PHYSICS

BOOKS - CHETANA PUBLICATION

Rational Dynamics

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1. Define : Uniform circular motion

2. State the characteristics of circular motion?

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3. Define: Centre of mass

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4. Define angular displacement and state its unit?

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5. Define angular velocity . State its unit.

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6. Define angular acceleration . State its unit.

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7. State right hand rule which gives direction of angular displacement.

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14

1. Define : Uniform circular motion

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2. Explain centripetal acceleration.

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3. State mathematical relation between linear velocity $(\bar{v})$ and angular velocity$(\overline{\omega})$ for a particle moving along the circumference of circle in counterclockwise direction.

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4. What is Non U.C.M ? What are the acceleration associated in Non U.C.M?

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5. U.C.M is an accelerated motion. Justify this statement

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6. A fan is rotating at 90rmp. It is then switched OFF . It stops after 21 revolutions. Calculate the time taken by it to stop assuming that the frictional torque is constant.

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7. Somehow, an ant is stuck to the rim of a bicycle wheel of diameter 1m . While the bicycle is on a central stand. The wheel is set into rotation and attains the frequency of $2\frac{rev}{s}$ in 10 seconds, with uniform angular acceleration. Calculate number of revolutions completed by the ant in these 10 seconds.

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8. Somehow, an ant is stuck to the rim of a bicycle wheel of diameter 1m . While the bicycle is on a central stand. The wheel is set into rotation and attains the frequency of $2\frac{rev}{s}$ in 10 seconds, with uniform angular acceleration. Calculate number of revolutions completed by the ant in these 10 seconds.

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1. Coefficient of static friction between a coin and gramophone disc is 0.5. Radius of the disc is 8cm . Initially the centre of the coin is πcm cm away from the centre of the disc. At what minimum frequency will it start slipping from there? By what factor will the answer change if the coin is almost at the rim? $(Use g = \pi^2 ms^{-2})$.

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2. Explain centripetal force with suitable example

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3. Explain centripetal force with suitable example

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1. Explain inertial frame of reference and non-inertial frame of reference.

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2. Define and explain centrifugal force.

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3. Explain applications of centrifugal force in our daily life?

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4. Define and explain centrifugal force.

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5. Do centripetal and centrifugal force constitute action- reaction pair? Explain.

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6. A racing car completes 5 rounds of a circular track in 2 minutes. Find the radius of the track if the car has uniform centripetal acceleration of $\pi^2 ms^{-2}$.

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7. What is banking of roads? Why it is necessary ?

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8. What is banking of roads? Why it is necessary ?

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1. Derive the expression for maximum safe speed with which vehicle should move along a curved horizontal road.

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2. Do we need a banked road for a two wheeler ? Explain.

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3. While driving along an unbanked circular road, a two- wheeler ride has to lean with the vertical. Why is it so? With what angle the rider has to lean? Derive the relevant expression . Why such a leaning is not necessary for a four wheeler?

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1. Derive an expression for minimum speed required by a vehicle driven in horizontal circles of a vertical cylindrical wall.

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2. Derive an expression for minimum speed required by a vehicle driven in horizontal circles of a well of Death without loosing contact.

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3. Derive an expression for most safe speed of a vehicle on a curved banked road ignoring friction.

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1. Derive an expression for most safe speed of a vehicle on a curved banked road ignoring friction.

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2. Derive an expression for most safe speed of a vehicle on a curved banked road ignoring friction.

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3. Show that the maximum safety speed $(V_{\max}) = \sqrt{\frac{rg(\mu_s + \tan\theta)}{(1 - \mu_s \tan\theta)}}$

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1. Derive an expression for most safe speed of a vehicle on a curved banked road ignoring friction.

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2. State the factors that affect the angle of banking .

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3. The curved horizontal road is banked at an angleθ . What will happen to a vehicle moving along this road if : $\theta' > \theta$. Where θ is the angle of banking for given road.

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4. The curved horizontal road is banked at an angleθ . What will happen to a vehicle moving along this road if : $\theta' < \theta$. Where θ is the angle of banking for given road.

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5. Define conical pendulum.

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6. Deduce an expression for linear speed of bob of the conical pendulum.

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7. For a conical pendulum, prove that $\tan\theta = \frac{V^2}{rg}$.

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1. Define period of conical pendulum and obtain an expression for its period.

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2. Draw a neat labelled diagram of conical pendulum . State the expression for its periodic time 'T' in terms of its length.

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3. State the mathematical relation for frequency of a conical pendulum.

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4. On what factors does the frequency of aconical pendulum depends? Is it independent of some factors?

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1. Is there any limitation on semi - vertical angle(θ) in conical pendulum?

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2. A motor cyclist is to undertake horizontal circles inside the cylindrical wall of a well of inner radius 4m . Coefficient of static friction between the tyres and the wall is 0.4. Calculate the minimum speed and frequency necessary to perform this stunt.

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3. A racing track of curvature 9.9m is banked at $\tan^{-1} 0.5$. coefficient of static friction between the track and the tyres of a vehicle is 0.2. Determine the speed limits with 10% margin.

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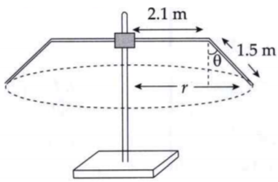
4. A merry-go-round usually consists of a central vertical pillar. At the top of it there are horizontal rods which can rotate about vertical axis. At the end of this horizontal rod there is a vertical rod fitted like an elbow joint . At lower end of each vertical rod, There is a horse on which the rider can sit. As the merry-go-round is set into rotation, these vertical rods move away from the axis by making some angle with the vertical. The figure above shows vertical section of a merry go round in which the 'initially vertical ' rods are inclined with the vertical at 37°,during rotation. Calculate the frequency of revolution of merry go round. $(Use g = \pi^2 ms^{-2} \text{ and } \sin 37^{\circ} = 0.6)$



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1. Semi - vertical angle of the conical section of a funnel is 37°. There is a small ball kept inside the funnel. On rotating the funnel, the maximum speed that the ball can have in order to remain in the funnel is 2 m/s. Calculate inner radius of the brim of the funnel . Is there any limit upon the frequency of rotation ? How much is it ? Is it lower or upper limit ? Given a logical reasoning. (Use g = 10 m/s^2 and sin 37° =0.6)`

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2. A coin kept on a horizontal rotating disc has its Centre at a distance of 0.1 m from the axis of the rotation of the disc. If the coefficient of friction between the coin and disc is 0.25, find the angular speed of the disc at which the coin would be about is slip off.

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3. A circular race course track has a radius of 500 m and is banked at 10°.The coefficient of static friction between the tyres of a vehicle and the road surface is 0.25 Compute: The maximum speed to avoid slipping.

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4. A circular race course track has a radius of 500 m and is banked at 10°.The coefficient of static friction between the tyres of a vehicle and the road surface is 0.25 Compute: The optimum speed to avoid wear and tear of the tyres.

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1. A meter gauge railway track is to be banked at a circular curve of a radius 450m. What should be the elevation of the outer rail above the inner rail for an optimum speed at

54km/h, So that there is no side thrust on the outer rail.

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2. A motor van weighing 4400 kg rounds a level curve of radius 200 m on unbanked road at 60 kmph. What should be the minimum value of coefficient of friction to prevent skidding? At what angle the road should be banked for this velocity.

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3. Part of a racing track is to be designed for a curvature of 72 m. We are not recommending the vehicles to drive faster than 216 kmph. With what angle should the road be tilted? By what height will its outer edge be, with respect to the inner edge if the track is 10m wide?

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4. The road in the question 45 above is constructed as per the requirement. The coefficient of static friction between the tyres of a vehicle on this road is 0.8, will there be any lower speed limit?By how much can the upper speed limit exceed in this case?

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1. During a stunt a cyclist (considered to be a particle is undertaking horizontal circles inside a cylindrical well of radius 6.05m. If the necessary friction coefficient is 0.5, how much minimum speed should the stunt artist maintain? Mass of the artist is 50kg. If she / he increases the speed by 20% how much will the force of friction be? $\left(Useg = 10ms^{2}\right)$

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2. A motorcyclist (as a particle) is undergoing vertical circles inside a sphere of death. The speed of the motorcycle varies between $6ms^{-1}$ and $10ms^{-1}$ Calculate diameter of the sphere of death . How much minimum value are possible for these two speed?

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3. What is vertical circular motion? State its type?

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1. Obtain expression for tension in the uppermost position, mid way position and lowermost position for an object revolving in a vertical circle under gravity.

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2. Using the energy conservation, derive the expression for the minimum speeds at different locations along a vertical circular motion controlled by gravity. Also prove that the difference between the extreme tensions (or normal forces) depends only upon the weight of the object.

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1. Derive an expression for upper limit on the speed of a vehicle at the top of a convex bridge?

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1. What is a rigid body? What is meant by axis of rotation of a rigid body?

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2. A tiny stone of mass $20g$ is tied to a practically massless, inextensible, flexible string and whirled along vertical circles. Speed of the stone is $8m/s$ when the centripetal force is exactly equal to the force due to the tension. Calculate minimum and maximum kinetic energies of the stone during the entire circle. Let $\theta = 0^0$ be the angular position of the string, when the stone is at the lowermost position. Determine the angular position of the string when the force due to tension is numerically equal to weight of the stone. Take g = $10m/s^2$ and Length string = 1.8 m

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1. Define moment of inertia.State its unit.State the factors on which moment of inertia depends.

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2. Explain the dependence of moment of inertia on the distribution of mass of the body.

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3. Derive an expression for M.I. of a uniform Disc .

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4. Prove that the M.I. of a uniform Disc about an axis perpendicular to in plane and passing through centre of mass is $\frac{1}{2}MR^2$

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1. Derive an expression for Kinetic Energy (K) of a rotating body with uniform angular velocity.

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2. Derive an expression for Kinetic Energy (K) of a rotating body with uniform angular velocity.

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3. Why is it useful to define radius of gyration (K)?

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4. Define radius of gyration (K). Explain its physical significance.

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5. What do you mean by radius of gyration of a body? State its unit. Also discuss the factors on which radius of gyration depends.

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1. What do you mean by radius of gyration of a body? State its unit. Also discuss the factors on which radius of gyration depends.

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2. A uniform disc and a hollow right circular cone have the same formula for their M.I, when rotating about their central axis. Why is it so?

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3. Show that Radius of gyration for a uniform disc is small as compared to Radius of gyration for a uniform ring, both of same mass M and same radius R.

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1. A body starts rotating from rest. Due to a couple of 20 Nm, it competes 60 revolution in one minute. Find the moment of inertia of the body.

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2. A metallic ring of mass 1 kg has moment of inertia $1 kgm^2$ when rotating about one of its diameters. It is molten and remolded into a thin uniform disc of the same Radius. How much will its moment of inertia be, when rotated about its own axis.

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3. Calculate the M.I. of a solid iron disc of radius 10 cm and thickness 5 cm. (Density of iron$(\rho) = 7800 kgm^{-3})$.

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4. Define Torque. State its unit.

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5. Obtain an expression relating the torque with angular acceleration for a rigid body.

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6. Obtain an expression relating the torque with angular acceleration for a rigid body.

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1. State the conditions under which the theorem of parallel axes and perpendicular axes are applicable. State the mathematical expression .

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2. State and prove the principle / Theorem of parallel axes.

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1. State and prove principle / theorem of perpendicular axes.

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2. Deduce an expression for M.I. about an axis passing through one end and perpendicular to length of a thin uniform rod .

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3. Prove that the M.I. of a uniform Disc about an axis perpendicular to in plane and passing through centre of mass is $\frac{1}{2}MR^2$

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4. State an expression for M.I. of a thin uniform disc about an axis passing through its centre and perpendicular to its plane. Determine M.I.about: its diameter.

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5. State an expression for M.I. of a thin uniform disc about an axis passing through its centre and perpendicular to its plane. Determine M.I.about: A tangent in its plane.

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1. State an expression for M.I. of a uniform solid sphere about an axis of rotation coinciding with its diameter. Also find M.I of solid sphere about its tangent.

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2. A fly wheel is a mechanical device specifically designed to efficiently store rotational energy. For a particular machine it is in the form of a uniform 20 kg disc of diameters 50 cm, able to rotate about its own axis. Calculate its kinetic energy when rotating at 1200 rpm. Use n

=10.Calculate its moment of inertia, in case it is rotated about a tangent in its plane.

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3. A solid sphere of diameter 25cm and mass 25kg rotates about an axis through its centre. Calculate its moment of inertia, if its angular velocity changes from $2rads^{-1}$ to $12rads^{-1}$ in 5 seconds. Also calculate the torque applied.

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1. A solid sphere has a radius R . If the radius of gyration of this sphere about its diameter is $\sqrt{2/5}\ R$, show that the radius of gyration about the tangential axis of rotation is $\sqrt{7/5}$ R

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2. The radius of gyration a body about an axis at a distance of 6 cm from its centre of mass is

10cm. Find its radius of gyration about a parallel axis through the centre of mass?

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3. A big dumb-bell is prepared by using a uniform rod of mass 60 g and length 20 cm. Two identical solid spheres of mass 50 g and radius 10 cm each are at the two ends of the rod. Calculate moment of inertia of the dumb-bell when rotated about an axis passing through its centre and perpendicular to the length.

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1. Define angular momentum. State its unit.

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2. Derive an expression that relates angular momentum with the angular velocity of a rigid body.

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3. Derive an expression that relates angular momentum with the angular velocity of a rigid body.

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4. State and explain the principle of conservation of angular momentum. Use a suitable illustration. Do we use it in our daily life ? When ?

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1. Prove principle of conservation of angular momentum. Explain it with example.

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2. A body rotating at a steady rate, does torque acts on the body?

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3. A spherical water balloon is revolving at 60rpm . In the course of time, 48.8% of its water leaks out. With what frequency will the remaining balloon revolve now? Neglect all non-conservative forces.

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4. A ceiling fan having moment of inertia $2kgm^2$ attains its maximum frequency of 60 rpm in 2π seconds. Calculate its power rating.

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1. The angular momentum of a body changes by $80 kgm^2 s^{-1}$ when its angular velocity changes from $20 rads^{-1}$ to $40 rads^{-1}$. Find the change in K.E of rotation.

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2. The kinetic energy of rotation of a body about a given axis is $157 J$. Its angular momentum about the same axis is $12.5 kgm^2 s^{-1}$ .Find the frequency of rotation of the body and moment of inertia about the given axis?

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3. A ballet dancer spins about a vertical axis at $2.5\pi rads^{-1}$ with his arms outstretched. With the arms folded, the M.I. about the same axis of rotation changes by 25%.Calculate the new speed of rotation in r.p.m.

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1. Two wheels of moment of inertia $4kgm^2$ rotate side by side of the rate of 120 r.p.m. and 240 r.p.m. respectively in the opposite direction. If now both the wheels are coupled by means of weightless shaft so that both the wheels now rotate with a common angular speed, find the new speed of rotation.

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2. A flywheel used to prepare earthenware pots is set into rotation at 100 rpm. It is in the form of a disc of mass 10 kg and radius 0.4 m. A lump of clay (to be taken equivalent to a particle) of mass 1.6 kg falls on it and adheres to it at a certain distance X from the centre. Calculate X if the wheel now rotates at 80rpm.

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3. A homogeneous rod XY of length 'L' and mass 'M' pivoted at the centre C such that it can rotate freely in vertical plane. Initially the rod is in the horizontal position .A blob of wax of same mass M as that of the rod falls vertically with the speed 'V' and the sticks to the rod midway between points 'C' and 'Y'. If the rod rotates with angular speed ω what will be angular speed in terms of V and L?

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4. What will be the duration of the day, If the earth suddenly shrinks to $\frac{1}{64}$ of its original volume, mass remains uncharged.

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5. Define Rolling motion of a rigid body.

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6. State mathematical expression for K.E of rolling body and state factors affecting K.E of rolling body.

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7. Deduce an expression for kinetic energy when a body is rolling on a plane surface without slipping.

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1. Derive an expression for the kinetic energy when a rigid body is rolling on a horizontal surface without slipping. Hence, find the kinetic energy of a solid sphere.

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2. Obtain an expression for total K.E. of rolling body in the from $\frac{1}{2}MV^2\left[1+\frac{K^2}{R^2}\right]$

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3. Discuss the interlink between translational, rotational and total kinectic energies of a rigid object that rolls without slipping.

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4. Derive an expression for linear speed (V) and linear acceleration (a) of a rigid uniform ring, uniform circular disc and uniform solid sphere rolling down the inclined plane without slipping.

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5. Derive an expression for linear speed (V) and linear acceleration (a) of a rigid uniform ring, uniform circular disc and uniform solid sphere rolling down the inclined plane without slipping.

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1. Is it possible to distinguish between a raw egg and hard boiled egg by spinning each one on a table with same torque? Justify your answer.

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1. A solid cylinder rolls down on inclined plane. Its mass is 2kg and radius 0.1m. If the height of the inclined plane is 4m, what is its rotational K.E. when it reaches foot of the plane? Take M.I. of solid cylinder about its axis $= \frac{Mr^2}{2}$.

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2. A solid sphere rolls up a plane inclined at an angle of 45°. If the linear velocity of its centre of mass of the bottom of the plane is $5ms^{-1}$, find how far the sphere travels up the plane.

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3. Starting from rest, an object rolls down along an inclined that rises by 3 in every 5(along it) . The object gains a speed of $\sqrt{10}\frac{m}{s}$ as it travel a distance of $\frac{5}{3}m$ along the incline. What can be the possible $shape/s$ of the object?

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4. Distinguish between: What is the difference between U.C.M. and Non-UCM? Give examples

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1. Distinguish between:Centripetal Force and Centrifugal Force.

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2. Distinguish between :Inertial frame of reference & Non - Inertial frame of reference.

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3. A motor cyclist rides in a vertical circle in a hollow sphere of 3m. Find the minimum speed required so that he does not lose contact while the sphere at the highest point.

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1. A simple pendulum is suspended from the roof of a railway carriage. What angle does the string make with the vertical if the carriage travels at a constant speed of 72 km/h around a circular track of radius 100m? Take $g = 9.8 m/s^2$.

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2. Find the angle of banking of a railway track of radius of curvature 250 m,if the optimum

velocity of the train is $90\frac{km}{h}$. Also find the elevation of the outer rail over the inner rail if the two tracks are 1.6m apart

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3. Find the maximum speed of a car which can be safely driven along a curve of radius 100 m and coefficient of friction between tyres and road is 0.2

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4. A conical pendulum has length 100 cm and the angle made by the string with the vertical is10°.The mass of the bob is 200 g, find The centripetal force on the bob

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5. A conical pendulum has length 100 cm and the angle made by the string with the vertical is 10°. The mass of the bob is 200 g, find frequency of circular motion of the bob.

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6. A body of mass 4 kg is rotating in a vertical circle at the end of a string of length 0.6 m. Calculate the difference of K.E. at the top and the bottom of the circle

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7. A gramophone twin-table rotating at an angular velocity$3\frac{rad}{s}$, stops after one revolution. Find the angular retardation.

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8. A 1kg stone tied at the end of 1 m long string is whirled in a vertical circle with constant speed of 5m/s. If the tension in string is 20N, then find the position of stone.

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9. An aircraft executes a horizontal loop at a speed of 720 km/h with its wings banked at

15°. What is the radius of the loop.

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10. Show that the minimum angular speed necessary to keep a rider $\omega = \sqrt{\frac{g}{\mu_s R}}$.

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11. Calculate the optimum speed and maximum speed of a four wheeler travelling along a curve track of radius 80 m. If the road is banked at an angle of $21^{\circ}48'$ and the coefficient of friction between the tyres and the road is 0.5.

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12. A solid sphere of radius 20 cm and mass 25 kg rotates about an axis through its centre. Calculate its moment of inertia. If its angular velocity the torque applied changes from $2rads^{-1}$ to $12\omega rads^{-1}$ in 5 sec, calculate the torque applied.

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13. A ballet dancer spins about a vertical axis at 90 rpm with arms outstretched. With her arms folded, the M.I. about the axis of rotation decreases to 75%.Calculate the new rate of revolutions

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14. The M.I. of a disc about an axis passing through its centre and perpendicular to its plane is $10kgm^2$, Determine its M.I. about a parallel axis: tangential to its rim and

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15. The M.I. of a disc about an axis passing through its centre and perpendicular to its plane is $10kgm^2$,Determine its M.I. about a parallel axis: Passing through a point midway between the centre and the rim.

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16. Radius of gyration of a disc of mass 5kg, about a transverse axis passing through its centre is 14.14 cm. Find radius of gyration about its diameter and, hence, calculate M.I. about the diameter

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17. Three particles, each of mass 0.5 kg, are situated at the comers of an equilateral triangle of side 0.4m. Find the M.I. and radius of gyration of the system about an axis passing through the centroid of the triangle and perpendicular to its plane

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18. Show that the ratio of radius of gyration of a thin ring about a tangential axis in its plane to its radius of gyration about an axis passing through its Centre and perpendicular to its plane is 1.225

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19. A person stands on a uniformly rotating turn table with outstretched arms holding two identical weights. The moment of inertia of the system is $60kgm^2$. When he brings the arms close to his body, the M.I. of inertia reduces to$58kgm^2$. The angular speed of the system now becomes $3rads^{-1}$. Find the initial angular speed and the final K.E.

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20. A thin uniform rod 2m long has a mass of 0.6 kg. Find its moment of inertia and radius of gyration about an axis perpendicular to its length and passing through: its centre

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21. A thin uniform rod 2m long has a mass of 0.6 kg. Find its moment of inertia and radius of gyration about an axis perpendicular to its length and passing through: one end

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22. A solid cylinder at rest at top of an inclined plane of height 2.7 m rolls down without slipping. If the same cylinder has to slide down a frictionless inclined plane and acquires the same velocity as that acquired by centre of mass of rolling cylinder at the bottom of the incline, what should be the height of the inclined plane?

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23. Angular acceleration of a body of mass 50 kg under the action of a torque of magnitude 500 Nm is $25rads^2$. Find the radius of gyration of the body about its axis of rotation.

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24. Four particles of masses 0.2 kg, 0.3 kg, 0.4 kg and 0.5 kg, respectively are kept at the comers A, B, C and D of square ABCD of side 1m. Find the M.I. about an axis passing through the point A and perpendicular to the plane of the square

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1. Moment of inertia of a disc about the axis of rotation is $10kgm^2$. A constant torque of 50 Nm acts on it. Find :Angular acceleration .

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2. Moment of inertia of a disc about the axis of rotation is$10 kgm^2$. A constant torque of 50 Nm acts on it. Find :Angular velocity at the end of 10s, if the disc is initially at rest.

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3. A torque of 1500 Nm acting on a body produces an angular acceleration of $13.2 rads^{-2}$. Find M.I of the body.

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4. The moment if inertia of the earth about its axis of rotation is $9.83 \times 10^{37} kgm^2$ and if its angular velocity is $7.3 \times 10^{-5} rads^{-1}$. Calculate Kinetic Energy of rotation.

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5. The moment if inertia of the earth about its axis of rotation is $9.83 \times 10^{37} kgm^2$ and if its angular velocity is $7.3 \times 10^{-5} rads^{-1}$. Calculate Radius of gyration

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6. Choose the correct answer from option given and write it with its corresponding alphabet: In ten minutes, the angular displacement of the minute hand of a wrist watch is

A. $\frac{\pi}{90} rad$

B. $\frac{\pi}{30} rad$

C. $\frac{\pi}{3} rad$

D. $2\frac{\pi}{3}rad$

Answer:

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7. The angular speed of a fly-wheel making 120 revolution per minute is

A. $\pi\left(\frac{rad}{s}\right)$

B. $2\pi\left(\frac{rad}{s}\right)$

C. $4\pi\left(\frac{rad}{s}\right)$

D. $4\pi^2\left(\frac{rad}{s}\right)$

Answer:

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8. To stimulate the acceleration of large rockets astronauts are spun at the end of a long rotating beam of radius 9.8m. Angular velocity, required to generate a centripetal acceleration 8 times the acceleration due to gravity, is.

A. $2\left(\frac{rad}{s}\right)$

B. $2\sqrt{2}\left(\frac{rad}{s}\right)$

C. $\sqrt{2}\left(\frac{rad}{s}\right)$

D. $8\left(\frac{rad}{s}\right)$

Answer:

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9. Define and explain centrifugal force.

A. it is in the accelerated frame of reference

B. it is opposite to that of centripetal force

C. it obeys newton's law of motion

D. it effect is not observed.

Answer:

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10. A particle moves with a constant angular velocity in circular path of certain radius and is acted upon by a certain force F. If the angular velocity is will be doubled, keeping the radius same, the new force

A. F/4

B. 4F

C. F/2

D. 2F

Answer:

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11. When the angular velocity of a unit uniformly rotating body becomes 3 times its original value, the resultant of forces applied to it increase by 60N. Find the acceleration of the body m= 3kg.

A. $2.5ms^{-2}, 7.5ms^{-2}$

B. $7.5ms^{-2}, 22.5ms^{-2}$

C. $5ms^{-2}, 45ms^{-2}$

D. $2.5ms^{-2}, 22.5ms^{-2}$

Answer:

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12. A circular road of radius 1000m has banking angle 45°. If the coefficient of friction between tyres and road is 0.5, the maximum safe speed of a car having mass 2000 kg will be

A. 172 m/s

B. 124m/s

C. 99m/s

D. 86m/s

Answer:

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13. A road is banked at an angle of 0.01 radian. If the radius of the road is 80m, then safe speed for the driver will be: $(g = 10Nkg^{-1})$

A. 2.8m/s

B. 3.8m/s

C. 4.8m/s

D. 5.8m/s

Answer:

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14. When seen from below, the blades of a ceiling fan are seen to be revolving anticlockwise and their speed is decreasing.Select correct statement about the directions of its angular velocity and angular acceleration.

A. Angular velocity upwards, angular accleration downwards

B. Angular velocity downwards, angular acceleration upwards

C. Both, angular velocity and angular acceleration, upwards

D. Both, angular velocity and angular acceleration, downwards

Answer:

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15. Find the length of a simple pendulum whose time period is same as at of a conical of length L and an angle 0 with vertical.

A. $\frac{L}{\cos\theta}$

B. L

C. $L \sin \theta$

D. $L \cos \theta$

Answer:

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16. The radius of orbit of the bob of a conical pendulum whose length is $\sqrt{2}$ m and time period of 2 second $(g = 9.8 ms^{-2})$

A. 1m

B. $\frac{1}{\sqrt{2}}m$

C. $\sqrt{3}m$

D. $\sqrt{2}m$

Answer:

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48

1. The minimum horizontal velocity that must be imparted to a small bob that is suspended by a string of length L, such that it reaches the height of suspension is :

A. $\sqrt{2gl}$

B. $\sqrt{gl}$

C. $\sqrt{5gl}$

D. $18gl$

Answer:

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2. A particle of mass1kg, tied to a 1.2 m long string is whirled to perform vertical circular motion, under gravity. Minimum speed of a particle is $5m/s$. Consider following statements. (P) Maximum speed must be $5\sqrt{5}m/s$. (Q) Difference between maximum and minimum tensions along the string is 60 N. Which of the following is true?

A. Only the statement P is correct

B. Only the statement Q is correct

C. Both the statements are correct.

D. Both the statements are incorrect

Answer:

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3. A body of mass 1kg is moving in a vertical circular path of radius 1m. The difference between kinetic energies at its highest and lowest position is

A. 20 J

B. 10 J

C. $4\sqrt{5}J$

D. $10\left(\sqrt{5}-1\right)J$

Answer:

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4. When a car crosses a convex bridge, the bridge exerts a force on it. It is given by

A. $F = mg + \frac{mv^2}{r}$

B. $F = \frac{mv^2}{r}$

C. $F = mg - \frac{mv^2}{r}$

D. $F = mg + \frac{mv^2}{r}$

Answer:

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5. A circular road is banked at an angle θ for an optimum speed V. The vertical component of the normal reaction on a car driven at the speed V on the road is equal to (in usual notations)

A. Mg

B. $Mg - \mu_s N \sin\theta$

C. $Mg + \mu_s N \sin\theta$

D. $N(1 - \mu_s N \sin\theta)$

Answer:

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6. In a conical pendulum, the axial height of the right circular cone described by the string is equal to half the radius of the circular path of its bob. The tension in the string is

A. $\frac{mg}{\sqrt{5}}$

B. $\frac{mg}{\sqrt{2}}$

C. $\sqrt{5}mg$

D. $\sqrt{2}mg$

Answer:

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7. A pendulum bob has a speed of $3m/s$ at its lowest is position. The pendulum is 0.5m long. The speed of the bob, when string makes an angle of 60° to the vertical is

A. 2 m/s

B. 1/2 m/s

C. 1 m/s

D. 2.5 m/s

Answer:

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8. In a conical pendulam, when the bob moves in a horizontal circle of radius r with uniform speed v, the string of length L describes a cone of semivertical angle θ. The tension in the string is given by

A. $T = \dfrac{mgl}{L^2 - r^2}$

B. $T = \dfrac{L^2 - r^2}{mgl}$

C. $T = \frac{mgl}{L^2 - r^2}$

D. $T = \frac{mgl}{(L^2 - r^2)^2}$

Answer:

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9. simple pendulam oscillates in a vertical plane. When it passes through the mean postion, the tension in the string is 3 times the weight of the pendulam bob. What is the maximum displacement of the pendulam of the string with respect to the vertical?

A. 30°

B. 45°

C. 60°

D. 90°

Answer:

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10. A simple pendulum is of length /. It is displaced so that its length becomes horizontal and then released, then its velocity at bottom will be:

A. $\sqrt{gl}$

B. $\sqrt{6gl}$

C. $\sqrt{5gl}$

D. $\sqrt{2gl}$

Answer:

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11. A bucket full of water is rotated in vertical circle of radius 20 m. The minimum speed that the bucket should have so that water will not fall when it is at the highest point is:

A. $\sqrt{98}\frac{m}{s}$

B. $\sqrt{9.8}\frac{m}{s}$

C. 14 m/s

D. 1.4 m/s

Answer:

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12. A body of mass m hangs at one end of a string of length Z, the other end of which is fixed. It is given a horizontal velocity so that the string would just become slack, when it makes an angle of 60° with the upward drawn vertical. The tension in string at this at this position is

A. 4.5mg

B. 2 mg

C. 3 mg

D. $\sqrt{mg}$

A. 4.5mg

B. mg

C. 3 mg

D. $\sqrt{mg}$

Answer:

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13. A bucket full of water is rotated in a vertical circle of radius R. If the water does not spill out, then the speed of the bucket at the topmost point will be

A. $\sqrt{Rr}$

B. $\sqrt{5gR}$

C. $\sqrt{2gR}$

D. $\sqrt{\left(\frac{R}{g}\right)}$

Answer:

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14. Select correct statement about the formula 9expression) of moment of inertia (M.I) in terms of mass M of the object and some of its distance parameter/s, suchy as R,L, etc.

A. Different objects must have different expressions for their MI.

B. When rotating, about their central axis, a disc have the same expression for the M.I.

C. Expression for the M.I. for a parallelepiped rotating about the trasverse axis passing through its centre includes its depth.

D. Expression for M.I. of a rod and that of a plane sheet is the same about a transverse axis.

Answer:

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1. In a certain unit, the radius of gyration of a uniform disc about its central and transverse axis is $\sqrt{2.5}$. Its radius of gyration about a tangent in its plane (in the same unit) must be

A. $\sqrt{5}$

B. 2.5

C. $2\sqrt{2.5}$

D. $\sqrt{12.5}$

Answer:

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2. Consider following cases:(P) A planet revolving in an elliptical orbit. (Q)A planet revolving in a circular orbit. Principle of conservation of angular momentum comes in force in which of these:

A. Only for (P)

B. Only for (Q)

C. For both, (P) and (Q)

D. Neither for (P), nor for (Q)

Answer:

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3. A thin walled hollow cylinder is rolling down an incline, without slipping. At any instant, the ratio "Rotational K.E.: Translational K.E.: Total K.E." is:

A. $1:1:2$

B. $1:2:3$

C. $1:1:1$

D. $2:1:3$

Answer:

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4. A body of mass M is rotating about an axis with angular velocity ω. If k is radius of gyration of the body about the given axis, its angular momentum is

A. $\frac{1}{2}MV^2\omega$

B. $MK\omega^2$

C. $MK\omega$

D. $MK^2\omega$

Answer:

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5. The moment of inertia of a thin uniform rod of mass M about an axis passing through its centre and perpendicular to its length is given to be I_0.The moment of inertia of the same road about an axis passing through one of it sends and perpendicular to its length is:

A. $\frac{1}{2}I_\circ$

B. $3I_\circ$

C. $5I_\circ$

D. $4I_\circ$

Answer:

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6. With the increase in temperature, moment of inertia of a solid sphere about a diameter:

A. decreases

B. increases

C. does not change

D. cannot be predicted

Answer:

Watch Video Solution

7. The sum of moments of masses of all the particles in a system about the centre of mass is always

A. zero

B. maximum

C. infinite

D. minimum

Answer:

Watch Video Solution

8. If a thin wire of length L and mass m is bent in the form of a semi-circle, then its M.I. about an axis joining its free ends will be

A. ML^2

B. Zero

C. $\frac{ML^2}{P}I^2$

D. $\frac{ML^2}{2PI^2}$

A. ML^2

B. Zero

C. $\frac{ML^2}{P}I^2$

D. $\frac{ML^2}{2PI^2}$

Answer:

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9. A loop of mass M and Radius R is rolling on a smooth horizontal surface with speed 'V'. Its total kinetic energy

A. $\frac{1}{2}mV^2$

B. $\frac{3}{2}mV^2$

C. Mv^2

D. $\frac{1}{2}MR^2\omega^2$

Answer:

Watch Video Solution

10. A sphere of moment of inertia I and mass 'm' rolls down on an inclined plane without slipping. Its K.E. of rolling is.

A. $I\omega + Mv$

B. $0.5mV^2$

C. $0.5I\omega^2$

D. $0.5I\omega^2 + 0.5mV^2$

Answer:

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11. A body of mass 'm' and radius of gyration 'K' is rotating with angular acceleration α. Then, the torque acting on the body is:

A. $\frac{1}{2}mK^2\alpha$

B. $\frac{1}{4}mK^2\alpha$

C. $2mk\alpha$

D. $Mk^2\alpha$

Answer:

Watch Video Solution

12. The radius of a wheel is R and its radius of gyration about an axis passing through its centre and perpendicular to its plane is K. If the wheel is rolling without slipping the ratio of its rotational kinetic energy to its translational kinetic energy is

A. $\frac{K^2}{R^2}$

B. $\frac{R^2}{K^2}$

C. $\frac{K^2}{R^2 + K^2}$

D. $\frac{R^2}{R^2 + K^2}$

Answer:

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13. A rod of mass M and length l is suspended freely from its end and it can oscillate in the vertical plane about the point of suspension. It is pulled to one side and then released. It passes through the equilibrium position with angular speed ω. What is the kinetic energy while passing through the mean position?

A. $\frac{Ml^2\omega^2}{2}$

B. $\frac{Ml^2\omega^2}{6}$

C. $\frac{Ml^2\omega^2}{4}$

D. $\frac{Ml^2\omega^2}{8}$

Answer:

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50

1. A person is standing on a rotating wheel. If he sits on the wheel, then the angular momentum of the system will

A. increase

B. decrease

C. remains same

D. double

Answer:

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2. A constant torque acting on a uniform circular wheel changes its angular momentum from A to 4A in 4 second, then the magnitude of the torque is

A. 0.75A

B. 4A

C. A

D. 12A

Answer:

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3. M.I of a thin uniform rod about the axis passing through its centre and perpendicular to its length is $\frac{ML^2}{12}$. The rod is cut transversely into two halves, which are then riveted end to end M.I. of the composite rod about the axis passing through its centre and perpendicular to its length will be:

A. $\frac{ML^2}{3}$

B. $\frac{ML^2}{12}$

C. $\frac{ML^2}{48}$

D. $\frac{ML^2}{6}$

Answer:

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4. The radius of disc is 2m, the radius of gyration of disc about an axis passing through its diameter is

A. 2m

B. 2cm

C. 1m

D. 0.2m

Answer:

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5. A coin is placed on a gramophone record rotating at a speed of 45 rpm, it flies away when the rotational speed is 50 rpm. If two such coins are placed one over the other on the same record both of then will fly away when rotational speed is

A. 10rpm

B. 25rpm

C. 12.5rpm

D. 50rpm

Answer:

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6. A fly wheel revolves at $100rev/\min$, a torque is applied to the flywheel for 10s. If the torque increases the speed to $200rev/\min$, then the angular acceleration of the fly wheel will be

A. $\frac{\pi}{6}rads^{-2}$

B. $\frac{\pi}{5} rads^{-2}$

C. $\frac{\pi}{3} rads^{-2}$

D. $\frac{\pi}{3} rad^{-2}$

Answer:

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7. The angular momentum $\overline{L}$, the linear momentum $\overline{P}$ and position vector $\bar{r}$ are related as:

A. $\overline{L} = \bar{r} \times \bar{p}$

B. $L = \dfrac{p}{r}$

C. $\overline{L} = \bar{p} \times \bar{r}$

D. $\overline{L} = \bar{p} . \bar{r}$

Answer:

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8. A disc of moment of inertia $\dfrac{9.8}{\pi^2} kgm^2$ is rotating at 600 r.p.m. If the frequency of rotation changes from 600 r.p.m. to 300 r.p.m., then what is the work done?

A. 1470J

B. 1452J

C. 1567J

D. 1632J

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9. By keeping moment of inertia of a body constant, if we double the time period, then angular momentum of body

A. remains constant

B. becomes half

C. Doubles

D. Quadruples

A.

A. remains constant

B. becomes half

C. Doubles

D. Quadruples

Answer:

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10. Calculate M.I. of a thin uniform ring about an axis tangent to the ring and in a plane of the ring, if its M.I. about an axis passing through the centre and perpendicular to plane is 4 kgm2

A. $3kgm^2$

B. $6kgm^2$

C. $9kgm^2$

D. $12kgm^2$

A. $0.25kgm^2$

B. $0.5kgm^2$

C. $2kgm^2$

D. $1kgm^2$

Answer:

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11. A uniform disc of mass 2 kg is rotated about an axis perpendicular to the plane of the disc. If radius gyration is 50 cm, then the M.I. of the disc about same axis is

A. $\frac{AL^3DW^2}{12}$

B. $\frac{AL^3DW^2}{24}$

C. $\frac{AL^2DW^2}{6}$

D. $\frac{AL^3DW^2}{48}$

Answer:

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51

1. Select and write the correct answer choosing the correct option :if the angular momentum of a body increases by 50% ,its kinetic energy of rotation increases by:

A. 0.5

B. 0.25

C. 1.25

D. 1

Answer:

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2. If L is the angular momentum and I is the moment of inertia of a rotating body, then $L^2 / 2I$ represents its:

A. Rotational P.E

B. Total Energy

C. Rotational K.E.

D. Translational K.E.

Answer:

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3. A body of mass 0.1 kg tied to a string of length 5 m is revolved in a vertical circle such that the maximum tension in the string is 9N. The minimum tension in the string is

A. 0N

B. 3N

C. 4N

D. 6N

A. 0N

B. 3N

C. 4N

D. 6N

Answer:

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4. The maximum speed at which a cyclist can ride on a curved road of radius 20 m when inclined at angle of 45° with horizontal is.... Given, g=9.8 ms −2 .

A. 10.74 m/s

B. 12m/s

C. 13m/s

D. 14m/s

A. 10.74 m/s

B. 12m/s

C. 13m/s

D. 14m/s

Answer:

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5. State characteristics of circular motion

Watch Video Solution

6. State Theorem of parallel Axes

Watch Video Solution

7. State the Law of conservation of momentum and derive the formula.

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8. A spherical water balloon is revolving at 60rpm . In the course of time, 48.8% of its water leaks out. With what frequency will the remaining balloon revolve now? Neglect all non-conservative forces.

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9. A racing track of curvature $9.9m$ is banked at $\tan^{-1} 0.5$. coefficient of static friction between the track and the tyres of a vehicle is 0.2. Determine the minimum and maximum speed of the vehicle.

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10. For a rolling hollow sphere find the relation, Translational K.E.: Rotational K.E.: Total K.E. Also find what percentage of total is translational and rotational

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11. Distinguish between centripetal and centrifugal force.

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12. Two wheels of moment of inertia 4 kgm^2` rotate side by side at the rate of 120 rev/min and 240 rev/min respectively in the opposite directions. If now both the wheels are coupled by means of weightless shaft so that the both wheels now rotates with a common angular speed. Find the new speed of rotation.

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13. Derive an expression for M.I. about an axes passing through one end and perpendicular to length of a thin uniform rod.

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14. Obtain an expression $\bar{\tau} = \bar{I} \times \overline{\alpha}$ for a rigid body rotating about perpendicular axis

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15. Derive an expression for most safe speed of a vehicle moving on a curved banked road ignoring friction?

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16. A metallic ring of a mass 1kg has moment of Inertia $1kgm^2$ when rotating about one of its diameters. It is molten remolded into a thin uniform disc of the same radius. Find M.I.

about central axis of uniform disc perpendicular to plane.

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17. A rogid object is rolling down an inclined plane. Derive an expressions for the acceleration along the track and the speed after falling through a certain vertical distance.

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18. Using the energy conservation, derive the expression for the minimum speeds at different locations along a vertical circular motion controlled by gravity. Also prove that the difference between the extreme tensions (or normal forces) depends only upon the weight of the object.

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