

Warm-up:

Factor :

$$1) x^2 - 25$$

$$2) x^2 - 12x + 36$$

2. Determine the roots of each equation by completing the square.

M4-75

a. $x^2 - 6x + 4 = 0$

b. $x^2 - 12x + 6 = 0$

You can identify the axis of symmetry and the vertex of any quadratic function written in general form by completing the square.

Worked Example

Consider the equation $y = ax^2 + bx + c$.

Step 1: $y - c = ax^2 + bx$

Step 2: $y - c = a\left(x^2 + \frac{b}{a}x\right)$

Step 3: $y - c + a\left(\frac{b}{2a}\right)^2 = a\left(x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2\right)$

Step 4: $y - c + \frac{b^2}{4a} = a\left(x + \frac{b}{2a}\right)^2$

Step 5: $y = a\left(x + \frac{b}{2a}\right)^2 + \left(c - \frac{b^2}{4a}\right)$

$$y = a\left(x + \frac{b}{2a}\right)^2 + \left(c - \frac{b^2}{4a}\right)$$

2. Given a quadratic function in the form $y = ax^2 + bx + c$:

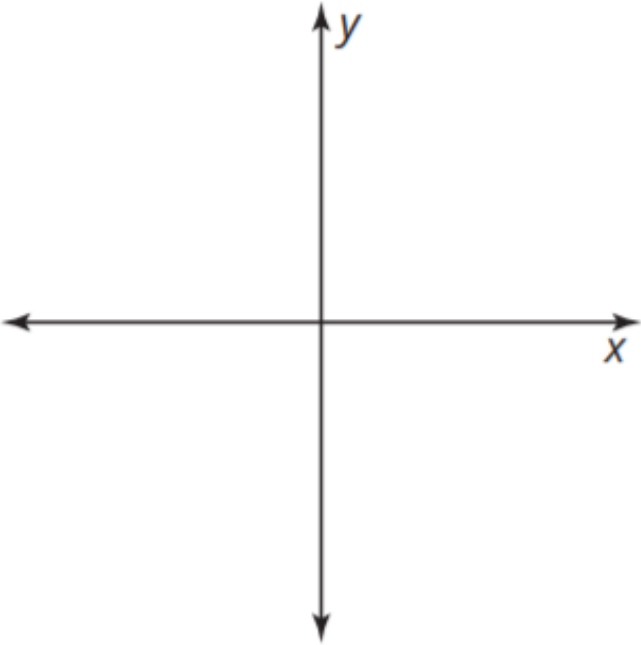
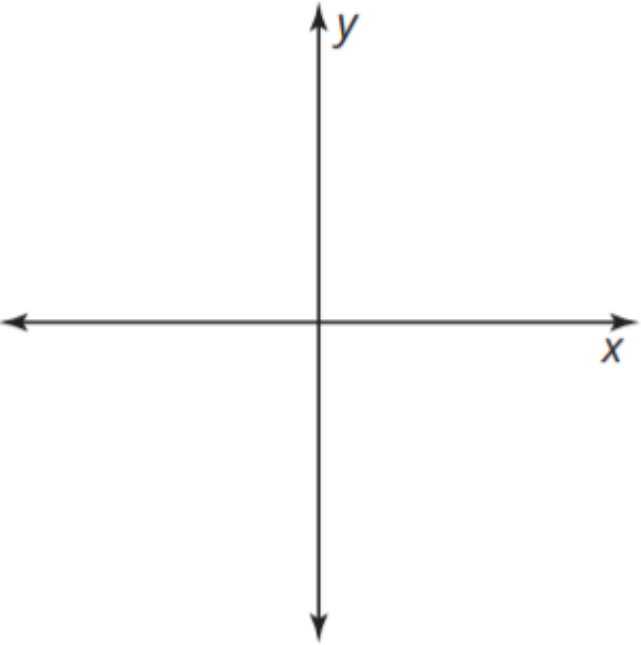
a. Identify the axis of symmetry.

b. Identify the location of the vertex.

3. Rewrite each quadratic equation in vertex form. Then identify the zeros and sketch a graph of each function. Write the zeros in terms of the axis of symmetry and the parabola.

a. $y = x^2 + 8x - 9$

b. $y = 3x^2 + 2x - 1$



4. A ball is thrown straight up from 4 feet above the ground with a velocity of 32 feet per second. The height of the ball over time can be modeled with the function $h(t) = -16t^2 + 32t + 4$. What is the maximum height of the ball?

Practice

1. Solve each equation.

a. $0 = x^2 - 7x - 18$

b. $x^2 + 10x = 39$

c. $0 = x^2 - 10x + 12$

d. $2x^2 + 4x = 0$

e. $3x^2 - 22x + 7 = 0$

2. Determine the roots of the equation $y = x^2 + 9x + 3$. Check your solutions.

3. Consider the equation $y = 2x^2 + 10x - 8$.

a. Graph the equation.

b. Use the graph to estimate the solutions to the equation. Explain how you determined your answer.

c. Two students completed the square to determine the solutions to this equation. Their work is shown. Who is correct? Explain your reasoning.

Student 1

$$y = 2x^2 + 10x - 8$$

$$2x^2 + 10x - 8 = 0$$

$$2x^2 + 10x = 8$$

$$2x^2 + 10x + 25 = 8 + 25$$

$$(2x + 5)^2 = 33$$

$$\sqrt{(2x + 5)^2} = \pm\sqrt{33}$$

$$2x + 5 = \pm\sqrt{33}$$

$$x = \frac{-5 \pm \sqrt{33}}{2}$$

$$x \approx -5.372 \text{ and } x \approx 0.372$$

Student 2

$$y = 2x^2 + 10x - 8$$

$$2x^2 + 10x - 8 = 0$$

$$\frac{2x^2 + 10x - 8}{2} = 0$$

$$x^2 + 5x = 4$$

$$x^2 + 5x + \frac{25}{4} = 4 + \frac{25}{4}$$

$$\left(x + \frac{5}{2}\right)^2 = \frac{41}{4}$$

$$\sqrt{\left(x + \frac{5}{2}\right)^2} = \pm\sqrt{\frac{41}{4}}$$

$$x + \frac{5}{2} = \pm\frac{\sqrt{41}}{2}$$

$$x = \frac{-5 \pm \sqrt{41}}{2}$$

$$x \approx -5.702 \text{ and } x \approx 0.702$$