27. A very broad elevator is going up vertically with a constant acceleration of 2 m/s². At the instant when its velocity is 4 m/s a ball is projected from the floor of the lift with a speed of 4 m/s relative to the floor at an elevation of 30°. The time taken by the ball to return the floor is ($g = 10$ m/s²)

(a) $\frac{1}{2}$ s (b) $\frac{1}{3}$ s

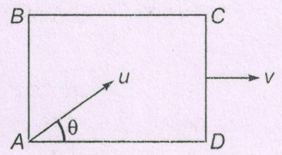
(c) $\frac{1}{4}$ s (d) 1s

28. In the above problem range of the ball over the floor of the lift is

(a) $2\sqrt{3}$ m (b) $\sqrt{3}$ m

(c) $\frac{2}{\sqrt{3}}$ m (d) 2 m

29. A smooth square platform *ABCD* is moving towards right with a uniform speed v. At what angle θ must a particle be projected from *A* with speed u so that it strikes the point *B* ?



(a) $\sin^{-1}\left(\frac{u}{v}\right)$ (b) $\cos^{-1}\left(\frac{v}{u}\right)$

(c) $\cos^{-1}\left(\frac{u}{v}\right)$ (d) $\sin^{-1}\left(\frac{v}{u}\right)$

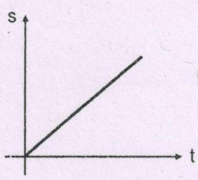
30. Two stones are thrown up simultaneously from the edge of a cliff with initial speeds v and $2v$. The relative position of the second stone with respect to first varies with time till both the stones strike the ground as

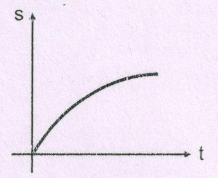
(a) linearly
(b) first linearly then parabolically
(c) parabolically
(d) first parabolically then linearly

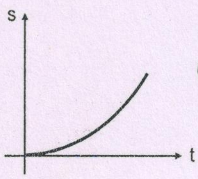
(Assume that the first stone comes to rest after striking the ground)

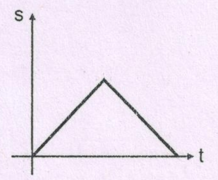
31. One stone is dropped from a tower from rest and simultaneously another stone is projected vertically upwards from the tower with some initial velocity. The graph of the distance(s) between the two stones varies with time (t) as

(before either stone hits the ground)

(a)


(b)


(c)


(d)


32. A particle is projected up an inclined plane with initial speed $v = 20$ m/s at an angle $\theta = 30°$ with plane. The component of its velocity perpendicular to plane when it strikes the plane is

(a) $10\sqrt{3}$ m/s (b) 10 m/s

(c) $5\sqrt{3}$ m/s (d) Data is insufficient

33. 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) $(6ac^2x + 2bc^2)\,\hat{\mathbf{k}}$ (b) $(2ax^2 + 6by^2)\,\hat{\mathbf{k}}$

(c) $(4bc^2x + 3ac^2)\,\hat{\mathbf{k}}$ (d) $(bc^2x + 2by)\,\hat{\mathbf{k}}$

34. 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) $\frac{2a^2}{b}$, $\tan^{-1}(a)$

35. Two particles are projected from the same point on ground simultaneously with speeds 20 m/s and $20/\sqrt{3}$ m/s at angles 30° and 60° with the horizontal in the same direction. The maximum distance between them till both of them strike the ground is approximately ($g = 10$ m/s²)

(a) 23.1 m (b) 16.4 m

(c) 30.2 m (d) 10.4 m

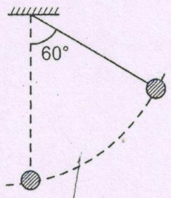
36. A projectile is given an initial velocity of $\hat{\mathbf{i}} + 2\hat{\mathbf{j}}$. The cartesian equation of its path is ($g = 10$ m/s²)

(a) $y = 2x - 5x^2$ (b) $y = x - 5x^2$

(c) $4y = 2x - 5x^2$ (d) $y = 2x - 25x^2$

(Here, $\hat{\mathbf{i}}$ is unit vector along horizontal and $\hat{\mathbf{j}}$ is unit vector vertically upwards)

37. A pendulum of length $l = 1$ m is released from $\theta_0 = 60°$. The rate of change of speed of the bob at $\theta = 30°$ is ($g = 10$ m/s²)



(a) $5\sqrt{3}$ m/s²
(b) 5 m/s²
(c) 10 m/s²
(d) 2.5 m/s²

38. A particle moves along a circle of radius $R = 1$ m so that its radius vector $\vec{\mathbf{r}}$ relative to a point on its circumference rotates with constant angular velocity $\omega = 2$ rad/s. The linear speed of the particle is

(a) 4 m/s (b) 2 m/s

(c) 1 m/s (d) 0.5 m/s