

Essential Question: How can you use piecewise-defined functions to solve real-world problems?

KEY EXAMPLE*(Lesson 13.1)*

Graph the piecewise function $f(x) = \begin{cases} -2x & \text{if } x \leq 2 \\ \frac{1}{2}x + 1 & \text{if } x > 2 \end{cases}$.

x	-4	-2	0	2	4	6
$f(x)$	$-2(-4) = 8$	$-2(-2) = 4$	$-2(0) = 0$	$-2(2) = -4$	$\frac{1}{2}(4) + 1 = 3$	$\frac{1}{2}(6) + 1 = 4$

The transition from one rule to the other occurs at $x = 2$. Show a closed dot at $(2, -4)$, since this point is part of the graph. Show an open dot at $(2, 2)$, since this is not part of the graph.

Key Vocabulary

absolute-value equation

(ecuación de valor absoluto)

absolute-value function

*(función de valor absoluto)*mean *(media)*

greatest integer function

*(función de entero mayor)*piecewise function *(función a trozos)*step function *(función escalón)***KEY EXAMPLE***(Lesson 13.3)*

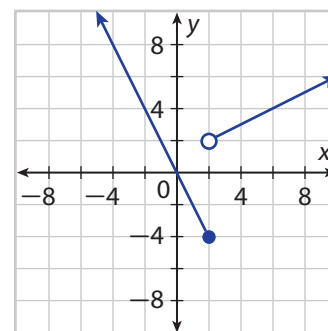
Solve $-4|x + 5| = -2$.

$$\begin{aligned} |x + 5| &= \frac{1}{2} \\ x + 5 &= \frac{1}{2} \quad \text{or} \quad x + 5 = -\frac{1}{2} \\ x &= -4\frac{1}{2} \quad \text{or} \quad x = -5\frac{1}{2} \end{aligned}$$

Divide both sides by -4 .

Write as two equations.

Subtract 5 from both sides.

**KEY EXAMPLE***(Lesson 13.4)*

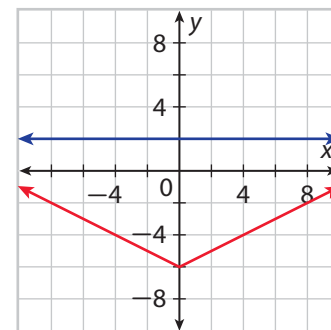
Solve $\frac{1}{2}|x| - 3 \leq 1$ graphically.

Let $f(x) = \frac{1}{2}|x| - 3$ and $g(x) = 1$.

Graph $f(x)$ and $g(x)$.

Determine when $f(x) \leq g(x)$.

The solution is $x \geq -8$ and $x \leq 8$.



EXERCISES

1. Copy and complete the table of values for $f(x) = \begin{cases} x - 3 & \text{if } x < -1 \\ -2x + 4 & \text{if } x \geq -1 \end{cases}$. Graph the function. (Lesson 13.1)

x	$f(x)$
-3	?
-2	?
-1	?
0	?
1	?
2	?
3	?

-4

Solve each equation and inequality. (Lesson 13.3)

2. $6|x| + 4 = -2$

3. $2|4x - 1| = 6$

4. $|2x + 3| + 7 = 7$

5. $|x + 4| - 12 \leq 20$

MODULE PERFORMANCE TASK

A Taxing Situation

The table below defines the amount of income tax a single U.S. taxpayer must pay to the federal government for income earned in 2013.

If taxable income is over	but not over	the tax is
\$0	\$8,925	10% of the amount over \$0
\$8,926	\$36,250	\$892.50 plus 15% of the amount over \$8,925
\$36,251	\$87,850	\$4,991.25 plus 25% of the amount over \$36,250
\$87,851	\$183,250	\$17,891.25 plus 28% of the amount over \$87,850
\$183,251	\$398,350	\$44,603.25 plus 33% of the amount over \$183,250
\$398,351	\$400,000	\$115,586.25 plus 35% of the amount over \$398,350
\$400,001	no limit	\$116,163.75 plus 39.6% of the amount over \$400,000

So, if your taxable income is \$30,000, you owe \$892.50 plus 15% of the amount by which your earnings exceed \$8,925.

- Write the equations for the piecewise-defined function that gives the income tax y on taxable income of x (where $x \leq \$100,000$).
- Graph the function.
- Find the percent of total taxable income that a person making \$50,000 and a person making \$100,000 pay in income tax.

Use numbers, words, or algebra to explain how you reached your conclusion.

Ready to Go On?

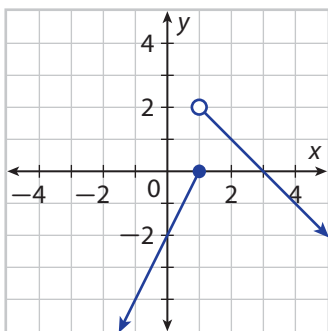
13.1–13.4 Piecewise-Defined Functions



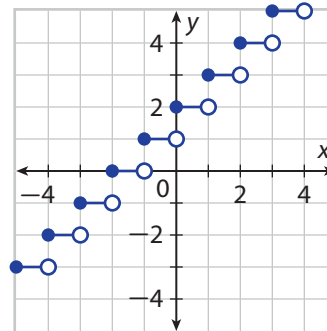
- Online Homework
- Hints and Help
- Extra Practice

Write a function to represent each graph shown. (*Lesson 13.1*)

1.



2.



3. The graph of $g(x)$ is a transformation of the graph of $f(x) = |x|$ left 2 units and reflected across the x -axis. Write a function for $g(x)$, and graph $g(x)$. (*Lesson 13.2*)

Solve each equation and inequality. (*Lessons 13.3, 13.4*)

4. $|5x| + 4 = 19$

5. $|2x| + 3 \geq 11$

6. $|4x + 2| - 2 = -18$

7. $|x + 8| - 5 < 2$

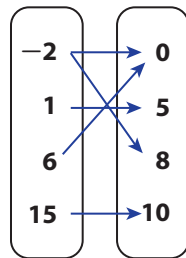
ESSENTIAL QUESTION

8. Write a real-world situation that could be modeled by $|x - 14| \leq 3$.



Assessment Readiness

1. Consider the function $f(x) = \begin{cases} 3 & \text{if } x < 2 \\ -x + 1 & \text{if } 2 \leq x < 6 \\ x & \text{if } x \geq 6 \end{cases}$. Tell whether each of the following is a solution of $f(x)$.
- A. $(-5, 3)$
 - B. $(2, -1)$
 - C. $(8, -7)$
2. Consider the relation represented by the mapping diagram. Determine if each statement is True or False.



- A. The domain is $\{-2, 1, 6, 15\}$.
 - B. The range is $\{0, 5, 8, 10\}$.
 - C. The relation is a function.
3. Find the intercepts and slope of $8x - \frac{1}{2}y = 12$. Determine if each statement is True or False.
- A. The x -intercept is 4.
 - B. The y -intercept is -24 .
 - C. The slope is 8.
4. How many solutions does the equation $|x + 6| - 4 = c$ have if $c = 5$? If $c = -10$? Justify your answers.