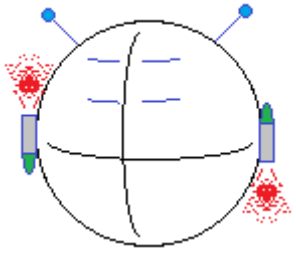
Physics I

Torque

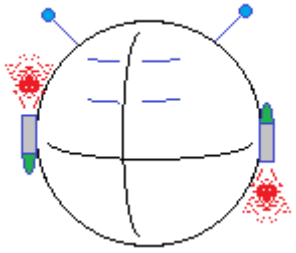
Torque: $\tau = Fr\sin\angle_F^r$

Newton's second law for a rotating system: $\tau = I\alpha$

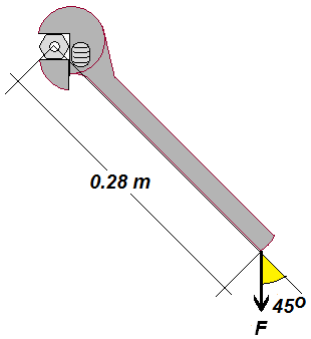
Problem 1.- Consider a spherical satellite of mass 5,500 kg and radius 2.5 m
Assume the mass of the satellite is uniformly distributed over the volume, so its moment of inertia is $\frac{2}{5}mR^2$
Two small rockets on the sides apply steady forces of 25N each to spin the satellite. Calculate how long we need to run the rockets to reach an angular velocity of 18rpm.



Problem 1a.- Consider a spherical satellite of 2.4m radius, whose mass is uniformly distributes close to its surface, so it can be modeled as a hollow sphere.
Two small rockets are turned on for 5 minutes and apply 15N each to make the satellite rotate from rest to 18rpm. Calculate the mass of the satellite. Ignore the mass lost by the rockets.



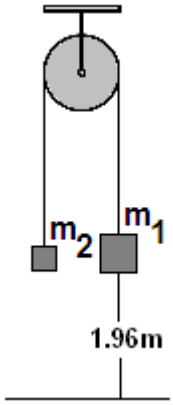
Problem 2.- What should be the force F if the torque about the center of the nut should be 25 Nm?



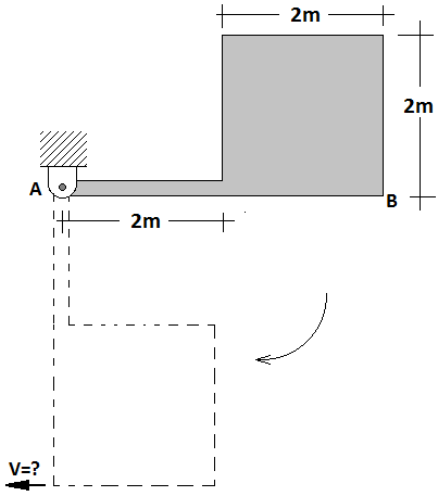
Problem 3.- A ballplayer swings the bat reaching an angular velocity of 3.5rev/s in a time of 0.18s. Approximate the bat as a uniform rod of mass 2.6 kg and length 1.05m and calculate the torque applied by the athlete.

Moment of inertia of a rod rotating about one end is $I = \frac{1}{3}mL^2$

Problem 4.- In the Atwood machine shown in the figure m_1=10kg and m_2=9kg and the mass of the pulley is 2kg. Approximate the pulley as a disk ($I = \frac{1}{2}mR^2$). Ignore friction in the axis of the pulley. Find how long it will take for m_1 to hit the ground if you release the masses with zero initial velocity.



Problem 5.- Consider a mechanical piece built by joining a 2m long bar of negligible mass and a square plate of 2m side and mass 4kg. The piece is released from rest from the position shown below and it rotates freely around A. Calculate the velocity of point B when it passes the vertical line below A.



Problem 5a.- Consider a mechanical piece in the shape of an L, built by joining two identical thin 20cm long bars AB and BC. The piece is released from rest from the position shown below and it rotates freely around A. Calculate the velocity of point B when it passes the vertical line below A.