

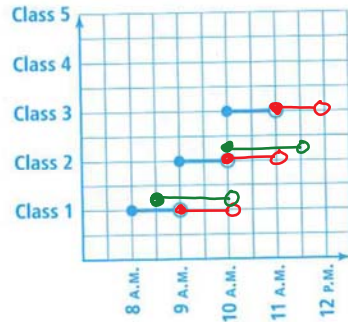
5-4

Transformations
of Piecewise-
Defined Functions

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MODEL & DISCUSS

Cleo takes three 1-hour classes at a community college. The graph shows the time she spends in each class.



- A. Next semester, each class will start an hour later. How will this change the graph?

Shifts the step 1 unit to the right

- B. How will the graph change if she takes two 90-minute classes, one starting at 8:30 A.M. and the second at 10:00 A.M.?

See above

- C. **Construct Arguments** Starting in the fall, Cleo will take three classes in a row with the first starting at 7:00 A.M. Cleo says that she can update the graph by moving all three steps one unit to the left. Do you agree? Justify your answer. © MP.3

HABITS OF MIND

Look for Relationships What have you learned about graphing functions that is useful in analyzing this problem? © MP.7

absolute value

$$y = a|x-h| + k$$

vert
refl,
stretch,
shrink

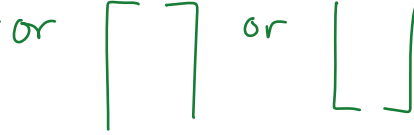
shift
left/
right

shift
up/down

EXAMPLE 1

Try It! Translate Step Functions

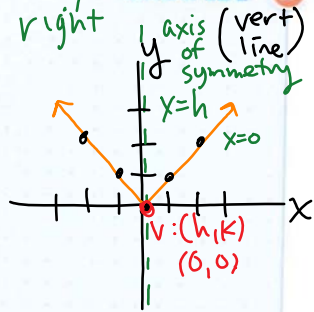
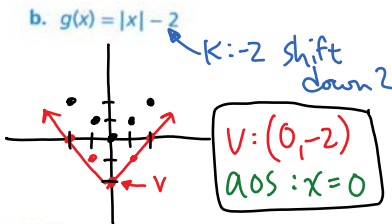
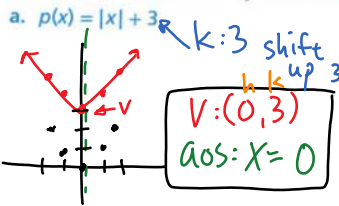
- How will the total points awarded for a \$1.25 juice drink change if the bonus points are decreased by 2 points?



EXAMPLE 2

Try It! Vertical Translations of the Absolute Value Function

- For each function, identify the vertex and the axis of symmetry.



HABITS OF MIND

Generalize What did you notice about the equations of step and absolute value functions that result in vertical translations? © MP.8

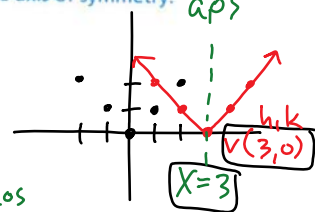
EXAMPLE 3

Try It! Horizontal Translations of the Absolute Value Function

- For each function, identify the vertex and the axis of symmetry.

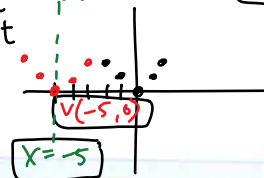
a. $g(x) = |x - 3|$

$h: 3$ shift right



b. $p(x) = |x + 5|$

$h: -5$ shift left



$$a|x-h| + k$$

$$y = a|x-h| + k$$

Notes

Assess

EXAMPLE 4 Try It! Understand Vertical and Horizontal Translations

4. Find the vertex of the graph of each function.

a. $g(x) = |x-1| - 3$
 $h: 1$ $k: -3 \rightarrow V: (1, -3)$

b. $g(x) = |x+2| + 6$
 $h: -2$ $k: 6 \rightarrow V: (-2, 6)$

HABITS OF MIND

Reason How is the algebraic representation of a function that translates the graph of $f(x) = |x|$ horizontally different from one that translates the graph of f vertically? © MP.2

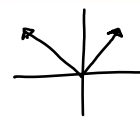


EXAMPLE 5 Try It! Understand Vertical Stretches and Compressions

5. Compare the graph of each function with the graph of $f(x) = |x|$.

a. $g(x) = 3|x|$
 $a: 3$
 Vert stretch by 3

b. $g(x) = -\frac{1}{3}|x|$
 $a: -\frac{1}{3}$
 Vert refl & shrink by $\frac{1}{3}$



EXAMPLE 6 Try It! Understand Transformations of the Absolute Value Function

6. a. Write a function for the graph shown.

$$y = a|x-h| + k$$

$$y = \frac{3}{2}|x-1| + 2$$

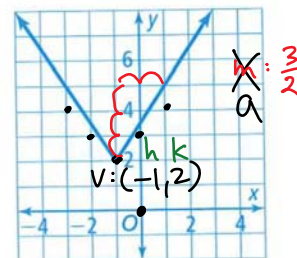
$$y = \frac{3}{2}|x+1| + 2$$

b. Write the function of the graph after a translation 1 unit right and 4 units up.

$$h: +1 \rightarrow 0$$

$$k: +4 \rightarrow 6$$

$$y = \frac{3}{2}|x| + 6$$



HABITS OF MIND

Use Structure How can you use the symmetric structure of the graph of $g(x) = a|x-h| + k$ to help you graph the function? Explain. © MP.7

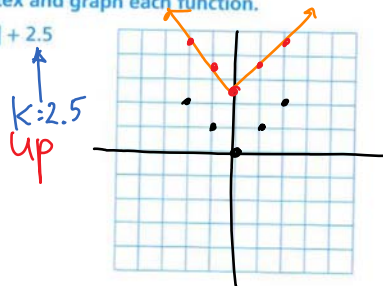
Do You UNDERSTAND?

- ESSENTIAL QUESTION** How do the constants affect the graphs of piecewise-defined functions?
- Generalize** How do the constants a , h , and k affect the domain and range of $g(x) = a|x - h| + k$ when $a > 0$? © MP.8
- Error Analysis** Jacy says that $f(x) = 4|x - 1|$ and $f(x) = |4x - 1|$ have the same graph. Is Jacy correct? Explain. © MP.3
- Use Structure** How can you reflect the graph of $f(x) = 3|x + 2| + 1$ across the x -axis? © MP.7

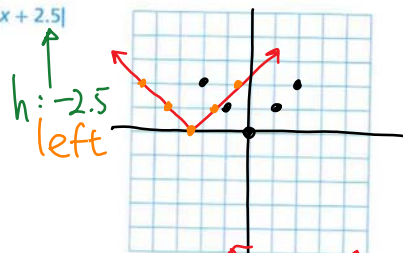
Do You KNOW HOW?

Find the vertex and graph each function.

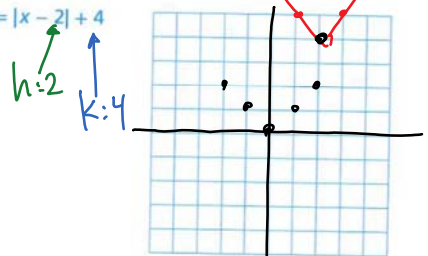
5. $f(x) = |x| + 2.5$



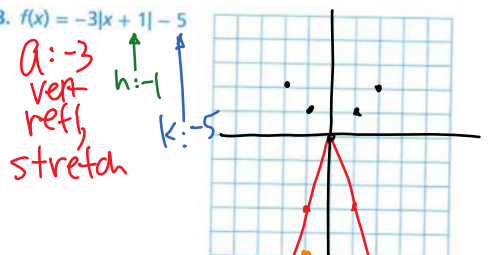
6. $f(x) = |x + 2.5|$



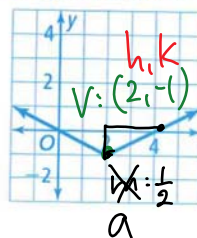
7. $f(x) = |x - 2| + 4$



8. $f(x) = -3|x + 1| - 5$



9. What is the equation of the graph?



$$y = \frac{1}{2}|x - 2| - 1$$