Name: _____

> Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page. *Please make an effort on all problems, partial credit is awarded for effort-based solutions which demonstrate familiarity with the physics concepts.*

1. (5 points) An ice skater spins at 2.5 rev/s when her arms are extended. She draws her arms in and spins at 6.0 rev/s. By what factor does her intertia change in the process. *Hint: Conservation of angular momentum.*

2. (2 points) Newton's second law in angular form is (*Hint: Each of these equations will be useful on this test*).

   ○ $\sum F_x = ma$ ○ $\sum F_y = ma$ ○ $I_1 \omega_1 = I_2 \omega_2$ ○ $\sum \tau = I \alpha$

3. (10 points) A uniform disk with mass $M = 3.0$ kg and radius $R = 10cm$ is mounted on a fixed horizontal axle. A block with mass $m = 2.0$ kg hangs from a massless cord that is wrapped around the rim of the disk. Find the acceleration of the falling block. *Hint: The angular intertia of a disk is $\frac{1}{2}MR^2$. What is the net torque on the disk? Is the angular acceleration α zero or not?*
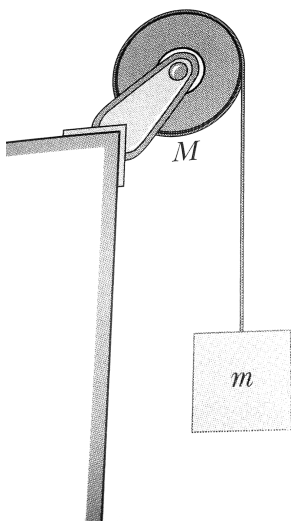

4. (3 points) Which of the following two systems (left or right) will spin the fastest and why? The solid disk, spheres, and box all have the exact same mass, the only difference is the location of the spheres

which alters the intertia. *Hint: You don't need to solve for inertia, or do much solving at all. Think of Newton's Second Law in angular form. Which of the two systems will have the greater angular intertia?*
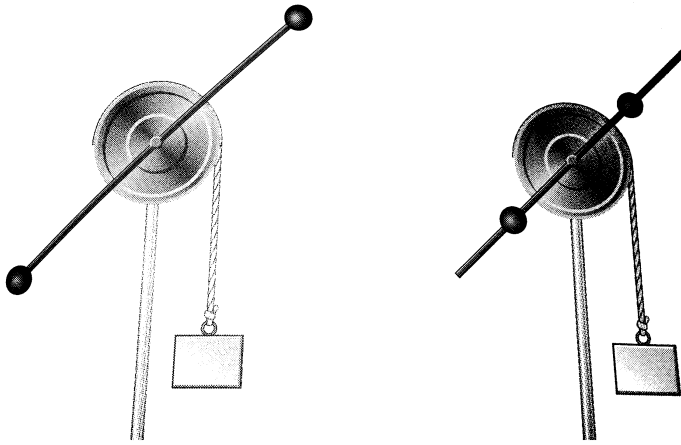
5. (5 points) (Bonus) List three important things you've learned from physics, and provide a real world example of each concept.

6. (15 points) A 5.00 m long diving board of negligible mass is supported by two pillars. One pillar is at the left end of the diving board, as shown, and the other is 1.50 m away. Find the forces exerted by the pillars when a 90.0 kg diver stands at the far end of the board. *Hint: F_1 in the graph will turn out to be negative. Why?*
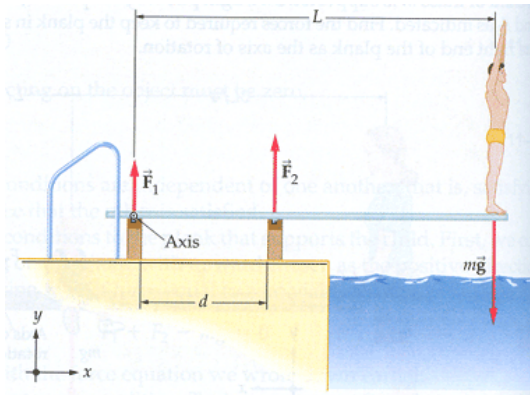
7. (15 points) A massive crane (assume it is fixed to the Earth) is lifting a mass of 7600 kg. The arm of
the crane is supported at its base at point B by a strong pivot and at its top at point A by a cable. The
arm makes an angle with the horizontal of 40° and the cable makes an angle 30° with the horizontal as
well. The arm is 12.0 m long. The mass is lifted from a point on the arm 0.52 m from the end point A.
Assume that the mass of the arm is small enough to ignore, find the tension in the cable.
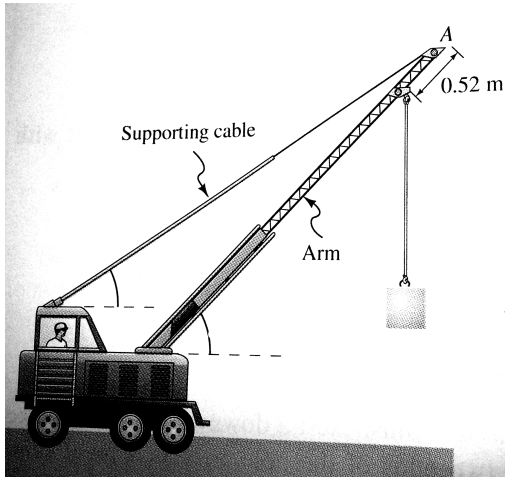
8. (15 points) A traffic light hangs from a pole as shown in the figure. The uniform aluminum pole AB is 7.20 m long and has a mass of 11.0 kg. The mass of the traffic light is 20.5 kg.

- Determine the tension in the horizontal massless cable CD.
- Determine the vertical component of the force exerted by the pivot A on the aluminum pole.
- Determine the horizontal component of the force exerted by the pivot A on the aluminum pole.
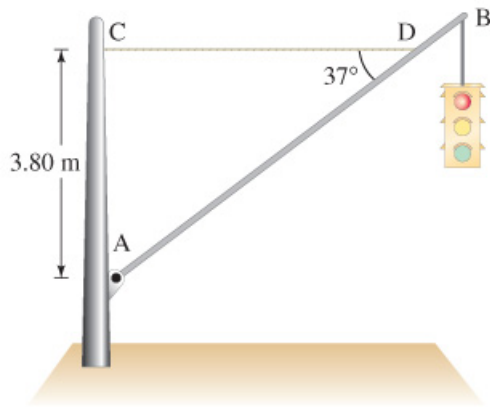
9. (3 points) List at least one of Newton's laws.

10. (1 point) Describe the difference between elastic and inelastic collisions.

11. (3 points) An old spaceship has a rotating tape recording device for storing data. What happens to the spaceship when the tape starts spinning? Why? *Hint: Something is being conserved.*

12. (3 points) Why are the curved ramps on and off major highways banked at an angle rather than kept horizontal?