U1 L7A Transformations: Shifts & Reflections

Name: _____ HR: _____

Skills: Read function notation to identify shifts (h, k) and reflections, sketch transformed parent functions, and write equations from graphs.

Warm-Up: Prerequisite Skills

1. Key points of a parent	*2. Substituting an expression*	*3. Evaluating with function notation*
Ex: $f(x)=\sqrt{x}$ → (0,), (1,), (,)	Ex: $f(x)=x^2$ find $f(x-3)=$	Ex: $f(x)=\lvert x\rvert$ find $f(-2)+1$
You try: $f(x)=\lvert x\rvert$ → three points:	You try: $f(x)=x^3$, $f(x+2)=$	You try: $f(x)=x^2$, $-f(3)=$

The Big Idea: Inside vs. Outside

The Transformation Template: $g(x)=a\cdot f\big(b(x-h)\big)+k$

· a and b are only 1 or -1 (reflections in this section) · h and k shift.

Note: the textbook uses the letter c for every shift. We use h (inside) and k (outside) so each position has its own letter.

OUTSIDE the parentheses → VERTICAL (a and k)	*INSIDE the parentheses → HORIZONTAL (b and h)*
Changes the **y-values** (outputs).	Changes the **x-values** (inputs).
Does what it says: $+k$ moves UP, $-k$ moves DOWN.	**Does the OPPOSITE:** $x-h$ moves RIGHT, $x+h$ moves LEFT.
$a=-1$ (a negative in front) flips over the _____-axis.	$b=-1$ ($-x$ inside) flips over the _____-axis.

Notation Key — Rigid Transformations

Rigid = the shape does not change, only the position. Fill in the middle columns.

Notation ($h,\ k>0$)	**Letter / In or Out**	**What happens to the graph of f**	**Example if $f(x)=\sqrt{x}$**
$g(x)=f(x)+k$			$\sqrt{x}+2$
$g(x)=f(x)-k$			$\sqrt{x}-2$
$g(x)=f(x-h)$			$\sqrt{x-2}$
$g(x)=f(x+h)$			$\sqrt{x+2}$
$g(x)=-f(x)$			$-\sqrt{x}$
$g(x)=f(-x)$			$\sqrt{-x}$

Sign Watch: In $f(x-h)$, h is the number being **subtracted**. $f(x-3)\rightarrow h=3$, moves right 3. $f(x+3)=f\big(x-(-3)\big)\rightarrow h=-3$, moves left 3.

Practice Reading the Notation —> *No formula needed — just read the left side.*

Ex: Find h and k (and any reflection). Describe how the graph of g compares to the graph of f.	*You try: Find h and k (and any reflection). Describe how the graph of g compares to the graph of f.*
(a) $g(x)=f(x)-5$	(a) $g(x)=f(x)+7$
(b) $g(x)=f(x+4)$	(b) $g(x)=f\big(x-6\big)$
(c) $g(x)=f(x-2)+3$	(c) $g(x)=f(x+1)-4$
(d) $g(x)=-f(x+3)$	(d) $g(x)=f(-x)-1$

From Notation to Graph

Step 1: name the parent. Step 2: write it in f-notation. Step 3: find h and k. Step 4: sketch.

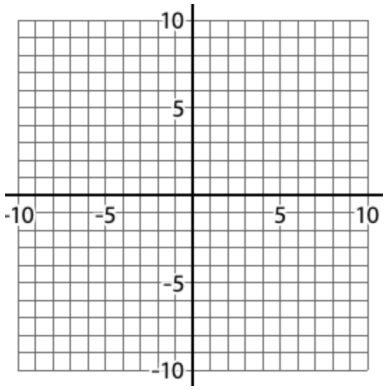
Ex: Use the graph of $f(x) = x^3$ ***to sketch*** $g(x) = (x+2)^3 + 1$.

Parent:

In f-notation: $g(x)$ =

h = k =

Transformations:



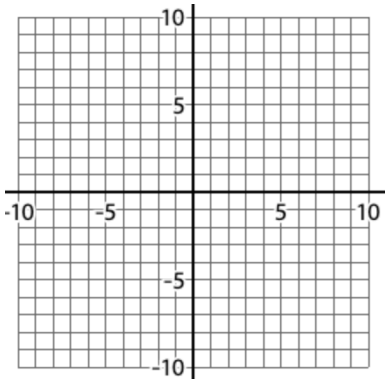
You try: Use the graph of $f(x) = x^3$ ***to sketch*** $g(x) = (x-3)^3 + 2$.

Parent:

In f-notation: $g(x)$ =

h = k =

Transformations:



Reflections in the Coordinate Axes: $-f(x)$ *(*$a = -1$*) flips over the x-axis.* $f(-x)$ *(*$b = -1$*) flips over the y-axis.*

Function	f-notation	Compare to the graph of $f(x) = \sqrt{x}$	Domain
Ex: $g(x) = -\sqrt{x}$	$g(x)$ =		
Ex: $h(x) = \sqrt{-x}$	$h(x)$ =		
Ex: $k(x) = -\sqrt{x+2}$	$k(x)$ =		

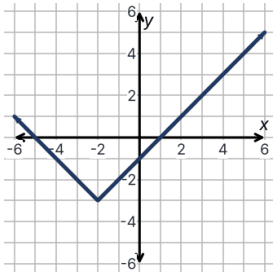
You try: Now let $f(x) = \sqrt{x-1}$. Compare the graphs of $g(x) = -\sqrt{x-1}$ and $h(x) = \sqrt{-x-1}$ to the graph of f.

g:

h:

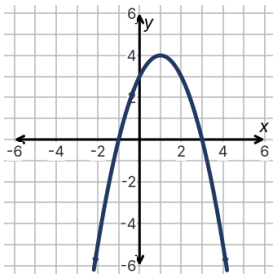
Writing Equations from Graphs: *Find the parent, then find where the anchor point (vertex or starting point) moved: that point is* (h, k).

Ex: The graph is a transformation of $f(x) = |x|$***. Write its equation.***



h = k = $g(x)$ =

You try: The graph is a transformation of $f(x) = x^2$***. Write its equation.***



h = k = $g(x)$ =

Section 1.7A Summary — Can you…

☐ Read the left side and name h, k, and any reflection?

☐ Rewrite a function like $(x+2)^3 + 1$ in f-notation?

☐ Sketch a shifted or reflected parent and write an equation from a graph?

Order Tip

When a graph is reflected AND shifted, apply the reflection first, then the shifts.

Example: $-|x-3| + 2 \rightarrow$ flip $|x|$ over the x-axis, then move right 3 and up 2.