PHYSICS 191 | **CLASS 1** | **Fall 2009**

26 August 2009

ASSIGNMENT: Text, Preface; Chapter 1, Sections 1–6; Chapter 2, sections 1–5

Read the assignment carefully. The material in Chapter 1 is fairly straightforward, so I won't talk about it at any length in class. Raise any questions on this material at the start of Class 2.

Note that Chapter 1 also contains several sections on vectors. I am not assigning them for now; we will return to them when we begin to use vectors later in the book.

CONCEPTS:
Chapter 1

1. mass, length, and time as fundamental physical quantities

   (There is a fourth fundamental quantity, electric charge, that you will not see until next semester.)

2. Metric system (We will use metric units almost exclusively.)
3. Units and dimensional analysis
4. order of magnitude calculations and unit conversions

Chapter 2

1. definition of position and displacement
2. average velocity
3. average acceleration

TURN IN: **Chapter 1**, Exercises 9, 12, 25
Chapter 2, Exercises 2.4, 2.5, 2.7

In addition, answer the following question (related to Ch. 2):

Question: Can the velocity of an object reverse direction when its acceleration is constant? If so, give an example; if not, explain why.

Be sure that you *explain* your answers on all homework questions and problems, and show all your work *in detail*.

Please note and follow the format for homework problems described on page 3 of the course outline.

OVER

NOTES AND ANNOUNCEMENTS

1. The laboratory will meet this cycle (Monday, Tuesday, and Wednesday, 31 August1–2 September, Days 4, 5, and 6). Please do the following **before you come to lab**. You may not start the in-class lab work or get credit for this experiment otherwise.

   - Read carefully the Introduction to the lab manual. Make sure you bring a *calculator* and a *lab book* with you to lab.
   - Read the write-up for Experiment 1. Note that this write-up asks you to start reading the Appendices to the manual. For this experiment, concentrate on Appendices B and C.

     In particular, read carefully the sections of Appendix C that show how to use semi-log and log-log graphs to analyze experimental data. If necessary, review the properties of logarithms—most calculus books have a good discussion.
   - Make a *careful* graph of each of the two sets of data *in your lab notebook*, following the guidelines given in Appendix B. There are also several examples in Appendix C of the lab manual that I hope will be helpful. Guidelines:
     - Use a straightedge to draw axes, and otherwise, be neat and careful.
     - Make the graph BIG—use the better part of a lab book page for each graph.

     You will find that when you make graphs of the two data sets in Experiment 1, the first set will describe a straight line, but the second set will not. For the first set, sketch the best line you can through the data (using a light pencil is best) and then calculate the slope and intercept.

     The second set will describe a curve. We want to find out what function (or functions) are consistent with a set of data that fall on a curve.
     For two classes of functions, power laws (equations of the form $y = Ax^B$, where *A* and *B* are constants) and exponentials (equations of the form $y = Ae^{Bx}$, where *A* and *B* are constants and *e* is the base for natural logarithms), it is possible to “straighten out” a curve by making either a semi-log graph (log y vs. x) or a log-log graph (log y vs. log x).

     Read Appendices B and C carefully, and make logarithmic plots that will tell you which function is consistent with the second data set in Experiment 1.

     Thus, *before you come to lab*, you should have the following in your lab notebook:

     - *carefully done* graphs of both sets of data
     - calculation of the slope and intercept for the first set
     - a third (logarithmic) graph that converts the second data set to a straight line
     - a *careful* calculation of the slope and intercept for the logarithmic graph

OFFICE HOURS
Fall 2009

1. before and after class

2. whenever I am in, and by appointment

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web site:	http://faculty.csbsju.edu/cgearhart/

I will often not be in on even mornings and on Friday afternoons. Otherwise, except for occasional seminars, dentist appointments, etc., I am usually around. If I am not in my office, I will often be found in one of the shops or laboratories nearby; please feel free to look for me there. Questions and other messages can be sent via e-mail. I check my email regularly, including evenings. It's a good way to get through to me quickly (**much** more reliable than voice mail). I will be glad to try to answer questions from the reading and problem assignments via e-mail.

PHYSICS 191 **CLASS 2** **Fall 2009**

28 August 09

ASSIGNMENT: Text, Chapter 2 (Section 2.6 is optional) and handout from last class.
Lab manual: Experiment 1; Appendices B and C

CONCEPTS:
1. Average and instantaneous velocity
2. Average and instantaneous acceleration
3. how position, velocity, and acceleration are related
4. When a velocity is *constant*, the average and instantaneous velocities are *equal*; same for acceleration. Be sure you can draw graphs that makes this point clear to you.
5. motion under constant acceleration: how do position and velocity behave if acceleration is constant? (This case is important because the acceleration of gravity near the surface of the earth is constant.)

TURN IN: Chapter 2, Question Q 2.17; Exercises 2.14, 2.31, 2.44; Problems 2.69, 2.76;
Extra credit: Question Q2.20

In addition, answer and turn in the following Question:

Question: On a planet where the value of g is one-half the value on Earth, an object is dropped from rest and falls to the ground. How is the time needed for it to reach the ground from rest related to the time required to fall the same distance on Earth? **Hint:** This question may require a short algebraic calculation.

NOTES AND ANNOUNCEMENTS

1. The Chapter 2 summary on page 60 lists 4 equations (2.8, 2.12, 2.12, 2.14) that apply to one dimensional motion with constant acceleration. I strongly recommend that you use only the first three. They are all you will ever need. Note that YF do NOT prove Eq. (2.14); their “proof” on page 50 appeals to Eq. (2.10) on page 48; but they never prove 2.10! (It is proven in my handout).
2. Be sure that you **explain** your answers on all homework questions and problems, and show all your work in detail.
3. We will be sneaking up on the idea of the derivative in class today. If you are just starting calculus, don’t let it alarm you. I will put little if any calculus on the first exam—you will have time to learn the ideas in your math classes before we start using them extensively here.
4. The first exam will come after Chapter 3.
5. The laboratory will meet this cycle (Monday, Tuesday, and Wednesday, 1–3 September, Days 4, 5, and 6). Please do the following **before you come to lab**. You may not start the in-class lab work or get credit for this experiment otherwise.

OVER

- Read carefully the Introduction to the lab manual. Make sure you bring a *calculator* and a *lab book* with you to lab.
- Read the write-up for Experiment 1. Note that this write-up asks you to start reading the Appendices to the manual. For this experiment, concentrate on Appendices B and C.

  In particular, read carefully the sections of Appendix C that show how to use semi-log and log-log graphs to analyze experimental data. If necessary, review the properties of logarithms—most calculus books have a good discussion.
- Make a *careful* graph of each of the two sets of data *in your lab notebook*, following the guidelines given in Appendix B. There are also several examples in Appendix C of the lab manual that I hope will be helpful. Guidelines:
  - Use a straightedge to draw axes, and otherwise, be neat and careful.
  - Make the graph BIG—use the better part of a lab book page for each graph.

  You will find that when you make graphs of the two data sets in Experiment 1, the first set will describe a straight line, but the second set will not. For the first set, sketch the best line you can through the data (using a light pencil is best) and then calculate the slope and intercept.

  The second set will describe a curve. We want to find out what function (or functions) are consistent with a set of data that fall on a curve.
  For two classes of functions, power laws (equations of the form $y = Ax^B$, where *A* and *B* are constants) and exponentials (equations of the form $y = Ae^{Bx}$, where *A* and *B* are constants and *e* is the base for natural logarithms), it is possible to "straighten out" a curve by making either a semi-log graph (log y vs. x) or a log-log graph (log y vs. log x).

  Read Appendices B and C carefully, and make logarithmic plots that will tell you which function is consistent with the second data set in Experiment 1.

  Thus, *before you come to lab*, you should have the following in your lab notebook:
  - *carefully done* graphs of both sets of data
  - calculation of the slope and intercept for the first set
  - a third (logarithmic) graph that converts the second data set to a straight line
  - a *careful* calculation of the slope and intercept for the logarithmic graph

PHYSICS 191 **CLASS 3** **Fall 2009**

1 September 09

ASSIGNMENT: Text, Chapter 2; Chapter 1, Sections 7–9

CONCEPTS:

1. scalar—any quantity that has only magnitude
2. vector—any quantity that has both magnitude and direction
3. addition and subtraction of vectors
4. coordinate systems
5. components of a vector in a coordinate system
6. unit vector

TURN IN: Chapter 2, Exercise 2.39; Problems 2.83, 2.87; Extra Credit Problem 2.80
Chapter 1, Question Q1.18; Exercise 1.39 (but express your answer in terms of unit vectors); Exercise 1.49; Problem 1.68

Hint: for Problem 1.68, begin by first writing all three vectors in terms of components and unit vectors. Convert to magnitude and direction at the end.

NOTES AND ANNOUNCEMENTS

1. We will postpone Section 10 in Chapter 1 until later in the semester, when we will see how the ideas of vector multiplication are used in physics. Since we will be using these ideas later, you might want to read this section now and begin to get used to the idea of vector multiplication.

2. The laboratory will meet today and tomorrow, Tuesday and Wednesday, (Days 5 and 6). Before you come to lab, please be sure that you have completed the work described on the assignment sheets for the first two classes.

3. For Chapter 1, be sure to review elementary trig definitions if you need to. Appendix B in the back of the book may help. Note that the law of cosines and law of sines can also be useful in solving vector problems; you may want to review them as well.

4. Remember that the first exam will follow Chapter 3.

5. Note that I occasionally assign optional extra credit problems for homework. I may well ask similar problems on exams, so even if you do not do these problems, be sure that you check my posted solutions.

PHYSICS 191 **CLASS 4** **Fall 2009**

3 September 09

ASSIGNMENT: Text, Chapter 3, Sections 1–3; and handout

CONCEPTS:

1. Two and three dimensional motion as combining the ideas of vectors and one dimensional motion
2. components of a three dimensional position vector as *independent* "one dimensional" position functions; this notion applies to velocity and acceleration vectors as well
3. trajectory problems as combining vertical motion with constant acceleration and horizontal motion with constant velocity

TURN IN: Chapter 3, Exercises 3.7, 3.23, 3.24, 3.27; Problem 3.67; and the following

Question: At what point in the path of a projectile is the *speed* a minimum? A maximum?

Hint on Exercise 3.7—calculus is helpful but *not* necessary. If you have understood what we have said so far about how position, velocity, and constant acceleration are related, you should have enough to tackle it.

Comment: Problems 3.25 and 3.26 are also interesting, and worth your attention.

NOTES AND ANNOUNCEMENTS

1. I am tentatively scheduling the first exam for Monday 14 September. The exam will consist of questions and problems similar to the homework problems and other problems and questions in YF. I will probably take at least some of the questions straight from the book. Work as many problems as you can.

   You may bring to the exam one sheet of paper with anything you like written on it *except* worked-out problem or example problem solutions. I will ask you to turn in this sheet of paper with the exam.

   A good way of studying is to give yourself a "sample exam." Pick a problem you haven't done and see if you can do it under exam conditions in 10 minutes or so.

2. The laboratory will meet next Wednesday, Thursday, and Friday 9–11 September, Days 4, 5 and 6. We will do Experiment 2, in which we will measure the acceleration of gravity. Please read the write-up and the associated material in the Appendices *carefully* before coming to lab.

3. Remember that solutions to the homework problems and answers to all YF even-numbered problems are posted on the course web site, in pdf format.

OVER

4. It can sometimes be a little tricky to write equations when you ask questions via email. It can help to use programming language notation. For example,

+	add
-	subtract
* or space	multiply
/	divide
^	exponentiation
sqrt	take square root

Examples: 2*3 = 6; x = x_0 + v_0 t + 1/2 a t^2; t = sqrt(2 x /a)

PHYSICS 191 | **CLASS 5** | **Fall 2009**

8 September 09

ASSIGNMENT: Text, Chapter 3, Section 4, and handout; you should also study Section 5, but you are not responsible for it on the exam.

CONCEPTS:

1. Uniform circular motion: speed is constant, direction changes, so motion is accelerated!
2. acceleration is directed toward the center of the circle in uniform circular motion
3. In uniform circular motion, velocity and acceleration are at right angles

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DO BUT DO NOT TURN IN: Chapter 3, Question Q3.12; Exercises 3.29, 3.33; Problems 3.50, 3.79

NOTES AND ANNOUNCEMENTS

1. The first exam will be next Monday, 12 September. It will include everything we have studied through chapter 3. The exam will consist of questions and problems similar to the homework problems. **Work as many problems as you can.**

   You may bring to the exam one sheet of paper with anything you like written on it *except* worked-out problem or example problem solutions. I will ask you to turn in this sheet of paper with the exam.

   A good way of studying is to give yourself a "sample exam." Pick a problem you haven't done and see if you can do it under exam conditions in 10 minutes or so.

2. We will schedule optional review sessions for the exam today.

3. The laboratory will meet Wednesday, Thursday, and Friday 9–11 September, Days 4, 5 and 6. We will do Experiment 2, in which we will measure the acceleration of gravity. Please read the write-up and the associated material in the Appendices *carefully* before coming to lab.

   Please note: Remember that it is a good idea to have at least **two** laboratory notebooks, so you will have one to work with while the other is being graded. Note that you can often start your write-up before lab—for example, you can write an introduction, and describe the purpose of the lab, and they theory behind it. By contrast, you can't say anything about the procedure—the lab manual has suggestions, but you may do something a little different in lab.