PHYSICS 151 — COLLEGE PHYSICS I
UH MANOA — Spring Semester 2017

Course Information & Policies

Lecture

MWF 12:30–1:20 p.m.
Physical Science Building ("PSB" or "PhySci"), Rm. 217

Instructor

Mr. Michael Nassir
E-mail: `nassir@hawaii.edu`
Office: Watanabe Hall, Rm. 426, (808) 956-2922
Office Hours: drop-in available most MWF afternoons, 2:00pm onward
(calling first will ensure that I am in), or by appointment

Learning Assistant (LA)
Weekly P151 Help Sessions: *TO BE ANNOUNCED, starting week of Jan. 17*

FREE Tutoring/Help:

see "Getting Help" section below for more info

- Physics Lab TAs tutoring in Watanabe 421
  — *starts week of Jan. 17*
- Natural Sciences Learning Emporium Physics tutoring in Bilger Addition 209
  — *starts week of Jan. 17*
- Learning Assistance Center tutoring in Sinclair Library
  — *starts week of Jan. 17*
  — one-on-one sessions, online appointment needed >24 hrs. in advance

Required Materials

TEXTBOOK: **OpenStax, *College Physics***, Chaps. 1–17
Available here: https://openstax.org/details/college-physics
- PDF version (free — download either low- or high-resolution)
  — *also uploaded to our course Dropbox "Textbook" folder*
- Web-based version (free — requires real-time Internet access)
- Enhanced iPad version ($5) (available only for Apple tablets)
- Hardcover version ($48.50 new, via Amazon.com)

ONLINE HOMEWORK ACCESS:
- *TO BE ANNOUNCED — details coming soon.*
- *Fee will be required — between $25 and $50.*

SCIENTIFIC CALCULATOR with scientific notation, trigonometric functions, exponents, & logarithms. *Graphing or programmable calculators are allowed, but NOT necessary.*
— Bring calculator to lab & exams (necessary!) and lectures (needed for occasional in-class questions).
— Smart phones, tablets, computers, or similar devices are NOT permitted during exams!

Optional Books

Gonick & Huffman, *The Cartoon Guide to Physics* (1990) paperback (~$20 new, ~$15 used at UH Bookstore)

Course Materials

Electronic copies of handouts, paper homework assignments, solutions, sample exams, and other course materials will be uploaded to a **publicly viewable Dropbox folder**. Please check it frequently throughout the semester for new additions. This link will also be frequently e-mailed to everyone in the class:
https://www.dropbox.com/sh/ti9k1g4srimteub/AAC11tEGDdJrdxibJpap6zjia

Course Description

This course is the first half of a two-semester introduction to the fundamentals of physics, and will cover mechanics (kinematics, dynamics, gravitation, energy, momentum, rotation), waves, and thermodynamics. Lectures and problems will regularly use the mathematical tools of algebra, geometry, trigonometry, and vectors, but *not* calculus.

Prerequisite: A grade of "C" or better in **MATH 140 (trigonometry & pre-calculus) or MATH 215 or higher**; or instead, a passing score on the Mathematics Department's Math Placement Exam ($\geq$14 on Part I & $\geq$10 on Part II).

Lab: If you also need to take PHYS 151L lab, it is strongly recommended that you do so concurrently with the lecture; the lab provides a hands-on way of reinforcing and complementing many of the topics presented in lecture. However, UH Manoa does *not* require concurrent enrollment in PHYS 151L lab with PHYS 151 lecture, so you can instead take PHYS 151L lab in a future term, or not at all.

PHYS 151 Learning Outcomes — General

At the conclusion of this course, students should be able to:

- Define and use the terminology of mechanics, waves, fluids, and simple thermodynamics.
- Apply the equations and principles of non-calculus-based physics to solve a wide range of problems in mechanics, waves, fluids, and simple thermodynamics.
- Recognize how and where these principles occur in natural phenomena, technological and professional applications, and daily life.

PHYS 151 Learning Outcomes — Detailed

At the conclusion of this course, students should be able to:

- Understand the instantaneous and average relationships among position, velocity, and acceleration; construct and interpret graphs of all three; and calculate all three for the special case of constant acceleration.
- Recognize vector vs. scalar quantities; convert two-dimensional vectors from magnitude & direction to coordinates; perform scalar multiplication and addition of vectors.
- Understand the nature of force and the meaning and implications of Newton's Three Laws of Motion.
- Apply Newton's 2^{nd} Law to calculate the dynamics of systems for the special case of constant net force (including static equilibrium), including systems with ideal springs, contact friction, inclined planes, cables/pulleys, and uniform circular motion.
- Apply Newton's Law of Universal Gravitation to simple systems of masses.
- Apply Kepler's Laws of Planetary Motion to describe and calculate the properties of simple orbits.
- Understand and be able to calculate various forms of energy, including mechanical work, kinetic energy, and potential energies.
- Understand the meaning of Conservation of Energy and its relationship to conservative vs. non-conservative forces, and apply Conservation of Energy to determine kinematic properties of appropriate systems.
- Understand the relationship between force and impulse/momentum, and apply it to determine kinematic properties of appropriate systems.
- Understand the meaning of Conservation of Linear Momentum and its relationship to elastic vs. inelastic collisions, and apply Conservation of Momentum to determine kinematic properties of appropriate systems.
- Understand the analogy between rotational and translational kinematic & dynamic quantities, formulas, and conservation laws, and apply them to determine kinematic properties of rotating systems.
- Understand the definitions of density and pressure, and apply them (and related laws) to a variety of fluid-mechanical situations, including hydrostatics, buoyancy, and systems of confined fluid flow.
- Describe the kinematics and energy conservation of simple harmonic motion and similar systems.
- Understand the nature and simple equations of waves and wave motion, superposition & interference, and formation of one-dimensional standing-wave modes.
- Understand the phases/states of matter, the kinetic basis of temperature, and the primary modes of heat/energy transport; use specific heat capacity and latent heat to quantitatively relate heat to temperature.
- Understand the basic kinetic theory of gases; apply the ideal gas law to various transformations of a confined gas; and find the work performed during isobaric expansion/contraction.
- Understand the 1^{st} Law of Thermodynamics in general, and apply it quantitatively to ideal gas transformations.
- Qualitatively and quantitatively define changes in entropy; describe the meaning of the 2^{nd} Law of Thermodynamics; understand the model of a heat engine and calculate its efficiency.

Grading & Course Work

• **Final grades** will be computed based on your **overall course percentage**, computed as follows:

Homework (Paper + Online)	**30%**
Midterm Exams #1 & #2	**17.5% each**
Final Exam	**35%**

Final letter-grade cutoffs:				
	90.0% A+	75.0% B+	60.0% C+	47.0% D+
	85.0% A	70.0% B	55.0% C	43.0% D
	80.0% A–	65.0% B–	50.0% C–	40.0% D–

At the end of the semester, these cutoffs may be lowered at the instructor's discretion, but they will not be raised.

After each major exam, I will publish grade sheets (listed by your "roster numbers," not names) displaying all of your scores, and I will provide a histogram showing the relative scores of everyone in the class. I urge you to double-check your scores on my grade sheets, as well as the score tallies on your individual papers. While I apologize in advance for any errors, they do happen with such a large class — please help me to correct them. Final exam scores and final grades will be published (and grades will appear in MyUH) shortly after the term ends.

Homework

• **Paper Homework** sheets will usually be due on **Fridays** in lecture (with frequent exceptions due to holidays, exams, or extensions), and will be graded either by our class grader or by me; please see me outside of class with any questions about grading.

- **Late paper homework** will **NOT** be accepted *for any reason* **after solutions** for that assignment have been published online. This can occur anytime after lecture on the due date, but will usually happen one lecture later.
- All paper homework assignments will be worth the same number of points, and your **TWO lowest paper homework scores** will be **dropped**.

• **Online Homework** will usually be due on **Mondays** at the start of lecture, and will be graded automatically on the website. Your scores likewise will be reported to me automatically. **Late online homework** is allowed with a penalty. Details on how to pay and log in and will be provided soon in a separate handout.

• For each of the assigned sections of our textbook, *I recommend that you attempt as many* **additional chapter problems** *as your time permits*. The small amount of assigned homework problems is NOT sufficient to fully develop your ability to solve physics problems.

– **Brief answers** to ~50% of end-of-chapter problems are embedded in the Web-based version of the text.
– **Full worked solutions** to ~15% of end-of-chapter problems appear in the free downloadable Student Solution Guide that accompanies our textbook.

Exams

• Two **Midterm Exams** will be 50 minutes long, given during regular class periods, to test you on material from the first two-thirds of the course.
• The **Final Exam** will consist of roughly one-half cumulative review all of this midterm material, and roughly one-half new material from the last third of the course.

Midterm #1	**Friday, February 17**	Chaps. 1–5
Midterm #2	**Friday, April 7**	Chaps. 6–10
Final Exam	**Monday, May 8, 12:00–2:00 p.m.**	Chaps. 11-17 & cumulative review

- *You must take all midterms and the final exam to avoid a failing grade in the course.*
- You are allowed to bring ONE 8.5-by-11-inch sheet, both sides, of **handwritten notes** (no printouts or photocopies) to the first and second Midterms.
- You are allowed to bring TWO 8.5-by-11-inch sheets, both sides, of **handwritten notes** (no printouts or photocopies) to the Final Exam.
- You will be allowed to retain your "cheat sheets" after each exam to build upon for later exams.
- Do NOT let your "cheat sheets" become a substitute for learning formulas and practicing problems! (Graduate school exams, like the MCAT or GRE, do NOT allow open notes — you must memorize your formulas.)

Reading Assignments

• **Reading assignments** are listed in the Course Schedule, and are also printed near the start of each Lecture-Tutorial. The listed reading assignments are the sections of the text that will be covered in lecture and that you will be responsible to know for exams. During lecture, most of the important formulas, concepts, and vocabulary related to each topic will be highlighted, and their correct applications will be demonstrated. I recommend that you skim-read a bit ahead of our current lecture topic, then go back and reread more carefully after lecture. Reading assignments are particularly valuable because they contain additional worked example problems beyond those of our in-class tutorials and homework assignments.

Solving Physics Problems & "Showing Your Work"

• You will need a **calculator** with **scientific functions** (trigonometric & exponential/logarithmic functions, and power-of-10 notation) for homework AND EXAMS. (Graphing calculators are not necessary.)

• On all assignments and exams that call for free-response answers, you must **SHOW YOUR WORK**. Writing only the correct final answer without showing your steps is *not* acceptable and will result in little or no credit. It is a central notion in science to show your method along with your results, so that others can follow your reasoning and can question any steps or assumptions. Also, clear and complete steps and explanations will help you later when you review your own work and study for exams. It is never possible to "show too much work," but it is easy not to show enough!

- Always display your major mathematical steps from your initial formula(s) to your final answer, and annotate your reasoning with **sketches** and **written explanations** where appropriate.
- Mathematical steps should read sequentially and logically, top-to-bottom, left-to-right.
- Final answers must include **UNITS** and use an appropriate number of **SIGNIFICANT FIGURES**, and sometimes should be written in **SCIENTIFIC NOTATION**.

To receive full credit, your answers to **free-response problems** MUST contain the following:

1. **initial formula**, followed by major algebraic rearrangement steps (if necessary)
2. **substitution** ("plugging in" known values), followed by major calculation steps (if necessary)
3. **final answer**, underlined or boxed, with proper **units**, **sci. notation** (if needed), & **significant figures**
4. additional **diagrams** or **comments**, as needed to define quantities (…a picture is worth 10^3 words!)

• **Organization** and **neatness** matter! Both will result naturally if you follow the above format. Disorganized or illegible work will be penalized.

• Please do NOT use **red ink** on any assignments or exams — we reserve that color for grading.

Collaboration

Working in pairs or groups is common in science, and indeed is encouraged: teamwork can help you to make more efficient measurements and to catch errors, and explaining something to another person is a great way to learn it yourself. However, if you are working with a classmate while completing a physics assignment (or while making measurements in lab), there are a few guidelines to follow:

(1) You are strongly encouraged **first to attempt each homework problem YOURSELF, individually** (or, in lab, to make some of your lab measurements yourself). That way, you will get the educational value and the experience that comes from working the problem (or using the equipment) and "seeing for yourself." Then, after you have tried first on your own, you can compare your answer (or lab results) to others' work as a "sanity check."

On homework: If you are stuck on a homework problem, you should seek just enough help to get unstuck. It is unwise to let someone simply feed you the entire solution, since you lose the educational value of working through the problem on your own. If necessary, try changing the numerical values in the problem and attempting it again by yourself, to ensure that you understand completely how to do the problem if you were to encounter it again on your own… say, on an exam.

In lab: If your results differ from other students' results by only a bit, then *you should keep your own results* — most scientific measurements vary slightly due to "random error" (this will be discussed in lab), so you should *not* change yours to match your classmates' results exactly. After all, how do you know which result is "correct," yours or your classmates'? Record what *you* see or measure. (If your results differ *wildly*, then it is appropriate to try to figure out "what went wrong." Small variations, however, are common and are a natural part of the random error inherent in making measurements.)

(2) All free-response solutions on all submitted assignments should ultimately be **in your own words**, reflecting ***your own understanding*** of the problems. You should plug numbers into your calculator and attempt (or re-attempt) all calculations *yourself*, even if you receive assistance from others along the way.

Any passages or calculations that are **directly copied or plagiarized** from another student (or portions lifted from any other uncited source) will be given a score of **zero**. Again, your submitted work should reflect *your own understanding* of the problems.

In lab: If you make measurements together with a lab partner, make a note in your lab report of who your lab partner was for any particular experiment. Then, be sure that your calculations and the written passages of your lab reports are ***in your own words***, even if your initial data or measurements are identical to your partner's.

(3) During **in-class exams**, **NO collaboration** of any sort is allowed; exams must be *entirely your own work*. Exams copied from another student, even partially, will be given a score of **zero**. Cases of cheating or plagiarism may be referred to the Office of Judicial Affairs for disciplinary review.

Getting Help

• **Regularly-scheduled PHYS 151 help sessions** (solving homework problems, answering questions, etc.) will be scheduled every week and facilitated by our course **Learning Assistants (LAs)**. Locations & times will be announced as soon as they are available. *These sessions will begin during the 2nd week of the semester.*

• The **Physics Learning Center in Watanabe 421** is open whenever Watanabe Hall is open, for all students to use to study (alone or together) on physics homework. There are tables, sofas, blackboards, etc., available for your use.

All Physics lab TAs schedule their two weekly office hours in Watanabe 421 as **tutoring hours** — FREE help with any physics homework problems or other physics questions (although lab TAs will give first priority to their own students with lab-related questions). Go to Wat 421 and check the posted schedule for tutoring times.

These sessions will begin during the 2nd week of the semester.

• The **Natural Sciences Learning Emporium** in Bilger Addition 209 is open M–F, 8am–6pm, for all students to seek help with lower-division math or science classes, or just to use the group study tables to work together. Schedules of tutors for physics and all other subjects are posted on the door to BilA 209 and online:
http://uhnatsci.org/emporium/tutorschedules.php#physics

These sessions will begin during the 2nd week of the semester.

• The **Learning Assistance Center** in Sinclair Library offers free, one-on-one tutoring for PHYS 151 & 152 and many other large math & science courses. Appointments are made online, at least 24 hours in advance:
http://manoa.hawaii.edu/undergrad/learning/tutoring/

These sessions will begin during the 2nd week of the semester.

• You may also drop in to see me in **my office, Watanabe 426**, during MWF afternoons at times other than the regularly scheduled help sessions. I suggest that you call first (956-2922) to make sure that I am in. Please forgive me if I happen to be busy and ask you to return at another time. You may also make an appointment with me if you wish. ***For questions about physics problems & concepts, please first try to attend our LA help sessions or use one of the above tutoring resources.***

• The Department of Physics & Astronomy Office (Watanabe 416) maintains a list of grad students and others who are available for hire as **private tutors** — please stop by Wat 416 and ask the Department secretary for a copy of the list.

Extra Handouts

• **Extra paper copies of all handouts** from the two or three previous lectures will be brought to every lecture.

• Electronic copies of handouts, paper homework assignments, solutions, sample exams, and other course materials will be uploaded to a **publicly viewable Dropbox folder**. Please check it frequently throughout the semester for new additions. This link will also be frequently e-mailed to everyone in the class:
https://www.dropbox.com/sh/ti9k1g4srimteub/AAC11tEGDdJrdxibJpap6zjia

Graded Papers

Graded papers will be circulated in lecture once they are graded. Any papers that are not picked up in lecture will be left in the **wooden cubby boxes outside the rear of our lecture hall, PSB 217**. Look for "PHYS 151 Spring 2017," and find the box containing your roster number. Please leave the boxes tidy and organized for your classmates' benefit. Mahalo!

PHYS 151 Spring 2017 Calendar & Reading Assignments

• This is our intended schedule of topics, however, *actual* subject matter covered during each lecture may vary or lag behind slightly. In that case, exams will only cover material actually discussed in lecture before each exam date. Relevant chapters and sections will be clarified before each exam.

• For all sections and topics listed below in regular type, you will be expected to know and understand the major formulas, concepts, and terminology, and how to apply them correctly to basic and intermediate-level problems. *Exception:* For sections/topics listed in *[[brackets]]*, you only need familiarize yourself *qualitatively* with their concepts and terminology. For these sections, you do NOT need to learn any specific formulas, NOR will you be asked to solve any numerical problems for those topics. (*Note*: Some of these topics do play important roles in PHYS 151L lab experiments.)

DATE	EVENT	READ: OpenStax *College Physics*
M Jan 9	Lect #1	*[[§1.1: Intro to Physics, Science & Sci. Method]]* §1.2: Metric Units & Prefixes, Sci. Notation, Unit Conversion
W Jan 11	Lect #2	§1.3: Uncertainty & Significant Figures *[[§1.4: Approximation]]*
F Jan 13	Lect #3	§2.1–2.3: Position & Displacement, Speed & Velocity
(M Jan 16)	HOLIDAY	
W Jan 18	Lect #4	§2.8: Graphing Position & Velocity
F Jan 20	Lect #5	§2.4: Acceleration; §2.8: Graphing Acceleration
M Jan 23	Lect #6	§2.5–2.6: Kinematics with Constant Acceleration
W Jan 25	Lect #7	§2.7: Freefall
F Jan 27	Lect #8	§3.1-3.3: Vectors vs. Scalars, Vector Notation, Vector Components
M Jan 30	Lect #9	§3.1-3.3: Vector Arithmetic
W Feb 1	Lect #10	§3.5: Adding Velocities & 2-D Kinematics
F Feb 3	Lect #11	§3.4: Projectile Motion
M Feb 6	Lect #12	§4.1–4.5: Common Forces, Newton's Laws of Motion
W Feb 8	Lect #13	§4.6–4.7: Free-body Diagrams, 1-D & 2-D Force Problems §16.1: Elastic Force (Ideal Springs) & Hooke's Law *[[§5.3: Stress & Strain]]*
F Feb 10	Lect #14	§5.1: Surface Friction *[[§5.2: Fluid Drag]]*
M Feb 13	Lect #15	§4.5: Inclines §9.5: Simple Machines & Mechanical Advantage §4.8: Four Fundamental Forces of Nature
W Feb 15	Lect #16	§16.2: Period & Frequency §6.1–6.3: Uniform Circular Motion, Centripetal Acceleration & Force *[[§6.4: Fictitious Forces: Centrifugal & Coriolis]]*
F Feb 17	**MIDTERM #1**	**Chaps. 1–5 (plus §9.5 & §16.1)**
(M Feb 20)	HOLIDAY	
W Feb 22	Lect #17	same as Lect #16
F Feb 24	Lect #18	§6.5: Newton's Law of Universal Gravitation
M Feb 27	Lect #19	§6.6: Orbits & Kepler's Laws
W Mar 1	Lect #20	§7.1: Work & Energy §7.2: Kinetic Energy & Work-Energy Theorem §7.7: Power *[[§7.8–7.9: Energy in Humans & Society]]*
F Mar 3	Lect #21	§7.3: Gravitational Potential Energy §16.1: Elastic Potential Energy §7.4–7.5: Conservative vs. Non-conservative Forces
M Mar 6	Lect #22	§7.6: Conservation of Energy
W Mar 8	Lect #23	§8.1–8.2: Momentum & Impulse
F Mar 10	Lect #24	§8.3: Conservation of Momentum §8.4–8.5: Elastic vs. Inelastic 1-D Collisions *[[§8.6: 2-D Collisions and §8.7: Rocket Propulsion]]*
M Mar 13	Lect #25	*not in textbook:* Center of Mass, Velocity of CM

W Mar 15	Lect #26	§10.1–10.2: Rotational Kinematics §10.3: Moment of Inertia
F Mar 17	Lect #27	§10.4: Rotational Kinetic Energy, Rolling Objects §9.1–9.2: Torque
M Mar 20	Lect #28	§10.3: Rotational Dynamics §9.3–9.4: Static Equilibrium & Stability §9.5: Mechanical Advantage of Levers *[[§9.6: Human Body Forces & Torques]]*
W Mar 22	Lect #29	§10.5 & 10.7: Angular Momentum, Conservation of Ang. Mom., Gyroscopes *[[§10.6: Collisions of Extended Bodies in 2-D]]*
F Mar 24	Lect #30	§11.1: States of Matter §11.2: Density §11.3 & 11.6: Pressure §11.5: Pascal's Principle *[[§11.9: Pressure in the Human Body]]*
Mar 27–31	**HOLIDAY**	**SPRING BREAK**
M Apr 3	Lect #31	§11.4: Hydrostatic Pressure Increase with Depth §11.7: Archimedes' Principle & Buoyancy
W Apr 5	Lect #32	§12.1: Continuity Equation §12.2–12.3: Bernoulli's Equation & Principle *[[§12.4–12.6: Viscosity]]*
F Apr 7	**MIDTERM #2**	**Chaps. 6–10 (plus §16.2)**
M Apr 10	Lect #33	§16.3 & 16.5–16.6: Simple Harmonic Motion
W Apr 12	Lect #34	§16.4: Simple Pendulums §16.7–16.8: Damped Oscillations, Driven Oscillations, Resonance
F Apr 14	Lect #35	§16.9: Continuous Waves *not in textbook:* Speed of Waves on a String §17.1–17.2, 17.6: Sound Waves §16.11: Wave Energy & Intensity *[[§17.3: Sound Intensity & Decibel Scale]]* *not in textbook:* Reflection & Transmission
M Apr 17	Lect #36	§16.10: Superposition Principle, Interference, Beats, Standing Wave Modes (Normal Modes) on a String
W Apr 19	Lect #37	§17.5: Standing Wave Modes in Air Columns §17.4: Doppler Effect & Shock Fronts
F Apr 21	Lect #38	§13.1: Temperature §13.5: *PT* Phase Diagrams §13.2: Thermal Expansion of Solids & Liquids
M Apr 24	Lect #39	§13.3: Ideal Gas Law §13.4: Kinetic Theory of Gases & Maxwell-Boltzmann Distributions
W Apr 26	Lect #40	§14.1: Heat §14.2: Heat Capacity & Specific Heat
F Apr 28	Lect #41	§14.3: Latent Heat & Phase Transitions *[[§14.4–14.7: Heat Transfer Methods: Conduction, Convection, Radiation]]* §15.1: 1st Law of Thermodynamics
M May 1	Lect #42	§15.2: Work Done by/on a Gas, *PV* Diagrams, Constant-Value Processes §15.3–15.4: Heat Engines *[[§15.5: Heat Pumps & Refrigerators]]*
W May 3	Lect #43	§15.6 *[[and §15.7]]*: Entropy & 2nd Law of Thermodynamics
M May 8	**FINAL EXAM**	**Cumulative, with emphasis on Chaps. 11–17**

OMITTED:
§11.8: Surface Tension & Capillary Action
§12.7: Molecular Transport: Diffusion & Osmosis
§13.6: Humidity, Evaporation, and Boiling
§17.7: Ultrasound