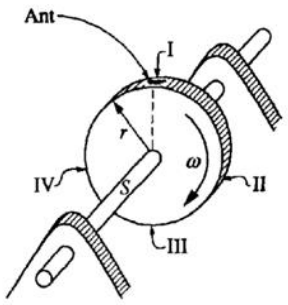
AP Physics – Unit 7 MC Review – Rotation
Wkst MC Review – Unit 7

Directions: Each of the questions or incomplete statements here is followed by four suggested answers or completions. Select the one that is best in each case and then enter the appropriate letter in the corresponding space on the answer sheet.

Note: To simplify calculations, you may use $g = 10\ \text{m/s}^2$ in all problems.

Questions 1 and 2 refer to the following material:

An ant of mass *m* clings to the rim of a flywheel of radius *r*, as shown in the figure. The flywheel rotates clockwise on a horizontal shaft S with constant angular velocity ω. As the wheel rotates, the ant revolves past the stationary points I, II, III, and IV. The ant can adhere to the wheel with a force much greater than its own weight.

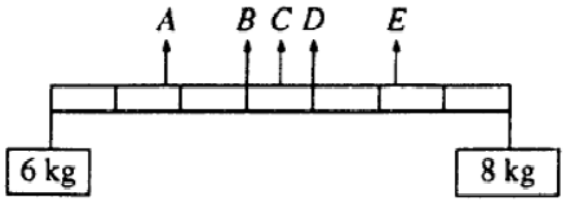


1. It will be most difficult for the ant to adhere to the wheel as it revolves past which of the four points?
   a. I
   b. II
   c. III
   d. IV

2. What is the magnitude of the minimum adhesion force necessary for the ant to stay on the flywheel at point III?
   a. mg
   b. $m\omega^2 r$
   c. $m\omega^2 r - mg$
   d. $m\omega^2 r + mg$

3. A bowling ball of mass M and radius R, whose moment of inertia about its center is $\frac{2}{5}MR^2$, rolls without slipping along a level surface at speed v. What is the maximum vertical height to which it can roll if it ascends an incline?
   a. $\frac{V^2}{5g}$
   b. $\frac{2V^2}{5g}$
   c. $\frac{V^2}{2g}$
   d. $\frac{7V^2}{10g}$

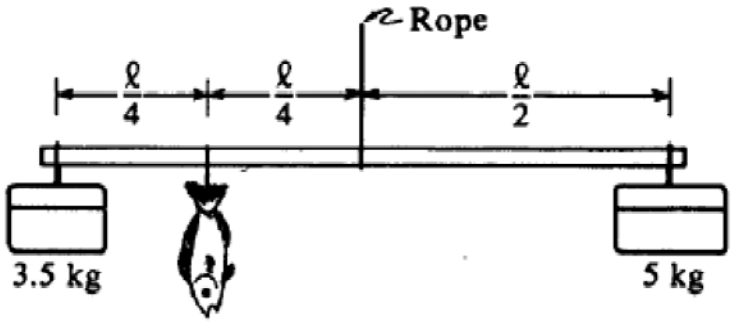
4. Two objects of masses 6 kg and 8 kg are hung from the ends of a stick that is 70 cm long and has marks every 10 cm, as shown in the diagram. If the mass of the stick is negligible, at which of the points indicated should a cord be attached if the stick is to remain horizontal when suspended from the cord?



   A) A
   B) B
   C) C
   D) D

5. A stunt woman is jumping several cars with a motorcycle. While the rider and the motorcycle are in the air, she uses the throttle to cause the rear wheel to spin faster. What happens to the rider-motorcycle system when the rear wheel spins faster?
   a. The front of the motorcycle rotates upward.
   b. The rear of the motorcycle rotates upward.
   c. The rider-motorcycle system does not rotate.
   d. The rider-motorcycle system rotates to the left

6. To weigh a fish, a person hangs a tackle box of mass 3.5 kg and a cooler of mass 5 kg from the ends of a uniform rigid pole that is suspended by a rope attached to its center. The system balances when the fish hangs at a point 1/4th of the rod's length from the tackle box. What is the mass of the fish?



a. 1.5 kg

b. 2 kg

c. 3 kg

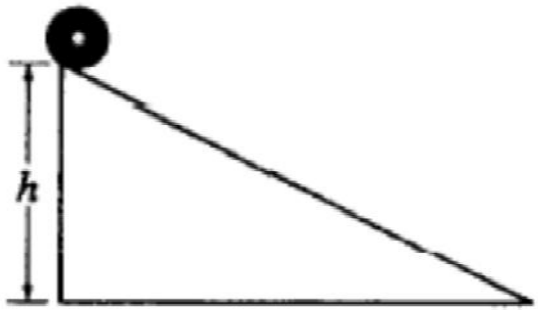
d. 6 kg

7. A child on a spinning merry-go-round walks from the center to the outside edge of the merry-go-round. What happens to the angular momentum, angular speed, and kinetic energy of the child/merry-go-round system?

	Angular Momentum	*Angular Speed*	*Kinetic Energy*
A)	Constant	Constant	Constant
B)	Constant	Decrease	Decrease
C)	Decrease	Constant	Decrease
D)	Increase	Increase	Increase

Questions 8 and 9 refer to the following material:

A sphere of mass M, radius r, and rotational inertia I is released from rest at the top of an inclined plane of height h, as shown in the diagram.



8. If the plane is frictionless, what is the speed v_{CM}, of the center of mass of the sphere at the bottom of the incline?

A) $\sqrt{2gh}$

B) $\dfrac{2Mghr^2}{I}$

C) $\sqrt{\dfrac{2Mghr^2}{I}}$

D) $\sqrt{\dfrac{2Mghr^2}{I+Mr^2}}$

9. If the plane has friction so that the sphere rolls without slipping, what is the speed V_{CM} of the center of mass at the bottom of the incline?

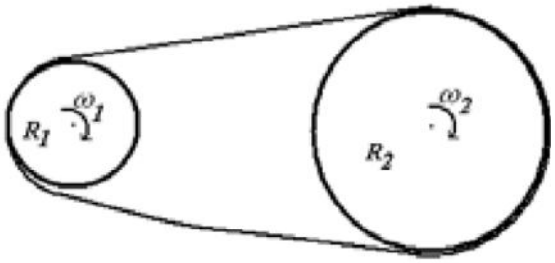
A) $\sqrt{2gh}$

B) $\dfrac{2Mghr^2}{I}$

C) $\sqrt{\dfrac{2Mghr^2}{I}}$

D) $\sqrt{\dfrac{2Mghr^2}{I+Mr^2}}$

10. The discs shown in the diagram are connected by a belt that rotates both discs at the same time. The belt does not slip as it rotates the discs. The discs have different radii as shown, with $R_1 < R_2$. What is the relationship between the angular velocities of the two discs



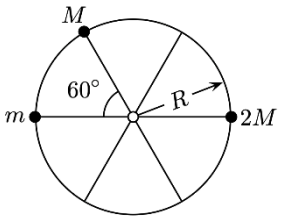
a. $\omega_1 = \omega_2$

b. $\omega_1 R_1 = \omega_2 R_2$

c. $\frac{\omega 1}{R1} = \frac{\omega 2}{R2}$

d. $\frac{R1}{\omega 1} = \frac{R2}{\omega 2}$

11. A wheel of radius *R* and negligible mass is mounted on a horizontal frictionless axle so that the wheel can rotate in a vertical plane. Three small objects having masses *m*, *M*, and 2*M* are mounted on the rim of the wheel, as shown in the diagram. If the system is in static equilibrium, what is the value of *m* in terms of *M?*



A) $\frac{1}{2}M$

B) M

C) $\frac{3}{2}M$

D) $2M$

Directions: For each of the questions or incomplete statements following, two of the suggested answers will be correct. For each of these questions, you must select both correct choices to earn credit. No partial credit will be earned if only one correct choice is selected. Select the two that are best in each case and then enter both of the appropriate letters in the corresponding space on the answer sheet.

12. A solid sphere has a mass of *M* and a radius of *R*. Which of the following statements are true about the sphere's rotational inertia? **Select two answers.**

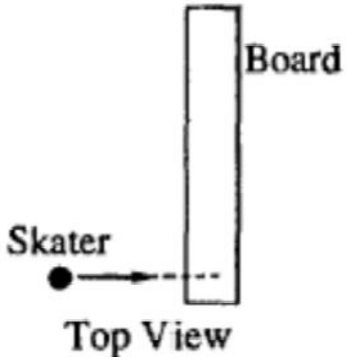
    A) Rotational inertia depends on the choice of the axis of rotation.

    B) Rotational inertia is proportional to the sphere's mass regardless of the choice the axis of rotation.

    C) Rotational inertia is inversely proportional to the sphere's speed.

    D) Rotational inertia has the units of $kg \cdot m/s^2$.

13. A long board is free to slide on a sheet of frictionless ice. As shown in the top view in the diagram, a skater skates to the board and hops onto one end, causing the board to slide and rotate. In this situation, which of the following occurs? **Select two answers.**



    E) Rotational kinetic energy is conserved

    F) Translational kinetic energy is conserved

    G) Linear momentum is conserved

    H) Angular momentum is conserved