



Mathematics

History

Science

Literature

Languages

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# Getting Ready for the SAT Subject Tests™

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## Who Is This Booklet For?

If you have already registered or are planning to register for the SAT Subject Tests™, you can use this book to get familiar with the tests. Remember, if you have access to the Internet you can find everything in this booklet and more at [sat.collegeboard.org](http://sat.collegeboard.org).

**All new for 2011-12: Free answer explanations online for every practice question in this booklet! Visit [collegeboard.org/subjecttests](http://collegeboard.org/subjecttests) to access web pages for each Subject Test, where you can download answer explanations for those practice questions.**

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## Protecting Your Privacy

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While the College Board recommends that students take advantage of our free and low cost practice tools in order to help you do your best on test day, it is our strict policy to NOT sell student information to test preparation companies, nor are such companies affiliated with the College Board.

We recommend the following precautions if you receive unsolicited calls from persons identifying themselves as belonging to a test preparation company:

- Never give credit card information
- Don't commit to a purchase regardless of the caller's high-pressure tactics
- Get the company's contact information and the name of the caller; ask for a call-back number
- Contact your local consumer affairs office, Better Business Bureau and/or the Federal Trade Commission (FTC) if the company continues to make unsolicited phone calls

To learn more about our Student Search Service policy, go to <http://www.collegeboard.com/sss/help/policiesandguidelines/authorizedusage/index.html>

Please don't hesitate to contact the College Board's Student Search Service (SearchCustomerService@collegeboard.org) if you have additional questions or concerns.

## About the College Board

The College Board is a mission-driven not-for-profit organization that connects students to college success and opportunity. Founded in 1900, the College Board was created to expand access to higher education. Today, the membership association is made up of more than 5,900 of the world's leading educational institutions and is dedicated to promoting excellence and equity in education. Each year, the College Board helps more than seven million students prepare for a successful transition to college through programs and services in college readiness and college success — including the SAT® and the Advanced Placement Program®. The organization also serves the education community through research and advocacy on behalf of students, educators and schools.

For further information, visit [www.collegeboard.org](http://www.collegeboard.org).

## Why Should I Take SAT Subject Tests™?

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The SAT Subject Tests are one-hour-long exams that give you the opportunity to demonstrate knowledge and showcase achievement in specific subjects. They provide a fair and reliable measure of your achievement in high school — information that can help enhance your college application portfolio.

SAT Subject Tests measure how well you know a particular subject area and your ability to apply that knowledge. SAT Subject Tests aren't connected to specific textbooks or teaching methods. The content of each test evolves to reflect the latest trends in what is taught in typical high school courses in the corresponding subject.

## How Do Colleges Use SAT Subject Test Scores?

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Colleges use SAT Subject Test scores to gain insight into your academic background and achievement in specific subject areas. They use this information, in combination with other factors (high school grades, letters of recommendation, extracurricular activities, essays, etc.) to make admission or placement decisions.

Even schools that don't require the tests often review them during the application process because the scores can give a fuller picture of your academic achievement. Many colleges also use Subject Tests for course placement and advising; some schools allow you to place out of introductory courses by taking certain Subject Tests.

## How Can I Get Ready for the Tests?

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- Take challenging classes, study hard and learn classroom material.
- Access free online practice tools at [www.collegeboard.org/subjecttests](http://www.collegeboard.org/subjecttests). Ask your college counselor to order a free SAT Subject Tests Practice CD from the College Board to let you practice Language with Listening Subject Test questions.
- Review the sample questions, test-taking approaches and recommended study methods in this book and online.
- Consider reviewing practice exams available for purchase online at [store.collegeboard.org](http://store.collegeboard.org) or in bookstores. Publications available include:
  - *The Official Study Guide for all SAT Subject Tests™, Second Edition* This new edition is the only study guide with actual, full-length, previously administered tests for all 20 Subject Tests, featuring all-new detailed answer explanations, the most up-to-date tips and approaches, and the latest version of the instructions, background questions and answer sheets so students know exactly what to expect on test day. Also includes two audio CDs for all six Language with Listening tests.
  - *The Official SAT Subject Tests in Mathematics Levels 1 & 2 Study Guide™* Recently updated with the most current instructions, background questions, answer sheet, and test-taking tips and approaches, this book includes sample

questions, four full-length practice tests, and detailed answer explanations to help students be better prepared on test day.

- *The Official SAT Subject Tests in U.S. and World History Study Guide™* Updated with the latest version of the instructions, background questions and answer sheet, this guide includes four full-length practice tests, detailed answer explanations, and the most up-to-date tips and approaches to help students prepare for the history Subject Tests. This book offers test-taking approaches, sample questions, two previously administered tests in United States history and two previously administered tests in world history.

## Which SAT Subject Tests Should I Take?

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SAT Subject Tests are the only college admission tests where you can choose the subjects in which you are tested. You select the Subject Test(s) and can take up to three tests in one sitting. With the exception of listening tests, you can even decide to change the subject or number of tests you want to take on the day of the test.

The SAT Subject Tests that you take should be based on the subject areas you enjoy in school as well as your academic strengths. The tests are a great way to indicate interest in specific majors or programs of study (e.g., engineering, pre-med, cultural studies).

You should also consider whether the colleges that you're interested in require or recommend Subject Tests. Certain colleges or programs of study require specific tests, such as mathematics or science, so it's important to make sure you understand the policies prior to choosing which Subject Tests to take. If you have questions or concerns about admission policies, contact admission officers at individual schools. They are usually pleased to meet with prospective students. Some colleges will grant an exemption from, or credit for, a freshman course requirement if a student performs above a certain score level on a particular Subject Test.

## When Should I Take SAT Subject Tests?

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In general, you'll want to take SAT Subject Tests right after you've completed the recommended classes because the material will still be fresh in your mind. In some cases, this may mean spring of your freshmen or sophomore year. For the language tests, however, you should consider taking these tests after you've studied the language for at least two years.

Check the recommended preparation guidelines for each Subject Test at [www.collegeboard.org/subjecttests](http://www.collegeboard.org/subjecttests) (click on each subject to view) to make sure you've completed the recommended course work.

Since not all Subject Tests are offered on every test date, see back cover of this booklet or check [sat.collegeboard.org/register/sat-subject-test-dates](http://sat.collegeboard.org/register/sat-subject-test-dates) to see when the Subject Tests that you're interested in are offered.

You should also balance this with college application deadlines. If you're interested in applying Early Decision or Early Action to any

college, many colleges advise that you take the SAT Subject Tests by October or November of your senior year. For regular decision applications, some colleges will accept SAT Subject Test scores through the January administration. Use [www.collegeboard.org/colleges](http://www.collegeboard.org/colleges) to look up policies for specific colleges.

Not sure when you should schedule your SAT Subject Tests? Talk to your school counselor or teacher to figure out the timing that works best for you.

## Approaches to Taking the SAT Subject Tests

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### Know What to Expect

Use the information in this book and online to help avoid surprises on test day. For additional details, see [www.collegeboard.org/subjecttests](http://www.collegeboard.org/subjecttests).

- **Review the equipment you need for each test.** You are allowed to use a calculator on the Mathematics Level 1 and Level 2 Subject Tests, and you are required to bring a CD player for Language with Listening Subject Tests. For more information on approved test day equipment, visit [www.collegeboard.org/sat-calculator](http://www.collegeboard.org/sat-calculator) or [www.collegeboard.org/sat-cdplayer](http://www.collegeboard.org/sat-cdplayer), or refer to *The Paper Registration Guide*, which you can get from your counselor.
- **Learn the test directions.** The directions for answering the questions in this booklet are the same as those on the actual test. If you become familiar with the directions now, you'll leave yourself more time to answer the questions when you take the test. Note that some Subject Tests, such as Chemistry, may have special instructions.
- **Review the sample questions.** The more familiar you are with the question formats, the more comfortable you'll feel when you see similar questions on the actual test.
- **Understand how the tests are scored.** You get one point for each right answer and lose a fraction of a point for each wrong answer. You neither gain nor lose points for omitting an answer. Hard questions count the same amount as easier questions. You may not be able to complete all the questions in the time given, but it is not necessary to get every question correct to receive the highest score for the test.

### Use These Test-taking Strategies

- **Read carefully.** Consider all the choices in each question. Avoid careless mistakes that will cause you to lose points.
- **Answer the easy questions first.** Work on less time-consuming questions before moving on to the more difficult ones. Questions on each test are generally ordered from easiest to hardest.
- **Eliminate answer choices that you know are wrong.** Cross them out in your test book so that you can clearly see which choices are left.
- **Make educated guesses or skip the question.** If you have eliminated the choices that you know are wrong, guessing is

your best strategy. However, if you cannot eliminate any of the answer choices, it is best to skip the question. You will lose points for incorrect answers. Refer to page 5 to learn more about how the tests are scored.

- **Keep your answer sheet neat.** The answer sheet is scored by a machine, which can't tell the difference between an answer and a doodle. If the machine mistakenly reads two answers for one question, it will consider the question unanswered.
- **Use your test booklet as scrap paper.** Use it to make notes or write down ideas. No one else will look at what you write.
- **Check off questions in the test booklet as you work on them.** This will save time and help you keep track of which questions you've skipped.
- **Check your answer sheet regularly.** Make sure you are in the right place. Check the number of the question and the number on the answer sheet every few questions. This is especially important when you skip a question. Losing your place on the answer sheet can cost you time and even points.
- **Work at an even, steady pace and keep moving.** Each question on the test takes a certain amount of time to read and answer. Through practice, you can develop a sense of timing to help you complete the test. Your goal is to spend time on the questions that you are most likely to answer correctly.
- **Keep track of time.** You are given one hour to complete each test. Occasionally check your progress so that you know where you are and how much time is left.
- **Remember to always use a No. 2 pencil.** All answer sheet circles must be filled in darkly and completely with a No. 2 pencil. If you need to erase an answer, erase it as completely as possible. IMPORTANT NOTE: If you start a test and decide not to complete it, you should cancel your scores. Do not erase all of your answers. You must complete a cancellation form. Visit <http://sat.collegeboard.org/scores/cancel-sat-scores> for more information about canceling scores.

## What to Bring on Test Day

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Be sure to bring the following with you on test day, regardless of what Subject Test you plan on taking:

- Your admission ticket
- An acceptable photo ID
- Two No. 2 pencils and a soft eraser

The following Subject Tests require special equipment.

### Mathematics Level 1 or Level 2

- **Make sure to bring an acceptable calculator to the test center.** See pages 15–16 for more information.
- Make sure your calculator is in good working order. Insert new batteries the day before the test. You may bring additional batteries and a backup calculator to the test center. Test center staff **WILL NOT** have batteries or calculators for your use.
- **You may not share a calculator with another test-taker.**

- **If your calculator malfunctions:**
  - Raise your hand and tell the test supervisor.
  - Switch to backup equipment, if you have it, and continue to test.
  - You may cancel your score on the mathematics test if you do not have backup equipment. Scores for other SAT Subject Tests you take that day will not be canceled.

### Language Tests with Listening

- **Bring an acceptable CD player to the test center.** Your CD player **MUST** be:
  - Equipped with earphones
  - Portable (handheld)
  - Battery operated
- **Your CD player should have this  icon.**
- **You are not allowed to use a CD player with recording or duplicating capabilities.**
- **Make sure your CD player is in good working order.** Insert new batteries the day before the test. You may bring additional batteries and a backup player to the test center. Test center staff **WILL NOT** have batteries, CD players or earphones for your use.
- **You may not share a CD player with another test-taker.**
- **If the volume on your CD player disturbs other test-takers,** the test center supervisor may ask you to move to another seat.
- **If your CD player malfunctions:**
  - Raise your hand and tell the test supervisor.
  - Switch to backup equipment, if you have it, and continue to test.
  - You may cancel your score on the listening test if you do not have backup equipment. Scores for other SAT Subject Tests you take that day will not be canceled.
- **If you encounter problems with your CD, such as occasional skipping, try to work through the problem and keep testing if possible. If necessary, raise your hand and ask the supervisor for a replacement CD. If a replacement is not available, a makeup test will be arranged.**

## Test Scores

Scores are available for free at [sat.collegeboard.org](http://sat.collegeboard.org) several weeks after each test is given. You can also get your scores, for a fee, by telephone. Call Customer Service at 866-756-7346 in the United States. From outside the United States, dial 212-713-7789.

Each test is scored slightly differently depending on how many answer choices there are. See specific subject sections in this booklet for more information. The total score for each test is on a 200- to 800-point scale. All questions on the Subject Tests are multiple-choice.

Each correct answer receives one point. Each incorrect answer is subtracted as follows:

- 1/4 point subtracted for each 5-choice question
- 1/3 point subtracted for each 4-choice question
- 1/2 point subtracted for each 3-choice question
- 0 points subtracted for questions you don't answer

### Canceling Scores

On test day, if you want to cancel your scores, you must cancel scores for **ALL** SAT Subject Tests you take that day unless your equipment malfunctions. Visit <http://sat.collegeboard.org/scores/cancel-sat-scores> for more information about canceling scores.

### Score Choice™

Score Choice™ is a feature that gives you the option to choose the individual SAT Subject Test scores you send to colleges at no additional cost. Designed to reduce your test day stress, Score Choice gives you an opportunity to show colleges the scores you feel best represent your abilities. Score Choice is optional, so if you don't actively choose to use it, all of your scores will be sent automatically with your score report. Since most colleges only consider your best scores, you should still feel comfortable reporting scores from all of your tests.

## Mathematics Level 1 and Level 2

Questions cover topics emphasized in most high school courses. Because of course differences, most students will find that there are some questions on topics with which they are not familiar. Students are not expected to have studied every topic on either test. You may not be able to complete all the questions in the time given, but it is not necessary to get every question correct to receive the highest score for the test.

### Recommended Preparation

#### Mathematics Level 1

- Three years of college-preparatory mathematics, including two years of algebra and one year of geometry

#### Mathematics Level 2

- More than three years of college-preparatory mathematics, including two years of algebra, one year of geometry, and elementary functions (precalculus) and/or trigonometry.
- If you have had preparation in trigonometry and elementary functions and have attained grades of B or better in these courses, select Level 2. If you are sufficiently prepared to take Level 2 but take Level 1 in hopes of receiving a higher score, you may not do as well as you expect.

### Scores

Because the content measured by the two tests differs considerably, you cannot use your score on one test to predict your score on the other or to compare scores.

### Geometric Figures

Figures that accompany problems are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a particular problem that the figure is not drawn to scale. Even when figures are not drawn to scale, the relative positions of points and angles may be assumed to be in the order shown. Also, line segments that extend through points and appear to lie on the same line may be assumed to be on the same line. The text “**Note:** Figure not drawn to scale.” is included on the figure when degree measures may not be accurately shown and specific lengths may not be drawn proportionally.

FORMAT/CONTENT	Approximate % of Test	
	Level 1	Level 2
50 multiple-choice questions each		
<b>Topics Covered*</b>	Level 1	Level 2
<b>Number and Operations</b>	<b>10–14%</b>	<b>10–14%</b>
Operations, ratio and proportion, complex numbers, counting, elementary number theory, matrices, sequences, <i>series, vectors</i>		
<b>Algebra and Functions</b>	<b>38–42%</b>	<b>48–52%</b>
Expressions, equations, inequalities, representation and modeling, properties of functions (linear, polynomial, rational, exponential, <i>logarithmic, trigonometric, inverse trigonometric, periodic, piecewise, recursive, parametric</i> )		
<b>Geometry and Measurement</b>	<b>38–42%</b>	<b>28–32%</b>
<b>Plane Euclidean/Measurement</b>	<b>18–22%</b>	-
<b>Coordinate</b>	8–12%	10–14%
Lines, parabolas, circles, <i>ellipses, hyperbolas, symmetry, transformations, polar coordinates</i>		
<b>Three-dimensional</b>	4–6%	4–6%
Solids, surface area and volume (cylinders, cones, pyramids, spheres, prisms), <i>coordinates in three dimensions</i>		
<b>Trigonometry</b>	6–8%	12–16%
Right triangles, identities, <i>radian measure, law of cosines, law of sines, equations, double angle formulas</i>		
<b>Data Analysis, Statistics, and Probability</b>	<b>8–12%</b>	<b>8–12%</b>
Mean, median, mode, range, interquartile range, <i>standard deviation, graphs and plots, least-squares regression (linear, quadratic, exponential), probability</i>		
<i>*Topics in italics are tested on the Level 2 Test only. The content of Level 1 overlaps somewhat with that on Level 2, but the emphasis on Level 2 is on more advanced content. Plane Euclidean geometry is not tested directly on Level 2.</i>		

### Calculators

Be sure to bring a calculator to use on these tests: if you take these tests without a calculator, you will be at a disadvantage.

In fact, some questions cannot be solved without a scientific or a graphing calculator.

- Verify that your calculator is in good working condition before you take the test.
- If possible, bring batteries and a backup calculator to the test center. No substitute calculators or batteries will be available. Students may not share calculators.
- If your calculator malfunctions during the Level 1 or Level 2 tests and you do not have a backup calculator, you can cancel scores on just the mathematics tests. You must tell your test supervisor when the malfunction occurs in order to cancel scores on these tests only.

### What Type of Calculator Should I Bring?

- Bring a calculator that you are used to using. It may be a scientific or a graphing calculator. If you're comfortable with both a scientific and a graphing calculator, bring a graphing calculator.
- We recommend the use of a graphing calculator over a scientific calculator because a graphing calculator may provide an advantage on some questions.

#### The following calculators are unacceptable:

- Models that have wireless, Bluetooth, cellular, audio/video recording and playing, camera, or any other cell phone type feature
- Models that can access the Internet
- Models that have QWERTY, pen-input, stylus,\* or touch-screen capability; require electrical outlets; or use paper tape (e.g., TI-92 Plus, Voyage 200, Palm, PDAs, Casio ClassPad)
- Models that "talk" or make unusual noises

\*The use of the stylus with the Sharp EL-9600 calculator is not permitted.

### Using the Calculator

You do not need to use a calculator to solve every question, but it is important to know when and how to use one. First decide how you will solve a problem; then determine whether the calculator is needed.

- You'll need a calculator for 40 to 50 percent of the questions on Level 1 and 55 to 65 percent of the questions on Level 2.
- For the rest of the questions, there is no advantage, perhaps even a disadvantage, to using a calculator.
- **Do not round any intermediate calculations.** If you get a result from the calculator for the first step of a solution, keep the result in the calculator and use it for the second step. If you round the result from the first step, your answer may not be one of the choices.
- You may not use a calculator for other Subject Tests and must put it away when not taking a mathematics test.

### Sample Questions

All questions in the Mathematics Level 1 and Mathematics Level 2 Subject Tests are multiple-choice questions in which you are asked to choose the BEST response from the five choices offered. The directions for the tests are below:

#### Directions

For each of the following problems, decide which is the **BEST** of the choices given. If the exact numerical value is not one of the choices, select the choice that best approximates this value. Then fill in the corresponding circle on the answer sheet.

**Notes:** (1) A scientific or graphing calculator will be necessary for answering some (but not all) of the questions in this test. For each question you will have to decide whether or not you should use a calculator.

(2) Level 1: The only angle measure used on this test is degree measure. Make sure your calculator is in the degree mode.

Level 2: For some questions in this test you may have to decide whether your calculator should be in the radian mode or the degree mode.

(3) Figures that accompany problems in this test are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.

(4) Unless otherwise specified, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$  for which  $f(x)$  is a real number. The range of  $f$  is assumed to be the set of all real numbers  $f(x)$ , where  $x$  is in the domain of  $f$ .

(5) Reference information that may be useful in answering the questions in this test can be found on the page preceding Question 1.

**Reference Information.** The following information is for your reference in answering some of the questions in this test.

Volume of a right circular cone with radius  $r$  and height  $h$ :  $V = \frac{1}{3}\pi r^2 h$

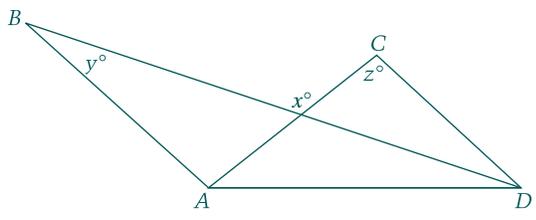
Volume of a sphere with radius  $r$ :  $V = \frac{4}{3}\pi r^3$

Volume of a pyramid with base area  $B$  and height  $h$ :  
 $V = \frac{1}{3}Bh$

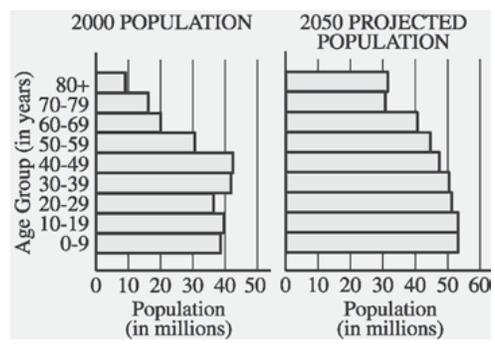
Surface Area of a sphere with radius  $r$ :  $S = 4\pi r^2$

**Mathematics Level 1**

1. A band wants to distribute its music on compact discs (CDs). The equipment to produce the CDs costs \$250, and blank CDs cost \$5.90 for a package of 10. Which of the following represents the total cost, in dollars, to produce  $n$  CDs, where  $n$  is a multiple of 10?
- (A)  $(250 + 0.59)n$     (B)  $250 + 0.59n$   
 (C)  $(250 + 5.90)n$     (D)  $250 + 5.90n$   
 (E)  $250n + 5.90$



2. In the figure above,  $\overline{AB}$  and  $\overline{CD}$  are parallel. What is  $x$  in terms of  $y$  and  $z$ ?
- (A)  $y + z$   
 (B)  $2y + z$   
 (C)  $2y - z$   
 (D)  $180 - y - z$   
 (E)  $180 + y - z$
3. A number  $n$  is increased by 8. If the cube root of that result equals  $-0.5$ , what is the value of  $n$ ?
- (A)  $-15.625$   
 (B)  $-8.794$   
 (C)  $-8.125$   
 (D)  $-7.875$   
 (E)  $421.875$
4. If  $a$  and  $b$  are real numbers,  $i^2 = -1$ , and  $(a + b) + 5i = 9 + ai$ , what is the value of  $b$ ?
- (A) 4                      (B) 5                      (C) 9  
 (D)  $4 + 5i$               (E)  $5 + 4i$
5. What are all values of  $x$  for which  $4 - x^2 \geq x - 2$ ?
- (A)  $x \geq -3$               (B)  $-5 \leq x \leq 0$   
 (C)  $-3 \leq x \leq 2$         (D)  $x \leq -3$  or  $x \geq 2$   
 (E)  $-2 \leq x \leq 3$



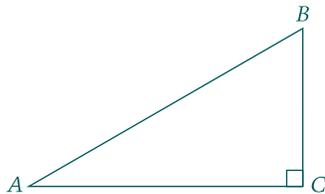
6. The graphs above show United States Census Bureau population figures for the year 2000 for various age groups, together with projections for the year 2050. Of the following age groups, for which is the projected percent increase in population from 2000 to 2050 greatest?
- (A) 30–39                  (B) 40–49                  (C) 50–59  
 (D) 60–69                  (E) 70–79
7. If  $\log_c a = x$ , which of the following must be true?
- (A)  $a^c = x$                   (B)  $a^x = c$                   (C)  $c^a = x$   
 (D)  $c^x = a$                   (E)  $x^c = a$
8. If  $f(x) = x + 3$  and  $g(x) = \frac{x^2 - 9}{x - 3}$ , which of the following statements are true about the graphs of  $f$  and  $g$  in the  $xy$ -plane?
- I. The graphs are exactly the same.  
 II. The graphs are the same except when  $x = 3$ .  
 III. The graphs have an infinite number of points in common.
- (A) I only                  (B) II only                  (C) III only  
 (D) I and III              (E) II and III

9. If line  $\ell$  is the perpendicular bisector of the line segment with endpoints  $(2, 0)$  and  $(0, -2)$ , what is the slope of line  $\ell$ ?

- (A) 2 (B) 1 (C) 0  
(D) -1 (E) -2

10. Twenty students have each sampled one or more of three kinds of candy bars that a school store sells. If 3 students have sampled all three kinds, and 5 have sampled exactly two kinds, how many of these students have sampled only one kind?

- (A) 8 (B) 12 (C) 15  
(D) 17 (E) 18



Note: Figure not drawn to scale.

11. In the figure above,  $\triangle ABC$  has a right angle at  $C$ . If the length of side  $\overline{AC}$  is 10 and the measure of  $\angle BAC$  is  $22^\circ$ , what is the length of side  $\overline{BC}$ ?

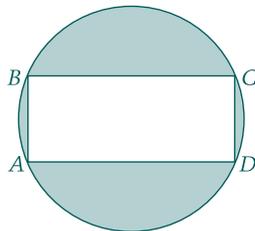
- (A) 3.7 (B) 4.0 (C) 5.8  
(D) 6.8 (E) 9.3

12. The function  $h$  given by  $h(t) = -16t^2 + 46t + 5$  represents the height of a ball, in feet,  $t$  seconds after it is thrown. To the nearest foot, what is the maximum height the ball reaches?

- (A) 5 (B) 23 (C) 35  
(D) 38 (E) 46

13. The front, side, and bottom faces of a rectangular solid have areas of 24 square centimeters, 8 square centimeters, and 3 square centimeters, respectively. What is the volume of the solid, in cubic centimeters?

- (A) 24 (B) 96 (C) 192  
(D) 288 (E) 576



14. Rectangle  $ABCD$  is inscribed in the circle shown above. If the length of side  $\overline{AB}$  is 5 and the length of side  $\overline{BC}$  is 12, what is the area of the shaded region?

- (A) 40.8 (B) 53.1 (C) 72.7  
(D) 78.5 (E) 81.7

15. If  $f(x) = x^4 - 3x^3 - 9x^2 + 4$ , for how many real numbers  $k$  does  $f(k) = 2$ ?

- (A) None (B) One (C) Two  
(D) Three (E) Four

Time $t$ (years)	0	1	2	5
Value $v(t)$ (dollars)	15,000	13,000	10,900	3,000

16. When purchased, an automobile is valued at \$15,000. Its value depreciates at the rate shown in the table above. Based on a least-squares linear regression, what is the value, to the nearest hundred dollars, of the automobile when  $t = 4$ ?

- (A) \$5,400 (B) \$5,500 (C) \$5,600  
(D) \$6,400 (E) \$7,000

### Mathematics Level 2

17. What is the distance in space between the points with coordinates  $(-3, 6, 7)$  and  $(2, -1, 4)$ ?

- (A) 4.36 (B) 5.92 (C) 7.91  
(D) 9.11 (E) 22.25

18. If  $f(x) = \frac{3x + 12}{2x - 12}$ , what value does  $f(x)$  approach as  $x$  gets infinitely larger?

- (A) -6 (B)  $-\frac{3}{2}$  (C) -1  
(D)  $\frac{2}{3}$  (E)  $\frac{3}{2}$

19. In January 1990 the world's population was 5.3 billion. Assuming a growth rate of 2 percent per year, the world's population, in billions, for  $t$  years after 1990 can be modeled by the equation  $P = 5.3(1.02)^t$ . According to the model, the population growth from January 1995 to January 1996 was

- (A) 106,000,000  
(B) 114,700,000  
(C) 117,000,000  
(D) 445,600,000  
(E) 562,700,000

20. What is the measure of one of the larger angles of a parallelogram in the  $xy$ -plane that has vertices with coordinates  $(2, 1)$ ,  $(5, 1)$ ,  $(3, 5)$ , and  $(6, 5)$ ?

- (A)  $93.4^\circ$  (B)  $96.8^\circ$  (C)  $104.0^\circ$   
(D)  $108.3^\circ$  (E)  $119.0^\circ$

21. For some real number  $t$ , the first three terms of an arithmetic sequence are  $2t$ ,  $5t - 1$ , and  $6t + 2$ . What is the numerical value of the fourth term?
- (A) 4 (B) 8 (C) 10  
(D) 16 (E) 19
22. The diameter and height of a right circular cylinder are equal. If the volume of the cylinder is 2, what is the height of the cylinder?
- (A) 1.37 (B) 1.08 (C) 0.86  
(D) 0.80 (E) 0.68
23. If  $\sin \theta = 0.57$ , then  $\sin(\pi - \theta) =$
- (A)  $-0.57$  (B)  $-0.43$  (C) 0  
(D) 0.43 (E) 0.57
24. In a group of 10 people, 60 percent have brown eyes. Two people are to be selected at random from the group. What is the probability that neither person selected will have brown eyes?
- (A) 0.13 (B) 0.16 (C) 0.25  
(D) 0.36 (E) 0.64
25. If  $x - 2$  is a factor of  $x^3 + kx^2 + 12x - 8$ , then  $k =$
- (A)  $-6$  (B)  $-3$  (C) 2  
(D) 3 (E) 6
26. If  $f(x) = \sqrt[3]{x^3 + 1}$ , what is  $f^{-1}(1.5)$ ?
- (A) 3.4 (B) 2.4 (C) 1.6  
(D) 1.5 (E) 1.3

$x$	$-9.8$	$-0.9$	$5.2$	$8.8$
$y$	$0.12$	$2.43$	$18.46$	$68.4$

27. Which of the following equations best models the data in the table above?
- (A)  $y = -3.3(1.4)^x$   
(B)  $y = -1.4(3.3)^x$   
(C)  $y = 1.4(3.3)^x$   
(D)  $y = 3.3(1.4)^x$   
(E)  $y = 1.4x^{3.3}$

$$C = -1.02F + 93.63$$

28. The linear regression model above is based on an analysis of nutritional data from 14 varieties of cereal bars to relate the percent of calories from fat ( $F$ ) to the percent of calories from carbohydrates ( $C$ ). Based on this model, which of the following statements must be true?
- I. There is a positive correlation between  $C$  and  $F$ .  
II. When 20 percent of calories are from fat, the predicted percent of calories from carbohydrates is approximately 73.  
III. The slope indicates that as  $F$  increases by 1,  $C$  decreases by 1.02.
- (A) II only (B) I and II only  
(C) I and III only (D) II and III only  
(E) I, II, and III
29. A line has parametric equations  $x = 5 + t$  and  $y = 7 + t$ , where  $t$  is the parameter. The slope of the line is
- (A)  $\frac{5}{7}$  (B) 1 (C)  $\frac{7+t}{5+t}$   
(D)  $\frac{7}{5}$  (E) 7
30. What is the range of the function defined by
- $$f(x) = \frac{1}{x} + 2?$$
- (A) All real numbers  
(B) All real numbers except  $-\frac{1}{2}$   
(C) All real numbers except 0  
(D) All real numbers except 2  
(E) All real numbers between 2 and 3
31. The number of hours of daylight,  $d$ , in Hartsville can be modeled by
- $$d = \frac{35}{3} + \frac{7}{3} \sin\left(\frac{2\pi}{365}t\right),$$
- where  $t$  is the number of days after March 21. The day with the greatest number of hours of daylight has how many more daylight hours than May 1? (March and May have 31 days each. April and June have 30 days each.)
- (A) 0.8 hr (B) 1.5 hr (C) 2.3 hr  
(D) 3.0 hr (E) 4.7 hr

	Day 1	Day 2	Day 3
Model X	20	18	3
Model Y	16	5	8
Model Z	19	11	10

32. The table above shows the number of digital cameras that were sold during a three-day sale. The prices of models X, Y, and Z were \$99, \$199, and \$299, respectively. Which of the following matrix representations gives the total income, in dollars, received from the sale of the cameras for each of the three days?

(A)  $\begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix} \begin{bmatrix} 99 & 199 & 299 \end{bmatrix}$

(B)  $\begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix} \begin{bmatrix} 99 \\ 199 \\ 299 \end{bmatrix}$

(C)  $\begin{bmatrix} 99 & 199 & 299 \end{bmatrix} \begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix}$

(D)  $\begin{bmatrix} 99 \\ 199 \\ 299 \end{bmatrix} \begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix}$

(E)  $99 \begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix} + 199 \begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix} + 299 \begin{bmatrix} 20 & 18 & 3 \\ 16 & 5 & 8 \\ 19 & 11 & 10 \end{bmatrix}$

## ANSWERS

The estimated difficulty level, on a scale of 1 to 5, with 1 the easiest and 5 the most difficult, is in parentheses.

### Mathematics Level 1

- |          |          |           |           |
|----------|----------|-----------|-----------|
| 1. B (2) | 5. C (3) | 9. D (4)  | 13. A (4) |
| 2. A (2) | 6. D (4) | 10. B (3) | 14. C (4) |
| 3. C (2) | 7. D (3) | 11. B (3) | 15. E (3) |
| 4. A (3) | 8. E (3) | 12. D (4) | 16. C (5) |

### Mathematics Level 2

- |           |           |           |           |
|-----------|-----------|-----------|-----------|
| 17. D (2) | 21. E (4) | 25. A (2) | 29. B (3) |
| 18. E (2) | 22. A (3) | 26. E (4) | 30. D (3) |
| 19. C (4) | 23. E (3) | 27. D (4) | 31. A (4) |
| 20. C (4) | 24. A (4) | 28. D (4) | 32. C (3) |

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