PHYS 121: General Physics I: Mechanics
Some Course Information and Course Policies
16 January 2024

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1 Student Learning, Active Learning

Mechanics is a subject that lies at the heart of the physical sciences. It remains extremely relevant today even though the material itself has been around and well understood for hundreds of years. So if we know the material, we know what to teach, right? So why don't we just teach what we know? What is there to think about?

Our answer here at Case Western Reserve University is that we know that main issue for our students is *not* about teaching physics, it's about *learning* physics. You have selected this course because you want to *learn* this material. And what we know after years of experience in teaching is that different students learn best in different ways. There are many styles of learning, and what works well for some students will not be so helpful for other students.

Everything we do in this course is designed to help you *learn*. Every assignment, every exercise and every exam is designed to motivate *learning*. Success for students and success for the instructors depends on achieving and demonstrating learning.

Your goal as an individual student is to learn the material to the point that you can *demonstrate* your learning by *solving* problems and *explaining* your work as you do this. Solving problems with good explanations corresponds to demonstrating *mastery* over both the *concepts* and *methods* that are central to the goals of the course.

Our goal as instructors, course assistants, graders and other staff at CWRU associated with Physics 121 is to provide with the tools you need to help you *learn* the concepts and to help you develop the skills to demonstrate *mastery* of the material by solving problems. We know that there is not one perfect method for presenting the materials and teaching students because we know that there are different learning styles and what works best for some students is not best for all. Therefore we offer a wide variety of learning tools and incentives support student learning in the class. We understand that by offering different approaches, we can help students with different learning styles succeed in mastering the course materials. However, we also know that certain approaches are generally more helpful to students based on research in education and human learning. In particular we know using the approach of **Active Learning** is generally the best way to help student achieve the deep understanding and confidence with a wide variety of skill sets required to demonstrate mastery of the subject.

Active Learning for PHYS 121 means that our goal is to spend *less* time presenting new materials that students passively absorb in lecture, and *more* time asking students to *engage* the material in lecture so as to strengthen understanding, confront misconceptions, develop connections between concepts, and strengthen problem solving skills. Active learning means engaged learning, where students develop the skills they need to solve problems in collaboration with the instructional staff and with their peers. Active learning means helping students to develop the best approach to teaching themselves how to tackle and solve both familiar problems and new and unfamiliar problems with confidence.

One way we will be doing that this year is by moving more in the direction of presenting some new materials for the first time in the assigned readings and in a series of short video clips. This will provide more time during the lecture for considering problems and demonstrations, completing short exercises, practice problems and (to the extent permitted by social distancing constraints) informal group work. By emphasizing the introduction of new materials outside of the lecture and by spending more time during the lecture actively working with problems and engaging students,

we are partially "flipping" the class relative to the more traditional arrangement whereby materials is presented in class and students are asked to solve problems outside of class. We are not completely flipping the class here – there will be materials presented in lecture and we will ask students to complete homework. But our approach is to have more work material presented out of lecture and more student engagement with problem solving done in lecture.

Please note that our pedagogical approach will be both experimental and dynamic. We will be checking in with students as we go through the course to see which approaches and activities seem most helpful for student learning and which are less effective, and we will strive to make adjustments as we go. Every year is different, and what has worked well in the past may not be best for a new generation. We will therefore warmly encourage student feedback and will consider incorporating suggestions as the class moves ahead. Again our overall goal is to do everything we can to make the learning experience effective and engaged for as many students as possible.

2 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 via the Canvas site.

- Students who are looking for a more traditional textbook may benefit from using pretty much any standard calculus-based physics textbook, such as, for example the text by *Ohanian and Markert* which you can buy or rent as a e-book. As a reference we will assign *entirely optional* readings from this textbook, although any textbook will cover the same topics. 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. These Review Sheets will also be used to build up comprehensive *Concept Map* for the material in the course so that students can better visualize how the presented concepts are interconnected.

- 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* as an announcement on Canvas.

- During most lectures, student in class will be presented with one or more *"concept questions"*. These are short conceptual problems that interactively probe student understanding. Students will be asked to respond in real time in class. Solutions to these problems will be presented in class and archived on the web page. Note: Participation for in-class activities is entirely optional and not graded or recorded in any way.

- We will provide students with other supplementary materials, including several short (less than 10 minutes each) online video clips to introduce major conceptual topics before most lectures. These video clips have been selected to be intriguing and informative providing a new way to engage the materials.

- We will encourage students to reach out to instructors during **Office Hours**. Course instructors will provide office hours with a range of times and modalities. Special office hours for students looking for extra help on particularly challenging topics will be provided.

It is worth reviewing this list. All-in-all, in the context of the course, students have access to a rather 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 here is to provide a strong array of proven learning tools to help every student learn in accordance with their own learning styles.

3 Lectures:

The lectures, reading assignments, and "Review Sheets" and associated course Concept Map essentially define the scope and central content of the course. **Lectures are Mondays, Wednesdays, and Fridays from 11:40 AM to 12:30 PM.** All lectures will be recorded and available to all students asynchronously. There will be occasional lecture demonstrations, video clips, concept questions, supplementary notes. and other in-class 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, we 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 Active Learning techniques in during the lecture.*

By the way, we will do everything we can 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 we cannot answer your question in class in a way that is relatively brief and helpful to the other students, then we will promise to respond after class or in a subsequent lecture or activity.

4 Textbooks, Online Class Notes

There are no "required" regular textbooks for you to purchase. These are the textbooks and other items 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.

- You might consider purchasing any standard calculus-based textbook on introductory mechanics. One example of a textbook I like is by **Ohanian and Markert** titled *Physics for Engineers and Scientists*, (ISBN: 9780393930030). You want the Third Edition, Volume I (Mechanics). Some students find having a "standard comprehensive calculus-based physics textbook" to be quite helpful, and this is one of the better ones. This is available in paperback in the CWRU bookstore or on Amazon as an e-book. You can often find a used copy. Again, this textbook is entirely optional, you do not need it to succeed in the course.

- Another "kind of textbook: for this course that I have often recommended to students is a cute little paperback entitled *The Cartoon Guide to Physics* by **Gonick and Huffman** (ISBN: 9780062731005). For PHYS 121 we cover materials in 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 the closer to that of the course than can be found in the other texts. Also, the artwork is great.

- Finally, there is one last tool that students may wish to obtain that is **entirely optional**. This year we will offer optional bonus points for students that complete **Optional Online Bonus Homework** problems. We will post between three and five optional online bonus homework problems every week. Students who wish to complete optional problems 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. The license fee is $35 per student for one semester. More details on accessing and registering for this software are provided in class and on the main course web page. We will use The Expert TA to distribute, administer, and collect the *Optional Online Bonus Homework* assignments. The Expert TA problems are are basically "warm-up" exercises that help you make sure you have the correct tools in hand to tackle the *Homework*. Note that the *Optional Online Bonus Homework* is generally due on Fridays whilst the *Homework* is due on Mondays.

5 Homework:

The weekly Homework is a *very* important part of this course, and will count **15%** of your final grade. The whole point of homework is to provide a consistent framework to motivate students to engage the materials of the course on a regular basis, to learn the main concepts and to develop skills in applying these concepts toward solving problems. Every homework problem is chosen to strengthen students skills and deepen conceptual understanding so that students are better prepared to succeed in solving problems on exams. There will be a total of **eleven** homework assignments. We will generally put out homework assignments on Fridays (along with a reading assignment).

Note that the weekly homework will be graded on a 15-point scale. Note that there will be a total of eleven assigned homeworks, but we will automatically drop your lowest combined single 15-point week homework score from the total. In other words, your combined homework grade will be based on a scale of 150 points made from the best ten out of eleven weekly homeworks that you submit.

Please note that students we can only accept Homework online as PDF format files via Canvas. All homework will be collected, graded, and returned to students online via Canvas. Note that **11:00 PM is a hard deadline for accepting homework on Canvas**.

Here is the deal on due dates for homework: Homework solutions will written by the instructor posted on the course web page to students on the day they are handed in. With almost 300 students in the class, it's not practical or fair to delay solution posts for late homework submissions. For this reason, and because the pace of the course is relatively fast, **no late homework will generally not be accepted.**

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 being excused from a homework is not at all the same thing as receiving an extension or accepting late homework. Generally we do not issue extensions, we only issue excuses.** Note that because of the "drop the lowest weekly score" policy we will generally only *excuse* students from homeworks because of *major* emergencies or illnesses – events that are completely out of a student's personal control and which would have a major impact on a student's performance in the class. Generally speaking, requests for *excuses* will need to be made in advance of the due date (when possible) and we may ask for *documentation* of the emergency or illness, especially if the concern lasts more than a day or two. This is usually coordinated through student navigators.

Note: having said all this, 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. You cannot annoy or upset the instructor by asking for consideration

in advance of a possible problem. It cannot hurt to ask. We 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 has hesitated to contact us in advance. As a rule we are generally able to accommodate students who contact us about potential problems *before* the homework is due. As a rule we are generally unable to accommodate students who come to us after the homework is due.

Note that the reason for enforcing these policies has nothing to do with being "strict" and everything to do with the fact that with a class this large, dealing with late homeworks and extensions can 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 **eleven** homework assignments during the semester. Each homework will be graded on a scale of 0 to 15 points.[1] For your homework grade, we will use the top *ten* best weekly combined homework scores for each student and will *drop* your single lowest 15-point homework score. We 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, we can account for this, and students in these situations do not need to make any special arrangements. 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 we have this fairly lenient policy where we throw away your one lowest homework scores, students do not have to worry too much about missing a single 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, we find that most students who try to do the homework all alone by themselves will not learn as well as those who join together with their classmates and study in groups. **Group learning 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 ever copy another student's homework! You must never ever write your solution to the homework while having another students solution visible to you. This is called homework copying and if you do this, you will be in violation of academic integrity and subject to disciplinary action.**

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. You can share and discuss conceptual approach and technical strategies. 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. Please 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 anthers homework. It is not acceptable to allow your homework to be copied by others. It is not acceptable to have another student's work visible while you write out your solution. It is not acceptable for you to allow another student to look at your homework. You absolutely must completely**

[1] Note that every homework counts for 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.

work out your own solution without direct access to any other student's work for each and every problem. Copied homework will result in zero credit assigned to both copi*er* and copi*ee*. 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. This is serious business and you risk your entire academic career when you go down this path. By the way, this kind of cheating is really very obvious to the graders and they spot this all of the time and pass it on to the instructors. Don't do it! Do not risk your academic career by copying your friends homework. Do not risk your academic career by allowing your friends to look at and/or copy your own homework. It's really not worth it.

Note also that the instructor for the course will almost always provide **Hints on Homework** in the announcement section on Canvas.

Finally regarding the **Optional Online Bonus Homework**: just want to reassure: Students shouldn't worry much about "losing points" for collecting hints or multiple attempts on multiple choice questions via Canvas or for the Expert TA. We have set things up so that the "penalty" of a few percent of the value of an individual problem for multiple attempts is *very small* with regards to your overall grade. The whole purpose of the **Optional Online Homework** is to motivate participation and engagement with the material. Not to penalize students for wrong answers.

Specifically: the Homework is graded on a 15 percent of your grade. The homework is graded on a "straight scale" with points totaled in. For students who want to see an "equivalent letter grade" for the homework, this is (approximately) right:

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13.0 out of 15 or higher is an A
10.5 out of 15 or higher B
8.0 out of 15 or higher C
5.5 out of 15 or higher D
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6 Practice Problems:

As an aide to student study and to provide examples applicable to homework problems, we will post a series of "practice problems" with solutions online. Some problems will be short and easy, others will be long and difficult. we will generally post detailed tutorial solutions with the practice problems. Sometimes we will include video commentary on practice problems.

Many students find practice problems to be a useful tool that we provide for students. But one of the most challenging academic goals for students is to learn how to use them effectively. On the one hand, some students try to solve every practice problem given and use much of time or 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 having glanced at the solutions.

Neither of these approaches is helpful. The correct approach of course is actually using the practice problems to help build skills to solve new problems. Looking at too meany practice problems without really doing them on your own can lead to be trouble. Your goal is not to memorize practice problems that you can solve. Your goal is to understand concepts deeply so that you can solve problems that you have never seen before.

7 Exams:

There will be a four exams. Please note the dates which are posted on the main syllabus.

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. These '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 18th from 3:30 to 6:30 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!**

8 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.

Important: A passing grade in Physics 121 generally 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: did2@case.edu. In the past, a minimum raw score of 60% or higher is required to earn a passing grade for the intro labs.

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 to dealing with the lab and/or do not properly hand in their laboratory assignments on time*. This is how the grading system has been set up. For the vast majority of the students who complete the labs 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 complete and submit your assigned lab and turn in your lab reports.

9 Grading policies:

We 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:

Work:	**Points:**	**Percentage:**
First hour exam	50	5%
Second hour exam	100	10%
Third hour exam	100	10%
Final exam	350	35%
Homeworks	$10 \times 15 = 150$	15%
Laboratories	$100 \times 2.5 = 250$	25%
Total:	1000	100%

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 we 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 we have students ask me about our 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 we grade:

For any particular exam we have an *apriori expectation* for how well students ought perform and we 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 we 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 mid-to-high 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 we *adjust* the grading system – but generally we 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 the grade of anyone else. 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, we usually attribute this to problems with my end of the course (ineffective lectures, over-difficult or over-long exams, etc.) In this case we 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 we "curve" the grades so that the average student can still generally expect a "B".

In a nutshell, then: we curve the class but only if it helps the students. And we can't tell you the curve in advance because it depends on how difficult the exam will be and how well students perform as a whole.

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.

Since we do not grade on an fixed "absolute" scale, we cannot precisely predict in advance what final point total will correspond to what particular grade assignments. We know that for some students it is very important to know exactly what their letter grade standing is. Unfortunately, we can only determine this *very* approximately until we reach the end of the semester. However, we are 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 the course instructor directly if you have any concerns or confusion as to how the grades for the course will be determined. Also on an occasional basis we will post a prescription for self-calculating approximate student grade standing at various points during the class. But the question we am asked over and over is "How many points do I need on the final to earn a grade of X." we *cannot* answer this question because the answer depends on how difficult the final exam ends up being, and we 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 when practical all of each exam problem will be graded by a small number of graders, 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 the syllabus.

10 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, students can earn "Optional Bonus Points." by participating in weekly Optional Online Bonus Homework assignments which are offered each week.

Students who participate with the bonus homework system (The Expert TA) and with I-clickers during lecture will generally earn between 0.5 and 1 point per problem. A maximum of about 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 between 6 and 9 problems, each worth between 30 and 50 points (when scaled to 350 points for the final exam). Bonus points will be *automatically* applied to only exactly *one* of the exam problem 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 points can only be applied up to the maximum score for that one particular 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 online bonus questions 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.

Important Disclaimer: Bonus points are awarded only for completely optional course activities. Therefore, The entire Bonus Point program for Physics 121 may be completely canceled or withdrawn for any reason by the instructor for any and/or for all students at any time during the semester at any time 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. There is no mechanism for reviewing or appealing the awarding of bonus points. Thanks for your understanding on this point.

11 Disability Accommodations

As instructors, we are fully committed to working with students to find the best solutions to accommodate students with disabilities. As a rule, student accommodation requests supported by the Disability Office will be granted. Most accommodation associated with exams will be coordinated through the Office of Accommodation Testing (OATS). Students who have other accommodation requests should not hesitate to reach out to the instructors. To register for accommodation and/or to find out more visit the CWRU Office of Disability Resources at https://case.edu/studentlife/disability/

12 Academic Integrity

The course instructors take Academic Integrity seriously. Students can expect that standard CWRU policies on academic integrity apply to all components of the course including homework, labs, and exams. In particular, any attempt to present another person's work as your own is considered a major academic integrity violation. Please see the CWRU policies on Academic Integrity at: https://bulletin.case.edu/undergraduate-academics/academic-integrity/