AP Physics - Unit 7

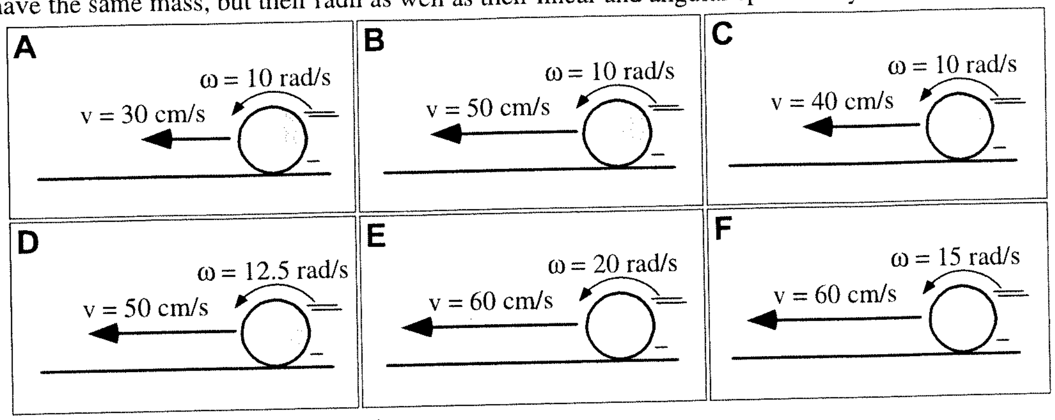
Tipper #3 - Unit 7

1/6

#1

B6-RT08: SPHERES ROLLING—ROTATIONAL KINETIC ENERGY

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 rotational kinetic energy of the spheres.

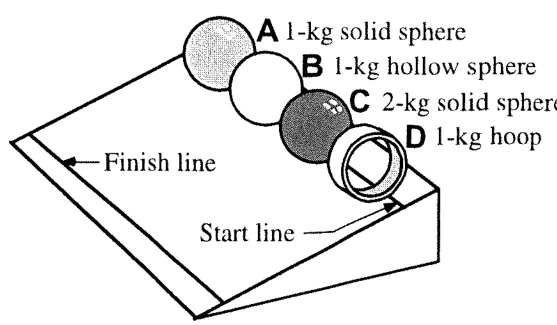
						OR	☐	☐	☐
1 Greatest	2	3	4	5	6 Least		All the same	All zero	Cannot determine

Explain your reasoning.

#2

B6-RT14: ROLLING OBJECTS RELEASED FROM REST—TIME DOWN RAMP

Four objects are placed in a row at the same height near the top of a ramp and are released from rest at the same time. The objects are (i) a 1-kg solid sphere; (ii) a 1-kg hollow sphere; (iii) a 2-kg solid sphere; and (iv) a 1-kg thin hoop. All four objects have the same diameter, and the hoop has a width that is one-quarter its diameter. The time it takes the objects to reach the finish line near the bottom of the ramp is recorded. The moment of inertia for an axis passing through its center of mass for a solid sphere is $\frac{2}{5}MR^2$; for a hollow sphere it is $\frac{2}{3}MR^2$; and for a hoop it is MR^2.



Rank the four objects from fastest (shortest time) down the ramp to slowest.

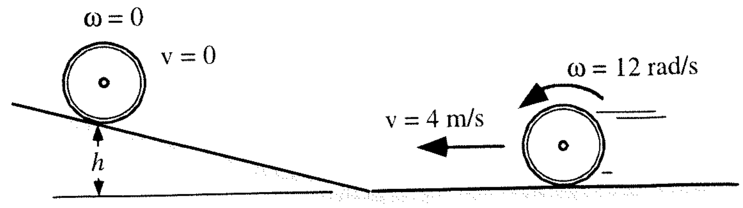
				OR	☐	☐
1 Fastest	2	3	4 Slowest		All the same	Cannot determine

Explain your reasoning.

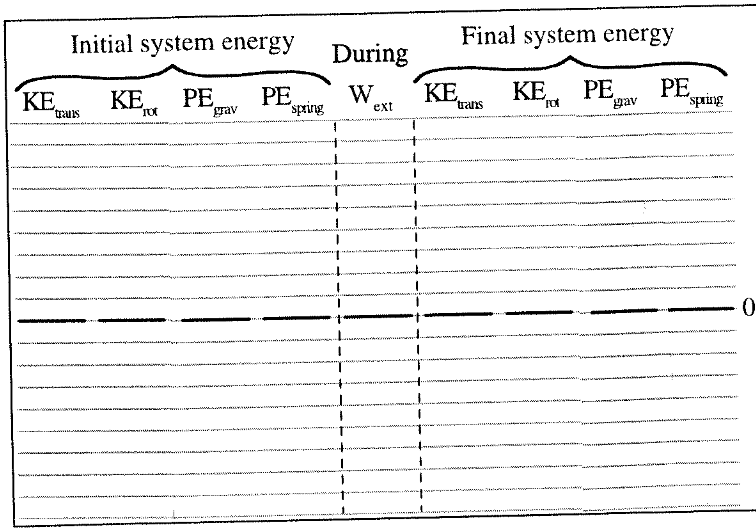
#3

B6-BCT28: Solid Disk Rolling up a Ramp—Rotational Energy Bar Chart

A solid disk is initially rolling without slipping along a flat, level surface. It then rolls up an incline, coming momentarily to rest as shown.



Complete the qualitative energy bar chart below for the earth-disk system for the time between when the disk is rolling on the horizontal 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.



Bar chart key	
KE_{trans}	Translational kinetic energy
KE_{rot}	Rotational kinetic energy
PE_{grav}	Gravitational potential energy
PE_{spring}	Spring potential energy
W_{ext}	Work done by external forces

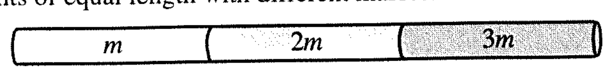
Use $g = 10\ m/s^2$ for simplicity

Explain your reasoning.

#4

B6-CT17: Special Rod—Moment of Inertia

A rod is made of three segments of equal length with different masses. The total mass of the rod is $6m$.



Will the moment of inertia of the rod be (i) *greater* about the left end, (ii) *greater* about the right end, or (iii) *the same* about both ends? _____

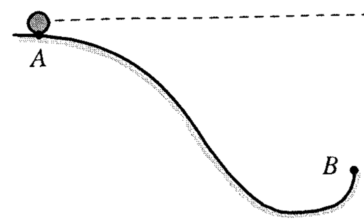
Explain your reasoning.

Tipper #3 - unit 7

#5

B6-QRT29: SOLID SPHERE ROLLING ALONG A TRACK—LOCATION AT HIGHEST POINT

A solid sphere rolls without slipping along a track shaped as shown at right. It starts from rest at point *A* and is moving vertically when it leaves the track at point *B*.



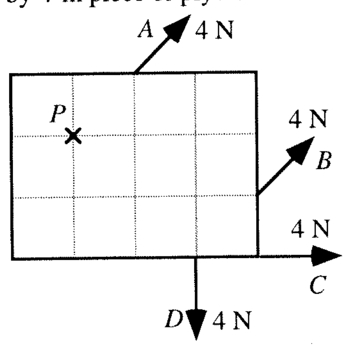
At its highest point while in the air, will the sphere be (a) *above*, (b) *below*, or (c) *at the same height as* point *A*? _____

Explain your reasoning.

#6

B6-RT25: FOUR FORCES ACTING ON A PIECE OF PLYWOOD—TORQUE

Four 4-Newton forces (*A–D*) act on a 3-m by 4-m piece of plywood as shown.



Rank the magnitudes of the torques due to the four forces about point *P*.

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

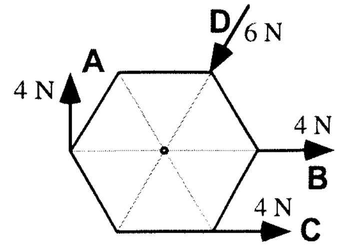
Explain your reasoning.

Tipper #3 - Unit 7

#7

B6-RT12: FOUR FORCES ACTING ON A HEXAGON—TORQUE ABOUT CENTER

Four forces act on a plywood hexagon as shown in the diagram. The sides of the hexagon each have a length of 1 m.



Rank the magnitude of the torque applied about the center of the hexagon by each force.

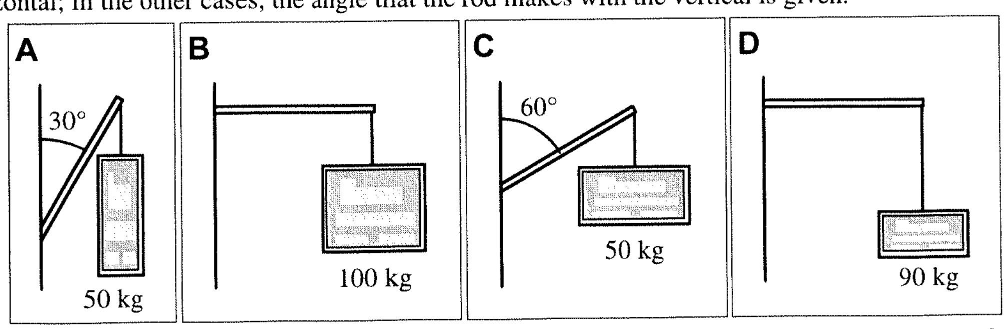
1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

#8

B6-RT11: SUSPENDED SIGNS—TORQUE

Signs are suspended from equal-length rods on the side of a building. For each case, the mass of the rod compared to the mass of the sign is small and can be ignored. The mass of the sign is given in each figure. In Cases B and D, the rod is horizontal; in the other cases, the angle that the rod makes with the vertical is given.



Rank the magnitude of the torque the signs exert about the point at which the rod is attached to the side of the building.

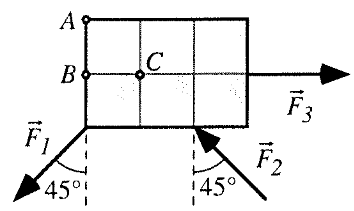
1 Greatest	2	3	4 Least	OR	All the same	All zero	Cannot determine

Explain your reasoning.

Tipper #3 - Unit 7 5/6

#9 **B6-QRT09: THREE FORCES APPLIED TO A RECTANGLE—TORQUE DIRECTION**

Three forces of equal magnitude are applied to a 3-m by 2-m rectangle. Forces $\vec{F}_1$ and $\vec{F}_2$ act at 45° angles to the vertical as shown, while $\vec{F}_3$ acts horizontally.



(a) Is the torque by $\vec{F}_1$ about point *A* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(b) Is the torque by $\vec{F}_1$ about point *B* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(c) Is the torque by $\vec{F}_1$ about point *C* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(d) Is the torque by $\vec{F}_2$ about point *A* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(e) Is the torque by $\vec{F}_2$ about point *B* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(f) Is the torque by $\vec{F}_2$ about point *C* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(g) Is the torque by $\vec{F}_3$ about point *A* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(h) Is the torque by $\vec{F}_3$ about point *B* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

Explain your reasoning.

(i) Is the torque by $\vec{F}_3$ about point *C* (i) *clockwise*, (ii) *counterclockwise*, or (iii) *zero*? _____

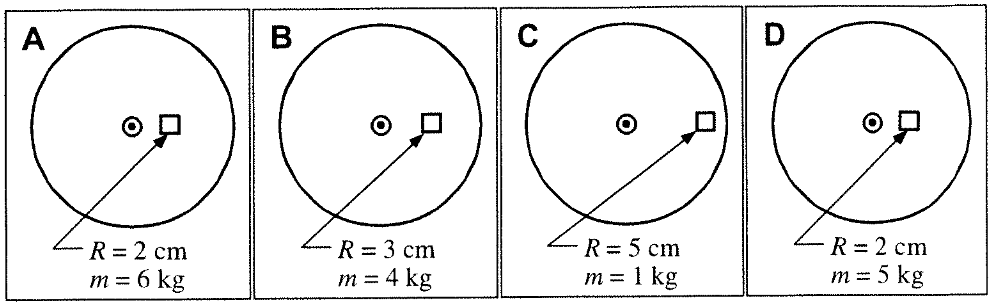
Explain your reasoning.

Tipper #3 - Unit 7

#10

B6-RT32: Blocks on Rotating Disc—Horizontal Frictional Force

A block is placed on a rotating disc and moves in a circular path. The discs have the same rotation rate in each case, but the masses of the blocks and their distance from the center varies.



Rank the magnitude of the frictional force on blocks by the discs.

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

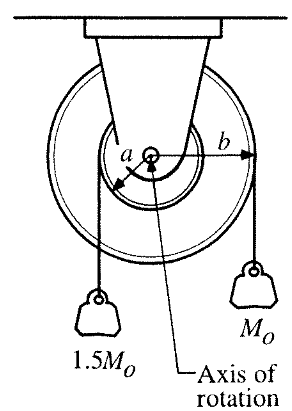
Explain your reasoning.

#11

B6-WWT15: Pulley with Hanging Weights—Angular Acceleration

Two pulleys with different radii (labeled a and b) are attached to one another so that they rotate together. Each pulley has a string wrapped around it with a weight hanging from it. The pulleys are free to rotate about a horizontal axis through the center. The radius of the larger pulley is twice the radius of the smaller one ($b = 2a$). A student describing this arrangement states:

"The larger mass is going to create a counterclockwise torque and the smaller mass will create a clockwise torque. The torque for each will be the weight times the radius, and since the radius for the larger pulley is double the radius of the smaller, and the weight of the heavier mass is less than double the weight of the smaller one, the larger pulley is going to win. The net torque will be clockwise, and so the angular acceleration will be clockwise."



What, if anything, is wrong with this contention? If something is wrong, explain how to correct it. If this contention is correct, explain why.