Physicsaholics

Exercise

Kinematics-2D

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Exercise-1

(Objective Type: Single Correct)

Level-1

Q 1. A particle is projected from the ground with an initial velocity of 20 m/s at an angle of 30° with horizontal. The magnitude of change in velocity in a time interval from t = 0 to t = 0.5s is : (g = 10 m/s^2)

(A) 5 m/s (B) 2.5 m/s (C) 2 m/s (D) 4 m/s

Q 2. A particle is projected from a horizontal plane (x-z plane) such that its velocity vector at time t is given by $\vec{V} = a\hat{i} + (b - ct)\hat{j}$. Its range on the horizontal plane is given by :-

(A) $\frac{ba}{c}$ (B) $\frac{2ba}{c}$ (C) $\frac{3ba}{c}$ (D) None

Q 3. A point moves in x-y plane according to the law x = 4 sin 6t and y = 4(1 – cos 6t). The distance traversed by the particle in 4 s is: (x and y are in metres)

(a) 96 m (b) 48 m (c) 24 m (d) 108 m

Q 4. A body of mass 5 kg starts from the origin with an initial velocity $\vec{u} = (30\hat{i} + 40\hat{j})$ ms^{-1}. If a constant force $(-6\hat{i} - 5\hat{j})$ N acts on the body, the time in which the y component of the velocity becomes zero, is :-

(A) 5s (B) 20 s (C) 40 s (D) 80 s

Q 5. A particle moves in space along the path z = ax^3 + by^2 in such a way that $\frac{dx}{dt}$ =c= $\frac{dy}{dt}$ where a, b and c are constants. The acceleration of the particle is :

(A) (6ac^{2}x + 2bc^2) $\hat{k}$ (B) (2ax^2 + 6by^2) $\hat{k}$

(C) (4bc^{2}x + 3ac^2) $\hat{k}$ (D) (bc^{2}x + 2by) $\hat{k}$

Q 6. A particle is moving in x-y plane. At certain instant, the components of its velocity and acceleration are as follows ; V_x = 3m/s, V_y = 4m/s, a_x = 2 m/s^2 and a_y = 1 m/s^2. The rate of change of speed at this moment is :-

(A) $\sqrt{10}$ m/s^2 (B) 4 m/s^2 (C) 10 m/s^2 (D) 2 m/s^2

Q 7. A boy throws a ball from shoulder height at an initial velocity of 30 m/s. Spending 4.8 s in air, the ball is caught by another boy as the same shoulder-height level. What is the angle of projection?

(A) 37° (B) 30° (C) 53° (D) 60°

Q 8. A projectile is thrown with a velocity of 20 m/s, at an angle of 60º with the horizontal. After how much time the velocity vector will make an angle of 45º with the horizontal (in upward direction) is (take g = 10m/s^2)-

(A) $\sqrt{3}$ sec (B) $1/\sqrt{3}$ sec (C) $(\sqrt{3}-1)$ sec (D) None of these

Q 9. A particle is projected from the ground with velocity u at angle θ with horizontal. The horizontal range, maximum height and time of flight are R, H and T respectively. They are given by

$$R=\frac{u^2\sin 2\theta}{g} \quad H=\frac{u^2\sin^2\theta}{2g} \text{ and } T=\frac{2u\sin\theta}{g}$$

Now keeping u fixed, θ is varied from 30° to 60°, then

(A) R will first increase then decrease, H will increase and T will decrease

(B) R will first increase then decrease while H and T both will increase

(C) R will decrease while H and T both will increase

(D) R will increase while H and T both will also increase

Q 10. Suppose a player hits several baseballs. Which baseball will be in the air for the longest time?

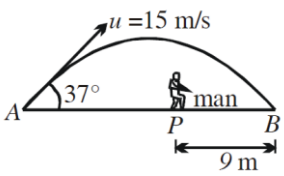
(A) The one with the farthest range.

(B) The one which reaches maximum height.

(C) The one with the greatest initial velocity.

(D) The one leaving the bat at 45° with respect to the ground.

Q 11. A ball is hit by a batsman at an angle of 37° as shown in figure. The man standing at P should run at what minimum velocity so that he catches the ball before it strikes the ground. Assume that height of man is negligible in comparison to maximum height of projectile.

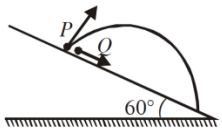


(A) 3 m/s (B) 5 m/s (C) 9 m/s (D) 12 m/s

Q 12. A ball is projected horizontally. After 3 s from projection its velocity becomes 1.25 times of the velocity of projection. Its velocity of projection is :-

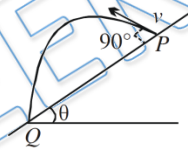
(A) 10 m/s (B) 20 m/s (C) 30 m/s (D) 40 m/s

Q 13. A particle P is projected from a point on the surface of smooth inclined plane (see figure). Simultaneously another particle Q is released on the smooth inclined plane from the same position. P and Q collide after t = 4 s. The speed of projection of P is :-



(A) 5 m/s (B) 10 m/s (C) 15 m/s (D) 20 m/s

Q 14. In the given figure, if time taken by the projectile to reach Q is T, than PQ =



(A) Tv sinθ (B) Tv cosθ (C) Tv secθ (D) Tv tanθ

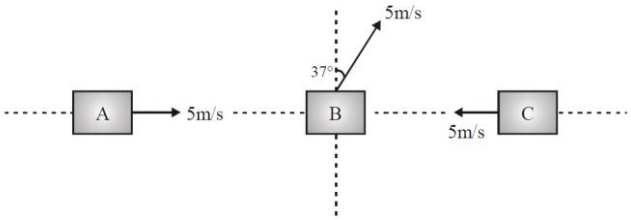
Q 15. A particle is projected up the incline such that its component of velocity along the incline is 10m/s. Time of flight is 2 second and maximum perpendicular distance during the motion from the incline is 5 m. Then velocity of projection will be :-

(A) 10 m/s (B) 10 $\sqrt{2}$ m/s (C) 5 $\sqrt{5}$ m/s (D) none of these

Q 16. A particle A is projected with speed v_A from a point making an angle 60° with the horizontal. At the same instant, a second particle B is thrown vertically upward from a point directly below the maximum height point of parabolic path of A with velocity v_B. If the two particles collide then the ratio of v_A/v_B should be :-

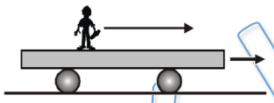
(A) 1 (B) $\frac{2}{\sqrt{3}}$ (C) $\frac{\sqrt{3}}{2}$ (D)$\sqrt{3}$

Q 17. Consider the motion of three bodies as shown for an observer on B, what is the magnitude of relative velocity of A with respect to C ?



(A) 10 m/s (B) 0 (C) $\sqrt{20}$ m/s (D) 8 m/s

Q 18. A trolley is moving horizontally with a constant velocity of v with respect to earth. A man starts running from one end of the trolley with a velocity 1.5 v with respect to trolley. After reaching the opposite end, the man returns back and continues running with a velocity of 1.5 v w.r.t. the trolley in the backward direction. If the length of the trolley is L then the displacement of the man with respect to earth during the process will be :-



(A) 2.5 L (B) 1.5 L (C) $\frac{5L}{3}$ (D) $\frac{4L}{3}$

Q 19. An elevator car (lift) is moving upward with uniform acceleration of 2 m/s^2. At the instant, when its velocity is 2 m/s upwards a ball is thrown upward from its floor. The ball strikes back the floor 2 s after its projection. Find the velocity of projection of the ball relative to the lift.

(A) 10 m/s↑ (B) 10 m/s↓ (C) 12 m/s↑ (D) 12 m/s↓

Q 20. A flag is mounted on a car moving due North with velocity of 20 km/hr. Strong winds are blowing due East with velocity of 20 km/hr. The flag will point in direction :-

(A) East (B) North-East (C) South-East (D) South-West

Q 21. Three ships A, B & C are in motion. Ship A moves relative to B is with speed v towards North-East. Ship B moves relative to C with speed v towards the North-West. Then relative to A, C will be moving towards :-

(A) North (B) South (C) East (D) West

Q 22. Wind is blowing in the north direction at speed of 2 m/s which causes the rain to fall at some angle with the vertical. With what velocity should a cyclist drive so that the rain appears vertical to him :

(A) 2 m/s south (B) 2 m/s north (C) 4 m/s west (D) 4 m/s south

Q 23. A boat having a speed of 5 km/hr in still water, crosses a river of width 1 km along the shortest possible path in 15 minutes. The speed of the river in Km/hr.

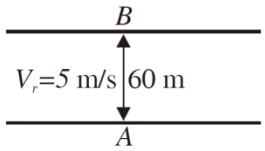
(A) 1 (B) 3 (C) 4 (D) $\sqrt{41}$

Q 24. A bus moves over a straight level road with an acceleration a . A boy in the bus drops a ball outside. The acceleration of the ball with respect to the bus and the earth are respectively -

(A) a and g (B) a + g and g – a

(C) $\sqrt{a^2+g^2}$ and g (D) $\sqrt{a^2+g^2}$ and a

Q 25. A man is crossing a river flowing with velocity of 5 m/s. He reaches a point directly across the river at a distance of 60 m in 5 sec. His velocity in still water should be :-



(A) 12 m/s (B) 13 m/s (C) 5 m/s (D) 10 m/s

Q 26. A motor boat is to reach at a point 30° upstream (w.r.t. normal) on other side of a river flowing with velocity 5m/s. The angle 30° is measured from a direction perpendicular to river flow. Velocity of motorboat with respect to water is $5\sqrt{3}$ m/s. The driver should steer the boat at an angle

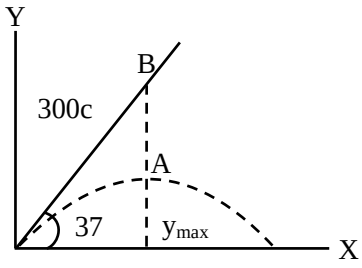
(A) 120° with respect to stream direction.

(B) 30° with respect to the perpendicular to the bank.

(C) 30° with respect to the line of destination from starting point.

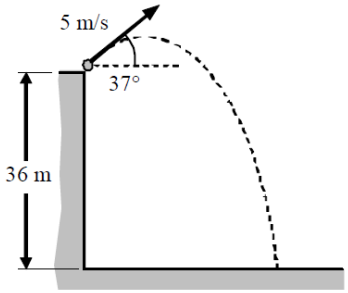
(D) None of these.

Q 27. A ball A is projected from origin with an initial velocity v_0 = 700 cm/s, in a direction 37º above the horizontal as shown in fig. Another ball B 300 cm from origin on a line 37º above the horizontal is released from rest at the instant A starts. then how far will B have fallen when it is hit by A –



(A) 90 cm (B) 80 cm (D) 70 cm (D) 60 cm

Q 28. A ball is thrown from the top of 36 m high tower with velocity 5 m/s at an angle 37° above ` the horizontal as shown. Its horizontal range on the ground is closest to [g = 10 m/s^2]



(A) 12 m (B) 18 m (C) 24 m (D) 30 m

Q 29. A particle leaves the origin with an initial velocity $\vec{v} = \left(3\hat{i} + 4\hat{j}\right)$ ms^{-1}and a constant acceleration $\vec{a} = \left(-\hat{i} - 0.5\hat{j}\right)$ ms^{-2}. When the particle reaches its maximum x–coordinate, what is the y–coordinate?

(A) $\frac{27}{4}$m (B) $\frac{37}{4}$m (C) $\frac{29}{4}$m (D) $\frac{39}{4}$m

Q 30. The position vector of a particle is determined by $\vec{r} = 3t^2\hat{i} + 4t^2\hat{j} + 7\hat{k}$. The distance travelled in first 10 sec is :-

(A) 100 m (B) 150 m (C) 500 m (D) 300 m

Answer Key

Q.1) A	Q.2) B	Q.3) A	Q.4) C	Q.5) A
Q.6) D	Q.7) C	Q.8) C	Q.9) B	Q.10) B
Q.11) B	Q.12) D	Q.13) B	Q.14) D	Q.15) B
Q.16) B	Q.17) A	Q.18) D	Q.19) C	Q.20) C
Q.21) B	Q.22) B	Q.23) B	Q.24) C	Q.25) B
Q.26) C	Q.27) A	Q.28) A	Q.29) D	Q.30) C