Homework 8

Due Friday, 14 April

The main part of HW8 is to redo Exam 3 and to answer a few questions about it. There are a few more questions on the next page.

You may either print the exam from the course website or use the one you got in recitation last Friday and write on it. Anyone who earned 80% or better on each question here is exempt from repeating it. (You can just write "exempt" on the question on the exam you turn in.) If you would like me to print it for you, I will have some available in the Physics Clinic starting Monday midday.

Two notes:

Grading standards: Your work must clearly show that you know what you are doing. We will not be scrounging around for "ways to give you a bit of partial credit". If it is not clear from looking at your submission that you understand the solution to the exam question and the physics involved, then we will not spend too much time trying to figure out whether it has earned for instance a 2/10 or a 4/10.

Academic integrity: Since this assignment can earn you some credit back on Exam 3, the seriousness of our academic integrity standards are the same as they would be on an exam. However, this is not an exam, and you are encouraged to collaborate with others and seek help in understanding things.

Just as on other homework, you may:

- Discuss the questions with any people you like, and ask them for help understanding the physics
- Collaborate with your classmates or anyone else in understanding the material

Just as on other homework, you may not:

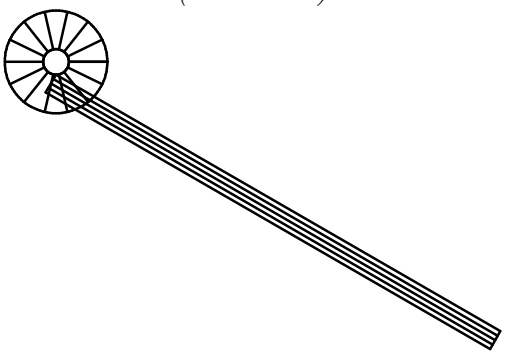
- Post the questions or their solutions to any commercial platform or any platform that facilitates academic dishonesty (such as Chegg or Bartleby)
- Submit any work that you do not fully understand or cannot explain
- Submit any work that is the result of copying from somewhere else rather than the authentic result of your own effort toward understanding

(This is an old exam problem.) A meter stick is elevated at a $\theta = 30°$ angle. A spool consists of a cylinder of radius 2 cm with two disks affixed on either end; the disks have a radius of 10 cm. The cylinder is very light; you may assume all of the mass of the spool is in the disks. The spool is placed at the top of the meter stick so that the cylinder is touching the stick; when it is released, it rolls without slipping to the bottom. *(The moment of inertia of a disk is* $\frac{1}{2}mr^2$*).*

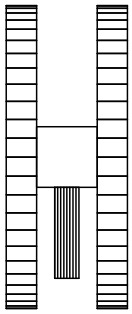
In this problem, you will calculate the speed of the spool at the bottom.

Rules for this problem: You may solve this problem in either symbols or numbers. If you use symbols, you must tell me the physical values of each symbol that you use (for instance: "$r = 2$ cm"). If you use numbers, you *must* retain the units (i.e. write "10 cm", not "10".)

(Side view)



(Rear view)



a) What is the relation between the spool's translational velocity v and its angular velocity ω?

b) Construct an equation showing the conservation of energy as the spool rolls down the slope. What sorts of energy does it have at the top? What about the bottom?

c) Calculate the velocity of the spool at the bottom. Remember, if you use variables, you must tell me what number each symbol represents!