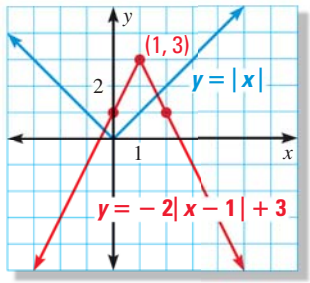
MULTIPLE TRANSFORMATIONS In part (b) of Example 2, graphing $y = -3|x|$ involves both vertically stretching and reflecting the graph of $y = |x|$. A graph may be related to a parent graph by even more than two transformations. For example, the graph of $y = a|x - h| + k$ can involve a vertical stretch or shrink, a reflection, and a translation of the graph of $y = |x|$.

EXAMPLE 3 Graph a function of the form $y = a|x - h| + k$

Graph $y = -2|x - 1| + 3$. Compare the graph with the graph of $y = |x|$.

Solution



STEP 1 **Identify** and plot the vertex, $(h, k) = (1, 3)$.

STEP 2 **Plot** another point on the graph, such as $(0, 1)$. Use symmetry to plot a third point, $(2, 1)$.

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

STEP 4 **Compare** with $y = |x|$. The graph of $y = -2|x - 1| + 3$ is the graph of $y = |x|$ stretched vertically by a factor of 2, then reflected in the x-axis, and finally translated right 1 unit and up 3 units.

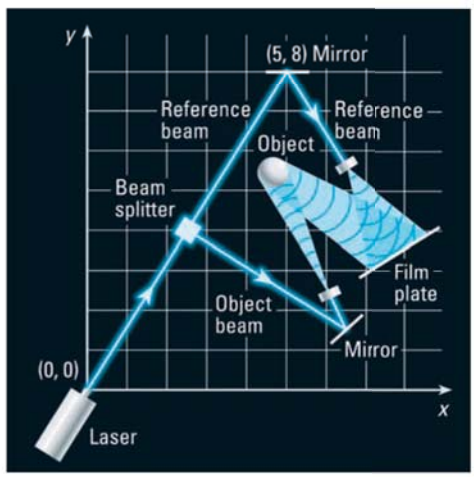
GUIDED PRACTICE for Examples 1, 2, and 3

Graph the function. *Compare* the graph with the graph of $y = |x|$.

1. $y = |x - 2| + 5$
2. $y = \frac{1}{4}|x|$
3. $f(x) = -3|x + 1| - 2$

EXAMPLE 4 Write an absolute value function

HOLOGRAMS In holography, light from a laser beam is split into two beams, a reference beam and an object beam. Light from the object beam reflects off an object and is recombined with the reference beam to form images on film that can be used to create three-dimensional images. Write an equation for the path of the reference beam.



Solution

The vertex of the path of the reference beam is (5, 8). So, the equation has the form $y = a|x - 5| + 8$. Substitute the coordinates of the point (0, 0) into the equation and solve for a.

$0 = a|0 - 5| + 8$ **Substitute 0 for *y* and 0 for *x*.**

$-1.6 = a$ **Solve for *a*.**

▶ An equation for the path of the reference beam is $y = -1.6|x - 5| + 8$.