

Spring 2014

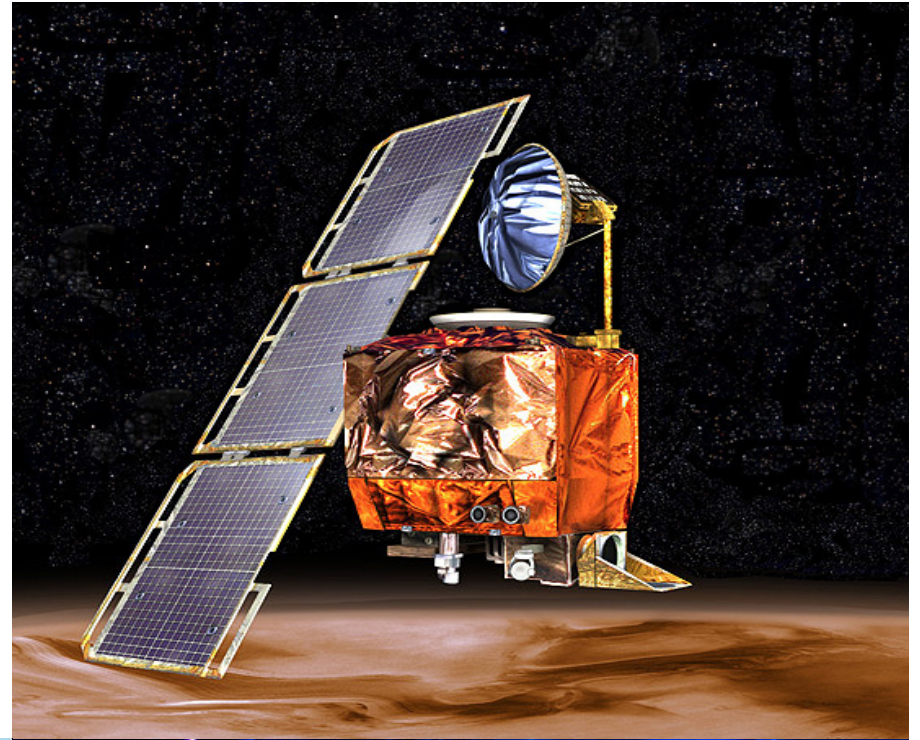
PHYS-2010

Lecture 2

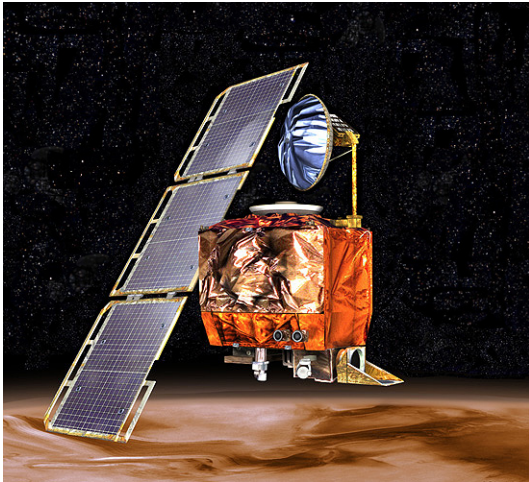
How would you describe your career ambition?

- A) Pre-Med or other medical professional.
- B) Architecture, Environmental Design, etc.
- C) Biological scientist, generally speaking
- D) Other
- E) Future Arch-Nemesis of Superman

What do
these things
have in
common?



Catastrophes due to Unit Conversion Errors



(1999) NASA lost \$125 million Mars Climate Orbiter due to Lockheed Martin giving thruster data in British units and NASA expecting metric units.

(1983) Air Canada Flight 143 ran out of fuel halfway into flight to Edmonton. Due to fuel units change and loading wrong amount.



(2004) Tokyo Disneyland's Space Mountain, axle broke off roller coaster mid-ride due to bolts machined to specification in English units instead of metric units.

Announcements I

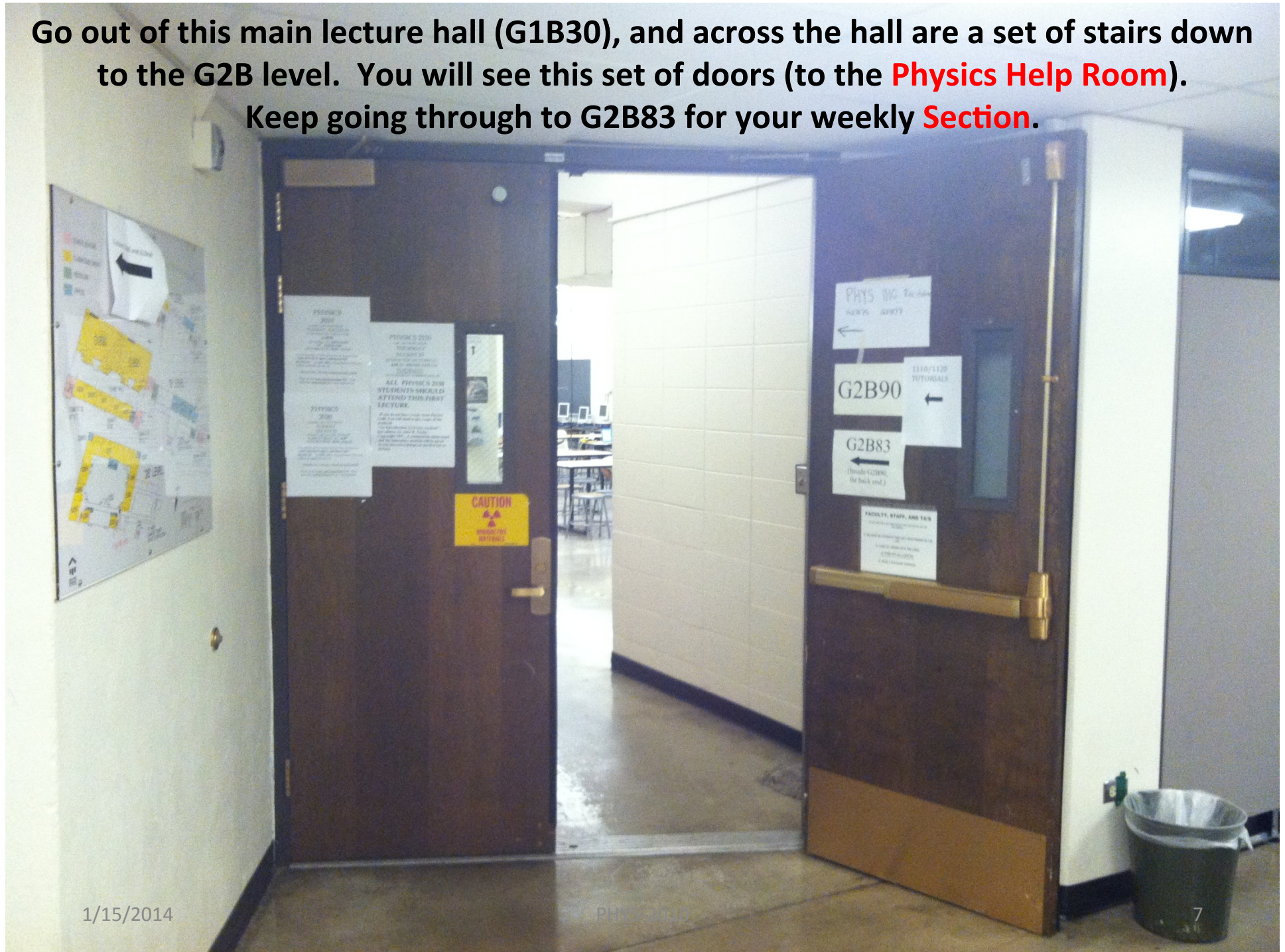
- Reminder: Attend your lab/recitation Section this week.
- Reminder: CAPA Homework #1 due next Tuesday at 11 pm.
- Reminder: Textbook Reading – Chapters 1 and 2.
- There are a couple of copies of **Giancoli's textbook on reserve** in Gemmill (Math Bldg.) and Norlin libraries.
- Office Hours:
 - Uzdensky: Tue. 11-12 (Help Room)
 - Pollock: Mon. 3-4 (Help Room); Fri. 1-2 (Gamow Tower F1013)
- Also, all Teaching Assistants (TAs) have Help Room hours:
<http://capa.colorado.edu/cgi-bin/HelpRoom>

Announcements II

Clarifications:

1. Everyone must be registered for one “**section**” – this includes both recitations and labs (each week you will have either a lab or a recitation). You meet at the same time and place every week.
2. If you are **waitlisted**, please continue attending lectures; check every day. Also please attend a lab/recitation section this week. Contact your TA (cc: Prof. Pollock) if you need to make rearrangements.
3. **Exams:** “You may bring your own handwritten notes”:
 - 1 single-side page for Exam I; 1 two-sided for Exam II;
 - 3 sides for Exam III; and 4 sides (2 double-sided pages) for Final.(see course syllabus/website for details)

Go out of this main lecture hall (G1B30), and across the hall are a set of stairs down to the G2B level. You will see this set of doors (to the **Physics Help Room**). Keep going through to G2B83 for your weekly **Section**.



CAPA Homework

The **CAPA dispensary folders** (check for PHYS2010) are downstairs. Each week it will have a printout of your assignment and PIN number.

You can always use the **PIN getter** on the CAPA page too.

If you are registered very recently and do not see your printout, use CAPA page **“late enrollment”** link.



Web Version

capa-new.colorado.edu

Class:

Student Number: CAPA ID:

Click to work on CAPA.

Click to clear Student Number and CAPA ID.

Forgot your PIN?
Try using the [CAPA PIN getter](#)

[Check your previous submissions.](#)

To end this Web session:
Choose File (from the browser menu), then
Exit/Quit

**WARNING:
Select your
class
carefully!**

Computer
Assisted
Personalized
Approach

Copyright 1997 MSU
Board of Trustees

Go to problem [1][2][3][4][5][6][7][8][9][10][11][12]
 1-12 Status: - - - - **Y** - - - - -

Set 1, Due Sat, Jan 17, 2009 at 08:00

1. [1pt]

Match each quantity with the appropriate symbol for its unit, in the SI system (If the first quantity corresponds to B, and the next 4 to C, enter BCCCC).

- | | | | |
|-----------------|---------------------|--------------------------------------|-----|
| 1) speed | A. m | Speed → meters/second | → F |
| 2) time | B. s | Time → seconds | → B |
| 3) length | C. m/s ² | Length → meters | → A |
| 4) velocity | D. m ² | Velocity → meters/second | → F |
| 5) acceleration | E. kg | Acceleration → meters/s ² | → C |
| | F. m/s | | |

Answer:

10. [1pt]

Calculate the perimeter of a rectangle with a length of 14.5cm and a width of 48mm. Enter units..

Answer:

Leave a blank before the units.

Leave no blanks before or after the answer.

Present result to 1% accuracy.

Including too many significant figures
will not be counted off in most cases.

You have six tries (no more) for each problem

DIMENSIONS, UNITS, ETC.

Clicker Question

Room Frequency BA

Which of the following are SI (aka mks/metric) “base units”?

- A) mm, mg, s
- B) cm, g, s
- C) mm, kg, s
- D) m, kg, s**
- E) km, g, h

Meters
Kilograms
Seconds

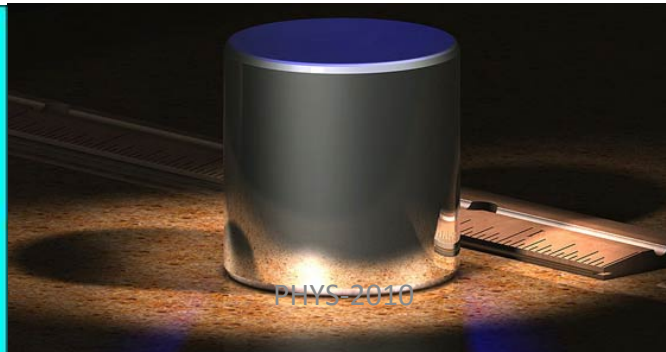
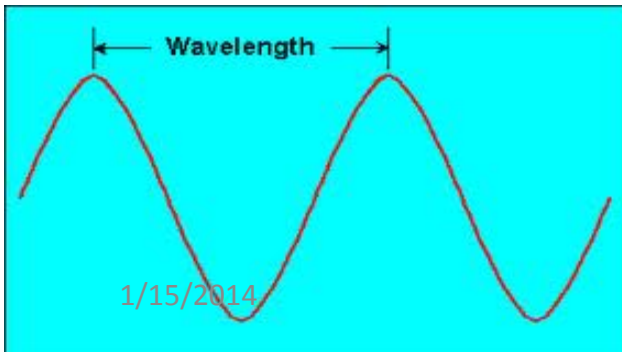


TABLE 1–5 SI Base Quantities and Units

Quantity	Unit	Unit Abbreviation
Length	meter	m
Time	second	s
Mass	kilogram	kg

For comparison, British System

Feet (ft)

Pounds (lb)

(actually a unit
of force)

Minutes, Hours,
Years, etc.

Clicker Question

Room Frequency BA

Why can't we all just switch to metric and be done?

Make an order-of-magnitude estimate for how much \$\$\$ are currently invested in drill bit sets in United States households?

- A) \$10
- B) \$1,000,000
- C) \$10,000,000
- D) \$1,000,000,000**
- E) \$1,000,000,000,000

How many US people?
How many US households?
How many have a drill set?
How much does a drill set cost?



$$\begin{aligned} 100 \text{ million} \times \$10 &= \\ (1 \times 10^8) \times (1 \times 10^1) &= \\ = 10^9 &= 1 \text{ billion} \end{aligned}$$



Mixed and Derived Units

Velocity, speed v m/s

Acceleration a m/s²

Force $F=ma$ kg m/s² = N (**Newton**)

Energy $E=(1/2) mv^2$ kg m²/s² = N m = J (**Joule**)

Dimensions and Units

Base dimensions: Length [L]; Time [T]; Mass [M]

“**Dimensions**” of any quantity are given by an algebraic combination of the base dimensions that comprise it.

Dimensions are usually written using square brackets.

Quantity	Dimensions	Units
Distance	[L]	meters, feet, light years
Time	[T]	seconds, years, fortnights
Velocity	[L]/[T]	meters/seconds, mph, knots

Dimensions of a quantity depend only on the type of quantity itself (e.g., distance, energy, volume). The units of a quantity also depend on the system of units used (e.g., metric, British, etc.)

Dimensional Analysis

(Unit Consistency Check)

Base dimensions: Length [L]; Time [T]; Mass [M]

“**Dimensions**” of any quantity are given by an algebraic combination of the base dimensions that comprise it.

Dimensions are usually written using square brackets.

Quantity	Dimensions	Units
Distance	[L]	meters, feet, light years
Time	[T]	seconds, years, fortnights
Velocity	[L]/[T]	meters/seconds, mph, knots

Quantities that are being **added** or **subtracted** must have the same dimensions (and the same units).

A quantity calculated as the **solution** to a problem should have the correct dimensions.

Clicker Question

Room Frequency BA

Energy has units of Joules = [**kg m² / s²**].

The speed of light has the symbol **c**.

Which of the following could be Einstein's famous equation.

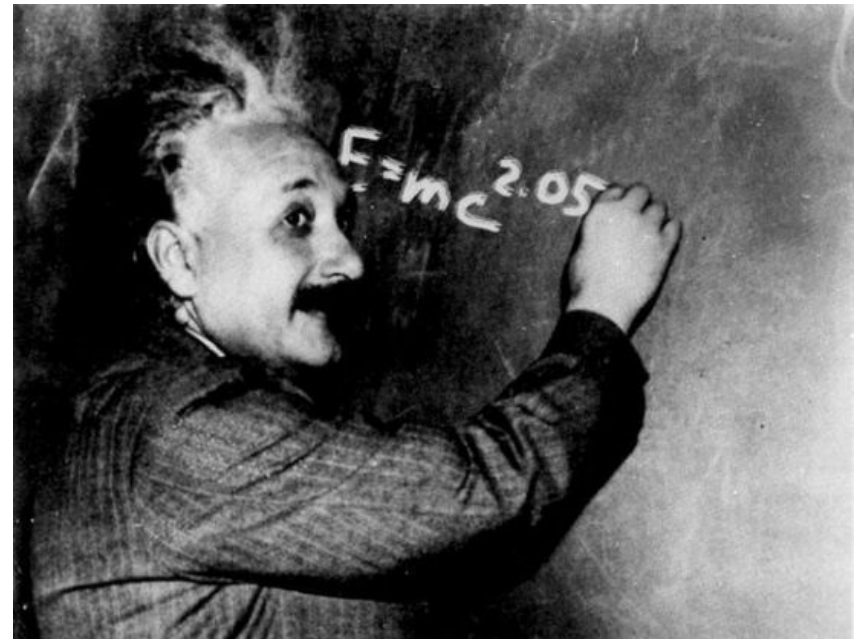
A) $E = mc$

B) $E = mc^2$

C) $E = mc^3$

D) $E = m^2c$

E) None of the above



Converting Units

I am a little over 6.0 feet tall. In Continental Europe where they use the metric system, what they would say?

Front cover of the textbook says 1 meter = 3.281 feet.

$$6.0 \text{ feet} \times \left(\frac{1 \text{ meter}}{3.281 \text{ feet}} \right) = 1.8287 \text{ meters}$$

What is the right number of **significant figures**?

- A) 1.8 meters
- B) 1 meter
- C) 2 meter
- D) 1.82 meters
- E) 1.838 meters

6.0 has 2 significant figures, and so 1.8 meters should have the same.

What if we did not have the textbook available?

Most of us know that 12 inches = 1 foot

Most of us know that 1 inch = 2.54 cm (centimeters)

$$6.0 \cancel{\text{feet}} \times \left(\frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}} \right) \times \left(\frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in}}} \right) \times \left(\frac{1 \text{m}}{100 \cancel{\text{cm}}} \right)$$

$$6.0 \times \left(\frac{12 \times 2.54}{100} \right) \text{meters} = 1.82 \text{ meters}$$



What an odd sign.

MPH = Miles per Hour

Convert to meters/second



Textbook has 1 mile = 1.609 kilometers (km)

We know that 1000 meters = 1 kilometer

We know that 1 hour = 60 x 60 seconds = 3600 seconds

$$669,136,766 \frac{\text{miles}}{\text{hour}} \times \left(\frac{1.609 \text{ km}}{\text{mile}} \right) \times \left(\frac{1000 \text{ m}}{1 \text{ km}} \right) \times \left(\frac{1 \text{ hr}}{3600 \text{ s}} \right)$$

$$299,066,960 \frac{\text{meters}}{\text{second}} \approx 3 \times 10^8 \frac{\text{meters}}{\text{second}}$$