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Exercise

Kinematics-2D

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Exercise-2

(Objective Type: Multi Correct)

Q 1. An aero plane flies along straight line from A to B with speed v and back again with the same speed. There is a steady wind speed w. The distance between A and B is d. Total time for the round trip –

(A) is $\frac{2vd}{v^2 - w^2}$ if the wind blows along the line AB.

(B) is $\frac{2d}{\sqrt{v^2 - w^2}}$ if the wind blows perpendicular to the line AB.

(C) is always increased by the presence of wind.

(D) depend on the direction of wind.

Q 2. A particle moves in the xy-plane and at time t is at the point $(t^2, t^3 - 2t)$. Then

(A) At t = 2/3 s, directions of velocity and acceleration are perpendicular

(B) At t = 0, directions of velocity and acceleration are perpendicular

(C) At t = $\sqrt{2/3}$ s, particle is moving parallel to x-axis

(D) Acceleration of the particle when it is at point (4, 4) is $2\hat{i} + 12\hat{j}$

Q 3. A particle moves in the x-y plane with a constant acceleration g in the negative y-direction. Its equation of motion is $y = ax - bx^2$, where a and b are constants. Which of the following is/are correct?

(A) The x-component of its velocity is constant.

(B) At the origin, the y-component of its velocity is $a\sqrt{\frac{g}{2b}}$

(C) At the origin, its velocity makes an angle $\tan^{-1}(a)$ with the x-axis.

(D) The particle moves exactly like a projectile.

Q 4. A man crosses a river in a boat. If he crosses the river in minimum time he takes 10 minutes with a drift 120 m. If he crosses the river taking shortest path, he takes 12.5 minute:(Assume $v_{b/r} > v_r$)

(A) width of the river is 200 m

(B) velocity of the boat with respect to water 12 m/min

(C) speed of the current 20 m/min

(D) velocity of the boat with respect to water 20 m/min

Q 5. Two particles A and B projected along different directions from the same point P on the ground with the same velocity of 70 m/s in the same vertical plane . They hit the ground at the same point Q such that PQ = 480 m. Then [g = 9.8 m/s^2]

(A) Ratio of their times of flight is 4 : 5

(B) Ratio of their maximum heights is 9 : 16

(C) Ratio of their minimum speeds during flights is 4 : 3

(D) The bisector of the angle between their directions of projection makes 45° with horizontal

Q 6. A train carriage moves along the x-axis with a uniform acceleration $\vec{a}$. An observer A in the train sets a ball in motion on the frictionless floor of the carriage with the velocity $\vec{u}$ relative to the carriage. The direction $\vec{u}$ of makes an angle θ with the x-axis. Let B be an observer standing on the ground outside train. The path of ball will be-

(A) A straight line with respect to observer A

(B) A straight line with respect to observer B

(C) A parabola with respect to observer A

(D) A parabola with respect to observer B

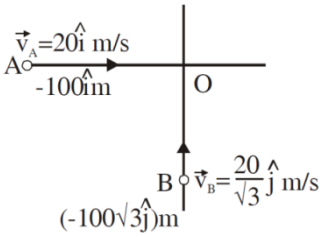
Q 7. Positions of two vehicles A and B with reference to origin O and their velocities are as shown.

(A) they will collide

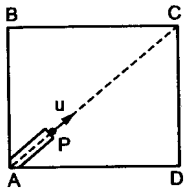
(B) distance of closest approach is 100 m.

(C) their relative speed is $\frac{40}{\sqrt{3}}\text{m/s}$

(D) their relative velocity is $\frac{20}{\sqrt{3}}\text{m/s}$



Q 8. A large rectangular box falls vertically with an acceleration a. A toy gun fixed at A and aimed towards C fires a particle P.



(A) P will hit C if a = g.

(B) P will hit the roof BC if a > g.

(C) P will hit the wall CD if a < g.

(D) May be either (a), (b) or (c), depending on the speed of projection of P.

Q 9. The initial velocity of the particle is given by $\vec{v} = \hat{i} + j - k$ and acceleration of the particle is given by $-\hat{i} - j + tk$ where t is the time in seconds.

(A) Particle may move in a straight line. (B) Particle may come to rest at some time.

(C) Particle will never come to rest. (D) The work done on the particle is zero at some instant.

Q 10. A particle is moving with a position vector, $\vec{r} = \left[a_0 \sin(2\pi t)\hat{i} + a_0 \cos(2\pi t)\hat{j} \right]$. Then

(A) Magnitude of displacement of the particle between time t = 4 sec and t = 6 sec is zero

(B) Distance travelled by the particle in 1 sec is $2\pi a_0$

(C) The speed of particle in the whole motion is constant and equal to $2\pi a_0$.

(D) None of these

Q 11. A point mass is moving in the x-y plane. Its acceleration is a constant vector perpendicular to the xaxis. Which of the following do/does not change with time?

(A) only y-component of its velocity vector

(B) only x-component of its velocity vector

(C) only y-component of its acceleration vector

(D) only x-component of its acceleration vector

Q 12. A man crosses a river in a boat. If he crosses the river in minimum time he takes 10 minutes with a drift 120 m. If he crosses the river taking shortest path, he takes 12.5 minute:(Assume $v_{b/r} > v_r$)

(a) width of the river is 200 m

(b) velocity of the boat with respect to water 12 m/min

(c) speed of the current 20 m/min

(d) velocity of the boat with respect to water 20 m/min

Q 13. A ball is thrown from ground such that it just crosses two poles of equal height kept 80 m apart. The maximum height attained by the ball is 80 m. When the ball passes the first pole, its velocity makes 45° with horizontal. The correct alternatives is/are :- ($g = 10\ m/s^2$)

(A) Time interval between the two poles is 4 s.

(B) Height of the pole is 60 m.

(C) Range of the ball is 160 m.

(D) Angle of projection is $\tan^{-1}(2)$ with horizontal.

Q 14. The vertical height of point P above ground is twice that of a point Q. A particle is projected vertically downward with speed 5 ms^{-1} from P and at the same time another particle is projected vertically upward with the same speed from Q. Both particles reach the ground simultaneously, then $\left(g = 10ms^{-2}\right)$. (P & Q are on the same vertical line).

(A) PQ = 30m

(B) PQ = 60m

(C) Time of flight of stones is 3 s

(D) Time of flight of stones is $\frac{1}{3}$ s

Q 15. Position vector of a particle is expressed as function of time by equation $\vec{r} = 2t^2 + (3t-1)\hat{j} + 5\hat{k}$, where r is in meters and t is in seconds.

(A) It always moves in a plane that is parallel to the x-y plane.

(B) At the instant t = 0 s, it is observed at point (0 m, –1 m, 5 m), moving with velocity 3 m/s in the positive y-direction.

(C) Its acceleration vector is uniform.

(D) It is an example of three dimensional motion.

Q 16. A projectile is thrown with speed u into air from a point on the horizontal ground at an angle θ with horizontal. If the air exerts a constant horizontal resistive force on the projectile then select correct alternative(s).

(A) At the farthest point, the velocity is horizontal.

(B) The time for ascent equals the time for descent.

(C) The path of the projectile may be parabolic.

(D) The path of the projectile may be a straight line.

Q 17. A block is thrown horizontally with a velocity of 2 m/s (relative to ground) on a belt, which is moving with velocity 4 m/s in opposite direction of the initial velocity of block. If the block stops slipping on the belt after 4 s it was dropped then choose the correct statement(s) :-

(A) Displacement with respect to ground is zero after 2.66 s and magnitude of displacement with respect to ground is 12 m after 4 s.

(B) Magnitude of displacement with respect to ground in 4 s is 4 m.

(C) Magnitude of displacement with respect to belt in 4 s is 12 m.

(D) Displacement with respect to ground is zero in 8/3 s.

Q 18. A man on a rectilinearly moving cart, facing the direction of motion, throws a ball straight up with respect to himself

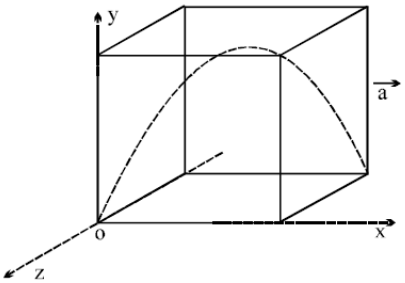
(A) The ball will always return to him.

(B) The ball will never return to him.

(C) The ball will return to him if the cart moves with constant velocity.

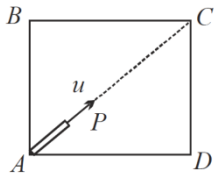
(D) The ball will fall behind him if the cart moves with some positive acceleration.

Q 19. A cubical box dimension L = 5/4 metre starts moving with an acceleration $\vec{a} = 0.5 m/s^2 \hat{i}$ from the state of rest. At the same time, a stone is thrown from the origin with velocity $\vec{V} = v_1\hat{i} + v_2\hat{j} - v_3\hat{k}$ with respect to earth. Acceleration due to gravity $\vec{g} = 10 m/s^2\left(-\hat{j}\right)$: The stone just touches the roof of box and finally falls at the diagonally opposite point then :



(A) $v_1 = \frac{3}{2}$ (B) $v_2 = 5$ (C) $v_3 = \frac{5}{4}$ (D) $v_3 = \frac{5}{2}$

Q 20. A large rectangular box moves vertically downward with an acceleration a. A toy gun fixed at A and aimed towards C fires a particle P.



(A) P will hit C if a = g

(B) P will hit the roof BC, if a > g

(C) P will hit the wall CD if a < g

(D) May be either (A), (B) or (C), depending on the speed of projection of P

Q 21. Two cars A & B are moving towards each other. When the separation between them is 30 m, the driver of car A takes a left turn at 30^0. At the same instant the driver of car B takes turn right to him at an angle 60^0. The two cars collide after 2 second. Then

[Assume both cars to be moving with constant speed]

(A) speed of car A is 7.5 ms^{-1}

(B) speed of car B is 7.5 ms^{-1}

(C) speed of car A is $7.5\sqrt{3} ms^{-1}$

(D) speed of car A with respect to car B after taking turns is 15ms^{-1}

Answer Key

Q.1) A, B, C, D	**Q.2) A, B, C, D**	**Q.3) A, B, C, D**	**Q.4) A, D**	**Q.5) B, C, D**
Q.6) A, D	**Q.7) B, C**	**Q.8) A, B, C**	**Q.9) C**	**Q.10) A, B, C**
Q.11) B, C	**Q.12) A, D**	**Q.13) A,B,C,D**	**Q.14) A, C**	**Q.15) A, B, C**
Q.16) B, C, D	**Q.17) B, C, D**	**Q.18) C, D**	**Q.19) A, B, C**	**Q.20) A, B**
Q.21) B, C, D				