

General Information

The handouts¹ are specifically meant to be a rigorous resource for physics courses at school that include all the concepts required with additional topics not taught sprinkled throughout for a more thorough understanding. Each handout contains ideas (core concepts for the unit) where each idea is followed by an example with a worked solution and finally a set of MCQ and FRQ style questions.

Problems

There are three types of problems in the handouts. The first, examples, are provided along with a worked solution directly after introducing an idea and are either meant to show a particularly hard problem or method corresponding to the concept or to specifically examine the topic in an isolated, rather easy problem. The examples are either made by the handout writers or are taken from sources that aren't very advanced (unless they need to show a difficult technique). The second, multiple choice questions, are usually computationally light focusing instead on the concepts. They are found through a variety of sources and are chosen based on their resemblance to questions seen on actual tests. Finally, free-response questions test the other part of an exam and are usually multi-part. More than one concept, including those not found in the specific unit, may be required and primarily have answers symbolically or as an explanation of a principle or calculated values.

Curriculum

We provide handouts for three classes, algebra based mechanics (A1-7), calculus based mechanics (M1-7), and calculus based electricity and magnetism (E1-5). The core curriculum is detailed below; however it is definitely not a rigid path and should be completed according to understanding or requirements.

- 7 handouts of algebra based mechanics
 - **A1**: kinematics – one and two dimensional
 - **A2**: dynamics – Newton's Laws and contact forces
 - **A3**: circular motion and gravitation
 - **A4**: work, mechanical energy, systems, conservation of energy, and work-energy theorem
 - **A5**: center of mass, momentum, and impulse
 - **A6**: simple harmonic motion – energy and period
 - **A7**: rotational kinematics, torque, and angular momentum
- 7 handouts of calculus based mechanics
 - **M1**: kinematics – one and two dimensional
 - **M2**: dynamics – Newton's laws and circular motion
 - **M3**: work-energy theorem, systems, force and potential energy, conservation of energy, and power

¹Thanks to [Kevin Zhou](#) for the wonderful template that we used to make the handouts

- **M4**: center of mass, momentum, and impulse.
- **M5**: rotational kinematics, torque, statics, rotational dynamics, energy, and angular momentum
- **M6**: simple harmonic motion – springs and pendulums
- **M7**: gravitation – forces and orbits
- 5 handouts of calculus based electricity and magnetism
 - **E1**: electrostatics – Coulomb’s law, electric fields and potential, and Gauss’s law
 - **E2**: conductors, capacitors, and dielectrics
 - **E3**: electric circuits – current, resistance, and power
 - **E4**: magnetic fields – charges and current in magnetic field, Bio-Savart law, and Ampere’s law
 - **E5**: electromagnetism – induction, inductance, and Maxwell’s equations

Resources

A class is (usually) the best way to learn physics or clear up any misconceptions or problems; however in the event that a course is not feasible or more background learning is required, the following resources may be useful. For a typical high school physics class, OpenStax provides wonderful free textbooks that come with a variety of problems. For algebra based mechanics, ch. 2-12 of [College Physics 2e](#) are relevant. For calculus based mechanics, ch. 1-13 and 15 in [University Physics Volume 1](#) are applicable. For calculus based electricity and magnetism use Unit 2 (ch. 5-16) in [University Physics Volume 2](#). Supplemental resources such as [Khan Academy](#) are a good option for physics through algebra as the videos are concise but understandable and the exercises are okay although they aren’t very difficult².

For a more in-depth treatment of physics beyond that taught in a usual high school course, see *Physics* 5th edition volumes 1 and 2 by Halliday Resnick and Krane for calculus based physics and *Physics* by Giancoli for an algebraic route.

How to use the handouts

Learning physics with calculus is the best way to begin as calculus was invented to solve physics problems. In that regard, M1-7 should be completed followed by E1-5. However, if the student does not know calculus or is not willing to learn it for the sake of physics then naturally P1-7 is the best. Algebra based physics is only useful for those wanting a cursory understanding of physics and should be avoided for the majority of purposes.

If the handouts are used as a supplement to a course, then they should be completed at a rate of one per unit. If there is no schedule, however, then one handout per 3-4 days is more than enough. They may be used as preparation for cumulative exams, but there are a few review handouts available too.

²Note that Khan Academy also has an AP Physics 1 course; however it is incomplete as a lot of the content was removed leaving videos that don’t flow well and exercises the expect knowledge not taught.