SAT MATH / DAILY CHALLENGE

Vertex form

2026-10-02 ▪ Question first, full lesson next

TODAY'S QUESTION

The function $f(x) = 6(x - 6)^2 + 12$ has a minimum at $x = h$. What is h?

A. 8

B. 6

C. 5

D. 7

Before you choose

Identify what the question asks for. Write the relationship you will use, show the substitutions, and check whether the answer represents a value, a coordinate or a coefficient. The complete solution and the supporting theory follow in this document.

Your reasoning

When you are ready, continue to the illustrated lesson. The worked answer to this exact challenge appears on the final page.

ADVANCED MATH / 01 UNDERSTAND

Vertex form

An illustrated lesson ▪ Theory, reasoning and worked examples

The vertex is a turning point

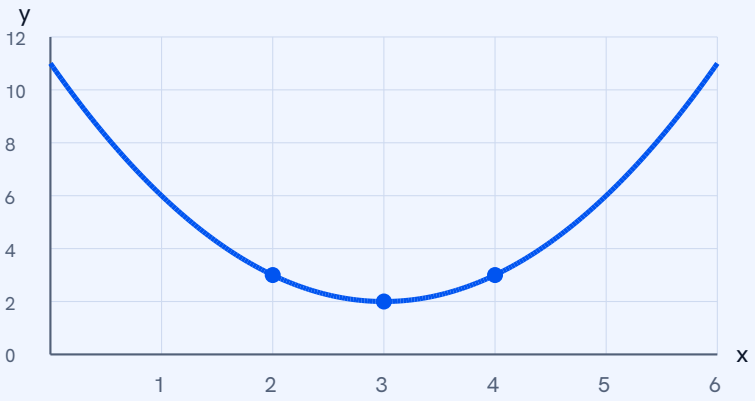
In $y = a(x - h)^2 + k$, the vertex is (h, k). If $a > 0$, the graph opens upward and its vertex is a minimum. If $a < 0$, it opens downward and its vertex is a maximum. The vertical line $x = h$ is the axis of symmetry.

Why the form works

A square is never negative for a real input, and $(x - h)^2$ equals zero exactly when $x = h$. For positive a, every other input adds a positive amount to k. For negative a, every other input subtracts from k. The extremum follows from this property of squares, not from a memorized sign trick.

Read shifts carefully

In $(x - 3)^2 + 2$, the horizontal shift is 3 to the right and the vertical shift is 2 upward. In $(x + 3)^2 + 2$, rewrite $x + 3$ as $x - (-3)$: the vertex moves left to $x = -3$. The input that makes the square zero is the reliable way to read h.



$y = (x - 3)^2 + 2$

Vertex: (3, 2)

Minimum output: 2

Equal distance from 3 gives equal output.

Illustrative teaching diagram. Values and examples are explained in the lesson.

THE ESSENTIAL IDEA

In $y = a(x - h)^2 + k$, the vertex is (h, k).

ADVANCED MATH / 02 BUILD THE METHOD

From idea to method

Convert from standard form

For $ax^2 + bx + c$, the vertex input is $h = -b/(2a)$. Substitute h into the function to obtain k. Completing the square gives the same result while explicitly rewriting the whole function in vertex form. Do not confuse the input h with the minimum or maximum output k.

Understand the scale factor

A larger absolute value of a makes the graph narrower relative to $y = x^2$ on the same axes. Moving one unit from h changes y by a; moving two units changes it by 4a. This squared growth explains the shape and provides quick points for a sketch.

Respect the domain of a model

A parabola used for height over time may only apply between launch and landing. A quadratic cost model may only permit nonnegative quantities. If the vertex lies outside a restricted interval, the greatest or least permitted value may occur at an endpoint instead.

WORKED EXAMPLE / FIND A MAXIMUM

A model is $H(t) = -2(t - 3)^2 + 20$. What is its maximum value and when does it occur?

01 Set up the reasoning

The coefficient -2 is negative, so the parabola opens downward.

02 Apply the relationship

The squared term is zero at $t = 3$. Then $H(3) = 20$.

03 Interpret and check

At $t = 2$ and $t = 4$, $H = 18$. Equal distances from 3 give equal outputs, confirming symmetry.

Keep these distinctions handy

Vertex form	$a(x - h)^2 + k$ exposes the vertex (h, k).
Standard form	$ax^2 + bx + c$ gives $h = -b/(2a)$; find k by substitution.
Opening direction	$a > 0$: minimum. $a < 0$: maximum.

ADVANCED MATH / 03 CONNECT & REMEMBER

See the deeper pattern

Recover vertex form by completing the square

For $x^2 - 6x + 11$, group $x^2 - 6x$ and add and subtract 9: $(x^2 - 6x + 9) + 2 = (x - 3)^2 + 2$. The added 9 completes a square; subtracting the same amount preserves the expression. The vertex is (3, 2), and the function has no real x-intercepts because its minimum is positive.

TODAY'S CHALLENGE / SOLUTION

The function $f(x) = 6(x - 6)^2 + 12$ has a minimum at $x = h$. What is h?

1. A square is nonnegative and 6 is positive.

2. The square is zero when $x = 6$, giving the minimum $f(x) = 12$.

Answer: 6

Mistakes to recognize

- The minimum value is k, not h.
- A negative a changes a minimum into a maximum.
- An x-intercept is generally not the vertex.

A quick understanding check

Where is the vertex of $2(x + 4)^2 - 1$?

Explanation: At (-4, -1), because $x = -4$ makes the square zero.

MORE PRACTICE IN YOUR DASHBOARD

Open prepvora.com/app/ and use the SAT question bank. Work on Advanced Math, then look for vertex form questions. Solve independently before reviewing the explanation. Use this guide for the theory; use the dashboard for a longer practice session.

Open your dashboard → | Explore the resource library →

Original Prepvora explanations and examples. Scope: this topic, not the entire SAT syllabus. 2026-10-02 ▪ theory-v2