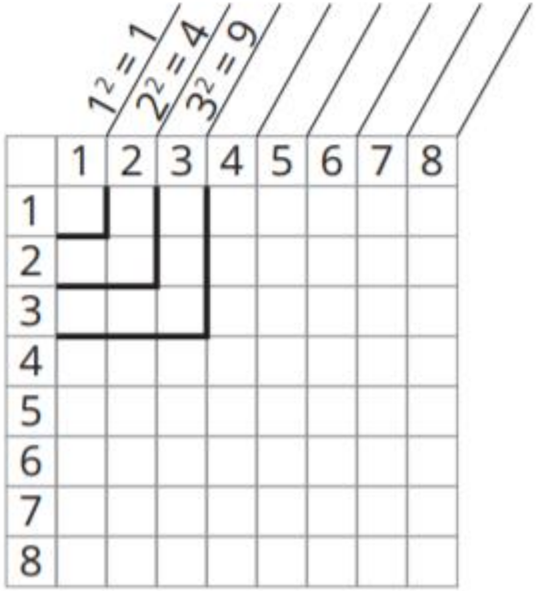
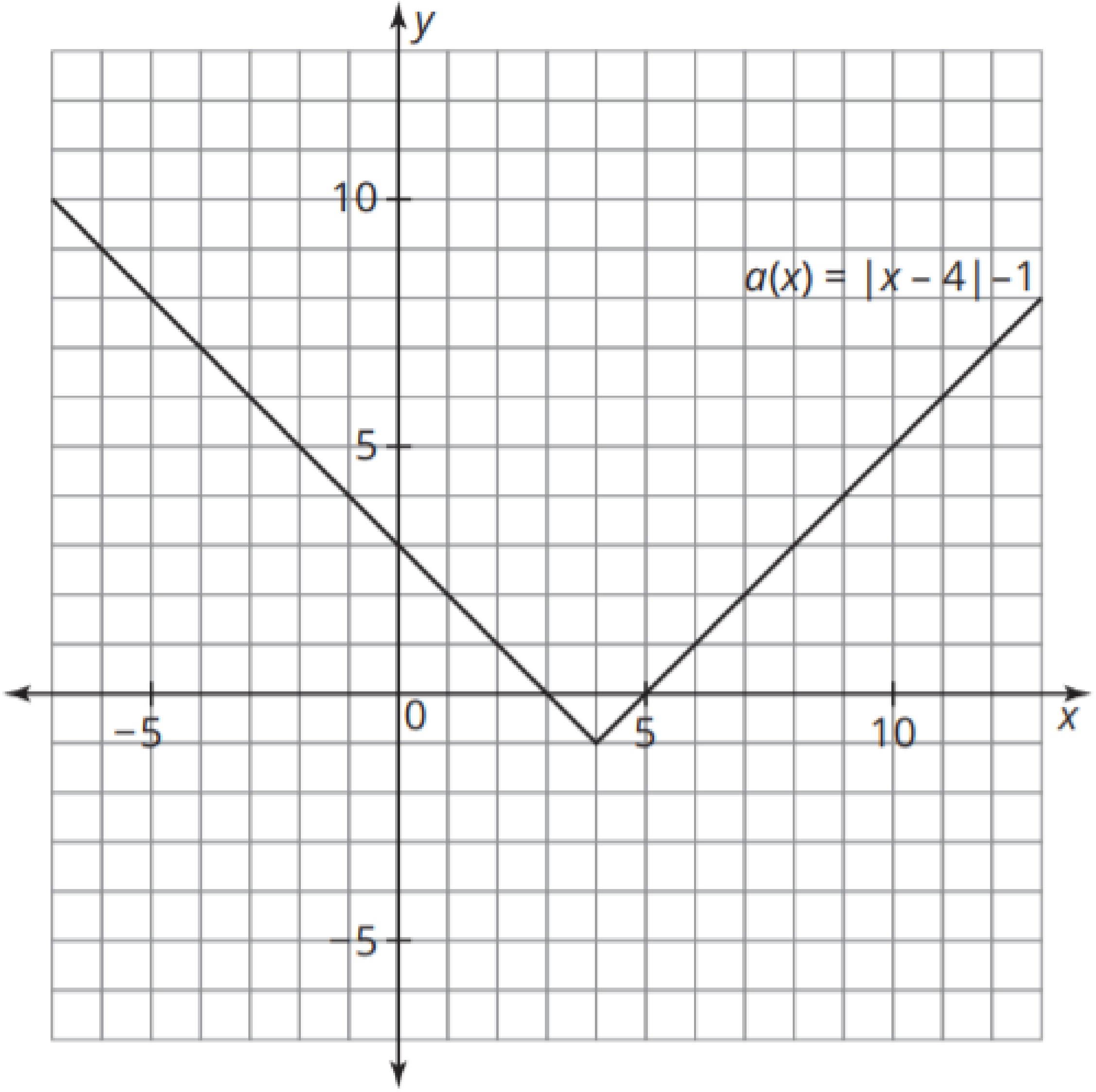
Warm Up

1. Complete the grid by continuing to make squares with side lengths of 4 through 8. Connect the side lengths together, and then write an equation using exponents to represent each perfect square.





Consider the absolute value function graphed.

1. Describe how the function is transformed from the basic function $f(x) = |x|$.

2. For each $y > -1$, how many solutions does the equation $y = |x - 4| - 1$ have? Use the graph to explain your answer.

3. Determine the solutions to $|x - 4| - 1 = 0$ and identify the solutions on the graph.

Remember:

Solutions for a function at $y = 0$ are called the zeros of the function.
The symbol $\pm$ means "plus or minus."

4. Use the graph and the function equation to explain why Escher's equation is correct.

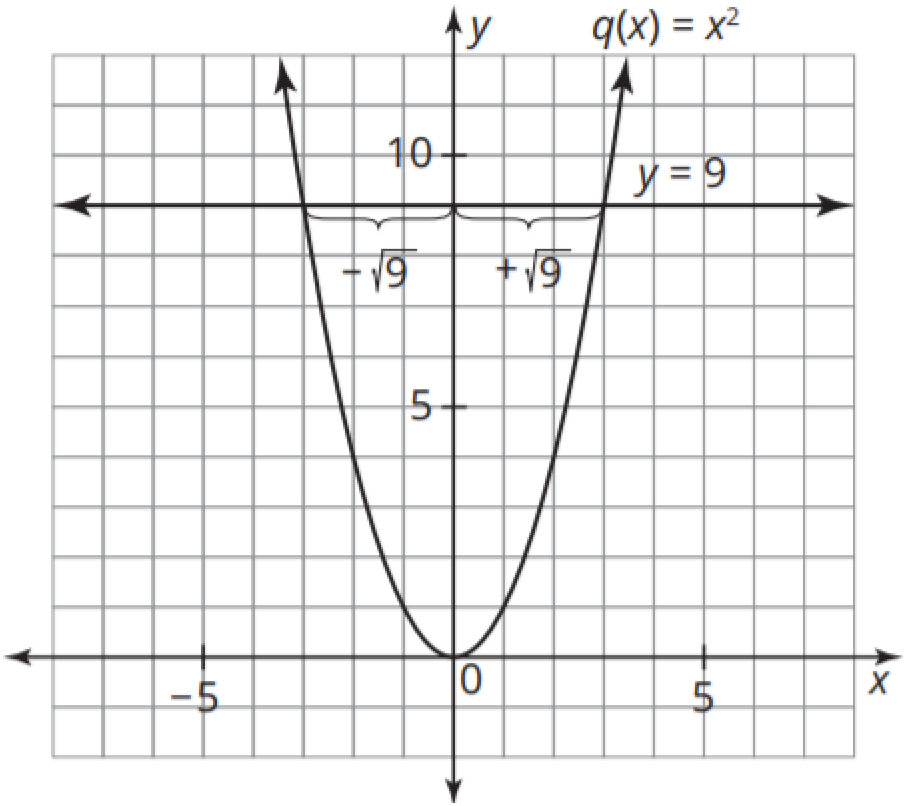
Escher

This absolute value function is symmetric about the line $x = 4$. So, for every y-value greater than -1, the solutions to the absolute value function are $x = 4 \pm (y + 1)$.

The two solutions of a basic quadratic function can be represented as square roots of numbers. Every positive number has two square roots, a positive square root (which is also called the **principal square root**) and a negative square root. To solve the equation $x^2 = 9$, you can take the square root of both sides of the equation.

$$\sqrt{x^2} = \pm\sqrt{9}$$
$$x = \pm 3$$

Solving $x^2 = 9$ on a graph means that you are looking for the points of intersection between $y = x^2$ and $y = 9$.



Remember:

The square root property is $\sqrt{a^2} = \pm a$.

1. Consider the graph of the function $q(x) = x^2$ shown.

a. What is the equation for the axis of symmetry? Explain how you can use the function equation to determine your answer.

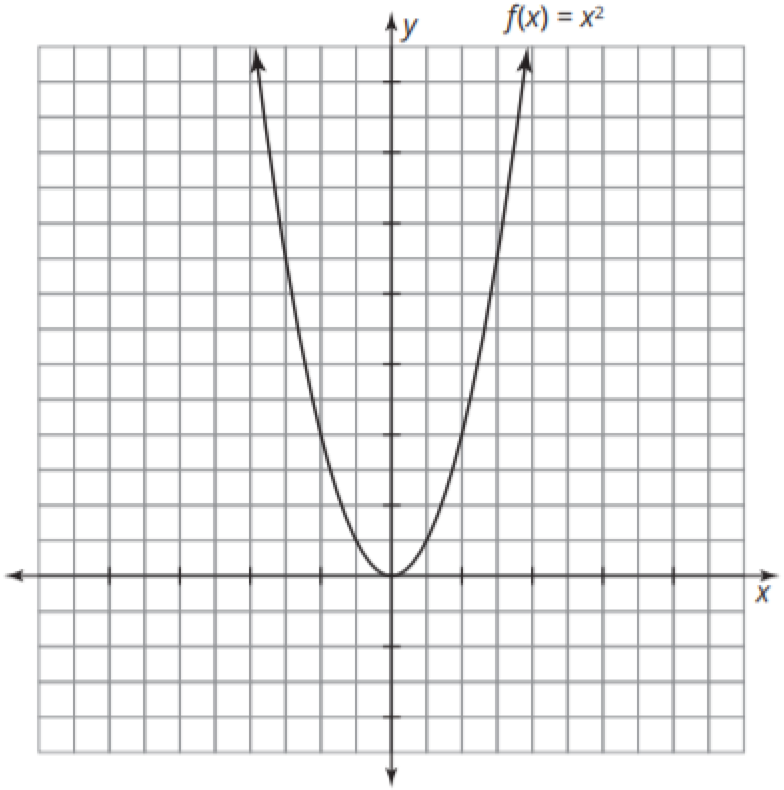
b. Explain how the graph shows the two solutions for the function at $y = 9$ and their relationship to the axis of symmetry. Use the graph and the function equation to explain your answer.

c. Describe how you can determine the two solutions for the function at $y = 2$. Indicate the solutions on the graph.

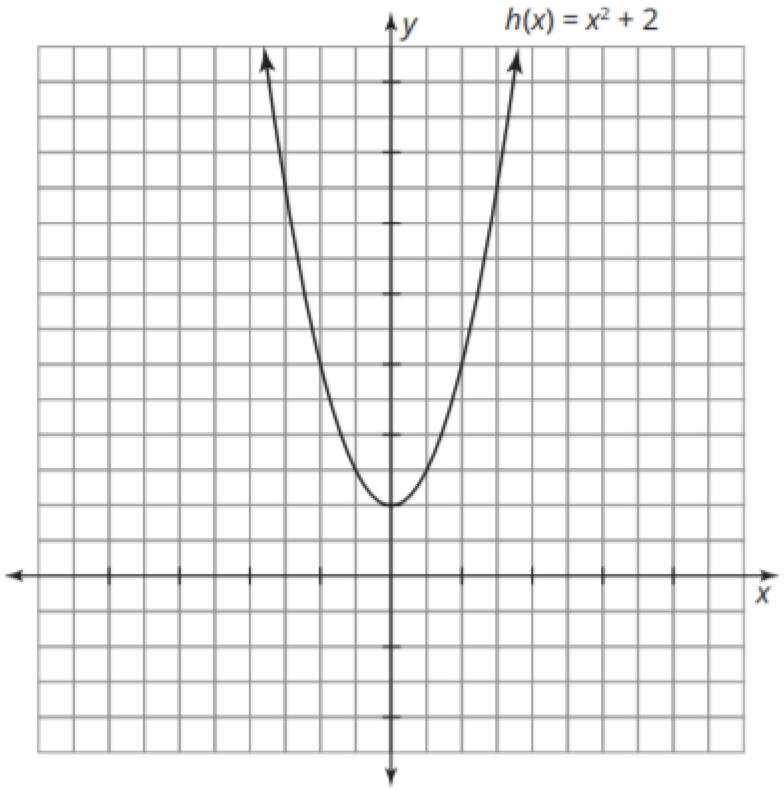
d. Describe how you can determine the two solutions for the function at each y-value for $y \geq 0$.

The quadratic function $q(x) = x^2$ has two solutions at $y = 0$. Therefore, it has 2 zeros: $x = +\sqrt{0}$ and $x = -\sqrt{0}$. These two zeros of the function, or roots of the equation, are the same number, 0, so $y = x^2$ is said to have a **double root,** or **1 unique root**.

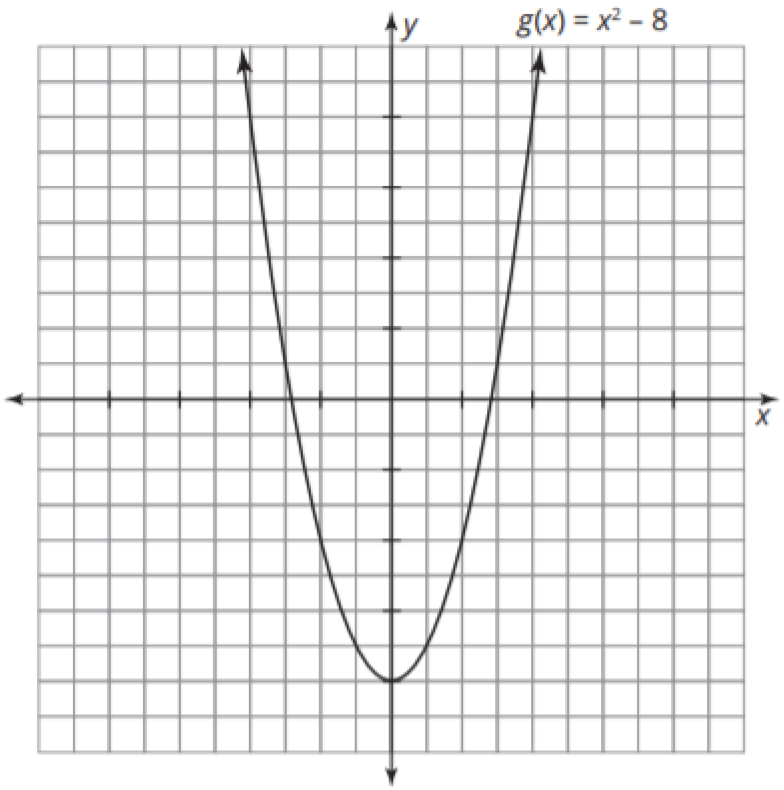
The root of an equation indicates where the graph of the equation crosses the x-axis. A double root occurs when the graph just touches the x-axis but does not cross it.



$f(x) = x^2$
y
x



$h(x) = x^2 + 2$
y
x



$g(x) = x^2 - 8$
y
x

3. **Use the graphs to identify the solutions to each equation. Then determine the solutions algebraically and write the solutions in terms of their respective distances from the axis of symmetry.**

a. $14 = x^2 + 2$

b. $x^2 = 10$

c. $-5 = x^2 - 8$

d. $19 = x^2 + 4$

e. $x^2 - 8 = 1$

f. $6 = x^2$

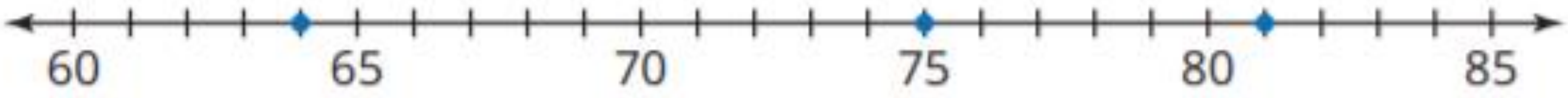
4. **Consider the graphs of $f(x)$, $h(x)$, and $g(x)$, which function has a double root? Explain your answer.**

Worked Example

You can determine the approximate value of $\sqrt{75}$.

Determine the perfect square that is closest to but less than 75. Then determine the perfect square that is closest to but greater than 75.

$$64 \le 75 \le 81$$



Determine the square roots of the perfect squares.

$$\sqrt{64} = 8 \qquad \sqrt{75} = ? \qquad \sqrt{81} = 9$$

Worked Example

You can use prime factors to rewrite $\sqrt{75}$ in an equivalent radical form.

First, rewrite the product of 75 to include any perfect square factors, and then extract the square roots of those perfect squares.

$$\begin{aligned}\sqrt{75} &= \sqrt{3 \cdot 5 \cdot 5}\\ &= \sqrt{3 \cdot 5^2}\\ &= \sqrt{3} \cdot \sqrt{5^2}\\ &= 5\sqrt{3}\end{aligned}$$

5. Estimate the value of each radical expression. Then, rewrite each radical by extracting all perfect squares, if possible.

a. $\sqrt{20}$

b. $\sqrt{26}$

c. $\sqrt{18}$

d. $\sqrt{116}$