Exercise-1

✍ **Marked Questions can be used as Revision Questions.**

OBJECTIVE QUESTIONS

Section (A) : Kinematics of circular motion

A-1. Two racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively ; their speeds are such that they each make a complete circle in the same time t. The ratio of the angular speed of the first to the second car is :
(1) $m_1 : m_2$ (2) $r_1 : r_2$ (3) 1 : 1 (4) $m_1r_1 : m_2r_2$

A-2 A wheel is at rest. Its angular velocity increases uniformly and becomes 80 radian per second after 5 second. The total angular displacement is :
(1) 800 rad (2) 400 rad (3) 200 rad (4) 100 rad

A-3 When a particle moves in a circle with a uniform speed
(1) its velocity and acceleration are both constant
(2) its velocity is constant but the acceleration changes
(3) its acceleration is constant but the velocity changes
(4) its velocity and acceleration both change

A-4 The relation between an angular velocity, the position vector and linear velocity of a particle moving in a circular path is.
(1) $\vec{\omega} \times \vec{r} = \vec{v}$ (2) $\vec{\omega}.\vec{r} = \vec{v}$ (3) $\vec{r} \times \vec{\omega} = \vec{v}$ (4) $\vec{\omega}\,\vec{r} = \vec{v}$

A-5 A wheel is of diameter 1m. If it makes 30 revolutions/sec., then the linear speed of a point on its circumference will be.
(1) 30π m/s (2) π m/s (3) 60π m/s (4) π/2 m/s

A-6✍ A particle moves along a circle of radius $\left(\frac{20}{\pi}\right)$m with constant tangential acceleration. If the speed of the particle is 80 m/s at the end of the second revolution after motion has begun, the tangential acceleration is:
(1) 160 π m/s^2 (2) 40 π m/s^2 (3) 40 m/s^2 (4) 640 π m/s^2

A-7 The second's hand of a watch has length 6 cm. Speed of end point and magnitude of difference of velocities at two perpendicular positions will be :
(1) 2π & 0 mm/s (2) $2\sqrt{2}\pi$ & 4.44 mm/s
(3) $2\sqrt{2}\pi$ & 2π mm/s (4) 2π & $2\sqrt{2}\pi$ mm/s

A-8 An aeroplane revolves in a circle above the surface of the earth at a fixed height with speed 100 km/hr. The magnitude of change in velocity after completing 1/2 revolution will be.
(1) 200 km/hr (2) 150 km/hr (3) 300 km/hr (4) 400 km/hr

Section (B) : Radial and Tangential acceleration

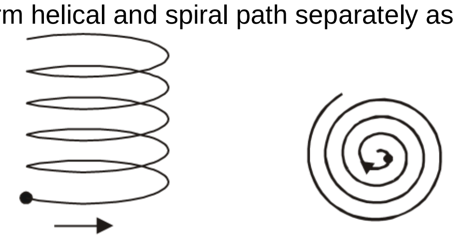
B-1 Two particles P and Q are located at distances r_P and r_Q respectively from the axis of a rotating disc such that $r_P > r_Q$:
(1) Both P and Q have the same acceleration
(2) Both P and Q do not have any acceleration
(3) P has greater acceleration than Q
(4) Q has greater acceleration than P

B-2 Let a_r and a_t represent radial and tangential acceleration. The motion of a particle may be circular if :
(1) $a_r = 0, a_t = 0$ (2) $a_r = 0, a_t \neq 0$ (3) $a_r \neq 0, a_t = 0$ (4) none of these

B-3 A stone is moved round a horizontal circle with a 20 cm long string tied to it. If centripetal acceleration is 9.8 m/sec^2, then its angular velocity will be
(1) 7 rad/s (2) 22/7 rad/s (3) 49 rad/s (4) 14 rad/s

B-4 A particle of mass m is executing a uniform motion along a circular path of radius r. If the magnitude of its linear momentum is p, the radial force acting on the particle will be.
(1) pmr (2) rm/p (3) mp^2/r (4) p^2/mr

B-5 A particle is going in a uniform helical and spiral path separately as shown in figure with constant speed.



(a) (b)

(1) The velocity of the particle is constant in both cases
(2) The acceleration of the particle is constant in both cases
(3) The magnitude of accleration is constant in (a) and decreasing in (b)
(4) The magnitude of accleration is decreasing continuously in both the cases

B-6 A car is travelling with linear velocity v on a circular road of radius r. If the speed is increasing at the rate of 'a' metre/sec^2, then the resultant acceleration will be -
(1) $\sqrt{\left[\frac{v^2}{r^2} - a^2\right]}$ (2) $\sqrt{\left[\frac{v^4}{r^2} + a^2\right]}$ (3) $\sqrt{\left[\frac{v^4}{r^2} - a^2\right]}$ (4) $\sqrt{\left[\frac{v^2}{r^2} + a^2\right]}$

Section (C) : Circular Motion in Horizontal plane

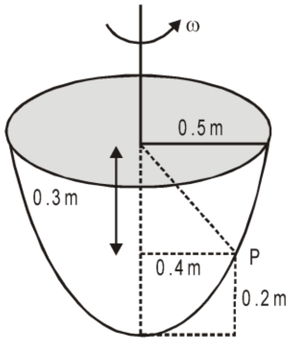
C-1 A coin placed on a rotating turntable just slips if it is placed at a distance of 4 cm from the centre. If the angular velocity of the turntable is doubled , it will just slip at a distance of
(1) 1 cm (2) 2 cm (3) 4 cm (4) 8 cm

C-2 A particle moving along a circular path due to a centripetal force having constant magnitude is an example of motion with :
(1) constant speed and velocity (2) variable speed and velocity
(3) variable speed and constant velocity (4) constant speed and variable velocity.

C-3 A stone of mass 0.5 kg tied with a string of length 1 metre is moving in a circular path with a speed of 4 m/sec. The tension acting on the string in newton is -
(1) 2 (2) 8 (3) 0.2 (4) 0.8

C-4 The breaking tension of a string is 10 N. A particle of mass 0.1 kg tied to it is rotated along a horizontal circle of radius 0.5 metre. The maximum speed with which the particle can be rotated without breaking the string is-
(1) $\sqrt{5}$ m/sec (2) $\sqrt{(50)}$ m/sec (3) $\sqrt{(500)}$ m/sec (4) $\sqrt{(1000)}$ m/sec

C-5 A particle P will be equilibrium inside a hemispherical bowl of radius 0.5 m at a height 0.2 m from the bottom when the bowl is rotated at an angular speed ($g = 10\ m/sec^2$)-



(1) $10/\sqrt{3} rad/sec$
(2) $10\sqrt{3} rad/sec$
(3) 10 rad/sec
(4) $\sqrt{20} rad/sec$

C-6 The formula for centripetal acceleration in a circular motion is.
(1) $\vec{\alpha} \times \vec{r}$ (2) $\vec{\omega} \times \vec{v}$ (3) $\vec{\alpha} \times \vec{v}$ (4) $\vec{\omega} \times \vec{r}$

C-7 A stone of mass of 16 kg is attached to a string 144 m long and is whirled in a horizontal smooth surface. The maximum tension the string can withstand is 16 newton. The maximum speed of revolution of the stone without breaking it, will be :
(1) $20\ ms^{-1}$ (2) $16\ ms^{-1}$ (3) $14\ ms^{-1}$ (4) $12\ ms^{-1}$

C-8 A mass is supported on a frictionless horizontal surface. It is attached to a string and rotates about a fixed centre at an angular velocity ω_0. If the length of the string and angular velocity are doubled, the tension in the string which was initially T_0 is now -
(1) T_0 (2) $T_0/2$ (3) $4T_0$ (4) $8T_0$

Section (D) : Radius of curvature

D-1 A particle of mass m is moving with constant velocity on smooth horizontal surface. A constant force starts acting on particle perpendicular to velocity v. Radius of curvature after force F start acting is :
(1) $\frac{mv^2}{F}$ (2) $\frac{mv^2}{F\cos\theta}$ (3) $\frac{mv^2}{F\sin\theta}$ (4) none of these

D-2 If the radii of circular paths of two particles of same masses are in the ratio of 1 : 2, then in order to have same centripetal force, their speeds should be in the ratio of :
(1) 1 : 4 (2) 4 : 1 (3) $1 : \sqrt{2}$ (4) $\sqrt{2} : 1$

D-3 A stone is projected with speed u and angle of projection is θ. Find radius of curvature at t = 0.
(1) $\frac{u^2\cos^2\theta}{g}$ (2) $\frac{u^2}{g\sin\theta}$ (3) $\frac{u^2}{g\cos\theta}$ (4) $\frac{u^2\sin^2\theta}{g}$

Section (E) : Circular motion in vertical plane :

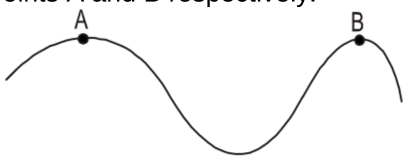
E-1 A motorcycle is going on an overbridge of radius R. The driver maintains a constant speed. As the motorcycle is ascending on the overbridge, the normal force on it :
(1) increase (2) decreases
(3) remains constant (4) first increases then decreases.

E-2 In a circus, stuntman rides a motorbike in a circular track of radius R in the vertical plane. The minimum speed at highest point of track will be :
(1) $\sqrt{2gR}$ (2) 2gR (3) $\sqrt{3gR}$ (4) $\sqrt{gR}$

E-3 A particle is moving in a vertical circle. The tensions in the string when passing through two positions at angles 30° and 60° from vertical (lowest positions) are T_1 and T_2 respectively. Then
(1) $T_1 = T_2$
(2) $T_2 > T_1$
(3) $T_1 > T_2$
(4) Tension in the string always remains the same

E-4 A stone tied to a string is rotated in a vertical plane. If mass of the stone is m, the length of the string is r and the linear speed of the stone is v when the stone is at its lowest point, then the tension in the string at the lowest point will be :
(1) $\frac{mv^2}{r} + mg$ (2) $\frac{mv^2}{r} - mg$ (3) $\frac{mv^2}{r}$ (4) mg

E-5✍ A car moves at a constant speed on a road as shown in figure. The normal force by the road on the car is N_A and N_B when it is at the points A and B respectively.



(1) $N_A = N_B$ (2) $N_A > N_B$ (3) $N_A < N_B$ (4) insufficient

E-6 A mass m is revolving in a vertical circle at the end of a string of length 20 cm. By how much times does the tension of the string at the lowest point exceed the tension at the topmost point -
(1) 2 mg (2) 4 mg (3) 6 mg (4) 8 mg

E-7 A body is suspended from a smooth horizontal nail by a string of length 0.25 metre. What minimum horizontal velocity should be given to it in the lowest position so that it may move in a complete vertical circle with the nail at the centre ?
(1) $\sqrt{12.25}$ ms^{-1} (2) 4.9 ms^{-1} (3) $7\sqrt{2}$ ms^{-1} (4) $\sqrt{9.8}$ ms^{-1}

E-8 The tension in the string revolving in a vertical circle with a mass m at the end when it is at the lowest position.
(1) $\frac{mv^2}{r}$ (2) $\frac{mv^2}{r} - mg$ (3) $\frac{mv^2}{r} + mg$ (4) mg

Section (F):Motion of a vehicle, Centrifugal force and rotation of earth

F-1 A car moving on a horizontal road may be thrown out of the road in taking a turn :
(1) By the gravitational force
(2) Due to lack of sufficient centripetal force
(3) Due to friction between road and the tyre
(4) Due to reaction of earth

F-2 Centrifugal force is an inertial force when considered by -
(1) An observer at the centre of circular motion
(2) An outside observer
(3) An observer who is moving with the particle which is experiencing the force
(4) none of the above

F-3✍ Water in a bucket is whirled in a vertical circle with a string attached to it.The water does not fall down even when the bucket is inverted at the top of its path. We conclude that in this position.
(1) mg = $\frac{mv^2}{r}$ (2) mg is greater than $\frac{mv^2}{r}$
(3) mg is not greater than $\frac{mv^2}{r}$ (4) mg is not less than $\frac{mv^2}{r}$

F-4 A train A runs from east to west and another train B of the same mass runs from west to east at the same speed along the equator. A presses the track with a force F_1 and B presses the track with a force F_2.
(1) $F_1 > F_2$
(2) $F_1 < F_2$
(3) $F_1 = F_2$
(4) the information is insufficient to find the relation between F_1 and F_2.

F-5.✍ A cyclist is moving on a circular track of radius 80 m with a velocity of 72 km/hr. He has to lean from the vertical approximately through an angle -
(1) $\tan^{-1}(1/4)$ (2) $\tan^{-1}(1)$ (3) $\tan^{-1}(1/2)$ (4) $\tan^{-1}(2)$

F-6 A car of mass m is taking a circular turn of radius 'r' on a fictional level road with a speed v. In order that the car does not skid -
(1) $\frac{mv^2}{r} \geq \mu mg$ (2) $\frac{mv^2}{r} \leq \mu mg$ (3) $\frac{mv^2}{r} = \mu mg$ (4) $\frac{v}{r} = \mu mg$

Exercise-2

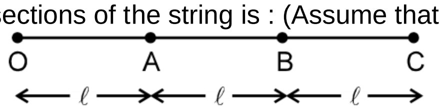
✍ **Marked Questions can the used as Revision Questions.**

PART - I : OBJECTIVE QUESTIONS

1. The velocity and acceleration vectors of a particle undergoing circular motion are $\vec{v} = 2\hat{i}$ m/s and $\vec{a} = 2\hat{i} + 4\hat{j}$ m/s² respectively at an instant of time. The radius of the circle is
(1) 1m (2) 2m (3) 3m (4) 4m

2.✍ A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2rt^2$ where k is a constant. The power delivered to the particle by the force acting on it is-
(1) $2\pi mk^2r^2$ (2) mk^2r^2t (3) $\frac{(mk^4r^2t^5)}{3}$ (4) Zero

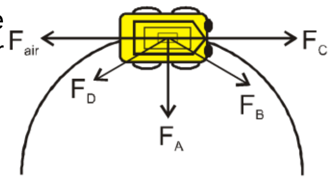
3. Three identical particles are joined together by a thread as shown in figure. All the three particles are moving on a smooth horizontal plane about point O. If the speed of the outermost particle is v_0, then the ratio of tensions in the three sections of the string is : (Assume that the string remains straight)



(1) 3 : 5 : 7 (2) 3 : 4 : 5 (3) 7 : 11 : 6 (4) 3 : 5 : 6

4. A Toy cart attached to the end of an unstretched string of length a, when revolved moves on a smooth horizontal table in a circle of radius 2a with a time period T. Now the toy cart is speeded up until it moves in a circle of radius 3a with a period T'. If Hook's law holds then (Assume no friction) :
(1) $T' = \sqrt{\frac{3}{2}}\,T$ (2) $T' = \left(\frac{\sqrt{3}}{2}\right)T$ (3) $T' = \left(\frac{3}{2}\right)T$ (4) $T' = T$

5.✍ A car travels with constant speed on a circular road on level ground. In the figure shown, F_{air} is the force of air resistance on the car. Which of the other forces best represents the horizontal force of the road on the car's tires ?

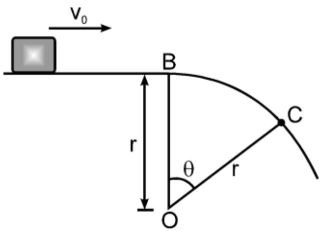


(1) F_A (2) F_B
(3) F_C (4) F_D

6.✍ A particle is projected horizontally from the top of a tower with a velocity v_0. If v be its velocity at any instant, then the radius of curvature of the path of the particle at that instant is directly proportional to:

(1) v^3 (2) v^2 (3) v (4) 1/v

7. A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the Figure. The block leaves the surface at point C. The angle θ in the Figure is :



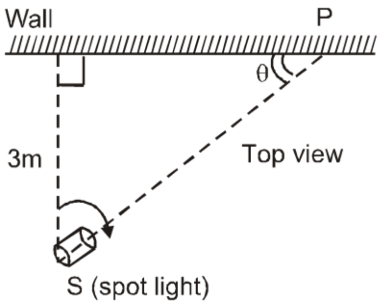
(1) $\cos^{-1}(4/9)$

(2) $\cos^{-1}(3/4)$

(3) $\cos^{-1}(1/2)$

(4) none of the above

8. A spot light S rotates in a horizontal plane with a constant angular velocity of 0.1 rad/s. The spot of light P moves along the wall at a distance 3 m. What is the velocity of the spot P when $\theta = 45^0$?



(1) 0.6 m/s

(2) 0.5 m/s

(3) 0.4 m/s

(4) 0.3 m/s

9. A particle moving on a circular path travels first one third part of circumference in 2 sec & next one third part in 1 sec. Average angular velocity of the particle is (in rad/sec) -

(1) $\frac{2\pi}{3}$ (2) $\frac{\pi}{3}$ (3) $\frac{4\pi}{9}$ (4) $\frac{5\pi}{3}$

10. A grind-stone starts revolving from rest, if its angular acceleration is 4.0 rad/sec^2 (uniform) then after 4 sec.What is its angular displacement & angular velocity respectively -

(1) 32 rad, 16 rad/sec (2) 16 rad, 32 rad/sec

(3) 64 rad, 32 rad/sec (4) 32 rad, 64 rad/sec

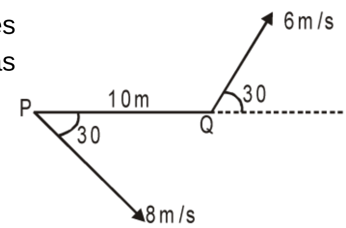
11. Angular displacement of any particle is given $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ where ω_0 & α are constant if $\omega_0 = 1$ rad/sec, $\alpha = 1.5$ rad/sec^2 then in t = 2 sec. angular velocity will be (in rad/sec)

(1) 1 (2) 5 (3) 3 (4) 4

12. A particle P is moving at constant speed V in a circular path of radius a. C is the centre of circle, AP is diameter then ratio of angular speed of particle P with respect to A and C -

(1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) 4 : 1

13. Two particles P and Q are at a distance of 10 m at any moment. Velocitites of P & Q are 8 m/s respectively. They make an angle of 30º with line PQ as shown in fig. Angular velocity of P with respect to Q will be-



(1) 0 rad/s

(2) 0.1 rad/s

(3) 0.4 rad/s

(4) 0.7 rad/s

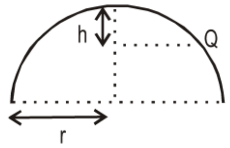
14. A stone of 1 kg tied up with 10/3 metre long string rotated in a vertical circle. If the ratio of maximum & minimum tension in string is 4 then speed of stone at heighest point of circular path will be -
(g = 10 m/s^2)

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

15. If mass, speed & radius of rotation of a body moving on a circular path are increased by 50% then to keep the body moving in circular path increase in force required will be -

(1) 225% (2) 125% (3) 150% (4) 100%

16. A small body of mass m moves downwards from the semisphere of radius r it if leaves the semisphere at a point that is at a distance h below the vertex then –



(1) h = r (2) $h = \frac{r}{3}$

(3) $h = \frac{r}{2}$ (4) $h = \frac{2r}{3}$

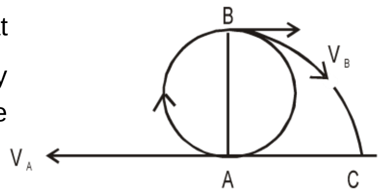
17. A gramophone recorder rotates at angular velocity of ω a coin is kept at a distance r from its centre. If μ is static friction constant then coil will rotate with gramophone if -

(1) $r > \mu g > \omega^2$ (2) $r = \mu g/\omega^2$ only (3) $r < \mu g/\omega^2$ (4) $r \le \mu g/\omega^2$

18. A heavy & big sphere is hang with a string of length ℓ, this sphere moves in a horizontal circular path making an angle θ with vertical then its time period is -

(1) $T = 2\pi\sqrt{\frac{\ell}{g}}$ (2) $T = 2\pi\sqrt{\frac{\ell\sin\theta}{g}}$ (3) $T = 2\pi\sqrt{\frac{\ell\cos\theta}{g}}$ (4) $T = 2\pi\sqrt{\frac{\ell}{g\cos\theta}}$

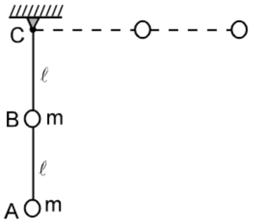
19. A body is tied up by a string of length ℓ and rotated in vertical circle at minimum speed. When it reaches at highest point string breaks and body moves on a parabolic path in presence of gravity according to fig. In the plane of point A, value of horizontal range AC will be –



(1) $x = \ell$ (2) $x = 2\ell$

(3) $x = \sqrt{2\ell}$ (4) $x = 2\sqrt{2}\,\ell$

20. A weightless rod of length 2ℓ carries two equal masses 'm', one tied at lower end A and the other at the middle of the rod at B. The rod can rotate in vertical plane about a fixed horizontal axis passing through C. The rod is released from rest in horizontal position. The speed of the mass B at the instant rod, become vertical is :



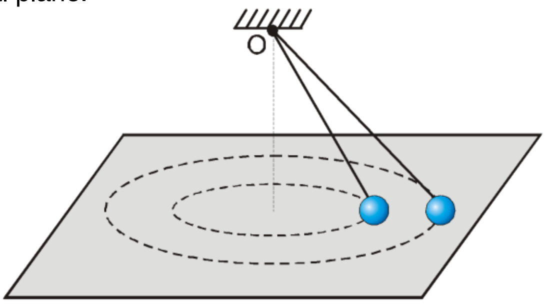
(1) $\sqrt{\frac{3g\ell}{5}}$ (2) $\sqrt{\frac{4g\ell}{5}}$

(3) $\sqrt{\frac{6g\ell}{5}}$ (4) $\sqrt{\frac{7g\ell}{5}}$

PART - II : MISCELLANEOUS QUESTIONS

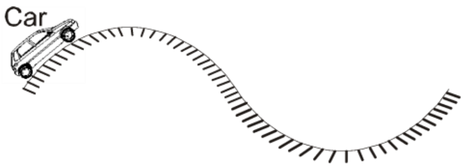
Section (A) : Assertion/Reasoning

A-1. **STATEMENT-1 :** Two small spheres are suspended from same point O on roof with strings of different lengths. Both spheres move along horizontal circles as shown. Then both spheres may move along circles in same horizontal plane.



STATEMENT-2 : For both spheres in statement-1 to move in circular paths in same horizontal plane, their angular speeds must be same.
(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True
(5) Both statements are false

A-2. **STATEMENT-1 :** A car moves along a road with uniform speed. The path of car lies in vertical plane and is shown in figure.The radius of curvature(R) of the path is same everywhere. If the car does not loose contact with road at the highest point, it will travel the shown path without loosing contact with road anywhere else.



STATEMENT-2 : For car to loose contact with road, the normal reaction between car and road should be zero.
(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True
(5) Both statements are false

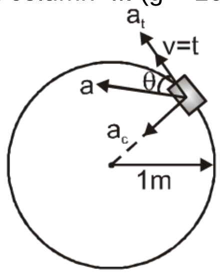
A-3. **STATEMENT-1 :** A ball tied by thread is undergoing circular motion (of radius R) in a vertical plane. (Thread always remains in vertical plane). The difference of maximum and minimum tension in thread is independent of speed (u) of ball at the lowest position (u > $\sqrt{5gR}$)
STATEMENT-2 : For a ball of mass m tied by thread undergoing vertical circular motion (of radius R), difference in maximum and minimum magnitude of kinetic energy of the ball is independent of speed (u) of ball at the lowest position (u > $\sqrt{5gR}$).
(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True
(5) Both statements are false

A-4. **STATEMENT-1 :** When a particle is projected at some angle (≠ 90º) with horizontal, the radius of curvature of its path during the ascent decreases continuously.
STATEMENT-2 : The radius of curvature is the ratio of square of magnitude of the velocity and the acceleration at that point.

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True
(5) Both statements are false

Section (B) : Match the Column

B-1 A toy car is moving on a circular track of of radius 1m. Speed of the car is given by v = t m/s. Mass of the car is $\sqrt{2}$ kg. Match the column–I with column–II. (g = 10 m/s2)



Column–I	**Column–II**
(1) Time (in sec.) at which resultant acceleration makes an angle of $\theta = \frac{\pi}{4}$ radian–with tangential acceleration	(p) $\frac{1}{\sqrt{10}}$
(2) Rate of change of angle θ (shown in figure) at above instant (in rad/sec.) is.	(q) 2
(3) Friction force acting on the car at above instant (in newton)	(r) 1
(4) If car starts sliding at t = $\sqrt{3}$ sec. then coefficient of friction is	(s) $\sqrt{10}$
	(t) $\sqrt{2}$

Section (C) : One or More Than One Options Correct

C-1. Which of the following quantities may remain constant during the motion of an object along a curved path :
(1) speed (2) velocity (3) acceleration (4) magnitude of acceleration

C-2. Assuming the motion of Earth around the Sun as a circular orbit with a constant speed of 30 km/s.
(1) The average velocity of the earth during a period of 1 year is zero
(2) The average speed of the earth during a period of 1 year is zero.
(3) The average acceleration during first 6 monts of the year is zero
(4) The instantaneous acceleration of the earth points towards the Sun.

Exercise-3

✍ **Marked Questions can be used as Revision Questions.**

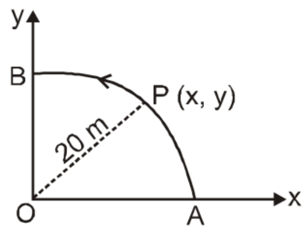
PART - I : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. The maximum velocity (in ms^{-1}) with which a car driver can traverse a flat curve of radius 150 m and cofficient of friction 0.6 to avoid skidding is : **[AIEEE-2002, 4/300]**
(1) 60 (2) 30 (3) 15 (4) 25

2. Which of the following statements is false for a particle moving in a circle with a constant angular speed ? **[AIEEE - 2004, 4/300]**
(1) The velocity vector is tangent to the circle
(2) The acceleration vector is tangent to the circle
(3) The acceleration vector point to the center of the circle
(4) The velocity and acceleration vectors are perpendicular to each other

3. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane, it follows that
[AIEEE - 2004, 4/300]
(1) its velocity is constant (2) its acceleration is constant
(3) its kinetic energy is constant (4) it moves in a straight line

4. A point P moves in counter-clockwise direction on a circular path as shown in the figure. The movement of 'P' is such that it sweeps out a length $s = t^3 + 5$, where s is in metres and t is in seconds. The radius of the path is 20 m. The acceleration of 'P' when t = 2 s is nearly.
[AIEEE - 2010, 4/144]
(1) 13 m/s^2 (2) 12 m/s^2
(3) 7.2 m/s^2 (4) 14 m/s^2

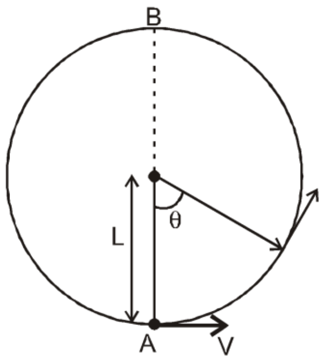


5. For a particle in uniform circular motion, the acceleration $\vec{a}$ at a point P (R, θ) on the circle of radius R is (Here θ is measured from the x-axis) **[AIEEE - 2010, 4/144]**
(1) $-\frac{v^2}{R}\cos\theta\,\hat{i} + \frac{v^2}{R}\sin\theta\,\hat{j}$ (2) $-\frac{v^2}{R}\sin\theta\,\hat{i} + \frac{v^2}{R}\cos\theta\,\hat{j}$
(3) $-\frac{v^2}{R}\cos\theta\,\hat{i} - \frac{v^2}{R}\sin\theta\,\hat{j}$ (4) $\frac{v^2}{R}\hat{i} + \frac{v^2}{R}\hat{j}$

6. Two cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2, respectively. Their speeds are such that they make complete circles in the same time t. The ratio of their centripetal acceleration is :
[AIEEE 2012 ; 4/120, –1]
(1) $m_1 r_1 : m_2 r_2$ (2) $m_1 : m_2$ (3) $r_1 : r_2$ (4) 1 : 1

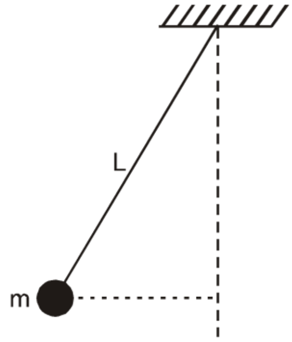
PART - II : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. A bob of mass M is suspended by a massless string of length L. The horizontal velocity V at position A is just sufficient to make it reach the point B. The angle θ at which the speed of the bob is half of that at A, satisfies
Figure : **[JEE 2008, 3/163]**
(A) $\theta = \frac{\pi}{4}$ (B) $\frac{\pi}{4} < \theta < \frac{\pi}{2}$
(C) $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$ (D) $\frac{3\pi}{4} < \theta < \pi$



2. A ball of mass (m) 0.5 kg is attached to the end of a string having length (L) 0.5 m. The ball is rotated on a horizontal circular path about vertical axis. The maximum tension that the string can bear is 324 N. The maximum possible value of angular velocity of ball (in radian/s) is :

[JEE 2011, 3/160, –1]

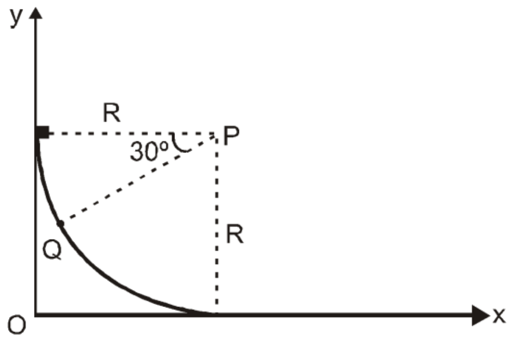


(A) 9
(B) 18
(C) 27
(D) 36

Comprehension

A small block of mass 1kg is released from rest at the top of a rough track. The track is a circular arc of radius 40m. The block slides along the track without toppling and a frictional force acts on it in the direction opposite to the instantaneous velocity. The work done in overcoming the friction up to the point Q, as shown in the figure below, is 150 J. (Take the acceleration due to gravity, g = 10 m s^{-2})

[JEE (Advanced)_2013]



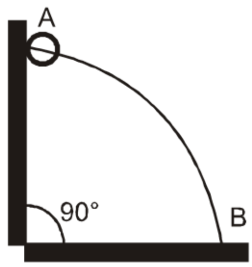
3. The speed of the block when it reaches the point Q is:

(A) 5 ms^{-1} (B) 10 ms^{-1} (C) $10\sqrt{3}$ ms^{-1} (D) 20 ms^{-1}

4. The magnitude of the normal reaction that acts on the block at the point Q is:

(A) 7.5 N (B) 8.6 N (C) 11.5 N (D) 22.5 N

5. A wire, which passes through the hole is a small bead, is bent in the form of quarter of a circle. The wire is fixed vertically on ground as shown in the figure. The bead is released from near the top of the wire and it slides along the wire without friction. As the bead moves from A to B, the force it applies on the wire is **[JEE (Advanced)-2014, 3/60, –1]**



(A) always radially outwards
(B) always radially inwards
(C) radially outwards initially and radially inwards later
(D) radially inwards initially and radially outwards later.

Answers

EXERCISE-1

Section (A)

A-1.	(3)	**A-2**	(3)	**A-3**	(4)
A-4	(1)	**A-5**	(1)	**A-6**	(3)
A-7	(4)	**A-8**	(1)		

Section (B)

B-1	(3)	**B-2**	(3)	**B-3**	(1)
B-4	(4)	**B-5**	(3)	**B-6**	(2)

Section (C)

C-1	(1)	**C-2**	(4)	**C-3**	(2)
C-4	(2)	**C-5**	(1)	**C-6**	(2)
C-7	(4)	**C-8**	(4)		

Section (D)

D-1	(1)	**D-2**	(3)	**D-3**	(3)

Section (E)

E-1	(1)	**E-2**	(4)	**E-3**	(3)
E-4	(1)	**E-5**	(2)	**E-6**	(3)
E-7	(1)	**E-8**	(3)		

Section (F)

F-1	(2)	**F-2**	(3)	**F-3**	(3)
F-4	(1)	**F-5.**	(3)	**F-6**	(2)

EXERCISE-2

PART - I

1.	(1)	**2.**	(2)	**3.**	(4)
4.	(2)	**5.**	(2)	**6.**	(1)
7.	(2)	**8.**	(1)	**9.**	(3)
10.	(1)	**11.**	(4)	**12.**	(2)
13.	(4)	**14.**	(4)	**15.**	(2)
16.	(2)	**17.**	(4)	**18.**	(3)
19.	(2)	**20.**	(3)		

PART - II

Section (A)

A-1.	(1)	**A-2.**	(4)	**A-3.**	(1)
A-4.	(3)				

Section (B)

B-1 (1 → r) ; (2 → r) ; (3 → q) ; (4 → p)

Section (C)

C-1. (1,3,4) **C-2.** (1,4)

EXERCISE-3

PART - I

1.	(2)	**2.**	(2)	**3.**	(3)
4.	(4)	**5.**	(3)	**6.**	(3)

PART - II

1.	(D)	**2.**	(D)	**3.**	(B)
4.	(A)	**5.**	(D)		