# Converting Conic Sections to Standard Form

Algebra & Pre-Calculus Worksheet · Grade 10–12

Name: _____ Date: _____

**Learning Objectives**

- Identify the type of conic section from its general equation
- Use the completing the square technique to rewrite general equations in standard form
- Extract key features such as vertex, center, and orientation from the standard form

## Problems

**1.** Identify the conic section represented by the equation below. Explain how you know.

$$y^2 - 8x + 4y + 4 = 0$$

**2.** Identify the conic section represented by the equation below.

$$x^2 + y^2 - 6x + 4y - 12 = 0$$

**3.** Complete the square for the expression below and write it as a perfect square trinomial in factored form.

$$y^2 + 10y$$

**4.** Complete the square for the expression below and write it in factored form.

$$x^2 - 12x$$

**5.** Convert the equation below to standard form. Then state the vertex and the direction the parabola opens.

$$y^2 + 6y - 4x + 33 = 0$$

**6.** Convert the equation below to standard form of a parabola. Then identify the vertex.

Scan to watch

$$x^2 - 4x - 8y + 28 = 0$$

**7.** Convert the equation below to standard form. Then identify the conic section and its center.

$$x^2 + y^2 - 6x + 4y - 12 = 0$$

**8.** Convert the equation below to standard form of an ellipse. Then identify the center.

$$x^2 + 4y^2 + 6x - 8y - 3 = 0$$

**9.** Convert the equation below to standard form of a hyperbola. Then identify the center.

$$9x^2 - 4y^2 - 18x + 24y - 63 = 0$$

**10.** Convert the equation below to standard form. Identify the conic section, its center or vertex, and describe its orientation.

$$4x^2 + y^2 - 16x + 6y - 39 = 0$$

Scan to watch

# Converting Conic Sections to Standard Form — Answer Key

Algebra & Pre-Calculus Worksheet · Grade 10–12

## Answer Key

**1. Answer: Parabola — only one variable is squared**

- Check which variables have an exponent of 2
- Only y is squared, so this is a parabola

**2. Answer: Circle — both variables are squared with equal coefficients**

- Both x and y are squared with the same coefficient (1)
- Equal coefficients indicate a circle

**3. Answer: (y + 5)^2 – 25**

- Take half of 10: 10 ÷ 2 = 5
- Square it: $5^2 = 25$
- Add and subtract 25: $y^2 + 10y + 25 – 25 = (y + 5)^2 – 25$

**4. Answer: (x – 6)^2 – 36**

- Take half of –12: –12 ÷ 2 = –6
- Square it: $(–6)^2 = 36$
- Add and subtract 36: $x^2 – 12x + 36 – 36 = (x – 6)^2 – 36$

**5. Answer: (y + 3)^2 = 4(x – 6); vertex (6, –3); opens right**

- Rearrange: $y^2 + 6y = 4x – 33$
- Complete the square: $y^2 + 6y + 9 = 4x – 33 + 9$
- Factor: $(y + 3)^2 = 4x – 24$
- Factor right side: $(y + 3)^2 = 4(x – 6)$
- Vertex is (6, –3); since y is squared and coefficient is positive, opens right

**6. Answer: (x – 2)^2 = 8(y – 3); vertex (2, 3)**

- Rearrange: $x^2 – 4x = 8y – 28$
- Complete the square: $x^2 – 4x + 4 = 8y – 28 + 4$
- Factor: $(x – 2)^2 = 8y – 24$
- Factor right side: $(x – 2)^2 = 8(y – 3)$
- Vertex is (2, 3); since x is squared, parabola opens upward

**7. Answer: (x – 3)^2 + (y + 2)^2 = 25; circle with center (3, –2)**

- Group: $(x^2 – 6x) + (y^2 + 4y) = 12$
- Complete the square for x: add 9; for y: add 4
- $(x^2 – 6x + 9) + (y^2 + 4y + 4) = 12 + 9 + 4$
- $(x – 3)^2 + (y + 2)^2 = 25$

Scan to watch

- This is a circle with center (3, –2) and radius 5

**8. Answer: \frac{(x+3)^2}{16} + \frac{(y-1)^2}{4} = 1; center (–3, 1)**

- Group: $(x^2 + 6x) + 4(y^2 – 2y) = 3$
- Complete the square for x: add 9; for y inside parentheses: add 1 (multiply by 4 outside)
- $(x^2 + 6x + 9) + 4(y^2 – 2y + 1) = 3 + 9 + 4$
- $(x + 3)^2 + 4(y – 1)^2 = 16$
- Divide by 16: $(x+3)^2/16 + (y–1)^2/4 = 1$; center (–3, 1)

**9. Answer: \frac{(x-1)^2}{4} - \frac{(y-3)^2}{9} = 1; center (1, 3)**

- Group: $9(x^2 – 2x) – 4(y^2 – 6y) = 63$
- Complete the square: $9(x^2 – 2x + 1) – 4(y^2 – 6y + 9) = 63 + 9 – 36$
- $9(x – 1)^2 – 4(y – 3)^2 = 36$
- Divide by 36: $(x–1)^2/4 – (y–3)^2/9 = 1$
- This is a hyperbola with center (1, 3)

**10. Answer: \frac{(x-2)^2}{16} + \frac{(y+3)^2}{64} = 1; ellipse, center (2, –3), major axis vertical**

- Group: $4(x^2 – 4x) + (y^2 + 6y) = 39$
- Complete the square: $4(x^2 – 4x + 4) + (y^2 + 6y + 9) = 39 + 16 + 9$
- $4(x – 2)^2 + (y + 3)^2 = 64$
- Divide by 64: $(x–2)^2/16 + (y+3)^2/64 = 1$
- Ellipse with center (2, –3); since 64 > 16, major axis is vertical

Scan to watch