Curriculum Map: AP Physics II

MASH

Science

Course Description: This is an AP laboratory course that meets six periods per week. It is designed to meet the requirements for students to be able to sit for the AP Physics 2 (algebra-based) exam. The course will explore principles of fluids, thermodynamics, electricity, magnetism, optics, and topics in modern physics. This is a mathematically rigorous course that will explore the subjects presented in great detail and at an accelerated pace. The focus will be on inquiry-based analyses of the properties of objects and systems, and their interactions.

Summary of Topics & Pacing

		Suggested Timing		Running Total	
Unit Title:	Thermodynamics	4	weeks	4	weeks
Unit Title:	Fluids Mechanics	4	weeks	8	weeks
Unit Title:	Electrostatics	3	weeks	11	weeks
Unit Title:	Electric Circuits	3	weeks	14	weeks
Unit Title:	Magnetism	3	weeks	17	weeks
Unit Title:	Electromagnetism	1	week	18	weeks
Unit Title:	Reflection & Refraction of Light	3	weeks	21	weeks
Unit Title:	Mirrors & Lenses	3	weeks	24	weeks
Unit Title:	Wave Optics	2	weeks	26	weeks
Unit Title:	Modern Physics	2	weeks	28	weeks
Unit Title:	Review for AP Physics 2 Exam	2	weeks	30	weeks
Unit Title:	Selected Topics/Project Based Analysis	3	weeks	33	weeks
Unit Title:	Review for Final Exam	2	weeks	35	weeks

Note: For the "Essential Questions" portion of the curriculum, the applicable "Big Idea" concepts, as presented in the AP Physics 2 materials from the College Board, are presented for each unit.

Unit Title: **Thermodynamics**

Suggested time frame: 4 weeks

Standards: Course - 3.2.P.A: PHYSICS

Standard 3.2.P.A6: Compare and contrast scientific theories.

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 7: The mathematics of probability can be used to describe the behavior of complex systems and to interpret the behavior of quantum mechanical systems.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define thermal equilibrium, thermal contact, and heat 2. State the zeroth law of thermodynamics 3. Relate temperature to the zeroth law of thermodynamics 4. Describe how thermometers work 5. Explain how absolute temperature was	temperature; zeroth, first, second & third laws of thermodynamics; thermometer; temperature; absolute zero; temperature scales; thermal expansion; ideal gas; ideal gas law; macroscopic theory of ideal gas; heat, internal energy; specific heat; fusion, vaporization; sublimation;	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
devised 6. Convert temperatures between temperature scales 7. State the properties that define an ideal gas 8. State the ideal gas law and apply it to systems of gases 9. State the assumptions that are used to create the kinetic theory of gas 10. State the relationship between the average kinetic energy of a molecule of monatomic ideal gas and temperature 11. Define heat and internal energy 12. Distinguish between heat and internal energy 13. Define specific heat 14. Calculate the energy transfer required to change the temperature of a system 15. Describe calorimetry and how it relates to the conservation of energy 16. Apply calorimetry techniques to systems of two or more objects 17. Define latent heat and phase change 18. Define latent heats of fusion, vaporization, and sublimation 19. Solve calorimetry problems 20. Define isobaric 21. Define the work done on a gas and by a gas in an isobaric adiabatic, isovolumetric, and isothermal processes 22. Calculate the work done on a gas in an isobaric process	calorimeter; calorimetry; latent heat; phase change; melting point; work; thermal processes; isobaric; adiabatic; isovolumetric; and isothermal; heat engine; entropy		

Competency	Vocabulary	Strategy	Resource
23. Calculate the work done on a gas using a PV diagram 24. State the first law of thermodynamics 25. Apply the first law of thermodynamics on systems and processes 26. Calculate thermodynamic properties for isobaric, adiabatic, isovolumetric, and isothermal processes. 27. State the second law of thermodynamics 28. State the thermodynamic and statistical definitions of entropy 29. Discuss the degradation of energy and the entropy of the universe			

Unit Title: **Fluids Mechanics**

Suggested time frame: 4 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State and contrast the four states of matter 2. Define the density of a uniform object 3. Define pressure and apply it to physical systems 4. Develop the equation for hydrostatic equilibrium to explain the variation of pressure with depth in a liquid at rest 5. Apply the equation of hydrostatic equilibrium to fluid systems 6. Explain Pascal's principle and apply it to fluid systems	states of matter; gas; solid; liquid; plasma; density; fluid; density; pressure; absolute pressure; Pascal's principle; fluid systems; gauge pressure; barometer; buoyancy; buoyant forces; Archimede's principle; equation of continuity; Bernoulli's equation	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
7. Define absolute pressure and gauge pressure 8. Calculate pressure from fluid heights in a barometer 9. State Archimede's principle 10. Define buoyant force 11. Apply Archimede's principle to floating and submerged objects 12. State the properties of an ideal fluid 13. State the equation of continuity and apply it to systems of fluid 14. State Bernoulli's equation and apply it to fluid systems			

Unit Title: **Electrostatics**

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define the SI unit of charge 2. Identify the basic carriers of positive and negative charges 3. Explain the concept of conservation of charge 4. Explain the concepts of insulators, conductors, and semiconductors as they relate to their ability to conduct electric charges	electric charge; fundamental charge; proton; electron; neutron; positive; negative; neutral; repel; attract; conservation of charge; insulator; conductor; induction; conduction; ground; coulomb; Coulomb's Law; superposition; electric field; Newton's per Coulomb; dipole; electrostatic	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
5. Explain the concepts of charge conduction and charge induction 6. State Coulomb's law 7. Describe the superposition principle 8. Apply Coulomb's law to systems of static charges 9. State the definition of an electric field 10. Determine the electric field produced by a system of charged particles 11. Relate electric field lines to the concept of electric fields 12. State the rules for drawing electric field lines and create field lines for simple charge configurations 13. Describe the properties of a conductor in electrostatic equilibrium 14. Define electric potential energy difference in a constant electric field in terms of the work done by the field 15. Contrast the concepts of electric potential and electric potential energy 16. Apply the work-energy theorem to systems involving electric potential and electric potential energy 17. Define the electric potential of point charges and pairs of point charges 18. Apply electric potential and	equilibrium; electric flux; permittivity; capacitance; dielectric; farad; voltage; emf; electric potential; equipotential surfaces; parallel and series capacitors; equivalent capacitance		

Competency	Vocabulary	Strategy	Resource
potential energy to systems of charges 19. Discuss the electric potential of an ideal conductor 20. Define the electron volt unit of energy 21. Define equipotential surface and describe its electrical properties 22. Describe a capacitor 23. Define capacitance 24. Derive the equation for a parallel plate capacitor 25. Describe the fundamental physical properties of a parallel plate capacitor 26. Derive the equations for the equivalent capacitance of capacitors in parallel, in series, and in parallel-series combinations 27. Determine the equivalent capacitance of a system of capacitors 28. Describe what a dielectric is 29. Describe electrically how a dielectric is used to affect the capacitance of a parallel plate capacitor 30. Define electrical current 31. Define an electric circuit 32. Explain the concepts of ammeters and voltmeters as they apply to measuring electrical characteristics in a circuit			

Competency	Vocabulary	Strategy	Resource
33. Explain the concept of electrical resistance 34. Explain resistance and resistivity 35. Use the equation for resistivity to determine the resistance of objects 36. Apply resistance to electrical systems 37. State Ohm's law 38. Use Ohm's law to relate current, voltage, and resistance in simple electrical circuits 39. Derive the expression for electrical power and apply to simple electrical systems			

Unit Title: Electric Circuits

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define electrical current 2. Define an electric circuit 3. Explain the concept of drift speed of electrons 4. Explain the concepts of ammeters and voltmeters as they apply to measuring electrical characteristics in a circuit 5. Explain the concept of electrical resistance 6. Explain resistance and resistivity	circuit; current; resistor; resistance; ohm; ampere/amp; battery; voltage source; resistivity; ohmic; Ohm's Law; power; power dissipation; node; parallel & series circuits; equivalent resistance; direct current; alternating current; emf; internal resistance; Kirchoff's Rules; loop equations; node equations; voltage polarity	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
7. Use the equation for resistivity to determine the resistance of objects 8. Apply resistance to electrical systems 9. State Ohm's law 10. Define the concept of an electrical circuit 11. Use Ohm's law to relate current, voltage, and resistance in simple electrical circuits 12. Derive the expression for electrical power and apply it to e electrical systems 13. Describe in physical terms the concepts of emf, terminal voltage, internal resistance, and load resistance 14. Calculate the current and power output of an emf source 15. Derive the equations for the equivalent resistance of resistors in parallel, in series, and in parallel-series combinations 16. Determine the equivalent resistance of a system of resistors 17. Explain the concept of direct current (DC) circuits 18. State Kirchoff's rules and relate them to the concepts of conservation of energy and conservation of charge 19. Apply Kirchoff's rules to systems DC circuits			

Competency	Vocabulary	Strategy	Resource
20. Describe a resistor-capacitor (RC) circuit 21. Describe the time dependent aspect of an RC circuit 22. Describe the concept of an RC circuit in steady-state equilibrium under DC conditions 23. Evaluate RC circuits involving DC emf sources and switches after the circuits reach steady-state equilibrium			

Unit Title: Magnetism

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Discuss the basic properties of magnets and magnetic fields 2. Describe the concepts of hard and soft magnetic materials and give examples of each 3. Identify the origin on magnetic fields in moving charges 4. Describe the Earth's magnetic field 5. Define the magnetic force on a charged particle in terms of experimental observations 6. Define the right-hand rule used to	magnetism; magnets; magnetic poles; south & north poles; soft & hard magnetic material; attract; repel; magnetic field; Earth's magnetic field; cross-product; tesla; right-hand rule; magnetic flux; motors; solenoid; magnetic domains;	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
relate moving charges, magnetic fields, and the force on the moving charge 7. Derive the equation for the force of a magnetic field on a long, current-carrying wire 8. Calculate the force of magnetic field on a current carrying conductor 9. State the equation for the magnitude of a magnetic field created by a long, straight wire carrying a current 10. State and use the right-hand rule for a long, straight wire to determining the magnetic field created by the wire carrying a current 11. Determine direction and magnitude of a magnetic field created by a wire loop carrying current 12. Describe, qualitatively, the creation of a magnetic field at the atomic level by orbiting electrons and electron spin 13. Define ferromagnetic materials and magnetic domains 14. Compare ferromagnetic, paramagnetic, and diamagnetic materials 15. Define magnetic flux 16. State the equation for magnetic flux 17. Describe the role magnetic flux has in producing and induced emf 18. Calculate the magnitude and change in the magnetic flux through a given area 19. State Faraday's law regarding magnetic induction 20. State Lenz's law regarding magnetic			

Competency	Vocabulary	Strategy	Resource
induction 21. Apply Farady's and Lenz's laws to systems with changing magnetic flux 22. Define motional emf 23. Use Faraday's law to calculate the potential difference across a moving conductor			

Unit Title: Electromagnetism

Suggested time frame:: 1 week

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard - 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Essential Questions:

- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Describe how an electromagnetic wave is produced 2. Describe the properties of an electromagnetic wave 3. State the equation relating the speed, frequency, and wavelength of an	Electromagnetism; frequency; wavelength; period; velocity/speed; plane wave; transverse wave; longitudinal wave—comparison with; spectrum; radio waves; microwaves; infrared waves; visible light; ultraviolet waves; x-rays;	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
electromagnetic wave 4. Describe the spectrum of electromagnetic waves 5. Describe the Doppler effect of electromagnetic waves	gamma rays; photon; Doppler effect		

Unit Title: Reflection & Refraction of Light

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Essential Questions:

- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Explain the dual nature of light have wave and particle properties 2. State the concept of a photon 3. State the equation for the energy of a photon 4. State and apply the ray approximation of light 5. State and apply the law of reflection for light 6. State the concept of refraction of light 7. Define the index of refraction of light 8. Calculate the wavelength of light in different media 9. State and apply Snell's law to light	particle-wave duality of light; Planck's constant (h); frequency; wavelength; c (speed of light); photon; wave front; reflection specular reflection; diffuse reflection; angle of incidence; index of refraction; refraction; law of reflection; Snell's law of refraction; dispersion; internal reflection; total internal reflection; critical angle	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
10. Define dispersion 11. Describe how a prism works 12. Define total reflection of light and determine critical angles for pairs of medium			

Unit Title: Mirrors & Lenses

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Essential Questions:

- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State the definitions of flat, concave, convex, and spherical mirrors 2. Define virtual and real images formed due to light reflecting off of a mirror 3. Derive the equation for the lateral magnification of an image formed due to light reflecting off of a mirror 4. Define the focal length for flat, concave, and convex mirrors 5. State relationship between the focal length and the radius of spherical mirrors 6. State the equation for the magnification of an image formed in front of a mirror 7. State and apply the mirror equation 8. State the sign conventions for concave and	mirror; lens; image; object; magnification; concave; convex; mirror equation; focal length; mirror radius; ray diagram; inverted image; upright image; refraction; reflection; thin lens; converging lens; diverging lens; spherical aberration; chromatic aberration	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
convex mirrors 9. State the definition of upright and inverted images for convex and concave mirrors 10. Create ray diagrams that show light rays forming images by reflected light from mirrors 11. Determine image position, magnification, and orientation, and whether the image is real or virtual for a mirror 12. Describe converging and diverging thin lenses 13. State the thin lens equation 14. State the sign conventions for the thin lens equation 15. Create a ray diagram that shows light rays forming images by light passing through a thin lens 16. Determine image position, magnification, and orientation, and whether the image is real or virtual for a thin lens and pairs of thin lenses			

Unit Title: Wave Optics

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Essential Questions:

- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State the two conditions that facilitate observations of interference in light waves 2. Define coherent and incoherent light 3. Describe Young's double-slit experiment 4. State the concepts of constructive and destructive interference 5. Describe how interference creates observed fringes in Young's double-slit experiment 6. Use the equations for constructive and destructive interference to calculate the fringe effect in Young's double-slit experiment 7. Describe the physical origins of diffraction 8. Discuss the appearance and ordering of	optics; interference; Young's double-slit experiment; constructive interference; destructive interference; fringes; wave front; point source of light; change of phase; diffraction; diffraction grating; polarization	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
maxima and minima in a diffraction pattern 9. State the condition for destructive interference in a single slit experiment 10. Apply the equation for single slit light refraction to determine the positions of dark fringes 11. Describe the effects of diffraction grating on incident plane waves 12. Describe the concept of order number in a diffraction pattern 13. Calculate maxima pattern for a diffraction grating to an optical system			

Unit Title: Modern Physics

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.A: PHYSICS

Course - 3.2.P.B: PHYSICS

Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard - 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
- Big Idea 7: The mathematics of probability can be used to describe the behavior of complex systems and to interpret the behavior of quantum mechanical systems.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define the rest energy of an object	rest energy; mass-energy equivalence; blackbody radiation; quantum number; Planck's constant;	Notes, example problems, labs, readings, homework, online simulations, formative assessment,	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015).

Competency	Vocabulary	Strategy	Resource
2. State Einstein's equation relating the rest energy of an object with the rest mass of an object 3. Calculate the energy equivalence of the mass of an object 4. Define thermal radiation 5. Define a blackbody and the reason for the definition 6. Sketch a typical curve the intensity of blackbody radiation as a function of wavelength 7. State Wein's displacement law regarding curve of blackbody radiation vs. wavelength 8. State Planck's equation relating the energy and the wavelength of blackbody radiation 9. Describe the photoelectric effect in terms of the photon theory of light 10. Define the work function in relation to the photoelectric effect 11. Use the equation for the photoelectric effect to determine the kinetic energy of a photoelectron 12. State de Broglie's hypothesis regarding the dual nature of light and matter 13. Apply de Broglie's hypothesis to quantum and classical objects 14. State the relationship of Schrödinger's wave equation and the probability function of a particles position 15. State the Bohr model of the atom 16. State the definition of the ground state	photoelectrons; photon; work function; photoelectric effect; dual nature of light; wave function; de Broglie's hypothesis; standard model of atoms; quantum mechanics; Bohr model; ground state; energy level; Pauli exclusion principle; Schrödinger's wave equation; binding energy; radioactive decay; atomic number; neutron number; mass number; isotope neutrino; antineutrino; beta decay; alpha decay; gamma decay; decay constant; half-life; nuclear reactions	summative assessment, differentiated instructions, cooperative learning.	• Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
of an electron 17. Describe the significance of the energy levels of an electron in an atom and the relationship to absorption and emission of a photon 18. Define the atomic, neutron, and mass number of a nucleus 19. Define an isotope of an atom 20. Relate the size of an nucleus to its stability 21. Define the binding energy in a nucleus 22. State the three types of radioactive decay 23. Define decay rate, decay constant, and half-life 24. State what a neutrino and an antineutrino is 25. State the processes for the three types of radioactive decay in terms of conservation of atomic number and charge 26. Determine the products of the three types of radioactive decay for given unstable atomic isotopes			

Unit Title: Preparation for the AP Physics 2 Exam

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.A: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard - 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
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- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
- Big Idea 7: The mathematics of probability can be used to describe the behavior of complex systems and to interpret the behavior of quantum mechanical systems.

Competency	**Vocabulary**	**Strategy**	**Resource**
Review of all topics presented to this point during the school year	All of the vocabulary addressed to this point during the school year	example problems, homework, online simulations, formative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015). • Simulation Websites

Unit Title: Selected Topics/Project Based Analysis

Possible Topics: Kepler's laws; Relativity; Car accident analysis; Using Microsoft Excel to analyze complex systems

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Unit Title: Review for Final Exam

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.