LESSON MAKER PRO

Vertex Value Hunt

Complete the square to uncover each quadratic's highest or lowest value.

HIGH SCHOOL · HSA-SSE.B.3b

CCSS.Math.Content.HSA-SSE.B.3b "Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines."

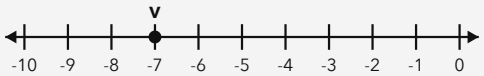
NAME _____ **DATE** _____

REVEAL THE VERTEX

Rewrite a quadratic as $a(x - h)^2 + k$ by completing the square. If a is positive, k is the minimum. If a is negative, k is the maximum.

WORKED EXAMPLE

The number line marks the vertex's x-coordinate for $f(x) = x^2 + 14x + 2$. Complete the square and find the minimum value.



1. $x^2 + 14x + 2 = x^2 + 14x + 49 - 49 + 2$
2. $= (x + 7)^2 - 47$
3. The coefficient is positive, so the minimum is -47.

Answer: $f(x) = (x + 7)^2 - 47$; minimum: -47

PRACTICE 4 problems

1 Rewrite $f(x) = x^2 - 10x + 3$ in vertex form. State its minimum value.

ANSWER _____

2 Rewrite $f(x) = -2x^2 + 12x + 5$ in vertex form. State its maximum value.

ANSWER _____

3 Rewrite $f(x) = 3x^2 + 18x - 1$ in vertex form. State its minimum value.

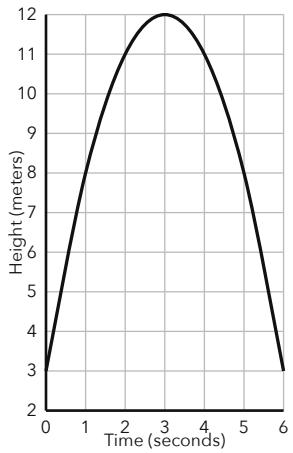
ANSWER _____

4 Rewrite $f(x) = -5x^2 - 20x + 6$ in vertex form. State its maximum value.

ANSWER _____

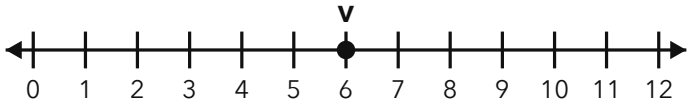
APPLY IT Show your work

1 A skate video tracks a jump's height. The graph and $f(x) = -x^2 + 6x + 3$ show height in meters after x seconds. Complete the square. What is the greatest height?



ANSWER _____

2 A music app models background noise during a sound check by $f(x) = x^2 - 12x + 40$, where x is minutes. The number line marks the time of the lowest noise level. Complete the square and find that level.



ANSWER _____

CHALLENGE One step up

Complete the square for $f(x) = -3x^2 + 18x - 5$. Explain why the value you find is a maximum.

WORK SPACE AND ANSWER

ANSWER KEY

Vertex Value Hunt

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Rewrite $f(x) = x^2 - 10x + 3$ in vertex form. State its minimum value.	**$f(x) = (x - 5)^2 - 22$; minimum: -22**
2	Rewrite $f(x) = -2x^2 + 12x + 5$ in vertex form. State its maximum value.	**$f(x) = -2(x - 3)^2 + 23$; maximum: 23**
3	Rewrite $f(x) = 3x^2 + 18x - 1$ in vertex form. State its minimum value.	**$f(x) = 3(x + 3)^2 - 28$; minimum: -28**
4	Rewrite $f(x) = -5x^2 - 20x + 6$ in vertex form. State its maximum value.	**$f(x) = -5(x + 2)^2 + 26$; maximum: 26**

PART 2 · APPLY IT

1. **$f(x) = -(x - 3)^2 + 12$; greatest height: 12 meters at x = 3 seconds** Factor out -1 from the x terms, then complete the square. The negative coefficient means the vertex value, 12, is a maximum.
2. **$f(x) = (x - 6)^2 + 4$; lowest noise level: 4 units at x = 6 minutes** Add and subtract 36 to form $(x - 6)^2$. Since the squared term has a positive coefficient, 4 is the minimum.

CHALLENGE

$f(x) = -3(x - 3)^2 + 22$. Since $(x - 3)^2$ is at least 0, $-3(x - 3)^2$ is at most 0, so the maximum is 22 at x = 3.

Accept equivalent vertex forms with correct parentheses and values. For explanations, students should connect a negative leading coefficient to a maximum and a positive leading coefficient to a minimum.