Precalc takeaways **Name:**

Math 3 Unit 8: Modeling with Functions

Standards

M3 8.1 I can describe functions as transformations of parent functions. (M)
M3 8.2 I can interpret the parameters of a function in context. (M)
M3 8.3 I can add, subtract, multiply, and compose functions. (M)

function transformations

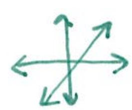
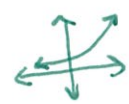
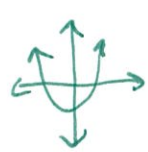
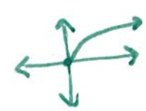
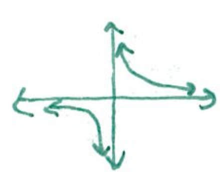
function family:

a group of functions of the same type.
the function formulas usually have similar forms but different numbers (parameters)

parent function:

the basic function on which a function family is based

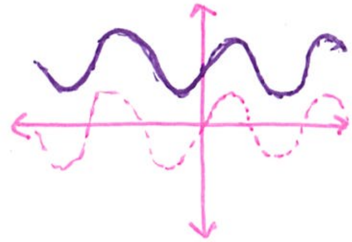
incomplete list of function families

family	parent function	formula	graph
linear	$y=x$	$y=mx+b$	
exponential	$y=e^x$	$y=a\cdot b^x$	 or 
quadratic	$y=x^2$	$y=ax^2+bx+c$ or $y=a(x-h)^2+k$ or $y=a(x-\#)(x-\#)$	 or 
radical	$y=\sqrt{x}$	$y=a\cdot\sqrt[n]{x}$	
rational	$y=\frac{1}{x}$	$y=\frac{a}{x-h}+k$ (many other forms)	
trigonometric	$y=\cos(x)$ $y=\sin(x)$	$y=a\cos(b(x-c))+d$ $y=a\sin(b(x-c))+d$	

Transformations that affect y values:

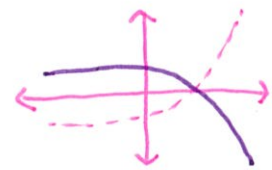
translate vertically: $f(x) + k$

Adding a number to the y-values translates the function up that many units.



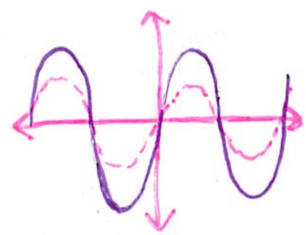
reflect across x-axis: $-f(x)$

Making the y-values negative reflects the function across the x-axis.



vertical dilations: $a \cdot f(x)$

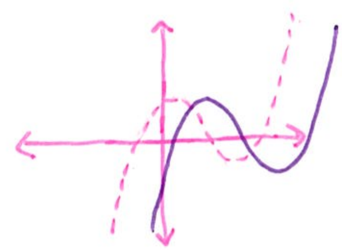
Multiplying the y-values by a number stretches the function up & down away from the x-axis.



Transformations that affect x values:

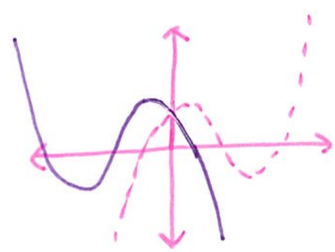
translate horizontally: $f(x-h)$

Subtracting a number from the x-values translates the function that many units to the right.



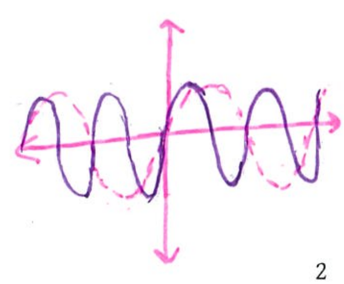
reflect across y-axis: $f(-x)$

Making the x-values negative reflects the function across the y-axis.



horizontal dilations: $f(b \cdot x)$

Multiplying the x-values by a number compresses the function right & left toward the y-axis.



parameters: the numbers in the function formula that make one function different from another function in the same family

parameters can relate to the story context by representing:

- rate of change
- starting amount / y-intercept
- maximum / minimum
- amplitude, period, frequency, phase shift, ...
- etc.

examples:

$f(x) = -2x + 5$

5 is starting amount

function goes down by 2 each time

$f(x) = 4 \cdot 1.03^x$

4 is starting amount

1.03 is growth rate (function increases by 3% each time)

$f(x) = 30 + 25\sin(18x° + 90°)$

30 is the midline / average value

25 is the amplitude / radius

18 is rotational speed (degrees per second)

90° is phase shift (a 90° lag behind parent sin function)

$f(x) = |x - 46|$

46 is Shakira's age

x represents a guess for Shakira's age

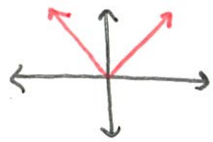
f(x) represents how far off the guess is

$f(x) = 10000e^{0.065x}$

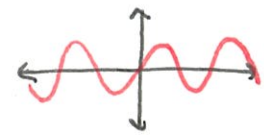
10000 is the starting amount

0.065 is 6.5% annual interest, compounded continuously example functions:

$f(x) = |x|$

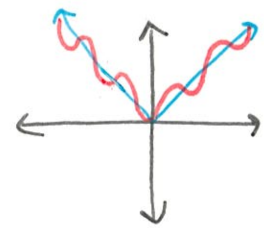


$g(x) = \sin(x)$



addition of functions $f(x) + g(x)$ or $f+g(x)$

at each x-value, the y-values of the two functions are added

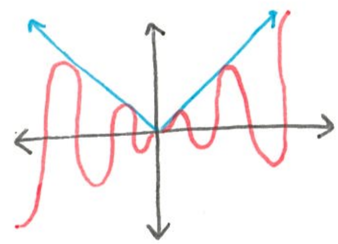


example:

$f(x) + g(x) = |x| + \sin(x)$

multiplication of functions $f(x) \cdot g(x)$ or $f \cdot g(x)$

at each x-value the y-values of the two functions are multiplied



example:

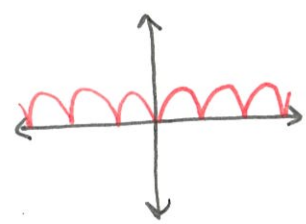
$f(x) \cdot g(x) = |x| \cdot \sin(x)$

function composition

$f(g(x))$ or $f \circ g(x)$

$f(g(x)) = |\sin(x)|$

each x-value is input into $g(x)$. then the output from $g(x)$ becomes the input into the f function, which produces the final output.



$x \rightarrow \boxed{g} \rightarrow g(x) \rightarrow \boxed{f} \rightarrow f(g(x))$

order matters!

$g(f(x))$ or $g \circ f(x)$

$g(f(x)) = \sin(|x|)$

$x \rightarrow \boxed{f} \rightarrow f(x) \rightarrow \boxed{g} \rightarrow g(f(x))$