

Correlation to West Virginia Content Standards and Objectives: Advanced Physics

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page
AP.1.01 Advanced Physics	Standard 1: History and Nature of Science	History and Nature of Science	formulate scientific explanations based on the student's observational and experimental evidence, accounting for variability in experimental results.	7	revising explanations through observation	16 what do the results tell you?
				8	refining theories based on observations	18 are the accelerations different?
				10	the usefulness of phlogiston theory despite being incorrect	19 does the ball accelerate? 25 find the average time
				42	controlling variables in experiments	43 discuss sources of error 43 what would happen if...?
				71	parachutes and air resistance	45 discuss sources of errors 58 find average of three trials
				306	explain why hearing can be damaged by loud sounds	58 explain why the angular acceleration is different
				412	average voltage and current of AC power	67 calculate average of three times 71 calculate average work and power 80 explain your observations 87 explain how force applied causes the response 90 explain why higher tension makes waves move faster 92 explain how wind might cause big waves in water 109 explain how the colored filters work 132 what conclusions can you draw?

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
					133 analyze data and explain a rule 204 build models of Na and Cl and use them to explain bonding
AP.1.02 Advanced Physics	Standard 1: History and Nature of Science	History and Nature of Science	recognize that science has practical and theoretical limitations.	62 acceleration of cars 188 perpetual motion machines 292 sound in space 372 holograms and science fiction special effects 440 scientists have never found single magnetic poles 568 understanding how gravity works inside atoms 576 transporter beams 583 the meaning of the uncertainty principle 637 areas of active research in physics 640 unresolved questions of history of universe 641 research on future of the universe	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page	
AP.1.03 Advanced Physics	Standard 1: History and Nature of Science	History and Nature of Science	recognize that science is based on a set of observations in a testable framework that demonstrate basic laws that are consistent.	7 7 40 101 102 330 492 560 644 645	in science inquiry is used to uncover truth developing models to explain observations creating useful models a model for friction a model for static friction optics and optical instruments the binary number system and its use in computers deep water submarine Alvin application proof of Einstein's theory of general relativity astronomers find black holes by what is around them	22 model for uniform accelerated motion

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page		Volume Two Investigation Manual Page	
AP.1.04 Advanced Physics	Standard 1: History and Nature of Science	History and Nature of Science	conclude that science is a blend of creativity, logic and mathematics.	60	creating the acceleration formula from experiments	15	collect time data
				66	developing the formulas for a model of motion with constant acceleration	22	uniform acceleration model
				282	write a formula relating velocity of wave to period and wavelength	24	create an algebraic model
				312	light intensity follows an inverse square law	28	solve second law equation for string tension
				367	Einstein and theory of special relativity	32	develop a model that predicts acceleration
				498	listing different types of matter in your home	43	follow the scientific method
				560	deep water submarine Alvin application	43	create algebraic model
						49	write a formula
						78	observe what happens
						87	observe what happens to the motion
		89	observe the wave pulse				
		94	give an equation that describes your observations				
		189	Bernoulli's equation				
		206	record your observations				

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Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page	
AP.1.05 Advanced Physics	Standard 1: History and Nature of Science	History and Nature of Science	trace the development of key historical concepts and principles describing their impact on modern thought and life by identifying the scientist's contributions.	41	Galileo and Newton conducted experiments with balls on ramps	75	the discovery of atom's nucleus
				52	Dr. Harold Edgerton and strobe photography	122	research types of electromagnetic waves
				52	Dr. Harold Edgerton and strobe photography	147	Gilbert built the first electroscope
				52	Dr. Harold Edgerton and strobe photography		
				78	Newton's laws of motion		
				81	Newton's discovery of the connection between force and mass and acceleration		
				91	biomechanics application		
				92	applications of biomechanics		
				152	Sir Isaac Newton and law of universal gravitation		
				155	first artificial human-made Earth satellite was Sputnik		
				178	Great Pyramid of Giza and simple machines		
				208	James Watt		
				257	Pierre and Jacques Curie and the piezoelectric effect		
				257	Pierre and Jacques Curie and the piezoelectric effect		
269	wave motion and equilibrium						

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				290	
					technological breakthrough of sound recording
				310	past theories of light
				311	Thomas Edison and the electric light
				314	Einstein and the speed of light
				316	Albert Einstein
				325	history of printing
				348	the usefulness of recorded images
				349	the telescope
				349	Galileo and telescopes
				350	Newtonian reflecting telescope
				361	Young's double-slit experiment
				361	Thomas Young
				366	Albert Einstein's theory of special relativity
				367	Albert A. Michelson and Edward R. Morley
				368	Einstein's thinking revolutionized physics
				382	Ben Franklin and current
				400	Gustav Robert Kirchhoff

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				420	
					Charles-Augustin de Coulomb
				440	magnetism
				447	discovering and using magnetism
				447	history of magnetism
				499	development of atomic theory
				501	search for elements and alchemy
				501	ancient Greeks' ideas of elements
				561	the Alvin research submarine
				574	Niels Bohr
				575	discovery of helium
				575	Johann Balmer
				578	Wolfgang Pauli
				580	Newton and classical physics
				580	Max Planck and Albert Einstein
				614	Marie Curie
				615	Henri Bequerel and beta rays
				625	turning lead into gold
				630	Wolfgang Pauli

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				644 proof of Einstein's theory of general relativity 647 Paul Dirac	

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Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page	
AP.1.06 Advanced Physics	Standard 1: History and Nature of Science	History and Nature of Science	integrate the history of science with cultural history to demonstrate that scientists work within their historical surroundings and are affected by them.	52	Dr. Harold Edgerton and strobe photography	122	research types of electromagnetic waves
				52	Dr. Harold Edgerton and strobe photography	147	Gilbert built the first electroscope
				155	first artificial human-made Earth satellite was Sputnik		
				178	Great Pyramid of Giza and simple machines		
				208	James Watt		
				257	Pierre and Jacques Curie and the piezoelectric effect		
				257	Pierre and Jacques Curie and the piezoelectric effect		
				269	wave motion and equilibrium		
				290	technological breakthrough of sound recording		
				310	past theories of light		
				311	Thomas Edison and the electric light		
				314	Einstein and the speed of light		
				316	Albert Einstein		
				325	history of printing		
348	the usefulness of recorded images						
349	the telescope						

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				361	Thomas Young
				361	Young's double-slit experiment
				366	Albert Einstein's theory of special relativity
				367	Albert A. Michelson and Edward R. Morley
				368	Einstein's thinking revolutionized physics
				400	Gustav Robert Kirchhoff
				440	magnetism
				447	discovering and using magnetism
				447	history of magnetism
				501	search for elements and alchemy
				501	ancient Greeks' ideas of elements
				561	the Alvin research submarine
				574	Niels Bohr
				575	discovery of helium
				575	Johann Balmer
				578	Wolfgang Pauli
				580	Max Planck and Albert Einstein
				625	turning lead into gold

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				630 Wolfgang Pauli 644 proof of Einstein's theory of general relativity 647 Paul Dirac	
AP.2.01 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	model and exhibit the skills, attitudes and/or values of scientific inquiry (e.g., curiosity, logic, objectivity, openness, skepticism, appreciation, diligence, integrity, ethical practice, fairness, creativity).	42 writing procedures in a lab notebook helps make sure your results are repeatable 242 finding a basic cycle of harmonic motion 367 Einstein and theory of special relativity 456 an experiment with a wire and compass 463 building an electromagnet with wire and a nail 467 experiment demonstrating electromagnetic induction 560 deep water submarine Alvin application	43 perform experiment 65 investigate motion on a roller coaster 67 investigate motion on a roller coaster 122 communicate your findings

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page		Volume Two Investigation Manual Page	
AP.2.02 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	demonstrate ethical practices for science (e.g., established research protocol, accurate record keeping, replication of results and peer review).	42	writing lab procedures	6	collecting data with precision
				142	finding x and y components of velocity for model rocket	15	collect time data with precision
						15	collect time data
						15	record data in a table
						17	use a data table
						18	collect time data with precision
						18	record data
						21	record results in table
						27	record position and time data
						29	record mass and force
						43	write a procedure
						66	record data in table
						70	record data in table
						82	create data table for self-designed experiment
						82	record your data in table
						201	develop a procedure

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AP.2.03 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	apply scientific approaches to seek solutions for personal and societal issues.	12 engineers design practical devices for solving problems 12 engineers design practical devices for solving problems 13 medical and health professions use physics 15 physics plays a role in nearly everything a person does 31 use of nanotechnology 72 antilock brakes application 91 careers in biomechanics 112 designing a bridge 138 use of robots 155 geostationary satellites 196 hydroelectric power application 209 range of power for common devices 216 energy from ocean tides 217 research into tidal power 219 using energy efficient products 227 police forensic scientists 228 seat belts and air bags 235 jet engines application	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				257	
					quartz crystals application
				280	
					microwave ovens application
				289	
					careers in acoustics
				293	
					uses of Doppler radar
				296	
					ultrasound technology
				311	
					invention of electric light
				325	
					the printing press
				349	
					the telescope
				378	
					importance of electricity
				392	
					environmental impact of auto pollution
				392	
					hybrid gas/electric cars application
				392	
					hybrid cars combine advantages of gasoline fuel and electric power
				404	
					electrical engineers
				413	
					wiring application
				434	
					how television works application
				451	
					MRI application
				490	
					why computers are useful
				534	
					energy-efficient building application
				534	
					energy-efficient building application

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				604 607 621 621 623 628 631 632	balancing chemical equation of acid rain impact of combustion reaction of gasoline human technology contributes to radiation in environment sources of radiation in the environment creation of CAT scans nuclear waste nuclear power application nuclear waste
AP.2.04 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	properly and safely manipulate equipment, materials, chemicals, organisms and models.	543	safety factors 79 safety note 129 safety precautions 131 safety precautions 150 safety note 159 safety note 160 electromagnet safety 176 safety note 176 heat safety 185 safety tip 192 gas pressure safety note 206 acid safety

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AP.2.05 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	conduct explorations in a variety of environments (e.g., laboratories, museums, libraries, parks and other outdoors locations).	242	finding a basic cycle of harmonic motion	43	perform experiment
				293	demonstrating the Doppler effect	65	investigate motion on a roller coaster
				456	an experiment with a wire and compass	65	studying motion of ball on loop track
				463	building an electromagnet with wire and a nail	67	investigate motion on a roller coaster
				467	experiment demonstrating electromagnetic induction		

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AP.2.06 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	use appropriate technology solutions (e.g., computer, CBL, probe interfaces, software) to measure and collect data; interpret data; analyze and/or report data; interact with simulations; conduct research; and to present and communicate conclusions.	<p>data tables and graphs can be created on computer or graphing calculator</p> <p>23 reading a digital timer</p> <p>91 the force platform</p> <p>383 using a multimeter to measure voltage</p> <p>385 measuring current with an ammeter or multimeter</p> <p>387 using a multimeter to measure resistance</p> <p>504 Celsius and Fahrenheit thermometers</p> <p>505 how thermometers work</p>	<p>4 using a timer</p> <p>5 using photogates</p> <p>7 using devices to measure mass</p> <p>9 using timer and photogates</p> <p>11 using timer and photogates</p> <p>14 using a timer and photogates</p> <p>17 using a timer and photogates</p> <p>18 use a timer and photogates</p> <p>21 use a timer and photogates</p> <p>23 use a timer and photogates</p> <p>26 use a timer and photogates</p> <p>29 use a spring scale</p> <p>29 find mass</p> <p>34 use a spring scale</p> <p>39 using a compass</p> <p>42 use a timer and photogates</p> <p>44 use a spring scale</p> <p>47 use a timer and photogate</p>

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					50 use a timer and photogate
					58 use a timer and photogate
					60 use a spring scale
					65 use a timer and photogate
					67 use a timer and photogate
					75 use a timer and photogates
					82 use a timer and photogate
					87 use photogate and timer to measure the period
					89 use a spring scale to measure tension of string
					90 use a timer and photogates
					93 use the timer to measure frequency
					106 experiment with mirrors
					112 use a laser and mirror to study law of reflection
					112 study reflection with a mirror
					115 use mirrors and lenses to learn how images are formed
					117 use a laser to locate images formed by a lens
					131 use a multimeter to measure current

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					132 use a multimeter to measure voltage
					135 use a multimeter to measure current and voltage
					139 use a multimeter
					140 use the multimeter
					157 reading a compass
					163 use a multimeter
					164 use a multimeter to measure voltage
					165 use a multimeter
					166 use a photogate and timer
					169 use a multimeter
					171 use a multimeter
					176 use a thermometer
					178 measure the temperature
					180 measure the temperature
					192 use a digital balance

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AP.2.07 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	demonstrate science processes within a problem solving setting (e.g., observing, measuring, calculating, communicating, comparing, ordering, categorizing, classifying, relating, hypothesizing, predicting)	<p>data tables and graphs can be created on computer or graphing calculator</p> <p>11 Ptolemy model vs. Copernicus model of the solar system</p> <p>18 measuring distance</p> <p>25 accuracy and precision of measurements</p> <p>25 why accuracy and precision are important</p> <p>40 making a good model</p> <p>42 writing procedures in a lab notebook helps make sure your results are repeatable</p> <p>42 controlling variables in experiments</p> <p>43 constructing a graph</p> <p>43 graphs are a way of representing data</p> <p>44 using a graphical model to make a prediction and checking the model's accuracy</p> <p>44 graphical models</p> <p>45 recognizing patterns using graphs</p>	<p>1 estimating length</p> <p>6 accuracy and resolution and printing</p> <p>13 is there a trend in measurements?</p> <p>13 create a graph</p> <p>13 compare prediction to measurement</p> <p>15 collect time data</p> <p>15 record data in a table</p> <p>16 create a graph</p> <p>16 describe the graph</p> <p>17 use a data table</p> <p>18 record data</p> <p>21 record results in table</p> <p>22 create graphs</p> <p>22 how do you measured positions compare to model?</p> <p>22 uniform acceleration model</p> <p>22 compare calculation with graph estimate</p> <p>24 create an algebraic model</p> <p>25 find the average time</p> <p>27 record position and time data</p>

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				54	understanding patterns in relationships between variables	28	solve second law equation for string tension
				54	constructing a graph	29	record mass and force
				55	create a graph from a data table	29	does experiment agree with prediction?
				56	indicate relationships between variables in graphs	32	develop a model that predicts acceleration
				60	creating the acceleration formula from experiments	37	make a graph
				66	developing the formulas for a model of motion with constant acceleration	38	make a graph
				142	finding x and y components of velocity for model rocket	43	sketch four graphs
				246	understanding graphs of harmonic motion	43	create algebraic model
				260	analyze graph of an oscillator	43	measure and record the distance
				282	write a formula relating velocity of wave to period and wavelength	43	discuss sources of error
				290	the process of digital sound reproduction	43	how does the measurement compare to your prediction?
				297	frequency spectrum	45	discuss sources of errors
				304	comparison of wave forms from guitar sounds	49	write a formula
						56	create a graph
						58	find average of three trials
						60	measure input and output forces
						63	as mechanical advantage increases what happens to length of pulled string?
						66	what does the graph tell you?

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page	
				307	decibel level vs. frequency graph for human hearing	66 record data in table
				312	light intensity follows an inverse square law	66 create a graph of speed vs. position
				411	the waveform of AC electricity	67 calculate average of three times
				412	average voltage and current of AC power	67 measure vertical distance
				427	diagramming electric fields using field lines	70 record data in table
				443	diagramming magnetic fields using magnetic field lines	71 calculate average work and power
				479	current vs.voltage graph for a transistor	76 compare predicted mass to actual mass
				498	listing different types of matter in your home	78 observe what happens
						82 measure the length of the string
						82 make three different graphs
						82 create data table for self-designed experiment
						82 record your data in table
						82 analyze data
						87 observe what happens to the motion
						87 sketch a graph
						89 observe the wave pulse
						94 give an equation that describes your observations

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
					114 are there differences between your prediction and measurement?
					133 did battery voltage change?
					135 graph voltage vs. current
					136 graph voltage vs. current
					151 make a graph of voltage vs. time
					160 create a graph
					167 make a graph of voltage vs. number of magnets
					169 make a current vs. voltage graph for the diode
					189 Bernoulli's equation
					202 identify two sources of experimental error
					206 record your observations

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AP.2.08 Advanced Physics	Standard 2: Science as Inquiry	Inquiry	design, conduct, evaluate and revise experiments	3	using life experiences and common sense	11	recognizing and controlling variables
				3	inquiry starts with questions	21	conduct the experiment
				7	revising explanations through observation	28	set up the ultimate pulley
				8	refining theories based on observations	43	perform experiment
				10	the usefulness of phlogiston theory despite being incorrect	65	investigate motion on a roller coaster
				40	defining variables	67	investigate motion on a roller coaster
				42	control and experimental variables	67	set up the straight track
				43	dependent and independent variables in graphs	82	design an experiment
				43	dependent and independent variables in graphs	82	determine which variable has the greatest effect
				54	importance of changing one variable at a time in an experiment	82	dependent and independent variables
				71	parachutes and air resistance	85	design and test a way to increase natural frequency
				242	finding a basic cycle of harmonic motion	85	select appropriate technology to make measurements
				251	changing the natural frequency of a stretched rubber band	89	what is it that moves in the case of a wave?
				432	making a simple capacitor	129	choose circuit parts to light a bulb
456	an experiment with a wire and compass	166	variables that affect the performance of the generator				
				201	design a procedure to separate a mixture		

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				463 building an electromagnet with wire and a nail	202 conduct your experiment
				467 experiment demonstrating electromagnetic induction	204 build models of Na and Cl and use them to explain bonding

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.3.01 Advanced Physics	Standard 3: Unifying Themes Objectives	Themes	analyze systems to understand the natural and designed world; use systems analysis to make predictions about behaviors in systems; recognize order in units of matter, objects or events.	2	structure of the universe and laws of nature	28	system of Atwood's machine
				24	time scales in physics	44	forces in equilibrium
				86	zero net force in equilibrium		
				99	weight in equilibrium problems		
				106	definition of equilibrium		
				108	applications of equilibrium		
				111	equilibrium and reaction or normal forces		
				115	understanding of equilibrium		
				119	drawing displacement vector using a scale		
				133	equilibrium of forces and balancing forces		
				163	rotational equilibrium		
				175	explain rotational equilibrium		
				194	conservation of energy		
				202	processes		
				204	efficiency in natural systems		
204	natural systems and efficiency						
205	efficiency of plants						

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				206	
					reversible and irreversible processes
				210	power in natural systems
				212	universe is matter and energy organized in systems
				212	energy flow in systems
				213	breaking down an energy flow system into processes
				214	natural systems work in cycles
				214	steady state energy balance of Earth
				215	food webs and ecosystems
				225	form changes in inelastic collisions
				244	harmonic motion in natural systems
				248	harmonic motion and equilibrium
				250	stable and unstable equilibrium
				251	restoring forces and inertia affect natural frequency
				255	a system view of resonance
				264	equilibrium level of waves

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				366	
					relationships between matter and energy in theory of special relativity
				370	
					the equivalence of energy and matter
				379	
					examples of circuits in nature
				420	
					lightning and electric charge
				447	
					the magnetic field of Earth
				449	
					shifting and reversal of Earth's magnetic poles
				499	
					scale and Brownian motion
				522	
					thermal equilibrium
				522	
					heat transfer in living things
				528	
					convection in the ocean
				541	
					form and the strength of materials
				566	
					knowing structure of atom
				582	
					matter and energy in quantum theory
				592	
					system of classifying matter
				616	
					matter and energy and radioactivity

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Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page
AP.3.02 Advanced Physics	Standard 3: Unifying Themes Objectives	Themes	apply evidence from models to make predictions about interactions and changes in systems.	7	creating theories based on observations	13 create a graph
				43	constructing a graph	13 predict speed of ball
				44	graphical models	16 describe the graph
				54	constructing a graph	16 create a graph
				55	create a graph from a data table	18 how would acceleration be different?
				60	creating the acceleration formula from experiments	22 uniform acceleration model
				66	developing the formulas for a model of motion with constant acceleration	22 create graphs
				282	write a formula relating velocity of wave to period and wavelength	24 create an algebraic model
				290	the process of digital sound reproduction	28 solve second law equation for string tension
				312	light intensity follows an inverse square law	32 develop a model that predicts acceleration
				411	the waveform of AC electricity	33 calculate the predicted speed
				498	since wood is created from other matter it must not be a fundamental substance	37 make a graph
						37 use your graph to make a prediction
						38 use your graph to make a prediction
						38 make a graph
		42 predict exact landing location				
		43 sketch four graphs				
		43 create algebraic model				
		49 write a formula				

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					56 create a graph
					65 predict where the ball moves fastest
					66 create a graph of speed vs. position
					82 make three different graphs
					87 sketch a graph
					94 give an equation that describes your observations
					132 predict what the current will be
					135 graph voltage vs. current
					136 graph voltage vs. current
					151 make a graph of voltage vs. time
					160 create a graph
					167 make a graph of voltage vs. number of magnets
					169 make a current vs. voltage graph for the diode
					189 Bernoulli's equation

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Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page	
AP.3.03 Advanced Physics	Standard 3: Unifying Themes Objectives	Themes	measure changes in systems using graphs and equations relating these to rate, scale, patterns, trends and cycles.	7	creating theories based on observations	10	calculate percent difference
				11	Ptolemy model vs. Copernicus model of the solar system	12	do your results agree with hypothesis?
				40	making a good model	13	compare prediction to measurement
				43	constructing a graph	13	is there a trend in measurements?
				43	graphs are a way of representing data	13	find percent error
				44	graphical models	13	predict speed of ball
				44	using a graphical model to make a prediction and checking the model's accuracy	13	create a graph
						16	describe the graph
						16	create a graph
				45	recognizing patterns using graphs	18	how would acceleration be different?
				54	understanding patterns in relationships between variables	22	compare calculation with graph estimate
				54	constructing a graph	22	how do you measured positions compare to model?
				55	create a graph from a data table	22	create graphs
				56	indicate relationships between variables in graphs	22	uniform acceleration model
				60	creating the acceleration formula from experiments	24	create an algebraic model
		28	solve second law equation for string tension				
66	developing the formulas for a model of motion with constant acceleration	29	does experiment agree with prediction?				

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
				188	perpetual motion machines	32	develop a model that predicts acceleration
				246	understanding graphs of harmonic motion	33	calculate the predicted speed
				282	write a formula relating velocity of wave to period and wavelength	33	does your experiment confirm your hypothesis?
				290	the process of digital sound reproduction	37	calculate percent difference
				297	frequency spectrum	37	make a graph
				304	comparison of wave forms from guitar sounds	37	use your graph to make a prediction
				307	decibel level vs. frequency graph for human hearing	38	calculate percent difference
				312	light intensity follows an inverse square law	38	make a graph
				411	the waveform of AC electricity	38	use your graph to make a prediction
				427	diagramming electric fields using field lines	42	predict exact landing location
				443	diagramming magnetic fields using magnetic field lines	43	sketch four graphs
				479	current vs.voltage graph for a transistor	43	calculate percent difference
				498	since wood is created from other matter it must not be a fundamental substance	43	create algebraic model
						43	how does the measurement compare to your prediction?
						49	write a formula
						50	does your experiment provide confirmation?

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
					56 create a graph
					63 as mechanical advantage increases what happens to length of pulled string?
					65 predict where the ball moves fastest
					66 create a graph of speed vs. position
					66 does this agree with your hypothesis?
					66 what does the graph tell you?
					76 compare predicted mass to actual mass
					82 analyze data
					82 make three different graphs
					83 calculate percent error
					87 sketch a graph
					94 give an equation that describes your observations
					114 are there differences between your prediction and measurement?
					132 predict what the current will be
					133 did battery voltage change?

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
					135 graph voltage vs. current 136 graph voltage vs. current 151 make a graph of voltage vs. time 160 create a graph 167 make a graph of voltage vs. number of magnets 169 make a current vs. voltage graph for the diode 189 Bernoulli's equation 202 find percent composition 208 calculating percent yield
AP.3.04 Advanced Physics	Standard 3: Unifying Themes Objectives	Themes	understand that different characteristics, properties or relationships within a system might change as its dimensions are increased or decreased (e.g., scale up, scale down).	24 time scales in physics 119 drawing displacement vector using a scale 499 scale and Brownian motion	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.01 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Mechanics	review Newton's Laws of Motion.	61	any acceleration must come from a force	26	study Newton's first law
				78	changes in motion only occur through force	27	collect data on Newton's first law
				79	all objects tend to resist changes in motion	27	explain how Newton's first law applies
				79	what systems in a car overcome the law of inertia	28	investigate Newton's second law
				80	seat belts and air bags and Newton's first law	30	Newton's third law and free body diagrams
				80	Newton's laws and cup holders	30	investigate Newton's third law
				81	Newton's second law of motion	31	draw free body diagrams and identify action- reaction pairs
				83	calculation using Newton's second law	77	relationship between force and motion and the second law
				84	Newton's second law and dynamics problems		
				85	finding force from acceleration		
				85	if there is acceleration there must be force		
				85	force problems		
				87	forces always occur in action-reaction pairs		
				87	explaining Newton's third law in terms of an astronaut moving through space		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				88	
				88	
				89	
				89	
				90	
				93	
				94	
				102	
				106	
				107	
				108	
				108	
				111	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				112	
					analysis of forces on a bridge
				116	
					calculate the acceleration of a toy
				135	
					normal force of an inclined plane
				136	
					calculating acceleration on a ramp
				137	
					calculating acceleration from 3-D forces
				137	
					the vector form of Newton's second law
				137	
					predicting motion in three dimensions and controlling force and acceleration in space missions
				139	
					determining position by triangulation and inertial navigation
				148	
					direction of force determines linear or rotational motion
				149	
					calculating centripetal force
				150	
					formula for centripetal acceleration
				150	
					using centripetal acceleration to create the feeling of gravity by rotating the space station

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				151	
					banked turns
				155	
					satellite motion application
				156	
					satellites in orbit
				168	
					Newton's first law and rotational inertia
				169	
					Newton's second law applies to rotational motion
				171	
					Newton's second law for rotational motion variables
				222	
					Newton's first law and momentum
				224	
					momentum and Newton's third law
				228	
					seat belts and air bags
				228	
					Newton's second law relating force and momentum
				229	
					momentum form of Newton's second law
				234	
					gyroscopes and the space shuttle
				238	
					cars that crumple in a collision
				240	
					forces in a car stopping
				252	
					Newton's second law and natural frequency

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				425	
					electric forces always occur in pairs according to Newton's third law
				548	
					Newton's third law and pressure in a fluid
				550	
					pressure and the third law
				557	
					pressure of gases

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.02 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Mechanics	using both given information and laboratory collected data, calculate velocity and acceleration along linear and circular paths.	36	the precise meaning of speed	9	calculate speed of rolling marble
				37	calculating speed	9	collect data and calculate speed of car
				37	how to calculate speed	10	make object move with speed of 1 m/sec
				38	the speed formula and calculating speed	12	finding speed of ball with one photogate
				38	compare and contrast speed and velocity	14	find the speed of the ball
				41	speed of a ball on a ramp	15	find speed of the ball
				46	speed is the rate of change of position	17	find the acceleration
				47	average and instantaneous speed	17	studying acceleration
				48	determining speed from the slope of a position vs. time graph	17	learn techniques for finding acceleration
				48		17	find two speeds
				55	calculate the average speed and distance traveled	20	understanding equation for uniform accelerated motion
				58	acceleration is the rate of change in the speed of an object	21	calculate speed of ball
				59	comparing speed and acceleration	25	derive acceleration equation
				60	formula for acceleration	26	make ball roll at constant speed
				60	calculating acceleration from experiments	29	calculate the acceleration
60		33	calculate the predicted speed				
61	general definition of acceleration	39	investigating vectors				
		42	find initial speed of ball				

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page	
				61	zero acceleration vs. constant acceleration vs. acceleration with zero speed	43 calculate the velocity vector
				62	acceleration is total change of speed divided by total change in time	46 investigating angular speed
				64	calculate speed in accelerated motion	46 contrasting linear and angular motion
				64	calculating the speed of an object that is accelerating	49 investigating centripetal force
				64	calculate speed in accelerated motion	50 calculate the speed of the ball
				67	calculate time and distance from acceleration	58 rotational application of Newton's second law
				70	calculating height and time of flight in free fall problems	66 find the speed of the ball
				74	understanding average speed and instantaneous speed	68 what is speed of the ball?
				75	calculations of speed	76 calculate speeds of projectile and target balls
				83	calculation using Newton's second law	77 relationship between force and motion and the second law
				84	direction of net force and acceleration and speed	90 calculate the speed of the wave pulse
				85	force problems	191 calculate speed of air in homemade air-speed tester
				103	calculate the acceleration of a car including friction	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				108	
					use equilibrium to find an unknown force
				116	
					calculate the acceleration of a toy
				118	
					vectors have magnitude and direction
				119	
					displacement vectors
				124	
					definition of the velocity vector
				125	
					speed is the magnitude of the velocity vector
				125	
					the velocity vector
				126	
					components of the velocity vector
				127	
					adding velocity vectors
				128	
					constant velocity of horizontal component of projectile motion
				129	
					analyze a horizontally launched projectile
				130	
					analyzing changing velocity in vertical component of projectile motion
				136	
					calculating acceleration on a ramp
				137	
					calculating acceleration from 3-D forces
				142	
					calculating acceleration for sled on slope

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				144	
					rotation and revolution and angular speed
				145	
					calculating angular speed in radians per second
				146	
					the relationship between linear and angular speed
				146	
					angular speed of a moving wheel
				146	
					calculating linear speed of a moving wheel
				147	
					the linear speed of a rolling wheel
				147	
					speedometers and odometers
				148	
					acceleration can be a change in the direction of motion
				149	
					calculating centripetal force
				149	
					calculating centripetal force
				150	
					centripetal acceleration
				150	
					calculate the centripetal acceleration of a motorcycle
				150	
					formula for centripetal acceleration
				154	
					satellites and orbital motion
				155	
					satellite motion application

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				155	
					centripetal force and the law of universal gravitation combine to form the orbit equation
				156	
					HEO and geostationary orbit
				157	
					compare linear and angular speeds
				158	
					calculating centripetal force
				160	
					translation and rotation
				169	
					Newton's second law applies to rotational motion
				169	
					relationship between angular acceleration and linear acceleration
				171	
					rotational motion and linear motion
				171	
					Newton's second law for rotational motion variables
				171	
					angular acceleration of a wheel
				229	
					momentum form of Newton's second law
				231	
					linear and angular momentum
				238	
					compare linear and angular momentum
				243	
					orbit is a type of cycle

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				252	
					Newton's second law and natural frequency
				460	
					orbital motion of a charge

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.03 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Mechanics	solve multi-step problems involving velocity, acceleration and net force.	36	the precise meaning of speed	9	collect data and calculate speed of car
				37	how to calculate speed	9	calculate speed of rolling marble
				37	calculating speed	10	make object move with speed of 1 m/sec
				38	the speed formula and calculating speed	12	finding speed of ball with one photogate
				41	speed of a ball on a ramp	14	find the speed of the ball
				41	effect of friction on motion of a ball on a ramp	15	find speed of the ball
				46	speed is the rate of change of position	17	learn techniques for finding acceleration
				47	average and instantaneous speed	17	find two speeds
				48	determining speed from the slope of a position vs. time graph	17	find the acceleration
				55	calculate the average speed and distance traveled	20	understanding equation for uniform accelerated motion
				60	formula for acceleration	21	calculate speed of ball
				60	calculating acceleration from experiments	23	investigate the effect of gravity
				61	zero acceleration vs. constant acceleration vs. acceleration with zero speed	25	derive acceleration equation
				61	general definition of acceleration	26	make ball roll at constant speed
				61	general definition of acceleration	27	were any forces acting on the ball?
				64	calculate speed in accelerated motion	27	collect data on Newton's first law

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
				64	calculate speed in accelerated motion	29	calculate the acceleration
				67	calculate time and distance from acceleration	33	calculate the predicted speed
				68	free fall and acceleration due to gravity	34	investigate static and sliding friction
				69	motion formulas for free fall	42	find initial speed of ball
				70	calculating height and time of flight in free fall problems	44	investigating force vectors
				70	solving problems with free fall	45	balancing a specified force
				70	solving problems with free fall	49	consider forces acting on the ball
				71	acceleration of gravity does not depend on mass	49	draw a free body diagram and label forces
				71	air resistance and terminal speed	50	calculate the speed of the ball
				71	air resistance and terminal speed	61	what effect does friction have on mechanical advantage?
				72	friction and traction and antilock brakes	66	find the speed of the ball
				74	understanding average speed and instantaneous speed	68	what is speed of the ball?
				75	problem understanding acceleration due to gravity	76	calculate speeds of projectile and target balls
				75	calculations of speed	77	relationship between force and motion and the second law
				78	force is an action that can change motion	90	calculate the speed of the wave pulse
				81	force is related to acceleration	191	calculate speed of air in homemade air-speed tester

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				83	
					calculation using Newton's second law
				83	
					finding the net force
				84	
					calculating net force
				85	
					force problems
				86	
					zero acceleration means net zero force
				94	
					seat belt problem
				94	
					force calculations in different units
				97	
					strength of gravity on Earth and Jupiter
				98	
					gravity and acceleration and weightlessness
				99	
					balanced force problems
				100	
					the force of friction and the different types of friction
				100	
					friction is a force that resists motion
				101	
					a model for friction
				102	
					calculating the force of friction
				103	
					friction and motion
				103	
					calculate the acceleration of a car including friction
				103	
					net force includes the force of friction

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				104	
					reducing friction force
				105	
					friction applications
				106	
					net force must be zero in equilibrium
				107	
					net force of zero and free-body diagram
				108	
					use equilibrium to find an unknown force
				115	
					friction of a pulled sled
				116	
					calculate the acceleration of a toy
				124	
					effects of friction on trajectories
				124	
					projectiles and trajectories
				128	
					constant velocity of horizontal component of projectile motion
				128	
					gravity only accelerates vertical motion
				129	
					analyze a horizontally launched projectile
				129	
					vertical motion of a projectile
				130	
					projectiles launched at an angle
				130	
					analyzing changing velocity in vertical component of projectile motion

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				131	
					range of projectiles
				132	
					the force vector describes the strength and direction of a force
				133	
					balancing forces in two dimensions
				134	
					resolving force of gravity in ramp coordinates
				135	
					acceleration down an inclined plane
				135	
					frictional force on an inclined plane
				136	
					calculating acceleration on a ramp accounting for friction
				136	
					calculating acceleration on a ramp
				136	
					calculate the acceleration of a skier on a slope
				137	
					calculating acceleration from 3-D forces
				141	
					calculate the net force
				141	
					effects of gravity on motion of a projectile
				142	
					effects of friction on acceleration
				142	
					calculating acceleration for sled on slope
				146	
					calculating linear speed of a moving wheel

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				147	
					the linear speed of a rolling wheel
				148	
					centripetal force causes circular motion
				149	
					calculating centripetal force
				150	
					centripetal acceleration
				150	
					calculate the centripetal acceleration of a motorcycle
				150	
					formula for centripetal acceleration
				152	
					law of universal gravitation and orbital motion
				154	
					orbits and gravitational force
				155	
					centripetal force and the law of universal gravitation combine to form the orbit equation
				158	
					compare projectile motion to orbital motion
				165	
					the motion of a tossed object
				166	
					centers of mass and gravity may differ
				169	
					Newton's second law applies to rotational motion

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				171	
					Newton's second law for rotational motion variables
				183	
					friction and mechanical advantage of wheel and axle
				184	
					friction and mechanical advantage of ramps and screws
				186	
					work done by a force at an angle to the distance
				187	
					work done against gravity
				191	
					potential energy comes from gravity
				229	
					momentum form of Newton's second law
				245	
					friction causes damping in oscillators
				252	
					Newton's second law and natural frequency
				254	
					definition of periodic force
				256	
					friction and steady state

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.04 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Mechanics	apply both graphical, algebraic, and trigonometric solutions to vector, problems involving two or more vectors; calculate both vector components and resultants including projectile motion in both one and two dimensions.	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall	39	investigating vectors
				70	solving problems with free fall	40	using polar coordinates
				71	acceleration of gravity does not depend on mass	41	calculate the resultant vector
				75	problem understanding acceleration due to gravity	41	plotting position with cartesian coordinates
				97	strength of gravity on Earth and Jupiter	43	calculate the velocity vector
				98	gravity and acceleration and weightlessness	44	investigating force vectors
				118	vectors have magnitude and direction	45	calculate force components
				119	adding vectors	49	draw a free body diagram and label forces
				119	displacement vectors		
				120	representing vectors in Cartesian and polar coordinates		
				120	adding vectors		
				121	adding and subtracting vectors		
				122	calculating vector components		
				123	finding magnitude and angle of a vector		
				124	projectiles and trajectories		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				124	
					definition of the velocity vector
				125	
					representing the velocity vector in polar and Cartesian coordinates
				125	
					the velocity vector
				125	
					the velocity vector
				126	
					representing the velocity vector in polar and Cartesian coordinates
				126	
					components of the velocity vector
				126	
					components of the velocity vector
				127	
					adding velocity vectors
				127	
					adding velocity vectors
				128	
					independence of horizontal and vertical motion in a velocity vector
				128	
					gravity only accelerates vertical motion
				129	
					vertical motion of a projectile
				130	
					projectiles launched at an angle
				130	
					calculating velocity components of initial velocity
				131	
					range of projectiles

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				132	
					interpreting the x-y components of force
				132	
					representing the force vector in Cartesian and polar coordinates
				133	
					calculating components of a force vector
				134	
					choosing coordinates for an inclined plane
				134	
					resolving force of gravity in ramp coordinates
				135	
					acceleration down an inclined plane
				136	
					calculate the acceleration of a skier on a slope
				141	
					effects of gravity on motion of a projectile
				141	
					explain vectors in Cartesian and polar coordinates
				152	
					law of universal gravitation and orbital motion
				154	
					orbits and gravitational force
				155	
					centripetal force and the law of universal gravitation combine to form the orbit equation
				158	
					compare projectile motion to orbital motion

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				165	
				166	
				186	
				187	
				191	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.05 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Mechanics	apply the concepts of potential and kinetic energy to final velocity of an object-independent of path; evaluate the conservation of energy and momentum in simple harmonic motion.	191	the formula for potential energy	66	law of conservation of energy
				192	the formula for kinetic energy	68	calculate potential and kinetic energy
				193	deriving the formula for kinetic energy	68	find the total energy at each position
				194	energy transformations	72	potential to kinetic energy conversion in a pendulum
				195	applying conservation of energy for a marble rolling on a hilly track	74	investigating collisions and conservation of energy
				196	energy transformation hydroelectric plant	78	which ball had a greater change in momentum?
				197	conservation of energy for Hoover Dam	81	investigate the motion of a pendulum
				199	kinetic and potential energy conversions while bouncing in a trampoline	88	potential to kinetic energy conversions of a pendulum
				212	energy flow in a pendulum		
				224	law of conservation of momentum		
				225	conservation of momentum in collisions		
				226	applying conservation of momentum		
				227	momentum conservation for collisions in two and three dimensions		
				231	conservation of angular momentum examples		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				232	
				235	
				242	
				244	
				245	
				245	
				249	
				251	
				253	
				253	
				258	
				260	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				266 speed of a wave is the speed at which a cycle moves 370 Einstein's thinking about momentum of particles moving near the speed of light 452 MRI--each nucleus is a resonant oscillator 629 conservation of momentum in nuclear reactions	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page		Volume Two Investigation Manual Page	
AP.4.06 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Mechanics	investigate and calculate the work, energy, power, mechanical advantage, and efficiency using simple machines involving linear and rotational motion.	13	biomechanics	59	investigate block and tackle machine
				13	physics and bicycles	60	operate and study a block and tackle machine
				105	friction is the force that keeps nails and screws in place	61	find the mechanical advantage
				134	forces on an inclined plane	62	investigate block and tackle machine
				160	using torque in household devices	64	compare output and input work
				161	force on a wrench	64	relationship between work and energy
				172	force and torque transformations in bicycles	66	law of conservation of energy
				173	changing gears in a bicycle	68	find the total energy at each position
				173	force and torque transformations in bicycles	69	calculate efficiency for each ball
				178	how simple machines manipulate forces	70	calculate work
				178	input and output for simple machines	70	calculate person's power
				179	types of simple machines	71	calculate work done
				179	how to calculate mechanical advantage	71	calculate power output for each climber
				180	mechanical advantage of human arm	74	investigating collisions and conservation of energy
				180	the mechanical advantage of a lever		
				181	how a lever works		
				181	how a lever works		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				181	
					crowbar as an example of a lever
				182	
					mechanical advantage of ropes and pulleys
				183	
					how wheels and gears work
				183	
					small drills use gears
				184	
					screw turns rotating motion into linear motion
				184	
					ramps and screws
				185	
					work and energy
				185	
					how to calculate work
				187	
					calculating work done against gravity
				188	
					for all machines work out cannot exceed work in
				189	
					relationship between work and energy
				191	
					the symmetry between work and energy
				191	
					calculate the potential energy of a cart
				192	
					calculating kinetic energy depends on speed and mass
				193	
					calculate the kinetic energy of a moving car

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				195	
					applying conservation of energy for a marble rolling on a hilly track
				197	conservation of energy for Hoover Dam
				197	calculating energy supplied by Hoover Dam
				200	calculate fulcrum point of a lever
				202	definition of efficiency
				203	efficiency explained
				207	calculate power in climbing stairs
				207	power is the rate of doing work or using energy
				208	power formulas
				208	units of power
				209	estimating power requirements based on force
				209	calculating power for common devices
				210	estimating the power in wind
				211	power in biological systems
				211	estimate average input power of a person

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				213	
					efficiency of an energy flow process
				216	
					estimating the energy in tides
				219	
					ideal vs. real machine
				220	
					calculate power rating
				220	
					calculate energy and power for humans
				220	
					calculate efficiency of model solar car
				228	
					car crash safety
				236	
					fuel efficiency of turbofan engines
				249	
					harmonic motion in machines
				311	
					efficiency of electric vs. fluorescent light bulbs
				393	
					efficiency of hybrid cars
				409	
					power and efficiency of electric cars
				440	
					the difference between magnetic poles and electric charge

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.07 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Fluids	define fluids and determine the magnitude of buoyant force exerted on floating and submerged objects; explain why some objects float or sink.	547 buoyancy explained 555 fluids and friction 556 buoyancy of gases 561 buoyancy of Alvin 622 x-rays are photons	
AP.4.08 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Fluids	relate the pressure exerted by a fluid to its depth; calculate the pressure exerted by a fluid.	549 formula for pressure in a liquid caused by gravity 550 pressure and force formula 560 pressure force on Alvin	
AP.4.09 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Fluids	examine the motion of a fluid; apply Bernoulli's equation to solve fluid problems; recognize the effects of Bernoulli's principle on fluid motion.	553 Bernoulli's equation 554 applying Bernoulli's equation 564 Bernoulli's equation calculation	189 explore Bernoulli's equation
AP.4.10 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Fluids	define the general properties of an ideal gas; apply the Ideal Gas Law to predict the properties of an ideal gas under different conditions.	557 Boyle's law 558 Charles' law 558 pressure and temperature of gases 559 the combined gas law 564 using Boyle's law	192 investigate the mass of a volume of gas at different pressures 193 investigate the effect of temperature on pressure

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.11 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Thermodynamics	distinguish between temperature and heat; relate these to kinetic energy and internal energy of matter; apply the principle of conservation of energy to calculate changes in potential, kinetic and internal energy.	190	conversions of energy	66	law of conservation of energy
				194	energy transformations	68	find the total energy at each position
				194	conservation of energy explained	72	potential to kinetic energy conversion in a pendulum
				194	energy transformations	72	draw an energy flow diagram
				194	the law of conservation of energy	74	investigating collisions and conservation of energy
				195	conservation of energy in a closed system	88	potential to kinetic energy conversions of a pendulum
				195	applying conservation of energy for a marble rolling on a hilly track	176	investigate temperature and its effect on materials
				195	frictional energy converted to heat	178	explore the connection between temperature and heat and energy
				196	energy transformation hydroelectric plant	179	specific heat
				196	energy transformation hydroelectric plant		
				197	conservation of energy for Hoover Dam		
				199	kinetic and potential energy conversions while bouncing in a trampoline		
				202	efficiency and energy conversions		
				203	friction converts input work to heat		
				203	efficiency and conservation of energy		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				205	
					efficiency in biological systems
				206	
					connection between efficiency and time
				212	
					energy conversion
				212	
					energy flow in a pendulum
				213	
					the conversion process of energy flow
				215	
					energy flows in biological systems
				219	
					energy flow of a model solar car
				227	
					kinetic energy conservation for elastic collisions
				245	
					kinetic to potential energy changes in motion of an oscillator
				253	
					oscillators exchange energy back and forth between potential and kinetic
				256	
					resonant systems accumulate energy
				277	
					waves propagate by exchanging energy between two forms
				320	
					photosynthesis converts light energy to chemical energy

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				324	
					light from chemical reactions
				356	
					electromagnetic waves exchange energy between electricity and magnetic parts
				370	
					relationship and conservation of mass and energy
				393	
					conversion of energy in regenerative braking
				400	
					energy conversions in a series circuit
				451	
					MRI--energy exchange by a nucleus in a magnetic field
				464	
					electric motor uses electromagnets to convert electrical energy to mechanical energy
				467	
					electric generators transform mechanical energy into electric energy
				469	
					energy conservation and Faraday's law
				504	
					temperature scales and Fahrenheit-Celsius conversions
				505	
					measuring temperature
				506	
					temperature measures average kinetic energy

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				507	
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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				552	conservation of energy in fluids
				553	energy conservation and Bernoulli's equation
				558	using temperature in Kelvins for Charles' law
				629	conservation of energy in nuclear reactions
AP.4.12 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Thermodynamics	investigate and apply concepts of specific heat, heat of fusion and vaporization to calculate phase changes of materials, and perform calculations using the specific heat equation; interpret phase diagrams.	509	temp vs. time graph for phase change of ice to water
				509	temp vs. time graph for phase change of ice to water
				514	specific heat and the heat equation
				519	temp vs. time graphs for various materials
				520	temp vs. time curve question
				179	specific heat

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.13 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Waves, Sound, and Optics	investigate and apply the reflective, refractive and diffractive properties of waves to study mechanical and electromagnetic waves.	270	waves and reflection	92	observing reflection in water waves
				270	waves and refraction	92	investigate reflection in a ripple tank
				270	waves and diffraction	92	investigate diffraction in a ripple tank
				271	waves and reflection and boundaries	106	study refraction in a prism
				271	waves and refraction and boundaries	106	use a mirror to study how light behaves
				272	waves and diffraction and boundaries	106	study reflection in a prism
				274	resonance and reflection	112	investigate law of reflection
				315	light rays bounce off a surface	113	study how refraction works
				315	light bends as it moves into a material	113	investigate Snell's law of refraction
				315	mirrors	114	apply Snell's law of refraction
				324	the process of how light is reflected	123	study light diffraction patterns
				331	mirrors reflect light		
				331	lenses bend light		
				332	the image in a mirror		
				332	specular and diffuse reflection		
				333	finding the normal line for reflection		
				333	the laws of reflection		
				334	refraction is the bending of light rays		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				335	
					Snell's law of refraction
				336	
					total internal reflection and the critical angle
				339	
					the image formed in a mirror
				340	
					lenses follow Snell's law of refraction
				340	
					design of a lens
				345	
					diffraction spot size image defect
				352	
					law of reflection
				354	
					using Snell's law
				356	
					electromagnetic waves are oscillations of an energy field
				362	
					diffraction grating

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.14 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Waves, Sound, and Optics	relate the wavelength, velocity and frequency of waves with the equation velocity=frequency x wavelength and use it to perform calculations.	264 frequency and amplitude and wavelength in waves 265 concept of speed of a wave 266 formula for speed of a wave 277 energy of a wave is proportional to frequency and amplitude 278 wavelength of a standing wave 282 describe relationship between wave characteristics 292 importance of wavelength of sound waves 357 relationship between frequency and energy and color of light 375 relate color to frequency for visible light	88 if frequency is increased what happens to total energy? 90 study the speed of the wave pulse 94 investigate the wavelength of standing waves 94 investigate the frequency of standing waves 124 use a spectrometer to measure wavelength of different colors of light

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.15 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Waves, Sound, and Optics	analyze the properties of sound waves and perform appropriate calculations; relate the physical properties of sound waves to the way sound is perceived.	251	concept of natural frequency	85	investigate natural frequency
				252	changing natural frequency	86	investigate resonance and its importance
				254	concept of resonance	94	investigate harmonic wave patterns
				254	periodic force and natural frequency	95	natural frequency and resonance of standing waves on a string
				255	resonance occurs when periodic force matches natural frequency	96	investigate range of frequencies the ear can detect
				255	resonance occurs when periodic force matches natural frequency	96	investigate human perception of sound
				259	resonance and amplitude	101	investigate interference with sound waves
				273	constructive and destructive interference		
				274	how resonance is created		
				274	natural frequency of waves		
				275	standing waves and natural frequency and resonance		
				275	boundaries and natural frequency		
				276	concept of harmonics		
				278	nodes and antinodes		
				279	vibration of a drum		
				280	microwaves and resonance		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				286	
					sound is a wave of pressure
				287	
					frequency and pitch of sound
				287	
					how we hear sound waves
				288	
					the decibel scale
				288	
					relationship of loudness and amplitude and pressure in sound wave
				288	
					loudness and decibels and the sensitivity of the ear
				289	
					acoustics
				289	
					vibrations create sound
				291	
					sound vibrates the eardrum
				291	
					how we know sound is a wave
				291	
					pressure and amplitude of sound waves
				292	
					frequency and wavelengths of sound
				294	
					effect of medium and temperature on speed of sound wave
				295	
					standing wave patterns of sound
				295	
					designing a musical instrument

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page	
				295	resonance of sound	
				296	interference of sound waves	
				296	design of a good concert hall	
				298	constructing meaning from sound	
				298	sonograms	
				299	how the ear works	
				300	pitch and frequency in music	
				300	music and sound	
				301	echolocation and beats	
				301	consonance and dissonance and beats	
				302	harmonics and frequency and the color of sound	
				302	musical instruments	
				303	sound from a guitar	
				306	beats in a musical sound	
				306	list evidence that sound is a wave	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.16 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Waves, Sound, and Optics	define Doppler shift and identify applications.	293 294 307 638	definition of the Doppler effect Doppler effect and supersonic and subsonic motion understanding of Doppler effect Doppler effect and red shift

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.17 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Waves, Sound, and Optics	apply ray optics diagrams to lenses and mirrors, use the lens/mirror equation and the magnification equation to solve optics problems.	315	mirrors	106	use a mirror to study how light behaves
				331	lenses bend light	112	investigate law of reflection
				331	mirrors reflect light	113	investigate Snell's law of refraction
				332	the image in a mirror	114	study the critical angle of refraction in a prism
				333	the laws of reflection	114	study index of refraction
				334	the index of refraction	114	apply Snell's law of refraction
				335	Snell's law of refraction	115	studying optical systems
				335	refraction depends on index of refraction in both materials	115	investigating the difference between an object and an image
				338	optics in terms of objects and images	116	investigate how focal length is related to focal point
				339	mirrors form virtual images	116	trace ray diagrams through a double convex lens
				339	finding an image in a ray diagram	116	investigate how a converging lens bends light
				340	lenses follow Snell's law of refraction	117	sketch the image formed by a lens
				340	focal point and focal length	117	compare the image of the arrow to the original arrow
				340	converging and diverging lenses	119	analyze optical systems
				341	the image formed by a lens		
				341	focus and focal plane of a lens		
				342	drawing ray diagrams of lenses		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				342	
					finding the image in a ray diagram
				343	
					ray diagram for a converging lens
				343	
					the images formed by a lens
				344	
					the functions of an optical system
				344	
					the brightness of an image formed by a lens
				346	
					calculating image and object distances for optical systems
				347	
					using multiple images allows an optical system to change the size of an image
				347	
					using image relay to analyze optical systems
				349	
					telescope as an optical system
				352	
					law of reflection
				353	
					explain index of refraction
				353	
					identifying rays from a ray diagram
				354	
					using Snell's law
				358	
					index of refraction is ratio of speed of light in material to speed of light in vacuum

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.18 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Waves, Sound, and Optics	investigate and analyze optical applications in technology.	344 the functions of an optical system 346 calculating image and object distances for optical systems 347 using image relay to analyze optical systems 349 telescope as an optical system 362 the diffraction pattern of laser light 585 laser application 586 how lasers make light	115 studying optical systems 119 analyze optical systems

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.19 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Electricity and Magnetism	measure and draw electrical and magnetic fields; describe applications of electrical and magnetic fields.	426	fields and forces	152	investigate magnetic forces
				427	an electric field exists around a charge	154	how are magnetic field lines similar to electric field lines?
				437	strength of an electric field	154	draw magnetic field lines for a bar magnet
				440	magnetism explained	155	test materials to see if they are affected by magnets
				443	understanding magnetic fields	160	study the right-hand rule
				443	magnets create a magnetic field around them	161	experiment with pushes and pulls of permanent magnet in a rotor
				445	alignment of domains responds to magnetic fields		
				446	creating permanent magnets		
				447	the magnetic field of Earth		
				448	a compass is a magnet that lines up with Earth's magnetic field		
				449	the strength of Earth's magnetic field		
				451	magnetic field of a nucleus		
				454	magnetic field between two unlike poles		
				457	right-hand rule		
				458	coils and solenoids		
				458	the magnetic field of loops and coils		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				459	
					the magnetic field of coils and permanent magnets
				459	
					the magnetic field of coils and permanent magnets
				460	
					magnetic force on a moving charge
				461	
					calculating magnetic fields and forces
				461	
					calculate magnetic field at the center of a coil
				462	
					coils used in electromagnets
				462	
					finding the poles of an electromagnet using right-hand rule
				463	
					adding turns increases an electromagnet's strength
				475	
					using right-hand rule
				649	
					every field has an associated particle

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Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.20 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Electricity and Magnetism	recognize the basic properties of electrical charge, charging by conduction and induction, and differentiate between conductors and insulators; calculate electrical force using Coulomb's law.	390	classifying materials as conductor or insulator or semiconductor	146 build a simple electroscope
				395	classify conductivity of materials	147 investigate and understand how an electroscope works
				418	electric charge is a fundamental property of matter	147 investigate the concept of electric charge
				419	electric forces are created between electric charges	148 investigate Coulomb's law
				419	observing forces between charges using an electroscope	149 investigate charged balloons
				419	observing forces between charges using an electroscope	159 build an electromagnet
				420	explanation of coulomb	160 find out what happens to strength of electromagnet when current is increased
				421	current is the flow of charge	160 what happens to the strength of an electromagnet when you increase the current?
				421	negative charges move in a conductor	
				422	atomic structures of conductors and insulators and semiconductors	165 investigate electromagnetic induction
				422	negative charge of electrons and current flow	
				423	static electricity and charge polarization and induction	
				423	charging an electroscope by induction	
				424	relationship of electric force and charge	

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				462	
				463	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				464	
				465	
				467	
				471	
				472	
				475	
				480	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.21 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Electricity and Magnetism	recognize that circuits are closed loops; define units of electrical measure.	381	open and closed circuits	130	understand the difference between open and closed circuits
				382	voltage measures differences in energy	131	use a multimeter to measure current
				382	unit of electric current is the ampere or amp (A)	131	measure current in a circuit
				382	electrical current explained	132	measure voltage in a circuit
				383	using a multimeter to measure voltage	132	use a multimeter to measure voltage
				383	voltage and potential energy	132	explore the concept of voltage
				383	voltage is measured in volts (V)	134	study the relationship between resistance and current
				383	voltage is a measure of electric potential energy	134	apply the concept of electrical resistance
				385	measuring current with an ammeter or multimeter	135	use a multimeter to measure current and voltage
				386	concept of electrical resistance	135	study the relationship between current and voltage
				387	measuring resistance	137	measure voltage and current in series circuits
				387	using a multimeter to measure resistance	138	determining total resistance in a series circuit
				387	electrical resistance is measured in ohms	139	use a multimeter
				389	the resistance of electrical devices		
				390	resistance of conductors and insulators		
				391	resistors		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page	
				395	knowing difference between types of resistors	140 use the multimeter
				399	adding resistance in a series circuit	163 use a multimeter
				408	voltage definition	163 measure direct current
				408	resistance definition	164 measure voltage of battery pack
				416	calculating resistance in a circuit	164 use a multimeter to measure voltage
				421	one ampere is the flow of one coulomb per second	165 measure voltage
				431	voltage of a capacitor circuit	165 use a multimeter
				479	resistance of a transistor	169 use a multimeter
						169 measure current and voltage
						171 use a multimeter
						171 measure current and voltage

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
AP.4.22 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Electricity and Magnetism	construct and analyze electrical circuits and calculate Ohm's law problems for series, parallel and complex circuits including voltage drops; calculate power and energy in electrical systems.	379	concept of a circuit	129	construct simple electric circuits
				380	circuit diagrams and electrical symbols	130	draw and interpret circuit diagrams
				380	understanding simple circuit and its diagram	131	construct a simple circuit
				382	voltage measures differences in energy	132	explore the concept of voltage
				382	electrical current explained	134	study the relationship between resistance and current
				383	voltage is a measure of electric potential energy	134	apply the concept of electrical resistance
				383	voltage and potential energy	134	Ohm's law
				384	battery uses chemical energy to produce electrical charge	135	study the relationship between current and voltage
				386	simple bulb and battery circuits to illustrate electrical resistance	135	derive Ohm's law from experiment
				386	relationship between current and resistance	136	use Ohm's law to calculate the resistance
				386	concept of electrical resistance	137	parallel circuit and Ohm's law
				387	measuring resistance	137	investigate series circuits
				388	Ohm's law	138	apply Ohm's law to series circuits
				388	calculate the current flowing in a circuit	138	build a parallel circuit
				389	the resistance of electrical devices	138	determining total resistance in a series circuit

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
				390	resistance of conductors and insulators	139	compare series and parallel circuits
				391	resistors	139	analyze parallel circuits
				395	knowing difference between types of resistors	140	build and analyze network circuits
				396	calculation of voltage from resistance and current	171	use Ohm's law to calculate the resistance of the transistor
				398	series circuit defined		
				398	parallel circuit defined		
				399	adding resistance in a series circuit		
				399	current and resistance in a series circuit		
				399	calculating current in a series circuit using Ohm's law		
				400	voltage in a series circuit		
				401	parallel circuits		
				402	voltage and current in a parallel circuit		
				402	advantages of parallel circuits over series circuits		
				403	using Ohm's law in parallel circuits		
				403	resistance in parallel circuits		
				404	using Ohm's law for circuit analysis		

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				405	
					voltage dividers
				406	
					comparing series and parallel circuits
				407	
					solving network circuits
				407	
					solving network circuits
				407	
					calculate currents and voltages in a network circuit
				408	
					voltage definition
				408	
					resistance definition
				414	
					why parallel circuits are used in homes and buildings
				414	
					why series circuits are not used in homes and buildings
				415	
					compare current in a series and parallel circuit
				416	
					calculating resistance in a circuit
				416	
					using Ohm's law to calculate current
				431	
					voltage of a capacitor circuit
				431	
					circuit symbol for a capacitor
				479	
					resistance of a transistor

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.23 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Astronomy and Modern Physics	describe the orbital relationships within the solar system; apply Kepler's Laws to calculate orbital periods.	154 satellites and orbital motion 155 satellite motion application 156 HEO and geostationary orbit 243 orbit is a type of cycle	
AP.4.24 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Astronomy and Modern Physics	apply Newton's law of Universal Gravitation to derive relationships to calculate acceleration of gravity on other planets and orbital velocities.	152 description of law of universal gravitation 153 formula and calculations for law of universal gravitation 154 orbital motion 158 calculate weight and acceleration due to gravity on Pluto 216 tides are due to force of gravity 642 Newton's laws and gravity	51 calculate gravitational force of attraction 51 investigate law of universal gravitation
AP.4.25 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Astronomy and Modern Physics	research and evaluate evidence of the Big Bang model of the universe.	639 the big bang	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.26 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Astronomy and Modern Physics	describe Einstein's special theory of relativity and its basic development through assumptions and logical consequences.	314 Einstein's theory of relativity 366 relationship between matter and energy and time and space 367 speed of light paradox 368 speed and time and clocks 369 consequences of time dilation 371 simultaneity depends on the relative motion of your frame of reference 642 Einstein's theory and gravity and inertial mass 644 general relativity and curved space-time 645 black holes and general relativity	127 when does special relativity become important?

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.4.27 Advanced Physics	Standard 4: Science Subject Matter/Concepts	Astronomy and Modern Physics	describe nuclear reactions and discuss applications of nuclear energy.	502 elements past #92 are radioactive and decay 570 use of radioactive isotopes in medicine 570 radioactive isotopes 573 fusion 573 nuclear reactions 614 radioactive decay 616 energy and radioactivity 622 x-ray machines 623 CAT scans 625 nuclear reactions 627 fusion reactions 628 fission reactions 632 nuclear energy 635 differences between fission and fusion	213 fusion and fission

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.5.01 Advanced Physics	Standard 5: Scientific Design and Application Objectives	Scientific Design	investigate, analyze, synthesize, and evaluate those devices in the home that were developed from the understanding of science and technology.	12 all technology is based on fundamental laws of physics 12 engineers design practical devices for solving problems 31 nanotechnology application 31 use of nanotechnology 31 use of nanotechnology 51 analyzing motion with video and strobe photography 72 antilock brakes application 72 antilock brakes application 73 use of control computers in cars 112 relationship between science and engineering and technology 112 designing a bridge 138 use of robots 155 geostationary satellites 172 bicycle physics application 196 hydroelectric power application 196 hydroelectric power application	168 electronic devices are part of our daily lives

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				209	
					range of power for common devices
				216	
					energy from ocean tides
				217	
					research into tidal power
				228	
					seat belts and air bags
				235	
					jet engines application
				235	
					jet engines application
				243	
					oscillators are used in communications and music and clocks
				257	
					quartz crystals application
				257	
					quartz crystals application
				263	
					waves can carry information
				280	
					microwave ovens application
				280	
					microwave ovens application
				293	
					uses of Doppler radar
				311	
					invention of electric light
				325	
					the printing press
				325	
					the printing press
				349	
					the telescope
				369	
					technological advances have allowed discovery of the expanding universe
				372	
					holography application

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				378	
					importance of electricity
				392	
					hybrid gas/electric cars application
				392	
					hybrid gas/electric cars application
				413	
					wiring application
				413	
					wiring application
				429	
					electron beam accelerators
				434	
					how television works application
				434	
					how television works application
				451	
					MRI application
				451	
					MRI application
				472	
					maglev train application
				473	
					how magplanes levitate
				490	
					why computers are useful
				492	
					computers and electronic addition of numbers application
				516	
					refrigerator application
				534	
					energy-efficient building application
				534	
					energy-efficient building application
				560	
					deep water submarine Alvin application

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				585	
				615	
				623	
				623	
				631	
				631	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.5.02 Advanced Physics	Standard 5: Scientific Design and Application Objectives	Scientific Design	investigate and analyze the interdependence of science and technology.	12	all technology is based on fundamental laws of physics
				12	engineers design practical devices for solving problems
				31	use of nanotechnology
				31	use of nanotechnology
				51	analyzing motion with video and strobe photography
				72	antilock brakes application
				72	antilock brakes application
				112	relationship between science and engineering and technology
				112	designing a bridge
				138	use of robots
				155	geostationary satellites
				172	bicycle physics application
				196	hydroelectric power application
				196	hydroelectric power application
				209	range of power for common devices
				216	energy from ocean tides
217	research into tidal power				

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				228	
				seat belts and air bags	
				235	
				jet engines application	
				235	
				jet engines application	
				243	
				oscillators are used in communications and music and clocks	
				257	
				quartz crystals application	
				257	
				quartz crystals application	
				263	
				waves can carry information	
				280	
				microwave ovens application	
				280	
				microwave ovens application	
				293	
				uses of Doppler radar	
				311	
				invention of electric light	
				325	
				the printing press	
				325	
				the printing press	
				349	
				the telescope	
				369	
				technological advances have allowed discovery of the expanding universe	
				372	
				holography application	
				378	
				importance of electricity	
				392	
				hybrid gas/electric cars application	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				392	
					hybrid gas/electric cars application
				413	wiring application
				413	wiring application
				429	electron beam accelerators
				434	how television works application
				434	how television works application
				451	MRI application
				451	MRI application
				472	maglev train application
				473	how magplanes levitate
				490	why computers are useful
				492	computers and electronic addition of numbers application
				516	refrigerator application
				534	energy-efficient building application
				534	energy-efficient building application
				560	deep water submarine Alvin application
				585	laser application
				615	smoke detectors

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				623 623 631 631	creation of CAT scans creation of CAT scans nuclear power application nuclear power application
AP.5.03 Advanced Physics	Standard 5: Scientific Design and Application Objectives	Scientific Design	apply scientific skills and technological tools to design solutions that address personal and societal needs.	15 113 113 113 113 296 389 543 543	physics plays a role in nearly everything a person does test and evaluate the prototype structure design build and test a prototype structure out of toothpicks conceptual design for a bridge the engineering design cycle ultrasound technology electrical devices are designed to operate at a certain voltage evaluate three designs for a bridge failure analysis in the design process
				83 85 163 163 163 164 167 173 191	design and construct a pendulum create a system that oscillates design and test different electric motors propose solutions that will work for each disk apply steps of the design cycle to building different electric motors evaluate the performance of motor designs suggest improvements you could make to the generator design designing and building logic circuits build an air-speed tester

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Standard #: Course	Content Standard	Topic	Objective		Volume One Student Text Page	Volume Two Investigation Manual Page
AP.5.04 Advanced Physics	Standard 5: Scientific Design and Application Objectives	Scientific Design	describe the scientific concepts underlying technological innovations.	12	all technology is based on fundamental laws of physics	166 build a generator
				12	engineers design practical devices for solving problems	168 explore the properties of diodes
				31	nanotechnology application	168 electronic devices are part of our daily lives
				31	use of nanotechnology	170 understand the uses of transistors in circuits
				31	use of nanotechnology	170 measure voltage and current characteristics of a transistor
				51	analyzing motion with video and strobe photography	172 investigate and describe the four basic logic gates
				72	antilock brakes application	
				72	antilock brakes application	
				73	use of control computers in cars	
				112	relationship between science and engineering and technology	
				112	designing a bridge	
				138	use of robots	
				155	geostationary satellites	
				172	bicycle physics application	
				196	hydroelectric power application	
				196	hydroelectric power application	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				209	
					range of power for common devices
				216	
					energy from ocean tides
				217	
					research into tidal power
				228	
					seat belts and air bags
				235	
					jet engines application
				235	
					jet engines application
				243	
					oscillators are used in communications and music and clocks
				257	
					quartz crystals application
				257	
					quartz crystals application
				263	
					waves can carry information
				280	
					microwave ovens application
				280	
					microwave ovens application
				293	
					uses of Doppler radar
				311	
					invention of electric light
				313	
					information in images
				321	
					televisions and the RGB color process using pixels
				325	
					the printing press
				325	
					the printing press

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				328	
					how television creates pictures using three types of pixels
				348	
					recording images electronically
				349	
					the telescope
				365	
					LCD screen pixels
				369	
					technological advances have allowed discovery of the expanding universe
				372	
					holography application
				378	
					importance of electricity
				392	
					hybrid gas/electric cars application
				392	
					hybrid gas/electric cars application
				413	
					wiring application
				413	
					wiring application
				429	
					electron beam accelerators
				434	
					how television works application
				434	
					how television works application
				451	
					MRI application
				451	
					MRI application
				470	
					generating electricity by induction

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				471	transformers
				472	maglev train application
				473	how magplanes levitate
				478	diodes and the bias voltage
				479	transistors
				483	p-n junction is a diode
				485	transistors act as electronic switches
				486	a transistor amplifier
				487	electronic logic and transistor circuits
				487	circuits that make decisions
				489	digital representation of a number
				489	digital representation of a number
				490	parts of a computer
				490	why computers are useful
				491	the logic circuits used by computers
				491	the four basic logic gates
				492	computers and electronic addition of numbers application
				492	the binary number system and its use in computers

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				493	binary numbers in an adding circuit
				493	logic gates and an electronic adding circuit
				495	main components of a computer
				495	knowing a diode's bias voltage
				496	conditions for a logic circuit
				516	refrigerator application
				534	energy-efficient building application
				534	energy-efficient building application
				560	deep water submarine Alvin application
				585	laser application
				615	smoke detectors
				623	creation of CAT scans
				623	creation of CAT scans
				631	nuclear power application
				631	nuclear power application

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.5.05 Advanced Physics	Standard 5: Scientific Design and Application Objectives	Scientific Design	use appropriate technology solutions to measure and gather data; interpret data; analyze data; and to present and communicate conclusions.	<p>data tables and graphs can be created on computer or graphing calculator</p> <p>9 physics vocabulary is very specific</p> <p>18 measuring distance</p> <p>20 understanding metric rulers</p> <p>23 reading a digital timer</p> <p>25 accuracy and precision of measurements</p> <p>37 understanding the word "per"</p> <p>42 writing procedures in a lab notebook helps make sure your results are repeatable</p> <p>43 graphs are a way of representing data</p> <p>44 using a graph to make predictions</p> <p>45 recognizing relationships between variables from graphs</p> <p>45 recognizing patterns using graphs</p> <p>54 understanding patterns in relationships between variables</p>	<p>1 estimating length</p> <p>2 measuring a pencil</p> <p>4 using a timer</p> <p>5 using photogates</p> <p>6 accuracy and resolution and printing</p> <p>6 collecting data with precision</p> <p>7 using devices to measure mass</p> <p>9 using timer and photogates</p> <p>11 using timer and photogates</p> <p>13 is there a trend in measurements?</p> <p>14 using a timer and photogates</p> <p>15 collect time data with precision</p> <p>15 record data in a table</p> <p>15 collect time data</p> <p>17 using a timer and photogates</p> <p>17 use a data table</p> <p>18 collect time data with precision</p> <p>18 record data</p>

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page		
				56	indicate relationships between variables in graphs	18	use a timer and photogates
				60	understanding the Greek letter delta	18	use a ruler
				91	the force platform	21	record results in table
				96	terms of mass and weight	21	use a timer and photogates
				97	understanding symbols	23	use a timer and photogates
				107	drawing free-body diagrams	26	use a timer and photogates
				116	draw a free-body diagram	27	record position and time data
				125	drawing the velocity vector	29	use a meter stick
				142	finding x and y components of velocity for model rocket	29	record mass and force
				212	making an energy flow diagram	29	find mass
				246	understanding graphs of harmonic motion	29	use a spring scale
				246	understanding graphs of harmonic motion	34	use a spring scale
				246	understanding graphs of harmonic motion	36	use a meter stick
				304	comparison of wave forms from guitar sounds	39	using a compass
				307	decibel level vs. frequency graph for human hearing	42	use a timer and photogates
				333	drawing a ray diagram	43	measure and record the distance
				342	drawing ray diagrams of lenses	43	measure the distance
						44	use a spring scale
						47	use a timer and photogate
						50	use a timer and photogate

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page	
				380	circuit diagrams and electrical symbols	58 use a timer and photogate
				383	using a multimeter to measure voltage	60 use a spring scale
				385	measuring current with an ammeter or multimeter	60 measure input and output forces
				387	using a multimeter to measure resistance	63 as mechanical advantage increases what happens to length of pulled string?
				427	diagramming electric fields using field lines	65 use a timer and photogate
				427	drawing the electric field using field lines	66 what does the graph tell you?
				443	diagramming magnetic fields using magnetic field lines	66 record data in table
				443	diagramming magnetic fields using magnetic field lines	67 use a timer and photogate
				479	current vs.voltage graph for a transistor	67 measure vertical distance
				498	listing different types of matter in your home	70 record data in table
				504	Celsius and Fahrenheit thermometers	75 use a timer and photogates
				505	how thermometers work	78 use meter stick to measure height
						78 observe what happens
						82 measure the length of the string
						82 create data table for self-designed experiment
						82 use a timer and photogate
						82 record your data in table
						82 analyze data

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
					87 observe what happens to the motion
					87 use photogate and timer to measure the period
					89 observe the wave pulse
					89 use a spring scale to measure tension of string
					90 use a timer and photogates
					93 use the timer to measure frequency
					106 experiment with mirrors
					112 use a laser and mirror to study law of reflection
					112 study reflection with a mirror
					115 use mirrors and lenses to learn how images are formed
					117 use a laser to locate images formed by a lens
					122 communicate your findings
					122 present your findings
					131 use a multimeter to measure current
					132 use a multimeter to measure voltage

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
					133 did battery voltage change?
					135 use a multimeter to measure current and voltage
					139 use a multimeter
					140 use the multimeter
					157 reading a compass
					163 use a multimeter
					164 use a multimeter to measure voltage
					165 use a multimeter
					166 use a photogate and timer
					169 use a multimeter
					171 use a multimeter
					175 display information you found for your element
					176 use a thermometer
					178 measure the temperature
					180 measure the temperature
					192 check the pressure with your gauge
					192 use a digital balance
					202 keep detailed notes as you work
					206 record your observations

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
AP.6.01 Advanced Physics	Standard 6: Science in Personal and Social Perspectives	Perspectives	describe the impact of cultural, technological, and economic influences on the evolving nature of scientific thought and knowledge.	12 14 31 51 52 52 72 91 92 112 112 155 172 178	all technology is based on fundamental laws of physics using analysis and problem solving and an understanding of technology to make economic decisions use of nanotechnology analyzing motion with video and strobe photography Dr. Harold Edgerton and strobe photography Dr. Harold Edgerton and strobe photography antilock brakes application biomechanics application applications of biomechanics impact of technology relationship between science and engineering and technology first artificial human-made Earth satellite was Sputnik bicycle physics application Great Pyramid of Giza and simple machines

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				196	
				hydroelectric power application	
				235	
				jet engines application	
				243	
				oscillators are used in communications and music and clocks	
				257	
				Pierre and Jacques Curie and the piezoelectric effect	
				257	
				quartz crystals application	
				263	
				waves can carry information	
				269	
				wave motion and equilibrium	
				280	
				microwave ovens application	
				290	
				technological breakthrough of sound recording	
				310	
				past theories of light	
				325	
				the printing press	
				325	
				history of printing	
				348	
				the usefulness of recorded images	
				349	
				the telescope	
				361	
				Young's double-slit experiment	
				368	
				Einstein's thinking revolutionized physics	

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				369	
					technological advances have allowed discovery of the expanding universe
				372	
					holography application
				392	
					hybrid gas/electric cars application
				413	
					wiring application
				429	
					electron beam accelerators
				434	
					how television works application
				447	
					discovering and using magnetism
				451	
					MRI application
				472	
					maglev train application
				473	
					how magplanes levitate
				492	
					computers and electronic addition of numbers application
				501	
					search for elements and alchemy
				516	
					refrigerator application
				534	
					energy-efficient building application
				535	
					designing buildings to be energy efficient
				560	
					deep water submarine Alvin application

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Standard #: Course	Content Standard	Topic	Objective	Volume One Student Text Page	Volume Two Investigation Manual Page
				561 the Alvin research submarine 575 discovery of helium 585 economics of laser technology 585 laser application 615 smoke detectors 623 creation of CAT scans 625 turning lead into gold 631 nuclear power application	
AP.6.02 Advanced Physics	Standard 6: Science in Personal and Social Perspectives	Perspectives	explore occupational opportunities in science and technology including the academic preparation necessary.	12 engineers design practical devices for solving problems 13 medical and health professions use physics 13 medical and health professions use physics 91 biomechanics application 91 careers in biomechanics 227 police forensic scientists 289 careers in acoustics 404 electrical engineers 449 Earth's magnetism	

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AP.6.03 Advanced Physics	Standard 6: Science in Personal and Social Perspectives	Perspectives	engage in decision making activities and actions to resolve science-technology-society issues.	219	using energy efficient products
				392	hybrid cars combine advantages of gasoline fuel and electric power
				392	environmental impact of auto pollution
				534	energy-efficient building application
				604	balancing chemical equation of acid rain
				607	impact of combustion reaction of gasoline
				621	sources of radiation in the environment
				621	human technology contributes to radiation in environment
				628	nuclear waste
632	nuclear waste				