

About the Advanced Placement Program[®] (AP[®])

The Advanced Placement Program[®] enables willing and academically prepared students to pursue college-level studies — with the opportunity to earn college credit, advanced placement, or both — while still in high school. AP Exams are given each year in May. Students who earn a qualifying score on an AP Exam are typically eligible to receive college credit and/or placement into advanced courses in college. Every aspect of AP course and exam development is the result of collaboration between AP teachers and college faculty. They work together to develop AP courses and exams, set scoring standards, and score the exams. College faculty review every AP teacher's course syllabus.

AP Biology Course Overview

AP Biology is an introductory college-level biology course. Students cultivate their understanding of biology through inquiry-based investigations as they explore the following topics: evolution, cellular processes — energy and communication, genetics, information transfer, ecology, and interactions.

LABORATORY REQUIREMENT

This course requires that 25 percent of the instructional time will be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to apply the science practices.

PREREQUISITE

Students should have successfully completed high school courses in biology and chemistry.

AP Biology Course Content

The course is based on four Big Ideas, which encompass core scientific principles, theories, and processes that cut across traditional boundaries and provide a broad way of thinking about living organisms and biological systems. The following are Big Ideas:

- The process of evolution explains the diversity and unity of life.
- Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
- Living systems store, retrieve, transmit, and respond to information essential to life processes.
- Biological systems interact, and these systems and their interactions possess complex properties.

Science Practices

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Focusing on these disciplinary practices enables teachers to use the principles of scientific inquiry to promote a more engaging and rigorous experience for AP Biology students. Such practices require that students:

- Use representations and models to communicate scientific phenomena and solve scientific problems;
- Use mathematics appropriately;
- Engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course;
- Plan and implement data collection strategies in relation to a particular scientific question;
- Perform data analysis and evaluation of evidence;
- Work with scientific explanations and theories; and
- Connect and relate knowledge across various scales, concepts, and representations in and across domains.

Inquiry-Based Investigations

Twenty-five percent of instructional time is devoted to hands-on laboratory work with an emphasis on inquiry-based investigations. Investigations require students to ask questions, make observations and predictions, design experiments, analyze data, and construct arguments in a collaborative setting, where they direct and monitor their progress.

AP Biology Exam Structure

AP BIOLOGY EXAM: 3 HOURS

Assessment Overview

Exam questions are based on learning objectives, which combine science practices with specific content. Students learn to

- Solve problems mathematically — including symbolically
- Design and describe experiments and analyze data and sources of error
- Explain, reason, or justify answers with emphasis on deeper, conceptual understanding
- Interpret and develop conceptual models

Due to the increased emphasis on quantitative skills and application of mathematical methods in the questions, students are allowed to use simple four-function calculators (with square root) on the entire exam. Students also receive a formula list as part of their testing materials.

Format of Assessment

Section I: Multiple Choice | 69 Questions | 90 Minutes | 50% of Exam Score

Multiple-Choice: 63 Questions

- Discrete Questions
- Questions in sets

Grid-In: 6 Questions

- Discrete Questions
- Questions integrate biology and mathematical skills

Section II: Free Response | 8 Questions | 90 minutes | 50% of Exam Score

- Long Free Response (2 questions, one of which is lab or data-based)
- Short Free Response (6 questions, each requiring a paragraph-length argument/response)

AP BIOLOGY SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Two flasks with identical medium containing nutrients and glucose are inoculated with yeast cells that are capable of both anaerobic and aerobic respiration. Culture 1 is then sealed to prevent fresh air from reaching the culture; culture 2 is loosely capped to permit air to reach the culture. Both flasks are periodically shaken.

Which of the following best **predicts** which culture will contain more yeast cells after one week, and most accurately **justifies** that prediction?

- A. Culture 1, because fresh air is toxic to yeast cells and will inhibit their growth
- B. Culture 1, because fermentation is a more efficient metabolic process than cellular respiration
- C. Culture 2, because fresh air provides essential nitrogen nutrients to the culture
- D. Culture 2, because oxidative cellular respiration is a more efficient metabolic process than fermentation.

Correct Answer: D

Sample Grid-In Question

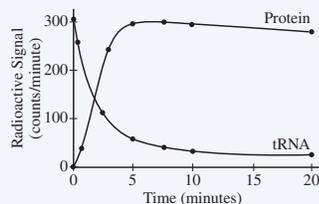
The data below demonstrate the frequency of tasters and non-tasters in an isolated population at Hardy-Weinberg equilibrium. The allele for non-tasters is recessive.

How many of the tasters in the population are heterozygous for tasting?

Tasters	Non-Tasters
8235	4328

Sample Short Free-Response Question

The role of tRNA in the process of translation was investigated by the addition of tRNA with attached radioactive leucine to an in vitro translation system that included mRNA and ribosomes. The results are shown by the graph.



In a **short paragraph**, describe how this figure justifies the claim that the role of tRNA is to carry amino acids that are then transferred from the tRNA to growing polypeptide chains.

AP[®] UNITED STATES GOVERNMENT AND POLITICS



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AP Government Program

The AP Program offers two government courses: AP United States (U.S.) Government and Politics and AP Comparative Government and Politics. Each course is designed to be equivalent to a one-semester introductory college course. There is no prescribed sequence of study. A school may offer one or both courses.

AP United States Government and Politics Course Overview

AP United States Government and Politics introduces students to key political ideas, institutions, policies, interactions, roles, and behaviors that characterize the political culture of the United States. The course examines politically significant concepts and themes, through which students learn to apply disciplinary reasoning assess causes and consequences of political events, and interpret data to develop evidence-based arguments.

RECOMMENDED PREREQUISITES

There are no prerequisite courses for AP United States Government and Politics. Students should be able to read a college level textbook and write grammatically correct, complete sentences.

AP United States Government and Politics Course Content

Students study general concepts used to interpret U.S. government and politics and analyze specific topics, including:

- Constitutional Underpinnings;
- Political Beliefs and Behaviors;
- Political Parties, Interest Groups, and Mass Media;
- Institutions of National Government;
- Public Policy; and
- Civil Rights and Civil Liberties.

An integral part of the course includes analysis and interpretation of basic data relevant to U.S. government and politics, and the development of connections and application of relevant theories and concepts.

Course Goals and Objectives

Students successfully completing this course will:

- Describe and compare important facts, concepts, and theories pertaining to U.S. government and politics.
- Explain typical patterns of political processes and behavior and their consequences (including the components of political behavior, the principles used to explain or justify various government structures and procedures, and the political effects of these structures and procedures).
- Interpret basic data relevant to U.S. government and politics (including data presented in charts, tables, and other formats).
- Critically analyze relevant theories and concepts, apply them appropriately, and develop their connections across the curriculum.

AP United States Government and Politics Exam Structure

AP UNITED STATES GOVERNMENT AND POLITICS EXAM:
2 HOURS 25 MINUTES

Assessment Overview

The AP United States Government and Politics Exam asks students to explain and apply key and supporting concepts. The exam measures students' understanding of American political culture and the interactions of governing and linkage institutions. Questions are based on the six major topics in the course, and students must be able to define, compare, explain, and interpret political concepts, policies, processes, perspectives, and behaviors that characterize the U.S. political system.

Format of Assessment

Section I: Multiple Choice | 60 Questions | 45 Minutes | 50% of Exam Score

- Demonstrate understanding of major course concepts, policies and institutions
- Apply skills of comparison and interpretation in addition to factual recall

Section II: Free Response | 4 Questions | 100 Minutes | 50% of Exam Score

- Define concepts and explain or interpret content across all course topics
- Analyze political relationships and evaluate policy changes using examples from the course to support the argument or response

AP UNITED STATES GOVERNMENT AND POLITICS SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question:

1. The Constitution and its amendments expressly prohibit all of the following except
 - (a) slavery
 - (b) double jeopardy
 - (c) cruel and unusual punishment
 - (d) unreasonable searches and seizures
 - (e) sex discrimination in employment

Correct Answer: E

Sample Free-Response Question:

1. While interest groups and political parties each play a significant role in the United States political system, they differ in their fundamental goals.
 - (a) Identify the fundamental goal of interest groups in the political process.
 - (b) Identify the fundamental goal of major political parties in the political process.
 - (c) Describe two different ways by which interest groups support the fundamental goal of political parties in the political process.
 - (d) For one of the forms of support you described in (c), explain two different ways in which that form of support helps interest groups to achieve their fundamental goal in the political process.

AP[®] STUDIO ART: 2-DIMENSIONAL DESIGN, 3-DIMENSIONAL DESIGN, AND DRAWING



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AP Studio Art Program

The AP Program offers three studio art courses and portfolios: Two-Dimensional Design, Three-Dimensional Design, and Drawing. The AP Studio Art portfolios are designed for students who are seriously interested in the practical experience of art. Students submit portfolios for evaluation at the end of the school year. The AP Studio Art Program consists of three portfolios — 2-D Design, 3-D Design and Drawing — corresponding to the most common college foundation courses. Students may choose to submit any or all of the Drawing, Two-Dimensional Design, or Three-Dimensional design portfolios. AP Studio Art students create a portfolio of work to demonstrate the artistic skills and ideas they have developed, refined, and applied over the course of the year to produce visual compositions.

PREREQUISITE

Although there is no prerequisite for AP Studio Art, prior experiences in studio art courses that address conceptual, technical, and critical thinking skills can support student success in the AP Studio Art Program.

AP Studio Art Content

AP Studio Art students work with diverse media, styles, subjects, and content. Each of the three portfolios consists of three sections:

- The Breadth section illustrates a range of ideas and approaches to art making.
- The Concentration section shows sustained, deep, and multiperspective investigation of a student-selected topic.
- The Quality section represents the student's most successful works with respect to form and content.

Works in this section may be selected from the other two sections. Students' work is informed and guided by observation, research, experimentation, discussion, critical analysis, and reflection, relating individual practices to the art world. Students are asked to document their artistic ideas and practices to demonstrate conceptual and technical development over time. The AP Studio Art Program supports students in becoming inventive artistic scholars who contribute to visual culture through art making.

Disciplinary Practices and Habits of Mind

Each AP Studio Art course and portfolio assessment focuses on students developing these practices and habits of mind through work with 2-dimensional design, 3-dimensional design, and drawing media and approaches, including the following:

- Critical analysis
- Evidence-based decision-making
- Innovative thinking
- Articulation of design elements and principles
- Systematic investigation of formal and conceptual aspects of art making
- Technical competence with materials and processes to communicate ideas
- Incorporation of expressive qualities in art making
- Demonstration of artistic intention
- Creation of a body of work unified by a visual or conceptual theme

1. Exams are administered for all AP subjects with the exception of Studio Art, which requires a portfolio assessment.

AP Studio Art Structure

Assessment Overview

In early May, students submit actual works and digital images of works for 2-D Design and Drawing Portfolios. These works should demonstrate artistic growth and development. For the 3-D Design Portfolio, students submit digital images of the art works they created as well as an artist statement in which they describe ideas investigated and explain how the ideas evolved as they created their body of work.

All portfolios are assessed by at least two highly experienced studio art educators (AP Studio Art teachers or college faculty) who apply standard scoring criteria, with respect to the forms and content.

Format of Assessment

Section I: Quality | 5 actual works for 2-D and Drawing, 12 digital images for 3-D | 33% of Portfolio Score

- Demonstrate mastery of design in concept, composition, and execution

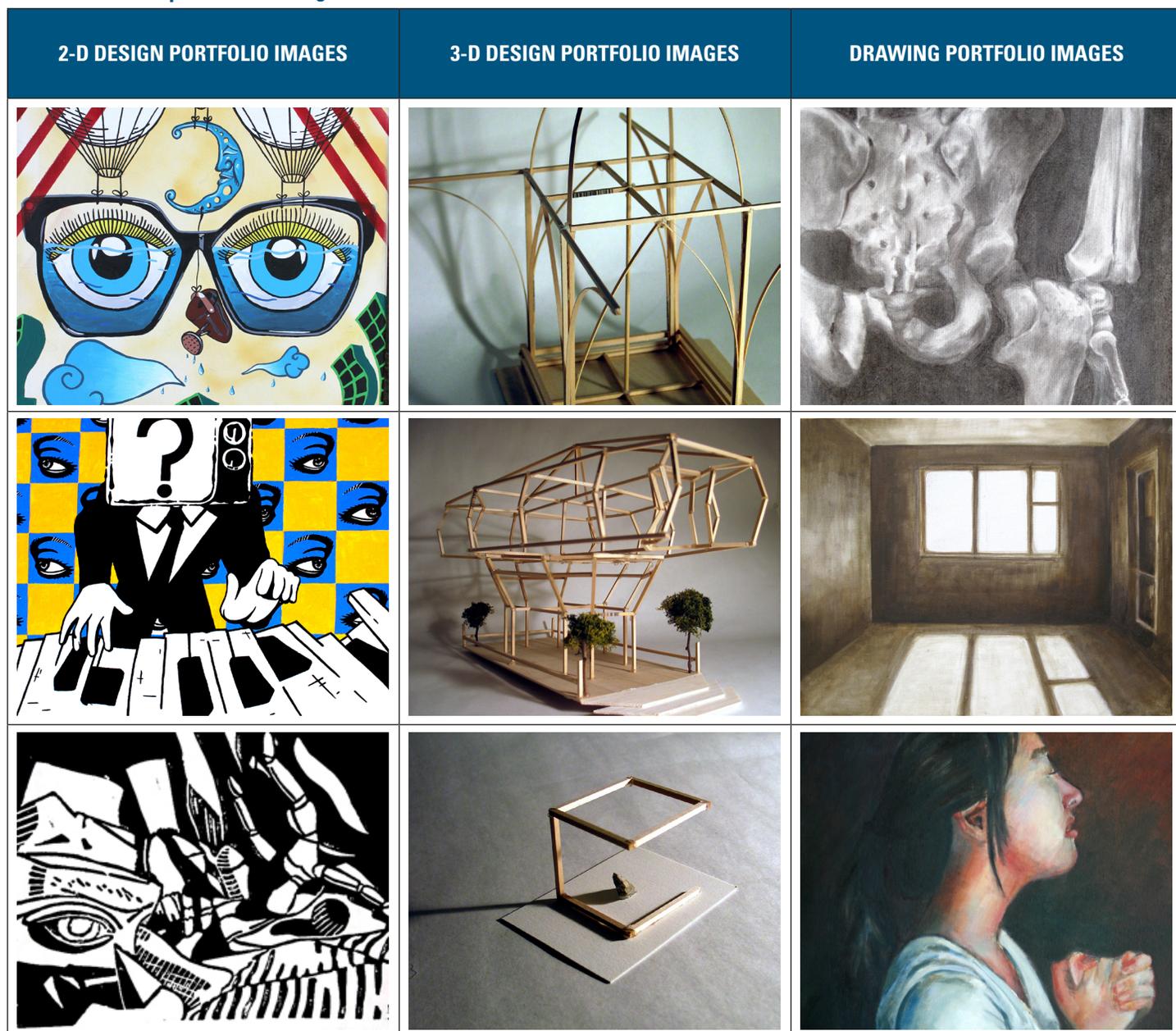
Section II: Concentration | 12 digital images | 33% of Portfolio Score

- Describe an in-depth explanation of a particular design concern

Section III: Breadth | 12 digital images for 2-D and Drawing, 16 digital images for 3-D | 33% of Portfolio Score

- Demonstrate understanding of design issues

AP Studio Art Sample Portfolio Images



Educators: apcentral.collegeboard.org/studioartdrawing

Educators: apcentral.collegeboard.org/studioart2d

Educators: apcentral.collegeboard.org/studioart3d

Students: apstudent.collegeboard.org/studioartdrawing

Students: apstudent.collegeboard.org/studioart2d

Students: apstudent/collegeboard.org/studioart3d

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AP Statistics Course Overview

The AP Statistics course is equivalent to a one-semester, introductory, non-calculus-based college course in statistics. The course introduces students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. There are four themes in the AP Statistics course: exploring data, sampling and experimentation, anticipating patterns, and statistical inference. Students use technology, investigations, problem solving, and writing as they build conceptual understanding.

PREREQUISITE

Students must have taken second-year algebra before enrolling in AP Statistics.

Use of Graphing Calculators and Computers

Professional mathematics organizations have strongly endorsed the use of calculators in mathematics instruction and testing. The use of a graphing calculator in AP Statistics is considered an integral part of the course. In addition, schools should make every effort to provide students and teachers easy access to computers to facilitate the teaching and learning of statistics.

Goals of AP Statistics

Students who are enrolled in AP Statistics are expected to

- Describe patterns and departures from patterns;
- Plan and conduct a study;
- Explore random phenomena using probability and simulation; and
- Estimate population parameters and test hypotheses.

Topic Outline for AP Statistics

I. Exploring Data

- Constructing and interpreting graphical displays of distributions of univariate data
- Summarizing and comparing distributions of univariate data
- Exploring bivariate and categorical data

II. Sampling and Experimentation

- Planning and conducting surveys and experiments using appropriate methods of data collection
- Generalizability of results and types of conclusions that can be drawn from observational studies, experiments, and surveys

III. Anticipating Patterns

- Exploring random phenomena using probability and simulation
- Combining independent random variables
- The normal distribution
- Sampling distributions

IV. Statistical Inference

- Estimating population parameters and testing hypotheses
- Tests of significance

AP Statistics Exam Structure

AP STATISTICS EXAM: 3 HOURS

Assessment Overview

Exam questions are based on the topics and skills addressed in the AP Statistics course. Formulas and tables needed to complete exam questions are provided to students taking the exam. Students are allowed to use a graphing calculator with statistical capabilities on the entire exam.

Format of Assessment

Section I: Multiple Choice | 40 Questions | 90 Minutes | 50% of Exam Score

- Discrete Questions

Section II: Free Response | 6 Questions | 90 Minutes | 50% of Exam Score

- 5 Short-Answer Questions
- 1 Investigative Task

AP STATISTICS SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

DESCRIPTIVE STATISTICS

Variable	N	Mean	Median	trMean	StDev	Se Mean
score	50	1045.7	1024.7	1041.9	221.9	31.4

Variable	Minimum	Maximum	Q1	Q3
score	628.9	1577.1	877.7	1219.5

Some descriptive statistics for a set of test scores are shown above. For this test, a certain student has a standardized score of $z = -1.2$. What score did this student receive on the test?

- (A) 266.28
- (B) 779.42
- (C) 1008.02
- (D) 1083.38
- (E) 1311.98

Correct Answer: B

Sample Free-Response Question: Experimental Design

As dogs age, diminished joint and hip health may lead to joint pain and thus reduce a dog's activity level. Such a reduction in activity can lead to other health concerns such as weight gain and lethargy due to lack of exercise. A study is to be conducted to see which of two dietary supplements, glucosamine or chondroitin, is more effective in promoting joint and hip health and reducing the onset of canine osteoarthritis. Researchers will randomly select a total of 300 dogs from ten different large veterinary practices around the country. All of the dogs are more than 6 years old, and their owners have given consent to participate in the study. Changes in joint and hip health will be evaluated after 6 months of treatment.

- (a) What would be the advantage to adding a control group in the design of this study?
- (b) Assuming a control group is added to the other two groups in the study, explain how you would assign the 300 dogs to these three groups using a completely randomized design.
- (c) Rather than using a completely randomized design, one group of researchers proposes blocking on clinics, and another group of researchers proposes blocking on breed of dog. How would you decide which one of these two variables to use as a blocking variable?

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AP World Languages and Cultures Program

The AP World Languages and Cultures program features eight courses and exams and includes the following languages: Chinese, French, German, Italian, Japanese, Latin, and Spanish (both Language and Literature courses).

In today's global community, competence in more than one language is an essential part of communication and cultural understanding. Study of another language not only provides individuals with the ability to express thoughts and ideas for their own purposes, but also provides them with access to perspectives and knowledge that is only available through the language and culture. The proficiencies acquired through the study of languages and literatures endow language learners with cognitive, analytical, and communication skills that carry over into many other areas of their academic studies. The three modes of communication (Interpersonal, Interpretive, and Presentational) defined in the *Standards for Foreign Language Learning in the 21st Century* and described in more detail in the *ACTFL Performance Descriptors for Language Learners*, are foundational to AP World Languages and Cultures courses.

AP Spanish Language and Culture Course Overview

The AP Spanish Language and Culture course emphasizes communication (understanding and being understood by others) by applying interpersonal, interpretive, and presentational skills in real-life situations. This includes vocabulary usage, language control, communication strategies, and cultural awareness. The AP Spanish Language and Culture course strives not to overemphasize grammatical accuracy at the expense of communication. To best facilitate the study of language and culture, the course is taught almost exclusively in Spanish.

The AP Spanish Language and Culture course engages students in an exploration of culture in both contemporary and historical contexts. The course develops students' awareness and appreciation of cultural products (e.g., tools, books, music, laws, conventions, institutions); practices (patterns of social interactions within a culture); and perspectives (values, attitudes, and assumptions).

RECOMMENDED PREREQUISITES

There are no prerequisites; however, students are typically in their fourth year of high school-level Spanish language study. In the case of native or heritage speakers, there may be a different course of study leading to this course.

Course Themes

The AP Spanish Language and Culture course is structured around six themes:

- Beauty and Aesthetics
- Contemporary Life
- Families and Communities
- Global Challenges
- Personal and Public Identities
- Science and Technology

Themes facilitate the integration of language, content, and culture and promote the use of the language in a variety of contexts.

The themes may be combined, as they are interrelated.

World Languages and Cultures Learning Objectives

The AP Spanish Language and Culture course provides students with opportunities to demonstrate their proficiency at the Intermediate to Pre-Advanced range in each of the three modes of communication described in the *ACTFL Performance Descriptors for Language Learners*.

Students are expected to:

- Engage in spoken interpersonal communication;
- Engage in written interpersonal communication;
- Synthesize information from a variety of authentic audio, visual, and audiovisual resources;
- Synthesize information from a variety of authentic written and print resources;
- Plan, produce, and present spoken presentational communications; and
- Plan and produce written presentational communications.

AP Spanish Language and Culture Exam Structure

AP SPANISH LANGUAGE AND CULTURE EXAM: 3 HOURS

Assessment Overview

Exam questions are based on the six learning objectives and assess all themes. As much as possible, students read and listen to authentic texts from the Spanish-speaking world throughout the exam.

Format of Assessment

Section I: Multiple Choice | 65 Questions | ~ 95 Minutes | 50% of Exam Score

Part A: (30 questions)

- Interpretive Communication: Print Tests

Part B: (35 questions)

- Interpretive Communication: Print and Audio Texts (combined)
 - Interpretive Communication: Audio Texts
-

Section II: Free Response | 8 Prompts | ~ 80 Minutes | 50% of Exam Score

- Interpersonal Writing: Email Reply (1 prompt)
- Presentational Writing: Persuasive Essay (1 prompt)
- Interpersonal Speaking: Simulated Conversation (5 prompts)
- Presentational Speaking: Cultural Comparison (1 prompt)

EXAM COMPONENTS

Note: On the AP Spanish Language and Culture Exam, all directions, questions, and texts are presented in Spanish.

Multiple-Choice Section

Part A:

Print Texts

Students respond to questions based on a variety of authentic print materials, including:

- Journalistic Texts
- Literary Texts
- Announcements
- Advertisements
- Letters
- Maps
- Tables

Part B:

Print and Audio Texts

Students respond to a variety of authentic audio texts*, including:

- Interviews
- Podcasts
- Public Service Announcements
- Conversations
- Brief Presentations

Audio Texts

Students respond to questions based on audio texts* that are paired with print materials.

*Note: All audio texts are played twice.

Free-Response Section

Interpersonal Writing: Email Reply (15 minutes)

Students read and respond to an email message.

Presentational Writing: Persuasive Essay (55 minutes: 15 minutes to examine texts and 40 minutes to write)

Students examine three authentic texts (article, table or graphic, audio text), then have 40 minutes to organize and write a persuasive essay in response to a prompt. In their essays they must present and defend their own viewpoint using information from all three sources.

Interpersonal Speaking: Simulated Conversation (2 minutes 40 seconds: 1 minute to preview and 20 seconds each for five prompts)

Students have one minute to preview a conversation, including an outline of each turn in the conversation, and then respond to five prompts.

Presentational Speaking: Cultural Comparison (6 minutes: 4 minutes to prepare and 2 minutes to present)

Students respond to a prompt by giving a presentation in which they compare cultural features of their own community to those found in an area of the Spanish-speaking world with which they are familiar.

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AP Physics Program

The AP Program offers four physics courses.

AP Physics 1 is a full-year course that is the equivalent of a first-semester introductory college course in algebra-based physics.

AP Physics 2 is a full-year course that is the equivalent of a second-semester introductory college course in algebra-based physics. The course covers fluids; thermodynamics; electrical force, field, and potential; electric circuits; magnetism and electromagnetic induction; geometric and physical optics; and quantum, atomic, and nuclear physics.

AP Physics C: Mechanics is a half-year course that is the equivalent of a semester-long, introductory calculus-based college course. It covers kinematics; Newton's laws of motion; work, energy, and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation.

AP Physics C: Electricity and Magnetism is a half-year course following Physics C: Mechanics that is the equivalent of a semester-long, introductory calculus-based college course. It covers electrostatics; conductors, capacitors, and dielectrics; electric circuits; magnetic fields; and electromagnetism.

AP Physics 1: Algebra-Based Course Overview

AP Physics 1 is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: kinematics; dynamics; circular motion and gravitation; energy; momentum; simple harmonic motion; torque and rotational motion; electric charge and electric force; DC circuits; and mechanical waves and sound.

LABORATORY REQUIREMENT

This course requires that 25 percent of the instructional time will be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to demonstrate the foundational physics principles and apply the science practices.

Inquiry-based laboratory experiences support the AP Physics 1 course and AP Course Audit curricular requirements by providing opportunities for students to engage in the seven science practices as they design plans for experiments, make predictions, collect and analyze data, apply mathematical routines, develop explanations, and communicate about their work.

Colleges may require students to present their laboratory materials from AP science courses before granting college credit for laboratory work, so students should be encouraged to retain their laboratory notebooks, reports, and other materials.

PREREQUISITES

There are no prerequisite courses. Students should have completed geometry and be concurrently taking Algebra II or an equivalent course. Although the Physics 1 course includes basic use of trigonometric functions, this understanding can be gained either in the concurrent math course or in the AP Physics 1 course itself.

AP Physics 1 Course Content

Students explore principles of Newtonian mechanics (including rotational motion); work, energy, and power; mechanical waves and sound; and introductory, simple circuits. The course is based on six big ideas, which encompass core scientific principles, theories, and processes that cut across traditional boundaries and provide a broad way of thinking about the physical world. The following are the big ideas:

- Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Fields existing in space can be used to explain interactions.
- The interactions of an object with other objects can be described by forces.
- Interactions between systems can result in changes in those systems.
- Changes that occur as a result of interactions are constrained by conservation laws.
- Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Science Practices

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Focusing on these disciplinary practices enables teachers to use the principles of scientific inquiry to promote a more engaging and challenging experience for AP Physics students. Such practices require that students:

- Use representations and models to communicate scientific phenomena and solve scientific problems;
- Use mathematics appropriately;
- Engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course;
- Plan and implement data collection strategies in relation to a particular scientific question;
- Perform data analysis and evaluation of evidence;
- Work with scientific explanations and theories; and
- Connect and relate knowledge across various scales, concepts, and representations in and across domains.

AP Physics 1 Exam Structure

AP PHYSICS 1 EXAM: 3 HOURS

Assessment Overview

Exam questions are based on learning objectives, which combine science practices with specific content. Students are assessed on their ability to:

- Provide both qualitative and quantitative explanations, reasoning, or justification of physical phenomena, grounded in physics principles and theories;
- Solve problems mathematically — including symbolically — but with less emphasis on only mathematical routines used for solutions;
- Interpret and develop conceptual models; and
- Transfer knowledge and analytical skills developed during laboratory experiences to design and describe experiments and analyze data and draw conclusions based on evidence.

Students will be allowed to use a four-function, scientific, or graphing calculator on the entire AP Physics 1 and AP Physics 2 Exams. Scientific or graphing calculators (including the approved

graphing calculators listed at www.collegeboard.org/ap/calculators) cannot have any unapproved features or capabilities.

Format of Assessment

Section I: Multiple Choice: 50 Questions | 1 Hour, 30 Minutes | 50% of Exam Score

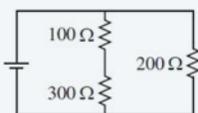
- Discrete questions
- Questions in sets
- Multiple-correct questions (two options are correct)

Section II: Free Response: 5 Questions | 1 Hour, 30 Minutes | 50% of Exam Score

- Experimental Design (1 question)
- Quantitative/Qualitative Translation (1 question)
- Short Answer (3 questions, one requiring a paragraph-length argument)

AP PHYSICS 1 SAMPLE EXAM QUESTIONS

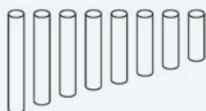
Sample Multiple-Choice Question



1. The figure above shows three resistors connected in a circuit with a battery. Which of the following correctly ranks the energy E dissipated in the three resistors during a given time interval?
- (A) $E_{300\Omega} > E_{200\Omega} > E_{100\Omega}$
(B) $E_{300\Omega} > E_{100\Omega} > E_{200\Omega}$
(C) $E_{200\Omega} > E_{300\Omega} > E_{100\Omega}$
(D) $E_{200\Omega} > E_{100\Omega} > E_{300\Omega}$

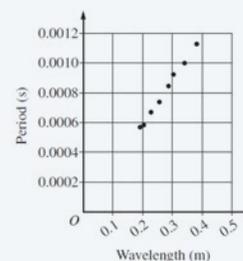
Correct Answer: C

Sample Free-Response Question: Experimental Design



You are given a set of chimes that consists of eight hollow metal tubes open at both ends, like those shown at left. The chimes are played by striking them with a small hammer to produce musical sounds. Your task is to use the chimes to determine the speed of sound in air at room temperature. You have available a set of tuning forks and other common laboratory equipment but are not allowed to use electronic equipment, such as a sound sensor. (A tuning fork vibrates when struck and produces sound at a particular frequency, which is printed on the tuning fork.)

- (A) Describe your experimental procedure in enough detail so that another student could perform your experiment. Include what measurements you will take and how you will take them.
- (B) Describe how you will use your measurements to determine the speed of sound in enough detail so that another student could duplicate your process.
- (C) Describe one assumption you made about the design of your experiment, and explain how it might affect the value obtained for the speed of sound.
- (D) A student doing a different experiment to determine the speed of sound in air obtained wavelength and period measurements and created the following plot of the data. Use the graph to calculate the speed of sound and include an explanation of your method.



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AP Physics Program

The AP Program offers four physics courses: AP Physics 1: Algebra-Based, AP Physics 2: Algebra-Based, AP Physics C: Mechanics, and AP Physics C: Electricity and Magnetism.

Guided by the National Research Council and National Science Foundation, the AP Program collaborated with college and university educators and AP teachers to develop two yearlong AP Physics courses to replace AP Physics B.

AP Physics 1: Algebra-Based and AP Physics 2: Algebra-Based are the equivalent of the first and second semesters of introductory, algebra-based college courses. Because these courses are intended to be yearlong courses, teachers have time to foster deeper conceptual understanding through student-centered, inquiry-based instruction. Students have time to master foundational physics principles while engaging in science practices to earn credit, placement, or both.

In addition, there are two AP Physics C courses: Physics C: Mechanics and Physics C: Electricity and Magnetism. Each corresponds to one semester of an introductory, calculus-based college course. Physics C: Mechanics is taught prior to Physics C: Electricity and Magnetism.

AP Physics C: Mechanics Course Overview

AP Physics C: Mechanics is equivalent to a one-semester, calculus-based, college-level physics course, especially appropriate for students planning to specialize or major in physical science or engineering. The course explores topics such as kinematics; Newton's laws of motion; work, energy and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation. Introductory differential and integral calculus is used throughout the course.

LABORATORY REQUIREMENT

AP Physics C: Mechanics should include a hands-on laboratory component comparable to a semester-long introductory college-level physics laboratory. Students should spend a minimum of 20 percent of instructional time engaged in hands-on laboratory work. Students ask questions, make observations and predictions, design experiments, analyze data, and construct arguments in a collaborative setting, where they direct and monitor their progress. Each student should complete a lab notebook or portfolio of lab reports.

PREREQUISITE

Students should have taken or be concurrently taking calculus.

AP Physics C: Mechanics Course Content

The AP Physics C: Mechanics course applies both differential and integral calculus and provides instruction in each of the following six content areas:

- Kinematics
- Newton's laws of motion
- Work, energy and power
- Systems of particles and linear momentum
- Circular motion and rotation
- Oscillations and gravitation

Learning Objectives for Laboratory and Experimental Situations

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Focusing on these disciplinary practices and experimental skills enables teachers to use the principles of scientific inquiry to promote a more engaging and rigorous experience for AP Physics C: Mechanics students. Such practices or skills require students to

- Design experiments
- Observe and measure real phenomena
- Organize, display, and critically analyze data
- Analyze sources of error and determine uncertainties in measurement
- Draw inferences from observations and data
- Communicate results, including suggested ways to improve experiments and proposed questions for further study

A minimum of 20 percent of instructional time is devoted to hands-on and inquiry-based laboratory investigations.

AP Physics C: Mechanics Exam Structure

AP PHYSICS C: MECHANICS EXAM: 90 MINUTES

Assessment Overview

The AP Physics C: Mechanics Exam includes questions posed in a laboratory or experimental setting. Questions assess understanding of content as well as experimental skills. The exam may also include questions that overlap several major topical areas or questions on miscellaneous topics such as identification of vectors and scalars, vector mathematics, or graphs of functions.

Students will be allowed to use a calculator on the entire AP Physics C: Mechanics and AP Physics C: Electricity and Magnetism Exams — including both the multiple-choice and free-response sections. Scientific or graphing calculators (including the approved graphing calculators listed at www.collegeboard.org/ap/calculators) may be used, provided that they do not have any unapproved features or capabilities.

Format of Assessment

Section I: Multiple Choice | 35 Questions | 45 Minutes | 50% of Exam Score

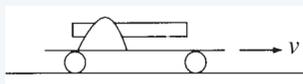
- Discrete Questions
- Questions in Sets

Section II: Free Response | 3 Questions | 45 Minutes | 50% of Exam Score

- Laboratory Based (graphing calculator permitted)
- Discrete Questions (graphing calculator permitted)

AP PHYSICS C : MECHANICS SAMPLE EXAM QUESTIONS

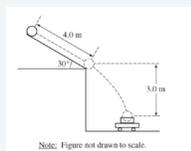
Sample Multiple-Choice Question



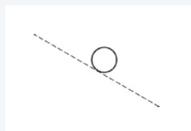
- (a) $\frac{Mv}{m}$
- (b) $\frac{(M + m)v}{m}$
- (c) $\frac{(M - m)v}{m}$
- (d) $\frac{mv}{M}$
- (e) $\frac{mv}{(M - m)}$

Correct Answer: B

Sample Free-Response Question



- (a) On the figure below, draw and label the forces (not components) acting on the ball at their points of application as it rolls along the roof.



- (b) Calculate the force due to friction acting on the ball as it rolls along the roof. If you need to draw anything other than what you have shown in part (a) to assist in your solution, use the space below. Do NOT add anything to the figure in part (a).
- (c) Calculate the linear speed of the center of mass of the ball when it reaches the bottom edge of the roof.
- (d) A wagon containing a box is at rest on the ground below the roof so that the ball falls a vertical distance of 3.0 m and lands and sticks in the center of the box. The total mass of the wagon and the box is 12 kg. Calculate the horizontal speed of the wagon immediately after the ball lands in it.

AP[®] PHYSICS C: ELECTRICITY & MAGNETISM



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AP Physics 1: Algebra-Based and AP Physics 2: Algebra-Based are the equivalent of the first and second semesters of introductory, algebra-based college courses. Because these courses are intended to be yearlong courses, teachers have time to foster deeper conceptual understanding through student-centered, inquiry-based instruction. Students have time to master foundational physics principles while engaging in science practices to earn credit, placement, or both.

In addition, there are two AP Physics C courses: Physics C: Mechanics and Physics C: Electricity and Magnetism. Each corresponds to one semester of an introductory, calculus-based college course. Physics C: Mechanics is taught prior to Physics C: Electricity and Magnetism.

AP Physics C: Electricity and Magnetism Course Overview

AP Physics C: Electricity and Magnetism is a one-semester, calculus-based, college-level physics course, especially appropriate for students planning to specialize or major in physical science or engineering. The course explores topics such as electrostatics; conductors, capacitors, and dielectrics; electric circuits; magnetic fields; and electromagnetism. Introductory differential and integral calculus is used throughout the course.

LABORATORY REQUIREMENT

AP Physics C: Electricity and Magnetism should include a hands-on laboratory component comparable to a semester-long introductory college-level physics laboratory. Students should spend a minimum of 20 percent of instructional time engaged in hands-on laboratory work. Students ask questions, make observations and predictions, design experiments, analyze data, and construct arguments in a collaborative setting, where they direct and monitor their progress. Each student should complete a lab notebook or portfolio of lab reports.

PREREQUISITE

Students should have taken or be concurrently taking calculus.

AP Physics C: Electricity and Magnetism Course Content

The AP Physics C: Electricity and Magnetism course applies both differential and integral calculus, and builds upon the AP Physics C: Mechanics course by providing instruction in each of the following five content areas:

- Electrostatics
- Conductors, capacitors, and dielectrics
- Electric circuits
- Magnetic fields
- Electromagnetism

Learning Objectives for Laboratory and Experimental Situations

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Focusing on these disciplinary practices and experimental skills enables teachers to use the principles of scientific inquiry to promote a more engaging and rigorous experience for AP Physics C: Electricity and Magnetism students. Such practices or skills require students to

- Design experiments
- Observe and measure real phenomena
- Organize, display and critically analyze data
- Analyze sources of error and determine uncertainties in measurement
- Draw inferences from observations and data
- Communicate results, including suggested ways to improve experiments and proposed questions for further study

A minimum of 20 percent of instructional time is devoted to hands-on and inquiry-based laboratory investigations.

AP Physics C: Electricity and Magnetism Exam Structure

AP PHYSICS C: ELECTRICITY AND MAGNETISM EXAM: 90 MINUTES

Assessment Overview

The AP Physics C: Electricity and Magnetism Exam includes questions posed in a laboratory or experimental setting. Questions assess understanding of content as well as experimental skills. The exam may also include questions that overlap several major topical areas or questions on miscellaneous topics such as identification of vectors and scalars, vector mathematics, or graphs of functions.

Students will be allowed to use a calculator on the entire AP Physics C: Mechanics and AP Physics C: Electricity and Magnetism Exams — including both the multiple-choice and free-response sections. Scientific or graphing calculators (including the approved graphing calculators listed at www.collegeboard.org/ap/calculators) may be used, provided that they do not have any unapproved features or capabilities.

Format of Assessment

Section I: Multiple Choice | 35 Questions | 45 Minutes | 50% of Exam Score

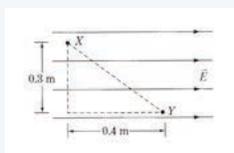
- Discrete Questions
- Questions in Sets

Section II: Free Response | 3 Questions | 45 Minutes | 50% of Exam Score

- Laboratory Based (graphing calculator permitted)
- Discrete Questions (graphing calculator permitted)

AP PHYSICS C : ELECTRICITY AND MAGNETISM SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

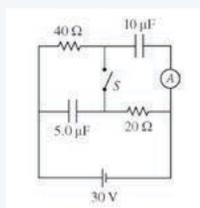


A uniform electric field \mathbf{E} of magnitude $6,000 \text{ V/m}$ exists in a region of space as shown above. What is the electric potential difference, $V_X - V_Y$, between points X and Y ?

- (a) $-12,000 \text{ V}$
- (b) 0 V
- (c) $1,800 \text{ V}$
- (d) $2,400 \text{ V}$
- (e) $3,000 \text{ V}$

Correct Answer: D

Sample Free-Response Question



In the circuit illustrated above, switch S is initially open and the battery has been connected for a long time.

- (a) What is the steady-state current through the ammeter?
- (b) Calculate the charge on the $10 \mu\text{F}$ capacitor.
- (c) Calculate the energy stored in the $5.0 \mu\text{F}$ capacitor. The switch is now closed, and the circuit comes to a new steady state.
- (d) Calculate the steady-state current through the battery.
- (e) Calculate the final charge on the $5.0 \mu\text{F}$ capacitor.
- (f) Calculate the energy dissipated as heat in the 40Ω resistor in one minute once the circuit has reached steady state.

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AP Economics Program

The AP Program offers two courses in economics: AP Macroeconomics and AP Microeconomics. Each course corresponds to one semester of a typical introductory college course in economics. AP Macroeconomics focuses on the principles that apply to an economic system as a whole. AP Microeconomics focuses on the principles of economics that apply to the functions of individual decision-makers, both consumers and producers, within the economic system.

AP Microeconomics Course Overview

AP Microeconomics is an introductory college-level course that focuses on the principles of economics that apply to the functions of individual economic decision-makers. The course also develops students' familiarity with the operation of product and factor markets, distributions of income, market failure, and the role of government in promoting greater efficiency and equity in the economy. Students learn to use graphs, charts, and data to analyze, describe, and explain economic concepts.

PREREQUISITE

There are no prerequisites for AP Microeconomics. Students should be able to read a college-level textbook and should possess basic mathematics and graphing skills.

AP Microeconomics Course Content

The AP Microeconomics course provides students with an understanding of the principles of economics as they apply to individual decision-making units, including individual households and firms. The course examines the theory of consumer behavior, the theory of the firm, and the behavior of profit-maximizing firms under various market structures. Students evaluate the efficiency of the outcomes with respect to price, output, consumer surplus, and producer surplus. They examine the behaviors of households and businesses in factor markets, and learn how the determination of factor prices, wages, interest, and rent influence the distribution of income in a market economy. There are ample opportunities to consider instances in which private markets may fail to allocate resources efficiently and examine various public policy alternatives aimed at improving the efficiency of private markets.

Topic Outline for AP Microeconomics

- I. Basic Economic Concepts
- II. The Nature and Functions of Product Markets
 - a. Supply and demand
 - b. Theory of consumer choice
 - c. Production and costs
 - d. Firm behavior and market structure
- III. Factor Markets
 - a. Derived Factor Demand
 - b. Marginal revenue product
 - c. Hiring decisions in the markets for labor and capital
 - d. Market distribution of income
- IV. Market Failure and the Role of Government
 - a. Externalities
 - b. Public goods
 - c. Public policy to promote competition
 - d. Income distribution

AP Microeconomics Exam Structure

AP MICROECONOMICS EXAM: 2 HOURS 10 MINUTES

Assessment Overview

The AP Microeconomics Exam questions measure students' knowledge of microeconomics principles and their ability to reason within the discipline.

Format of Assessment

Section I: Multiple Choice | 60 Questions | 70 Minutes | 66% of Exam Score

- Questions require the use of economics content knowledge and reasoning across the range of course topics.
- Some questions require analysis of different hypothetical situations.

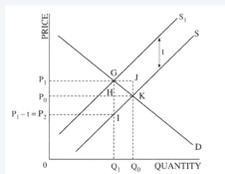
Section II: Free Response | 3 Questions | 60 Minutes | 33% of Exam Score

- 1 Long free-response question (50% of section score)
- 2 Short free-response questions (each worth 25% of section score)
- Questions ask students to analyze unique scenarios using different course concepts.
- Some questions in the free-response section require graphical analysis.

AP MICROECONOMICS SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Assume that the original supply and demand curves of a commodity are S and D , respectively. Also assume that the government imposes an excise tax (per unit tax) of t dollars on the commodity, which shifts the supply curve to S_1 .



The total amount of tax collected by the government is equal to

- (a) P_1GQ_10
- (b) P_1GIP_2
- (c) P_0P_1JK
- (d) P_0P_1GH
- (e) P_0P_2IH

Correct Answer: B

Sample Free-Response Question

Assume that Company XYZ is a profit-maximizing firm that hires its labor in a perfectly competitive labor market and sells its product in a perfectly competitive output market.

- (a) Define the marginal revenue product of labor (MRPL).
- (b) Using correctly labeled side-by-side graphs, show each of the following:
 - (i) The equilibrium wage in the labor market
 - (ii) The labor supply curve the firm faces
 - (iii) The number of workers the firm will hire
- (c) Company XYZ develops a new technology that increases its labor productivity. Currently this technology is not available to any other firm. For Company XYZ, explain how the increased productivity will affect each of the following:
 - (i) Wage rates
 - (ii) Number of workers hired

Educators: apcentral.collegeboard.org/apmicroecon

Students: apstudent.collegeboard.org/apmicroecon

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AP Macroeconomics Course Overview

AP Macroeconomics is an introductory college-level course that focuses on the principles that apply to an economic system as a whole. The course places particular emphasis on the study of national income and price-level determination; it also develops students' familiarity with economic performance measures, the financial sector, stabilization policies, economic growth, and international economics. Students learn to use graphs, charts, and data to analyze, describe, and explain economic concepts.

PREREQUISITE

There are no prerequisites for AP Macroeconomics. Students should be able to read a college-level textbook and should possess basic mathematics and graphing skills.

AP Macroeconomics Course Content

The AP Macroeconomics course provides students with a thorough understanding of the principles of economics and how economists use those principles to examine aggregate economic behavior. Students learn how the measures of economic performance, such as gross domestic product (GDP), inflation, and unemployment are constructed and how to apply them to evaluate the macroeconomic conditions of an economy. The course recognizes the global nature of economics and provides ample opportunities to examine the impact of international trade and finance on national economies. Various economic schools of thought are introduced as students consider solutions to economic problems.

Topic Outline for AP Macroeconomics

- I. Basic Economic Concepts
- II. Measurement of Economic Performance
 - a. National income accounts
 - b. Inflation measurement and adjustment
 - c. Unemployment
- III. National Income and Price Determination
 - a. Aggregate demand
 - b. Aggregate supply
 - c. Macroeconomics equilibrium
- IV. Financial Sector
 - a. Money, banking, and financial markets
 - b. Loanable funds market
 - c. Central bank and control of the money supply
- V. Stabilization Policies
 - a. Fiscal and monetary policies
 - b. The Phillips curve
- VI. Economic Growth
 - a. Definition of economic growth
 - b. Determinants of economic growth
 - c. Growth policy
- VII. Open Economy: International Trade and Finance
 - a. Balance of payments accounts
 - b. Foreign exchange market
 - c. Imports, exports, and financial capital flows
 - d. Relationships between international and domestic financial and goods markets

AP Macroeconomics Exam Structure

AP MACROECONOMICS EXAM: 2 HOURS 10 MINUTES

Assessment Overview

The AP Macroeconomics Exam questions measure students' knowledge of macroeconomics principles and their ability to reason within the discipline.

Format of Assessment

Section I: Multiple Choice | 60 Questions | 70 Minutes | 66% of Exam Score

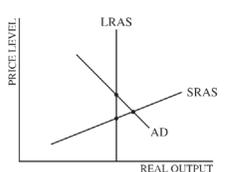
- Questions require the use of economics content knowledge and reasoning across the range of course topics.
- Some questions require analysis of different hypothetical situations.

Section II: Free Response | 3 Questions | 60 Minutes | 33% of Exam Score

- 1 long free-response question (50% of section score)
- 2 short free-response questions (each worth 25% of section score)
- Questions ask students to analyze unique scenarios using different course concepts.
- Some questions in the free-response section require graphical analysis.

AP MACROECONOMICS SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question



In the graph above, AD denotes the aggregate demand curve, SRAS the short-run aggregate supply curve, and LRAS the long-run aggregate supply curve. If no policy action were taken, which of the following changes would move the economy to its long-run equilibrium?

- (a) An increase in aggregate demand
- (b) An increase in exports
- (c) An increase in wages
- (d) A decrease in wages
- (e) A decrease in the expected price level

Correct Answer: C

Sample Free-Response Question

Country Y is experiencing severe and unanticipated inflation.

- (a) Explain the effect of this inflation on each of the following:
 - (i) A family with savings in a fixed-interest-rate time deposit account
 - (ii) A business repaying a long-term, fixed-interest-rate loan
- (b) Identify one fiscal policy action that could be implemented to reduce inflation.
- (c) Identify an open-market operation that could be implemented to reduce inflation.
- (d) Suppose that Country Y continues to experience high inflation in the long run. Indicate the effect of this inflation on the nominal interest rate in Country Y.
- (e) If Country Y's inflation is high relative to that of other countries, explain the effect of this inflation on the international value of Country Y's currency.

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AP World Languages and Cultures Program

The AP World Languages and Cultures program features eight courses and exams and includes the following languages: Chinese, French, German, Italian, Japanese, Latin, and Spanish (both Language and Literature courses).

In today's global community, competence in more than one language is an essential part of communication and cultural understanding. Study of another language not only provides individuals with the ability to express thoughts and ideas for their own purposes, but also provides them with access to perspectives and knowledge that is only available through the language and culture. The proficiencies acquired through the study of languages and literatures endow language learners with cognitive, analytical, and communication skills that carry over into many other areas of their academic studies. The three modes of communication (Interpersonal, Interpretive, and Presentational), defined in the *Standards for Foreign Language Learning in the 21st Century* and described in more detail in the *ACTFL Performance Descriptors for Language Learners*, are foundational to the AP World Languages and Cultures courses.

AP German Language and Culture Course Overview

The AP German Language and Culture course emphasizes communication (understanding and being understood by others) by applying interpersonal, interpretive, and presentational skills in real-life situations. This includes vocabulary usage, language control, communication strategies, and cultural awareness. The AP German Language and Culture course strives not to overemphasize grammatical accuracy at the expense of communication. To best facilitate the study of language and culture, the course is taught almost exclusively in German.

The AP German Language and Culture course engages students in an exploration of culture in both contemporary and historical contexts. The course develops students' awareness and appreciation of cultural products (e.g., tools, books, music, laws, conventions, institutions); practices (patterns of social interactions within a culture); and perspectives (values, attitudes, and assumptions).

PREREQUISITE

There are no prerequisites; however, students are typically in their fourth year of high school-level study. In the case of native or heritage speakers, there may be a different course of study leading to this course.

Course Themes

The AP German Language and Culture course is structured around six themes:

- Beauty and Aesthetics
- Contemporary Life
- Families and Communities
- Global Challenges
- Personal and Public Identities
- Science and Technology

Themes facilitate the integration of language, content, and culture and promote the use of the language in a variety of contexts.

The themes may be combined, as they are interrelated.

World Languages and Cultures Learning Objectives

The AP German Language and Culture course provides students with opportunities to demonstrate their proficiency at the Intermediate to Pre-Advanced range in each of the three modes of communication described in the *ACTFL Performance Descriptors for Language Learners*.

Students are expected to:

- Engage in spoken interpersonal communication;
- Engage in written interpersonal communication;
- Synthesize information from a variety of authentic audio, visual, and audiovisual resources;
- Synthesize information from a variety of authentic written and print resources;
- Plan, produce, and present spoken presentational communications; and
- Plan and produce written presentational communications.

AP German Language and Culture Exam Structure

AP GERMAN LANGUAGE AND CULTURE EXAM: 3 HOURS

Assessment Overview

Exam questions are based on the six learning objectives and assess all themes. As much as possible, students read and listen to authentic texts from the German-speaking world throughout the exam.

Format of Assessment

Section I: Multiple Choice | 65 Questions | ~ 95 Minutes | 50% of Exam Score

Part A: (30 questions)

- Interpretive Communication: Print Texts

Part B: (35 questions)

- Interpretive Communication: Print and Audio Texts (combined)
 - Interpretive Communication: Audio Texts
-

Section II: Free Response | 8 Prompts | ~ 80 Minutes | 50% of Exam Score

- Interpersonal Writing: Email Reply (1 prompt)
- Presentational Writing: Persuasive Essay (1 prompt)
- Interpersonal Speaking: Simulated Conversation (5 prompts)
- Presentational Speaking: Cultural Comparison (1 prompt)

EXAM QUESTION TYPES

Note: On the AP German Language and Culture Exam, all directions, questions, and texts are presented in German.

Multiple-Choice Section

Part A:

Print Texts

Students respond to questions based on a variety of authentic print materials, including:

- Journalistic Texts
- Literary Texts
- Announcements
- Advertisements
- Letters
- Maps
- Tables

Part B:

Print and Audio Texts

Students respond to a variety of authentic audio texts*, including:

- Interviews
- Podcasts
- Public Service Announcements
- Conversations
- Brief Presentations

Audio Texts

Students respond to questions based on audio texts* that are paired with print materials.

*Note: All audio texts are played twice.

Free-Response Section

Interpersonal Writing: Email Reply (15 minutes)

Students read and respond to an email message.

Presentational Writing: Persuasive Essay (55 minutes: 15 minutes to examine texts and 40 minutes to write)

Students examine three authentic texts (article, table or graphic, audio text), then have 40 minutes to organize and write a persuasive essay in response to a prompt. In their essays they must present and defend their own viewpoint using information from all three sources.

Interpersonal Speaking: Simulated Conversation (2 minutes 40 seconds: 1 minute to preview and 20 seconds each for five prompts)

Students have one minute to preview a conversation, including an outline of each turn in the conversation, and then respond to five prompts.

Presentational Speaking: Cultural Comparison (6 minutes: 4 minutes to prepare and 2 minutes to present)

Students respond to a prompt by giving a presentation in which they compare cultural features of their own community to those found in an area of the German-speaking world with which they are familiar.

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AP World Languages and Cultures Program

The AP World Languages and Cultures program features eight courses and exams and includes the following languages: Chinese, French, German, Italian, Japanese, Latin, and Spanish (both Language and Literature courses).

In today's global community, competence in more than one language is an essential part of communication and cultural understanding. Study of another language not only provides individuals with the ability to express thoughts and ideas for their own purposes, but also provides them with access to perspectives and knowledge that is only available through the language and culture. The proficiencies acquired through the study of languages and literatures endow language learners with cognitive, analytical, and communication skills that carry over into many other areas of their academic studies. The three modes of communication (Interpersonal, Interpretive, and Presentational), defined in the *Standards for Foreign Language Learning in the 21st Century* and described in more detail in the *ACTFL Performance Descriptors for Language Learners*, are foundational to the AP World Languages and Cultures courses.

AP French Language and Culture Course Overview

The AP French Language and Culture course emphasizes communication (understanding and being understood by others) by applying interpersonal, interpretive, and presentational skills in real-life situations. This includes vocabulary usage, language control, communication strategies, and cultural awareness. The AP French Language and Culture course strives not to overemphasize grammatical accuracy at the expense of communication. To best facilitate the study of language and culture, the course is taught almost exclusively in French.

The AP French Language and Culture course engages students in an exploration of culture in both contemporary and historical contexts. The course develops students' awareness and appreciation of cultural products (e.g., tools, books, music, laws, conventions, institutions); practices (patterns of social interactions within a culture); and perspectives (values, attitudes, and assumptions).

PREREQUISITE

There are no prerequisites; however, students are typically in their fourth year of high school-level study. In the case of native or heritage speakers, there may be a different course of study leading to this course.

Course Themes

The AP French Language and Culture course is structured around six themes:

- Beauty and Aesthetics
- Contemporary Life
- Families and Communities
- Global Challenges
- Personal and Public Identities
- Science and Technology

Themes facilitate the integration of language, content, and culture and promote the use of the language in a variety of contexts.

The themes may be combined, as they are interrelated.

World Languages and Cultures Learning Objectives

The AP French Language and Culture course provides students with opportunities to demonstrate their proficiency at the Intermediate to Pre-Advanced range in each of the three modes of communication described in the *ACTFL Performance Descriptors for Language Learners*.

Students are expected to:

- Engage in spoken interpersonal communication;
- Engage in written interpersonal communication;
- Synthesize information from a variety of authentic audio, visual, and audiovisual resources;
- Synthesize information from a variety of authentic written and print resources;
- Plan, produce, and present spoken presentational communications; and
- Plan and produce written presentational communications.

AP French Language and Culture Exam Structure

AP FRENCH LANGUAGE AND CULTURE EXAM: 3 HOURS

Assessment Overview

Exam questions are based on the six learning objectives and assess all themes. As much as possible, students read and listen to authentic texts from the francophone world throughout the exam.

Format of Assessment

Section I: Multiple Choice | 65 Questions | ~ 95 Minutes | 50% of Exam Score

Part A: 30 questions

- Interpretive Communication: Print Texts

Part B: 35 Questions

- Interpretive Communication: Print and Audio Texts (combined)
 - Interpretive Communication: Audio Texts
-

Section II: Free Response | 8 Prompts | ~ 80 Minutes | 50% of Exam Score

- Interpersonal Writing: Email Reply (1 prompt)
- Presentational Writing: Persuasive Essay (1 prompt)
- Interpersonal Speaking: Simulated Conversation (5 prompts)
- Presentational Speaking: Cultural Comparison (1 prompt)

EXAM QUESTION TYPES

Note: On the AP French Language and Culture Exam, all directions, questions, and texts are presented in French.

Multiple-Choice Section

Part A:

Print Texts

Students respond to questions based on a variety of authentic print materials, including:

- Journalistic Texts
- Literary Texts
- Announcements
- Advertisements
- Letters
- Maps
- Tables

Part B:

Print and Audio Texts

Students respond to a variety of authentic audio texts*, including:

- Interviews
- Podcasts
- Public Service Announcements
- Conversations
- Brief Presentations

Audio Texts

Students respond to questions based on audio texts* that are paired with print materials.

*Note: All audio texts are played twice.

Free-Response Section

Interpersonal Writing: Email Reply (15 minutes)

Students read and respond to an email message.

Presentational Writing: Persuasive Essay (55 minutes: 15 minutes to examine texts and 40 minutes to write)

Students examine three authentic texts (article, table or graphic, audio text), then have 40 minutes to organize and write a persuasive essay in response to a prompt. In their essays they must present and defend their own viewpoint using information from all three sources.

Interpersonal Speaking: Simulated Conversation (2 minutes 40 seconds: 1 minute to preview and 20 seconds each for five prompts)

Students have one minute to preview a conversation, including an outline of each turn in the conversation, and then respond to five prompts.

Presentational Speaking: Cultural Comparison (6 minutes: 4 minutes to prepare and 2 minutes to present)

Students respond to a prompt by giving a presentation in which they compare cultural features of their own community to those found in an area of the French-speaking world with which they are familiar.

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AP History Program

The AP Program offers three history courses: AP European History, AP United States History, and AP World History. All three history courses focus on helping students develop historical thinking skills while they learn the required course content. Course themes foster deep analysis by making connections and comparisons across different topics. Each AP History course corresponds to two semesters of a typical introductory college history course.

AP European History Course Overview

AP European History focuses on developing students' abilities to think conceptually about European history from approximately 1450 to the present and apply historical thinking skills as they learn about the past. Five themes of equal importance—Interaction of Europe and the World, Poverty and Prosperity, Objective Knowledge and Subjective Visions, States and Other Institutions of Power, and Individual and Society—provide areas of historical inquiry for investigation throughout the course. These require students to reason historically about continuity and change over time and make comparisons among various historical developments in different times and places.

RECOMMENDED PREREQUISITES

There are no prerequisite courses, although students should be able to read a college-level textbook and write grammatically correct, complete sentences.

AP European History Course Content

The AP European History course is structured around themes and concepts in four different chronological periods from approximately 1450 to the present:

Period 1: c. 1450 to c. 1648

Period 2: c. 1648 to c. 1815

Period 3: c. 1815 to c. 1914

Period 4: c. 1914 to the present

Within each period, key concepts organize and prioritize historical developments. Themes allow students to make connections and identify patterns and trends over time.

Historical Thinking Skills

The historical thinking skills provide opportunities for students to learn to think like historians, most notably to analyze evidence about the past and to create persuasive historical arguments. Focusing on these practices enables teachers to create learning opportunities for students that emphasize the conceptual and interpretive nature of history. Skill types and examples for each are listed below.

I. Chronological Reasoning

- Compare causes and/or effects, including between short-term and long-term effects
- Analyze and evaluate historical patterns of continuity and change over time
- Connect patterns of continuity and change over time to larger historical processes or themes
- Analyze and evaluate competing models of periodization of American history

II. Comparison and Contextualization

- Compare related historical developments and processes across place, time, and/or different societies, or within one society
- Explain and evaluate multiple and differing perspectives on a given historical phenomenon
- Explain and evaluate ways in which specific historical phenomena, events, or processes connect to broader regional, national, or global processes occurring at the same time

III. Crafting Historical Arguments from Historical Evidence

- Analyze commonly accepted historical arguments and explain how an argument has been constructed from historical evidence
- Construct convincing interpretations through analysis of disparate, relevant historical evidence
- Evaluate and synthesize conflicting historical evidence to construct persuasive historical arguments
- Analyze features of historical evidence such as audience, purpose, point of view, format, argument, limitations, and context germane to the evidence considered
- Based on analysis and evaluation of historical evidence, make supportable inferences and draw appropriate conclusions

IV. Historical Interpretation and Synthesis

- Analyze diverse historical interpretations
- Evaluate how historians' perspectives influence their interpretations and how models of historical interpretation change over time
- Draw appropriately on ideas and methods from different fields of inquiry or disciplines
- Apply insights about the past to other historical contexts or circumstances, including the present

AP European History Exam Structure

AP EUROPEAN HISTORY EXAM: 3 HOURS 15 MINUTES

Assessment Overview

The AP Exam questions measure students' knowledge of European history and their ability to think historically. Questions are based on key and supporting concepts, course themes, and historical thinking skills.

Format of Assessment

Section I Part A: Multiple Choice | 55 Questions | 55 Minutes | 40% of Exam Score

- Questions appear in sets of 3–5.
- Students analyze historical texts, interpretations, and evidence.
- Primary and secondary sources, images, graphs, and maps are included.

Section I Part B: Short Answer | 4 Questions | 50 Minutes | 20% of Exam Score

- Questions provide opportunities for students to demonstrate what they know best.
- Some questions include texts, images, graphs, or maps.

Section II Part A: Document Based | 1 Question | 55 Minutes | 25% of Exam Score

- Analyze and synthesize historical data.
- Assess written, quantitative, or visual materials as historical evidence.

Section II Part B: Long Essay | 1 Question | 35 Minutes | 15% of Exam Score

- Students select one question among two.
- Explain and analyze significant issues in European history.
- Develop an argument supported by an analysis of historical evidence.

AP EUROPEAN HISTORY SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Marx himself was passionately interested in the history of the French Revolution... in all of Marx's historical writings, the Revolution served as a touchstone; it fostered the development of capitalism by breaking the feudal stranglehold on production, and it brought the bourgeoisie as a class to power. These two, inseparable elements—the establishment of a suitable legal framework for capitalist development and the class struggle won by the bourgeoisie—have characterized Marxist historical accounts of the Revolution ever since... In the Marxist account, the Revolution was bourgeois in nature because its origins and outcomes were bourgeois.

Lynn Hunt, historian, *Politics, Culture, and Class in the French Revolution*, 1984

In the passage, Lynn Hunt outlines the Marxist interpretation of the French Revolution. What evidence would support the argument that the Revolution was fundamentally bourgeois?

- (A) The wave of spontaneous peasant attacks on the nobility in 1789
- (B) The abolition of hereditary privileges by the National Assembly during the first phase of the Revolution
- (C) The price controls on basic foodstuffs instituted by the Revolutionary government
- (D) The leading role in the Revolution of members of the nobility, such as the Marquis de Lafayette

Correct Answer: B

Sample Free Response Question: Document-Based Question

Evaluate the extent to which the experience of war altered the lives of European women during the First World War and its immediate aftermath.

Students examine seven primary source documents, including a weekly magazine cover illustration, two letters (one from the Chief of the German General Staff to the German Chancellor, and one from a British frontline soldier to his fiancée), writings by a French female countess, a poem, a memoir, and a chart showing women as a percentage of the industrial workforce in France in the early 20th century.

Sample Free-Response Question: Periodization Essay

Students select one from among a set of two questions.

1. Analyze whether or not the revolutions of 1848 can be considered a turning point in European political and social history.
2. Analyze whether or not the collapse of communism (1989–91) can be considered a turning point in European economic and political history.

Sample Short-Answer Question: Comparison

Answer parts A, B, and C.

- A) Briefly explain ONE important similarity between the wars of religion in France and the English Civil War.
- B) Briefly explain ONE important difference between the wars of religion in France and the English Civil War.
- C) Briefly analyze ONE factor that accounts for the difference you identified in part B.

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AP European History Exam Structure

AP EUROPEAN HISTORY EXAM: 3 HOURS 15 MINUTES

Assessment Overview

The AP Exam questions measure students' knowledge of European history and their ability to think historically. Questions are based on key and supporting concepts, course themes, and historical thinking skills.

Format of Assessment

Section I Part A: Multiple Choice | 55 Questions | 55 Minutes | 40% of Exam Score

- Questions appear in sets of 3–5.
- Students analyze historical texts, interpretations, and evidence.
- Primary and secondary sources, images, graphs, and maps are included.

Section I Part B: Short Answer | 4 Questions | 50 Minutes | 20% of Exam Score

- Questions provide opportunities for students to demonstrate what they know best.
- Some questions include texts, images, graphs, or maps.

Section II Part A: Document Based | 1 Question | 55 Minutes | 25% of Exam Score

- Analyze and synthesize historical data.
- Assess written, quantitative, or visual materials as historical evidence.

Section II Part B: Long Essay | 1 Question | 35 Minutes | 15% of Exam Score

- Students select one question among two.
- Explain and analyze significant issues in European history.
- Develop an argument supported by an analysis of historical evidence.

AP EUROPEAN HISTORY SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Marx himself was passionately interested in the history of the French Revolution... in all of Marx's historical writings, the Revolution served as a touchstone; it fostered the development of capitalism by breaking the feudal stranglehold on production, and it brought the bourgeoisie as a class to power. These two, inseparable elements—the establishment of a suitable legal framework for capitalist development and the class struggle won by the bourgeoisie—have characterized Marxist historical accounts of the Revolution ever since... In the Marxist account, the Revolution was bourgeois in nature because its origins and outcomes were bourgeois.

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In the passage, Lynn Hunt outlines the Marxist interpretation of the French Revolution. What evidence would support the argument that the Revolution was fundamentally bourgeois?

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Correct Answer: B

Sample Free Response Question: Document-Based Question

Evaluate the extent to which the experience of war altered the lives of European women during the First World War and its immediate aftermath.

Students examine seven primary source documents, including a weekly magazine cover illustration, two letters (one from the Chief of the German General Staff to the German Chancellor, and one from a British frontline soldier to his fiancée), writings by a French female countess, a poem, a memoir, and a chart showing women as a percentage of the industrial workforce in France in the early 20th century.

Sample Free-Response Question: Periodization Essay

Students select one from among a set of two questions.

1. Analyze whether or not the revolutions of 1848 can be considered a turning point in European political and social history.
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Sample Short-Answer Question: Comparison

Answer parts A, B, and C.

- A) Briefly explain ONE important similarity between the wars of religion in France and the English Civil War.
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AP European History Exam Structure

AP EUROPEAN HISTORY EXAM: 3 HOURS 15 MINUTES

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Sample Free Response Question: Document-Based Question

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AP History Program

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AP World History Course Overview

AP World History is designed to be the equivalent of a two-semester introductory college or university world history course. In AP World History students investigate significant events, individuals, developments, and processes in six historical periods from approximately 8000 B.C.E. to the present. Students develop and use the same skills, practices, and methods employed by historians: analyzing primary and secondary sources; developing historical arguments; making historical comparisons; and utilizing reasoning about contextualization, causation, and continuity and change over time. The course provides five themes that students explore throughout the course in order to make connections among historical developments in different times and places: interaction between humans and the environment; development and interaction of cultures; state building, expansion, and conflict; creation, expansion, and interaction of economic systems; and development and transformation of social structures.

PREREQUISITES

There are no prerequisites for the AP World History course. Students should be able to read a college-level textbook and write grammatically correct, complete sentences.

AP World History Course Content

The AP World History course is structured around themes and concepts in six different chronological periods from approximately 8000 BCE to the present:

- Technological and Environmental Transformations (to c. 600 BCE)
- Organization and Reorganization of Human Societies (c. 600 BCE to c. 600 CE)
- Regional and Transregional Interactions (c. 600 CE to c. 1450)
- Global Interactions (c. 1450 to c. 1750)
- Industrialization and Global Integration (c. 1750 to c. 1900)
- Accelerating Global Change and Realignment (c. 1900 to the Present)

Within each period, key concepts organize and prioritize historical developments. Themes allow students to make connections and identify patterns and trends over time.

AP History Disciplinary Practices and Reasoning Skills

The AP history courses seek to apprentice students to the practice of history by emphasizing the development of disciplinary practices and reasoning skills while learning historical content. The practices and skills that students should develop in all AP history courses are listed below, along with a condensed description of what students should be able to do with each. Every AP Exam question will assess one or more of these practices and skills.

AP HISTORY DISCIPLINARY PRACTICES

Practice 1: Analyzing Historical Evidence

Primary Sources

- Explain the relative historical significance of a source's point of view, purpose, historical situation, and/or audience.
- Evaluate a source's credibility and/or limitations.

Secondary Sources

- Explain how a historian's claim or argument is supported with evidence.
- Analyze patterns and trends in quantitative data in non-text-based sources.
- Evaluate the effectiveness of a historical claim or argument.

Practice 2: Argument Development

- Make a historically defensible claim in the form of an evaluative thesis.
- Support an argument using specific and relevant evidence.
- Use historical reasoning to explain relationships among pieces of historical evidence.
- Consider ways that diverse or alternative evidence could be used to qualify or modify an argument.

AP HISTORY REASONING SKILLS

Skill 1: Contextualization

- Use context to explain the relative historical significance of a specific historical development or process.

Skill 2: Comparison

- Explain the relative historical significance of similarities and/or differences between different historical developments or processes.

Skill 3: Causation

- Explain the difference between primary and secondary causes and between short- and long-term effects.
- Explain the relative historical significance of different causes and/or effects.

Skill 4: Continuity and Change Over Time

- Explain the relative historical significance of specific historical developments in relation to a larger pattern of continuity and/or change.

AP World History Exam Structure

AP WORLD HISTORY EXAM: 3 HOURS 15 MINUTES

Assessment Overview

The AP Exam questions measure students' knowledge of world history and their ability to think historically. Questions are based on learning objectives, key concepts, course themes, and AP history disciplinary practices and reasoning skills. Exam questions represent various geographical regions, with no more than 20 percent of the multiple-choice questions focusing solely on Europe.

Format of Assessment

Section I Part A: Multiple Choice | 55 Questions | 55 Minutes | 40% of Exam Score

- Questions appear in sets of 2–5.
- Students analyze primary and secondary texts, images, graphs, and maps.
- Questions cover all course periods.

Section I Part B: Short Answer | 3 Questions | 40 Minutes | 20% of Exam Score

- Students respond to 2 required questions and choose between 2 options for a third question.
- Questions 1 and 2 cover periods 3–8 of the course; students choose between answering either question 3 (covering periods 1–3) or question 4 (periods 4–6).
- Students analyze historians' interpretations, historical sources, and propositions about history.

Section II Part A: Document Based | 1 Question | 60 Minutes | 25% of Exam Score

- Students assess written, visual, and quantitative sources as historical evidence.
- Students develop an argument supported by an analysis of historical evidence.
- Question covers periods 3–6 of the course.

Section II Part B: Long Essay | 1 Question | 40 Minutes | 15% of Exam Score

- Students select one question among three different periods (1–2, 3–4, 5–6) of the course.
- Students explain and analyze significant issues in world history.
- Students develop an argument supported by an analysis of historical evidence.

AP WORLD HISTORY SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

"The ruler is a boat; people are the water. The water can carry the boat; the water can capsize the boat. . . . A man may be the descendant of kings, lords, or nobles, but if he does not observe the norms of ritual and proper behavior he must be relegated to the status of a commoner. Similarly, he may be a descendant of commoners, but if he accumulates learning of the texts, corrects his behavior, and observes the norms of ritual and proper behavior—then he must be elevated to the ranks of high ministers, lords, and nobles."

Xunzi, Chinese philosopher, circa 250 B.C.E.

Ideas similar to those expressed in the passage have directly contributed to the development of which of the following aspects of later Chinese imperial history?

- (A) The long-standing tradition of Chinese leadership in technological, agricultural, and commercial innovation relative to the rest of the world
- (B) The expectation that emperors must be judged by a different set of ethical standards all other members of society
- (C) The virtual elimination of the threat of rebellion against established political authority
- (D) The practice of recruiting capable bureaucrats on the basis of educational achievement rather than noble birth

Correct Answer: D

Sample Short-Answer Question: Comparison

- A) Identify ONE similarity in the way elites used art or architecture in Europe and in Asia during the period 1450–1750.
- B) Explain ONE difference in the way elites used art or architecture in Europe and in Asia during the period 1450–1750.
- C) Explain ONE reason for the difference in the way elites used art or architecture in Europe and in Asia during the period 1450–1750.

Sample Free-Response Question: Document-Based Question

Evaluate the extent to which industrialization in Japan was similar to industrialization in Russia between 1850 and 1914.

Students examine seven primary source documents, including a secret diplomatic letter, excerpts from two different magazine articles, image of Japanese silk factory, excerpts from two different memoirs, chart documenting Japanese silk workers' impressions of life in the factories.

Sample Free-Response Question: Long Essay Question Focused on Continuity and Change over Time

Evaluate the extent to which the relationship between labor systems and social hierarchies changed in the period c. 600 C.E. to c. 1750 C.E.

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AP Environmental Science Course Overview

The AP Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science, through which students engage with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. Environmental Science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography.

LABORATORY REQUIREMENT

Although there are no specific AP Environmental Science labs or field investigations required for the course, it is expected that students perform as many labs/field investigations as possible.

PREREQUISITE

Students should have completed two years of high school laboratory science — one year of life science and one year of physical science (for example, a year of biology and a year of chemistry). Due to the quantitative analysis required in the course, students should also have taken at least one year of algebra. Also desirable (but not necessary) is a course in earth science.

AP Environmental Science Course Content

Environmental science is interdisciplinary; it embraces a wide variety of topics from different areas of study. There are several unifying themes that cut across topics. The following are course themes:

- Science is a process.
- Energy conversions underlie all ecological processes.
- The Earth itself is one interconnected system.
- Humans alter natural systems.
- Environmental problems have a cultural and social context.
- Human survival depends on developing practices that will achieve sustainable systems.

Topic Outline

- I. Earth Systems and Resources
- II. The Living World
- III. Population
- IV. Land and Water Use
- V. Energy Resources and Consumption
- VI. Pollution
- VII. Global Change

Inquiry-Based Investigations

Because it is designed to be a course in environmental *science* rather than environmental studies, the AP Environmental Science course includes a strong laboratory and field investigation component.

The AP Environmental Science course requires teachers to provide students with opportunities to perform experiments and analyses involving the study of air, water, and soil qualities as an essential core for the lab/field investigation activities. These investigations challenge students' abilities to

- Critically observe environmental systems;
- Develop and conduct well-designed experiments;
- Utilize appropriate techniques and instrumentation;
- Analyze and interpret data, including appropriate statistical and graphical presentations;
- Think analytically and apply concepts to the solution of environmental problems;
- Make conclusions and evaluate their quality and validity;
- Propose further questions for study; and
- Communicate accurately and meaningfully about observations and conclusions.

AP Environmental Science Exam Structure

AP ENVIRONMENTAL SCIENCE EXAM: 3 HOURS

Assessment Overview

Exam questions are based on each major topic area. They are designed to cover the breadth of students' knowledge and depth of understanding of environmental science.

Format of Assessment

Section I: Multiple Choice: 100 Questions | 90 Minutes | 60% of Exam Score

- Discrete Questions
- Questions in sets

Section II: Free Response: 4 Questions | 90 Minutes | 40% of Exam Score

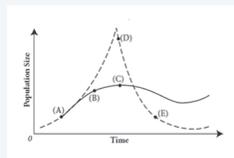
- Data Set (1 question)
- Document-Based Question (1 question)
- Synthesis and Evaluation (2 questions)

AP ENVIRONMENTAL SCIENCE SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

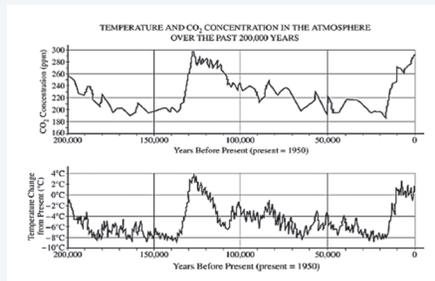
Directions: The lettered choices on the graph below refer to the numbered statements immediately following it. Select the one lettered choice that best fits each statement. Each choice may be used once, more than once, or not at all in each set.

Questions 1–3 refer to the lettered points of the curves plotted on the graph below. The curves show two possible patterns of change in population size over time for a certain species of small mammal in an ecosystem.



1. Population growing exponentially
2. Population decreasing at greatest rate
3. Population growing at a decreasing rate

Sample Free-Response Question: Data-Set Question



According to atmospheric temperature and CO₂ concentration records derived from Antarctic ice cores, Earth's climate has undergone significant changes over the past 200,000 years. Two graphs are shown to the left. The upper graph shows the variation in atmospheric CO₂ concentration, and the lower graph shows the variation in air temperature. Both graphs cover the same time period from approximately 200,000 years ago up until the year 1950, which is represented as year 0 on the graphs.

- (A) Answer the following questions that relate to the graphs above. Remember that for any calculation you must clearly indicate how you arrived at your answer. Answers must also include appropriate units.
- (i) Determine the net change in atmospheric CO₂ concentration between 140,000 years ago and 125,000 years ago.
 - (ii) Calculate the ratio of the change in the mean global temperature to the change in atmospheric CO₂ concentration between 140,000 years ago and 125,000 years ago.
 - (iii) Scientists predict that between 1950 and 2050, the atmospheric CO₂ concentration will increase by 200 ppm. Predict the change in mean global temperature between 1950 and 2050 using the ratio that you calculated in part (ii).
 - (iv) Describe one major assumption that was necessary to make the prediction in part (iii) above. Discuss the validity of the assumption.
- (B) Identify and describe TWO major causes for the predicted 200 ppm increase in atmospheric CO₂ concentration between 1950 and 2050.
- (C) Identify TWO gases other than CO₂ that contribute to the anthropogenic increase in mean global temperature. For each gas, describe a major human activity that leads to its release.

AP[®] ENGLISH LITERATURE AND COMPOSITION



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AP English Program

The AP Program offers two courses in English studies, each designed to provide high school students the opportunity to engage with a typical introductory-level college English curriculum.

The AP English Language and Composition course focuses on the development and revision of evidence-based analytic and argumentative writing and the rhetorical analysis of nonfiction texts.

The AP English Literature and Composition course focuses on reading, analyzing, and writing about imaginative literature (fiction, poetry, drama) from various periods.

There is no prescribed sequence of study, and a school may offer one or both courses.

AP English Literature and Composition Course Overview

The AP English Literature and Composition course aligns to an introductory college-level literary analysis course. The course engages students in the close reading and critical analysis of imaginative literature to deepen their understanding of the ways writers use language to provide both meaning and pleasure. As they read, students consider a work's structure, style, and themes, as well as its use of figurative language, imagery, symbolism, and tone. Writing assignments include expository, analytical, and argumentative essays that require students to analyze and interpret literary works.

PREREQUISITE

There are no prerequisite courses for AP English Literature and Composition.

Students should be able to read and comprehend college-level texts and apply the conventions of Standard Written English in their writing.

AP English Literature and Composition Course Content

The course is designed to help students become skilled readers and writers through engagement with the following course requirements:

- Reading complex imaginative literature (fiction, drama, and poetry) appropriate for college-level study¹
- Writing an interpretation of a piece of literature that is based on a careful observation of textual details, considering the work's structure, style, and themes; the social and historical values it reflects and embodies; and such elements as the use of figurative language, imagery, symbolism, and tone
- Composing in several forms (e.g., narrative, expository, analytical, and argumentative essays) based on students' analyses of literary texts
- Writing that proceeds through several stages or drafts, with revision aided by teacher and peers
- Writing informally (e.g., response journals, textual annotations, collaborative writing), which helps students better understand the texts they are reading
- Revising their work to develop
 - o A wide-ranging vocabulary used appropriately and effectively;
 - o A variety of sentence structures, including appropriate use of subordination and coordination;
 - o Logical organization, enhanced by techniques such as repetition, transitions, and emphasis;
 - o A balance of generalization and specific, illustrative detail; and
 - o An effective use of rhetoric, including tone, voice, diction, and sentence structure.

1. The selection of literature for the course should consider texts used in students' previous high school ELA courses, so that by the time students finish the AP course, they will have read texts from 16th- to 21st-century American and British literature, along with other literature written in or translated to English. The College Board does not mandate the use of any particular authors or reading list, but representative authors are cited in the AP English Course Description.

AP English Literature and Composition Exam Structure

AP ENGLISH LITERATURE AND COMPOSITION EXAM: 3 HOURS

Assessment Overview

The AP English Literature and Composition Exam employs multiple-choice questions and free-response prompts to test students' skills in literary analysis of passages from prose and poetry texts.

Format of Assessment

Section I: Multiple Choice | 60 Minutes | 55 Questions | 45% of Exam Score

- Includes excerpts from several published works of drama, poetry, or prose fiction
- Each excerpt is accompanied by several multiple-choice questions or prompts

Section II: Free Response | 120 Minutes | 3 Questions | 55% of Exam Score

- Students have 120 minutes to write essay responses to three free-response prompts from the following categories:
 - A literary analysis of a given poem
 - A literary analysis of a given passage of prose fiction
 - An analysis that examines a specific concept, issue, or element in a work of literary merit selected by the student

AP ENGLISH LITERATURE AND COMPOSITION SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Students are given a passage of writing and asked to respond to a set of prompts and questions based on the passage. Below is one example.

The chief effect of the first paragraph is to

- (A) foreshadow the outcome of Papa's meeting
- (B) signal that change in the family's life is overdue
- (C) convey the women's attachment to the house
- (D) emphasize the deteriorating condition of the house
- (E) echo the fragmented conversation of the three women

Sample Free-Response Prompt

Read carefully the following poem by the colonial American poet, Anne Bradstreet. Then write a well-organized essay in which you discuss how the poem's controlling metaphor expresses the complex attitude of the speaker.

"The Author to Her Book"

Thou ill-formed offspring of my feeble brain,
Who after birth did'st by my side remain,
Til snatched from thence by friends, less wise than true,
Who thee abroad exposed to public view;
Made thee in rags, halting, to the press to trudge,
Where errors were not lessened, all may judge.
At thy return my blushing was not small,
My rambling brat (in print) should mother call,
I cast thee by as one unfit for light,
Thy visage was so irksome in my sight;
Yet being mine own, at length affection would
Thy blemishes amend, if so I could.

I washed thy face, but more defects I saw,
And rubbing off a spot, still made a flaw.
I stretched thy joints to make thee even feet,
Yet still thou run'st more hobbling than is meet;
In better dress to trim thee was my mind,
But nought save homespun cloth in the house I find.
In this array, 'mongst vulgars may'st thou roam;
In critics' hands beware thou dost not come;
And take thy way where yet thou are not known.
If for thy Father asked, say thou had'st none;
And for thy Mother, she alas is poor,
Which caused her thus to send thee out of door.
(1678)

AP[®] ENGLISH LITERATURE AND COMPOSITION



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AP ENGLISH LITERATURE AND COMPOSITION EXAM: 3 HOURS

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Who after birth did'st by my side remain,
Til snatched from thence by friends, less wise than true,
Who thee abroad exposed to public view;
Made thee in rags, halting, to the press to trudge,
Where errors were not lessened, all may judge.
At thy return my blushing was not small,
My rambling brat (in print) should mother call,
I cast thee by as one unfit for light,
Thy visage was so irksome in my sight;
Yet being mine own, at length affection would
Thy blemishes amend, if so I could.

I washed thy face, but more defects I saw,
And rubbing off a spot, still made a flaw.
I stretched thy joints to make thee even feet,
Yet still thou run'st more hobbling than is meet;
In better dress to trim thee was my mind,
But nought save homespun cloth in the house I find.
In this array, 'mongst vulgars may'st thou roam;
In critics' hands beware thou dost not come;
And take thy way where yet thou are not known.
If for thy Father asked, say thou had'st none;
And for thy Mother, she alas is poor,
Which caused her thus to send thee out of door.
(1678)

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The AP English Literature and Composition course focuses on reading, analyzing, and writing about imaginative literature (fiction, poetry, drama) from various periods.

There is no prescribed sequence of study, and a school may offer one or both courses.

AP English Language and Composition Course Overview

The AP English Language and Composition course aligns to an introductory college-level rhetoric and writing curriculum, which requires students to develop evidence-based analytic and argumentative essays that proceed through several stages or drafts. Students evaluate, synthesize, and cite research to support their arguments. Throughout the course, students develop a personal style by making appropriate grammatical choices. Additionally, students read and analyze the rhetorical elements and their effects in non-fiction texts, including graphic images as forms of text, from many disciplines and historical periods.

PREREQUISITE

There are no prerequisite courses for AP English Language and Composition.

Students should be able to read and comprehend college-level texts and apply the conventions of Standard Written English in their writing.

AP English Language and Composition Course Content

The AP English Language and Composition course is designed to help students become skilled readers and writers through engagement with the following course requirements:

- Composing in several forms (e.g., narrative, expository, analytical, and argumentative essays) about a variety of subjects
- Writing that proceeds through several stages or drafts, with revision aided by teacher and peers
- Writing informally (e.g., imitation exercises, journal keeping, collaborative writing), which helps students become aware of themselves as writers and the techniques employed by other writers
- Writing expository, analytical, and argumentative compositions based on readings representing a variety of prose styles and genres
- Reading nonfiction (e.g., essays, journalism, science writing, autobiographies, criticism) selected to give students opportunities to identify and explain an author's use of rhetorical strategies and techniques¹
- Analyzing graphics and visual images both in relation to written texts and as alternative forms of text themselves
- Developing research skills and the ability to evaluate, use, and cite primary and secondary sources
- Conducting research and writing argument papers in which students present an argument of their own that includes the analysis and synthesis of ideas from an array of sources
- Citing sources using a recognized editorial style (e.g., Modern Language Association, The Chicago Manual of Style)
- Revising their work to develop
 - A wide-ranging vocabulary used appropriately and effectively;
 - A variety of sentence structures, including appropriate use of subordination and coordination;
 - Logical organization, enhanced by techniques such as repetition, transitions, and emphasis;
 - A balance of generalization and specific, illustrative detail; and
 - An effective use of rhetoric, including tone, voice, diction, and sentence structure.

1. The College Board does not mandate any particular authors or reading list, but representative authors are cited in the AP English Language Course Description.

AP English Language and Composition Exam Structure

AP ENGLISH LANGUAGE AND COMPOSITION EXAM:
3 HOURS 15 MINUTES

Assessment Overview

The AP English Language and Composition Exam employs multiple-choice questions to test students' skills in rhetorical analysis of prose passages. Students are also required to write three essays that demonstrate their skill in rhetorical analysis, argumentation, and synthesis of information from multiple sources to support the student's own argument. Although the skills tested on the exam remain essentially the same from year to year, there may be some variation in format of the free-response (essay) questions.

Format of Assessment

Section I: Multiple Choice: 52–55 Questions | 60 Minutes | 45% of Exam Score

- Includes excerpts from several non-fiction texts
- Each excerpt is accompanied by several multiple-choice questions

Section II: Free Response: 3 Prompts | 2 Hours 15 Minutes | 55% of Exam Score

- 15 minutes for reading source materials for the synthesis prompt (in the free-response section)
- 120 minutes to write essay responses to the three free-response prompts

Prompt Types

Synthesis: Students read several texts about a topic and create an argument that synthesizes at least three of the sources to support their thesis.

Rhetorical Analysis: Students read a non-fiction text and analyze how the writer's language choices contribute to his or her purpose and intended meaning for the text.

Argument: Students create an evidence-based argument that responds to a given topic.

AP ENGLISH LANGUAGE AND COMPOSITION SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Students are given a passage of writing and asked to respond to a set of prompts and questions based on the passage. Below is one example.

The primary rhetorical function of lines 14–22 is to

- (A) provide support for a thesis supplied in lines 1–2
- (B) provide evidence to contrast with that supplied in the first paragraph
- (C) present a thesis that will be challenged in paragraph three
- (D) introduce a series of generalizations that are supported in the last two paragraphs
- (E) anticipate objections raised by the ideas presented in lines 12–14

Sample Free-Response Question

The following passage is from *Rights of Man*, a book written by the pamphleteer Thomas Paine in 1791. Born in England, Paine was an intellectual, a revolutionary, and a supporter of American independence from England. Read the passage carefully. Then write an essay that examines the extent to which Paine's characterization of America holds true today. Use appropriate evidence to support your argument.

If there is a country in the world, where concord, according to common calculation, would be least expected, it is America. Made up, as it is, of people from different nations, accustomed to different forms and habits of government, speaking different languages, and more different in their modes of worship, it would appear that the union of such a people was impracticable; but by the simple operation of constructing government on the principles of society and the rights of man, every difficulty retires, and all the parts are brought into cordial union. There, the poor are not oppressed, the rich are not privileged.... Their taxes are few, because their government is just; and as there is nothing to render them wretched, there is nothing to engender riots and tumults.

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AP Computer Science Program

When AP Computer Science Principles launches in the 2016–17 academic year, AP will have two computer science offerings, and students can take either course in any order. Currently one of the fastest growing AP courses, the AP Computer Science A course and exam continues to focus on computing skills related to programming in Java. The new AP Computer Science Principles course will complement AP Computer Science A as it aims to broaden participation in the study of computer science. The courses underscore the importance of communicating solutions appropriately and in ways that are relevant to current societal needs. AP Computer Science courses can help address traditional issues of equity, access, and broadening participation in computing while providing a strong and engaging introduction to fundamental areas of the discipline.

AP Computer Science A Course Overview

AP Computer Science A is equivalent to a first-semester, college-level course in computer science. The course introduces students to computer science with fundamental topics that include problem solving, design strategies and methodologies, organization of data (data structures), approaches to processing data (algorithms), analysis of potential solutions, and the ethical and social implications of computing. The course emphasizes both object-oriented and imperative problem solving and design using Java language. These techniques represent proven approaches for developing solutions that can scale up from small, simple problems to large, complex problems. The AP Computer Science A course curriculum is compatible with many CS1 courses in colleges and universities.

RECOMMENDED PREREQUISITES

Students should be comfortable with functions and the concepts found in the uses of function notation, such as $f(x) = x + 2$ and $f(x) = g(h(x))$. It is important that students and their advisers understand that any significant computer science course builds upon a foundation of mathematical reasoning that should be acquired before attempting such a course.

Lab Requirements

The AP Computer Science A course must include a minimum of 20 hours of hands-on structured lab experiences to engage students in individual or group problem solving. Thus, each AP Computer Science A course includes a substantial laboratory component in which students design solutions to problems, express their solutions precisely (e.g., in the Java programming language), test their solutions, identify and correct errors (when mistakes occur), and compare possible solutions.

Computer Language

The AP Computer Science A course requires that solutions of problems be written in the Java programming language. Because the Java programming language is extensive with far more features than could be covered in a single introductory course, the AP Computer Science A Exam covers a subset of Java. The AP Java subset can be found in Appendix A of the Course Description.

Goals of AP Computer Science A

Students should be able to

- Design, implement, and analyze solutions to problems;
- Use and implement commonly used algorithms;
- Develop and select appropriate algorithms and data structures to solve new problems;
- Write solutions fluently in an object-oriented paradigm;
- Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset;
- Read and understand programs consisting of several classes and interacting objects;
- Read and understand a description of the design and development process leading to such a program; and
- Understand the ethical and social implications of computer use.

Topic Outline for AP Computer Science A

- I. Object-Oriented Program Design
 - A. Program and class design
- II. Program Implementation
 - A. Implementation techniques
 - B. Programming constructs
 - C. Java library classes and interfaces included in the AP Java Subset
- III. Program Analysis
 - A. Testing
 - B. Debugging
 - C. Runtime exceptions
 - D. Program correctness
 - E. Algorithm analysis
 - F. Numerical representations of integers
- IV. Standard Data Structures
 - A. Primitive data types (int, boolean, double)
 - B. Strings
 - C. Classes
 - D. Lists
 - E. Arrays (1-dimensional and 2-dimensional)
- V. Standard Operations and Algorithms
 - A. Operations on data structures
 - B. Searching
 - C. Sorting
- VI. Computing in Context
 - A. System reliability
 - B. Privacy
 - C. Legal issues and intellectual property
 - D. Social and ethical ramifications of computer use

AP Computer Science A Exam Structure

AP COMPUTER SCIENCE A EXAM: 3 HOURS

Assessment Overview

All code on the AP Computer Science A Exam is consistent with the AP Java subset that can be found in Appendix A of the Course Description. All questions involving code should be answered in Java. Students are not tested on minor points of syntax.

Format of Assessment

Section I: Multiple Choice | 40 Questions | 75 Minutes | 50% of Exam Score

- Discrete Questions

Section II: Free Response | 4 Questions | 105 Minutes | 50% of Exam Score

- Short Answer (each requiring Java programming language)

AP COMPUTER SCIENCE A SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

A car dealership needs a program to store information about the cars for sale. For each car, they want to keep track of the following information: number of doors (2 or 4), whether the car has air-conditioning, and its average number of miles per gallon. Which of the following is the best object-oriented program design?

- (a) Use one class, `Car`, with three instance variables: `int numDoors`, `boolean hasAir`, and `milesPerGallon`.
- (b) Use four unrelated classes: `Car`, `Doors`, `AirConditioning`, and `MilesPerGallon`.
- (c) Use a class `Car` with three subclasses: `Doors`, `AirConditioning`, and `MilesPerGallon`.
- (d) Use a class `Car`, with a subclass `Doors`, with a subclass `AirConditioning`, with a subclass `MilesPerGallon`.
- (e) Use three classes: `Doors`, `AirConditioning`, and `MilesPerGallon`, each with a subclass `Car`.

Correct Answer: A

Sample Free-Response Question: Experimental Design

A travel agency maintains a list of information about airline flights. Flight information includes a departure time and an arrival time. You may assume that the two times occur on the same day. These times are represented by objects of the `Time` class.

The declaration for the `Time` class is shown below. It includes a method `minutesUntil`, which returns the difference (in minutes) between the current `Time` object and another `Time` object.

Students are provided with a scenario and part of the program to solve that scenario. They are then asked to complete a method in that program so that the program can calculate the duration of flights.

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AP Computer Science Program

There are two computer science offerings, and students can take either course in any order. The AP Computer Science A course and exam continues to focus on computing skills related to programming in Java. The new AP Computer Science Principles course complements AP Computer Science A as it aims to broaden participation in the study of computer science. The courses underscore the importance of communicating solutions appropriately and in ways that are relevant to current societal needs. AP Computer Science courses can help address traditional issues of equity, access, and broadening participation in computing while providing a strong and engaging introduction to fundamental areas of the discipline.

AP Computer Science Principles Course Overview

The AP Computer Science Principles course is designed to be equivalent to a first-semester introductory college computing course. In this course, students will develop computational thinking skills vital for success across all disciplines, such as using computational tools to analyze and study data and working with large data sets to analyze, visualize, and draw conclusions from trends. The course engages students in the creative aspects of the field by allowing them to develop computational artifacts based on their interests. Students will also develop effective communication and collaboration skills by working individually and collaboratively to solve problems, and will discuss and write about the impacts these solutions could have on their community, society, and the world.

PREREQUISITES

It is recommended that a student in the AP Computer Science Principles course should have successfully completed a first year high school algebra course with a strong foundation on basic linear functions and composition of functions, and problem solving strategies that require multiple approaches and collaborative efforts. In addition, students should be able to use a Cartesian (x, y) coordinate system to represent points in a plane. It is important that students and their advisers understand that any significant computer science course builds upon a foundation of mathematical and computational reasoning that will be applied throughout the study of the course.

Computer Language

Unlike AP Computer Science A, which is taught in Java, the AP Computer Science Principles course does not have a designated programming language. Teachers select the programming language(s) that is most appropriate for their students.

AP Computer Science Principles Course Content

The following are the major areas of study, or big ideas, that are foundational to studying computer science:

- **Creativity:** Computing is a creative activity. Creativity and computing are prominent forces in innovation; the innovations enabled by computing have had and will continue to have far-reaching impact.

- **Abstraction:** Abstraction reduces information and detail to facilitate focus on relevant concepts. It is a process, a strategy, and the result of reducing detail to focus on concepts relevant to understanding and solving problems.
- **Data and Information:** Data and information facilitate the creation of knowledge. Computing enables and empowers new methods of information processing, driving monumental change across many disciplines — from art to business to science.
- **Algorithms:** Algorithms are used to develop and express solutions to computational problems. Algorithms realized in software have affected the world in profound and lasting ways.
- **Programming:** Programming enables problem solving, human expression, and creation of knowledge. Programming and the creation of software has changed our lives. It results in the creation of software, and facilitates the creation of computational artifacts, such as music, images, and visualizations.
- **The Internet:** The Internet pervades modern computing. The Internet and the systems built on it have had a profound impact on society. Computer networks support communication and collaboration.
- **Global Impact:** Computing has global impact. Our methods for communicating, collaborating, problem solving, and doing business have changed and are changing due to innovations enabled by computing.

Computational Thinking Practices

The course also incorporates computational thinking practices that set clear expectations of what students will do in the course:

- **Connecting Computing** – Students learn to draw connections between different computing concepts.
- **Creating computational artifacts** – Students engage in the creative aspects of computing by designing and developing interesting computational artifacts as well as by applying computing techniques to creatively solve problems.
- **Abstracting** – Students use abstraction to develop models and simulations of natural and artificial phenomena, use them to make predictions about the world, and analyze their efficacy and validity.
- **Analyzing problems and artifacts** – Students design and produce solutions, models, and artifacts, and they evaluate and analyze their own computational work as well as the computational work others have produced.
- **Communicating** – Students describe computation and the impact of technology and computation, explain and justify the design and appropriateness of their computational choices, and analyze and describe both computational artifacts and the results or behaviors of those artifacts.
- **Collaborating** – Students collaborate on a number of activities, including investigation of questions using data sets and in the production of computational artifacts.

AP Computer Science Principles Exam Structure

AP COMPUTER SCIENCE PRINCIPLES EXAM: 2 HOURS

Assessment Overview

This assessment comprises two parts: performance tasks and the end-of-course AP Exam and the through-course AP assessment.

The AP Computer Science Principles Exam will be a multiple-choice, paper and pencil exam.

The two performance tasks require students to explore the impacts of computing and create computational artifacts through programming.

Format of Assessment

AP COMPUTER SCIENCE PRINCIPLES EXAM: 2 HOURS (60% of AP Exam score)

- Multiple Choice (single- and multiple-select) | 74 Questions | 120 minutes | 60% of assessment score

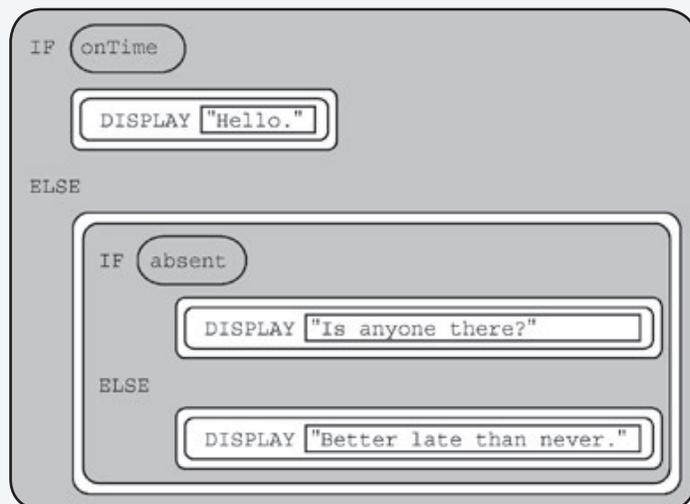
AP COMPUTER SCIENCE PRINCIPLES THROUGH-COURSE PERFORMANCE TASKS (2) (Combined 40% of AP Exam Score):

- Explore – Impact of Computing Innovations | 8 hours (classroom time) | 16% of assessment score
- Create – Application to Ideas | 12 hours (classroom time) | 24% of assessment score

AP COMPUTER SCIENCE PRINCIPLES SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

Consider the code segment below.



If the variables `onTime` and `absent` both have the value `false`, what is displayed as a result of running the code segment?

- (A) Is anyone there?
- (B) Better late than never.
- (C) Hello. Is anyone there?
- (D) Hello. Better late than never.

Answer: B

Performance Task: Create – Applications from Ideas

- This performance task focuses on students developing computer programs and describing significant aspects of the program that allow it to run correctly.
 - Students have the flexibility to write programs that reflects their interests (e.g., their desire to solve a problem; program a game; or produce digital art appealing to a specific audience, etc.) This allows students to engage in the study of computer science from a creative perspective. Students will provide evidence of their knowledge of important programming concepts such as developing algorithms and using abstractions. Students are required to submit an individual program but are able to collaborate on the development of their program.

Performance Task: Explore – Impacts of Computing Innovations

- This performance task focuses on students using and applying computational analysis in the exploration of a significant computing innovation to determine and describe the impact of the innovation on people and society.
 - Students select and explore an innovation of their choosing. Then, they create a computational artifact about the innovation and describe how it works and how it used, its purpose, how it consumes and/or produces data, and the harmful and beneficial effects of the innovation on people and society.

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AP Chemistry Course Overview

The AP Chemistry course provides students with a college-level foundation to support future advanced course work in chemistry. Students cultivate their understanding of chemistry through inquiry-based investigations, as they explore topics such as: atomic structure, intermolecular forces and bonding, chemical reactions, kinetics, thermodynamics, and equilibrium.

LABORATORY REQUIREMENT

This course requires that 25 percent of the instructional time provides students with opportunities to engage in laboratory investigations. This includes a minimum of 16 hands-on labs, at least six of which are inquiry based.

RECOMMENDED PREREQUISITES

Students should have successfully completed a general high school chemistry course and Algebra II.

AP Chemistry Course Content

The key concepts and related content that define the AP Chemistry course and exam are organized around underlying principles called the Big Ideas. They encompass core scientific principles, theories, and processes that cut across traditional boundaries and provide a broad way of thinking about the particulate nature of matter underlying the observations students make about the physical world. The following are Big Ideas:

- The chemical elements are the building blocks of matter, which can be understood in terms of the arrangements of atoms.
- Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.
- Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.
- Rates of chemical reactions are determined by details of the molecular collisions.
- The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.
- Bonds or attractions that can be formed can be broken. These two processes are in constant competition, sensitive to initial conditions and external forces or changes.

Science Practices

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Focusing on these disciplinary practices enables teachers to use the principles of scientific inquiry to promote a more engaging and rigorous experience for AP Chemistry students. Such practices require that students:

- Use representations and models to communicate scientific phenomena and solve scientific problems;
- Use mathematics appropriately;
- Engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course;
- Plan and implement data collection strategies in relation to a particular scientific question;
- Perform data analysis and evaluation of evidence;
- Work with scientific explanations and theories; and
- Connect and relate knowledge across various scales, concepts, and representations in and across domains.

Inquiry-Based Investigations

Twenty-five percent of instructional time is devoted to inquiry-based laboratory investigations. Students ask questions, make observations and predictions, design experiments, analyze data, and construct arguments in a collaborative setting, where they direct and monitor their progress.

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AP Calculus Program

AP Calculus AB and AP Calculus BC focus on students' understanding of calculus concepts and provide experience with methods and applications. Although computational competence is an important outcome, the main emphasis is on a multirepresentational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations are important.

Teachers and students should regularly use technology to reinforce relationships among functions, to confirm written work, to implement experimentation, and to assist in interpreting results. Through the use of the unifying themes of calculus (e.g., derivatives, integrals, limits, approximation, and applications and modeling) the courses become cohesive rather than a collection of unrelated topics.

AP Calculus BC Course Overview

AP Calculus BC is roughly equivalent to both first and second semester college calculus courses and extends the content learned in AB to different types of equations and introduces the topic of sequences and series. The AP course covers topics in differential and integral calculus, including concepts and skills of limits, derivatives, definite integrals, the Fundamental Theorem of Calculus, and series. The course teaches students to approach calculus concepts and problems when they are represented graphically, numerically, analytically, and verbally, and to make connections amongst these representations.

Students learn how to use technology to help solve problems, experiment, interpret results, and support conclusions.

PREREQUISITE

Before studying calculus, all students should complete four years of secondary mathematics designed for college-bound students: courses in which they study algebra, geometry, trigonometry, analytic geometry, and elementary functions. These functions include linear, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric, and piecewise-defined functions. In particular, before studying calculus, students must be familiar with the properties of functions, the algebra of functions, and the graphs of functions. Students must also understand the language of functions (domain and range, odd and even, periodic, symmetry, zeros, intercepts, and so on) and know the values of the trigonometric functions at the numbers 0 , $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$, and their multiples.

Use of Graphing Calculators

Professional mathematics organizations have strongly endorsed the use of calculators in mathematics instruction and testing. The use of a graphing calculator in AP Calculus BC is considered an integral part of the course.

Goals of AP Calculus BC

Students who are enrolled in AP Calculus BC are expected to

- Work with functions represented in multiple ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations.
- Understand the meaning of the derivative in terms of a rate of change and local linear approximation and use derivatives to solve problems.
- Understand the meaning of the definite integral as a limit of Riemann sums and as the net accumulation of change and use integrals to solve problems.
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Communicate mathematics and explain solutions to problems verbally and in writing.
- Model a written description of a physical situation with a function, a differential equation, or an integral.
- Use technology to solve problems, experiment, interpret results, and support conclusions.
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

Topic Outline for AP Calculus BC

I. Functions, Graphs, and Limits

- Analysis of Graphs
- Limits of Functions (including one-sided limits)
- Asymptotic and Unbounded Behavior
- Continuity as a Property of Functions
- Parametric, Polar, and Vector Functions

II. Derivatives

- Concept of the Derivative
- Derivative at a Point
- Derivative as a Function
- Second Derivatives
- Applications and Computation of Derivatives

III. Integrals

- Interpretations and Properties of Definite Integrals
- Applications of Integrals
- Fundamental Theorem of Calculus
- Techniques and Applications of Antidifferentiation
- Numerical Approximations to Definite Integrals

IV. Polynomial Approximations and Series

- Concept of Series
- Series of constants
- Taylor Series

AP Calculus BC Exam Structure

AP BC CALCULUS EXAM: 3 HOURS 15 MINUTES

Assessment Overview

The AP Calculus BC Exam questions measure students' understanding of the concepts of calculus, their ability to apply these concepts, and their ability to make connections among graphical, numerical, analytical, and verbal representations of mathematics. Adequate preparation for the exam also includes a strong foundation in algebra, geometry, trigonometry, and elementary functions, though the course necessarily focuses on differential and integral calculus. Students may not take both the Calculus AB and Calculus BC Exams within the same year. A Calculus AB sub-score is reported based on performance on the portion of the Calculus BC Exam devoted to Calculus AB topics.

The free-response section tests students' ability to solve problems using an extended chain of reasoning. During the second timed portion of the free-response section (Part B), students are permitted to continue work on problems in Part A, but they are not permitted to use a calculator during this time.

Format of Assessment

Section I: Multiple Choice | 45 Questions | 105 minutes | 50% of Exam Score

- **Part A:** 28 questions; 55 minutes (no calculator permitted)
- **Part B:** 17 questions; 50 minutes (graphing calculator permitted)

Section II: Free Response | 6 Questions | 90 minutes | 50% of Exam Score

- **Part A:** 2 problems; 30 minutes (graphing calculator permitted)
- **Part B:** 4 problems; 1 hour (no calculator permitted)

AP CALCULUS BC SAMPLE QUESTIONS

Sample Multiple-Choice Question

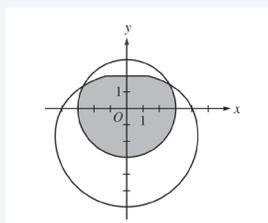
x	2	5	7	8
$f(x)$	10	30	40	20

The function f is continuous on the closed interval $[2,8]$ and has values that are given in the table above. Using the subintervals $[2,5]$, $[5,7]$, and $[7,8]$, what is the trapezoidal approximation of $\int_2^8 f(x)dx$?

- (A) 110 (B) 130 (C) 160 (D) 190 (E) 210

Correct Answer: C

Sample Free-Response Question: Experimental Design



The graphs of the polar curves $r = 3$ and $r = 4 - 2\sin \theta$ are shown in the figure above. The curves intersect when $\theta = \frac{\pi}{6}$ and $\theta = \frac{5\pi}{6}$.

- Let S be the shaded region that is inside the graph of $r = 3$ and also inside the graph of $r = 2\sin \theta$. Find the area of S .
- A particle moves along the polar curve $r = 4 - 2\sin \theta$ so that at time t seconds, $\theta = t^2$. Find the time t in the interval $1 \leq t \leq 2$ for which the x -coordinate of the particle's position is -1 .
- For the particle described in part (b), find the position vector in terms of t . Find the velocity vector at time $t = 1.5$.

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AP Calculus Program

AP Calculus AB and AP Calculus BC focus on students' understanding of calculus concepts and provide experience with methods and applications. Although computational competence is an important outcome, the main emphasis is on a multirepresentational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations are important.

Teachers and students should regularly use technology to reinforce relationships among functions, to confirm written work, to implement experimentation, and to assist in interpreting results. Through the use of the unifying themes of calculus (e.g., derivatives, integrals, limits, approximation, and applications and modeling) the courses become cohesive rather than a collection of unrelated topics.

AP Calculus AB Course Overview

AP Calculus AB is roughly equivalent to a first semester college calculus course devoted to topics in differential and integral calculus. The AP course covers topics in these areas, including concepts and skills of limits, derivatives, definite integrals, and the Fundamental Theorem of Calculus. The course teaches students to approach calculus concepts and problems when they are represented graphically, numerically, analytically, and verbally, and to make connections amongst these representations.

Students learn how to use technology to help solve problems, experiment, interpret results, and support conclusions.

PREREQUISITE

Before studying calculus, all students should complete four years of secondary mathematics designed for college-bound students: courses in which they study algebra, geometry, trigonometry, analytic geometry, and elementary functions. These functions include linear, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric, and piecewise-defined functions. In particular, before studying calculus, students must be familiar with the properties of functions, the algebra of functions, and the graphs of functions. Students must also understand the language of functions (domain and range, odd and even, periodic, symmetry, zeros, intercepts, and so on) and know the values of the trigonometric functions at the numbers 0 , $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$, and their multiples.

Use of Graphing Calculators

Professional mathematics organizations have strongly endorsed the use of calculators in mathematics instruction and testing. The use of a graphing calculator in AP Calculus AB is considered an integral part of the course.

Goals of AP Calculus AB

Students who are enrolled in AP Calculus AB are expected to

- Work with functions represented in multiple ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations.
- Understand the meaning of the derivative in terms of a rate of change and local linear approximation and use derivatives to solve problems.
- Understand the meaning of the definite integral as a limit of Riemann sums and as the net accumulation of change and use integrals to solve problems.
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Communicate mathematics and explain solutions to problems verbally and in writing.
- Model a written description of a physical situation with a function, a differential equation, or an integral.
- Use technology to solve problems, experiment, interpret results, and support conclusions.
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

Topic Outline for AP Calculus AB

I. Functions, Graphs, and Limits

- Analysis of Graphs
- Limits of Functions (including one-sided limits)
- Asymptotic and Unbounded Behavior
- Continuity as a Property of Functions

II. Derivatives

- Concept of the Derivative
- Derivative at a Point
- Derivative as a Function
- Second Derivatives
- Applications and Computation of Derivatives

III. Integrals

- Interpretations and Properties of Definite Integrals
- Applications of Integrals
- Fundamental Theorem of Calculus
- Techniques and Applications of Antidifferentiation
- Numerical Approximations to Definite Integrals

AP Calculus AB Exam Structure

AP AB CALCULUS EXAM: 3 HOURS 15 MINUTES

Assessment Overview

The AP Calculus AB Exam questions measure students' understanding of the concepts of calculus, their ability to apply these concepts, and their ability to make connections among graphical, numerical, analytical, and verbal representations of mathematics. Adequate preparation for the exam also includes a strong foundation in algebra, geometry, trigonometry, and elementary functions, though the course necessarily focuses on differential and integral calculus. Students may not take both the Calculus AB and Calculus BC Exams within the same year.

The free-response section tests students' ability to solve problems using an extended chain of reasoning. During the second timed portion of the free-response section (Part B), students are permitted to continue work on problems in Part A, but they are not permitted to use a calculator during this time.

Format of Assessment

Section I: Multiple Choice | 45 Questions | 105 minutes | 50% of Exam Score

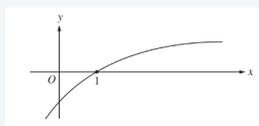
- **Part A:** 28 questions; 55 minutes (no calculator permitted)
- **Part B:** 17 questions; 50 minutes (graphing calculator permitted)

Section II: Free Response | 6 Questions | 90 minutes | 50% of Exam Score

- **Part A:** 2 problems; 30 minutes (graphing calculator permitted)
- **Part B:** 4 problems; 1 hour (no calculator permitted)

AP CALCULUS AB SAMPLE QUESTIONS

Sample Multiple-Choice Question



The graph of a twice-differentiable function f is shown in the figure above. Which of the following is true?

- (A) $f(1) < f'(1) < f''(1)$
- (B) $f(1) < f''(1) < f'(1)$
- (C) $f'(1) < f(1) < f''(1)$
- (D) $f''(1) < f(1) < f'(1)$
- (E) $f''(1) < f'(1) < f(1)$

Correct Answer: D

Sample Free-Response Question: Experimental Design

t (minutes)	0	1	2	3	4	5	6
$C(t)$ (ounces)	0	5.3	8.8	11.2	12.8	13.8	14.5

Hot water is dripping through a coffeemaker, filling a large cup with coffee. The amount of coffee in the cup at time t , $0 \leq t \leq 6$, is given by a differentiable function c , where t is measured in minutes. Selected values of $C(t)$, measured in ounces, are given in the table above.

- (a) Use the data in the table to approximate $C'(3.5)$. Show the computations that lead to your answer, and indicate units of measure.
- (b) Is there a time t , $2 \leq t \leq 4$, at which $c'(t) = 2$? Justify your answer.
- (c) Use a midpoint sum with three subintervals of equal length indicated by the data in the table to approximate the value of $\frac{1}{6} \int_0^6 C(t) dt$. Using correct units, explain the meaning of $\frac{1}{6} \int_0^6 C(t) dt$ in the context of the problem.
- (d) The amount of coffee in the cup, in ounces, is modeled by $B(t) = 16 - 16e^{-0.4t}$. Using this model, find the rate at which the amount of coffee in the cup is changing when $t = 5$.