Title ***Advanced Physics in Creation***
ISBN 978-1-932012-18-7 (student text) 978-1-932012-19-4 (solutions and tests)

Science Credits	1
Lab Credits[1]	1
Honors Designation[2]	Yes
Science Type	Physical

This laboratory-based advanced physics course is designed to be taken after the student has completed trigonometry and *Exploring Creation with Physics*. If the student takes both courses, he or she will cover the entire AP physics 1 syllabus. You cannot call it an AP course, however, unless you have your specific implementation of the course approved by the College Board.

The book begins with a review of vectors and then discusses cross and dot products. Work is used as an example of the importance of the dot product, and torque is used as an example of the importance of the cross product. Free fall is discussed, and a detailed analysis of air resistance and terminal velocity is given.

Newton's laws of motion are then reviewed, and the concepts of inertial reference frames and inertial mass are discussed. Equilibrium is analyzed using Atwood's machine, and an in-depth discussion of kinetic friction is given. Energy concepts and momentum conservation are then used to analyze one- and two-dimensional collisions, both elastic and inelastic.

The book turns next to rotational motion, discussing the center of mass, moment of inertia, and angular momentum. This leads to a discussion of oscillation and waves, focusing on the mass/spring system, the physical pendulum, standing waves, wave propagation, reflection, and superposition. Sound is related to those concepts using the bottle paradox, standing sound waves, beats, and the Doppler Effect. Light is also related to those concepts, using the interference of light waves. Geometric optics is then reviewed, followed by the mirror equation being applied to both curved mirrors and lenses.

Gravity is the next topic, and it is related to the solar system, concentrating on Kepler's Laws and why they exist. The effect of the earth's rotation on a person's measured weight is discussed as is gravitational potential energy. Einstein's Special Theory of Relativity is covered (including the Twin Paradox) so that his General Theory of Relativity can then be covered.

Next, the book turns to a discussion of heat, temperature scales, and phases. Volume and length change as a result of temperature change is covered, as is the behavior of gases. This leads to a discussion of the first three laws of thermodynamics, cyclic processes, heat engines, and the Carnot cycle.

Electrostatics is then discussed, concentrating on a quantitative description of the electric field. That concept is then applied to insulators, conductors, and superconductors. The electric field of capacitors is discussed, as well as the dielectrics used in them. DC circuits are then analyzed in detail, using Ohm's Law, the equations for combining resistors, the equations for combining capacitors, and Kirchoff's rules. The internal resistance of batteries is also covered.

Magnetism comes next, emphasizing the motion of charged particles in magnetic fields, cyclotrons, and the behavior of current-carrying wires in a magnetic field. That leads to a detailed discussion of motional emf and electromagnetic induction. Alternating current is also covered.

The book ends with atomic physics and nuclear physics. A detailed analysis of the Bohr model is given, requiring the student to calculate the wavelengths of light emitted and absorbed by one-electron atoms. Atomic size is discussed, as is the quantum-mechanical model of the atom. A detailed discussion of binding energy follows. The student then learns the various modes of radioactive decay, the kinetics of radioactive decay, and the dangers of radiation. The student is then taught about radiometric dating, other uses of radioactivity, and nuclear reactions (including fission and fusion).

There are 23 experiments in the course, comprising approximately 28 hours of laboratory instruction.

[1]To qualify as a lab credit, all of the experiments must be performed. Those experiments must be fully documented in a laboratory notebook, as discussed in the introduction to the text.

[2]To qualify as an honors credit, all modules must be completed, the tests must be taken closed book, and all experiments must be performed. Those experiments must be fully documented in a laboratory notebook, as discussed in the introduction to the text. In addition, a grade of B or higher must be earned following the pedagogy in the answer key.