PHYS-1800 **Homework 7** **Due: 12 Mar, 2010**

Name:_____ **(show all your workings)**

1. A bicycle exhibits greatest stability when the angular momentum of the wheels is _____ (small, large, any value) (1 point)

2. If the net torque on a body is zero the net force is _____ (always, not necessarily, cannot be) zero. (1 point)

3. The angular momentum of a rotating body is conserved when: (1 point)
   A. No net force acts on the body.
   B. No net torque acts on the body.
   C. When the body has a constant angular acceleration.

4. You stand with your heels against a wall and bend 90 degrees forward at the waist. (1 point)
   A. You are able to maintain your balance
   B. You fall forward because of the momentum you gained when you moved
   C. You fall forward because your center of gravity moves ahead of your base support
   D. You fall forward as the muscles in your feet aren't strong enough to stop you.

5. When a bicycle pedal is at the top of its motion, you can exert the greatest torque on the crank by: (1 point)
   A. Pushing straight down on the pedal with your foot.
   B. Pushing straight forward on the pedal with your foot.
   C. Hooking your toes under the pedal and pulling upwards.

6. Consider three different bodies of circular cross-sections each with the **same radius and same mass.** One is a uniform sphere, another is a uniform disk and the third is a hoop with light spokes. The body with the largest rotational inertia will be: (1 point)
   A. The hoop.
   B. The sphere.
   C. The disk.
   D. They all have the same value.

7. A disk rotates through six revolutions in 4 sec. Determine: (2 points)
   (a) Its total displacement in radians in this time

   (b) Its average rotational velocity in rad/s.

Name:_____ **(show all your workings)**

8. A student plays on a see-saw with her father. The student has a weight of 250 N and is seated 2.0 m from the pivot point. Her father balances her when he is seated 0.75 m from the axis. The father's weight is: (2 points)
   A. 250 N
   B. 500 N
   C. 262 N
   D. 667 N
   E. 725 N

9. The armature of a motor is accelerated uniformly from rest to a rotational velocity of 1800 rev/min in 10 sec. The rotational acceleration of the motor is: (2 points)
   A. Zero
   B. 180 rad/s^2
   C. 18.8 rad/s^2
   D. 90 rad/s^2
   E. 37.7 rad/s^2

10. A body of rotational inertia 1.0 kg m^2 is acted upon by a torque of 2.0 Nm. The angular acceleration of the body will be: (2 points)
    A. 0.50 rad/s^2
    B. 0.5 rev/s^2
    C. 1.0 rad/s^2
    D. 2.0 rad/s^2
    E. 2.0 rev/s^2

11. Determine the **difference in angular momentum** of a solid sphere and a disk both of which have a mass of 10 kg, a diameter 0.2 m and are spinning at 20 rev/sec. (use I = 2/5 mr^2 for a solid sphere, and I = 1/2mr^2 for a solid disc). (2 points)

    What is this difference due to?

Name:_____ **(show all your workings)**

12. In 1982 a remarkable "Pulsar" was discovered spinning at 640 rev/sec (about three times faster than the blades of a kitchen blender!). Assuming the Pulsar is a solid sphere of radius of 15 km and mass of 4 x 10^{30} kg, determine: (4 points)
(use $I = 2/5\ mr^2$ for a solid sphere)

    (i) Its rotational inertia (I).

    (ii) Its rotational kinetic energy.

Additional (optional) question worth up to a total of 10 extra points:

A distant star of similar mass to our Sun (2 x 10^{30} kg) is in its dying stages and has a diameter of 2 x 10^6 km and a rotational period (T) of 30 earth days. The nuclear fusion inside its core suddenly dies and the star collapses rapidly under its tremendous gravity to create a very dense neutron-type star of diameter 50 km. Assuming no mass is lost in this cataclysmic event determine: (use $I = 2/5\ mr^2$ for a solid sphere, and $T = 2\pi/\omega$)

(a) Its original rotational inertia (I_o)

(b) Its original angular velocity (ω_o)

(c) Its final rotational inertia (I_f)

(d) Its final angular velocity (ω_f).

(e) What law did you use to determine these results?