SCI 440U: AP Physics C
Fall 2022
Maine School of Science and Mathematics

Instructor

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Office Hours: Sun 6:30–7:30 PM; MTR 11:30–12:25; W 9:30–10:25

Class Meetings

Room B216. *Class*: 10:30–11:25 AM; *Lab*: Friday 10:30 AM–12:20 PM.

Objectives

After completion of this course, the successful student will be able to:

- Explore and interpret scientific models.
- Identify and describe the physics underlying mechanical phenomena.
- Get a good score on the AP Physics C: Mechanics exam.

Course Content and Approach

This course is the first of a two-semester sequence of calculus-based physics. Using introductory differential and integral calculus, it addresses mechanics, including kinematics, energy and momentum, circular motion, oscillations, and gravitation. Students will learn to analyze physical systems, construct rigorous mathematical models of the systems, and solve the models when mathematically tractable.

Resources

Textbook

Fundamentals of Physics, Tenth Edition, by Jearl Walker, David Halliday; and Robert Resnick. Wiley, 2014. ISBN 978-1-118-23061-9. This is a calculus-based, college level textbook.

Canvas

Homework assignments are administered on Canvas.

Infinite Campus

Grade records are maintained on Infinite Campus.

AP Classroom

The Educational Testing Service provides some resources for students and teachers of AP classes. I will let you know about them when I figure it out myself.

Grading

Your course grade is determined by your scores for the following course components.

In-class work	5%
AP Classroom	5%
Homework	10%
Quizzes	10%
Labs	30%
Exams	40%

Year Grades

Although the Fall and Spring semesters are separate AP courses, each with its own AP test, at MSSM AP Physics C is a single year-long course. The year grade will be the average of Fall and Spring semester grades.

A note about grades

Your grade in this course reflects only your physics performance over a 15-week period on a limited set of evaluations. Your grade does not reflect your worth as a person or what I think of you. It is not a prediction of your future success. In short, do not cause anxiety by making more of your grade than it is.

Course Components

Class

Attendance is expected.

Group Work

Lectures will include class work to be done in groups. This work is important to the class! Please strive to solve all class work problems, and to ensure that all members of your group understand each problem and solution.

Student Groups and seating

Student groups for class work may be assigned, and seats may be assigned. Assigned groups will change from time to time.

Formative Assessment

Informal assessments, including but not limited to reflection questions

Homework

Homework is assigned every two or three days. It is due in two parts. The rough draft, worth ¼ of the total (5 points), is due at the next class meeting. You will receive feedback on your work, including what the score would be as a final draft. The final version, worth ¾ of the total, is due after you receive the feedback. The most important part is explaining how to approach and solve the problem.
For numerical problems, the points are awarded as follows. For a rough draft, 5 points:

- 2 for identifying the quantities given in the problem,
- 1 for identifying the quantities requested in the problem, and
- 1 for identifying at least one formula or law involving a given quantity and

- 1 for one formula involving a requested quantity.

For a final draft, 15 points:

- 2 for a diagram,
- 3 for identifying the physical principles applying to the situation,
- 5 for matching the quantities in the problem to the quantities in the formulas (correctly setting up the problem),
- 3 for solving the solution symbolically, and
- 2 for the correct answer.

Quizzes

There will be a brief quiz every three or so class meetings. Some quizzes will be administered in class. Subject to convenience and availability, some may be administered on-line. Most quizzes will be open-note and open-book. Calculators are permitted. You are permitted to access the internet during on-line quizzes.

However, you are encouraged to first try to answer quiz questions without consulting external resources, because the AP test itself will be just you and the test. If you find that you need to look something up, resolve to study it.

AP Classroom Personal Progress Checks

These are AP Test-style unit reviews in AP Classroom, to help you identify topics you need to reinforce. They are graded on completion for this course. Your performance is for your information, and to alert the instructor to skills that need reinforcement.

Exams

There will be three one-hour exams during the semester and a two-hour midterm during midterm week. The midterm will be in two parts: the first part is the third exam in the sequence, and the second part is cumulative, covering the entire semester. The lowest score of the four exams is dropped. Exams are closed book, closed note, no computers or internet, as the AP tests would run.

Laboratories

There are fifteen (15) labs. Laboratory participation is an essential component of the course.

Lab Groups

It is expected that you will work in groups in lab. Many of the experiments require several people just to take the data. Groups may contain **no more than four students**. All group members are responsible for completing all data tables, graphs, and analyses.

Data collection

Your primary data is to be immediately recorded in ink in a bound, permanent lab notebook. Data may be transcribed to a spreadsheet or other computer file, not the other way around. When measurements are collected and logged by a computer apparatus, the raw data file names must be identified in your bound notebook. When computer-collected data sets are used to

calculate a single summary statistic (such as the slope of a plot), the summary statistic is treated as a primary measurement.

Lab Report

Written lab reports are a key component of the course. They are due at the beginning of the next lab. In a report, you demonstrate your ability to organize and interpret data, to draw inferences, and to communicate conclusions. Each student must complete their own lab report individually. Because the laboratory component of the course is not directly evaluated by the AP examination, students should preserve their lab notebook and portfolio of laboratory reports for inspection by college officials.

A standard lab report consists of the following sections. Lab grades are calculated from the parts of the laboratory report. Labs that deviate from this format will be accompanied by specific guidelines.

Abstract 5%

This briefly summarizes the investigation, including procedure and conclusions.

Purpose 5%

Identifies the question investigated, hypothesis tested, or skill taught.

Theory 20%

Identifies the physics principles relevant to the situation. Develops the formulas or equations to show how the desired information is obtained from the measurements.

Experimental 15%

Describes the apparatus and procedure in enough detail for a reader to duplicate your experiment.

Observations and Data 15%

Data are to be presented to the instructor at the end of the lab period in which they are recorded. If they need to be included in the report for reference, they should be transcribed.

Analysis and Discussion 30%

Report all processing of data, such as statistics and plots. The actual formulas and procedures you use should already have been addressed in the "Theory" section above.

Detail the meaning of your results, particularly pertaining to the "Purpose" above.

Describe possible sources of measurement error, and how errors would affect your results.

Conclusion 10%

What is the answer to the question you investigated? Is your hypothesis supported or not? Is your study conclusive? Explain, referring to your "Discussion" above.

Absences

Assessments missed due to an excused absence may be made up. Arrangements for make-up assessments must be made within seven calendar days of your return to class. If you are unable to attend a lab due to an excused absence, contact me. I may either schedule a make-up at another time or pro-rate your missed lab.

Remote learning during extended medical absences

If you are unable to be on campus due to a medical absence, you may participate in the class remotely. However, it is not technically possible for me to deliver the full classroom experience to students attending remotely; when I attend to students physically in lab or lecture, I am not able to optimize cameras, microphones, and narration. Students attending labs remotely may use data gathered from the group in which they synchronously participated, and which they record in their own data tables. Students taking quizzes or exams remotely are subject to the same conditions, including time limits, as if they were physically present.

Academic Integrity

2022-2023 Community Handbook

At MSSM, students and staff take great pride in academic honesty and a supportive academic environment. All are expected to maintain habits of rigorous debate, healthy inquiry, and the vigorous pursuit of truth. Academic dishonesty, in any of its forms, disrupts the learning process and tarnishes the integrity of our community. As a result, MSSM will treat instances of academic dishonesty very seriously.

If an instructor grants permission, students may collaborate in completing assignments and homework. Any unauthorized collaboration, copying, using of notes on exams/major assessments, storing of non-permitted information on calculators or on computers, or any other unacceptable activity that gives a student or a group of students advantages over others is cheating and will not be tolerated.

While the assimilation of ideas from many sources is basic to academic research and intellectual development, students must always reference the use of any non-original materials. Failure to do so is plagiarism and this dishonesty impairs an instructor's ability to accurately evaluate a student's performance. Plagiarism is using someone else's ideas, wording, or data without proper or complete acknowledgment. Credit must be given for ideas and information that belong to someone else, whether it is quoted, summarized, or paraphrased. Faculty members may require that notes, drafts, and a list of sources be submitted along with the finished project. Failure to provide evidence of the work process may constitute an admission of plagiarism.

This class

Students are expected to respect others' opinions and abilities. Those who disrupt the class or interfere with other students' opportunity to learn will be asked to leave the class. If you have a mobile phone or any other distracting equipment, turn it off or silence it and refrain from non-class use during class.

Students are expected to work together on group work and labs, and encouraged to study together. However, all submissions must represent your OWN work. Copying, collaborating,

and sharing of materials during quizzes is not permitted, as described in detail above. Other prohibited practices include, but are not limited to, signing an absent student's name to a sign-in sheet, submitting material for grading that is also submitted to another class without clearance by both instructors, and "dry-labbing" or recording data in lab that you did not actually observe.

Disclaimer

Information in the syllabus was, to the best of the instructor's knowledge, correct when distributed at the beginning of the term. However, the instructor reserves the right to correct errors and to make changes in the course content or instructional techniques during the term. The instructor will make every effort to ensure that any such changes benefit the students. Before any changes to the syllabus take effect, students will be notified and given the opportunity to comment, object, and propose alternatives.

Notice of Non-Discrimination

MSSM does not discriminate on the basis of race, color, sex, sexual orientation, gender identity or expression, religion, ancestry, national origin, genetic information, or disability in its programs and activities. The following person has been designated to handle inquiries regarding the non-discrimination policies:

- Dr Greg Hamlin (he/him/his)
- Title IX Coordinator, Affirmative Action Officer
- Email: hamling@mssm.org
- Cell: 607-301-3922

For further information on notice of non-discrimination you may contact the U.S. Department of Health and Human Services, Office for Civil Rights. Web: https://www.hhs.gov/ocr/index.html, Phone: 1-800-368-1019, Email: OCRMail@hhs.gov, TDD: 1-800-537-7697.

Sexual Discrimination Reporting Statement—UMPI

"The University of Maine System is committed to creating a safe place for students. Because of this commitment, if you tell a teacher about an experience of sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination, your teacher is required to report this information to the Office of Equal Opportunity."

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Fall Semester Planner (Tentative)

Day	Topic	Reading	Homework*	Quiz
8/22	Fundamental indefinables	Ch.1		
8/23	Position, velocity, and time	2.1–2.2		
8/24	Acceleration	2.3–2.6		
8/25	Vectors; Newton's second law	3.1	HW 1 ↑	
8/26	*Lab 1: Sonic Ranger*			
8/29	Vector addition and scalar multiplication	3.2–3.3	HW 1 R ↓	
8/30	Ballistic trajectories: position and velocity	4.1–4.4		
8/31	Ballistic trajectories: range when $y_f \neq y_0$			
9/1	Ballistic trajectories: other quantities		HW 1 F ↓, HW 2 ↑	1
9/2	*Lab 2: Representing motion*			
9/5	Uniform circular motion: velocity	4.5	HW 2 R ↓	
9/6	Uniform circular motion: frequency			
9/7	Uniform circular motion			
9/8	Acceleration v. rate of change of speed	4.6–4.7	HW 2 F ↓, HW 3 ↑	2
9/9	*Lab 3: Range of a projectile*			
9/12	Newton's first law; statics	5.1–5.2	HW 3 R ↓	
9/13	Weight, normal force			3
9/14				
9/15	**Exam 1**			
9/16	(Compressed schedule) *Lab 4: Force Table*			
9/19–9/20	**break** (4-day weekend)			
9/21	Inclined coordinates	6.1–6.3		
9/22	Newton's second law		HW 3 F ↓, HW 4 ↑	
9/23	*Lab 5: Friction*			
9/26	Kinetic friction		HW 4 R ↓	
9/27	Newton's third law; linked bodies			
9/28	Newton's second law problems			
9/29	Newton's second law problems		HW 4 F ↓, HW 5 ↑	4
9/30	*Lab 6: Net force and acceleration*			
10/3	Work, energy, and power	7.1–7.6	HW 5 R ↓	
10/4	Kinetic energy; work-energy theorem			
10/5	Potential energy; Hooke's law	8.1–8.5		
10/6	Practice		HW 5 F ↓, HW 6 ↑	5
10/7	*Lab 7: Simple machines*			

Day	Topic	Reading	Homework*	Quiz
10/10	Mechanical energy; conservation of energy		HW 6 R ↓	
10/11	Potential diagrams			
10/12	PSAT Day—no class			
10/13	**Exam 2**			
10/14	Parent conferences Lab 8: Pendulum challenge			
10/17–10/18	**break** (4-day weekend)			
10/19	Conservation of momentum	9.2–9.3		
10/20	1-D inelastic collisions		HW 6 F ↓, HW 7 ↑	
10/21	*Lab 9: collisions*			
10/24	1-D elastic collisions	9.4–9.7	HW 7 R ↓	
10/25	2-D inelastic collisions	9.8		
10/26	Center of mass; com frame	9.1		
10/27	Energy partition theorem		HW 7 F ↓, HW 8 ↑	7
10/28	*Lab 10: Ballistic pendulum*			
10/31	Rotational kinematics: rolling w/o slipping	10.1–10.3	HW 8 R ↓	
11/1	K_{rot}, moment of inertia	10.4–10.6		
11/2	Torque and angular acceleration	10.7		
11/3	Work by a torque; static torques	10.8	HW 8 F ↓, HW 9 ↑	8
11/4	*Lab 11: Torque and angular acceleration*			
11/7	Parallel axis theorem	11.1–11.4	HW 9 R ↓	
11/8	Finding moments of inertia			
11/9	**Exam 3**			
11/10	Conservation of angular momentum	11.6	HW 10 ↑	
11/11	*Lab 12: Ramp race*			
11/14	Angular momentum partition theorem	11.6–11.9	HW 9 F ↓, HW 10 R ↓	
11/15	Harmonic oscillator $\omega^2 = k/m$	15.1		
11/16	Harmonic oscillator energy partitioning	15.2		
11/17	Torsional oscillator; physical pendulum	15.3	HW 10 F ↓	9
11/18	*Lab 13: Hooke's law*			
11/19–11/27	**Thanksgiving break**			
11/28	Simple pendulum	15.4		
11/29				
11/30	Newton's gravitational formula; field	13.1–13.4		
12/1	Gravitational potential energy	13.5	HW 11 ↑	10
12/2	*Lab 14: physical pendulum*			

Day	Topic	Reading	Homework*	Quiz
12/5	Escape speed; Kepler's laws	13.6	HW 11 R ↓	
12/6	Orbital dynamics	13.7		
12/7	Practice			
12/8	Review		HW 11 F ↓	
12/9	*Lab 15: Cavendish apparatus*			
Midterm week			**Midterm parts 1 & 2**	

* R = rough draft, F = final draft; ↑ = assigned; ↓ = due.

Spring Semester Planner (Tentative)

Day	Topic	Reading	Homework*	Quiz
1/24	Coulomb's law; E field	21.1–22.1		
1/25	Potential	24.1		
1/26	*E* and *V* of point charges	22.2	HW 12 ↑	
1/27	*Lab 16: Electrostatic force*			
1/30	*E* and *V* of charge distributions	22.4–22.7	HW 12 R ↓	
1/31	Practice	24.2–24.8		
2/1	Gauss's law for electricity	23.1–23.6		
2/2	Conductors and shielding		HW 12 F ↓, HW 13 ↑	11
2/3	*Lab 17: Potential and field maps*			
2/6	Capacitors and capacitance	25.1–25.4	HW 13 R ↓	
2/7	Energy density; combining capacitors			
2/8	Dielectrics, dielectric strength	25.5–25.6		
2/9	Ohm's law, power	26.1, 26.4	HW 13 F ↓, HW 14 ↑	12
2/10	*Lab 18: Electric polarization*			
2/13	Combining resistors; Kirchhoff's rules	27.1–27.3	HW 14 R ↓	
2/14	Review			
2/15	**Exam 6**			
2/16	DC Circuits			
2/17	*Lab 19: Simple circuits*			
2/18–2/26	**Break**			
2/27	Resistivity, drift speed, current density	26.2–26.3		
2/28	Circuits practice			13
3/1	RC Circuits	27.4		
3/2	RC Circuits practice		HW 14 F ↓, HW 15 ↑	
3/3	*Lab 20: Kirchhoff's rules*			
3/6	Magnetic field	28.1	HW 15 R ↓	

Day	Topic	Reading	Homework*	Quiz
3/7	Practice			
3/8	Lorentz force	28.2–28.5		
3/9	Laplace force	28.6	HW 15 F ↓, HW 16 ↑	14
3/10	*Lab 21: RC Circuits*			
3/13			HW 16 R ↓	
3/14	Magnetic dipole; torque on a loop	28.7–28.8		
3/15	Review			
3/16	**Exam 7**			
3/17	*Lab 22: Magnetic field*			
3/20–3/21	**break** (4-day weekend)			
3/22	Biot-Savart law	29.1–29.2		
3/23	*B* fields of current distributions		HW 16 F ↓, HW 17 ↑	15
3/24	*Lab 23: Non-ideal circuit components*			
3/27	Ampere's law	29.3–29.5	HW 17 R ↓	
3/28	Ampere's law			
3/29	Practice			
3/30	Motional emf		HW 17 F ↓, HW 18 ↑	16
3/31	*Lab 24: Currents and magnets*			
4/3	Faraday's law, Lenz's law	30.1–30.3	HW 18 R ↓	
4/4	Practice			
4/5	Inductors and inductance	30.4–30.7		
4/6	Energy density of magnetic fields	30.8	HW 18 F ↓, HW 19 ↑	17
4/7	*Lab 25: Magnetic Induction*			
4/10	LR Circuits	30.6	HW 19 R ↓	
4/11	Practice			
4/12	Combining inductors; transformers	31.6		
4/13	Displacement current	32.3	HW 19 F ↓	18
4/14	*Lab 26: Oscilloscope and time constant*			
4/15–4/23	**Break**			
4/24	Maxwell's equations		HW 20 ↑	
4/25	Electromagnetic waves	33.1–33.2		
4/26	E&M Review		HW 20 R ↓	
4/27	**Exam 8**			
4/28	*Lab 27: Make an inductor*			
5/1	LC circuits; SHO analogy	31.1	HW 20 F ↓	
5/2	E&M Review			

Day	Topic	Reading	Homework*	Quiz
5/3	Mechanics review			
5/4	Mechanics review			19
5/5	*Lab 28: AC circuits and reactance*			
5/8	Questions review			
5/9	**AP Tests, Physics C**			
5/10	Wave motion	16.1		
5/11	Wave equation	16.4	HW 21 ↑	
5/12	*Lab 29: Resonant circuits*			
5/15	Wave interference; beats	16.5, 17.6	HW 21 R ↓	20
5/16	Standing waves and resonance	16.7		
5/17	Double-slit and diffraction gratings	36.4–36.5		
5/18	Practice		HW 21 F ↓	
5/19	*Lab 30: Light and color*			
Finals week			**Final parts 1 & 2**	