Engineering Physics I
PHYS 1210

Name ____________________

Spring 2015

Discussion 9 – More Rotation (Ch 10)

Equations

$K_{rot} = \frac{1}{2} I\omega^2$

$\sum \vec{\tau} = I\vec{\alpha}$

$I_{disk} = \frac{1}{2} MR^2$

$\vec{\tau} = \vec{r} \times \vec{F}$

$\tau = rF_{\perp} = r_{\perp}F = rF\sin\theta$

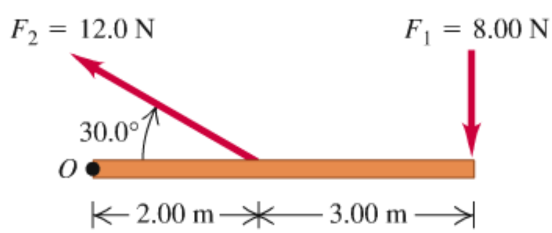
$\vec{L} = m\vec{\omega}$

$\vec{L} = \vec{r} \times m\vec{v}$

Problems (Young & Freedman, 13e)

10.2 • Calculate the net torque about point O for the two forces applied as in Fig. E10.2. The rod and both forces are in the plane of the page.

Figure **E10.2**



A) As above.

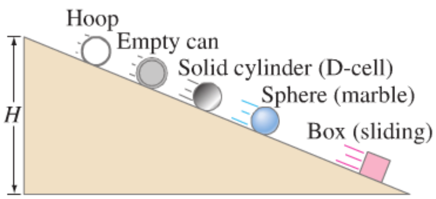
B) What would be the torque about the right end?

The Rolling Race (Giancoli 4e)

CONCEPTUAL EXAMPLE 10–17 **Which is fastest?** Several objects roll without slipping down an incline of vertical height H, all starting from rest at the same moment. The objects are a thin hoop (or a plain wedding band), a spherical marble, a solid cylinder (a D-cell battery), and an empty soup can. In what order do they reach the bottom of the incline? Compare also to a greased box that slides down an incline at the same angle, ignoring sliding friction.

(cont'd on next page)

FIGURE 10–34 Example 10–17.



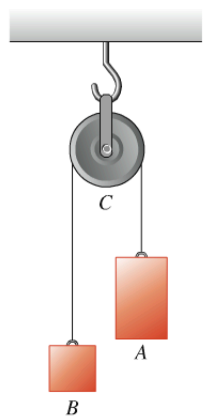
Also add a hollow tennis ball.

Ring or Hollow Cylinder $I=MR^2$, *Disk or Solid Cylinder* $\frac{1}{2}MR^2$, *Hollow Sphere* $(2/3)MR^2$, *Solid Sphere* $(2/5)MR^2$

Hint: The fastest one will reach the bottom first. How can you find their speeds?

10.67 •• Atwood's Machine. Figure P10.67 illustrates an Atwood's machine. Find the linear accelerations of blocks *A* and *B*, the angular acceleration of the wheel *C*, and the tension in each side of the cord if there is no slipping between the cord and the surface of the wheel. Let the masses of blocks *A* and *B* be 4.00 kg and 2.00 kg, respectively, the moment of inertia of the wheel about its axis be $0.300\ \text{kg}\cdot\text{m}^2$, and the radius of the wheel be 0.120 m.

Figure **P10.67**



A) As above.
B) Assuming the wheel/pulley acts as a disk, find an algebraic expression for the acceleration, *a*, of blocks A and B.
C) Sanity check: compare this to the solution for the massless pulley version in Problem 5.15 (Discussion 4), below.

$$a = \left(\frac{m_A - m_B}{m_A + m_B}\right)g$$

D) What is the total Moment of Inertia of this system?
E) After 0.50s, what is the linear velocity of the two blocks?
F) …angular velocity of the pulley?
G) …kinetic energy of the system?
H) …angular momentum of the system?