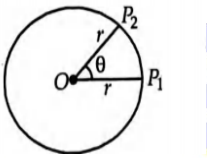
Chapter 03

Kinematics

Practice Section-01

Q.1 A particle is moving on circular path as shown in the figure. Then displacement from P_1 to P_2 is –



(1) $2r\cos\frac{\theta}{2}$ (2) $2r\tan\frac{\theta}{2}$ (3) $2r\sin\theta$ (4) $2r\sin\frac{\theta}{2}$

Q.2 If the distance covered is zero, the displacement :

(1) must be zero (2) may or may not be zero (3) cannot be zero (4) depends upon the particle

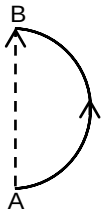
Q.3 Three girls skating on a circular ice ground of radius 200 m start from a -point P on the edge of the ground and reach a point Q diametrically opposite to P following different paths as shown in figure. For which girl is the magnitude of displacement is equal to the actual length of path skate?

(1) A (2) B (3) C (4) None

Q.4 A man moves 4 m along east direction, then 3m along north direction, after that he climbs up a pole to a height 12 m. Find the distance covered by him and his displacement.

(1) 19m ,19m (2) 19m ,13m (3) 16m ,8m (4) 19m , zero

Q.5 A person moves on a semicircular track of radius 40 m. If he starts at one end of the track and reaches the other end, find the distance covered and magnitude of displacement of the person.



(1) 40π m, 40 m (2) 80π m, 80 m (3) 40π m, 80 m (4) 80π m, zero

Q.6 A man has to go 50 m due north, 40 m due east and 20 m due south to reach a cafe from his home.

(i) What distance he has to walk to reach the cafe?

(ii) What is his displacement from his home to cafe?

(1) 110m , 50m (2) 50m , 50m (3) 100m , 70m (4) 90m , 45m

Q.7 The numerical ratio of distance to the displacement covered is always :–

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

(3) equal to or less than one (4) equal to or greater than one

Q.8 Distance travelled by the tip of minute hand of length 10 cm in 100 sec is

(1) $\frac{\pi}{180}$m (2) $\frac{\pi}{360}$m (3) $\frac{\pi}{1200}$m (4) $\frac{3\pi}{2160}$m

Practice Section-02

Q.1 A car travels from A to B at a speed of 20 km/hr and returns at a speed of 30 km/hr. The average speed of the car for the whole journey is

(1) 25 km/hr (2) 24 km/hr (3) 50 km/hr (4) 5 km/hr

Q.2 A particle moves on a straight line in such way that it cover 1st half distance with speed 3 m/s and next half distance in 2 equal time interval with speeds 4.5 m/s and 7.5 m/s respectively. Find average speed of the particle.

(1) 6 m/s (2) 5 m/s (3) 4 m/s (4) 7.5 m/s

Q.3 Length of a minute hand of a clock is 4.5 cm. Find the average velocity of the tip of minite's hand between 6 A.M. to 6.30 A.M. & 6 A. M. to 6.30 P.M.

(1) 5×10^{-3} cm/s, 2×10^{-4} cm/s (2) 2×10^{-3} cm/s, 5×10^{-4} cm/s

(3) 3×10^{-3} cm/s, 4×10^{-4} cm/s (4) 4×10^{-3} cm/s, 2×10^{-4} cm/s

Q.4 A particle of mass 2 kg moves on air circular path with constant speed 10 m/s. Find change in speed and magnitude of change in velocity. When particle completes half revolution.

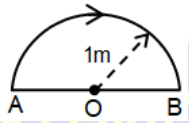
(1) 20 m/s, 20 m/s (2) 10 m/s, 10 m/s (3) Zero, 20 m/s (4) 20 m/s, zero

Q.5 The distance travelled by a particle in time t is given by $s = (2.5\ t^2)$ m. Find (a) the average speed of the particle during time 0 to 5.0 s and (b) the instantaneous speed at t = 5.0 s.

(1) 12.5 m/s, 25 m/s (2) 15 m/s, 30 m/s

(3) 12.5 m/s, zero (4) 12 m/s, 32 m/s

Q.6 A particle goes from point A to point B, moving in a semicircle of radius 1 m in 1 second. Find the magnitude of his average velocity.



(1) 1 m/s (2) 1.8 m/s (3) 2.2 m/s (4) 2 m/s

Q.7 If a car covers 2/5th of total distance with v_1 speed and 3/5th distance with v_2 speed then the average speed is :-

(1) $\frac{1}{2}\sqrt{v_1 v_2}$ (2) $\frac{v_1 + v_2}{2}$ (3) $\frac{2v_1 + v_2}{v_1 + v_2}$ (4) $\frac{5v_1 v_2}{3v_1 + 2v_2}$

Q.8 Air distance between Kota to Jaipur is 260 km and road distance is 320 km. A deluxe bus which moves from Jaipur to Kota takes 8 h while an aeroplane reaches in just 15 min. Find

(i) average speed of bus in km/h (ii) average velocity of bus in km/h

(iii) average speed of aeroplane in km/h (iv) average velocity of aeroplane in km/h

Practice Section-03

Q.1 A particle moves on circular path of radius 5 m with constant speed 5 m/s. Find the magnitude of its average acceleration when it completes half revolution.

(1) $\frac{5}{\pi}$ m/s^2 (2) 5π m/s^2 (3) $\frac{10}{\pi}$ m/s^2 (4) $\frac{\pi}{5}$ m/s^2

Q.2 The velocity of a body depends on time according to the equation v = 20 + 0.1t. The body has :

(1) uniform acceleration (2) uniform retardation

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

Q.3 A particle starts from rest, moves with constant acceleration for 15s. If it covers s_1 distnace in fitst 5s then distance s_2 in next 10s, then find the relation between s_1 & s_2.

(1) $s_1 = s_2$ (2) $s_1 = s_2/2$ (3) $s_1 = 4s_2$ (4) $s_1 = s_2/8$

Q.4 The engine of a train passes an electric pole with a velocity 'u' and the last compartment of the train crosses the same pole with a velocity v. Then find the velocity with which the mid-point of the train passes the pole. Assume acceleration to be uniform.

(1) $\sqrt{v^2+u^2}$ (2) $\sqrt{\frac{v+u}{2}}$ (3) $\sqrt{\frac{v^2}{v^2-u^2}}$ (4) $\sqrt{\frac{u^2+v^2}{2}}$

Q.5 A bullet losses 1/n its velocity in passing through a plank. What is the least number of planks required to stop the bullet ? (Assuming constant retardation)

(1) $\frac{n}{2n-1}$ (2) $\frac{n^2}{n-1}$ (3) $\frac{n^2}{2n-1}$ (4) $\frac{2n^2}{n-1}$

Q.6 A car moving along a straight highway with speed 126 km h^{-1} is brought to a halt within a distance of

200 m. What is the retardation of the car (assume uniform) and how long does it take for the car to stop ?

(1) 1.83 m/s^2, 6.2 s (2) 3.06 m/s^2, 11.4 s (3) 1.23 m/s^2, 6.2 s (4) 5.06 m/s^2, 12.3 s

Q.7 If for a particle position $x \propto t$ then :–

(1) velocity is constant (2) acceleration is non zero

(3) acceleration is variable (4) none of these

Q.8 The position of a particle moving on X-axis is givne by $x = At^2 + Bt + C$. The numerical values of A, B and C are 7, –2 and 5 respectively and SI unit are used. Find

(i) The velocity of the particle at t = 5

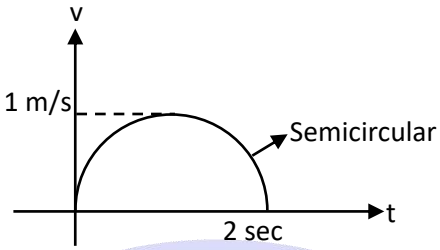
(ii) The acceleration of the particle at t = 5

(iii) The average velocity during the interval t = 0 to t = 5

(iv) The average acceleration during the interval t = 0 to t = 5

Practice Section-04

Q.1 Which option is correct for the given below –



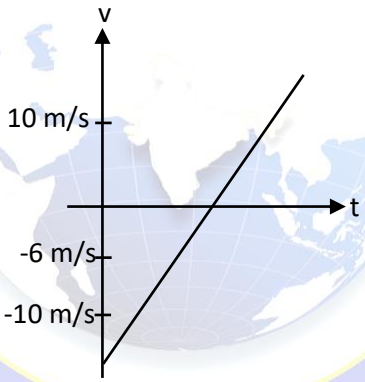
(1) Particle continuously changes its direction of motion.

(2) Instantaneous velocity is along tangent to circlular path

(3) Final distance from initial position is $\frac{\pi}{4}$ m

(4) Average speed for first two seconds is $\frac{\pi}{4}$ m/s

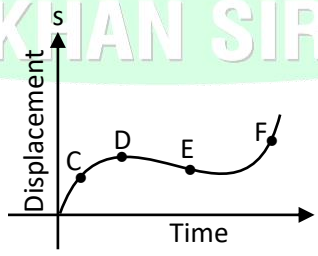
Q.2 Choose the correct option for velocity time graph



(1) Speed first decreases then increases (2) Speed contineoustly increases

(3) Speed first increases then decreases (4) Speed continuously decreases

Q.3 The displacement-time graph of a moving particle is as shown in figure. The instantaneous velocity of the particle is negative at the point

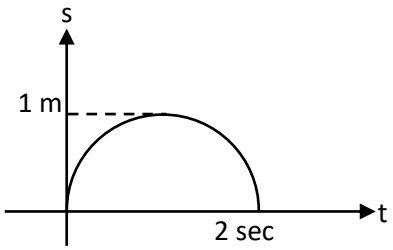


(1) D (2) F (3) C (4) E

Q.4 A body starts from rest and moves with a uniform acceleration of10 ms^{-2} for 5 seconds. During the next 10 seoconds it moves with uniform velocity. Find the total distance travelled by the body (Using graphical analysis).

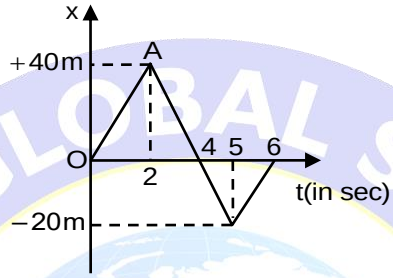
(1) 180 m (2) 324 m (3) 625 m (4) 676 m

Q.5 Particle moves on a straight-line path whose graph is given as follows then total displacement of the particle will be–



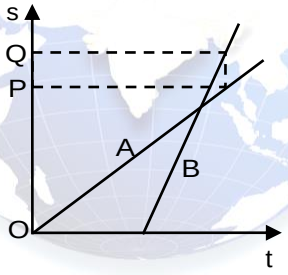
(1) 2 m (2) 4 m (3) 2 π m (4) Zero

Q.6 Position-time graph of a particle is shown in figure Calculate –



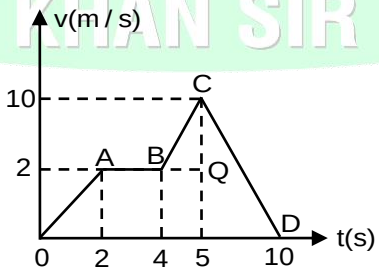
(i) Total distance covered (ii) Displacement
(iii) Average speed (iv) Average velocity

Q.7 The position-time (x-t) graphs for two children A and B returning from their school O to their homes P and Q respectively are shown in figure. Choose correct entries in the brackets below :



(i) (A/B) lives closer to the school than (B/A) (ii) (A/B) starts from the school earlier than (B/A)
(iii) (A/B) walks faster than (B/A) (iv) A and B reach home at the (same/distance) time
(v) (A/B) overtake (B/A) on the road (once/twice)

Q.8 A particle moves on straight line according to the velocity-time graph shown in figure. Calculate –



(i) Total distance covered
(ii) Average speed
(iii) In which part of the graph the acceleration is maximum and also find its value.
(iv) Retardation

Practice Section-05

Q.1 A particle is dropped from the top of a tower. The distance covered by it in the last one second is equal to that covered by it in the first three seconds. Find the height of the tower.
(1) 80 m (2) 125 m (3) 210 m (4) 500 m

Q.2 A balloon starts rising from the ground with an acceleration of 1.25 m/s^2. A stone is released from the balloon after 10s. Determine
(i) maximum height of stone from ground (ii) time taken by stone from ground
(1) 70.3 m, 8 s (2) 70.3 m, 5 s (3) 35.6 m, 4 s (4) 35.6 m, 8 s

Q.3 Water drops are falling in regular intervals of time from top of a tower of height 9m. If 4th drop begins to fall when Ist drop reaches the ground, find the positin of 2nd & 3rd drops from the top of the tower.
(1) 5 m, 3 m (2) 4 m, 2 m (3) 4 m, 3 m (4) 4 m, 1 m

Q.4 A particle is dropped from the top of a tower. During its motion it covers $\frac{9}{25}$ part of height of tower in the last 1 second. Then find the height of tower.
(1) 80 m (2) 125 m (3) 210 m (4) 500 m

Q.5 A particle is dropped from the top of a tower. It covers 40 m in last 2s. Find the height of the tower.
(1) 45 m (2) 80 m (3) 120 m (4) 160 m

Q.6 A player throws a ball upwards with an initial speed of 29.4 m/s.
(i) What is the direction of acceleration during the upward motion of the ball ?
(ii) What are the velocity and acceleration of the ball at the highest point of its motion ?
(iii) Choose x = 0 m and t = 0 s to be the location and time of the ball at its highest point, vertically downward direction to be the positive direction of x-axis and give the signs of position, velocity and acceleratin of the ball during its upward and downward motin.
(iv) To what height does the ball rise and how long does the ball take to return to the player's hands ?
(Take g = 9.8 m/s^2 and neglect air resistance).

Q.7 A particle is projected verticaly up from the top of a tower with velocity 10 m/s. It reaches the ground in 5s. Find –
(i) Height of tower (ii) Striking velocity of particle at ground
(iii) Distance traversed by particle (iv) Average speed & average velocity of particle.

Q.8 A rocket is fired vertically up from the ground with an acceleration 10 m/s^2. If its fuel is finished after 1 minute then calculate –
(i) Maximum velocity attained by rocket in ascending motion.
(ii) Height attained by rocket before fuel is finished.
(iii) Time taken by the rocket in the whole motion.
(v) Maximum height attained by rocket.

Practice Section-06

Q.1 A ball is thrown up from the top of a tower with an initial velocity of 10 m/s at an angle of 30° with the horizontal. It hits the ground at a distance of 17.3 m from the base of tower. Calculate the height of the tower. ($g = 10\ m/s^2$).

(1) 10 m (2) 5 m (3) 7.5 m (4) 15 m

Q.2 A cricketer can throw a ball to a maximum horizontal distance of 100 m. How high above the ground can the cricketer throw the ball, with the same speed ?

(1) 25 m (2) 40 m (3) 50 m (4) 80 m

Q.3 Two bodies are thrown with the same initial speed at angels α and $(90° - \alpha)$ with the horizontal. What will be the ratio of (i) maximum heights attained by them and (ii) horizontal ranges ?

(1) $\tan\alpha, \tan^2\alpha$ (2) 1, $\tan\alpha$ (3) $\tan^2\alpha$, 1 (4) $\tan^2\alpha, \tan\alpha$

Q.4 A ball is thrown at angle θ and another ball is thrown at angle $(90° - \theta)$ with the horizontal direction from the same point each with speeds of 40 m/s. The second ball reaches 50 m higher than the first ball. Find their individual heights. $g = 10\ m/s^2$.

(1) 25 m, 40 m (2) 15 m, 65 m (3) 25 m, 60 m (4) 22 m, 38 m

Q.5 A ball of mass m is thrown vertically up. Another ball of mass 2 m is thrown at an angle θ with the vertical. Both of them stay in air for the same periods of time. What is the ratio of the height attained by the two balls ?

(1) $\frac{1}{2}$ (2) $\frac{1}{4}$ (3) $\frac{2}{3}$ (4) 1

Q.6 The ceiling of a long hall is 25 m high. What is the maximum horizontal distance that a ball thrown with a speed of 40 m/s can go without hitting the ceiling of the hall ? ($g = 10\ m/s^2$).

(1) 124.12 m (2) 68.62 m (3) 154.44 m (4) 148.32 m

Q.7 Two paper screens A and B are separated by a distance of 100 m. A bullet pierces A and then B. The hole in B is 10 cm below the hole in A. If the bullet is travelling horizontally at the time of hitting the screen A, calculate the velocity of the bullet when it hits the screen A. ($g = 9.8\ m/s^2$)

(1) 320 m/s (2) 580 m/s (3) 910 m/s (4) 700 m/s

Q.8 Two tall buildings face each other and are at a distance of 180 m from each other. With what velocity must a ball be thrown horizontally from a window 55 m above the ground in one building, so that it enters a window 10 m above the ground in the second building ? ($g = 10\ m/s^2$)

(1) 30 m/s (2) 45 m/s (3) 60 m/s (4) 90 m/s

Q.9 A projectile is fired horizontally with a velocity of 98 ms^{-1} from the top of a hill 490 m high. Find (i) the time taken to reach the ground (ii) the distance of the target from the hill and (iii) the angle at which the projectile hits the ground. ($g = 9.8\ m/s^2$)

Q.10 A football player kicks a ball at an angle of 30° to the horizontal with an initial speed of 20 m/s. Assuming that the ball travels in a vertical plane, calculate (i) the time a at which the ball reaches the highest point (ii) the maximum height reached (iii) the horizontal range of the ball (iv) the time for which the time for which the ball is in the air. ($g = 10\ m./s^2$).

Practice Section-07

Q.1 Two trains A and B each of length 50 m, are moving with constant speeds. If one train A overtakes the other in 40 s, while crosses the other in 20s. Find the speeds of each train.

(1) 3.75 m/s & 1.25 m/s (2) 2.25 m/s & 2.75 m/s

(3) 1.75 m/s & 2.25 m/s (4) 1.5 m/s & 3.5 m/s

Q.2 Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of 72 km/h in the same direction, with A ahead of B. The driver of B decrides to overtake A and acceleration by 1 m/s^2. If after 50 s, the guard of B just brushes past the driver of A, what was the original distance between the guard of B & driver of A ?

(1) 625 m (2) 1250 m (3) 375 m (4) 2225 m

Q.3 A man 'A' moves in the north direction with a speed 10 m/s and another man B moves in E-30°-N with 10 m/s. Find the relative velocity of B w,.r.t. A.

(1) $5\sqrt{5}\hat{i}-5\hat{j}$ (2) $5\sqrt{5}\hat{i}-10\hat{j}$ (3) $\sqrt{5}\hat{i}-10\hat{j}$ (4) $5\sqrt{3}\hat{i}-5\hat{j}$

Q.4 A and B are moving with the same speed 10 m/s in the direction E-30°-N and E-30°-S respectively. Find the relative velocity of A w.r.t. B.

(1) 10 m/s north (2) 5 m/s north (3) 15 m/s south (4) 5 m/s south

Q.5 A body is projected with velocity u_1 from point A as shown in figure. At the same time another body is projected vertically upwards with a velocity u_2 from point B. What should be the value of $\frac{u_1}{u_2}$ for both bodies to collide.

(1) $\frac{\sqrt{2}}{3}$ (2) $\frac{1}{3}$ (3) $\frac{2}{\sqrt{3}}$ (4) $\frac{1}{\sqrt{3}}$

Q.6 Rain is falling vertically with a speed of 30 m/s. A woman rides a bicycle with a speed of 10 m/s in the north to south direction. What is the direction in which she should hold her umbrella ?

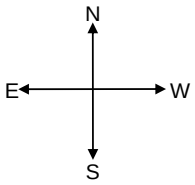
(1) 18.4° from vertical towards south (2) 24.4° from vertical towards north

(3) 36.8° from vertical towards south (4) 54.3° from vertical towards north

Q.7 A man is running up hill with a velocity $(2\hat{i}+3\hat{j})$ m/s w.r.t. ground. He feels that the rain drops are falling vertically with velocity 4 m/s. If he runs down hill with same speed, find v_{rm}.

(1) $\sqrt{10}$ m/s (2) $\sqrt{20}$ m/s (3) $5\sqrt{2}$ m/s (4) $10\sqrt{2}$ m/s

Q.8 Two bodies A and B are 10 km apart such that B is to the south of A. A and B start moving with the same speed 20 km/hr eastward and northward respectively then find.



(i) relative velocity of A w.r.t B.

(ii) minimum separation attained during motion

(iii) time elapsed from starting, to attain minimum separation.

Q.9 A man can swim at a speed 2 m/s in still water. He starts swimming in a river at an angle 150° to the direction of water flow and reaches the directly opposite point on the opposite bank.

(i) Find the speed of flowing water.

(ii) If width of river is 1 km then calculate the time taken to cross the river.

Q.10 2 km wide river flowing at the rater of 5 km/hr. A man can wwim in still water with 10 km/hr. He wants to cross the river along the shortest path. Find –

(i) in which direction should the person swim. (ii) Crossing time.

ANSWER KEY

PRACTICE SECTION-01

Que.	1	2	3	4	5	6	7	8
Ans.	4	1	2	2	3	1	4	1

PRACTICE SECTION-02

Que.	1	2	3	4	5	6	7
Ans.	2	3	1	3	1	4	4

Q.8 (i) 40 km/hr (ii) 32.5 km/hr (iii) 1040 km/hr (iv) 1040 km/hr

PRACTICE SECTION-03

Que.	1	2	3	4	5	6	7
Ans.	3	1	4	4	3	2	1

Q.8 (i) 68 m/s (ii) 14 m/s^2 (iii) 33 m/s (iv) 14 m/s^2

PRACTICE SECTION-04

Que.	1	2	3	4	5
Ans.	4	1	4	3	4

Q.6 (i) 120 m (ii) 0 (iii) 20 m/s (iv) 0

Q.7 (i) A, B, (ii) A, B (iii) B, A (iv) Same, (v) B, A, once

Q.8 (i) 37 m (ii) 3.7 m/s (iii) Part BC, a = 8 m/s^2 (iv) 2 m/s^2

PRACTICE SECTION-05

Que.	1	2	3	4	5
Ans.	2	2	4	2	1

Q.6 (i) Vertically downwards
(ii) zero velocity, accel eration of 9.8 m/s^2 downwards.
(iii) x > 0 (upward and downward motion) v < 0 (upwatd), v > 0 (downward), > 0 throught
(iv) 44.2 m,6 s

Q.7 (i) 75 m, (ii) 40 m/s, (iii) 85 m, (iv) 17 m/s, 15 m/s

Q.8 (i) 600 m/s, (ii) 18 km, (iii) $(2+\sqrt{2})$ min, (iv) 36 km

PRACTICE SECTION-06

Que.	1	2	3	4	5	6	7	8
Ans.	1	3	3	2	4	4	4	3

Q.9 (i) 10s, (ii) 980 m, (iii) $\beta = 45°$

Q.10 (i) 1s, (ii) 5m, (iii) 34.64m, (iv) 2s

PRACTICE SECTION-07

Que.	1	2	3	4	5	6	7
Ans.	1	2	4	1	3	1	2

Q.8 (i) $20\sqrt{2}$ km/hr S – E, (ii) $5\sqrt{2}$ km, (iii) 15 min

Q.9 (i) $\sqrt{3}$ m/s (ii) 1000 s

Q.10 (i) Direction from Down Stream = 120° (ii) $\frac{2}{5\sqrt{3}}$ hr = t_{min} v_R = t_{min} v_R = $\frac{d}{v}v_R$