PHYS 121
Introductory Physics I: Mechanics
Dr. Eric C. Anderson
UMBC•Fall•2026
Syllabus

Welcome to Physics 121! This course is designed to help you build a deep conceptual understanding of mechanics while developing the problem-solving habits used by physicists and engineers. Learning physics takes sustained practice, discussion, and feedback—not inborn ability—and this course is structured to support you every step of the way. This syllabus explains how the course works and how to make the most out of the many resources available to you.

•Getting ready•

Prerequisites•You must have completed MATH 151 (Calc I), or be enrolled in it this semester.

Workload•Experience shows that success requires at least 8 hours per week of intensive effort outside of scheduled class time, consistent with the usual higher education expectation of 2-3 hours outside of class for each credit hour.

Required resources•

(1) Pencils or pens, and paper, *brought to each class.*

(2) Achieve access: Blackboard → Current Content Folder → Achieve prelectures/bridges, or Achieve HW. (You may need to follow some prompts first time you access Achieve.) Any difficulties, click on the *Achieve support* link under the Start Here tab. Achieve access provided through CMI (Course Materials Initiative).

Equation sheet• Print or download. Access: Blackboard → Getting started.

Staying in the loop•Check Blackboard announcements DAILY for clarifications, updates, and advice.

Class• *Section 01* MWF 9-9:50 AM in Meyerhoff Chemistry 030
Section 10 MWF 11-11:50 AM in Physics 101

Discussion•Check your schedule for your weekly discussion meeting (beginning *first* week of semester). Here are your graduate teaching assistants (TAs) and undergraduate learning assistants (LAs) who will lead your meetings:

Section	Location	Day and time	TA	LAs
02	Interdisciplinary Life S 201	W 5:00-6:50 PM	*Hassan, M.*	*Nicholas, George*
03	Interdisciplinary Life S 101	Th 8:00-9:50 AM	*Hassan, M.*	*Urvi, Lily F.*
04	Interdisciplinary Life S 230	Th 11:30-1:20 PM	*Jong L.*	*Adoniram, Lily A.*
05	Interdisciplinary Life S 237	Th 2:30-4:20 PM	*Hamesha R.*	*Nicholas, Lily A.*
06	Interdisciplinary Life S 101	W 5:00-6:50 PM	*Hamesha R.*	*Dakshesh, Naomi*
08	Interdisciplinary Life S 201	Th 8:00-9:50 AM	*Ansel L.*	*Tahmid, Noah, Abby*
09	Interdisciplinary Life S 237	Th 5:00-6:50 PM	*Hassan, M.*	*Levi, Raymond*
11	Interdisciplinary Life S 237	W 1:00-2:50 PM	*Ansel L.*	*Noah, Adoniram*
12	Interdisciplinary Life S 101	Th 11:30-1:20 PM	*Dylan H.*	*Urvi, Tahmid (until 12:45)*
13	Interdisciplinary Life S 201	Th 2:30-4:20 PM	*Dylan H.*	*Levi, George*
14	Interdisciplinary Life S 230	Th 5:00-6:50 PM	*Hamesha R.*	*Abby, Lily F., Naomi*
15	Interdisciplinary Life S 237	W 7:00-8:50 PM	*Dylan H.*	*Raymond, Dakshesh*

Contact info•

TAs:

Ansel L.	(alavitz1@umbc.edu)
Jong L.	(jlee103@umbc.edu)
Dylan H.	(d297@umbc.edu)
Hassan, M.	(mdtouhh1@umbc.edu)
Hamesha R.	(hameshr1@umbc.edu)

Instructor: Eric Anderson (andersoe@umbc.edu)

Learning goals•

General education program (GEP) goals: *This course addresses the GEP's Functional Competency* Scientific and Quantitative Reasoning. *It has been approved to meet the GEP* Sciences *distribution requirement. Assessment is through elements of select free-response exam items, which require achievement of this Functional Competency.*

- Understand and use mathematical and scientific methods of inquiry, reasoning, processes, and strategies to investigate and solve problems.
- Organize, interpret, draw inferences, and make predictions about natural or behavioral phenomena using mathematical and scientific models and theories.
- Recognize the ethical and social implications of scientific inquiry and technological change and distinguish science from non-science and pseudoscience.
- Recognize that mathematical, statistical, and scientific evidence requires evaluation.

Course-level goals: Be able to:

1. Carry out graphical and analytic vector addition; interpret and carry out scalar and vector products.
2. Interpret and relate kinematic quantities including graphical representations; apply constant acceleration equations to one- and two-dimensional examples.
3. Apply Newton's Laws in a plane to systems including multiple interacting objects; apply special models of spring, frictional, and gravitational forces.
4. Determine work and changes in kinetic and potential energy, and apply the relation between work and mechanical energy for various processes and to various systems; relate conservative forces to potential energy functions and graphs.
5. Address interactions between two objects using ideas of impulse and momentum and apply conservation of momentum to appropriate systems; in both one and two dimensions.
6. Extend kinematics, dynamics, and energy ideas to rotating objects using angular kinematic quantities, torque, and moment of inertia; apply to systems of multiple objects, combined translation and rotation, and static systems.
7. Determine angular momentum and relate torque and angular momentum change to rotating objects, and apply conservation of angular momentum to appropriate systems.
8. Use appropriate physical quantities to describe simple harmonic motion and relate to kinematic graphs and equations; apply dynamics and energy ideas to simple harmonic motion.

Assessment is through responses to select exam items, which require achievement of these course-level goals.

More detailed learning goals: Blackboard → Start Here → Learning goals.

•How This Course Works•

Achieve prelectures and bridges•Provide essential background for class. Access: Blackboard → Current Content Folder → Achieve prelectures/bridges. Respond to prelecture questions and bridge questions, graded for completion. Due most class days at 8:50 AM (see day-by-day guide at the end of syllabus).

Wise counsel: It pays to spend the WHOLE 20 or 25 minutes viewing the prelecture for a unit. Most of your learning will come with practice *applying* the material later (in class, discussion, and homework), but the prelectures provide an essential foundation.

Class•Deepens your conceptual understanding and begins to develop your problem-solving skills. Expect a mix: Sit and listen as I present a concept or model a strategy, engage with your neighbors over a question that I pose, then we'll follow up together.

Life hack: Find the pdf lecture outline before each class: Blackboard → Current Content Folder → Class outlines. Print it out and take notes or annotate it on your tablet; skip writing down what's projected on the screen. Listen, think, discuss. I post my own notes (Blackboard → Current Content Folder → Class notes) after class, so don't worry about getting everything down.

Exit tickets•Exercises to practice ideas we've developed in class, and help you tune up for homework and discussion problems. No phones/devices/AI. Conversations with your peers and instructor are encouraged.

Grading: 1 pt for substantial evidence that you've attempted an analysis according to frameworks developed in class, whether or not complete, or correct answers given, 0.5 pt for attempt which lacks grounding in the frameworks, or that gives equations or answers without support, 0 for missing or irrelevant response. Exit tickets will be collected and graded about a third of the time, to be determined through a random process. If it's collected, be sure to include at the top of your paper your first and last name, very clearly written.

Discussion•Where you'll practice and refine your problem-solving skills with the help of your group members, your TA, and your LA. To help you share your knowledge and insights and gain the most from other group members, we'll assign roles for each of you to take in your groups, changing roles each item. The names of the roles, the actions taken by those members, and examples of appropriate remarks are given below: (Groups of two use the first two roles, and share responsibility for the third.)

	Actions:	*What it sounds like:*
Manager	*Gets group members engaged on each item* *Leads discussion* *Submits pic of whiteboard to assignment in Blackboard.*	*What do you think our approach should be?* *What's a good first step?* *What would you say we need to solve for?*
Recorder	*Does ALL the whiteboard work, with involvement of all group members* *Checks understanding of all group members*	*What all should go in the diagram?* *Everyone agree on what we're solving for?* *Is this the right trig function?*
Skeptic	*Encourages consideration of different viewpoints* *Proposes ways to check approach and results*	*Did we set this up right?* *Is there another approach?* *Is it OK to make that assumption?* *Did we get all the forces in the diagram?* *Everyone follow the algebra?*

Allowed resources: *Equation sheet, group members, TAs and LAs*. Course materials are not forbidden, but I encourage you to instead practice with your group members *recalling and applying* ideas and strategies presented in prelecture and class. You may not use solutions from another group, obviously. AI? No, discussion is designed to help you build real, human intelligence.

Groups are not expected to complete all parts of a discussion item within the given time frame. Focus on quality: work together to practice applying appropriate concepts and frameworks presented in prelecture and class, and make sure all group members are on board. There's enough material to challenge even the most resolute groups–questions near the end of each item are there for you if you're ready: for reinforcement and more advanced practice.

Your TA will grade your group submission for each item on the following basis. All participating group members receive the same grade.

5 Applies appropriate concepts and frameworks (as presented in prelecture and class, beginning with fundamental equations on the equation sheet) most of the time, and carries out valid analyses the majority of the time, and *quantity* satisfactory (got at least as far as the majority of groups).

4 Applies appropriate concepts and frameworks and begins with fundamental equations the majority of the time, carries out valid analyses some of the time, and *quantity* adequate (at least close to the majority of groups)

3 Rarely applies appropriate concepts and frameworks, or rarely carries out valid analyses, or quantity lacking (attempts far less than most)

0 No submission, or used disallowed materials

Please be sure to include in your pic your team, roles, and participants. Example:

Team Delta
Manager: Marie C.
Recorder: Linus P.
Skeptic: Werner H.

Check in with your TA or LA each item to keep you on track, check your work, and help you see the big picture.

Solutions posted on Blackboard each Thursday at 7 PM.

Best way to prepare for discussion? Keep up with prelectures and class so discussion becomes practice–not your first exposure to the material.

Achieve homework (HW)•Access: Blackboard → Current Content Folder → Achieve HW. HW assignments are designed to build conceptual understanding and problem-solving skills through systematic practice and feedback.

You're allowed 5 attempts for each numerical item. Your response should be within 1% of the correct answer, so enter at least three significant figures, and don't round intermediate results.

Due: (1) Exam weeks: Tuesdays at midnight. (2) Non-exam weeks: Thursdays at midnight. Keep a written record of your work for future studying. Some items provide an AI tutor and/or a detailed solution.

Pro tips: First-line resources: class examples, Achieve prelecture examples, discussion materials, the supplemental text, working with classmates, visiting the Physics Tutorial Center, SI PASS sessions. Equation sheet? Have it in front of you, like you'll have during exams. Second-line resources: AI tutor and written solutions, if provided.

Regarding using AI for HW: You might be inclined to turn to AI in various ways: give your attempted solution and ask how you did. Or ask for hints on how to get started. Or ask it to just do the whole thing for you. Nobody really knows yet what kinds of AI use lead to durable learning. What we do know is that the effort you invest in the homework pays off on exams, where AI won't be available.

(Optional resource) **Supplemental text** (*Physics for Scientists and Engineers,* by Tipler)•Massive intro calc-based physics textbook, full of detailed examples, precise derivations, illustrations, etc. that you might occasionally find helpful. Access: Blackboard → Start Here → *My Textbooks & Course Resources*. Provided through CMI (Course Materials Initiative).

•Learning Resources•

Discussing ideas, asking questions, making mistakes, and getting feedback are the essence of learning physics. The resources below are available to every student and are intended to be used throughout the semester—not just before exams or when you're stuck.

Physics Tutorial Center (PTC)•The Physics Tutorial Center is a place where all students work on intro physics together. Whether you're looking for some motivation to get going on your homework, grappling with a tough problem, hazy on a basic idea, or grinding through practice exams, come here to lock in. You'll find instructors, TAs, and classmates ready to work with you. Location: Physics building room 226A. Hours: 12 – 5 PM Monday through Thursday through Wed 9 Dec.

My "office hours"•Homework help? Exam prep? Questions? Concerns? General advice or perspective? Held in the PTC (Physics 226A) Mondays 1-2 PM, Tuesdays 12 – 2 PM, and Wednesdays 12 – 1 PM. Subject to change; check Blackboard announcements. (We can always step outside for privacy, if you prefer.)

Supplemental Instruction Peer Assisted Study Sessions (SI PASS)•A successful peer from a recent semester leads twice-weekly study sessions. More info to come on Blackboard.

UMBC's Academic Success Center (ASC) •Provides a range of resources to support students as they progress toward degree completion. The ASC has created a specialized set of Online Learning Resources. In addition, check out the following resources:

ASC Resources include: Online tutoring and writing support, supplemental instruction peer-assisted study sessions (SI PASS), placement testing, FYI academic alerts, success courses, academic advocacy, academic policy and academic success meetings.

- Tutoring and Writing Center Appointments
- Academic Advocates: Advocates work one-on-one with students who need support navigating academic and institutional challenges, no matter how complex the concerns (i.e., personal, academic, or financial).
- Academic Success Meetings - Schedule a one-to-one virtual meeting with an Academic Success Center Professional who can help you with time management, study skills, and accessing campus resources.

If you have a question, please contact the ASC at academicsuccess@umbc.edu

Technology Support Center•Offers help with technology-related concerns.

•Exams and Grading•

Exams•Six exams. Expect multiple-choice and other objective items (some qualitative and some quantitative), and a few bigger free-response problems affording partial credit. Equation sheet and TI-30XIIS scientific calculator provided (to ensure all have access to an equivalent, functioning calculator.) Given at 8 AM, in multiple lecture halls. To find your assigned lecture hall and seat: Blackboard → Exam seating charts. Anticipate traffic and parking. Have a Plan B.

How to study for exams•First, be sure to build a sound foundation by putting in the effort in prelectures, class, discussion, and homework. Then, actively work through some practice exams, both with a study partner or two, and independently. Try a range of strategies: (1) Read through a problem and examine the provided solution. Ask yourself "why" and then try to explain to yourself. (2) Try a problem and if you get stuck, peek at the solution for a hint. (3) Try a problem, a page, or a whole exam under exam conditions (only calculator and equation sheet, time limit), then check solutions. Access past exams and solutions: Blackboard → Current Content Folder → Practice exams.

Final exam•Similar to exams, comprehensive.

Exam instructions•Familiarize yourself with these exam instructions, designed to ensure that everyone has an equal opportunity to be successful:

- Admission to the lecture hall begins at **7:50 AM**.
- Your **bubble sheet** and **calculator** will be at your assigned seat when you enter. Confirm that you have the correct bubble sheet and that your calculator is functioning properly.
- Bring **pencil(s) or pen(s)**. You are encouraged to enter the lecture hall with minimal personal belongings. Be prepared to present your **UMBC ID**.
- Before entering the lecture hall, all papers, notes, books, and all electronic devices (phones, personal calculators, smart watches, headphones, earbuds, smart glasses, etc.) must be powered off (if applicable), secured in your bag under your seat, and remain there for the duration of the exam.
- Sit only in your assigned seat or a seat designated by the proctors.
- Hoods, dark glasses, and hats that obscure your face must be removed or adjusted so that proctors can clearly see you. Religious headwear may be worn.
- Exams will be distributed just before **8:00 AM**. You may begin only when directed by the proctors, at **8:00 AM**.
- After **8:00 AM**, you may not leave your seat for any reason until you submit your exam.
- You may not attempt to communicate with another student during the exam.
- Your provided calculator must remain visible and in your possession at all times.
- For **multiple-choice** questions, record your answers on the provided bubble sheet. No work is required, and no partial credit will be awarded.
- For **free-response** questions, clearly show your reasoning. A correct answer without supporting work will receive **no credit**. An incorrect answer may receive partial credit based on clear, complete, and correct supporting work. For numerical answers, report your final result to **two significant figures** and include appropriate units.
- Standards of academic integrity will be enforced as described in the syllabus. Consequences include a score of **0** on the exam, a report to **UMBC's Academic Integrity Database**, and potentially additional disciplinary action.
- You may submit your exam between **8:30 AM and 8:50 AM**. Submit only:
    1. Your bubble sheet (one pile)
    2. Your free-response sheet (the last page of the exam; a separate pile)
    3. Your provided calculator (in the collection bin)
- Proctors will leave the lecture hall at **8:50 AM**. Exams will **not** be accepted after the proctors have left the room.

Grading•5% for exit tickets, 5% for Achieve (prelectures/bridges and homework), 10% for discussion, 10% for each of 6 exams, 20% for final exam. 89.5% required for A, 79.5% for B, 69.5% for C, and 59.5% for D.

Monitor your performance•Best indicator of your current grade in the course is the "overall grade" that may be found in Blackboard in *MyGrades*. Achieve grades will be factored in at the end of the semester.

•Policies•

Exam redemption•Your lowest exam score may be increased at the end of the semester. If you score higher on the Final Exam than your lowest exam, I'll replace your lowest exam score with the average of your original score on your lowest exam and your Final Exam score. Example: Your lowest exam score is 55%, and your Final Exam score is 85%. That 55% is replaced with 70%. (Does not apply to a grade of 0 earned for a violation of academic integrity policies.)

Reclaiming and reviewing work•Exams are returned to you at the end of your subsequent discussion session. If not claimed, they will be available any time during my PTC hours. Exam solutions are posted on Blackboard at 5 PM after each exam. Please review graded work right away, and check that we enter your grades correctly. *Notify us of any grading mistakes within a week*: Contact your discussion TA about discussion grade mistakes. For exam grading mistakes, get to me directly, or through the Physics Department office (Physics 221), along with a note describing the mistake. For errors in assigning partial credit, make sure that you've examined the posted solutions and the grading sheet, and that your note explicitly addresses the discrepancy.

Late and missed work•

It's expected that illness, attention to family matters, technical difficulties, and the like may occasionally keep you from completing your work on time. Hence the following policies:

Achieve ceiling: Earning 80% of possible points on Achieve will get you full credit. Examples: You earn 84% of possible *Achieve* points? That becomes 100%. You earn 71% of possible Achieve points? That becomes (71/80)*100% = 89%.

Late homework: Completing **homework** up to 24 hrs late gets you 90% of possible points, and up to 48 hrs late 80% of possible points. (No late submissions for prelectures/bridges.)

Lowest discussion grades: Your lowest six discussion grades will be dropped at the end of the semester. (Ordinarily there are three discussion grades each weekly session, so that's like missing discussion twice.)

Exit ticket: Your best two-thirds will count, to allow for occasional absences.

Makeup exams: If you must miss an exam due to officially sanctioned UMBC activities, illness, family emergency, detention by authorities, or similar difficulty, contact me as soon as possible. With written verification of the cause of your absence, I'll arrange a makeup exam over the same material.

Recording policy•Recording of any kind is not permitted in class or discussion.

Academic integrity•By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal, and will be addressed according to the UMBC Policy on Academic Integrity (https://www.umbc.edu/policies/pdfs/UMBC%20III%201.10.03%20Undergraduate%20Student%20Academic%20Conduct%20Policy.pdf) Examples include attempting to make use of disallowed materials on exams and in discussion, attempting to communicate with anyone other than the instructor or TA during an exam, altering graded work and submitting it for regrading, asking someone else to take an exam in your place, having another student submit an exit ticket for you, and permitting or assisting another student to carry out any of the above.

University policies and resources•https://ecr.umbc.edu/sample-title-ix-responsible-employee-syllabus-language/

•Day-by-day guide•

Achieve prelecture/bridges, Achieve Homework (HW), Discussion,
Exams, Supplemental source: (Tipler)

Week of:	Monday	Wednesday	Discussion (Wed or Thur)	Friday
24 – 28 Aug	***Special*** Blackboard syllabus quiz due **8:50 AM** ***Special*** **Welcome to the course**	*Motion* Unit 1 One-dimensional kinematics (1.3-4, 2.1-4)	Motion I	Unit 1 One-dimensional kinematics (continued)
31 Aug – 4 Sep	Unit 2 Vectors and two-dimensional kinematics (1.6-7, 3.1-2)	Unit 2 Vectors and two-dimensional kinematics (continued) Motion I HW (due Thurs midnight)	Motion II	Unit 3 Relative and circular motion (3.1, 3)
7 – 11 Sep	Motion II HW (due Tues midnight)	*Force* Unit 4 Newton's Laws (4.1-5,7)	Motion III	Exam 1 Motion (Units 1-3) 8 AM No class
14 – 18 Sep	Unit 4 Newton's Laws (continued)	Unit 5 Forces and free-body diagrams (4.6,8, 5.3) Force I HW (due Thurs midnight)	Force I	Unit 5 Forces and free-body diagrams (continued)
21– 25 Sep	Unit 5 Forces and free-body diagrams (continued)	Unit 6 Friction (5.1) Force II HW (due Thurs midnight)	Force II	Unit 6 Friction (continued)

28 Sep – 2 Oct	*Energy* Unit 7 Work and kinetic energy (6.1-4, 11.2-3) Force III HW (due Tues midnight)	Unit 8 Conservative forces and potential energy (7.1-3, 11.2-3)	Force III	Exam 2 Force (Units 4-6) 8 AM No class
5 – 9 Oct	Unit 8 Conservative forces and potential energy (continued)	Unit 9 Work and potential energy II (7.1-3, 11.2-3) Energy I HW (due Thurs midnight)	Energy I	Unit 9 Work and potential energy II (continued)
12 – 16 Oct	Energy II HW (due Tues midnight)	*Momentum* Unit 10 Center of mass (5.5, 6.5)	Energy II	Exam 3 Energy (Units 7-9) 8 AM No class
19 – 23 Oct	Unit 11 Conservation of momentum (8.1,3)	Unit 12 Elastic collisions (8.3-4) Momentum I HW (due Thurs midnight)	Momentum I	Unit 13 Collisions, impulse, and reference frames (8.2-3)
26 – 30 Oct	*Rotation* Unit 14 Rotational kinematics and moment of inertia (9.1-3) Momentum II HW (due Tues midnight)	Unit 15 Parallel axis theorem and torque (9.3-4)	Momentum II	Exam 4 Momentum (Units 10-13) 8 AM No class
2 – 6 Nov	Unit 15 Parallel axis theorem and torque (continued)	Unit 16 Rotational dynamics (9.4-6) Rotation I HW (due Thurs midnight)	Rotation I	Unit 16 Rotational dynamics (continued)
9 – 13 Nov	Unit 16 Rotational dynamics (continued) Rotation II HW (due Tues midnight)	*Statics* Unit 17 Rotational statics (12.1-5)	Rotation II	Exam 5 Rotation (Units 14-16) 8 AM No class

16 – 20 Nov	Unit 18 Rotational statics II (12.1-5)	*Angular momentum* Unit 19 Angular momentum (10.1-3) Statics HW (due Thurs midnight)	Statics and Angular momentum	Unit 19 Angular momentum (continued)
23 – 27 Nov	*Simple harmonic motion* Unit 20 Simple harmonic motion (14.1-3) Angular momentum HW (due Tues midnight)			
30 Nov – 4 Dec	Unit 20 Simple harmonic motion (continued) Simple harmonic motion HW (due Tues midnight)	Unit 20 Simple harmonic motion (continued)	Simple harmonic motion	Exam 6 Statics, angular momentum, and SHM (Units 17-20) 8 AM No class
7 – 11 Dec	Final exam practice	Final exam practice		
14 – 18 Dec		Final Exam: Units 1-20 TBA (no later than Thurs 17 Dec)		