

PHYS 211 Homework Assignment

Chapter 10

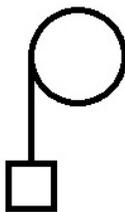
Problem 1 An athlete at the gym holds a 3.0 kg steel ball in his hand. His arm is 70 cm long and has a mass of 4.0 kg (assume it is uniform). What is the magnitude of the torque about his shoulder if he holds his arm straight, but 45° below the horizontal?

Problem 2 Two masses are connected to either end of a rigid rod of length 2 meters. If the left mass is 3 kg and the right mass is 8 kg, where is the center of mass? Assume the mass of the rod is negligible compared to the other masses. If this object begins to rotate about its center of mass with an angular frequency of 0.50 radians per second, what is the tangential velocity of each mass?

Problem 3 While working on your car you need to tighten your spark plugs to a torque of 41 N m. The wrench you are using is 0.25 meters long, and because of the limited space under the hood you have to pull at an angle 60 degrees from the radial axis. What force must you apply to the wrench?

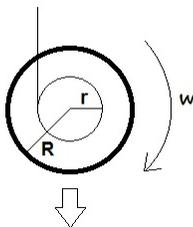
Problem 4 A 5.0 kg mass is attached to a string wrapped around a uniform 0.50 kg pulley with radius $R = 0.20$ m, as seen below.

- What will be the speed of the mass after falling through 5 meters? (Assume it starts from rest and there is no slipping of the string on the pulley.)
- What will be the angular velocity of the pulley at this instant?



Problem 5 You drop a yo-yo of mass 100 g from rest and hang on to the string such that it unwinds on its way down.

- If the outer radius of the yo-yo is 2.5 cm ($R = 2.5$ cm) and the inner radius is 1 cm ($r = 1$ cm), what is the acceleration at which it falls? (Assume that $I_{yo-yo} = \frac{1}{2}mR^2$)
- After falling 2 meters, what will the angular velocity be?



Problem 6 A sphere of radius 10 cm and mass 1 kg, rolls down a 15° incline without slipping. If the sphere starts at rest and rolls down the incline 3 meters,

- (a) What is the total kinetic energy after the 3 meters?
- (b) What is the angular velocity of the sphere at this point?
- (c) What is the amount of rotational kinetic energy at this point?