

Physics 1151 Principles of Physics 1 Agenda for Today

- Advice
- Structure of this course
- Measurement and Units
 - Fundamental units
 - Systems of units
 - Converting between systems of units
 - Dimensional Analysis
- Uncertainty & Significant Figures
- Estimates & Orders of Magnitude (heart)

Course Info & Advice

- **Course has several components:**
 - **Pre-Lecture:** you learn from web-based tutorial
 - **Checkpoint:** you answer questions before class
 - **Lecture:** (me talking, demos and **Active learning**)
 - **Discussion & Group Problem Solving**
 - **Homework:** online – some with extensive guided questions
- **It is important for you to keep up!**

Instructor

- Cherie Bibo Lehman
- cblehman@eiu.edu ← fastest way to reach me
 - Please include course number in the Subject Line
- **1112 Physical Science – (c) 217.251.3734**
- **Office Hours**
 - **M: 11:00 AM – 12:00 PM**
 - **T: 11:00 AM – 12:00 PM**
 - **W: 11:00 AM – 12:00 PM**
 - **R: 11:00 AM – 12:00 PM; 1:00 PM – 2:00 PM**

<http://ux1.eiu.edu/~cblehman/>

Grade Components

• Prelectures	5%
• Checkpoints	5%
• Class Participation*	10%
• Homework & Quizzes	25%
• Hour Exams (highest 3 of 4)	30%
• Final Exam	<u>25%</u>
	100%

*Based on clicker responses

grade = 0.05 · PL + 0.05 · ChP + 0.1 · CP + 0.25 · HW + 0.30 · Exams + 0.25 · Final

Grading Scale

• 90-100	A
• 80-89	B
• 70-79	C
• 60-69	D
• <60	F

SmartPhysics

- <http://www.smartphysics.com>
- Online prelectures, checkpoints, and homework found there.
- You will setup your password when you register for an account. Your logon is your EIU email. For example, my logon is cblehman@eiu.edu
- Once you have set up an account, click on the **Enrollments** tab.
- Course access key: **Lehman13**
- The unique identifier can be your name.
- **DO NOT ever contact SmartPhysics for tech support. Always contact me.**

Pre-Lectures

- Completing the Pre-Lectures will be 5% of your grade.
- 24 hours prior to each class, I will post on the SmartPhysics schedule a link to a pre-lecture power point or movie.
- You should
 - go through the pre-lecture
 - read the relevant sections in the text before you move on to the **checkpoint**.

Checkpoints

- Complete the checkpoints - 5% of your grade
 - 2 points (full credit) for honest attempt at preflight.
 - Must do the entire checkpoint to earn any credit, including responding to questions about what you find most interesting or most difficult.
- Click on link from Calendar View in SmartPhysics.
- Checkpoints are due by 6am the day of lecture – with the exception of checkpoint 1 which is due Tuesday night at 11pm

Homework

- Credit for a problem is awarded when you submit the correct answer.
- You can work a problem as many times as needed in order to obtain full credit.
- After the due date, you will have 7 days to submit the homework for 80% credit.
- Homework is due by 11pm on the due date.

PHY1151 Lectures

- Clicker questions will be a fundamental component of lecture. You should purchase a clicker from the bookstore or borrow one from a friend. If you borrow a clicker or use one not purchased at the EIU bookstore, you should be certain that I have your clicker information.
- Taking Notes
 - Lecture note handouts will be available online prior to class
 - Key pieces for you to fill in

Scope of Physics 1151

- **Classical Mechanics:**
 - **Mechanics:** How and why things work
 - **Classical:**
 - Not too fast ($v \ll c$)
 - Not too small ($d \gg \text{atom}$)
- Most everyday situations can be described in these terms.
 - Path of baseball
 - Orbit of planets
 - etc...

Units

- How we measure things!
- All things in classical mechanics can be expressed in terms of the fundamental units:
 - Length L
 - Mass M
 - Time T
- For example:
 - Speed has units of L / T (i.e. miles per hour).
 - Force has units of ML / T^2 etc... (as you will learn).

Length: <http://scaleofuniverse.com>

Distance__	Length (m)
Radius of visible universe	1×10^{26}
To Andromeda Galaxy	2×10^{22}
To nearest star	4×10^{16}
Earth to Sun	1.5×10^{11}
Radius of Earth	6.4×10^6
Sears Tower	4.5×10^2
Football field	1.0×10^2
Tall person	2×10^0
Thickness of paper	1×10^{-4}
Wavelength of blue light	4×10^{-7}
Diameter of hydrogen atom	1×10^{-10}
Diameter of proton	1×10^{-15}

Time:

Interval__	Time (s)
Age of universe	5×10^{17}
Age of Grand Canyon	3×10^{14}
32 years	1×10^9
One year	3.2×10^7
One hour	3.6×10^3
Light travel from Earth to Moon	1.3×10^0
One cycle of guitar A string	2×10^{-3}
One cycle of FM radio wave	6×10^{-8}
Lifetime of neutral pi meson	1×10^{-16}
Lifetime of top quark	4×10^{-25}

Mass:

Object__	Mass (kg)
Milky Way Galaxy	4×10^{41}
Sun	2×10^{30}
Earth	6×10^{24}
Boeing 747	4×10^5
Car	1×10^3
Student	7×10^1
Dust particle	1×10^{-9}
Top quark	3×10^{-25}
Proton	2×10^{-27}
Electron	9×10^{-31}
Neutrino	1×10^{-38}

Units...

• SI (Système International) Units:

- mks: L = meters (m), M = kilograms (kg), T = seconds (s)
- cgs: L = centimeters (cm), M = grams (gm), T = seconds (s)

• British Units:

- Inches, feet, miles, pounds, slugs...

- We will use mostly SI units, but you may run across some problems using British units. You should know how to convert back & forth.

Converting between different systems of units

• Useful Conversion factors:

- 1 inch = 2.54 cm
- 1 m = 3.28 ft
- 1 mile = 5280 ft
- 1 mile = 1.61 km

- Example: convert miles per hour to meters per second:

Which is a faster speed, 30.0 mi/h or 13 m/s?

1. 30 mi/h > 13 m/s
2. 13 m/s > 30 mi/h
3. 13 m/s = 30 mi/h

Dimensional Analysis

- This is a helpful tool to check your work
 - It's also very easy!
- Example:

Doing a problem you get the answer distance
 $d = vt^2$ (velocity x time²)

Units on left side = L
 Units on right side = L / T x T² = L x T
- Left units and right units don't match, so answer must be wrong!!

Dimensional Analysis Example

- The period P of a swinging pendulum depends only on the length of the pendulum d and the acceleration of gravity g .
- Which of the following formulas for P could be correct ?

(a) $P = 2\pi (dg)^2$ (b) $P = 2\pi \frac{d}{g}$ (c) $P = 2\pi \sqrt{\frac{d}{g}}$

Given: d has units of length (L) and g has units of (L / T^2).

Solution

- Realize that the left hand side P has units of time (T)
- Try the first equation

(a) $\left(L \cdot \frac{L}{T^2}\right)^2 = \frac{L^4}{T^4} \neq T$ Not Right !!

(a) $P = 2\pi (dg)^2$ (b) $P = 2\pi \frac{d}{g}$ (c) $P = 2\pi \sqrt{\frac{d}{g}}$

Solution

- Try the second equation

(b) $\frac{L}{T^2} = T^2 \neq T$ Not Right !!

(a) $P = 2\pi (dg)^2$ (b) $P = 2\pi \frac{d}{g}$ (c) $P = 2\pi \sqrt{\frac{d}{g}}$

Solution

- Try the third equation

(c) $\sqrt{\frac{L}{L/T^2}} = \sqrt{T^2} = T$ This has the correct units!!
 This must be the answer!!

(a) $P = 2\pi (dg)^2$ (b) $P = 2\pi \frac{d}{g}$ (c) $P = 2\pi \sqrt{\frac{d}{g}}$

Tips:

- **Read !**
 - Before you start work on a problem, read the problem statement thoroughly. Make sure you understand what information is given, what is asked for, and the meaning of all the terms used in stating the problem.
- **Watch your units !**
 - Always check the units of your answer, and carry the units along with your numbers during the calculation.
- **Understand the limits !**
 - Many equations we use are special cases of more general laws. Understanding how they are derived will help you recognize their limitations (for example, constant acceleration).

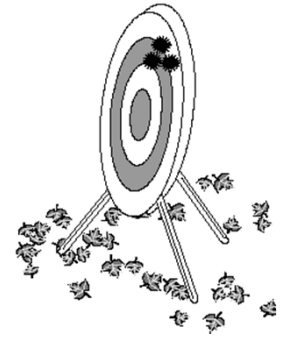
Uncertainty

• Classification of Errors

- **Blunders:**
 - mistakes in using or reading a measuring device
 - mistakes in recording a reading or in calculating a result
- **Systematic Errors:**
 - mistakes that result from improper calibration, personal bias, imperfect technique, or unjustified experimental assumptions
- **Random Errors:**
 - Persist because it is impossible to run an experiment twice under exactly matched conditions

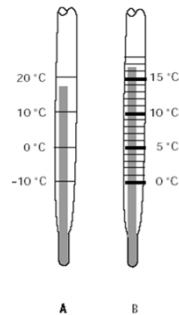
Accuracy & Precision

- **Accuracy** – impacted by systematic error & blunders
- **Precision** – impacted by random error



Significant Figures

- A directly measured quantity should be reported so that only the last figure is uncertain.
- How would you read thermometer A?
- How would you read thermometer B?



Order of Magnitude

- An order of magnitude calculation is an estimate.
- We round off or guess at various inputs to obtain a result that is usually reliable to within a factor of 10.
- To get the order of magnitude of a given quantity, we round off to the closest power of 10
- 75 kg \rightarrow 100 kg

OM Example 1

- How many full size pages of paper could you carry if they were bound up in boxes?
- You may have no idea how much a page of paper masses. But you know roughly how much a book masses; a nice 500 page novel might be a kilogram, most of which is the paper.

OM Example 2

- How many liters of fluid have you drunk in your lifetime?
- The amount you drink in a given day depends on the temperature, how much you're moving around, and so on.
- About two liters per day is probably typical.

To Do

- Purchase your clicker.
- Read Sections 19-1 -- 19-5
- Do checkpoint 1 before 6:00 AM 1/10/13.
- Watch prelecture 2 before 6:00 AM 1/10/13
- Do checkpoint 2 before 6:00 AM 1/10/13.

See you next time!

Estimate the number of seconds (order of magnitude) in a human "lifetime." You choose the definition of "lifetime."

1. 10^6 seconds
2. 10^9 seconds
3. 10^{12} seconds
4. 10^{15} seconds

To Do

- Purchase your clicker.
- Read Sections 1-1 -- 1-8 & 2-1 – 2-6
- Do checkpoint1 before 6:00 AM 8/22/13.
- Watch Pre-Lecture-2 before 8:00 AM 8/22/13.
- Do checkpoint 2 before 6:00 AM 8/22/13.

See you next time!