2024 STUDENT GUIDE TO SUBJECT TESTS

ACT® International Subject Tests

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ACT® International Subject Tests

ACT International Subject Tests

General Introduction:

ACT International Subject Tests are unique, research-based assessments. Designed in partnership with the nation's leading educators, the assessments offer a comprehensive, aligned approach to measuring student skills and knowledge.

The ACT International Subject Tests are designed to be aligned to your high school curriculum. Whether you are studying the national, IB, or US Common Core, you will find a subject test that works for you and rewards you for your academic excellence. The ACT offers subject tests in the following content areas: Biology, Chemistry, English 1 and 2, Math 1 and 2, and Physics.

This guide provides an overview of the content of all ACT subject tests, as well as specific information about the various subject tests. It includes practice questions, including some questions from earlier tests for the specific content area being described. Additionally, you will find some test taking tips and strategies to use to achieve greater success on your testing day.

Review carefully the contents of this booklet and consider taking the online practice test before your scheduled test. This will help better prepare you for success on test day in the subject area of your choosing.

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Brief Descriptions of Subject

BIOLOGY
Biology test questions ask students to solve problems and demonstrate understanding of topics including Biochemistry and the Cell, Genetics and Evolution, Animal and Plant systems, and Ecology.

CHEMISTRY
Chemistry test questions ask students to solve problems and demonstrate understanding of topics such as states of matter and phase changes, mole concept, chemical formulas, chemical equations, stoichiometry, gas laws, atomic structure, periodicity, chemical bonding, and solution properties. Chemistry test questions ask students to apply proportional reasoning and other mathematical thinking to solve problems.

ENGLISH 1/ENGLISH 2
ACT subject tests for English 1 and 2 assess students' knowledge, skills, and abilities as readers and writers. Questions use a diverse collection of authentic, high-quality texts that have been taught in successful classrooms across the United States, including drama, fiction, nonfiction, and poetry texts, as well as film scripts. The English tests also assess knowledge and skills required to write effectively in high school and college.

MATH 1 (ALGEBRA, GEOMETRY)
This test measures students' Algebra and Geometry skills typically developed through the first years of secondary school. These skills include solving equations, drawing conclusions from data, finding areas and volumes, and making judgments about proofs. Calculators are allowed, and a reference sheet provides common formulas.

MATH 2 (ALGEBRA II, PRECALCULUS)
Students can affirm their advanced Algebra and Precalculus skills. These skills include understanding complex numbers, modeling with vectors and matrices, applying advanced functions, finding limits, fitting a normal distribution, and interpreting graphs of the polar coordinate plane. Calculators are allowed, and a reference sheet provides common formulas.

PHYSICS
Physics test questions ask students to solve problems and demonstrate understanding of topics such as forces and motion (e.g., displacement, velocity, acceleration, momentum, force, impulse, Work-Energy theorem, power, work), fundamental forces (e.g., Newton's law of gravitation, Coulomb's law), and waves and periodic motion. Physics test questions ask students to apply proportional reasoning, graphical models, and other mathematical thinking to solve problems.

On Test Day

Items to Bring for Testing:

- An admission ticket
- A photo ID, as specifically requested in correspondence and outlined on the ticket. This is likely to be your passport. The information on your admission ticket should exactly match the information included on your photo ID. You must keep your ID and admission ticket with you at all times, especially if you leave the testing room. You may be asked to show your ID or admission ticket at any time while in the test center. Do not write on your admission ticket.
- You may have a calculator for either math test and for the Chemistry and Physics tests. Calculators are not permitted for any other tests.
- You may wear a non-digital watch.

Items NOT Allowed in Testing Center

- Electronic devices of any kind, including Smart watches with audible alarms, all phones, fitness bands, media players, iPads, headphones, and cameras.
- Textbooks, foreign language or other dictionaries, scratch paper, notes or other aids.
- Reading Material

Preparing for a Subject Test

Your ability to do well on a subject test depends on the knowledge and skills you have gained from taking your high school classes and your familiarity with the test format and the kinds of questions you will be asked. If you've paid attention in your class and met all requirements of your assignments and activities, you should feel confident about your ability to do well on a subject test.   Your level of comfort and confidence with a test and its format will also likely help you do well on any test you choose to take.

Calculators

Students are encouraged, but not required, to bring an approved scientific calculator for the following ACT Subject Tests:
- Math 1
- Math 2
- Chemistry
- Physics

Scientific calculators are available as on-screen tools within all four of the subject tests listed above. Therefore, if students do not bring an approved calculator with them

to the testing location, they will be able to use the on-screen version.

The following types of calculators are **prohibited:**

- Calculators with built-in computer algebra systems – Prohibited calculators in this category include:
  - ▷ Texas Instruments: All model numbers that begin with TI-89 or TI-92 and the TI-Nspire CAS – *NOTE: THE TI-NSPIRE (NON-CAS) IS PERMITTED.*
- Handheld, tablet, or laptop computers, including PDAs
- Electronic writing pads or pen-input devices – *NOTE: THE SHARP EL 9600 IS PERMITTED.*
- Calculators built into cell phones or any other electronic communication devices
- Calculators with a typewriter keypad (letter keys in QWERTY format) *NOTE: LETTER KEYS NOT IN QWERTY ARE PERMITTED.*

A Few Test Taking Strategies

- When you take the ACT Subject Tests, please think carefully about all the choices in each question and answer.
- Plan to use the allotted time as follows:
  - ✓ Answer the easy questions first.
  - ✓ Work on less time-consuming questions.
  - ✓ Move to more challenging questions, giving them enough time.

- Make educated guesses: eliminate choices you know are wrong.

- Work at a steady pace and keep track of time.

ACT International Subject Tests - Biology

Overview

Biology test questions ask students to solve problems and demonstrate understanding of topics including: Biology Processes; Genetics and Evolution; and Animal and Plant systems, and Ecology.

The test encompasses the following overarching themes and/or foundational concepts:

- Exploring and defining the fundamental unifying concepts, organization, and inquiry techniques underlying the science of biology
- Investigating life processes at the cellular level and understanding both how these processes work and how they are maintained and regulated
- Delving into heredity by investigating how genetic structures and processes provide the mechanism for continuity and variety among organisms
- Investigating processes that allow populations to change in response to different environmental and genetic pressures
- Identifying and deciphering the distinguishing characteristics of all categories of living things and establishing the genetic, ancestral, and behavioral relationships among them
- Analyzing the ecological processes by which living things interact with their environments and with each other

Preparing for the Biology Subject Test

Your ability to do well on the Biology Subject Test depends on the knowledge and skills you have gained from taking a high school biology class and your familiarity with the test format and the kinds of questions you will be asked on the test. If you have paid attention in your biology class and met all requirements of your biology assignments and activities, you should feel confident about your ability to do well on the test. Your level of comfort and confidence with the test and its format will also likely help you to do well on this test.

Mapping to the ACT:

ACT Subject Tests are end-of-course assessments that rigorously measure students' understanding of content and practices in each subject. The tests are derived from items and research on ACT QualityCore tests, and have a score scale that links directly to the ACT. In addition to measuring whether students have mastered ACT course standards, these tests predict success in postsecondary courses.

Why do some questions seem easy and some questions seem much harder?

The ACT test is designed to enable test takers from across the performance continuum to demonstrate what they know and are able to do. Questions are designed therefore to measure a range of critical thinking skills and a range of cognitive complexities. Since content knowledge is so crucial in biology, some questions on the test will require you to demonstrate that knowledge simply through recall or recognition of important terms, facts, and concepts. In addition, competency in biology requires that you demonstrate the ability to interpret, compare, or explain ideas. You must be able to apply also what you have learned to specific contexts or experiments. Consequently, the test also includes questions that assess your ability to analyze, evaluate, design and/or modify experiments. By measuring both simple and more complex knowledge and skills, you will have an opportunity to show what you have learned and are able to do in the topics assessed.

Components of the Biology Test
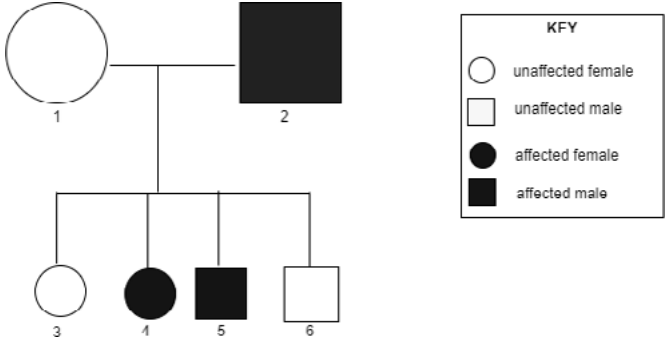
Prerequisites:
It is recommended that you have taken Biology and Algebra I before taking the ACT Biology Subject Test.

Test Length: 90 minutes (Two 45-minute sessions)
Number of Questions: 38 per 45-minute session

The test covers topics studied in most high-school level Biology courses. Within each of those topics, you will be asked to demonstrate your understanding of overarching themes and/or foundational concepts.

Content on the Test : Biology	Sample Test Questions	What Sample Test Questions Assess
Biology Process: (10-20%) • Scientific Inquiry • Math and Measurement in Science • Science in Practice • Foundations in Biology: Criteria necessary to characterize life; Define biological organization levels	1. Chan wants to determine how much the mass of fungus growing on a nutrient agar plate changes over an 8 hr period. What is the most appropriate unit of measure for him to use? a. Kilogram b. Kilometer c. Milligram d. Millimeter 2. Which experiment design would provide scientists with the best data for investigating which type of feed yields the greatest gain in lean muscle in cattle? a. Test 5 different types of cows with the same feed mixture and measure their weight gain at the end of a six week trial. b. Test 5 similar groups of cows with 5 different feed mixtures and measure their weight gain at the end of a six week trial. c. Test 5 similar groups of cows with the same feed mixture and measure their weight gain at the end of a six week trial. d. Test 5 different cows with 5 different feed mixtures, give each group varying amounts of feed and measure their weight gain at the end of a six week trial.	1. This question assesses your ability to understand and to use mathematical representations. This requires that you be able to distinguish between terms relating to distance, mass, scale, and size. In order to answer this question correctly, you need to know grams refer to weight and that the prefix milli indicates one thousandth while the prefix kilo means one thousand. The correct answer is **c**. 2. This question tests your ability to design, evaluate, and revise experiments. In order to answer this question correctly, you must know and understand the difference between dependent and independent variables, and how to choose them. You should also be able to apply a control-of-variables approach to evaluate experimental designs. The correct answer is **b**.
Biochemistry; Cell (20-35%) • Atomic structure; chemical bonds; organic and inorganic compounds, enzymes; ATP • Properties of water; pH of solutions • Cell types; functions of cell organelles • Movement of substances in and out of cells • Cellular respiration • Cell division and mitosis	1. Which process generates most of the ATP produced during cellular respiration? a. Electron transport chain b. Fermentation c. Glycolysis d. Krebs Cycle 2. Which functional group found in amino acids is absent from monosaccharides, poly-saccharides, fatty acids and glycerol? a. -COOH b. -NH2 c. -OH d. -PO4	1. You need to demonstrate a conceptual understanding of the inputs and outputs of the process of cellular respiration in order to answer this question correctly. This includes such aspects of the process as ATP synthase, proton gradients, the electron transport chain, the energy investment phase, etc. The correct answer is **d**. 2. This question assesses your understanding of the atomic structures of these organic compounds. In order to answer this question correctly, you must know that nitrogen is a major component of all proteins, and is not present in the other chemicals listed. The correct answer is **b**.

Content on the Test : Biology	Sample Test Questions	What Sample Test Questions Assess
Genetics; Evolution (25-40%) • Basic structure and function of DNA, RNA, and proteins • Meiosis • Terminology of Genetic Crosses • Evolution and the Theory of Natural Selection • Requirements to be a Species • Explain shared evolutionary relationships between organisms	1. When comparing 2 populations of animals, which state most likely indicates that they are the same species? a. They produce fertile offspring. b. They inhabit the same general area. c. Their outward appearance is similar. d. They consume the same type of diet. 2. Huntington's disease is a genetic disorder of the nervous system. This disorder is determined by 1 allele at 1 locus. What is the genotype for individual 4 in the diagram? KEY ○ unaffected female □ unaffected male ● affected female ■ affected male a. *HH* or *Hh* b. *HH* c. *Hh* d. *hh*	1. This question assesses your understanding of the process of evolution as it results from 1) the potential for a species to increase in numbers, 2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, 3) competition for limited resources, and 4) the proliferation of those organisms that are better able to survive and reproduce in the environment. The correct answer is a. 2. This question assesses your understanding of and ability to apply the terminology of Genetic Crosses. In order to answer this question correctly, you must recognize from the question and diagram that Huntington's disease is a dominant trait, and that having only one allele, H, will result in an offspring having the disorder. The correct answer is **c.**
Animal/Plant Systems and Ecology (25-40%) • Describe types of Animal and Plant Cells and Tissues; describe Photosynthesis • Identify taxonomic levels of organism classification; explain binomial nomenclature • Define ecological levels of organization; describe influence of biotic and abiotic factors on biome type	1. Based on their taxonomic classification, which two organisms share the most recent common ancestor? a. Centipede and earthworm (same kingdom) b. Alligators and crocodiles (same phylum) c. Fox and wolf (same family) d. Lemurs and racoons (same class) 2. Pistol shrimp build and maintain burrows on the ocean floor in which they and goby fish live. The goby fish provides the virtually blind shrimp protection from predators. Describe the relationship(s) between the pistol shrimp and the goby fish. a. Mutualism only b Mutualism and predation c. Mutualism and parasitism d. Mutualism and commensalism	1. This question assesses your understanding of the taxonomic levels of organism classification. In order to answer the question correctly, you must understand the relationship between the taxonomic levels and genetic traits. The correct answer is **c.** 2. This question assesses your understanding of the complex interactions among organisms in ecosystems. In order to answer this question correctly, you must understand and be able to distinguish among the types of symbiotic relationships that exist within an ecosystem. The correct answer is **a.**

The objectives of high school biology courses are to provide instruction and to emphasize the importance of the following:

- The foundations and practices of science in general,
- The basic processes of scientific inquiry, and
- The importance of mathematics and accurate measurement in the field of biology.

Biology Processes

To best prepare yourself for the Biology subject test, seek out activities that will help you to think like a scientist. Of course, your biology course itself is designed to help you practice such skills as asking good questions and making arguments. To understand better the science of biology, take the time to explore and define some of the discipline's most fundamental unifying concepts and organization. Work to uncover the relationships among such biological disciplines as chemistry, ecology, and environmental science. This multidimensional approach to science uses scientific practices, cross cutting concepts in science, and disciplinary core ideas that are the basis for science standards assessed by the Biology Subject test.

Additionally, the Biology subject test will assess your understanding of those inquiry techniques most associated with the discipline of biology. Consider the design of experiments you conduct in the classroom and practice interpreting the data you collect. When you conduct such experiments, you should be able to use mathematical representations to support and revise your explanations and outcomes. Pay close attention in your math courses, as well. An understanding of Math will support your understanding of such chemical equations as that of cellular respiration. Ten to 20 percent of test questions will have biology processes as their focus.

Resources:

Scientific Inquiry
Math in Science
Biological Organizations

Biochemistry

A number of questions on the test will assess your understanding of various life processes at the cellular level. You should know how these life processes function as well as how they are also maintained and regulated. You should be able to explain, using evidence, how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. Consider constructing models of photosynthesis to help you better to understand that process. In particular, you'll need to understand the inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. The models you construct can include diagrams, chemical equations, and conceptual models.

To prepare for the test, familiarize yourself with the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. You should know and understand, that is, the processes of nutrient uptake, water delivery, and organism movement in response to neural stimuli. Some 20 to 35 percent of test

questions focus on cellular structures and processes.

Resources:

[Cellular Respiration](#)
[Cellular Respiration and Photosynthesis](#)
[Photosynthesis](#)

Genetics, Evolution

To answer test questions about Genetics and Evolution, you will need to understand the role of cellular division and differentiation in producing and maintaining complex organisms. You will need to understand the role of DNA and chromosomes in coding instructions for those traits passed from parents to offspring. Prepare to apply concepts of statistics and probability to explain the variation and distribution of expressed traits in populations.

Consider forming a study group with your peers to participate in such activities as discussing how theories about genetics and evolution develop. Prepare to evaluate on the text evidence for the role of group behavior on individual and species chances to survive and reproduce. Additionally, be able to distinguish between group and individual behaviors.

A number of questions on the Biology subject test will assess your knowledge of the processes that allow populations to change in response to different environmental and genetic pressures. With your study group, practice constructing cause-and effect explanations for these processes and changes. These kinds of activities will help to prepare you to answer question that also assess your understanding of how these structures and processes provide the mechanism for continuity and variety among organisms. Twenty-five to 40 percent of test questions will focus on this topic.

Resources:

[DNA](#)
[Evolution](#)
[Mitosis and Meiosis](#)
[Natural Selection](#)

Animals/Plant Systems and Ecology

As you study animals and plant systems and other topics associated with ecology in your Biology course, you will learn to identify and decipher the distinguishing characteristics of these living things. To best prepare for the Biology Subject test, practice constructing arguments based on evidence about factors affecting biodiversity and populations in different ecosystems. To do well on the test, you will need to understand and be able to explain the interdependent relationships in ecosystems, such as food chains and pyramids. With a group of your peers, consider finding or designing activities that will require that you and your peers to design, evaluate, and refine solutions that reduce the impacts of human activities on the environment and biodiversity.

Some of the questions on the Biology Subject test will require you to evaluate or analyze the genetic, ancestral, and behavioral relationships among the organisms you study. Be prepared then, to analyze the ecological processes by which living things interact with their environments and with each other. Twenty-five to 40 percent of test questions will

focus on this topic.

Resources:

Consider Taking a Practice Test

It makes sense to take a practice test to prepare yourself for the ACT Biology Subject test. Discuss this possibility with your instructor. This will also give you the chance to practice several test taking strategies.

Test Taking Strategies to Use on the Biology Subject Test

Pacing

Spend some time identifying your strengths as a biology test taker. That way, when you open your test on your test day, you can quickly read through all of the questions and determine which questions are easiest to answer correctly when you first read the question. If you can identify which questions you can answer more quickly, this will help you with pacing and allow you to spend more time on questions you might find to be more difficult later on in the test.

Similarly, know in what areas of biological inquiry you most need to improve. Do you have trouble reading tables? Spend extra time in the weeks leading up to the test date reading sample experimental results that require you to see how the information included in a table has led researchers to the conclusions they draw. When you get to the test, you will more likely be able to answer questions that require interpretation of data more quickly as well.

Remember you are not penalized for wrong answers. If you look up and realize that there are only a few minutes left before time is called, but you have another 10-15 questions to answer, consider bubbling in the rest of the answers as all Bs and Fs or Cs and Gs. This gives you a one-in-four chance of getting the rest of the answers correct. This strategy should only be used when you are running short of time. Nonetheless, having this knowledge in the back of your mind should lessen your anxiety. The more calm you are, the less likely you are to make mistakes.

To avoid running out of time in the first place, though, divide the number of questions by the amount of time you will have to answer them. For the biology test, this means you have just slightly more than a minute per question.

Practice Interpreting Graphs, Tables, and Diagrams

Some of the questions on the biology test will require you to analyze and to interpret information presented in the form of graphs, tables, or diagrams. As your prepare for the test, pay close attention to the way data is labeled, organized, and plotted on graphs. Practice interpreting the information on a variety graphs, charts and diagrams, such as pie charts, scatter plots, or bar charts. This will help you to become familiar with what is associated with the x-axis (typically the independent variable) versus what is being measured by the y-axis (typically what is being measured, or the dependent variable). Find and analyze multiple line graphs and graphs with multiple variables measured on the y-axis to become familiar with graphics that are frequently used in science, but not often used in high school. Practice using keys and legends to understand the data presented

in a graphic. For tables, notice the column and row headings that will name quantities and units or measure. Typically, one can find the independent variables on the left hand side of the table and the quantities measured in the experiment on the right. To read diagrams, look for important information in the title, captions, and labels of the diagram. Make sure you spend a little time figuring out what a graph, table, or diagram is revealing to its viewer, including the relationships between variables. Having a good idea of what the graphic information presents will help you to interpret what the questions on the test are asking.

Reading the Questions and Possible Answers Carefully

Pay close attention to the way questions are worded. Restate questions in your own words. Practice pulling out data, concepts, and information from questions. Use logic to arrive at the correct answer. Using a combination of knowledge and elimination strategies will allow you to best demonstrate what you understand about the key ideas in the Biology course.

ACT International Subject Tests - Chemistry

Overview

The ACT International Subject Test in Chemistry explores the makeup of the physical world, from the properties and structures of matter to the laws explaining the activity of gases, as well as the chemical structures of elements, molecules, and compounds. Like other Chemistry courses, a rigorous course studies the periodic table of elements and the proper symbolic nomenclature of elements as well as the symbolic representation of chemical reactions in formulas and equations. Investigations into the microscopic world lead to deeper understanding of the macroscopic world, from atomic structure and bonding to the properties of salts, acids, and bases. More advanced subjects, such as REDOX reactions or nuclear chemistry, are also introduced in a rigorous Chemistry course. In support of students' introduction to the discipline, a rigorous course emphasizes the foundations and practices of science in general, teaching the basic processes of scientific inquiry and emphasizing the importance of mathematics and measurement.

Skills and Concepts Covered:

What students should know about the ACT International Subject Test in Chemistry: It encompasses the following overarching themes and/or foundational concepts:

- Understanding Chemistry as Inquiry
- Exploring the Physical World
- Discovering the Language of Chemistry
- Building Models of Matter
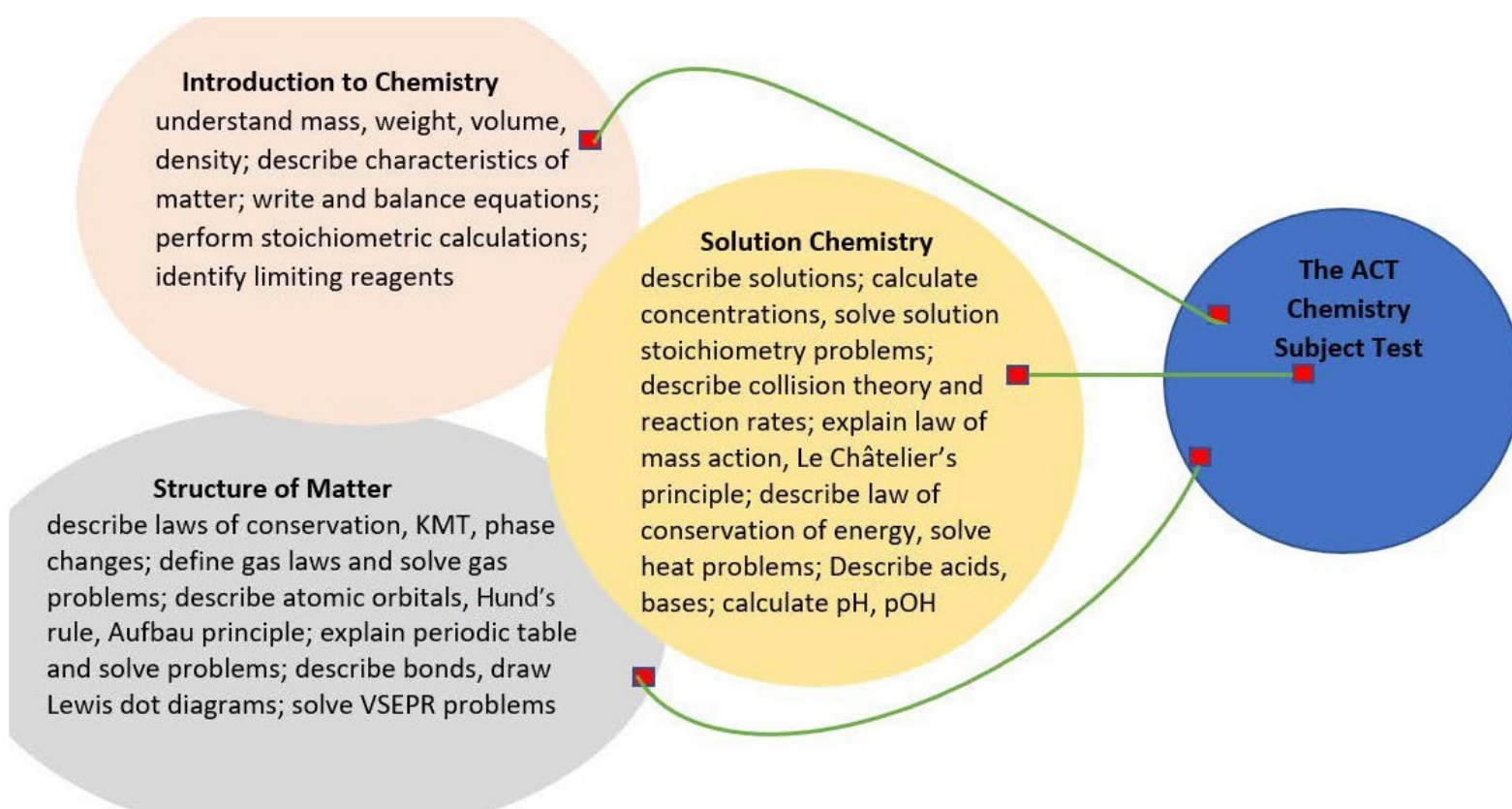- Integrating the Macroscopic, Microscopic, and Symbolic Worlds
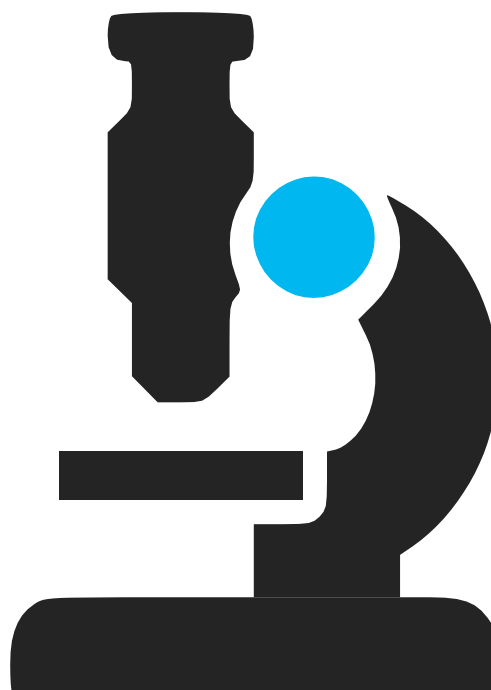
Preparing for the Chemistry Subject Test

Your ability to do well on the Chemistry Subject Test depends on the knowledge and skills you have gained from taking a high school chemistry class and your familiarity with the test format and the kinds of questions you will be asked on the test. If you have paid attention in your chemistry class and met all requirements of your chemistry assignments and activities, you should feel confident about your ability to do well on the test. Your level of comfort and confidence with the test and its format will also likely help you do well on this test.

Mapping to the ACT:

ACT Subject Tests are end-of-course assessments that rigorously measure students' understanding of content and practices in each subject. The tests are derived from items and research on ACT QualityCore tests, and have a score scale that links directly to the ACT. In addition to measuring whether students have mastered ACT course standards, these tests predict success in postsecondary courses.

Introduction to Chemistry
understand mass, weight, volume, density; describe characteristics of matter; write and balance equations; perform stoichiometric calculations; identify limiting reagents

Structure of Matter
describe laws of conservation, KMT, phase changes; define gas laws and solve gas problems; describe atomic orbitals, Hund's rule, Aufbau principle; explain periodic table and solve problems; describe bonds, draw Lewis dot diagrams; solve VSEPR problems

Solution Chemistry
describe solutions; calculate concentrations, solve solution stoichiometry problems; describe collision theory and reaction rates; explain law of mass action, Le Châtelier's principle; describe law of conservation of energy, solve heat problems; Describe acids, bases; calculate pH, pOH

The ACT Chemistry Subject Test

Why do some questions seem easy and some questions seem much harder?

The ACT test is designed to enable test takers from across the performance continuum to demonstrate what they know and can do. Questions are designed therefore to measure a range of critical thinking skills and a range of cognitive complexities. Since content knowledge and skills are so crucial in chemistry, some questions on the test require you to demonstrate that knowledge simply through recall or recognition of important terms, facts, concepts, and procedures. In addition, competency in chemistry requires you to demonstrate the ability to interpret, compare, explain ideas, and relate to world problems. Test takers must also be able to apply what they have learned to specific contexts or experiments. Consequently, the test also includes questions that assess students' ability to interpret, analyze, evaluate, design and/or modify experiments. By measuring both simple and more complex knowledge and skills, all test takers have an opportunity to show what they have learned and are able to do in the topics assessed.
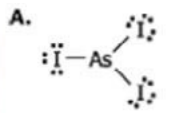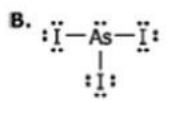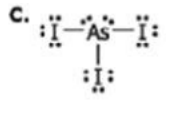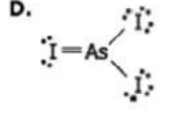
Components of the Chemistry Test

Prerequisites:
It is recommended that test takers have taken Chemistry and Algebra II before taking the ACT Chemistry Subject Test.

Test Length: 90 minutes (Two 45-minute sessions)
Number of Questions: 38 per 45-minute session

The test covers topics studied in most high-school level Chemistry courses. Within each of those topics, you will be asked to demonstrate your understanding of overarching themes and/or foundational concepts.

Content on the Test : Chemistry	Sample Test Questions	What Sample Test Questions Assess
Introduction to Chemistry: (30-50%) • Introduction to Chemistry • Mass, Volume and Density • Elements, Atomic Mass, and Nomenclature • The language of Chemistry • Formulas, Equations • Chemical Equations and Stoichiometry	1. What is the volume in mL, of a sample of glycerol with a density of 1.20g/mL and a mass of 43.7g? a. 36.4 b. 42.5 c. 44.9 d. 52.4 2. Which statement correctly describes one mole of iodine (I2)? a. Its mass is 126.9 g b. Its mass is 380.7 g c. It contains 6.02 x 1023 atoms d. It contains 6.02 x 1023 molecules 3. Which balanced equation is a double replacement reaction? a. $2H2O(l) \longrightarrow 2H2(g) + O2(g)$ b. $4Fe(s) + 3O2(g) \longrightarrow 2Fe2O3(s)$ c. $Ag(s) + Ca3(PO4)2(s) \longrightarrow Ca(aq) + Ag3PO4(s)$ d. $AgNO3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO3(aq)$	1. This question assesses your understanding of the mathematical relationship between density, mass, and volume where density is proportional to mass and inversely proportional to volume. Using D = M/V, the relationship can be applied to solve the unknown volume. The correct answer is **a**. 2. This question assesses your understanding of conversions between mass, moles, and the number of particles of a substance, but more importantly, you must know Avogadro's constant, which describes the number of atoms or molecules in a mole of a substance as equal to 6.02 × 1023. Since I2 is a molecule, the answer is **d**. 3. This question assesses your ability to express types of balanced chemical reaction in the form of equations. You should also understand that double replacement reactions typically occur in aqueous solutions. The correct answer is **d**.
Structure of Matter (20-40%) • Properties of Matter and Gas • Building Models of Matter	1. What volume of H2 gas is made when 30.2 g of zinc reacts with an excess of HCl at STP? $Zn\ (s) + 2HCl\ (aq) \longrightarrow ZnCl2\ (aq) + H2\ (g)$ a. 0.46 L b. 1.37 L c. 10.4 L d. 65.4 L 2. What is the Lewis dot structure for arsenic triiodide? 	1. This question assesses your ability to solve gas stoichiometry problems given data and conditions. Additional skills being assessed by this item include your ability to interpret and analyze chemical equations, to select a routine problem-solving procedure for gas stoichiometry and perform it, and to correctly convert units. The correct answer is **c.** 2. This question assesses whether you can interpret data using Lewis dot structures and identify the correct valence electron configurations of a covalently bonded compound. You can use your knowledge of Lewis dot structures, with the help of the periodic table, to determine how three atoms of iodine (I) combine with one atom of arsenic (As). The correct answer is **b.**

Content on the Test : Chemistry	Sample Test Questions	What Sample Test Questions Assess
Solutions Chemistry (20-40%) • Integrating Macroscopic, Microscopic and Symbolic Worlds • Types of Solution, Concentration, Solubility • Kinetics, Equilibrium and Thermodynamics • Salts, Acids and Bases • REDOX Reactions and Electrochemistry • Nuclear Chemistry	1. How many mL of 0.280 M barium nitrate are required to precipitate as barium sulfate all the sulfate ions from 15.0 mL of 0.350 M aluminum sulfate? a. 15.0 mL b. 15.8 mL c. 56.0 mL d. 56.25 mL	1. This question assesses your ability to solve solution stoichiometry problems given data and conditions. Additional skills that may be assessed by this item include your ability to model scientific concepts or relationships in words or diagrams; to select a procedure according to specified criteria and perform it; to organize, represent, and interpret data; and to correctly convert units. The correct answer is **d.**
	2. The chemical reaction below is known as the Haber process for producing ammonia from nitrogen and hydrogen. $N_2 + 3H_2 \rightleftharpoons 2NH_3$ Which statement describes the effect of adding more H2 to this reaction? a. The reaction will stop. b. The reaction will not change. c. The equilibrium shifts to the left. d. The equilibrium shifts to the right.	2. You will have to apply what you know about Le Châtelier's principle with respect to concentration when you analyze what will happen when more hydrogen gas is added to a reversible reaction. The correct answer is **d.**
	3. What are the pOH and pH of a 4.22×10^{-5}M aqueous sodium hydroxide solution? a. pOH = 2.37, pH = 11.63 b. pOH = 3.40, pH = 10.6 c. pOH = 4.37, pH = 9.63 d. pOH = 4.39, pH = 9.61	3. This question assesses your ability to calculate the pH and pOH of solutions. You should know that you should first use the formula pOH = -log $[OH^-]$ to solve for pOH, and then subtract that number from 14. The correct answer is **c.**

The objectives of high school chemistry courses are to provide instruction and to emphasize the importance of the following:
• The foundations and practices of chemistry in general,
• The basic processes and skills of scientific inquiry, and
• The importance of mathematics and accurate measurement in chemistry.

Introduction to Chemistry

"Introduction to Chemistry" is designed to help you master the fundamental basics of chemistry through exploration of unifying concepts within related disciplines such as physics, biology, biochemistry, geology, environmental science, and astronomy, to name a few. This multidimensional approach to science uses scientific and engineering practices, cross cutting concepts in science, and disciplinary core ideas that are the basis for science standards and frameworks such as PISA, TIMSS, and NGSS.

The Chemistry Subject Test will assess your understanding of many basic concepts that are essential for you to understand chemistry. For example, the relationships between mass, weight, volume, and density can be found in many chemistry topics. Practice developing and using models that explain characteristics of matter compounds, mixtures, elements, and isotopes. You will need to apply mathematics when converting between mass, moles, and number of particles. You will also need to be able to write and balance equations, classify and predict products of chemical reactions, as well as calculate percent yields of these reactions. Since stoichiometry is a common thread through many chemistry topics, it is important that you practice these types of calculations using worksheets and quality resources. Also, to be successful you must acquire strong measurement and mathematic skills. Find and complete activities that will help you to build confidence in those areas. As you gain experience in a lab setting, look for opportunities to perform open-ended experiments and try out different solutions to chemistry problems posed to you by your instructor. Be sure to follow the lab safety rules with regard to, for example, heating and measuring tools to

ensure you will also be successful when you conduct your scientific investigations.

Some 30% - 50% of test questions will assess skills aligned with concepts covered in the "Introduction to Chemistry" category.

Resources:

[Overview of High School Chemistry Topics](#)
[Phet Interactive Simulations: Balancing Chemical Equations](#)
[Chemistry Archive](#)

Structure of Matter

Questions on the test that assess your understanding of the Structure of Matter include such topics as conservation of matter, kinetic molecular theory (KMT), and phase changes. Your understanding of these concepts can be enhanced through the use of molecular kits, diagrams, and physical models during hands-on activities. Modeling activities (e.g., a block of ice melting into water) can help you to develop a better understanding of such concepts as how KMT relates to phase changes and the law of conservation of matter.

To prepare for this section of the test, you should also know the chemical and physical properties of matter. Using hands-on lab activities that compare properties along with their physical and chemical changes may work well in reinforcing these concepts for you. Understanding and solving problems based on gas laws is an integral part of the Structure of Matter course work. Practicing these calculations through worksheets and conducting gas stoichiometry experiments will ensure that you have mastered the problem solving skills required to be successful on the test.

Become familiar with concepts such as atomic orbitals and the rules and principles that apply to them (Hund's rule and Aufbau principle). This can be extended into an understanding of how the periodic table is organized, by number and pattern of electrons. Understanding electron patterns will help you to predict chemical reactivity and bond formation between various types of atoms. Consider using Lewis dot structures as you practice drawing molecules formed by atoms bonded together. Try to solve problems with respect to your drawn shapes using the VSEPR theory. Try to first predict molecular shapes using the VSEPR theory. Having made these predictions, use molecular model kits to help you confirm your predictions. Some 20% - 40% of test questions will have content that focuses on the concepts in "Structure of Matter."

Resources:
[Gas Stoichiometry](#)
[The Periodic Table](#)
[Valence-Shell Electron Pair Repulsion Theory](#)

Solutions Chemistry

To answer test questions about Solutions Chemistry, you will need to understand the preparations and properties of solutions as well as the related theories, principles, and laws. You will need to be able to calculate concentrations of solutions and solve solution stoichiometry problems. Additionally, you will need to understand the collision theory and how to apply concepts such as the law of mass action, Le Châtelier's principle, and the law of conservation of energy to help answer questions and solve problems. Work with your peers to become familiar with the characteristics of acids and bases. Practice calculating the pH and pOH and writing neutralization reactions. It is essential that

you practice your laboratory skills and techniques. Consider forming a study group with your peers to discuss the ways in which the scientific skills you practice in the classroom might be practically used in the real world. These kinds of discussions and practical use of skills will prepare you well for those questions that assess your understanding of solutions chemistry. Between 20% and 40% of test questions will be focused on content and skills related to Solutions Chemistry.

Resources:

[Preparation of Solution](#)
[Le Chatelier's Principle](#)
[Calorimetry and Heat Flow](#)

Consider Taking a Practice Test

It makes sense to take a practice test to help prepare yourself for the test. This will also give you the chance to use several test taking strategies that are explained below.

Test Taking Strategies

Pacing

Spend some time identifying your strengths as a chemistry test taker. Ask your instructor to give you a practice Chemistry Subject Test. That way, when you open your test on test day, you can quickly read through all of the questions and determine which questions are easiest for you to answer correctly. Since you are likely to be able to answer easier questions more quickly, this will help with your pacing and allow you to spend more time on questions you might find to be more difficult.

Similarly, know in what areas of chemistry you most need to improve. Do you have trouble reading tables? Spend extra time in the weeks leading up to the test date reading sample experimental results that require you to see how the information included in a table has led researchers to the conclusions they draw. When you get to the test, you will then likely be able to answer questions that require interpretation of data more quickly as well.

It's important to remain calm during the test. Remember, you are not penalized for wrong answers. If you look up and realize that there are only a few minutes left before time is called, but you have another 10-15 questions to answer, consider bubbling in the rest of the answers as all Bs and Fs or Cs and Gs. This gives you a one-in-four chance of getting the rest of the answers correct. This strategy should only be used when you are running short of time. Nonetheless, knowing you can use this strategy in a pinch lessens the chance that you'll make mistakes simply because your anxiety has distracted you.

To avoid running out of time in the first place, divide the total test time by the number of questions: you have slightly more than a minute per question. Again, be willing to guess on a question that you do not know and mark the question.

Practice Mathematical Skills

Some of the questions on the chemistry test will require you to make calculations as well as to analyze and interpret information. Try to master both basic and more advanced chemistry calculations before attempting the test. Basic calculations include ensuring accuracy and precision when applying significant figures and scientific notation, correctly applying physical constants (e.g., atomic mass unit, Avogadro's number, etc.), correct use of metric base units (e.g., length, mass, time, mole, etc.), correct use of derived metric

units (e.g., m^2, m/s, etc.), correct use of metric prefixes (e.g., giga, mega, centi, deci, etc.), canceling units in advanced calculations and correct temperature conversions. More advanced calculations could include applying chemical formulas to solve complex and multi-step problems.

Make sure you know how to use scientific calculators. Check to see, for example, if you can perform some logarithmic calculations needed for pH and pOH. Check the ACT Calculator policy to make certain that the calculator you plan to use for the ACT Chemistry Subject Test is allowed.

Interpreting graphs, tables, and diagrams is an essential part of answering questions on the test. Pay close attention to the way data is labeled, organized, and plotted on graphs. Find and practice interpreting the various types of graphs, charts and diagrams you will encounter on the test, including line graphs, pie graphs, and bar graphs. Analyze chemistry graphs with multiple variables measured on the y-axis to become familiar with graphics that are frequently used in chemistry, but not often used in high school. Practice using keys and legends to understand the data presented in a graphic.

For tables, notice the column and row headings that will name quantities and units of measure. Typically, one can find the independent variables on the left hand side of the table and the quantities measured in the experiment on the right. To read diagrams, look for important information in the title, captions, and labels of the diagram. Make sure you spend a little time figuring out what a graph, table, or diagram is revealing to its viewer, including the relationships between variables. Having a good idea of what the graphic information presents will help you to interpret what the questions on the test are asking.

Practice Skills Needed in a Laboratory Setting:

The proper use of lab equipment is essential in collecting data that is both valid and reliable. In the chemistry test you might need to answer questions about common sources of error as they relate to such things as systematic errors due to inaccurate information or incorrectly using equipment (parallax error in measurement). In class, you will quite often perform calculations within a lab environment where you need to use both technical lab skills and mathematics. Data errors can arise from incorrect use of lab equipment or incorrectly applying a mathematical formula. Incorrect measurements, miscalculating answers, or placing the decimal in the wrong place can skew the results of experiments. If you do not carefully observe and record raw data, there is a good chance there will be problems with data analysis. Keep a detailed, written log of your lab activities including techniques, procedures, calculations, and findings. This will help accuracy, quality control and more importantly, help you learn from your mistakes.

Reading the Questions and Possible Answers Carefully

Pay close attention to the way questions are worded on your practice test. Try to restate them in your own words. Practice pulling out data, concepts, and information from questions. Use logic to arrive at the correct answer. Using a combination of knowledge and elimination strategies will allow you to best demonstrate what you understand about the key ideas in the Chemistry course.

ACT International Subject Tests - English

Overview

English 1 and 2

ACT Subject Tests for English 1 and 2 assess students' knowledge, skills, and abilities as readers and writers. Questions use a diverse collection of authentic, high-quality texts that have been taught in successful classrooms across the United States, including drama, fiction, nonfiction, and poetry texts, as well as film scripts. The English tests also assess knowledge and skills required to write effectively in high school and college.

English test questions ask you to demonstrate your ability to read and comprehend various modes of writing as well as your understanding of the mechanics of writing.
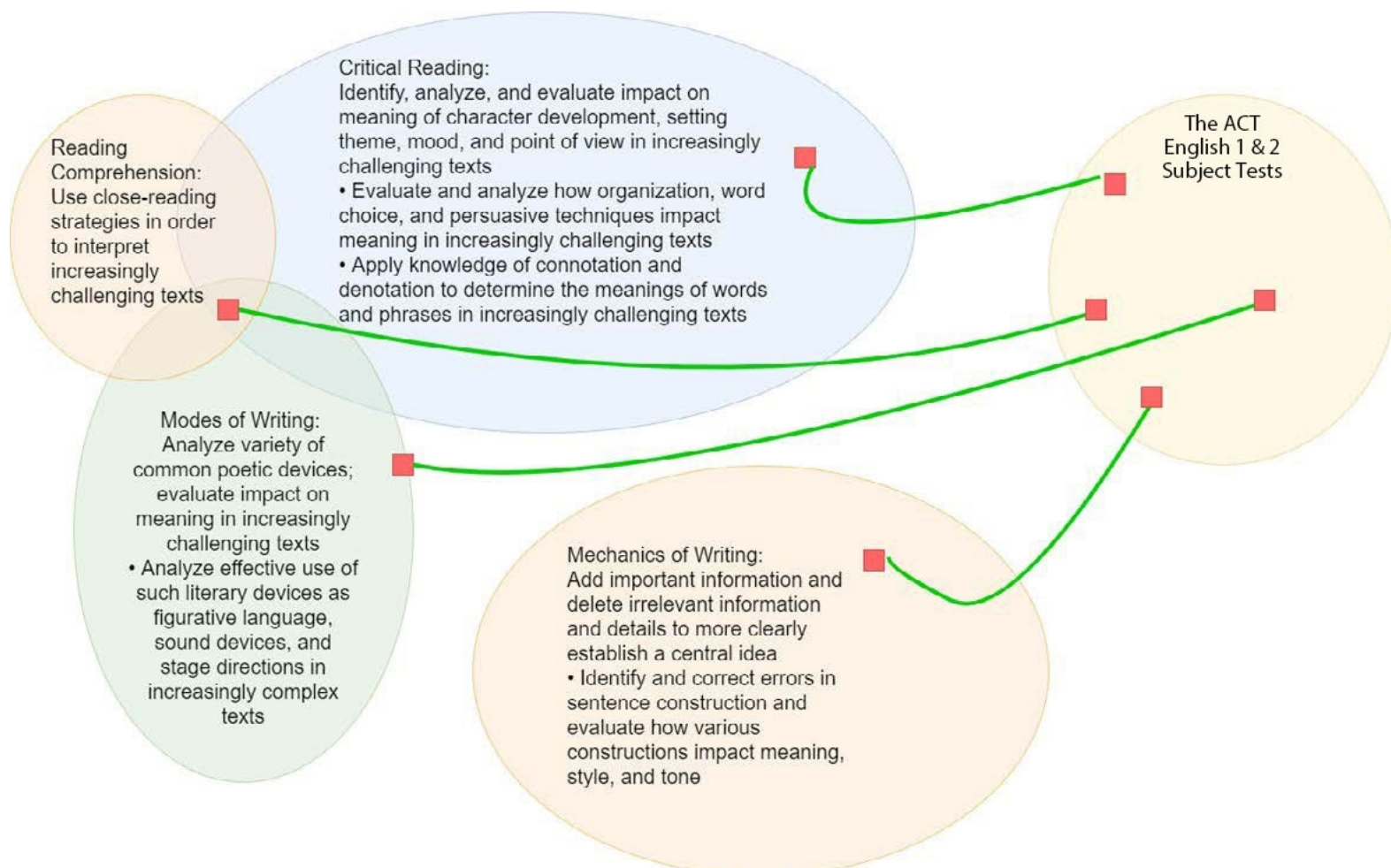
Preparing for the English Subject Test

Students' ability to do well on the English Subject Test depends on the knowledge and skills they have gained from taking a high school English class and their familiarity with the test format and the kinds of questions they will be asked on the test. If you have paid attention in your English class and met all requirements of your English assignments and activities, you should feel confident about your ability to do well on the English 1 or English 2 tests. Your level of comfort and confidence with the tests and their formats will also likely help you do well on either the English 1 Subject Test or the English 2 Subject Test.

Why do some questions seem easy and some questions much harder?

The ACT test is designed to enable test takers from across the performance continuum to demonstrate what they know and are able to do. Questions are designed to measure a range of critical thinking skills and represent a range of cognitive complexities. Some questions on the test require students to demonstrate that knowledge simply through recall or recognition of key literary terms. In addition, competency in English requires students to demonstrate the ability to interpret, compare, or explain ideas. Test takers must also be able to apply what they have learned to specific contexts. Consequently, the test includes questions that assess students' ability to analyze and to evaluate information or arguments in passages. By measuring both simple and more complex knowledge and skills, all test takers have an opportunity to show what they have learned and are able to do in the topics assessed.

Mapping to the ACT

ACT Subject Tests are end-of-course assessments that rigorously measure students' understanding of content and practices in each subject. The tests are derived from items and research on ACT QualityCore tests and have a score scale that links directly to the ACT. In addition to measuring whether students have mastered ACT course standards, these tests predict success in postsecondary courses.

Reading Comprehension: Use close-reading strategies in order to interpret increasingly challenging texts

Critical Reading: Identify, analyze, and evaluate impact on meaning of character development, setting theme, mood, and point of view in increasingly challenging texts
• Evaluate and analyze how organization, word choice, and persuasive techniques impact meaning in increasingly challenging texts
• Apply knowledge of connotation and denotation to determine the meanings of words and phrases in increasingly challenging texts

The ACT English 1 & 2 Subject Tests

Modes of Writing: Analyze variety of common poetic devices; evaluate impact on meaning in increasingly challenging texts
• Analyze effective use of such literary devices as figurative language, sound devices, and stage directions in increasingly complex texts

Mechanics of Writing: Add important information and delete irrelevant information and details to more clearly establish a central idea
• Identify and correct errors in sentence construction and evaluate how various constructions impact meaning, style, and tone

The objectives of high school English courses are to provide instruction and to emphasize the importance of the following:

Key Ideas and Details

A number of questions on the English 1 Subject Test will assess students' ability to understand the overall meaning of passages, to determine main ideas and themes, to identify important details that support main ideas and themes, or to analyze the relationships among ideas, individuals, and/or events in the passages read.

Of most use in preparing you to determine, analyze, interpret, and evaluate information in the various passages you will read will, of course, be those activities that help you to develop your close reading skills. Activities that can help you pay closer attention to the details of the text include targeted highlighting and text annotation.

Resources:
Close Reading
Finding the Main Idea and Supporting Details
Finding Connections between Ideas in a Passage

Components of the English Test

Prerequisites
It is recommended that students take English 11 before taking the English 1 Subject Test, and English 12 before taking the English 2 Subject Test.

Test Length: 90 minutes (Two 45-minute sessions)
Number of Questions: 36-38 per 45-minute session

The test covers topics studied in most high school English courses. Within each of those topics, you will be asked to demonstrate your understanding of overarching themes and/or foundational concepts. Note that in the chart below, supporting details from selected passages have been highlighted as a way to emphasize that all answers in the English Subject Tests require you to find evidence within the passages themselves.

Content on the Test and Related Standards:	Support/ Reference to Details in Passage	Sample Test Questions	What Sample Test Questions Assess
Reading Comprehension (25%-50%) • Use close-reading strategies in order to interpret increasingly challenging texts. • Apply knowledge of connotation and denotation to determine the meanings of words and phrases in increasingly challenging texts.	1. The other day an acquaintance of mine, a gregarious and charming man, told me he had found himself unexpectedly alone in New York for an 5 hour or two between appointments. He went to the Whitney Museum and spent the "empty" time looking at things in solitary bliss. For him it proved to be a shock nearly as great as falling in love to 10 discover that he could enjoy himself so much alone. What had he been afraid of, I asked myself? That, suddenly alone, he would discover that he bored himself, or that 15 there was, quite simply, no self there to meet? But having taken the plunge, he is 2. Rose was pleased with herself for thinking of the grapefruit and with the 55 way she had said it in so bold yet so natural, a voice. Her voice could go dry altogether in school, her heart could roll itself up into a thumping ball and lodge in her throat. Her nerves were calamitous.	1. Which of the following statements best paraphrases lines 5-11? A. Taking time to experience culture can be a pleasant surprise. B. It is easier to fall in love with art when one is alone. C. Some people rarely allow themselves to experience the joys of solitude. D. Many people are afraid to spend time alone in museums. 2. As it is used in line 59, the word "calamitous" most nearly means: A. stormy. B. not entirely reasonable. C. gratifying. D. likely to create discomfort.	1. Students must be able to recognize the facts and details from the passage that will help them to interpret the text. A close reading of the identified sentence provides a clue that helps to reveal the best response to this question. The correct answer is C. 2. This question tests students' ability to determine the meaning of words or phrases by paying close attention to context clues in the passages they read. Remember that reading a few lines above and/or below the identified line in a passage will often make clear which response is correct. The answer is D.
Critical Reading (35%-55%) • Identify, analyze, and evaluate affect on meaning of character development, setting, theme, mood, and point of view in increasingly challenging texts • Evaluate how organization, word choice, and persuasive techniques affect meaning in increasingly challenging texts	1. to do, had behaved exactly as it must, had been true to itself and to the sun and moon. It knew its place in the scheme of things, and its place was there, with its 55 right destiny, in the tracks of the wagon. In my mind's eye I could see it at that very moment, miles away, plodding in the familiar shadows, panting easily with relief, after a bad night, contemplating 60 the wonderful ways of man. Caveat emptor. But from that experience I learned something about the heart's longing. It was a lesson worth many times five dollars. 2. 25 It was full of resistance, and yet it was ready to return my deep, abiding love; I could see that. It needed only to make a certain adjustment in its lifestyle, to shift the focus of its vitality from one frame of 30 reference to another. But I had to drag my dog from its previous owner by means of a rope. Its bushy tail wagged happily all the while.	1. The author's attitude toward the main subject of the passage can best be described as: A. appreciation and respect. B. disbelief and cynicism. C. amusement and nostalgia. D. boredom and indifference. 2. The narrator develops the third paragraph (lines 19-29) mainly through: A. detached philosophical musing on her inner thoughts and feelings. B. a detailed outline of the dog's movements. C. antithetical statements that foreshadow the dog's later actions. D. imaginative speculation on what the dog might be thinking.	1. This question asks students to analyze the author's point of view, or perspective, about the subject of a passage. Note, too, however, that this question also assesses your ability to apply your knowledge of connotation and denotation of tone words and phrases to determine the best answer to this question. The answer is A. 2. Students need to understand how writers use rhetorical strategies such as description or the use of sensory details to have an impact on the meaning of a passage. The evidence in the passage makes clear that the correct answer is C.

Content on the Test and Related Standards:	Evidence from Passage	Sample Test Questions	What Sample Test Questions Assess
Modes of Writing (0%-10%) • Identify key characteristics of various literary genres; evaluate impact on meaning in increasingly complex texts • Analyze variety of common poetic devices; evaluate impact on meaning in increasingly challenging texts. • Analyze effective use of such literary devices as figurative language, sound devices, and stage directions in increasingly complex texts.	1. But let me confess that, even as a child, I was insanely jealous of the city in which I was raised, because it was my parents' other love. They loved each 35 other (good), they loved me (very good), and they loved her (not so good). Bombay was my rival. It was on account of their romance with the city that they drew up that weekly rota (list) of shared parental responsibilities. When my mother wasn't with me— 40 when I was riding on my father's shoulders, or staring, with him, at the fish in the Taraporewala Aquarium— she was out there with *her*, with Bombay; out there bringing her into being. (For of course construction 2. **CLAUDIUS** and **POLONIUS** *withdraw* *Enter* **HAMLET** **HAMLET** To be, or not to be? That is the question— Whether 'tis nobler in the mind to suffer The slings and arrows of outrageous fortune, 60 Or to take arms against a sea of troubles, And, by opposing, end them? To die, to sleep— No more—and by a sleep to say we end The heartache and the thousand natural shocks That flesh is heir to—'tis a consummation 65 Devoutly to be wished! To die, to sleep. To sleep, perchance to dream—ay, there's the 3. I have been one acquainted with the night. a I have walked out in rain, and back in rain. b I have outwalked the furthest city light. a I have looked down the saddest city lane. b I have passed by the watchman on his beat c And dropped my eyes, unwilling to explain. b I have stood still and stopped the sound of feet c When far away an interrupted cry d Came over houses from another street, c But not to call me back or say good-bye; d And further still at an unearthly height, e O luminary clock against the sky d Proclaimed the time was neither wrong nor right. f I have been one acquainted with the night. f	1. In lines 32-43, the narrator uses which of the following literary devices to describe Bombay? A. Alliteration B. Allusion C. Personification D. Simile 2. The primary purpose of Hamlet's words in lines 57-90 is to: A: express his indecisiveness to Claudius and Polonius. B. speak aloud his conflicted feelings about life and death**.** C. foreshadow how Ophelia will resolve her feelings of loneliness. D. reveal to the audience his utter exhaustion and need for sleep. 3. Which statement best describes the rhyme scheme in the poem? A. Every other line rhymes. B. The first four lines in each stanza rhyme. C. The rhyme pattern reverses itself in each stanza. D. The rhyme pattern is similar to that of a sonnet.	1. Students need first to be able to recognize key literary devices in order to be able to analyze their impact on the meaning of a passage. As is true for all questions on the English Subject Tests, only answers for which there is clear evidence in the passage should be chosen. The correct answer is C. 2. This question requires you to recognize that Hamlet's speech is a soliloquy and to analyze the purpose of this speech in the play. The correct answer is B. 3. Students need to identify a common poetic device, rhyme scheme, so that they might better understand its impact on the meaning of the poem as a whole. The correct answer is D.

Content on the Test and Related Standards:	Evidence from Passage	Sample Test Questions	What Sample Test Questions Assess
Mechanics of Writing (10%-20%) • Add important information and delete irrelevant information and details to more clearly establish a central idea. • Identify and correct errors in sentence construction and evaluate how various constructions affect meaning, style, and tone.	1. At Edinburgh's Filmhouse Cinema, a three-dimensional sculpted scene shows patrons sitting in a movie theater as horses leap out of the screen. At the Scottish Storytelling Centre, a dragon crafted from the pages of a mystery novel was found nesting in a window. At the National Museum of Scotland, a paper tail was spotted emerging from the spine of Sir Arthur Conan Doyle's book *The Lost World*. Inside, a dinosaur charges through shredded pages of the open book. More creations appeared at several libraries and museums devoted to books and writing. <u>A total of ten sculptures were bestowed on special institutions, whose staff are thrilled by their luck.</u> 2. Down in the cool basement of the hotel restaurant, Alejo Santino looked over a yellowed newspaper clipping dating back to 1961. He had not looked at it recently, although in the past had always been proud to show it to visitors. <u>And why because it was a brief moment of glory.</u> In the picture Alejo and his friend Diego were in their best dress whites standing before a glittering case of desserts. Beside them was a fat, cheery beaming face, the Soviet premier Nikita Khrushchev, who was attending a luncheon in his honor at the hotel.	1. The writer of this passage wishes to add a transition between the underlined sentence (lines 11-13) and the sentence that precedes it. Which word or phrase will best make clear the central idea of the paragraph? A. Therefore, B. Eventually, C. Of course, D. However 2. What is the correct way to punctuate the underlined portion of lines (lines 5-6)? A. And why because it was a brief moment of glory. B. And why? Because it was a brief moment of glory. C. And why, because it was a brief moment of glory. D. And why, because it was a brief moment of glory?	1. This question requires that students determine that the main idea of the paragraph is to emphasize the discovery of unusual objects over a period of time. To do so, they must note that several sentences begin in the same style, and the verb tense shifts from present to past. The correct answer is B. 2. Students should understand that writers use punctuation purposefully as a means to shape the style, tone, and meaning of the texts they create. For that reason, merely knowing the rules regarding comma usage will not help them to choose the correct response. They must read the whole sentence in which this phrase belongs. The correct answer is B.

Craft and Structure

A number of questions on the test will assess your understanding of craft and structure. Some might assess your ability to determine what or how words and phrases mean in a passage, or to identify what type of figurative language is used. Other questions might assess your ability to infer how a narrator's or author's perspective, purpose, or intent shapes the content and style of a passage.

Practice determining the meaning of words and phrases based on context clues. Because you will be asked these questions about a variety of modes that include narratives, poetry, drama, and informational texts, take the time to read a variety of literary and non-literary texts. Additionally, consider forming a study group with your peers so that you might discuss such issues as how genre affects the content and style of the texts you read.

Resources:

The Structure of Texts
Three Lessons on Irony
Learning Vocabulary

Integration of Knowledge and Ideas

Some of the questions on the test are likely to assess your ability to identify main claims and to analyze how writers offer reasons or support for the claims they make. Practice evaluating the evidence informational arguments use in support of their claims. Practice, too, comparing two or more passages and drawing logical conclusions using information from both of them.

Resources:

Analyzing Arguments
Reading Multiple Accounts

Mechanics of Writing

In their English courses in high school, students will typically be assessed on their ability to write unified and coherent persuasive essays that make clear claims with well-organized and developed support, and that are also mechanically correct. Adequately preparing for this task will also prepare you for the types of multiple-choice questions on the English 1 or English 2 Subject Tests.

Some of the multiple-choice questions on the English 1 and English 2 Subject Tests might ask students to determine whether new sentences might better state an idea from the passage. Additionally, students might be asked to revise writing that is unclear or confusing. Other questions may ask students to identify what punctuation is needed in a particular sentence.

Resources:
Writing Tips
4-Ted Ed Lessons on Grammar and Word Choice

Consider Taking a Practice Test

It makes sense to take a practice test to prepare. This will also give you the chance to discuss several test taking strategies with others.

Test-Taking

Pacing

Spend some time identifying your strengths as an English test taker. Take a practice English 1 or English 2 Subject Test. That way, when you open your test on your chosen test day, you can quickly read through all of the questions and determine which questions will be easiest for you to answer correctly. Since you are likely to be able to answer easier questions more quickly, this will help with your pacing and allow you to spend more time on questions you might find to be more difficult.

Similarly, know in what areas of English Language Arts you most need to improve. Do you have trouble interpreting poetry? Spend extra time in the weeks leading up to the test date interpreting some poems from poetry anthologies or collections. When you get to the test, you will then more likely be able to answer questions that require interpretation of poetry more quickly, as well.

Spend some time answering some sample test questions. If you are unsure what your strengths and areas of needed improvement are, this activity can help you to identify them.

Remember that it is important for you to remain calm during the test. This should help: You are not penalized for wrong answers. If you look up and realize that there are only a few minutes left before time is called, but you have another 10-15 questions to answer, consider bubbling in the rest of the answers as all Bs and Fs or Cs and Gs. This gives you a one-in-four chance of getting the rest of the answers correct. While this strategy should only be used when you are running short on time, having this knowledge in the back of your mind might lessen the chance that you'll make mistakes simply because your anxiety has distracted you.

Be willing to guess on a question that you do not know and mark the question to return to later. Since you are not penalized for wrong answers, you should try to answer as many questions as possible while spending less time on topics where you know your knowledge is weaker.

Reading the Questions and Possible Answers Carefully

Pay close attention to the way questions are worded. Practice restating sample questions in your own words. Use logic to arrive at the correct answer. Using a combination of knowledge and elimination strategies will allow you to best demonstrate what you understand about the key ideas in English courses.

ACT International Subject Tests - Math 1 and 2

Overview

Math 1 and Math 2 subject area tests

The subject area tests in mathematics are rigorous assessments of mathematics taught in secondary school. Math 1 focuses on the first years of study in algebra and geometry. Math 2 focuses on more-advanced algebra with trigonometry and precalculus. For both tests, students will need to apply what they have learned in order to solve problems with a range of complexities. Students use content understanding, estimation skills, insights from representations, and reasoning to solve problems.

Math 1

Students can show what they know and can do using algebra and geometry typically learned through the first years of secondary school. The topics measured on the assessment range from solving equations to drawing conclusions from data, from finding areas and volumes to making judgments about proof. The 1-hour test contains 50 multiple-choice questions: approximately 30 questions assessing Algebra I topics and 20 questions for geometry topics. Calculators are encouraged, and a reference sheet provides common formulas.

Math 2

Students can demonstrate their knowledge of advanced algebra and precalculus topics. These topics range from understanding complex numbers to modeling with vectors and matrices, from applying advanced functions to finding limits, from fitting a normal distribution to interpreting graphs in the polar coordinate plane. The 1-hour test contains 50 multiple-choice questions, approximately 25 questions assessing Algebra II topics and 25 questions for precalculus topics. Calculators are encouraged, and a reference sheet provides common formulas.

**Should a student take Math 1 or Math 2 subject test?**

If a student has studied the advanced algebra, trigonometry, and precalculus topics, then the Math 2 score will allow the student to demonstrate these higher-level skills. If the student has not studied these topics, then the Math 1 test will be a more appropriate choice and give a better measure of the student's ability.

Mapping to the ACT:

ACT Subject Tests are end-of-course assessments that rigorously measure students' understanding of content and practices in each subject. The tests are derived from

items and research on ACT QualityCore tests, and have a score scale that links directly to the ACT. In addition to measuring whether students have mastered ACT course standards, these tests predict success in postsecondary courses. For more information about how the score scales are related, please refer to the [ACT QualityCore Technical Manual](#) p. 49-55. The figures below show how the math content on each subject test maps to the ACT reporting categories.

Map 1: Math 1
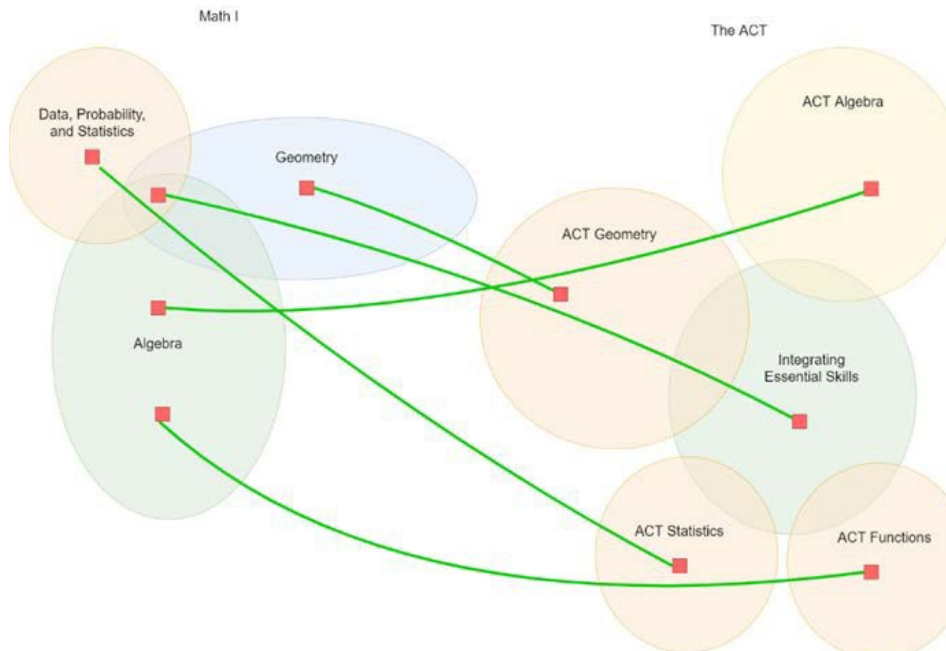
 Map 2: Math 2
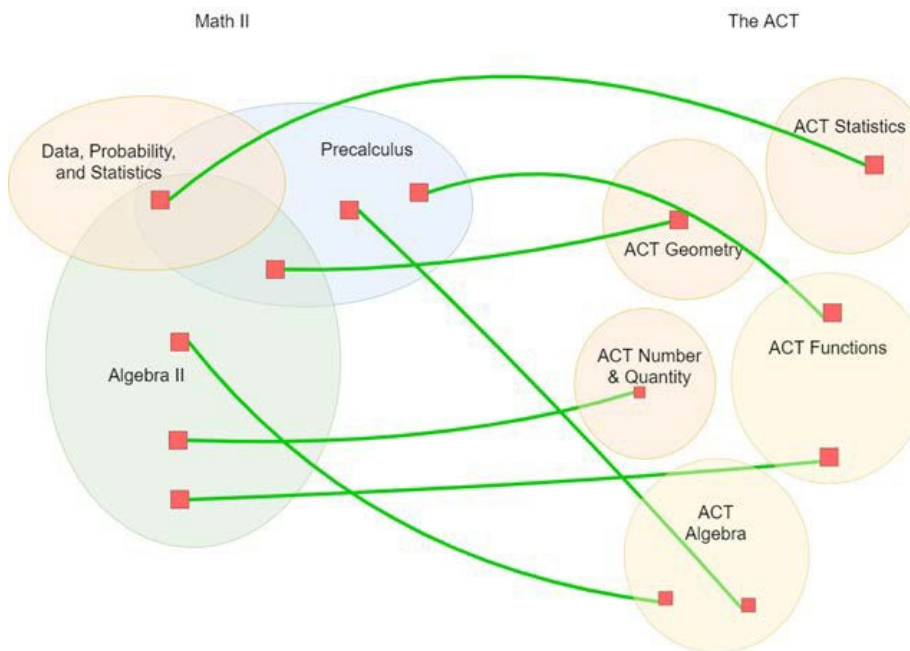
Why do some questions seem easy and some questions seem much harder?

The ACT test is designed to enable test takers from across the performance continuum to demonstrate what they know and are able to do. Therefore, questions are designed to measure a range of critical thinking skills and a range of cognitive complexities. The ACT Math Subject Tests include problems at Webb's Depth of Knowledge Levels 1, 2, and 3. Some items require students to perform routine procedures using mathematics (Level 1). At

Level 2, students make some decisions about how to approach a problem. Level 3 tasks require strategic thinking, planning, explaining, and justifying with evidence. By using a variety of tasks at different cognitive complexities, the ACT Math Subject Tests are able to allow all students to show what they know and can do. Some tasks require students to use skills from multiple domains -- for example: algebra and geometry or precalculus and statistics. The ability to integrate across areas in mathematics is predictive of success in postsecondary math classes.
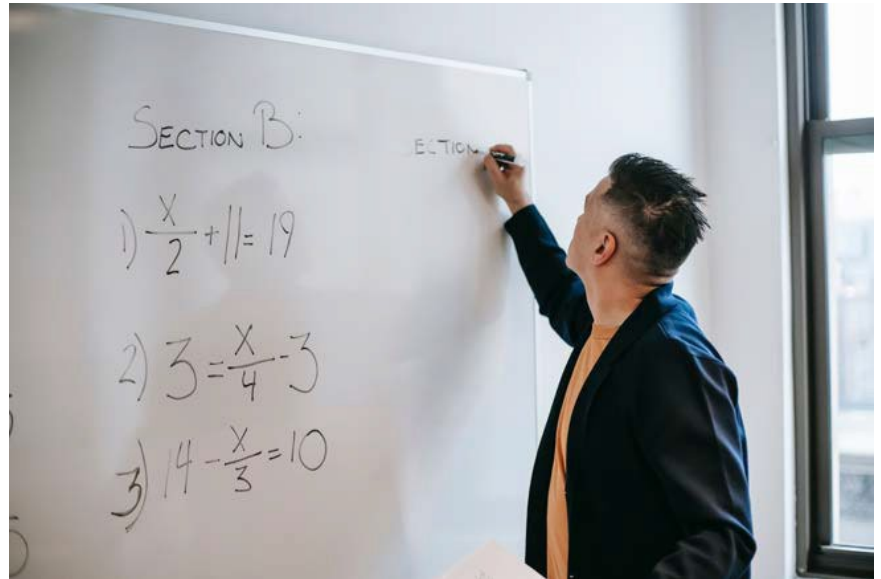
Test Details

- Test time: 60 minutes
- Test length: 50 questions
- Multiple choice questions with 4 choices
- Questions vary in cognitive complexity and domain
- A reference sheet will be provided
- No penalty for wrong answers

Calculators

Students are encouraged to use a calculator that they are familiar with that complies with the ACT Calculator Policy. Some of the questions are best solved with a calculator and some without. The online testing platform has a digital calculator available. Most 4-function, scientific, or graphing calculators are permitted. The link above will provide the most up to date revisions of the calculator policy.

Reference sheets

Each test has a reference sheet that contains formulas and other reference information that may be useful for solving test problems. These are available in the online testing platform when the student clicks on the reference icon.

Test Content - Math 1

Algebra I Topics

- Solve equations and inequalities in 1 variable and graph solutions on the number line
- Solve absolute-value equations
- Solve a formula for a specified variable
- Write linear equations and inequalities to capture relationships from real-world situations and graph in the coordinate plane
- Find an equation of a line that goes through 2 given points, or through a given point with a given slope
- Translate between different representations of a line, including graph, table, verbal description, and different forms of equation
- Represent direct and inverse variation
- Solve systems of 2 equations in 2 variables; understand solution methods
- Apply function concepts and determine if a relationship is a function
- Find domain and range
- Evaluate functions at given values
- Find rate of change in a function and connect this to slope for linear functions
- Translate between different representations of a function, including graph, table, set of ordered pairs, verbal description, and equation
- Factor trinomials; recognize perfect-square trinomials
- Recognize and factor difference of squares
- Solve quadratic equations using different methods
- Identify graphs of quadratic functions
- Relate factors, solutions, zeros, and intercepts
- Use properties of exponents
- Manipulate radical and rational expressions
- Interpret data representations
- Identify arithmetic sequences
- Identify patterns and patterns of growth in a set of data
- Find the probability of simple events
- Distinguish between independent and dependent events
- Identify an approximate line of best fit to model data and use a model to make predictions

Test Content - Math 1

Geometry Topics

- Use inductive and deductive reasoning to make valid conclusions
- Apply theorems, definitions, and axioms to solve problems and draw conclusions
- Interpret a mathematical proof in different forms
- Use properties of quadrilaterals to solve problems and identify valid reasoning
- Use coordinate methods and geometric relationships to deduce whether 2 lines are parallel or not
- Use various methods, including SSS, SAS, ASA, AAS, and HL, to deduce that triangles are congruent and corresponding parts are congruent
- Use various methods, including AA, SAS, and SSS, to deduce that triangles are similar, corresponding sides are proportional, and corresponding angles are congruent
- Understand and interpret geometric language
- Use angle relationships to solve problems and draw conclusions
- Use relationships when a transversal crosses 2 parallel lines to solve problems and draw conclusions
- Interpret geometric constructions
- Identify and make deductions about a locus (the set of possible positions) in a plane or in 3-dimensional space
- Use relationships involving medians, altitudes, perpendicular bisectors, and angle bisectors to solve problems and draw conclusions
- Apply the triangle inequality theorem about the relative size of angles and the relative size of opposite sides
- Recognize Pythagorean relationships in complex diagrams and real-world contexts, and use this to solve problems and draw conclusions
- Relate interior and exterior angles and angle sums to the number of sides of a polygon
- Recognize isosceles triangles in complex contexts and use properties to solve problems and draw conclusions
- Recognize relationships between lines and line segments associated with circles, central angles, inscribed angles, intercepted arcs, and inscribed polygons and use properties to solve problems and draw conclusions
- Identify and classify 2- and 3-dimensional shapes and use their properties to solve problems
- Recognize cross sections of prisms, cylinders, pyramids, and cones and use relationships to solve problems and draw conclusions
- Determine points or lines of symmetry and apply properties of symmetry to solve problems and draw conclusions about figures
- Identify congruent figures and corresponding parts
- Identify similar figures and use ratio-and-proportion reasoning to solve mathematical and real-world problems, including situations with a geometric-mean relationship such as a right triangle and its altitude
- Identify transformations and transformed figures
- Understand relationships between corresponding lengths, areas, and volumes for similar figures in terms of scale factor
- Use length, width, perimeter, circumference, area, surface area, and volume relationships and formulas to solve problems and draw conclusions
- Find geometric probability and draw conclusions
- Use coordinates to solve problems about geometric figures, including the effects of reflections, rotations, translations, and dilations
- Find distance and midpoint and use distance and midpoint relationships to solve problems and draw conclusions
- Identify parallel and perpendicular lines on the basis of slope
- Find trigonometric ratios for right triangles, in particular for 45-45-90 and 30-60-90 triangles
- Recognize right triangles in real-world contexts and use trigonometric ratios to find side lengths or angle measures

Algebra II Topics

- Model relationships from a context as equations and inequalities
- Solve compound linear inequalities with implied or explicit "and" and "or" connectors
- Solve linear inequalities containing absolute value
- Solve systems of equations in 3 variables
- Identify solutions to systems of equations and inequalities from a graph
- Find maximum and minimum values of a linear function over a region defined by linear inequalities
- Solve quadratic equations and inequalities; understand different methods
- Interpret the discriminant
- Solve quadratic equations with complex number solutions
- Perform operations with complex numbers
- Solve quadratic systems
- Recognize functions as compositions of other functions, in particular for translation and reflection, and connect to graphs
- Classify conic sections from their equations in standard form
- For circles and parabolas, translate between equations, graphs, and descriptions in terms of the characteristics
- For a polynomial function, determine or approximate zeros, local minima and maxima, domain, and range
- Relate factors, solutions, zeros, and intercepts
- Determine the number and multiplicity of rational zeros for a polynomial function
- Find all rational zeros of a polynomial function
- Manipulate rational expressions and solve rational equations
- Manipulate expressions with rational exponents and radicals
- Solve equations expressed in terms of rational exponents and radicals
- Identify graphs of exponential and logarithmic functions
- Convert equations between exponential and logarithmic form
- Apply the law of sines and law of cosines
- Find the measure of angles in standard position in degrees or radians
- Find values of sine and cosine functions for general angles and relate to coordinates on the unit circle
- Model relationships with sine and cosine functions and their transformations
- Find and interpret domain, range, period, and amplitude for sine and cosine functions and their transformations
- Determine the number of ways an event can happen using counting techniques such as the Fundamental Counting Principle, permutations, and combinations.
- Find probabilities using properties of events including independence and mutual exclusivity
- Solve problems involving conditional probability
- Represent sample spaces and events in terms of unions, intersections, and complements and use these relationships to find probabilities of compound events
- Find terms and term-positions in arithmetic and geometric sequences
- Interpret sigma notation and find sums of finite arithmetic and geometric sequences
- Add, subtract, and multiply matrices
- Calculate determinants of 2×2 and 3×3 matrices
- Find the inverse of 2×2 matrices
- Use inverse matrices to solve systems of linear equations

Precalculus Topics

- Identify and graph piecewise-defined functions including greatest integer, step, and absolute value functions
- Find inverses (or partial inverses) and transformations of various functions including polynomial, rational, radical, absolute value, and trigonometric
- For ellipses and hyperbolas, translate between equations, graphs, and descriptions in terms of the characteristics
- Solve systems of conics
- Solve polynomial equations exactly or approximately to find rational, real, and complex solutions; understand different methods
- Identify polynomial functions and graphs given characteristics such as degree, sign of lead coefficient, zeros, and multiplicities
- Classify functions as even, odd, or neither; identify symmetry
- Expand polynomials or find terms using the binomial theorem and Pascal's triangle
- Use limits to approximate the slope of a curve at a point
- Use limits to approximate the area under a curve
- Identify rational functions and graphs given characteristics such as intercepts, symmetry, asymptotes, and removable discontinuities
- Find characteristics of rational and radical functions such as intercepts, symmetry, asymptotes, removable discontinuities, domain, and range
- Evaluate exponential functions and use properties of exponents to rewrite in different forms
- Evaluate logarithmic functions, including those with base e, and use properties of logarithms to rewrite in different forms
- Solve exponential and logarithmic equations and real-world problems such as compound interest and exponential growth/decay
- Identify graphs of trigonometric functions and characteristics such as period, amplitude, amount of stretch, phase shift, vertical translation, and midline
- Use and interpret trigonometric identities including double-angle and half-angle, sum and difference, and $sin^2(x) + cos^2(x) = 1$
- Identify and graph inverse sine, cosine, and tangent functions and use them to solve trigonometric equations
- Determine quartiles and interquartile range of a set of data
- Understand and apply the concepts of standard deviation and z-scores to data sets
- Estimate population characteristics based on samples
- Recognize different types of sampling procedures and identify strengths and limitations
- Use properties of the normal distribution to approximate percent of data within a given interval
- Find the sum of an infinite geometric series
- Determine or approximate the limit of an infinite sequence or determine that it does not exist
- Interpret arguments that use mathematical induction
- Use matrices as transformations of the plane
- Find the reduced row-echelon form of an augmented matrix to solve systems of equations
- Graph polar functions and points in the polar coordinate plane
- Convert points and functions between rectangular and polar forms
- Find powers and roots of complex numbers in polar form using De Moivre's theorem
- Find the magnitude and direction of a vector
- Identify the results of vector addition, subtraction, and scalar multiplication with coordinates and graphically
- Resolve a vector into horizontal and vertical components
- Find the angle between vectors using the dot product
- Solve real-world problems involving vector displacements such as path of airplane in wind
- Identify parametric equations of lines and graphs of parametric equations

Content on the Test : Math 1	Sample Test Questions	What Sample Test Questions Assess
Algebra I • Evaluate functions at given values • Find rate of change in a function and connect this to slope for linear functions • Add, Subtract, and Multiply monomials, binomials, trinomials, and polynomials • Find domain and range	1. What is the value of the function $f(x) = \frac{2}{x} + \frac{3}{x^2} + \frac{4}{x^3}$ when $x = 5$? A. $\frac{3}{5}$ B. $\frac{3}{10}$ C. $\frac{29}{30}$ D. $\frac{69}{125}$	1. To answer this question correctly, students must understand function notation and must be able to apply properties of fractions and exponents to find the correct value. The answer is D.
	2. What is the rate of change in the equation $\frac{3}{5}y + 2x = 10$? A. $-\frac{10}{3}$ B. $\frac{3}{5}$ C. 2 D. 5	2. Students must be familiar with the structure of linear equations and be able to rearrange them algebraically using properties. The student must understand that the rate of change of a linear equation is the slope. The answer is A.
	3. What is the product of $x + 2y + z$ and $2z^2 + 1$? A. $x + 2y + 2z^3 + 1$ B. $2xz^2 + 4yz^2 + 2z^3 + 1$ C. $2xz^2 + 4yz^2 + 2z^3 + x + 2y + z$ D. $2xz^2 + 4yz^2 + 2z^2 + x + 2y + z$	3. In this question, students must recognize that the distributive property of multiplication can be applied to polynomials and work through the algebraic steps. Careful work will be required to determine the correct coefficients for each term in the product. The answer is C.
	4. Give the domain and range of the function $f(x) = \frac{1}{\sqrt{4x-16}}$. A. Domain: $(-\infty, \infty)$ Range: $(0, \infty)$ B. Domain: $(0, \infty)$ Range: $(0, \infty)$ C. Domain: $(4, \infty)$ Range: $(-\infty, \infty)$ D. Domain: $(4, \infty)$ Range: $(0, \infty)$	4. This question tests a student's understanding of domain and range as well as strategies for finding them. Some students may approach this algebraically while others will find the domain and range graphically. The answer is D.

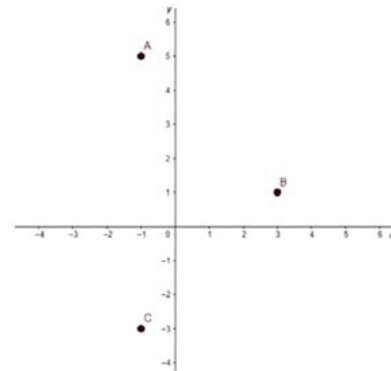| Content on the Test : Math 1	Sample Test Questions	What Sample Test Questions Assess
Geometry • Use angle relationships to solve problems and draw conclusions • Identify similar figures and use ratio-and-proportion reasoning to solve mathematical and real-world problems, including situations with a geometric-mean relationship such as a right triangle and its altitude • Use coordinates to solve problems about geometric figures, including the effects of reflections, rotations, translations, and dilations	1. In the figure below, A, B, C, and D are collinear, segment FC is parallel to segment ED, segment BE is perpendicular to segment FD, and the measures of angle FAB and angle FBA are as marked. What is the measure of angle FCB? A. 33° B. 57° C. 63° D. 84°	1. In this question, students need to identify angle relationships in two overlapping triangles. Careful work will be required to solve for the desired angle. The answer is B.
	2. In the figure below, angle ABC is congruent to angle DFE, angle BAC is congruent to angle FDE, D and F are on segment AB, segment AD is congruent to segment FB, and distances in centimeters are as shown. What is the length of segment AD, in centimeters? A. 4 B. 3 C. 2 D. 1	2. Students must first identify that these two nested triangles are similar in order to approach this question. They will need to find the similarity ratio and apply it to the missing sides. The answer is C.
Geometry • Write equations for circles in standard form and solve problems using equations and graphs	3. Which of the following is an equation of the circle with its center at (0,0) that passes through (3,4) in the standard (x,y) coordinate plane? A. $x - y = 1$ B. $x - y = 25$ C. $x^2 + y^2 = 25$ D. $x^2 + y^2 = 5$	3. In this question, students should be familiar with the structure of circle equations in order to identify which equation fits the criteria. Students unfamiliar with the structure may notice that (3,4) will be a solution to the equation and find the correct answer by substitution. The answer is C.
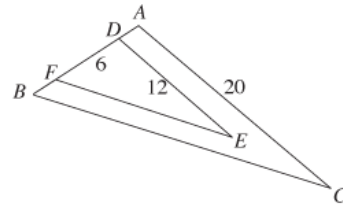
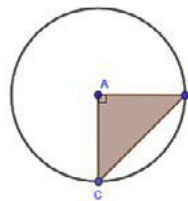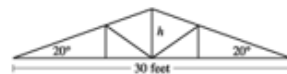| Content on the Test : Math 1	Sample Test Questions	What Sample Test Questions Assess
Geometry · Find geometric probability and draw conclusions · Recognize right triangles in real-world contexts and use trigonometric ratios to find side lengths or angle measures	4. What is the equation of a circle going through A, B, and C? A. $x^2 + y^2 = 16$ B. $(x + 1)^2 + (y - 1)^2 = 4$ C. $(x - 1)^2 + (y + 1)^2 = 4$ D. $(x + 1)^2 + (y - 1)^2 = 16$ 5. A point will randomly be selected in the area of Circle A. Points B and C are on the circle. Angle A is a right angle. What is the probability the point will also be in the area of triangle ABC? A. $\frac{1}{4}$ B. $\frac{1}{2\pi}$ C. $\frac{r}{4\pi}$ D. $\frac{1}{\pi r^2}$ 6. Which of the following expressions is the closest approximation to the height h, in feet, of the roof truss shown below? A. $15 \tan 20°$ B. $15 \sin 20°$ C. $30 \tan 20°$ D. $30 \sin 20°$	4. This question requires students to construct the equation of a circle using strategies in the coordinate plane. Students will need to find the center and radius of a circle going through the 3 given points and then apply those properties to the equation. The answer is D. 5. This question combines a simple probability situation with a geometric context. Students must be comfortable with defining unknowns since no concrete length measurements are given. Students need to use their understanding of probability as a fraction of desired outcomes over possible outcomes and apply it to area concepts. The answer is B. 6. This question requires students to apply trigonometric ratios to a real-world situation to generate an expression for a missing side in the figure. The answer is A.

Content on the Test : Math 2	Sample Test Questions	What Sample Test Questions Assess

Algebra II
• Model relationships from a context as equations and inequalities
• Perform operations with complex numbers
• Manipulate expressions with rational exponents and radicals
• Find values of sine and cosine functions for general angles and relate to coordinates on the unit circle
	1. Hunter's Transport Company has 7 trucks that can haul 6 tons each, 5 trucks that can haul 10 tons each, and 9 drivers. The company has a contract to transport 360 tons of gravel per day to a road construction site. The 6-ton trucks can make 8 trips a day, while the 10-ton trucks can make 6 trips a day. A 6-ton truck costs $30 per day, and a 10-ton truck costs $42 per day. If all 9 drivers work on this job, using how many trucks of each type will minimize the cost?
	  A. Four 6-ton trucks and five 10-ton trucks
	  B. Five 6-ton trucks and four 10-ton trucks
	  C. Six 6-ton trucks and three 10-ton trucks
	  D. Seven 6-ton trucks and two 10-ton trucks
	
	2. If $c - d = 7$ and $c = 3 - 4i$, what is d?
	  A. $-4 - 4i$
	  B. $-4 + 4i$
	  C. $4 - 4i$
	  D. $4 + 4i$
	
	3. What is the value of $\left[8\left(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}\right)\right]^{\frac{2}{3}}$?
	
	  A. $1 + i\sqrt{3}$
	  B. $2\left(1 + i\sqrt{3}\right)$
	  C. $2\left(\sqrt{3} + i\right)$
	  D. $4\left(1 + i\sqrt{3}\right)$
		1. This question will test a student's ability to make sense of a complex real-world situation where a system will enable a solution path. Students must demonstrate solid mathematical practices to create the system and work through the solution process. The answer is D.
		
		2. Students will demonstrate their proficiency with operations and substitution with complex numbers in this question. The answer is A.
		
		3. Simplifying this expression will require a student to have an understanding of the unit circle applied to trigonometric functions as well as the properties of rational exponents. The answer is B.

PreCalculus
 	
• Find the sum of an infinite geometric series
 	
• Evaluate logarithmic functions, including those with base e, and use properties of logarithms to rewrite in different forms
	1. Which of the following is the value of the expression $\sum_{n=1}^{\infty}\frac{1}{2}(-3)^{-n}$?
	
	  A. $-\frac{1}{4}$
	  B. $-\frac{1}{8}$
	  C. $\frac{1}{8}$
	  D. $\frac{3}{4}$
	
	2. Which of the following expressions is equivalent to $\log_b a^3 - \log_b a^2$?
	
	  A. $\log_b a$
	  B. $\log_b a^5$
	  C. $\log_b a^6$
	  D. $\log_b a^{\frac{3}{2}}$
		1. Students will need to use their understanding of infinite series to determine the value of this expression. Many will use the formula for an infinite geometric series while some may use convergence concepts with partial sums. The answer is B.
		
		2. In this question, students will need to apply the properties of logarithms by noticing that the two bases, while being unknown, are the same. The answer is A.

Preparing for the Math Subject Tests

The most important consideration for preparing to take the subject tests will be to complete rigorous assignments that are aligned to standards and cover the topics that are measured on each test. Consider forming a study group with your peers to review and to discuss these topics. Then provide for yourselves plenty of opportunities to study, review, and then explain each topic to each other.

Consider using a computer on which you can apply what you've learned in a digital space. Use tools such as graphing software to strengthen coordinate plane and geometric concepts. Spreadsheets are an important skill for college and career success. Excel and Google Sheets are great computer tools that allow you to work collaboratively with your peers to learn how to develop your spreadsheet skills. Many introductory programming exercises are based in math concepts and can be used as a way to reinforce variable and function concepts. For example, one assignment could involve writing a program that will apply the quadratic formula for given values of a, b, and c. This will demonstrate to you and your peers the value of functional thinking and save some tedious calculation time by using a computer, and it can be very rewarding to use a program that you yourself create in order to make your work go more quickly. Statistical concepts are also an excellent fit for a computer since you can use tools used by real statisticians such as the R programming language, as well as real data sets that are far too large to compute with by hand.

Here are some additional ideas to strengthen key areas for each test:

Math 1

As a foundation for all topics on the Math 1 test, you should have:

1.   A solid understanding of the basic properties of various number sets such as Integers, Rational Numbers, and Real Numbers.
2.   A mnemonic or other method of remembering order of operations so you can apply it to complicated expressions.
3.   A complete understanding of what variables are and how we can use them to represent numbers and generalize situations.
4.   Experience working with coordinate planes and the ability to visualize problems in the coordinate plane.

To deepen your understanding of the purpose of studying linear equations, locate real-world examples of linear modeling being used. Linear modeling is one of the most widely used models, so there are plenty of real-world examples of both accurate and inaccurate usage. Try to find both accurate and inaccurate cases so that you might critically think about flaws, assumptions, and simplifications in those models.

Be able to explain what the different parameters of equations indicate and use them to predict relationships such as parallel and perpendicular lines. Practice with graphing software such as GeoGebra or Desmos when possible because this allows you to experiment quickly and build intuition around these concepts.

For radical and rational equations and functions, it will be important for you to have a solid grasp on some of the basic number properties, particularly integers and fractions. Spend time reviewing integer multiples, factoring, simplifying fractions, and using exponent properties, including fractional and negative exponents. A common issue on the Math Subject Tests arises when students apply false properties to expressions, such as canceling variables when not appropriate, for example concluding $(x+2)/(x-1) \to -2$. One way to address

this is to practice two-column proof exercises where you must declare your steps using named or written properties. This technique will be helpful as you practice writing Geometry proofs as well.

Be familiar with the terms converse, inverse, and contrapositive and be able to apply them to both mathematical and non-mathematical statements. Internet articles are a rich source of non-mathematical statements for critiquing logic. Practice creating logical chains with tools such as the two-column proof and flow chart formats. Geometry proofs are the course objective, but include algebraic statements and non-mathematical logic chains for variety.
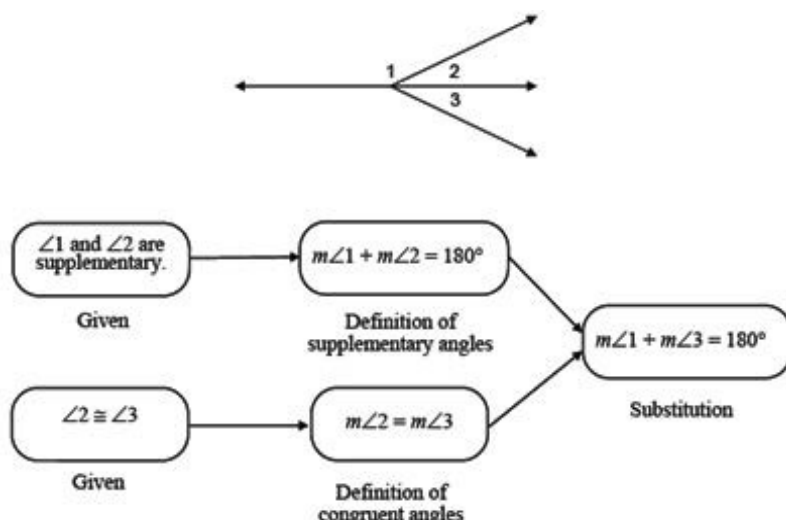
Practice solving a wide variety of plane geometry problems since there are many relationships that you need to be familiar with. With your study group, walk through proofs of some of these plane geometry problems as a way to understand more complicated situations. Being able to decompose shapes is critical so that you will not get overwhelmed, if asked to decompose a shape on the test itself.

For congruence, use physical or digital manipulatives as much as possible to build your intuition. You should also be able to think of relationships between objects without measurement using geometry concepts. Euclid's classic "Elements" text is an excellent source for demonstrating geometric concepts without measurements.

You should be able to understand the effects of reflections, rotations, translations, and dilations algebraically – e.g., a point at (a,b) reflected across the y-axis goes to $(-a,b)$. This is another topic where taking the time to practice writing the equivalent forms will help you better understand the concept.

Math 2

Practice graph visualizations to help you to understand the complex plane as an extension of the standard (x,y) coordinate system. Apply what you learn to specific problems, such as finding the total voltage of alternating current circuits so that you can see that these concepts are useful. This approach should also be taken with vectors and matrices. The physics of motion is an excellent demonstration of the usefulness of vectors and computer network graphs can be a very interesting application of matrices.

Real-world applications are also useful for introducing exponential, logarithmic, and periodic models. Try to find and examine different real-world situations where a model is needed and determine whether to apply a linear, quadratic, exponential, logarithmic, periodic, or some other kind of model. Demonstrate the best answers with data. This can be a good research task to work on with your study group: one student tries to predict the answer intuitively,

one student studies the factors of the situation, and one student finds previously developed models for that situation to compare results.

In precalculus, limits can be a challenging topic conceptually. Practice demonstrating the concept graphically. Don't be afraid to rewrite expressions in different forms. Finding clever ways to solve limits can pay off on the test.

Engage in the techniques and use the tools of real-world mathematics. Practice using spreadsheets, a computer algebra system, or a programming language to implement some of the ideas you have learned in your math courses.

Suggested Resources:

Applications
3 Act Math

Graphing software
GeoGebra
Desmos

Mathematical reference
Wolfram Mathworld
Wolfram|Alpha

Math exercises
Khan Academy

Computer Algebra systems
SageMath

 Programming exercises
 Codecademy

Data sets and statistical questions
Kaggle

Drawing Tools
Diagrams .net

ACT International Subject Tests - Physics

Overview

Physics

Physics test questions ask students to demonstrate skills and understandings related to a wide range of topics in chemistry, including Forces and Motion, Fundamental Forces, and Waves and Periodic Motion.

Preparing for the Physics Subject Test

Students' ability to do well on the Physics Subject Test depends on the knowledge and skills they have gained from taking a high school physics class and their familiarity with the test format and the kinds of questions they will be asked on the test. If you have paid attention in your physics class and met all requirements of your physics assignments and activities, you should feel confident about your ability to do well on the test. Your level of comfort and confidence with the test and its format will also likely help you do well on this test.

The ACT Physics Subject Test is designed to enable test takers from across the performance continuum to demonstrate what they know and can do. Questions are designed therefore to measure a range of critical thinking skills and a range of cognitive complexities. Since content knowledge and skills are so crucial in physics, some questions on the test require you to demonstrate that knowledge simply through recall or recognition of important terms, facts, concepts, and procedures. In addition, competency in physics requires students to demonstrate the ability to interpret, compare, explain ideas, and relate to world problems. You must also be able to apply what you have learned to specific contexts or experiments. Consequently, the test also includes questions that assess your ability to interpret, analyze, evaluate, design, and/or modify experiments. By measuring both simple and more complex knowledge and skills, all test takers have the opportunity to show what they have learned and are able to do in the topics assessed.
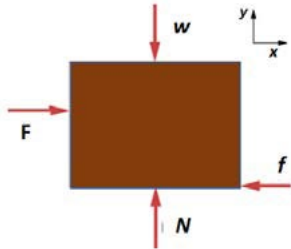
Components of the Physics Test
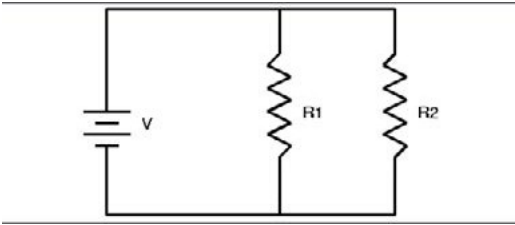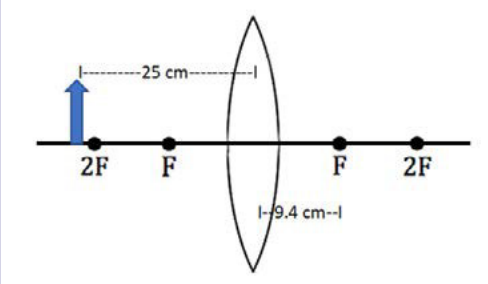
Prerequisites:
It is recommended that test takers have taken Physics and Pre-Calculus before taking the ACT Physics Subject Test.

Test Length: 90 minutes (Two 45-minute sessions)
Number of Questions: 38 per 45-minute session

The test covers topics studied in most high-school-level physics courses. Within each of those topics, students will be asked to demonstrate their understanding of overarching themes and/or foundational concepts.

Content on the Test : Physics	Sample Test Questions	What Sample Test Questions Assess
Forces and Motion: (45%-55%) • Speed, Velocity, Acceleration • One and Two Dimensional Motion • Work and Energy • Momentum • Newton's Law	1. Which statement about the velocity and acceleration of an object travelling in a circle at a constant speed is true? a. Neither the velocity nor the acceleration is constant. b. Both the velocity and acceleration are constant. c. The acceleration is constant, but the velocity is not. d. The velocity is constant, but the acceleration is not. 2. A wooden 30.0 kg crate is at rest on a wooden floor. The coefficient of static friction between the crate and floor is 0.500. A horizontal force (F) is applied to the crate. Which horizontal force (F) applied to the crate will cause it to move? a. F = 15 N b. F = 35 N c. F = 120 N d. F = 149 N 3. In which situation is mechanical energy conserved? a. A spring oscillating up and down without any change in amplitude b. A ball dropped to the floor and bouncing back half its height c. A box kicked across the floor that stops after sliding a few feet d. A parachutist jumping from an airplane and coming to terminal velocity due to air friction	1. This question assesses students' understanding of velocity and acceleration in relation to circular motion. Students need to understand that while the speed of an object is constant in circular motion, the direction changes; therefore velocity, which is speed and direction, does not remain constant. Centripetal acceleration has constant magnitude and is always perpendicular to its velocity, so it is always changing in direction as well. The correct answer is **a.** 2. This question assesses students' ability to apply the formula for static friction ($f_{s(max)} = \mu_s N$) to determine the horizontal force applied to a crate. Students need to understand that a value greater than 147 N of force will cause the crate to move and a value less than or equal to 147 N will not. The correct answer is **d.** 3. This question assesses students' understanding of how the law of conservation of mechanical energy applies to real-world examples. Students need to understand that in a closed system, in the absence of dissipative forces (e.g., surface friction, air resistance, surface impacts), the total amount of mechanical energy remains constant. A spring oscillating up and down, without a change in amplitude, indicates there is no loss of energy due to dissipative forces (i.e., total conversion of P.E. to K.E. and vice versa). The correct answer is **a.**

Content on the Test : Physics	Sample Test Questions	What Sample Test Questions Assess
Fundamental Forces (25%-35%) • Gravity • Electric Charges and Coulomb's Law • Electric Potential and Electric Fields • Magnetism • Electrical Circuits	1. A 448 kg space orbiter is placed 2000 km above a planet's surface. Given that the planet has a radius of 3390 km and a mass of 6.417 x 10²³, what is the gravitational force, in Newtons, acting on the orbiter? a. 660 N b. 665 N c. 1670 N d. 49400 N 2. What is the equivalent resistance, in ohms, in this circuit where v = 15 V, R1 = 10 Ω, and R2 =115Ω? a. 0.11 b. 9.2 Ω c. 125 Ω d. 150 Ω	1. This question assesses students' understanding and application of Newton's Law of Universal Gravitation [$Fg = GmM/(r)^2$]. This includes assessing students' ability to make the appropriate unit conversions such as converting km into m for the radius(r). The correct answer is **a**. 2. This question assesses students' understanding of equivalent resistance and how it is applied to parallel circuits. Students need to understand that equivalent resistance is where the combined resistance, connected either in parallel or series, is calculated. In parallel circuits it can be found using: $$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$ The correct answer is **b.**
Periodic Wave Motion (15-25%) • Wave Properties • Periodic Motion • Light Waves • Sound Waves	1. Which statement describes only transverse waves? a. Energy is transferred through wave movements. b. Matter is not transferred through wave movements. c. Vibrations are parallel to the direction of wave travel. d. Vibrations are perpendicular to the direction of wave travel. 2. An object is placed 25 cm from a convex lens and has a focal length of 9.4 cm. Which statement describes the image produced by the lens? a. Inverted image produced 15 cm from the lens. b. Inverted image produced 25 cm from the lens. c. Upright image produced 15 cm from the lens. d. Upright image produced 25 cm from the lens. 3. A woman is standing at a bus stop. She hears a fire engine siren moving in her direction. If the fire engine is traveling at 30 m/s and its siren emits a frequency of 900 Hz, what frequency does she hear at the bus stop? a. 332 Hz b. 828 Hz c. 931 Hz d. 986 Hz	1. This question assesses students' understanding of the differences between transverse and longitudinal waves. Students need to be familiar with the properties of both types of waves so they can identify a property that is characteristic of only transverse waves. The correct answer is **d**. 2. This question assesses student's ability to apply the thin lens equation ($1/f = 1/d_o + 1/d_i$) to solve the image's distance from a convex lens. It also evaluates students' ability to determine the inverted orientation of the image through knowledge of convex lens properties or drawing a representation of rays on a diagram. The correct answer is **a.** 3. This item assesses the students' ability to apply the correct Doppler shift formula in relation to sound waves. Students should be able to formulate and solve a routine Doppler problem given data on the conditions of the source and the observer. In this case, students need to apply the formula $f = f_o (v/v-v_s)$ for a source moving towards a stationary observer. The correct answer is **d.**

Mapping to the ACT:

ACT Subject Tests are end-of-course assessments that rigorously measure students' understanding of content and practices in each subject. The tests are derived from items and research on ACT Quality Core tests and have a score scale that links directly to the ACT. In addition to measuring whether students have mastered ACT course standards, these tests predict success in postsecondary courses. The graphic below illustrates how the key physics standards are integrated on the test. Physics as Inquiry undergirds the multidimensional approach to understanding physics. Many items combine content from one or more of the content circles with scientific (inquiry) practices to assess students' knowledge and understanding of physics.
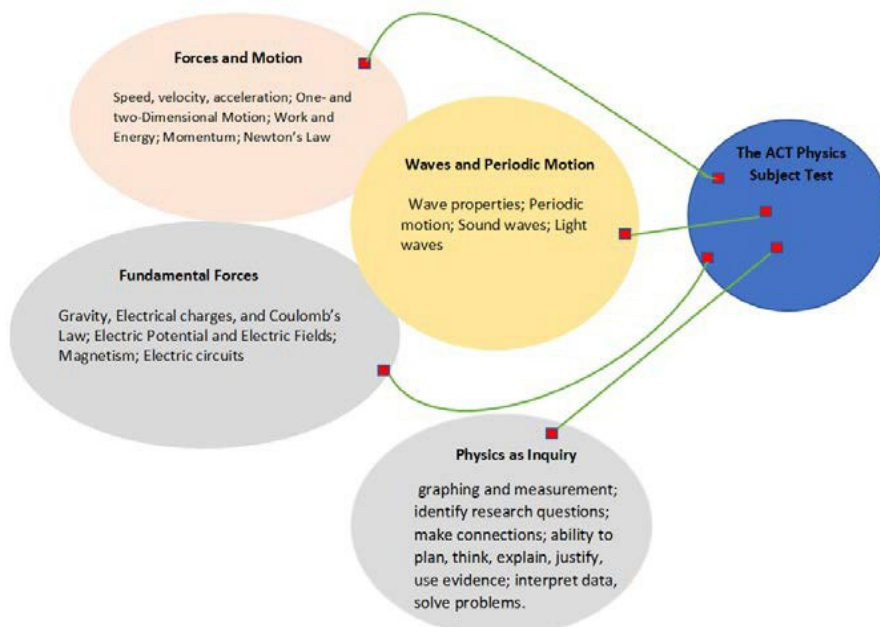
The objectives of high school physics courses are to provide instruction and to emphasize the importance of the following:
- The foundations and practices of physics in general,
- The basic processes and skills of scientific inquiry, and
- The importance of mathematics and accurate measurement in physics.

Forces and Motion

To best prepare for the Forces and Motion component of the Physics subject test, engage in hands-on activities, including online simulations. Hands-on activities are an essential part of your understanding in physics as they have been proven to be motivational and highly correlated with increased conceptual learning. Forces and Motion is designed to help you master the fundamental basics of physics through exploration of unifying concepts within related disciplines such as chemistry, biology, biochemistry, geology, environmental science, and astronomy, to name a few. This multidimensional approach to science uses scientific and engineering practices, cross-cutting concepts in science, and disciplinary core ideas that are the basis for science standards and frameworks such as PISA, TIMSS, and NGSS.

The Physics Subject Test will assess your understanding of many basic concepts that are essential for your understanding of forces and motion. Through your classroom investigations, you should become familiar with the kinematic concepts of displacement, velocity and acceleration, momentum, force, work, energy, and power. You should be able to represent these scientific concepts or relationships in words and diagrams. For example, after gathering data from real-world examples, you should be able to graph velocity vs. time and explain how this

representation can be used to find acceleration. It is also essential that you be able to provide standard scientific representations for simple phenomena such as applying metric units when calculating routine motion or energy problems. Consider working wit h a group of your peers to design your own experiment and to interpret the data you collect. When you conduct such an experiment, you should be able to use representations to support and revise your explanations. Approximately 45% and 55% of test questions will have Forces and Motion as their focus.

Resources:

Newton's Laws of Motion
Amusement Park Physics
Work and Energy

Fundamental Forces

Questions on the test will assess your understanding of Fundamental Forces, which includes topics such as Newton's Law of Gravitation, Coulomb's Law, Magnetic Fields, Ohm's Law, and Resistance. Physics test questions often ask students to apply proportional reasoning, graphical models, and other mathematical thinking to solve problems related to these concepts. Practice activities will help build your confidence and proficiency in mathematical thinking. Find and use a hands-on activity that requires you to collect, organize, represent, interpret, and use data from a real world scenario. This will provide a much deeper understanding of fundamental forces. Examples could include adapting NASA's activity that relates Newton's Law of Gravitation to the Swift Gamma-Ray Burst Explorer spacecraft or using canceling units in advanced calculations and correct temperature conversions. Some 25 to 35% of test questions will have Fundamental Forces as their focus. Models could include diagrams, equations, and conceptual models.

Resources:

Teaching Engineering
Newton's Law of Gravity
Coulomb's Law Interactive

Waves and Periodic Motion

To answer test questions about Waves and Periodic Motion, you will need to understand the properties of different types of waves, their interactions with matter, simple harmonic motion, and the Doppler effect. You need math skills to solve both routine and non-routine problems related to topics such as wavelength, frequency, speed of wave propagation, and the thin lens equation. To prepare well for this section of the test, you should develop scientific models for complex situations that involve simple harmonic motion, comparing transverse and longitudinal waves, sketching standing waves in pipes and strings, and describing the Doppler effect on light and sound. You should be able to construct and interpret ray diagrams for reflection and refraction using Snell's Law, total internal reflection, and the mirror/lens equations. Between 15% and 25% of test questions will be focused on content and skills related to Waves and Periodic Motion.

Resources:

Periodic Motion and Waves
The Physics of Surfing
Waves and Sound
Waves and Wave Properties

Test Taking Strategies

Pacing

Spend some time identifying your strengths as a physics test taker. Take a practice Physics Subject Test. That way, when you open your test on your chosen test day, you can quickly read through all the questions and determine which questions are easiest for you to answer correctly. Since you are likely to be able to answer easier questions more quickly, this will help with your pacing and allow you to spend more time on questions you might find to be more difficult.

Similarly, know in what areas of physics you most need to improve. Do you have trouble interpreting graphs or reading tables? Spend extra time in the weeks leading up to the test date reading sample experimental results that require you to see how the information included in a graph or table has led researchers to the conclusions they draw. When you get to the test, you will likely be able to answer questions that require interpretation of data more quickly, as well.

Spend some time answering some sample test questions. If you are unsure what your strengths and areas of needed improvement are, this activity can help you to identify them.

Remember to remain calm during the test. This should help: you will not be penalized for wrong answers. If you look up and realize that there are only a few minutes left before time is called, but you have another 10-15 questions to answer, consider bubbling in the rest of the answers as all Bs and Fs or Cs and Gs. This will give you a one-in-four chance of getting the rest of the answers correct. While this strategy should only be used when you are running short of time, having this knowledge in the back of your mind will lessen the chance that you will make mistakes simply because your anxiety has distracted you.
To avoid running out of time in the first place, divide the number of questions by the amount of time you will have to answer them. Be willing to make the best educated guess on a question you do not know how to answer, and mark the question to return to later. Remember, since you are not penalized for wrong answers, you should try to answer as many questions as possible while spending less time on topics where you know your knowledge is weaker.

Practice Mathematical Skills

Some of the questions on the physics test will require you to make calculations as well as analyze and interpret information. You should have mastered both basic and more advanced physics calculations before attempting the test. Basic calculations include ensuring accuracy and precision when applying significant figures and scientific notation, correctly applying physical constants (speed of light, gravitational constant, etc.), correct use of metric base units (length, mass, time, etc.), correct use of derived metric units (m², m/s, etc.), correct use of metric prefixes (giga, mega, centi, deci, etc.), canceling units in advanced calculations and correct temperature conversions. Practice using your scientific calculator as well. Providing some example inputs into the calculator and then checking your answers will help to ensure you are using the instrument properly.

Practice using a scientific calculator. Check the [ACT Calculator policy](#) to make certain that the calculator you plan to use for the ACT Physics Subject Test is allowed.

Interpreting graphs, tables, and diagrams is an essential part of answering questions on the test. With graphs, pay close attention to the way data is labeled, organized, and plotted. Practice creating and interpreting examples of the various types of graphs, charts and diagrams you might encounter including line graphs and bar graphs. Analyze physics

graphs with multiple variables measured on the y-axis to become familiar with graphics that are frequently used in physics, but not often used in high school. You should also practice using keys and legends to understand the data presented in a graphic.

For tables, notice the column and row headings that name quantities and units of measure. Typically, one can find the independent variables on the left hand side of the table and the quantities measured in the experiment on the right. To read diagrams, look for important information in the title, captions, and labels of the diagram. Make sure you spend a little time figuring out what a graph, table, or diagram is revealing to its viewer, including the relationships between variables. Having a good idea of what the graphic information presents will help you to interpret what the questions on the test are asking.

Practice Skills Needed in a Laboratory Setting

The proper use of lab equipment is essential in collecting data that is both valid and reliable. On the physics test, you may need to answer questions about common sources of error as it relates to such things as systematic errors due to inaccurate information or incorrectly using equipment (e.g. parallax). As a student, you often perform calculations within a lab environment that require both technical lab skills and mathematics. Therefore data errors can arise from incorrect use of lab equipment or incorrectly applying mathematical formulae. Incorrect measurements, miscalculating answers, or placing the decimal in the wrong place can skew the results of experiments. If you do not practice carefully observing and recording raw data, there is a good chance there will be problems with data analysis. Keep a detailed, written log of all of your lab activities including techniques, procedures, calculations, and findings. This will help accuracy and quality control, and more importantly, help you learn from your mistakes.

Reading the Questions and Possible Answers Carefully

Pay close attention to the way questions are worded. Restate them in your own words. Practice pulling out data, concepts, and information from questions. Use logic to arrive at the correct answer. Using a combination of knowledge and elimination strategies will allow you to best demonstrate what you understand about the key ideas in the Physics course.