

Morgan Hill Unified School District

Course Outline

Course Title: Advanced Placement Physics (AP)

Course Length: One year

Grades: 10-12

Recommended: Completion of Algebra 2.

Course Goals

- Students will demonstrate knowledge of the following:
 - motion and forces
 - conservation of Energy and momentum
 - heat and thermodynamics
 - waves and optics
 - electronic and magnetic phenomena
 - nuclear and modern physics

Texts and Supplemental Instructional Materials

- **Texts:** Physics Serway and Faughn, Holt Rinehart and Winston, ISBN003050976. Conceptual Physics, Paul Hewitt, Foresman and Wesley, ISBN 0201286521.
- **Supplemental Materials:** Holt Interactive Physics Tutor, Lab Materials, Audiovisual, Internet, and CD ROM simulations.

Course Description

AP Physics is a rigorous course involving mathematical applications of the natural laws. The course follows the AP Physics B topics listed below. The course fulfills the California University A-G list as a Lab Science and will prepare the student to take the AP Physics B exam.

Course Objectives by Essential Standards

Standard 1:

Students will understand Newton's Laws of Motion. This knowledge will be measured by a variety of methods, such as quizzes, tests, presentations, projects, labs, activities, notes, journals, portfolios, visual and/or verbal assessments. In order to exhibit proficiency students will demonstrate knowledge that:

- Students will be able to solve problems involving constant speed and average speed.
- Inertia, Newton's first law. Preservation of uniform motion in the absence of a net force.
- Applications of Newton's 2nd Law, $F=ma$, in one-dimensional motion problems.
- Applications of Newton's 3rd Law, Conservative forces. For every action there is an equal and opposite reaction.
- Applications of Newton's Law of Universal Gravitation near the surface of the earth. Acceleration of gravity, 9.8 m/s^2 used as a constant due to problems limiting range to close to Earth's surface.
- Satellite motion. Speed and velocity relationships in circular motion. Centripetal force as a perpendicular force and the effects on motion.

- Circular motion as a consequence of a centripetal force causing a centripetal acceleration.
- Establishing the range of applications for Newton's Laws. High Speed applications require special relativity and extremely small objects are subject to quantum effects which classical mechanics cannot predict.
- Projective motion and two dimensional kinematics applications.
- Two-dimensional vector resolution, addition and subtraction.
- Problem solving in static equilibrium applications.
- Problem solving in circular motion.
- Calculating forces, distances, masses, or charges using Newton's Law of Universal Gravitation or Coulomb's Law.

Standard 2:

Students will understand the conservation of energy and momentum. This knowledge will be measured by a variety of methods, such as quizzes, tests, presentations, projects, labs, activities, notes, journals, portfolios, visual and/or verbal assessments. In order to exhibit proficiency students will demonstrate knowledge that:

- The student will know how to calculate kinetic energy using the formula: $E = \frac{1}{2} mv^2$
- The student will know how to calculate changes in gravitational potential energy near the Earth using the formula: $E = mgh$
- The student will be able to apply conservation of energy to solve simple systems such as falling objects.
- The student will be able to calculate an object's momentum using the formula: $P = mv$
- The student will recognize momentum as a separately conserved quantity, different from energy.
- Students will recognize that an unbalance force acting on an object will change the object's momentum.
- Students will solve one-dimensional elastic and inelastic collision problems by applying conservation of momentum and conservation of energy appropriately.
- Students will solve various problems using conservation of energy in simple systems with assorted forms of potential (i.e. elastic, electrical, gravitational, thermal).

Standard 3:

Students will understand heat and thermodynamics. This will be measured by a variety of methods, such as quizzes, tests, presentations, projects, labs, activities, notes, journals, portfolios, visual and/or verbal assessments. In order to exhibit proficiency students will demonstrate knowledge that:

- Students will identify heat flow and work as two forms of energy transferred between systems.
- Students will identify the difference in heat flow input compared to heat flow exhausted from a heat engine as equal to the work done by the engine. And that conservation of energy applies to heat as stated in the first law of thermodynamics.
- Students will understand the Kinetic Theory of matter, or that heat is random motion, vibration, and rotation of atoms and molecules. The greater the temperature, the greater the motion.

- Students will understand that systems will move on their own to equilibrium, decreasing order or energy concentrations until energy is eventually distributed uniformly.
- Entropy is a quantity that measures disorder of a system. As entropy increases, order decreases.
- Students will recognize that entropy is a consequence of the second law of thermodynamics and that heat flow from hot to cold is a required condition of the kinetic theory and probability statistics which govern closed system.

Standard 4:

Students will understand the properties of waves. This will be measured by a variety of methods, such as quizzes, tests, presentations, projects, labs, activities, notes, journals, portfolios, visual and/or verbal assessments. In order to exhibit proficiency students will demonstrate knowledge that:

- Students will recognize that all waves carry energy from one place to another.
- Students will identify longitudinal and transverse waves in mechanical media such as springs, ropes, and the Earth (seismic waves).
- Students will know how to solve problems involving wave speed, frequency, and wavelength.
- Students will recognize sound as a longitudinal wave whose speed depends on the physical properties of the medium in which it propagates.
- Students will recognize the various types of electromagnetic radiation. And that x-rays, light, radio waves, etc. are all part of the spectrum of electro-mag waves whose speed in a vacuum is 3×10^8 .
- Students will recognize the various wave properties such as constructive and destructive interference, beats, diffraction, reflection, refraction, Doppler effect, and polarization.

Standard 5:

Students will understand electric and magnetic phenomena. This will be measured by a variety of methods, such as quizzes, tests, presentations, projects, labs, activities, notes, journals, portfolios, visual and/or verbal assessments. In order to exhibit proficiency students will demonstrate knowledge that:

- Students will be able to predict currents and voltages in simple direct current circuits including batteries, resistors, capacitors, and wires.
- Students will be able to solve problems using Ohm's Law.
- Students will be able to solve problems for energy dissipation as heat in a resistor using power. $P=IV$, $V=IR$, and $P=I^2R$.
- Students will know the properties of transistors and their role in a circuit.
- Students will recognize that charged particles are sources of electric fields and experience forces due to the fields of other charged particles.
- Students will recognize that moving charge (currents) and magnetic materials (magnets) give rise to magnetic fields which experience forces due to other magnetic fields.
- Students will determine the direction of the magnetic field around a current carrying straight or coiled wire.

- Students know that changing magnetic fields produce electric fields and therefore cause currents in nearby conductors.
- A student recognize plasma, the fourth state of matter, as containing ions or free electrons and therefore conducts electricity.
- Students know that Electric and magnetic fields have regions of potential and act as vector force fields on charged objects.
- Students know that the force on a charge in an electric field is equal to QE where Q is charge and E is field.
- Students can calculate the field around a point charge. $E=F/Q$ or $E=KZ/R^2$ where K is Coulomb's constant, F is force, R is distance.
- Students know that static electric fields have at their source some arrangement of electric charge.
- Students will find the force on a moving charge in a magnetic field as the product of $QvB\sin A$ where Q is charge, v is velocity, B is magnetic field and A is the Angle between v and B . The direction of the force will be determined by the right hand rule.
- Students will apply the concepts of gravitational and electrical potential energy to solve problems based on conservation of energy.

Outline of Course

- Introduction to Science and Philosophy
 - Kinematics, one and two dimensional
 - Mechanics, translational and rotational
 - Momentum
 - Physical Properties of Matter*
 - Special Relativity*
 - Thermodynamics and Heat
 - Wave Properties, Light and Sound
 - Electricity and Magnetism
 - Optics
 - Modern Physics, Nuclear and quantum*
 - Final Exam, review, and Standardized test prep
- *topics covered in AP curriculum that go beyond state standards

Methods of Instruction

- Lecture
- Laboratory Investigations
- Group/Individual Activities
- Discussion
- Critical reading assignments
- Audio Visual Materials
- Guest Speakers
- Writing Assignment including:
 - CD ROM simulations to practice problem-solving
 - Standardized test item drills for reading practice

- Reports and papers that demonstrate appropriate format, style, usage, spelling, punctuation and vocabulary.
- Internet as a research tool.
- Written reports, essays, and lab reports practicing different styles of writing using appropriate formats, usage, spelling, punctuation, and vocabulary
- Program spreadsheets for analysis and graphical presentation of data

Assessment methods and/or tools

Assessment methods include formative assessment, which will promote learning throughout the course or summative assessments, such as final exams, which document student progress toward meeting standards. These methods include:

- Multiple-choice, true/false, matching, and short answer fill-in items, which can appear on single topic quizzes, unit, midterm and final exams.
- Performance, e.g. student projects, lab performances and reports, debates, oral and written presentations, class participation, essays and written reports, problem-solving sets.