Torque and rotational dynamics

Physics 211
Syracuse University, Physics 211 Spring 2019
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April 25, 2019

Announcements

Final exam review schedule:

- Tuesday, 29 April: 4PM - 8PM, Physics Building room 208
- Wednesday, 1 May: 10AM - 3PM, Physics Building room 106
- Friday, 3 May: 10AM - 4PM, room TBA

These reviews have no agenda other than yours – please come prepared with questions.

Friday's recitation problems are a good benchmark for the material from this unit on the final.
If you understand them well, it will help you substantially for the Unit 4 material.

Paper submissions

Submit your papers two different ways:

- Physically in your TA's mailbox, by Monday close of business
- By email to `suphysics211papers@gmail.com`

You must submit your paper using **both** methods.

How do the gears on a bicycle work?

A few things to remember about the homework:

- The only parts that matter are:
  - The rear wheel and the gears attached to it
  - The crank and the gears attached to it
  - The chain connecting them
- The top portion of the chain exerts an equal and opposite force on the front and rear gears
- The *tangential velocity* of the front and rear gears are the same, since they're connected by a chain
- The tension that the chain applies to the front and rear gears is the same
- The angular velocity of the front and rear gears *isn't* the same

Sample problem 1: a brave cat

A board of length 3 meters rests on a table. One meter of the board is hanging off the table.
The board has a mass $m_b = 10$ kg.

Toby the cat walks out on the board. If Toby has a mass of 6 kg, how far will she make it before the board falls over?

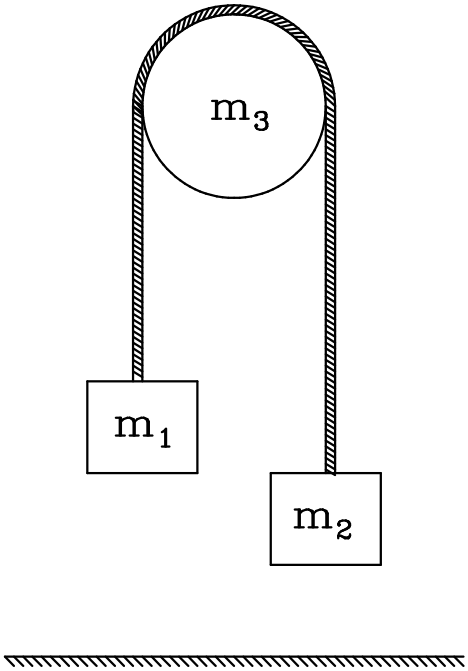
Sample problem 2: the Atwood machine

What will the acceleration of the masses be?

Does the answer make sense?

Some things to keep in mind:

- The two tensions are not necessarily the same now
- Draw force diagrams for everything
- Write $\sum F = ma$ for the hanging masses, since they only translate
- Write $\sum \tau = I\alpha$ for the pulley, since it only rotates
- Solve the resulting system of equations



Sample problem 3: a bad bowler

A bowler throws a ball down the lane with no spin at all at an initial velocity v_0.

If the coefficient of kinetic friction is μ, how long does it take before the ball begins to roll without slipping?

Tips for this problem:

- $v = \omega r$ is only true at the end – we have to solve for the time at which this is true
- Kinetic friction causes both an acceleration...
- ... and a torque and thus an angular acceleration

- Over time, ω goes up, and v goes down