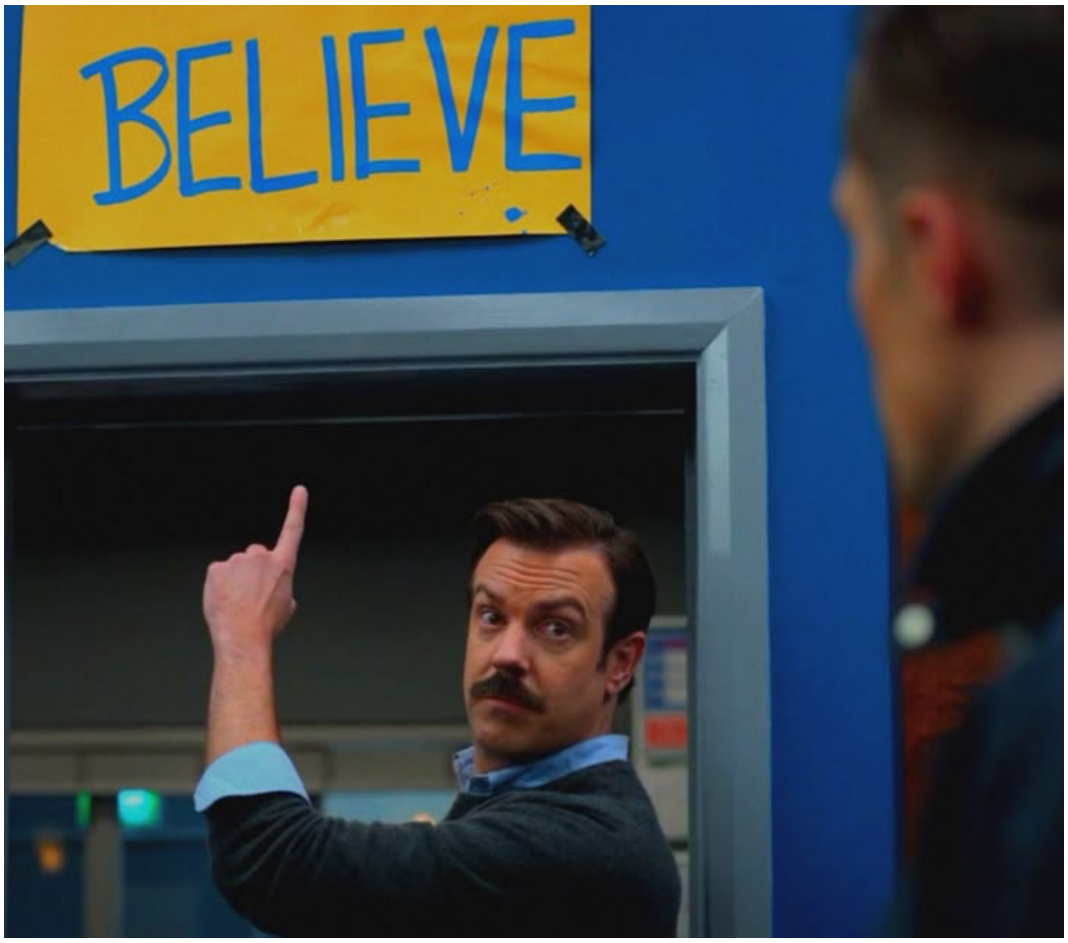
Mr. Mahler's

AP Calculus AB

Summer assignment

2026-2027 School Year



For each assignment, there is a discovery activity which you should attempt on your own or with real friends (Claude or ChatGPT do not count as friends). Then you you can access the mini video lessons connecting what you discovered with the lesson. Watch the video lesson and take notes in the small box/in the margins of the discovery activity. Then finish the "check your understanding" questions to make sure you remember how to do these prerequisite math skills before we get into AP calculus Proper. There will be a test on the summer assignment the Monday/Tuesday of the second week of school. Some lessons require you to log into Amplify Classroom (used to be Desmos). There are links for everything in the pdf versions of the assignment. Otherwise email jmahler@bsmschool.org with questions.

See you in August!

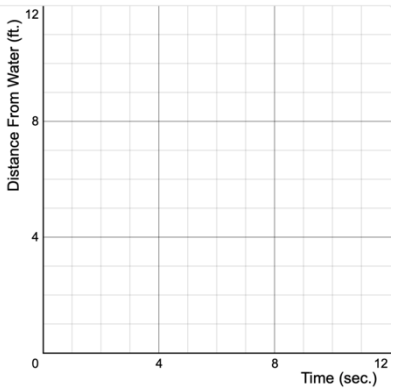
M.M. 0.1 How does the Turtle Cross the Sand?

Today we're going to use Desmos to investigate the journeys of turtles crossing the sand. Click this link or go to student.desmos.com and type in the code ZAC3ZM. Then look for Turtle Activity in your assigned activities. Complete the questions below as you're going through the activity.

1. On **slide 1**, draw a distance vs. time graph to represent a turtle's journey crossing the sand. Then press play on the animation to see what happens. What do you notice? What do you wonder?

2. Copy Luca's graph on the coordinate grid shown. Then finish the story to describe this turtle's journey based on the graph.

   For the first two seconds, the turtle moved away from the water at a constant rate. Then…

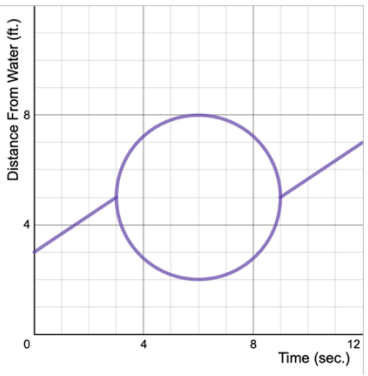


3. a. How far away from the water was the turtle after 8 seconds?

   b. At what time was the turtle 4 feet away from the water? How do you know?

   c. At what time was the turtle 12 feet away from the water? How do you know?

4. Arnav's distance vs. time graph is shown below. Does this graph represent a possible journey for the turtle? Why or why not?



5. Complete **slides 7-10** on Desmos.

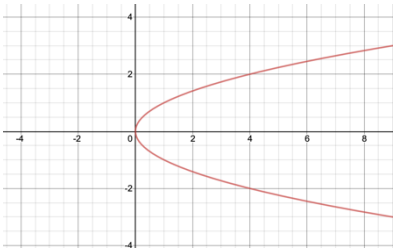
6. Is it possible for the turtle to be 5 feet away from the water at multiple points in his journey? Explain.

There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

Lesson 0.1 – Functions and Function Notation

QuickNotes

Check Your Understanding

1. Determine if the following relations represent a function. Give a reason for your answer.
   a. {(0,-2), (3,5), (4,-2), (0,7)}
   b. X is height of student; Y is his/her age
   c. X is the number of minutes on the treadmill; Y is the number of calories burned.
   d. 

2. Let $g(x) = x^2 + 5$. Find the following values:
   a. $g(2) =$
   b. $g(-7) =$
   c. $g(t) =$
   d. $g(\text{🤓}) =$
   e. $g(x + h)$

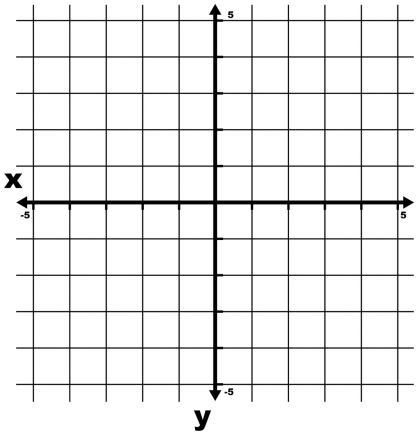
3. Let $P(t)$ represent the number of people in a store, t hours after the store opens at 6 AM. Interpret each of the following statements in context.
   a. $P(2) = 83$
   b. $P(3) = P(6)$
   c. $P(L) = 121$

MM 0.2 What's Your Domain Name?

Today we're going to look at some functions in multiple representations to determine the inputs and outputs.

1. Fill in the table of values for $f(x) = \sqrt{9 - x^2}$. Then sketch the graph.

x	$f(x)$
-3.5	
-3	
-1	
0	
1	
2	
7	

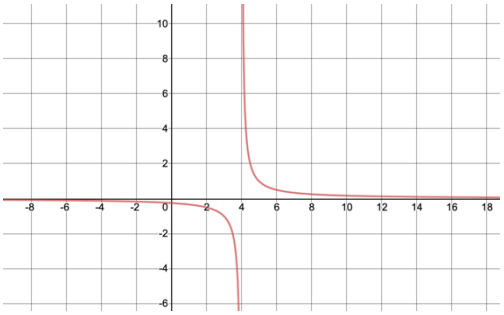


2. Which values of *x* do NOT have an associated output? Why do you think this is?

3. What kinds of values of *x* DO have an output?

4. What is the highest y-value that is reached by the graph? What is the lowest y-value?

5. The graph of $g(x) = \frac{1}{x-4}$ is shown below.
   a. When Leslie plugs in $x = 4$ into the equation, her calculator says ERROR. Can you explain why this is?



   b. What is the domain of $g(x)$? What is the range?

6. Without graphing, explain how you can determine the domain of $j(x) = \frac{1}{5x-3}$.

There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

QuickNotes

Check Your Understanding!

1. A Ford Escape has a 14-gallon fuel tank and can travel approximately 26 miles with one gallon of gas.
    a. Write a function $d(x)$, that gives the distance the Escape can travel with *x* gallons of gas in the tank.

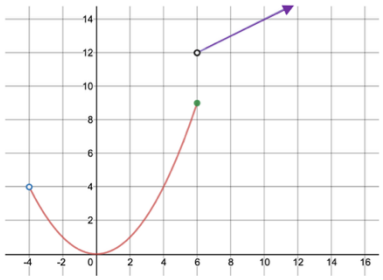
    b. What is a reasonable domain and range for this function?

    c. If you were to graph this function without knowing about the context, what would you say the domain and range is?

2. Find the domain and range of $f(x) = \frac{2}{x+7}$. Express your answer using set notation.

3. Find the domain of $g(x) = \sqrt{16 - x^2}$ and $h(x) = \sqrt{x^2 - 16}$. Express your answer using interval notation.

4. Find the domain of the function shown below.

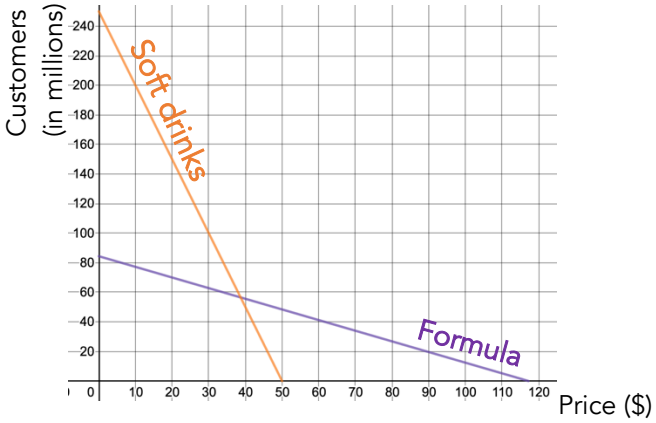


MM 0.3 How Does the Food Industry Set Prices?

The food industry is made up of a collective of diverse businesses that together make the majority of the food consumed by the world's population. How do these businesses decide which items to advertise and how much to charge for each product?

1. What types of food or drink do you see advertised often? For what types do you see very little advertising? Why do you think this is?

2. The lines below model the possible relationship between the price and number of customers for two popular supermarket purchases: baby formula and soft drinks.



a) What do you notice about the two graphs? What do you wonder?

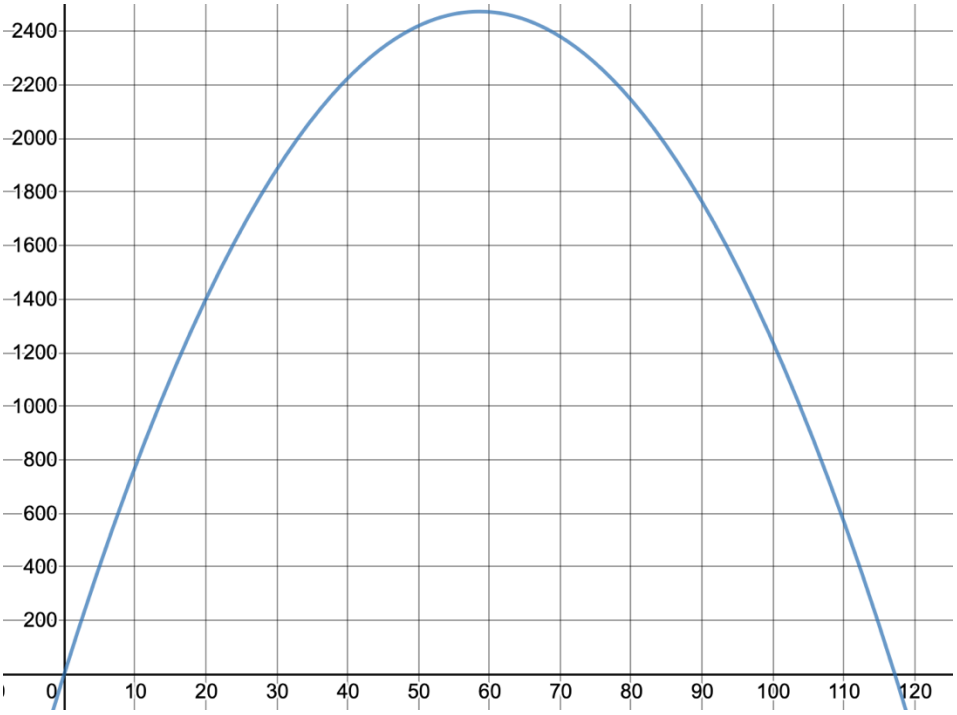
b) Which customer base, formula or soft drinks, is more swayed by an increase in price? How do you know?

3. Look at the data in the table below.
   a. Calculate the company's **revenue** for each item when the price is $10 and when the price is $45.

	Price=$10		Price=$45	
	Customers	Revenue	Customers	Revenue
Soft Drinks	200 million		30 million	
Formula	78 million		52 million	

   b. Do you think it's a good idea for food companies to always charge more? Explain.

4. The graph below gives the food company's revenue for baby formula. The x-axis represents the price of the formula. Label the y-axis "revenue (in millions)" and the x-axis "price". Label the function $r(p)$.



5. a. The new intern at the company suggests selling the formula for $20. Is this the best price? How do you know?

   b. The second intern suggests selling the formula for $80. Is this the best price? How do you know?

   c. If the goal is to make the most money, what is the optimal price for the formula? How do you know?

6. At what price(s) will the company make no money on formula? Why?

7. Between $p = 0$ and $p = 60$, how much does revenue change, *on average*, when the price of formula increases by $1? Explain.

8. When or why might companies use factors besides revenue to determine their prices?

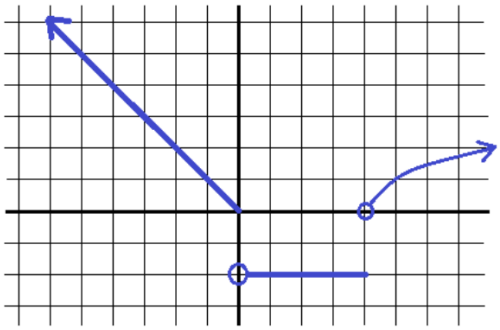
There is a little video of mini notes in this folder when you've finished the first pages to jot down in quicknotes before you check your understanding.

Lesson 0.3 – Rates of Change and Graph Behavior

QuickNotes

Check Your Understanding

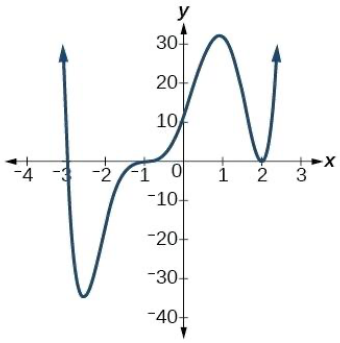
1. Give the intervals on which f(x) is increasing, decreasing, and constant.



2. The function $g(x)$ is shown below.
   a. Find all x-values where $g(x) = 0$.

   b. Estimate the relative minimums of $g(x)$.

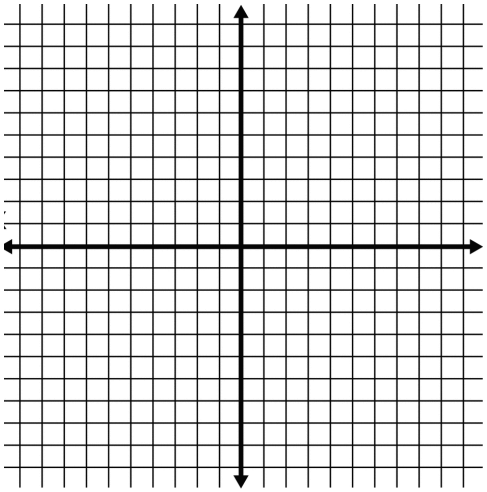
   c. Estimate the relative maximums of $g(x)$.



3. For $g(x) = x^2 - 5x + 8$, find the average rate of change on the interval [1, 6].

MM 0.4 Graph Library

Today we will look at six parent functions and explore their basic properties. Draw each of the graphs below without the aid of your calculator. Fill in at least three ordered pairs in your table and determine the domain and range of each curve. Find both intercepts, as well as the intervals on which the function is increasing and decreasing.



$f(x) = x$

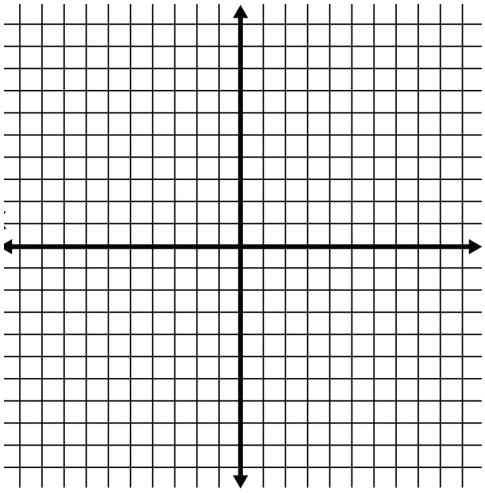
x	$f(x)$

Domain: _____

Range: _____

X-intercept: _____Y-intercept: _____

Increasing on _____ Decreasing on _____



$f(x) = |x|$

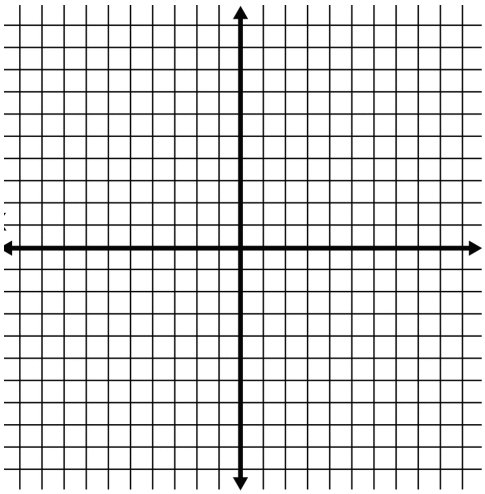
x	$f(x)$

Domain: _____

Range: _____

X-intercept: _____Y-intercept: _____

Increasing on _____ Decreasing on _____



$f(x) = x^2$

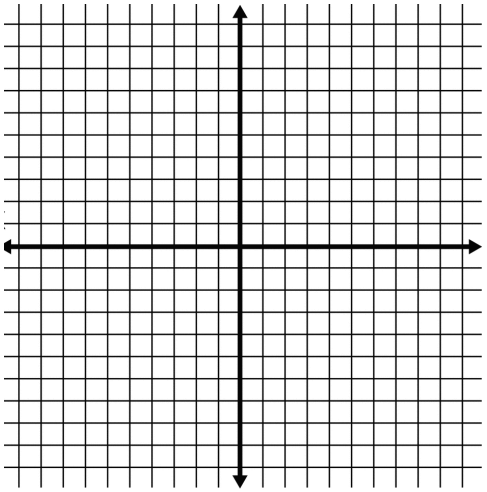
x	$f(x)$

Domain: _____

Range: _____

X-intercept: _____Y-intercept: _____

Increasing on _____ Decreasing on _____



$f(x) = x^3$

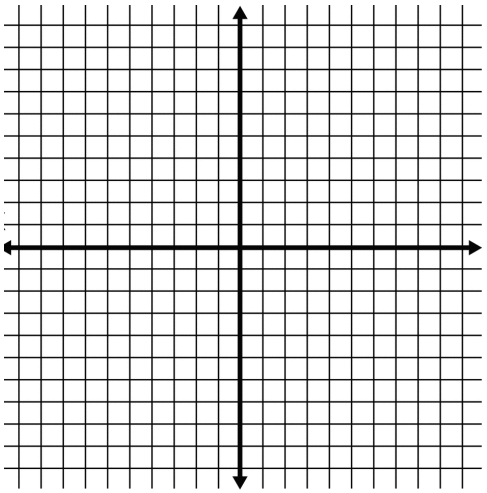
x	$f(x)$

Domain: _____

Range: _____

X-intercept: _____Y-intercept: _____

Increasing on _____ Decreasing on _____



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

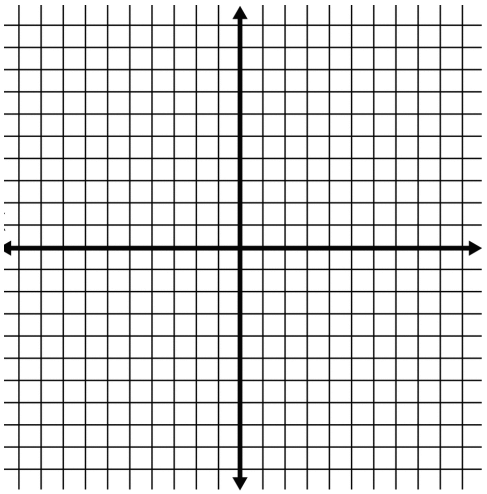
x	$f(x)$

Domain: _____

Range: _____

X-intercept: _____Y-intercept: _____

Increasing on _____ Decreasing on _____



$f(x) = \frac{1}{x}$

x	$f(x)$

Domain: _____

Range: _____

X-intercept: _____Y-intercept: _____

Increasing on _____ Decreasing on _____

There is a little video of mini notes in this folder when you get to the "Lesson 0.4" below to jot down in quicknotes before you check your understanding.

Lesson 0.4 – Library of Parent Functions

QuickNotes

Check Your Understanding

1. Which parent function(s) demonstrate a constant rate of change?

2. Identify the parent function in each of the following equations:
   a. $f(x) = \frac{2}{x-3}$
   b. $g(x) = 4x^2 + 5x^3 - 1$
   c. $h(x) = -|7x - 4|$

3. Determine if the relationship is linear, quadratic, or neither. How do you know?

a.

x	y
-7	20
-5	18
-3	14
-1	8
1	0

b.

Hours studied	Points earned on test
0.5	62
1	70
2	86
2.5	92
3	98

4. Investigate the range of each parent function below over the interval $0 < x < 1$. Then order the ranges from least to greatest.
   Identity function, reciprocal function, quadratic function, cubic function, square root function

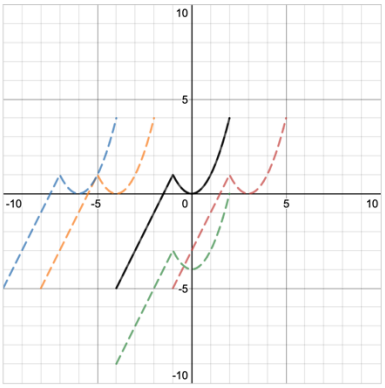
MM 0.5 What's my Transformation?

We have spent time making a graph library of some parent functions. But what about all those other more complicated functions? Today we will explore how many functions are simply transformations of the parent function using Desmos. Go to student.desmos.com and log in (you should have joined the class in the first lesson. Look for "What's my Transformation" in assigned activities.

1. Why is there really only one parabola in the world (**slide 2**)?

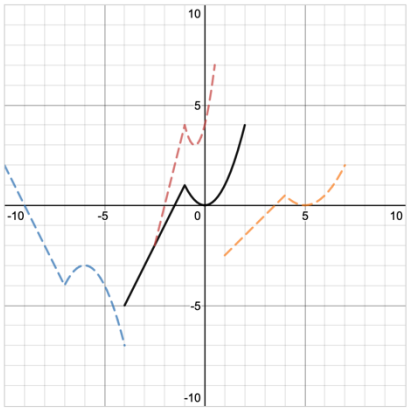
2. What happened to the parangula when you typed in $f(x-4)$ (**slide 6**)?

3. Record your answers from **slide 7**. Use colored pencils to trace each of the parangulas so they match the ones on Desmos.



Graph	Function
Red	
Orange	
Green	
Blue	

4. Starting in **slide 9**, the parangulas don't just shift around the page, they're actually getting wider and narrower! Record your answers from **slide 13**. Use colored pencils to trace the parangulas.



Graph	Function
Red	
Orange	
Blue	

5. Based on what you learned in the Desmos activity, answer the following questions:
   a. What's the difference between the graphs of $y = x^2 - 4$ and $y = (x-4)^2$?

   b. What's the difference between the graphs of $y = 3x^2$ and $y = \frac{1}{3}x^2$?

There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

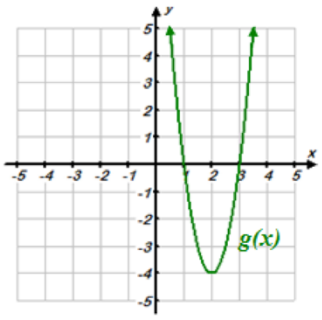
Transformation	Function Notation	Characteristics
Vertical Shift		Moves up when… Moves down when…
Horizontal Shift		Moves right when… Moves left when…
Vertical Dilations		Stretches in the y-direction when… Shrinks/compresses in the y-direction when…
Horizontal Dilations		Shrinks/compresses in the x-direction when… Stretches in the x-direction when…
Reflection about x-axis		
Reflection about y-axis		

Check Your Understanding

1. List the parent function and then the transformations that occurred to the parent function.
   a. $f(x) = 2x^2 - 3$ b. $g(x) = |x - 4|$ c. $h(x) = -(4x)^3$

2. Give the equation of the parent function $y = \sqrt{x}$ after it has been shifted left 7 and up 2.

3. (Multiple Choice) The graph of $g(x)$ below is a transformation of a parent function. Which function correctly describes the graph of $g(x)$?

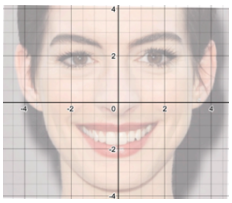


a. $g(x) = \left(\frac{1}{4}x + 2\right)^2 - 4$
b. $g(x) = (4x + 2)^2 - 4$
c. $g(x) = \frac{1}{4} \cdot (x + 2)^2 - 4$
d. $g(x) = 4 \cdot (x - 2)^2 - 4$

4. (Multiple Choice) Pilar's parents give him an allowance amount $a(t)$, based on his age, t, in years. Which of the following expressions would give the allowance amount of Pilar's younger sister, who is three years younger than he is?

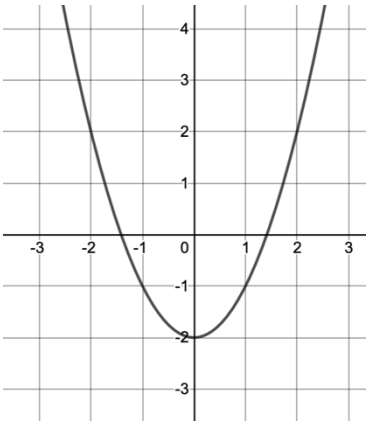
   a. $a(t) - 3$ b. $a(t) + 3$ c. $a(t - 3)$ d. $a(t + 3)$

MM 0.6 Seeing Symmetry: Faces and Functions



Symmetry in everyday language refers to a sense of harmonious and beautiful proportion and balance. There's even research says that we rate symmetric faces as being more attractive! Today we will investigate further what it means for functions to be symmetric and how we might predict the symmetry of a graph from its equation.

1. The graph of $f(x) = x^2 - 2$ is below. What do you notice about the symmetry of $f(x)$?



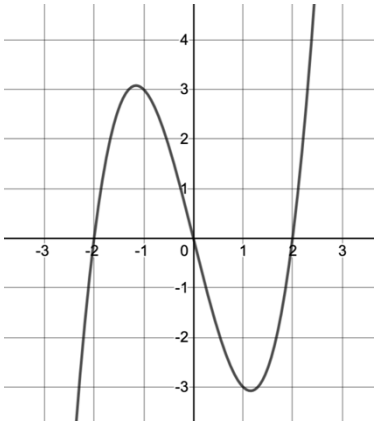
2. Fill in the table of values for $f(x)$.

x	$f(x)$
-4	
-2	
0	
2	
4	

3. What patterns do you notice in the ordered pairs?

4. Given an equation of a function, how could you check if the function has y-axis symmetry without looking at a graph?

5. The graph of $g(x) = x^3 - 4x$ is below. What do you notice about the symmetry of $g(x)$?



6. Fill in the table of values.

x	$g(x)$
-4	
-1	
0	
1	
4	

7. What patterns do you notice in the ordered pairs?

8. Given an equation of a function, how could you check if the function is symmetric across the origin without looking at a graph?

9. How symmetric is Anne Hathaway's face? (See photo above). How can you tell?

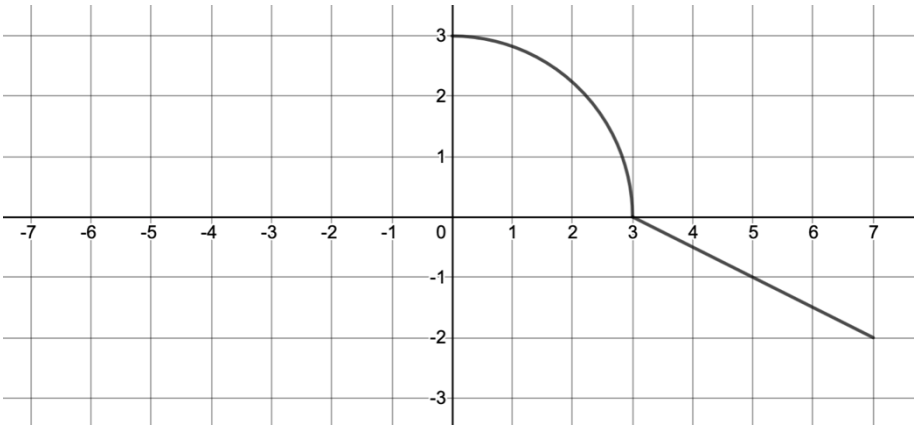
There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

Lesson 0.6 – Even and Odd Functions

QuickNotes

Check Your Understanding

1. Half of the graph of an *odd* function is shown below. Sketch the other half of the function.



2. If $(3, -18)$ is on the graph of an *even* function, what other point is guaranteed to be on the graph?

3. Is $y = x^5 + x^3 + 3$ an even function, an odd function, or neither? Prove your answer algebraically.

4. True or false: If the statement is true, explain *why* it must be true using the definitions of even and odd functions. If it is false, provide a counterexample.
   a. All even functions go through the origin.

   b. If each term in a polynomial function has an even exponent, the function is even.

MM 0.7 How Much do I Pay for 4G Data?

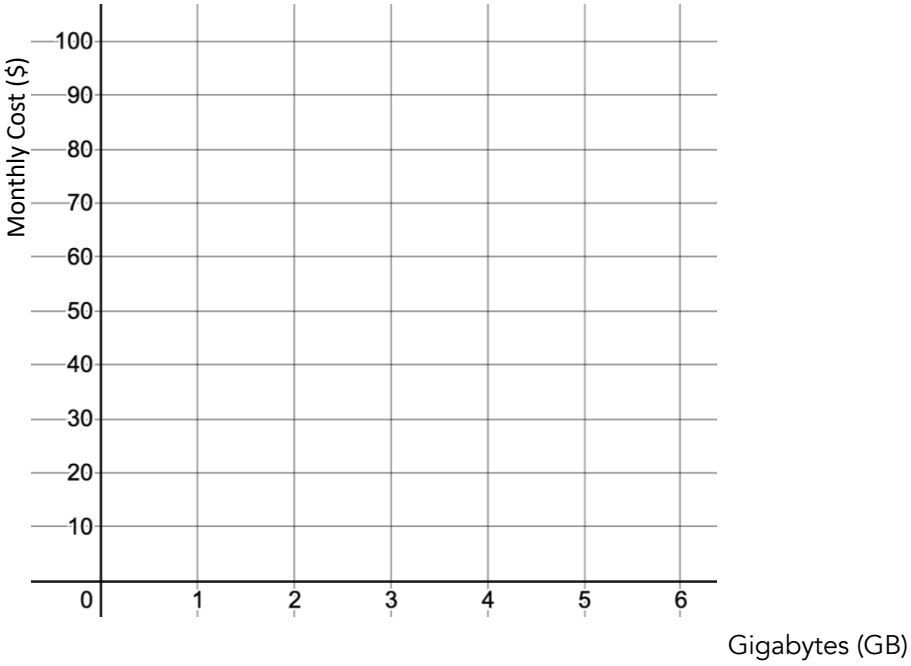
Cell phone plans used to charge by number of minutes and texts sent. Now most phone plans have unlimited talk and text but offer different amounts of data at various costs. Today we'll look at some pricing structures for phone plans.

1. What factors play a role in choosing a cell-phone service provider and picking a plan?

2. Metro® by T-Mobile offers an unlimited text and talk option with 2GB of data per month for $30. If you exceed the 2GB, you pay a rate of $10 per GB for each additional GB.
   a. What would the monthly phone bill be for a person that used 1.7 GB of data?

   b. What would the monthly phone bill be for a person that used 3.5 GB of data?

3. Sketch a graph of the monthly cost of this phone plan based on the number of gigabytes of data used.



4. Write a rule that gives the monthly cost of using *x* GB of data.

There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

Lesson 0.7 – Piecewise Functions

QuickNotes

Check Your Understanding

Pizza Palace is offering a promotion. The cost of a large pizza (in dollars) as a function of time (measured in days since February 10th) can be described by the function

$$C(t) = \begin{cases} 7 & 0 \le t \le 3 \\ 7 + t & 3 < t \le 8 \\ 18 & 8 < t \le 28 \end{cases}$$

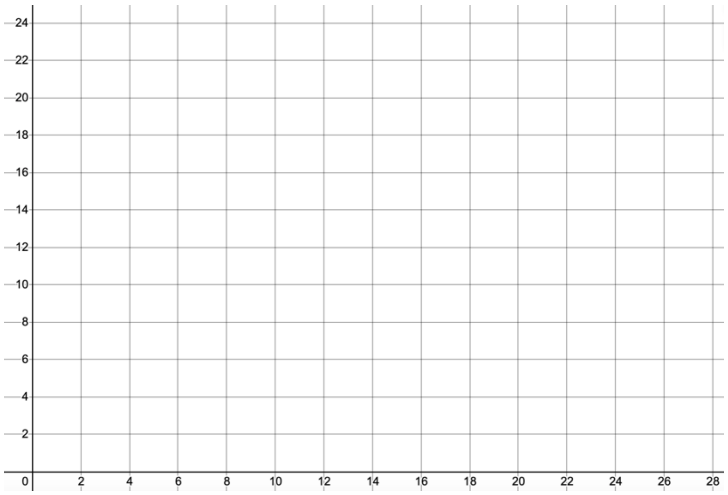
1. What is the price of pizza on Valentine's Day (February 14th)?

2. On what day(s) should you go to Pizza Palace to get the best deal? How do you know?

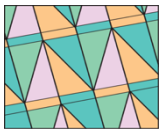
3. Find $C(9) - C(8)$. Interpret the result in the context of this problem.

4. What is the significance of the domain restriction $0 \le t \le 28$?

5. Sketch a graph of $C(t)$. Label both axes.

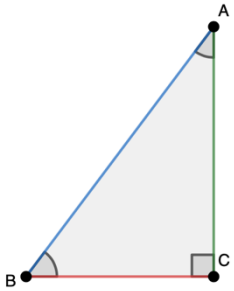


MM 0.8 Getting Triggy with It!



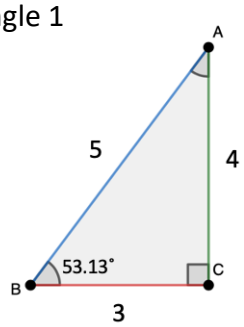
In Geometry you learned a lot about triangles and the relationships between their sides and angles. Today we're going to continue this exploration.

1. Order the sides in the triangle from smallest to largest. Then order the angles in the triangle from smallest to largest. How are these two related?

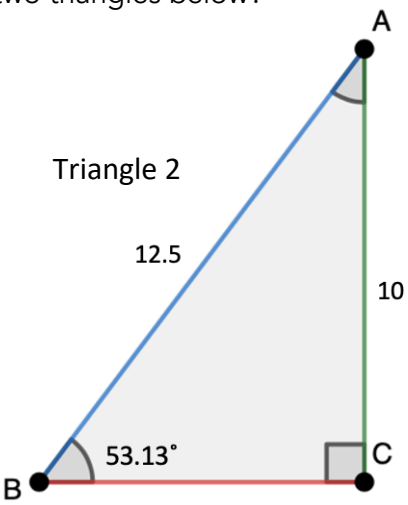


2. What relationships do you see between the two triangles below?

Triangle 1



Triangle 2



3. In triangle 2, what is the length of the red side? How do you know?

4. Fill out the chart below with the given ratios. Write your answer as a fraction and a decimal.

	$\frac{Green}{Blue}$	$\frac{Red}{Blue}$	$\frac{Green}{Red}$
Triangle 1			
Triangle 2			

5. What do you notice about the values in the table? Why do you think this happens?

6. Explain how each ratio in the table would change if we made $\angle B$ bigger but kept $\overline{BC}$ the same length (and $\angle C$ is still a right angle).

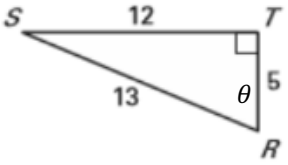
There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

Lesson 0.8 – Right Triangle Trig

QuickNotes

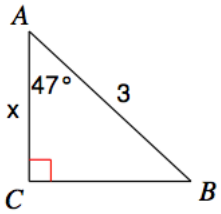
Check Your Understanding

1. In the triangle shown, find $\sin\theta$, $\cos\theta$, and $\tan\theta$.

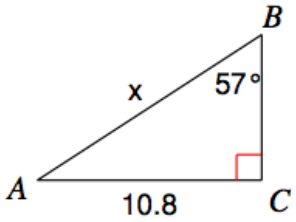


2. Solve for the missing side.

a.

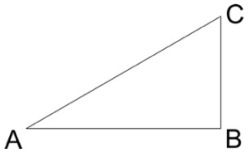


b.



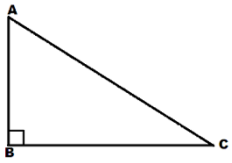
3. (Multiple Choice) Which of the following right triangles could demonstrate $\tan A = \frac{5}{3}$?

A)

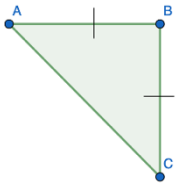


B)

C)

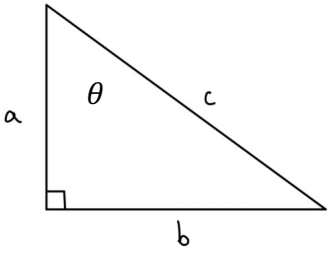


D)



4. Explain in words what the statement $\tan(11.31) = 0.2$ means.

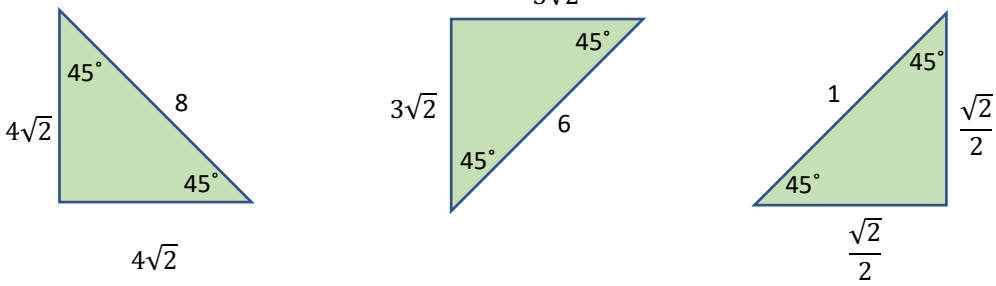
5. If $\sin\theta = 0.75$, find one set of possible values for *a*, *b*, and *c*.



MM 0.9 Coming Full Circle

In Geometry you learned about two special right triangles. They are considered "special" because there are simple relationships between the sides that are worth knowing. Today we will see how these triangles can help us understand the unit circle and trigonometry.

1. Three 45, 45, 90° triangles are shown below.

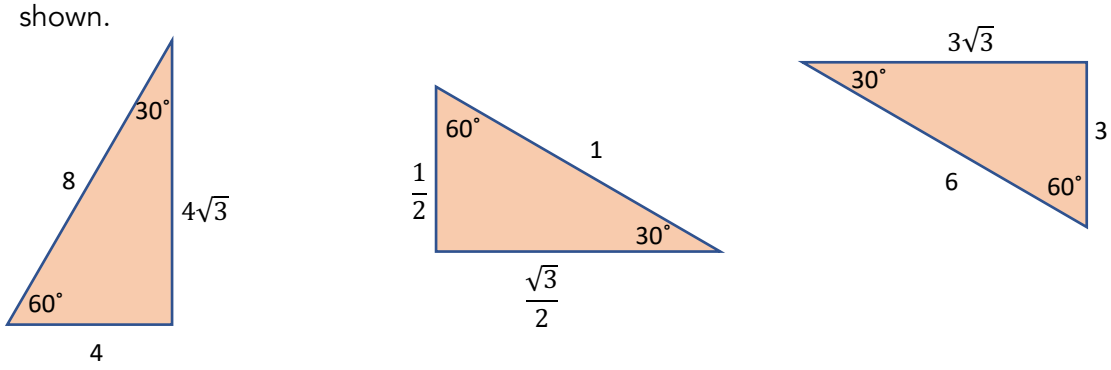


a. What relationships do you notice between the side lengths?

b. Show how you can use any of the above triangles to find $\sin 45°$ and $\cos 45°$.

c. In which triangle is the sine and cosine ratio most obvious? Why?

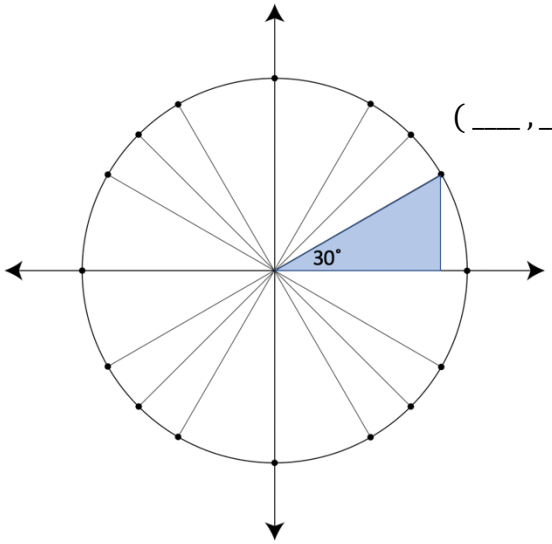
2. Another special right triangle is the 30°, 60°, 90° triangle. Three of such triangles are shown.



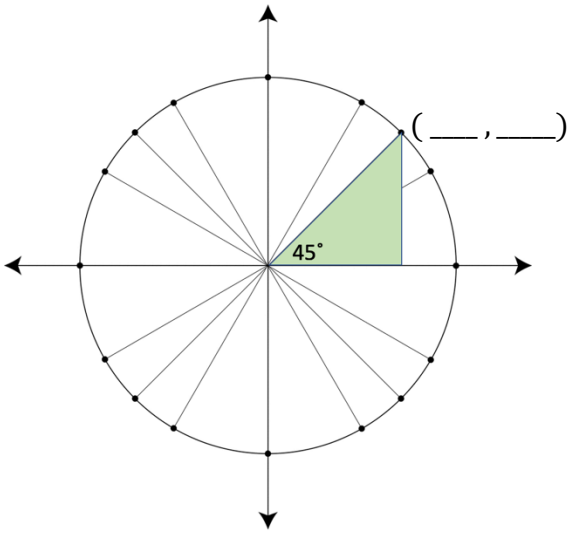
a. Choose one of the triangles above to find the $\sin 30°$ and the $\cos 30°$. Which triangle did you choose and why?

b. Now find $\sin 60°$ and $\cos 60°$. What patterns do you notice?

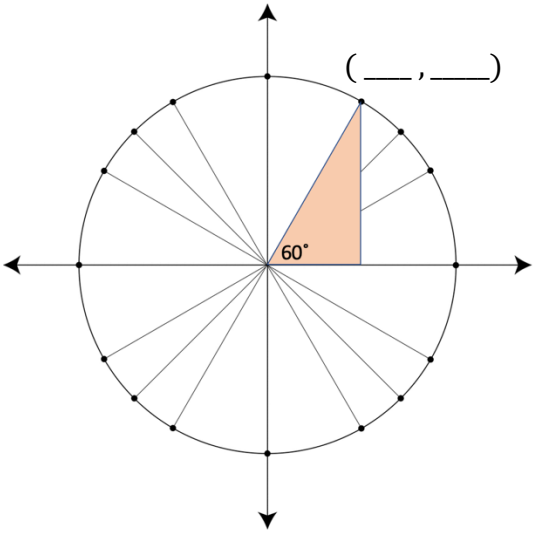
3. We're going to look at circles of radius 1 that are centered at the origin. These are called unit circles.



a. Label the three side lengths of the triangle. Then find the x and y coordinate of the point on the circle.



b. Find the x and y coordinate of the point on the circle.



c. Explain how you can use the ordered pair to find $\sin 60^\circ$ and $\cos 60^\circ$.

d. Find $\tan 60^\circ$.

There is a little video of mini notes in this folder when you've finished the first page to jot down in quicknotes before you check your understanding.

Lesson 0.9 – The Unit Circle

QuickNotes

Check Your Understanding

1. For $0 < \theta < \frac{\pi}{2}$, describe how the cosine and sine ratios change as the angle increases.

2. Evaluate:
   a) $\sin\left(\frac{\pi}{3}\right)$ b) $\cos\left(\frac{\pi}{2}\right)$ c) $\tan\left(\frac{\pi}{4}\right)$

3. Find $\tan\left(\frac{\pi}{6}\right)$.

4. At which angle is $\sin\theta = 1$? Give your answer in degrees and radians.

5. Use the unit circle to explain why $\sin\theta$ and $\cos\theta$ are always less than or equal to 1.

6. There is a mathematical identity that states: $\sin^2\theta + \cos^2\theta = 1$. Use the unit circle to explain why this is true.