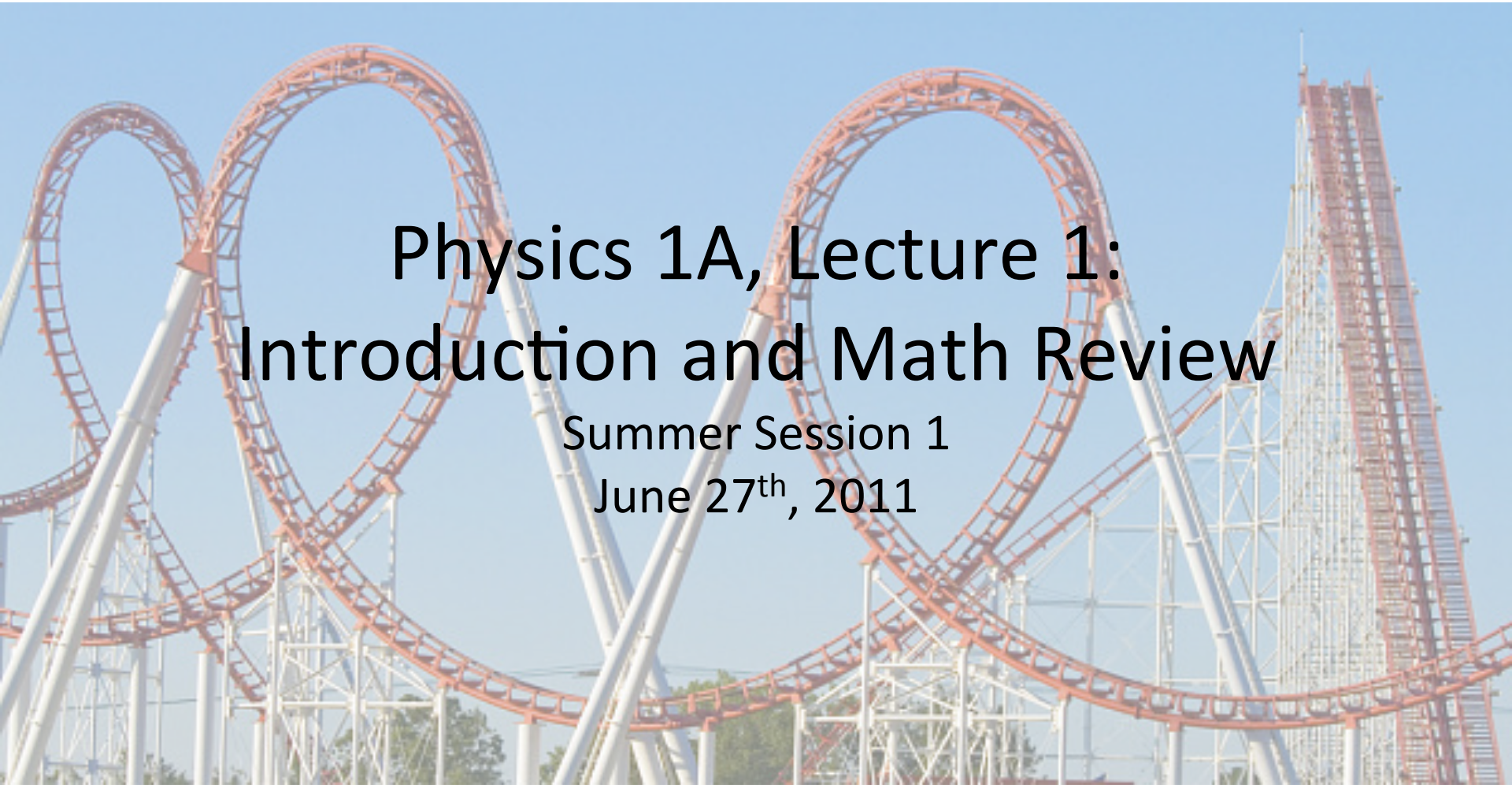


Physics 1A, Lecture 1: Introduction and Math Review

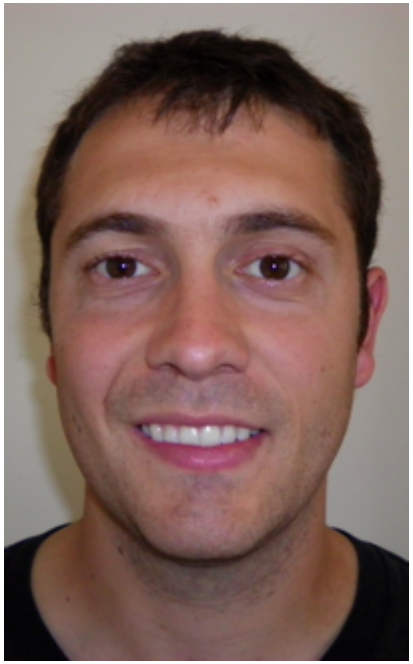
Summer Session 1

June 27th, 2011

Welcome to Physics 1A!

- Mike Anderson
  - Lab instructor (separate class)

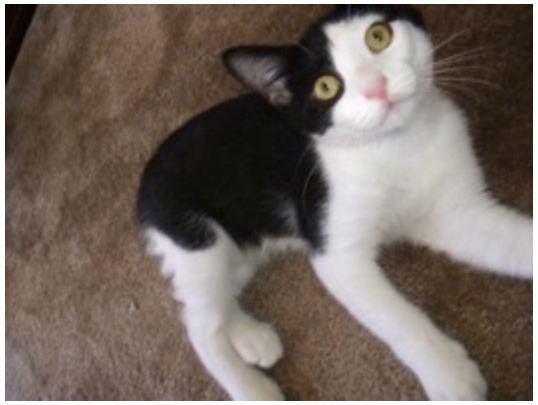
- Evan Grohs (TA)
  - Office hours and problem sessions on Wednesdays



Anat Burger mini bio

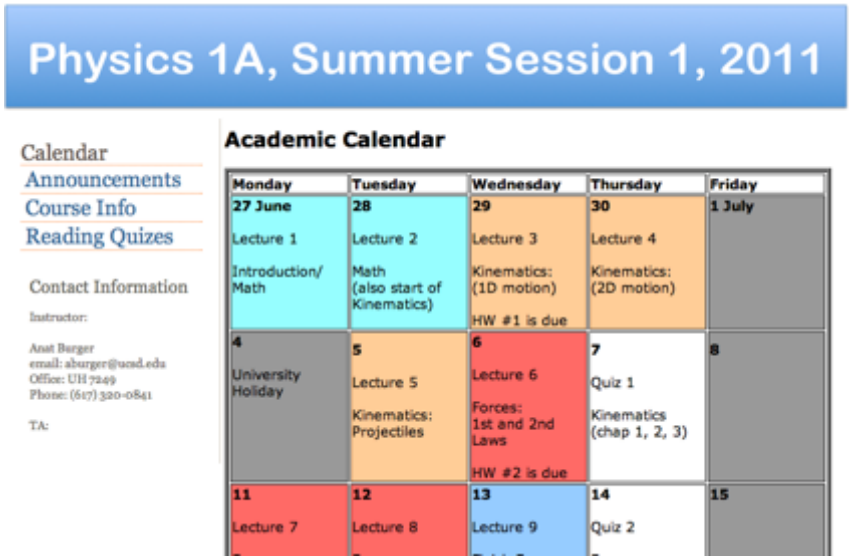
- pronounced like “A-knot”

- I’ll be getting a PhD in Theoretical Biophysics next year
- My cat Rabo
- I’m really excited to be teaching



Our website

- http://physics.ucsd.edu/students/courses/summer2011/session1/1A/
  - Course Info
  - Announcements
  - Lecture slides
  - Homework assignments
  - Reading assignments



Physics 1A, Summer Session 1, 2011

Calendar
Announcements
Course Info
Reading Quizes

Contact Information

Instructor:

Anat Burger
email: aburger@ucsd.edu
Office: UH 7249
Phone: (617) 320-0841

TA:

Academic Calendar

Monday	Tuesday	Wednesday	Thursday	Friday
27 June Lecture 1 Introduction/ Math	**28** Lecture 2 Math (also start of Kinematics)	**29** Lecture 3 Kinematics: (1D motion) HW #1 is due	**30** Lecture 4 Kinematics: (2D motion)	**1 July**
4 University Holiday	**5** Lecture 5 Kinematics: Projectiles	**6** Lecture 6 Forces: 1st and 2nd Laws HW #2 is due	**7** Quiz 1 Kinematics (chap 1, 2, 3)	**8**
11 Lecture 7	**12** Lecture 8	**13** Lecture 9	**14** Quiz 2	**15**

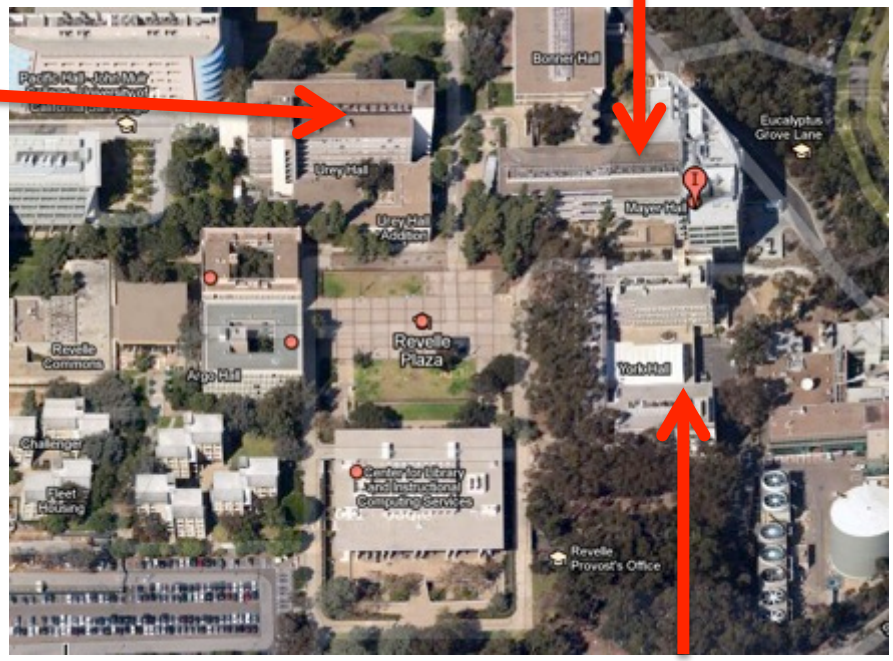
Schedule

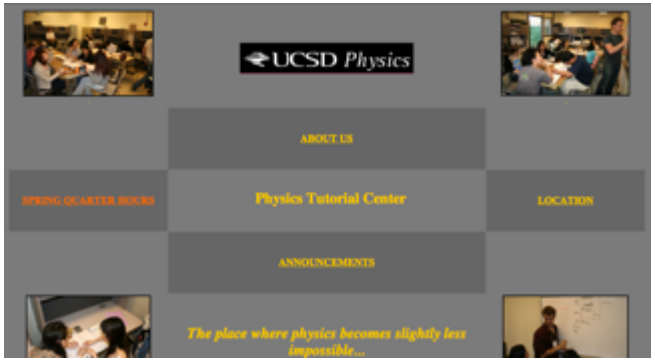
- Lecture: M-Th, 9:30-10:50 am, York 2622
- Quizzes: Thursday (2^{nd}, 3^{rd}, and 4^{th} week)
- Final: Friday July, 29^{th} 8-11am
  - Check to see that you can make it!
- Problem Sessions: Wednesdays 5-6pm
  - Peterson Hall room 104

Get Extra Help

- Office Hours:
  - **Anat Burger**
  - Mayer Hall 5623
  - M/W 12-1pm

  - **Evan Grohs**
  - Physics tutorial center
  - Mayer Hall 2702
  - Wed TBD
- Physics tutorial center:
  - Check schedule:
  - http://tutorialcenter.ucsd.edu/





Full Schedule

- Intro/math
- Kinematics
- Forces
- Energy
- Momentum
- Rotational Motion
- Fluids

Monday	Tuesday	Wednesday	Thursday	Friday
27 L1 Introduction/ Math	28 L2 Math (also start of Kinematics)	29 L3 Kinematics: (1D motion) HW#1 due: (Math)	30 L4 Kinematics: (2D motion)	1 July
4 University Holiday	5 L5 Kinematics: Projectiles	6 L6 Forces: 1st and 2nd Law HW#2 due: Kinematics	7 Quiz #1 Kinematics (chapters 1, 2, and 3)	8
11 L7 Forces: Special Forces	12 L8 Forces: 3rd Law, springs and pulleys	13 L9 Forces: Applications (also start of Energy) HW#3 due: Forces	14 Quiz #2 Forces (chapters 4 and 5)	15
18 L10 Energy: Work/Energy theorem	19 L11 Energy: Potential Energy	20 L12 Momentum: Impulse and Collisions HW#4 due: Energy	21 Quiz #3 Energy (chapters 6 and 7)	22
25 L13 Momentum: Conservation Laws	26 L14 Rotational motion: Torque	27 L15 Rotational motion: Angular momentum (also start Fluids) HW#5 due: Momentum	28 L16 Fluids: Bernoulli's Law (also review for Final)	29 Final

Rules

- Laptops are not allowed in during lecture.
- No cheating during quizzes/final

Grading Breakdown

- Quizzes 35%
- Final Exam 35%
- Homework 20%
- Reading Quizzes 10%
- Clickers 5% (Extra Credit)

Homework

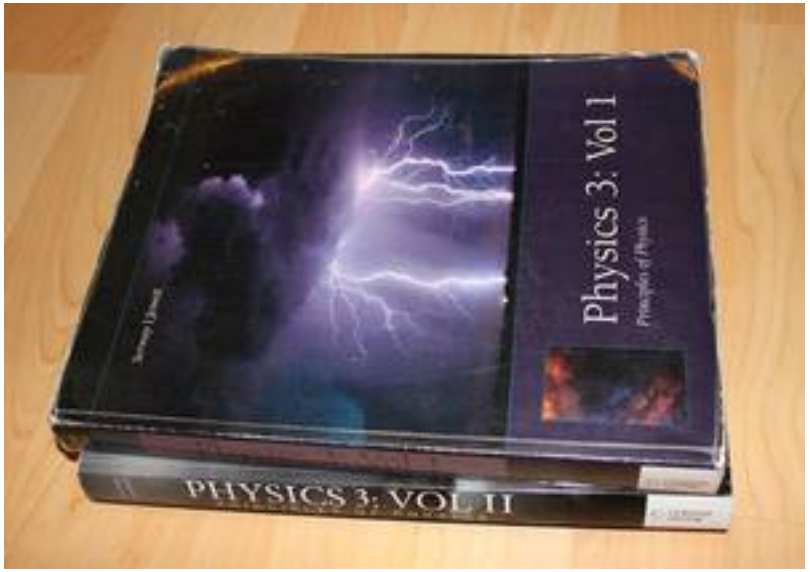
- Graded for completion
  - might try to grade selected problems later on.
- Can work with friends, **but** you can only learn how to solve physics problems by practicing solving them on your own.
- First one is due this Wednesday (6/30)! Download and print it out today!
- Can turn it in during class or at my office hours (12-1pm)
- After 1pm, I will post solutions online.
- All 5 will go towards 20% of final grade
- Can pick up at problem session (or make a copy for yourself) to study for the next day's quiz. (No quiz this week)

The Book

- Serway and Jewitt

Principles of Physics

  - Daily reading assignments
  - Extra homework practice problems, divided by difficulty



Reading Quizzes

- First 5 minutes of class every day besides quiz days
- 12 out of 16 reading quizzes will go towards 10% of final grade (I will drop lowest 4), so no excuses about being late for class.
- Several multiple choice questions to test that you've done the reading
- Check the reading assignment online and see the questions ahead of time (without the multiple choice answers)
- Tomorrow's assignment:
  - Check the website!

Clickers

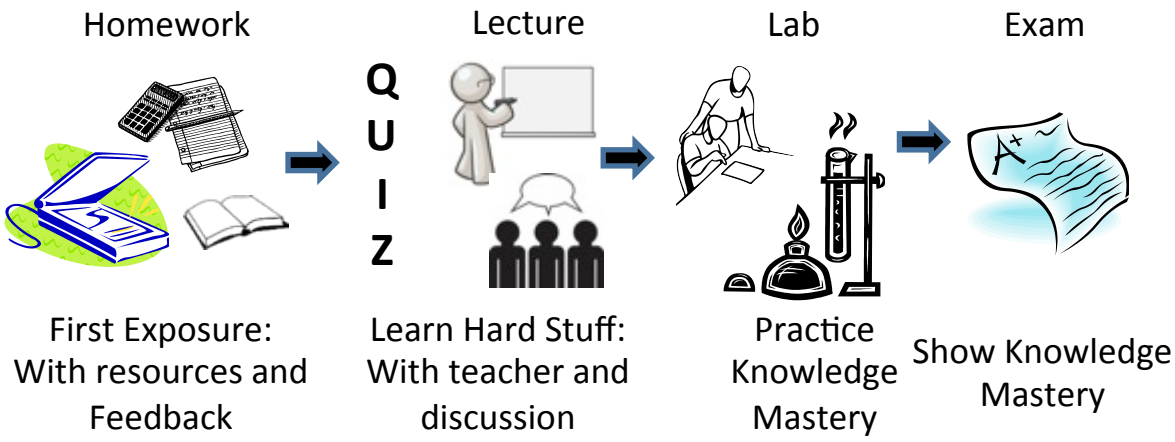
1. Why are we using clickers?
2. What does the research say?
3. How are we getting started?
4. How will we use clickers in class?

Clickers – Why? (many reasons)

- To focus the class around YOU and your learning
- Give you credit for reading and being prepared for class
- Measure what you guys know about a topic before and after I teach
- Get immediate feedback on what you know and what you don't
- Find out your opinions on things (can be anonymous)
- Practice discussing physics with your peers
- Confront misconceptions

Clickers – What does the research say?

- Research on how people learn:
  - Everyone constructs their own understanding
    - I can't dump understanding into your brain
  - To learn YOU must actively work with a problem and construct your own understanding of it



Clickers – How? (Logistics)

- Register your clicker at iclicker.com
- Each room has a two digit code, set at the beginning of each class
- You don't have to aim, just pick A-E
- Make sure you get a green light
- You can change your answer until I stop the timer
- Cheating is not acceptable
- Each question will be 1 participation point and 1 point for getting it right

Clickers – How will we use them in class?

- To take reading quiz at the beginning of class.
- Think/pair/share:
  - Think about question and come up with an answer on your own
  - Discuss with your neighbors, reach a consensus
  - Maybe change your answer
- Class wide discussion (Candy for participation?)
  - Led by YOU and what you discussed in groups
- Try to be as engaged as possible: “No brain, no gain”.

Clicker Question Practice

- What is your TA's name?

A. Mike
B. Evan
C. Chris
D. Jeff
E. Matt

Clicker Question Practice

- What is your favorite candy?

A. Snickers

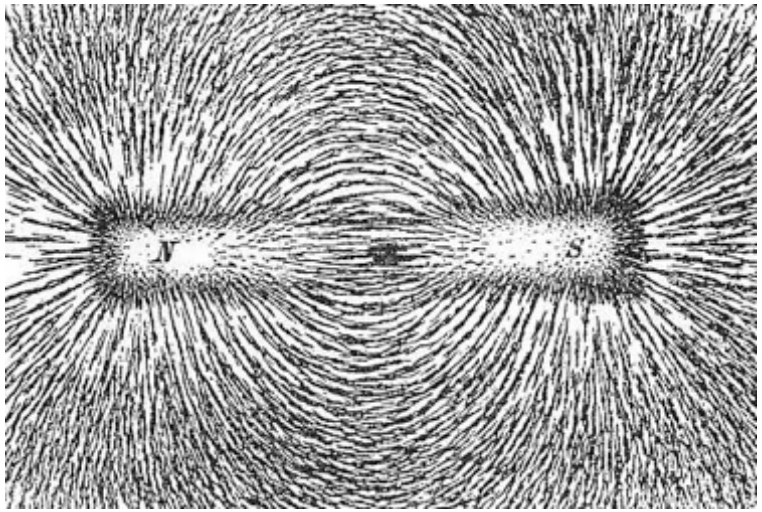
B. Kit-Kat

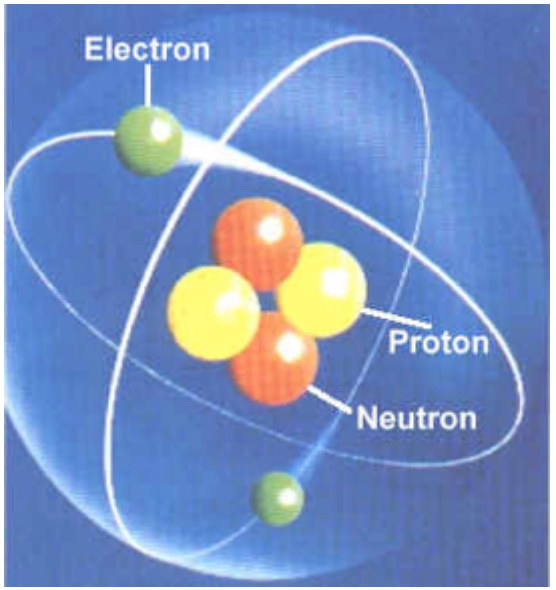
C. M&Ms

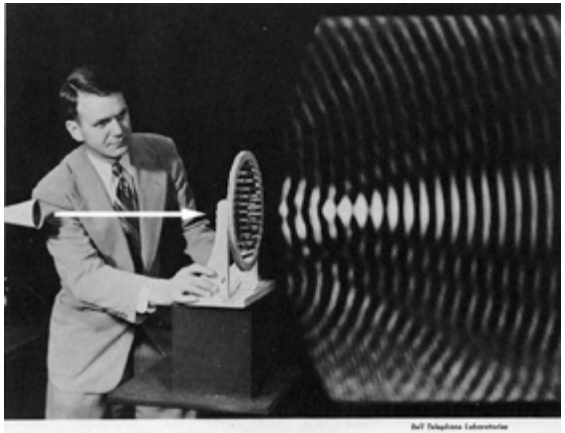
D. Reeses

E. Twix

What is physics?

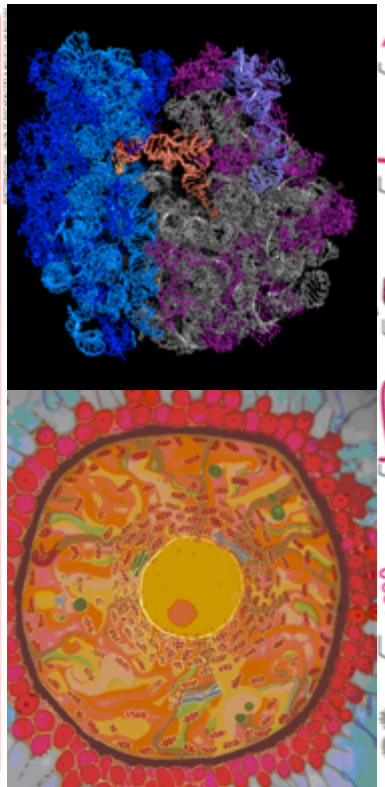




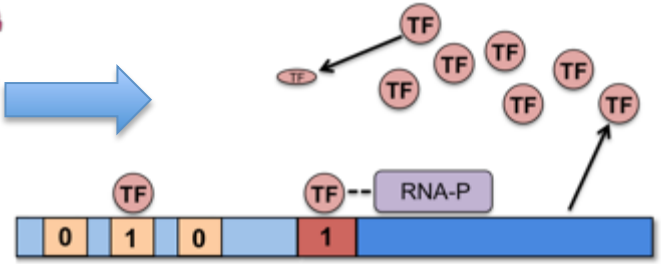


What do physicists do? My research:

- Physicists take complicated systems and turn them into simple cartoons by making approximations:



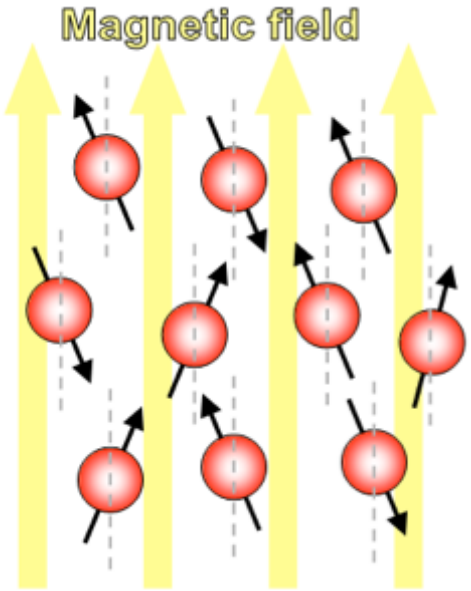
My model of a gene:

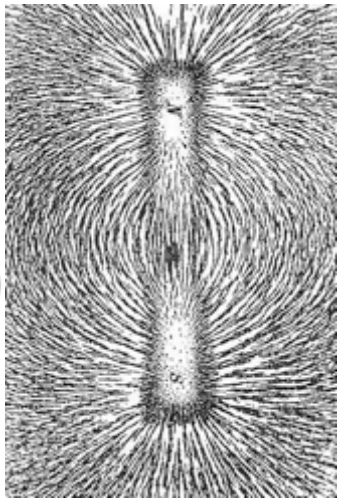


What do physicists do? My research:

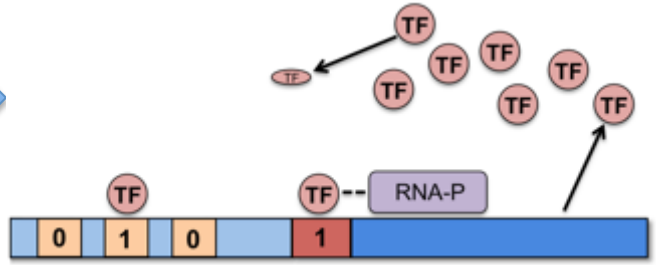
- Physicists make analogies between systems they know a lot about and systems they want to know more about.

Model of a magnet:



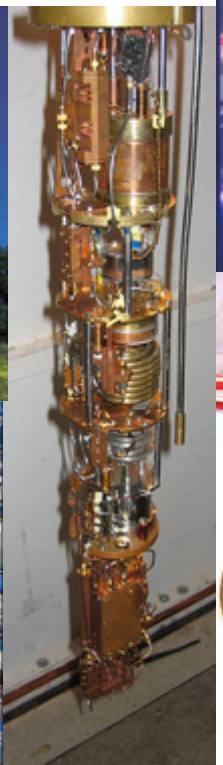
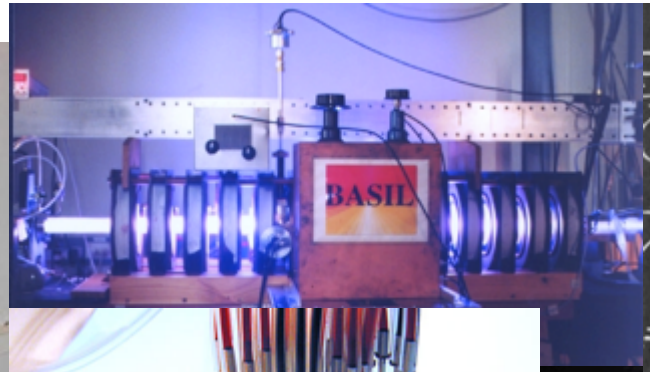


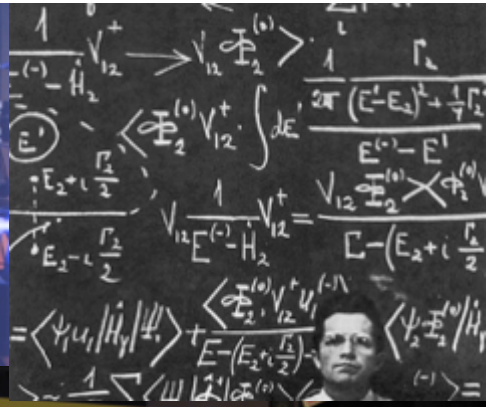
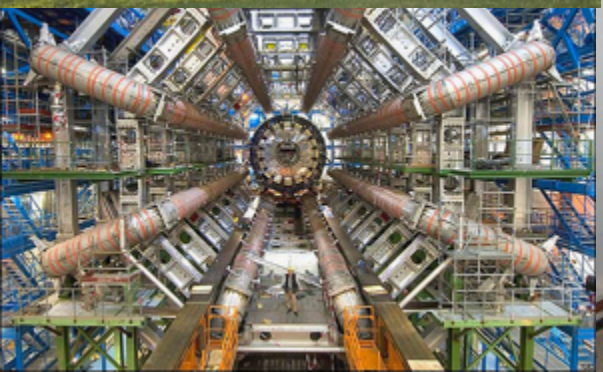
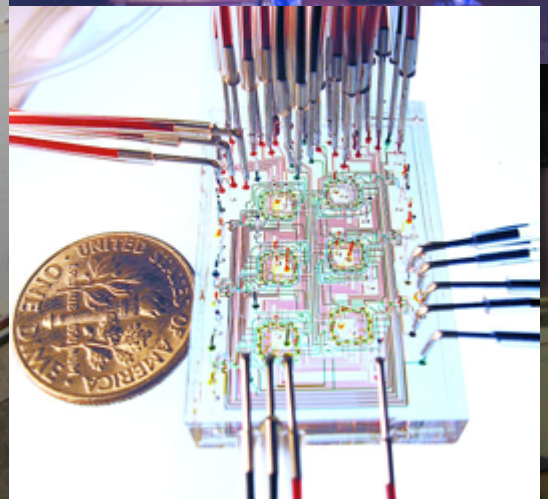
My model of a gene:



What do physicists do? My research

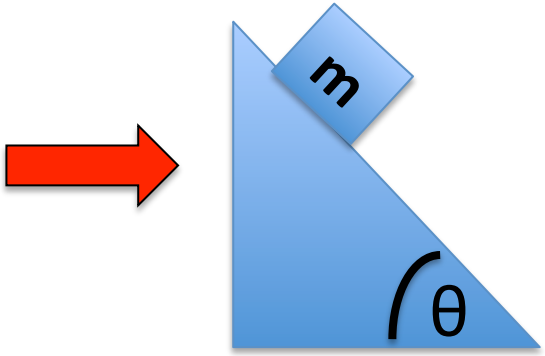
- Physicist use mathematical tools and build very sophisticated instruments to discover new things about the world.


Physics in this class?

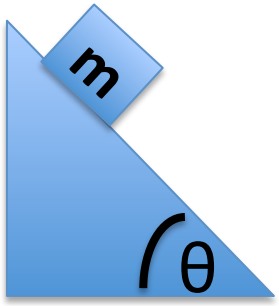
We will be turning real world systems into cartoons by making approximations:

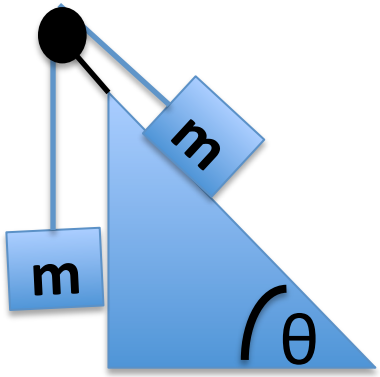


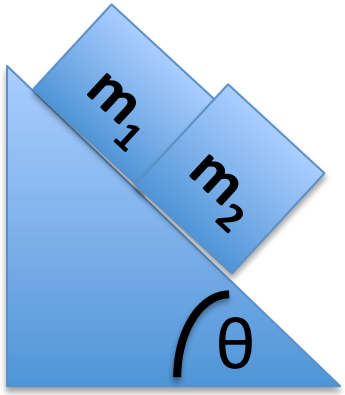
--Ignore things that make problem hard: friction, body shape, poles

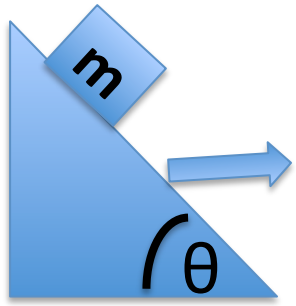
--Focus on set of important details: mass and incline angle

We will be seeing how many different systems are essentially similar and develop tools to attack them:









Different types of knowledge

V

Vocabulary

P

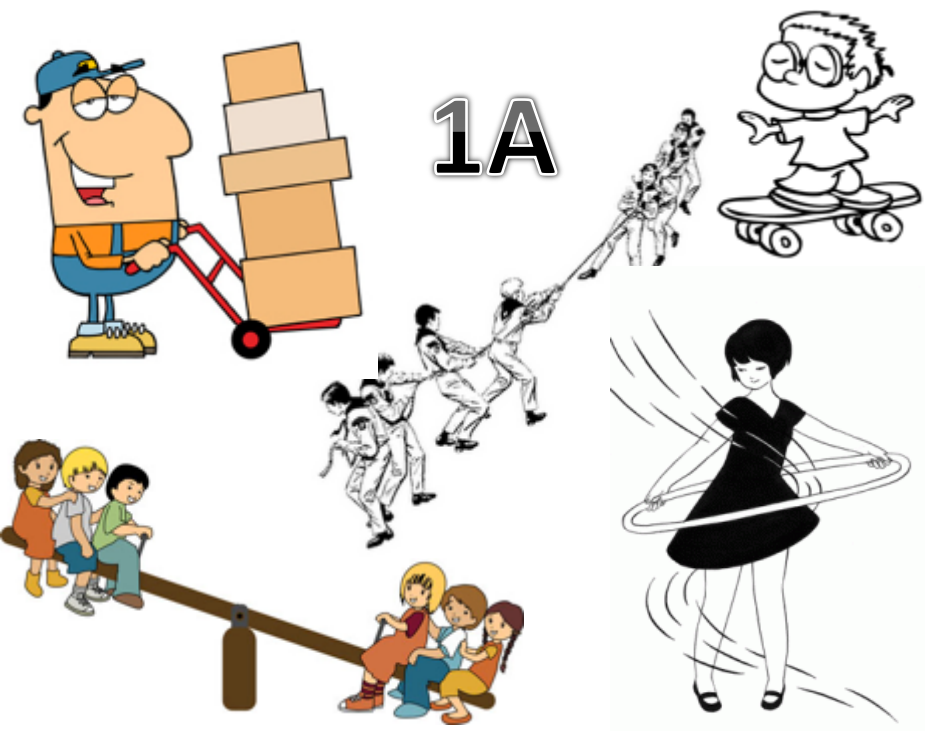
Procedural

C

Conceptual

How will this class help me in life?

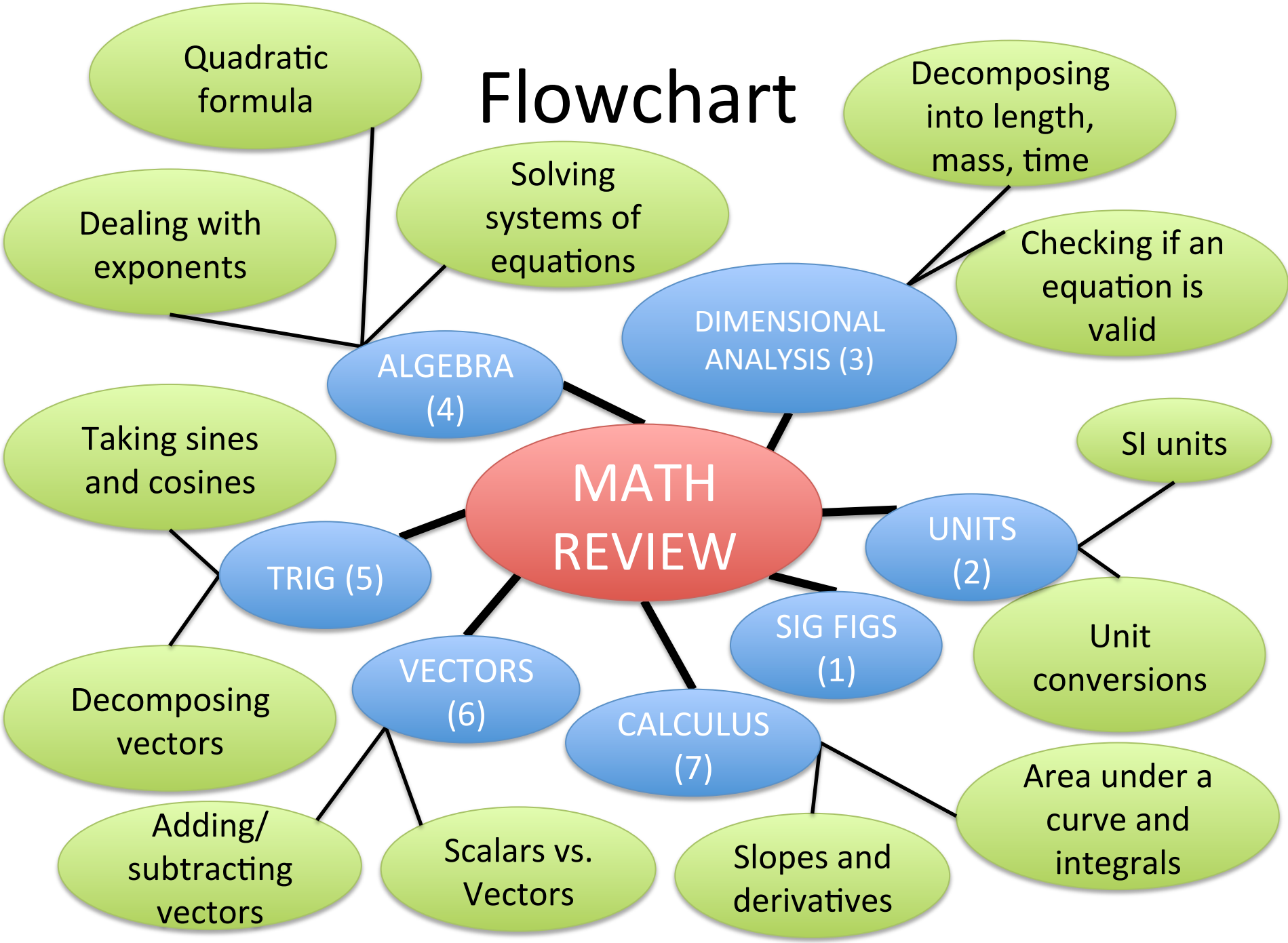
- Go out into the world with the knowledge that the universe is not just *observable* but also *understandable*.



How can I do well in this course?

1. Do the reading! And the homework!
2. Practice solving problems!

   -Only way to truly digest physics concepts.
3. Talk about physics!
4. Ask tons of questions!
5. Get one-on-one help from me, Evan, or the Tutorial Center.


Flowchart
MATH REVIEW
ALGEBRA (4)
Quadratic formula
Dealing with exponents
Solving systems of equations
DIMENSIONAL ANALYSIS (3)
Decomposing into length, mass, time
Checking if an equation is valid
UNITS (2)
SI units
Unit conversions
SIG FIGS (1)
TRIG (5)
Taking sines and cosines
VECTORS (6)
Decomposing vectors
Adding/ subtracting vectors
Scalars vs. Vectors
CALCULUS (7)
Slopes and derivatives
Area under a curve and integrals

Clicker Question 1-1
Sig-Figs

- How many significant figures does the number 1.120 have?

A. 0
B. 1
C. 2
D. 3
E. 4

Clicker Question 1-2
Sig-Figs

- How many significant figures does the number 1.120 + 0.03 have?

A. 0
B. 1
C. 2
D. 3
E. 4

Clicker Question 1-3
Sig-Figs

- How many significant figures does the number 1.120 x 4000 have?

A. 0
B. 1
C. 2
D. 3
E. 4

Math Review: Sig figs

- Number of nonzeros in front of decimal, number of digits after a decimal (starting with the leftmost non-zero)
- Adding numbers:
  - Find number whose last sig fig is furthest left when decimal points are lined up. Your answer has to have the last sig fig in that position
- Multiplying numbers:
  - Answer has as many sig figs as input number with least number of sig figs.
- Why is this important?
  - No measurement is exact, and we need to have an idea of how much accuracy is retained through a calculation
- Example:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{8.2\ \text{g}}{2.3\ \text{cm}^3} = 3.56521739 \frac{\text{g}}{\text{cm}^3} \rightarrow 3.6 \frac{\text{g}}{\text{cm}^3}$$

Math Review: SI Units

- Fundamental physical units:
  - Length [L] → meter (m)
  - Mass [M] → kilogram (kg)
  - Time [T] → second (s)
- Other SI units:
  - Force $[M][L]/[T]^2$ → Newton (N)
  - Energy $[M][L]^2/[T]^2$ → Joule (J)
  - Power $[M][L]^2/[T]^3$ → Watt (W)
- Important prefixes:
  - nano (n) = 10^{-9}
  - micro (μ) = 10^{-6}
  - milli (m) = 10^{-3}
  - centi (c) = 10^{-2}
  - kilo (k) = 10^{3}
  - mega (M) = 10^{6}

Math Review: Unit conversion

- Multiply by factors that equal one:

$$3.6\frac{\cancel{\mathrm{g}}}{\cancel{\mathrm{cm}^3}} \times \frac{(100\ \cancel{\mathrm{cm}})^3}{(1\ \mathrm{m})^3} \times \frac{1\ \mathrm{kg}}{1000\ \cancel{\mathrm{g}}} = 3600\frac{\mathrm{kg}}{\mathrm{m}^3}$$

- Make sure you calculate the power correctly:

$$\frac{(10^2)^3}{10^3} = \frac{10^6}{10^3} = 10^3$$

Clicker Question 1-4
Unit conversion

- Which of these shows correct conversion of 54 ft^2 to SI units?

- A) $54\ \text{ft}^2 \times \dfrac{1\ \text{m}}{3.281\ \text{ft}} = 16\ \text{m}$
- B) $54\ \text{ft}^2 \times \left(\dfrac{3.281\ \text{ft}}{1\ \text{m}}\right)^2 = 580\ \text{m}^2$
- C) $54\ \text{ft}^2 \times \left(\dfrac{1\ \text{m}}{3.281\ \text{ft}}\right)^2 = 5.0\ \text{m}^2$
- D) $54\ \text{ft}^2 \times \dfrac{1\ \text{m}}{3.281\ \text{ft}} = 16.46\ \text{m}^2$
- E) $54\ \text{ft}^2 \times \left(\dfrac{1\ \text{m}}{3.281\ \text{ft}}\right)^2 = 5.02\ \text{m}^2$

Clicker Question 1-5
Evaluating Powers

- Which is the correct evaluation of $\dfrac{(10^2)^5}{(10^3)^4}$?

A) 10^8

B) 10

C) 1

D) 10^{-1}

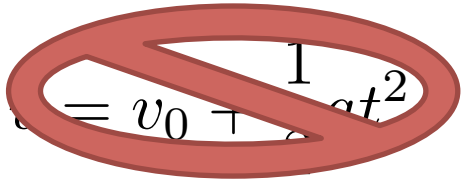
E) 10^{-2}

Dimensional Analysis: Check equation validity

$$KE = \frac{1}{2}mv^2$$

$$[\text{Kinetic Energy}] = \frac{1}{2}[\text{mass}] \cdot [\text{velocity}]^2$$

$$[\text{Kinetic Energy}] = [M] \cdot \frac{[L]^2}{[T]^2}$$



Not valid

$$\frac{[L]}{[T]} = \frac{[L]}{[T]} + \frac{[L]}{[T]^2} \cdot [T]^2$$

Clicker Question 1-6
Dimensional analysis

- Is the following equation valid?

$$P = Fd$$

$$\text{pressure: } [P] = [M][L]^3/[T]^2$$

$$\text{force: } [F] = [M][L]/[T]^2$$

$$\text{distance: } [d] = [L]$$

A) Yes

B) No

Clicker Question 1-7
Dimensional analysis

- Is the following equation valid?

$$F = \frac{dp}{dt}$$

$$\text{force: } [F] = [M][L]/[T]^2$$
$$\text{momentum: } [p] = [M][L]/[T]$$

A) Yes

B) No

Algebra review: Solving systems of equations

- In order to get a solution:

$$\text{number of equations} \geq \text{number of unknowns}$$

- Example:
  - Two equations:

$$P = \rho g h$$

$$\rho = M/V$$

  - Knowns: $h = 5\ \text{m}$, $g = 10\ \text{m/s}^2$, $V = 4.3\ \text{cm}^3$

→ Three unknowns, so unsolvable!

Clicker Question 1-8
Solving systems of equations

- You are given the values for the variables v_0, v and t. Do you have enough information to solve the system of equations below for (Δx)?

$$v = v_0 + at$$

$$v^2 - v_0^2 = 2a(\Delta x)$$

A. Yes

B. No

Algebra review: Quadratic Formula

- Example: You are given Δx , v_{0x}, and a_x and you know the following equation: $\Delta x = v_{0x}t + (1/2)a_x t^2$, You need to solve for t.

- Rewrite so that it takes the form of $Ax^2 + Bx + C = 0$

$$\frac{1}{2}a_x t^2 + v_{0x}t - \Delta x = 0$$

- Quadratic Formula:

$$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

$$t \to x \qquad \frac{1}{2}a_x \to A \qquad v_{0x} \to B \qquad -\Delta x \to C$$

- Substitute:

$$t = \frac{-v_{0x} \pm \sqrt{(v_{0x})^2 - 2a_x \Delta x}}{a_x}$$

Homework

- Get ready for tomorrow's reading quiz
  - See assignment and questions posted on website
  - First reading quiz is not for credit
- Start on Homework #1, which is due Wednesday
  - Download this from the website
- Buy a clicker. After you use it in class register it at iclicker.com
  - Credit for clickers starts on Wednesday.