SAT MATH TEST

INTRODUCTION

How long is the SAT Math Test?

The SAT Math Test consists of 58 questions, split across two sections. The first is a non-calculator section, consisting of 20 questions to be completed in 25 minutes (75 seconds per question). This section is followed by a calculator section, which consists of 38 questions over 55 minutes (87 seconds per question). This may not seem like a lot of time, but if you prep effectively and efficiently for the test, it can be more than enough.

What's on the Test?

The goal of the SAT Math Test has shifted from evaluating your overall knowledge of the math you have learned in high school to evaluating your abilities in subject areas that will be prominently used in college courses across various disciplines. Starting in March 2016, the SAT will cover three main areas of math: Heart of Algebra, Problem Solving & Data Analysis, and Passport to Advanced Math. There are also six questions that cover other topics not listed in the three main areas. The questions are broken down as follows:

Subject Area	Non-Calculator	Calculator	Total	Percentage of Test
Heart of Algebra	8	11	19	33%
Problem Solving & Data Analysis	0	17	17	29%
Passport to Advanced Math	9	7	16	28%
Other	3	3	6	10%
TOTAL	20	38	58	100%

Heart of Algebra

Questions in the Heart of Algebra subject area will focus solely on linear equations and their applications. Students will be asked to solve linear equations, translate word problems into linear equations and systems, interpret and utilize equation components in word problems and the relationships between them, solve systems of linear equations; analyze linear equations graphically, and use absolute values and inequalities.

Problem Solving & Data Analysis

Perhaps the biggest change in the redesigned SAT is its focus on the practical applications of data analysis. You will be asked to use data tables, graphs (bar, circle, line, scatterplots), and other representations of data to answer questions in a number of different subject areas, such as: direct and inverse variation; slopes and average rates of change; mean, median and mode; probability; domain and range; properties of functions; ratios, fractions, and percentages; and many others.

Questions will often be situated within common situations across many disciplines, such as economics, history, physics, and many others.

Passport to Advanced Math

Questions in this area will draw on topics you would normally learn at the end of Algebra I and in Algebra II. Most questions in this category deal with interpreting, solving, and manipulating polynomial, rational and exponential functions. You will need an advanced knowledge of how to interpret and solve linear and non-linear functions that appear in questions based in the sciences and economics.

Additional Topics

The SAT lumps a number of different topics into this section, including plane geometry, trigonometry (radians!), and complex numbers. The good news is that these tough topics account for only 10% of the test. This is perhaps the College Board's boldest change to the SAT, as previous versions of the test have been heavy on geometry.

The Big Takeaway!

The SAT might as well have called these sections "The SAT Algebra Test". Over sixty percent of the SAT Math Test (Heart of Algebra and Passport to Advance Math) is completely based in Algebra I or II, and many Problem Solving & Data Analysis questions involve topics learned in Algebra I or II, such as percentages, ratios, proportions, direct and inverse variation, and mean/median/mode. **Therefore, almost NINETY percent of the test uses algebra!**

However, this isn't your math teacher's Algebra test. The questions on the SAT Math Test are designed to take these topics, which can often be simple, and twist and contort them into confusing and difficult questions. **The trick is to use your knowledge of algebra and your test-taking strategies to break down confusing questions into digestible components.**

THE GENERAL APPROACH

Because the SAT presents information in so many ways, it is extremely important to have the same strategic approach for **every** question. If you don't, you might get bogged down in the wordiness and unnecessary details meant to throw you off. Below is a general outline of how to approach each question. While the smaller details of these steps vary depending on skill level and pacing, the basics should generally be followed by all students.

1. Read the question CAREFULLY to determine what it is asking you to find.

This step may seem like common sense, but undoubtedly the most important. After reading a math question, you should have a clear idea of what it is asking **in your own, simplified context.** Do not just assume you know what a question is asking because you can isolate the sentence with a question mark at the end!

If you are unsure what a question is asking after you read it the first time, skip it and come back to it later. Your time is best used answering all the questions you immediately understand, and then coming back to the ones that were unclear to you. **Make sure you mark any questions skipped on your answer sheet!**

1a. Look for keywords and key phrases as clues!

During your initial read-through, be on the lookout for certain words that can help you categorize questions into certain mathematical topics, which will help you decide what to do next. Some keywords are obvious, such as slope, mean/median/mode, and perimeter. However, there are some phrases that can be a bit harder to detect. For example, a question that starts with "at this rate" usually means that you will have to deal with proportions. For a list of key phrases, refer to the "Translating Word Problems" section of the SAT Annotated Index.

2. Determine what information you are given.

On every question, you want to extract as much information as you can and jot it down in your workspace. You might not see how each piece of information in the question relates to the others on your first read-through, so writing down EVERY piece of information can help you see the relationships much more clearly.

Writing down given information is especially important for geometry problems.   If a problem provides you with a figure, such as a triangle, and information that is relevant to the figure, such as the length of sides or angle measures, write this information directly on the figure! Doing so can point you toward other info like side lengths or angle measures. If a geometry problem does not give you a figure, **draw one yourself** and add all of the information you can.

If a geometry problem involves geometric keywords such as area, perimeter, circumference, midpoint, or distance, write down the formulas that define those words - which you will have memorized by test day! Doing so can help you to easily determine what variables you need.

3. Notice what the answers look like.

After reading the question and writing down all relevant information, take a peek at the answer choices. Knowing what form the answers are in can point you in the right direction. Answer choices can also offer hints about the problem if you look closely. For example, if a geometry question involving triangles has answer choices containing $\sqrt{2}$ or $\sqrt{3}$, you might realize that it tests properties of special right triangles.

Answer choices can also help dictate what test-taking strategies you can possibly use on a question. If answer choices involve a variable, then you may be able to use the "Choosing Your Own Values" strategy. If the answer choices are numbers but are very far apart in value, you may be able to estimate.

4. Ask yourself: can you solve it?

If you read a problem, know what it's asking, and immediately know how to solve for the answer, jump right in and solve it! These are the questions that you want to complete FIRST, no matter where they are in the test.

If you do not how to solve the problem right away, check to see if you can use any of the test-taking strategies we will practice in the "Specific SAT Math Strategies" lesson that follows.

If you do not know how to solve a problem, do not waste time trying to figure out how to do so. Just circle the question in your test booklet, make an educated guess using one or more of the guessing strategies we have practiced, and move on.

Once you have gone through each of the questions and completed the questions you knew how to do immediately, return to the ones you were unsure of and try to solve them using other methods. The perplexities you initially faced when reading the question the first time often disappear after you have gotten into the flow of the section and answered most of the questions!

The Basic Steps: Example Problems

Now that we have reviewed the basic approach to any math problem on the SAT, let's practice putting it into action by looking at an example. We'll start with a Heart of Algebra question:

> In a certain game, a player can solve easy or hard puzzles. A player earns 30 points for solving an easy puzzle and 60 points for solving a hard puzzle. Tina solved a total of 50 puzzles playing this game, earning 1,950 points in all. How many hard puzzles did Tina solve?
>
> A) 10
> B) 15
> C) 25
> D) 35

After carefully reading the question, we must first determine what it is asking. While the question asks us to find how many hard puzzles Tina solved, that isn't enough analysis to set us up for the next step. Instead, we have to use our knowledge and previous experience with word problems to determine that the question is asking us for the value of a variable. We may even recognize that this is a classic systems of equation problem, but do not worry if that doesn't pop into our heads. Next, go back into the question to extract all of the important information from the question, and jot down any formulas that might be useful.

The first sentence tells us that there are easy and hard puzzles to solve. Since we know that the amount of hard puzzles is the variable we are looking for, let's assign the two values the variables e and h, respectively. Next, we learn that a player earns 30 points for solving an easy puzzle and 60 points for solving a hard puzzle. The word 'for' often implies multiplication, but we don't know how that factors in quite yet.

The next sentence tells us that Tina solved a total of 50 puzzles. If e is the amount of easy puzzles solved, and h is the amount of hard puzzles solved, then their sum must equal 50. We can jot that down as follows:

$$e + h = 50$$

Next, we learn that Tina earns 1,950 points in all. We know that she earns 30 points for solving an easy puzzle and 60 points for solving a hard puzzle, so we can create another equation:

$$30e + 60h = 1950$$

Now we have two equations with the same variables (also known as a system), and are asked to solve for h. We can accomplish this by using either substitution or elimination. Let's use elimination here:

$$e + h = 50$$

$$30e + 60h = 1950$$

We have to keep h and eliminate e, so let's multiply the top equation by -30:

$$-30(e + h) = -30(50)$$

$$30e + 60h = 1950$$

Distribute the coefficient:

$$-30e - 30h = -1500$$
$$30e + 60h = 1950$$

We can then eliminate by adding down each column of the equation:

$$-30e - 30h = -1500$$
$$\underline{30e + 60h = 1950}$$
$$30h = 450$$

Divide both sides by 30:

$$h = 15$$

The correct answer is 15, or answer choice (B).

If you had trouble following the math in this problem or coming up with equations, don't worry! We will go over a test-taking strategy later that can help you solve this without knowing the "right" way.

"Okay, sure - The Basic Steps are great. But what do I do when I'm not sure how to answer the problem?"

We're glad you asked.

SPECIFIC SAT MATH STRATEGIES

If you don't know how to solve a math problem on the SAT the "right" way, try using one of the test-taking strategies outlined below. Remember, **there is no one correct way to solve any problem on the SAT**.

Strategy #1: Insert Your Own Numbers for Variables

As we mentioned previously, the SAT now places great emphasis on the applications of linear equations. While practicing problems the "right" way will certainly pay dividends come test day, it is important to practice "backup" strategies that can help us arrive at the correct answer. One such way is inserting our own values for variables in questions. **This works well for problem with variables in both the question and answer choices.** Let's put this strategy to use in a relatively easy example:

1

Tyra subscribes to an online gaming service that charges a monthly fee of $5.00 and $0.25 per hour for time spent playing premium games. Which of the following functions gives Tyra's cost, in dollars, for a month in which she spends x hours playing premium games?

A) $C(x) = 5.25x$

B) $C(x) = 5x + 0.25$

C) $C(x) = 5 + 0.25x$

D) $C(x) = 5 + 25x$

These problems, that ask you to formulate equations from word problems, are EVERYWHERE on the SAT. Your ability to create and use formulas will significantly impact your

Here we are asked to create a function that models the amount Tyra spends on videos games. Let's assume that we don't see how to solve this problem right away. Because there are variables in the answer choices, we can use our own value for x to come up with the correct answer choice.

Let's try to use the information in the question to determine how much Tyra would spend if she spent two hours playing video games ($x = 2$). She would pay the monthly fee of $5.00, and then pay $0.50 for the two hours she played, giving her a total of $5.50. We can now evaluate the four answer choices to see which answer choice gives us a value of $5.50 when x equals 2:

A) • $C(2) = 5.25(2) = 11.50$; incorrect.

B) • $C(2) = 5(2) + 0.25 = 10.25$; incorrect.

C) • $C(2) = 5 + 0.25(2) = 5.50$; **CORRECT!**

D) • $C(2) = 5 + 25(2) = 55$; incorrect.

By determining a point (2,5.50) that must be included in the correct model function and then evaluating each answer choice, we are able to quickly determine that the correct answer is (C).

Tips for Inserting Your Own Numbers for Variables

- Be sure to test ALL answer choices. There is a possibility that two answer choices could give you the same result based on the value you chose to evaluate them. If this is the case, pick a second number with which to test them again.

- Don't make it hard on yourself. Choose small numbers that make doing arithmetic as easy as possible.

- Avoid using 0, 1, and 2 for questions involving exponents or multiplication/division (2 can cause problems because squaring it is the same as doubling it).

- For questions that involve variables but ask you to take percents in the question, use 100!

Strategy #2: The "Plug 'n Chug" Strategy

Plugging in answer choices can be a very effective strategy on the SAT, especially when a question asks you to find the value of a variable (as many often do on this test!). This strategy is very similar to the "Guess and Check" strategy you have been told not to use in math class for years. The main difference is that, instead of having to "guess" a value to use, you are instead given four choices from which to choose.

Note that this method differs from the first strategy, inserting numbers for variables, because instead of choosing numbers, you're taking numbers directly from the answer choices.

Almost every question that asks you to find a value can be solved with this method. It may seem like it will take a long time to test every answer choice, but if you use the strategy correctly, you should only have to evaluate a maximum of two answer choices. Let's take a look at a question that we have already solved using our strategic approach:

In a certain game, a player can solve easy or hard puzzles. A player earns 30 points for solving an easy puzzle and 60 points for solving a hard puzzle. Tina solved a total of 50 puzzles playing this game, earning 1,950 points in all. How many hard puzzles did Tina solve?

A) 10
B) 15
C) 25
D) 35

We already established that this is a systems of equation question, but let's pretend that we read this once and had no idea how to solve the question. Because this question is asking us for the value of a variable, let's plug our answer choices into the question and see what we can find. Let's start out with answer choice (C), which states that Tina solved 25 hard puzzles.

If Tina solves 25 hard puzzles and solved 50 in total, then we know she solved 25 easy puzzles as well. We can then use the point values for each puzzle to determine how many points she would earn if she solved 25 hard puzzles:

$$30(25) + 60(25) = 2,250$$

Tina would have earned 2,250 points if she solved 25 hard puzzles, which is more points than she earned in the question. Therefore, answer choice (C) is incorrect. We can also eliminate answer choice (D), because we know that she will earn more points the more hard puzzles she solves, as each hard puzzle is worth more than an easy one.

Let's go ahead and plug in answer choice (A), though it doesn't necessarily matter which of the two remaining answer choices you choose. If she solves 10 hard puzzles, then she solves 40 easy puzzles:

$$30(40) + 60(10) = 1,800$$

This is not enough points, so answer choice (B) must be correct.

> *If you came up with the correct system of equations for this question but did not know how to solve it, you could still use this strategy. In fact, it would be easier to plug these values into equations if we have them!*

Tips for the Plug and Chug Method:

This strategy works best with any questions involving linear functions. When using it with non-linear functions, such as polynomial functions of even degree, do not eliminate any answer choices without plugging them in. Smaller integers, when plugged into these types of functions, will not always produce a smaller value for the function. For example:

$$f(x) = x^2$$

$$f(2) = 4$$

$$f(-3) = 9$$

Notice that even though -3 is smaller than 2, it produces a bigger result when plugged into $f(x)$. Be sure to test all answer choices when you are dealing with either type of function.

Strategy #3: Translating from English to Math

Word problems are everywhere on the SAT. Many students find these problems to be difficult and intimidating. They are often wordy, and try to bog students down with unnecessary words in order to disguise the important information. However, these problems can be made easier by learning how to translate English into mathematical terms. Many of the words in these word problems have direct translations into mathematics. The following table will provide you with these translations and tell you how to use them on the test:

Key Words	Meaning	Example
Increased by, more than, combined, together, total of, sum, plus, added to	Addition	"Five more than thirty" 30 + 5
Decreased by, minus, less, difference between/of, less than, fewer than	Subtraction	"8 less than 12" 12 – 8
Of, times, multiplied by, product of, increased by a factor of	Multiplication	"Half of 12" ½(12)
Per, a, out of, ratio of, quotient of, percent, decrease by a factor of	Division	"50 decreased by a factor of 10" $\dfrac{50}{10}$

Squared, cubed, square root, cube root, to the power of	**Exponential**	**"The square of 8"** 8^2
***Is*, are, was, were, will be, gives, yields, sold for, result is**	**Equality**	**"Five plus five is ten"** 5 + 5 = 10
***A number*, what number, what percent, another number**	**Variable**	**A number is 3 less than 11** x = 11 - 3

Note: when you have a subtraction problem written in English, it can be confusing as to which number to put first. See the following examples of different ways to say 8 – 5:

"Eight **minus** five"

"Eight **is decreased by** five"

"Five **subtracted from** eight"

"Five **less than** eight"

> *This is one of the most important skills needed to excel on the SAT Math Test! For more practice with translating word problems, please consult the Heart of Algebra section of the SAT Annotated Index.*

Strategy #4: The Estimating Method

Remember, "estimate" is just a fancy word for guess. This is far from your ideal strategy, but there are times when it's okay to estimate:

1. When you don't know how to solve a problem, and can't use any of the aforementioned strategies.

> Estimating is simply not as surefire a strategy as solving a problem correctly! Don't take shortcuts at the risk of answering questions incorrectly. Only estimate as a last resort, and try to never estimate on grid-in questions.

**2. On geometry questions that include a figure.**

> The directions at the beginning of the SAT Math Test say, "Figures provided in this test are drawn to scale unless otherwise indicated". That means you can use figures to estimate based on the measures of other parts of the figure in question! You can also estimate on questions that require you to draw your own figure, but you must draw it as close to scale as possible.

> Estimating is not as useful for algebra questions in the calculator section, as we can use our calculators to find exact answers in a shorter amount of time.

3. When you are running out of time

> If you are short on time but need to come up with more than a blind guess, estimating can be an effective strategy. This is especially true for questions that have answer choices that are numerically far apart from each other.

Let's take a look at a question for which estimating is admissible:
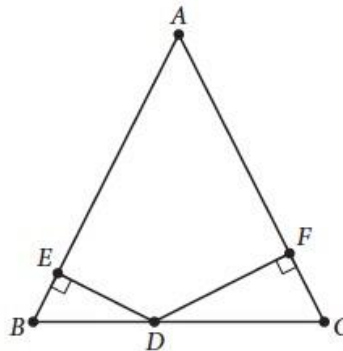
Note: Figure not drawn to scale.

Triangle ABC above is isosceles with $AB = AC$ and $BC = 48$. The ratio of DE to DF is $5 : 7$. What is the length of $\overline{DC}$?

A) 12
B) 20
C) 24
D) 28

This question asks you to find the length of a portion of the base of an isosceles triangle. If we don't know how to use the ratios given to find the length of $\overline{DC}$, we can estimate.

> *While this figure does say that the figure is not drawn to scale, but they are lying! For estimating, we will always assume that a figure is drawn correctly.*

Point D looks to be a little bit left of the midpoint of BC (not pictured). The midpoint would split the length of BC in half, with $\overline{BD}$ and $\overline{DC}$ both having a length of 24. Because $\overline{DC}$ looks to be bigger than half of BC, we should estimate that the correct answer will be bigger than 24. Therefore, we should choose answer choice (D).

HOW TO PREPARE FOR THE SAT MATH TEST

By reading this guide, you have taken an excellent first step in your preparation for the SAT Math Test, but it will not be an effective step unless you supplement it with scheduled practice! Below are a few important suggestions on how to sculpt the perfect SAT Math Study Plan.

1. Master the Basics

Mastering the basic approach to an SAT math problem (described above) is the most important step in doing well on the test. **Practice steps one through four for every single math problem that you practice.** Your goal is to become an SAT Math machine that takes in information and processes it in a uniform and efficient way!

Make sure to practice with different types of problems to find the categories of problems in which you excel, and those in which you struggle. Turning relative weaknesses into relative strengths will significantly increase your overall SAT Math score.

2. Language is Key

One of the more difficult aspects of the SAT Math Test is its use of complicated and convoluted language to make straightforward mathematical problems more difficult. When practicing, take notes on what language confuses you, and then work to determine what that word or phrase means mathematically so you will be prepared when it is used in another question.

3. Repeat and Adapt

With regards to math, many students are used to a repetitive learning style: they are taught one concept, practice that one concept on a homework assignment or two, and then take a quiz or test on that concept to make sure they have learned it.

Repetition is important for SAT Math practice, but it can't be the only type of practice you do. You should certainly repeatedly practice question types that you don't understand until you understand them. However, try to incorporate a full section of the test into your practice, or try a practice quiz with a number of different concepts on it. The SAT Math Test will require you to use a number of different math strategies and concepts in a completely random order. You have to be skilled at adapting from one question to the next. Adaptive learning through randomized practice will help you do so effectively.

4. Review your work extensively

Whether you are doing practice problems in the SAT Annotated Index or completing a full practice test, make sure you go over **EVERY** problem that you do to make sure you understood it fully. Don't skip past a problem that you answered correctly; you may have done it a way that is unsustainable in the long run (also known as "getting lucky"). Make sure to go over every question you complete with your ESM mentor to make sure you are completing the problem in a correct and efficient way.