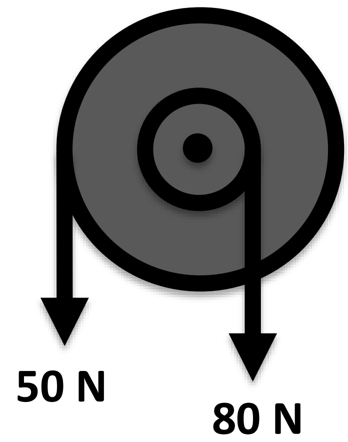
Problem Set #5 due beginning of class, Tuesday, Feb. 18

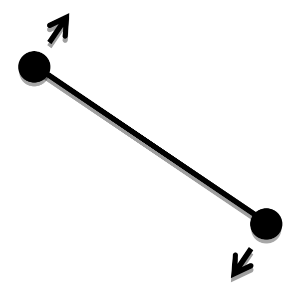
1) Section 4.5 Exercise 1, Ranking Several Objects
2) Section 4.5 Exercise 2, Rolling Objects up a hill
3) Section 4.6 Exercise 2, person on diving board

4) A 10 kg disc of radius 2 m has an attached pulley wheel of radius 80 cm. The wheel/pulley assembly is of uniform mass density and is free to spin on a low friction bearing. Strings are wrapped around the outside of the wheel and inner pulley as shown. With the wheel initially at rest, I pull on the string with the tensions indicated.
   a) Please describe the subsequent motion of the wheel.
   b) Quantify the resulting motion, and include the direction using the correct right-hand rule.



5) Section 4.7, Exercise 1. Dropping larger disk on rotating disk

6) This is a variation of Section 4.7, Exercise 2
   Two identical bodies are tied together with a string, are spinning in space about the center at angular speed, ω_i, when a motor at the center pulls them both inward such that the final diameter of their paths is 1/3 the original diameter, or, d => <u>1/3</u> d_i. If this is in outer space, we can be sure there are no outside forces. We might consider conserving energy and/or angular momentum.



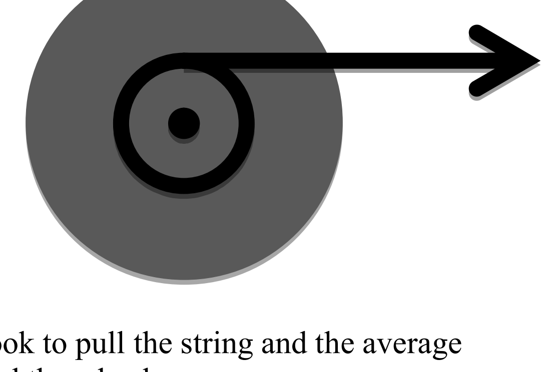
   a) Is it possible for the angular momentum to change? If so how?
   b) Is it possible for energy to change? if so, where did the energy go or come from?

   Is it possible to conserve both angular momentum ***and*** energy? Let's find out!

   c) What happens to the moment of inertia with this change? I => ___ I_i
   d) If we conserve angular momentum what should be the new angular velocity? ω => ___ ω_i,
   e) Would this change the kinetic energy? If so, by what factor: KE =>___ KE_i
   f) Can we conserve angular momentum ***and*** energy? If not, which one must have changed, and where did that extra energy (or angular momentum) come from?

7) You have an ax to grind, and you decide to grind it on the outer rim of a round 5 kg stone grinding wheel of uniform thickness and radius 30 cm. The coefficient of friction between steel and stone is 0.3. You spin the wheel up to 1000 rpm with a 100 W motor.
   a) What is the angular velocity of 1000 rpm?
   b) How long does it take to spin the wheel up to 1000 rpm? What lens do you use?
   c) Then I push the ax against the wheel with a force of 100 N and the sparks fly! But as soon as you start, the electricity goes out and the wheel is spinning freely without power. What is the angular acceleration of the wheel as you push against it with the ax?

8) A concrete flywheel of uniform thickness has a mass of 50 kg and a radius of 40 cm. If I pull on the string with a force of 100 N that is wound around a pulley of radius 16 cm.
   a) what will be the angular velocity, ω after 10 s? Remember, no credit without lens.
   b) What if instead of pulling for 10 s, I ask you to find the final angular velocity, ω after pulling 2 meters of string. Would this change the lens that you would look through? Please find the final angular velocity, ω.
   c) Just as we did in linear problems, for problem (b) above, knowing the final ω, please find the average angular velocity, the time it took to pull the string and the average power that the wheel/ax produced in thermal energy as you slowed the wheel.



9) Chapter 5.0, Exercise 1, You see something moving in a circle.

10) Chapter 5.1 Exercise 1, Lunar period!

11) Chapter 5.2, Exercise 2, Lower Earth Orbit