LESSON MAKER PRO

Vertex Value Vault

Complete the square to uncover each 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 EXTREME

Rewrite a quadratic so it has a squared term plus or minus a constant. Because a square is never negative, a positive squared term reveals a minimum, and a negative squared term reveals a maximum.

WORKED EXAMPLE

Complete the square and find the minimum value of f(x) = x^2 + 10x + 1.

1. Group the quadratic and linear terms: f(x) = (x^2 + 10x) + 1.
2. Complete the square: x^2 + 10x = (x + 5)^2 - 25.
3. Substitute: f(x) = (x + 5)^2 - 24.
4. Since (x + 5)^2 is at least 0, the minimum is -24 when x = -5.

Answer: f(x) = (x + 5)^2 - 24; minimum value: -24 at x = -5

PRACTICE 6 problems

1 Complete the square and find the minimum value of f(x) = x^2 + 6x + 11.

ANSWER _____

2 Complete the square and find the minimum value of g(x) = x^2 - 14x + 20.

ANSWER _____

3 Complete the square and find the maximum value of h(x) = -x^2 + 4x + 9.

ANSWER _____

4 Complete the square and find the maximum value of p(x) = -x^2 - 12x - 8.

ANSWER _____

5 Complete the square and find the minimum value of q(x) = 2x^2 + 14x + 6.

ANSWER _____

6 Complete the square and find the maximum value of r(x) = -3x^2 + 18x - 4.

ANSWER _____

APPLY IT Show your work

1 A skateboarder's height, h(t), in feet is modeled by h(t) = -7t^2 + 28t + 6, where t is time in seconds after takeoff. Complete the square, then find the skateboarder's maximum height and the time when it occurs.

WORK SPACE

ANSWER _____

2 A school music club models its profit, P(x), in tens of dollars by P(x) = -2x^2 + 16x + 3. Here, x is the number of 1-dollar ticket price increases from the current ticket price. Complete the square, then find the price increase that gives the greatest profit and the greatest profit.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Complete the square for m(x) = 3x^2 - 9x + 2. Then state the minimum value and explain why it is a minimum.

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ANSWER KEY

Vertex Value Vault

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Complete the square and find the minimum value of f(x) = x^2 + 6x + 11.	**f(x) = (x + 3)^2 + 2; minimum value: 2 at x = -3**
2	Complete the square and find the minimum value of g(x) = x^2 - 14x + 20.	**g(x) = (x - 7)^2 - 29; minimum value: -29 at x = 7**
3	Complete the square and find the maximum value of h(x) = -x^2 + 4x + 9.	**h(x) = -(x - 2)^2 + 13; maximum value: 13 at x = 2**
4	Complete the square and find the maximum value of p(x) = -x^2 - 12x - 8.	**p(x) = -(x + 6)^2 + 28; maximum value: 28 at x = -6**
5	Complete the square and find the minimum value of q(x) = 2x^2 + 14x + 6.	**q(x) = 2(x + 7/2)^2 - 37/2; minimum value: -37/2 at x = -7/2**
6	Complete the square and find the maximum value of r(x) = -3x^2 + 18x - 4.	**r(x) = -3(x - 3)^2 + 23; maximum value: 23 at x = 3**

PART 2 · APPLY IT

1. **h(t) = -7(t - 2)^2 + 34; maximum height: 34 feet at 2 seconds** Factor -7 from the quadratic and linear terms, then complete the square. The negative squared term is greatest when (t - 2)^2 = 0.
2. **P(x) = -2(x - 4)^2 + 35; greatest profit: $350 with a $4 price increase** Rewrite the function as -2(x - 4)^2 + 35. The maximum model value is 35 tens of dollars when x = 4.

CHALLENGE

m(x) = 3(x - 3/2)^2 - 19/4; minimum value: -19/4 at x = 3/2. It is a minimum because 3(x - 3/2)^2 is always greater than or equal to 0.

Accept equivalent completed-square forms, including reordered terms. Students should identify both the extreme value and the x-value where it occurs.