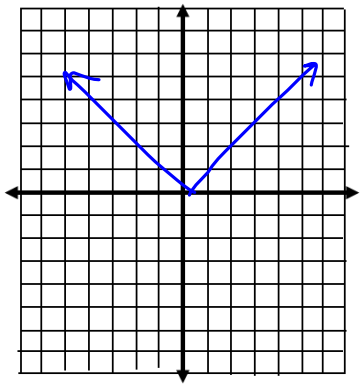
1.9 Transforming Absolute Value Functions

Objectives: Students will transform absolute value functions.
Students will solve problems involving transformations of absolute value functions.

Parent Function: the simplest function in the family of functions.

The parent function for a linear function is f(x) = |x| or y = |x|.

Every absolute value function is a **transformation** of the parent function.



A translation moves the graph right, left, up or down. The transformation can also flip, stretch or compress the graph.

General form of an absolute value function:

$f(x) = a|x - h| + k$

k represents the **vertical** translation

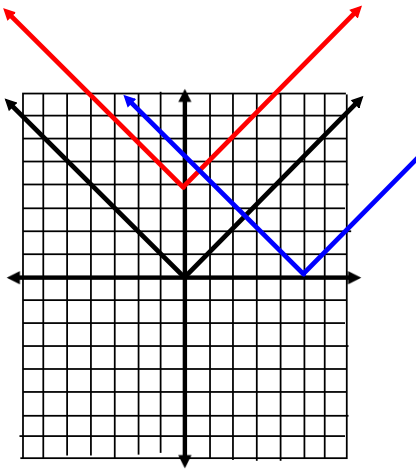
+ k move UP
- k move DOWN

a represents the **steepness** of the rays, if a is negative the graph is **flipped**

h represents the **horizontal** translation
+ h move LEFT $|x + h|$
- h move RIGHT $|x - h|$

Parent function: y = |x|
Domain: (-∞,∞)
Range: [0,∞)
max or min? At x=0, the min is 0.

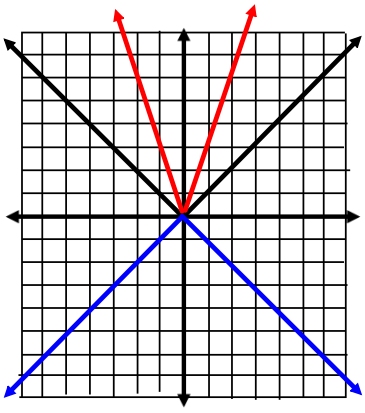
y value



shifted up 4: y = |x| + 4
Domain: (-∞,∞)
Range: [4,∞)
max or min? At x=0, the min is 4.

shifted right 5: y = |x - 5|
Domain: (-∞,∞)
Range: [0,∞)
max or min? At x=5, the min is 0.

Parent function: y = |x|
Domain: (-∞,∞)
Range: [0,∞)
max or min? At x=0, the min is 0.



stretched vertically,
made steeper by a factor of 3: y = 3|x|
Domain: (-∞,∞)
Range: [0,∞)
max or min? At x=0, the min is 0.

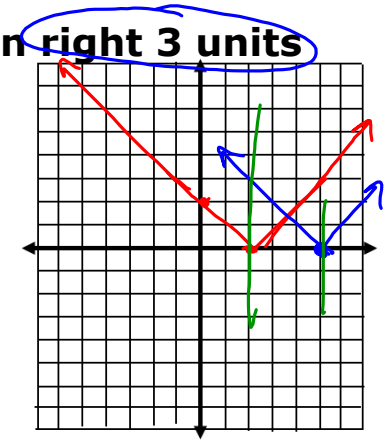
reflected over the x-axis: y = -|x|
Domain: (-∞,∞)
Range: (-∞,0]
max or min? At x=0, the max is 0.

Ex. 1 Let $g(x)$ be the indicated transformation of $f(x)$. Write the rule for $g(x)$. Graph both functions, give the domain & range for each, & identify the line of symmetry of each.

$f(x) = |x - 2|$, horizontal translation right 3 units

right 2

$g(x) = |x - 5|$



$f(x)$ | $g(x)$

Domain $(-\infty, \infty)$ | $(-\infty, \infty)$

range $[0, \infty)$ | $[0, \infty)$

line of symmetry $x = 2$ | $x = 5$

Ex. 2 Let $g(x)$ be the indicated transformation of $f(x)$. Write the rule for $g(x)$. Graph both functions, give the domain & range for each, & identify the min or max of each.

$f(x) = |x - 3|$, reflection across x-axis

$g(x)$

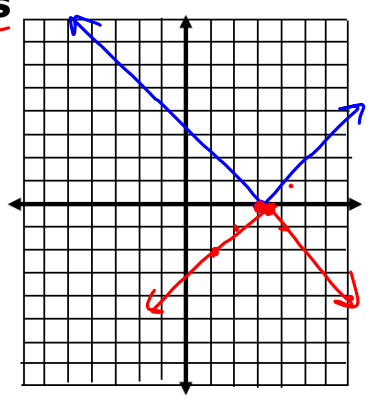
$g(x) = -|x - 3|$

D: $(-\infty, \infty)$

R: $[0, \infty)$ | $(-\infty, \infty)$

min is 0 | $(-\infty, 0]$

max is 0



Ex. 3 Let $g(x)$ be the indicated transformation of $f(x)$. Write the rule for $g(x)$. Graph both functions, give the domain & range for each, identify the min or max of each, and identify their line of symmetry.

$f(x) = |x + 1|$; translation 2 units up

left 1 from parent

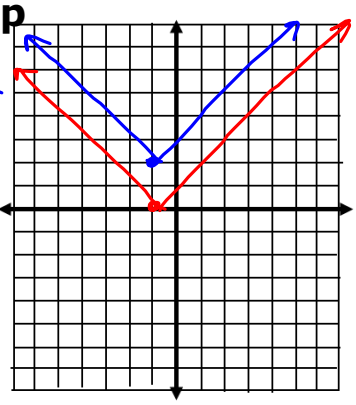
D: $(-\infty, \infty)$

R: $[0, \infty)$

min is 0

$x = -1$

$g(x) = |x + 1| + 2$



D: $(-\infty, \infty)$

R: $[2, \infty)$

min is 2

$x = -1$

Ex. 4 Let $g(x)$ be the indicated transformation of $f(x) = 2|x - 2|$. Write the rule for $g(x)$. Graph both functions, give the domain & range for each, & identify the min or max of each.

$f(x) = 2|x - 2|$; vertical shift 1 unit up

steeper

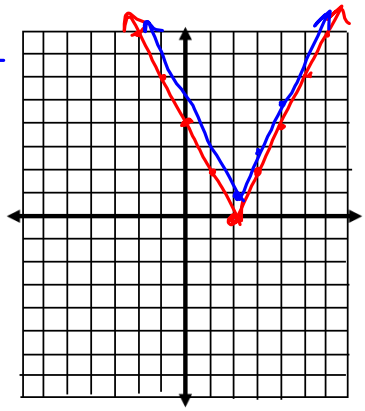
right 2

D: $(-\infty, \infty)$

R: $[0, \infty)$

min is 0

$g(x) = 2|x - 2| + 1$

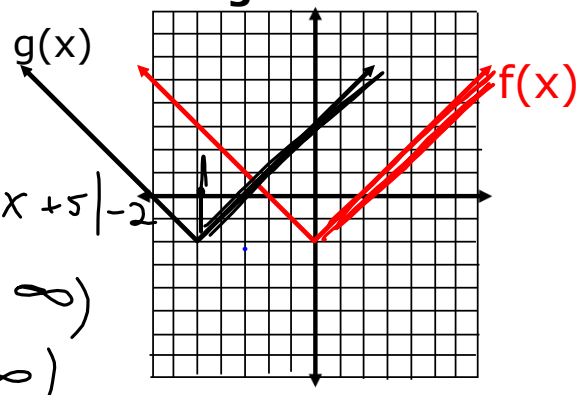


D: $(-\infty, \infty)$

R: $[1, \infty)$

min is 1

Ex. 5 Given f(x) and g(x), state the translation from f(x) to g(x). Write the equation for each function. For each function, give the domain & range, the minimum, and the intervals where each function is increasing.



left 5

$f(x) = |x| - 2$

D: $(-\infty, \infty)$

R: $[-2, \infty)$

min is -2

incr. on $(0, \infty)$

$g(x) = |x+5| - 2$

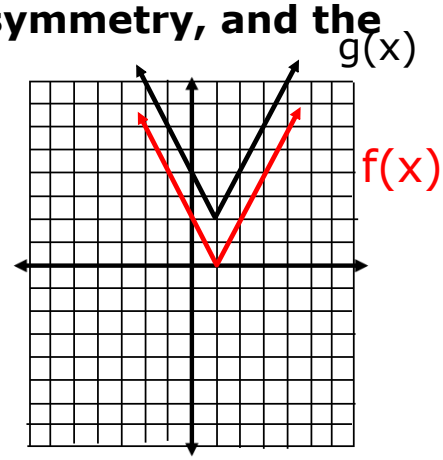
$(-\infty, \infty)$

$[-2, \infty)$

min is -2

incr. on $(-5, \infty)$

Ex. 6 Given f(x) and g(x), state the translation from f(x) to g(x). Write the equation for each function. For each function, give the domain & range, the line of symmetry, and the minimum.



g(x) is up 2 from f(x)

$f(x) = 2|x-1|$

D: $(-\infty, \infty)$

R: $[0, \infty)$

line of symmetry: $x = 1$

min is 0

$g(x) = 2|x-1| + 2$

$(-\infty, \infty)$

$[2, \infty)$

$x = 1$

min is 2