Introduction

Lecturer:
Professor Stephen T. Thornton

This is the first semester of an introductory, calculus-based physics course.

The first semester covers motion, force, collisions, rotational motion, simple harmonic motion, fluids, heat, and thermodynamics.

The second semester will cover electricity, magnetism, waves, sound, and optics.

You will be given an Internet site for this course. All course information is on the website. Please read through the website carefully to see how homework and exams are assigned and administered. You will find textbook information.

Course Objectives

We want you to learn and understand about the physical world.

We do this through **problem solving** and **conceptual understanding**.

- Lectures
- Reading quizzes and conceptual questions
- Homework – required. See course website. There is lots of homework.

Homework

Homework will be found and submitted on an Internet website. For information on how to log in, access, and submit answers to the homework, please see the course website. We will also send you emails on how to access the homework.

Collab

We will use the UVa website Collab for many aspects of this course. You will find the lectures, syllabus, course website, and much other information located there.

You will be sent separately information on how to log into Collab and obtain this information.

Questions and Help

Collab is also the place where you will be able to obtain help with this course. You will see under Resources (on Collab) links to where you can ask physics questions and questions about each homework problem. We will strive to answer your questions within 24 hours. It is okay for students to ask and answer questions about physics, but the Instructors will always read everything and correct anything that is wrong.

Questions and Help

We will have threads for each homework problem and separate physics questions for you to follow. We believe you will find this to be a useful resource, and it has worked effectively for many years for our online courses.

There is also a place on Collab to submit anonymous questions and comments.

Final Grades

Grades will be determined approximately by the following, although the exact percentages may be different for your course. The precise percentages are subject to change and will be given on the course website.

Final Exam	40%
Midterm/Chapter Exams	40%
Homework	20%

What are you going to learn this semester?

- This semester covers the basis of physics, its mathematics, notation, etc.
- Force and Newton's laws
- Work and energy
- Momentum and collisions
- Rotational motion
- Simple harmonic motion and fluids
- Heat and thermodynamics

We cover waves and sound in the next course.

Ways to Learn from Textbook

- Questions at end of each chapter. Odd or even numbered problems have answers at end of each chapter in text.
- Work extra problems - especially general ones at end.
- Purchase optional Student Study Guide
- Use Problem-Solving Summaries given in lecture and textbook.

Significant Figures

This is very important!!

- Final answer is known no better than the *least* accurately known quantity.
- Keep all significant figures in calculation until last step, especially in Internet (WebAssign) problems, always keep all your significant figures.

Reading Quiz

The number 3.69×10^4 has how many significant figures?

A) 1

B) 2

C) 3

D) 4

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A) 1

B) 2

C) 3

D) 4

What You Need For Course

Textbook

Optional: Student Study Guide & Selected Solutions Manual.

Why do you study physics?

Let's look at a collision of a 1959 Chevrolet Bel Air with a 2009 Chevrolet Malibu and see what 50 years of engineering has done!!!

Watch video
(http://www.iihs.org/50th/default.html)

Length, Mass, and Time

Length – meter (m)

1/10,000,000 equator to NP

scratches on bar outside Paris

distance light travels in 1/299,792,458 s

1 inch ≡ 2.54 cm

Mass – kilogram (kg), particular object outside Paris

Time – second (s), transition in ^{133}Cs atom

TABLE 1–4 Metric (SI) Prefixes

Prefix	Abbreviation	Value
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
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}

† μ is the Greek letter "mu."

These are the standard SI prefixes for indicating powers of 10. Many are familiar; yotta, zetta, exa, hecto, deka, atto, zepto, and yocto are rarely used.

Do demos

Measurements and standards
Grains of rice

Systems of Units

We always use the International System or SI (after the French Systeme International).

TABLE 1–5
SI Base Quantities and Units

Quantity	Unit	Unit Abbreviation
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

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These are base units. Other units are derived from them.

Conceptual Quiz – significant figures

A car is traveling at a constant speed. It is measured to travel 39 m in 4.352398 s. What is its speed?

A) (39 m/4.4 s) = 8.8636 m/s

B) (39 m/4.4 s) = 8.9 m/s

C) (39 m/4.352398 s) = 8.9658 m/s

D) (39 m/4.352398 s) = 9.0 m/s

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Significant Figure Example

We chose the last answer, because we want to utilize all the information we have. However, the answer can only be quoted to 2 sig figs.

Exception: in WebAssign problems, you must get within 1% of the correct answer. Use all sig fig in calculation and express answers to at least 4 sig figs. Look at previous answers.

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Use this one for WebAssign!!

D) (39 m/4.352398 s) = 9.0 m/s

Scientific Notation

Commonly known now.

Speed of light

299,792,458 m/s

2.99792458×10^8 m/s

3.0×10^8 m/s might be okay

0.30 m/ns (what does this mean?)

WebAssign: 2.9979E+8 or 2.9979e+8

How do we obtain 0.30 m/ns?

Use unit conversion:

$3.0\times10^{8}\,\text{m/s}$

$$3.0\times10^{8}\,\frac{\text{m}}{\text{s}}\,\frac{\text{s}}{10^{9}\,\text{ns}}=\frac{3.0\,\text{m}}{10\,\text{ns}}$$

$$=0.30\ \text{m/ns}$$

Round-Off Errors

Significant errors can occur if you round off numbers within calculations. Get in the habit of keeping several (or all in your calculator) significant figures while doing calculations. Round off only in last step. See example in book. If at all possible, wait until the end to put in any numbers.

Order of magnitude (or “back of the envelope” or “ballpark”) calculations are useful to discern whether a particular answer seems valid. Get in the habit of doing them. Let’s do an example.

Volume of lecture table?

5 m long $\times$ 1 m high $\times$ 1 m deep

equals 5 m^3

Problem Solving Techniques

- Read the problem.
- Prepare a sketch.
- Write down what is known and what is to be found.
- Strategy to solve problem. Probably the most difficult step.
- Identify appropriate equations.

Problem Solving, continued

- Work it out. Multi-step solutions are the hardest. Find one parameter in order to find the next one.
- Check your answer; units, order of magnitude, does it make sense?
- Explore limits and special cases.