**Rotation Review**

1. A turntable has a velocity of 4 rad/s.

a) How many revolutions does the turntable make per second?

b) What is the translational velocity of a point that is 0.4 m from the center of the turntable?

c) If the turntable were to experience an angular acceleration of 2 rad/s2, what angular displacement would it cover will speeding up to 12 rad/s?

2. We have learned about revolving objects and rotating objects.

a) What is a revolution and what is needed to make an object revolve?

b) Draw a diagram showing the velocity and acceleration of a rotating object.

c) What is a rotation and what is needed to make an object revolve?

d) What equations relate angular quantities to linear quantities?

e) What factors affect the moment of inertia of an object?

5 kg

F

3. The diagram to the right shows a wheel in rotational equilibrium. A string is wrapped around the axle of the wheel, which has a radius of 0.2 m. The other end is tied to a mass of 5 kg. A force F is applied to the outer rim of the wheel, which has a radius of 0.8 m, perpendicular to the radius of the wheel. The moment of inertia of the wheel is 8 kg·m2.

a) What is the magnitude of the force F?

b) If the force F were removed, what would the acceleration of the 5 kg mass be?

c) Small washers which are part of the pulley are moved from the inner part of the wheel to the edge. How does this affect the acceleration of the 5 kg mass? Justify your answer.

P

12 N

12 N

**F** = ??

24 N

30°

4. The diagram above shows a meter stick of mass 2 kg and moment of inertia of 0.4 kg∙m2, upon which several forces act. The meter stick is fixed at point P but is free to pivot around point P. The meter stick is initially in rotational equilibrium. The meter stick’s center of mass is at 50 cm.

a) What is the magnitude of the force labeled **F**?

b) Assume the force **F** was removed and calculate the initial angular acceleration of the meter stick and state its direction.

4. A wheel of radius 0.8 m is supported by an axle in the center. The moment of inertia for the wheel, which is given by MR2, is 1.92 kg·m2. A force of 28.8 N is applied to the edge of the wheel, perpendicular to its radius.

a) Calculate the mass of the wheel.

b) Calculate the angular acceleration of the wheel.

c) List four ways that the angular acceleration of the wheel could be decreased.

5. Jill is pushing her brother on a merry-go-round. The merry-go-round with her brother on it has a moment of inertia of 500 kg∙m2 and initially rotates at 4 rad/s. If Jill is going to stop the merry-go-round in 2 seconds, how much torque does she need to apply to the merry-go-round?

6. A man stands on a small platform which can rotate without friction. The man holds two small weights in his hands. In this configuration, the man has a moment of inertia of 500 kg∙m2. The platform initially rotates at a rate of $\frac{6}{π}$ rotations per minute.

a) Is this a closed system? Explain how you know.

b) Describe what will happen if the man pulls the weights closer to his body and explain why it happens.

c) When the man pulls the weights in closer, his angular velocity changes to $\frac{8}{π}$ rotations per second. Calculate the moment of inertia of the man in this configuration.

7. A solid wheel has a radius of 0.8 m and a moment of inertia of 50 kg∙m2 and is initially at rest. The axle of the wheel is fixed in place. A dart of mass 2 kg is thrown into the wheel at a velocity of 50 m/s such that it strikes the wheel at its edge, perpendicular to its radius. As a result, the wheel rotates around its axle. Calculate the angular velocity of the wheel after the dart strikes it.

8. A disk (*I = ½ MR2*)of radius 0.5 m and mass 2 kg is at the top of a hill with a height of 8m. The disk is released from the top and allowed to roll down the incline.

a. If the disk rolls without slipping, what is its speed at the bottom of the incline? What is its angular speed?

b. If there is no friction, what is the speed at the bottom of the incline? What is the angular speed? Why are these answers different than (a)?

c. How would the answer to (a) change if the disc were replaced by a hoop of the same mass and radius? Explain.



9. A rod of length *L = 1.2 m* and mass *m = 3 kg* is released from the horizontal position shown above.

a. What is the potential energy of the rod when it is in the position shown above?

b. What kind of kinetic energy does the rod have at the bottom?

c. What is the angular speed of the rod when it is completely vertical?

d. What is the linear speed at the end of the rod when it is completely vertical?