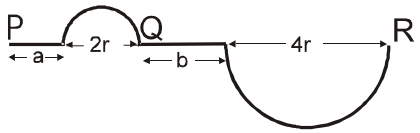
Exercise-1

Marked Questions can be used as Revision Questions.

PART - I : SUBJECTIVE QUESTIONS

Section (A) : Distance and Displacement

A-1. A car starts from P and follows the path as shown in figure. Finally car stops at R. Find the distance travelled and displacement of the car if a = 7 m, b = 8 m and r = $\frac{11}{\pi}$ m ?



[Take $\pi = \frac{22}{7}$]

A-2. A man moves to go 50 m due south, 40 m due west and 20 m due north to reach a field.

(a) What distance does be have to walk to reach the field ?

(b) What is his displacement from his house to the field?

Section (B) : Average speed and average velocity

B-1. When a person leaves his home for sightseeing by his car, the meter reads 12352 km. When he returns home after two hours the reading is 12416 km. During journey he stay for 15 minute at midway.

(a) What is the average speed of the car during this period ?

(b) What is the average velocity?

B-2. A particle covers each $\frac{1}{3}$ of the total distance with speed v_1, v_2 and v_3 respectively. Find the average speed of the particle ?

Section (C) : Velocity, Acceleration, Average acceleration

C-1. The position of a body is given by $x = At + 4Bt^3$, where A and B are constants, x is position and t is time. Find (a) acceleration as a function of time, (b) velocity and acceleration at t = 5 s.

C-2. Find the velocity as a function of time if $x = At + Bt^{-3}$, where A and B are constants, x is position and t is time.

C-3. An athelete takes 2s to reach his maximum speed of 18 km/h after starting from rest. What is the magnitude of his average accleration?

C-4 A boy start towards east with uniform speed 5m/s. After t = 2 second he turns right and travels 40 m with same speed. Again he turns right and travels for 8 second with same speed. Find out the displacement; average speed, average velocity and total distance travelled.

Section (D) : Equations of motion and motion under gravity

D-1. A car accelerates from 36 km/h to 90 km/h in 5 s on a straight rod. What was its acceleration in m/s^2 and how far did it travel in this time? Assume constant acceleration and direction of motion remains constant.

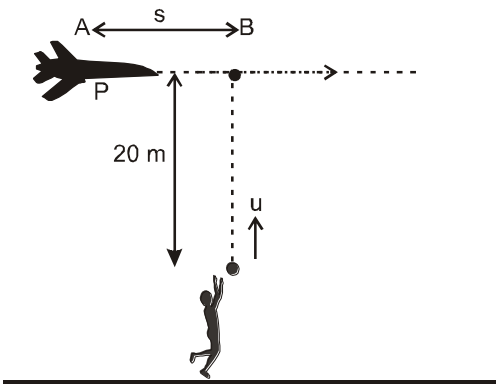
D-2. A train starts from rest and moves with a constant acceleration of 2.0 m/s^2 for half a minute. The brakes are then applied and the train comes to rest in one minute after applying breaks. Find (a) the total distance moved by the train, (b) the maximum speed attained by the train and (c) the position(s) of the train at half the maximum speed. (Assume retardation to be constant)

D-3. A particle moving along a straight line with constant acceleration is having initial and final velocity as 5 m/s and 15 m/s respectively in a time interval of 5 s. Find the distance travelled by the particle and the acceleration of the particle. If the particle continues with same acceleration, find the distance covered by the particle in the 8th second of its motion. (Direction of motion remains same)

D-4. A car travelling at 72 km/h decelerates uniformly at 2 m/s^2. Calculate (a) the distance it goes before it stops, (b) the time it takes to stop, and (c) the distance it travels during the first and third seconds.

D-5. A ball is dropped from a tower. In the last second of its motion it travels a distance of 15 m. Find the height of the tower. [Take g = 10m/sec^2]

D-6. A toy plane P starts flying from point A along a straight horizontal line 20 m above ground level starting with zero initial velocity and acceleration 2 m/s^2 as shown. At the same instant, a man P throws a ball vertically upwards with initial velocity 'u'. Ball touches (coming to rest) the base of the plane at point B of plane's journey when it is vertically above the man. 's' is the distance of point B from point A. Just after the contact of ball with the plane, acceleration of plane increases to 4 m/s^2. Find :



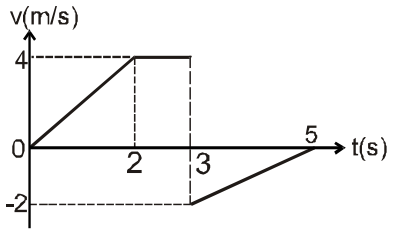
(i) Initial velocity 'u' of ball.

(ii) Distance 's'.

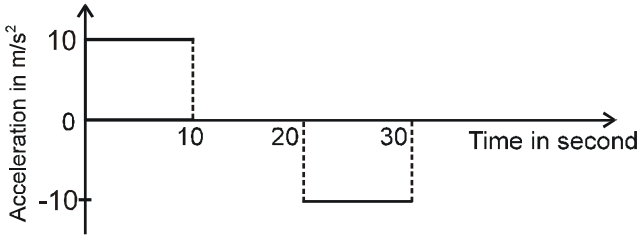
(iii) Distance between man and plane when the man catches the ball back. (g = 10 m/s^2) (Neglect the height of man)

Section (E) : Graph related questions

E-1. For a particle moving along x-axis, velocity-time graph is as shown in figure. Find the distance travelled and displacement of the particle? Also find the average velocity of the particle in intervel 0 to 5 second.



E-2. A cart started at t = 0, its acceleration varies with time as shown in figure. Find the distance travelled in 30 seconds and draw the position-time graph.



E-3. Two particles A and B start from rest and move for equal time on a straight line. The particle A has an acceleration a for the first half of the total time and 2a for the second half. The particle B has an acceleration 2a for the first half and a for the second half. Which particle has covered larger distance?

E-4 A tiger running 100 m race, accelerates for one third time of the total time and then moves with uniform speed. Then find the total time taken by the tiger to run 100 m if the acceleration of the tiger is $8 m/s^2$.

PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Distance and Displacement

A-1. A hall has the dimensions 10 m × 10 m × 10 m. A fly starting at one corner ends up at a farthest corner. The magnitude of its displacement is:

(A) $5\sqrt{3}$ m (B) $10\sqrt{3}$ m (C) $20\sqrt{3}$ m (D) $30\sqrt{3}$ m

Section (B) : Average speed and average velocity

B-1. 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 :

(A) 5 km h^{-1} (B) 24 km h^{-1} (C) 25 km h^{-1} (D) 50 km h^{-1}

B-2. A person travelling on a straight line without changing direction moves with a uniform speed v_1 for half distance and next half distance he covers with uniform speed v_2. The average speed v is given by

(A) $v = \frac{2v_1v_2}{v_1+v_2}$ (B) $v = \sqrt{v_1v_2}$ (C) $\frac{v_1+v_2}{2}$ (D) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

B-3. A body covers first $\frac{1}{3}$ part of its journey with a velocity of 2 m/s, next $\frac{1}{3}$ part with a velocity of 3 m/s and rest of the journey with a velocity 6m/s. The average velocity of the body will be

(A) 3 m/s (B) $\frac{11}{3}$ m/s (C) $\frac{8}{3}$ m/s (D) $\frac{4}{3}$ m/s

B-4. A car runs at constant speed on a circular track of radius 100 m taking 62.8 s on each lap. What is the average speed and average velocity on each complete lap? (π = 3.14)

(A) velocity 10m/s, speed 10 m/s (B) velocity zero, speed 10 m/s
(C) velocity zero, speed zero (D) velocity 10 m/s, speed zero

Section (C) : Velocity, Acceleration and Average acceleration

C-1. The displacement of a body is given by $2s = gt^2$ where g is a constant. The velocity of the body at any time t is:

(A) gt (B) gt/2 (C) $gt^2/2$ (D) $gt^3/6$

C-2. A stone is thrown vertically upward with an initial speed u from the top of a tower, reaches the ground with a speed 3u. The height of the tower is:

(A) $\frac{3u^2}{g}$ (B) $\frac{4u^2}{g}$ (C) $\frac{6u^2}{g}$ (D) $\frac{9u^2}{g}$

C-3. A particle starts from rest with uniform acceleration a. Its velocity after n seconds is v. The displacement of the particle in the last two seconds is :

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

Section (D) : Equations of motion and motion under gravity

D-1. A particle performs rectilinear motion in such a way that its initial velocity has opposite direction with its uniform acceleration. Let x_A and x_B be the magnitude of displacements in the first 10 seconds and the next 10 seconds, then :

(A) $x_A < x_B$

(B) $x_A = x_B$

(C) $x_A > x_B$

(D) the information is insufficient to decide the relation of x_A with x_B.

D-2. A body starts from rest and is uniformly acclerated for 30 s. The distance travelled in the first 10 s is x_1, next 10 s is x_2 and the last 10 s is x_3. Then $x_1 : x_2 : x_3$ is the same as

(A) 1 : 2 : 4 (B) 1 : 2 : 5 (C) 1 : 3 : 5 (D) 1 : 3 : 9

D-3. A ball is dropped from the top of a building. The ball takes 0.5 s to fall past the 3 m height of a window some distance from the top of the building. If the speed of the ball at the top and at the bottom of the window are v_T and v_B respectively, then ($g = 9.8$ m/sec^2)

(A) $v_T + v_B = 12$ ms^{-1} (B) $v_T - v_B = 4.9$ m s^{-1} (C) $v_B v_T = 1$ ms^{-1} (D) $\frac{v_B}{v_T} = 1$ ms^{-1}

D-4. A stone is released from an elevator going up with an acceleration a and speed u. The acceleration and speed of the stone just after the release is

(A) a upward, zero (B) (g-a) upward, u (C) (g-a) downward, zero (D) g downward, u

D-5. The initial velocity of a particle is given by u (at t = 0) and the acceleration by f, where f = at (here t is time and a is constant). Which of the following relation is valid?

(A) $v = u + at^2$ (B) $v = u + \frac{at^2}{2}$ (C) $v = u + at$ (D) $v = u$

D-6. A stone is dropped into a well in which the level of water is h below the top of the well. If v is velocity of sound, the time T after dropping the stone at which the splash is heard is given by

(A) $T = 2h/v$ (B) $T = \sqrt{\frac{2h}{g}} + \frac{h}{v}$ (C) $T = \sqrt{\frac{2h}{g}} + \frac{h}{2v}$ (D) $T = \sqrt{\frac{h}{2g}} + \frac{2h}{v}$

D-7. A student determined to test the law of gravity for himself walks off a sky scraper 320 m high with a stopwatch in hand and starts his free fall (zero initial velocity). 5 second later, superman arrives at the scene and dives off the roof to save the student. What must be superman's initial velocity in order that he catches the student just before reaching the ground ? [Assume that the superman's acceleration is that of any freely falling body.] ($g = 10$ m/s^2)

(A) 98 m/s (B) $\frac{275}{3}$ m/s (C) $\frac{187}{2}$ m/s (D) It is not possible

D-8. In the above question, what must be the maximum height of the skyscraper so that even superman cannot save him.

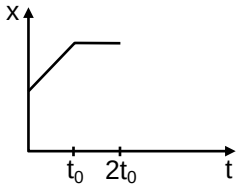
(A) 65 m (B) 85 m (C) 125 m (D) 145 m

D-9. Two particles held at different heights a and b above the ground are allowed to fall from rest. The ratio of their velocities on reaching the ground is :

(A) a : b (B) $\sqrt{a} : \sqrt{b}$ (C) $a^2 : b^2$ (D) $a^3 : b^3$

Section (E) : Graph related questions

E-1. Figure shows the position time graph of a particle moving on the X-axis.



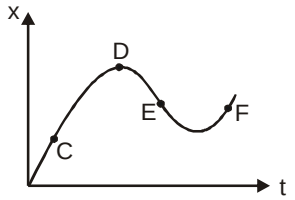
(A) the particle is continuously going in positive x direction

(B) area under x–t curve shows the displacement of particle

(C) the velocity increases up to a time t_0, and then becomes constant.

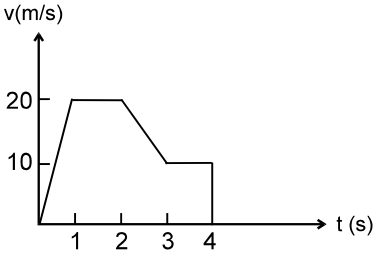
(D) the particle moves at a constant velocity up to a time t_0, and then stops.

E-2. In the displacement–time graph of a moving particle is shown, the instantaneous velocity of the particle is negative at the point :



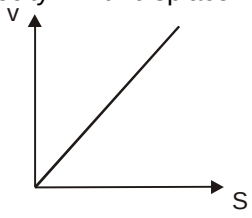
(A) C (B) D (C) E (D) F

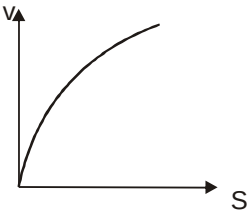
E-3. The variation of velocity of a particle moving along a straight line is shown in the figure. The distance travelled by the particle in 4 s is :

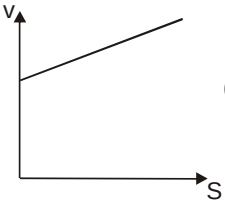


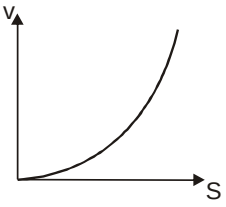
(A) 25 m (B) 30 m (C) 55 m (D) 60 m

E-4. A particle starts from rest and moves along a straight line with constant acceleration. The variation of velocity v with displacement S is :

(A) 

(B) 

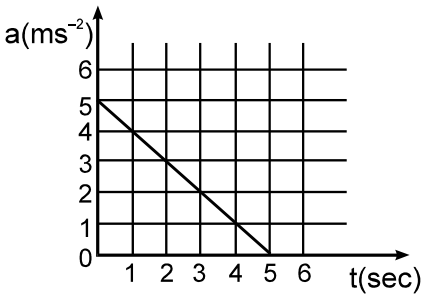
(C) 

(D) 

E-5. The displacement time graphs of two particles A and B are straight lines making angles of respectively 30° and 60° with the time axis. If the velocity of A is v_A and that of B is v_B, then the value of $\frac{v_A}{v_B}$ is

(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\sqrt{3}$ (D) $\frac{1}{3}$

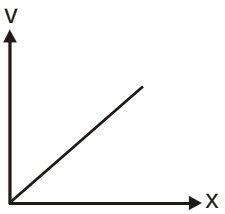
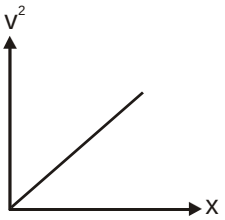
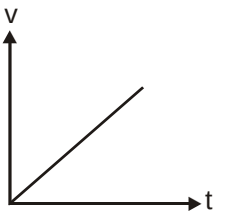
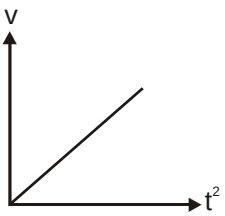
E-6. Starting from rest at t = 0, a car moves in a straight line with an acceleration given by the accompanying graph. The speed of the car at t = 3 s is :



(A) 1 m s^{-1} (B) 2 m s^{-1} (C) 6.0 m s^{-1} (D) 10.5 m s^{-1}

PART - III : MATCH THE COLUMN

1. Column I gives some graphs for a particle moving along x-axis in positive x–direction. The variables v, x and t represent velocity of particle, x–coordinate of particle and time respectively. Column II gives certain resulting interpretation. Match the graphs in Column I with the statements in Column II.

Column-I		**Column-II**	
(A)	 v - x graph	(p)	Acceleration of particle is uniform
(B)	 v^2 - x graph	(q)	Acceleration of particle is nonuniform
(C)	 v - t graph	(r)	Acceleration of particle is directly proportional to 't'
(D)	 v - t^2 graph	(s)	Acceleration of particle is directly proportional to 'x'.

2. **Match the following :**

Column-I		**Column-II**	
(A)	Rate of change of displacement	(p)	Magnitude of average velocity
(B)	Average speed is always greater than or equal to	(q)	Initial to final position
(C)	Displacement has the same direction as that of	(r)	Velocity
(D)	Motion under gravity is considered as the case of	(s)	Uniform acceleration

Exercise-2

Marked Questions can be used as Revision Questions.

PART - I : ONLY ONE OPTION CORRECT TYPE

1. A body starts from the origin and moves along the X-axis such that the velocity at any instant is given by $(4t^3 - 2t)$, where t is in second and velocity is in m/s. What is acceleration of the particle, when it is at distance 2m from the origin.
(A) 28 m/s^2 (B) 22 m/s^2 (C) 12 m/s^2 (D) 10 m/s^2

2. In the one-dimensional motion of a particle, the relation between position x and time t is given by $x^2 + 2x = t$ (here $x > 0$). Choose the correct statement :
(A) The retardation of the particle is $\frac{1}{4(x+1)^3}$ (B) The uniform acceleration of the particle is $\frac{1}{(x+1)^3}$
(C) The uniform velocity of the particle is $\frac{1}{(x+1)^3}$ (D) The particle has a variable acceleration of 4t + 6.

3. Two balls of equal masses are thrown upward, along the same vertical line at an interval of 2 seconds, with the same initial velocity of 40 m/s. Then these collide at a height of (Take g = 10 m/s^2)
(A) 120 m (B) 75 m (C) 200 m (D) 45 m

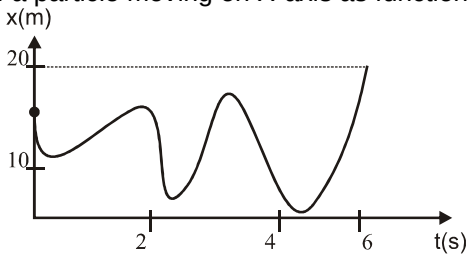
4. A body is released from the top of a tower of height h metre. It takes T seconds to reach the ground. Where is the ball at the time T/2 seconds ?
(A) at h/4 metre from the ground (B) at h/2 metre from the ground
(C) at 3h/4 metre from the ground (D) depends upon the mass of the ball

5. A ball is thrown vertically upwards from the top of a tower of height h with velocity v. The ball strikes the ground after time.
(A) $\frac{v}{g}\left[1+\sqrt{1+\frac{2gh}{v^2}}\right]$ (B) $\frac{v}{g}\left[1-\sqrt{1+\frac{2gh}{v^2}}\right]$ (C) $\frac{v}{g}\left(1+\frac{2gh}{v^2}\right)^{1/2}$ (D) $\frac{v}{g}\left(1-\frac{2gh}{v^2}\right)^{1/2}$

6. A balloon is moving upwards with velocity 10 ms^{-1}. It releases a stone which comes down to the ground in 11 s. The height of the balloon from the ground at the moment when the stone was dropped is :
(A) 495 m (B) 592 m (C) 460 m (D) 500 m

7. Water drops fall at regular intervals from a tap which is 5m above the ground. The third drop is leaving the tap at the instant the first drop touches the ground. How far above the ground is the second drop at that instant ? (Take g = 10 ms^{-2})
(A) $\frac{5}{4}$m (B) 4 m (C) $\frac{5}{2}$m (D) $\frac{15}{4}$m

8. Figure shows the position of a particle moving on X-axis as function of time.



(A) The particle has come to rest 5 times
(B) Initial speed of particle was zero
(C) The velocity remains positive for t = 0 to t = 6 s
(D) The average velocity for the total period shown is negative.

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

1. A particle moving in straight line, traversed half the distance with a velocity v_0. The remaining part of the distance was covered with velocity v_1 for half the time and with velocity v_2 for the other half of the time. Mean velocity of the particle averaged over the whole time of motion comes out to be $av_0\left(\frac{v_1 + v_2}{b\,v_0 + v_1 + v_2}\right)$, where a and b are positive integers. Find a + b.

2. A man walking with a speed v = 2 m/s constant in magnitude and direction passes under a lantern hanging at a height H above the ground (consider lantern as a point source). Find the velocity in m/s with which the edge of the shadow of the man's head moves over the ground, if his height is ' h ' given that H = 3h.

3. The displacement of a particle moving on a straight line is given by $x = 16t - 2t^2$. Distance travelled by the particle during the first 2 sec. is S_1 and during first 6 sec. is S_2. Find $\frac{3S_2}{S_1}$

4. A healthy youngman standing at a distance of 6 m from a 11.5 m high building sees a kid slipping from the top floor. With what uniform acceleration in m/s^2 (starting from rest) should he run to catch the kid at the arms height (1.5 m) ? Take g = 10 m/s^2.

5. A body freely falling from rest has a velocity v after it falls through distance 2m. The distance it has to fall down further in m for its velocity to become double is :

6. Two objects moving along the same straight line are leaving point A with an acceleration a, 2 a & velocity 2 u, u respectively at time t = 0. The distance moved by the object with respect to point A when one object overtakes the other is $\frac{\alpha u^2}{a}$. Here α is an integer. Find α :

7. A particle is thrown upwards from ground. It experiences a constant air resistance which can produce a retardation of 2 m/s^2 opposite to the direction of velocity of particle. The ratio of time of ascent to the time of descent is $\sqrt{\frac{\alpha}{\beta}}$. Where α and β are integers. Find minimum value of $\alpha + \beta$ [g = 10 m/s^2]

8. A police jeep is chasing a culprit going on a moter bike. The motor bike crosses a turn at a speed of 72 km/h. The jeep follows it at a speed of 108 km/h, crossing the turn 10 seconds later than bike (keeping constant speed). After crossing the turn, jeep acclerates with constant accleration 2 m/s^2. Assuming bike travels at constant speed, after travelling a distance 20α m. from the turn,the jeep catches the bike. Where α is an integer. Find α.

9. A lift is descending with uniform acceleration. To measure the acceleration, a person in the lift drops a coin at the moment when lift was descending with speed 6 ft/s. The coin is 5 ft above the floor of the lift at time it is dropped. The person observes that the coin strikes the floor in 1 second. Calculate from these data, the acceleration of the lift in ft/s^2. [Take g = 32 ft/s^2]

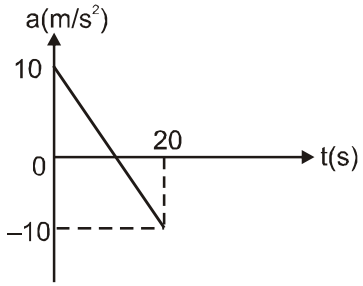
10. A body starts with an initial velocity of 10 m/s and moves along a straight line with a constant acceleration. When the velocity of the particle becomes 50 m/s the acceleration is reversed in direction without changing magnitude. Find the speed of the particle in m/s when it reaches the starting point.

11. A lift starts from the top of a mine shaft and descends with a constant speed of 10 m/s. 4 s later a boy throws a stone vertically upwards from the top of the shaft with a speed of 30 m/s. If stone hits the lift at a distance x below the shaft write the value of $\frac{x}{3}$ (in m) [Take: g = 10 m/s²] (Give value of $20\sqrt{6} = 49$)

12. The maximum possible acceleration of a train starting from the rest and moving on straight track is 10 m/s² and maximum possible retardation is 5 m/s². The maximum speed that train can achieve is 85 m/s. Minimum time in which the train can complete a journey of 1000m ending at rest, is $n\sqrt{\frac{2}{3}}$ sec . Where n is integer. Find n.

PART - III : ONE OR MORE THAN ONE OPTION CORRECT TYPE

1. The acceleration time plot for a particle (starting from rest) moving on a straight line is shown in figure. For given time interval,



(A) The particle has zero average acceleration
(B) The particle has never turned around.
(C) The particle has zero displacement
(D) The average speed in the interval 0 to 10s is the same as the average speed in the interval 10s to 20s.

2. The acceleration of a particle is zero at t = 0
(A) Its velocity must be constant.
(B) The speed at t = 0 may be zero.
(C) If the acceleration is zero from t = 0 to t = 5 s, the speed is constant in this interval.
(D) If the speed is zero from t = 0 to t = 5 s the acceleration is also zero in the interval.

3. Mark the correct statements for a particle going on a straight line (x-position coordinate, v-velocity, a-acceleration) :
(A) If v and a have opposite sign, the object is slowing down.
(B) If x and v have opposite sign, the particle is moving towards the origin.
(C) If v is zero at an instant, then a should also be zero at that instant.
(D) If v is zero for a time interval, then a is zero at every instant within the time interval.

4. The position of a body from a fixed reference point is given by, $\sqrt{x} = 2t - 3$, where 'x' is in meters and t in seconds. This shows that the body:
(A) is at rest at t = 3/2 (B) is accelerated (C) is decelerated (D) is in uniform motion

5. The displacement of a moving particle is proportional to the square of the time. For this particle **[REE-1994]**
(A) the velocity is constant (B) the velocity is variable
(C) the acceleration is constant (D) the acceleration is variable

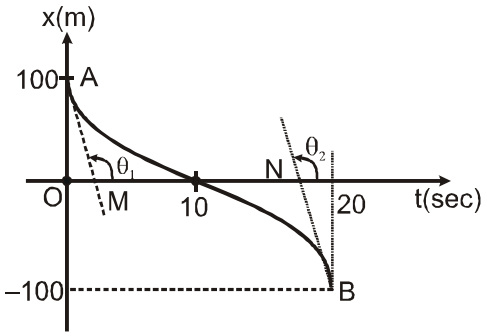
6. A particle moves along the Y-axis and its y-coordinate(y) changes with time(t) as $y = u(t-2) + a(t-2)^2$
(A) the initial velocity (at t = 0) of the particle is u (B) the acceleration of the particle is a
(C) the acceleration of the particle is 2a (D) at t =2s particle is at the origin

PART - IV : COMPREHENSION

Comprehension - 1

Read the following write up and answer the questions based on that.

The graph below gives the coordinate of a particle travelling along the X-axis as a function of time. AM is the tangent to the curve at the starting moment and BN is tangent at the end moment ($\theta_1 = \theta_2 = 120°$).



1 The average velocity during the first 20 seconds is

(A) – 10 m/s (B) 10 m/s (C) zero (D) 20 m/s

2. The average acceleration during the first 20 seconds is

(A) – 1 m/s^2 (B) 1 m/s^2 (C) zero (D) 2 m/s^2

3. The direction ($\hat{i}$ or $-\hat{i}$) of acceleration during the first 10 seconds is _____ .

4. Time interval during which the motion is retarded.

(A) 0 to 20sec.' (B) 10 to 20sec. (C) 0 to 10sec. (D) None of these

Comprehension-2

The position of a particle is given by $x = 2(t - t^2)$ where t is expressed in seconds and x is in meter. Positive direction is towards right.

5. The acceleration of the particle is

(A) 0 (B) 4 m/s^2 (C) –4 m/s^2 (D) None of these.

6. The maximum value of position co-ordinate of particle on positive x-axis is

(A) 1 m (B) 2 m (C) $\frac{1}{2}$ m (D) 4 m

7. The particle

(A) never goes to negative x-axis

(B) never goes to positive x-axis

(C) starts motion from the origin then goes upto x = 1/2 in the positive x-axis then goes to negative x-axis

(D) final velocity of the particle is zero

8. The total distance travelled by the particle between t = 0 to t = 1 s is :

(A) 0 m (B) 1 m (C) 2 m (D) $\frac{1}{2}$ m

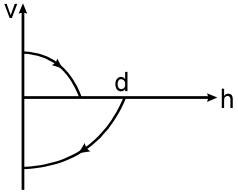
Exercise-3

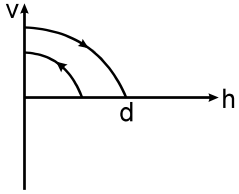
✍ Marked Questions can be used as Revision Questions.

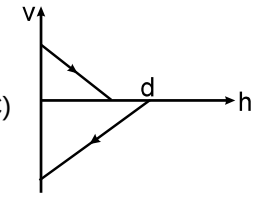
*** Marked Questions may have more than one correct option.**

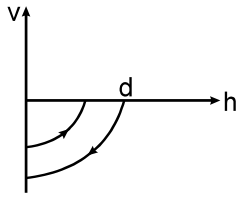
PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1.✍ 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 **[JEE '2000, 1/35]**

(A) 

(B) 

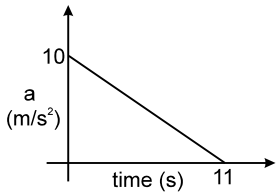
(C) 

(D) 

2.✍ A block is moving down 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. The ratio $\frac{S_n}{S_{n+1}}$ is **[JEE (Scr.), 2004, 3/84, –1]**

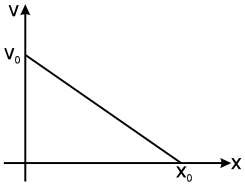
(A) $\frac{2n-1}{2n}$ (B) $\frac{2n-1}{2n+1}$ (C) $\frac{2n+1}{2n-1}$ (D) $\frac{2n}{2n-1}$

3.✍ A particle is initially at rest, It is subjected to a linear acceleration a, as shown in the figure. The maximum speed attained by the particle is **[JEE (Scr.), 2004, 3/84, –1]**

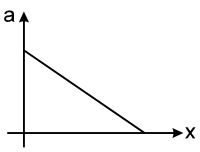


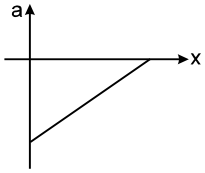
(A) 605 m/s (B) 110 m/s (C) 55 m/s (D) 550 m/s

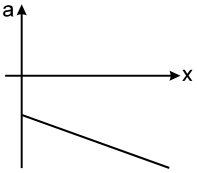
4. The velocity displacement graph of a particle moving along a straight line is shown.

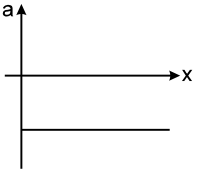


The most suitable acceleration-displacement graph will be **[JEE (Scr.), 2005, 3/84, –1]**

(A) 

(B) 

(C) 

(D) 

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. If a body loses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest? **[AIEEE - 2002, 4/300]**

(1) 1 cm (2) 2 cm (3) 3 cm (D) 4 cm

2. From a building two balls A and B are thrown such that A is thrown upwards and B downwards (both vertically with same speed). If V_A and V_B are their respective velocities on reaching the ground, then **[AIEEE - 2002, 4/300]**

(1) $v_B > v_A$ (2) $v_A = v_B$

(3) $v_A > v_B$ (4) their velocities depends on their masses

3. Speeds of two identical cars are u and 4u at a specific instant. The ratio of the respective distances at which the two cars are stopped at the same instant is : **[AIEEE - 2002, 4/300]**

(1) 1 : 1 (2) 1 : 4 (3) 1 : 8 (4) 1 : 16

4. The coordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time t is given by : **[AIEEE - 2003, 4/300]**

(1) $\sqrt{\alpha^2 + \beta^2}$ (2) $3t^2\sqrt{\alpha^2 + \beta^2}$ (3) $t^2\sqrt{\alpha^2 + \beta^2}$ (4) $\sqrt{\alpha^2 + \beta^2}$

5. 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 : **[AIEEE - 2003, 4/300]**

(1) 12 m (2) 18 m (3) 24 m (4) 6 m

6. A ball is released from the top of a tower of height h metres. It takes T seconds to reach the ground. What is the position of the ball in T/3 seconds? **[AIEEE - 2004, 4/300]**

(1) h/9 metre from the ground (2) 7h/9 metre from the ground

(3) 8h/9 metre from the ground (4) 17h/9 metre from the ground

7. An automobile travelling with a speed of 60 km/h, can brake to stop within a distance of 20 m. If the car is going twice as fast, i.e. 120 km/h, the stopping distance will be **[AIEEE - 2004, 4/300]**

(1) 20 m (2) 40 m (3) 60 m (4) 80 m

8. The relation between time t and distance x is $t = ax^2 + bx$, where a and b are constants. The acceleration is: **[AIEEE 2005, 4.300]**

(1) $-2abv^2$ (2) $2bv^2$ (3) $-2av^3$ (4) $2av^3$

9. A car, starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate $\frac{f}{2}$ to come to rest. If the total distance travelled is 15 S, then : **[AIEEE 2005, 4/300]**

(1) S = ft (2) $S = \frac{1}{6}ft^2$ (3) $S = \frac{1}{72}ft^2$ (4) $S = \frac{1}{4}ft^2$

10. A particle is moving eastwards with a velocity of 5 ms^{-1}. In 10 second the velocity changes to 5 ms^{-1} northwards. The average acceleration in this time is : **[AIEEE 2005, 4/300]**

(1) $\frac{1}{\sqrt{2}}$ ms^{-2} towards north-west (2) $\frac{1}{2}$ ms^{-2} towards north

(3) zero (4) $\frac{1}{2}$ ms^{-2} towards north-west.

11. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with a speed of 3 m/s. At what height approximately, did he bail out ?
[AIEEE 2005, 4/300]

(1) 91 m (2) 182 m (3) 293 m (4) 111 m

12. A particle located at x = 0 at time t = 0, starts moving along the positive x-direction with a velocity v that varies as $v = \alpha\sqrt{x}$. The displacement of the particle varies with time as **[AIEEE-2006, 3/180]**

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

13. The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is x = 0 at t = 0, then its displacement after unit time (t = 1) is **[AIEEE 2007, 3/120]**

(1) $v_0 + 2g + 3f$ (2) $v_0 + \frac{g}{2} + \frac{f}{3}$ (3) $v_0 + g + f$ (4) $v_0 + \frac{g}{2} + f$

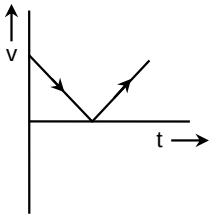
14. An object moving with a speed of 6.25 m/s, is decelerated at a rate given by $\frac{d\upsilon}{dt} = -2.5\sqrt{\upsilon}$ where υ is the instantaneous speed. The time taken by the object, to come to rest, would be :
[AIEEE - 2011, 4/120, –1]

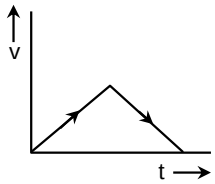
(1) 1 s (2) 2 s (3) 4 s (4) 8 s

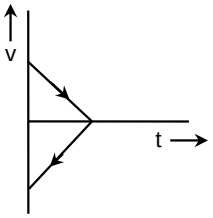
15. From a tower of height H, a particle is thrown vertically upwards with a speed u. The time taken by the particle, to hit the ground, is n times that taken by it to reach the highest point of its path. The relation between H, u and n is : **[JEE(Main) 2014, 4/120, –1]**

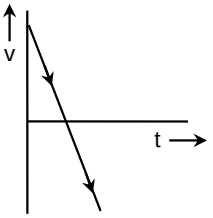
(1) $2gH = n^2u^2$ (2) $gH = (n-2)^2u^2$ (3) $2gH = nu^2(n-2)$ (4) $gH = (n-2)u^2$

16. A body is thrown vertically upwards. Which one of the following graphs correctly represent the velocity vs time ? **[JEE (Main) 2017 ; 4/120, –1]**

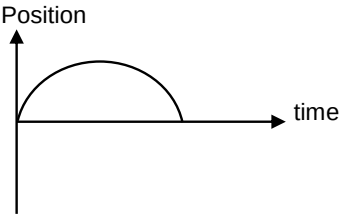
(1) 

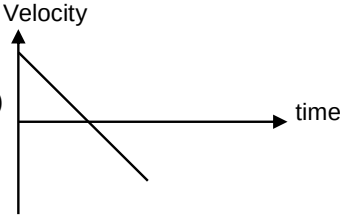
(2) 

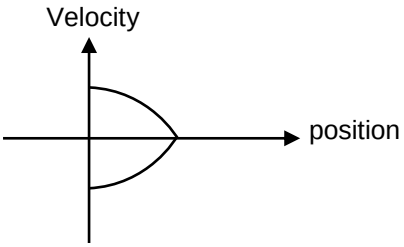
(3) 

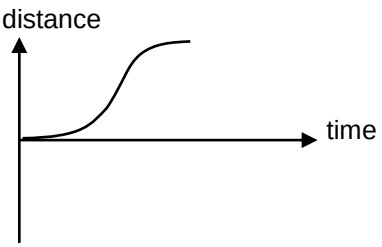
(4) 

17. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up. **[JEE (Main) 2018; 4/120, –1]**

(1) 

(2) 

(3) 

(4) 

Answers

EXERCISE-1

PART - I

Section (A) :

A-1. Distance travelled by the car = 48 m, Displacement of the car = 36 m

A-2. (a) 110 m (b) 50 m, $\tan^{-1}\frac{4}{3}$ west of south

Section (B) :

B-1. (a) 32 km/h (b) zero

B-2. $\frac{3v_1v_2v_3}{v_1v_2+v_2v_3+v_1v_3}$

Section (C) :

C-1. (a) 24 Bt ; (b) A + 300 B, 120 B

C-2. A – 3 Bt^{-4} **C-3.** $\frac{5}{2}$ = 2.5 m/s^2

C-4 50m at 53° S of W, 5m/s, 25/9 m/s at 53° S of W, 90 m

Section (D) :

D-1. a = 3 m/s^2 ; $\frac{175}{2}$ = 87.5 m

D-2. (a) 2700 m = 2.7 km, (b) 60 m/s, (c) 225 m and 2.25 km

D-3. 50m ; 2m/s^2 ; 20 m

D-4. (a) 100 m ; (b) 10 s ; (c) 19 m, 15 m

D-5. 20m

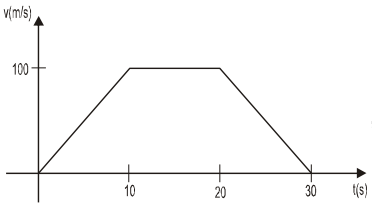
D-6. (i) 20 m/s (ii) 4 m (iii) $\sqrt{656}$ m.

Section (E) :

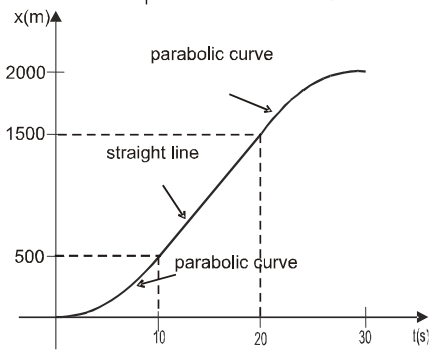
E-1. distance travelled =10 m; displacement=6 m;

average velocity = $\frac{6}{5}$ = 1.2 m/s

E-2. 2000 m,



,



E-3. Particle B

E-4 T = $3\sqrt{5}$ m /s

PART - II

Section (A) :

A-1. (B)

Section (B) :

B-1. (B) **B-2.** (A) **B-3.** (A)
B-4. (B)

Section (C) :

C-1. (A) **C-2.** (B) **C-3.** (A)

Section (D) :

D-1. (D) **D-2.** (C) **D-3.** (A)
D-4. (D) **D-5.** (B) **D-6.** (B)
D-7. (B) **D-8.** (C) **D-9.** (B)

Section (E) :

E-1. (D) **E-2.** (C) **E-3.** (C)
E-4. (B) **E-5.** (D) **E-6.** (D)

PART - III

1. (A) – q, s ; (B) – p ; (C) – p ; (D) – q, r
2. (A) – r ; (B) – p ; (C) – q ; (D) – s

EXERCISE-2

PART - I

1. (B) **2.** (A) **3.** (B)
4. (C) **5.** (A) **6.** (A)
7. (D) **8.** (A)

PART - II

1. 4 **2.** 3 **3.** 5
4. 6 **5.** 6 **6.** 6
7. 5 **8.** 20 **9.** 22
10. 70 **11.** 43 **12.** 30

PART - III

1. (ABD) **2.** (BCD) **3.** (ABD)
4. (AB) **5.** (BC) **6.** (CD)

PART - IV

1 (A) **2.** (C) **3.** î
4. (C) **5.** (C) **6.** (C)
7. (C) **8.** (B)

EXERCISE-3

PART - I

1. (A) **2.** (B) **3.** (C)
4. (B)

PART - II

1. (1) **2.** (2) **3.** (2)
4. (2) **5.** (3) **6.** (3)
7. (4) **8.** (3) **9.** (3)
10. (1) **11.** (3) **12.** (3)
13. (2) **14.** (2) **15.** (3)
16. (4) **17.** (4)