LEVEL # 1

Questions based on Equations of Circular motion

Q.1 A wheel is subjected to uniform angular acceleration about its axis. Initially its angular velocity is zero. In the first 2 sec, it rotates through an angle θ_1; in the next 2 sec, it rotates through an additional angle θ_2. The ratio of θ_2 / θ_1 is-

(A) 1 (B) 2 (C) 3 (D) 5

Q.2 The linear and angular acceleration of a particle are 10 m/sec^2 and 5 red/sec^2 respectively it will be at a distance from the axis of rotation -

(A) 50 m (B) 1/2 m
(C) 1 m (D) 2 m

Q.3 A grinding wheel attained a velocity of 20 rad/sec in 5 sec starting from rest. Find the number of revolutions made by the wheel.

(A) $\frac{\pi}{25}$ revolution per sec

(B) $\frac{1}{\pi}$ revolution per sec

(C) $\frac{25}{\pi}$ revolution

(D) None

Q.4 A wheel having a diameter of 3 m starts from rest and accelerates uniformly to an angular velocity of 210 r.p.m in 5 seconds. Angular acceleration of the wheel is -

(A) $1.4\pi \frac{rad}{s^2}$ (B) $3.3\pi \frac{rad}{s^2}$

(C) $2.2\pi \frac{rad}{s^2}$ (D) $1.1\pi \frac{rad}{s^2}$

Q.5 A wheel starts rotating at 10 rad/sec and attains the angular velocity of 100 rad/sec in 15 seconds. What is the angular acceleration in rad/sec^2?

(A) 10 (B) 110/15
(C) 100/15 (D) 6

Q.6 A wheel starts rotating from rest and attains an angular velocity of 60 rad/sec in 5 seconds. The total angular displacement in radians will be-

(A) 60 (B) 80 (C) 100 (D) 150

Q.7 A body rotates at 300 rotations per minute. The value in radian of the angle described in 1 sec is-

(A) 5 (B) 5π (C) 10 (D) 10π

Q.8 A chain couples and rotates two wheels in a bicycle. The radii of bigger and smaller wheels in a bicycle. The radii of bigger and smaller wheels are 0.5m and 0.1. respectively. The bigger wheel rotates at the rate of 200 rotations per minute, then the rate of rotation of smaller wheel will be -

(A) 1000 rpm (B) 50/3 rpm
(C) 200 rmp (D) 40 rpm

Q.9 If the position vector of a particle is $\hat{r} = (3\hat{i} + 4\hat{j})$ metre and its angular velocity is $\vec{\omega} = (\hat{j} + 2\hat{k})$ rad/sec then its linear velocity is (in m/s)-

(A) $-(8\hat{i} - 6\hat{j} + 3\hat{k})$ (B) $(3\hat{i} + 6\hat{j} + 8\hat{k})$

(C) $-(3\hat{i} + 6\hat{j} + 6\hat{k})$ (D) $(6\hat{i} + 8\hat{j} + 3\hat{k})$

Q.10 A car is moving with a speed of 72 Km/hour. The diameter of its wheels is 50cm. If its wheels come to rest after 20 rotations as a result of application of brakes, then the angular retardation produced in the car will be

(A) 25.5 Radians/sec^2 (B) 0.25 Radians/sec^2
(C) 2.55 Radians/sec^2 (D) 0

Q.11 A particle, situated in an object, moves with angular acceleration of 6 rad/sec^2 and with $2\sqrt{2}$ rad/sec angular velocity. If the radius of the circular path is 1m, its total acceleration in m/sec^2 will be :

(A) 1 (B) 100
(C) 10 (D) $\sqrt{10}$

Q.12 A particle starts from rest under the effect of an angular acceleration of 5 rad/sec^2. The value of angular displacement in 2 seconds in radian will be ?
(A) 10 (B) 20 (C) 20π (D) 50

Q.13 When a body rotates about an axis the quantity which remains same for all its particles, is-
(A) linear velocity (B) angular velocity
(C) linear acceleration (D) angular momentum

Q.14 A wheel of an engine executes 4800 revolutions per minute. Its angular velocity (in rad/sec) would be-
(A) 4800π (B) 2400π
(C) 160π (D) 80π

Q.15 A fan is rotating with a frequency 50Hz, its angular speed would be-
(A) 50π rad/sec (B) 200π rad/sec
(C) 100π rad/sec (D) $\left(\frac{100}{\pi}\right)$ rad/sec

Q.16 A particle moves by 1 cm in 1 sec in a path of radius 10cm. Its angular speed would be
(A) 10°/sec (B) 10 rad/sec
(C) 0.1 rad/sec (D) 1 rad/sec

Q.17 Two particles of masses m_1 and m_2 complete one revolution of respective radii r_1 and r_2 in same time. The ratio of their angular speeds would be -
(A) $m_1r_1^2 : m_2r_2^2$ (B) $r_1 : r_2$
(C) $r_2 : r_1$ (D) 1 : 1

Q.18 When a mass rotates about any axis, the direction of the angular velocity will be -
(A) towards radius
(B) towards the tangent to the orbit
(C) at an angle of 45° to the plane of rotation
(D) along the direction of axis of rotation

Q.19 If a rigid body a point rotates 60° in 6 minutes the angular velocity of the body is-
(A) 1/6 rad/sec (B) 3.14/18 rad/sec
(C) 3.14/180 × 6. (D) None of these

Q.20 A particle, moving along a circular path has equal magnitudes of linear and angular acceleration. The diameter of the path is (in metre) :
(A) 1 (B) π (C) 2 (D) 2π

Questions based on Uniform circular motion

Q.21 A tachometer is a device to measure -
(A) gravitational pull (B) speed of rotation
(C) surface tension (D) tension in a spring

Q.22 The ratio of angular speed of hours hand and seconds hand of a clock is-
(A) 1 : 1 (B) 1 : 60
(C) 1 : 720 (D) 3600 : 1

Q.23 The ratio of angular speeds of minutes hand and hour hand of a watch is -
(A) 1 : 12 (B) 6 : 1 (C) 12 : 1 (D) 1:6

Q.24 Two cars of masses m_1 and m_2 are moving along the circular path of radius r_1 and r_2. They take one round in the same time. The ratio of angular velocities of the two cars will be-
(A) $m_1 : m_2$ (B) $r_1 : r_2$
(C) 1 : 1 (D) $m_1 r_1 : m_2 r_2$

Q.25 The angular velocity of earth about its axis of rotation is-
(A) 2π / (60 × 60 × 24) rad/sec
(B) 2π / (60 × 60) rad/sec
(C) 2π / 60 rad/sec
(D) 2π / (365 × 24 × 60 × 60) rad/sec

Q.26 A particle rests on the top of a hemisphere of radius R. Find the smallest horizontal velocity that must be imparted to the particle if it is to leave the hemisphere without sliding down it-
(A) $\sqrt{gR}$ (B) $\sqrt{2gR}$
(C) $\sqrt{3gR}$ (D) $\sqrt{5gR}$

Q.27 In circular motion, the centripetal acceleration is given by-
(A) $\mathbf{a} \times \mathbf{r}$ (B) $\boldsymbol{\omega} \times \mathbf{v}$
(C) $\mathbf{a} \times \mathbf{v}$ (D) $\boldsymbol{\omega} \times \mathbf{r}$

Q.28 A particle moves in a circle of radius 25 cm at two revolutions per second. The acceleration of particle in m/s^2 is -
(A) π^2 (B) $8\pi^2$ (C) $4\pi^2$ (D) $2\pi^2$

Q.29 A particle moves in circular path with uniform speed v. The change in its velocity on rotating through 60^o is -
(A) $v\sqrt{2}$ (B) $\frac{v}{\sqrt{2}}$ (C) v (D) Zero

Q.30 Two bodies of masses 10 kg and 5 kg moving on concentric orbits of radii R and r such that their period of revolution are same. The ratio of their centripetal acceleration is -
(A) $\frac{R}{r}$ (B) $\frac{r}{R}$ (C) $\frac{R^2}{r^2}$ (D) $\frac{r^2}{R^2}$

Q.31 A particle is moving in a horizontal circle with constant speed. State whether, the-
(A) K.E. is constant
(B) P.E. is constant
(C) Both K.E. and P.E. are constant
(D) Neither K.E. nor P.E. are constant

Q.32 A stone of mass m is tied to a string of length l and rotated in a circle with a constant speed v. If the string is released, the stone flies-
(A) radially outward
(B) radially inward
(C) tangentially outward
(D) with an acceleration mv^2/l

Q.33 If a particle moves in a circle describing equal angles in equal interval of times, its velocity vector –
(A) remains constant
(B) changes in magnitude
(C) changes in direction
(D) changes both in magnitude and direction

Q.34 In uniform circular motion-
(A) both velocity and acceleration are constant
(B) acceleration and speed are constant but velocity changes
(C) both acceleration and velocity change
(D) both acceleration and speed are constant

Q.35 When a body moves with a constant speed along a circle-
(A) no work is done on it
(B) no acceleration is produced in the body
(C) no force acts on the body
(D) its velocity remains constant

Q.36 What happens to the centripetal acceleration of a revolving body if you double the orbital speed v and halve the angular velocity ω ?
(A) the centripetal acceleration remains unchanged
(B) the centripetal acceleration is halved
(C) the centripetal acceleration is doubled
(D) the centripetal acceleration is quadrupled

Q.37 A body of mass m is moving in a circle of radius r with a constant speed v. The force on the body is mv^2/r and u is directed towards the centre. What is the work done by this force in moving the body over half the circumference of the circle?
(A) $mv^2/r \times \pi r$ (B) zero
(C) mv^2/r (D) $\pi r^2/mv^2$

Q.38 Centrifugal force is considerd as pseudo force when
(A) An observer at the centre of circular motion
(B) An outside observe
(C) An observer who is moving with the particle which is experiencing the force
(D) None of the above

Q.39 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-
(A) 2 (B) 8 (C) 0.2 (D) 0.8

Q.40 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-

(A) $\sqrt{5}$ m/sec (B) $\sqrt{(50)}$ m/sec

(C) $\sqrt{(500)}$ m/sec (D) $\sqrt{(1000)}$ m/sec

Q.41 What happens to centripital force of a revolving body if you double the orbital speed v and halve the angular velocity ω-

(A) Centripetal force remains unchanged

(B) Centripital force is halved

(C) Centripital force is doubled

(D) Centripital force is quadrupled

Q.42 A body is moving with a constant speed v in a circle of radius r. Its angular acceleration is-

(A) Zero (B) $\frac{v}{r}$ (C) $\frac{v^2}{r^2}$ (D) $\frac{v^2}{r}$

Q.43 A body of mass 10 kg is rotated in vertical circle of radius 4 cm at constant angular velocity of 5 rad/ sec. The maximum tension in the string is-

(A) 100 N (B) 600 N

(C) 110 N (D) 1100 N

Q.44 If both the speed and radius of circular path of a revolving body are doubled, the magnitude of centripetal force will be-

(A) equal to the former

(B) twice the former

(C) 4 times the former

(D) 8 times the former

Q.45 A particle is moving along a circular path of radius 6 m with uniform speed of 8 ms^{-1}. The average acceleration when the particle completes one half of the revolution is -

(A) $\frac{16}{3\pi}$ m/s^2 (B) $\frac{32}{3\pi}$ m/s^2

(C) $\frac{64}{3\pi}$ m/s^2 (D) None of these

Q.46 A string of length 1 m is fixed at one end and carries a mass of 100 gm at the other end. The string makes $(2/\pi)$ revolutions per second around vertical axis through the fixed end. Calculate the tension in the string-

(A) 1.0 N (B) 1.6 N

(C) 2 N (D) 4 N

Q.47 When the road is dry and the coefficient of friction is μ, the maximum speed of a car in a circular path is 10 m/s, if the road becomes wet and $\mu' = \mu/2$. What is the maximum speed permitted ?

(A) 5 m/s (B) 10 m/s

(C) $10\sqrt{2}$ m/s (D) $5\sqrt{2}$ m/s

Q.48 A person with a mass of M kg stands in contact against the wall of the cylindrical drum of radius r rotating with an angular velocity ω. The coefficient of friction between the wall and the clothing is μ. The minimum rotational speed of the cylinder which enables the person to remain stuck to the wall when the floor is suddenly removed is -

(A) $\omega_{min} = \sqrt{\frac{g}{\mu r}}$ (B) $\omega_{min} = \sqrt{\frac{\mu r}{g}}$

(C) $\omega_{min} = \sqrt{\frac{2g}{\mu r}}$ (D) $\omega_{min} = \sqrt{\frac{gr}{\mu}}$

Q.49 A body is revolving with a uniform speed V in a circle of radius r. The angular acceleration of the body is -

(A) $\frac{V}{r}$

(B) Zero

(C) $\frac{V^2}{r}$ along the radius and towards the centre

(D) $\frac{V^2}{r}$ along the radius and away from the centre

Q.50 A particle completes 3 revolutions per second on a circular path of radius 8 cm. Find the values of angular velocity and centripetal acceleration of the particle -

(A) $6\pi \ \frac{rad}{s}$; $288\pi^2 \ \frac{cm}{s^2}$

(B) $\pi \ \frac{rad}{s}$; $275\pi^2 \ \frac{cm}{s^2}$

(C) $6\pi \ \frac{rad}{s}$; $288 \ \frac{cm}{s^2}$

(D) None

Q.51 A car of mass 1000 kg moves on a circular track of radius 20 m. if the coefficient of friction is 0.64, what is the maximum velocity with which the car can be moved?

(A) 1.12 m/s (B) 11.2 m/s

(C) $\frac{0.64\times 20}{1000}$ m/s (D) $\frac{1000}{0.64\times 20}$ m/s

Q.52 A stone of mass 0.1 kg tied to one end of a string 1.0 m long is revolved in a horizontal circle at the rate of $10/\pi$ revolution per second. Calculate the tension of the string ?

(A) 30 N (B) 40 N (C) 50 N (D) 60 N

Q.53 A coin placed on a rotating turn table just slips if it is at a distance of 40 cm from the centre if the angular velocity of the turntable is doubled, it will just slip at a distance of -

(A) 10 cm (B) 20 cm (C) 40 cm (D) 80 cm

Q.54 A stone of mass 0.5 kg tied with a string of length 1 m is moving in a circular path with a speed of 4 m/sec. The tension acting on the string in Newton is-

(A) 2 (B) 8 (C) 0.2 (D) 0.8

Q.55 A particle is acted upon by a constant force always normal to the direction of motion of the particle. It is therefore inferred that-

(a) Its velocity is constant

(b) It moves in a straight line

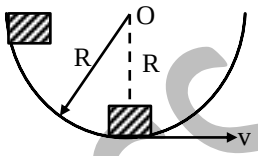
(c) Its speed is constant

(d) It moves in circular path

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

Questions based on Non uniform circular motion/Vertical circular motion

Q.56 A block of mass m slides down along the surface of the bowl from the rim to the bottom as shown in fig. The velocity of the block at the bottom will be-



(A) $\sqrt{\pi Rg}$ (B) $2\sqrt{\pi Rg}$

(C) $\sqrt{2Rg}$ (D) $\sqrt{gR}$

Q.57 A sphere is suspended by a thread of length l. What minimum horizontal velocity is to be imparted to the sphere for it to reach the height of suspension?

(A) $\sqrt{gl}$ (B) $g\,l$ (C) $\sqrt{2gl}$ (D) $\sqrt{l/g}$

Q.58 A body of mass 2 kg is moving in a vertical of radius 2 m. The work done when it moves from the lowest point to the highest point is-

(A) 80 J (B) 40 J (C) 20 J (D) 0

Q.59 A particle rests on the top of the hemisphere of radius R. The small horizontal velocity that must be imparted to the particle if it is to leave the hemisphere without sliding down. is-

(A) $v = (2gR)^{1/2}$ (B) $v = (gR/2)^{1/2}$

(C) $v = (gR)^{1/2}$ (D) $v = (2g/R)^{1/2}$

Q.60 A mass m is revolving in a vertical circle at the end of a string of length 20 cm. By how much does the tension of the string at the lowest point exceed the tension at the top most point?

(A) 2 m g (B) 4 m g (C) 6 m g (D) 8 m g

Q.61 A car is travelling with linear velocity v on a circular road of radius r. If it is increasing it speed at the rate of 'a' metre/sec^2, then the resultant acceleration will be-

(A) $\sqrt{\left(\frac{v^2}{r^2}-a^2\right)}$ (B) $\sqrt{\left(\frac{v^4}{r^2}+a^2\right)}$

(C) $\sqrt{\left(\frac{v^4}{r^2}-a^2\right)}$ (D) $\sqrt{\left(\frac{v^2}{r^2}+a^2\right)}$

Q.62 On an unbanked road, a cyclist negotiating a bend of radius r at velocity v must lean inwards by an angle θ equal to -
(A) $\tan^{-1}(v^2/g)$ (B) $\tan^{-1}(g/v)$
(C) $\tan^{-1}(v^2/gr)$ (D) $\tan^{-1}(rg/v^2)$

Q.63 A particle of mass m is rotating by means of a string in a vertical circle. The difference in the tension at the bottom and top would be-
(A) 6 mg (B) 4 mg (C) 3 mg (D) 2 mg

Q.64 A body of mass m crosses the top most point of a vertical circle with critical speed. What will be tension in string when it is horizontal-
(A) mg (B) 2 mg (C) 3 mg (D) 6 mg

Q.65 A motor - cycle is moving in a vertical circular path. At what stage will the speed of the motor cycle be maximum ?
(A) At the highest point of the path
(B) At the lowest point of the path
(C) At the mid height of the path
(D) At all the points in the path

Q.66 A string can bear a maximum tension of 100 Newton without breaking. A body of mass 1 kg is attached to one end of 1 m length of thin string and it is revolved in a horizontal plane. The maximum linear velocity which can be imparted to the body without breaking the string, will be -
(A) 10 m/s (B) 1 m/s
(C) 100 m/s (D) 1000 m/s

Q.67 A cane filled with water is revolved in a vertical circle of radius 4 metre and the water just does not fall down. The time period of revolution will be -
(A) 1 sec (B) 10 sec (C) 8 sec (D) 4 sec

Q.68 A 2 kg stone at the end of a string 1m long is whirled in a vertical circle at a constant speed. The speed of the stone is 4 m /sec. The tension in the string will be 52 N when the stone is-
(A) at the top of the circle
(B) at the bottom of the circle
(C) half way down
(D) none of the above

Q.69 The roadway of a bridge over a canal is in the form of a circular arc of radius 18 m. What is the greatest speed with which a motor cycle can cross the bridge without leaving ground.
(A) $\sqrt{98}$ m/s (B) $\sqrt{18\times9.8}$ m/s
(C) 18 × 9.8 m/s (D) 18 / 9.8 m/s

Q.70 The maximum speed with which a car can cross a convex bridge over a river with radius of curvature 9 m is : (given that the centre of gravity of car is 1m above the road)-
(A) 50 m/s (B) 30 m/s
(C) 20 m/s (D) 10 m/s

Q.71 A car is moving with speed 30 m/s on a circular path of radius 500 m. Its speed is increasing at the rate of 2 m/s^2. The net acceleration of the car is-
(A) 3.7 m/s^2 (B) 2.7 m/s^2
(C) 1.8 m/s^2 (D) 2 m/s

Questions based on Banking of roads

Q.72 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-
(A) $\tan^{-1}(1/4)$ (B) $\tan^{-1}(1)$
(C) $\tan^{-1}(1/2)$ (D) $\tan^{-1}(2)$

Q.73 Keeping the banking angle same to increase the maximum speed with which a vehicle can travel on a curved road by 10%, the radius of curvature of road has to be changed from 20 m to-
(A) 16 m (B) 18 m
(C) 24.25 m (D) 30.5 m

Q.74 A motor cyclist moving with a velocity of 72 km per hour on a flat road takes a turn on the road at a point where the radius of curvature of the road is 20 metres. The acceleration due to gravity is 10 m/s^2. In order to avoid skidding, he must not bend with respect to the vertical plane by an angle greater than-
(A) $\theta = \tan^{-1} 6$ (B) $\theta = \tan^{-1} 2$
(C) $\theta = \tan^{-1} 25.92$ (D) $\theta = \tan^{-1} 4$