Physics 203 June 22, 2015
Tutorial Session #7 Rotational Dynamics

These are the notes for the tutorial session #7. The topics including chapter 9 and a small part of chapter 10 of the textbook, namely, rotational dynamics, statics, rotational kinetic energy, angular momentum, and springs. Some of the problems which are a bit more advanced will be marked with an asterisk (*). It means that solving them might not help you on the quiz or the exams, but it's fun to think about these problems.
If you haven't gotten any email from me, please stay around after class so that I can get an email address from you.
The textbook is the 9th edition of Physics by Cutnell and Johnson. The numbers are almost the same as 10th edition.
Keywords: Rotational Dynamics, Statics, Springs, Moment of Inertia.

1) Consider two mass connected over a massive pulley as shown in fig. 1. The masses are $m_1 = 10$ kg, $m_2 = 20$ kg, and the moment of inertia of the pulley is $I = 4.0$ kgm^2. The radius of the pulley is $R = 0.20$ m. The coefficient of kinetic friction between the mass m_1 and the ground is $\mu_K = 0.40$. The rope does not slide on the pulley, so the pulley rotates while the masses are moving. There is no friction at the axis of the pulley.
a) Draw the forces acting on the masses and on the pulley. Hint: Remember that the tension force changes over the pulley.
b) Find the acceleration of the masses.

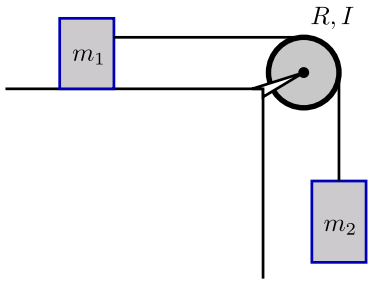

Figure 1: Two masses connected over a massive pulley.

2) We want to solve the previous problem, using the work-energy theorem, or equivalent formulation in terms of energies rather than forces. We release the blocks from the rest. After the masses moved $d = 2.0$ m, using energy methods, find their velocities. Check if this matches the acceleration you have found in the previous problem.

3) A 0.200 m uniform bar has a mass of 0.750 kg and is released from rest in the vertical position, as the fig. 2 indicates. The spring is initially unstrained and has a spring constant of $k = 25.0$ N/m. Find the tangential speed with which end A strikes the horizontal surface. This is a verbatim copy of the problem 88, Chapter 10, Physics, by Cutnell & Johnson, 9th edition.

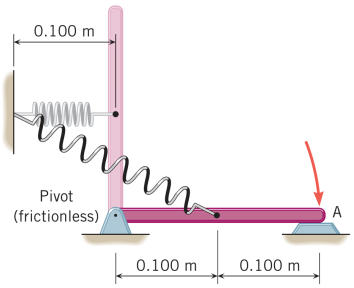

Figure 2: A rod attached to a spring, falling down.

4) 9.24 from the textbook
Taking a wheel up a step

5) 9.25 from the textbook
The beam attached to a vertical wall

6) 9.30 from the textbook
The tension in the crossbar of the ladder

7) 9.45 from the textbook
The bicycle slowing down by the breaks

8) 9.56 from the textbook
Making the rod stop at a straight-up orientation

9) 9.58 from the textbook
The tennis ball rolling down the hill

10) 9.68 from the textbook
How close the block can get to the axis and conservation of angular momentum

11) 9.80 from the textbook
Knowing the acceleration, find the mass of the pulley