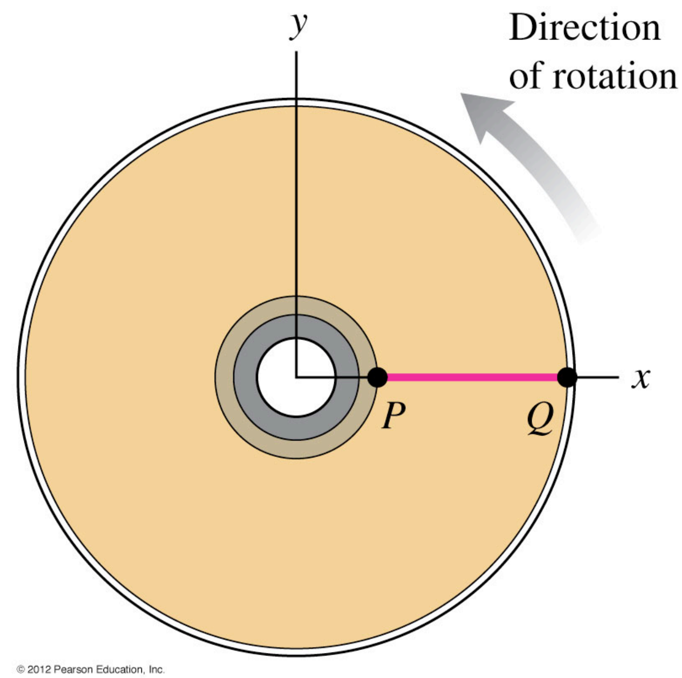
Q9.3

A DVD is rotating with an ever-increasing speed. How do the centripetal acceleration a_{rad} and tangential acceleration a_{tan} compare at points P and Q?



A. P and Q have the same a_{rad} and a_{tan}.

B. Q has a greater a_{rad} and a greater a_{tan} than P.

C. Q has a smaller a_{rad} and a greater a_{tan} than P.

D. P and Q have the same a_{rad}, but Q has a greater a_{tan} than P.

Exam #2

- April 7, 5-7pm
- CR 214 (Wednesday Labs) & CR 222 (Thursday Labs)
- Chapters 6-9
- Closed book, closed notes. One page single-sided equation sheet allowed.

Ch 9.4-5: Energy in Rotational Motion

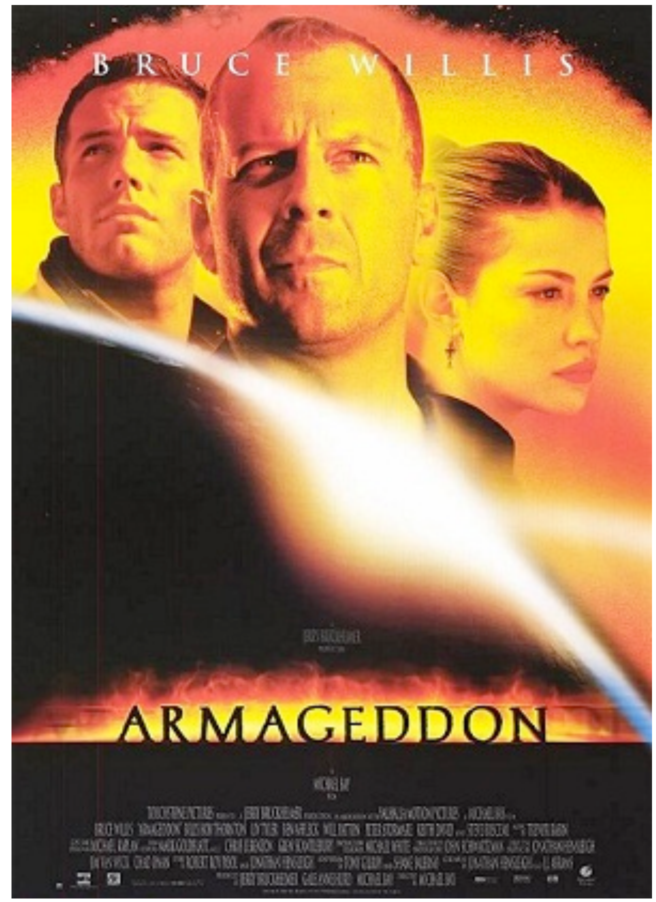
PHYS 1210 - Prof. Jang-Condell

A near-earth asteroid is on a collision course with the Earth!

Is sending Bruce Willis to blow it up a good idea?

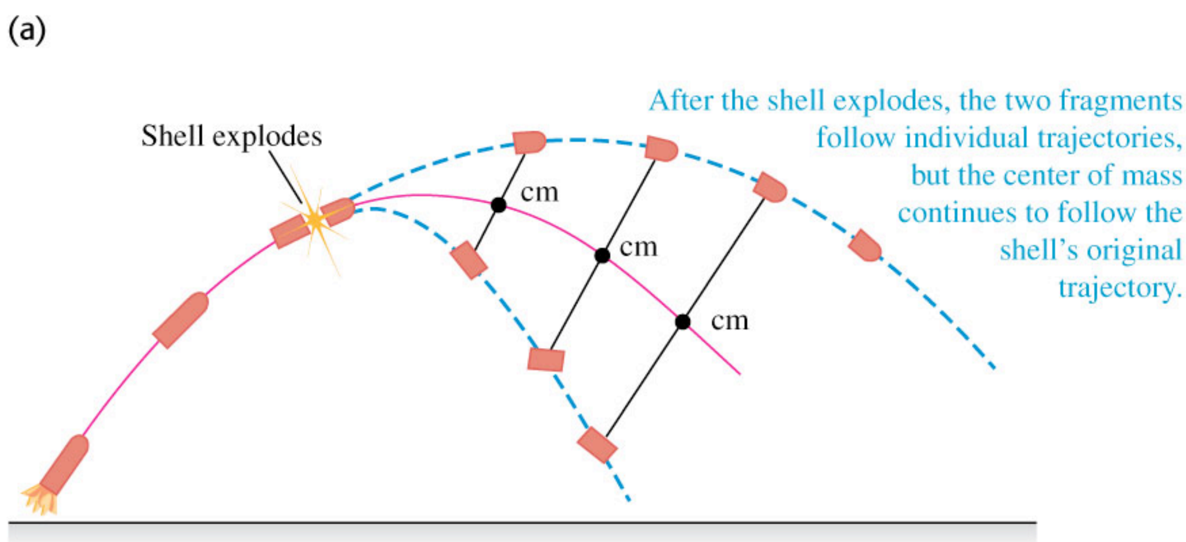
Why or why not?

Text PHYSJC and your answer to 22333.



External forces and center-of-mass motion

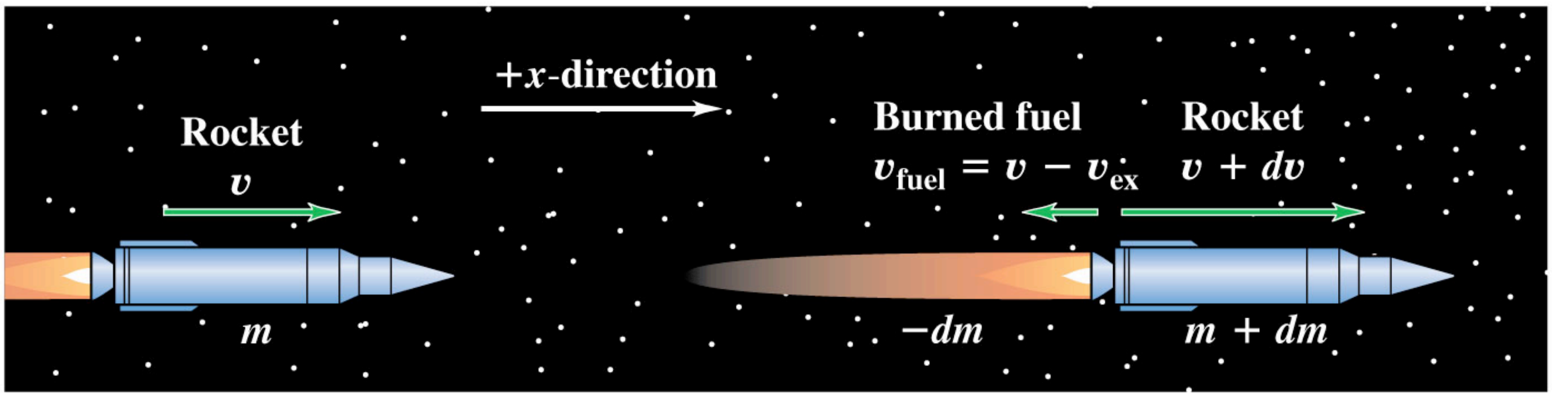
- When a body or collection of particles is acted upon by external forces, the center of mass moves as though all the mass were concentrated there (see Figure 8.31 below).



Rocket propulsion

- How does a rocket move in space?
- As a rocket burns fuel, its mass decreases.

(a) (b)



At time t**,** the rocket has mass m and x-component of velocity v.

At time $t + dt$**,** the rocket has mass $m + dm$ (where dm is inherently *negative*) and x-component of velocity $v + dv$. The burned fuel has x-component of velocity $v_{fuel} = v - v_{ex}$ and mass $-dm$. (The minus sign is needed to make $-dm$ *positive* because dm is negative.)

An astronaut is stranded in space. He decides to try to fly "like Iron Man" by poking holes in his hands and directing the airflow to propel himself. He loses 0.0100 kg of air per second, and the air flows at 300 m/s. If his total mass, including the space suit, is 150 kg, what is his acceleration?

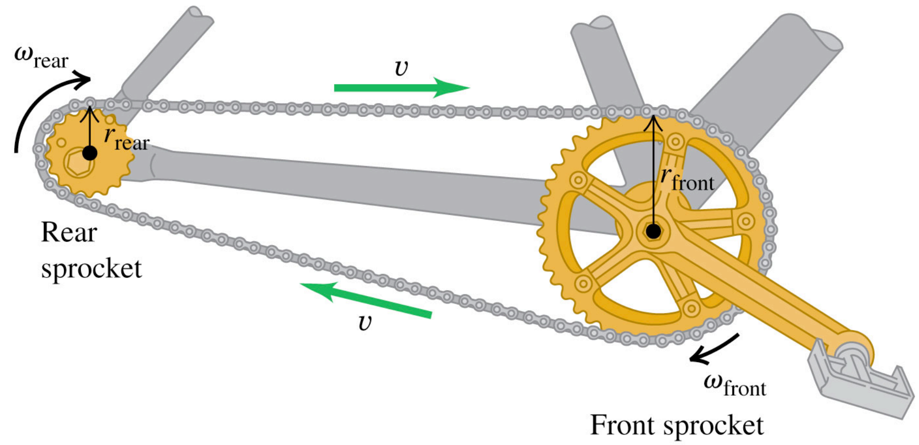
How long will it take him to reach a speed of 1 m/s?

Goals for Chapter 9

- To describe rotation in terms of angular coordinate, angular velocity, and angular acceleration
- To analyze rotation with constant angular acceleration
- To relate rotation to the linear velocity and linear acceleration of a point on a body
- To understand moment of inertia and how it relates to rotational kinetic energy
- To calculate moment of inertia

Q9.4

Compared to a gear tooth on the rear sprocket (on the left, of small radius) of a bicycle, a gear tooth on the *front* sprocket (on the right, of large radius) has



F. a faster linear speed and a faster angular speed.

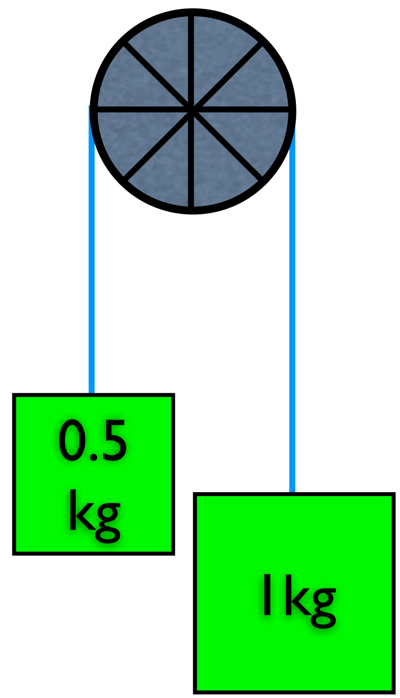
G. the same linear speed and a faster angular speed.

H. a slower linear speed and the same angular speed.

I. the same linear speed and a slower angular speed.

J. none of the above

The two weights pictured below are attached to a frictionless, massless pulley of radius 10 cm. What is the angular acceleration on the pulley?



Rotational Kinetic Energy

Rotational kinetic energy

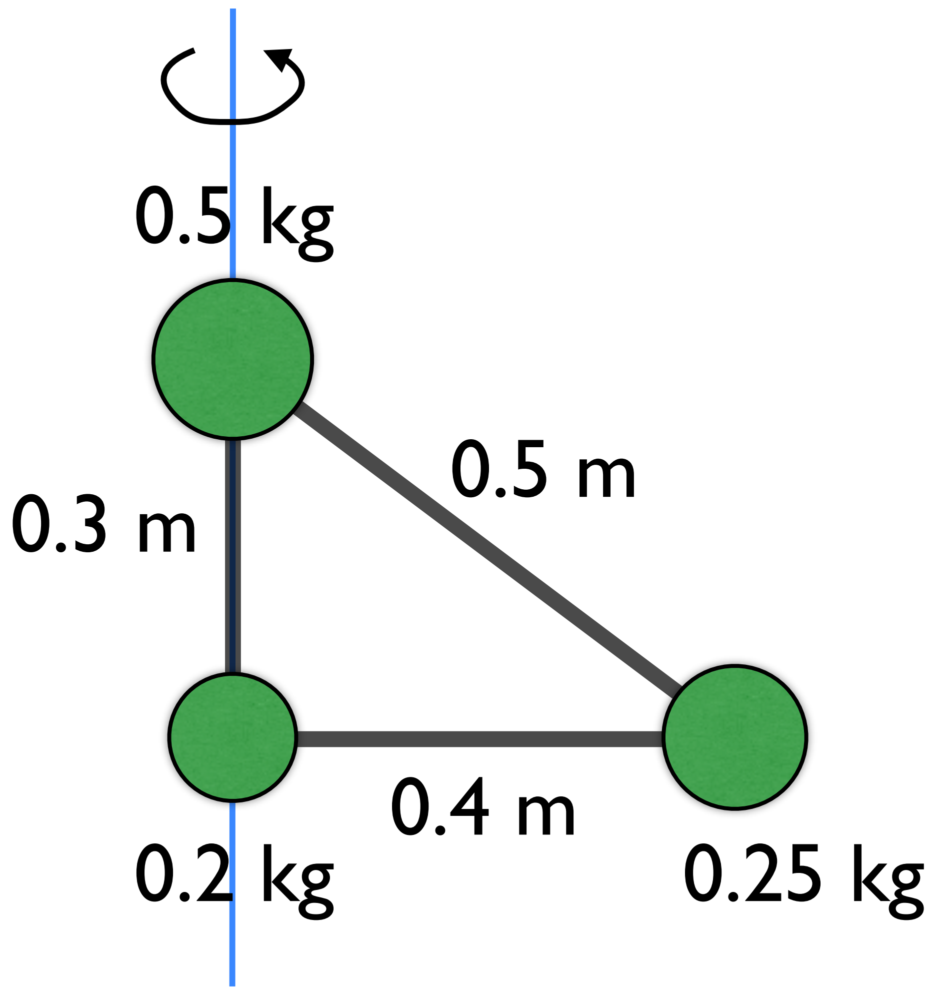
- The moment of inertia of a set of particles is

$$I = m_1 r_1^2 + m_2 r_2^2 + \ldots = \Sigma m_i r_i^2$$

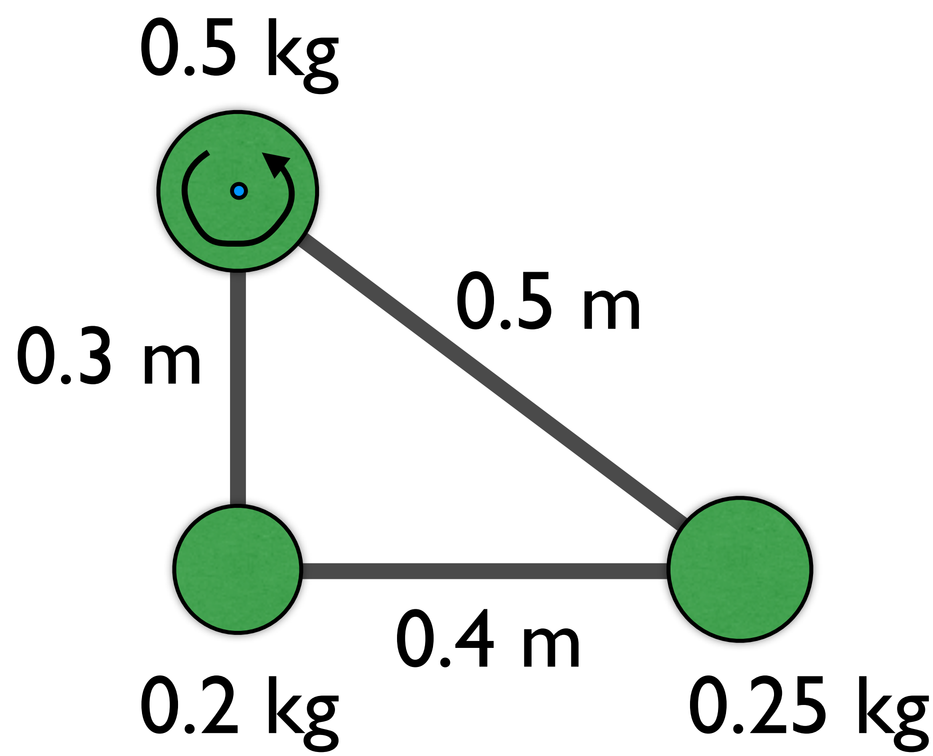
- The rotational kinetic energy of a rigid body having a moment of inertia I is

$$K = \frac{1}{2} I \omega^2$$

Find the Moment of Inertia

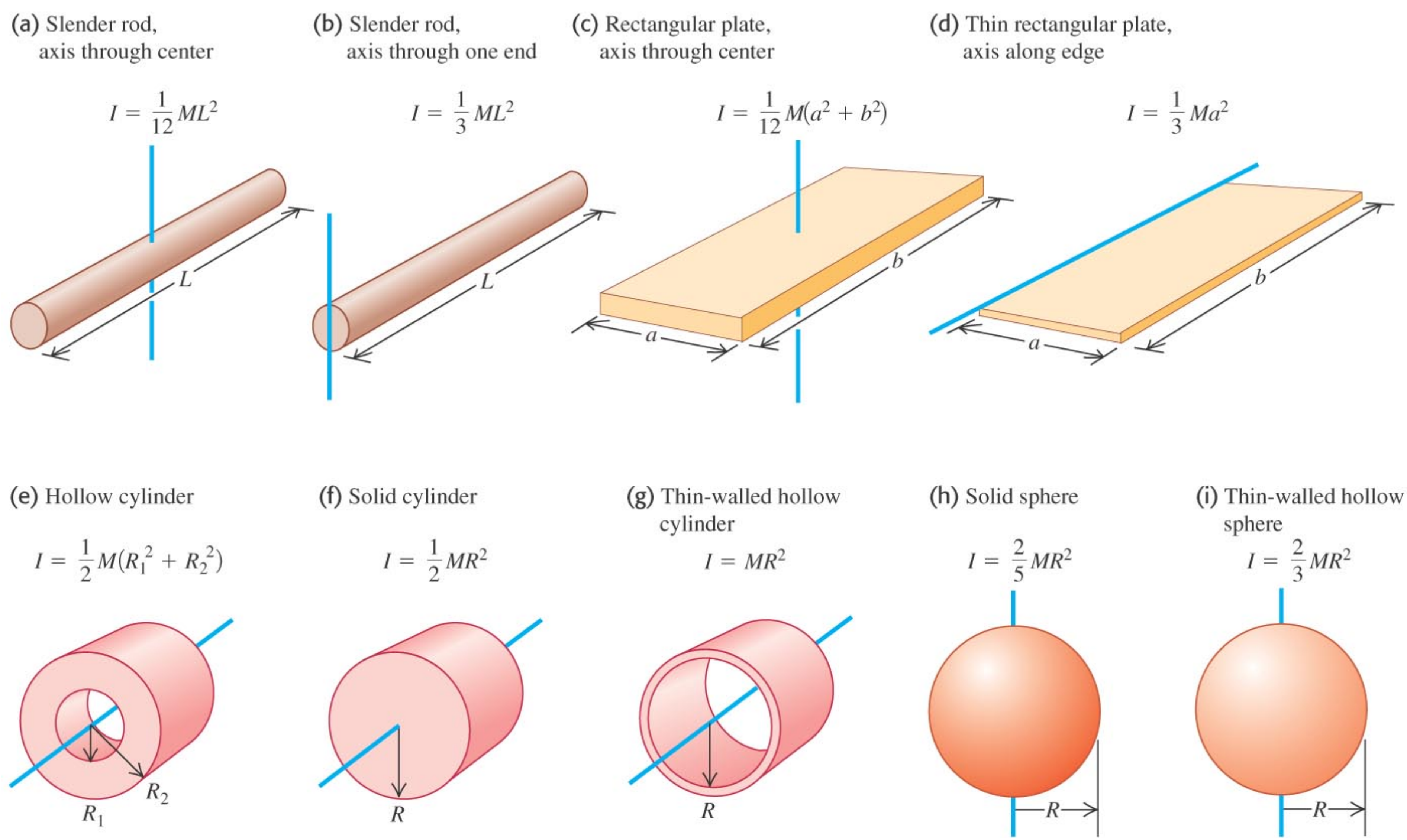


Find the Moment of Inertia



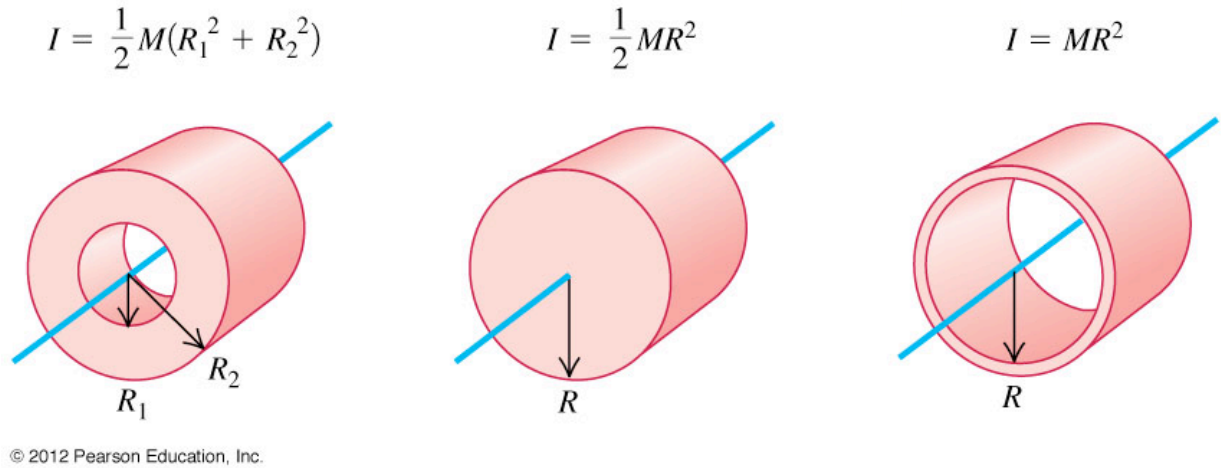
Moments of inertia of some common bodies

- Table 9.2 gives the moments of inertia of various bodies.



Q9.6

The three objects shown here all have the same mass *M* and radius *R*. Each object is rotating about its axis of symmetry (shown in blue). All three objects have the *same* rotational kinetic energy. Which one is rotating *fastest*?



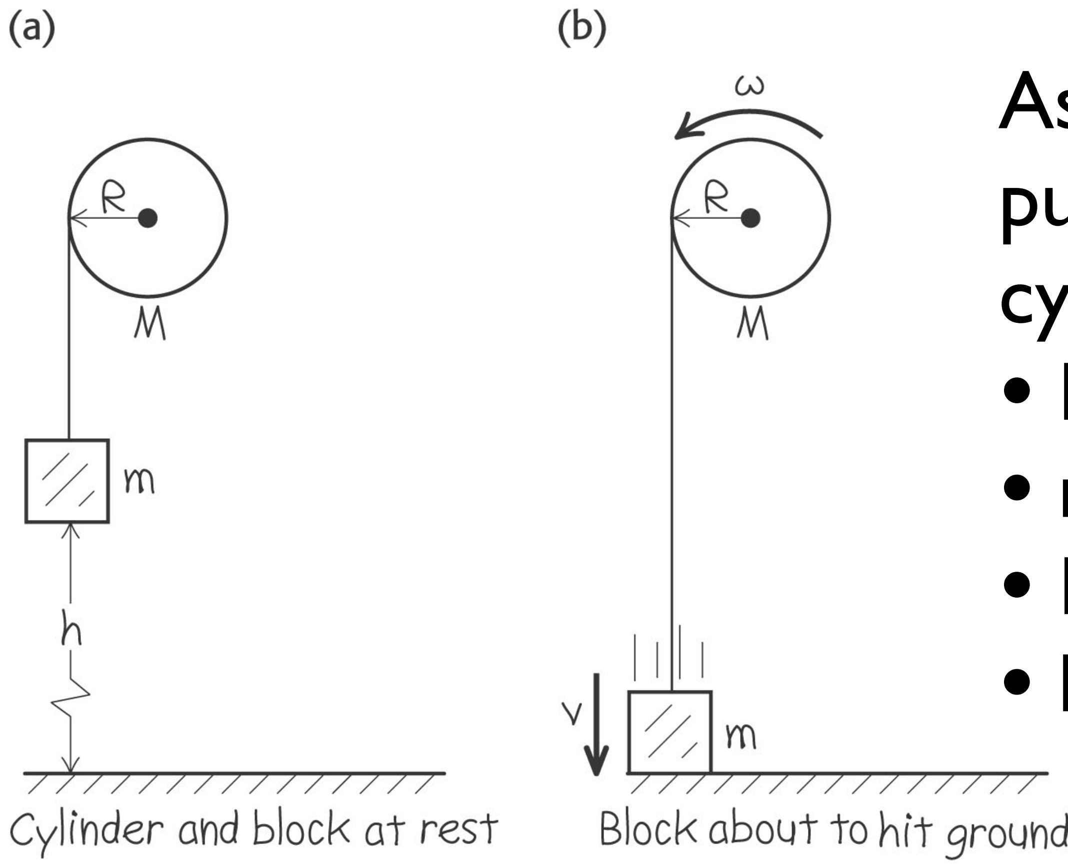
K. thick-walled cylinder

L. solid cylinder

M. thin-walled hollow cylinder

N. two or more of these are tied for fastest

A pulley with mass



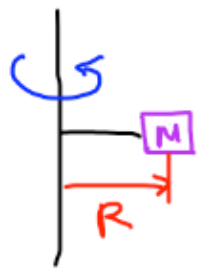
Assume the pulley is a solid cylinder, and

- M = 0.50 kg
- m = 1.0 kg
- R = 10 cm
- h = 1.0m

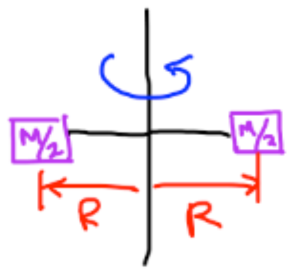
What is the speed of the block just before it hits the ground?

Which of these have $I = MR^2$?

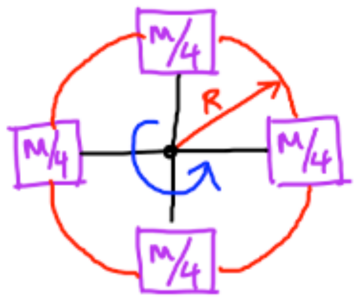
A. Single mass



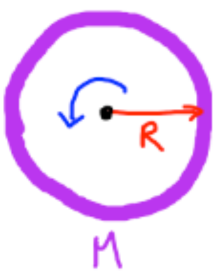
B. 2 masses



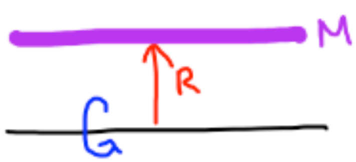
C. 4 masses



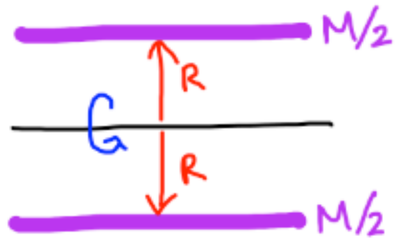
G. Hollow cylinder



D. Ring



E. Bar



F. 2 bars

Text your answer to 22333