Welcome!

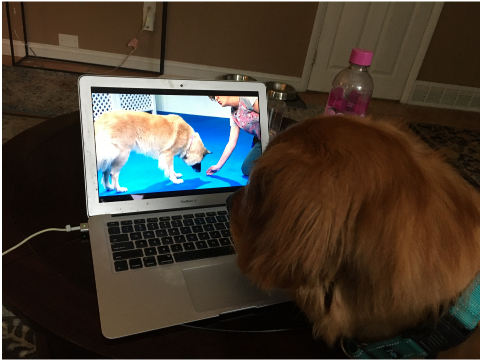
- Web page: `http://positron.hep.upenn.edu/physics8`
- Note that this course is offered every **other** year! So Phys 0008 will next be offered in fall 2023. (Remind your friends.)
- Remember to check in with Bill or Marija or Ryan on your way out (if you leave early) or during the last 10 minutes of class (if you stay to the end), so that we can ask how today's work went for you and perhaps offer you some quick feedback on what you've written down.
- I plan to mix up your groups of 3 pretty infrequently, mainly if people add/drop or to form groups that work well together.
- But groups will move from table to table, so that your group of 3 will share a table with a different group of 3 each time.
- Warm-up question: ask your teammates – as well as the other group at your table – whether they have any family pets.
- You could also ask others at your table about their majors or likely majors.

On the count of 3, shout out your major or likely major.

On the count of 3, shout out what species, in your opinion, makes a good family pet: one word – cat, dog, gerbil, hamster, fish, etc.

(There's no right answer to this question . . . .)



In this demonstration (repeated from today's video), which version of the model do you expect to fail first?

(A) The left-hand version will fail first.
(B) The right-hand version will fail first.
(C) There is no way to predict which version will fail first.

(On the count of 3, shout out "**A**lpha" or "**B**ravo" or "**C**harlie.")

Where will it fail?

(A) Upper level.
(B) Lower level.
(C) There is no way to predict at which level the failure will occur.

(On the count of 3, shout out "**A**lpha" or "**B**ravo" or "**C**harlie.")

How will it fail?

(A) A wooden dowel will snap.
(B) A column will buckle.
(C) A clothespin will “lose its grip” on a wooden dowel.

(On the count of 3, shout out “**A**lpha” or “**B**ravo” or “**C**harlie.”)

Which clothespin will lose its grip?

(A) A clothespin just beneath the lower level, which holds the lower level onto its wooden dowel.
(B) A clothespin just beneath the upper level, which holds the upper level onto its wooden dowel.
(C) A clothespin above the upper level.

(On the count of 3, shout out "**A**lpha" or "**B**ravo" or "**C**harlie.")

- Remember before next Wednesday's class meeting to:
  - **Skim** Mazur chapter 01 (PDF on Canvas).
  - Watch my day02 video (motion in 1D), perhaps at $2\times$ speed;
  - or if you dislike videos, skim Mazur ch 02 (PDF on Canvas).
- If you didn't yet turn in your reading/video response form for today, please do so during the long weekend.
- Remember to check in with Bill or Marija or Ryan on your way out (if you leave early) or during the last 10 minutes of class (if you stay to the end), so that we can ask how today's work went for you and perhaps offer you some quick feedback on what you've written down.

Physics 8, Fall 2023, Worksheet #1.

Upload PDF (smartphone scan or tablet edit) to Canvas at end of class on Wed, Aug 30, 2023.

Problems marked with (*) must include your own drawing or graph representing the problem and at least one complete sentence describing your reasoning.

Discuss each problem with your teammates (usually groups of 3), then write up your own solution. Be sure to compare final results with your teammates, as a way to catch mistakes. It can also be very interesting when you and a teammate use different methods to arrive at a result! Do not hesitate to ask for help from other students or from the instructors.

1*. At the unused round tables (Table 9,10), we have placed several copies of a “bridge model” similar to the one I demonstrated in today’s video. Please monitor the status of these stations and when you see one open, your lab group should visit an open station to complete this exercise. (Groups will need to take turns, as we have more groups than we have “bridge model” stations.) I left blank space at the end of this question.

(a) Determine the “weight” of the wooden plank, in kilograms. (We will soon learn that kilograms are in fact a unit of mass, not weight, but today we will gloss over this nuance.)

(b) When the two supports are beneath the extreme ends of the plank, how much of the plank’s weight does each support bear (ie what does each scale read)? What is the sum of the two readings? Does the sum agree with your intuition (even though we have not yet learned any formal rules for evaluating this result)?

(c) When one support is at the extreme end of the plank, while the other support is at the three-quarter point (so it is halfway between the end and the center of the plank), what is the sum of the two scale readings? What is the ratio of the two scale readings? If you reflect on your experience of helping a friend to move a heavy piece of furniture, does your intuition agree with which reading is larger than the other?

(d) Choose one or two other placements for the two supports (ie the two scales), and report both the sum and the ratio of the two scale readings. In every case, keep track of how far each of the two scales is from the center of the plank.

(e) Can you and your teammates figure out a rule that would predict or concisely summarize the ratios that you see in parts (a), (b), (c), and (d)? One hint is to imagine two people sitting on a see-saw. Think about how two people of different weights can balance on a see-saw. (If you're stuck, ask for help.)

When we study torque, in early November, we will develop a systematic way to evaluate problems like this. For now, just use your imagination, your experience, and your intuition to see if you can find an empirical rule-of-thumb to describe what you observe. My hope is that once we study torque, you will appreciate knowing how to approach methodically this problem that you puzzle over today.

2*. Make a rough estimate of the total mass of the Great Pyramid of Giza. Approximate the shape as a solid pyramid whose height is 140 meters and whose base is a square whose sides have length 230 meters. (We're neglecting any passageways, burial chambers, etc.) For such a pyramid, $V = Bh/3$, where B is the area of the base. You'll need to look up a value for the density of stone (eg limestone or granite or even modern concrete — all of which are close enough for an estimate).

3*. A husband and wife work in buildings exactly fifteen (equal-length) blocks apart and plan to meet for lunch. The husband strolls at a leisurely pace of 1.00 meter per second, while the wife walks at a much brisker pace of 2.00 meters per second. (In other words, the wife walks $2\times$ as fast as the husband walks.) Knowing this, the wife picks a restaurant between the two buildings at which she and her husband will arrive in the same instant if the two of them leave their respective buildings at the same time. In blocks, how far from the wife's building is the restaurant?

It is a bit unfair for you to have to solve this problem before having learned any physics! But you may have learned in a math class that $\mathrm{distance} = \mathrm{speed} \times \mathrm{time}$. You know that the travel times for the husband and the wife are equal, and you know that the wife's speed is $2\times$ the husband's speed. So I think that you can infer the ratio of distances that the wife and husband walk, and take it from there. The main point of this problem is for you to have fun reasoning it out with your teammates.

4. Convert 55 miles per hour (a) to kilometers per hour, (b) to meters per second, and (c) to feet per second. Use the textbook's (or intro video's) ratio method and write out your work step-by-step. You can double-check your answer using Google Calculator if you like, but don't just write down an answer without showing the steps.

5. Airplanes commonly fly at an altitude of 33,000 feet above sea level. What is this distance in miles? In meters?

Rubric: 4 points per problem: 2 for effort, 2 for correctness.

- 4 points = correct or very nearly correct
- 3 points = minor mistake
- 2 points = major mistake
- 1 point = you haven't convinced us that you put in much effort to try to solve the problem
- 0 points = nothing or very little of substance written down
- For some problems (such as today's hands-on bridge model), it may be unreasonable for us to look for "correctness," so instead all 4 points will be for effort.
- 4 additional overall points for presenting your work clearly, with adequate reasoning. So if n is the number of problems, the total points will usually be $4n + 4$.

Equations

unit conversions: "multiply by 1" as in $\frac{1\,\mathrm{kg}}{1000\,\mathrm{g}}$ such that unwanted units cancel out and desired units remain

$$\frac{1\,\mathrm{mile}}{5280\,\mathrm{feet}} = 1 \qquad \frac{1\,\mathrm{foot}}{12\,\mathrm{inches}} = 1 \qquad \frac{1\,\mathrm{inch}}{2.54\,\mathrm{cm}} = 1$$

$$\frac{1\,\mathrm{m}}{100\,\mathrm{cm}} = 1 \qquad \frac{1\,\mathrm{km}}{1000\,\mathrm{m}} = 1 \qquad \frac{1\,\mathrm{hour}}{3600\,\mathrm{s}} = 1$$

example:

$$3\,\mathrm{mi} = 3\,\mathrm{mi} \times \frac{5280\,\mathrm{ft}}{\mathrm{mi}} \times \frac{12\,\mathrm{in}}{\mathrm{ft}} \times \frac{2.54\,\mathrm{cm}}{\mathrm{in}} \times \frac{1\,\mathrm{m}}{100\,\mathrm{cm}} \times \frac{1\,\mathrm{km}}{1000\,\mathrm{m}} = 4.8\,\mathrm{km}$$

mass $=$ density $\times$ volume

distance $=$ speed $\times$ time