Chapter 8 Problem Set Advanced Physics I

1. Why can't you stand against the wall and touch your toes?

2. What is the main objective to the various high jump techniques (Fossberry flop and Western Roll)? Why is it better to be tall?

3. Find the center of gravity of two pieces of large black metal, one with a regular shape and one that is irregular.

4. Play with the center of gravity toys. How is it possible to get the various objects to balance at such strange angles?

5. What do you notice when a tennis racket or hammer is thrown? A book?

6. Mr. L is sitting on a 1.0ft wide by 1.0in thick by 60.0ft long teeter-totter. The plank is made of Argentine Brown Ebony wood that has a density of 4.0lbs per board foot. If Mr. L weighs 200lbs can the teeter-tatter be balanced without anyone else getting on? Why?

7. In the film *Jurassic Park* two scientists (neither a physicists) try to hold the kitchen door closed against the velociraptors while one reaches for a gun. What should they do?

8. Dr. H is cleaning the gutters on his house. At spot where he is cleaning the ground is soft. As he moves along the edge of the house he has to set up at another spot where there is a hard very smooth rock. Will he need to set the ladder at different angles to be able to reach the gutter?

9. Mr. K has a flat tire on his car on his way home yesterday. If the lug nuts were put on by a mechanic at Tire World using a pneumatic torque wrench set at 40.0nm, what force must Mr. K apply at the end of his 30.0cm tire iron.

10. Make a proportional sketch of a water molecule. The bonds have 106^{o} angle between them. The hydrogen atomic radius is .031nm and the oxygen atomic radius is .069nm. Find the center of gravity mathematically and mark it in the proper spot on your sketch.

11. Student Government wants to hang signs with the Res. Halls numbers along the back driveway. The signs are uniform rectangles (4.00m wide and 3.00m high and 5.00cm thick) that weigh 500.0n. They are to be suspended from a horizontal, 6.00m long 100.0n rod hinged to a 4.0m tall 4x4 post. The end of the rod is attached to the top of the post by a cable 10.39m above the sign to hold the sign horizontal. a.) Find the tension in the cable. b.) find the horizontal and vertical force components exerted by the hinge.

12. A baton twirler spins her baton at the half time of IMSA's homecoming football game. The baton consists of 3.0kg ball with a 6.0cm diameter connected to a 2.0kg ball with a 4.0cm diameter by a very light 1.3m aluminum rod. What is the moment of inertia as she twirls it? What is the angular momentum if the tangential velocity of the balls is 5.0m/s? She accidentally drops it and it rolls along the ground. Now what is its moment of inertia?

13. What is the rate of acceleration of a 3.00kg bucket dropped into a well that is tied to a 5.00kg spool with a diameter of 1.2m? How long will it take to reach the water 10.0m below?

14. A top at rest with a moment of inertia of $4.00 \times 10^{-4} kgm^2$ is started spinning by pulling an 80.0cm string with a constant force of 5.57n. What is the final angular velocity?

15. At present time the polar icecaps contribute very little to the Earth's moment of inertia since they rest close to the axis of rotation. If they melt due to global warming, 2.3×10^{19}kg of ice would roughly uniformly cover the planet. How would this change the length of a day?