PHYS 121: General Physics I: Mechanics
August 26, 2013

Summary Information:

Content: Kinematics, Particle dynamics, Newton’s laws of motion, Work, Kinetic energy, Energy and momentum conservation, Rotational motion, Conservation of angular momentum, Path integrals Gravity, Relativity, Astrophysics, Cosmology

Prerequisites: One of these (concurrent) MATH 121 or MATH 125 or one year of high school calculus

Schedule: Lectures: M W F 11:30 to 12:20 PM in Strosacker Auditorium, Case Quad Labs: every other week as scheduled.

Instructor: Corbin Covault, Rockefeller 207 (2nd floor) Phone: 216-368-4006 (office) or 216-339-3861 (mobile) E-mail: corbin.covault@cwru.edu

Co-Instructor: Cory Christenson Rockefeller 225A (2nd floor) Phone: 216-368-4002 (office) E-mail: cwc39@cwru.edu

Course Web Page: [http://www.phys.cwru.edu/courses/p121](http://www.phys.cwru.edu/courses/p121)

Lab Web Page: [http://physicslabs.phys.cwru.edu/MECH/121](http://physicslabs.phys.cwru.edu/MECH/121)


Office Hours: TBD but likely Mon 1-4PM, Tue 1:30-4PM, and Fri 1:30-2:30PM, and other times by appointment.

(Summary Information continues next page....)
Summary Information Continued:

Online Text:  
[Physics 121 Online Notes] by Bob Brown

Recommended Texts:  
Physics for Engineers and Scientists, Vol 1, 3rd Ed. by Ohanian and Markert  
The Cartoon Guide to Physics by Gonick and Huffman

Also Recommended:  
ResponseCard RF LCD by Turning Technologies (clicker, available at bookstore)  
Or, alternatively, ResponseWare software license (use your smartphone as a clicker)

Required for Online Homework:  
The Expert TA, software license, student Class Code: 82DC25-BE register at:  
https://www.theexpertta.com/registration/

Also Required for Lab:  
Intro Mechanics Lab Manual and a Lab Notebook (available in bookstore)

Homework:  
Worth 15% of your grade. Students are encouraged to work in groups.

Online Homework generally due weekly, usually Fridays, 11 PM via The Expert TA.

Written Homework generally due weekly, usually Mondays, 5 PM outside Rock 207.  
Written Homework solutions worked by instructor, will be posted online.

Eleven weekly homework assignments, lowest homework score will be dropped.

No late homework will be accepted under any circumstances.

Workload:  
Homework 15% (12 homeworks, 2 lowest scores are dropped)

1st hour exam (Fri Sep 27)  5%
2nd hour exam (Fri Oct 18)  10%
3rd hour exam (Fri Nov 15)  10%
Laboratory  25%
Final exam (Mon Dec 16, 4PM)  35%

Bonus Points:  
Optional: up to 4% extra points for clicker participation and for watching pre-lecture video clips.
## Course Schedule:

Here is an *approximate* schedule for the course (subject to modification in the weekly reading and homework assignment). For this table, I count fifteen weeks in the class and label each week by the date of the Monday on that week. Note that all hour exams will be held on Fridays. **Important:** the dates indicated for the exams are fixed. Also dates where no class will be held are so indicated:

<table>
<thead>
<tr>
<th>Cycle 1</th>
<th>Wk</th>
<th>Monday Date</th>
<th>Assigned Reading from Online Notes:</th>
<th>Important Dates</th>
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<tbody>
<tr>
<td>Cycle 1</td>
<td>1</td>
<td>Aug 26</td>
<td>Ch 00 to Ch 04</td>
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<td></td>
<td>2</td>
<td>Sep 02</td>
<td>Ch 05 to Ch 08</td>
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<td></td>
<td>3</td>
<td>Sep 09</td>
<td>Ch 09 to Ch 12</td>
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<td></td>
<td>4</td>
<td>Sep 16</td>
<td>Ch 13 to Ch 15</td>
<td><strong>No Class: Mon Sep 2</strong></td>
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<tr>
<td>Cycle 2</td>
<td>5</td>
<td>Sep 23</td>
<td>Ch 01+ to Ch 04+</td>
<td><strong>1st Exam: Fri Sep 27</strong></td>
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<td>6</td>
<td>Sep 30</td>
<td>Ch 05+ to Ch 08+</td>
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<td></td>
<td>7</td>
<td>Oct 07</td>
<td>Ch 09+ to Ch 12+</td>
<td><strong>2nd Exam: Fri Oct 18</strong></td>
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<td>8</td>
<td>Oct 14</td>
<td>Ch 13+ to Ch 15+</td>
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<tr>
<td>Cycle 3</td>
<td>9</td>
<td>Oct 21</td>
<td>Ch 01++ to Ch 04++</td>
<td><strong>No Class: Mon Oct 21</strong></td>
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<td>10</td>
<td>Oct 28</td>
<td>Ch 05++ to Ch 07++</td>
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<td>11</td>
<td>Nov 04</td>
<td>Ch 08++ to Ch 10++</td>
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<td></td>
<td>12</td>
<td>Nov 11</td>
<td>Ch 10++ to Ch 13++</td>
<td><strong>3rd Exam: Fri Nov 15</strong></td>
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<td>Cycle 4</td>
<td>13</td>
<td>Nov 18</td>
<td>Ch 14++ to Ch 15++</td>
<td><strong>No class: Fri Nov 22</strong></td>
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<td></td>
<td>14</td>
<td>Nov 25</td>
<td>Gravity &amp; Relativity</td>
<td><strong>Fri Dec 06, Last Day of Class</strong></td>
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<td></td>
<td>15</td>
<td>Dec 02</td>
<td>Astrophysics &amp; Cosmology</td>
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<td>Dec 09</td>
<td>Reading Days, Dec 9, 13</td>
<td><strong>Review Session: Sat Dec 14</strong></td>
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<td></td>
<td>Dec 16</td>
<td><strong>Final Exam 4PM to 7PM</strong></td>
<td><strong>Final Exam: 4PM to 7 PM, Mon Dec 16</strong></td>
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For summary descriptions of Cycles, details on Lectures, Recitations, Labs, Office hours, etc. see following pages....
Goals and Philosophy of the Course:

The main goals for the course are:

- To introduce students to the formal method of investigating the world through physical sciences, and in particular, to have students learn for themselves how physics as a discipline can be used to obtain a deep understanding of how the world works.

- To have students learn directly the basic formalism of describing the motion of bodies (called kinematics) and the major paradigm of Newton Laws which seeks to explain the causes of that motion (dynamics) in terms of forces.

- To have students understand how important reformulations and extensions of Newton’s Laws lead to explaining essential phenomena including conservation laws, harmonic motion, rotational motion, and motion due to the influence of gravity.

- To have students learn and be able to demonstrate the application of these concepts and methods toward solving a broad range of both familiar and unfamiliar problems with precision and with mathematical sophistication.

- To have the students become familiar with a select set of modern physics topics so as to earn an appreciation for both the flavor of cutting-edge research and the general method of “thinking like a physicist” – a powerful and general approach to tackling a broad range of technical problems in almost any field of endeavor.
Structure of the Course: A Cyclic Approach to Mechanics:

The topic of introductory mechanics has been generally taught in more-or-less the same manner in colleges and universities across the country for decades. Specifically, the material is traditionally presented in a linear fashion, starting with kinematics, moving to Newton’s Laws, then onto Conservation Laws, etc. Each topic is introduced and then expanded-upon fully before moving onto the next topic.

The attraction of this approach is understandable, especially for the students who are already expecting the material to be presented in this way. Traditionally physics is presented as a coherent and unified method with a linear logical flow. All we need to do is state our axiomatic assumptions and derive our fundamental theorems. The rest follows logically. There is real charm to this approach. It’s neat, it’s tidy, it’s elegant, it’s beautiful.

And, as research shows, it’s generally not the best way to teach introductory physics.

Indeed, pedagogically, the difficulty with the traditional approach is that students will usually cover a given topic only once in a semester. The linear approach assumes that we learn each topic right and completely the first time we see it. It models the human brain as a blank slate where the student fully comprehends the the materials the first time. But research done in real classrooms demonstrates conclusively that this is not how students learn. The human brain is not a blank slate. Instead students learn any given physics concept in fits and starts. This involves both learning new ideas and sometimes unlearning and forgetting old ones. In particular, unless major concepts are re-visited, students tend to lose comprehension later in the semester or even in future courses. In a nutshell: the material does not “stick” when it’s presented in a simple linear fashion.

This difficulty is not surprising when we consider what is known about how most people really learn. Most people generally do not learn at any level of depth through a single exposure to a topic. Rather, material is learned through repeated exposure to ideas, re-visiting and expanding at several different points and different times. Generally speaking, we need to see it, reflect on it, act on it, and then see it all over again before we really learn it. This has to happen once, again, each time with increasing level of sophistication and synthesis so that student not only learn the concepts, they learn how these concepts are connected to other concepts.

To help students deepen learning in the course we use a cyclic syllabus for Physics 121. The basic idea is that the course is divided into roughly three main cycles, each several weeks long. During each of the first cycles we will cover an abbreviated version of the content of the entire course, from kinematics to torque, followed by an exam. We then repeat the pattern so that during each subsequent cycle we will look more deeply into the material.

In Cycle 1 we will cover pretty much all of the basic topics in any standard introductory mechanics course. Of course we will not cover each topic in depth, and we will skip over a number of technical and tedious details. Our goal with be a solid conceptual foundation for each topic.

In Cycle 2 we will move our way rather more systematically through the material, and in particular, we will be much more inclined to apply general methods of calculus to problems at a deeper level of sophistication. Having seen the “basics” for each topic in Cycle 1, we will be well-prepared to move to a higher level of practical problem solving.
In Cycle 3 we will complete our study of all of the major topics in mechanics with special emphasis on conservation laws and rotational motion. By the end of the cycle we will have covered every topic at a level of depth required for the course.

In Cycle 4 we will focus on the application of all of the physical and mathematical tools that we have developed to a select number of more modern topics including Einstein’s relativity, and perhaps some topics in astrophysics and cosmology, as time permits. This will allow students to see how all of these materials can be applied to a wide variety of real-world problems while at the same time providing some extra time at the end of the semester for student to fully integrate the materials before the final exam.

For example, during the Cycle 1 we will introduce motion in one dimension and then we will move quickly to applications of Newton’s Law’s. During Cycle 2 we will look in more detail at the mathematics of circular motion, developing a deeper formalism for vectors. For Cycle 3 we will take these idea further with a complete description of 3-dimensional kinematics including consideration of both tangential and centripetal acceleration for motion along arbitrary curves. For Cycle 4 we will develop a treatment of motion within non-inertial reference frames that we will extend to explain the Principle of Equivalence, which is the cornerstone of Einstein’s General Theory of Relativity.

In other words, we will see the same topic three or four times, each time revisiting what we learned previously before adding further details to increase the depth of our understanding.

This approach has many advantages, but one disadvantage is that the presentation of materials is not closely linked to the content and organization of any commercially available college-level textbook. We will therefore provide several different mechanisms to help students keep track of “where we are” in the course, regarding the Cyclic Syllabus as follows:

- We will provide via the course web page a complete set of Online Notes for Physics 121 written by Prof. Robert Brown. These cover all of the materials presented in the first three cycles: These are available to all students free-of-charge as PDF documents. You can also purchase a hardcopy bound copy these notes from the CWRU bookstore for a nominal fee.

- We will be using the text by Ohanian and Markert. This is an optional textbook in the standard linear format. I will assign optional readings from this textbook. This is one way that students can see the connections between topics that we are covering in a cyclic fashion vs. the more traditional approach.

- On an occasional basis, short documents, called Review Sheets will be presented to the class which delineate the scope and depth of key topic areas for students. These Review Sheets will be specifically designed to let students know which topics they are responsible for in advance of each exam.

- Every lecture will be videotaped by Mediavision and will be available for viewing online afterward by any student at any time during the course.

- Example Practice Problems that delineate the scope and level anticipated for exams will be presented for students online. Solutions will also be posted on the web page.
• The instructor will post weekly *hints on homework* on the online Phorum Discussion Board. The instructor will also endeavor to respond promptly to student questions posted there.

• During most lectures, student in class will be presented with one or more *Clicker problems*. These are short conceptual problems that interactively probe student understanding. Students will be asked to respond using the Turning Technology ResponsCard clicker system. Solutions to these problems will be presented in class and archived on the web page. Note: Participation with clickers is optional but will allow students to earn optional bonus points. Students can obtain Turning Technology ResponsCard clicker transmitters at the bookstore. Alternatively, you can use the Turning Technology ResponseWare app which turns your smartphone into a clicker. You are responsible for bringing your clicker to lecture each day.

• This year we will be trying something new. We will provide to the students a set of short online video clips to introduce major conceptual topics before certain lectures. These pre-lecture videos will allow students to “see it first” before class. These video clips have been selected to be intriguing and informative providing a new way to engage the materials. Students will have an opportunity to earn optional bonus points by watching recommended online pre-lecture video clips and answering short online survey questions.

It is worth reviewing this list. All-in-all, in the context of the course, students have access to a large number of resources that are available to help gain mastery of the material. And this list does not even include the “extra-help” options offered by SI leaders and instructor’s office hours. Students have many learning styles, no two students learn the material the same way. Our goal is to provide to the students a variety of resources that can be used to help them learn in accordance with their own learning styles.
Lectures:

The lectures, reading assignments, and “review sheets” essentially define the scope and central content of the course. **Lectures are Mondays, Wednesdays, and Fridays from 11:30 AM to 12:20 PM.** I will try to start and end promptly. There will be occasional lecture demonstrations, video clips, clicker questions, and other interactive activities that will take place during the lecture to reinforce conceptual understanding of the material. The entire aim of the lecture is to do whatever we can in 50 minutes together to facilitate student learning of the main concepts of the course. Lectures are not “mandatory” in the sense that we do not take attendance or anything like this. But the lectures are specifically designed to provide real value added to student experience in the course through actually being there in person with the instructor. In all of my teaching, from discussions at the chalkboard to hands-on demonstrations, I try to make the lecture as engaging and interactive for students as possible. The simple proven-by-research fact is that students who skip lecture will not get nearly as much out of the course and will not do as well on the exams. **This is especially true since we are using the Cycle Method.** Note also that if you skip lecture, you will also lose the opportunity for Optional Bonus Points via clicker participation.

By the way, I would very much like to encourage student participation as far as possible during the lecture. Please feel very free to raise your hand to ask a question or clarify a point. If you are puzzled, then chances are your fellow students are puzzled too and will be grateful that you asked the question. If I cannot answer your question in class in a way that is relatively brief and helpful to the other students, then I’ll promise to respond after class or in a subsequent lecture. Also, if you see me doing something obviously wrong on the chalkboard, make a noise or something so I do not get too far before I correct myself (I do make mistakes!)
Textbooks, Online Class Notes, and Clickers

There are no “required” textbooks for you to purchase. These are the textbooks that we have available for your consideration:

- You will also be assigned **required** reading the *Online Notes for Physics 121* by **Robert Brown** (CWRU). These note are available to you free of charge as PDF documents available on the course web page. Alternatively, you can purchase a set of these in the CWRU bookstore in the form of a hardcopy “Coursepack” for less than $20.

- You will also be assigned **recommended** reading from the textbook by **Ohanian and Markert** titled *Physics for Engineers and Scientists*, (ISBN: 9780393930030). You want the Third Edition, Volume I (Mechanics). This is available in the bookstore. Many students find having a “standard comprehensive textbook” to be quite helpful, and this is one of the better ones. This is available in paperback in the CWRU bookstore. You can often find a used copy. Again, this textbook is recommended but not required.

- Another **recommended** textbook for this course is a paperback entitled *The Cartoon Guide to Physics* by **Gonick and Huffman** (ISBN: 9780062731005). We cover Chapters One through Eleven. Although the illustrated media is much less formal than the traditional textbook, the central ideas of the course are presented with refreshing clarity and the organization of the book is closer to that of the course than can be found in the other texts. Also, the artwork is great.

- For the laboratory component, you are **required** to purchase a hardcopy of the *Physics 121/123/115 Laboratory Manual*, which is available for purchase as a Coursepak in the CWRU bookstore. You must have a hardcopy of the lab manual before your lab starts.

- For the lab you are also **required** to have a proper bound laboratory notebook which provides duplicate pages (carbon paper copies) for each sheet. We recommend the *Scientific Lab Notebook* by Hayden (ISBN: 9781930882843).

- We also **recommend** that you purchase a “clicker” so that you can participate by responding to clicker questions during lecture. The clicker we will use for Fall 2013 are the **Response-Card RF LCD** by Turning Technologies (ISBN: 9781934931400). This clicker is available for purchase in the CWRU bookstore for less than $50. Alternatively, you can purchase a ResponseWare software license for your smartphone. This is an app that will let you use your phone as a clicker in class. The license will cost less than $20. More detailed information using and registering Turning Technology clickers will be described in class and can also be found on the main course web page. Again participation in clickers is optional but recommended. *Note that the previously used “i-clicker” will not work for Physics 121 Fall 2013 semester.*

- Finally, there is one last tool that students are **required** to obtain in order to access and submit online homework: students will need to purchase a software license for an online tool called **The Expert TA**. This tool can only be purchased online directly from the software provider. More details on accessing and registering for this software will be provided in class and on the main course web page.
Important: You will find the lectures much more helpful if you have read the Online Course Notes and/or the assigned textbook in advance of the lectures. I cannot overstate the value of doing this. When I give the lectures, I will already assume that students have read the Online Notes for that day. In this class we will generally not introduce or present any “new” materials in lecture. Instead, new materials will only be presented or introduced in the online notes and/or the textbook. In lecture, we will discuss the materials that students should already have read about.

Therefore, this is my strong advice to all students: Decide here and now that you will do everything you can to try to read the assigned readings for the textbook and online notes before coming to lecture. During Cycle 1, the Online Notes are written in an informal and terse style. Each lecture only corresponds to a few pages of the Notes. Likewise, the amount of text from the textbook for each lecture will not be large. Keeping up with the reading will not require many hours per week. But catching up if you get behind will be very time-consuming. Therefore you should adopt a discipline that you will always read the assigned notes for each lecture before you come to class. This one action will at least triple the educational value of the lectures for you. I promise.
Homework:

The homework is a very important part of this course, and will count 15% of your final grade. There will be a total of twelve homework assignments. You will generally be given homework assignments on Mondays in lecture (along with a reading assignment). This year, each homework assignment will consist of two distinct components:

- The **Online Homework** will consist of a selection of homework problems assigned, accessed, and submitted via *The Expert TA* online homework system. The Online Homework will generally be due by 11 PM on the Friday of the same week.

- The **Written Homework** will consist of a selection of homework problems assigned as a PDF document which the student will work by hand and submit via hardcopy only to the course homework collection box. The Written Homework will generally be due by 5 PM on the Monday of the following week.

The idea here is that the Online Homework will correspond to a set of “warm-up problems” to allow you to check your understanding of definitions, basic concepts, and central mathematical relationships. With the Online Homework, students will be able to receive timely and detailed feedback which they can use as a jumping off point for more complicated problems. In contrast, the Written Homework will include somewhat more sophisticated problems that will require the student to correctly integrate and apply one or more main physics concepts. The Written Homeworks correspond more closely to the kinds of problems that students can expect to see on exams.

Note that each weekly homework will be graded on a 15-point scale with the Online Homework counting for 5 points and the Written Homework counting for 10 points. Note that there will be a total of twelve assigned homeworks, but we will automatically drop your two lowest scores from the total. In other words, your homework grade will be based on a scale of 150 points made from the best ten out of twelve homeworks that you submit.

Please note that students may turn in Written Homework only in hardcopy form via the appropriately marked box located at the front of the lecture hall before lecture or alternatively they can put the homework in the same box outside Mr. Covault’s office (Rock 207) after lecture on Monday afternoons until 5 PM. Note that **5:00 PM is a hard deadline for the written homework**. If you are someone who will be having a difficult time getting things done on time, you should plan your life to be sure that the homework arrives before 5 PM or it will not be accepted. Homework will be graded and returned to students in folder boxes.

**Here is the deal on due dates for homework:** Homework solutions will be written by the instructor posted on the course web page to students on the day they are handed in. For this reason, and because the pace of the course is relatively fast, *and* because of the very large number of students in the class **no late homework will be accepted under any circumstances**. There will be no exceptions. This sounds really hard-nosed but it is actually pretty straightforward so I hope that students can live with this arrangement.

Having said this, I know that sometimes things happen and there are serious and legitimate reasons why students might not be able to submit homework on time. If you anticipate a serious personal emergency that might prevent you from handing in your homework on time, then you need to contact me (the instructor) *in advance of the homework due date* to make special arrangements.
Likewise, if you are too ill to complete the work, you should notify the instructor. I am open to working out arrangements for students with special problems provided that you come to me before homework is due. In this case, usually what I will do is ask the student to agree to complete the homework and then once the homework is completed I will excuse that student from that particular homework. If student is excused from an assignment because of a personal emergency then the grade from that assignment will not be counted and instead the total homework grade will be based on the scores of the other submitted homeworks. Note that because of the “drop two” policy I will generally only excuse students from homeworks because of major emergencies or illnesses – events that are completely out of ones personal control and which have a major impact on a students performance in the class. Generally speaking, requests for excuses will need to be made in advance of the due date (when possible) and documentation of the emergency or illness will need to be provided.

Note: you should always contact the instructor as soon as it seems possible that you might not be able to submit any given homework by the due date as required. There is no penalty for asking for special arrangements in advance and then subsequently turning in your homework on time. I would much rather handle a potential problem before the fact that turns out to be a false alarm than to deal with a problem after the due date because the student hesitated to contact me in advance. As a rule I am generally able to accommodate students who contact me about potential problems before the homework is due. As a rule I generally unable to accommodate students who come to me on the day that the homework is due or later.

Note that the reason for enforcing this policy has nothing to do with being “strict” and everything to do with the fact that with a class this large, one that moves so quickly, dealing with late homeworks and extensions and stuff would take up an enormous amount of instructor time – time that could be better spent helping students learn.

Here is the deal on how homework will be graded: You will be asked to submit a total of twelve homework assignments during the semester. Each homework will be graded on a scale of 0 to 15 points. For your homework grade, we will use the top ten best homework scores for each student and will drop your two lowest homework score. I figure that during the semester, a typical student has one unanticipated personal problem, or one minor illness or unresolvable academic conflict that substantially negatively impacts the ability of the student to complete their given homework. By throwing out the lowest score, I can account for this, and students in these situations do not need to make any special arrangements with me. Note that in any case if you have a genuine personal emergency – something out of your personal control that would prevent you from completing the homework on time – you should contact the instructor in advance as described above. But the basic idea is this: since I have this fairly lenient policy where I throw away your two lowest homework scores, I tend to be non-inclined to be lenient about missed or late homework.

Here is the deal on working with others to get your homework done: You are allowed and even strongly encouraged to work together on your homework. In fact, I believe that most students who try to do the homework all alone by themselves will perform worse and learn more slowly than those who join together with their classmates and study in groups. Group learning

Note that each homework counts the same 15 points even though some homeworks are much shorter and much easier than others. This means that it is especially to your advantage not to skip the easy/short homeworks.
**is strongly encouraged.** Learning from peers is really one of the best ways to learn physics. Just *don’t over-do it.*

Indeed, there is a “bright red line” that you must not cross: **You must never even copy another student’s homework!**

In principle this is straightforward, but in practice, students get into all kinds of trouble with this idea. So let’s spell it out: You can help each other figure out how to *approach* each problem, but you must *actually do each problem by yourself.* You cannot ask a friend to work out the whole problem and then go and write out that friend’s solution on your paper. You also can’t nominate one person to write down the solution that you collectively worked out and then copy this. Don’t let other people do the work for you. You need to learn to do the problems on your own.

So: Please do not copy other people’s homework. **It is not acceptable to copy another’s homework. It is not acceptable to allow your homework to be copied by others. You must completely work out your own solution to each problem.** Copied homework will result in zero credit assigned to both copier and copiée. Furthermore, depending on how egregious the copying is, your actions may be reported to the Board of Academic Integrity and you may be subject to further academic sanctions. By the way, this kind of cheating is really very obvious to the graders and they spot this all of the time. Don’t risk your academic career by copying your friends homework. It’s really not worth it.

Also: just in case it is not clear: Students are asked not to loiter near the homework box by Rock 207. Please do not work problems on the floor or in the hallway near by office or on the stage at the start of lecture. Please drop off your homework quietly and then move clear of the submission box so others can approach the box.

Note also that the instructor for the course will almost always provide **hints on homework** on the online Phorum Discussion Board.
Practice Problems:

As an aide to student study and to provide examples applicable to homework problems, I will post a series of “practice problems” with solutions online. Some problems will be short and easy, others will be long and difficult. I will generally post detailed tutorial solutions with the practice problems. Sometimes I might even also provide written, audio, or video commentary.

Many students find practice problems to be a useful tool that I provide for students. But one of the most challenging academic goals is to learn how to use them effectively. On the one hand, some students try to solve every practice problem given and judge themselves a failure if they cannot solve each one without assistance. On the other hand, some students skip immediately to the solutions and then falsely convince themselves that they understand how to solve the problem.

Neither of these approaches is helpful. The correct approach of course is something in between. For every practice problem, you first want to read carefully the commentary so that you know if the problem is primarily tutorial (demonstrates a problem solving technique) or diagnostic (is designed to determine whether you have learned something you were supposed to have learned). The commentary also tells you how difficult the problem is and whether or not the solution method is possibly helpful for one or more particular homework problems. You also learn in the commentary if the practice problem is characteristic of something you see on an exam.

Students should try to work practice problems for some “reasonable effort” and then if they get stuck, they can glance at part of the solution – enough to get unstuck or re-directed. Then they should go back to trying the problems again. This back-and-forth between actually working the problem yourself and then studying the solution to get unstuck is one of the best ways to use practice problems to self-teach problem solving methods. All of this is hard work, but it pays off in developing real skills.
Exams:

There will be a four exams. Please note the dates which will not change:

- **First Hour Exam – Friday, Sep 27 – in class:** Worth 5% of your grade.
- **Second Hour Exam – Friday, Oct 18 – in class:** Worth 10% of your grade.
- **Third Hour Exam – Friday, Nov 15 – in class:** Worth 10% of your grade.
- **Final Exam – Monday, Dec 16 – 4:00 to 7:00 PM:** Worth 35% of your grade.

Exams will be “closed book”. For hour exams you will be able to bring a single sheet of $8\frac{1}{2} \times 11$ paper upon which you may put any hand-written notes that you wish. The hour exams will be given during the regular lecture time slots. The final exam will three hours long. All exams together will count for a total of 60% of your grade.

**Note Regarding Missing Exams:** Students are expect to make *every possible effort* to attend exams as scheduled. As a rule, there is *no mechanism* for rescheduling or arranging for a make-up exam for a missed exam. Unless there are very compelling extenuating circumstances, student who miss exams will be assigned a score of zero for that exam. Students who incur a personal emergency (accident, illness, etc.) must contact the instructor directly and *immediately* and – as a rule – this must be done *well prior* to the exam time. Students who must miss a regular hour exam during the semester, and who wish to avoid academic penalty must must document the nature of the personal emergency with the instructor. Again, as a rule this must be done in advance of the exam. Students must make every effort to notify the instructor and/or make arrangements for a make-up exam as soon as possible. Students who simply “no-show” to an hour exam and then appear the next week asking for a make-up will not be accommodated. Note that any potential conflict between a scheduled exam and a university activity, such as a varsity athletic event must be brought to my attention of the instructor *at least 10 days prior* to the exam.

**Note:** There is a special rule regarding absences for the Final Exam. In accordance with university policy, only the Dean of Undergraduate Studies can authorize an excused absence from the Final Exam of any course. If you believe you might miss the final exam for *any* reason, you need to contact the Dean’s office directly – not the instructor. Note that as a rule, the Dean will *not* authorize make-up final exams to accommodate early departures from campus for the holidays. The final exam for Physics 121 is on Monday, December 16th from 4 to 7 PM. All students *must* take the exam at that time. Any student who does not take the final at the proper time will not pass the course. Plan your holiday travel accordingly!
Laboratories:

For many of you the labs will be “something different”. We take our intro labs seriously at Case Western Reserve and the level and quality of the labs here is, in my opinion, far superior to what you will find at peer institutions. You will get much more out of the lab experience if you understand the goals of the lab and invest yourself toward these goals. These goals are articulated in an article entitled “A Sermon on the Labs” that Dan Schultz and I wrote and that you will find in the first section of your lab manual.

You will do seven labs. **Participation in the labs is required.** The labs will meet every other week starting Thursday August 29, 2013. If you have not done so already, you should have purchased the lab manual from the bookstore, and you should have obtained a required lab notebook. You must bring a lab notebook to the lab. You must also bring a calculator. **You must also read the lab manual before coming in to do each lab.** Labs will be due at the end of each lab session (you will hand in your notebook pages with data and calculations before you leave the lab). Labs will be graded and returned to you the following week. Labs are worth 25% of your grade.

**Important:** A passing grade in Physics 121 usually requires a passing grade in the laboratories! Yes, it is true that the laboratory counts “only” 25 percent of your total score. But note that the labs are administered and graded separately from the rest of the course, and because of the absolute grading scale, they actually have a large impact on your grade. Grading policies for the labs are determined and applied by the Laboratory Director: Dr. Diana Driscoll: diana.driscoll@cwru.edu. In the past, a minimum raw score of 60% or higher is required to earn a passing grade for the intro labs.

**Important:** **Do not miss your lab assignment!** Each student is assigned to a lab that meets every other week. Students can easily get confused about this. I suggest that you sort out any confusion about when your assigned lab slot is right away and make sure you mark on your calendar the specific times and dates for your lab so that you do not miss them. The bottom line on the labs is that you must do a decent job on them or your grade will suffer substantially. **You must not miss your assigned lab.** Several people got into serious grade trouble each year by not taking the labs seriously. If you fail to attend or complete even one or two lab reports you can quickly find yourself in serious danger of failing labs and failing the course.

It’s worth repeating this because it is so critical: **The single most common reason that students in Physics 121 fail or are forced to withdraw from the class is because they do not properly attend lab and/or do not properly hand in their laboratory assignments on time.** If you fail the labs, you will almost always fail the course. This is how the grading system has been set up. On the other hand, for the vast majority of the students who attend lab faithfully and complete the assignments on time, the lab grade has a positive effect on the overall course grade. So, bottom line: do what you need to do to make sure that you attend your assigned lab and turn in your lab reports. You really don’t want to have to explain to your parents that you had to withdraw from physics just because you forgot to mark your calendar to attend a lab.
How to Contact the Instructor:

In the modern age of communications, there are several ways to reach me:

Corbin Covault
Office Phone: (216)-368-4006 (with voice mail)
Mobile Phone: (216)-339-3861 (with text messaging)
Internet Email: corbin.covault@cwr.edu

(For Email Please always put “PHYS 121” in subject!)

Office Hours: Rockefeller 207
Mondays 1:00PM to 4:00PM
Thursdays 1:30PM to 4:00PM
Fridays 1:30PM to 2:30PM
Other times: by appointment

The easiest and the best way to contact me is send me e-mail. Please put the words “PHYS 121” in your subject line as I am much more likely to notice this sooner. I check my e-mail frequently and I save everything. If you call and ask me something on the phone or ask me for something right after class, I am more likely to forget. If it is important, send e-mail, and include a header like: “Phys 121: Important: Need help on Homework Problem 3” or whatever. As an alternate to email, you should also feel free to send a text message to my mobile phone, but again it’s very important that you make it clear from your text that you are a current student in Physics 121 when you do this. I generally do not respond to texts from anyone I don’t recognize.

You should feel to try to reach me any time, day or night. However, follow these guidelines: From 7:00 AM to 9:30 PM please feel free to contact me at work or at home using my office or mobile phone, and/or my e-mail and/or text. If you leave a message on my voice mail, please speak clearly and loudly and be sure to state your full name, indicate when you are calling (time and date) and how I can reach you. After 9:30 PM, please send me e-mail or text message only. Do not call me on the phone, as this will disturb my family. But feel free to send email or a text, no matter how late it is. If you are up late working, chances are high that I am too. If I am awake, I will respond as quickly as possible. If I am asleep, then I will try to respond to you when I wake up.

This document has just told you everything you need to know to track me down. Please do so as soon as it is clear to you that you need to communicate with me about anything regarding this course, particularly if you have a concern or problem. If you leave a message I will try to get back to you as soon as I can.

Note also that I get email notification whenever someone leaves a message on the P121 Phorum Discussion Board. So if you have a question that you think might be of general interest post it there and I will reply so that everyone can benefit. I check the bulletin board on the web page most every day. Last year our Discussion Board outpaced every other similar site for postings on any other topic on campus.
Instructor’s Office Hours:

I love to meet directly with students. **Office Hours are subject to change** but will generally be something like this: **Mondays 1:00 PM to 4:00 PM, Thursdays 1:30 PM to 4:00 PM** and **Fridays 1:30 PM to 2:30 PM** in my office, Rockefeller 207. These may vary from week-to-week, so I will try to keep timeslots updated on the web page. If these time slots are bad for you, contact me directly to schedule an appointment at a more convenient time. I encourage you to approach me immediately after the lecture if you would like to clarify some point or discuss anything in the course material that is not clear to you.

I want to be as accessible as possible during the semester. I am willing to meet with students on most any day if you make an appointment. I welcome students visits. Please come see me often. Call ahead if you are able, since I sometimes have lab meetings and so forth that take me out of the office. Sometimes there is a sign on my door if I am out indicating where I am and when I will return. But in any case I am always happy to schedule an appointment. **Note: I am generally not on campus on Saturdays or Sundays, although I should be reachable by phone or email during these days.**

Again, I especially want to encourage students to post questions on the **Phorum** Discussion Board. This is the one web site that I look at several times a day and I will always try to respond quickly to student questions.
Additional Support for Physics 121: Co-Instructor Prof. Cory Christenson

Cory Christenson  
Office Phone: (216)-368-4002 (with voice mail)  
Internet Email: cwc39@cwru.edu  
(For Email Please always put “PHYS 121” in subject!)  
Office: Rockefeller 225A  
Office Hours: TBD and by appointment

This year Physics 121 Fall 2013 will include a co-instructor for the course, Cory Christenson. Prof. Christenson will in particular be available to provide extra support for students to help students understand and apply the main concepts in the course so as to succeed with homework and exams. **Prof. Christenson will serve as the “first point of contact” for students who find themselves confused or struggling with the materials and are otherwise unsure of how to proceed.** Contact details and office hours for Prof. Christenson will be provided in class and on the course web page.

Even More Help for Physics 121: SI Sessions:

Another extremely valuable resource for students are the university Supplementary Instruction Leaders (so-called ‘SI Leaders’) which are top-ranked upper-class students who have been hand-picked by the office of Educational Services for Students to act as “peer tutors” for major classes. We will have two SI Leaders for Physics 121: Stephanie Hougen (stephanie.hougen@case.edu) and Nathaniel Lombard-Poirot (njl49@case.edu). Nate and Stephanie will be very helpful when students need extra help with homework or in preparing for exams. The SI Leaders will run their own tutorial programs independently of the department (a good thing!). Schedules for SI review sessions and/or homework help sessions will be announced in lecture and will be posted on the web page.
The Physics 121 Web Page:

We are supporting the administration of this class on the web. The URL address of the Physics 121 Web Page is:

http://www.phys.cwru.edu/courses/p121

The P121 Home page will support the following:

- A copy of every document generated for the class including syllabus, homework assignments, exams, announcements, etc.,
- A copy of the Online Class Notes.
- Typeset homework solutions and exam solutions,
- Special practice problems with solutions,
- A link to the Phorum Discussion Board for interactive Q&A between students and instructor (very handy and very popular with students), and
- Links to pre-lecture online video clips.
- Link to instructions for registering for Turning Technology clickers.
- Likes for access and registration for The Expert TA system for online homework.
- Pointers to other resources that might be useful for P121.

There is also a web page which has all of the details on the introductory physics labs:

http://physicslabs.phys.cwru.edu

Please check this out for any details concerning the lab.
Your feedback is welcome.

Note that for Physics 121, we will only make very limited use of the Blackboard course management system. Go to the Physics 121 Blackboard site to check your grades for the course. For all other materials, go to the main Physics 121 Web Page.
Grading policies:

I strive for a fair and impartial grading policy. You grade should reflect the degree to which you have demonstrated mastery of the material and central concepts of the course. The grading will be based strictly on a comparative total numerical score tallied at the end of the semester. Your numerical score alone will determine your assigned grade. This means that everyone with the same total numerical score will get the same letter grade. **There is no mechanism for extra credit.**

The numerical grading system assigns a total of 1000 points, as follows:

<table>
<thead>
<tr>
<th>Work:</th>
<th>Points:</th>
<th>Percentage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>First hour exam</td>
<td>100 \div 2 = 50</td>
<td>5%</td>
</tr>
<tr>
<td>Second hour exam</td>
<td>100</td>
<td>10%</td>
</tr>
<tr>
<td>Third hour exam</td>
<td>100</td>
<td>10%</td>
</tr>
<tr>
<td>Final exam</td>
<td>350</td>
<td>35%</td>
</tr>
<tr>
<td>Homeworks</td>
<td>10 \times 15 = 150</td>
<td>15%</td>
</tr>
<tr>
<td>Laboratories</td>
<td>100 \times 2.5 = 250</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>1000</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

In addition to the numerical score there is an important additional constraint: **Any student who is not present for and/or does not take the final exam will not earn a passing grade in P121.**

Note that I do **not** assign letter grades to individual assignments or exams. Letter grades are assigned only in two instances: (1) provisionally at mid-terms and (2) at the very end of the course.

Letter grade assignments will correspond to numerical score ranges. The correspondence between numerical scores and letter grades will depend both upon the distribution of the scores and upon a reasonable expectation for performance in the course. Students who can demonstrate minimal understanding of the key concept of the course will receive a passing grade. Students who display deeper understanding will receive higher grades.

All of the time I have students ask me about my grading policy. The question usually boils down to **Do you grade on a curve or do you grade straight percentages?** The answer is **neither**, exactly. So here, in detail, is how I grade:

For any particular exam I have an *apriori expectation* for how well students ought perform and I check my expectation by calibrating it against the actual performance of the students in the class. As a rule, this “exam calibration” corresponds to a typical student who is near the middle of the class earning a letter grade of a “B”. My expectation value will vary from assignment to assignment but I will generally target a median performance level of very approximately 70 to 75 percent of the points on exams. Note that this range is subject to change. This means that if everything goes according to my *apriori expectation*, students who earn scores in this percentage range on exams and who keep up to class average on homeworks and labs can probably expect to earn a “B”. Students who perform at levels substantially higher or lower can expect to earn correspondingly better or worse letter grades. If student performance has a distribution that matches my expectations, then very roughly half of the students will earn B’s, about one quarter will earn A’s and the remaining 1/4 will earn something else. In the past, the “A/B” cutoff percentage has been somewhere in the mid to high-80’s. The “B/C” cutoff has been somewhere in the low to mid 60’s.
All of these numbers correspond to the very approximate “apriori expectation baseline” for exams scores, subject to change.

However, sometimes student exam scores to not match my expectations. In this case I adjust the grading system – but generally I only do this if this works to the advantage of students.

For example, if – for the class as a whole – student performance on exams is generally better than my baseline expectations, then on average letter grades will be generally higher and all students who perform better than my expectations can expect at least a “B” and possibly a “A”. In other words, if exam averages are significantly higher than the a priori expected values, the average letter grade for the course can in fact be significantly higher than a “B”. In principle, every student in the course can earn an “A” by performing at a level that is significantly higher than my apriori B-level expectations. Note: This means that you cannot raise your grade in the course by working actively to lower anyone else’s grade. Your grade will depend upon your performance alone.

Conversely, however, if – for the class as a whole – student performance is generally worse than my expectations, I usually attribute this to problems with my end of the course (ineffective lectures, over-difficult or over-long exams, etc.) In this case I will be inclined to adjust (i.e. curve) the course grade so that the student who performs at an average level relative to the overall level can still expect a grade of “B”. In other words, if the class average on exams drops much below the apriori expected scores, then I “curve” the grades so that the average student can still generally expect a “B”.

In a nutshell, then: I curve the class but only if it helps the students.

Warning: all of these numbers above are very approximate. Another warning: these percentage numbers are guidelines for exams only, and do not directly apply to the homework or lab components of the grade. In particular the lab grade is administered and calculated separately based on a completely different (absolute) numerical grade scale.

One last point on grades: Since I do not grade on an fixed “absolute” scale, I cannot precisely predict in advance what final point total will correspond to what particular grade assignments. I know that for some students it is very important to know exactly what their letter grade standing is. Unfortunately, I can only determine this very approximately until we reach the end of the semester. However, I am very happy to meet with individual students who are interested in learning “where they stand” at any point in the course based on work completed. Please see me directly if you have any concerns or confusion as to how the grades for the course will be determined. Also on an occasional basis I will post a prescription for self-calculating approximate student grade standing at various points during the class. But the question I am asked over and over is “How many points do I need on the final to earn a grade of X.” I cannot answer this question because the answer depends on how difficult the final exam ends up being, and I cannot determine this until after students have taken the final exam.

One last point: In evaluating the work we will strive to achieve the most fair and objective grading strategies. This means, for example, that all of each exam problem will be graded by a single grader, for consistency, etc. Exams will cover materials discussed within lecture or material in the texts referred to within lectures, assigned readings, and homework assignments You will not be responsible for material outside the scope of the course as delineated in this syllabus.
Bonus Points:

Note that there is, in general, no mechanism for “extra credit” in Physics 121. Grades are based strictly on numerical point totals only. However, there will be several occasions during the semester for students to earn “Bonus Points.” Students can earn bonus points two ways:

- By participating with clicker during some lectures, or
- By watching selected pre-lecture video clips and submitting surveys.

Students who participate with the Turning Technology clicker system during lecture will earn one or two bonus points per lecture. Students who watch selected pre-lecture online video clips can also earn bonus points. A maximum of 40 bonus points per student will be awarded over the whole semester. Bonus points earned can only be used one way: to raise a given student’s score of any one problem on the P121 Final Exam. The final exam will consist of nine problems, each worth between 30 and 50 points. Bonus points will be automatically applied to exactly one of the nine problems on the final exam so as to maximize the total score for the whole exam. Note that no matter how many bonus points a student has, these points can only be applied to only one problem on the final exam and the point can only be applied up to the maximum score for that one problem.

Note that all course grades will be initially determined prior to the application of bonus points. All bonus point activities are completely optional. Failure to participate with optional clickers and/or optional pre-lecture video clips cannot lower any students grade.

Important: Note that all bonus points are experimental, provisional, and are not guaranteed. Bonus points may not be traded or negotiated or appealed for in any way. The entire Bonus Point program for Physics 121 may be completely canceled or withdrawn for any reason by the instructor for any and/or all students at any time during the semester before grades are assigned. All decisions regarding the application of bonus points are completely at the discretion of the instructor and all decisions regarding bonus points are final.