

# AP Physics C: Mechanics and E&M Syllabus 2019-2020

Mr. Bates

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This course will parallel college freshman-level physics classes in the study of both Mechanics and Electricity & Magnetism, and will prepare you to take either or both of the AP Physics C exams in May. Topics will align with those commonly found as components of introductory physics classes at a variety of technical colleges and universities.

## Class Philosophy

This is not a do-the-problems-get-the-grade class. As a college-level subject, we will pursue complex, open-ended inquiries, by experiment, research, calculation, and simulation, to discover, describe, analyze, and refine our understanding of the fundamental laws that govern our universe. Often you will be given a goal, or a general area of investigation, phrased as a messy, real-world problem, and you must use or identify whatever tools necessary to come to a meaningful approach to understanding it. It's difficult, it takes time, and it can be frustrating - but it's also 100% authentic learning. **You must put in learning time outside of class.** Start your UT Quests early. Find a study partner. Come in for help. This is tough stuff, but I know you can do it.

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## Grading policy

Grades for this course will be calculated as follows:

10% Video Checks    40% Exams, Quizzes, MC & FRQ Practice    50% Labs, Classwork, UT Quests

**Video Checks** There will be few to no in-class lectures; your first point of contact with the material will be through your textbook or through annotated video lectures. **It is imperative that you watch all videos and complete all readings on-time.** We will answer specific questions, but will *not* recap the material for you. You are responsible for taking notes, rewatching as necessary, and getting the most out of your own learning.

**UT Quests** All practice problem sets will be completed on UT Quest; all unit problem sets will generally be released on the first Monday of a unit, and will generally be due on Mondays. Most weeks will have a problem set due. UT Quests will be assessed *only* for correct completion; I do not take off points for using guesses. Extensions are available by request; extensions will be one-time per problem set, and provide an additional two days. Further extensions will not be provided.

**Labs** Inquiry-based labs are the heart and soul of physics. We will spend at least two days every two weeks (sometimes more) in labs and open-ended inquiry projects. Labs will often feature pre-Lab work that will be checked for completion, as well as submission of results, analysis, and conclusions in your Lab Journal.

**Quizzes** Quizzes will occur at least once a week, and will take the form of selected Multiple Choice questions or Free Response Questions. Short quizzes will generally be about 10-15 points, and take about 7-15 minutes. Quizzes may be reassessed once each on an alternate "retake" version, provided you have reviewed the original quiz and completed all videos.

- Exams** There will be one, 45-minute, AP-style exam for each unit of study; exams will be cumulative and will *always* include questions on earlier material. Exams will be effectively half of an AP exam - 17 multiple choice questions (scaled to 22.5 points) and 1½ free response questions (for 22.5 points), for a total of 45 points. Test corrections are available for up to 50% of points back.
- Final exam** There will be two cumulative semester final exams; Mechanics (near the end of Semester A), and E&M (prior to the AP exam). They will be full, 90-minute mock-AP exams. These will be counted as twice the value of a normal exam.

These points, as a percentage of the total points, will constitute your grade *exactly* as follows:

$$89.5 \leq A \leq 100; 79.5 \leq B < 89.5; 69.5 \leq C < 79.5; 59.5 \leq D < 69.5; E < 59.5$$

I expect you to keep track of your grade to make sure it is accurate; if there's a problem, please bring it to my attention. Students with a D or an E as a current grade will be summoned via weekly passes to fix this.

### **Late and Make-Up Work**

When you are absent, it is your responsibility to determine the work missed. **Refer to the calendar** and myMCPS tools to figure out what happened. You may have as much time as you missed to make up the work; if this is insufficient, talk to me.

If you are absent from a test, you must email me by the end of **that** school day. The email should explain to me why you are absent and when you intend to make-up the test. I will expect that make-up, unless there are extenuating circumstances, to occur within one day of your return.

There will be a flat 10% "late fee" deducted from **all** late formative work (this does not apply to UT Quests if you have an approved extension). The deadline for all late work is the Unit Exam for that unit; work will no longer be accepted after that date, and retakes of quizzes will no longer be available.

### **Snow Days**

If we have a snow day, *our schedule proceeds as normal*. Watch the videos, do the UT quests. We will make up what we can afterwards. If we miss multiple days, I will revise and post an updated calendar on myMCPS or in class.

### **Class activities**

I expect you to be in your seats ready to learn (with your calculator, formula sheet, notebook, etc.) when the late bell rings, and we will begin. Warmups and practice quizzes will be timed from the bell. We have a great deal to learn this year, so we will try to use every minute of class time productively and efficiently. There will not be time available for working on other homework, socializing, etc.

### **Notebook**

You should keep an organized notebook and bring it to class every day. It should be a bound notebook, not a bunch of papers. Take careful notes on videos and textbook readings. If you keep a careful notebook, it will help in your studying for tests and exams. If you're not sure how to take good notes, ask - it's time to learn.

All work submitted must be neat, organized, and readable. Failure to adhere may result in a required reassessment.

### **Honesty**

Don't cheat yourself. This is an AP class, and a tough one. Collaboration is the norm - find good partners and work with them, but do your own work. Cheating will be reported in all circumstances. Lying about cheating is extra bad.

**Academic support**

I am available at lunch most days, and after school at times detailed in class. If you're not in the habit of making appointments for help, develop it *now*. It will serve you very well in college. Making an appointment requires emailing or coming to me and asking "Mr. Bates, can I come by after school?" I will do my best to make myself available. I will also be available at Saturday School and at least once a week for "Office Hours" (to be detailed in class).

**Crucial Class Codes:**

UT Quest: Bates1920

PlayPosit: 1233156-827906

Remind: bk3he8

# Course Outline

The course discusses topics in two broad categories:

- (1) Mechanics
- (2) Electricity & Magnetism.

Students are prepared to take one **or both** of the Advanced Placement Physics C examinations at the end of this course: AP Physics C Mechanics Test **and/or** AP Physics C E&M Test.



Students in AP Physics C **MUST** either be currently enrolled in Calculus (AB or BC), or must have previously taken Calculus. The methods of differential and integral calculus - including, but not limited to, taking derivatives, integration, related rates, volume and area integrals, and differential equations - are *essential* to the study of physics at the college level.

Our text will be *Physics for Scientists and Engineers (3rd Ed.)* by **Randall D. Knight**. This is a comprehensive, calculus-based text covering all necessary topics (and then some).

## Semester A (16 weeks)

AP Physics C: Mechanics	# of Weeks
Kinematics <ul style="list-style-type: none"><li>- 1-Dimensional</li><li>- 2-Dimensional</li></ul> Including Projectiles	3
Newton's laws of Motion <ul style="list-style-type: none"><li>- Static Equilibrium (1<sup>st</sup>)</li><li>- Dynamics of a single particle (2<sup>nd</sup>)</li><li>- Systems of 2 or more objects (3<sup>rd</sup>)</li></ul>	3
Work Energy Power <ul style="list-style-type: none"><li>- Work/Work Energy</li><li>- Forces and Potential Energy</li><li>- Conservation of Energy</li><li>- Power</li></ul>	2
Linear Momentum <ul style="list-style-type: none"><li>- Center of Mass</li><li>- Impulse and Momentum</li><li>- Conservation of Linear momentum and collisions</li></ul>	2
Circular Motion & Rotation <ul style="list-style-type: none"><li>- Uniform Circular Motion</li><li>- Torque and Rotational Statics</li><li>- Rotational Kinematics and Dynamics</li><li>- Moment of Inertia</li><li>- Conservation of Angular Momentum</li></ul>	3
Oscillations and Gravitation <ul style="list-style-type: none"><li>- Simple Harmonic Motion</li><li>- Mass on Spring</li><li>- Pendulum / Other Oscillations</li><li>- Newton's Law of Gravity</li><li>- Circular Orbits of Planets / Satellites</li></ul>	3

## Semester B (14 weeks before AP Exam)

AP Physics C: Electricity and Magnetism	# of weeks
Electrostatics - Charge and Coulomb's Law - Electric Field & Electric Potential (point charges) - Gauss's Law - Fields and Potentials of Charge Distributions	3
Conductors, Capacitors - Electrostatics with Conductors - Capacitors -Capacitance -Parallel Plate -Spherical and Cylindrical - Dielectrics	2
Electric Circuits - Current, Resistance, Power - Steady-state direct current circuits with batteries and resistors only - Capacitors in circuits -Steady State -Transients in RC Circuits	3
Magnetic Fields - Forces on Moving Charges in Magnetic Fields - Forces on Current-Carrying Wires in Magnetic Fields - Fields of Long Current-Carrying Wires - Biot-Savart Law and Ampere's Law	2
Electromagnetism - Electromagnetic Induction (Faraday's Law & Lenz's Law) - Inductance (including LR and RC circuits) - Maxwell's Equations	2
Mock AP Tests/Review (MC and FR)	2
<b>AP EXAM</b>	
3 Weeks remain after the AP Exam	
Additional Laboratory Exercises	
Final Project Lab Practicum	

## Laboratory Work

Students are expected to spend at least 20% of the work time of class engaged in the below lab activities (we'll do a lot more than that). Each lab will consist of pre-lab questioning, an **open-ended inquiry** requiring student ingenuity and intuition to design, execute, and evaluate an approach, and a written lab report at the conclusion of the exercise. This requirement is reflective not only of the AP exam's focus on measurement and lab approaches, but also of the expectations of a college-bound science student.

## MECHANICS LABS (at least 5 will be completed)

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### General Labs

Error Analysis  
Density  
Vector Addition

### Kinematics Labs

Position vs Time  
High-Speed Video Analysis  
Measuring “g”  
Air Drag (Coffee Filter)

### Projectile Motion Labs

Muzzle Velocity of a  
Projectile Launcher

### Newton’s Laws and Force Labs

$a = F/m$   
Force Equilibrium  
Frictional Coefficient  
Centripetal Force  
Atwood Machine

### Work, Energy, and Momentum Labs

Non-Conservative Work  
Linear Momentum  
2D Collisions  
Rotational Dynamics  
Torque  
Angular Momentum

### Simple Harmonic Motion Labs

Hooke’s Law  
Simple Pendulum  
Physical Pendulum

## Electricity & Magnetism LABS (at least 5 will be completed)

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### Electricity Labs

1. Mapping Electric Fields
2. Resistivity of Unknown Metal
3. Internal Resistance of a Battery

### DC Circuit Labs

4. Ohm’s Law
5. Series vs. Parallel Circuits
6. Wheatstone Bridge
7. Kirchhoff’s Laws

### AC Circuit Labs

8. Induction of a Slinky
9. RLC Circuit
10. Ampere’s Law

### Magnetism Labs

11. Electric Balance
12. Mass of an Electron
13. Measuring Earth’s Magnetic Field

## ONLINE HOMEWORK RESPONSIBILITIES

UT Homework: <http://quest.cns.utexas.edu>

In addition to your Lab work and readings, you will be responsible for completing practice homework assignments on the University of Texas’s Quest website. This website is specifically registered for Wheaton High School students and will allow you to work on, submit, and verify answers for various Physics problems.

You WILL be able to work in groups on these problems and I **STRONGLY** encourage you to work with others!! You can / will work on these problems on your own time, but you are always able to ask me for help during class, during lunch or after school and/or via email.