Waves

Physics 211
Syracuse University, Physics 211 Spring 2015
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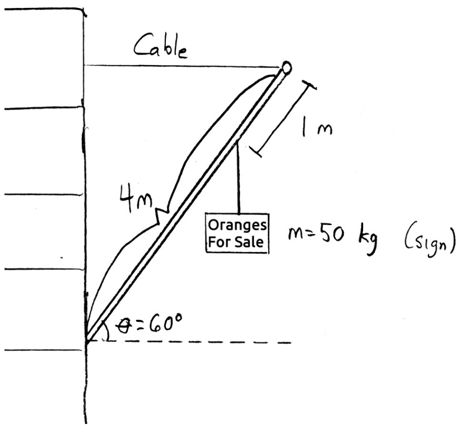
Announcements

- First thing while it's still fresh: a recap of a problem from Exam 3

The static equilibrium problem

A 4m-long pole of mass 80 kg extends from the side of a building, angled at 60 degrees above the horizontal. One meter from the end of the pole, a sign of mass 50 kg is attached. To support the pole, a horizontal cable runs from the end of the pole to the building. (See the attached figure.)



... b) Compute the tension in the cable. (15 points)

Grading and preparation for the final

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- The average was around 55, which is not unusual for this exam
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- Remember, you can drop one of your exam grades
- The final will be cumulative
- More, easier problems; more conceptual problems
- Multiple topical extra review sessions during the run-up to the final
- Remaining recitation sections are **all** review

Final exam "makeup opportunity"

- If you do substantially better on the final than one of your other exams...
  - That exam counts less
  - The final counts more
  - This is being done **after the curve**, so it can only help you

Grade appeals for Exam 3

- To appeal your grade, you must attend Friday's recitation, and submit a correct solution with your appeal form
  - (Remember recitation attendance counts toward your grade anyway!)
- Same procedure as before

Waves, overview

- The next few classes are going to focus on the physics of waves
- We'll use strings and tubes – musical instruments – as examples
- ... but all waves behave the same!
    - Light waves
    - Radio waves: an antenna is just like waves on a string!
    - Sound waves
    - Water waves

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    - Sound waves
    - Water waves
    - Matter waves in quantum mechanics: s, p, d, f orbitals!

Waves in 1D – modeling

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- This isn't very flexible, is it? How do we do better?
- Use more springs and masses (simple10.c)
- If we use very many of them, we should get "real" behavior
    - Like pixels on a digital display: enough and you forget that they're there!
    - Now, what can we learn from how this behaves?

Waves in 1D – learning from our model

Some important properties: (pulse.c)

- Pulses (regardless of their size or shape) go at a constant speed
- **The wave speed** c refers to how fast pulses travel down the string
- The property of **linearity:** (twopulse.c)
  - Multiple pulses can pass through each other without interference
  - We will take this as absolutely true for our study here
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  - Wave speed c goes up with more tension!

Sine waves

- We're particularly concerned with waves that look like sines and cosines (sines.c)
- These waves have two new properties: **wavelength** λ and **frequency** f
  - Wavelength: distance from crest to crest
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- What kind of sine and cosine waves can we put on our string?
- Not any wavelengths will do, since the ends have to be fixed

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- We can make a table of the wavelengths that will "fit"
- $\lambda = 2L, 2L/2, 2L/3, 2L/4...$
- $f = \frac{c}{2L}, 2\frac{c}{2L}, 3\frac{c}{2L}, 4\frac{c}{2L}...$
- This is a remarkable result!
  - Only certain frequencies of waves can "live" on my string
  - These are called "standing waves"
  - This idea will occupy us for the rest of the course; for now, let's play! (harm.c)