Practice Exam 3

1. An objects rotates about an axis. The slope of the graph of its rotation angle vs. time is
   a) angular velocity
   b) angular acceleration
   c) rate of change of angular acceleration
   d) linear velocity

2. A compact disc in a CD player is initially at rest. Then it undergoes a constant angular acceleration of 20 degrees/sec/sec. How long will it take for the compact disk to have rotated 20 times?

3. If the compact disk in problem 2 has radius of 7.5 cm, what is the tangential component of its acceleration vector?

4. Which has the greater moment of inertia: 1) a hollow cylinder of mass M and radius R, or 2) a solid cylinder of mass M and radius $R?$
a) hollow cylinder   b) solid cylinder   c) same

5. Hoops of various masses and radii, each initially at rest, roll down an incline plane. Solid spheres of various masses and radii, each initially at rest, roll down the same inclined plane.   Which of the following is false?
a) All spheres will take longer to roll down than all hoops
b) The speed of each rolling object at the bottom of the inclined plane does not depend on its mass
c) The greater the moment of inertia of the rolling object, the slower its linear speed at the bottom of the inclined plane

6. A solid sphere of mass M and radius R, whose moment of inertia is $(2/5)MR^2$, rotates at 50 rotations per minute. If $M = 1.0$ kg and $R = 10$ cm, what is the sphere's kinetic energy in Joules?

7. True or False: Torque is a vector quantity.

8. An elephant weighing 30,000 N is suspended as shown from a Ferris wheel whose radius is 40 m.   How much torque (in N-meters) does the elephant's weight apply to the Ferris wheel?
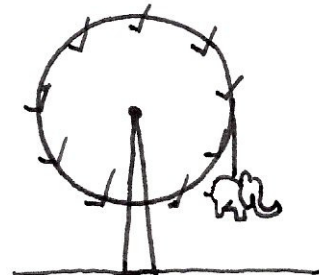
9. Consider the figure for question #8.   In what direction does the torque vector point?
a) out of the paper   b) into the paper   c)   same as the radius vector   d) same as the elephant's weight vector
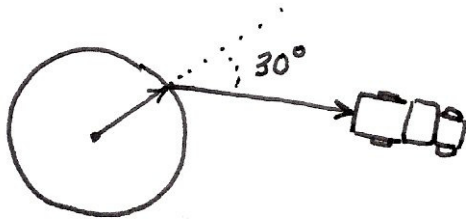
10. A cable connects the edge of a carousel of radius 15 m and the back of a pickup truck as shown. If the pickup pulls with a force of 10,000 N at an angle that deviates from a radial direction by 30 degrees (see figure). What is the magnitude and direction of the torque vector?

magnitude =

_____ N-m

direction (circle one) = a) out of the page b) into the page c) other

11. A constant torque τ is applied to an object about its axis of symmetry. If the object's moment of inertial about this axis is I, what is the angular acceleration of the object about this axis.

12. True or False: In the absence of external torques, the angular momentum of a system is conserved.

13. The angular momentum of $\vec{L}$ an object orbiting the sun is given by $\vec{L} = \vec{r} \times \vec{p}$, where $\vec{r}$ is the position vector of the object in a coordinate system in which the sun is at the origin, $\vec{p}$ is the linear momentum of the object, and $\times$ is the cross product. If an object is falling directly toward the sun, what is its angular momentum?

14. An ice skater pirouettes at angular velocity of 200 rpm with her arms outstretched. When she pulls her arms in close, her moment of inertial about her axis of rotation decreases to 1/3 of its former value. What is the magnitude of her new angular velocity?

15. A 100-kg astronaut floats stationary in space. How fast would she have to throw a 1-kg wrench in order to move at 1.0 m/s in the opposite direction.

16. Particle 1 has a mass of 10 kg and a velocity of +20 m/s. Particle 2 has a mass of 10 kg and a velocity of -20 m/s. After the particles collide, Particle 1 has a velocity of -5 m/s and Particle 2 has a velocity of +5 m/s. Was the collision elastic or inelastic?

17. Is it possible for the total kinetic energy of a pair of particles to be greater than zero, while the total momentum of the pair is zero?

18. A 100-kg stunt man jumps from a tall building onto a gigantic inflated "mattress". When he first hits the mattress he is falling at 30 m/sec.   It takes the mattress 1 second to bring him momentarily to rest.
a) What is the impulse that the mattress imparted to the stunt man?
b) How much force did the mattress exert against the stunt man?

19. A 60 kg mass and a 40 kg mass are suspended on a pulley as shown and held stationary.

40 kg

60 kg
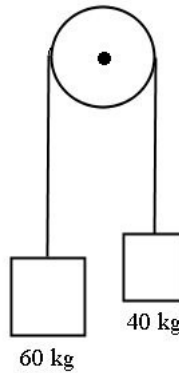
a) When they are released, what will be the acceleration of the masses? [Assume that the moment of inertia of the pulley can be ignored.]

b)   What will be the acceleration of the masses if the moment of inertia of the pulley is given by $I =(1/2)m_p r^2$ where m_P is the mass of the pulley (= 2000 kg), r is its radius. [Note that that m_1 and m_2 are small compared to m_P.]

20. A bolt requires a torque of 500 Nm to be loosened.   A woman can apply a maximum force of 250 N.   What is the minimum length of the wrench that will enable her to loosen the bolt?