Warm Up

Lesson Presentation

Lesson Quiz

Warm Up

1. For the power 3^5, identify the exponent and the base.

Evaluate.

2. $\left(\frac{2}{3}\right)^{-2}$

3. $f(9)$ when $f(x)=2x + \sqrt{x}$

Objectives

Identify parent functions from graphs and equations.

Use parent functions to model real-world data and make estimates for unknown values.

Vocabulary

parent function

Holt McDougal Algebra 2
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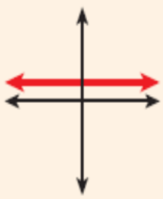
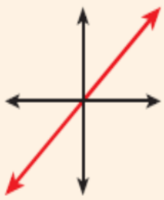
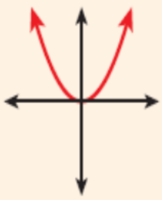
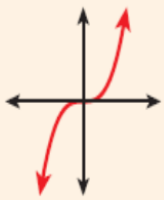
Similar to the way that numbers are classified into sets based on common characteristics, functions can be classified into *families of functions*. The **<u>parent function</u>** is the simplest function with the defining characteristics of the family. Functions in the same family are transformations of their parent function.

Parent Functions

Family	Constant	Linear	Quadratic	Cubic	Square root
Rule	$f(x) = c$	$f(x) = x$	$f(x) = x^2$	$f(x) = x^3$	$f(x) = \sqrt{x}$
Graph					
Domain	$\mathbb{R}$	$\mathbb{R}$	$\mathbb{R}$	$\mathbb{R}$	$x \geq 0$
Range	$y = c$	$\mathbb{R}$	$y \geq 0$	$\mathbb{R}$	$y \geq 0$
Intersects y-axis	$(0, c)$	$(0, 0)$	$(0, 0)$	$(0, 0)$	$(0, 0)$

Domain: *x* values of the function, independent variable, input value, **how far left to right the function will run.**

Range: *y* values of the function, dependent variable, output value, **how far up or down the function will run.**

Parent functions pass through the origin. Adding or subtracting a parent function will result in a vertical shift.

Example 1A: Identifying Transformations of Parent Functions

Identify the parent function for *g* from its function rule. Then graph *g* on your calculator and describe what transformation of the parent function it represents.

$y = x$

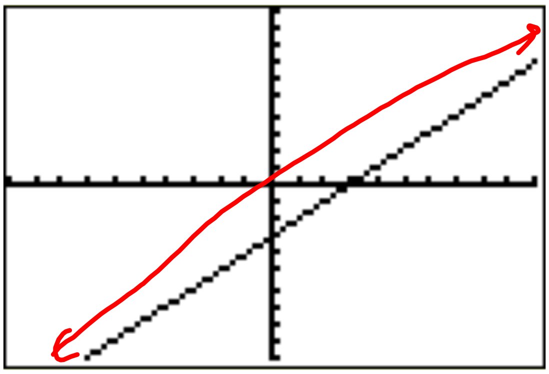
$$g(x) = x - 3$$

$g(x) = x - 3$ is linear *x has a power of 1.*

The linear parent function $f(x) = x$ intersects the *y*-axis at the point (0, 0).

Graph $\mathbf{Y_1 = x - 3}$ on the graphing calculator. The function $g(x) = x - 3$ intersects the *y*-axis at the point (0, –3).

So $g(x) = x - 3$ represents a vertical translation of the linear parent function 3 units down.



Example 1B: Identifying Transformations of Parent Functions

Identify the parent function for *g* from its function rule. Then graph on your calculator and describe what transformation of the parent function it represents.

$2\cos x + 7$

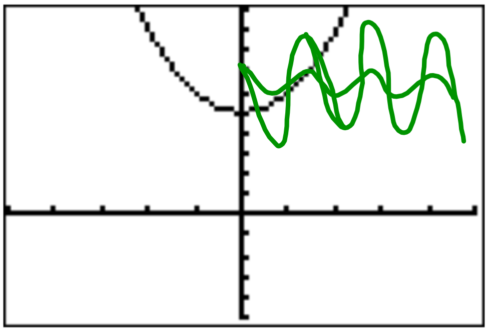
$\mathbf{g(x) = x^2 + 5}$

$g(x) = x^2 + 5$ is quadratic. *x has a power of 2.*

The quadratic parent function $f(x) = x$ intersects the y-axis at the point (0, 0).

Graph $\mathbf{Y_1 = x^2 + 5}$ on a graphing calculator. The function $g(x) = x^2 + 5$ intersects the y-axis at the point (0, 5).

So $g(x) = x^2 + 5$ represents a vertical translation of the quadratic parent function 5 units up.



Check It Out! Example 1a

Identify the parent function for *g* from its function rule. Then graph on your calculator and describe what transformation of the parent function it represents.

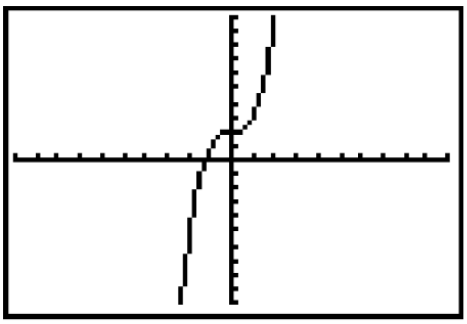
$\mathbf{g(x) = x^3 + 2}$

$g(x) = x^3 + 2$ is cubic. *x has a power of 3.*

The cubic parent function $f(x) = x$ intersects the y-axis at the point (0, 0).

Graph $\mathbf{Y_1 = x^3 + 2}$ on a graphing calculator. The function $g(x) = x^3 + 2$ intersects the y-axis at the point (0, 2).

So $g(x) = x^3 + 2$ represents a vertical translation of the quadratic parent function 2 units up.

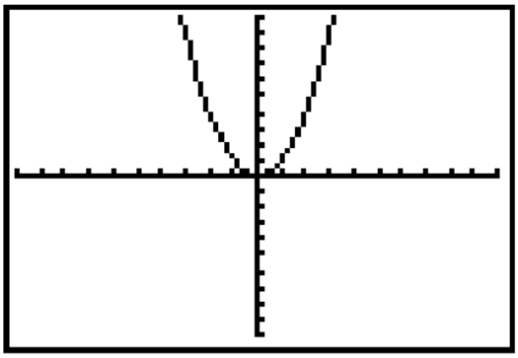


Check It Out! Example 1b

Identify the parent function for *g* from its function rule. Then graph on your calculator and describe what transformation of the parent function it represents.

$$g(x) = (-x)^2$$

$g(x) = (-x)^2$ is quadratic. *x has a power of 2.*



Example 2: Identifying Parent Functions to Model Data Sets

(0,0) (1,1)

Graph the data from this set of ordered pairs. Describe the parent function and the transformation that best approximates the data set. {(−2, 12), (−1, 3), (0, 0), (1, 3), (2, 12)}

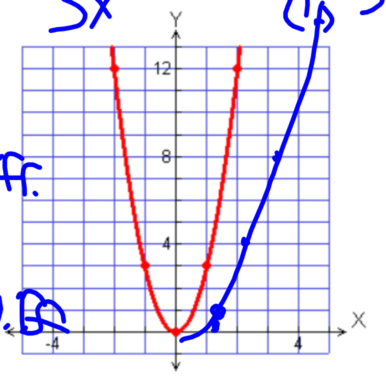
x	−2	−1	0	1	2
y	12	3	0	3	12

−9 −3 +3 +9 1st diff.

+6 +6 +6 2nd diff.

x^2

$3x^2$ (1, 3)



Check It Out! Example 2

Graph the data from the table. Describe the parent function and the transformation that best approximates the data set.

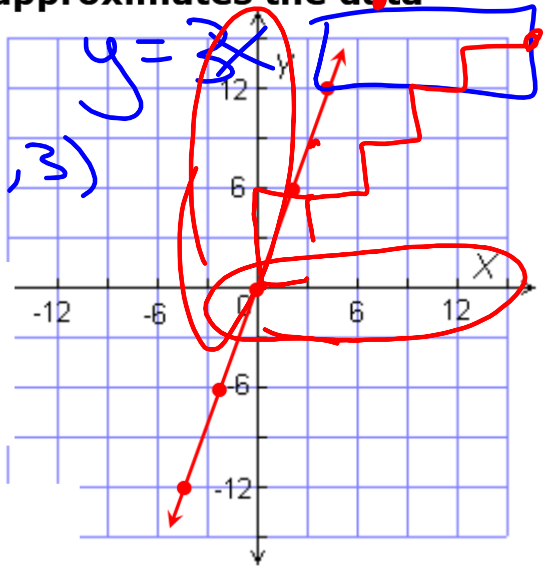
+2

x	−4	−2	0	2	4
y	−12	−6	0	6	12

+6 +6 +6 +6

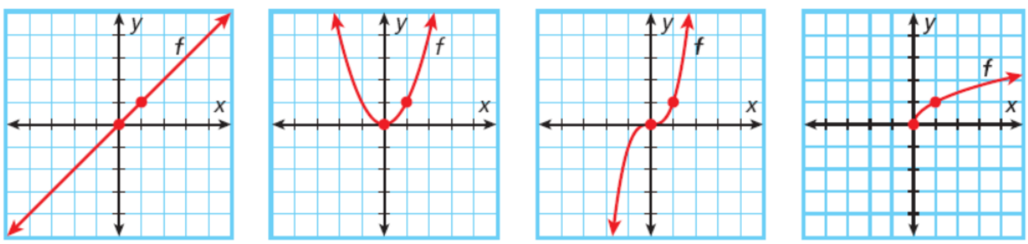
(1,3)

y = 3x



Consider the two data points (0, 0) and (1, 1). If you plot them on a coordinate plane you might very well think that they are part of a linear function. In fact they belong to each of the parent functions below.

Linear	Quadratic	Cubic	Square Root
$f(x) = x$	$f(x) = x^2$	$f(x) = x^3$	$f(x) = \sqrt{x}$



Example 3: Application

Graph the relationship from year to sales in millions of dollars and identify which parent function best describes it. Then use the graph to estimate when cumulative sales reached $10 million.

(1, 1)

(1, .6)

Cumulative Sales	
Year	Sales (million $)
1	0.6
2	1.8
3	4.2
4	7.8
5	12.6

1.2, 2.4, 3.6, 4.8

1.2, 1.2, 1.2

$.6x^2$

Step 1 Graph the relation.

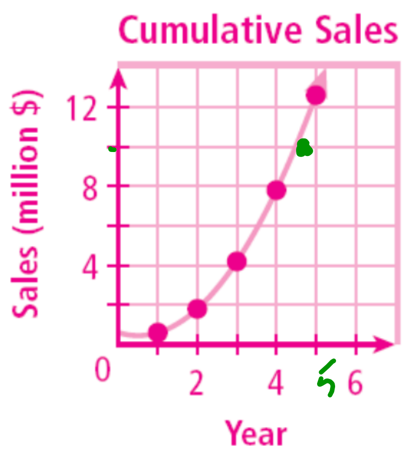
Example 3 Continu

Step 2 Identify the parent function.

The graph of the data set resembles the shape of the quadratic parent function $f(x) = x^2$.

Step 3 Estimate when cumulative sales reached $10 million.

The curve indicates that sales will reach the $10 million mark after about 4.5 years.



Check It Out! Example 3 Continued

The cost of playing an online video game depends on the number of months for which the online service is used. Graph the relationship from number of months to cost, and identify which parent function best describes the data. Then use the graph to estimate the cost of 5 months of online service.

$y = x$

$f(x) = 8x$

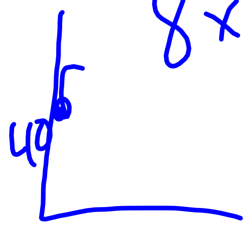
$8x + 40$

+2 +3 +3 +3

Cost of Online Video Game					
Time (mo)	1	3	6	9	12
Cost ($)	40	56	80	104	128

16 24 24 24

8



Lesson Quiz: Part I

Identify the parent function for *g* from its function rule. Then graph *g* on your calculator and describe what transformation of the parent function it represents.

1. $g(x) = x + 7$

Lesson Quiz: Part II

Identify the parent function for *g* from its function rule. Then graph *g* on your calculator and describe what transformation of the parent function it represents.

2. $g(x) = x^2 - 7$

$\sqrt{x+4}$