

# 25 Challenging SAT Problems

From [learnsatmath.com](https://learnsatmath.com)

These questions are all variations of the hardest problems from the Fall 2024 and Spring 2025 SATs. The difficulty of these problems is comparable to the difficulty of the final 3 problems on the hardest module 2.

This set is also fairly comprehensive, meaning that it covers almost *every* challenging topic that you can expect to see.

If you find these problems too challenging, check out my book, *SAT Math from the Ground Up* at [learnsatmath.com](https://learnsatmath.com). It will teach you... you'll never guess this one... the SAT math from the ground up. Rather than focusing on *how* to solve problems, it'll teach you *why* the math really works, which is *essential* to tackle problems of this difficulty.

These 25 problems follow the book's ordering:

- Chapter 1: Algebra & Functions - Q1-5
- Chapter 2: Exponentials - Q6-8
- Chapter 3: Quadratics - Q9-14
- Word Problems (scattered): Q15-16
- Chapter 4: Geometry & Trig - Q17-22
- Chapter 5: Statistics - Q23-25

Final footnote: You may notice that a disproportionate number of these problems have you evaluate 3 options (the I, II, III problems). This is because:

1. These problems are harder/longer
2. These problems cover more concepts in less time

Just know that on the actual SAT, you won't be getting nearly as many of these.

## 1 Challenging Functions

$$f(x) = a\sqrt{x-b} + 12\sqrt{x-b}$$

For the function  $f$ ,  $a$  and  $b$  are constants, and  $f(4) = 0$ . If  $f(5) > 0$ , which of the following could be a value for  $a + b$ ?

- A) -20
- B) -12
- C) -8
- D) -4

## 2 Fraction Algebra 1 - Constant Denominators

$$\frac{16}{a} = \frac{16}{b} + \frac{16}{c}$$

Which of the following expresses  $a$  in terms of  $b$  and  $c$ ?

- A)  $a = \frac{b+c}{bc}$
- B)  $a = \frac{bc}{b+c}$
- C)  $a = bc(b+c)$
- D)  $a = 16bc(b+c)$

### 3 Fraction Algebra 2 - Solving Coefficients

$$\frac{ax^3 + bx^2 + cx + d}{(x^2 - 9)(x + 2)} = \frac{5}{x + 3} + \frac{6x}{x - 3}$$

What is the value of  $a + b + c$ ?

### 4 Unintuitive Linear Models

There are two lawn mowing companies. Company A charges a flat fee of \$80 for the first hour, then an hourly rate of \$60 for each additional hour. Company B charges no flat fee, but an hourly rate of \$75 per hour. After how many *minutes* will company A's total cost exceed company B's?

## 5 Standard Form Solutions

$$\begin{aligned}\frac{5}{6}x + ay &= b \\ \frac{11}{10}x + cy &= 2d\end{aligned}$$

If the system of equations above has infinite solutions, what must be the value of  $\frac{b}{d}$ ?

## 6 Percentages

$a$  is 540% more than  $b$  and  $b$  is 0.02% of  $c$ .

If  $a$  is  $k\%$  of  $c$ , then what must  $k$  equal?

## 7 Exponential Functions 1 - Fractional Exponents

$$f(t) = a(2)^{\frac{2t}{11}}$$

The given function  $f(t)$  models the amount of money in an investment account  $t$  years after the account is opened, where  $a$  is a constant. How many months will it take for the initial investment to increase by 700%?

## 8 Exponential Functions 2 - Constants & Coefficients

$$f(x) = k^3(k^x) + b$$

The function  $f$  is defined by the equation above for  $x \geq 0$ .  $k$  and  $b$  are positive constants and  $k < 1$ . Which of the following must be true?

I. The maximum value of the function is displayed as a constant or coefficient of the function.

II.  $f(1) = f(0) * k$

III.  $f(a) < b$  for some  $a > 0$ .

- A) I only
- B) II and III only
- C) I and III only
- D) Neither I, II, nor III

## 9 Integer Factors 1 - Maximizing Products

$$15x^{18} + kx^9 + 24$$

The expression above has factors  $ax^9 + b$  and  $cx^9 + d$ , where  $a$ ,  $b$ ,  $c$ , and  $d$  are all integer constants. What is the maximum value of  $k$ ?

## 10 Integer Factors 2 - Identifying Integers

$$(hx + k)(qx + z) = ax^2 + bx + 35$$

For the expression above,  $h$ ,  $k$ ,  $q$ , and  $z$  are all integer constants. Which of the following must be an integer?

I.  $\frac{35}{k}$

II.  $b$

III.  $-\frac{a}{q}$

- A) I and II only
- B) II and III only
- C) I and III only
- D) I, II, and III

## 11 Quadratics 1 - Vertex Form

$$f(x) = -3x^2 + bx + c$$

In the given quadratic function,  $b$  and  $c$  are constants. The graph of  $y = f(x)$  in the  $xy$ -plane is a parabola that has a vertex at the point  $(h, k)$ , where  $h$  and  $k$  are constants. If  $f(-4) = f(8)$ , and the quadratic function has  $x$ -intercepts at  $(r, 0)$  and  $(s, 0)$ , which of the following must be true?

I.  $r + s = 4$

II.  $b < 0$

III.  $c < k$

- A) I and II only
- B) II and III only
- C) I and III only
- D) I, II, and III

## 12 Quadratics 2 - Applications

A quadratic function models a rock's height, in feet, above the ground in terms of the time, in seconds, after it's thrown. The rock was thrown from an initial height of  $c$  feet above the ground and reached a maximum height of 200 feet above the ground 3 seconds after it was thrown. Then it hit the ground 8 seconds after being thrown. At what initial height  $c$  was the rock thrown?

## 13 Quadratics 3 - Solutions

$$2rx^2 - 5sx + 8r = 0$$

If the quadratic equation above has one real solution and  $rs = 160$ , what is  $|r + s|$ ?

## 14 Polynomial Functions

$$f(x) = -(x + a)^2(x - b)(x - c)$$

For the polynomial function above,  $a$ ,  $b$ , and  $c$  are positive constants. Let  $b < k < c$  for some constant  $k$ . Which of the following must be true?

I.  $k > 0$

II.  $f(k) > 0$

III.  $f(0) > 0$

- A) I and II only
- B) II and III only
- C) I and III only
- D) I, II, and III



## 15 Translating English to Math

3 consecutive even integers are ordered from smallest to largest. 5 times the first integer is at least 9 more than the sum of the second and third integers. What is the minimum possible value for the second integer?

## 16 Unit Conversion

If a car accelerates at 108 kilometers per hour squared, what is its acceleration in meters per minute squared? (1 kilometer = 1000 meters)

## 17 Sine & Cosine

In triangle  $\triangle ABC$ , the measure of angle  $B$  is  $90^\circ$ ,  $\overline{AB}$  is a leg with a length of 12, and segment  $\overline{AC}$  contains the point  $D$ . Which of the following must be true?

I.  $\overline{BC} = 12 \tan(\angle CAB)$

II.  $\cos(\angle ABD) - \sin(\angle DBC) = 0$

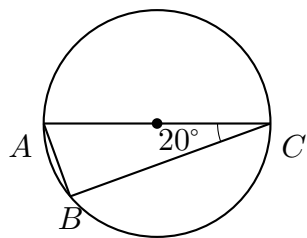
III.  $\angle ABD = \angle BDC$

- A) I and II only
- B) II and III only
- C) I and III only
- D) I, II, and III

## 18 Altitudes

In triangle  $\triangle ABC$ , the measure of angle  $B$  is  $90^\circ$ , and  $\overline{BD}$  is an altitude of the triangle. The length of  $\overline{BC}$  is 10 and  $\angle ABD = 60^\circ$ . What is the length of  $\overline{AD}$ ?

## 19 Arcs & Inscribed Angles



If the circumference of the circle above is 90 inches, then what is the length of arc  $BC$ ?

## 20 Circle Formula

In the  $xy$ -plane, the graph of  $x^2 + 6x + y^2 + 2y = 15$  is a circle. Line  $k$  is tangent to this circle at the point  $(a, b)$ , and has a slope of  $\frac{3}{4}$ . What is the value of  $b$ ?

## **21 Scale Factors**

Rectangular prism A and rectangular prism B are similar. The height of rectangular prism A is 4 inches and the height of rectangular prism B is 10 inches. If the volume of prism A is 200 cubic inches, then what is the volume of prism B?

## **22 Pyramids**

Consider a square right pyramid with a volume of 400 cubic inches and a slant height of 13 inches. The pyramid's length, width, and height (in inches) are all integers. What is the surface area of the pyramid in cubic inches?

## **23 Statistics 1 - Integer Mean**

Data set A consists of 4 integers greater than or equal to 10 but less than or equal to 20. Data set B consists of the same four integers and adds one more integer, which must also

be between 10 and 20. What is the largest possible difference between the mean of data set A and the mean of data set B?

## 24 Statistics 2 - Frequency Chart Analysis

Data	Frequency
1	2
2	5
3	6
4	5
5	2

The frequency table above summarizes data set A. Data set B is created by multiplying all of the values in data set A by 2. Which of the following must be true?

- I. The difference between the mean and median of data set B is 0.
- II. The standard deviation of data set B is equal to the standard deviation of data set A.
- III. The range of data set B is double the range of data set A.

- A) I and II only
- B) II and III only
- C) I and III only
- D) I, II, and III

## 25 Margin of Error

A sample of students was selected at random from all 11th graders in at a school. Based on the sample, it is estimated that the proportion of 11th graders in at least one AP class is 60% with a margin of error of 5%. Which of the following conclusions are appropriate?

I. It is not possible for just 40% of the 11th graders in the school to be in at least one AP class.

II. It is plausible that the proportion of all students at the school in at least one AP class is between 45% and 55%.

III. If the sample size is increased, the margin of error will drop below 5%.

- A) I and II only
- B) II and III only
- C) III only
- D) I, II, and III

## Answer Key

1. D
2. B
3. 72
4. 80
5.  $50/33$
6. 0.128
7. 198
8. D
9. 361
10. D
11. C
12. 128
13. 26
14. A
15. 8
16. 30
17. A
18. 15
19. 35
20. -5
21. 3125
22. 360
23. 12
24. C
25. C