Writing the Equation of a Parabola

Conic Sections Worksheet · Grade 10–12

Name: _____ Date: _____

Learning Objectives

- Write the standard equation of a parabola given its vertex and focus
- Determine the correct standard form based on the direction the parabola opens
- Convert the standard equation of a parabola to its general form

Problems

1. Find the standard equation of the parabola with vertex at the origin and focus at the point below.

$F(1, 0)$

2. Find the standard equation of the parabola with vertex at the origin and focus at the point below.

$F(0, 3)$

3. Find the standard equation of the parabola with vertex at the origin and focus at the point below.

$F(-4, 0)$

4. Find the standard equation of the parabola with vertex at the origin and focus at the point below.

$F(0, -5)$

5. Find the standard equation of the parabola with the vertex and focus given below.

Vertex: $(1, 2)$, Focus: $(4, 2)$

6. Find the standard equation of the parabola with the vertex and focus given below.

Vertex: $(3, -1)$, Focus: $(3, 4)$

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7. Find the standard equation of the parabola with the vertex and focus given below.

Vertex: $(-2, 5)$, Focus: $(-2, 2)$

8. Write both the standard equation and the general equation of the parabola with the vertex and focus given below.

Vertex: $(2, 1)$, Focus: $(2, 4)$

9. Write both the standard equation and the general equation of the parabola with the vertex and focus given below.

Vertex: $(-1, 3)$, Focus: $(2, 3)$

10. A parabola has a vertex at the point below and its focus is 4 units directly to the left of the vertex. Write the standard equation and then convert it to general form.

Vertex: $(5, -2)$

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Writing the Equation of a Parabola — Answer Key

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Answer Key

1. Answer: y^2 = 4x

- Vertex is at (0,0), focus is at (1,0), so the parabola opens to the right.
- Use the formula y^2 = 4px.
- p = 1 (distance from vertex to focus).
- Substitute: y^2 = 4(1)x = 4x.

2. Answer: x^2 = 12y

- Vertex is at (0,0), focus is at (0,3), so the parabola opens upward.
- Use the formula x^2 = 4py.
- p = 3 (distance from vertex to focus).
- Substitute: x^2 = 4(3)y = 12y.

3. Answer: y^2 = -16x

- Vertex is at (0,0), focus is at (-4,0), so the parabola opens to the left.
- Use the formula y^2 = 4px, where p is negative.
- p = -4.
- Substitute: y^2 = 4(-4)x = -16x.

4. Answer: x^2 = -20y

- Vertex is at (0,0), focus is at (0,-5), so the parabola opens downward.
- Use the formula x^2 = 4py, where p is negative.
- p = -5.
- Substitute: x^2 = 4(-5)y = -20y.

5. Answer: (y-2)^2 = 12(x-1)

- The focus and vertex share the same y-coordinate, so the parabola opens to the right.
- Use the formula (y - k)^2 = 4p(x - h).
- h = 1, k = 2, p = 4 - 1 = 3.
- Substitute: (y - 2)^2 = 4(3)(x - 1) = 12(x - 1).

6. Answer: (x-3)^2 = 20(y+1)

- The focus and vertex share the same x-coordinate, so the parabola opens upward.
- Use the formula (x - h)^2 = 4p(y - k).
- h = 3, k = -1, p = 4 - (-1) = 5.
- Substitute: (x - 3)^2 = 4(5)(y + 1) = 20(y + 1).

7. Answer: (x+2)^2 = -12(y-5)

- The focus and vertex share the same x-coordinate and the focus is below the vertex, so the parabola opens downward.

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- Use the formula (x - h)^2 = 4p(y - k).
- h = -2, k = 5, p = 2 - 5 = -3.
- Substitute: (x + 2)^2 = 4(-3)(y - 5) = -12(y - 5).

8. Answer: Standard: (x-2)^2 = 12(y-1); General: x^2 - 4x - 12y + 16 = 0

- Parabola opens upward; use (x - h)^2 = 4p(y - k).
- h = 2, k = 1, p = 3. Standard form: (x - 2)^2 = 12(y - 1).
- Expand: x^2 - 4x + 4 = 12y - 12.
- Rearrange to zero: x^2 - 4x - 12y + 16 = 0.

9. Answer: Standard: (y-3)^2 = 12(x+1); General: y^2 - 6y - 12x - 3 = 0

- Parabola opens to the right; use (y - k)^2 = 4p(x - h).
- h = -1, k = 3, p = 2 - (-1) = 3. Standard form: (y - 3)^2 = 12(x + 1).
- Expand: y^2 - 6y + 9 = 12x + 12.
- Rearrange to zero: y^2 - 6y - 12x - 3 = 0.

10. Answer: Standard: (y+2)^2 = -16(x-5); General: y^2 + 4y + 16x - 76 = 0

- Focus is 4 units to the left, so p = -4 and the parabola opens left.
- Use (y - k)^2 = 4p(x - h) with h = 5, k = -2, p = -4.
- Standard form: (y + 2)^2 = -16(x - 5).
- Expand: y^2 + 4y + 4 = -16x + 80.
- Rearrange to zero: y^2 + 4y + 16x - 76 = 0.

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