LESSON MAKER PRO

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

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.

WORK SPACE AND ANSWER

ANSWER KEY

Parabola Feature Forge

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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

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

CHALLENGE

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

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.