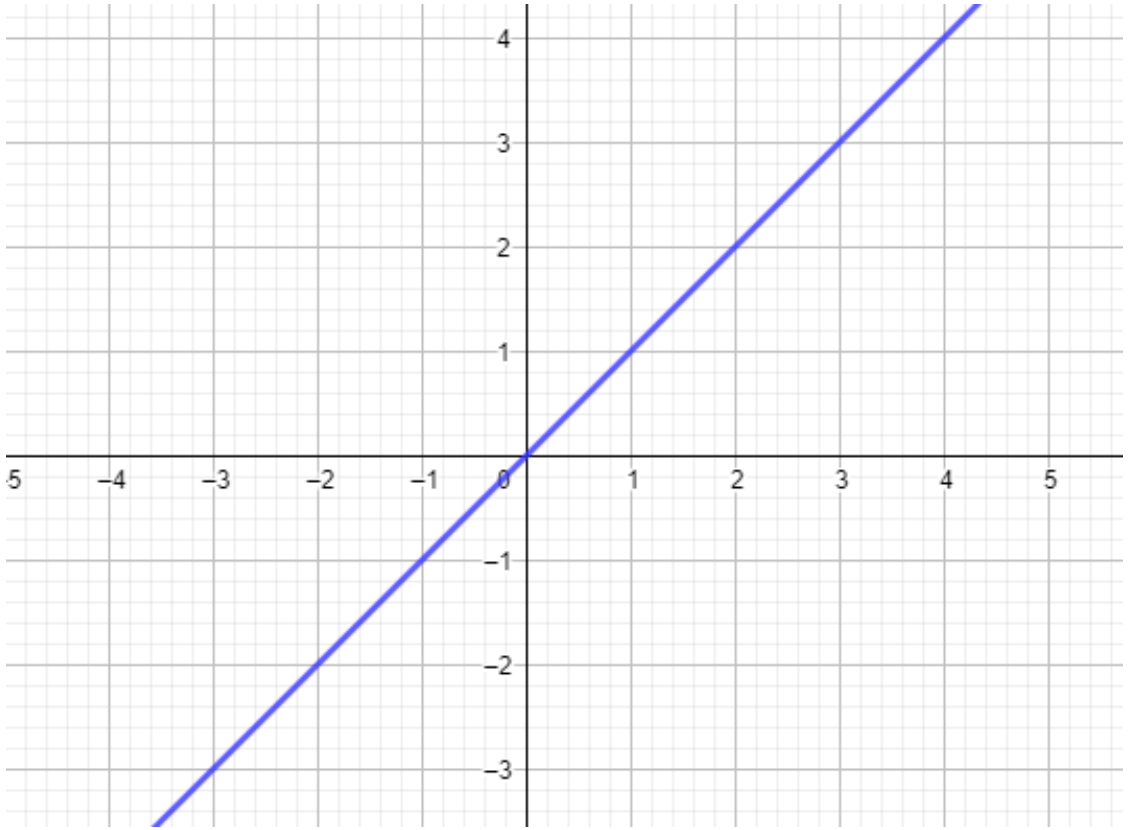
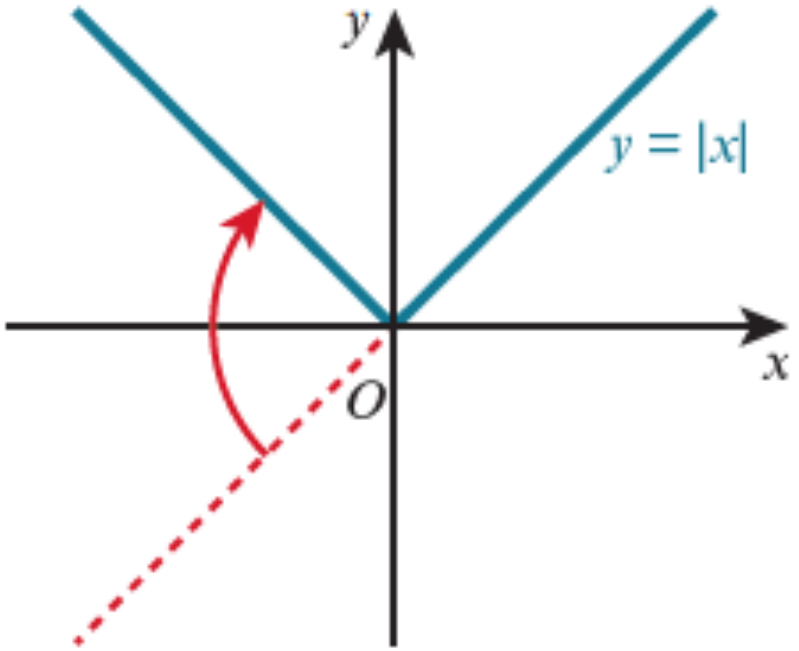
# Chapter 1.2
# Graphs of $y = |f(x)|$ where $f(x)$ is linear

A level

**Example 1:** Consider drawing the graph of $y = |x|$.

1. Draw the line $y = x$.

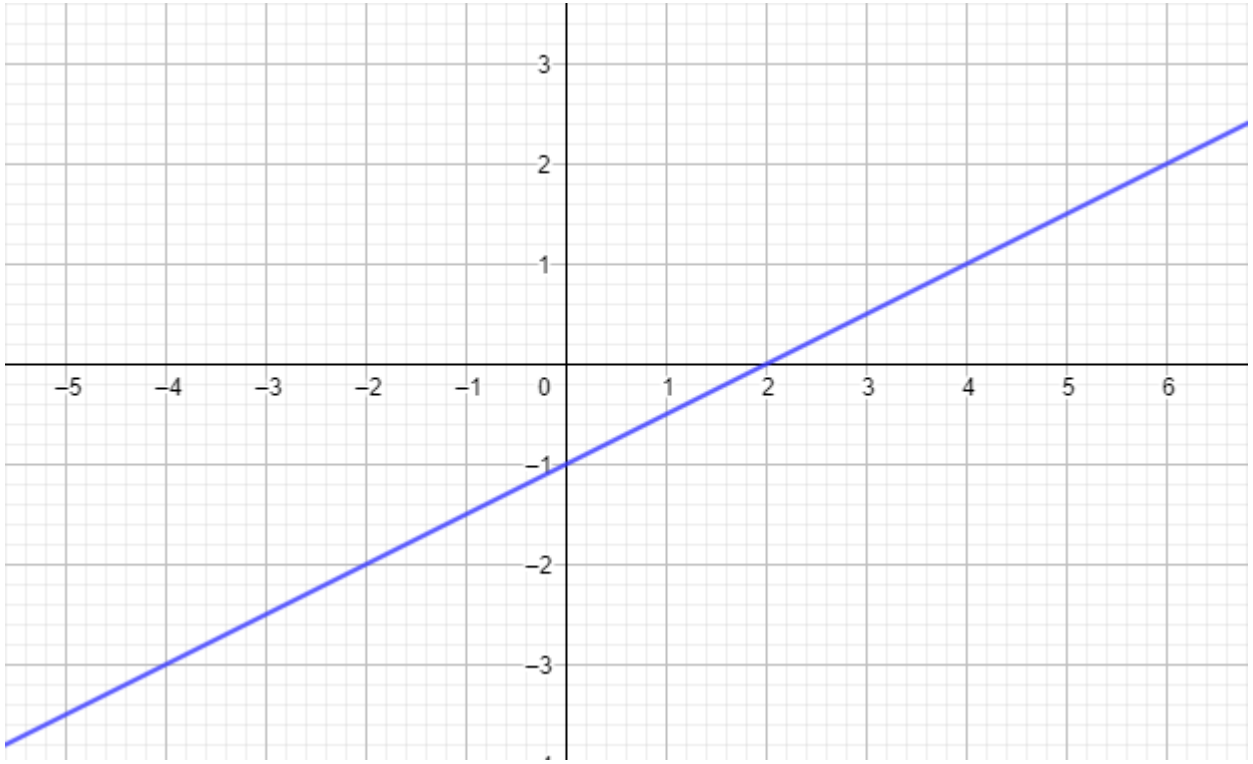


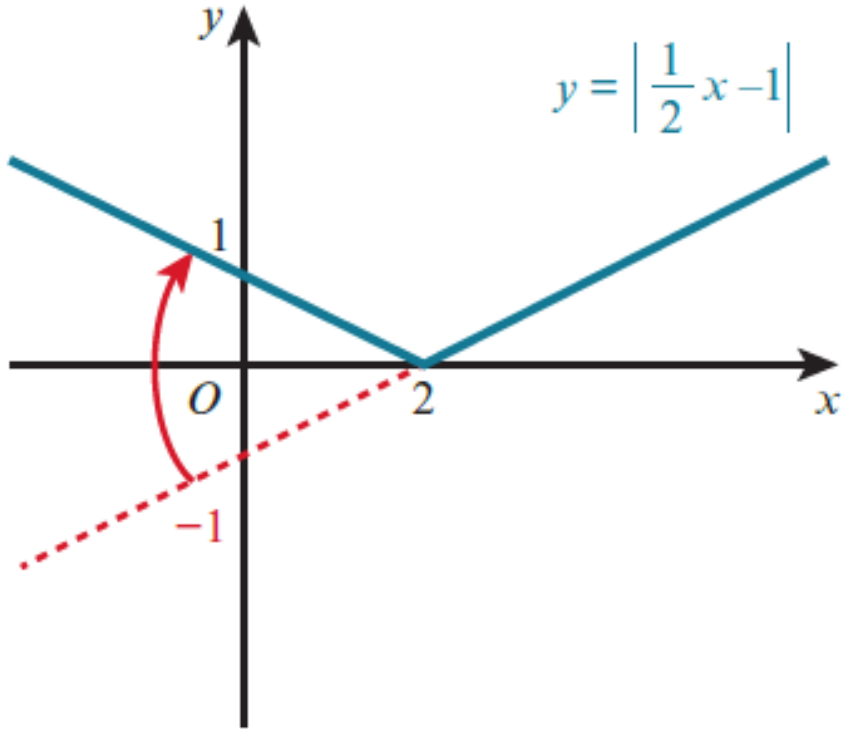




2. Reflect, in the $x - axis$, the part of the line that is below the $x - axis$.

**Example 2:** Sketch the graph of $y = \left|\frac{1}{2}x - 1\right|$, showing the points where the graph meets the axes.

1. Draw the line $y = \frac{1}{2}x - 1$.

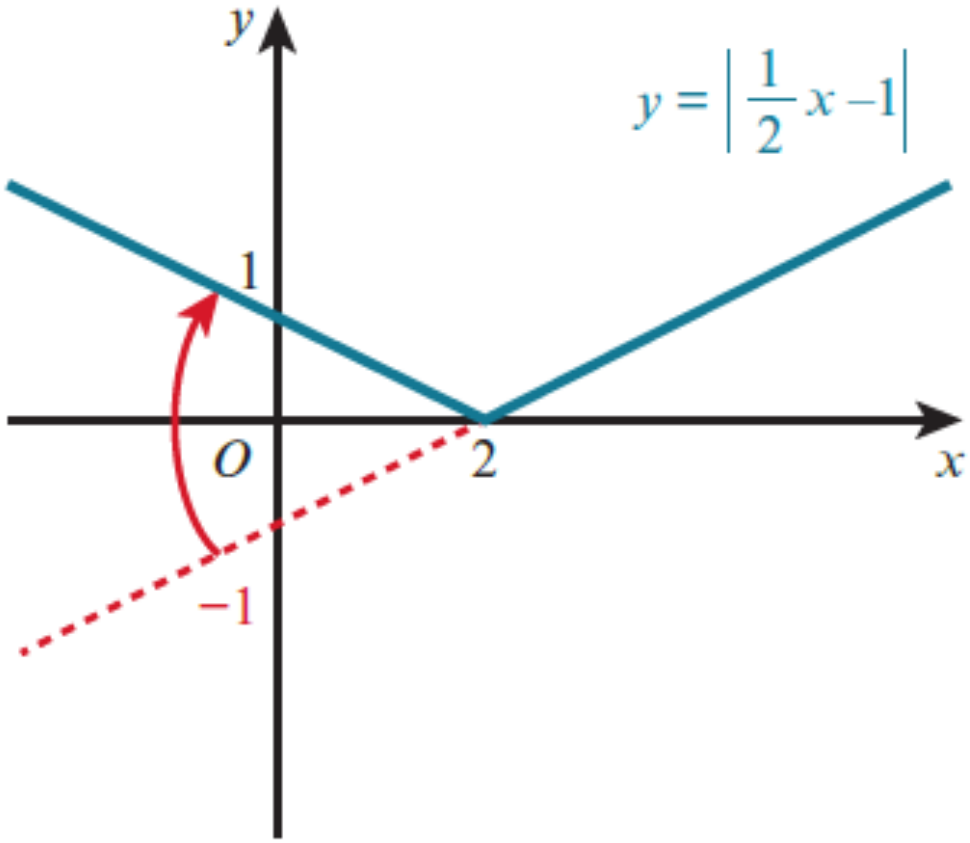



2. Reflect, in the $x - axis$, the part of the line that is below the $x - axis$.

**Example 2:** Use your graph to express $y = \left|\frac{1}{2}x - 1\right|$ in an alternative form.

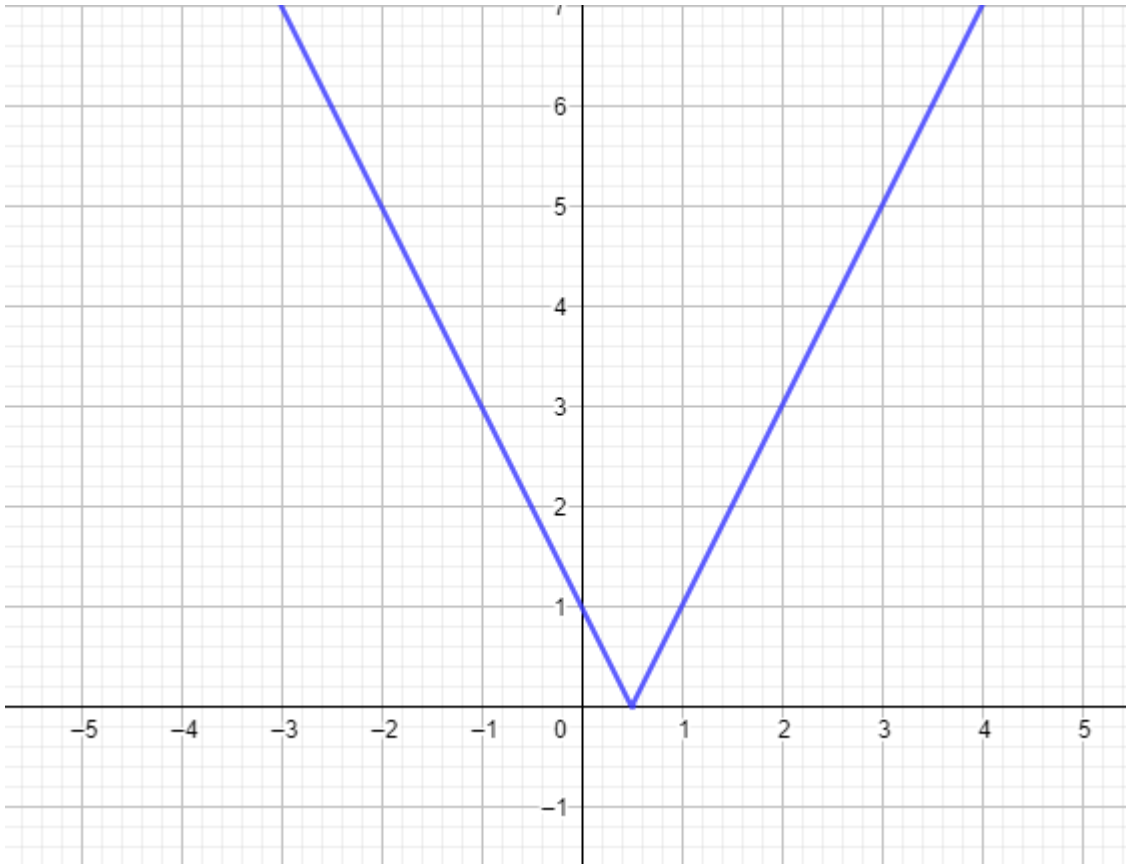
$$\left|\frac{1}{2}x - 1\right| = \begin{cases} \frac{1}{2}x - 1 & if\ x \geq 2 \\ -\left(\frac{1}{2}x - 1\right) & if\ x < 2 \end{cases}$$

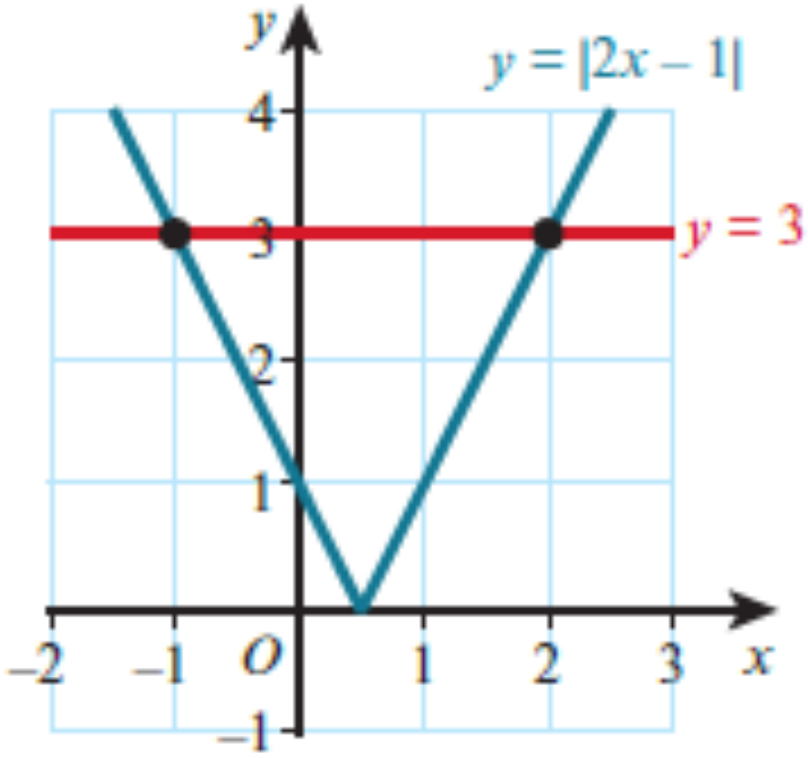


## Example 3: $|2x - 1| = 3$

$y = |2x - 1|$

$y = 3$



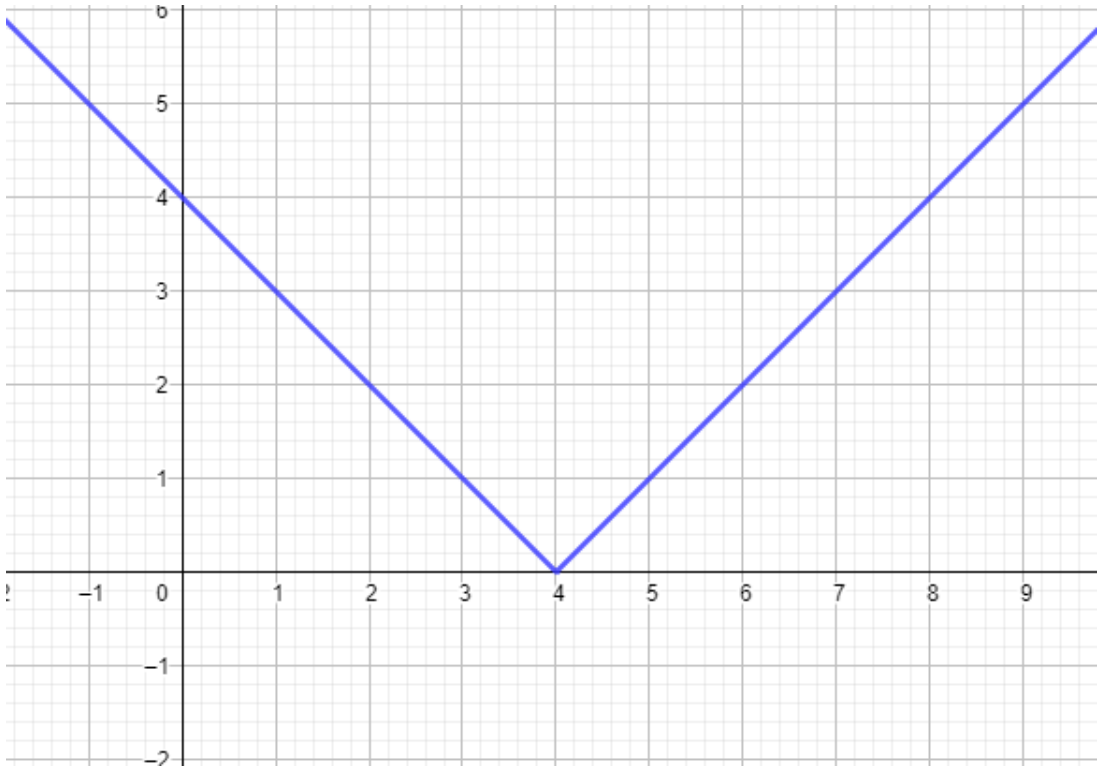



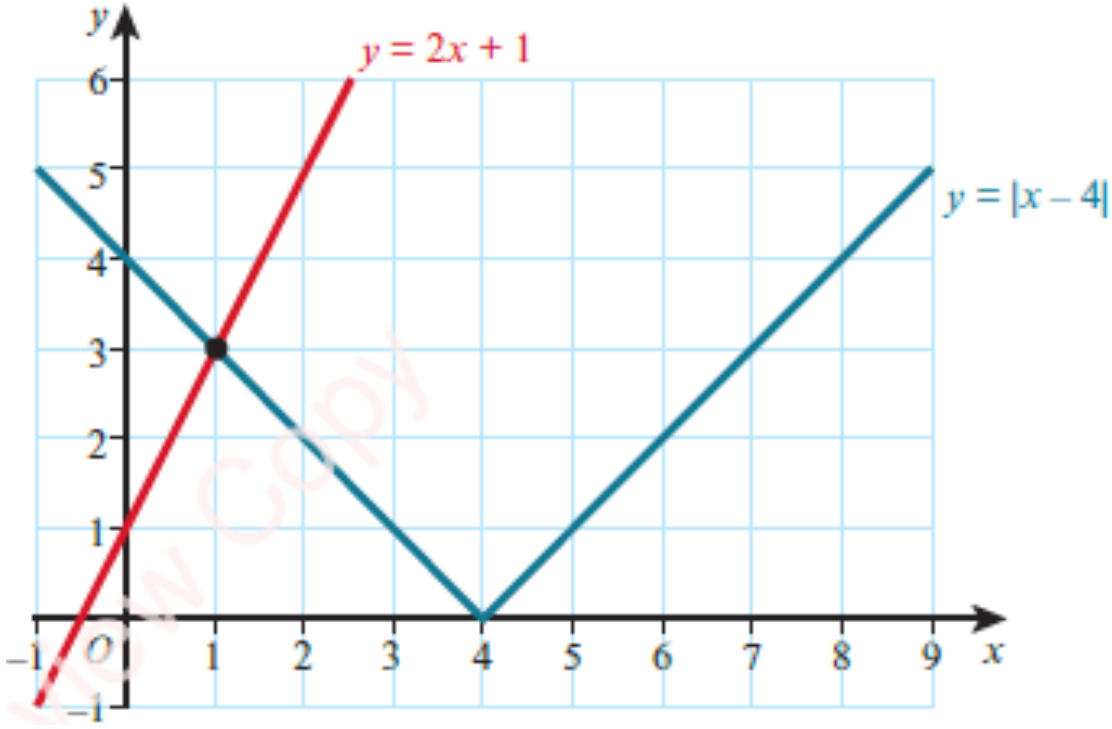

$x = -1; 2$

## Example 4: $|x-4| = 2x+1$

$y = |x-4|$

$y = 2x+1$




$x = 1$

## EXERCISE 1B

**1** Sketch the graphs of each of the following functions showing the coordinates of the points where the graph meets the axes. Express each function in an alternative form.

**a** $y = |x + 2|$ **b** $y = |3 - x|$ **c** $y = \left|5 - \frac{1}{2}x\right|$

**2** **a** Complete the table of values for $y = |x - 3| + 2$.

| $x$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| $y$ | 5 | | 3 | | | | |

**b** Draw the graph of $y = |x - 3| + 2$ for $0 \leqslant x \leqslant 6$.

**c** Describe the transformation that maps the graph of $y = |x|$ onto the graph of $y = |x - 3| + 2$.

**3** Describe fully the transformation (or combination of transformations) that maps the graph of $y = |x|$ onto each of these functions.

**a** $y = |x + 1| + 2$ **b** $y = |x - 5| - 2$ **c** $y = 2 - |x|$

**d** $y = |2x| - 3$ **e** $y = 1 - |x + 2|$ **f** $y = 5 - 2|x|$

**4** Sketch the graphs of each of the functions in question 3. For each graph, state the coordinates of the vertex.

**5** $f(x) = |5 - 2x| + 3$ for $2 \leqslant x \leqslant 8$

Find the range of function f.

| Vertical transformation | |
|---|---|
| $y = f(x) + a$ | Translation $\begin{pmatrix} 0 \\ a \end{pmatrix}$ |
| $y = -f(x)$ | Reflection in the x – axis |
| $y = af(x)$ | Vertical stretch, factor *a* |

| Horizontal transformation | |
|---|---|
| $y = f(x - a)$ | Translation $\begin{pmatrix} a \\ 0 \end{pmatrix}$ |
| $y = f(-x)$ | Reflection in the y – axis |
| $y = f(ax)$ | Horizontal stretch, factor $\frac{1}{a}$ |

6 **a** Sketch the graph of $y = 2|x-2|+1$ for $-2 < x < 6$, showing the coordinates of the vertex and the $y$-intercept.

**b** On the same diagram, sketch the graph of $y = x+2$.

**c** Use your graph to solve the equation $2|x-2|+1 = x+2$.

7 **a** Sketch the graph of $y = |x-2|$ for $-3 < x < 6$, showing the coordinates of the vertex and the $y$-intercept.

**b** On the same diagram, sketch the graph of $y = |1-2x|$.

**c** Use your graph to solve the equation $|x-2| = |1-2x|$.

8 **a** Sketch the graph of $y = |x+1| + |x-1|$.

**b** Use your graph to solve the equation $|x+1| + |x-1| = 4$.