

Newport-Mesa Unified School District
Office of Secondary Curriculum and Instruction
High School Course of Study

Department	Science		Course Title	AP Physics C: Mechanics 1A			
Course Code			Grade Level(s)	11-12		Course Length	1 Semester
Credits/Semester	5	Required for Graduation?		No	Elective Credit?	No	
Prerequisites	Concurrent enrollment in Calculus, teacher recommendation						
Community College Articulation?			Name of College				
UC/CSU Articulation?			Name of University				
Meets UC/CSU “a-g” Requirement?			Meets NCAA Requirement?			Weighted Course Credit?	

COURSE DESCRIPTION

Mechanics 1A is divided into 4 units, covered in the first semester before the AP Exam. Concepts and problem-solving techniques are introduced through a combination of lectures, demonstrations, lab experiments, question–answer sessions, assignments from the textbook, and teacher-generated worksheets. Calculus is used throughout and where appropriate.

This course is equivalent to the pre-engineering introductory Physics course for university bound students. The emphasis is on understanding the concepts and skills and using concepts and formulae to solve problems. Laboratory work is an integral part of this course. Students engage in inquiry-based activities to develop their understanding of the material of the course.

Traditionally, the AP Physics C: Mechanics course has been taught to first year physics students. Students who have taken regular physics will skip this course and start at Mechanics 1B.

GOALS:

The goal in the Advanced Placement Physics course is to provide an excellent first-year college-level calculus-based physics education.

1. Students will master a conceptual understanding of kinematics in both one dimension and two dimensions. The two dimensions that will be accentuated will be for projectiles in a constant gravitational field and for objects undergoing circular motion.
2. Students will study the concepts of dynamics. Newton’s three laws and their impact on motion will be critical to understanding the principles of physics.
3. Students will study kinetic and potential energies, and their conservation. Conservative and non-conservative forces and their impact on energy will be discussed
4. Students will study the importance of momentum in the interactions between objects.
5. Students should also be able to apply their understanding to approach and solve problems that are essentially new to them.
6. Students will develop skills in performing lab experiments, by practicing experimental design and proper data collection methods.
7. Students will develop skills in analyzing laboratory experiments, using calculus and graphical methods to analyze data.

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California Content Standards

Motion and Forces

1. Newton's laws predict the motion of most objects. As a basis for understanding this concept:
 - a. Students know how to solve problems that involve constant speed and average speed.
 - b. Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).
 - c. Students know how to apply the law $F=ma$ to solve one-dimensional motion problems that involve constant forces (Newton's second law).
 - d. Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
 - e. Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.
 - f. Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).
 - g. Students know circular motion requires the application of a constant force directed toward the center of the circle.
 - h.* Students know Newton's laws are not exact but provide very good approximations unless an object is moving close to the speed of light or is small enough that quantum effects are important.
 - i.* Students know how to solve two-dimensional trajectory problems.
 - j.* Students know how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.
 - k.* Students know how to solve two-dimensional problems involving balanced forces (statics).
 - l.* Students know how to solve problems in circular motion by using the formula for centripetal acceleration in the following form: $a=v^2/r$.

Conservation of Energy and Momentum

2. The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept:
 - a. Students know how to calculate kinetic energy by using the formula $E=(1/2)mv^2$.
 - b. Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) = mgh (h is the change in the elevation).
 - c. Students know how to solve problems involving conservation of energy in simple systems, such as falling objects.
 - d. Students know how to calculate momentum as the product mv .
 - e. Students know momentum is a separately conserved quantity different from energy.
 - f. Students know an unbalanced force on an object produces a change in its momentum.
 - g. Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.
 - h.* Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.

Investigation and Experimentation

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
 - a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
 - b. Identify and communicate sources of unavoidable experimental error.
 - c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
 - d. Formulate explanations by using logic and evidence.
 - e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
 - f. Distinguish between hypothesis and theory as scientific terms.
 - g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.

Evaluation

Student achievement will be measured using multiple assessment tools, included but not limited to benchmark test results, final exams, end-of-unit tests, quizzes, homework, classwork, notebooks, portfolios, authentic performance assessments, and written assessments using the district's rubric. District-wide benchmark assessments will be assessed using the following chart:

Performance Standards - Benchmark Assessments				
Far Below Basic = F	Below Basic = D	Basic = C	Proficient = B	Advanced Proficient = A

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Unit 1	Length of Unit (5 weeks)				
	Key Terms	Standards*		Model Tasks**	Tools & Text
<i>Kinematics</i>	Position Displacement Velocity Acceleration Derivative Integral Vector Components Centripetal	1 a. Students know how to solve problems that involve constant speed and average speed. 1i.* Students know how to solve two-dimensional trajectory problems. 1j.* Students know how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.		1. Students will draw graphs of position vs. time, velocity vs. time and acceleration vs. time. Using calculus principles, students will be able to find a, v, or x from any of the three graphs 2. Students will discover through experimentation how the principles of kinematics can be applied to projectiles and predict the range of a lab’s trajectory 3. Students will experimentally discover the relationship between velocity and acceleration for an object undergoing circular motion.	D C B A Teacher resource book Student textbook Mechanical Universe video series AP Released exams
Differentiation	Support -- for students who are struggling with the content	Meet with instructor during Prep periods to help with understanding, Up to date website communications to facilitate understanding.			
	Extension – for high achieving students. Required activities for all honors courses.	This course is designed as an advanced course to earn College Credit. The course itself is designed as an extension of the regular HS curriculum.			
Evaluation	<i>Formative Assessments: Students will be assessed through weekly quizzes, homework review, chapter tests.</i> <i>Summative Assessments: Unit exams, Complete AP exams</i>				

* Standards are to be identified by frequency on California Standards Tests. A high frequency standard will be labeled with an “H”, a medium frequency standard will be labeled “M”, and a low frequency standard will be labeled “L”.

** Tasks are to be identified by the Application Taxonomy Quadrant designed by the International Center for Leadership in Education.

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Unit 2	Length of Unit (5 weeks)				
	Key Terms	Standards*	Model Tasks**		Tools & Text
Dynamics	Newton’s Laws Inertia Force Friction Air Resistance Normal Force Coefficient of friction	1b. Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton’s first law). 1c. Students know how to apply the law $F=ma$ to solve one-dimensional motion problems that involve constant forces (Newton’s second law). 1d. Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton’s third law). 1k.* Students know how to solve two-dimensional problems involving balanced forces (statics).	1. Students will set up an Atwood’s Machine and measure its acceleration. Students will compare the theoretical values to the values they were able to measure. 2. Students will create graphs of air resistance, studying the acceleration and velocity as a function of time. 3. Students will experimentally find the coefficient of friction for several different combinations of surfaces.	D C B A	Teacher resource book Student textbook Mechanical Universe video series AP Released exams
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Unit 3	Length of Unit (3-4 Weeks)				
	Key Terms	Standards*	Model Tasks**		Tools & Text
Energy	Energy Kinetic Potential Work Conservative Power	2a. Students know how to calculate kinetic energy by using the formula $E=(1/2)mv^2$. 2b. Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =mgh (h is the change in the elevation). 2c. Students know how to solve problems involving conservation of energy in simple systems, such as falling objects. 2h.* Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.	Students will design an experiment to test the conservation of energy, measuring at least one energy change between kinetic and potential energy. Students will then be able to discuss the application of a non-conservative force that did work on the system. Students will able to predict the change in speed of an object by analyzing the change in potential energy.	D C B A	Teacher resource book Student textbook Mechanical Universe video series AP Released exams
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Unit 4	Length of Unit (3-4 Weeks)				
	Key Terms	Standards*		Model Tasks**	Tools & Text
Momentum	Momentum Impulse Collisions Elastic/Inelastic	2d. Students know how to calculate momentum as the product mv . 2e. Students know momentum is a separately conserved quantity different from energy. 2f. Students know an unbalanced force on an object produces a change in its momentum. 2g. Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.		1. Students will be able to predict the speed of and direction of and an object after an inelastic collision in 2 dimensions. 2. Students will create a ballistic pendulum and determine the initial velocity of the bullet given the angle the pendulum raises. 3. Using an air track, students will create elastic collisions and solve the simultaneous conservation of momentum and energy.	D C B A Teacher resource book Student textbook Mechanical Universe video series AP Released exams
Differentiation	Support -- for students who are struggling with the content	Meet with instructor during Prep periods to help with understanding, Up to date website communications to facilitate understanding.			
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