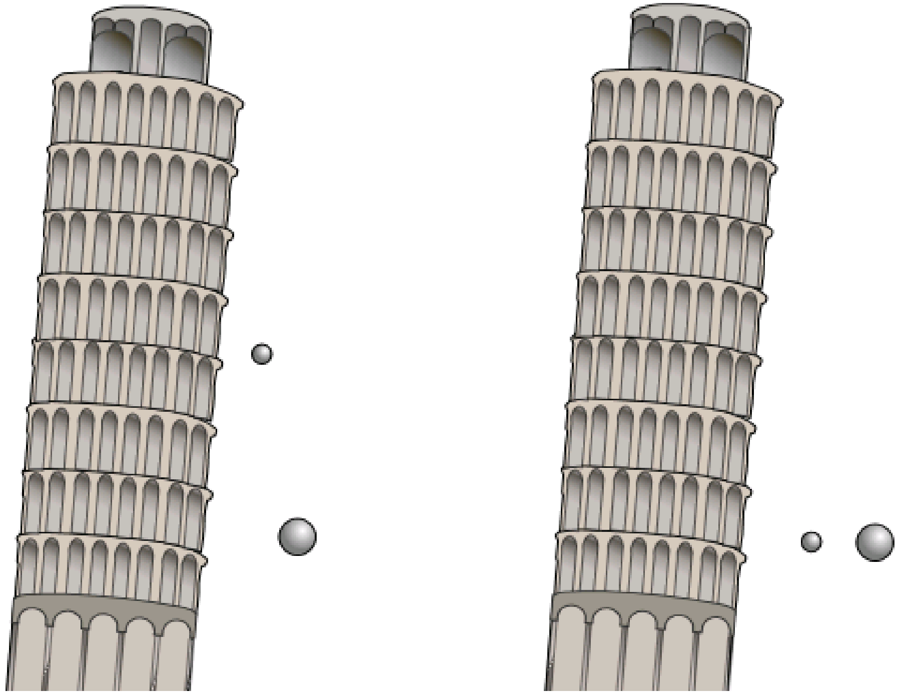
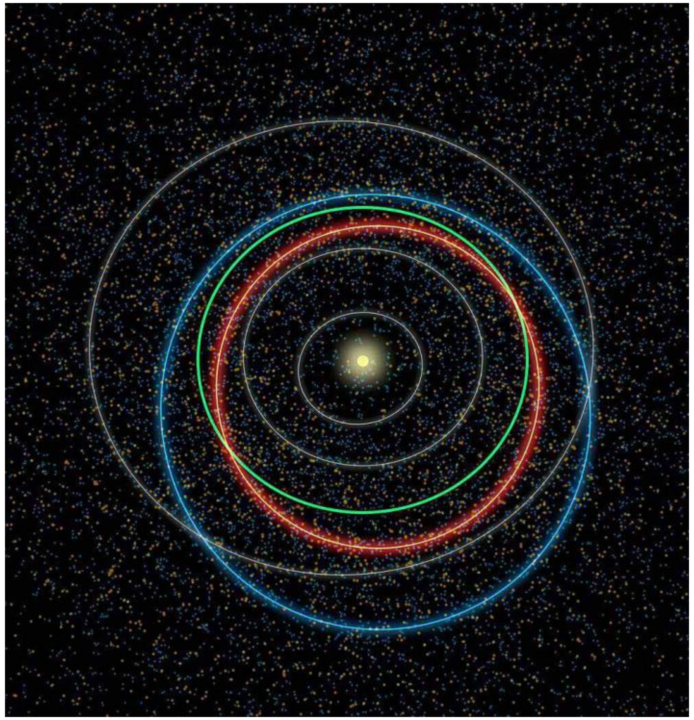
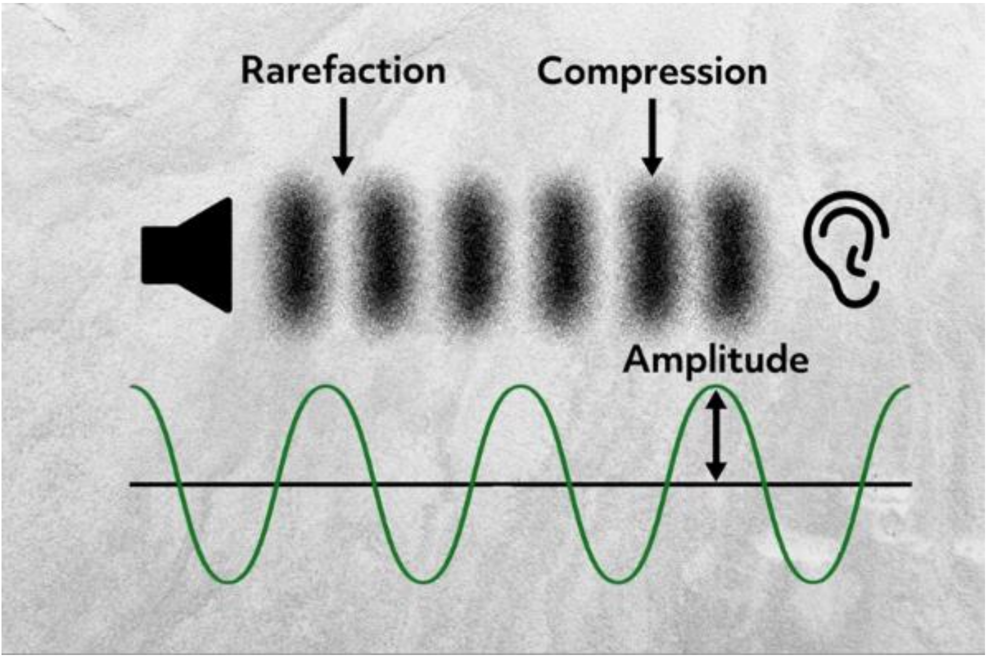






Engineering Physics I
PHY 303K

Kinematics, Statics, Dynamics, and Waves

Plan for Today

- Introductions and notecard assignment
- Course Topics and Syllabus Overview
- Space, Time, Mass - and Units
- First Example Problem
- Upcoming due dates etc.

Introductions: Instructional Team

<u>Instructor of Record</u>

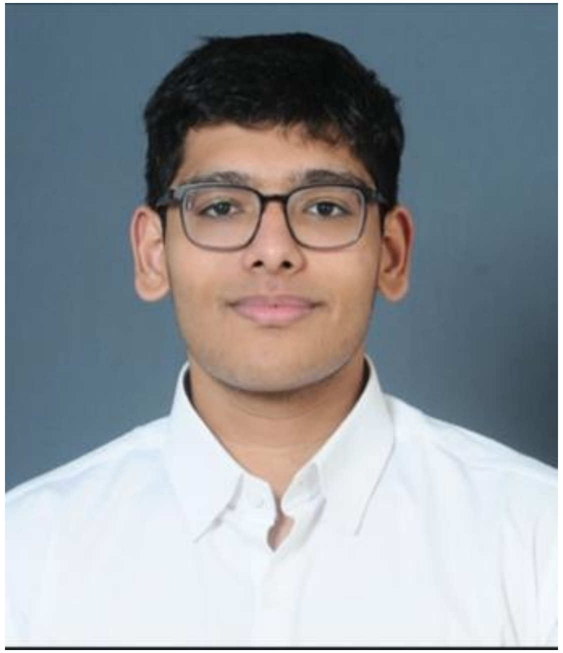
Andrew Loveridge

<u>Graduate Teaching Assistant</u>

Vaishnavi Patil

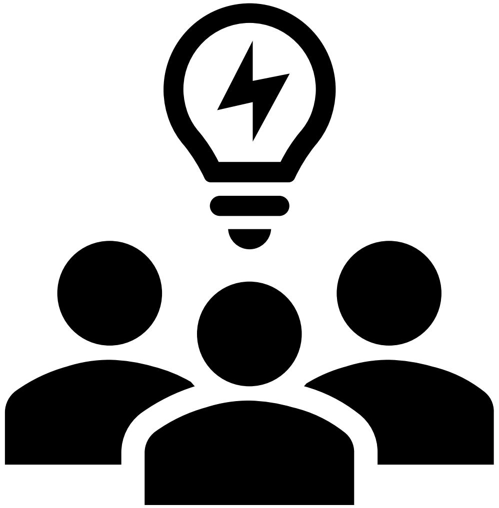
<u>Undergraduate Learning Assistant</u>

Megan McAfee



<u>Undergraduate Learning Assistant</u>

Sushmit Gupta



Introductions: Class

Turn to one of your neighbors, introduce yourself, and talk until you find *one "uncommon" thing in common*. Then raise your hand.

Introductions

First Assignment: Fill out Notecard, drop by PMA 12.224

Purpose: I'd like to get to know a bit about each of you, to get you to get to know each other a little bit, for you to know where my office is, to signal my availability and interest (btw your entitled to office hour time from all your professors…hold them to this!)

Follow Up: I'll get sense of common interests, concerns, and majors

Introductions

First Assignment: Fill out Notecard, drop by PMA 12.224

1. Name
2. How should I refer to you?
3. Which School + City were you at just before here?
4. Which subjects (e.g. major or majors) are you interested in?
5. What's something you'd like to get out of this course, or how might you use it in the future?
6. Do you have any concerns/challenges that come to mind about the course?'
7. Who did you talk to? What do you have in common? (their signature)

Introductions

First Assignment: Fill out Notecard, drop by PMA 12.224

1. Andrew Loveridge
2. Andrew, Dr. Loveridge, Prof. Loveridge
3. UC Denver (Beijing), University of Wisconsin Madison
4. Theoretical Physics, Physics Education
5. Understand student interests, experiment with teaching methods.
6. A lot to cover – how to do it in an organized and meaningful way?

Brief Review of Prelecture: Syllabus

- Learning Outcomes:
  - **Physics Content**: Kinematics/Statics, Dynamics and applications, Gravity, Waves/Sound
  - **Physics Reasoning**: Problem Solving and Modeling
  - **Physics Attitudes**: Appreciation for and comfort with the topics
- Course Timeline: 3 + 1 units, midterm exams ***during class time Sept 25, Oct 23, Nov 20 in <u>WEL 3.502</u>***
- Course Structure:
  - **Participation**: Completion grade, choose your own adventure to 140. Lectures and discussions each worth 2 points, prelectures 1 point, other assignments 1-2 points each
  - **Practice**: Graded on accuracy but multiple attempts, Expert TA, we'll do 2-4 problems in class/discussion each week
  - **Assessment**: 3 midterms (1/2 credit back), final exam

Brief Review of Prelecture: Syllabus

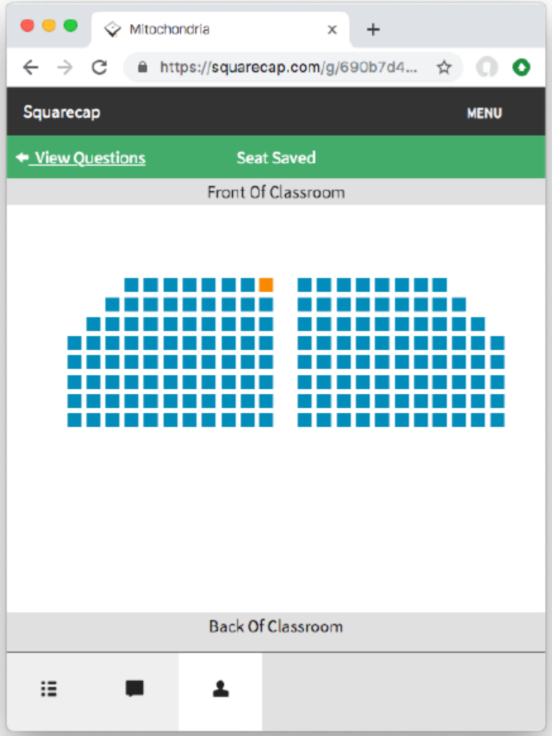
- There is no competitive curving for this class, so does that mean there will be no curves for the exams?
- Will practice exams be offered, or is there a tool on Expert TA that will allow us to create our own with past homework questions?
- As far as time outside of class for homework, do you have a rough extimate on how much time per week a typical student would spend working?
- Does this physics have Calculus?
- Regarding participation, are the Squarecap questions the only form of participation in class, and how is participation determined in discussion sections
- What have you found is the best method to study for exams?
- How do I sign up with Expert TA?
- What is one thing students typically struggle the most with in this class?
- Does this course have in-person office hours for homework or conceptual help? If so, what times?

How do you plan to get your 140 participation points?

Lectures are worth 2 points each, while each associated prelecture is 1. There'll be 42 of them. Discussion sections are worth 2 points each. There will be 13 of them.

You can make up classes/discussions with the make up assignments/catch up discussions

There will be a variety of assignments (notecard) throughout the semester, each worth 1-2 points. There'll be ~10 of these.

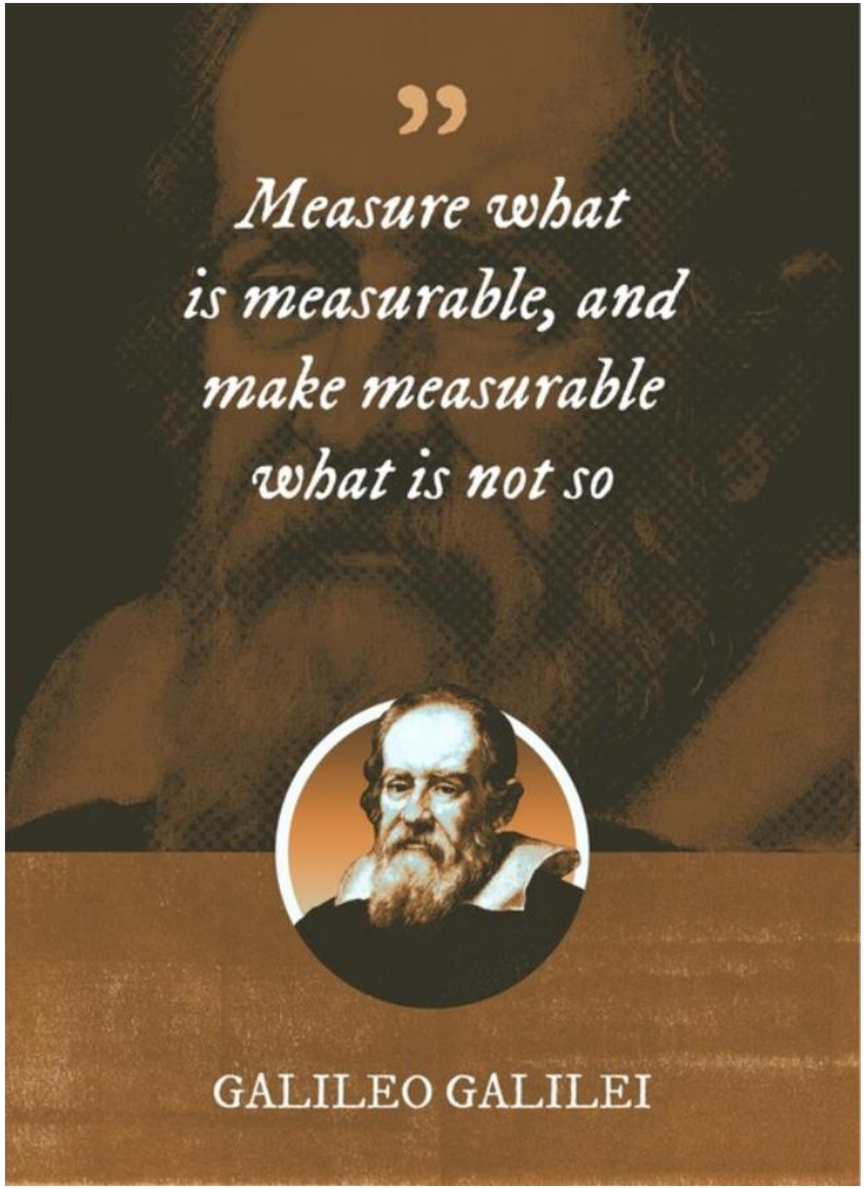


Answer on SquareCap

- Open the app on any device (what if I don't have a device?)
- Put in your seat (letter and #) if possible

Units: Measurements of Space (L), Time (T), and Matter (M)

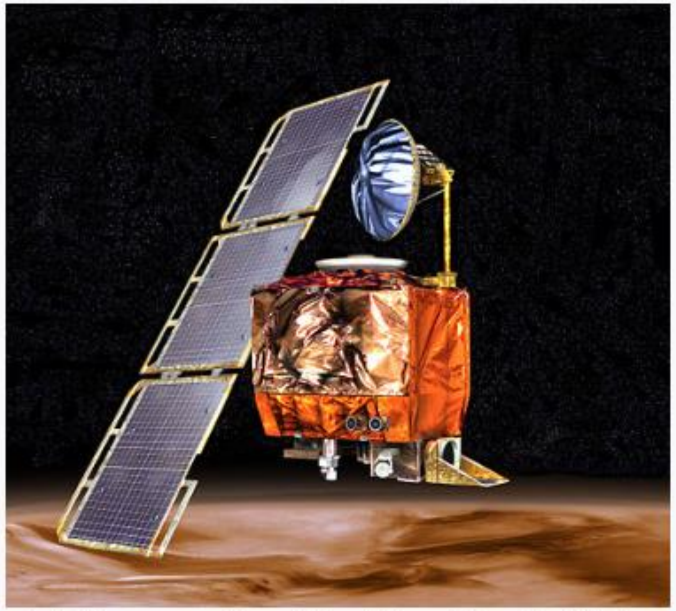
- International System of Units (SI) “Metric System”
- The meter (m), second (s), and kilogram (kg) are the fundamental units
- Other units, such as Newtons, or meters squared, are derived
- Decimal-based system (mega, kilo, centi, milli, micro, nano, etc.)



Why do Units Matter?

- Necessary for comparison – our own units can help us get a sense of scale
- Useful for constraining equations ("checking your answer")
- NASA crashed a spacecraft due to unit conversion confusions (LM used US Customary Units)

Mars Climate Orbiter



Artist's conception of the *Mars Climate Orbiter*

Names	Mars Surveyor '98 *Orbiter*
Mission type	Mars orbiter
Operator	NASA/JPL
COSPAR ID	1998-073A
SATCAT no.	25571
Website	science.nasa.gov
Mission duration	286 days Mission failure

Distances (in meters, m):

- Diameter of a hydrogen atom: 1.06×10^{-10} m
- Thickness of a human hair: 1×10^{-5} m
- Height of a standard door: 2 m
- Length of a football field: 100 m
- Height of Mount Everest: $8,848$ m
- Diameter of the Earth: $12,742 \times 10^3$ m
- Distance from the Earth to the Moon: 3.84×10^8 m
- Distance from the Earth to the Sun: 1.496×10^{11} m
- Radius of the Milky Way galaxy: 5×10^{20} m

Masses (in kilograms, kg):

- Mass of a proton: 1.67×10^{-27} kg
- Mass of a typical virus: 1×10^{-18} kg
- Mass of a grain of sand: 1.6×10^{-7} kg
- Mass of a human: 70 kg
- Mass of an elephant: 5×10^3 kg
- Mass of the Eiffel Tower: 10.1×10^6 kg
- Mass of the Moon: 7.35×10^{22} kg
- Mass of the Earth: 5.97×10^{24} kg
- Mass of the Sun: 1.99×10^{30} kg

Times (in seconds, s):

- Time for light to travel across a hydrogen atom: 3.52×10^{-19} s
- Period of a human heartbeat: 1×10^{-1} s
- Time for one rotation of the Earth (day): 8.64×10^4 s
- Time for one orbit of the Earth around the Sun (year): 3.16×10^7 s
- Average human lifespan: 2.37×10^9 s
- Half-life of Uranium-238: 1.41×10^{17} s
- Age of the Earth: 1.4×10^{17} s
- Age of the Universe: 4.35×10^{17} s

Checking Units!

- Suppose you are solving to find a distance and you work out a formula for the answer:

$$d = vt^2$$

[L]=[L]/[T]*[T]*[T]=[L][T]

- This can’t be correct! Must’ve made a mistake!
- In fact, you can sometimes “guess” the answer up to a numerical factor.

$$d = cvt$$

(c a dimensionless constant! (just a number))

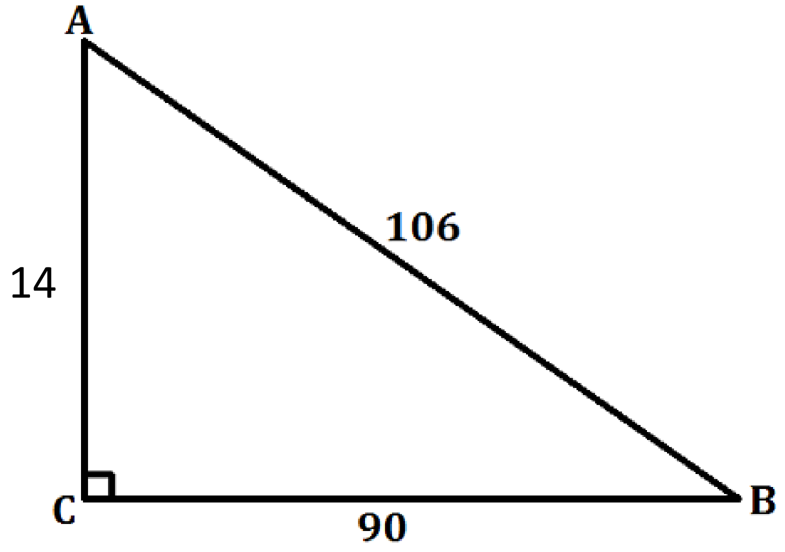
- The mathematically exact statement is the ***Buckingham π Theorem***

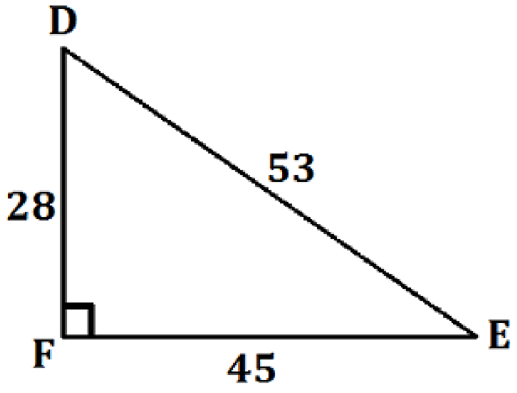
Example: Area of a right triangle

Let's say we want the area of a right triangle, but know only the hypotenuse? What can we say?

$$A = kh^2$$

The quantity k is some dimensionless constant that depends on the kind of right triangle → So it's the same for ones that are similar!





Dimensional Analysis Example: Parallax

You travel a distance of 3 meters straight. Then you turn very exactly to your left and walk 4 meters straight.

How far away are you from your original position?

How to Solve a Physics Problem

(An example of *Structured Problem Solving*)

V	S P
C	R

1. Visualize: Draw/imagine a picture or diagram, label it
2. Collect Info: Relevant concepts, relations, equations
3. Solve: Work out *symbolically*, then plug in at the end
4. Review/check the answer: Units, size, relationships

First Homework Due: Friday Sept 6
First Discussions: Wednesday Sept 4
(so none this week!)