General Information

The handouts[1] 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 goes over the necessary theory and contains a plethora of problems to work on. Remarks and notes are placed as needed to elaborate on specifics.

Problems

Each handout contains problems to demonstrate the concepts covered. There are few types of questions that are included and server various purposes. The first, examples, are provided with their solution directly after an important idea is covered. The second are fifteen multiple choice questions that are conceptual or less computationally intensive. Next, there are four multi-part free response questions that require the use of multiple different physics concepts, although all should be covered before the handout in question. The MCQ and FRQ most model a real life exam and should be the priority to solve. Finally, a collection of problems pertaining to a specific topic are sprinkeled throughout the handout. These vary in difficulty and are placed for extra practice, challenges, or to highlight something important.

Curriculum

We provide handouts for three classes, algebra based mechanic (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
  - **M4**: center of mass, momentum, and impulse.

[1]Thanks to Kevin Zhou for the wonderful template that we used to make this document!

  - **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 difficult[2].

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

For a calculus path, complete M1-7 and then E1-5. For algebra, complete A1-7. If the handouts are used as a supplement to a course, then they should be completed one per unit. However, if they are begin used for self-study, then 3-4 days for one handout is plenty. They can be used to study for unit exams or cummulative exams, although there are specific review handouts available too. The algebra series expects knowledge of pre-calculus including geometry, trigonometry, and algebra. When completing a handout, the MCQ and FRQ questions should be prioritized. It is not necessary to go through all the problems, however 75-80% completion is good enough (although most of these shouldn't be from extra questions found throught the handouts). When stuck on a problem, ask the course instructor or refer to the resources listed above.

[2]Note 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.