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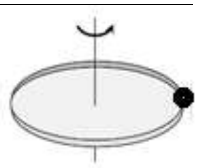
Chapter 10
Rotation

Q.1 What is the angular speed in radians per second of the Earth in its orbit about the Sun. (w=1.99E-7 rad/s)
Q.2 Calculate the required time for a wheel, initially at rest, to turn through 10 full revolutions if it can accelerate at a rate of 1π rad/s^2.t=6.3s
Q.3 A wheel spins at a rate of 30 revs/sec comes to a complete stop in 10 seconds. Find:
a) the angular acceleration of the wheel. -6π rad/s^2
b) the number of revolutions the wheel undergoes before it comes to a stop. 300 π rad

Q.4 The angular position of a point on the rim of a rotating wheel is given by $\theta(t) = 4.0t - 3.0t^2 + t^3$, where θ is in radians if t is given in seconds.
a- What are the angular velocities at t = 2.0 s and t = 4.0 s?4 rad/s ---28 rad/s
b- What is the average angular acceleration for the time interval that begins at t = 2.0 s and ends at t = 4.0 s? 12 rad/s^2
c- What are the instantaneous angular accelerations at the beginning and end of this time interval? 6rad/s^2---18rad/s^2

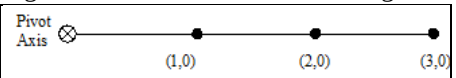


Q.5 The angular position of a point on the rim of a rotating wheel is given by $\theta(t) = -1.00 - 0.600t + 0.250t^2$, where θ is in radians if t is given in seconds. What theta at time t_{min}

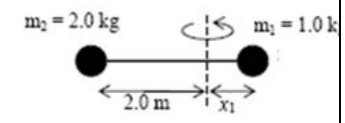
H.W. At what time, t_{min}, does $\theta(t)$ reach the minimum value? What is $\theta(t)$ at t_{min}?
Answer: Calculate $\omega(t) = 0$ to find $t_{min} = 1.20$ s, and $\theta(t_{min}) = -1.36$ rad $\approx -77.9°$

Q.6 An electric motor rotating a grinding wheel at 100 rev/min is switched off. Assuming constant negative angular acceleration of magnitude 2.00 rad/s^2, (a) How long does it take the wheel to stop? 5.24s
(b) Through how many radians does it turn during the time found in (a)? 27.5 rad
Q.7 A disk, of radius 6.0 cm, is free to rotate at a constant rate of 1200 rpm about its axis. Find:
a- the radial acceleration b- the tangential acceleration. 948m/s^2----0
Q.8 A disk—a horizontal rotating platform—of radius r is initially at rest, and then begins to accelerate constantly until it has reached an angular velocity ω after 2 complete revolutions. What is the angular acceleration of the disk during this time? w^2/8π
Q9. A racing car travels on a circular track of radius 275 m. Suppose the car moves with a constant linear speed of 51.5 m/s. a) Find its angular speed. 0.19 rad/s
b) Find the magnitude and direction of its acceleration. a_t =0---a_r =9.645 m/s^2
Q.10 A wheel 1.65 m in diameter lies in a vertical plane and rotates about its central axis with a constant angular acceleration of 3.70 rad/s2. The wheel starts at rest at t = 0, and the radius vector of a certain point P on the rim makes an angle of 57.3^o with the horizontal at this time. At t = 2.00 s , find the following:
a) the angular speed of the wheel. 7.4 rad/s b) the tangential speed of the point P.6.11m/s
c) the total acceleration of the point P.45.28 rad/s^2----3.86^0
d) the angular position of the point P.8.4 rad
Q.11 Calculate the rotational inertia of a wheel that has a kinetic energy of 24400J when rotating at $\omega = 602$ revs/min .12.3kg.m^2

Q.12 As shown in the figure, three masses, of 1.5 kg each, are fastened at fixed position to a very light rod pivoted at one end. Find the moment of inertia for the rotation axes shown. 21kg.m^2

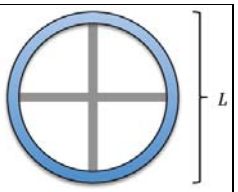


Q.13 A rigid body consists of two particles attached to a rod of negligible mass. The rotational inertia of the system about the axis shown in Figure is 10 kg m^2. What is x_1? 1.14m

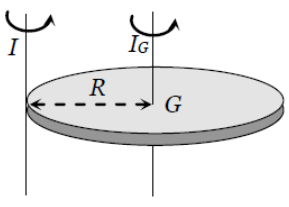


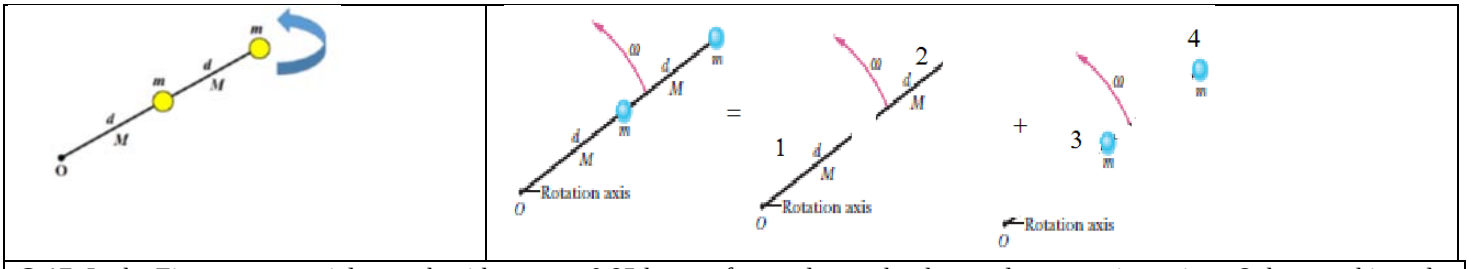
Q.14A hoop rolls without sliding on a horizontal floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about its central axis) is. 1

Q.15 A pair of long, thin, rods, each of length L and mass M, are connected to a hoop of mass M and radius $L/2$ to form a 4-spoked wheel as shown in the figure. Express all answers in terms of the given variables and fundamental constants. Calculate the moment of inertia for the entire spoked-wheel assembly for an axis of rotation through the center of the assembly and perpendicular to the plane of the wheel.15/12ML^2
Answer: The moment of inertia for the spoked wheel is simply the sum of the individual moments of inertia of its three components: the two long thin rods and the hoop around the outside:



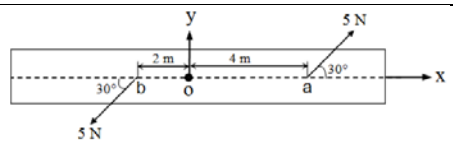
Q.16 Moment of inertia of a disc about an axis through its center of mass and perpendicular to its plane is $I_G = \frac{1}{2}MR^2$. Calculate the moment of inertia about an axis through its tangent perpendicular to the plane. 3/2MR^2



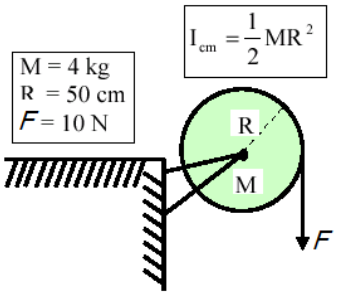


Q.17: In the Figure, two particles, each with mass m 0.85 kg, are fastened to each other, and to a rotation axis at O, by two thin rods, each with length d = 5.6 cm and mass M = 1.2 kg. The combination rotates around the rotation axis with the angular speed ω = 0.30 rad/s. Measured about O, what are the combination's
(a) rotational inertia and . 0.023kg.m^2
(b) kinetic energy?1.1E-3 j

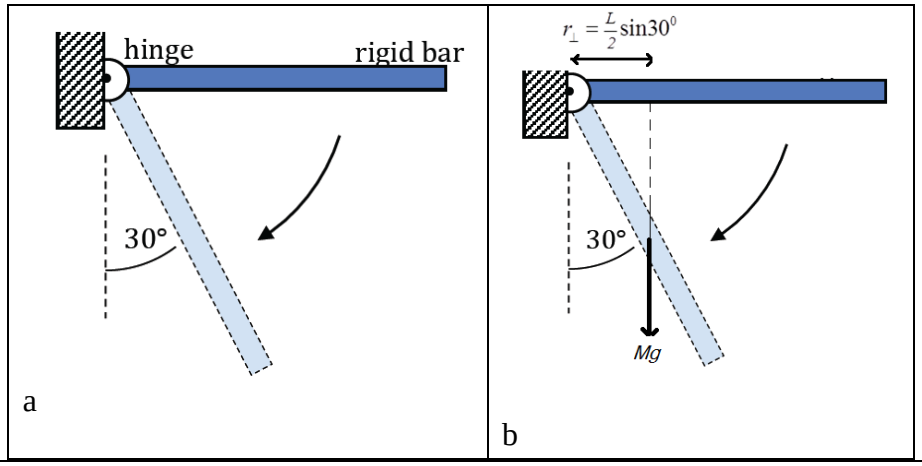
Q.18 Calculate the net torque (magnitude, in N.m, and direction) on a uniform beam shown in the Figure about a point O passing through its center.15N.m K direction



Q.19



Q.20

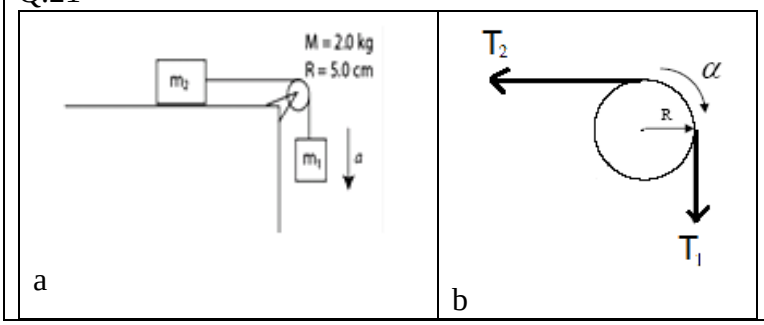


Q.19 A uniform disk of radius 50 cm and mass 4 kg is mounted on a frictionless axle, as shown in Figure. A light cord is wrapped around the rim of the disk and a steady downward pull of 10 N is exerted on the cord. Find the tangential acceleration of a point on the rim of the disk. 5m/s^2 clockwise

Q.20 A rigid bar with a mass M and length L is free to rotate about a frictionless hinge at a wall, see figure a. The bar has a moment of inertia I = 1/3 ML^2 about the hinge, and is released from rest when it is in a horizontal position as shown. What is the instantaneous angular acceleration when the bar has swung down so that it makes an angle of 30° to the vertical? $\alpha = \frac{3g}{4L}$ Clockwise

Q.21 A mass, m_1 = 5.0 kg, hangs from a string and descends with a linear acceleration "a". The other end is attached to a mass m_2 = 4.0 kg which slides on a frictionless horizontal table. The string goes over a pulley (a uniform disk) of mass M = 2.0 kg and radius R = 5.0 cm (see Figure a). Find the value of a .4.9m/s^2

Q.21



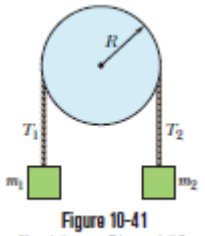


Figure 10-41
Problems 51 and 83.

Q.22

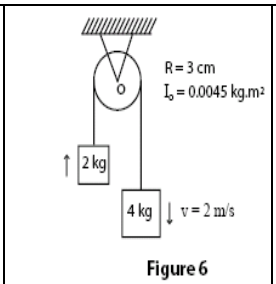
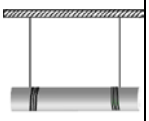


Figure 6

Q.24

Q.25



Q.22 In Fig. 10-41, block 1 has mass $m_1 = 0.460$ kg, block 2 has mass $m_2 = 0.500$ kg, and the pulley, which is mounted on a horizontal axle with negligible friction, has radius R = 5.00 cm. When released from rest, block 2 falls 75.0 cm in 5.00 s without the cord slipping on the pulley. (a) What is the magnitude of the acceleration of the blocks? 6*10-2 m/s^2 .What are (b) tension T_2 . 4.87N and (c) tension T_1?4.54N (d) What is the magnitude of the pulley's angular acceleration.1.2rad/s^2 ? (e) What is its rotational inertia?1.38*10-2kg.m^2

Q.23 A grinding wheel of moment of inertia 0f 0.01 kg.m^2 is brought to rest, in 10 revolutions, from an initial angular velocity of $\omega = 3000$ rpm = 314.2 rad/s. What is the power dissipated? 2.47*103W

Q.24 Figure shows a pulley (R =3.0 cm and I_o = 0.0045 kg.m^2) suspended from the ceiling. A rope passes over it with a 2.0 kg block attached to one end and a 4.0 kg block attached to the other. When the speed of the heavier block is 2.0 m/s, calculate the total kinetic energy of the pulley and blocks. 22J

Q.25 A uniform cylinder of mass $m = 2$ kg and radius $r = 0.15$ m is suspended by two strings wrapped around it, as shown in Figure. The cylinder remains horizontal while descending. Calculate the acceleration of the center of mass of the cylinder. 6.53m/s^2