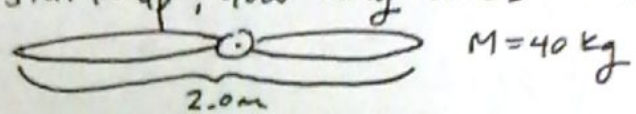


Rotational Motion Problems (moments of inertia & rolling)

1. In the 'caber toss' (a contest of strength and skill) of Scotland, contestants toss a heavy uniform pole, landing it on its end. A 5.9 tall pole with a mass of 79 kg has just landed on its end. It is tipped by 25° from the vertical and is starting to rotate about the end that touches the ground. Estimate the angular acceleration. $I = \frac{1}{3} mL^2$
2. The engine in a small airplane is specified to have a torque of 500 Nm. This engine drives a 2.0 meter long 40 kg single blade propeller. On start-up, how long does it take to reach 2000 rpm?
 $I = \frac{1}{2} ML^2$

3. Caleb has just raised a 2.5 kg bucket of water using a well's winch when he accidentally lets go of the handle. The winch consists of a rope wrapped around a 3 kg 4.0 cm diameter cylinder, which rotates on an axle through the center. The bucket is released from rest 4.0 meters above the water level of the well. How long does it take to reach the water? $I = \frac{1}{2} MR^2$
4. The diameter of a tire is .6 meters. If a trip is taken for 60 miles at a speed of 45 mph, (a) During the trip, what is the tires' angular speed? (b) How many times did they revolve? (4 tires)
5. A gyroscope is a top-like toy consisting of a heavy ring attached by light spokes to a central axle. The axle and ring are free to turn on bearings. To get the gyroscope spinning, a 30 cm long string is wrapped around a 2.0 mm diameter axle, then pulled with a constant force of 5 N. If the ring's diameter is 5 cm and its mass is 30 grams, at what rate is the it spinning, in rpm, once the string is completely unwound?
6. You can balance a meterstick or baseball bat in the palm of your hand with relative ease. But it is nearly impossible to balance a pencil this way. Why?