

Parabola Feature Forge

Build equations from the clues a parabola gives you.

HIGH SCHOOL • MA.912.GR.7.4

MA.912.GR.7.4 "Given a mathematical or real-world context, derive and create the equation of a parabola using key features."

NAME _____

DATE _____

BUILD FROM FEATURES

For a vertical parabola with vertex (h, k) , start with $y = a(x - h)^2 + k$. Substitute a point on the parabola to find a . When you know a focus and directrix, find the vertex halfway between them, then use $(x - h)^2 = 4p(y - k)$.

WORKED EXAMPLE

Write the equation of the parabola with vertex $(4, -3)$ that passes through $(6, 5)$.

1. Start with $y = a(x - 4)^2 - 3$.
2. Substitute $(6, 5)$: $5 = a(6 - 4)^2 - 3$.
3. Solve: $8 = 4a$, so $a = 2$.
4. Substitute $a = 2$ into the equation.

Answer: $y = 2(x - 4)^2 - 3$

PRACTICE 6 problems

- 1** Write the equation of the parabola with vertex $(-1, 2)$ that passes through $(1, 10)$.

ANSWER _____

- 2** Write the equation of the parabola with vertex $(3, 1)$ that passes through $(1, -7)$.

ANSWER _____

- 3** Write the equation of the horizontal parabola with vertex $(-1, 3)$ that passes through $(7, 1)$.

ANSWER _____

- 4** A parabola has focus $(7, 15)$ and directrix $y = 9$. Write its equation.

ANSWER _____

- 5** A parabola has x-intercepts at -1 and 3 and a y-intercept of -6 . Write its equation.

ANSWER _____

- 6** A parabola has vertex $(0, -2)$ and passes through $(2, 0)$. Write its equation.

ANSWER _____

APPLY IT Show your work

- 1** A robotics team models the path of a launched foam ball. In their coordinate system, the ball reaches a highest point at $(1, 12)$ and passes through $(3, 8)$. Write an equation for the ball's path.

WORK SPACE

ANSWER _____

- 2** A skate park ramp is modeled by a parabola. The ramp meets the ground at $x = -2$ and $x = 3$, and it passes through $(0, 12)$. Write an equation for the ramp.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A parabola has axis of symmetry $x = 2$ and passes through $(0, 10)$ and $(3, 1)$. Write its equation in vertex form. Show how the two points help you find both a and k .

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write the equation of the parabola with vertex $(-1, 2)$ that passes through $(1, 10)$.	$y = 2(x + 1)^2 + 2$
2	Write the equation of the parabola with vertex $(3, 1)$ that passes through $(1, -7)$.	$y = -2(x - 3)^2 + 1$
3	Write the equation of the horizontal parabola with vertex $(-1, 3)$ that passes through $(7, 1)$.	$x = 2(y - 3)^2 - 1$
4	A parabola has focus $(7, 15)$ and directrix $y = 9$. Write its equation.	$(x - 7)^2 = 12(y - 12)$
5	A parabola has x-intercepts at -1 and 3 and a y-intercept of -6 . Write its equation.	$y = 2(x + 1)(x - 3)$
6	A parabola has vertex $(0, -2)$ and passes through $(2, 0)$. Write its equation.	$y = 1/2x^2 - 2$

PART 2 · APPLY IT

- $y = -(x - 1)^2 + 12$ Use vertex form $y = a(x - 1)^2 + 12$. Substituting $(3, 8)$ gives $8 = 4a + 12$, so $a = -1$.
- $y = -2(x + 2)(x - 3)$ Start with $y = a(x + 2)(x - 3)$. Substituting $(0, 12)$ gives $12 = -6a$, so $a = -2$.

CHALLENGE

$y = 3(x - 2)^2 - 2$. Using $y = a(x - 2)^2 + k$ gives $10 = 4a + k$ and $1 = a + k$. Subtracting gives $9 = 3a$, so $a = 3$ and $k = -2$.

Accept equivalent expanded, factored, or vertex forms when they represent the same parabola. For the focus and directrix item, accept $y = 1/12(x - 7)^2 + 12$ as equivalent.