KINEMATICS OF CIRCULAR MOTION

1. A particle of mass 'm' describes a circle of radius (r). The centripetal acceleration of the particle is $\frac{4}{r^2}$. The momentum of the particle :-

(1) $\frac{2m}{r}$ (2) $\frac{2m}{\sqrt{r}}$ (3) $\frac{4m}{r}$ (4) $\frac{4m}{\sqrt{r}}$

2. A particle is moving around a circular path with uniform angular speed (ω). The radius of the circular path is (r). The acceleration of the particle is :-

(1) $\frac{\omega^2}{r}$ (2) $\frac{\omega}{r}$ (3) vω (4) vr

3. A car moves on a circular road, describing equal angles about the centre in equal intervals of times. Which of the statements about the velocity of car is true :-

(1) velocity is constant

(2) magnitude of velocity is constant but the direction of velocity change

(3) both magnitude and direction of velocity change

(4) velocity is directed towards the centre of circle

4. An insect trapped in a circular groove of radius 12 cm moves along the groove steadily and completes 7 revolutions in 100 s. What is the linear speed of the motion :-

(1) 2.3 cm/s (2) 5.3 cm/s (3) 0.44 cm/s (4) none of these

5. A particle moves in a circle of the radius 25 cm at two revolutions per second. The acceleration of the particle in m/sec^2 is :-

(1) π^2 (2) $8\pi^2$ (3) $4\pi^2$ (4) $2\pi^2$

6. A particle moves in a circle describing equal angle in equal times, its velocity vector :-

(1) remains constant (2) change in magnitude

(3) change in direction (4) changes in magnitude and direction

7. A mass of 2 kg is whirled in a horizontal circle by means of a string at an initial speed of 5 r.p.m. Keeping the radius constant the tension in the string is doubled. The new speed is nearly :-

(1) 7 r.p.m. (2) 14 r.p.m. (3) 10 r.p.m. (4) 20 r.p.m.

8. A particle moving along a circular path. The angular velocity, linear velocity, angular acceleration and centripetal acceleration of the particle at any instant respectively are & $\vec{\omega}, \vec{v}, \vec{\alpha}, \vec{a}_c$. Which of the following relation is/are correct :-

(a) $\vec{\omega} \perp \vec{v}$ (b) $\vec{\omega} \perp \vec{\alpha}$ (c) $\vec{v} \perp \vec{a}_c$ (d) $\vec{\omega} \perp \vec{a}_c$

(1) a, b, d (2) b, c, d (3) a, b, c , (4) a, c, d

9. 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 :-

(1) its velocity is constant (2) its K.E. is constant

(3) its acceleration is constant (4) it moves in a straight line

10. If the equation for the displacement of a particle moving on a circular path is given by $(\theta) = 2t^3 + 0.5$, where θ is in radians and t in seconds, then the angular velocity of the particle after 2 s from its start is :-

(1) 8 rad/s (2) 12 rad/s (3) 24 rad/s (4) 36 rad/s

11. A sphere of mass m Is tied to end of sting of length λ and rotated through the other end along a horizontal circular path with speed v. The work done in full horizontal circle is :-

(1) 0 (2) $\left(\frac{mv^2}{l}\right).2\pi l$ (3) $mg.2\pi\lambda$ (4) $\left(\frac{mv^2}{l}\right).l$

12. A body moves with constant angular velocity on a circle. Magnitude of angular acceleration :-

(1) $r\omega^2$ (2) Constant (3) Zero (4) None of the above

13. A particle of mass (m) revolving in horizontal circle of radius(R) with uniform speed v. When particle goes from one end to other end of diameter, then :-

(1) K.E. changes by $\frac{1}{2}mv^2$ (2) K.E. change by mv^2

(3) no change in momentum (4) change in momentum is 2 mv

14. A stone is tied to one end of string 50 cm long and is whirled in a horizontal circle with constant speed. If the stone makes 10 revolutions in 20 s, then what is the magnitude of acceleration of the stone :-

(1) 493 cm/s^2 (2) 720 cm/s^2 (3) 860 cm/s^2 (4) 990 cm/s^2

15. For a particle in a non-uniform accelerated circular motion:-

(1) velocity is radial and acceleration is transverse only

(2) velocity is transverse and acceleration is radial only

(3) velocity is radial and acceleration has both radial and transverse components

(4) velocity is transverse and acceleration has both radial and transverse components

16. The angular Velocity of a particle rotating in a circular orbit 100 times per minute is

(1) 1.66 rad / s (2) 10.47 rad / s (3) 10.47 degree / s (4) 60 degree / s

17. Two particles having mass 'M' and 'm' are moving in a circular path having radius R and r. If their time period are same then the ratio of angular velocity will be:-

(1) $\frac{r}{R}$ (2) $\frac{R}{r}$ (3) 1 (4) $\sqrt{\frac{R}{r}}$

18. Angular velocity of minute hand of a clock is :-

(1) $\frac{\pi}{30}$ rad/s (2) 8π rad/s (3) $\frac{2\pi}{1800}$ rad/s (4) $\frac{\pi}{1800}$ rad/s

19. A car moving with speed 30 m/s on a circular path of radius 500 m. Its speed is increasing at the rate of $2m/s^2$. The acceleration of the car is:-

(1) 9.8 m/s^2 (2) 1.8 m/s^2 (3) 2 m/s^2 (4) 2.7 m/s^2

20. If a particle is rotating uniformly in a horizontal circle, then-
(1) no force is acting on particle (2) velocity of particle is constant
(3) particle has no acceleration (4) no work is done

21. A body of mass 1 kg tied to one end of string is revolved in a horizontal circle of radius 0.1 m with a speed of 3 revolution/sec, assuming the effect of gravity is negligible, then linear velocity, acceleration and tension in the string will be :-
(1) 1.88 m/s, 35.5 m/s^2, 35.5 N (2) 2.88 m/s, 45.5 m/s^2, 45.5 N
(3) 3.88 m/s, 55.5 m/s^2, 55.5 N (4) None of these

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

23. The angular velocity of a wheel is 70 rad/s. If the radius of the wheel is 0.5 m, then linear velocity of the wheel is :.-
(1) 70 m/s (2) 35 m/s (3) 30 m/s (4) 20 m/s

24. A stone tied to the end of a string of 1m long is whirled in a horizontal circle with a constant speed. If the stone makes 22 revolution in 44 seconds, what is the magnitude and direction of acceleration of the stone :-
(1) π^2 m/s^2 and direction along the tangent to the circle.
(2) π^2 m/s^2 and direction along the radius towards the centre.
(3) $\frac{\pi^2}{4}$ m/s^2 and direction along the radius towards the centre.
(4) π^2 m/s^2 and direction along the radius away from the centre.

24. A fly wheel rotating at 600 rev/min is brought under uniform deceleration and stopped after 2 minutes, then what is angular deceleration in rad/sec^2 ?
(1) $\frac{\pi}{6}$ (2) 10 π (3) $\frac{1}{12}$ (4) 300

25. The linear and angular acceleration of a particle are 10 m/s^2 and 5 rad/s^2 respectively. It will be at a distance from the axis of rotation.
(1) 50 m (2) $\frac{1}{2}$m (3) 1 m (4) 2 m

DYNAMICS OF HORIZONTAL CIRCULAR MOTION

27. The angular acceleration of particle moving along a circular path with uniform speed :-
(1) uniform but non zero (2) zero
(3) variable (4) as can1not be predicted from given information

28. If the speed and radius both are tripled for a body moving on a circular path, then the new centripetal force will be :-
(1) Doubled of previous value (2) Equal to previous value
(3) Triple of previous value (4) One third of previous value

29. When a body moves with a constant speed along a circle :-
(1) no acceleration is present in the body (2) no force act on the body
(3) its velocity remains constant (4) no work gets done on it

30. A pendulum is suspended from the roof of a rail road car. When the car is moving on a circular track the pendulum inclines :
(1) Forward (2) Backward
(3) Towards the centre of the path (4) Away from the centre of the path

31. A string of length 0.1 m cannot bear a tension more than 100N. It is tied to a body of mass 100g and rotated in a horizontal circle, The maximum angular velocity can be -
(1) 100 rad/s (2) 1000 rad/s (3) 10000 rad/s (4) 0.1 rad/s

32. The radius of the circular path of a particle is doubled but its frequency of rotation is kept constant. If the initial centripetal force be F, then the final value of centripetal force will be :-
(1) F (2) $\frac{F}{2}$ (3) 4F (4) 2F

33. A 0.5 kg ball moves in a circle of radius 0.4 m at a speed of 4 m/s. The centripetal force on the ball is :-
(1) 10 N (2) 20 N (3) 40 N (4) 80 N

34. A body is revolving with a constant speed along a circle. If its direction of motion is reversed but the speed remains the same then :-
(a) the centripetal force will not suffer any change in magnitude
(b) the centripetal force will have its direction reversed
(c) the centripetal force will not suffer any change in direction
(d) the centripetal force is doubled
(1) a, b (2) b, c (3) c, d (4) a, c

35. a_r and a_t represent radial and tangential acceleration. The motion of a particle will be uniform circular motion, if :-
(1) $a_r = 0$ and $a_t = 0$ (2) $a_r = 0$ but $a_t \neq 0$ (3) $a_r \neq 0$ but $a_t = 0$ (4) $a_r \neq 0$ and $a_t \neq 0$

36. In uniform circular motion, the velocity vector and acceleration vector are
(1) Perpendicular to each other (2) Same direction
(3) Opposite direction (4) Not related to each other

37. A string of length 10 cm breaks if its tension exceeds 10 newton. A stone of mass 250 g tied to this string, is rotated in a horizontal circle. The maximum angular velocity of rotation can be:-
(1) 20 rad/s (2) 40 rad/s (3) 100 rad/s (4) 200 rad/s

38. The earth ($M_e = 6 \times 10^{24}$ kg) is revolving round the sun in an orbit of radius (1.5×10^8) km with angular velocity of (2×10^{-7}) rad/s. The force (in newton) exerted on the earth by the sun will be:
(1) 36×10^{21} (2) 16×10^{24} (3) 25×10^{16} (4) Zero

39. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/hr. The centripetal force is:
(1) 250 N (2) 1000 N (3) 750 N (4) 1200 N

40. A motor cycle driver doubles its velocity when he is taking a turn. The force exerted towards the centre will become:-
(1) double (2) half (3) 4 times (4) $\frac{1}{4}$ times

41. The force required to keep a body in uniform circular motion is :-
(1) Centripetal force (2) Centrifugal force
(3) Resistance (4) None of the above

BANKING OF TRACKS

42. 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 proper centripetal force
(3) due to rolling friction between the tyres and the Road
(4) due to reaction of the road

43. Radius of the curved road on national highway is R. Width of the road is b. The outer edge of the road is raised by h with respect to inner edge so that a car with velocity can pass safely over it. The value of h is :-
(1) $\frac{v^2b}{Rg}$ (2) $\frac{v}{Rgb}$ (3) $\frac{v^2R}{bg}$ (4) $\frac{v^2b}{R}$

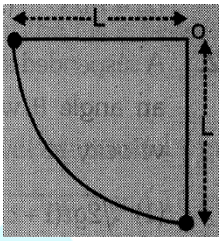
44. A boy holds a pendulum in his hand while standing at the edge of a circular platform of radius r rotating at an angular speed ω. The pendulum will hang at an angle θ with the vertical so that : (Neglect length of pendulum)
(1) $\tan\theta = 0$ (2) $\tan\theta = \frac{\omega^2 r^2}{g}$ (3) $\tan\theta = \frac{r\omega^2}{g}$ (4) $\tan\theta = \frac{g}{\omega^2 r}$

VERTICAL CIRCULAR MOTION

45. Let 'θ' denote the angular displacement of a simple pendulum oscillating in a vertical plane. If the mass of the bob is (m), then the tension in string is mg cosθ :-
(1) always (2) never
(3) at the extreme positions (4) at the mean position

46. A pendulum bob has a speed 3 m/s while passing through its lowest position, length of the pendulum is 0.5 m then its speed when it makes an angle of 60º with the vertical is :- ($g = 10$ m/s^2)
(1) 2 m/s (2) 1 m/s (3) 4 m/s (4) 3 m/s

47. The mass of the bob of a simple pendulum of length L is m. If the bob is left from its horizontal position then the speed of the bob and the tension in the thread in the lowest position of the bob will be respectively :-



(1) $\sqrt{2gL}$ and 3 mg (2) 3 mg and $\sqrt{2gL}$

(3) 2 mg and $\sqrt{2gL}$ (4) 2 gL and 3 mg

48. A stone of mass 1 kg is tied to the end of a string of 1 m length. It is whirled in a vertical circle. If the velocity of the stone at the top be 4 m/s. What is the tension in the string (at that instant) ?

(1) 6 N (2) 16 N (3) 5 N (4) 10 N

49. In a vertical circle of radius (r), at what point in its path a particle may have tension equal to zero:

(1) highest point
(2) lowest point
(3) at any point
(4) at a point horizontal from the centre of radius

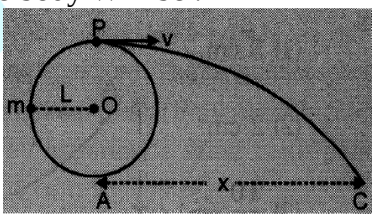
50. A stone attached to one end of a string is whirled in a vertical circle. The tension in the string is maximum when :-

(1) the string is horizontal
(2) the string is vertical with the stone at highest position
(3) the string is vertical with the stone at the lowest position
(4) the string makes an angle of 45º with the vertical

51. A weightless thread can with stand tension upto 30 N. A stone of mass 0.5 kg is tied to it and is revolved in a circular path of radius 2 m in a vertical plane. If g = 10 m/s^2, then the maximum angular velocity of the stone can be :-

(1) 5 rad/s (2) $\sqrt{30}$ rad/s (3) $\sqrt{60}$ rad/s (4) 10 rad/s

52. A body tied to a string of length L is revolved in a vertical circle with minimum velocity, when the body reaches the upper most point the string breaks and the body moves under the influence of the gravitational field of earth along a parabolic path.
The horizontal range AC of the body Will be :-



(1) x = L (2) x = 2L (3) x = $2\sqrt{2L}$ (4) x = $\sqrt{2L}$

53. A particle is moving in a vertical circle the tension in the string when passing through two position at angle 30° and 60° from vertical from lowest position are T_1 and T_2 respectively then:-

(1) $T_1 = T_2$ (2) $T_1 > T_2$ (3) $T_1 < T_2$ (4) $T_1 \geq T_2$

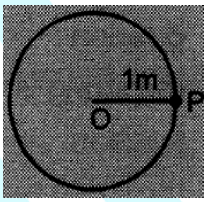
54. A body crosses the topmost point of a vertical circle with critical speed. What will be its centripetal acceleration when the string is horizontal :-

(1) g (2) 2g (3) 3g (4) 6g

55. Stone tied at one end of light string is whirled round a vertical circle. If the difference between the maximum and minimum tension experienced by the string wire 2 kg wt, then the mass of the stone must be :-

(1) 1 kg (2) 6 kg (3) l/3 kg (4) 2 kg

56. A mass tied to a sting moves in a vertical circle with a uniform speed of 5 m/s as shown. At the point P the string breaks. The mass will reach a height above P of nearly ($g = 10\ m/s^2$) :-



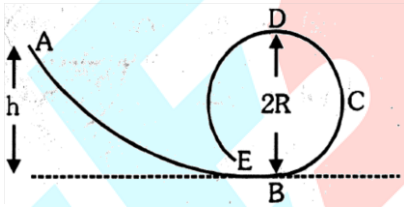
(1) 1 m (2) 0.5 m

(3) 1.75 m (4) 1.25 m

57. If the overbridge is concave instead of being convex, then the thrust on the road at the lowest position will be :-

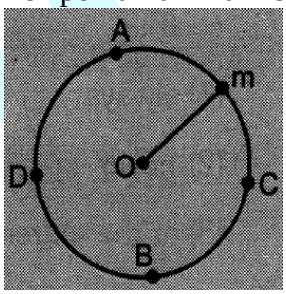
(1) $mg + \frac{mv^2}{r}$ (2) $mg - \frac{mv^2}{r}$ (3) $\frac{m^2v^2g}{r}$ (4) $\frac{v^2g}{r}$

58. A frictionless track ABCDE ends in a circular loop of radius R. A body slides down the track from point A which is at a height h = 5 cm. Maximum value of R for the body to successfully complete the loop is :-



(1) 5 cm. (2) 2 cm. (3) $\frac{10}{3}$ cm. (4) $\frac{15}{4}$

59. A particle of mass m is performing vertical circular motion (see figure). If the average speed of the particle is increases, then at which point maximum breaking possibility of the string :-



(1) A (2) B (3) C (4) D

ANSWER KEY

EXERCISE-I (Conceptual Questions)

1.	(2)	**2.**	(3)	**3.**	(2)	**4.**	(2)	**5.**	(3)	**6.**	(3)	**7.**	(1)
8.	(4)	**9.**	(2)	**10.**	(3)	**11.**	(1)	**12.**	(3)	**13.**	(4)	**14.**	(1)
15.	(4)	**16.**	(2)	**17.**	(3)	**18.**	(4)	**19.**	(4)	**20.**	(4)	**21.**	(1)
22.	(1)	**23.**	(2)	**24.**	(2)	**25.**	(1)	**26.**	(4)	**27.**	(2)	**28.**	(3)

29.	(4)	**30.**	(4)	**31.**	(1)	**32.**	(4)	**33.**	(2)	**34.**	(4)	**35.**	(3)
36.	(1)	**37.**	(1)	**38.**	(1)	**39.**	(2)	**40.**	(3)	**41.**	(1)	**42.**	(2)
43.	(1)	**44.**	(3)	**45.**	(3)	**46.**	(1)	**47.**	(1)	**48.**	(1)	**49.**	(1)
50.	(3)	**51.**	(1)	**52.**	(2)	**53.**	(2)	**54.**	(3)	**55.**	(3)	**56.**	(4)
57.	(1)	**58.**	(2)	**59.**	(2)	**60.**	(3)	**61.**	(2)	**62.**	(3)		