Assignment No. 10 ***Chapter 10***

Problem 1)

An airplane propeller is 2.08 m in length (tip to tip) and a mass of 117 kg. When the airplain's engine is first started, it applies a constant torque of 1950 N.m to propeller, which starts from rest.

a) What is the angular acceleration of the propeller? Model the propeller as a slender rod.

b) What is the propeller angular speed after making 5.00 revolutions?

c) How much work is done by the engin during the first 5.00 revolutions?

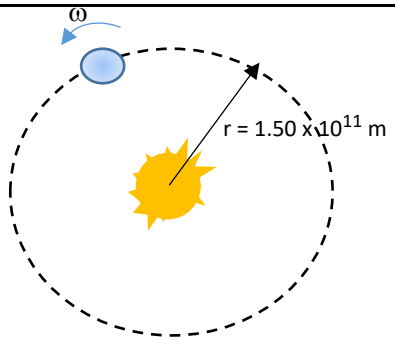
d) What is the average power output of the engine during the first 5.00 revlutions?

e) What is the instaneous power output of the motor at the instant that propeller has turned through 5.00 revolutions?

Problem 2)

a) Calculate the magnitude of the angular momentum of the earth in a circular orbit around the sun. Is it reasonable to model it as a particle ?

b) Calculate the magnitude of the angular momentum of the earth due to its rotation around an axis through the north and south poles, modeling it as uniform sphere.

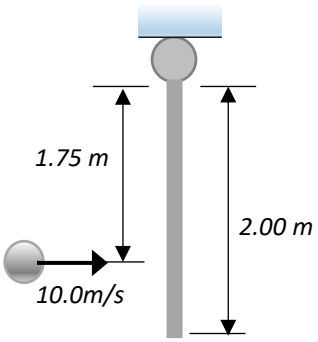


Problem 3)

A thin, uniform metal bar, 2.00 m long and weighing 90.0 N, is hanging vertically from the ceiling by a frictionless pivot. Suddenly it is struck 1.75 m below the ceiling by a small 3.00 kg ball, initially traveling horizontally at 10.0 m/s. The ball rebounds in opposite direction with a speed of 6.00 m/s.

a) Find the angular speed of the bar just after the collision.

b) During the collision, why is the angular momentum conserved but not the linear momentum?



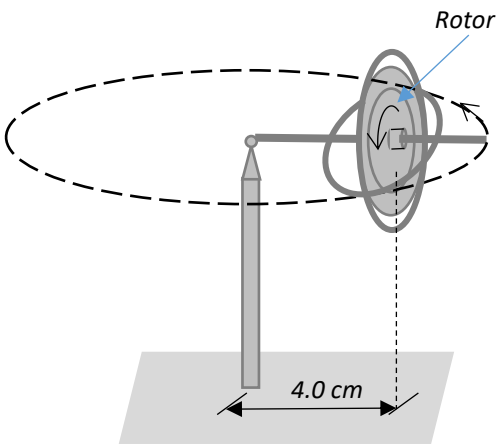
Problem (4)

The rotor (flywheel) of a toy gyroscope has mass 0.140 kg. Its moment of inertia about its axis is 1.20×10^{-4} kg.m^2. The mass of the frame is 0.0250 kg. The gyroscope is supported on a single pivot with its center 4.00 cm from the pivot. The gyroscope is precessing in a horizontal plane at tha rate of one revolution in 2.20 s.

a) Find the upward force exerted by the pivot.

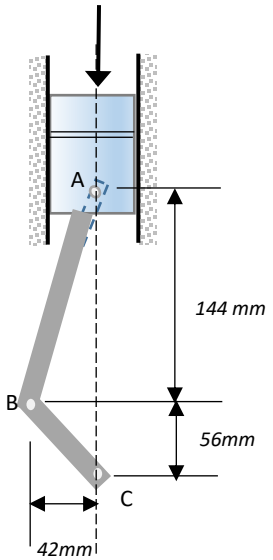
b) Find the angular speed with which the rotor is spinning about its axis, expressed in rev/min.

c) Copy the diagram and draw vectors to show the angular momentum of the rotor and the torque on it.



Problem 5)

Connection rod AB exerts on the crank BC a 2.5 - kN force directed down and to the left along the centerline AB. Determine the torque of that force about C.

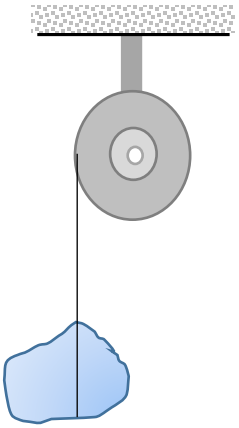


Problem 6)

A stone is suspended from the free end of a wire that is wrapped around the outer rim of a pulley. The pulley is uniform disk with mass of 10.0 kg and radius of 50.0 cm and turns on a frictionless bearings. In the first 30.0 s starting from rest the stone travels 12.6 m. Find

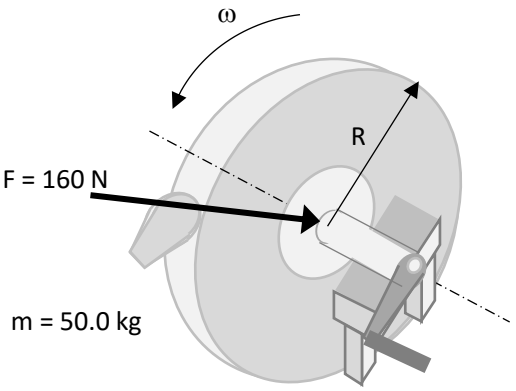
a) the mass of the stone,

b) the tension in the wire.



Problem 7)

A 50.0-kg grindstone is a solid disk 0.520 m in diameter. You press an ax down on the rim with normal force of 160 N. The coefficient of kinetic friction between the blade and stone is 0.60, and there is a constant friction torque of 6.5 N.m between the axle of the stone and its bearing.



a) How much force must be applied tangentially at the end of a crank handle 0.50 m long to bring the stone from rest to 120 rev/min in 9.0 s?

b) After the grindstone attains an angular speed of 120.0 rev/min what tangential force at the end of the handle is needed to maintain a constant angular speed of 120.0 rev/min.

c) How much time does it take the grindstone to come from 120.0 rev/min to rest it it is acted by the axle friction alone?