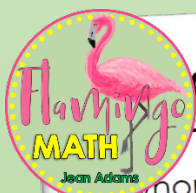


Algebra 2 Honors

Transforming Polynomials



Lesson 9: Transforming Polynomial Functions

Polynomial functions can be transformed by using the same rules we have seen in the linear and quadratic function units of study. Let's review those rules here.

Rigid Transformations of $f(x)$

Keep the original shape and size of the graph unchanged.

Let c be any real number . . .

Transformation	$f(x)$ Notation	Examples	Ordered Pairs
Vertical Translation	$y = f(x) + c$	$y = x^3 + 4$ up	$(x, y+c)$
	$y = f(x) - c$	$y = x^3 - 2$ down	$(x, y-c)$

Completely Editable

5.9

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Let c be any real number...

Transformation	$f(x)$ Notation	Examples	Ordered Pairs
Vertical Translation	$y = f(x) + c$		
	$y = f(x) - c$		
Horizontal Translation	$y = f(x - c)$		
	$y = f(x + c)$		
Reflections	$y = -f(x)$		
	$y = f(-x)$		

NON-RIGID TRANSFORMATIONS:

Stretch and Shrink Factors

Distorts the shape of a graph

Let c be any real number...

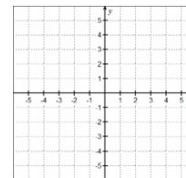
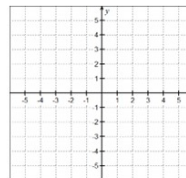
Transformation	$f(x)$ Notation	Examples	Ordered Pairs
Vertical Stretch	$y = c \cdot f(x)$ $c > 1$		
Vertical Compression	$y = c \cdot f(x)$ $0 < c < 1$		
Horizontal Compression	$y = f(c \cdot x)$ $c > 1$		
Horizontal Stretch	$y = f(c \cdot x)$ $0 < c < 1$		

Translating a Polynomial Function

EX #1: Given $f(x) = x^2 + 2$, write the rule for each function and sketch its graph.

A. $g(x) = f(x) + 3$

B. $h(x) = f(x - 4)$



Reflecting Polynomial Functions

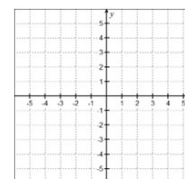
EX #2: Given $f(x) = x^3 - 2x^2 - x + 2$, write a function rule $k(x)$ that performs each transformation. Then, use a calculator to verify the rule works.

A. Reflect $f(x)$ across the x -axis.

B. Reflect $f(x)$ across the y -axis.

Compressing and Stretching Polynomial Functions

EX #3: Given $f(x) = x^4 - 4x^2 + 3$ and $g(x) = f\left(\frac{1}{2}x\right)$, Graph $f(x)$ and $g(x)$ on the same coordinate plane. Describe g as a transformation of f .



Real-World Application

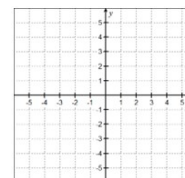
EX #7: The manufacturer of Speedy Scooters found that the number of scooters sold during the year can be modeled by the function $S(x) = 0.01x^3 + 0.72x^2 + 0.5x + 150$ where x represents the number of months since January. Let $g(x) = S(x) - 20$.

A. Find the rule for g .

B. Explain the meaning of the transformation in terms of monthly scooter sales.

C. Suppose $h(x) = S(x - 3)$. Find the rule for h and explain the meaning of the transformation in terms of the monthly scooter sales.

EX #4: Given $f(x) = x^4 - 4x^2 + 3$ and $g(x) = 2f(x)$, Graph $f(x)$ and $g(x)$ on the same coordinate plane. Describe g as a transformation of f .



Combining Transformations

EX #5: Write a function that transforms $f(x) = x^3 - 2x + 1$ in the following ways. Support your work algebraically and check using a graphing calculator.

A. Stretch vertically by a factor of 2 and shift 3 units right.

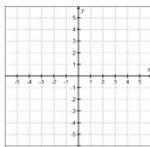
B. Reflect across the x -axis and shift 2 units down.

NOTES

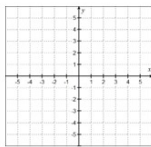
Transforming Polynomials Practice

Problems 1 - 4, for $f(x) = x^4 - 5$, write the rule for each function and sketch its graph.

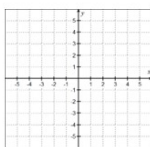
1. $g(x) = f(x) + 3$



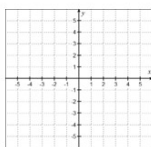
2. $h(x) = f(x - 2)$



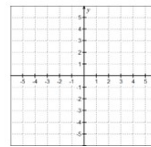
3. $k(x) = f(2x)$



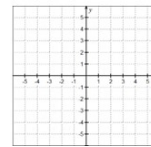
4. $m(x) = f\left(\frac{1}{2}x\right)$

**Problems 5 - 6**, given $f(x) = -x^3 - x^2 + 3x + 2$. Write a function g that performs each transformation. Support your work algebraically.5. Reflect $f(x)$ across the y -axis6. Reflect $f(x)$ across the x -axis**Problems 7 - 10**, let $f(x) = x^3 - 3x^2 + 2$. Graph f and g on the same coordinate plane. Describe g as a transformation of f .

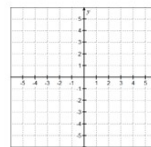
7. $g(x) = 2f(x)$



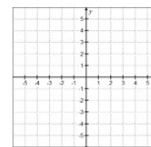
8. $g(x) = f\left(\frac{1}{2}x\right)$



9. $g(x) = f(2x) - 3$



10. $g(x) = f(x - 1) + 2$

**Problems 11 - 14**, write a function that transforms $f(x) = 2x^3 - 4$ in each of the following ways. Support your solution by using a graphing calculator.11. Compress vertically by a factor of $\frac{1}{2}$, move the y -intercept 3 units up.12. Reflect across the x -axis and compress horizontally by a factor of $\frac{1}{2}$.13. Move 2 units left and 3 units down. Then reflect across the x -axis.14. Reflect across the y -axis, stretch horizontally by a factor of $\frac{1}{2}$.**Problems 15 - 17**, solve.15. The volume of a rectangular prism can be modeled by the function $v(x) = x^3 + 3x^2 + 2x + 4$, where V is the volume in cubic feet and x represents the length in feet. Describe the transformation $V\left(\frac{3}{4}x\right)$ by writing the new rule and explain the change in the context of the problem.16. The cost to manufacture x widgets can be modeled by $C(x) = 2x^3 - 3x + 40$, where the cost is in thousands of dollars. Describe the transformation $2C(x)$ by writing the new rule and explain the change in the context of the problem.17. The manufacturer of a set of Bluetooth headphones reports that the number of headphones sold during the year can be modeled by the function $S(x) = 0.01x^3 + 0.65x^2 + 0.4x + 120$ where x represents the number of months since January. Let $g(x) = f(x) + 20$ A. Find the rule for g .

Practice Sets

Lesson Warm-Ups

5.9 Transforming Polynomials Form A	5.9 Transforming Polynomials Form B
Name _____	Name _____
Date _____ Period _____	Date _____ Period _____
1. Given $f(x) = 2(x - 4)^3 - 5$ describe the sequence of the basic transformations from the parent function $y = x^3$.	1. Given $f(x) = 3(x + 2)^3 - 4$ describe the sequence of the basic transformations from the parent function $y = x^3$.
Questions 2 - 3, use $f(x) = x^3 + 2x - 3$	Questions 2 - 3, use $f(x) = x^3 - 3x + 4$
2. Write the rule for $g(x) = f(x) + 2$	2. Write the rule for $g(x) = f(x) - 6$
3. Write the rule for $h(x) = f(2x)$	3. Write the rule for $h(x) = f(2x)$
4. Write a function rule for $f(x) = x^3 - 5x$ that performs the transformations reflect across x -axis and moved up 3 units.	4. Write a function rule for $f(x) = x^3 + 3x$ that performs the transformations reflect across x -axis and moved down 4 units.
Grade: _____	Grade: _____

Name _____ Date _____ Period _____	
Lesson 5.9: Transforming Polynomial Functions Warm-Up #1	
1. Given the parent function $y = x^3$ write a cubic function that represents a translation 3 units right.	3. Find a cubic function with only real zeros at $x = 2, x = 1$ and $x = -1$
2. Find all the real zeros of $y = 2(x + 1)^3 - 4$	
Name _____ Date _____ Period _____	
Lesson 5.9: Transforming Polynomial Functions Warm-Up #2	
1. Given the parent function $y = x^3$ write a cubic function that represents a translation 2 units left.	3. Find a cubic function with only real zeros at $x = -3, x = -1$ and $x = 1$.
2. Find all the real zeros of $y = 3(x - 2)^3 + 1$	

Daily Lesson Quiz