Physics 221

Sections 1 and 2

S. Yost

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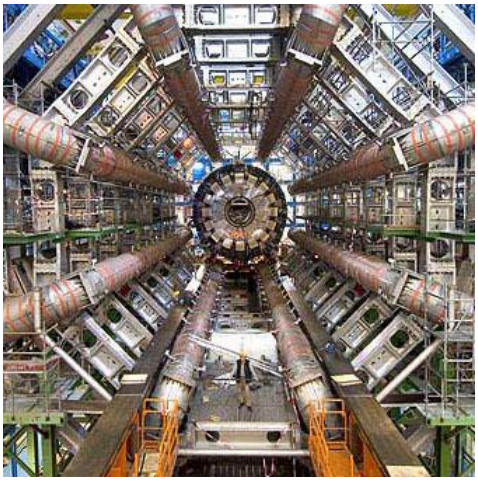
Introduction

Welcome to Physics 221

- I am **Prof. Yost**, your instructor for sections 1 and 2.
- My contact information is:
  - Phone: 953-5475
  - E-Mail: scott.yost@citadel.edu
  - Office: Grimsley 216
- Office hours: MWF 10:00 – 11:00.
- If you can't make it then, you can make an appointment for another time. If these hours turn out not to work well, they may be subject to change.
- Web site: www.vic.com/syost/phys221

Introduction

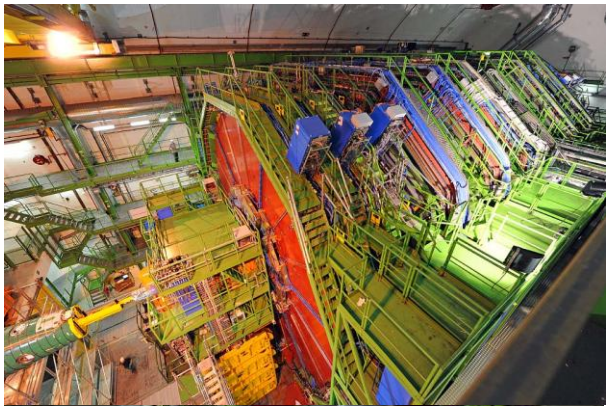
- I am a theoretical elementary particle physicist. That means I am interested in how the smallest constituents of the universe interact – we study these because we are still trying to find the most basic laws behind how the universe works.



ATLAS under construction at CERN

Introduction

- Specifically, I work with the CMS project at the Large Hadron Collider: this detector…



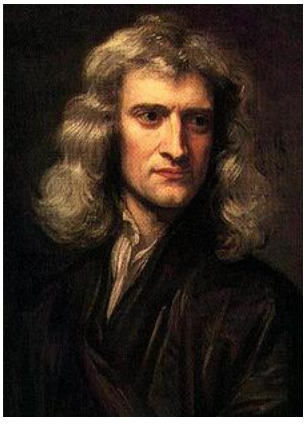
Introduction

In this course we'll go back to the beginning:

Isaac Newton's laws of mechanics.

His *Principia Mathematica*, published in 1687, may be considered to be the birth of physics.

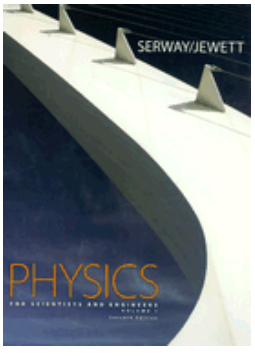
Its foundations lie in celestial mechanics and successfully explained the motion of the planets and their moons.



Textbook

- The textbook is Serway & Jewitt, Physics for Scientists and Engineers, 7th Edition

- We will use chapters 1-14.
- These chapters are available separately in Vol. 1, but we will use more of the book next semester.



Class Preparation

- Reading the assignments is an important part of preparing for class.
- I will not be reading the book to you. The lectures are intended to illuminate the material in the text, and give practice with problem solving, not to explain every detail.
- Starting the problems early helps to understand the material – you will see your goal more clearly, and understand why we are doing what we do in the classes better if you've tried them.

Next Assignment

- Read S&J Chapters 1 and 2, through sec. 2.5 for **Friday**.

  Chapter 1 is introductory material. The topic of Chapter 2 is kinematics – the study of motion without regard to its cause. For now, we are limited to one dimension.
- The first homework set is due **Friday, 7 AM**:
  - Introductory WebAssign questions
  - Ch. 1, # 2, 5, 9, 10.

Homework Assignments

- Homework will be posted on WebAssign:
  - http://www.webassign.net
- All sets are due at 7:00 AM on the due date.
- This is so we can discuss them in class that morning, after the set has closed.
- These sets are graded by WebAssign, You must get the answer right for credit.
- We will go to the computer lab later to be sure everyone can access the system.

WebAssign Access

To access WebAssign, go to www.webassign.net and fill in the log-in form at the right of the screen. (You may need to scroll over.)

The login screen will ask for your Username, Institution, and Password. If your name is John Smith and your Citadel ID is CIT-07-1234, enter:

Username:	jsmith
Institution:	Citadel
Password:	1234

WebAssign Problems

- WebAssign problems can be answered in any order. You can log in as often as you want before the set is due, and submit as many answers as you wish. Normally you will have 5 tries, unless it says otherwise. No points are deducted for multiple attempts.
- Beware of using **Reload** or **Back** buttons on your browser, since this may resubmit your wrong answers. Use only the navigation buttons inside WebAssign.

WebAssign Access

- The next screen will ask you to register your access code. If you don't have one yet, you can still log in for two weeks, but will have to purchase one during this grace period. After you register, you will no longer be bothered by this screen.
- The next screen will show the options for this course, including any open problem sets. Click the set to open it.

Exams

- A final exam is scheduled for 13:00 on
  - Section 1: Dec. 14
  - Section 2: Dec. 12
- There will be three in-class exams throughout the semester.
- The exams will test the depth of your understanding of the material by presenting new situations to analyze using the concepts you have learned.

Course Philosophy

This course is an introduction to physics (mostly mechanics) from the point of view of a practicing physicist – in my case, theoretical elementary particle physics.

Many of you may apply the concepts in this course in other areas, but this may be your best opportunity to think about where the concepts came from, and why they were developed as they were.

The Role of Mathematics

- Physics has a reputation for being very mathematical, and it is… mathematics is the language of physics.
- This is because physics aims at an all-encompassing quantitative description of nature, and mathematics is the only language precise enough to express this.

The Role of Calculus

- Newton invented the calculus because it was essential to adequately describe mechanical phenomena.
- This course is designed to be taken concurrently with calculus. We will be using it from the start, but primarily at a conceptual level at first – delaying the more technical aspects until later in the course when you have had more experience with it.

Grading

Grades are assigned according to the following weights:

- Hour Exams (three) 50%
- Comprehensive Final 25%
- Homework 25%

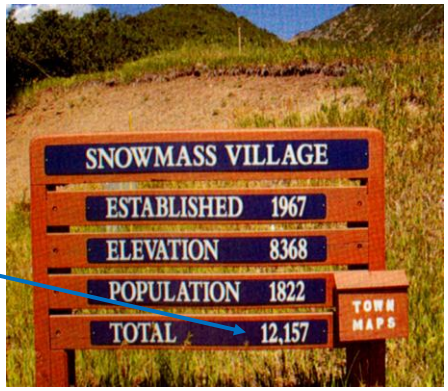
Grades will be based on a careful comparative ranking of students in both of my sections. I expect an average of a low B with A's comprising approximately 20% of the grades.

If You Need Help

- Some confusion and puzzling while working the homework is normal and expected – that is where the learning occurs.
- Be sure you are allocating enough time – many students need 10 or more hours a week to understand physics adequately!
- If you are still having trouble – help is available
- Come to office hours or make an appointment.
- The Writing and Learning Center has math tutorials (http://www.citadelwritingandlearning.com/math_tutorials)
- The Physics Department has tutors.

What's Wrong With This Picture?

How do you add a time, a distance, and a number of people?



Units

- In physics, numbers have **units** that show what is being measured.
- Giving a number without showing the units is meaningless.
- Numbers with different units cannot be added.
- What is a year + a foot? Nonsense!

Units

- Some elementary units are
  - Mass: kilograms (kg)
  - Distance: meters (m)
  - Time: seconds (s)
- Some derived units are
  - Velocity: meters/second (m/s)
  - Volume: cubic meters (m^3)
  - Density: mass/volume (kg/m^3)

Unit Conversions

If a car goes **25 m/s**, what is its speed in miles per hour?

- Given: 1 km = 0.62 mi, 1 hour = 3600 s.
- Then $1\ m = 0.62 \times 10^{-3}$ mi
- Multiply by conversion factors to cancel the unwanted units, given the wanted ones.

Unit Conversions

Multiply 25 m/s by factors of 1 to cancel unwanted units:

$1 = 0.62 \times 10^{-3}$ mi / 1 m

1 = 3600 s / 1 hr

Get

$25 \text{ m/s} = 25 \text{ m/s} \, (0.62 \times 10^{-3} \text{ mi/m})(3600 \text{ s/hr})$

$= 56$ mi/hr. The unwanted units cancel.

Note that the answer is not really 55.8 mi/hr (what the calculator says), since we were given only two **significant digits**.

Significant Digits

- No number can be measured with perfect precision. We know only a certain number of **significant digits**.
- Numbers in physics always are known to a certain accuracy, and it makes no sense to calculate something to more accuracy than the input numbers are known.

1.15 m x 0.727 m = 0.836 m^2,

not 0.83605 m^2.

Significant digits

Significant digits are ones that can be known based on the measurements.

- 1.25 3 significant digits
- 1.20 3 significant digits
- 125 3 significant digits
- 120 maybe 3, but maybe only 2

WebAssign won't complain if you enter too many digits, but may give an error if you enter too few. In labs, it is more important to give the correct number of digits.

Scientific Notation

Scientific Notation is more precise:

- 1.2×10^2 has 2 significant digits
- 1.20×10^2 has 3 significant digits.

All displayed digits are significant in scientific notation: no "place holders" such as the zero in 120 are needed.

WebAssign Scientific notation: enter

1.2e2 for 1.2×10^2 (calculator-style)

No spaces!

Density

Density: $\rho = m/V$ units: kg/m^3

Note: $1m^3 = (100\ cm)^3 = 10^6\ cm^3$

Example: Metal ball $9000\ kg/m^3$

$1\ cm$ diameter. What is the mass?

$V = 4/3\ \pi r^3 = 5.23 \times 10^{-7}\ m^3$

$(\ r = 5 \times 10^{-3}\ m\ )$

$m = \rho V = 4.71 \times 10^{-3}\ kg = 4.71\ g.$