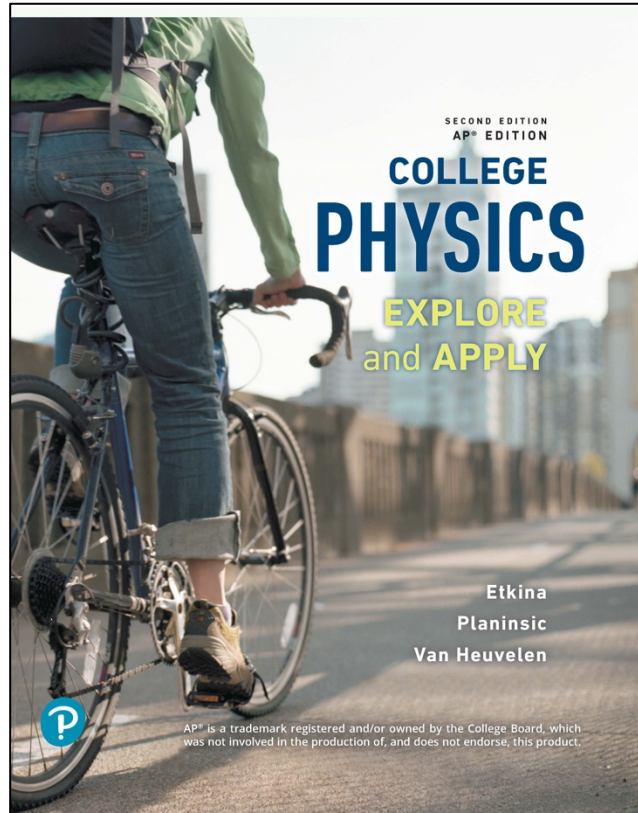


A Correlation of  
**College Physics:**  
**Explore and Apply**  
2nd Edition, AP<sup>®</sup> Edition ©2019



To the  
**AP<sup>®</sup> Physics 2**  
**Course Framework**  
**Effective Fall 2024**



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The units above reflect the College Board's AP® Physics 2 Course Framework.

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to the College Board AP® Physics 2 Course Framework**

<b>Unit 9: Thermodynamics (6 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
9.1 Kinetic Theory of Temperature and Pressure	<p>9.1.A Describe the pressure a gas exerts on its container in terms of atomic motion within that gas.</p> <p>9.1.B Describe the temperature of a system in terms of the atomic motion within that system.</p>	<p>12.2 Pressure, density, and the mass of particles</p> <p>12.3 Quantitative analysis of an ideal gas</p> <p>12.4 Temperature</p> <p>12.6 Speed distribution of particles</p>
9.2 The Ideal Gas Law	9.2.A Describe the properties of an ideal gas.	<p>12.1 Structure of matter</p> <p>12.4 Temperature</p> <p>12.5 Testing the ideal gas law</p> <p>12.7 Skills for analyzing processes using the ideal gas law</p>
9.3 Thermal Energy Transfer and Equilibrium	9.3.A Describe the transfer of energy between two systems in thermal contact due to temperature differences of those two systems.	<p>15.2 Two ways to change the energy of a system</p> <p>15.3 First law of thermodynamics</p> <p>15.7 Heating mechanisms</p>
9.4 The First Law of Thermodynamics	<p>9.4.A Describe the internal energy of a system.</p> <p>9.4.B Describe the behavior of a system using thermodynamic processes.</p>	<p>12.8 Thermal energy, the Sun, and diffusion</p> <p>15.1 Internal energy and work in gas processes</p> <p>15.2 Two ways to change the energy of a system</p> <p>15.3 First law of thermodynamics</p> <p>15.4 Applying the first law of thermodynamics to gas processes</p>

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<b>Unit 9: Thermodynamics (6 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
9.5 Specific Heat and Thermal Conductivity	<p>9.5.A Describe the energy required to change the temperature of an object by a certain amount.</p> <p>9.5.B Describe the rate at which energy is transferred by conduction through a given material.</p>	<p>15.5 Specific heat</p> <p>15.7 Heating mechanisms</p>
9.6 Entropy and the Second Law of Thermodynamics	9.6.A Describe the change in entropy for a given system over time.	<p>16.1 Irreversible processes</p> <p>16.2 Entropy: the microscopic approach</p> <p>16.3 Entropy: the macroscopic approach</p>

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<b>Unit 10: Electric Force, Field, and Potential (7 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
10.1 Electric Charge and Electric Force	<p>10.1.A Describe the electric force that results from the interactions between charged objects or systems.</p> <p>10.1.B Describe the electric and gravitational forces that result from interactions between charged objects with mass.</p> <p>10.1.C Describe the electric permittivity of a material or medium.</p>	<p>17.1 Electrostatic interactions</p> <p>17.2 Explanations for electrostatic interactions</p> <p>17.3 Conductors and insulators (dielectrics)</p> <p>17.4 Coulomb's force law</p> <p>17.6 Skills for analyzing processes involving electric charges</p>
10.2 Conservation of Electric Charge and the Process of Charging	<p>10.2.A Describe the behavior of a system using conservation of charge.</p>	<p>17.1 Electrostatic interactions</p> <p>17.2 Explanations for electrostatic interactions</p>
10.3 Electric Fields	<p>10.3.A Describe the electric field produced by a charged object or configuration of point charges.</p> <p>10.3.B Describe the electric field generated by charged conductors or insulators.</p>	<p>18.1 A model of the mechanism for electrostatic interactions</p> <p>18.2 Skills for analyzing processes involving E fields</p> <p>18.5 Conductors in electric fields</p> <p>18.6 Dielectric materials in an electric field</p>
10.4 Electric Potential Energy	<p>10.4.A Describe the electric potential energy of a system.</p>	<p>17.5 Electric potential energy</p> <p>17.6 Skills for analyzing processes involving electric charges</p>

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<b>Unit 10: Electric Force, Field, and Potential (7 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
10.5 Electric Potential	<p>10.5.A Describe the electric potential due to a configuration of charged objects.</p> <p>10.5.B Describe the relationship between electric potential and electric field.</p>	<p>18.3 The V field: electric potential</p> <p>18.4 Relating the E field and the V field</p> <p>18.5 Conductors in electric fields</p> <p>18.6 Dielectric materials in an electric field</p>
10.6 Capacitors	10.6.A Describe the physical properties of a parallel-plate capacitor.	18.7 Capacitors
10.7 Conservation of Electric Energy	10.7.A Describe changes in energy in a system due to a difference in electric potential between two locations.	<p>17.5 Electric potential energy</p> <p>17.6 Skills for analyzing processes involving electric charges</p> <p>18.3 The V field: electric potential</p>

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<b>Unit 11: Electric Circuits (8 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
11.1 Electric Current	11.1.A Describe the movement of electric charges through a medium.	19.1 Electric current
11.2 Simple Circuits	11.2.A Describe the behavior of a circuit.	19.1 Electric current 19.2 Batteries and emf 19.3 Making and representing simple circuits
11.3 Resistance, Resistivity, and Ohm's Law	11.3.A Describe the resistance of an object using physical properties of that object.  11.3.B Describe the electrical characteristics of elements of a circuit.	19.4 Ohm's law 19.10 Properties of resistors
11.4 Electric Power	11.4.A Describe the transfer of energy into, out of, or within an electric circuit, in terms of power.	19.6 Joule's law
11.5 Compound Direct Current (DC) Circuits	11.5.A Describe the equivalent resistance of multiple resistors connected in a circuit.  11.5.B Describe a circuit with resistive wires and a battery with internal resistance.  11.5.C Describe the measurement of current and potential difference in a circuit.	19.5 Qualitative analysis of circuits 19.7 Kirchhoff's rules 19.8 Resistor and capacitor circuits 19.9 Skills for solving circuit problems

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<b>Unit 11: Electric Circuits (8 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
11.6 Kirchhoff's Loop Rule	11.6.A Describe a circuit or elements of a circuit by applying Kirchhoff's loop rule.	19.7 Kirchhoff's rules 19.9 Skills for solving circuit problems
11.7 Kirchhoff's Junction Rule	11.7.A Describe a circuit or elements of a circuit by applying Kirchhoff's junction rule.	19.7 Kirchhoff's rules 19.9 Skills for solving circuit problems
11.8 Resistor-Capacitor (RC) Circuits	11.8.A Describe the equivalent capacitance of multiple capacitors.  11.8.B Describe the behavior of a circuit containing combinations of resistors and capacitors.	19.8 Resistor and capacitor circuits



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<b>Unit 12: Magnetism and Electromagnetism (4 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
12.1 Magnetic Fields	<p>12.1.A Describe the properties of a magnetic field.</p> <p>12.1.B Describe the magnetic behavior of a material as a result of the configuration of magnetic dipoles in the material.</p> <p>12.1.C Describe the magnetic permeability of a material.</p>	<p>20.1 Magnetic interactions</p> <p>20.2 Magnetic field</p> <p>20.6 Skills for analyzing magnetic processes</p> <p>20.7 Magnetic properties of materials</p>
12.2 Magnetism and Moving Charges	<p>12.2.A Describe the magnetic field produced by moving charged objects.</p> <p>12.2.B Describe the force exerted on moving charged objects by a magnetic field.</p>	<p>20.4 Magnetic force exerted on a single moving charged particle</p> <p>20.6 Skills for analyzing magnetic processes</p>
12.3 Magnetism and Current-Carrying Wires	<p>12.3.A Describe the magnetic field produced by a current-carrying wire.</p> <p>12.3.B Describe the force exerted on a current-carrying wire by a magnetic field.</p>	<p>20.3 Magnetic force on a current-carrying wire</p> <p>20.5 Magnetic fields produced by electric currents</p> <p>20.6 Skills for analyzing magnetic processes</p>
12.4 Electromagnetic Induction and Faraday's Law	<p>12.4.A Describe the induced electric potential difference resulting from a change in magnetic flux.</p>	<p>21.1 Inducing an electric current</p> <p>21.2 Magnetic flux</p> <p>21.3 Direction of the induced current</p> <p>21.4 Faraday's law of electromagnetic induction</p> <p>21.5 Skills for analyzing processes involving electromagnetic induction</p>

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<b>Unit 13: Geometric Optics (4 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
13.1 Reflection	13.1.A Describe light as a ray.  13.1.B Describe the reflection of light from a surface.	22.1 Light sources, light propagation, and shadows 22.2 Reflection of light 22.5 Skills for analyzing reflective and refractive processes
13.2 Images Formed by Mirrors	13.2.A Describe the image formed by a mirror.	23.1 Plane mirrors 23.2 Qualitative analysis of curved mirrors 23.3 The mirror equation 23.6 Skills for analyzing processes involving mirrors and lenses
13.3 Refraction	13.3.A Describe the refraction of light between two media.	22.3 Refraction of light 22.4 Total internal reflection 22.5 Skills for analyzing reflective and refractive processes 24.2 Refractive index, light speed, and wave coherence
13.4 Images Formed by Lenses	13.4.A Describe the image formed by a lens.	23.4 Qualitative analysis of lenses 23.5 Thin lens equation and quantitative analysis of lenses 23.6 Skills for analyzing processes involving mirrors and lenses

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<b>Unit 14: Waves, Sound, and Physical Optics (9 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
14.1 Properties of Wave Pulses and Waves	14.1.A Describe the physical properties of waves and wave pulses.	11.1 Observations: pulses and wave motion 11.3 Dynamics of wave motion: speed and the medium 11.7 Sound 25.2 Discovery of electromagnetic waves
14.2 Periodic Waves	14.2.A Describe the physical properties of a periodic wave.	11.2 Mathematical descriptions of a wave 11.3 Dynamics of wave motion: speed and the medium
14.3 Boundary Behavior of Waves and Polarization	14.3.A Describe the interaction between a wave and a boundary.	11.4 Energy, power, and intensity of waves 11.5 Reflection and impedance 25.1 Polarization of waves 25.6 Polarization and light reflection
14.4 Electromagnetic Waves	14.4.A Describe the properties of an electromagnetic wave.	25.2 Discovery of electromagnetic waves 25.4 Frequency, wavelength, and the electromagnetic spectrum
14.5 The Doppler Effect	14.5.A Describe the properties of a wave based on the relative motion between the source of the wave and the observer of the wave.	11.10 The Doppler effect

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<b>Unit 14: Waves, Sound, and Physical Optics (9 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
14.6 Wave Interference and Standing Waves	14.6.A Describe the net disturbance that occurs when two or more wave pulses or waves overlap.  14.6.B Describe the properties of a standing wave.	11.6 Superposition principle and skills for analyzing wave processes 11.7 Sound 11.8 Standing waves on strings 11.9 Standing waves in air columns
14.7 Diffraction	14.7.A Describe the behavior of a wave and the diffraction pattern resulting from a wave passing through a single opening.	24.5 Diffraction of light 24.7 Skills for applying the wave model of light
14.8 Double-Slit Interference and Diffraction Gratings	14.8.A Describe the behavior of a wave and the diffraction pattern resulting from the wave passing through multiple openings.	24.1 Young's double-slit experiment 24.2 Refractive index, light speed, and wave coherence 24.3 Gratings: an application of interference 24.7 Skills for applying the wave model of light
14.9 Thin-Film Interference	14.9.A Describe the behavior of light that interacts with a thin film.	24.4 Thin-film interference

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<b>Unit 15: Modern Physics (8 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
15.1 Quantum Theory and Wave-Particle Duality	15.1.A Describe the properties and behavior of an object that exhibits both particle-like and wave-like behavior.	22.7 Explanation of light phenomena: two models of light 27.4 Photons 28.6 Particles are not just particles
15.2 The Bohr Model of Atomic Structure	15.2.A Describe the properties of an atom.	28.1 Early atomic models 28.2 Bohr's model of the atom: quantized orbits
15.3 Emission and Absorption Spectra	15.3.A Describe the emission or absorption of photons by atoms.	28.2 Bohr's model of the atom: quantized orbits 28.3 Spectral analysis
15.4 Blackbody Radiation	15.4.A Describe the electromagnetic radiation emitted by an object due to its temperature.	27.1 Black body radiation
15.5 The Photoelectric Effect	15.5.A Describe an interaction between photons and matter using the photoelectric effect.	27.2 The photoelectric effect 27.3 Quantum model explanation of the photoelectric effect
15.6 Compton Scattering	15.6.A Describe the interaction between photons and matter using Compton scattering.	(none)

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<b>Unit 15: Modern Physics (8 topics) AP® Physics 2 Course Framework</b>		
<b>Topic</b>	<b>Learning Objectives</b>	<b>College Physics: Explore and Apply Chapters and Sections</b>
15.7 Fission, Fusion, and Nuclear Decay	<p>15.7.A Describe the physical properties that constrain the behavior of interacting nuclei, subatomic particles, and nucleons.</p> <p>15.7.B Describe the radioactive decay of a given sample of material consisting of a finite number of nuclei.</p>	<p>29.1 Radioactivity and an early nuclear model</p> <p>29.2 A new particle and a new nuclear model</p> <p>29.3 Nuclear force and binding energy</p> <p>29.4 Nuclear reactions</p> <p>29.5 Nuclear sources of energy</p> <p>29.7 Half-life, decay rate, and exponential decay</p> <p>29.8 Radioactive dating</p>
15.8 Types of Radioactive Decay	15.8.A Describe the processes by which individual nuclei decay.	<p>29.1 Radioactivity and an early nuclear model</p> <p>29.6 Mechanisms of radioactive decay</p>