EXERCISE – 1

(Single option Correct)

1. For motion in a straight line, which of the following is incorrect?
   (a) Acceleration at some instant may be zero even if the velocity is not zero
   (b) Velocity at some instant may be zero even if the acceleration is not zero
   (c) Speed is zero but velocity may not be zero
   (d) The direction of velocity and acceleration, at any instant, may be different.

2. A particle moving in a straight line starts from a point and comes back to the same point after some time, then:
   (a) The speed of the particle, must have reduced to zero at some instant
   (b) The direction of the velocity must have reversed at some instant
   (c) Both the above
   (d) None of these

3. Choose the correct statement:
   (a) If the average velocity of a particle moving along a straight line in a given interval of time is zero, instantaneous speed within that interval is never zero.
   (b) If the direction of displacement of a particle moving in a straight line is opposite to the direction of acceleration, the particle is necessarily moving towards the point from where it started.
   (c) If the direction of velocity for a particle moving in a straight line is opposite to that of acceleration then the particle is heading towards the point from where it started.
   (d) None of these

4. Choose the correct statement.
   (a) The speed of a particle may never be zero even though the average speed within a time interval is zero
   (b) The average velocity of a particle moving along a straight line is zero in a time interval. It is possible that the instantaneous speed is never zero in that interval
   (c) The magnitude of the instantaneous velocity is equal to the instantaneous speed
   (d) The magnitude of the average velocity in a time interval is equal to its average speed in that interval.

5. A particle moving in a straight line covers half the distance with a speed of 3 m/s. The other half of the distance is covered in two equal time intervals with uniform speeds of 4.5 m/s and 7.5 m/s respectively. The average speed of the particle during this motion is
   (a) 1 m/s (b) 2 m/s (c) 3 m/s (d) 4 m/s

6. A bullet fired into a thick block loses half of its velocity after penetrating 3 cm. The total length penetrated by the bullet before it comes to rest inside the block is
   (a) 3 cm (b) 5 cm (c) 4 cm (d) 6 cm

7. A particle starts from rest and travels a distance of 6 m along a straight line in two parts, the first part of the journey at a constant acceleration of 2 m/s^2 and the second part at a constant retardation of 4 m/s^2. The particle comes to rest at the end of the second part of the motion .The total time during which the particle is in motion is
   (a) 2s (b) 1s (c) 3 s (d) $\sqrt{3}$ s

8. A train moves in a straight line with a uniform acceleration. If x and y be the velocities with which the front end and the rear end of the train respectively cross a fixed electric pole, which is adjacent to the railway track, then the velocity with which the middle of the train crosses the pole is :

(a) $\frac{x+y}{2}$ (b) $\frac{2xy}{x+y}$ (c) $\sqrt{\frac{1}{2}\left(x^2+y^2\right)}$ (d) $\sqrt{\frac{1}{2}\left(y^2-x^2\right)}$

9. A body leaving a certain point O moves with an acceleration which is constant in magnitude and direction. At the end of the first second its velocity is 1.5 m/s. At the end of the sixth second the body stops momentarily and begins to move backwards. The distance traversed by the body before it stops momentarily is:

(a) 9 m (b) 18 m (c) 5.4 m (d) 36 m

10. A particle moving with an initial velocity $\hat{i}-4\hat{j}+10\hat{k}$ has acceleration $\hat{i}+\hat{j}-2\hat{k}$. Its velocity at the end of 2 seconds, is directed along the unit vector:

(a) $\frac{1}{7}\left(-3\hat{j}+2\hat{j}-6\hat{k}\right)$ (b) $\frac{1}{\sqrt{382}}\left(3\hat{i}-7\hat{j}+18\hat{k}\right)$

(c) $\frac{1}{7}\left(3\hat{j}-2\hat{j}+6\hat{k}\right)$ (d) $\frac{1}{\sqrt{77}}\left(2\hat{j}-3\hat{j}+8\hat{k}\right)$

11. A bus starts from rest and moves with an acceleration of $1 m/s^2$. A boy who is 48m behind the bus starts running with constant speed of 10m/s. The earliest time in which the boy can catch the bus is

(A) 8 sec. (B) 10 sec. (C) 12 sec. (D) 14 sec.

12. A person is travelling from the ground floor to the first floor in a mall using an escalator. Consider the following three separate cases. When the person is standing on the moving escalator it takes one minute for him to reach the first floor. If the escalator does not move it takes him 3 minutes to walk up the stationary escalator to reach the top. How long will it take for the person to reach the top if he walks up the moving escalator?

(A) 30 sec (B) 45 sec (C) 40 sec (D) 35 sec

13. A particle takes t second less and acquires a velocity of v ms^{-1} more in falling through a certain height (starting from rest) on a planet where the acceleration due to gravity is 8 g when compared with freely falling motion of a particle on another planet, where the particle is released from rest at the same height as the previous planet. The acceleration due to gravity on the second planet is 2g, then

(A) v = 2gt (B) v = 4gt (C) v = 5 gt (D) v = 16 gt

14. A ball is thrown vertically down with velocity of 5m/s from the top of a tower. With what velocity should another ball be thrown vertically down after 2 seconds from the top of the same tower, so that it can hit the first ball in a further 2 seconds(Take $g=10 m/s^2$)

(A) 40 m/s (B) 55 m/s (C) 15 m/s (D) 25 m/s

15. A particle is projected vertically upwards from a point A on the ground. It takes t_1 time to reach a point B but it still continues to move up. If it takes further t_2 time to reach the ground from point B, then height of point B from the ground is

(A) $\frac{1}{2}g\left(t_1+t_2\right)^2$ (B) $g\,t_1\,t_2$ (C) $\frac{1}{8}g\left(t_1+t_2\right)^2$ (D) $\frac{1}{2}g\,t_1\,t_2$

16. A juggler throws balls vertically upwards in such a way that the next ball is thrown when the previous one is at the maximum height. If the maximum height attained by each ball is 5 m, the number of balls thrown per minute will be (Take $g=10\ m/s^2$)

(A) 40 (B) 50 (C) 60 (D) 120

17. Four particles are fired with the same speed at angles $25^0, 40^0, 55^0$ and 70^0 with the horizontal, from a point on horizontal ground. The horizontal range covered will be maximum for the particle projected at angle

(A) 25^0 (B) 55^0 (C) 40^0 (D) 70^0

18. Two stones are projected from horizontal ground with the same speed but making different angles with the horizontal. Their ranges are equal. If the angle of projection of the first stone is $\pi/3$ and the maximum height attained by the first stone is y_1, then the maximum height attained by the second stone will be -

(A) $3y_1$ (B) $2y_1$ (C) $y_1/2$ (D) $y_1/3$

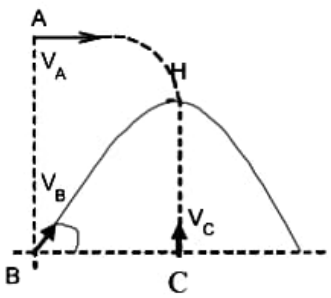
19. A ball is projected upwards from the top of a tower with a velocity 50m/s making an angle 30° with the horizontal. The height of the tower is 70m. After how many seconds from the instant of projection, will the ball reach the ground- (Take $g=10\ m/s^2$).

(A) 2 s (B) 5 s (C) 7 s (D) 9 s

20. A cannon ball has a range R, when fired from the ground level, on a horizontal plane. If h and h' are the greatest heights attained by the cannon ball in the two paths for which the Range R is possible, then-

(A) $R = 4\sqrt{(hh')}$ (B) $R = \frac{4h}{h'}$ (C) $R = 4h\,h'$ (D) $R = \sqrt{hh'}$

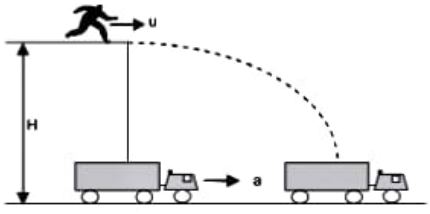
21. Three particle A, B and C are thrown with speeds v_A, v_B, and v_C respectively. A is projected horizontal, B is projected at an angle of 30° with the horizontal and C is projected vertically in such a manner that they collide simultaneously at H, the highest point of the parabolic path of B, as shown in the figure. If the acceleration due to gravity is g, then the possible ratio of the speeds $v_A : v_B : v_C$ is –



(A) 1 : 1 : 1 (B) 1 : 2 : √3

(C) √3 : 1 : 1 (D) √3 : 2 : 1

22. A stunt performer is to run and dive off a tall platform and land in a net in the back of a truck below. Originally the truck is directly under the platform. It starts forward with a constant acceleration a at the same instant that the performer leaves the platform. If the platform is H above the net in the truck, then the horizontal velocity u that the performer must have as he leaves the platform is

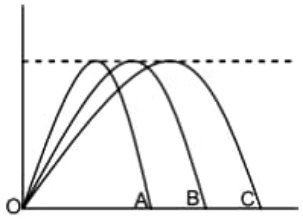


(A) $a\sqrt{2H/g}$ (B) $a\sqrt{H/2g}$ (C) $\sqrt{g/2H}$ (D) None of these

23. An object is thrown at an angle α to the horizontal ($0° < \alpha < 90°$) with a certain velocity on horizontal ground. Then during ascent (ignoring air drag)
(A) Acceleration with which the object moves is equal at all points
(B) Magnitude of acceleration tangential to the path decreases
(C) Magnitude of acceleration normal to the path increases, becoming equal to g at the highest point
(D) all of the above

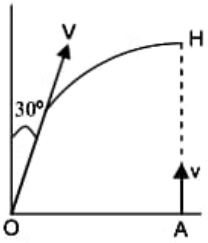
24. A bullet is fired in the horizontal direction from the top of a tower while a stone is simultaneously dropped form the same point then -
(A) The bullet and the stone will reach the ground simultaneously
(B) The stone will reach earlier
(C) The bullet will reach earlier
(D) Nothing can be predicted

25. Three projectile A, B and C are thrown from the same point in the same plane. Their trajectories are shown in the figure. Then which of the following statement is true –



(A) The time of flight is the same for all the three
(B) The launch speed is greatest for particle C
(C) The horizontal velocity component is greatest for particle C
(D) All of the above

26. A particle is projected with a speed V from a point O making an angle of $30°$ with the vertical. At the same instant, a second particle is thrown vertically upwards form a point A with speed v. Refer the figure. The two particles reach point H, the highest point of the parabolic path of the first particle, simultaneously. The ratio $\frac{V}{v}$ is –



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

27. R is the horizontal range of a projectile, fired with a certain speed at a certain angle with the horizontal, on a horizontal plane and h is the maximum height attained by it. Then the maximum horizontal range that can be attained with the same speed of projection as before is -

(A) 2h (B) $\frac{R^2}{8h}$ (C) $2R + \frac{h^2}{8R}$ (D) $2h + \frac{R^2}{8h}$

28. A particle is thrown over a scalene triangle from one end of the horizontal base of the triangle. It grazes the vertex and falls on the other end of the base. If α and β be the base angles of the triangle and θ be the angle of projection of the particle with the horizontal, then the relation between θ, α and β is -
(A) $\tan\theta = \tan\alpha - \tan\beta$ (B) $\tan\theta = \tan\alpha + \tan\beta$
(C) $\tan\beta = \tan\theta - \tan\alpha$ (D) None of these

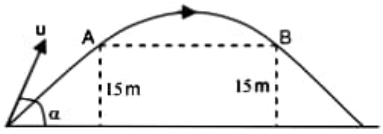
29. A bomber is flying horizontally with a constant speed of 150 m/s at a height of 78.4 m. The pilot has to drop a bomb at the enemy target. At what horizontal distance from the target should he release the bomb so that it hits the target - $\left(g = 9.8\,m/s^2\right)$

(A) Zero (B) 300 m (C) 600 m (D) 750 m

30. An aircraft dives towards a stationary target which is at sea level. When it is at a height of 1390 m above sea level it launches a missile towards the target. The initial velocity of the missile is 410m/s in a direction making an angle θ below the horizontal where $\tan\theta = 9/40$. Then the time of flight of the missile from the instant it was launched until it reaches sea level is nearly -

(A) 10 sec (B) 15 sec (C) 20 sec (D) 25 sec

31. A golfer standing on level ground hits a ball with a velocity of $u = 52$m/s at an angle α above the horizontal. If $\tan\alpha = 5/12$, then the time for which the ball is at least 15m above the ground(i.e. between A and B) will be (take $g = 10$ m/s^2) –



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

32. A projectile is thrown with a velocity of 20m/s, at an angle of 60° with the horizontal. After how much time will the velocity vector make an angle of 45° with the horizontal (take $g = 10$m/s^2) -

(A) $\sqrt{3}$ sec (B) $1\sqrt{3}$ sec (C) $(\sqrt{3}+1)$ sec (D) $(\sqrt{3}-1)$ sec

33. If T be the total time of flight of a ground to ground projectile on a horizontal plane and H be the maximum height attained by it from the point of projection, then H/T will be- (u = projectile velocity, θ = projectile angle with the horizontal)

(A) (1/2) u sin θ (B) (1/4) u sin θ (C) u sin θ (D) 2 u sin θ

34. A hunter aims his gun and fires a bullet directly at a monkey hanging on the branch of a tree. At the instant the bullet leaves the gun, monkey leaves the branch and drops freely, the bullet:

(A) hits the monkey (B) misses to hit the monkey
(C) can not be said (D) None of these

35. A projectile can have the same range R for two angles of projections. If t_1 and t_2 be the times of flight in the two cases, then the product of the times of flight will be-

(A) $t_1t_2 \propto R$ (B) $t_1t_2 \propto R^2$ (C) $t_1t_2 \propto 1/R$ (D) $t_1t_2 \propto 1/R^2$

36. If a baseball player can throw a ball from the ground level so that it covers a maximum distance of d over a horizontal ground, the maximum vertical height to which he can throw it, will be – (The speed of projection of the ball is the same in both the cases)

(A) d/2 (B) d (C) 2d (D) d/4

37. A projectile is launched from the ground level with a speed u at an angle θ with the horizontal. What is its average velocity between the two instants that it crosses half the maximum height.

(A) u sin θ (B) u cos θ (C) u tan θ (D)u

38. A boy throws a ball with a velocity V_0 at an angle α to the horizontal. At the same instant, he starts running with uniform velocity to catch the ball before it hits the ground. To achieve this, he should run with a velocity of –

(A) $V_0 \cos\alpha$ (B) $V_0 \sin\alpha$ (C) $V_0 \tan\alpha$ (D) $\sqrt{V_0^2 \tan\alpha}$

39. An artillery piece which consistently shoots its shells with the same muzzle speed has a maximum range of R. To hit a target which is R/2 from the gun and on the same level, at what elevation angle should the gun be pointed-

(A) 30° (B) 45° (C) 60° (D) 75°

40. A large number of bullets are fired in all direction with the same speed v. What is the maximum area on the ground on which these bullets will spread-

(A) $\frac{\pi v^2}{g}$ (B) $\frac{\pi v^4}{g^2}$ (C) $\frac{\pi^2 v^4}{g^2}$ (D) $\frac{\pi^2 v^2}{g^2}$

41. A stone is thrown from a bridge at an angle of 30° with the horizontal in the downward direction with a speed of 25m/s. If the stone strikes the water after 2.5sec, then calculate the height of the bridge from the water surface - $\left(g = 9.8\,m/s^2\right)$

(A) 61.9m (B) 35m (C) 70m (D) None

42. An aeroplane is flying horizontally with a velocity of 720km/h at an altitude of 490m. When it is just vertically above the target a bomb is dropped from it. How far horizontally does it miss the target ? $\left(g = 9.8\,m/s^2\right)$

(A) 1000m (B) 2000m (C) 100m (D) 200m

43. An aeroplane is flying in the horizontal direction with a velocity 600 km/hr, at a height 1960m. When it is vertically above a point A, on the ground, a body is dropped from it. The body strikes the ground at point B. The distance AB is equal to: $\left(g = 9.8\,m/s^2\right)$

(A) 3.333km (B) 33.33km (C) 333.3km (D) 33.33m

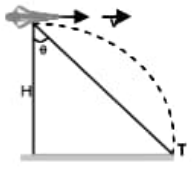
44. An aeroplane is moving with a horizontal velocity u at a height h above the ground. If a packet is dropped from it the speed of the packet when it reaches the ground will be –

(A) $\sqrt{u^2 + 2gh}$ (B) $\sqrt{2gh}$ (C) $\sqrt{u^2 - 2gh}$ (D) 2gh

45. From the top of a tower A of height h a body of mass m is projected in the horizontal direction with a velocity v. It falls on the horizontal ground at a distance x from the foot of the tower A. If a body of mass 2m is projected from the top of another tower B of height 2h in the horizontal direction so that if falls on the ground at a distance 2x from the foot of the tower B, the horizontal velocity of the second body is –

(A) 2v (B) $\sqrt{2}V$ (C) $\frac{V}{2}$ (D) $\frac{V}{\sqrt{2}}$

46. A bomber is moving in horizontal direction with a velocity v (m/s) at a height of H meter from the ground. The bomber releases a bomb to hit a target T when the sighting angle with the vertical is θ as shown in the figure. Then the relation between θ, H and v is –



(A) $\theta = \tan^{-1} V\sqrt{2Hg}$ (B) $\theta = \tan^{-1} V\sqrt{2/gH}$

(C) $\theta = \tan^{-1} V\sqrt{H/2g}$ (D) None of these

EXERCISE – 2

(One or more option may be correct)

1. A particle has initial velocity 10 m/s. It moves against a constant retarding force along the line of velocity which produces a retardation of 5 m/s^2. Then
   (A) the maximum displacement in the direction of the initial velocity is 10 m
   (B) the distance travelled in the first 3 seconds is 7.5 m
   (C) the distance travelled in the first 3 seconds is 12.5 m
   (D) the distance travelled in the first 3 seconds is 17.5 m.

2. Mark the correct statements for a particle going on a straight line
   (A) if the velocity is zero at any instant, the acceleration should also be zero at that instant
   (B) if the average velocity is zero for a given time interval, the average speed must also be zero within the same time interval.
   (C) if the velocity and acceleration have opposite sign, the object is slowing down
   (D) if the position and velocity have opposite sign, the particle is moving towards the origin

3. An observer moves with a constant speed along the line joining two stationary objects. He will observe that the two objects
   (A) have the same speed (B) have the same velocity
   (C) move in the same direction (D) move in opposite directions

4. For a body in one–dimensional motion
   (A) Speed must decrease when acceleration is negative
   (B) Speed must increase when acceleration is positive
   (C) Speed will increase when both velocity and acceleration are positive
   (D) Speed will decrease when velocity is negative and acceleration is positive

5. Which of the following statements are true for a moving body?
   (A) If its speed changes, its velocity must change and it must have some acceleration
   (B) If its velocity changes, its speed must change and it must have some acceleration
   (C) If its velocity changes, its speed may or may not change, and it must have some acceleration
   (D) If its speed changes but direction of motion does not change, its velocity may remain constant

6. Let 'v' and 'a' denote the instantaneous velocity and the instantaneous acceleration respectively of a body, then
   (A) 'a' can be non zero when 'v' = 0
   (B) 'a' must be zero when 'v' = 0
   (C) 'a' may be zero when 'v' $\neq$ 0
   (D) The direction of 'a' must have some correlation with the direction of 'v'

7. An object may have
   (A) varying speed without having varying velocity
   (B) varying velocity without having varying speed
   (C) non zero acceleration without having varying velocity
   (D) non zero acceleration without having varying speed

8. A body moving with uniform acceleration in a straight line describes 25 m in the 5th second & 33 m in 7th second.

(A) Initial velocity is 6 m/s
(B) Initial velocity is 7 m/s
(C) Acceleration is $2\,m/s^2$
(D) acceleration is $4\,m/s^2$

9. A particle starts with an initial velocity of 4 m/s & an acceleration of $2\ m/s^2$

(A) The distance described in the 5^{th} second is 13 m .
(B)Time taken to attain velocity of 50 m/s is 23 s.
(C) Time taken in travelling the first 60 m is 6 s.
(D) Velocity it attains when it has described 45 m is 14 m/s.

10. A motorist is travelling at 54 km /hr when he observes a traffic signal at a distance of 280 m ahead turning red at time t = 0. If he decides to decelerate & then accelerate by the same magnitude, so as to pass the signal at 54 km/hr at t = 28 seconds, when the signal turns green, then

(A) Magnitude of deceleration is $\frac{5}{7}\,m/s^2$
(B) Magnitude of deceleration is $1\,m/s^2$
(C) Minimum speed reached is 5 m/s
(D) Minimum speed reached is 10 m/s

11. A particle moving with constant acceleration along a straight line covers distance between 2 points 80 m apart in 10 seconds. Its velocity as it passed the second point is 18 m/s.

(A) Its velocity at the first point is -2 m/s
(B) Its acceleration is $2\,m/s^2$
(C) The total distance travelled during these 10 seconds is 82 m
(D) All above are false.

12. A projectile is projected with an initial velocity of $(6\hat{i}+8\hat{j})$ m/s. Then $(g=10\,m/s^2)$.

(A) Its horizontal range is 9.6 m
(B) Maximum height attained is 3.2 m
(C) Time of flight is 1.6 s
(D) All above are false.

13. An enemy ship is at a horizontal distance of $180\sqrt{3}$ m from a security cannon having a muzzle velocity of 60 m/s $(g=10\,m/s^2)$

(A) Angle of elevation of cannon to hit ship is 30^0 or 60^0
(B) Time of flight can be 6 s
(C) Time of flight can be 10.4 s
(D) Distance that the ship should be moved away from its initial position so that it becomes beyond the range of the cannon is 48.6 m .

14. A dive bomber, diving at an angle of 53^0 with the vertical, releases a bomb at an altitude of 2400 ft. The bomb hits the ground 5s after being released $(g=32\,ft/s^2)$.

(A) Speed of the bomber is 667 ft/s
(B) Horizontal distance travelled during the flight is 2667 ft.
(C) Horizontal component of the velocity of the bomb just before striking the ground is 534 ft /s
(D) Vertical component of the velocity of the bomb just before striking the ground is 560 ft/s

EXERCISE – 3

Comprehension – 1

Two balls A and B are thrown with the same speed from the top of a tower. Ball A is thrown vertically upwards and the ball B is thrown vertically downwards. $\left(g = 10\,m/s^2\right)$

1. Choose the correct statement
   (A) Ball B reaches the ground with greater velocity
   (B) Ball A reaches the ground with greater velocity
   (C) Both the balls reach the ground with same velocity
   (D) Cannot be interpreted

2. If t_A and t_B are the times taken by the balls A and B respectively to reach the ground, then identify the correct statement
   (A) $t_A > t_B$ (B) $t_A = t_B$ (C) $t_A < t_B$ (D) Cannot be interpreted

3. If $t_A = 6$ s and $t_B = 2$ s, then the height of the tower is
   (A) 80 m (B) 60 m (C) 45 m (D) none of these

4. The speed with which each ball was thrown is
   (A) 10 ms^{-1} (B) 15 ms^{-1} (C) 20 ms^{-1} (D) none of these

5. If a ball C is thrown with the same speed as A and B, but in the horizontal direction from the top of the tower, then it will reach the ground in time
   (A) 4 s (B) 3.46 s (C) 4.2 s (D) none of these

Match List - I

In column I, the description of the change in the velocity of a body moving with constant acceleration (or retardation) in a 10 s interval is given , while column II gives the information about the acceleration in corresponding time interval. Match the entries of column I with the entries of column II.

Column – I	**Column – II**
(A) At the beginning of the interval the body is moving towards the right along the x – axis at 5 m/s and at the end of the interval it is moving towards right at 20 m/s	(p) magnitude of acceleration is 1.5 m/s^2
(B) At the beginning , the body is moving towards right at 20 m/s and at the end it is moving towards right at 5 m/s.	(q) average acceleration is towards right
(C) At the beginning, the body is moving towards left at 5m/s and at the end it is moving towards left at 20m/s.	(r) average acceleration is towards towards left
(D) At the beginning the body is moving towards right at 5 m/s and at the end it is moving towards left at 10 m/s.	(s) body is decelerated for atleast some part of its motion

Match List – II

For a particle moving along x -axis with constant acceleration towards negative x - axis, match the entries of column (I) with entries of column (II) .

Column – I	**Column – II**
(A) Initial velocity > 0	(p) Particle may move in positive x – direction with increasing speed.
(B) Initial velocity < 0	(q) Particle may move in positive x – direction with decreasing speed.
(C) displacement > 0	(r) Particle may move in negative x – direction with increasing speed.
(D) displacement < 0	(s) Particle may move in negative x – direction with decreasing speed.

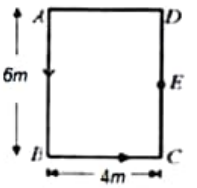
EXERCISE – 4

1. A particle starts from a point A with a velocity of 200 cm/sec towards east and moves in a straight line with a constant acceleration of 10 cm/sec^2 towards west. Find the time it takes to reach a point B which is at a distance of 1500 cm east of A.

2. A particle starts from a point A with an initial velocity of 10 m/sec and moves along a straight line with a constant acceleration. At the instant the particle attains velocity of 50 m/sec, the direction of its acceleration gets reversed, magnitude of the acceleration remaining the same. Find the velocity of the particle when it reaches the point A again.

3. A bullet enters a thick wooden block with a certain velocity and loses $\frac{1}{20}$ of its velocity when it emerges from the opposite face of the block. What is the minimum number of such identical blocks that must be placed in series (in contact one after the other) so that the bullet fired into the first of the blocks with the same velocity as before will come to rest inside the last of the blocks. Assume that all the blocks offer same uniform retardation to the bullet.

4. A particle starts moving from point A, along a rectangular plot via the path shown in Figure. If time taken to reach point E (where E is the mid point of DC) is 0.5 sec, then find the average speed and average velocity of the particle between points A & E.



5. A parachutist drops from a stationary helicopter and falls freely for 10 sec. At this instant, the parachute opens out after which he decends with a net deceleration of 2m/sec^2. If he reaches the ground with a velocity of 8m/sec, find the height above the ground at which he dropped out of the helicopter. (g = 10m/sec^2)

6. A particle is projected vertically upwards from the ground at time t = 0. The particle is at height h at t = t_1 seconds and is again at height h at t = t_2 seconds. Prove that h = (1/2)gt_1t_2. Also find the initial velocity of projection.

7. From the foot of a tower 90m high, a stone is thrown vertically upwards with velocity of $30\sqrt{2}$ m/s. Two seconds later another stone is dropped from the top of the tower. This stone collides with the first stone after a certain time interval. Find when and where the two stones meet. ($g = 10m/sec^2$)

8. From an elevated point A, a stone is projected vertically upwards. In the course of its motion, velocity of the stone at a distance *h* below A, is double of its velocity at a height *h* above A. Show that the greatest height attained by the stone above point A is (5/3)*h*.

9. A person sitting on the top of a tall building is dropping balls at regular intervals of one second. Find the positions of the 3rd, 4th and 5th balls with respect to the top of the building, when the 6th ball is being dropped. ($g = 10m/sec^2$)

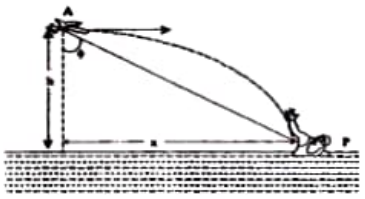
10. A steamer moving in a river takes m seconds to go 'a' meters downstream and n seconds to go 'a' meters upstream. Find the speed of the river water and the speed of the steamer relative to the river water in m/sec.

11. A particle projected vertically upwards from the top of a tower with a certain speed strikes the ground in 9 seconds. The same particle thrown vertically downwards from the top of the same tower with the same speed as before strikes the ground in 4 seconds. Find the speed of projection and the height of the tower $\left(g = 10\,m/s^2\right)$

12. A particle is projected from horizontal ground with a speed of 20m/s at a certain angle with the horizontal, so that it just clears two vertical walls of equal heights 10m which are at a horizontal distance of 20m from each other. Find the time taken by the particle to pass between the two walls.

13. A stone is thrown horizontally from an elevated point. After 0.5 seconds, the magnitude of its velocity is 1.5 times the magnitude of its initial velocity. Find the initial speed of stone.

14. A relief aeroplane is flying horizontally at a constant height of 1960m above the water level with speed 600km/hr towards a point directly over a person struggling in flood water (see figure). At what angle of sight with the vertical ϕ, should the pilot release a survival kit if it is to reach the person in water. ($g = 9.8\ m/s^2$)



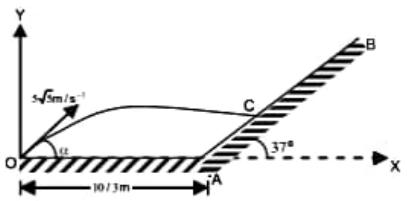
15. An aeroplane is flying at a constant vertical height of 1960 meter with a constant horizontal velocity of 100m/s. When it is vertically above an object M on the ground it drops a bomb. If the bomb reaches the ground at the point N, then calculate the time taken by the bomb to reach the ground and also find the distance MN. ($g = 9.8m/sec^2$)

16. Show that a bullet fired from a gun on horizontal ground, will attain three times the maximum height, when elevated at an angle of 60° with the horizontal, as compared to the maximum height attained when fired at an angle of 30° with the horizontal. Also show that the horizontal distance covered in the two cases will be equal. Assume that the muzzle velocity is the same in both the cases.

17. Two balls are projected from the same point on horizontal ground at angles of projection 60° and 30° to the horizontal respectively. If they attain the same maximum height, what is the ratio of their speeds of projection? If they are now projected with new speeds, what is the ratio of their speeds of projection if they attain the same horizontal range, the angles of projection being the same as before?

18. A batsman hits a pitched ball at a height 4.0 ft above the ground so that the balls leaves the bat at 45° with the horizontal and its horizontal range is 350 ft. The ball approaches a 24 ft high vertical fence which is located at a horizontal distance of 320 ft from the batsman. Will the ball clear the fence?
(Take g = 32 ft /sec^2)

19. A particle is projected from point O on the ground with velocity $u = 5\sqrt{5}$ m/s at angle $\alpha = \tan^{-1}(0.5)$ with the horizontal. It strikes a point C on a fixed smooth plane AB having inclination of 37° with horizontal as shown in the figure. Calculate the coordinates of point C in reference to coordinate system shown in figure.



20. A train is moving along a straight line with a constant acceleration *a*. A boy standing in the train throws a ball forward with a speed of 10 m/s, at an angle of 60^0 to the horizontal. The boy has to move forward by 1.15 m inside the train to catch the ball back at the initial height. The acceleration of the train, in m/s^2, is

ANSWER KEY

EXERCISE – 1

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

EXERCISE – 2

1. (A, C)	2. (C, D)	3. (A, B, C)	4. (C, D)	5. (A, C)	6. (A, C)
7. (B. D)	8. (B,D)	9. (A, B, C, D)	10. (A, C)	11. (A, B, C)	12. (A, B, C)
13. (A, B, C, D)	14. (A, B, C, D)				

EXERCISE – 3

COMPREHENSION – 1

1. (C)	2. (A)	3. (B)	4. (C)	5. (B)

MATCH LIST – I

A – p, q	B – p, r, s	C – p, r	D – p, r, s

MATCH LIST – II

A –q, r	B –r	C – q, r	D – q, r

EXERCISE – 4

1. 10s, 30s
2. 70 m/s
3. 11
4. 26 m/s, 10 m/s
5. 2984 m
6. $u = \frac{g}{2}(t_1 + t_2)$
7. 3.12 s, 6.3 m from tower top
9. 45 m, 20 m, 5 m
10. $\frac{a}{2}\left(\frac{1}{m} - \frac{1}{n}\right), \frac{a}{2}\left(\frac{1}{m} + \frac{1}{n}\right)$
11. 25m/s, 180m
12. 2 sec
13. 4.5 m/s
14. $\tan^{-1}(1.7)$
15. 20 s, 2000 m
17. $1:\sqrt{3}, 1:1$
18. Yes
19. (5m, 1.25 m)
20. 5