

Parabola Power

Use equivalent forms to reveal key features.

HIGH SCHOOL • AI-F.IF.8.a

AI-F.IF.8.a "For a quadratic function, use an algebraic process to find zeros, maxima, minima, and symmetry of the graph, and interpret these in terms of context."

NAME _____

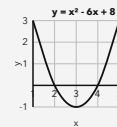
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REVEAL THE FEATURES

In factored form, $f(x) = a(x - r)(x - s)$, the zeros are r and s . The axis of symmetry is halfway between the zeros. In vertex form, $f(x) = a(x - h)^2 + k$, the vertex is (h, k) , and k is a maximum when a is negative or a minimum when a is positive.

WORKED EXAMPLE

The graph shows $y = x^2 - 6x + 8$. Find the zeros, minimum, and axis of symmetry.



1. Factor: $x^2 - 6x + 8 = (x - 2)(x - 4)$.
2. Set each factor equal to 0: $x = 2$ or $x = 4$.
3. Average the zeros: $(2 + 4)/2 = 3$. The vertex is $(3, -1)$.

Answer: Zeros: $x = 2$ and $x = 4$.

Minimum: -1 at $x = 3$. Axis of symmetry: $x = 3$.

PRACTICE 4 problems

- 1** 1. For $f(x) = x^2 + 4x - 21$, find the zeros and the axis of symmetry.

ANSWER _____

- 2** 2. For $f(x) = -x^2 + 10x - 21$, find the maximum value and the axis of symmetry.

ANSWER _____

- 3** 3. For $f(x) = (x - 7)^2 - 9$, find the minimum value and the axis of symmetry.

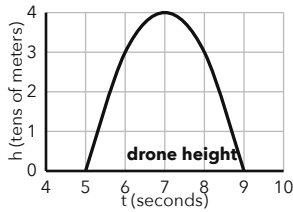
ANSWER _____

- 4** 4. For $f(x) = 2(x + 1)(x - 5)$, find the zeros and the axis of symmetry.

ANSWER _____

APPLY IT Show your work

- 1** A drone's height h , in tens of meters, is $h = -t^2 + 14t - 45$, where t is seconds. Use the graph. Write the function in factored form, then state when the drone is at ground level and its greatest height.



ANSWER _____

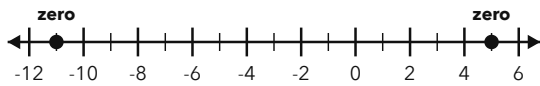
- 2** A student club models its profit P , in hundreds of dollars, by $P = -3n^2 + 30n - 63$, where n is the number of batches sold. Find the maximum profit and the two break-even numbers of batches.

WORK SPACE

ANSWER _____

CHALLENGE One step up

The number line marks the zeros of a downward-opening quadratic. Its function is $f(x) = -2(x + 11)(x - 5)$. Find the axis of symmetry and maximum value. Explain how the zeros help you find the axis.



WORK SPACE AND ANSWER

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	1. For $f(x) = x^2 + 4x - 21$, find the zeros and the axis of symmetry.	Zeros: $x = -7$ and $x = 3$. Axis of symmetry: $x = -2$.
2	2. For $f(x) = -x^2 + 10x - 21$, find the maximum value and the axis of symmetry.	Maximum: 4 at $x = 5$. Axis of symmetry: $x = 5$.
3	3. For $f(x) = (x - 7)^2 - 9$, find the minimum value and the axis of symmetry.	Minimum: -9 at $x = 7$. Axis of symmetry: $x = 7$.
4	4. For $f(x) = 2(x + 1)(x - 5)$, find the zeros and the axis of symmetry.	Zeros: $x = -1$ and $x = 5$. Axis of symmetry: $x = 2$.

PART 2 • APPLY IT

- $h = -(t - 5)(t - 9)$. The drone is at ground level at 5 seconds and 9 seconds. Its greatest height is 40 meters at 7 seconds.**
Factor to get $-(t - 5)(t - 9)$, so the zeros are 5 and 9. Their midpoint is 7, and $h(7) = 4$ tens of meters.
- Maximum profit: \$1,200 at 5 batches. Break-even: 3 batches and 7 batches.** Factor $P = -3(n - 3)(n - 7)$, so break-even occurs at 3 and 7 batches. The axis is $n = 5$, and $P(5) = 12$ hundreds of dollars.

CHALLENGE

Axis of symmetry: $x = -3$. Maximum value: 128 at $x = -3$. The axis is halfway between the zeros because $(-11 + 5)/2 = -3$.

Accept equivalent factored or vertex forms when they are correct. For contextual answers, require both the numerical result and appropriate units.