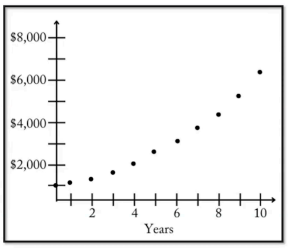
Topic 1.12 Transformations of Functions (Daily Video 1)

AP Precalculus

In this video, we will explore how and why an additive transformation impacts the graph of a function.

Let's WARMUP!

Invest $1,000 and Earn 20% Return per Year!



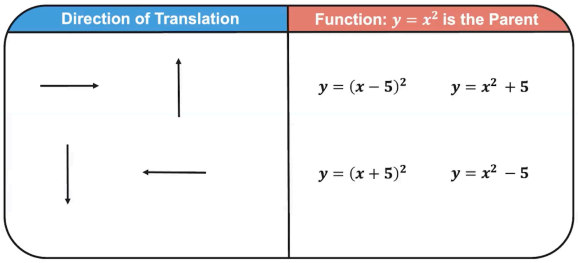
What is the equation of this function? _____

The equation of $f(x)$ is changed to $f(x) + 5$. Describe how the graph of $f(x)$ is changed.

The equation of $f(x)$ is changed to $f(x - 1)$. Describe how the graph of $f(x)$ is changed.

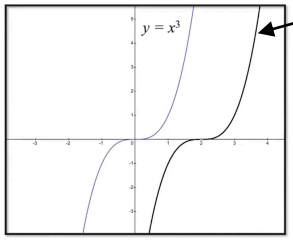
Let's REVIEW!

Match the Direction with the Transformation

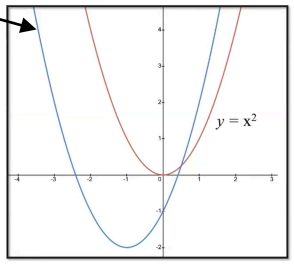


Let's PRACTICE!

What is the equation of the graph to the right?



What is the equation of the graph to the left?



What should we take away?

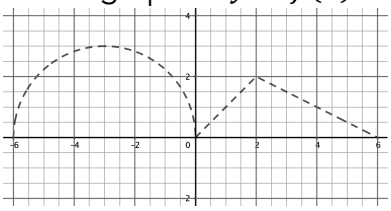
We should be able to recognize, based on graphs and/or equations, when an additive transformation has occurred. $f(x) + k$ is a _____ shift and $f(x + k)$ is a _____ shift of the graph of $f(x)$.

Topic 1.12 Transformations of Functions (Daily Video 2)

AP Precalculus

In this video, we will explore how and why a multiplicative transformation impacts the graph of a function.

The graph of $y = f(x)$

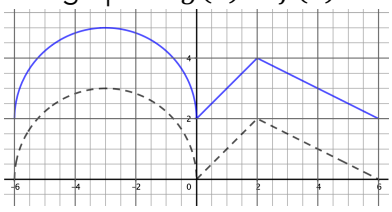


Let's Review!

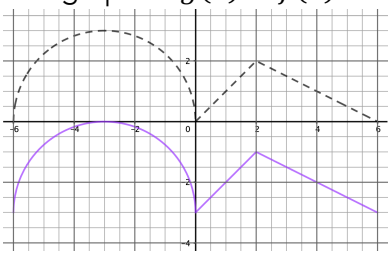
$f(x)$ is a piecewise defined function with a semicircle and 2 linear pieces.

Additive transformations

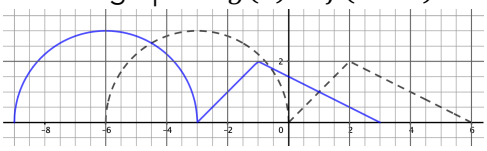
The graph of $g(x) = f(x) + 2$



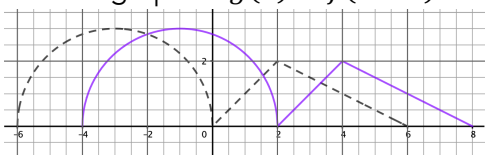
The graph of $g(x) = f(x) - 3$



The graph of $g(x) = f(x + 3)$



The graph of $g(x) = f(x - 2)$

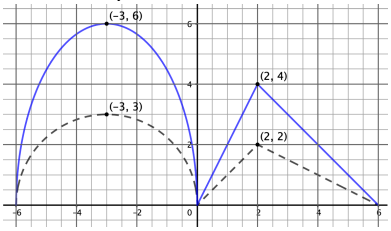


Let's look at an EXAMPLE!

$g(x) = af(x)$ is a multiplicative transformation of the function f. The result is a _____ dilation of the graph of f by a factor of _____.	$g(x) = f(bx)$ is a multiplicative transformation of the function f. The result is a _____ dilation of the graph of f by a factor of _____.

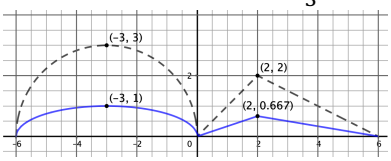
Effect of Multiplying a Function by a Constant $g(x) = af(x)$

The graph of $g(x) = 2f(x)$



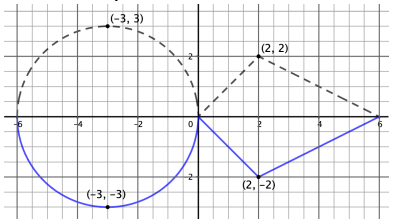
How were the y −values changed?

The graph of $g(x) = \frac{1}{3}f(x)$



How were the y −values changed?

The graph of $g(x) = -f(x)$

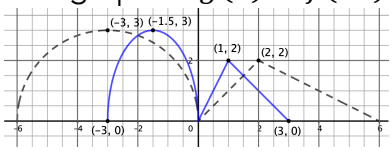
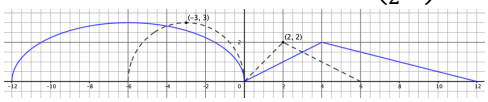
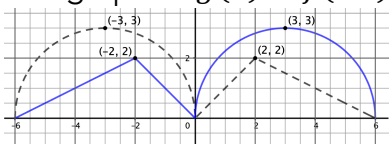


This example was not included in the video. How were the y −values changed?

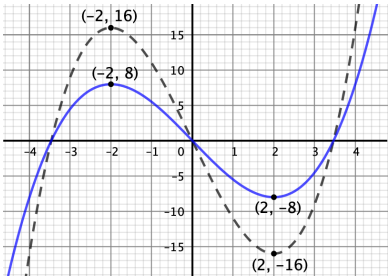
- If $|a| > 1$, the function is vertically _____ by a factor of a.
- If $0 < |a| < 1$, the function is vertically _____ by a factor of a.

- If $a < 0$, the function has a vertical dilation by a factor $|a|$ **and** is _____ over the x −axis.

Effect of Multiplying x by a Constant $g(x) = f(bx)$

The graph of $g(x) = f(2x)$	The graph of $g(x) = f\left(\frac{1}{2}x\right)$	The graph of $g(x) = f(-x)$
 How were the x −values changed?	 How were the x −values changed?	 This example was not included in the video. How were the x −values changed?
• If $\|b\| > 1$, the function is horizontally _____ by a factor of $\frac{1}{b}$. • If $0 < \|b\| < 1$, the function is horizontally _____ by a factor of $\frac{1}{b}$.		• If $b < 0$, the function has a horizontal dilation by a factor $\left\|\frac{1}{b}\right\|$ **and** is _____ over the y −axis.

Let's PRACTICE!



Identify the Transformation

The black (dashed) graph's equation is $f(x) = x^3 - 12x$.

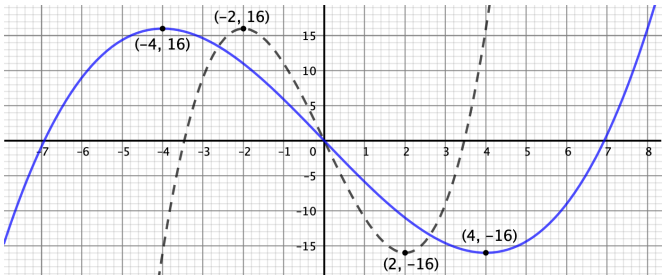
How is the blue (solid) graph different?

The blue graph is a _____ dilation.

The equation of for the blue graph has a form of $g(x) =$ _____

What is the value of a? Explain your reasoning.

The equation of the transformed function is $g(x) =$ _____



How is the blue (solid) graph different?

The blue graph is a _____ dilation.

The equation of for the blue graph has a form of $g(x) =$ _____

What is the value of b? Explain your reasoning.

The equation of the transformed function is $g(x) =$ _____

What should we take away?

1. Given a function, produce the graph of a new function with multiplicative transformations.
2. Create an equation for a function given its parent function and its horizontal and vertical dilations.

Topic 1.13 Function Model Selection and Assumption Articulation (Daily Video 1)

AP Precalculus

In this video, we will explore the most appropriate functions to use to model given data sets based on our knowledge of rates of change.

Let's REVIEW!

Linear data sets have a _____rate of change.

Is Data Set A linear? Justify your answer.

Data Set A

x	$y = f(x)$
0	3
1	7
2	11
3	15
4	19

Quadratic data sets have constant _____ differences for equal increments of input.

Is Data Set B linear or quadratic? Justify your answer.

Data Set B

x	$y = g(x)$
0	-12
1	-3
2	0
3	-3
4	-12

Let's PRACTICE!

Is the data, to the right, linear or quadratic? Justify your answer.

x	-2	2	4	6	12
$f(x)$	5	-1	-4	-7	-16

Is the data, to the right, linear or quadratic? Justify your answer.

Linear or Quadratic?

x	$f(x)$
-2	-8
-1	-2
0	0
1	-2
2	-8

What should we take away?

Linear models always have a _____ rate of change.

Quadratic models have a constant _____ difference for equal increments of input.

Topic 1.13 Function Model Selection and Assumption Articulation (Daily Video 2)

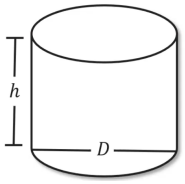
AP Precalculus

In this video, we will use quadratic and cubic functions to model given scenarios and discuss physical constraints on a function's domain and range.

Let's look at an EXAMPLE!

Volume of a Cylinder

Part 1: Suppose the volume of a right cylinder has a height, h, that is twice the length of its diameter, D. Identify, from the choices below, the function, $V(r)$, that represents the volume of the cylinder in terms of the radius. Recall: $V = \pi r^2 h$.



A. $V(r) = \pi r^2 h$ B. $V(r) = 2\pi r^2 D$ C. $V(r) = 2\pi r^3$ D. $V(r) = 4\pi r^3$

Part 2: Using the formula found in part 1, $V(r) =$_____, what is a reasonable domain and range for this problem and why?

Part 3: Using the formula found in part 1, $V(r) =$_____, what is a reasonable domain and range for this problem if the diameter can never be larger than 20 cm?

Domain: _____ Range: _____

What should we take away?

When we a dealing with "real-world" problems, we must always consider what restrictions the _____ _____ of the scenario might put on the _____ values and _____ values.

Topic 1.14 Function Model Construction and Application (Daily Video 1)

AP Precalculus

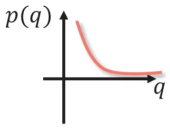
In this video, we will explore quantities that are inversely proportional and build appropriate models.

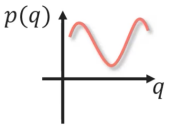
Let's look at an EXAMPLE!

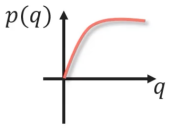
Suppose the output of a function, $f(x)$, is **inversely proportional** to the square of its input. Write a generic equation for the function. $f(x) =$ _____	If we know that one data point of the function $f(x) = \frac{k}{x^2}$ is $(10, 30)$ then what is the value of the constant k? Show how you arrived at your answer. What is the output for an input of 50 units? $f(50) =$ _____

Let's PRACTICE!

Suppose the price per pound, $p(q)$, of a particular whole grain is inversely proportional to the quantity, q, demanded. Which of the following graphs could represent this relationship? Circle a choice and explain your reasoning.







Write an equation for $p(q)$ if we know that the price per pound of whole grain is \$4 when 2,000 pounds are being demanded. Show how you arrived at your answer.

$p(q) =$ _____

What should we take away?

If the output values and input values are inversely proportional, then as input values increase, output values _____ and as input values _____, output values increase.

Topic 1.14 Function Model Construction and Application (Daily Video 2)

AP Precalculus

In this video, we will compute average rates of change and compare the changes in those average rates of change to draw conclusions about a given model.

Let's REVIEW! Rational Function Review: Topics 1.7 – 1.9

$$g(t) = \frac{3t+1}{t+2}$$

Asymptotes for $y = g(t)$: horizontal asymptote: _____ vertical asymptote: _____

List the domain and range: domain: _____ range: _____

Let's look at an EXAMPLE!

Suppose that the previous function, $g(t)$, can be used to model the population of a species since 1951 ($t \geq 0$, measured in years) and $g(t)$ is the population (in thousands).

Calculate the value of $g(0)$ and explain the meaning of $g(0)$ in the context of this problem.	State the range of $g(x)$ in the context of the problem. Explain your reasoning.
Find the average rate of change between $t = 1$ and $t = 2$ and the average rate of change between $t = 8$ and $t = 10$. Be sure to use proper units. Show your work.	Compare the average rate of change between $t = 1$ and $t = 2$ with the average rate of change between $t = 8$ and $t = 10$. Be sure to use the context of the problem in your discussion.
Both average rates of change are positive over these intervals so the graph of $g(t)$ is _____.	The average rates of change are decreasing over these intervals so the graph of $g(t)$ is _____.

What should we take away?

When the rate of change over an interval is _____, the function is increasing and when the rate of change over an interval is _____, the function is decreasing.

When the rates of change over an interval are increasing, the function is _____ and when the rates of change over an interval are decreasing, the function is _____.