Physics 212  
Physics for Scientists and Engineers II  
Spring, 2016

Meets:  
Sect. 2: 10:00 am – 11:50 am  
Mon., Wed., Fri.  
150 Meldrum Hall

Instructor:  
Dr. Christopher Cline  
278 Meldrum Hall  
832-2346  
ccline@westminstercollege.edu

Conditions of enrollment: A passing grade of C- or better in Math 141 (Algebra), Math 142 (Trigonometry), Math 201 or 201B (Calculus I), and Phys 211 is a prerequisite for all students enrolled in this course. Also, concurrent enrollment or a passing grade of C- or better in Math 202 (Calculus II) is required.

Textbook:  
Required:  
Understanding Physics, 1st Ed., Karen Cummings et al.  
Workshop Physics Activity Guide, Modules 3 & 4, Priscilla W. Laws

On Reserve:  
Improve Your Physics Grade, Ronald and Robin Aaron  
Conceptual Physics, Paul G. Hewitt

Grading:  
Your grade will be based on a professional judgment of your work using the following weighting scheme:

15% Exam 1  
Friday, February 12, 10:00 am - 11:50 am, 150 Meldrum  
15% Exam 2  
Friday, March 25, 10:00 am - 11:50 am, 150 Meldrum  
15% Exam 3  
Friday, April 29, 10:00 am - 11:50 am, 150 Meldrum  
15% Written Homework  
15% Activity Guide Entries  
15% Formal Laboratory Project  
10% Class Participation

Your final letter grade will be determined from percentages in the following manner:

93 to 100 A (superior)  
90 to 92.9 A- (excellent)  
87 to 89.9 B+ (extremely respectable)  
83 to 86.9 B (very respectable)  
80 to 82.9 B- (respectable)  
77 to 79.9 C+ (very acceptable)  
73 to 76.9 C (acceptable)  
70 to 72.9 C- (tolerably acceptable)  
67 to 69.9 D+ (passable)  
63 to 66.9 D (barely passable)  
60 to 62.9 D- (hardly passable)  
0 to 59.9 F (unacceptable)

Course Objectives and Goals:  
1. Development of Transferable Scientific Skills  
   a. Ability to work well in a group  
   b. Research and development skills  
      i. Development of conceptual understanding through observation of physical phenomena  
      ii. Reasoning about physical phenomena on the basis of available evidence  
      iii. Use of experimental data in the development, testing, and refinement of theoretical models  
      iv. Evaluation of data sets containing extraneous information and/or noise in regard to identifying relevant/important information.  
      v. Experimental design  
      vi. Scientific writing ability  
2. Applying course material in quantitative problem solving  
3. Increased comfort in using educational technologies

CAC:8/18/15
How to get help: My office hours are MW 1:00 pm-2:00 pm and TTh 1:00 pm-4:00 pm. If you can’t come during any of these hours, I will be happy to make an appointment with you for another time. For me, the most enjoyable aspect of teaching is working with students one-on-one. Please, please come see me often—especially if you run into difficulties with concepts.

Philosophy, Policy, and Procedures

Physics: From the practical to the profound: Physics is not a large collection of facts or formulas to be memorized. Physics is also not the dreaming up of theories in the absence of data, or the exposé of truth, whatever that means. Physics is not mathematics; in physics, math is demoted from the wonderful art that it is to a necessary tool for dealing with quantitative predictions and data treatment. And the laws of physics do not command objects to behave in certain ways.

Physics is a science that attempts to unify elements of the natural world by means of observation, mathematics, and the use of precise language. Using methods developed by physicists, we can describe many events that occur in our everyday lives. The principles of physics provided a basis for most of the technologies that are an essential part of modern life. In this sense, physics is practical. Many laws developed by physicists, such as the law of conservation of energy, are of tremendous practical importance. These same laws also help physicists understand the very tiny constituents of matter as well as the motions of giant clusters of galaxies. Thus the study of physics helps us understand some fundamental relationships between the matter in our surroundings and the evolution of the universe. In this sense physics is profound. You are about to begin your own exploration of the natural world using some of the concepts, tools, and methods commonly employed by physical scientists. Thus, you are beginning what we hope will become a grand journey from the practical to the profound that will continue long after you have completed introductory physics.

The Workshop Physics Philosophy

I hear, I forget.
I see, I remember
I do, I understand

Anon

In traditional science courses, attending lectures, reading a textbook, and solving problems are the primary learning activities. These activities are usually supplemented by a weekly laboratory session taught by an instructor other than the lecturer. The emphasis in traditional courses is on what you know.

Physics 212 will be taught using the award-winning Workshop Physics method developed by Dr. Priscilla Laws of Dickinson College and used at hundreds of colleges and universities across the country. The workshop method is based upon the simple principle that understanding comes not from listening but from doing.

At its heart, physics is a science that is based upon experimentation; physics was developed through a process of observation, prediction, and refinement through further experimentation. In this course we will take a very similar approach. Instead of reading and memorizing the laws of physics from a textbook (and taking someone else’s word for it that they are correct), we will seek to discover and verify them for ourselves during in-class activities. We’ll use a whole host of high-tech tools such as computer driven sensors, video software, and spreadsheets to both acquire and analyze data. Abstract physics concepts will make much more sense when you can plot data instantaneously on the computer and model them using Excel. Your learning will go beyond simply memorizing physics equations; you will develop a conceptual understanding of physics as well as concrete reasoning and computer skills that will be useful in any other science course that you take. The critical question in this course is not “What do you know” but rather “How do you know what you know?”

Finally, let us emphasize that you are not losing anything by not being taught in the traditional lecture format - quite the contrary. Students who have completed workshop based general physics courses have been shown to perform far better than their peers who have gone through traditional courses. Workshop physics students demonstrate a far better overall understanding of physics, and, although it may seem surprising, their ability to solve traditional textbook problems is also superior. We truly believe that you will find workshop physics to be an enriching, rewarding, and, we hope, an enjoyable experience.

Before, during, and at the end of class - what’s expected: An Activity Guide has been developed to support the Workshop Physics approach to learning. In-class written work will consist primarily of documenting your class activities by filling in the entries in the “activity” spaces provided. You are encouraged to keep your own notes in the margins of the Activity Guide. You should not make a practice of waiting until after class to fill in your guide.
Before coming to each class session, you should have completed the Activity Guide entries from the previous class session (hopefully in the previous class) and done the assigned reading from the text or other documents, as listed in the course outline. You are also strongly encouraged to have attempted to do relevant portions of the assigned homework.

You are expected to show up for class on time. Coming to class late is both inconsiderate and distracting to your instructor and fellow classmates. Repeatedly coming to class late will be detrimental to your class participation grade.

You are expected to show respect for others and their ideas.

During class sessions, your willingness to discuss ideas with classmates, devise clever ways to measure or observe things, and make brief presentations using the board at the front of the classroom are important aspects of your participation in the course.

You are expected to be participating actively in the class sessions at all times.

The use of the computer during scheduled class periods is restricted to course related activities. In particular, reading and sending personal e-mail, working on materials for other courses, creating personal documents, and playing computer games will be detrimental to your class participation grade and could affect your understanding of the course material.

We expect you to be careful with the lab equipment and to keep your lab table clean and neat. At the end of every class period your table should be left with equipment arranged neatly, computer equipment off, and scrap materials thrown away.

Written and Oral Work

Activity Guide Entries: Activity Guide entries describe observations, derivations, calculations, and answers to questions. In the guide, a group of numbers signifying the unit, section, and activity number followed by the bold word Activity: (e.g. 16.3.2. Activity: Converting Between Temperature Scales) indicates that a series of entries using data, words, sketches, or graphs is requested. Although you may use the same data and graphs as your partner(s) and discuss concepts with your classmates, all entries should reflect your own understanding of the concepts and the meaning of the data and graphs you are presenting. Thus each Activity Guide entry must be written in your own words. Students who copy Activity Guide entries from current or old Guides will be reported for plagiarism. The first such occurrence will result in a score of zero on that entry; the second occurrence will result in failure of the course.

All of your Activity Guide Units will be examined for completeness. In addition, several of your Units will be chosen at random to be carefully evaluated by the instructor and given a percentage grade for quality and completeness. The instructor will look for a correct understanding of the physics involved, complete sentences, clear expository writing, proper labeling of graphs and tables, the use of appropriate units with numbers, accuracy of calculations, the expression of results to the correct number of significant figures, and adherence to instructions. It is ultimately your responsibility to see that your entries reflect a sound understanding of the phenomena you are observing and analyzing. Since these Activity Guide entries will be open to you when you take examinations, it is to your advantage to create a set of entries and marginal notes based on in-class discussions and text book readings that are useful references as you complete examinations.

At the end of the semester your Activity Guide scores will be translated into a percentage grade with 70% of the grade on it determined by the quality grades given by the instructor and 30% determined by the completion scores. Activity Guide Units are due by 5:00 p.m. two days after the Unit work is completed, or on the following Monday if the due day falls on a weekend (or an Exam day). For example, if a particular unit is finished in class on Monday, the Activity Guide is due by 5:00 p.m. on the following Wednesday. If a unit is finished in class on Friday, the Activity Guide is due by 5:00 p.m. on the following Monday. Late Activity Guides take teaching assistants and instructors much longer to review. In order to discourage late work, the grade on the Activity Guides will be reduced by 10% for each day or part of a day after the due date unless a written notification of illness is provided by Student Services. If an Activity Guide Unit is chosen to be quality graded, the quality grade is zero if it is handed in late.

Homework Assignments: There will be a homework assignment to complete for each unit; the assignments will be available from your instructor’s web page. Some of the homework assignments will consist of questions based on class activities, while others are fairly difficult mathematical problems. Some of these may be adapted from problems in your textbook. Sometimes you will need to finish activities you started during class before starting the homework. At times you will need to come back to the classroom to do computer assignments. This out-of-class work will typically take 2 or more hours to complete after each class session. A typical student can expect to work about 6 to 8 hours each week out of class, and spend anywhere from 15 to 60 minutes on each homework problem.
What is the Purpose of Regular Homework?

There are two reasons why we assign homework on a regular basis. First and for most doing regular exercises right after class activities helps you clarify, retain, and extend the concepts developed during in-class activities. Our research has shown that students who do well-designed homework exercises on a regular basis learn much more physics than those who don’t. The second reason for the homework assignments is to help both you and your instructors assess your progress in the course on a regular basis. For this reason we grade the homework so we can give you continuous feedback.

We have noted in the past that there is a strong correlations between the steady effort needed to successfully complete homework and performance on examinations. For example, during a recent year all of the students with exam averages above 90% had homework averages of over 85%.

It is often difficult for beginning physics students to appreciate that the primary purpose of assigned problems in physics is absolutely not to see if you can get the right answer. Rather, it is for you to practice and then demonstrate that you have learned 1) how to determine the fundamental physical principles that are involved in a described situation and 2) how to apply those principles in a disciplined and orderly fashion. Of course, if you have learned how to do these things, you should expect to get the right answer too, but that is - really - of secondary importance. You will find - indeed, you probably have found - that, given time, an open book, lots of worked examples, and knowledge of the correct answer, it is very often possible to "get the answer" without the slightest understanding of what you are doing. Please guard against this; it is a complete waste of your time because it does not prepare you for, and it obviously will not work on, exams.

Accordingly, we are not - and you should not be - satisfied with problem "solutions" that simply consist of a series of mathematical manipulations leading to a result. Instead, your problem solutions should be "presented." By this we mean that they should be readable by someone who does not have access to the problem statement; should include written explanations and thoughtful comments about what you are doing and, especially, why; should use well-defined and consistent notation (employing unique and meaningful subscripts and superscripts as necessary); should be accompanied by neatly drawn and carefully labeled diagrams; and should flow in a logical and orderly progression down the page. They should use more space for the written explanatory information than for the mathematics! They should not include lengthy, multiple-step, purely mathematical manipulations because it only serves to obscure the physics. Do this kind of work on scratch paper and simply say something like "solving this equation for \(v\), substituting the result into the equation for \(F\), and simplifying we obtain..."

Handwritten Homework

Homework is due by 5:00 p.m. two days after the Unit work is completed, or on the following Monday if the due day falls on a weekend (or an Exam day). For example, if a particular unit is finished in class on Monday, the homework is due by 5:00 p.m. on the following Wednesday. If a unit is finished in class on Friday, the homework is due by 5:00 p.m. on the following Monday. Late homework takes teaching assistants and instructors much longer to grade. In order to discourage late work, no late assignments will be accepted. Students who have been ill should arrange with the instructor to hand in make-up assignments. The grader will accept no late assignments unless your instructor has signed them.

Homework should be submitted on 8 1/2” X 11” sheets of paper headed with your name, the due date, and your section number. The number of each exercise in the assignment should be listed at the top of the page and to the left of each answer. A sample of the required format is shown below. You will lose credit if you do not follow the format.

If more than one sheet of paper is required to write up your homework then you need to staple the pages together. Pages that are simply held together with paper clips or corner fold-overs may come apart and pages might get lost. The graders are not responsible for lost pages if you used paper clips or folded over the page corners.
Grading of Homework
There will typically be between 5 and 10 problems for each homework assignment. The problems will be a mix of conceptual questions that will require a short essay, and mathematical problems (which will include problems where data is collected and/or analyzed using the computer). We will randomly choose one problem on each assignment for careful grading on a 10-point range with written feedback. We will grade the other problems without written feedback for what we describe as "honest effort", but not as to whether they are correct or not. Collectively, the other problems will be graded on a 5-point range. A "good" score on an assignment does not necessarily mean that the problems were done correctly. It is the student's responsibility to make sure that they understand all the problems. Solutions to the problems for each homework assignment will be provided on the Homework Assignments web page. In the case of mathematical problems, a properly worked problem should contain:

- Diagrams or drawings of the physical situation (graphs, free-body diagram, etc.).
- A brief description of the physical situation in clear, grammatically correct English.
- A list of the known and unknown quantities (with proper symbols, significant figures, and units).
- A list of the equations used, in symbol form.
- A running narrative, with complete English sentences, describing the step you take in solving the problem. The narrative should also include:
  - a description of the physics concepts being used (i.e. Newton's 1st Law, Conservation of Energy, etc.),
  - a reference to the particular activity in the Activity Guide that relates to this problem.
- The equations solved in symbol form before substituting in any numbers. (You'll get better and better at this, we promise, but you must practice.)
- Calculations shown with the numbers substituted into the equations having the correct units and number of significant figures.
- The final answer clearly shown (usually with a box around it), with the correct units and number of significant figures.
- A check of the final result to make sure that it makes sense (i.e. having a snail crawling at 25 m/s would indicate a mistake was made somewhere).

Homework will usually be graded by an upperclassman who has taken physics. Your grader may occasionally make an error in judgment or a mistake. If you think this is the case, feel free to ask the instructor to review your homework assignment. At the end of the semester your homework scores will be translated into a percentage grade.

Non-existence of Late Homework
Homework solutions will be posted on the Homework Assignments web page in the late afternoon on the day an assignment is due. **No late homework will be accepted under any circumstances.** In cases where you have an extended illness lasting more than three class periods with a note from student services, you may negotiate a due-date for your make-up homework with your instructor.

Academic Honesty
You are encouraged to discuss and work on homework with classmates. However, you should write out answers to questions and problem solutions using your own format, equations, and words to reflect the understanding of the assignment. As is the case for Activity Guide Entries, **any student who copies homework from another student will be reported for plagiarism.** The first such occurrence will result in a score of zero on that homework; the second occurrence will result in failure of the course.

Course Project: During the last two months of the course, you will be required to work with two or three other classmates to complete a course project on a topic covered in the course. An important requirement is that these projects have both an experimental and theoretical aspect to it. The goal of the project is to help you consolidate or extend your understanding of an introductory physics topic of interest to you to learn more about the process of doing collaborative research in physics.

Each formal report must be word-processed with data and graphs included in appropriate places in the main body of the text rather than tacked on at the end. Each project report will be graded and returned for revision. After you revise it, you will resubmit it and the instructor will assign a second grade to it. The project procedures and due dates for the reports given on the project information page and in the course outline. **Late projects will not be accepted.**

Examinations: There will be **three in-class examinations** during the semester. Questions on these examinations will be based primarily on course activities and homework assignments. Emphasis will be placed on demonstration of the ability
to apply the concepts and techniques learned to new situations. Material for the examinations will be drawn from the Activity Guide, assigned problems, and suggested readings as well as from class discussions and oral presentations by instructors. Unless we specify otherwise, examinations will be open to the Activity Guide, your graded homework, and other written material and notes that you generated during the course. You may also use an electronic calculator and at times you may be required to use one of the computers to perform analyses and make calculations during examinations. Examinations will not be open to your textbook or other books, published exam or homework solutions, and other people's ideas. You may not work with or gain assistance from anyone except your instructor.

Cheating on exams will not be tolerated. Again, the first such occurrence will result in a score of zero on that exam; the second occurrence will result in failure of the course.

Working old examinations, additional problems, and previously assigned problems, as well as reviewing assigned readings and your written Activity Guide work, is probably the best way to prepare for an examination. Each exam will have questions on (1) concepts, (2) observations or data analysis, and (3) problems. Although successful completion of examinations will require a working knowledge of key definitions, concepts, and problem solving techniques, rote memorization of material will not help you to pass examinations.

Policies

Arriving Late to Class: You are expected to show up for class on time. Coming to class late is both inconsiderate and distracting to your instructor and fellow classmates. Repeatedly coming to class late will be detrimental to your class participation grade.

Attendance: If you are in the habit of skipping class occasionally, you should think carefully about taking this type of course. Absences create real difficulties, since practically all of the work done in the class requires the participation of two or more partners, and occasionally, special equipment. You can make up the work if you have a legitimate excuse for your absence. If you are permitted to make up an absence, try to get one of your lab partners to help you do the work. If that is not possible, I will do my best to help you get it done. However, under no circumstances should you copy data, graphs, or anything else if you were not in class to do the work. If there are reasons you cannot attend class, and you know about it ahead of time, please let me know before that class meeting. The nature of this class is such that you will do poorly if you skip class, because your grade depends to a great extent on what you do in class. It is not possible to skip class and "do the reading" or "get the notes" to make up for your absence.

Cell Phones: You will be expected to turn off all cell phones and pagers while in class. The noise produced by cell phones and pagers, as well as the activity of text messaging, is very distracting and is a detriment to the learning environment.

Athletics: Participation in athletic events will not ordinarily be considered a legitimate excuse for missing class. Athletes who anticipate potential conflicts should see the instructor during the first week of the semester to make arrangements for making up missed classes.

Making Up Excused Absences: Any class period missed for which there is a legitimate excuse must be made up at a time arranged for in advance.

Respect for Equipment: We expect you to be careful with the lab equipment and to keep your lab table clean and neat. At the end of every class period your table should be left with equipment arranged neatly, computer equipment off, and scrap materials thrown away.

Late Work: Because it is helpful to your learning to have rapid feedback on your written work, the instructors will try to see that all work is graded as soon as possible. It is very inconsiderate to expect an instructor or student assistant to grade late work once the same work from the rest of the students has been graded. It takes 2-3 times longer to grade late work separately. For these reasons, your instructor will not accept homework assignments handed in after they are due. As far as Activity Guides are concerned: In order to discourage late work, the grade on an Activity Guide Unit will be reduced by 10% for each day or part of a day after the due date unless a written notification of illness is provided by Student Services. However, if that particular Activity Guide Unit happens to be chosen to be quality graded, the quality grade is zero if it is handed in late.

Academic Integrity: You are encouraged to discuss and debate the ideas in any of your assignments with your instructors, TA's, lab partners, and other classmates. If you work on assignments cooperatively, rather than independently, you may share ownership of spreadsheet, graph, and diagram files based on data you have taken with partners. However, any
other spreadsheet or written assignments must be expressed in your own words and reflect your own format details. Thus, you may not copy (even with some modification) problem solutions or spreadsheet assignments, Activity Guide entries, or written material on examinations. If there is reasonable evidence of copying, it will be construed as an act of plagiarism. The first such occurrence will result in a score of zero on that assignment; the second occurrence will result in failure of the course.

Please make sure that you have read and fully understood Westminster's Policy on Academic Honesty (and Dishonesty) (as listed in the 2015-2016 Westminster Academic Catalog). My sincere desire is to act as facilitator - not an enforcer! - for your studies in physics. Accordingly, I operate on the assumption that all of our interactions are based on openness, honesty, and good faith. I expect all of us to be honest and to treat each other fairly and with respect. Because our trust in each other is absolutely crucial to the effectiveness of our relationship, I take an uncompromising stance, as should you, on the necessity for sanctions when it is violated.

Services for Students with Disabilities: Westminster College is committed to providing a working and learning atmosphere that reasonably accommodates qualified persons with disabilities. If you have any disability that may affect your access to this course, please contact the Office of Disability Services (DS), specifically Ginny DeWitt, Disability Services Coordinator, in the START Center (801-832-2280). Reasonable academic accommodations are reviewed for all students who have qualified, documented disabilities. Services are coordinated with the student and instructor by the DS Coordinator. Westminster College provides reasonable access to courses but this does not necessarily equate to ensuring your success in any course. If you need assistance or if you feel you have been unlawfully discriminated against on the basis of disability, you may seek resolution through established grievance policy and procedures by contacting the ADA Coordinator (Jason Sweat, 801-832-2657, jsweat@westminstercollege.edu, Gore 213) and/or the Office of the General Counsel at 801-832-2565.

Additional information about disabilities service guidelines is on the Disabilities Services web page. If you have questions regarding services for students with disabilities or require alternate format of this information, please call 832-2280, TTY 832-2286, or email startcenter@westminstercollege.edu.

Title IX: Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds. The act is intended to eliminate sex discrimination and harassment in education. Title IX covers discrimination and harassment based on sex in programs, admissions, and activities. Westminster College’s Discrimination, Harassment, and Sexual Misconduct Policy strictly prohibits gender-based discrimination and harassment, sexual harassment, sexual misconduct, sexual assault, rape, stalking, dating violence, domestic violence, sexual exploitation, and any other form of sexual or interpersonal violence. The Policy extends not only to students of the college but also to employees. The Policy is available at the Title IX web page and discusses your rights, the process for investigating complaints, and sanctions for violations of the Policy. The Policy strictly prohibits retaliation against anyone who reports or participates in an investigation regarding alleged or suspected violations of the Policy. Westminster’s Title IX Coordinator is Jason Schwartz-Johnson. Jason can be reached at 801-832-2262, jsj@westminstercollege.edu, or in Malouf 107. The Policy has additional support services and resources as well. Please note that to the extent permitted by law, the College aims to protect the privacy of all parties involved in the investigation and resolution of alleged or suspected violations of the Policy. However, the College has a duty to investigate and take remedial measures in response to complaints and cannot guarantee confidentiality. As an instructor I am also required by our school to report incidents of gender-based discrimination or harassment, sexual harassment, sexual misconduct, or other forms of sexual or interpersonal violence to the Title IX Coordinator and thus cannot guarantee confidentiality.

Additional information about Title IX is on the Title IX web page.

Title VI: Title VI of the Civil Rights Act of 1964 prohibits discrimination based on race, color or national origin in any program or activity receiving federal financial assistance. The Department of Education has interpreted Title VI as prohibiting racial harassment, and such harassment is prohibited in all facets of campus life at Westminster College. If you encounter this type of discrimination/harassment, you can contact the Office of the General Counsel at 801-832-2565.

Portions of this syllabus have been adapted from other instructors, including Dr. Priscilla Laws (Dickinson College), Dr. Karen Cummings (S. Connecticut State Univ.), and Dr. John Mallinckrodt (CS-Pomona).