

Section 1.4 Shifting, Reflecting, and Stretching Graphs

Objective: In this lesson you learned how to identify and graph shifts, reflections, and nonrigid transformations of functions

Important Vocabulary

Vertical Shift

Horizontal Shift

Rigid Transformation

Non-rigid Transformation

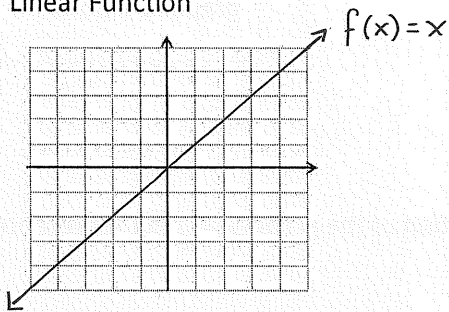
I. Summary of Graphs of Parent Functions

Sketch an example of each of the six most commonly used functions in Algebra.

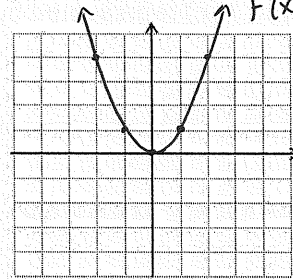
What you should learn:

How to recognize graphs of parent functions

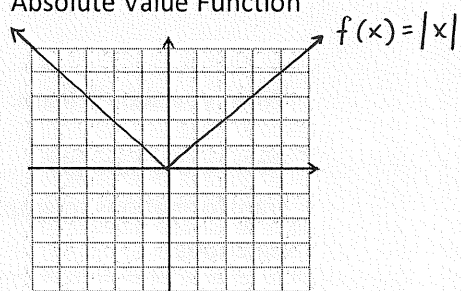
Linear Function



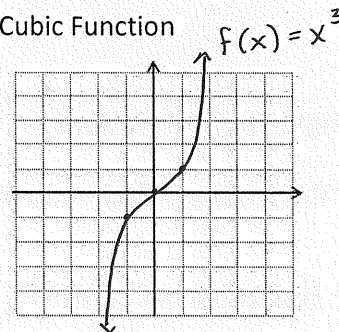
Quadratic Function $f(x) = x^2$



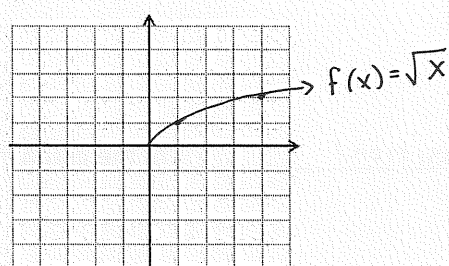
Absolute Value Function



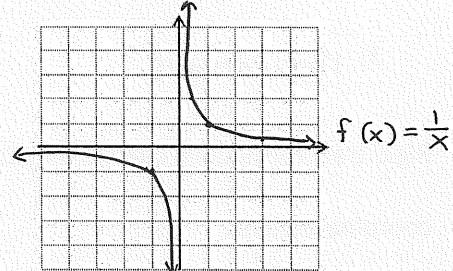
Cubic Function



Square Root Function



Rational Function



II. Vertical and Horizontal Shifts

Let c be a positive real number. Complete the following representations of shifts in the graph of $y = f(x)$:

What you should learn:

How to use vertical and horizontal shifts to graph functions

- 1) Vertical shift c units upward: $h(x) = f(x) + c$
- 2) Vertical shift c units downward: $h(x) = f(x) - c$
- 3) Horizontal shift c units to the right: $h(x) = f(x - c)$
- 4) Horizontal shift c units to the left: $h(x) = f(x + c)$

III. Reflecting Graphs

A **reflection** in the x -axis is a type of transformation of the graph of $y = f(x)$ represented by

$$h(x) = -f(x)$$

A **reflection** in the y -axis is a type of transformation of the graph $y = f(x)$ represented by

$$h(x) = f(-x)$$

What you should learn:

How to use reflections to graph functions

IV. Non-rigid Transformations

Name three types of rigid transformations:

- 1) HORIZONTAL SHIFTS
- 2) VERTICAL SHIFTS
- 3) REFLECTIONS

What you should learn:

How to use nonrigid transformations to graph functions

Rigid transformations change only the Position of the graph in the coordinate plane.

Name four types of non-rigid transformations:

1) VERTICAL STRETCH $\rightarrow y = c f(x)$ WITH $c > 1$

2) VERTICAL SHRINK $\rightarrow y = c f(x)$ WITH $0 < c < 1$

3) HORIZONTAL STRETCH $\rightarrow y = f(cx)$ WITH $0 < c < 1$

4) HORIZONTAL SHRINK $\rightarrow y = f(cx)$ WITH $c > 1$

A non-rigid transformation $y = c f(x)$ of the graph $y = f(x)$ is a VERTICAL STRETCH if $c > 1$ or a VERTICAL SHRINK if $0 < c < 1$. A nonrigid transformation $y = f(cx)$ of the graph of $y = f(x)$ is a HORIZONTAL SHRINK if $c > 1$ or a HORIZONTAL STRETCH if $0 < c < 1$.

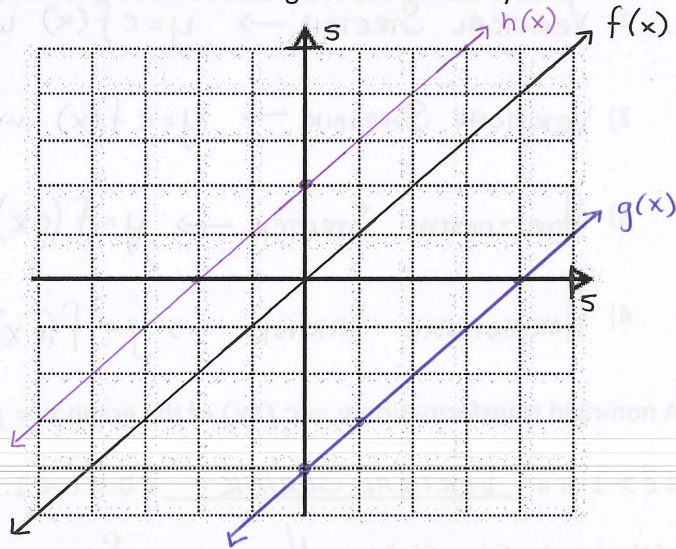
Section 1.4 Examples – Shifting, Reflecting, and Stretching Graphs

(1) Sketch the graph of the 3 functions on the same rectangular coordinate system.

$$f(x) = x$$

$$g(x) = x - 4$$

$$h(x) = x + 2$$



(2) Compare the graph of $g(x)$ with the graph of its parent function.

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

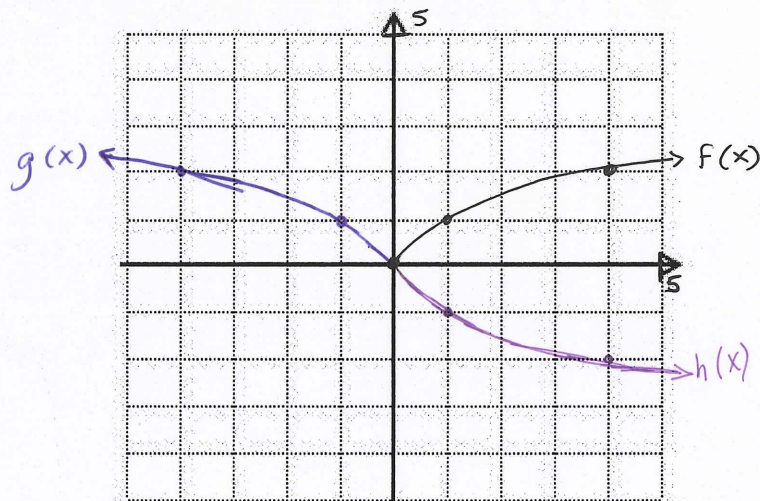
SHIFT $\leftarrow 1, \downarrow 2$

(3) Sketch the graph of the 3 functions on the same rectangular coordinate system.

$$f(x) = \sqrt{x}$$

$$g(x) = \sqrt{-x}$$

$$h(x) = -\sqrt{x}$$



(4) Compare the graph of $g(x)$ with the graph of its parent function.

$$g(x) = -(x + 2)^3 + 1$$

SHIFT $\leftarrow 2, \uparrow 1$

Reflect OVER
X-AXIS

(5) Sketch the graph of the 3 functions on the same rectangular coordinate system.

$$f(x) = x^2$$

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

$$h(x) = \frac{1}{2}x^2$$

