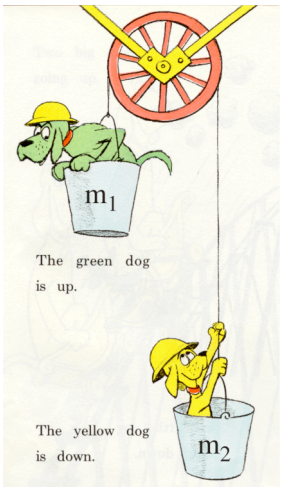
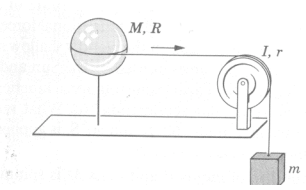
Ph 202H/212H
W09 Homework – Due Tuesday, January 20 at 10:00 am

1. Two objects (m_1 = 1.2 kg and m_2 = 3.5 kg) hang from a string that passes over a pulley. The pulley is a thin disk of mass M = 2.6 kg and radius R = 0.3 m. The pulley is free to rotate with negligible friction about a horizontal axis through its center. The string that passes over the pulley does not slip on the disk as it moves, so the pulley rotates as the objects move. The system is released from rest. Calculate the speed at the end of 3.0 seconds. Hint: You will need to use some techniques from PH211 for this problem. Draw a force diagram for each of the three objects in this system and use Newton's second law (in linear form for the 2 hanging objects and in rotational form for the pulley). The tension will be different in the strings on either side of the pulley, and the tension in neither string is equal to the weight of the hanging object.



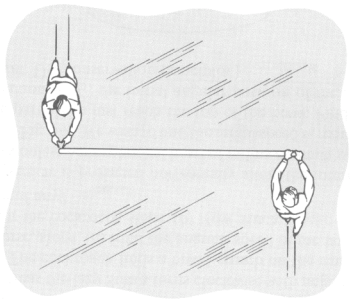
Answer: 1_.3 m/s

2. A solid sphere of mass m_1 = 3.6 kg and radius R = 0.12 m is free to rotate without friction about a vertical axis. A thin string is wrapped around the sphere and attached to a hanging block (m_2 = 2.5 kg) over a small frictionless pulley of negligibly small mass. The system is released from rest. What is the speed of the block after it has fallen a distance of h = 0.45 m. Hint: use energy methods.



Answer: 2._ m/s

3. Two skaters on frictionless ice, each of mass 51.2 kg, approach each other along parallel paths separated by 2.92 m. They have equal and opposite velocities of 1.38 m/s. The first skater carries a pole of length 2.92 m and negligibly small mass, and the second skater grabs the end of the pole. (a) Describe quantitatively (using numerical values) the motion of the skaters after they are connected by the pole. (b) By pulling on the pole, the skaters reduce their separation to 0.940 m. Find their angular speed at the reduced separation.



Answer: 9._2 rad/s