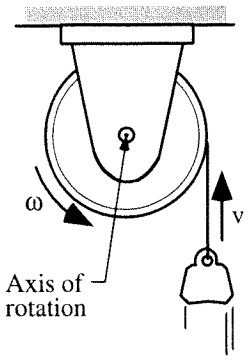
#1

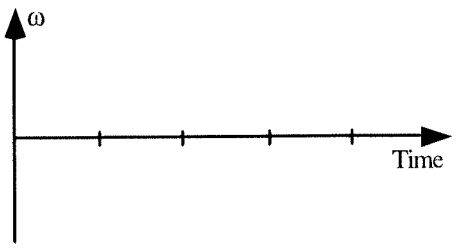
B6-CRT01: Pulley and Weight—Angular Velocity-Time and Acceleration-Time Graphs

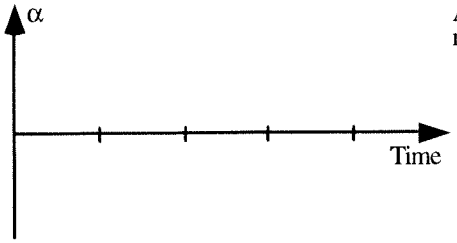
A weight is tied to a rope that is wrapped around a pulley. The pulley is initially rotating counterclockwise and is pulling the weight up. The tension in the rope creates a torque on the pulley that opposes this rotation. The weight slows down, stops momentarily, and then moves back downward.



(a) Graph of the angular velocity (ω) versus time for the period from the initial instant shown until the weight comes back down to the same height. Take the initial angular velocity as positive.

(b) Graph the angular acceleration (α) versus time for the same time period.



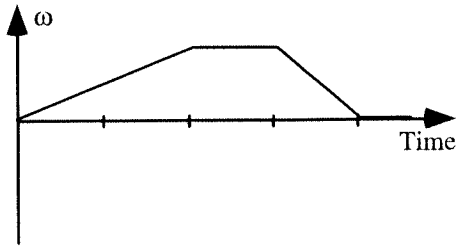


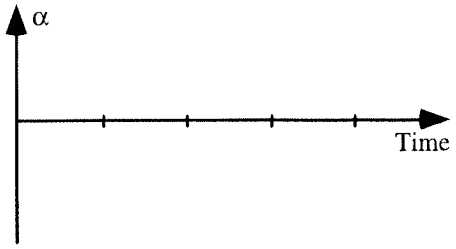
Explain your reasoning.

#2

B6-CRT02: Angular Velocity-Time Graph—Angular Acceleration-Time Graph

Sketch an angular acceleration versus time graph given the angular velocity versus time graph shown for the same time interval.





Explain your reasoning.

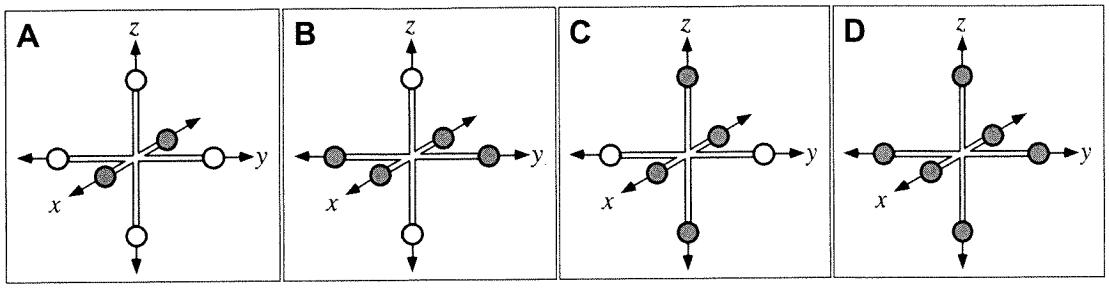
AP Physics - Tipper #1 - Unit 7

2/5

#3

B6-RT03: Three-Dimensional Point Objects—Moment of Inertia about the *x*-Axis

Six small brass and aluminum spheres are connected by three stiff, lightweight rods to form a rigid object shaped like a jack. The rods are joined at their centers, are mutually perpendicular, and lie along the axes of the coordinate system shown. All spheres are the same distance from the connection point of the three rods at the origin of the coordinate axis. The brass spheres are shaded in the diagram and are identical. The aluminum spheres are identical, have less mass than the brass spheres, and are unshaded in the diagram. For this problem, ignore the mass of the connecting rods.



Rank the moment of inertia about the *x*-axis.

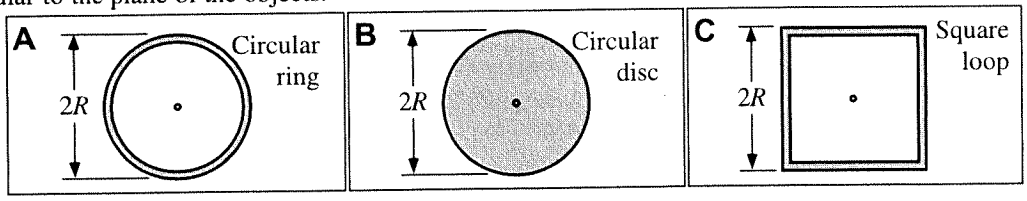
☐ 1 Greatest ☐ 2 ☐ 3 ☐ 4 Least OR ☐ All the same ☐ All zero ☐ Cannot determine

Explain your reasoning.

#4

B6-RT04: Flat Objects—Moment of Inertia Perpendicular to Surface

Three flat objects (circular ring, circular disc, and square loop) have the same mass M and the same outer dimension (circular objects have diameters of $2R$ and the square loop has sides of $2R$). The small circle at the center of each figure represents the axis of rotation for these objects. This axis of rotation passes through the center of mass and is perpendicular to the plane of the objects.



Rank the moment of inertia of these objects about this axis of rotation.

☐ 1 Greatest ☐ 2 ☐ 3 Least OR ☐ All the same ☐ Cannot determine

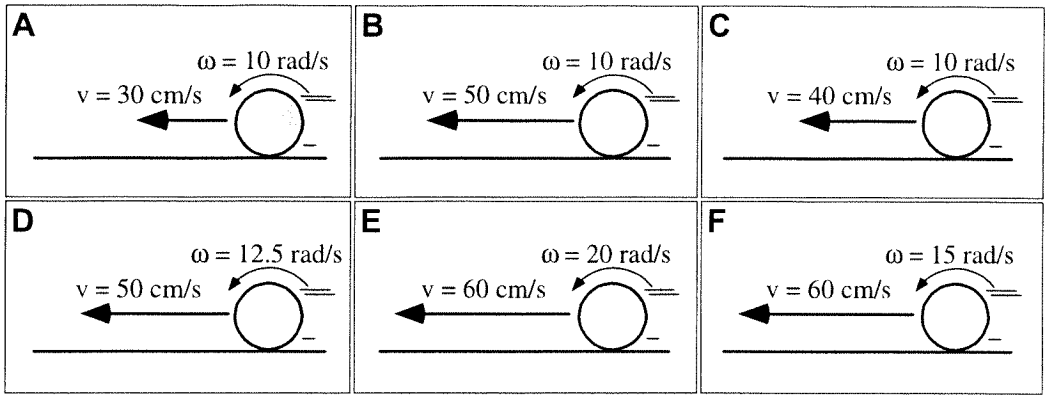
Explain your reasoning.

AP Physics - Tipler #1 - unit 7

3/5

#5 **B6-RT06: SPHERES ROLLING—RADIUS**

The figures below show hollow spheres (not drawn to scale) that are rolling at a constant rate without slipping. The spheres all have the same mass, but their radii as well as their linear and angular speeds vary.



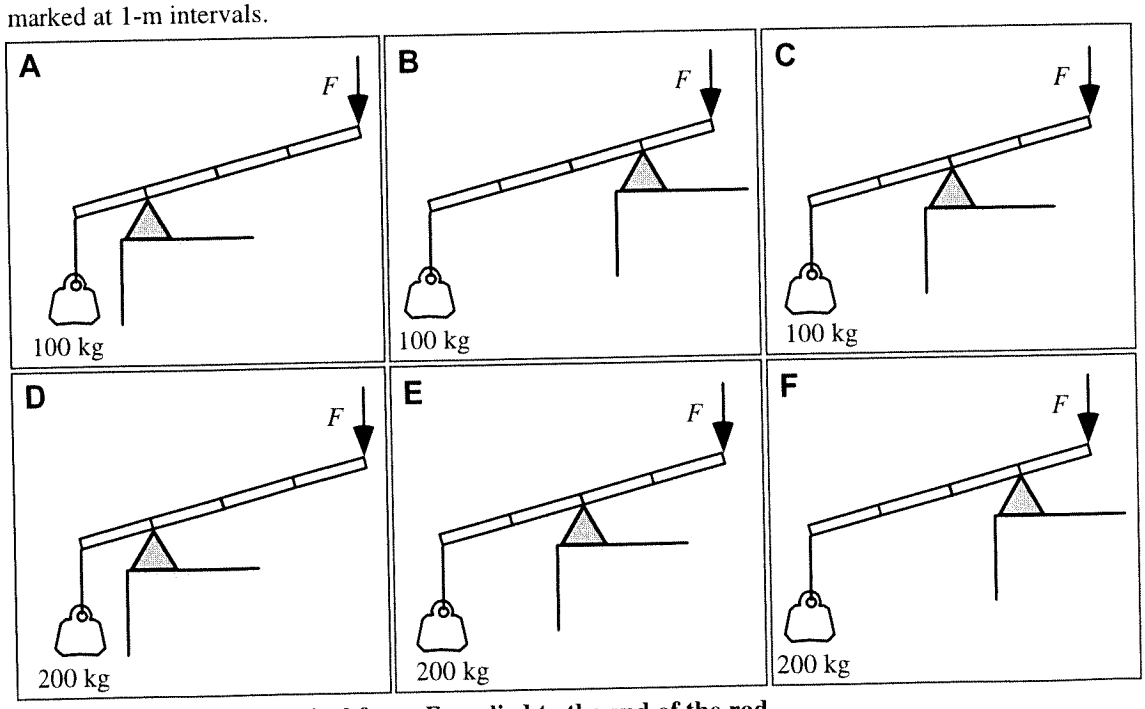
Rank the radius of the spheres.

						OR	☐	☐	☐
1 Greatest	2	3	4	5	6 Least		All the same	All zero	Cannot determine

Explain your reasoning.

#6 **B6-RT16: TILTED PIVOTED RODS WITH VARIOUS LOADS—FORCE TO HOLD RODS**

Six identical massless rods are supported by a fulcrum and are tilted at the same angle to the horizontal. A mass is suspended from the left end of the rod, and the rods are held motionless by a downward force on the right end. Each rod is marked at 1-m intervals.



Rank the magnitude of the vertical force *F* applied to the end of the rod.

						OR	☐	☐
1 Greatest	2	3	4	5	6 Least		All the same	Cannot determine

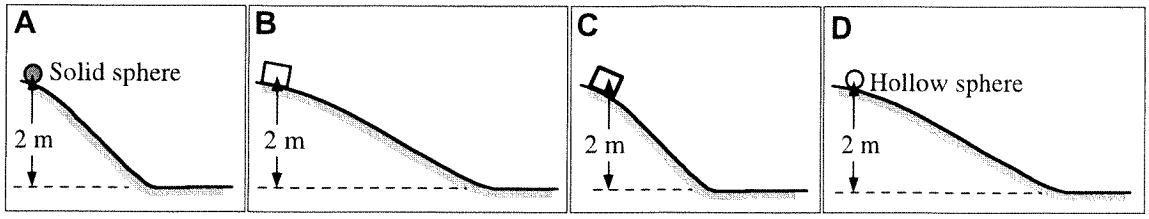
Explain your reasoning.

AP Physics - Tipper #1 - Unit 7

4/5

#7 **B6-RT31: Objects Moving down Ramps—Speed at Bottom**

In each case, a 1-kg object is released from rest on a ramp at a height of 2 m from the bottom. All of the spheres roll without slipping, and the blocks slide without friction. The ramps are identical in Cases A and C. The ramps in Cases B and D are identical and are not as steep as the others.



Rank the speed of the objects when they reach the horizontal surface at the bottom of the ramp.

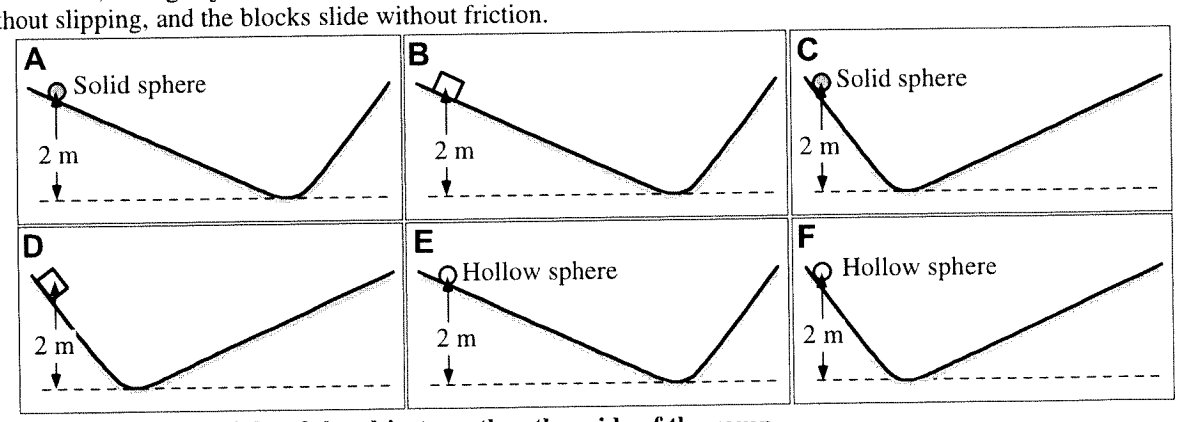
☐ ☐ ☐ ☐ OR ☐ ☐ ☐

1 Greatest | 2 | 3 | 4 Least | All the same | All zero | Cannot determine

Explain your reasoning.

#8 **B6-RT30: Moving down a Ramp—Maximum Height on the Other Side of a Ramp**

In each case, a 1-kg object is released from rest on a ramp at a height of 2 m from the bottom. All of the spheres roll without slipping, and the blocks slide without friction.



Rank the maximum height of the objects on the other side of the ramp.

☐ ☐ ☐ ☐ ☐ ☐ OR ☐ ☐ ☐

1 Greatest | 2 | 3 | 4 | 5 | 6 Least | All the same | All zero | Cannot determine

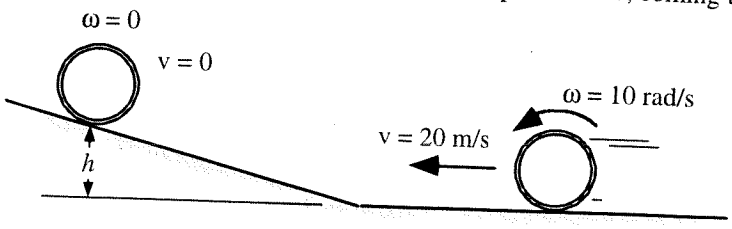
Explain your reasoning.

AP Physics · Tippen #1-Unit 7

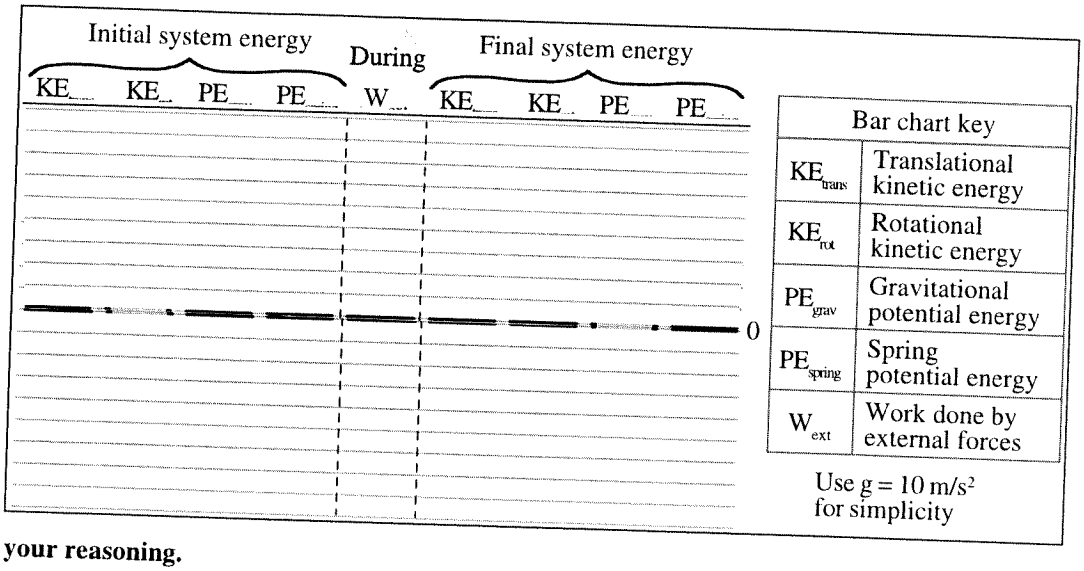
5/5

#9 **B6-BCT27: HOOP ROLLING UP A RAMP—ROTATIONAL ENERGY BAR CHART**

A thin hoop or ring with a radius of 2 m is moving so that its center of mass is initially moving at 20 m/s while also rolling without slipping at 10 rad/s along a horizontal surface. It rolls up an incline, coming to rest as shown.



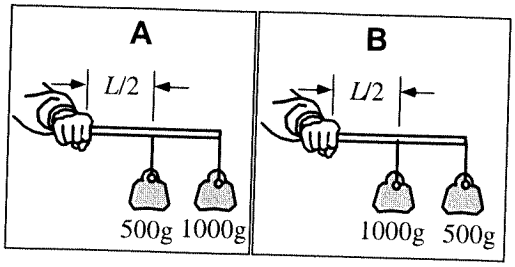
Complete the qualitative energy bar chart below for the earth-hoop system for the time between when the hoop is rolling on the horizontal surface and when it has rolled up the ramp and is momentarily at rest. Put the zero point for the gravitational potential energy at the height of the center of the hoop when it is rolling on the horizontal surface.



Explain your reasoning.

#10 **B6-CT24: HORIZONTAL METER STICK WITH TWO HANGING MASSES—TORQUE**

In each case, a student is holding a meter stick horizontally. Each meter stick has a mass attached at the 50 cm mark and another at the 100 cm mark. The meter sticks are identical, and the specific values and locations are given in the figures.



Is the magnitude of the torque by the student on the meter stick (i) *greater* in Case A, (ii) *greater* in Case B, or (iii) *the same* in both cases? ____

Explain your reasoning.