PHYS 1441 – Section 002
Lecture #2

Wednesday, Aug. 29, 2018

Dr. Jaehoon Yu

- What do we want from this class?
- Brief history of physics
- Some basics
- Ch 21
  - Static Electricity and Charge Conservation
  - Charges in Atom, Insulators and Conductors & Induced Charge
  - Coulomb's Law

Announcements

- 93/101 of you have registered in the homework system.
  - 83/93 submitted the homework!
  - Fantastic job!!
  - You need my enrollment approval… So move quickly…
  - Remember, the deadline for the first freebee homework is 11pm today, Wednesday, Aug. 29
  - You **MUST** submit the homework to obtain 100% credit!
  - Also please be sure to make the payment in time otherwise your access as well as my access to the site for grading is cut.
- Reading assignment: CH21 – 7
- Quiz at the beginning of the class, Wed. Sept. 5
  - Appendix A1 – A8 and what we've learned today!
- No class coming Monday, Sept. 3, Labor Day

Extra Credit Special Project #1

- Compare the Coulomb force to the Gravitational force in the following cases by expressing Coulomb force (F_C) in terms of the gravitational force (F_G)
  - Between two protons separated by 1m
  - Between two protons separated by an arbitrary distance R
  - Between two electrons separated by 1m
  - Between two electrons separated by an arbitrary distance R
- Five points each, totaling 20 points
- BE SURE to show all the details of your work, including all formulae, proper references to them and explanations
- Please staple them before the submission
- Due at the beginning of the class Wednesday, Sept. 5

What can you expect from this class?

- All A's?
  - This would be really nice, wouldn't it?
  - But if it is too easy it is not fulfilling or meaningful….
- This class is not going to be a stroll in the park!!
- You will earn your grade in this class.
  - You will need to put in sufficient time and sincere efforts
  - Exams and quizzes will be tough!!
    - Sometimes problems may not look exactly like what you learned in the class
    - Just putting the right answer for free response problems does not work!
- But you have a great control (up to 45%) of your grade in your hands
  - Homework is 25% of the total grade!!
    - Means you will have many homework problems
      - Sometimes much more than any other classes
      - Some homework problems will be something that you have yet to learn in class
      - Exam problems will be easier than homework problems but the same principles!!
  - Lab 10%
  - Extra credit 10%
- I will work with you so that your efforts are properly rewarded

What do we want to learn in this class?

- Physics is everywhere around you.
- Skills to understand the fundamental principles that surrounds you in everyday lives…
- Skills to identify what laws of physics applies to what phenomena and use them appropriately
- Understand the impact of physical laws and apply them
- Learn skills to think, research and analyze observations.
- Learn skills to express observations and measurements in mathematical language
- Learn skills to express your understanding in a systematic manner in writing
- But most importantly the confidence in your physics ability and to take on any challenges laid in front of you!!

Even more importantly, let us have a lot of FUN!!

Specifically, in this course, you will learn…

- Concept of Electricity and Magnetism
- Electric charge and magnetic poles
- Electric and Magnetic Forces
- Electric and magnetic potential and energies
- Propagation of electric and magnetic fields
- Relationship between electro-magnetic forces and light
- Behaviors of light and optics, the study of it
- Special relativity and quantum theories

How to be successful in this course?

- Keep up with the class for comprehensive understanding of materials
  - Come to the class and participate in the discussions and problems solving sessions diligently
  - Follow through the lecture notes after each lecture
  - Work out example problems in the book yourself without looking at the solution
  - Have many tons of fun in the class!!!!!
- Keep up with the homework to put the last nail in the coffin
  - One can always input the answers as you solve problems. Do NOT wait till you are done with all the problems.
  - Form a study group and discuss how to solve problems with your friends, then work the problems out on your own!
- Prepare for upcoming classes
  - Read the textbook for the material to be covered in the next class
- The extra mile
  - Work out additional problems in the back of the book starting the easiest problems to harder ones

Why do Physics?

Exp.
- To understand nature through experimental observations and measurements (**Research**)

Theory
- Establish limited number of fundamental laws, usually with mathematical expressions
- Predict the nature's course

⇒Theory and Experiment work hand-in-hand

⇒Discrepancies between experimental measurements and theory are good for improvements

⇒The general principles formulated through theory is used to improve our everyday lives, even though some laws can take a while till we see them amongst us

Brief History of Physics

- AD 18th century:
  - Newton's Classical Mechanics: A theory of mechanics based on observations and measurements
- AD 19th Century:
  - Electricity, Magnetism, and Thermodynamics
- Late AD 19th and early 20th century (Modern Physics Era)
  - Einstein's theory of relativity: Generalized theory of space, time, and energy (mechanics)
  - Quantum Mechanics: Theory of atomic phenomena
- Physics has come very far, very fast, and is still progressing, yet we've got a long way to go
  - What is matter made of?
  - How do matters get mass?
  - How and why do matters interact with each other?
  - How is universe created?

Models, Theories and Laws

- Models: An analogy or a mental image of a phenomena in terms of something we are familiar with
  - Thinking light as waves, behaving just like water waves
  - Often provide insights for new experiments and ideas
- Theories: More systematically improved version of models
  - Can provide quantitative predictions that are testable and more precise
- Laws: Certain concise but general statements about how nature behaves
  - Energy conservation law
  - The statement must be found experimentally valid to become a law
- Principles: Less general statements of how nature behaves
  - Has some level of arbitrariness

Uncertainties

- Physical measurements have limited precision, however good they are, due to:

Stat.{ – Number of measurements

Syst.{ – Quality of instruments (meter stick vs micro-meter)
– Experience of the person doing measurements
– Etc

- In many cases, uncertainties are more important and difficult to estimate than the central (or mean) values

Significant Figures

- Denote the precision of the measured values
  - The number 80 implies precision of +/- 1, between 79 and 81
    - If you are sure to +/-0.1, the number should be written 80.0
  - Significant figures: non-zero numbers or zeros that are not place-holders
    - 34, 34.2, 0.001, 34.100
      - 34 has two significant digits
      - 34.2 has 3
      - 0.001 has one because the 0's before 1 are place holders to position "."
      - 34.100 has 5, because the 0's after 1 indicates that the numbers in these digits are indeed 0's.
    - When there are many 0's, use scientific notation for simplicity:
      - $31400000=3.14\text{x}10^{7}$
      - $0.00012=1.2\text{x}10^{-4}$
    - How about 3000?
      - This book assumes all 0's are significant but it could be different in other cases!

Significant Figures

- Operational rules:
  - Addition or subtraction: Keep the **smallest number of decimal place** in the result, independent of the number of significant digits: 12.001+ 3.1= 15.1
  - Multiplication or Division: Keep the **smallest number of significant digits** in the result: 12.001 x 3.1 = 37, because the smallest significant figures is ?

What does this mean? **The worst precision determines the precision of the overall operation!!**

In English? **Can't get any better results than the worst measurement!**

SI Base Quantities and Units

Quantity	Unit	Unit Abbrevation
Length	Meter	m
Time	Second	s
Mass	Kilogram	kg
Electric current	Ampere	A
Temperature	Kelvin	k
Amount of substance	Mole	mol
Luminous Intensity	Candela	cd

- *There are prefixes that scales the units larger or smaller for convenience (see pg. 7)*

Prefixes, expressions and their meanings

Larger

- deca (da): 10^{1}
- hecto (h): 10^{2}
- kilo (k): 10^{3}
- mega (M): 10^{6}
- giga (G): 10^{9}
- tera (T): 10^{12}
- peta (P): 10^{15}
- exa (E): 10^{18}
- zetta (Z): 10^{21}
- yotta (Y): 10^{24}

Smaller

- deci (d): 10^{-1}
- centi (c): 10^{-2}
- milli (m): 10^{-3}
- micro (μ): 10^{-6}
- nano (n): 10^{-9}
- pico (p): 10^{-12}
- femto (f): 10^{-15}
- atto (a): 10^{-18}
- zepto (z): 10^{-21}
- yocto (y): 10^{-24}

How do we convert quantities from one unit to another?

Unit 1 = Conversion factor X Unit 2

1 inch	2.54	cm
1 inch	0.0254	m
1 inch	2.54×10^{-5}	km
1 ft	30.3	cm
1 ft	0.303	m
1 ft	3.03×10^{-4}	km
1 hr	60	minutes
1 hr	3600	seconds
And many	More	Here….