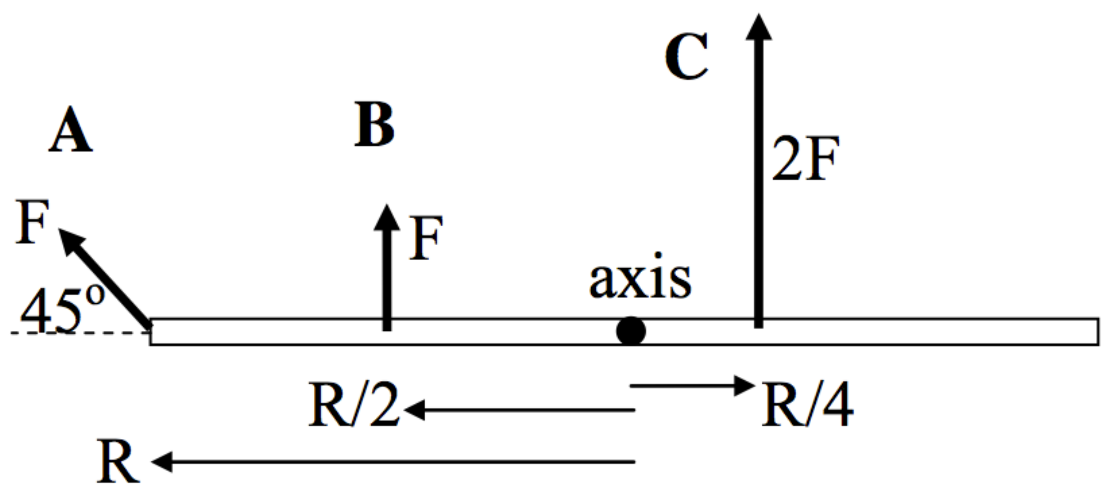
10-1) What is the magnitude of the angular acceleration α of a spinning wheel that is spinning at constant rate?

A) Zero
B) v^2/R
C) g
D) $2\pi R/T$
E) None of these

10-2) Three forces labeled A, B, C are applied to a rod which pivots on an axis through its center.

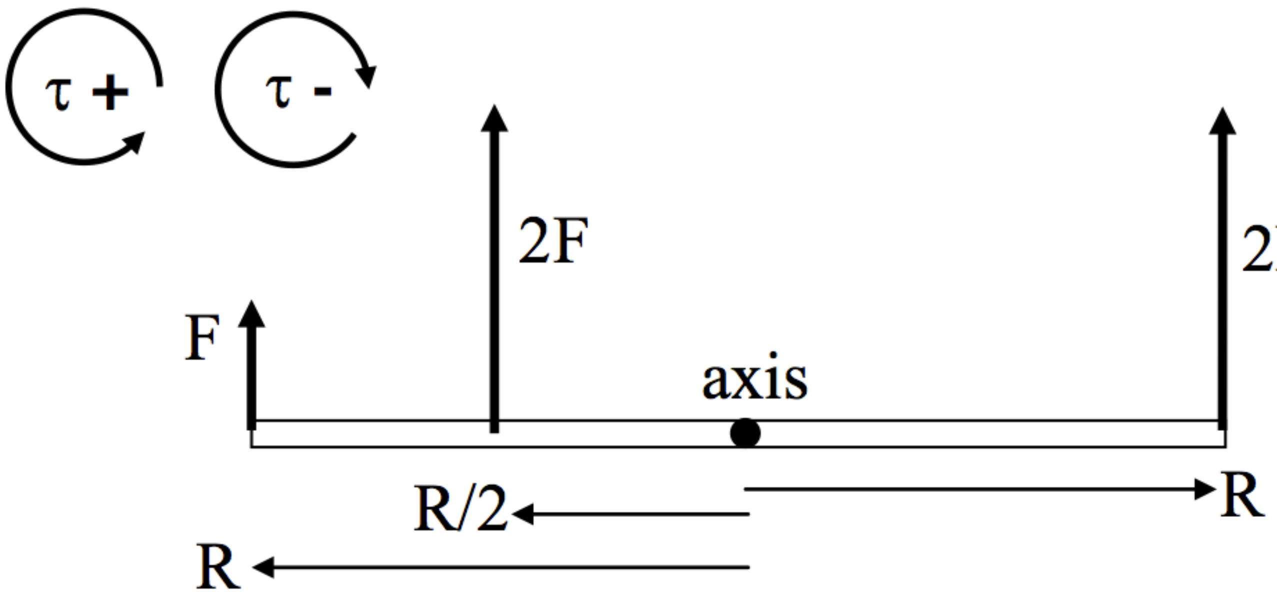
$$\left[\cos(45°) = \sin(45°) = 1/\sqrt{2} = 0.707\right]$$

Which force causes the largest magnitude torque?



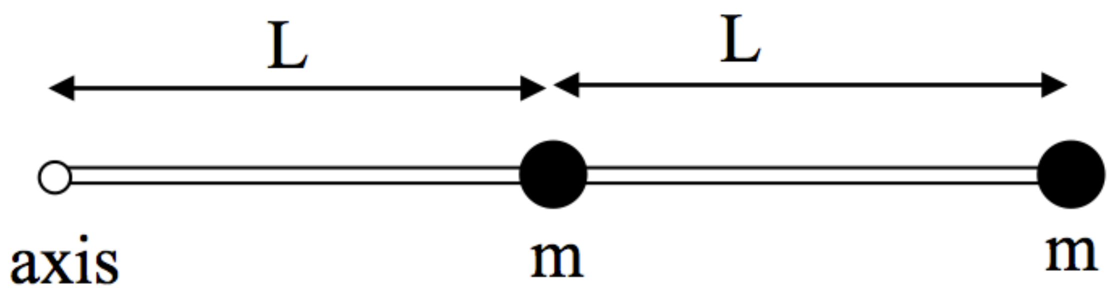
D) Two or more tie for the largest torque.

10-3) Three forces are applied to a rod which rotates about the center. What is the net torque about the axis? Recall the sign convention.



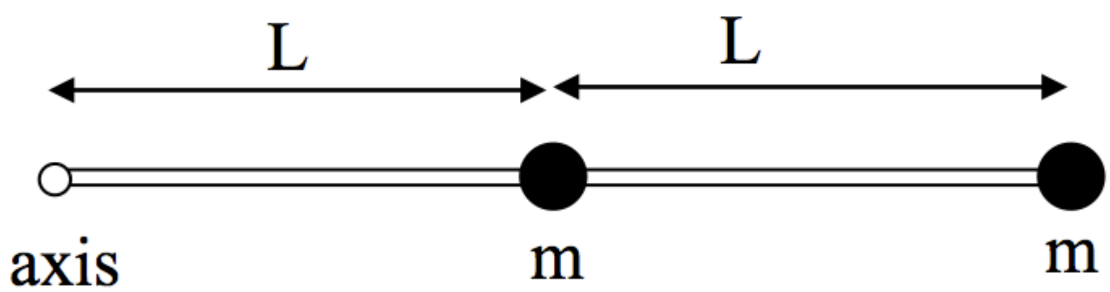
A) +RF B) –RF C) Zero D) +3RF E) -3RF

10-4a) A light rod of length 2L has 2 small heavy masses (each with mass m) attached at the end and the middle. The axis of rotation is at one end, as shown. What is the moment of inertia about the axis?



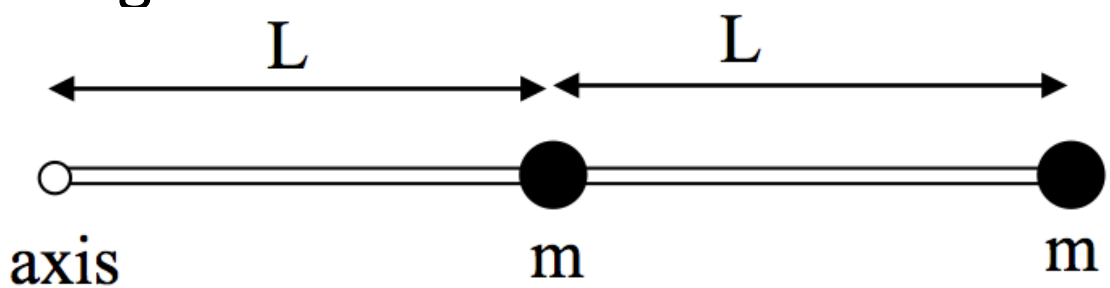
A) $2mL^2$ B) $4mL^2$ C) $5mL^2$ D) $8mL^2$ E) None of these

10-4b) A light rod of length 2L has 2 small heavy masses (each with mass m) attached at the end and the middle. The axis of rotation is at one end, as shown. What is the magnitude of the net torque due to gravity?



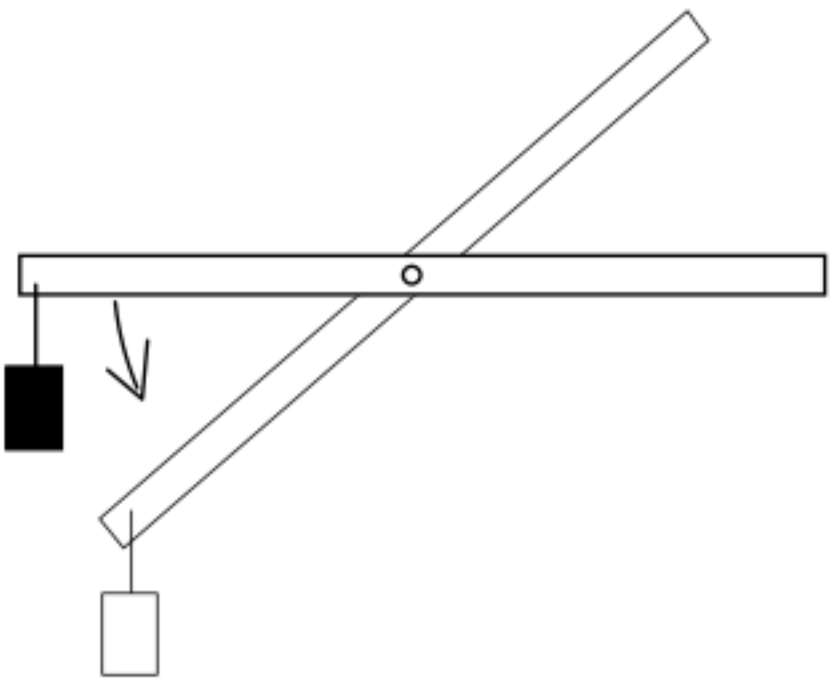
A) 2mgL B) 3mgL C) 4mgL D) 5mgL

10-4c) A light rod of length 2L has 2 small heavy masses (each with mass m) attached at the end and the middle. The axis of rotation is at one end, as shown. If the bar is released from rest what is the magnitude of the initial angular acceleration?



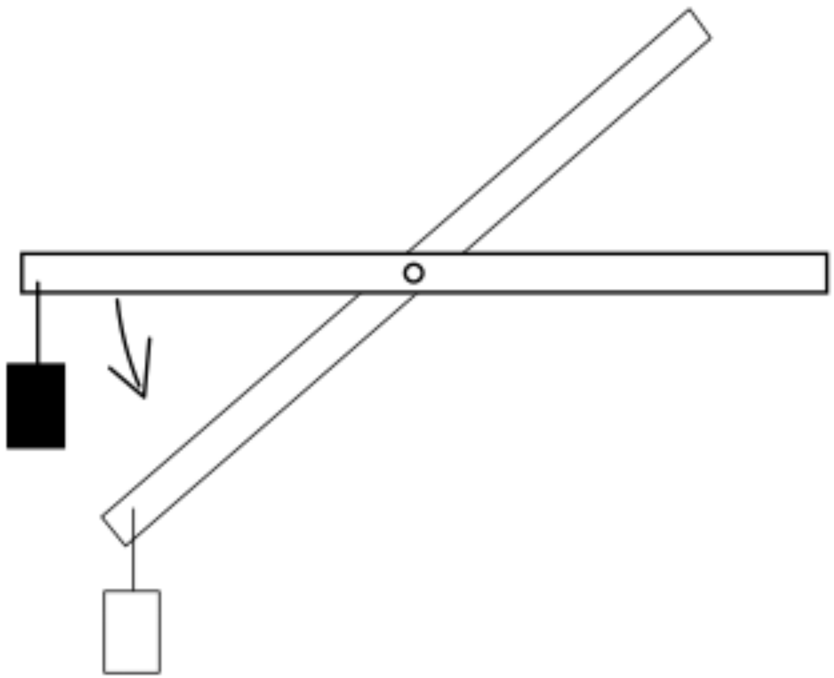
A) 3g/(5L) B) 5g/(3L) C) 7L/(3g) D) 3L/(5g)

10-5a) A mass is hanging from the end of a horizontal bar which pivots about an axis through it center, but it being held stationary. The bar is released and begins to rotate. As the bar rotates from horizontal to vertical, the magnitude of the torque on the bar..



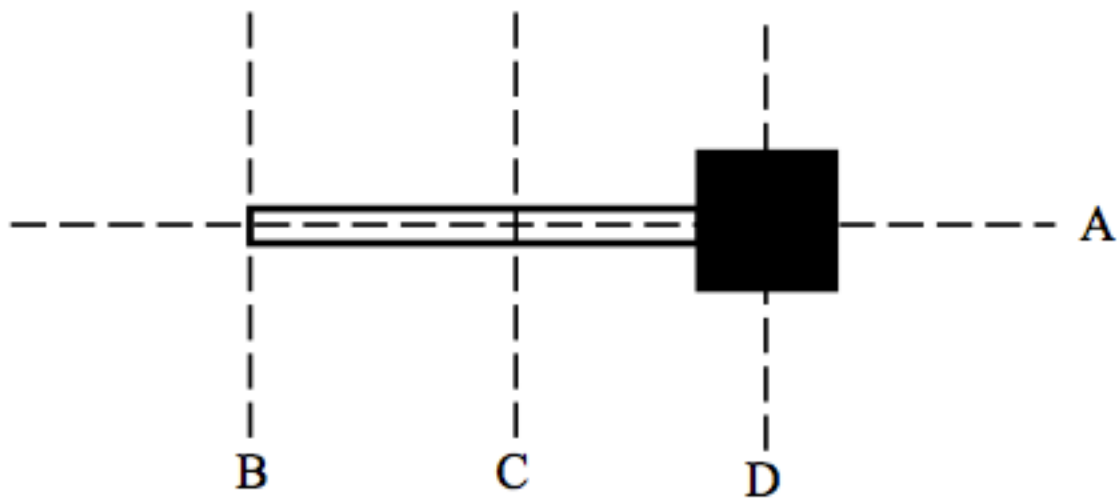
A) Increases
B) Decreases
C) Remains constant

10-5b) As the bar rotates from horizontal to vertical, the magnitude of the angular acceleration α of the bar..

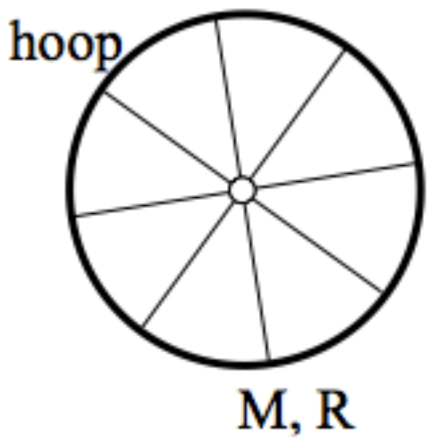


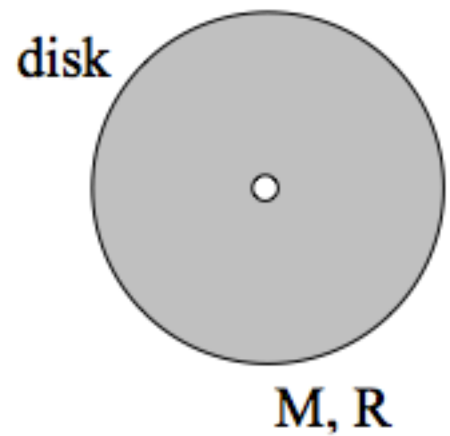
A) Increases
B) Decreases
C) Remains constant

10-6) A mallet consists of a heavy steel cubical head on a light wooden handle. About which axis of rotation is the moment of inertia I a **maximum**?



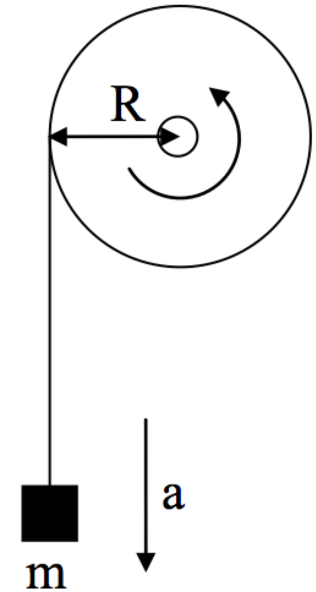
10-7) Two wheels, each with the same radius R and the same total mass M, are rotating about their fixed axels. Wheel A is a hoop with all the mass very near the rim. Wheel B is a disk with the mass spread out uniformly. Which has the larger moment-of-inertia $I = \Sigma m_i r_i^2$?





A) Hoop B) Disk C) Both have the same I

10-8a) A mass m hangs from string wrapped around a pulley of radius R. The pulley has a moment of inertia I and its pivot is frictionless. Because of gravity, the mass accelerates downward and the pulley rotates.



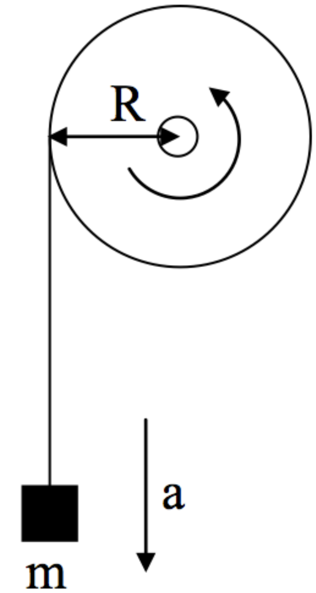
Which has greater magnitude, the string tension F_T or the weight mg?

A) $F_T = mg$

B) $F_T < mg$

C) $F_T > mg$

10-8b) A mass m hangs from string wrapped around a pulley of radius R. The pulley has a moment of inertia I and its pivot is frictionless. Because of gravity, the mass accelerates downward and the pulley rotates.



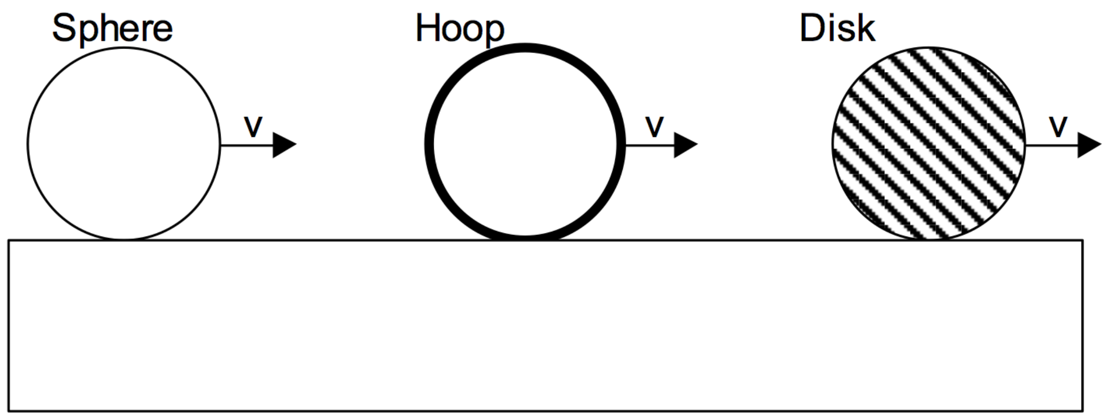
The magnitude of the torque on the pulley is..

A) greater than mgR

B) less than mgR

C) equal to mgR

10-9a) A sphere, a hoop, and a cylinder, all with the same mass M and same radius R, are rolling along, all with the same speed v. Which has the most **total** kinetic energy?



A) Sphere
B) Hoop
C) Disk
D) All have the same KE.

10-9b) I roll a disk and a hoop (same mass, m) down an inclined plane, which one reaches the bottom first?

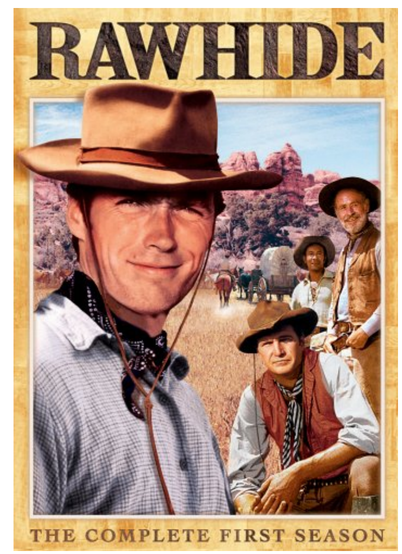
A) Hoop
B) Disk
C) Both at the same time

10-9c) I roll two disks with different masses down an inclined plane, which one reaches the bottom first?

A) Heavy disk
B) Light disk
C) Both at the same time

Example: Rolling, rolling, rolling…

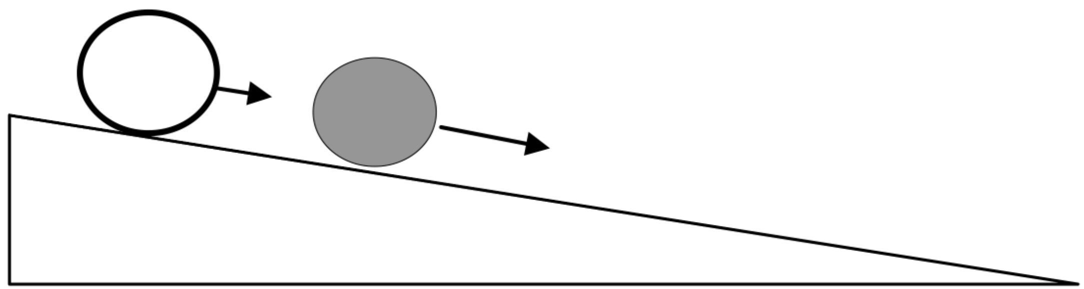
Consider rolling a variety of objects down the same incline. We need to explain why objects that are similarly shaped always tie, and objects that are different don't (i.e., that disks always beat hoops).



10-9d) So in the example, a big β gives rise to a __________ final speed.

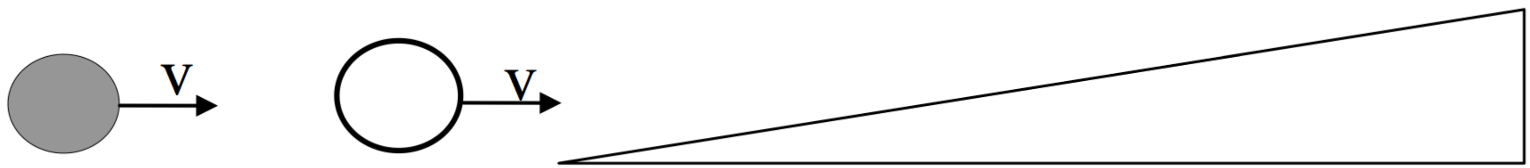
A) Large
B) Small
C) Can't tell

10-10) A disk and a hoop, both with the same mass M and the same radius R, both start from rest at the top and roll down an incline. Which one has the largest total kinetic energy at the bottom?



A) Disk
B) Hoop
C) same K_{tot} for both

10-11) A disk and a hoop, both with the **same mass** M and the **same radius** R, both roll without slipping with the **same speed** v, and are rolling toward an inclined plane, as shown. Which object will roll up to the greatest height on the incline?



A) Disk
B) Hoop
C) same max height for both

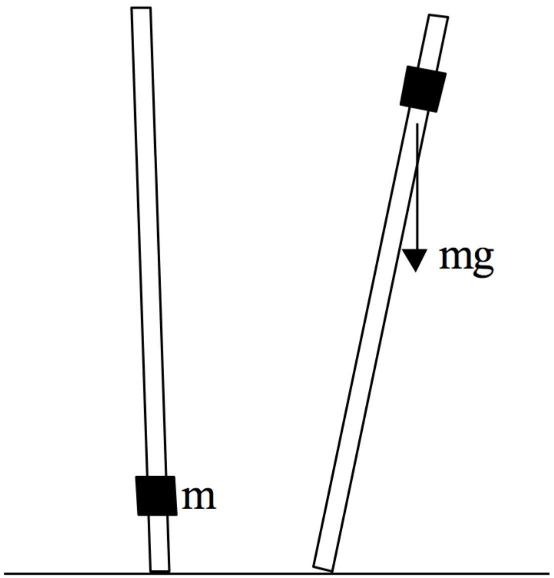
Your thoughts

- More examples
  (Just ask, but do it early – Tuesday-ish)
- Solutions to homework
  (Use the Google)
- It doesn't help you, but believe things are changing (slowly).

10-11) A disk and a hoop, both with the **same mass** M and the **same radius** R, both roll without slipping with the **same speed** v, and are rolling toward an inclined plane, as shown. Which object will roll up to the greatest height on the incline?

A) Disk
B) Hoop
C) same max height for both

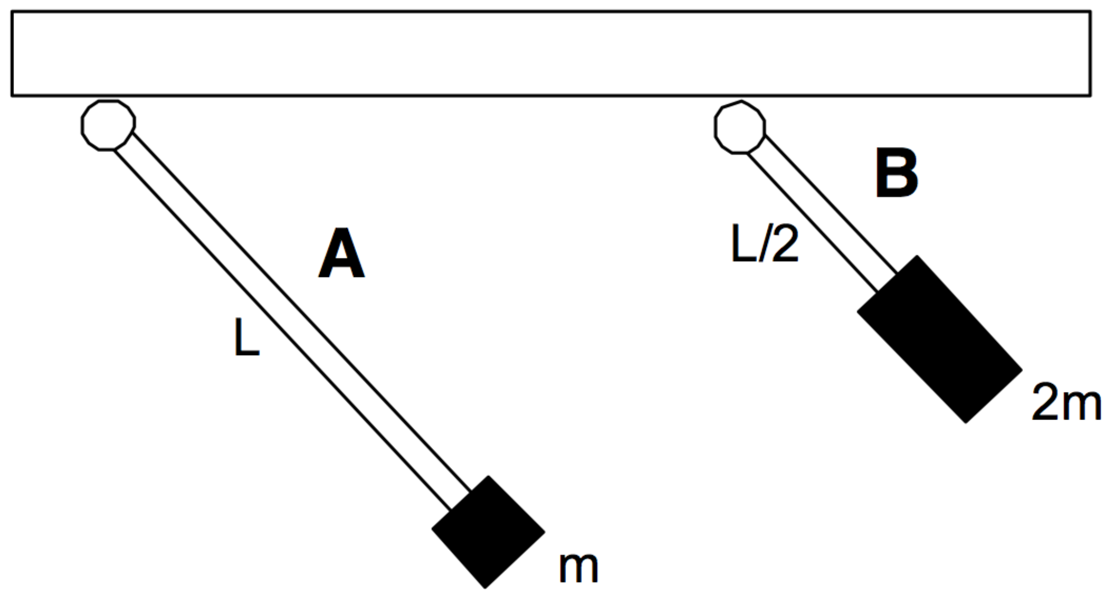
10-12) A mass m is attached to a long , massless rod. The mass is close to one end of the rod. Is it easier to balance the rod on end with the mass near the top or near the bottom?



Hint: Small α means sluggish behavior and $\alpha = \tau / I$

A) Easier with mass near top
B) Easier with mass near bottom
C) No difference.

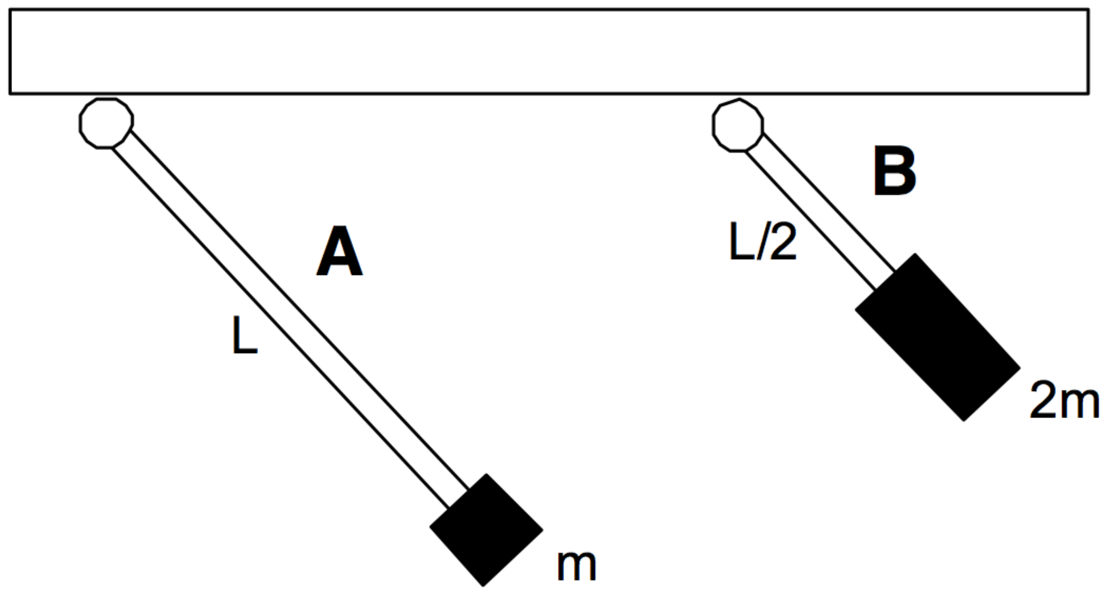
10-13a) Two light (massless) rods, labeled A and B, each are connected to the ceiling by a frictionless pivot. Rod A has length L and has a mass m at the end of the rod. Rod B has length L/2 and has a mass 2m at its end. Both rods are released from rest in a horizontal position.



Which one experiences the larger torque?

A) A
B) B
C) Same τ

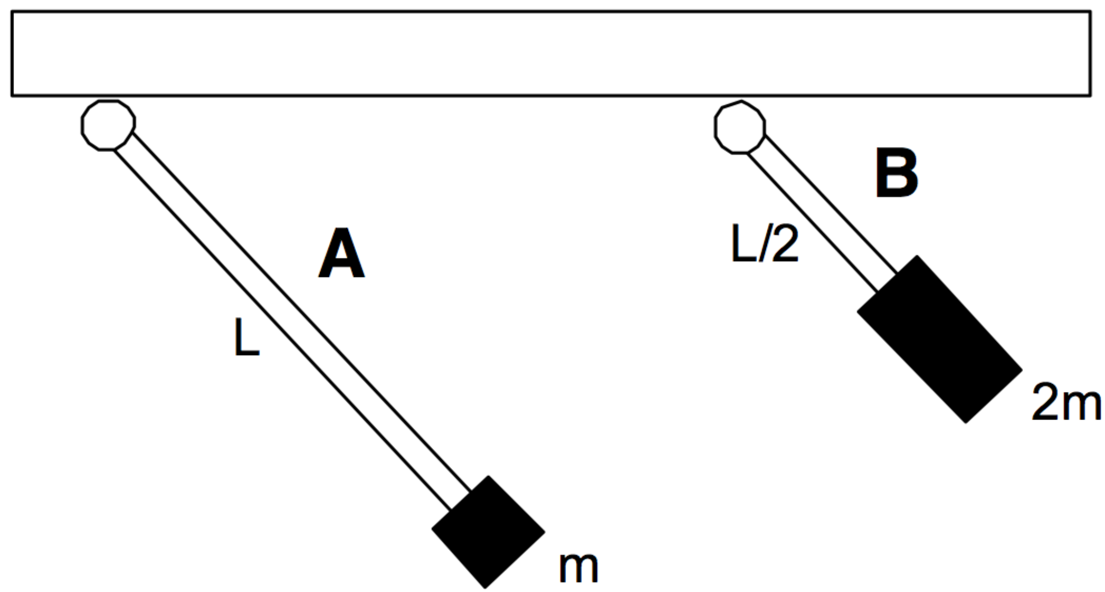
10-13b) Two light (massless) rods, labeled A and B, each are connected to the ceiling by a frictionless pivot. Rod A has length L and has a mass m at the end of the rod. Rod B has length L/2 and has a mass 2m at its end. Both rods are released from rest in a horizontal position.



Which one has the largest moment of inertia I (about the pivot)?

A) A
B) B
C) Same I

10-13c) Two light (massless) rods, labeled A and B, each are connected to the ceiling by a frictionless pivot. Rod A has length L and has a mass m at the end of the rod. Rod B has length L/2 and has a mass 2m at its end. Both rods are released from rest in a horizontal position.



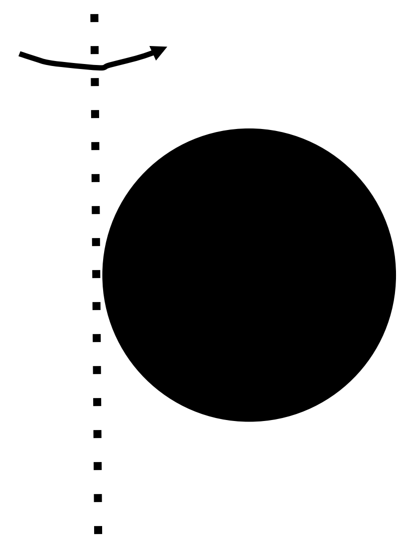
Which one falls to the vertical position fastest?

A) A
B) B
C) Same rate

Hint: $\alpha = \tau / I$

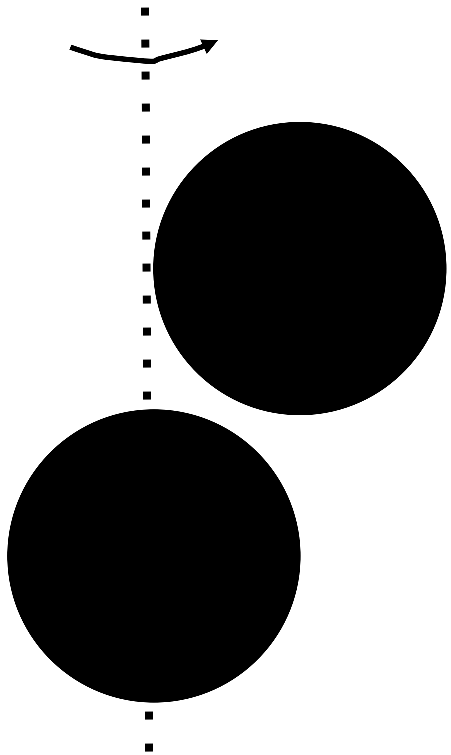
10-21a) Here's a puzzle. Consider a sphere that is not rotated about its center but about the edge? Does the moment of inertia change?
Hint: Has the configuration changed?

A) Yes, it's gone up
B) Yes, it's gone down
C) No, the moment of inertia of a sphere is always $2/5\ MR^2$



10-21b) What about these two objects (same M, same R)? I =

A) $2/5\ MR^2$
B) $2/5\ MR^2 + 2/5\ MR^2 = 4/5\ MR^2$
C) $2/5\ MR^2 + 2/5\ MR^2 + MR^2 = 9/5MR^2$
D) Something else

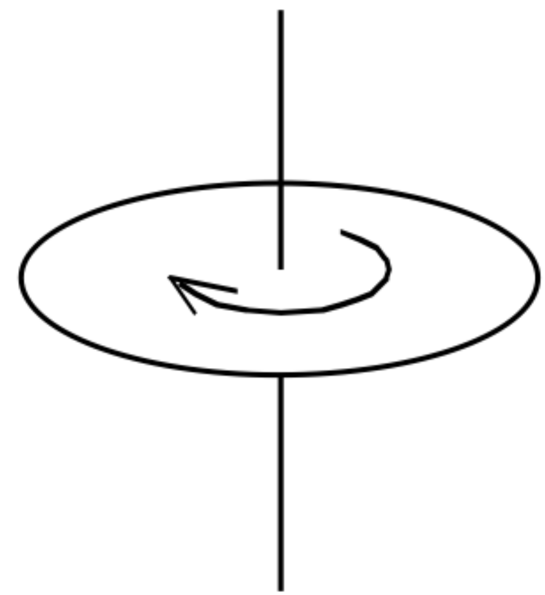


10-14) Have you ever studied the cross (vector) product before?

A) Yes
B) No
C) What?!

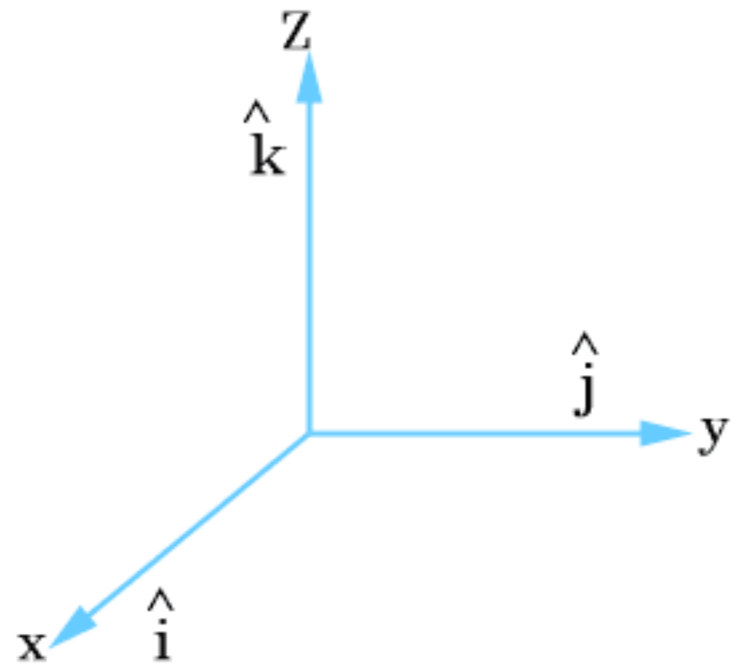
10-15) A disk is spinning as shown with angular velocity ω. It begins to slow down. While it is slowing, what is the direction of its vector angular acceleration $\vec{\alpha}$?

A) Up
B) Down
C) Left
D) Right
E) Some other direction, or zero.

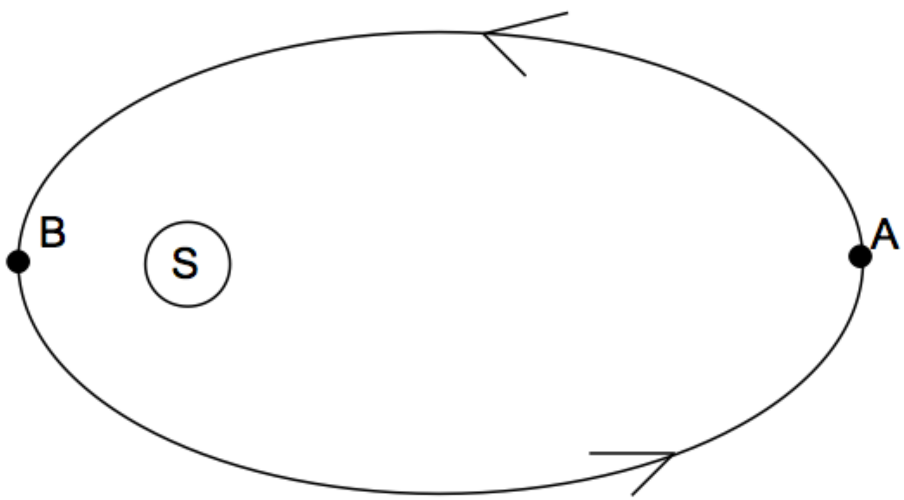


10-22) What is $\hat{i} \times \hat{j} + \hat{k}$?

A) 0
B) $2\hat{k}$
C) 2
D) $1\hat{k}$
E) 1

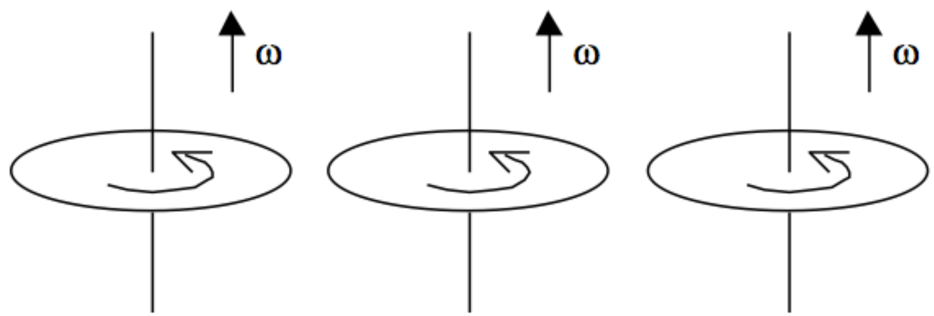


10-17) How does the magnitude of the angular momentum of the planet L_{planet} (with the origin at the Sun) at positions A and B compare?



A) $L_A = L_B$
B) $L_A > L_B$
C) $L_A < L_B$

10-18) Three identical wheels, all with momentum of inertia I, are all spinning with the same angular velocity ω. The total angular momentum of the 3-wheel system has magnitude 3Iω.

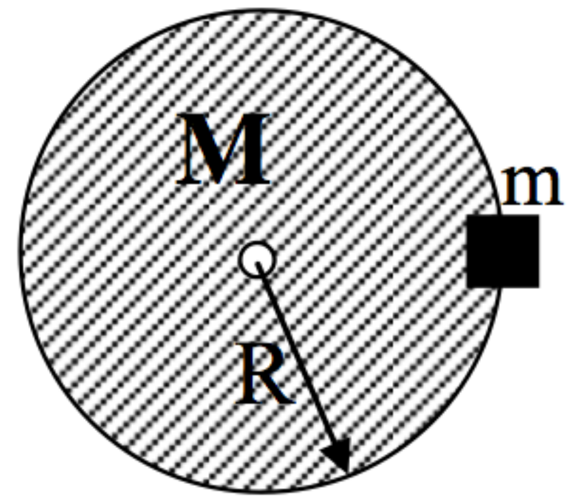


One of the three wheels is flipped upside-down, while the magnitude of its angular velocity remains constant.
The new angular momentum of the 3-wheel system has magnitude..

A) 3Iω (same as before)
B) 2Iω
C) Iω
D) some other value

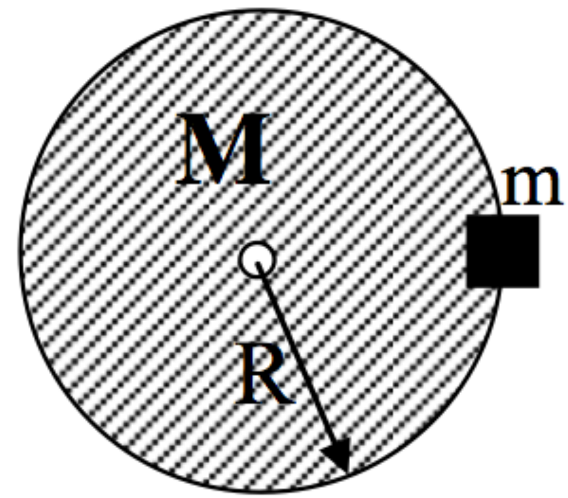
10-19a) Consider a solid disk with an axis of rotation through the center (perpendicular to the diagram). The disk has mass M and radius R. A small mass m is placed on the rim of the disk. What is the moment of inertia of this system?

A) $(M+m)R^2$
B) less than $(M+m)R^2$
C) greater than $(M+m)R^2$



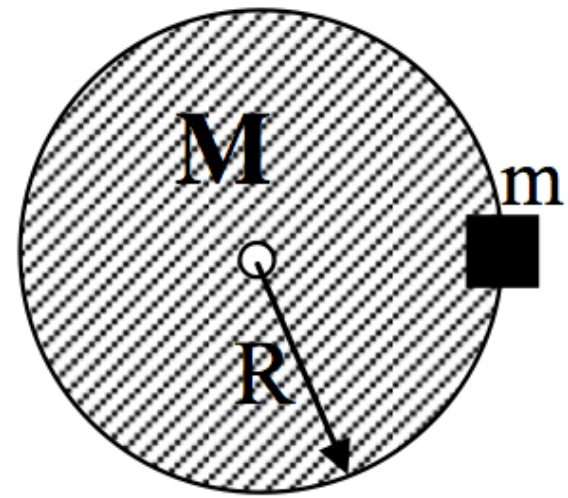
10-19b) Suppose that mass-disk system is rotating and the axle is frictionless. Atom-Ant carries the mass m toward the center of the rotating disk. As Atom-Ant moves inward, the magnitude of the angular momentum L of the system..

A) Increases
B) Decreases
C) Remains constant



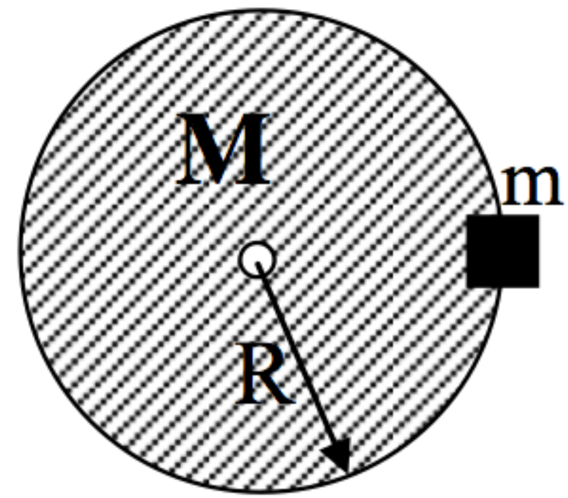
10-19c) As Atom-Ant moves inward, the kinetic energy of the system..

A) Increases
B) Decreases
C) Remains constant

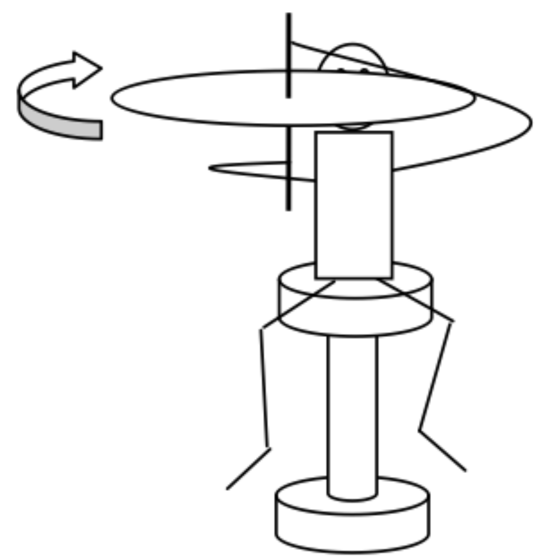


10-19d) Suppose the disk was on a phonograph player, so that it always turned at 33 rpm. As Atom-Ant moves inward, the speed v of the mass m

A) Increases
B) Decreases
C) Remains Constant



10-20) A stationary person is sitting on a frictionless stool while holding a frictionless spinning wheel. The axis of the wheel is vertical, and the magnitude of the angular momentum of the wheel is L_W. The person then flips the axis of the wheel, rotating it 180°. The wheel continues to spin at the same rate. After the wheel is flipped, the final angular momentum of the person +stool (just the person+stool, not the person+stool+wheel) is



A) Zero
B) L_W
C) $2L_W$
D) $(1/2)L_W$
E) None of these.

10-23) A star is rotating with a period T. Over a period of a million years, its radius decreases by a factor of 2. What is the new period of the star? (Hint: $I_{sphere} = 2/5\ MR^2$)

A) T/2
B) 2T
C) 4T
D) T/4
E) None of these.