Physics 0008 – before day 1

Please watch this video **before** the first day of class.

If you forget, or you join the course late, then watch it as soon as you remember.

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 2025. (Remind your friends.)
- Physics 8 covers a pretty similar set of topics to other introductory college physics courses, such as Phys 0101 (for premeds), Phys 0150 (for engineers), Phys 0170 (for physics majors). What makes it **Physics for Architects?**
  - About half of you are ARCH students. Having your own course lets us tailor it to your interests and your backgrounds.
  - Once we've covered the basics, we'll spend several weeks applying what we've learned to study topics related to architectural structures: trusses, cables, beams, etc. Fun!
  - Most of you are "visual learners." Lots of lecture demonstrations make the physics concepts memorable.
  - You're used to working together. We'll do most of the learning cooperatively, in small groups, in this course.
  - We know how much time you spend on your studio projects. So we do our best to keep this course low-stress for you.

Physics can give us new insights into the everyday world. We should go through this video a second time at end of semester.

https://www.youtube.com/watch?v=XfZFuw7a13E https://www.youtube.com/watch?v=XfZFuw7a13E&t=35

- 0:35 — impulse
- 0:43 — rotational inertia, torque
- 0:51 — torque, periodic motion, velocity, projectile motion
- 2:53 — friction, circular motion, projectile motion (173 s)
- 3:30 — center of mass (210 s)
- 6:18 — friction, “normal force” (378 s)

https://www.youtube.com/watch?v=XfZFuw7a13E&t=378

- For a long time, architects have been designing structures to span spaces. Is physics relevant to this pursuit?
- Let's make a **model** of a bridge. (Physics often uses models to simplify problems into a form you can analyze more easily.)

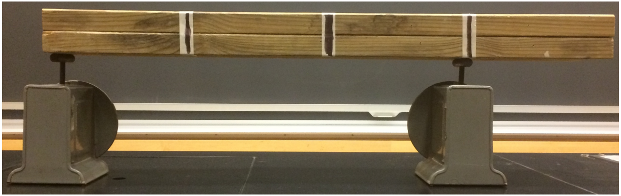
- The two supports are spring scales that read kilograms. The "bridge deck" is an 8 kg wooden plank.
- If I use the two scales to support the plank symmetrically, as shown, from its very ends, what will each scale read?
- (For now, use your intuition to "guess." As we study forces and torques in Sep/Oct, we'll draw diagrams to analyze more formally.)

(A) Both scales will read 8 kg

(B) Both scales will read 4 kg

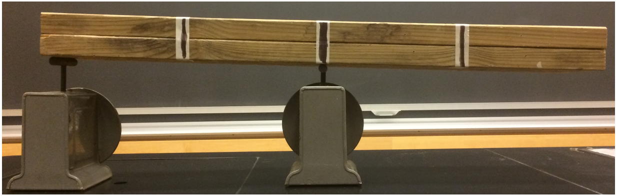
(C) The left scale will read more than the right scale

(D) The left scale will read less than the right scale



- The "bridge deck" is an 8 kg wooden plank.
- Now one support stays at the far left, but the right support moves left, so that 1/4 of the plank hangs over the R end.
- What will the left and right scales read now?

(A) 4 kg (L) and 4 kg (R)
(B) (2/3)(8 kg)=5.33 kg (L) and (1/3)(8 kg)=2.67 kg (R)
(C) (1/3)(8 kg)=2.67 kg (L) and (2/3)(8 kg)=5.33 kg (R)
(D) (3/4)(8 kg)=6 kg (L) and (1/4)(8 kg)=2 kg (R)
(E) (1/4)(8 kg)=2 kg (L) and (3/4)(8 kg)=6 kg (R)
(F) 3 kg (L) and 6 kg (R)



- The "bridge deck" is an 8 kg wooden plank.
- Now one support stays at the far left, but the right support moves left, so that 1/2 of the plank hangs over the R end.
- What will the left and right scales read now?

OK, let's watch the demonstration and see what happens in real life. You will then repeat a version of this demonstration in our first class meeting.

Here, next, is a closely related demonstration: we'll position a 5 kg mass at several different locations along a "bridge deck," and we'll see how position affects how much of the 5 kg is borne by the left vs the right support beneath the bridge.

Oops! You will hear me say that the "bridge deck" seems to have a mass just below 1 kg. In fact I should have said that it was just below 2 kg. See if you can find my mistake!

By the way, these two scales report values in kilograms. What does a spring-based scale (like this one) really measure, anyway?

(A) mass

(B) weight

(C) inertia

(D) What's the difference?

- All materials deform (change shape) when you push or pull on them. In November, we'll study how the beams (or joists) beneath a floor bend in response to the "load" (the downward push) imposed by e.g. heavy furniture in the middle of the floor. (Illustrate with ruler.)
- The scale measures how far an internal metal spring bends in response to an object's pushing down on the scale's platform.
- Usually(*) that downward push exerted by the object on the scale is equal to the downward pull that Earth's gravity exerts on the object. We call that downward pull of gravity the object's **weight**. Weight is usually measured in Newtons (a unit of **force**), while mass is usually measured in kilograms.
- (*) Assuming that the object and scale are not accelerating.
- But weight is proportional to mass. The constant of proportionality is smaller on the Moon than it is on Earth.
- By the way, *inertia* is the same thing as mass. It measures an object's tendency to resist being accelerated.
- After a few weeks, this vocabulary will feel much more familar.

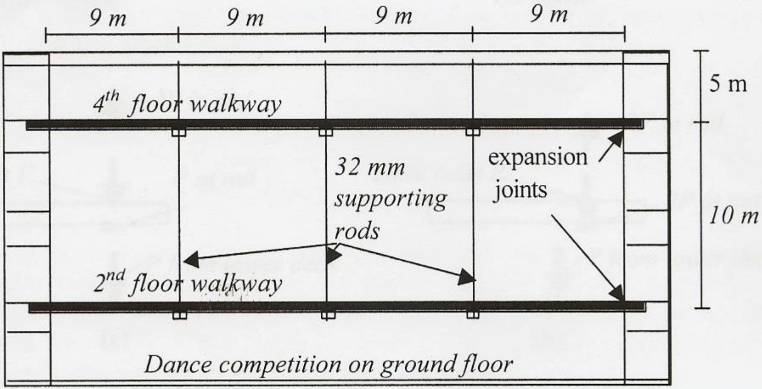
Next, we'll use two different models to demonstrate the physics behind the 1981 Hyatt Regency walkway collapse, in Kansas City. If you're curious, you can pause to glance at the Wikipedia article:

https://en.wikipedia.org/wiki/Hyatt_Regency_walkway_collapse

In my youth, I enjoyed reading the excellent discussion of this and other disasters in *To Engineer is Human* by Henry Petroski. If you decide to read Petroski's book, ask me how you can earn extra credit for doing so.

Kansas City Hyatt Regency skywalk collapse

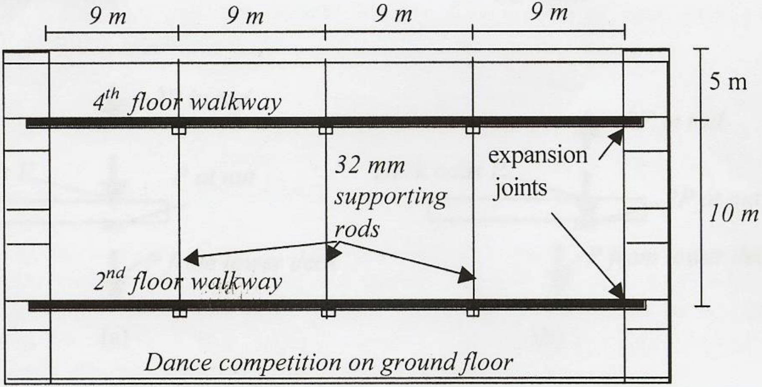
On 7^{th} July *1981*, a dance was being held in the lobby of the Hyatt Regency Hotel, Kansas City. As spectators gathered on suspended walkways above the dance floor, the support gave way and the upper walkway fell on the lower walkway, and the two fell onto the crowded dance floor, killing *114* people and injuring over *200*.



For more like this, read *To Engineer is Human* by Henry Petroski.

Kansas City Hyatt Regency skywalk collapse

On 7^{th} July *1981*, a dance was being held in the lobby of the Hyatt Regency Hotel, Kansas City. As spectators gathered on suspended walkways above the dance floor, the support gave way and the upper walkway fell on the lower walkway, and the two fell onto the crowded dance floor, killing *114* people and injuring over *200*.



For more like this, read *To Engineer is Human* by Henry Petroski.

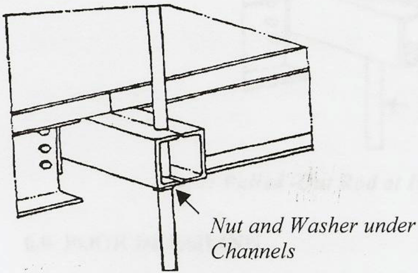


Fig. 5(a): Hyatt Regency Hanger Details As-Designed

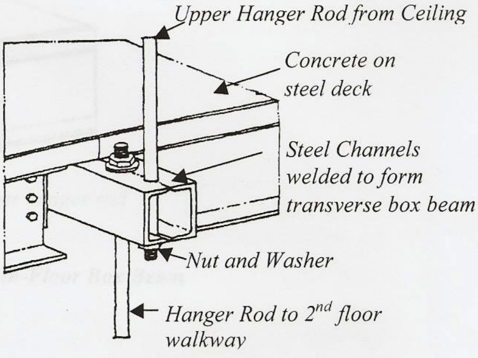


Fig. 5(b): Hyatt Regency Hanger Details As-Built

As designed, each of the two skywalks hangs onto the rope with its own hands. As built, the lower skywalk's hands are effectively hanging onto the upper skywalk's feet! So the upper skywalk's grip on the rope feels $2\times$ larger force than in original design. Oops!

"Free-body diagram" from Petroski's book

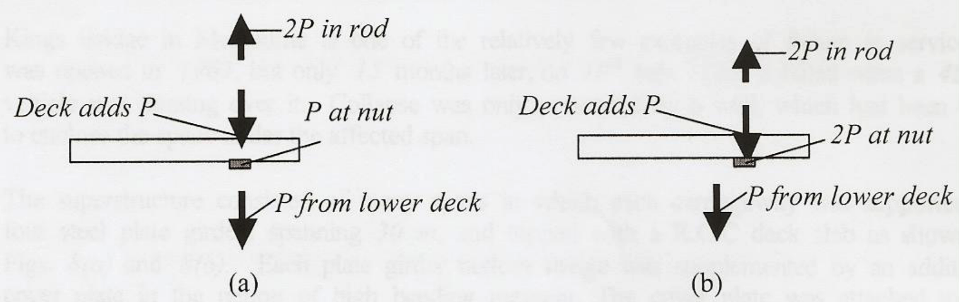


Fig. 6: Free-Body Diagram (a) As Designed (b) As Built

We'll learn, in a few weeks, how to draw free-body diagrams as a graphical method to analyze forces (and then later, torques).
(When we draw our own diagrams, we will be more methodical about clearly spelling out all relevant forces.)

Upper skywalk loses its grip on the “rope”

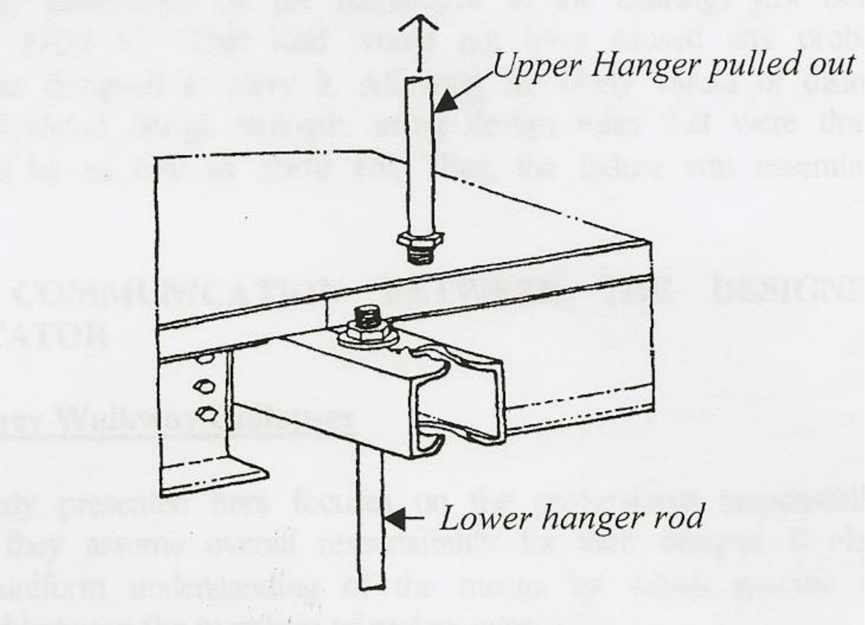
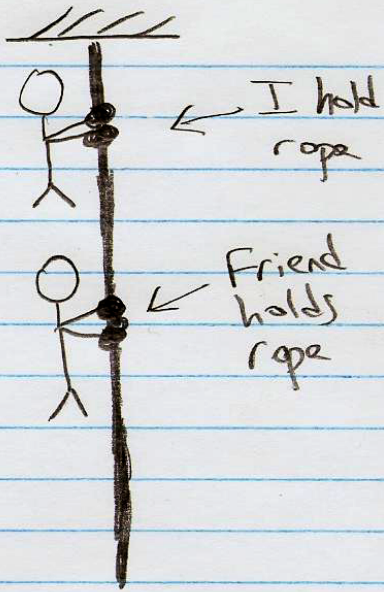
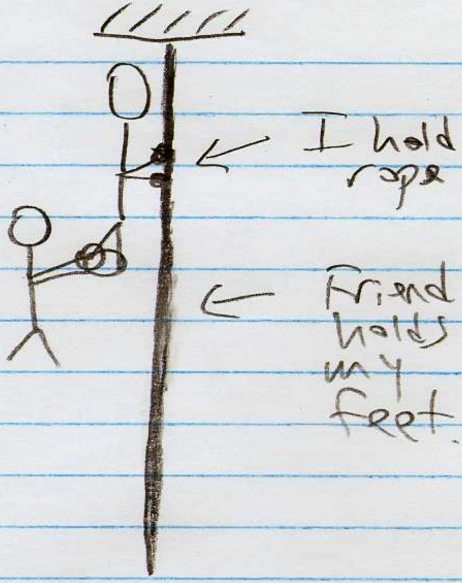


Fig. 7: Pulled -Out Rod at Fourth-Floor Box Beam

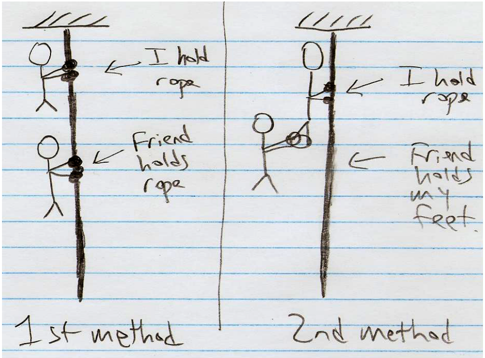


1st method



2nd method

To keep me from falling, the required force between *my* hands and the rope is . . .

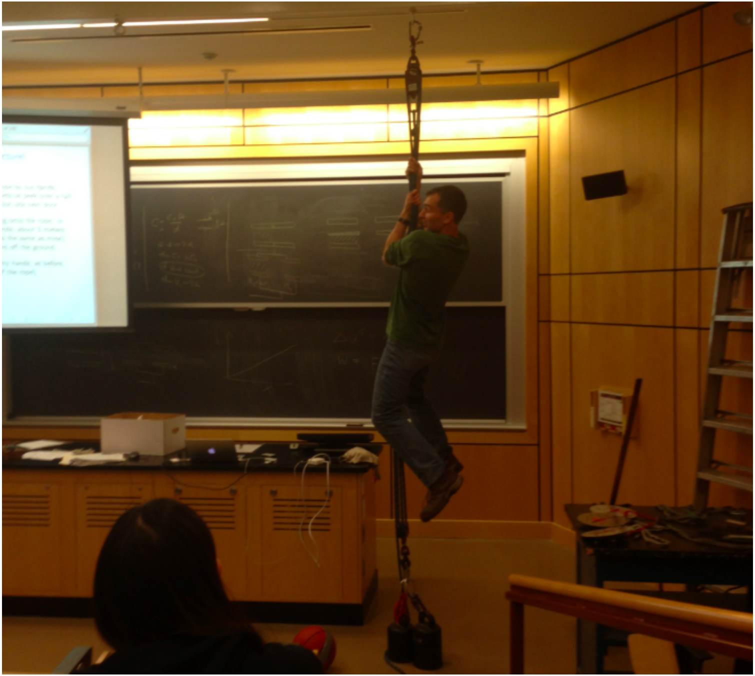


(A) The same for both methods: equal to my weight

(B) The same for both methods: equal to $2\times$ my weight

(C) Twice as much for 1st method ($2\times$ vs $1\times$ my weight)

(D) Twice as much for 2nd method ($2\times$ vs $1\times$ my weight)



Instructor: Dr Bill Ashmanskas (me)

Bill, Dr Bill, Prof Bill, etc — whichever is most comfortable for you

`ashmansk@hep.upenn.edu` office: DRL 1W15
tel. 215-746-8210 mobile: (write on board)
Stop in any time my door is open, or email to set up a time.

I teach physics & electronics here in the Physics Dept, and I design electronics for research projects in both the Physics and the Radiology departments. My design work usually involves writing computer code, but sometimes I use CAD software for Printed Circuit Board design

I grew up in the Boston suburbs, where my dad (a carpenter / framing contractor) built wood-frame houses. Working for him one summer taught me a lot about what holds our homes up! So it felt like destiny that I should teach Physics for Architects.

Course format

- We'll typically have textbook reading / video watching due on Mondays and Wednesdays. That lets us spend most of our classroom time solving problems together in small groups.
- In-class problem-solving should be fun and cooperative. We're here to help you — and your classmates are too.
- Some class meetings will include a hands-on activity: during our first class, you'll assemble and measure your own copy of the "bridge" demonstration that I did using a plank and two scales.
- We won't have any midterm exams. But we want you to be responsible for knowing how to solve, on your own, the worksheet problems that you solve with your classmates. So once every 1–2 weeks, after a given worksheet has been graded and returned, we'll spend the first 15 minutes of class on a closed-book exercise that repeats, with minor edits, a (not so difficult) problem from that worksheet.

Why are we here?

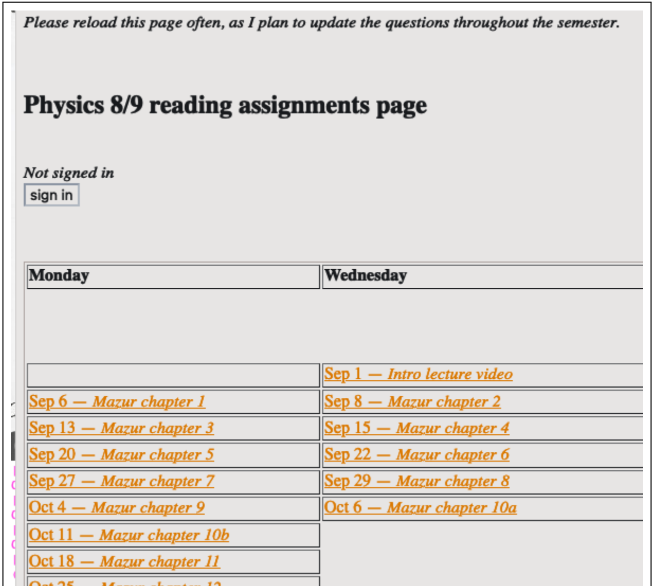
- If you're here just to take a college physics course, that's great. Here are my terms: You put in a consistent 8–10 hours each week (total) on reading/videos and in-class work; and I'll do my best to make Physics 8 fun, informative, and stress-free for you.
- You may be here because a college physics course is required for entrance to most graduate programs in architecture.
- . . . or because eventually, to be certified as a practicing architect, you will take exams covering structures, heating/ cooling systems, plumbing, electrical systems, acoustics, etc.
- . . . or because making a detailed energy model of a building depends on the physics of heat and light.
- But I think more generally you're here because many of you will someday design things that will exist, will be seen, and will function in the physical world that surrounds us. A better understanding of the physical world will make you a better designer. And if you work with engineers on designs, you can ask better questions if you all speak the same language.

- So this fall we'll focus on *mechanics*, which should prepare you well for the Structures course that many of you will take as seniors.
- While learning (or re-learning) Newton's laws of motion, you'll exercise the mathematical side of your brain.
- Prof Farley, who teaches Structures (ARCH 4350/4360) here, tells me that he wants students to enter his course with a solid understanding of **forces, torques, vectors,** and **trigonometry.** One key goal of Physics 8 is to leave you well prepared for his course.

Online response forms

After watching this video, go to

`http://positron.hep.upenn.edu/q008/`



Please reload this page often, as I plan to update the questions throughout the semester.

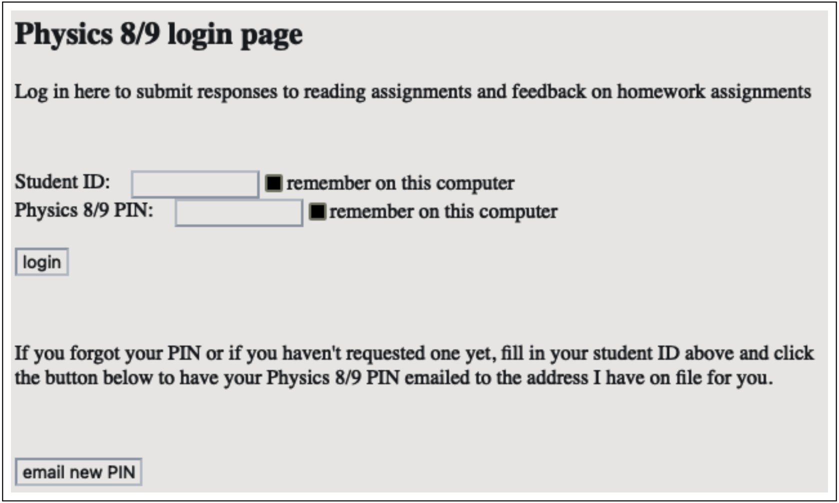
Physics 8/9 reading assignments page

Not signed in

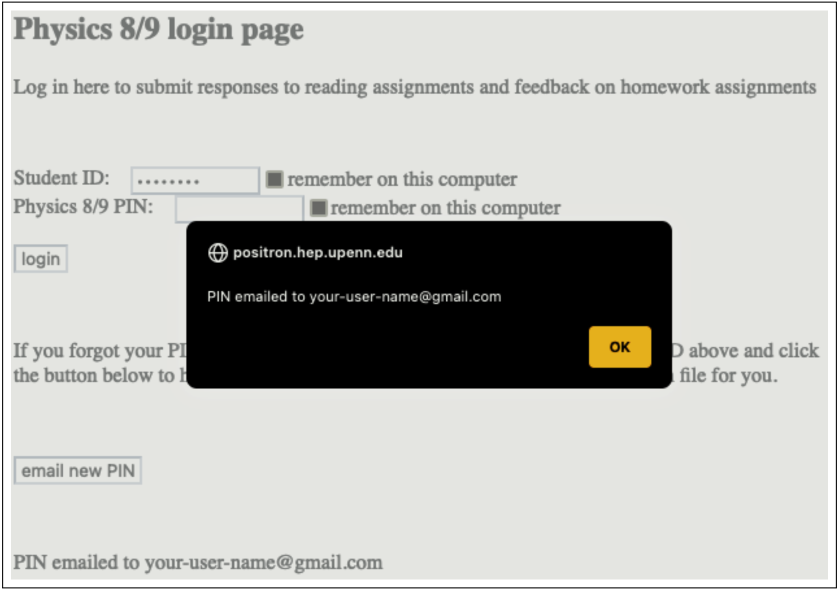
sign in

Monday	Wednesday
	Sep 1 — *Intro lecture video*
Sep 6 — *Mazur chapter 1*	Sep 8 — *Mazur chapter 2*
Sep 13 — *Mazur chapter 3*	Sep 15 — *Mazur chapter 4*
Sep 20 — *Mazur chapter 5*	Sep 22 — *Mazur chapter 6*
Sep 27 — *Mazur chapter 7*	Sep 29 — *Mazur chapter 8*
Oct 4 — *Mazur chapter 9*	Oct 6 — *Mazur chapter 10a*
Oct 11 — *Mazur chapter 10b*	
Oct 18 — *Mazur chapter 11*	

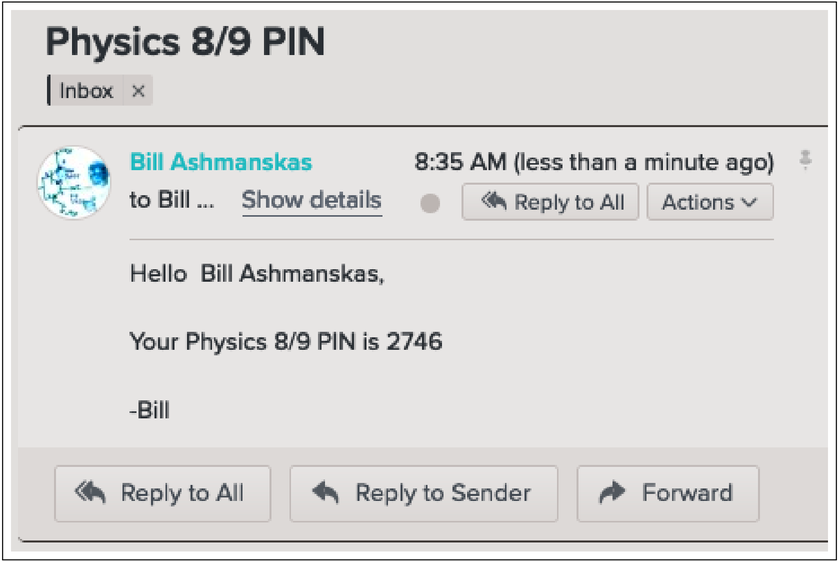
Click “sign in.” Enter 8-digit student ID number (from your PennCard). Click “email new PIN.”



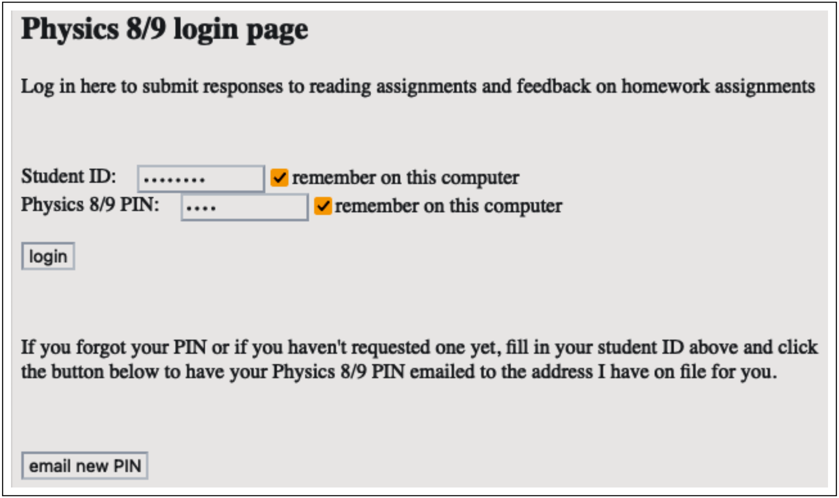
Click "sign in." Enter ID number. Click "email new PIN."



Your PIN should arrive by email.



Now log in. If you click “remember on this computer,” then you don’t have to bother logging back in next time.



Physics 8/9 login page

Log in here to submit responses to reading assignments and feedback on homework assignments

Student ID: ········· remember on this computer
Physics 8/9 PIN: ···· remember on this computer

login

If you forgot your PIN or if you haven't requested one yet, fill in your student ID above and click the button below to have your Physics 8/9 PIN emailed to the address I have on file for you.

email new PIN

You should see yourself signed in now. Click on today's assignment.

Physics 8/9 reading assignments page

Signed in as Bill Ashmanskas

sign out | my info

Monday	Wednesday
	Sep 1 — *Intro lecture video*
Sep 6 — *Mazur chapter 1*	Sep 8 — *Mazur chapter 2*
Sep 13 — *Mazur chapter 3*	Sep 15 — *Mazur chapter 4*
Sep 20 — *Mazur chapter 5*	Sep 22 — *Mazur chapter 6*
Sep 27 — *Mazur chapter 7*	Sep 29 — *Mazur chapter 8*
Oct 4 — *Mazur chapter 9*	Oct 6 — *Mazur chapter 10a*
Oct 11 — *Mazur chapter 10b*	
Oct 18 — *Mazur chapter 11*	
Oct 25 — *Mazur chapter 12*	
Nov 1 — *Giancoli chapter 9*	Nov 3 — *Onouye chapters 1+2*
Nov 8 — *Onouye chapter 3*	Nov 10 — *Onouye chapters 4+5*
Nov 15 — *Onouye chapter 6*	Nov 17 — *Onouye chapter 7*
Nov 22 — *Onouye chapter 8*	
Nov 29 — *Mazur chapter 15*	Dec 1 — *Giancoli chapter 11 (vibrations)*

Fill out the form and then click “submit.”

Assignment due 2021-09-01 (Wed Sep 1): Intro lecture video

Signed in as Bill Ashmanskas

sign out | my info | assignment list

Before our first class meeting, please watch my introductory lecture online at tinyurlxyz. I sometimes go more slowly than I intend, so you may prefer to watch it at 2x speed.

1. What televised sports entertainment competition do we use to illustrate and to bring to life a few of the physics phenomena we will study this semester?

edit

2. In the video, how do we model the way a bridge deck's weight is shared between two supports? Did you find anything interesting about the result, even though we do not yet have the tools to describe it methodically?

edit

3. What famous 1981 structural collapse do we demonstrate with a model in this lecture? (There is a Wikipedia page that describes this collapse, FYI.)

Fill out the form and then click "submit."

1. What televised sports entertainment competition do we use to illustrate and to bring to life a few of the physics phenomena we will study this semester?

American Ninja Warrior.

2. In the video, how do we model the way a bridge deck's weight is shared between two supports? Did you find anything interesting about the result, even though we do not yet have the tools to describe it methodically?

We use two scales, one to measure the load that each support bears. I found it interesting to compare with my experience when moving heavy furniture with a friend.

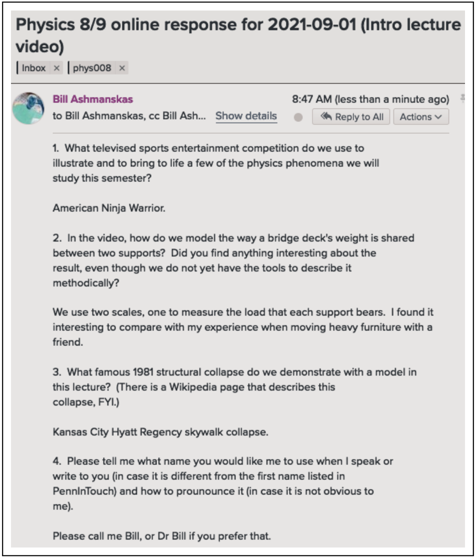
3. What famous 1981 structural collapse do we demonstrate with a model in this lecture? (There is a Wikipedia page that describes this collapse, FYI.)

Kansas City Hyatt Regency skywalk collapse.

4. Please tell me what name you would like me to use when I speak or write to you (in case it is different from the first name listed in PennInTouch) and how to prounounce it (in case it is not obvious to me).

Please call me Bill, or Dr Bill if you prefer that.

This should generate an email to me, CC to you. If you have any trouble, just email your answers to `ashmansk@hep.upenn.edu`



Physics 8/9 online response for 2021-09-01 (Intro lecture video)

Inbox × phys008 ×

Bill Ashmanskas 8:47 AM (less than a minute ago)

to Bill Ashmanskas, cc Bill Ash... Show details Reply to All Actions

1. What televised sports entertainment competition do we use to illustrate and to bring to life a few of the physics phenomena we will study this semester?

American Ninja Warrior.

2. In the video, how do we model the way a bridge deck's weight is shared between two supports? Did you find anything interesting about the result, even though we do not yet have the tools to describe it methodically?

We use two scales, one to measure the load that each support bears. I found it interesting to compare with my experience when moving heavy furniture with a friend.

3. What famous 1981 structural collapse do we demonstrate with a model in this lecture? (There is a Wikipedia page that describes this collapse, FYI.)

Kansas City Hyatt Regency skywalk collapse.

4. Please tell me what name you would like me to use when I speak or write to you (in case it is different from the first name listed in PennInTouch) and how to prounounce it (in case it is not obvious to me).

Please call me Bill, or Dr Bill if you prefer that.

I do this so that the reading-response emails are automatically formatted in a way that is easy for me to process and search.

You decide to add to your hirise design a rooftop swimming pool, big enough for people to swim laps for exercise. Make an order-of-magnitude estimate of the mass of the water contained in the pool. First guess by pure intuition, then try multiplying out some plausible numbers. [What size cube of water has a mass of a metric tonne?]

(A) 10^3 kg (1 tonne)

(B) 10^4 kg (10 tonnes)

(C) 10^5 kg (10^2 tonnes)

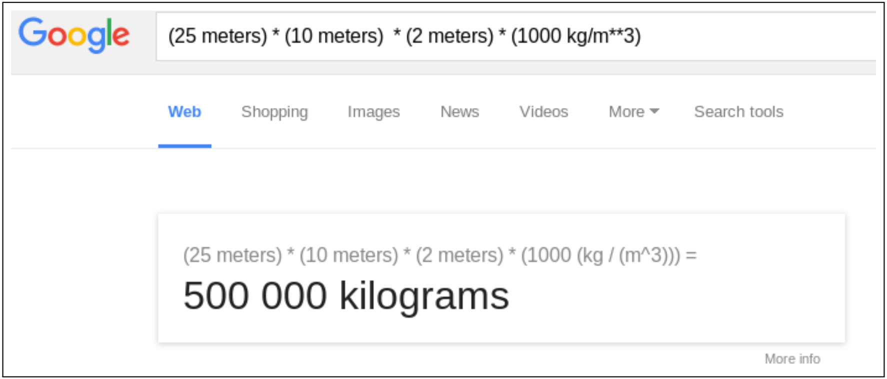
(D) 10^6 kg (10^3 tonnes)

(E) 10^7 kg (10^4 tonnes)

(F) 10^8 kg (10^5 tonnes)

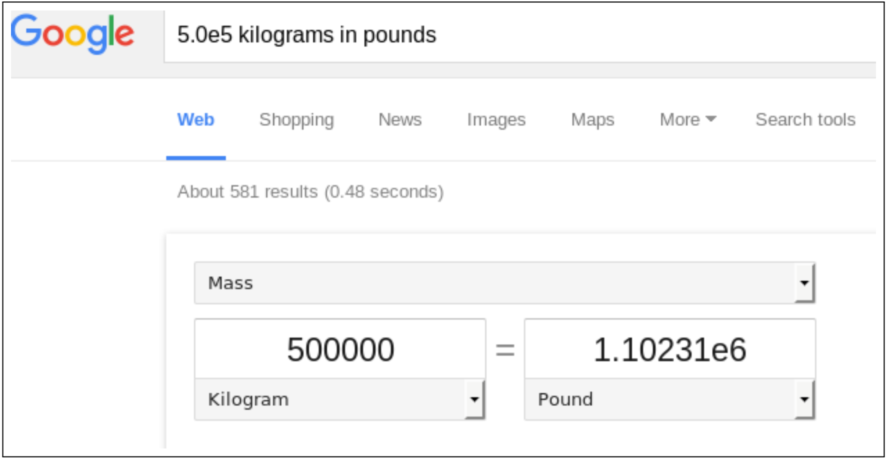
Here's my estimate

Useful trick: google understands units!

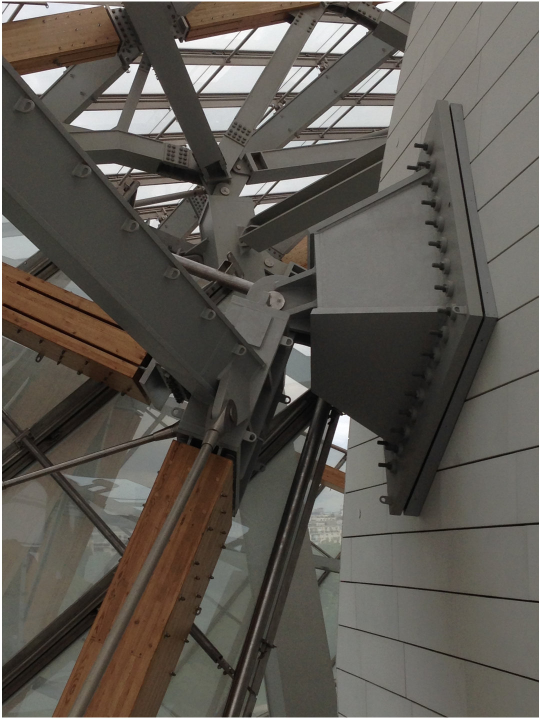


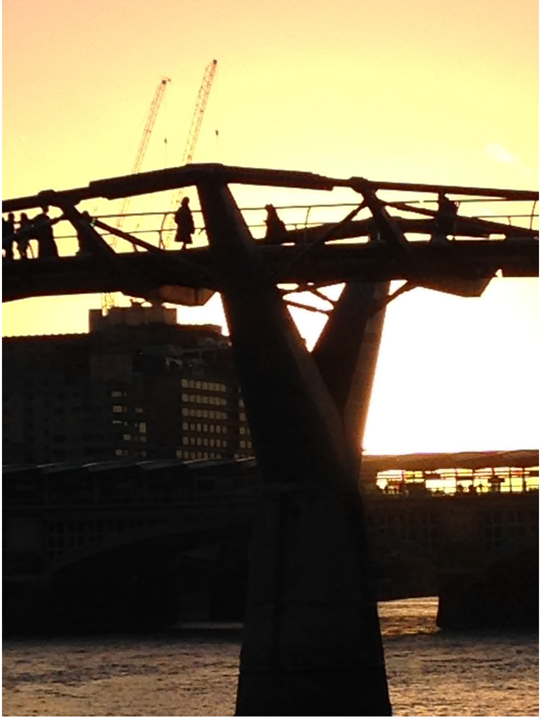
OK, what weight in pounds corresponds to this mass in kilograms?

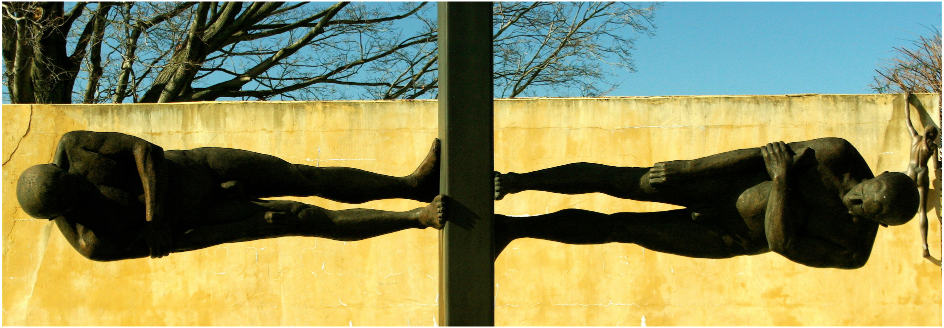
Another trick: google can convert units!



The rest of these slides are an intro from Prof Richard Farley, who plans to join us in class most Wednesdays. He has been contributing to our two Physics for Architects courses for over a decade now.







- Course web page is at `http://positron.hep.upenn.edu/physics8`
- The reading for the first segment of the course is on Canvas. I'll explain later how to purchase or borrow a copy of the textbook for the second segment of the course.
- **To do before next class meeting:**
- Skim Chapter 1 during the long weekend.
- **Watch video then skim Chapter 2 before our 2nd class meeting.**
- Remember to fill out online response forms for both reading assignments at `http://positron.hep.upenn.edu/q008` . (This is linked from Canvas and from course web page, so you don't need to write it down.)
- PDFs of these slides and other handouts can be found at `http://positron.hep.upenn.edu/physics8/files`