four balls in the air throwing the balls after intervals. When one ball leaves his hand (speed= 20 ms^{-1}) the position of other balls (height in m) will be (Take g = 10 ms^{-2})
(1) 10, 20, 10 2) 15, 20, 15 (3) 5, 15, 20 (4) 5, 10, 20

58. Similar balls are thrown vertically each with a velocity 20 ms^{-1}, one on the surface of earth and the other on the surface of moon. What will be ratio of the maximum heights attained by them? (Acceleration on moon = 1.7 ms^{-2} approx.)
(1) 6 (2) 1/6 (3) 1/5 (4) 4

Topic 4: Relative Motion

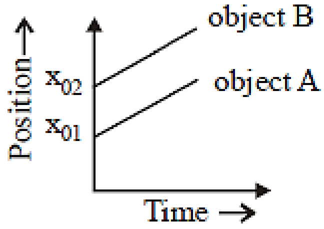
59. Two trains are each 50 m long moving parallel towards each other at speeds 10 m/s and 15 m/s respectively. After what time will they pass each other?
1) $5\sqrt{\frac{2}{3}}$ sec 2) 4 sec 3) 2sec 4) 6 sec

60. A train of 150 m length is going towards north direction at a speed of 10 ms^{-1} A parrot flies at a speed of 5 ms^{-1} towards south direction parallel to the railway track. The time taken by the parrot to cross the train is equal to
(1) 12 s (2) 8 s (3) 15 s (4) 10 s

61. An object has velocity $\vec{v}_1$ relative to the ground. An observer moving with a constant velocity $\vec{v}_0$ relative to the ground measures the velocity of the object to be $\vec{v}_2$ (relative to the observer). The magnitudes of these velocities are related by
1) $v_0 \le v_1 + v_2$ 2) $v_1 \le v_2 + v_0$ 3) $v_2 \le v_0 + v_1$ 4) All of the above

62. A boat takes 2 hours to travel 8 km and back in still water lake. With water velocity of 4 km h^{-1} , the time taken for going upstream of 8 km and coming back is
(1) 160 minutes (2) 80 minutes (3) 100 minutes (4) 120 minutes

63. The graph shown below represent



(1) A and B are moving with same velocity in opposite directions
(2) velocity of B is more than A in same direction
(3) velocity of A is more than B in same direction
(4) velocity of A and B is equal in same direction

64. A car is standing 800 m behind a bus, which is also at rest. The two start moving at the same instant but with different forward accelerations. The bus has acceleration 4 m/s^2 and the car has acceleration 8 m/s^2. The car will catch up with the bus after a time of :
(1) 20 s (2) 10 s (3) 5 s (4) 15 s

65. A thief is running away on a straight road on a jeep moving with a speed of 9 m/s. A police man chases him on a motor cycle moving at a speed of 10 m/s. If the instantaneous separation of jeep from the motor cycle is 100 m, how long will it take for the policemen to catch the thief?
(1) 1 second (2) 19 second (3) 90 second (4) 100 second

66. Three particles P, Q and R are situated at the vertices of an equilateral triangle PQR of side D at t = 0. Each of the particles moves with constant speed V. P always has its velocity along PQ, Q along QR and R along RP. At what time will the particles meet each other?
(1) 2D/3V (2) 5D/7V (3) 6D/10V (4) 7D/9V

67. A ball is thrown vertically upward with a velocity 'u' from the balloon descending with velocity v. The ball will pass by the balloon after time
1) $\frac{u-v}{2g}$ 2) $\frac{u+v}{2g}$ 3) $\frac{2(u+v)}{g}$ 4) $\frac{2(u-v)}{g}$

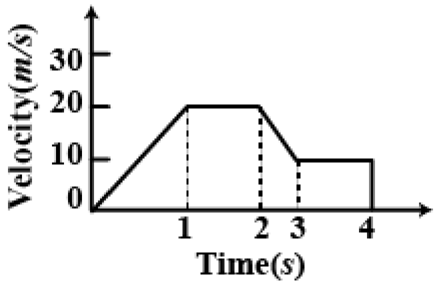
68. A bus is moving with a speed of 10 ms^{-1} on a straight road. A scooterist wishes to overtake the bus in 100 s. If the bus is at a distance of 1 km from the scooterist, with what speed should the scooterist chase the bus?
(1) 40 ms^{-1} (2) 25 ms^{-1} (3) 10 ms^{-1} (4) 20 ms^{-1}

69. A boy running on a horizontal road at 8 km/h finds the rain falling vertically. He increases his speed to 12 km/h and finds that the drops makes 30° with the vertical. The speed of rain with respect to the road is
(1) 4 7 km/h (2) 9 7 km/h (3) 12 7 km/h (4) 15 7 km/h

70. An airplane flies from a town *A* to a town *B* when there is no wind and takes a total time *T*0 for a return trip. When there is a wind blowing in a direction from town *A* to town *B*, the plane's time for a similar return trip, *Tw*, would satisfy
(1) $T0 < Tw$ (2) $T0 > Tw$ (3) $T0 = Tw$
(4) the result depends on the wind velocity between the towns

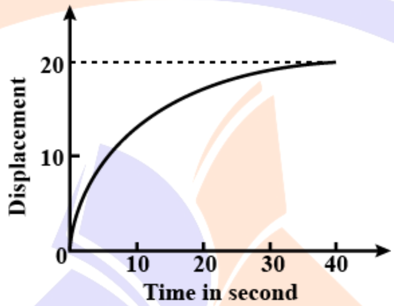
Topic 5 : Graphs

71. The variation of velocity of a particle with time moving along a straight line is illustrated in the following figure. The distance travelled by the particle in four seconds is



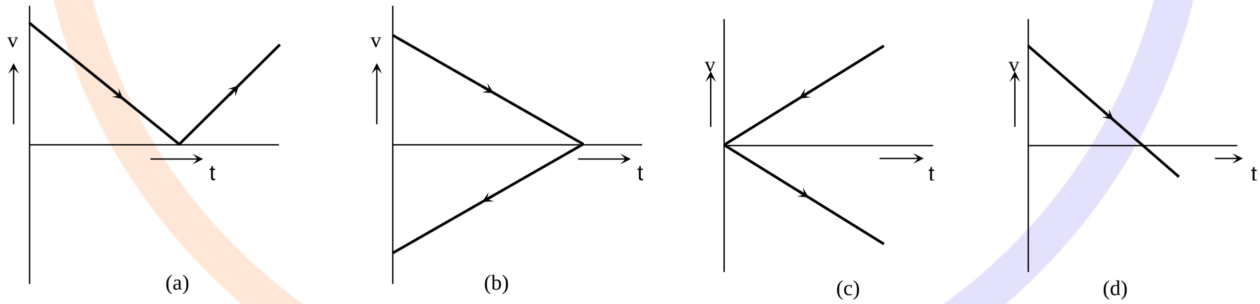
(1) 60 m (2) 55 m (3) 25 m (4) 30 m

72. The displacement of a particle as a function of time is shown in the figure. The figure shows that



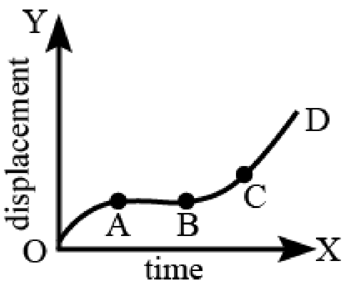
(1)The particle starts with certain velocity but the motion is retarded and finally the particle stops
(2) The velocity of the particle is constant throughout
(3) The acceleration of the particle is constant throughout.
(4) The particle starts with constant velocity, then motion is accelerated and finally the particle moves with another constant velocity

73. A ball is thrown vertically upwards. Which of the following graph/graphs represent velocity-time graph of the ball during its flight (air resistance is neglected)



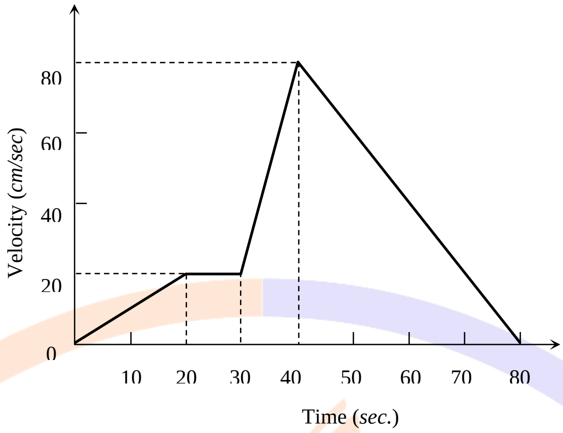
(1) A (2) B (3)C (4)D

74. The graph between the displacement x and time t for a particle moving in a straight line is shown in figure. During the interval OA, AB, BC and CD, the acceleration of the particle is



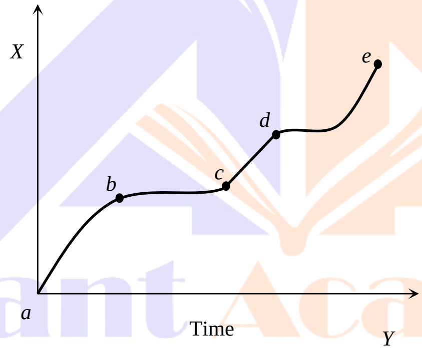
	OA,	AB,	BC,	CD
(1)	+	0	+	+
(2)	–	0	+	0
(3)	+	0	–	+
(4)	–	0	–	0

75. The $v-t$ graph of a moving object is given in figure. The maximum acceleration is



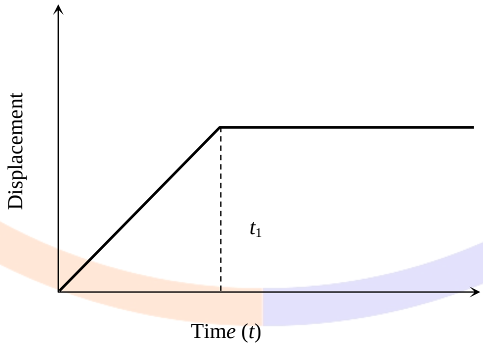
(1) $1cm/\sec c^2$ (2) $2cm/\sec^2$ (3) $3\ cm/\sec^2$ (4) $6\ cm/\sec^2$

76. The displacement versus time graph for a body moving in a straight line is shown in figure. Which of the following regions represents the motion when no force is acting on the body



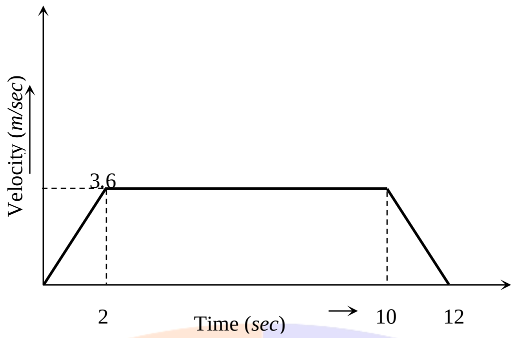
(1) ab (2) bc (3) cd (4) de

77. The $x-t$ graph shown in figure represents



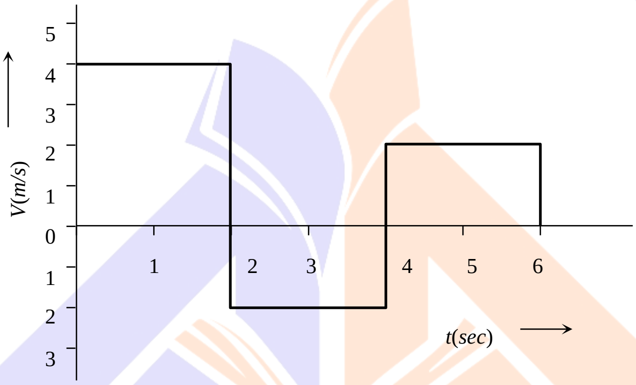
(1) Constant velocity
(2) Velocity of the body is continuously changing
(3) Instantaneous velocity
(4) The body travels with constant speed upto time t_1 and then stops

78. A lift is going up. The variation in the speed of the lift is as given in the graph. What is the height to which the lift takes the passengers



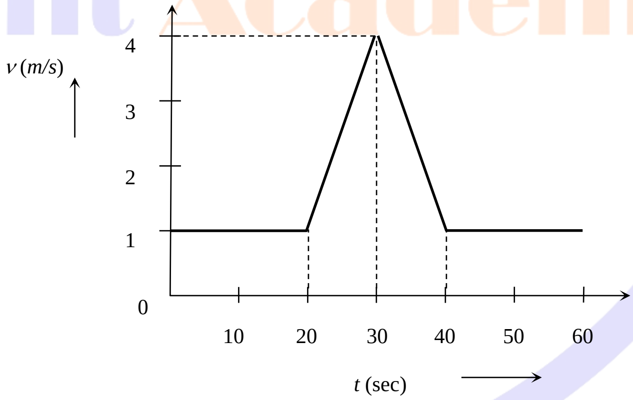
(1) 3.6 *m* (2)28.8 *m* (3)36.0 *m* (4)Cannot be calculated from the above graph

79. The velocity-time graph of a body moving in a straight line is shown in the figure. The displacement and distance travelled by the body in 6 *sec* are respectively



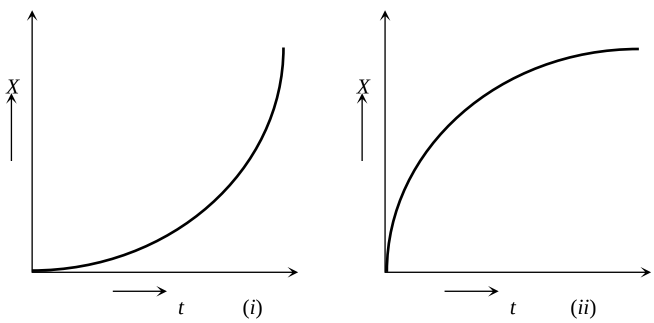
(1) 8 *m*, 16 *m* (2) 16 *m*, 8 *m* (3)16 *m*, 16 *m* (4)8 *m*, 8 *m*

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



(1) 60 *m* (2)50 *m* (3)30 *m* (4)40 *m*

81. Figures (i) and (ii) below show the displacement-time graphs of two particles moving along the *x*-axis. We can say that



(1) Both the particles are having a uniformly accelerated motion

(2) Both the particles are having a uniformly retarded motion

(3) Particle (i) is having a uniformly accelerated motion while particle (ii) is having a uniformly retarded motion

(4) Particle (i) is having a uniformly retarded motion while particle (ii) is having a uniformly accelerated motion

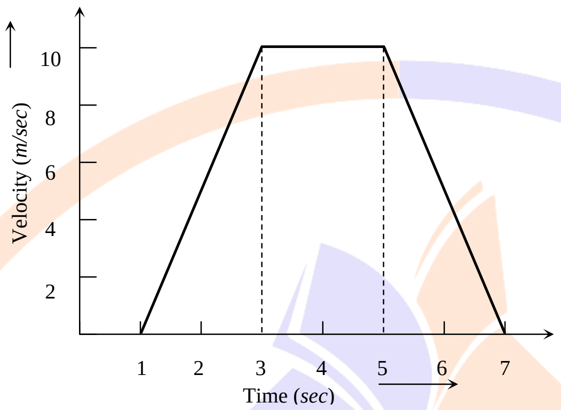
82. For the velocity-time graph shown in figure below the distance covered by the body in last two seconds of its motion is what fraction of the total distance covered by it in all the seven seconds

(1) $\frac{1}{2}$

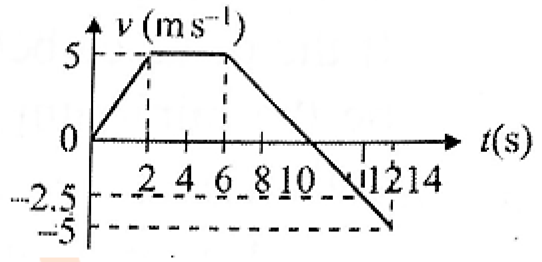
(2) $\frac{1}{4}$

(3) $\frac{1}{3}$

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



83. The variation of velocity of a particle moving along a straight line is shown in figure. The distance travelled by the particle in 12s is

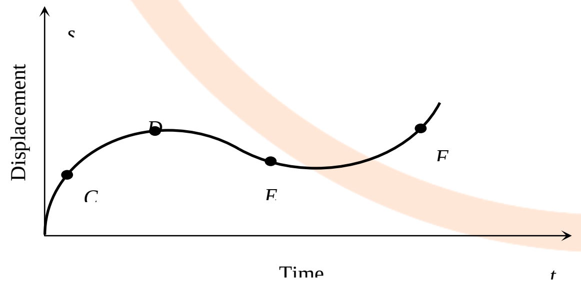


1) 37.5m 2) 35.5m 3) 35.0m 4) none of these

84. Velocity-time curve for a body projected vertically upwards is

(1)Parabola (2) Ellipse (3) Hyperbola (4) Straight line

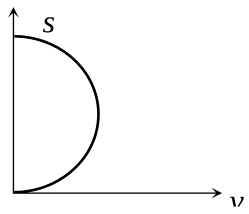
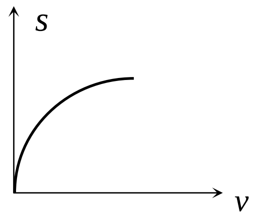
85. The displacement-time graph of moving particle is shown below

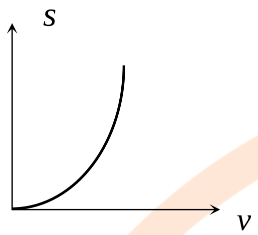
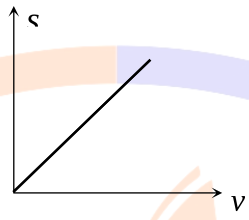


The instantaneous velocity of the particle is negative at the point

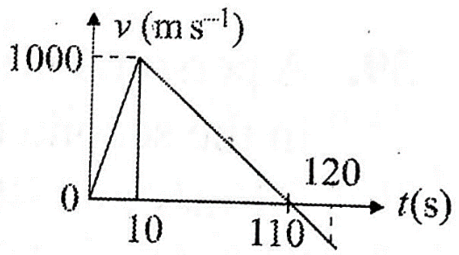
(1) D (2) F (3)C (4)E

86. An object is moving with a uniform acceleration which is parallel to its instantaneous direction of motion. The displacement (s) – velocity (v) graph of this object is

1)  2) 

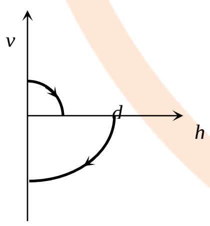
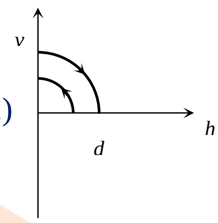
3)  4) 

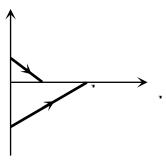
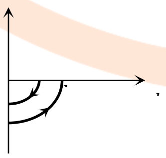
87. The following graph (figure) shows the variation of velocity of a rocket with time .Then the maximum height attained by the rocket is



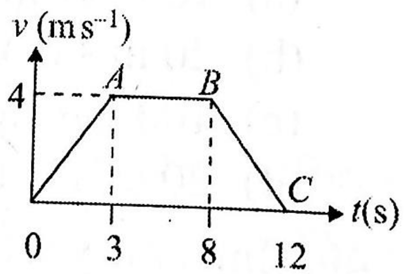
1) 1.1km 2) 5km 3) 55km 4) none of these

88. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground is

(1)  (2) 

(3)  (4) 

89. From the velocity –time graph, given in figure of a particle moving in a straight line, one can conclude that



1) Its average velocity during the 12s interval is $24/7 ms^{-1}$
2) Its velocity for the first 3s is uniform and is equal to $4\ ms^{-1}$

3) The body has a constant acceleration between t = 3s and t = 8s

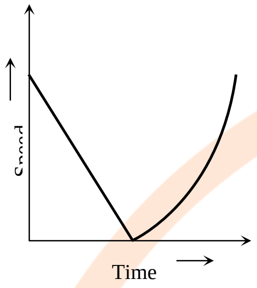
4) The body has a uniform retardation from t = 8 s to t = 12s

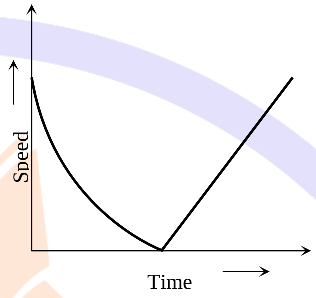
90. The area under acceleration-time graph gives

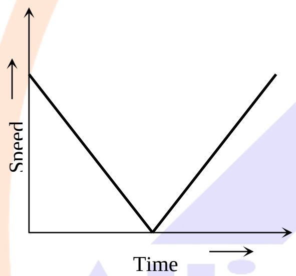
(1)Distance travelled (2) Change in acceleration

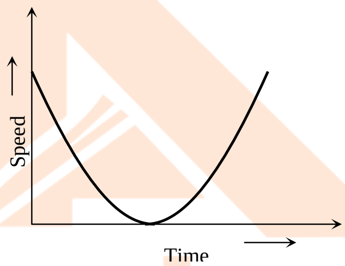
(3) Force acting (4) Change in velocity

91. A ball is thrown vertically upwards. Which of the following plots represents the speed-time graph of the ball during its height if the air resistance is not ignored

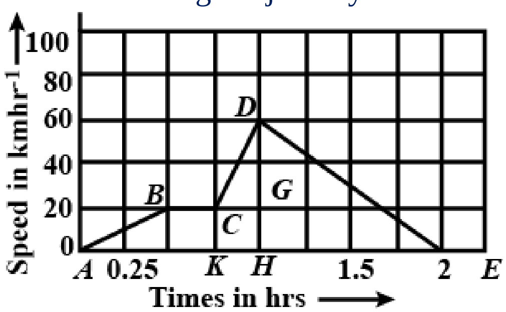
(1) 

(2) 

(3) 

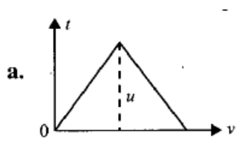
(4) 

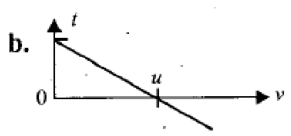
92. A train moves from one station to another in 2 hours time. Its speed-time graph during this motion is shown in the figure. The maximum acceleration during the journey is

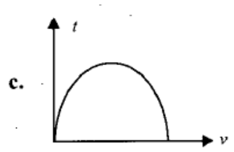


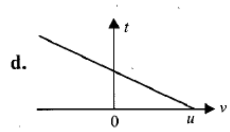
(1)140 $km\ h^{-2}$ (2) 160 $km\ h^{-2}$ (3)100 $km\ h^{-2}$ (4)120 $km\ h^{-}$

93. An object is thrown up vertically. The velocity –time graph for the motion of the particle is

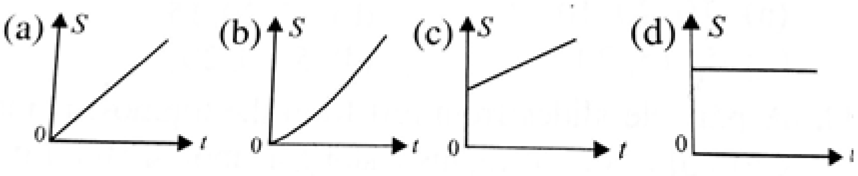
1) 

2) 

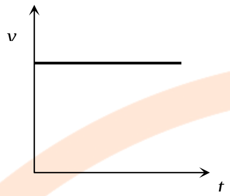
3) 

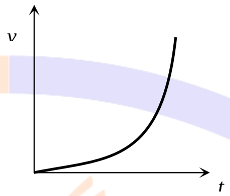
4) 

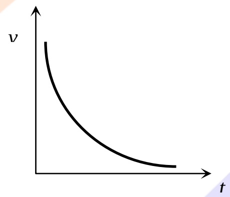
94. From a high tower, at time t = 0, one stone is dropped from rest and simultaneously another stone is projected vertically up with an initial velocity. The graph of distance S between the two stones plotted against time t will be

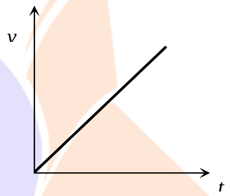


95. Which of the following velocity-time graphs represent uniform motion

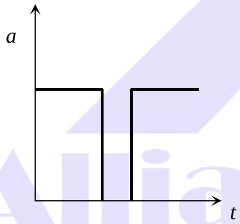
1) 

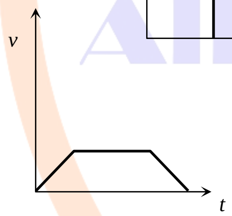
2) 

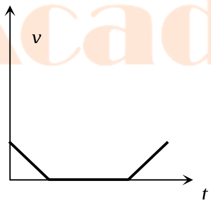
3) 

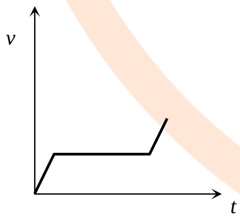
4) 

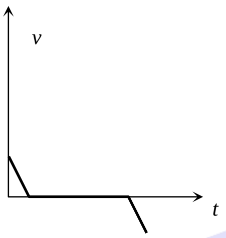
96. Acceleration-time graph of a body is shown. The corresponding velocity-time graph of the same body is



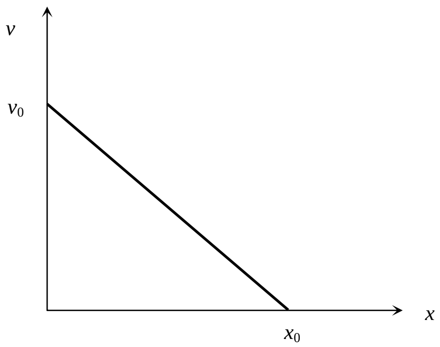
(1) 

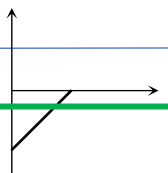
(2) 

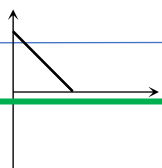
(3) 

(4) 

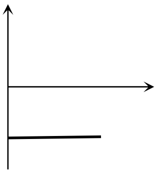
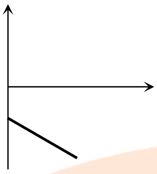
97. The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration with displacement



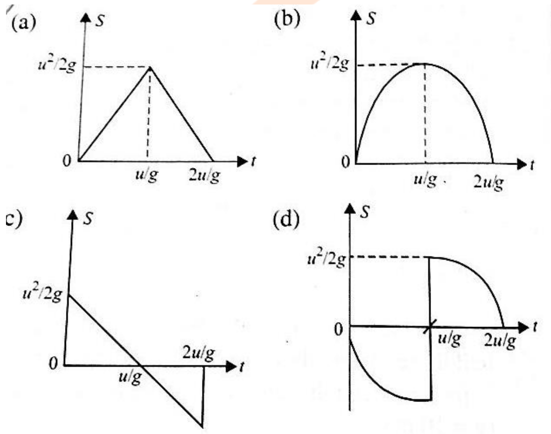




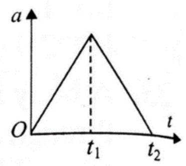
(1) (2)

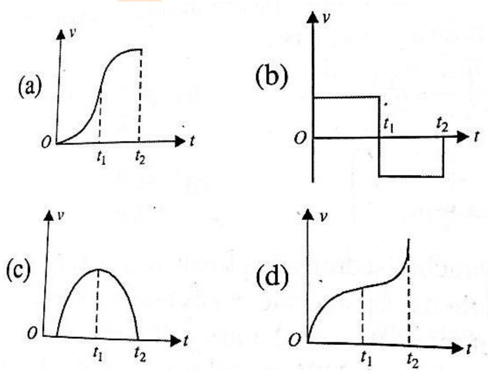
(3)  (4) 

98. An object is vertically thrown upwards. Then the displacement-time graph for the motion is as shown in



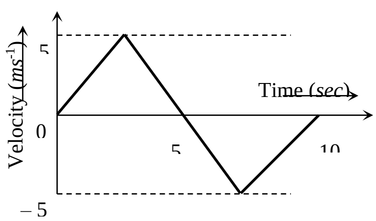
99. The acceleration versus time graph of a particle is shown in figure. The respective v-t graph of the particle is





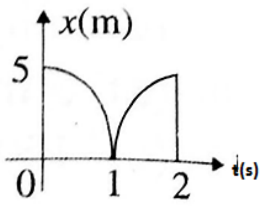
1) a 2)b 3)c 4)d

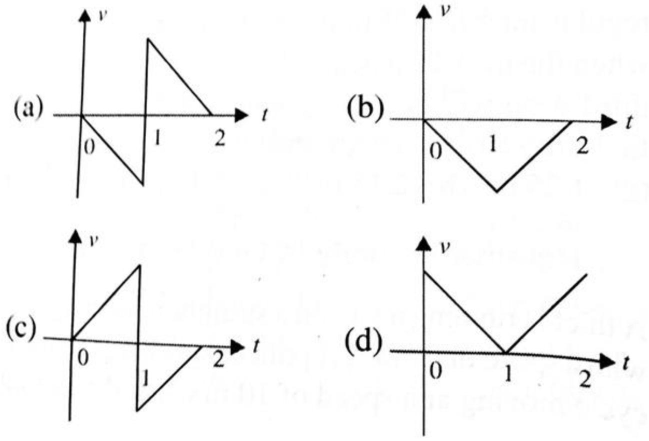
100. The $\upsilon - t$ plot of a moving object is shown in the figure. The average velocity of the object during the first 10 seconds is



(1)0 (2)2.5 ms^{-1} (3)5 ms^{-1} (4)2 ms^{-}

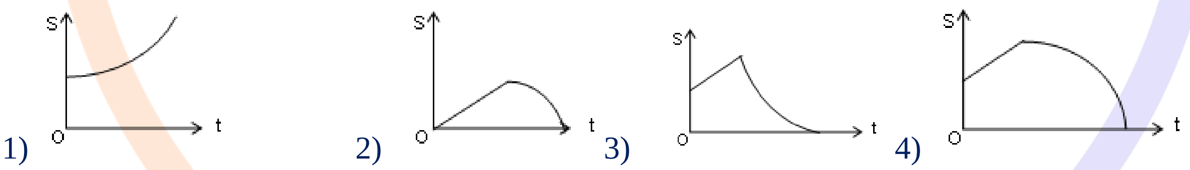
101. The displacement- time graph of a moving particle with constant acceleration is shown in figure. The velocity –time graph is given by



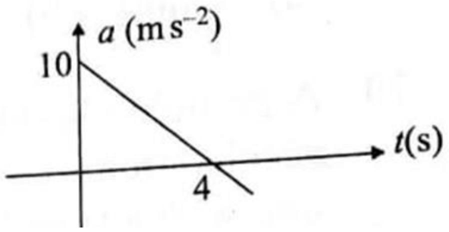


1)a 2)b 3)c 4)d

102. Two balls are dropped from the top of a high tower with a time interval of t_0 second, where t_0 is smaller than the time taken by the first ball to reach the floor, which is perfectly inelastic. The distance S between the two balls, plotted against the time lapse t from the instant of dropping the second ball, is best represented by

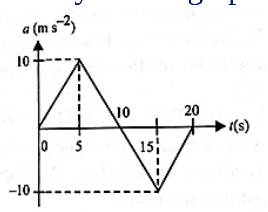


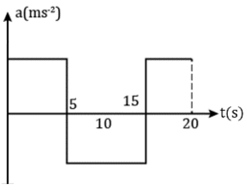
103. The acceleration –time graph of a particle moving along a straight line is as shown in figure. At what time the particle acquires its initial velocity?

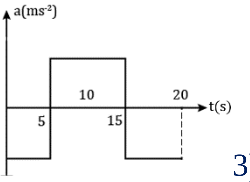


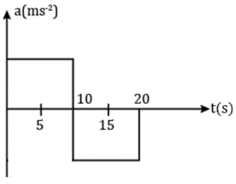
1) 12s 2) 5s 3) 8s 4) 16s

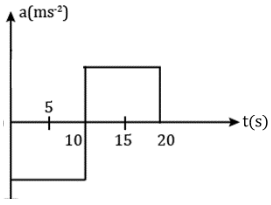
104. Plot the acceleration –time graph of the velocity – time graph given in the figure.



1) 

2) 

3) 

4) 

NEET PREVIOUS YEARS QUESTIONS

1. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t2. The time taken by her to walk up on the moving escalator will be: (2017)

1) $\frac{t_1t_2}{t_2-t_1}$ 2) $\frac{t_1t_2}{t_2+t_1}$ 3) t_1-t_2 4) $\frac{t_1+t_2}{2}$

2. If the velocity of a particle is v = At + Bt^2, where A and B are constants, then the distance travelled by it between 1s and 2s is: (2016)

1) $\frac{3}{2}A+4B$ 2) 3A+7B 3) $\frac{3}{2}A+\frac{7}{3}B$ 4) $\frac{A}{2}+\frac{B}{3}$

3. A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to v(x)= bx^{-2n} where b and n are constants and *x* is the position of the particle. The acceleration of the particle as d function of x, is given by: (2015)

1) -2nb^{2}x^{-4n-1} 2) -2b^{2}x^{-2n+1} 3) -2nb^{2}e^{-4n+1} 4) -2nb^{2}x^{-2n-1}

4. A person travelling in a straight line moves with a constant velocity v_1 for certain distance 'x' and with a constant velocity v_2 for next equal distance. The average velocity v is given by the relation

[NEET – 2019 (ODISSA)]

1) $\frac{1}{v}=\frac{1}{v_1}+\frac{1}{v_2}$ 2) $\frac{2}{v}=\frac{1}{v_1}+\frac{1}{v_2}$ 3) $\frac{v}{2}=\frac{v_1+v_2}{2}$ 4) $v=\sqrt{v_1v_2}$

5. A person sitting in the ground floor of a building notices through the window, of height 1.5 m, a ball dropped from the roof of the building crosses the window in 0.1 s. What is the velocity of the ball when it is at the topmost point of the window? (g = 10 m/s^2) **NEET-2020(COVID-19)**

(1) 15.5 m/s (2) 14.5 m/s (3) 4.5 m/s (4) 20 m/s

6. A ball is thrown vertically downward with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of 80 m/s. The height of the tower is (g = 10 m/s^2) **(NEET 2020)**

1) 300 m 2) 360 m 3) 340 m 4) 320 m

7. A small block slides down on a smooth inclined plane, starting from rest at time t=0. Let S_n be the distance travelled by the block in the interval $t=n-1$ to $t=n$. Then , the ratio $\frac{S_n}{S_{n+1}}$ is: **[NEET-2021]**

1. $\frac{2n-1}{2n+2}$ 2. $\frac{2n+1}{2n-1}$ 3. $\frac{2n}{2n-1}$ 4. $\frac{2n-1}{2n}$

8. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second**[NEET-2022]**

1) 1 : 2 : 3 : 4 2) 1 : 4 : 9 : 16 3) 1 : 3 : 5 : 7 4) 1 : 1 : 1 : 1

NCERT LINE BY LINE QUESTIONS – ANSWERS

1) b 2) c 3) d 4) d 5) c 6) b 7) a 8) d 9) b 10) d
11) b 12) c 13) b 14) c 15) a 16) a 17) b 18) d 19) a 20) d

NCERT BASED PRCTICE QUESTONS-ANSWERS

1)c 2) b 3) a 4) c 5) a 6) d 7) a 8) a 9) c 10) b
11)d 12) a 13) a 14) c 15) a 16) a 17) b 18) a 19) a 20) c
21)a 22) b 23) a 24) d 25) d 26) c 27) a 28) b 29) d 30) c
31)b 32) a 33) a 34) d

TOPIC WISE PRACTICE QUESTIONS - ANSWERS

1) 1	2) 4	3) 3	4) 3	5) 2	6) 1	7) 3	8) 4	9) 2	10) 3
11) 1	12) 1	13) 4	14) 3	15) 3	16) 1	17) 2	18) 3	19) 2	20) 2
21) 3	22) 3	23) 3	24) 2	25) 4	26) 2	27) 2	28) 2	29) 4	30) 4
31) 1	32) 3	33) 3	34) 2	35) 3	36) 2	37) 3	38) 4	39) 2	40) 4
41) 2	42) 3	43) 1	44) 1	45) 2	46) 2	47) 4	48) 2	49) 1	50) 1
51) 3	52) 4	53) 3	54) 4	55) 3	56) 1	57) 2	58) 2	59) 2	60) 4
61) 4	62) 1	63) 2	64) 1	65) 4	66) 1	67) 4	68) 4	69) 1	70) 1
71) 2	72) 1	73) 4	74) 2	75) 4	76) 3	77) 4	78) 3	79) 1	80) 2
81) 3	82) 2	83) 1	84) 4	85) 4	86) 3	87) 3	88) 1	89) 4	90) 4
91) 3	92) 2	93) 4	94) 1	95) 1	96) 3	97) 1	98) 2	99) 1	100) 1
101) 1	102) 4	103) 3	104) 1						

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1) 2	2) 3	3) 1	4) 2	5) 2	6) 1	7) 1	8) 3		

TOPIC WISE PRACTICE QUESTIONS – SOLUTIONS

1. 1) Since displacement is zero
2. 4) average velocity is equal to or less than one
3. 3) $\bar{v} = \frac{(8\times1-3\times1\times1)}{1} = 5ms^{-1}$
4. 3) This is because speed can never be negative
5. 2) average velocity = $\frac{2\times20\times30}{20+30} = 24kmh^{-1}$
6. 1) when location of a particle has changed, it must have covered some distance and undergone some displacement
7. 3) Velocity, $v = \frac{dy}{dt} = -\frac{4}{3}t + 16$

   For body to be at rest, v = 0 $\Rightarrow -\frac{4}{3}t + 16 = 0$ or $t = 12$ sec.

8. 4) $v_A = \tan 30^0$ and $v_B = \tan 60^0$

$$\therefore \frac{v_A}{v_B} = \frac{\tan 30^0}{\tan 60^0} = \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$$

9. 2) $|\text{Average velocity}| = \frac{|\text{displacement}|}{\text{time}} = \frac{2r}{t} = 2\times\frac{1}{1} = 2m/s$

(c) 

10 3)

$v_L = 8km/h, s = v_0 \times t \Rightarrow t = \frac{40}{8} = 5h$

Total distance flown by the bird = $10\times 5 = 50km$

11. 1) total time of motion is 3 min 20sec = 20sec. As time period of circular motion is 40 sec so in 20 sec athlete will complete 5 revolution i.e., he will be at starting point i.e., displacement = zero

12. 1) $v = \alpha\sqrt{x}, \frac{dx}{dt} = \alpha\sqrt{x} \Rightarrow \frac{dx}{\sqrt{x}} = \alpha dt$

$$\int_0^x \frac{dx}{\sqrt{x}} = \alpha\int_0^t dt$$

$$\left[\frac{2\sqrt{x}}{1}\right]_0^x = \alpha[t]_0^t \Rightarrow 2\sqrt{x} = \alpha t \Rightarrow x = \frac{\alpha^2}{4}t^2$$

13. 4) Let the total distance be d. Then for first half distance, time $= \frac{d}{2v_0}$, next distance. = v t and last half distance = v_2 t

$$\therefore v_1 t + v_2 t = \frac{d}{2}; t = \frac{d}{2(v_1+v_2)}$$

Now average speed $t = \frac{d}{\frac{d}{2v_0} + \frac{d}{2(v_1+v_2)} + \frac{d}{2(v_1+v_2)}} = \frac{2v_0(v_1+v_2)}{(v_1+v_2)+2v_0}$

14. 3) $\because t = \sqrt{x} + 3 \Rightarrow \sqrt{x} = t-3 \Rightarrow x = (t-3)^2$

$v = \frac{dx}{dt} = 2(t-3) = 0 \Rightarrow t = 3$; $\therefore x = (3-3)^2 \Rightarrow x = 0$

15. 3) As x – t graph is a straight line in either case, velocity of both is uniform. As the slope of x – t graph for P is greater, therefore, velocity of P is greater than that of Q.

16. (1) When a body moves along a straight line with constant retardation, its speed goes on decreasing.

17. 2)

18. 3)

19. 2) Distance along a line i.e., displacement (*s*) = $t^3 (\because s \propto t^3)$ given By double differentiation of displacement, we get acceleration.

$$V = \frac{ds}{dt} = \frac{dt^3}{dt} = 3t^2 \text{ and } a = \frac{dv}{dt} = \frac{d3t^2}{dt} = 6t$$

$a = 6t$ or $a \propto t$

Hence graph 2) is correct

20. 2) $u = 10m/s, t = 5sec, v = 20m/s, a = ?$

$$a = \frac{20-10}{5} = 2ms^{-2}$$

From the formula $v_1 = u_1 + a\,t$, we have

$10 = u_1 + 2\times3$ or $u_1 = 4m/sec$

21. 3) Let a be the constant acceleration of the particle. Then

$s = ut + \frac{1}{2}at^2$ or $s_1 = 0 + \frac{1}{2}\times a\times(10)^2 = 50a$ and $s = \left[0 + \frac{1}{2}a(20)^2\right] - 50a = 150a$

$\therefore s_2 = 3s_1$

22. 3) $s_x = u_x t + \frac{1}{2}a_x t^2 \Rightarrow s_x = \frac{1}{2}\times6\times16 = 48m$

$s_y = u_y t + \frac{1}{2}a_y t^2 \Rightarrow s_y = \frac{1}{2}\times8\times16 = 64m$

$s = \sqrt{s_x^2 + s_y^2} = 80m$

23. 3)Distance travelled in the nth second is given by

$d = u + \frac{a}{2}(2n-1)$ put $u = 0, a = \frac{4}{3}ms^{-2}, n = 3$

$\therefore d = 0 + \frac{4}{3\times2}(2\times3-1) = \frac{4}{6}\times5 = \frac{10}{3}m$

24. 2) $a = ft, a = \frac{dv}{dt} = ft$ at $t = 0$, velocity $= u$

$\int_u^v dv = \int_0^t ft\,dt, v - u = f\frac{t^2}{2} \Rightarrow v = u + f\frac{t^2}{2}$

Do not use $v = u + at$ directly because the acceleration is not constant

25. 4)

26. 2)

27. 2) $8 = at_1$ and $0 = 8 - a(4 - t_1)$ or $t_1 = \frac{8}{a}\therefore 8 = a\left[4 - \frac{8}{a}\right]$

$8 = 4a - 8$ or $a = 4$ and $t_1 = 8/4 = 2sec$ Now, $s_1 = 0\times2 + \frac{1}{2}\times4(2)^2$ or $s_1 = 8m$

$s_2 = 8\times2 - \frac{1}{2}\times4(2)^2$ or $s_2 = 8m$

$\therefore s_1 + s_2 = 16m$

28. 2) Let after a time t, the cyclist overtake the bus. Then $96 + \frac{1}{2}\times2\times t^2 = 20\times t$ or $t^2 - 20t + 96 = 0$

$\therefore t = \frac{20\pm\sqrt{400-4\times96}}{2\times1} = \frac{20\pm4}{2} = 8sec.$ and 12sec

29. 4)

30. 4) Let u be the initial velocity that have to find and a be the uniform acceleration of the particle. For t = 3s, distance travelled S = 12 m and for t = 3+3 =6 s distance travelled S' = 12+30=42m from, S = ut+1/2at^2

$12 = u\times3 + \frac{1}{2}\times a\times3^2$ or $24 = 6u + 9a$ ……………..(i)

similarly, 42 = $u\times6 + \frac{1}{2}\times a\times6^2$ or 42 = 6u+18a……….(ii)

on solving, we get u = 1 ms^{-1}

31. 1) Let initial (t = 0) velocity of particle = u

For first 5 sec motion the distance is, s_5 = 10 metre

$s = ut + \frac{1}{2}at^2 \Rightarrow 10 = 5u + \frac{1}{2}a(5)^2$

$2u + 5a = 4$ ……………..(i)

For first 8 sec of motion the distance is, $s_8 = 20metre \Rightarrow 20 = 8u + \frac{1}{2}a(8)^2 \Rightarrow 2u + 8a = 5$……….(ii)

By solving $u = \frac{7}{6}m/s$ and $a = \frac{1}{3}m/s^2$ now distance travelled by particle in total 10sec.

$s_{10} = u \times 10 + \frac{1}{2}a(10)^2$

By substituting the value of u and a we will get $s_{10} = 28.3m$ So, the distance in last 2 sec = $s_{10} - s_8 = 28.3 - 20 = 8.3m$

32. 3)
33. 3)
34. 2) The distance travel in n^{th} second is

$S_n = u + \frac{1}{2}(2n-1)a\text{.............}(1)$

So distance travel in t^{th} & $(t+1)^{th}$ second are

$S_t = u + \frac{1}{2}(2t-1)a\text{................}(2)$

$S_{t+1} = u + \frac{1}{2}(2t+1)a\text{................}(3)$

As per question,

$S_t + S_{t+1} = 100 = 2(u+at)\text{...............}(4)$

Now from first equation of motion the velocity, of particle after time t, if it moves with an acceleration a is $v = u + at\text{..........}(5)$

Where u is initial velocity

So from eq(4) and (5), we get v = 50cm/sec

35. 3) Let PQ = x, then

$a = \frac{40^2 - 30^2}{2x} = \frac{350}{x}\left[\because v^2 = u^2 + 2as\right]$ also, velocity at mid point is given by

$v^2 - 30^2 = 2 \times \frac{350}{x} \times \frac{x}{2}$

This gives $v = 25\sqrt{2}km/h$

36. 2) $V_i = 0, V_f = V_{max}$

$\Delta V =$ area under the curve $= 10 \times \frac{11}{2} = 55$ or $V_f - V_i = 55\,m/s$ since $V_i = 0$

$V_f = 55m/s = V_{max}$

37. 3)
38. 4) Velocity, $v = \frac{ds}{dt} = 3t^2 - 12t + 3$ acceleration, $a = \frac{dv}{dt} = 6t - 12$; for a = 0, we have, 0 = 6 t – 12 or t = 2s. Hence, at t = 2s the velocity will be

$v = 3 \times 2^2 - 12 \times 2 + 3 = -9ms^{-1}$

39. 2) $x = 40 + 12t - t^3$

$v = \frac{dx}{dt} = 12 - 3t^2$ for $v = 0;\ t = \sqrt{\frac{12}{3}} = 2\,sec$

So, after 2 seconds velocity becomes zero.

Value of x in 2 secs = $40 + 12 \times 2 - 2^3 = 40 + 24 - 8 = 56m$

40. 4)
41. 2) height attained by ball in 2 second = $\frac{1}{2} \times (9.8) \times 2^2 = 19.6m$

The same distance will be covered in 2 second (for descent). Time interval of throwing balls, remains same. So, for two balls remaining in the air, the time of ascent or descent must be greater than 2 second. This is achieved only at speed more than 19.6 m/sec.

42. 3) $h=\frac{1}{2}gt^2 \Rightarrow t=\sqrt{2h/g}$

$t_a=\sqrt{\frac{2a}{g}}$ and $t_b=\sqrt{\frac{2b}{g}} \Rightarrow \frac{t_a}{t_b}=\sqrt{\frac{a}{b}}$

43. 1) Before hitting the ground, the velocity v is given by $v^2=2gd$ further, $v'^2=2g\times\left(\frac{d}{2}\right)=gd$;

$\therefore\left(\frac{v}{v'}\right)=\sqrt{2}$ or $v=v'\sqrt{2}$ As the direction is reversed and speed is decreased and hence graph 1) represents these conditions correctly.

44. 1) $S=ut+\frac{1}{2}at^2-76=4\times6-\frac{1}{2}\times10\times(6)^2 \Rightarrow u=\frac{52}{3}m/s$

45. 2)

46. 2)

47. 4) For A to B

$S=\frac{1}{2}gt^2$ ....(i)

For A to C

$2S=\frac{1}{2}gt'^2$ ....(ii)

Dividing (i) by (ii) we get

$\frac{t}{t'}=\frac{1}{\sqrt{2}}$

48. 2) Let the body fall through the height of tower in t seconds. From, $D_n=u+\frac{a}{2}(2n-1)$ we have, total distance travelled in last 2 second of fall is

$D=D_t+D_{(t-1)}=\left[0+\frac{g}{2}(2t-1)\right]+\left[0+\frac{g}{2}\{2(t-1)-1\}\right]=\frac{g}{2}(2t-1)+\frac{g}{2}(2t-3)=\frac{g}{2}(4t-4)=\frac{10}{2}\times4(t-1)$

or, 40 = 20(t-1) or t = 2+1 = 3s

Distance travelled in t second is

$s=ut+\frac{1}{2}at^2=0+\frac{1}{2}\times10\times3^2=45m$

49. 1)

50. 1) From third equation of motion v2 = u2 + 2ahIn first case initial velocity u1 = 5 m/sec final velocity v1 = 0, a = – g and max. height obtained is H1, then, $H_1=\frac{25}{2g}$ In second case u2 = 10 m/sec, v2 = 0, a = –g and max. height is H2 then, $H_2=\frac{100}{2g}$ It implies that $H_2=4H_1$

51. 3) The ball thrown upward will lose velocity in 1s. It return back to thrown point in another 1 s with the same velocity as second. Thus the difference will be 2 s.

52. 4)

53. 3) Height of tap = 5m and (g) = 10 m/sec2. For the first drop,

$5=ut+\frac{1}{2}gt^2=(0\times t)+\frac{1}{2}\times10t^2=5t^2 \text{or } t^2=1 \text{or } t=1$

It means that the third drop leaves after one second of the first drop. Or, each drop leaves after every 0.5 sec. Distance covered by the second drop in 0.5 sec = $ut+\frac{1}{2}gt^2=(0\times0.5)+\frac{1}{2}\times10=(0.5)^2=1.25m$.

Therefore, distance of the second drop above the ground = 5 – 1.25 = 3.75 m.

54. 4)

55. 3) Distance travelled by the stone in the last second is

$\frac{9h}{25}=\frac{g}{2}(2t-1)(\because u=0)$ ....(i)

Distance travelled by the stone in t s is

$h=\frac{1}{2}gt^2$(using $s=ut+\frac{1}{2}at^2$)..................(ii)

Divide (i) by (ii),we get $\frac{9}{25}=\frac{(2t-1)}{t^2}\Rightarrow 9t^2-50t+25=0$

Solving, we get t = 5s or t = 5/9s

Substituting t = 5s in (ii), we get $h=\frac{1}{2}\times 9.8\times(5)^2=122.5m$

56. 1) the distance travelled by the body A is h_1 given by $v_1t-\frac{gt^2}{2}$ and that travelled by the body B is $h_2=\frac{gt^2}{2}$ the distance between the bodies = $x=h-(h_1+h_2)$. Since $h_1+h_2=v_1t$, the relation sought is $x=h-v_1t$

57. 2) Time taken by same ball to return to the hands of juggler $=\frac{2u}{g}=\frac{2\times 20}{10}=4s$. So he is throwing the balls after each 1 s. Let at some instant he is throwing ball number 4. Before 1 s of it he throws ball. So height of ball 3 $h_3=20\times 1-\frac{1}{2}10(1)^2=15m$

Before 2s, he throws ball 2. So height of ball 2 :

$h_2=20\times 2-\frac{1}{2}10(2)^2=20m$

Before 3 s, he throws ball 1. So height of ball 1 :

$h_1=20\times 3-\frac{1}{2}10(3)^2=15m$

58. 2)

59. 2) Relative speed of each train with respect to each other be, v = 10 + 15 = 25 m/s Here distance covered by each train = sum of their lengths = 50 + 50 = 100 m
$\therefore$ Required time =100/25 = 4 se

60. 4) So by figure the velocity of parrot w.r. t. train is = 5–(–10) = 15m/sec so time taken to cross the train is

=length of train/ relative velocity=150/15=10sec

61. 4) By definition of relative velocity $\vec{v}_1=\vec{v}_0+\vec{v}_2\Rightarrow\vec{v}_0+\vec{v}_2+(-\vec{v}_1)=0$ $\Rightarrow v_0, v_1$ and v_2 will be sides of a triangle and we know that the sum of any two sides is greater than third side of the triangle.

62. 1) velocity of boat = 8+8/2= 8kmh^{-1}
Velocity of water = 4 kmh^{-1}

$t=\frac{8}{8-4}+\frac{8}{8+4}=\frac{8}{3}h=160$ minute

63. 2) Relative speed = 0 when velocity of A = velocity of B $\therefore$ displacement-time graphs of A and B must have same slope (other than zero).

64. 1)

65. 4) Relative speed of police with respect to thief = 10 – 9 = 1 m/s
Instantaneous separation = 100 m

$\text{Time}=\frac{\text{Dis tan ce}}{\text{Velocity}}=\frac{100}{1}=100\,\text{sec}$

66. 1) If we consider the ΔPQR, velocity of P along PQ is V = V_Q along QR. It's component along QP is V_{cos} 60° = V/2. So separation PQ decreases at the rate of V + (V/2) = 3v/2. Tie taken will be $\frac{D}{(3V/2)}=\frac{2D}{3V}$

67. 4) $\vec{v}_{BB}$ = Relative velocity of ball w.r.t balloon = $\vec{u}+\vec{v}$

$$0=-(u+v)+gt \text{ of } t=\frac{u+v}{g}\Rightarrow T=\frac{2(u+v)}{g}$$

68. 4) Let v be the relative velocity of scooter w.r.t bus as $v = v_S - v_B$

$\therefore v_S = v + v_B,$ S .... B $\rightarrow_{u=10ms^{-1}} = 10 + 10 = 20ms^{-1}$

Velocity of scooter = 20 ms^{-1}

69. 1)

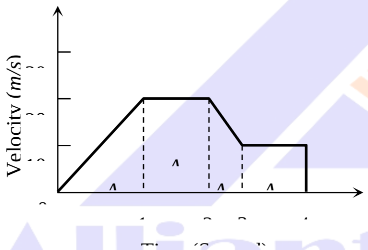
70. 1) $\frac{2s}{v} = T_0$

$$T_w = \frac{s}{v+v_w} = s\left[\frac{2v}{v^2-v_w^2}\right] = \frac{2s}{v}\left[\frac{v^2}{v^2-v_w^2}\right]$$

$$T_w = T_0\left[\frac{1}{1-(v_w/v)^2}\right]$$

GRAPHS

71. (2) Distance = Area under $v-t$ graph $= A_1 + A_2 + A_3 + A_4$



$$= \frac{1}{2}\times 1\times 20 + (20\times 1) + \frac{1}{2}(20+10)\times 1 + (10\times 1)$$

$$= 10 + 20 + 15 + 10 = 55\ m$$

72. (1) The slope of displacement-time graph goes on decreasing, it means the velocity is decreasing *i.e.* It's motion is retarded and finally slope becomes zero *i.e.* particle stops.

73. (4) In the positive region the velocity decreases linearly (during rise) and in the negative region velocity increases linearly (during fall) and the direction is opposite to each other during rise and fall, hence fall is shown in the negative region.

74. (2) Region *OA* shows that graph bending toward time axis *i.e.* acceleration is negative.

Region *AB* shows that graph is parallel to time axis *i.e.* velocity is zero. Hence acceleration is zero.

Region *BC* shows that graph is bending towards displacement axis *i.e.* acceleration is positive.

Region *CD* shows that graph having constant slope *i.e.* velocity is constant. Hence acceleration is zero.

75. (4) Maximum acceleration means maximum change in velocity in minimum time interval.

In time interval $t=30$ to $t=40$ sec

$$a = \frac{\Delta v}{\Delta t} = \frac{80-20}{40-30} = \frac{60}{10} = 6\ cm/\sec^2$$

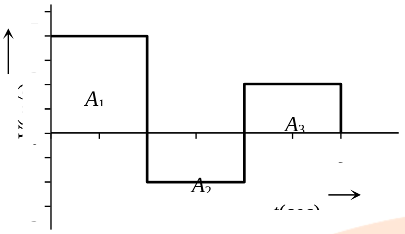
76. (3) In part *cd* displacement-time graph shows constant slope *i.e.* velocity is constant. It means no acceleration or no force is acting on the body.

77. (4) Up to time t_1 slope of the graph is constant and after t_1 slope is zero *i.e.* the body travel with constant speed up to time t_1 and then stops.

78. (3) Area of trapezium $= \frac{1}{2}\times 3.6\times(12+8) = 36.0\ m$

79. (1) Displacement = Summation of all the area with sign

$$=(A_1)+(-A_2)+(A_3)=(2\times4)+(-2\times2)+(2\times2)$$



$\therefore$ Displacement = 8 *m*

Distance =Summation of all the areas without sign

$$=|A_1|+|-A_2|+|A_3|=|8|+|-4|+|4|=8+4+4$$

$\therefore$ Distance = 16 *m*.

80. (2) Between time interval 20 *sec* to 40 *sec*, there is non-zero acceleration and retardation. Hence distance travelled during this interval

= Area between time interval 20 *sec* to 40 *sec*

$= \frac{1}{2}\times20\times3+20\times1$ = 30 + 20 = 50 *m*.

81. (3) From equation of 2nd law of motion for uniform acceleration, we get $x=x_0+\frac{1}{2}at^2$ thus when acceleration or retardation is uniform, displacement time graph will be a parabola, In fig.(i) the particle is accelerated uniformly and in fig. (ii) the particle is decelerated uniformly.

82. (2) $\frac{(S)_{(last\ 2s)}}{(S)_{7s}}=\frac{\frac{1}{2}\times2\times10}{\frac{1}{2}\times2\times10+2\times10+\frac{1}{2}\times2\times10}=\frac{1}{4}$

83. (1) area from 0 to 10 s = $\frac{1}{2}[10+4]5=35\text{m}$

Area from 10 to 12 s = $\frac{1}{2}\times2\times(-2.5)=-2.5\text{m}$

Distance travelled = 35 + 2.5 = 37.5m

84. (4) Because acceleration due to gravity is constant so the slope of line will be constant *i.e.* velocity time curve for a body projected vertically upwards is straight line.

85. (4) Slope of displacement time graph is negative only at point *E*.

86. (3) $v^2=u^2+2aS$, If $u=0$ then $v^2\propto S$

i.e. graph should be parabola symmetric to displacement axis.

87. (3) Maximum height will be attained at 110s. Because after 110s, velocity becomes negative and rocket will start coming down. Area from 0 to 110s is

$\frac{1}{2}\times110\times1000=55,000\text{m}=55\text{km}$.

88. (1) For the given condition initial height $h=d$ and velocity of the ball is zero. When the ball moves downward its velocity increases and it will be maximum when the ball hits the ground & just after the collision it becomes half and in opposite direction. As the ball moves upward its velocity again decreases and becomes zero at height $d/2$. This explanation match with graph (*A*).

89. (4) Displacement in 12s = area under v-t graph = $\frac{1}{2}\times(12+5)4=34\text{m}$

$$V_{av}=\frac{\text{Displacement}}{\text{Time}}=\frac{34}{12}=\frac{17}{6}\text{ms}^{-1}$$

Hence, 1) is incorrect; 2) is incorrect because during first 3s, velocity increases from 0 to 4 ms^{-1} option 3 is incorrect, because in part AB velocity is constant.

90. (4) Acceleration – time graph represents the objects change in velocity. Acceleration = $\frac{\Delta v}{\Delta t}$

Area between acceleration – time graph gives:

$$a\times\Delta t=\frac{\Delta v}{\Delta t}\times\Delta t=\Delta v$$

91. (3)For upward motion

Effective acceleration $=-(g+a)$

and for downward motion

Effective acceleration $=(g-a)$

But both are constants. So the slope of speed-time graph will be constant.

92. (2) Maximum acceleration will be represented by *CD* part of the graph

$$\text{Acceleration}=\frac{dv}{dt}=\frac{(60-20)}{0.25}=160\ km/h^2$$

93. (4)At t = 0, velocity is positive and maximum. As the particle goes up, velocity decreases and becomes zero at the highest point. When the particle starts coming down, velocity increases in the negative direction.

94. (1) At time t, let the displacement of first stone be $S_1=\frac{1}{2}gt^2$ and that of the second stone be $S_2=ut-\frac{1}{2}gt^2$

distance between two stones at time t :

$S=S_1+S_2=u\Rightarrow S=ut$ so the graph should be a straight line passing through origin as shown in option 1

95. (1) Slope of velocity-time graph measures acceleration. For graph (a) slope is zero. Hence $a=0$ *i.e.* motion is uniform.

96. (3) From acceleration time graph, acceleration is constant for first part of motion so, for this part velocity of body increases uniformly with time and as a = 0 then the velocity becomes constant. Then again increased because of constant acceleration.

97. (1) Given line have positive intercept but negative slope. So its equation can be written as

$v=-mx+v_0$ .....(i) [where $m=\tan\theta=\frac{v_0}{x_0}$]

By differentiating with respect to time we get $\frac{dv}{dt}=-m\frac{dx}{dt}=-mv$

Now substituting the value of v from eq. (i) we get $\frac{dv}{dt}=-m[-mx+v_0]=m^2x-mv_0$ $\therefore$

$$a=m^2x-mv_0$$

i.e. the graph between *a* and *x* should have positive slope but negative intercept on *a*-axis. So graph (a) is correct.

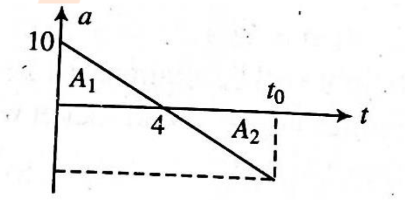
98. (2) Let the particle be thrown up with initial velocity u. displacement (s) at any time t is $S = ut - \frac{1}{2}gt^2$ the graph should be parabolic downwards as shown in option 2.

99. (1) From 0 to t_1, acceleration is increasing linearly with time; hence, v-t graph should be parabolic upwards. From t_1 to t_2, acceleration is decreasing linearly with time; hence, the v-t graph should be parabolic downwards.

100. (1) Since total displacement is zero, hence average velocity is also zero.

101. (1) At t = 0, slope of the x-t graph is zero; hence, velocity is zero at t = 0, as time increases, slope increases in negative direction; hence, velocity increases in negative direction. At point (1), slope changes suddenly from negative to positive value; hence, velocity changes suddenly from negative to positive and then velocity starts decreasing and becomes zero at (2). Option 1 represents all these clearly.

102. 4) Before the second ball is dropped, the first ball would have travelled some distance say $S_0 = \frac{1}{2}gt_0^2$ .After dropping the second ball, the relative acceleration of both balls becomes zero. So distances between them increase linearly. After some time, the first ball will collide with the ground and the distance between them will start decreasing and the magnitude of relative velocity will be increasing for this time .Option 4 represents all these clearly.



103. 3) particle will acquire the initial velocity when areas A_1 and A_2 are equal. For this, t_0 = 8s.

104. 1) for 0 to 5s, acceleration is positive, for 5 to 15s acceleration is negative, for 15 to 20s acceleration is positive.

NEET PREVIOUS YEARS QUESTIONS-SOLUTIONS

1. 2) Velocity of preeti w.r.t elevator $v_1 = \frac{d}{t_1}$

Velocity of elevator w.r.t ground $v_2 = \frac{d}{t_2}$ then

Velocity of preeti w.r.t ground

$v = v_1 + v_2$

$\frac{d}{t} = \frac{d}{t_1} + \frac{d}{t_2}$

$\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}$

$\therefore t = \frac{t_1 t_2}{(t_1 + t_2)}$ (time taken by preeti to walk up on the moving escalator)

2. 3) Given : Velocity

$V = At + Bt^2 \Rightarrow \frac{dx}{dt} = At + Bt^2$

By integrating we get distance travelled $\Rightarrow \int_0^x dx = \int_1^2 (At + Bt^2)dt$

Distance travelled by the particle between 1s and 2s

$x = \frac{A}{2}(2^2 - 1^2) + \frac{B}{3}(2^3 - 1^3) = \frac{3A}{2} + \frac{7B}{3}$

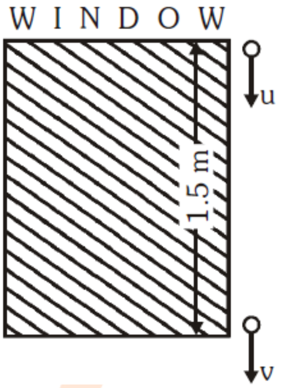
3. 1) According to question, $V(x) = bx^{-2n}$ So, $\frac{dv}{dx} = -2nbx^{-2n-1}$

Acceleration of the particle as function of x.

$a = v\frac{dv}{dx} = bx^{-2n}\{b(-2n)x^{-2n-1}\} = -2nb^2x^{-4n-1}$

4. 2)

5. 2)

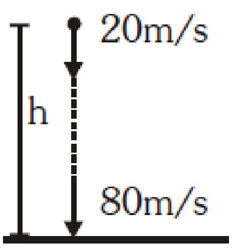


By using $s = ut + \frac{1}{2}at^2$

$1.5 = u(0.1) + \frac{1}{2}(10)(0.1)^2$

$\Rightarrow 15 = u + 0.5 \quad \Rightarrow u = 14.5 ms^{-1}$

6. 1) $v^2 - u^2 = 2gh$; $v^2 = u^2 + 2gh$; $6400 = 400 + 2\times 10h$



$\frac{6000}{20} = h = 300m$

7. 1)Distance travelled by black in n-1 to nth sec$=\frac{1}{2}a(n^2)$; $\frac{S_n}{S_{n+1}} = \frac{2n-1}{2(n+1)-1}\left[\frac{2n-1}{2n+1}\right]$

8. $S_n \propto \left(n - \frac{1}{2}\right)$

$S_1 : S_2 : S_3 : S_4 = 1:3:5:7$