

**AP Physics C: Electricity & Magnetism
2007-2008**

Instructor: Mr. Secrest
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Text:

Fundamentals of Physics by Halliday, Resnick, and Walker

Supplies Needed:

2 notebooks (one for homework and one for in-class notes), **scientific calculator** (TI 83, 84, 86, or 89 recommended), **small 3 ring binder** (for lab handouts, lab reports, etc.)

Course Description:

This course prepares students for the AP Physics C: Electricity & Magnetism exam (calculus based physics). This is a second year physics course that covers in depth concepts from electricity and magnetism. Problem solving is a major component of this course. The topics studied include: electrostatics; conductors, capacitors and dielectrics; electric circuits; magnetic fields; and electromagnetism. Students should expect to use the concepts covered in an integrated fashion. Excellent math skills are required, including the ability to use derivatives and integrals. Because of this, a prerequisite or co-requisite for the class is calculus. At the end of this class students should have a strong conceptual understanding of physics, well-developed laboratory skills, and know how to approach and solve problems that are new to them, which will help them in future science classes.

Sometimes we may move on to new topics before all students are comfortable with the material, but many of the topics build on each other so many things will become clearer as the year goes on. I am available for help outside of class to answer any questions that you have. I will usually be in the building after school every day, and I am also available by email if you are unable to see me. I am willing to help as much as possible, but you must ask.

Homework:

Written homework will be assigned almost every night and will include both conceptual and numeric questions. In your **homework notebook**, write the date and then work out the problems under it. During the next class we will often go through parts of the homework that people have questions on, but I also may ask people to explain how they did some of the problems. The assignments will help you learn the material, **but only if you put thought and effort into doing the problems**. You are expected to attempt all the problems (setting the problems up, showing some work, or at least a written explanation of what you think you should do if you are really stuck). I encourage you to work with other people if you are having trouble. This does not mean copying what they have written down because you do not learn anything from that. *You* need to understand how to do the problems too. Make sure *you* understand the steps too.

I will randomly (by rolling dice) check your homework notebooks to see if your assignment from the night before is completed (by completed, I mean each problem attempted). When I check the homework it is either 10 points if it is completed, or zero points if it is not (or if you forgot to bring your homework notebook to class – ***you will not be allowed to go get it from your locker***). You will be able to get partial credit ***once per quarter*** if your homework was not complete by turning it in the following day, but it will be graded on correctness, and it will be worth less than the full ten points.

You are responsible for understanding how to do the problems after we have talked about them the next day. If you do not, **ask questions!** Either ask me (in class or outside of class) or talk to one of your classmates that does understand.

We may also do some assignments using the University of Texas online homework system. More details will be given on that in class.

Many nights you will also be given reading assignments from the textbook (often just a section or two) that will serve as an introduction to the next day's class. It is important to keep up with the reading because it makes it easier to follow what we talk about in class. The time in the class will not be spent repeating what you should have read, but rather discussing and explaining it. I will not always be working out the example problems that are given in the book, but you should try to work through them because they will often help with problems in the following night's homework, and if there is a part that you do not understand, then ***ask about it***.

Quizzes:

There will be a quiz each week on Friday (for the 1st Semester we will discuss in class and figure out how this will work). There will be two parts to the quizzes: four multiple choice questions based on the material we have learned up to that point (not just from the past week, but *everything*), and one or two problems that will be similar to ones that you had in the homework during the previous week. The quizzes will be out of 10 points, with the multiple choice questions counting for 1 point each, and the other problem(s) will make up the remaining 6 points. On these quizzes you may use your AP formula sheet, but no other notes.

There will also be other smaller quizzes throughout the quarter, worth between 1-5 points. Some will be one or more questions based on problems or concepts that we have been covering in class, and some will be quizzes to make sure that you are doing your reading. These would not focus on small details, but rather main concepts that you should have picked up from the reading. Sometimes these extra quizzes will be announced, sometimes they will be pop quizzes, so you need to do the reading each night and spend a few minutes looking over the day's material before class the next day.

Note: You will be allowed to make corrections for quizzes and some tests to get some of the credit back that you missed. There is a separate handout that you will be given that gives the guidelines for these corrections. Just because you turn in corrections does not automatically mean that you get the points. The corrections must be correct and follow the required format. See me if you have any questions.

Tests:

There will be two styles of tests: **AP style** and **non-AP style**. **AP style tests** will be based on the AP exam. There will be a multiple choice section (**no calculators**) and a free response section (**calculators allowed/equation sheet provided**). The questions will come from old AP exams (or be similar). There is a curve built into this type of test, so I only allow you to correct multiple-choice questions. You can get 1% added to your test for each question you correct (if done correctly). The format would be the same as above for the multiple-choice quiz questions. You must all return these tests. I hold onto them. If you want to look them over at any time during the year, just ask and I will let you see them, but I never give them back to you for good. These will be more common later in the year because many of the free response questions cover several topics all in one question, which means we have to have covered all those topics first.

The **non-AP style tests** will be a mix of both conceptual questions and problems which require calculations. The problems are shorter than AP free response questions. They would be similar to the size of homework or quiz problems. There could also be some multiple choice or short answer questions. The format will change a little from test to test. You may use calculators and the AP formula sheet for the entire test (no other notes are allowed). These tests are allowed to be corrected in the same way that quizzes are.

Later in the year there may be a few take home tests, which would consist of around three free response problems that you have a few days to work on, and then must redo in class without any notes. No corrections will be allowed for this type of test. They will not be curved in the same way that the AP style tests are, but there may be a small adjustment built in depending on the level of difficulty of the problems (some problems have one very difficult part worth a small number of points, so those points might be treated more as "bonus" than as part of the actual test).

Labs:

Each week we have time given to us for labs (although for this class it is before school starts on Tuesday and Thursday – we will talk about how this will work in class). It won't always be used for labs. Sometimes it will be used for tests, or we might have a quiz or go over homework questions and then still have time to cover new topics, or it might be used to do group work on problems based on topics that we cover in the first part of class. It might also get used for classroom demonstrations for topics where it is more difficult to get reliable results, or video labs that allow us to go frame by frame through an experiment. Throughout the year we will be trying to do as many labs as possible. Some of them will be very straight forward, but some of them will be open ended where you will be figuring out the experiment yourself. Some of the labs will be completed at home as projects. Sometimes you will be writing a formal lab report for the experiment, and sometimes you might be answering a few questions or graphing your results to turn in. Sometimes your grade will come from something that you have to predict in the lab itself. The labs will not all be worth the same amount of points. The number of points will usually have to do with how much work you have to put into the lab. A straightforward lab usually won't count as much as an open ended lab, and a lab where you are writing a full lab report will count much more than either of those. You will be given details about the amount of points that each lab is worth when we get to it. Because of this, I don't know how many total points there will be for the lab each quarter, and it could vary a lot from quarter to quarter (some topics have lots of possibilities, while others have just a few things that can be done). **Any goofing around in the lab results in a zero for that lab and a trip to the dean's office.**

Participation

In class we are going to be using an interactive electronic response system for me to ask questions on concepts to the class. This allows both of us to get feedback each day on how well you understand the material. You will receive a participation grade based on whether or not you submit answers to the questions, not based on how many you got correct. This is going to be used as a learning tool, not an assessment tool. If you are paying attention in class, responding to the questions, and discussing with your neighbors when you are asked to you will receive +1 point for the day. If you are sleeping, or not paying attention (but not distracting others) you will receive 0 points for the day. If you are being very disruptive (or have to be reminded several times to be quiet) you will receive -5 points for the day. If you are causing problems and I have to either write a JUG or ask you to leave, you will receive -10 points for the day. *Also, for safety reasons goofing around will not be tolerated when we are doing labs.* This type of behavior will result in -20 points for the day.

Grading:

Tests (3 or 4 per quarter), homework, quizzes, labs, and participation are used to calculate the quarter grade. Tests count for 40% of the quarter grade, quizzes count for 25%, labs (including lab reports) count for 20%, homework counts for 10%, and participation counts for 5%. The semester exam consists of the equivalent to a full AP test (35 multiple choice questions in 45 minutes and 3 free response questions in 45 minutes). Almost all the questions are taken from old AP tests. This is to give the students a good feel for what the exam will be like in May. The semester grade will be calculated in the following fashion: **1st Quarter (37.5%) + 2nd Quarter (37.5%) + Semester Exam (25%) = Semester grade.** The second semester is calculated the same way, although for students that take the AP test, their semester exam will be replaced by the average of their 3rd and 4th quarter grades. For juniors there is a small test on your exam day covering material that we do after the AP exam, but this counts in your 4th quarter grade.

If you have questions or any concerns about how you are doing, **do not hesitate** to talk to me.

Content:

Below is a breakdown of what topics are covered, and approximately how many days are planned to be spent on each topic throughout the year (leaving time at end of year to review). *Note: This schedule is only an approximate guideline. Also some topics will be started and then returned to later in the year to look at more mathematically complicated problems (for example with electric fields in Chapters 23 and 24)*

Chapter 1: Introduction to Physics and Measurement (2 days)

- SI units and unit conversion
- Dimensional Analysis

Chapter 3: Introduction to Vectors (8 days)

- Finding components of vectors
- Vector addition and subtraction
- Unit vector notation
- Vector multiplication (dot product and cross product)

Supplementary Material: Introduction to Calculus (10 days)

(This is not in text but will be covered using worksheets and worked examples)

- Derivatives of polynomials using power rule
- Relationship between derivative and slope on graph
- Product rule
- Quotient rule
- Integration of polynomials
- Integration of trigonometric functions
- Relationship between integration and area under curve on graph

Chapter 22: Electric Charge (15 days)

- Types of charge
- Conductors and insulators
- Conservation of charge
- Charging by conduction
- Charging by induction
- Coulomb's law

Chapter 23: Electric Fields (15 days)

- Definition of electric field
- Electric field lines
- Electric field of point charge
- Electric fields due to line of charge, ring of charge, and charged disk
- Point charge in an electric field

Chapter 24: Gauss' Law (15 days)

- Concept of flux
- Electric flux
- Using Gauss' law to get field of point charge
- Properties of charged conductor
- Applying Gauss' law to situations with cylindrical, planar, or spherical symmetry

Chapter 25: Electric Potential (15 days)

- Electric potential energy
- Finding electric potential energy of point charge using integration
- Electric potential
- Equipotential lines and surfaces
- Calculating potential from electric field using integration
- Potential due to point charge and group of point charges
- Potential due to continuous charge distribution
- Calculating the electric field from equation for potential using derivatives
- Electric potential energy of system of point charges
- Potential of charged conductor

Chapter 26: Capacitance (15 days)

- Uses of capacitors
- Capacitance
- Calculating capacitance of different objects
- Capacitors in series and parallel
- Energy stored in electric field
- Dielectrics
- Capacitors with dielectrics
- Dielectrics and Gauss' law

Chapter 27: Current and Resistance (5 days)

- Moving charges and electric currents
- Current density and microscopic model of current
- Resistance, resistivity and conductivity
- Ohm's law
- Microscopic view of Ohm's law
- Power in electric circuits

Chapter 28: Circuits (15 days)

- "Pumping" charges through circuit – water analogy
- Work, energy, and EMF
- Calculating current in single loop circuit
- Voltage differences
- Resistors in series and parallel and finding equivalent resistance
- Kirchhoff's junction rule
- Kirchhoff's loop rule
- Analyzing multiloop circuits
- Ammeter and voltmeter
- RC circuits
- Finding equations for charge, current, and voltage of charging and discharging capacitors using Kirchhoff's rules and differential equations

Chapter 29: Magnetic Fields (10 days)

- Definition of magnetic field
- Effect of magnetic field on moving charge
- Circulating charged particle, cyclotrons and synchrotrons
- Magnetic force on current carrying wire
- Torque on current loop and electric motors

Chapter 30: Magnetic Fields Due to Currents (10 days)

- Magnetic field due to current carrying wire using Biot-Savart law
- Force between two parallel current carrying wires
- Ampere's law
- Magnetic fields of solenoids and toroids

Chapter 31: Induction and Inductance (10 days)

- Magnetic flux
- Faraday's law to calculate induced voltage
- Lenz's law to determine direction of induced current
- Induced electric fields
- Inductors and inductance
- Self-induction for an inductor with a varying current in it
- RL circuits
- Energy stored in magnetic field and energy density of field

Chapter 32: Maxwell's Equations (5 days)

- Gauss' law for magnetic fields and nonexistence of magnetic monopoles
- Displacement current in charging capacitor
- Combining Maxwell's law of induction with Ampere's law

Chapter 33: AC Circuits (10 days)

- LC oscillations
- AC current vs. DC current
- Forced oscillations in AC circuit
- Resonance in general
- Similarity of resistance, capacitive reactance, and inductive reactance
- Series RLC circuit
- Impedance
- Current amplitude in RLC circuit
- Phase constant
- Resonant frequency in RLC circuit
- Power in AC circuit
- Define rms current, average power, and rms voltage
- Transformers

Chapter 32: Electromagnetic Waves (5 days)

- Electromagnetic spectrum
- Traveling electromagnetic wave
- Polarization
- Intensity of polarized and unpolarized light transmitted through polarizing sheet