UNIT-4 CIRCULAR AND ANGULAR MOTION

1 A wind turbine for generating electricity rotates clockwise at the rate of 17.0 rpm (revolutions per minute). What is its angular velocity in rad/s?
[1.78 rad/s]

2 A CD rotates through an angle of 106° in 0.0860 s. What is the angular speed of the CD in rad/s? [21.5 rad/s]

3. Find the period of a microwave tray that is rotating with an angular speed of 5.0 rpm. [12 s]

4. A ceiling fan that was rotating with an angular velocity of 12.6 rad/s begins to slow down when it is turned off. How much time does it take for the fan to come to rest if it has a constant angular acceleration of - 0.168 rad/s^2? [75 s]

5 If the angular velocity of the disk is 6.43 rad/s at a given time, and its constant angular acceleration is 0.491 rad/s^2, what is the angular velocity of the pulley 1.25 s later?
[ω = 7.04 rad/s]

6 The rotor on a helicopter turns at an angular speed of 3.20 x 10^2 revolutions per minute. (a) Express this angular speed in radians per second. (b) Angular displacement (b) If the rotor has a radius of 2.00 m, what arclength does the tip of the blade trace out in 3.00 x 10^2 s? [33.5 rad/s, 1.01 x 10^4 rad, 2.02 x 10^4 m]

7 A wheel rotates with a constant angular acceleration of 3.5 rad/s^2. If the angular speed of the wheel is 2.0 rad/s at t = 0, (a) through what angle does the wheel rotate between t = 0 and t = 2.0 s? Give your answer in radians and revolutions. (b) What is the angular speed of the wheel at t = 2.00 s?
[11 rad, 1.75 rev, 9.0 rad/s]

8 Find the angular speed a CD must have to give a linear speed of 1.25 m/s when the laser beam shines on the disk (a) 2.50 cm and (b) 6.00 cm from its center.
[50 rad/s, 20.8 rad/s]

9 A centrifuge rotor is accelerated for 30 s from rest to 20,000 rpm (revolutions per minute). (a) What is its average angular acceleration? (b) Through how many revolutions has the centrifuge rotor turned during its acceleration period, assuming constant angular acceleration?
[70 rad/s^2 , 5.0 x 10^3 rev]

10 A compact disc rotates from rest up to an angular speed of 31.4 rad/s at a time of 0.892 s. (a) What is the angular acceleration of the disc, assuming the angular acceleration is uniform? (b) Through what angular displacement does the disc turn while coming up to speed?
[35.2 rad/s^2, 14 rad]

PHYSICS-XI

CENTRIPETAL FORCE AND BANKING CURVE

1 A 0.5 kg mass is rotated in a horizontal circle of radius 20 cm. Calculate the centripetal force acting on it, if its angular speed of revolution is 0.8 rad /s.
[0.064 N]

2 A one kg mass tied at the end of the string 0. 5 m long is whirled in a horizontal circle, the other end of the string being fixed. The breaking tension in the string is 50 N. Find the greatest speed that can be given to the mass.
[5 m/s]

3 Calculate the centripetal force exerted on a 900 kg car that negotiates a 500 m radius curve at 25 m/s. [1125 N]

4 Curves on some test tracks and race courses, such as Daytona International Speedway in Florida. calculate the speed at which a 100.0-m radius curve banked at 31.0° should be driven if the road were frictionless.
[24.4 m/s]

5 A 1 500-kg car moving on a flat, horizontal road negotiates a curve as shown in Figure. If the radius of the curve is 35.0 m and the coefficient of static friction between the tires and dry pavement is 0.523, find the maximum speed the car can have and still make the turn successfully. [13.6 m/s]

6 Civil engineers generally bank curves on roads in such a manner that a car going around the curve at the recommended speed does not have to rely on friction between its tires and the road surface to round the curve. Suppose that the radius of curvature of a given curve is r = 60 m and that the recommended speed is v = 40 km/h. At what angle θ should the curve be banked?
[11.8^0]

7 To what angle must a racing track of radius of curvature 600 m be banked so as to be suitable for a maximum speed of 72 km/h? [3.89^0]

8 A 1000 kg car travels around a frictionless curve of radius 100 m. If the curve is banked at 15.0^0 to the horizontal, what is the maximum speed that the car can safely round the curve?Hint [$F_c = W \sin\theta$, $F_c = 9800x \sin 15^0 = 2536$ N] [16 m/s]

ORBITAL SPEED

1 The mass of the Moon is 7.34×10^{22} kg and the radius is 1.74×10^6 m. Then, determine the orbital speed of the Moon.[1.67×10^3 m/s]

2 A satellite launch is made for the study of Jupiter. Determine its velocity around Jupiter. [mass of Jupiter = 1.9×10^{27} kg , radius of Jupiter = 6.99×10^7 m]

3 The International Space Station orbits at an altitude of 200 km above the surface of the earth. What is the space station's orbital speed? [7.77×10^3 m/s]

4 Two satellites orbit Earth at altitudes of 7500 km and 15,000 km above the Earth's surface. Which satellite is faster, and by what factor?

5 A satellite is orbiting the Earth with an orbital velocity of 4500 m/s. What is the orbital radius? [1.96×10^7 m/s]

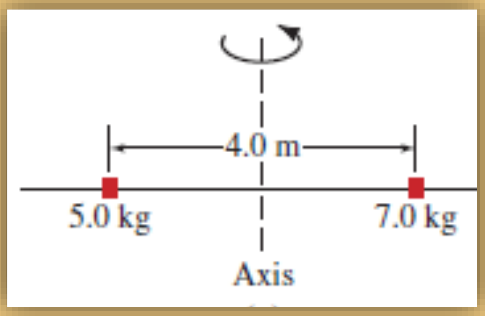
TORQUE , MOMENT OF INERTIA, AND ANGULAR MOMENTUM

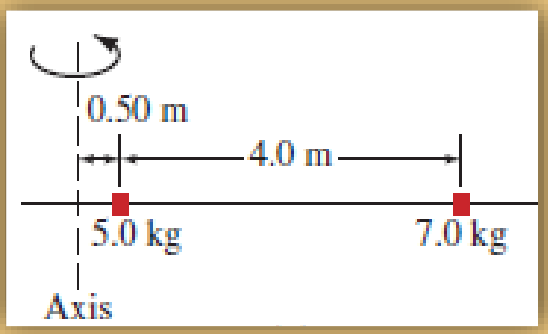
1 How much torque is created by a 100 N perpendicular force placed 0.45 meters from the fulcrum? [45 Nm]

2 How much force would Joe have to apply perpendicularly to create 550 Nm of torque 0.20 meters away from the bolt he is trying to loosen? [2750 N]

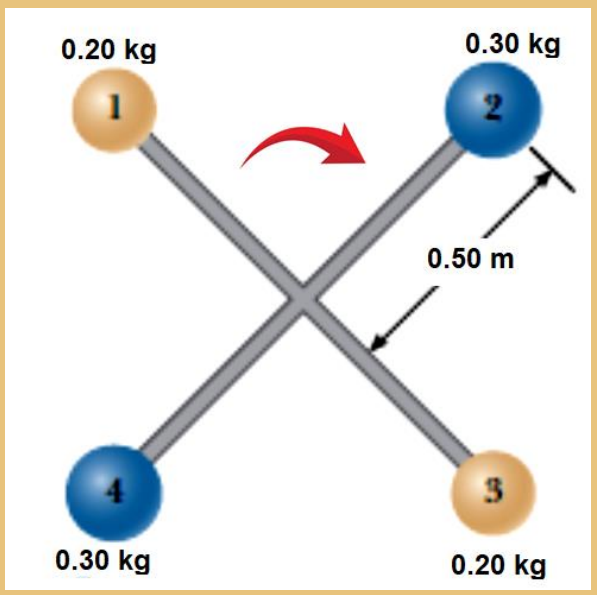
3 What torque results from a 250 N force 30° from perpendicular on a wrench 0.28 meters away from the bolt? [35 Nm]

4 Two small "weights," of mass 5.0 kg and 7.0 kg, are mounted 4.0 m apart on a light rod (whose mass can be ignored), as shown in Fig. Calculate the moment of inertia of the system (a) when rotated about an axis halfway between the weights, (b) when rotated about an axis 0.50 m to the left of the5.0-kg mass



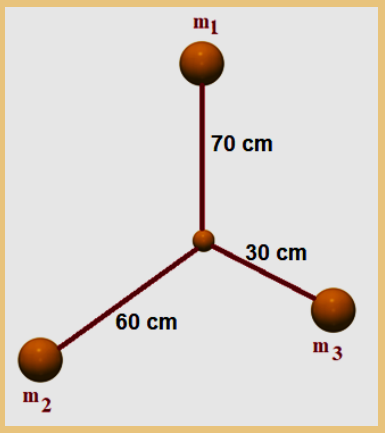


5 Four tiny spheres are fastened to the ends of two rods of negligible mass lying in the xy plane to form an unusual baton. Each rod is 1.0 m long. Find the moment of inertia of the baton about an axis perpendicular to the page and passing through the point where the rods cross. [0.25 kg m^2]



6 A thin disk with a 0.2m diameter and a total moment of inertia of 0.65kg·m^2 is rotating about its center of mass. There are three rocks with masses of 0.3 kg on the outer part of the disk. Find the total moment of inertia of the system.?
[0.659 kg m^2]

7 A system of points is shown in the figure. Each particle has the same mass of 0.4 kg and all lie in the same plane. What is the moment of inertia of the system about a given axis? [0.376 kg m^2]



8 A light rope wrapped around a disk-shaped pulley is pulled tangentially with a force of 0.51 N. Find the torque, moment of inertia, and angular acceleration of the pulley, given that its mass is 2.4 kg and its radius is 0.13 m.
[0.066 N.m , 0.020 kg.m^2 , 3.3 rad/s^2]

9 (a) What is the angular momentum of a 2.8 kg uniform cylindrical grinding wheel of radius 25 cm when rotating at 1800 rpm? (b) How much torque is required to stop it in 12 s? [ω =188.5 rad/s, 16.49 kg m^2, -1.37 Nm]

10 Determine the angular momentum of the Earth (a) about its rotation axis (Assume the Earth a uniform sphere) $[7.08 \times 10^{33}\, J\, s]$

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