KINEMATICS

1. The trajectory of a projectile in a vertical plane is $y = ax - bx^2$, where a and b are constants and x and y are respectively horizontal and vertical distances of the projectile from the point of projection. The maximum height attained by the particle and the angle of projection from the horizontal are:
(a) $\frac{b^2}{2a}$, $\tan^{-1}$ (b) (b) $\frac{a^2}{b}$, $\tan^{-1}$ (2a)
(c) $\frac{a^2}{4b}$, $\tan^{-1}$ (a) (d) $\frac{2a^2}{b}$, $\tan^{-1}$ (a)

2. The speed of a projectile when it is at its greatest height is $\frac{1}{2}$ times its initial speed. The angle of projection is -
(a) 30° (b) 60°
(c) 45° (d) $\tan^{-1}$ (3/4)

3. A body is thrown from a point with speed 50 m/s at an angle 37° with horizontal. When it has moved a horizontal distance of 80 m then it's distance from point of projection -
(a) 40 m (b) $40\sqrt{2}$ m
(c) $40\sqrt{5}$ m (d) none of these

4. A particle is thrown with a speed u at an angle θ to the horizontal When the particle makes an angle ϕ with the horizontal, its speed changes to v -
(a) $v = u \cos\theta$ (b) $v = u \cos\theta . \cos\phi$
(c) $v = u \cos\theta . \sec\phi$ (d) $v = u \sec\theta . \cos\phi$

5. A projectile is given an initial velocity of $\hat{\imath} + 2\hat{\jmath}$. The Cartesian equation of its path is - ($g = 10\ m/s^2$)
(a) $y = 2x - 5x^2$ (b) $y = x - 5x^2$
(c) $4y = 2x - 5x^2$ (d) $y = 2x - 25x^2$

6. If time of flight of a projectile is 10 seconds. Range is 500 meters. The maximum height attained by it will be -
(a) 125 m (b) 50 m
(c) 100 m (d) 150 m

7. A ball is projected upwards from the top of tower with a velocity 50 ms^{-1} making an angle 30° with the horizontal. The height of tower is 70 m. After how many seconds from the instant of throwing will the ball reach the ground -
(a) 2s (b) 5s
(c) 7s (d) 9s

8. A ball is projected with kinetic energy K at an angle of 45° to the horizontal. At the highest point during its flight, its kinetic energy will be
(a) K (b) $K/\sqrt{2}$
(c) K/2 (d) zero

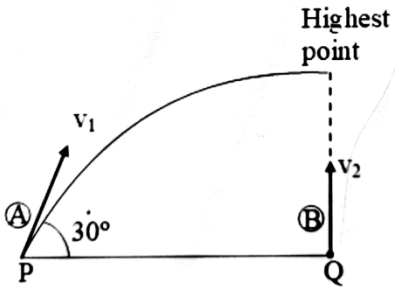
9. A body is projected at an angle of 30° with the horizontal with momentum p. At its highest point, the momentum is-
(a) p (b) $\frac{p}{2}$
(c) $\frac{\sqrt{3}}{2}$p (d) $\frac{2}{\sqrt{3}}$p

10. A body is projected at 30° angle with the horizontal with velocity 30 ms^{-1}.What is the angle with the horizontal after 1.5 s? (Take $g = 10\ ms^{-2}$)
(a) 0° (b) 30°
(c) 60° (d) 90°

11. A bullet is fired horizontally with a velocity of 80m/s. During the first second -
(a) it falls 9.8 m
(b) it falls $\frac{80}{9.8}$ m
(c) it does no fall at all
(d) it falls 4.9 m

12. A large number of bullets are fired in all directions 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) none

13. A projectile A is the thrown at an angle of 30° to the horizontal from point P. At the same time, another projectile B is thrown with velocity v_2 upwards from the point Q vertically below the highest point. For B to collide with A, $\frac{v_2}{v_1}$ should be-



(a) 1 (b) 2
(c) 1/2 (d) 4

14. For a projectile thrown into space with a speed v, the horizontal range is $\frac{\sqrt{3}v^2}{2g}$. The vertical range is $\frac{\sqrt{3}v^2}{8g}$. The angle which the projectile makes with the horizontal initially is-
(a) 15° (b) 30°
(c) 45° (d) 60°

15. Two trains travelling on the same track are approaching each other with equal speeds of 40 ms^{-1}.

The drivers of the trains begin to decelerate simultaneously when they are just 2 km apart. If the decelerations are both uniform and equal, then the value of deceleration to barely avoid collision should be?
(a) 0.8 ms^{-2} (b) 2.1 ms^{-2}
(c) 11.0 ms^{-2} (d) 13.2 ms^{-2}

16. A particle moves a, distance x in time t according to equation $x = (t + 5)^{-1}$. The acceleration of particle is proportional to
(a) $(Velocity)^{2/3}$ (b) $(Velocity)^{3/2}$
(c) $(distance)^{2}$ (d) $(distance)^{-2}$

17. Water drops fall at regular intervals from a tap which is 5 m 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?
(a) 2.50 m (b) 3.75 m
(c) 4.00 m (d) 1.25 m

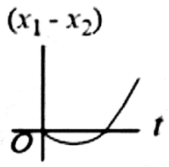
18. A boggy of uniformly moving train is suddenly detached from train and stops after covering some distance. The distance covered by the boggy and distance covered by the train in the same time has relation?
(a) Both will be equal
(b) First will be half of second
(c) First will be 1/4 of second
(d) No definite ratio

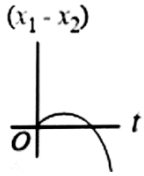
19. The wind appears to blow from the north to a man moving in the north-east direction. When he doubles his velocity the wind appears to move in the direction $\cot^{-1}$ (2) east of north. The actual direction of the wind is?
(a) $\sqrt{2}$v towards east (b) $\frac{v}{\sqrt{2}}$ towards west
(c) $\sqrt{2}$v towards west (d) $\frac{v}{\sqrt{2}}$ towards east

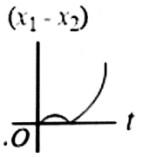
20. A particle moves along x-axi as $x = 4(t - 2) + a(t - 2)^2$
Which of the following is true?
(a) The initial velocity of particle is 4
(b) The acceleration of particle is 2a
(c) The particle is at origin at t = 0
(d) None of the above

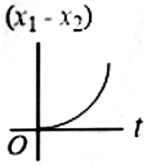
21. An object, moving with a speed of 6.25 m/s, is decelerated at a rate given by $\frac{dv}{dt} = -2.5\sqrt{v}$ where v is the instantaneous speed. The time taken by the object, to come to rest, would be?
(a) 2 s (b) 4 s
(c) 8 s (d) 1 s

22. A body is at rest at x = 0. At t = 0, it starts moving in the positive x-direction with a constant acceleration. At the same instant another body passes through x = 0 moving in the positive x-direction with a constant speed. The position of the first body is given by $x_1(t)$ after time y and that of the second body by $x_2(t)$ after the same time interval. Which of the following graphs correctly describes $(x_1 - x_2)$ as a function of time 't'?

(a) 

(b) 

(c) 

(d) 

23. A body starts from rest. What is the ratio of the distance travelled by the body during the 4th and 3rd second?
(a) 7/5 (b) 5/7
(c) 7/3 (d) 3/7

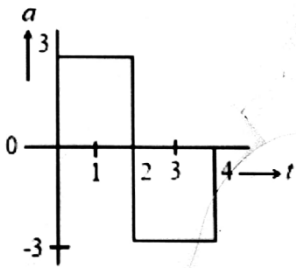
24. A particle starts from rest, acceleration at 2 m/s^2 for 10s and then goes with constant speed for 30 s and then decelerates at 4 m/s^2 till it stops. What is the distance travelled by it?
(a) 750 m (b) 800 m
(c) 700 m (d) 850 m

25. The retardation experienced by a moving motor boat, after its engine is cut off, is given by $\frac{du}{dt} = -kv^3$, where k is a constant. If v_0 is the magnitude of the velocity at cut-off, the magnitude of the velocity at time t after the cut-off is?
(a) v_0 (b) $v_0/2$
(c) v_0e^{-kt} (d) $\frac{v_0}{\sqrt{2v_0^2kt+1}}$

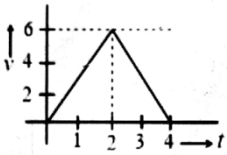
26. A boy walks to his school at a distance of 6km with constant speed of 2.5 km/hour and walks back with a constant speed of 4 km/hr. His average speed for round trip expressed in km/hour, is
(a) 24/13 (b) 40/13
(c) 3 (d) 1/2

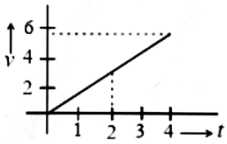
27. A stone is dropped from A height h. Simultaneously, another stone is thrown up from the ground which reaches a height 4 h. The two stones cross other after time?
(a) $\sqrt{\frac{8h}{g}}$ (b) $\sqrt{8gh}$
(c) $\sqrt{2gh}$ (d) $\sqrt{\frac{h}{2g}}$

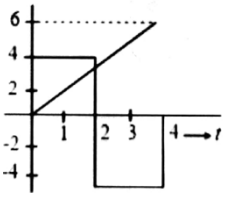
28. A particle starts from rest at t = 0 and undergoes an acceleration a in ms^{-2} with time t in seconds which is as shown.

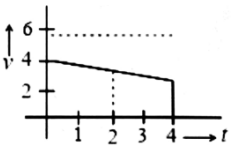


Which one of the following plot represents velocity v in ms^{-1} versus time t in seconds?

(a) 

(b) 

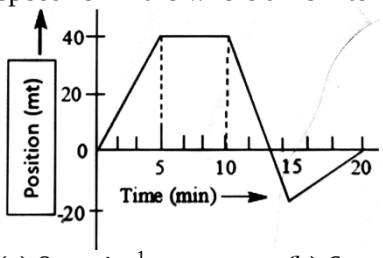
(c) 

(d) 

29. 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, did he bail out?

(a) 293 m (b) 111 m
(c) 91 m (d) 182 m

30. A boy begins to walk eastward along a street infront of his house and the graph of his displacement from home is shown in the following figure. His average speed for in the whole time interval is equal to?

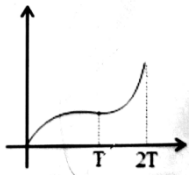
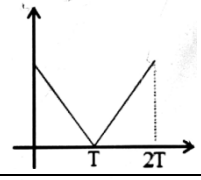
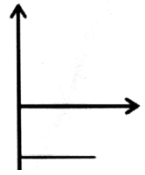
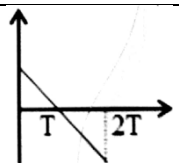


(a) 8m min^{-1} (b) 6m min^{-1}
(c) $\frac{8}{3}$m min^{-1} (d) 2 m min^{-1}

31. The displacement of the particle varies with time according to the relation $x = \frac{k}{b}[1 - e^{-bt}]$. Then the velocity of the particle is?

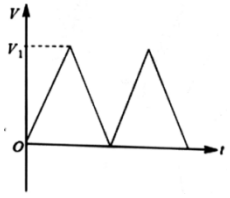
(a) $k(e^{-bt})$ (b) $\frac{k}{b^2e^{-kt}}$
(c) kbe^{-bt} (d) None of these

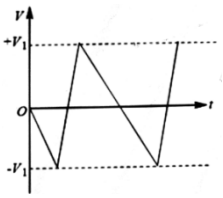
32. The displacement - time graph of a body moving on a straight line is given by:

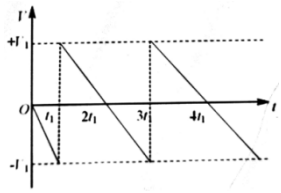
(A) Velocity - time graph	(P) 
(B) Acceleration- time graph	(Q) 
(C) Distance - time graph	(R) 
(D) speed - time graph	(S) 

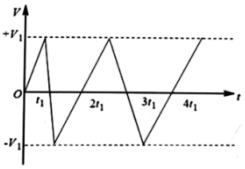
(a) (A) → S (B) → R (C) → P (D) → Q
(b) (A) → R (B) → S (C) → P (D) → Q
(c) (A) → S (B) → R (C) → Q (D) → P
(d) (A) → S (B) → P (C) → R (D) → Q

33. Consider a rubber ball freely falling from a height h = 4.9 m onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic. Then the velocity as a function of time will be :

(a) 

(b) 

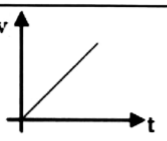
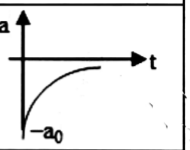
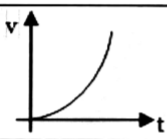
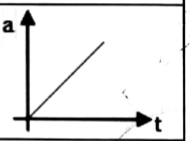
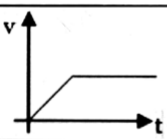
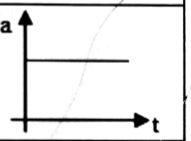
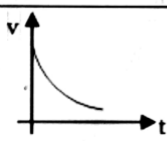
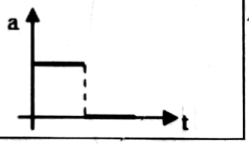
(c) 

(d) 

34. A body is moving from rest under constant acceleration and let S_1 be the displacement in the first (P – 1) sec and S_2 the displacement in the first P sec. The displacement in $(P^2 - P + 1)^{th}$ see will be:

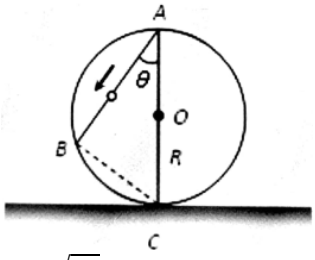
(a) $S_1 + S_2$ (b) S_1S_2
(c) $S_1 - S_2$ (d) S_1/S_2

35. Match the following?

COLUMN-1	COLUMN-2
A) 	(P) 
(B) 	(Q) 
(C) 	(R) 
(D) 	(S) 

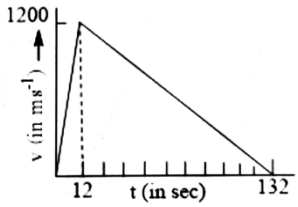
(a) A → Q, B → R, C → S, D → P
(b) A → R, B → Q, C → S, D → P
(c) A → R, B → Q, C → P, D → S
(d) A → R, B → S, C → Q, D → P

36. A frictionless wire AB is fixed on a sphere of radius R. A very small spherical ball slips on this wire. The time taken by this ball to slip from A to B is ?



(a) $\frac{2\sqrt{gR}}{g\cos\theta}$ (b) $2\sqrt{gR}.\frac{\cos\theta}{g}$
(c) $2\sqrt{\frac{R}{g}}$ (d) $\frac{gR}{\sqrt{g\cos\theta}}$

37. A rocket is fired upwards. Its engine explodes fully is 12s. The height reached by the rocket as calculated from its velocity-time graph is ?

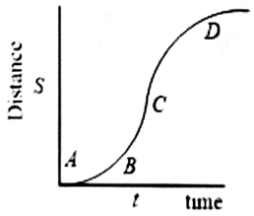


(a) 1200 × 6 × 132m (b) 1200 × 132m
(c) $\frac{1200}{12}$ m (d) 1200 × 12^2m

38. The relation between time and distance is $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is:
(a) $2\alpha v^3$ (b) $2\alpha\beta v^3$
(c) $2\beta^2 v^3$ (d) $2\beta v^3$

39. Four marbles are dropped front the top of a tower one after the other with an interval of one second. The first one reaches the ground 4 seconds. When the first one reaches the ground the distances between the first and second, the second and third and the third and forth will be respectively
(a) 35,25 and 15 m (b) 30,20 and 10 m
(c) 20,10 and 5 m (d) 40,30 and 20 m

40. A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point:



(a) D (b) A
(c) B (d) C

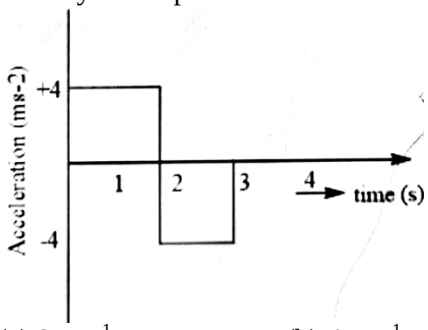
41. A point initially at rest moves along x-axis. Its acceleration varies with time as a = (6t + 5) in ms^{-2}. It starts from origin, the distance covered in 1s is?
(a) 3 m (b) 3.5 m
(c) 4 m (d) 4.5 m

42. A boat crosses a river from port A to port B, which are just on the opposite side. The speed of the water is V_W and that of boat is V_B relative to still water. Assume $V_B = 2V_W$. What is the time taken by the boat, if It has to cross the river directly on the AB line?
(a) $\frac{2D}{V_B\sqrt{3}}$ (b) $\frac{\sqrt{3}D}{2V_B}$
(c) $\frac{D}{V_B\sqrt{2}}$ (d) $\frac{D\sqrt{2}}{V_B}$

43. Two boys are standing at the ends A and B of a ground where AB = a. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at a starts running simultaneously with velocity v and catches the other
boy in a time t, when t is?
(a) $\frac{a}{\sqrt{(v^2+v_1^2)}}$ (b) $\sqrt{a^2/(v^2-v_1^2)}$
(c) $a/(v - v_1)$ (d) $a/(v + v_1)$

44. A particle crossing the origin of co-ordinates at time = 0, moves in the xy-plane with a constant acceleration a in the y-direction. If its equation of motion is $y = bx^2$ (b is a constant), its velocity component in the x-direction is?
(a) $\sqrt{\frac{2b}{a}}$ (b) $\sqrt{\frac{a}{2b}}$
(c) $\sqrt{\frac{a}{b}}$ (d) $\sqrt{\frac{b}{a}}$

45. A particle starts from rest at t = 0 and moves in a straight line with acceleration as shown in figure. The velocity of the particle at t = 3 s is?



(a) 2 ms^{-1} (b) 4 ms^{-1}
(c) 6 ms^{-1} (d) 8 ms^{-1}

46. **Statement 1:** A body, whatever its motion is always at rest in a frame of reference which is fixed to the body itself.
Statement 2: The relative velocity of a body with respect to itself is zero.
(a) Both Statements are Correct
(b) Statement 1 is Correct and Statement 2 is incorrect.
(c) Statement 1 is incorrect and Statement 2 is correct.
(d) Both Statements are incorrect.

47. **Statement 1:** In projectile motion, the acceleration is constant in both magnitude and direction but the velocity changes in both magnitude and direction.
Statement 2: When a force or acceleration is acting in an oblique direction to the direction of velocity then both magnitude and direction of the velocity may be changed.
(a) Both Statements are Correct
(b) Statement 1 is Correct and Statement 2 is incorrect.
(c) Statement 1 is incorrect and Statement 2 is correct.
(d) Both Statements are incorrect.

48. A loose nut from a bolt on the bottom of an elevator which is moving up the shaft at 3m/s falls freely. The nut strikes. the bottom of the shaft in 2s. Distance of the elevator from the bottom of the shaft when the nut fell off is ?
(a) 19.6m (b) 13.6m
(c) 9.8m (d) 3.8m

49. A javelin thrown into air at an wangle with the horizontal has range of 200m. If the time of flight is 5 second, then the horizontal component of velocity of the projectile at the highest point of the trajectory is
(a) 40 m/s (b) 0 m/s
(c) 9.8 m/s (d) infinite

50. A man who can swim at the rate of 2 km/hr (in Still River) crosses a river to a point exactly opposite on the other bank by swimming in a direction of 120° to the flow of the water in the river. The velocity of the water current in km/hr is
(a) 1 (b) 2
(c) 1/2 (d) 3/2.