Graph a function of the form $y = |x - h| + k$

Graph $y = |x + 4| - 2$. Compare the graph with the graph of $y = |x|$.

Solution

> **INTERPRET FUNCTIONS**
> To identify the vertex, rewrite the given function as $y = |x - (-4)| + (-2)$. So, $h = -4$ and $k = -2$. The vertex is $(-4, -2)$.
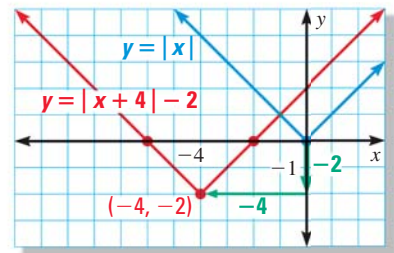
STEP 1 **Identify** and plot the vertex, $(h, k) = (-4, -2)$.

STEP 2 **Plot** another point on the graph, such as $(-2, 0)$. Use symmetry to plot a third point, $(-6, 0)$.

STEP 3 **Connect** the points with a V-shaped graph.

STEP 4 **Compare** with $y = |x|$. The graph of $y = |x + 4| - 2$ is the graph of $y = |x|$ translated down 2 units and left 4 units.

STRETCHES, SHRINKS, AND REFLECTIONS When $|a| \neq 1$, the graph of $y = a|x|$ is a vertical *stretch* or a vertical *shrink* of the graph of $y = |x|$, depending on whether $|a|$ is less than or greater than 1.

For $|a| > 1$	For $|a| < 1$
• The graph is vertically *stretched*, or elongated.	• The graph is vertically *shrunk*, or compressed.
• The graph of $y = a|x|$ is *narrower* than the graph of $y = |x|$.	• The graph of $y = a|x|$ is *wider* than the graph of $y = |x|$.

When $a = -1$, the graph of $y = a|x|$ is a **reflection** in the x-axis of the graph of $y = |x|$. When $a < 0$ but $a \neq -1$, the graph of $y = a|x|$ is a vertical stretch or shrink with a reflection in the x-axis of the graph of $y = |x|$.

Graph functions of the form $y = a|x|$

Graph (a) $y = \frac{1}{2}|x|$ and (b) $y = -3|x|$. Compare each graph with the graph of $y = |x|$.

Solution

a. The graph of $y = \frac{1}{2}|x|$ is the graph of $y = |x|$ vertically shrunk by a factor of $\frac{1}{2}$. The graph has vertex $(0, 0)$ and passes through $(-4, 2)$ and $(4, 2)$.

b. The graph of $y = -3|x|$ is the graph of $y = |x|$ vertically stretched by a factor of 3 and then reflected in the x-axis. The graph has vertex $(0, 0)$ and passes through $(-1, -3)$ and $(1, -3)$.