Christina School District Assignment Board

Grade Level: 12th

Week of April 27th, 2020

		Day 1	Day 2	Day 3	Day 4	Day 5
ELA		Read a Modest Proposal by Jonathan Swift. As you read underline/mark words and phrases that support the definition of satire and identify the method of satire the author uses (sarcasm, irony, humor, exaggeration, ridicule or word play).	Answer the Text Dependent questions 1-4.	**Complete Day 3 - The Irony of It All** Re-read 'A Modest Proposal', identify examples of each term from the text.	**Complete Day 4 - The Persuasiveness of It All** Re-read 'A Modest Proposal', identify examples of each term from the text.	In a CSET address the following using explanations and evidence from the text. Which **TWO** groups is Swift ultimately criticizing in "A Modest Proposal"?
Math	**IM4**	*Arithmetic Series* Review Concept Summary: Arithmetic Sequences and Series (attached), and complete Arithmetic Sequences and Series Worksheet 1 #1-3. (attached)	Complete Arithmetic Sequences and Series Worksheet 2 #1-15. (attached) Reference Concept Summary if needed.	Complete Arithmetic Sequences and Series Worksheet 3 #1-4. (attached) Reference Concept Summary if needed.	Read pages 116-117. (attached) Use the examples as a guide. Complete page 118 #1-7. (attached - refer back to page 1 of packet)	Use the examples from pages 116-117 as a guide to complete p. 118 #8-13. (attached- refer back to page 1 of packet)

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	PreCalc	Graphs of Sine and Cosine Functions Review 4.5 PP and examples to complete Transformations of Trig Functions Practice Worksheet #1-4. (attached)	Use 4.5 PP notes and examples to complete Transformations of Trig Functions Practice Worksheet #5-10. (attached)	Review 4.8. PP and examples to complete Graphing Trig Functions Application Worksheet #1-4. (attached)	Use 4.8 PP notes and examples to complete Graphing Trig Functions Application Worksheet #5-10. (attached)	Use 4.8 PP notes and examples to complete Graphing Trig Functions Application Worksheet #11-14. (attached)
	Calc	*Related Rates*				
Science		**In honor of Earth Day (4/22), this week will focus on Earth Day related information.** **Earth Day 20:** Read article. Highlight, annotate, and/or underline for understanding.	**The Truth About Plastic:** Read article. Highlight, annotate, and/or underline for understanding.	**Can You Do Anything?** Read article. Highlight, annotate, and/or underline for understanding. On a piece of paper, write down things you already do and/or things you will try to implement to reduce the impact.	**A Look at the Non-Lethal Effects of Plastic on Seabirds:** Read article. Highlight, annotate, and/or underline for understanding.	**Lethal Effects of Plastic on Seabirds:** Read article. Highlight, annotate, and/or underline for understanding.
Social Studies		Complete Activity 6 from the document titled, “Spanish American War Inquiry” NOTE: You have this document from last week’s CSD Assignment Board.	Complete Activity 1 from the document titled, “US Soldiers in the Philippines”	Complete Activity 2, Hypothesis #1 from the document titled, “US soldiers in the Philippines”	Complete Activity 2, Hypothesis #2 from the document titled, “US soldiers in the Philippines”	Complete Activity 2, Hypothesis #3 from the document titled, “US soldiers in the Philippines” NOTE: Activity 3 & 4 will be on next week’s CSD Assignment Board.

CHAPTER 20
READING

Jonathan Swift's "Modest Proposal"

Jonathan Swift (1667-1745) was raised and educated in Ireland, but he was a strong supporter of the Tory government in England. In 1713, in reward for his defense of Tory policies, Queen Anne appointed him dean of St. Patrick's Cathedral in Dublin. In later years, Swift wrote many pamphlets protesting the suffering of the Irish under their British rulers, especially under Robert Walpole, Britain's first prime minister.

The excerpts below are from Swift's "A Modest Proposal for Preventing the Children of Ireland From Being a Burden to Their Parents or Country."

GUIDED READING *In this selection, read to learn how Swift uses satire to expose the brutality of Irish suffering and to portray England's absentee landlords and leaders as fools.*

****

It is a melancholly Object to those, who walk through this great Town or travel in the Country [Ireland], when they see the Streets, the Roads and Cabbin-doors crowded with Beggers of the Female Sex, followed by three, four, or six Children, all in Rags, and importuning every Passenger for an Alms. These Mothers instead of being able to work for their honest livelyhood, are forced to employ all their time in Stroling to beg Sustenance for their helpless Infants, who, as they grow up, either turn Thieves for want of Work, or leave their dear Native Country, to fight for the Pretender in Spain, or sell themselves to the Barbadoes.

I think it is agreed by all Parties, that this prodigious number of Children in the Arms, or on the Backs, or at the Heels of their Mothers, and frequently of their Fathers, is in the present deplorable state of the Kingdom [England], a very great additional grievance; and therefore whoever could find out a fair, cheap and easy method of making these Children sound and useful Members of the Common-wealth, would deserve so well of the publick, as to have his Statue set up for a Preserver of the Nation.

...I shall now therefore humbly propose my own Thoughts, which I hope will not be liable to the least Objection.

I have been assured by a very knowing American of my acquaintance in London, that a young healthy Child well Nursed is at a year Old a most delicious nourishing and wholesome Food, whether Stewed, Roasted, Baked, or Boiled; and I make no doubt that it will equally serve in a Fricasie, or a Ragoust.

...A Child will make two Dishes at an Entertainment for Friends, and when the Family dines alone, the fore or hind Quarter will make a reasonable Dish, and seasoned with a little Pepper or Salt will be very good Boiled on the fourth Day, especially in Winter.

...I grant this food will be somewhat dear, and therefore very proper for Landlords, who, as they have already devoured most of the Parents seem to have the best Title to the Children.

...Those who are more thrifty (as I must confess the Times require) may flay the Carcass; the Skin of which, Artificially dressed, will make admirable Gloves for Ladies, and Summer Boots for fine Gentlemen.

...Some Persons of a desponding Spirit are in great concern about that vast Number of poor People, who are Aged, Diseased, or Maimed, and I have been desired to imploy my Thoughts what Course may be taken, to ease the Nation of so grievous an Incumbrance. But I am not in the least Pain upon that matter, because it is very well known, that they are every Day dying, and rotting, by cold and famine, and filth, and vermin, as fast as can be reasonably expected.

... I think the Advantages by the Proposal which I have made are obvious and many, as well as of the highest Importance.

For *First*,...it would greatly lessen the Number of Papists [Catholics], with whom we are Yearly over-run, being the principal Breeders of the Nation, as well as our most dangerous Enemies,....

Secondly, The poorer Tenants will have something valuable of their own which by Law may be made lyable to Distress, and help to pay their Landlord's Rent, their Corn and Cattle being already seized, and Money a Thing unknown.

Thirdly, Whereas the Maintenance of an hundred thousand Children, from two Years old, and upwards, cannot be computed at less than Ten Shillings a Piece per Annum, the Nation's Stock will be thereby increased fifty thousand Pounds per Annum, besides the Profit of a new Dish, introduced to the Tables of all Gentlemen of Fortune in the Kingdom, who have any Refinement in Taste,....

Fourthly, The constant Breeders, besides the gain of eight Shillings Sterling per Annum, by the Sale of their Children, will be rid of the Charge of maintaining them after the first Year.

Fifthly, This Food would likewise bring great Custom to Taverns, where the Vintners will certainly be so prudent as to procure the best Receipts [recipes] for dressing it to Perfection; and consequently have their Houses frequented by all the fine Gentlemen, who justly value themselves upon their Knowledge in good Eating;....

Sixthly, This would be a great Inducement to Marriage, which all wise Nations have either encouraged by Rewards, or enforced by Laws and Penalties. It would encrease the Care and Tenderness of Mothers towards their Children, when they were sure of a Settlement for Life, to the poor Babes,....

...I desire those Politicians, who dislike my Overture, and may perhaps be so bold to attempt an Answer, that they will first ask the Parents of these Mortals, Whether they would not at this Day think it a great Happiness to have been sold for Food at a Year Old, in the manner I prescribe, and thereby have avoided such a perpetual Scene of Misfortunes, as they have since gone through, by the Oppression of Landlords, the Impossibility of paying Rent without Money or Trade, the Want of common Sustenance, with neither House nor Cloaths to cover them from the Inclemencies of the Weather, and the most inevitable Prospect of intailing the like, or greater Miseries, upon their Breed for ever.

——From *Satires* and *Personal Writings* by Jonathan Swift, edited by William Alfred Eddy. London: Oxford University Press, 1932.

INTERPRETING THE READING

Directions: *Use information from the reading to answer the following questions. If necessary, use a separate sheet of paper.*

1. What is the author's "modest proposal"? ______________________________

____

2. Why does the author say this proposal is "very popular for Landlords"? ______________________________

____

3. What are the "advantages" of this proposal? ______________________________

____

____

____

Critical Thinking

4. Hypothesizing What effect do you think Swift's proposal had on England's leaders? ______________________________

____

____

Day 3 -The Irony of It All

Instructions: Re-read ‘A Modest Proposal’, identify examples of irony from the text.

Types of Irony	Example	Example	Example
Verbal irony- when you say one thing but mean something completely different. Ex. Calling a bald man Curly.			
Situational irony- a contrast between what you expect and what actually happens. Ex. A bride cries at her wedding.			
Dramatic irony- the reader knows something that the characters don't. Ex. The audience knows a character will die, the character does not.			

Day 4- The Persuasiveness of It All

Types of Irony	Example	Example	Example
Logical appeal- use of facts or statistics to support a position.			
Emotional appeal- use of words that stir up strong feelings.			
Ethical Appeal- use of details that confirm trustworthiness or fairness.			

IM4 – Week of April 27th

Arithmetic Series

CONCEPT SUMMARY Arithmetic Sequences and Series

In an arithmetic sequence, each term is equal to the previous term plus a constant d, the common difference.

	Recursive Formula	Explicit Formula	Arithmetic Series
ALGEBRA	$a_n = \begin{cases} a_1, n = 1 \\ a_{n-1} + d, n > 1 \end{cases}$	$a_n = a_1 + d(n-1)$	$S_n = \frac{n(a_1 + a_n)}{2}$
NUMBERS	For $a_1 = 1$ and $d = 7$, $a_2 = 1 + 7 = 8$ $a_3 = 8 + 7 = 15$ $a_4 = 15 + 7 = 22$ ....and so on	For $a_1 = 90$ and $d = -4$, $a_2 = 90 + 1(-4) = 86$ $a_3 = 90 + 2(-4) = 82$ $a_4 = 90 + 3(-4) = 78$ ....and so on	$\sum_{i=1}^{8} 5i - 2$ $3 + 8 + 13 + 18 + 23 + 28 + 33 + 38 = 164$ or $S_8 = \frac{8(3+38)}{2} = 164$

(Save this Problem Set until Thursday/Friday…. just printed here to save space)

Problems

Write the following series in summation notation and find each sum.

1. $5 + 7 + 9 + \ldots + 25$
2. $1 + 11 + 21 + \ldots + 161$
3. $-5 + -11 + -17 + \ldots + -47$
4. $1 + 2 + 3 + \ldots + 100$
5. $2 + 5 + 8 + \ldots + 89$
6. $5 + 4 + 3 + \ldots + -5$
7. Sum the positive even integers less than or equal to 100.

Expand the following series and find each sum.

8. $\sum_{k=1}^{15} (3k+1)$
9. $\sum_{j=1}^{68} (11j-8)$
10. $\sum_{k=1}^{22} (50-4k)$
11. $\sum_{i=1}^{17} (4i+9)$
12. $\sum_{k=1}^{9} (1-6k)$
13. $\sum_{j=1}^{4} j^2$

Arithmetic Sequences and Series Worksheet 1

An arithmetic sequence is a sequence with a constant difference between consecutive terms. This difference is known as the common difference, or *d.* To write a recursive definition for an arithmetic sequence, each term is defined by operations on the previous term. An explicit definition allows you to find any term in the sequence without knowing the previous term.

The recursive equation is defined by $a_n = a_{n-1} + d$
a_n = denotes the n^{th} term in the sequence
d = difference between the terms

The explicit equation is defined by $a_n = a_1 + d(n - 1)$
n = the number of the term

1. Given the sequence 3, 8, 13, 18, …

a. Use the sequence to find the recursive formula and find the 5^{th} and 6^{th} term.

Step 1	Find the value of the 1^{st} term.	3
Step 2	Find the difference between each pair of terms, which is *d*.	$d =$
Step 3	Write the formula by filling in the missing variables. $a_n = a_{n-1} + d$	$a(1) = 3$ $a(2) = 8$ $a(3) =$ $a(4) =$ *so, when* $a(5)$ $a_5 =$
Step 4	Use the formula to find the 5^{th} term.	$a(5) =$
Step 5	Use the formula to find the 6^{th} term.	$a(6) =$

2. Carla says the following sequence is an arithmetic sequence. 11, 13, 17, 25, … Explain her error. How could Carla fix the sequence so that it is an arithmetic sequence?

3. Find the 15^{th} term of the sequence 45, 48, 51, 54, …

a. What formula should you use?

b. Fill in the blanks and find the 15th term. 45, 48, 51, 54, _______, 60, _______, 66, 69,…_______

Arithmetic Sequences and Series Worksheet 2

Are the following sequences arithmetic? If so, what is the common difference? What is the next term in the sequence?

1. 0, −3, −6, −9.... **2.** 2, 3, 5, 8, ... **3.** 127, 140, 153, 166....

Translate between the recursive and explicit definitions for each sequence.

4. $a_n \begin{cases} 6, n = 1 \\ a_{n-1} + 3, n > 1 \end{cases}$ **5.** $a_n = 12 - 2(n - 1)$ **6.** $a_n = 5 - 4(n - 1)$

7. Each year, a volunteer organization expects to add 5 more people for whom the group provides home maintenance services. This year, the organization provides the service for 32 people.

a. Write an explicit formula for the number of people the organization expects to serve each year.

b. How many people would the organization expect to serve during the year, 20 years from now?

Find the sum of an arithmetic series with the given number of terms, a_1 and a_n.

8. 9 terms; 2, 5, 8, 11.... **9.** 12 terms; −2, 2, 6, 10,.... **10.** 20 terms; 5, 10, 15, 20, ...

Find the sum of each of the following series.

11. $\sum_{n=2}^{5} (5n + 3)$ **12.** $\sum_{n=1}^{4} (2n + 0.5)$ **13.** $\sum_{n=1}^{4} (-n - 3)$

14. A marching band formation consists of 6 rows. The first row has 9 musicians, the second has 11, the third has 13 and so on. How many musicians are in the last row and how many musicians are there in all?

15. A student identifies the series 10, 15, 20, 25, 30 as an infinite arithmetic series. Is he correct? Explain.

Arithmetic Sequences and Series Worksheet 3

A brand new restaurant opened five weeks ago. The warehouse that supplies their food asks the owner to estimate the inventory needed for each of five different weeks throughout the next six months. To make the estimate, they will use the sales to date and assume that they will continue to expand at the same rate.

1. Write an explicit definition to model the amount of each food needed each week.

Pounds of Hamburger	
Dozen Rolls	
Pounds of Cheese	
Pounds of French Fries	

2. Use the formulas from item 1 to complete the table.

	Pounds of Hamburger	Dozen Rolls	Pounds of Cheese	Pounds of French Fries
Week 1	50	21	3.1250	83
Week 2	75	29	4.6875	105
Week 3	100	37	6.2500	127
Week 4	125	45	7.8125	149
Week 5	150	53	9.3750	171
Week 6				
Week 10				
Week 16				
Week 20				
Week 24				

3. If each hamburger uses $\frac{1}{5}$ of a pound of meat, how many hamburgers will the restaurant make in week 34?

4. How many of each item will the restaurant need for their one year anniversary party?

Pounds of Hamburger	Dozen Rolls	Pounds of Cheese	Pounds of French Fries

Pounds of Hamburger	
Dozen Rolls	
Pounds of Cheese	
Pounds of French Fries	

SERIES 10.1.1 – 10.1.4

This chapter revisits sequences—arithmetic then geometric—to see how these ideas can be extended, and how they occur in other contexts. A sequence is a list of ordered numbers, whereas a series is the sum of those numbers. Students develop methods for finding those sums and learn a compact way to write the sums, known as summation notation. These ideas are extended with explorations into Pascal's Triangle, the Binomial theorem, and natural logarithms. For more information, see the Math Notes boxes in Lessons 10.1.2, 10.1.3, and 10.1.4.

Example 1

Find the sum of each of the following series.

a. $4 + 9 + 14 + 19 + 24 + \ldots + 59$.

b. Twelve terms with $t(1) = 3$ and $t(12) = 69$.

c. $t(n) = -3n + 10$, for integer values starting at 1 and ending at 15.

Each of these problems represents an arithmetic series because there is a constant difference between each consecutive term. They are series because they are the sums of the terms. For part (a), we could simply add each term, filling in the terms represented by the "…," but that would take some time and there is a good chance for an arithmetic error. Instead, we will use one of the methods developed in the chapter.

We will need to know the formula for the n^{th} term of this sequence, as well as which term the number 59 is. The formula for the n^{th} term is $t(n) = 5(n-1) + 4$ (verify this!) and by setting this equal to 59, we find that 59 is the 12^{th} term. To find the sum, we write out the sum labeling it S. We repeat this by writing it in reverse order. Adding these two equations gives us a new equation that makes it easier to solve for S. The sum of these twelve terms is 378.

$$
\begin{aligned}
S &= 4 + 9 + 14 + 19 + 24 + \ldots + 59 \\
+S &= 59 + 54 + 49 + 44 + 39 + \ldots + 4 \\
2S &= \underbrace{63 + 63 + 63 + 63 + 63 + \ldots + 63}_{12 \text{ of these}} \\
2S &= 12(63) \\
S &= 378
\end{aligned}
$$

In part (b) we determine the formula for the n^{th} term by using the given information to write an equation and solve. This gives us the formula $t(n) = 6(n-1) + 3$. Knowing the first and last terms is enough information to use the method of the previous example to find the sum. The method generalizes as follows: add the first and last terms, multiply the result by the number of terms in the series, then divide by two.

$$
\begin{aligned}
t(1) &= 3 \\
t(12) &= 69 \\
t(n) &= d(n-1) + t(1)
\end{aligned}
\qquad
\text{So: }
\begin{aligned}
t(12) &= d(12-1) + 3 \\
69 &= 11d + 3 \\
66 &= 11d \\
d &= 6
\end{aligned}
$$

$$S = \frac{12(3+69)}{2} = 432$$

In part (c) we have the formula for the n^{th} term and we know there will be 15 terms. We will calculate the first and the last term, and use them in the same procedure as above, using $S(n) = \frac{n(t(1)+t(n))}{2}$.

$$\begin{aligned} t(n) &= -3n+10 \\ t(1) &= -3(1)+10 \\ &= 7 \\ t(15) &= -3(15)+10 \\ &= -45+10 \\ &= -35 \end{aligned} \qquad \begin{aligned} S &= \tfrac{15(7-35)}{2} \\ S &= -210 \end{aligned}$$

Example 2

Expand the series $\sum_{k=1}^{15}(5k-7)$ and find the sum.

The expression above is known as summation notation, and it is a shorthand way to write out a series. The Σ is the Greek letter sigma and stands for "sum." We let the variable k (called the index when we are using summation notation) start at 1, and equal each integer up to 15 in the expression $5k - 7$. This looks like:

$$\begin{aligned} \sum_{k=1}^{15}(5k-7) &= [5(1)-7]+[5(2)-7]+[5(3)-7]+[5(4)-7]+\ldots+[5(15)-7] \\ &= -2+3+8+13+\ldots+68 \end{aligned}$$

To find the sum, use the same method as we used in Example 1 with $t(1) = -2$ and $t(15) = 68$ to find $S = 495$.

Example 3

Write the series $5 + 3 + 1 + -1 + -3 + \ldots + -29$ in summation notation.

First we need the formula for the n^{th} term. Here, $t(1) = 5$ and the common difference is -2. We can write $t(n) = -2(n - 1) + 5 = -2n + 7$. If we set the right side equal to -29, we can determine which term number -29 is.

$$\begin{aligned} -29 &= -2n+7 \\ -36 &= -2n \\ n &= 18 \end{aligned}$$

Since the last term is the 18^{th} term, we can now put this all together in summation notation. $\sum_{k=1}^{18}(-2n+7)$

PreCalculus 4.5 Basic Sine and Cosine Curves

Here you will study techniques for sketching the graphs of the sine and cosine functions. The graph of the sine function is a **sine curve.**

In Figure 4.43, the black portion of the graph represents one period of the function and is called **one cycle** of the sine curve.

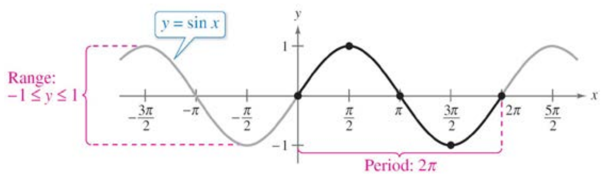


Figure 4.43

The gray portion of the graph indicates that the basic sine wave repeats indefinitely to the right and left.

4.5 Basic Sine and Cosine Curves

The graph of the cosine function is shown in Figure 4.44.

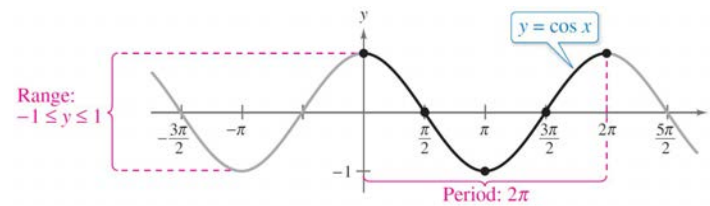


Figure 4.44

4.5 Basic Sine and Cosine Curves

The domain of the sine and cosine functions is the set of all real numbers. The range of each function is the interval

[–1, 1]

and each function has a period 2π.

4.5 Basic Sine and Cosine Curves

Do you see how this information is consistent with the basic graphs shown in Figures 4.43 and 4.44?

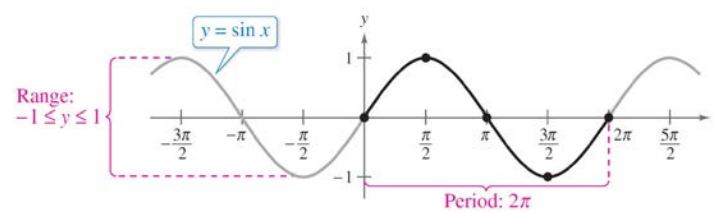


Figure 4.43

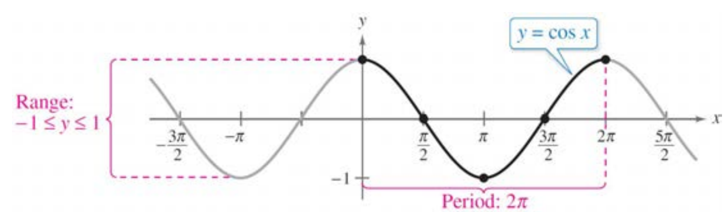


Figure 4.44

4.5 Basic Sine and Cosine Curves

To sketch the graphs of the basic sine and cosine functions by hand, it helps to note five *key points* in one period of each graph: the *intercepts*, the *maximum points*, and the *minimum points*.

The table below lists the five key points on the graphs of

$y = \sin x$ and $y = \cos x$.

x	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
$\sin x$	0	1	0	-1	0
$\cos x$	1	0	-1	0	1

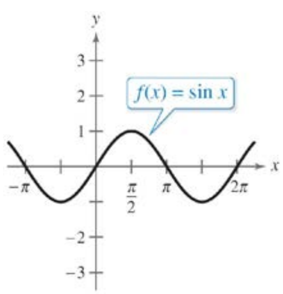
4.5 Basic Sine and Cosine Curves

Note in Figures 4.43 and 4.44 that the sine curve is symmetric with respect to the *origin*, whereas the cosine curve is symmetric with respect to the *y-axis*.

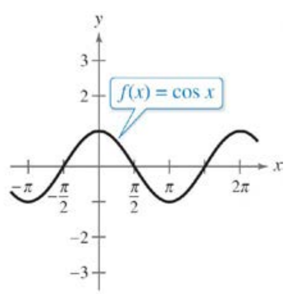
These properties of symmetry follow from the fact that the sine function is odd whereas the cosine function is even.

4.5 Basic Sine and Cosine Curves

The basic characteristics of the parent sine function and parent cosine function are listed below



Domain: $(-\infty, \infty)$
Range: $[-1, 1]$
Period: 2π
x-intercepts: $(n\pi, 0)$
y-intercept: $(0, 0)$
Odd function
Origin symmetry



Domain: $(-\infty, \infty)$
Range: $[-1, 1]$
Period: 2π
x-intercepts: $\left(\frac{\pi}{2} + n\pi, 0\right)$
y-intercept: $(0, 1)$
Even function
y-axis symmetry

4.5 Example 1 – *Library of Parent Functions: f (x) = sin x*

Sketch the graph of $g(x) = 2 \sin x$ by hand on the interval $[-\pi, 4\pi]$.

Solution:

Note that $g(x) = 2 \sin x = 2(\sin x)$ indicates that the y-values of the key points will have twice the magnitude of those on the graph of $f(x) = \sin x$.

Divide the period 2π into four equal parts to get the key points

Intercept	*Maximum*	*Intercept*	*Minimum*		*Intercept*
$(0, 0)$,	$\left(\frac{\pi}{2}, 2\right)$,	$(\pi, 0)$,	$\left(\frac{3\pi}{2}, -2\right)$,	and	$(2\pi, 0)$.

4.5 Example 1 – *Solution*

cont'd

By connecting these key points with a smooth curve and extending the curve in both directions over the interval $[-\pi, 4\pi]$, you obtain the graph shown in Figure 4.45.

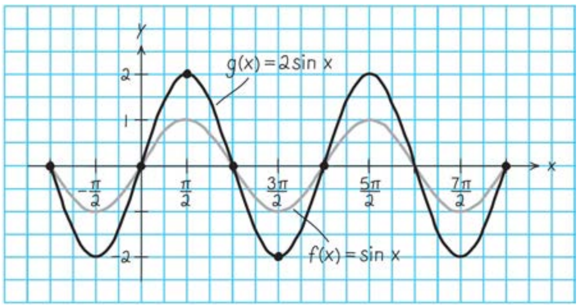


Figure 4.45

4.5 Amplitude and Period of Sine and Cosine Curves

Let us discuss the graphic effect of each of the constants *a*, *b*, *c*, and *d* in equations of the forms

$$y = d + a \sin(bx - c) \quad \text{and} \quad y = d + a \cos(bx - c).$$

The constant factor *a* in $y = a \sin x$ acts as a *scaling factor*—a *vertical stretch* or *vertical shrink* of the basic sine curve.

When $|a| > 1$, the basic sine curve is stretched, and when $|a| < 1$, the basic sine curve is shrunk.

4.5 Amplitude and Period of Sine and Cosine Curves

The result is that the graph of $y = a \sin x$ ranges between $-a$ and a instead of between -1 and 1. The absolute value of *a* is the **amplitude** of the function $y = a \sin x$.

The range of the function $y = a \sin x$ for $a > 0$ is $-a \le y \le a$.

Definition of Amplitude of Sine and Cosine Curves

The **amplitude** of

$y = a \sin x$ and $y = a \cos x$

represents half the distance between the maximum and minimum values of the function and is given by

Amplitude $= |a|$.

4.5 Example 2 – *Scaling: Vertical Shrinking and Stretching*

On the same set of coordinate axes, sketch the graph of each function by hand.

a. $y = \frac{1}{2} \cos x$ **b.** $y = 3 \cos x$

Solution:

a. Because the amplitude of $y = \frac{1}{2} \cos x$ is $\frac{1}{2}$, the maximum value is $\frac{1}{2}$ and the minimum value is $-\frac{1}{2}$.

Divide one cycle, $0 \le x \le 2\pi$, into four equal parts to get the key points

Maximum	Intercept	Minimum	Intercept		Maximum
$\left(0, \frac{1}{2}\right)$,	$\left(\frac{\pi}{2}, 0\right)$,	$\left(\pi, -\frac{1}{2}\right)$,	$\left(\frac{3\pi}{2}, 0\right)$,	and	$\left(2\pi, \frac{1}{2}\right)$.

4.5 Example 2 – *Solution* cont'd

b. A similar analysis shows that the amplitude of $y = 3\cos x$ is 3, and the key points are

Maximum	*Intercept*	*Minimum*	*Intercept*		*Maximum*
$(0, 3)$,	$\left(\frac{\pi}{2}, 0\right)$,	$(\pi, -3)$,	$\left(\frac{3\pi}{2}, 0\right)$,	and	$(2\pi, 3)$.

4.5 Example 2 – *Solution* cont'd

The graphs of these two functions are shown in Figure 4.46.

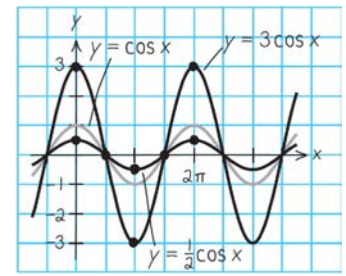


Figure 4.46

Notice that the graph of

$$y = \frac{1}{2}\cos x$$

is a vertical shrink of the graph of $y = \cos x$ and the graph of

$$y = 3\cos x$$

is a vertical stretch of the graph of $y = \cos x$.

4.5 Amplitude and Period of Sine and Cosine Curves

The graph of $y = -f(x)$ is a *reflection* in the x-axis of the graph of $y = f(x)$.

For instance, the graph of $y = -3\cos x$ is a reflection of the graph of $y = 3\cos x$, as shown in Figure 4.47.

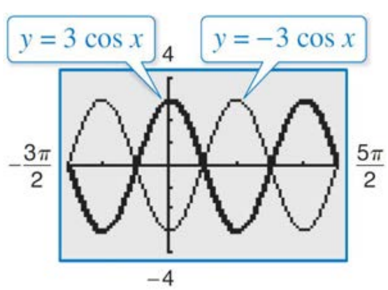


Figure 4.47

4.5 Amplitude and Period of Sine and Cosine Curves

Next, consider the effect of the *positive* real number b on the graphs of $y = a\sin bx$ and $y = a\cos bx$.

Because $y = a\sin x$ completes one cycle from $x = 0$ to $x = 2\pi$, it follows that $y = a\sin bx$ completes one cycle from $x = 0$ to $x = 2\pi/b$.

Period of Sine and Cosine Functions

Let b be a positive real number. The **period** of

$y = a\sin bx$ and $y = a\cos bx$

is given by

$$\text{Period} = \frac{2\pi}{b}.$$

4.5 Amplitude and Period of Sine and Cosine Curves

Note that when $0 < b < 1$, the period of $y = a \sin bx$ is greater than 2π and represents a *horizontal stretching* of the graph of $y = a \sin x$.

Similarly, when $b > 1$, the period of $y = a \sin bx$ is less than 2π and represents a *horizontal shrinking* of the graph of $y = a \sin x$. When b is negative, the identities

$$\sin(-x) = -\sin x \qquad \text{and} \qquad \cos(-x) = \cos x$$

are used to rewrite the function.

4.5 Translations of Sine and Cosine Curves

The constant c in the general equations

$$y = a \sin(bx - c) \qquad \text{and} \qquad y = a \cos(bx - c)$$

creates *horizontal translations* (shifts) of the basic sine and cosine curves.

Comparing $y = a \sin bx$ with $y = a \sin(bx - c)$, you find that the graph of $y = a \sin(bx - c)$ completes one cycle from $bx - c = 0$ to $bx - c = 2\pi$. By solving for x, you can find the interval for one cycle to be

$$\overbrace{\frac{c}{b}}^{\text{Left endpoint}} \le x \le \overbrace{\frac{c}{b} + \underbrace{\frac{2\pi}{b}}_{\text{Period}}}^{\text{Right endpoint}}.$$

4.5 Translations of Sine and Cosine Curves

This implies that the period of $y = a \sin(bx - c)$ is $2\pi/b$, and the graph of $y = a \sin bx$ is shifted by an amount c/b. The number c/b is the **phase shift.**

Graphs of Sine and Cosine Functions

The graphs of $y = a \sin(bx - c)$ and $y = a \cos(bx - c)$ have the following characteristics. (Assume $b > 0$.)

$$\text{Amplitude} = |a| \qquad \text{Period} = \frac{2\pi}{b}$$

The left and right endpoints of a one-cycle interval can be determined by solving the equations

$$bx - c = 0 \qquad \text{and} \qquad bx - c = 2\pi.$$

4.5 Example 4 – *Horizontal Translation*

Analyze the graph of $y = \frac{1}{2} \sin\left(x - \frac{\pi}{3}\right)$.

Solution:

The amplitude is $\frac{1}{2}$ and the period is 2π. By solving the equations

$$x - \frac{\pi}{3} = 0 \quad \text{and} \quad x - \frac{\pi}{3} = 2\pi$$

$$x = \frac{\pi}{3} \qquad\qquad x = \frac{7\pi}{3}$$

you see that the interval

$$\left[\frac{\pi}{3}, \frac{7\pi}{3}\right]$$

corresponds to one cycle of the graph.

4.5 Example 4 – *Solution*

cont'd

Dividing this interval into four equal parts produces the following key points.

Intercept	*Maximum*	*Intercept*	*Minimum*	*Intercept*
$\left(\frac{\pi}{3}, 0\right)$,	$\left(\frac{5\pi}{6}, \frac{1}{2}\right)$,	$\left(\frac{4\pi}{3}, 0\right)$,	$\left(\frac{11\pi}{6}, -\frac{1}{2}\right)$,	$\left(\frac{7\pi}{3}, 0\right)$

4.5 Mathematical Modeling

Sine and cosine functions can be used to model many real-life situations, including electric currents, musical tones, radio waves, tides, and weather patterns.

4.5 Example 8 – *Finding a Trigonometric Model*

Throughout the day, the depth of the water at the end of a dock varies with the tides. The table shows the depths (in feet) at various times during the morning.

Time	Depth, y
Midnight	3.4
2 A.M.	8.7
4 A.M.	11.3
6 A.M.	9.1
8 A.M.	3.8
10 A.M.	0.1
Noon	1.2

4.5 Example 8 – *Finding a Trigonometric Model*

cont'd

a. Use a trigonometric function to model the data. Let t be the time, with $t = 0$ corresponding to midnight.

b. A boat needs at least 10 feet of water to moor at the dock. During what times in the evening can it safely dock?

Solution:

a. Begin by graphing the data, as shown in Figure 4.53. You can use either a sine or cosine model. Suppose you use a cosine model of the form

$$y = a\cos(bt - c) + d.$$

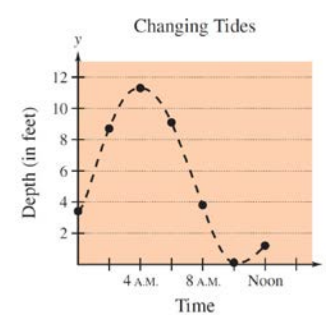


Figure 4.53c

4.5 Example 8 – *Solution*

cont'd

The difference between the maximum height and minimum height of the graph is twice the amplitude of the function.

So, the amplitude is

$a = \frac{1}{2}[(\text{maximum depth}) - (\text{minimum depth})]$

$= \frac{1}{2}(11.3 - 0.1)$

$= 5.6.$

4.5 Example 8 – *Solution*

cont'd

The cosine function completes one half of a cycle between the times at which the maximum and minimum depths occur. So, the period p is

$p = 2[(\text{time of min. depth}) - (\text{time of max. depth})]$

$= 2(10 - 4)$

$= 12$

which implies that $b = 2\pi/p \approx 0.524$.

4.5 Example 8 – *Solution*

cont'd

Because high tide occurs 4 hours after midnight, consider the left endpoint to be $c/b = 4$, so $c \approx 2.094$.

Moreover, because the average depth is

$\frac{1}{2}(11.3 + 0.1) = 5.7$

it follows that $d = 5.7$. So, you can model the depth with the function

$y = 5.6 \cos(0.524t - 2.094) + 5.7.$

4.5 Example 8 – *Solution*

cont'd

b. Using a graphing utility, graph the model with the line

$y = 10.$

Using the *intersect* feature, you can determine that the depth is at least 10 feet between 2:42 P.M. ($t \approx 14.7$) and 5:18 P.M. ($t \approx 17.3$), as shown in Figure 4.54.

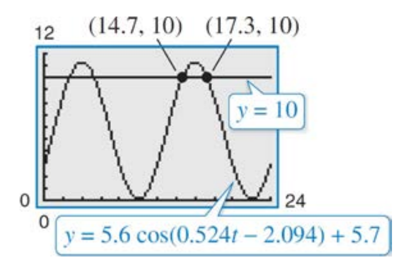


Figure 4.54

Practice Worksheet:
Transformations of Trig Functions
Graph two full periods of each function. Label the scale on both axes.

1. $y = \sin\left(x - \frac{\pi}{3}\right)$
Amplitude:
Period:
Phase Shift:
Vertical Displacement:
Reflection?

2. $y = 2 + \tan x$
Amplitude:
Period:
Phase Shift:
Vertical Displacement:
Reflection?

3. $y = \cos(2x + \pi)$
Amplitude:
Period:
Phase Shift:
Vertical Displacement:
Reflection?

4. ~~XXXXXXXXXXXXXXXX~~
y = -sin(3x)+1
Amplitude:
Period:
Phase Shift:
Vertical Displacement:
Reflection?

5. $y = 1 - \cos x$
Amplitude:
Period:
Phase Shift:
Vertical Displacement:
Reflection?

6. $y = \frac{1}{2}\sin(2x)$ ~~XXXX~~
Amplitude:
Period:
Phase Shift:
Vertical Displacement:
Reflection?

Write an equation of the graph described.

7. The graph of $y = \tan x$ translated down 4 units and left 1 unit.

8. The reflection of the graph of $y = \cos x$ with a period of 4π.

9. The graph of $y = \sin x$ with an amplitude of 4 that is translated right 3 units.

10. The reciprocal of $y = \sin x$ that is translated left 5 units and up 4 units.

PreCalculus 4.8 Applications and Models

The three angles of a right triangle are denoted by the letters *A*, *B* and *C* (where *C* is the right angle), and the lengths of the sides opposite these angles by the letters *a*, *b* and *c* (where *c* is the hypotenuse).

4.8 Example 1 – *Solving a Right Triangle*

Solve the right triangle shown in Figure 4.77 for all unknown sides and angles.

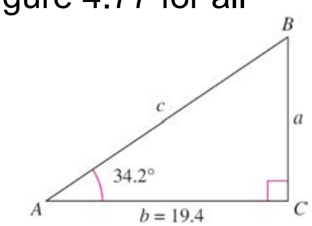


Figure 4.77

Solution:

Because $C = 90°$, it follows that

$$A + B = 90°$$

and

$$B = 90° - 34.2°$$
$$= 55.8°.$$

4.8 Example 1 – *Solution* cont'd

To solve for *a*, use the fact that

$$\tan A = \frac{\text{opp}}{\text{adj}} = \frac{a}{b} \quad a = b \tan A.$$

So, $a = 19.4 \tan 34.2° \approx 13.18$. Similarly, to solve for *c*, use the fact that

$$\cos A = \frac{\text{adj}}{\text{hyp}} = \frac{b}{c} \quad c = \frac{b}{\cos A}.$$

$$\text{So, } c = \frac{19.4}{\cos 34.2°} \approx 23.46.$$

4.8 Trigonometry and Bearings

In surveying and navigation, directions are generally given in terms of **bearings.** A bearing measures the acute angle a path or line of sight makes with a fixed north-south line, as shown in Figure 4.81. For instance, the bearing of S 35° E in Figure 4.81(a) means 35° degrees east of south.

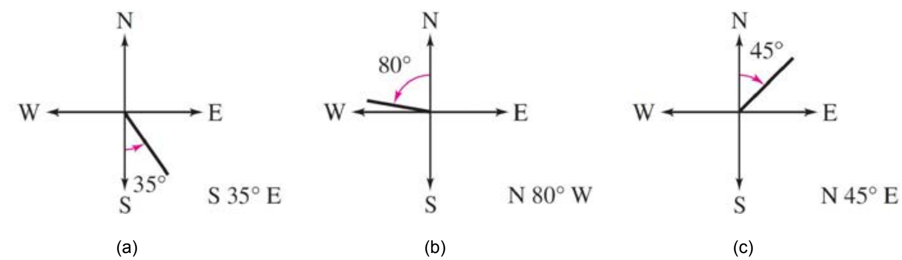


Figure 4.81

4.8 Example 5 – *Finding Directions in Terms of Bearings*

A ship leaves port at noon and heads due west at 20 knots, or 20 nautical miles (nm) per hour. At 2 P.M. the ship changes course to N 54° W, as shown in Figure 4.82. Find the ship's bearing and distance from the port of departure at 3 P.M.

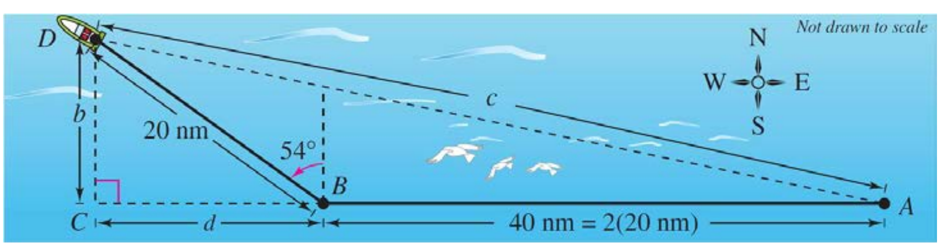


Figure 4.82

4.8 Example 5 – *Solution*

For triangle *BCD* you have

$$B = 90° - 54°$$

$$= 36°.$$

The two sides of this triangle can be determined to be $b = 20 \sin 36°$ and $d = 20 \cos 36°$.

In triangle *ACD*, you can find angle *A* as follows.

$$\tan A = \frac{b}{d + 40} = \frac{20 \sin 36°}{20 \cos 36° + 40} \text{092494}$$

4.8 Example 5 – *Solution*

cont'd

$A \approx \arctan 0.2092494$

≈ 0.2062732 radian

≈ 11.82

The angle with the north-south line is

$90° – 11.82° = 78.18°.$

4.8 Example 5 – *Solution*

cont'd

So, the bearing of the ship is N 78.18° Finally, from triangle *ACD* you have

$$\sin A = \frac{b}{c}$$

which yields

$$c = \frac{b}{\sin A}$$

$$= \frac{20 \sin 36°}{\sin 11.82°}$$

≈ 57.39 nautical miles Distance from port

4.8 Harmonic Motion

The periodic nature of the trigonometric functions is useful for describing the motion of a point on an object that vibrates, oscillates, rotates, or is moved by wave motion.

For example, consider a ball that is bobbing up and down on the end of a spring, as shown in Figure 4.83.

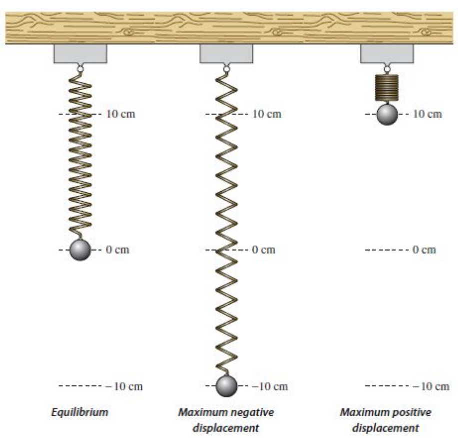


Figure 4.83

4.8 Harmonic Motion

Suppose that 10 centimeters is the maximum distance the ball moves vertically upward or downward from its equilibrium (at-rest) position. Suppose further that the time it takes for the ball to move from its maximum displacement above zero to its maximum displacement below zero and back again is

$t = 4$ seconds.

Assuming the ideal conditions of perfect elasticity and no friction or air resistance, the ball would continue to move up and down in a uniform and regular manner.

4.8 Harmonic Motion

From this spring you can conclude that the period (time for one complete cycle) of the motion is

Period = 4 seconds

its amplitude (maximum displacement from equilibrium) is

Amplitude = 10 centimeters

and its **frequency** (number of cycles per second) is

Frequency = $\frac{1}{4}$ cycle per second.

Motion of this nature can be described by a sine or cosine function, and is called **simple harmonic motion.**

4.8 Harmonic Motion

Definition of Simple Harmonic Motion

A point that moves on a coordinate line is said to be in **simple harmonic motion** when its distance d from the origin at time t is given by either

$$d = a \sin \omega t \qquad \text{or} \qquad d = a \cos \omega t$$

where a and ω are real numbers such that $\omega > 0$. The motion has amplitude $|a|$, period $2\pi/\omega$, and frequency $\omega/(2\pi)$.

4.8 Example 6 – *Simple Harmonic Motion*

Write the equation for the simple harmonic motion of the ball illustrated in Figure 4.83, where the period is 4 seconds. What is the frequency of this motion?

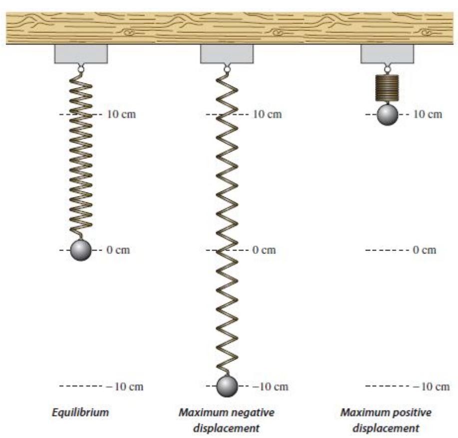


Figure 4.83

4.8 Example 6 – *Solution*

Because the spring is at equilibrium ($d = 0$) when $t = 0$, you use the equation

$$d = a \sin \boldsymbol{\omega} t.$$

Moreover, because the maximum displacement from zero is 10 and the period is 4, you have the following.

Amplitude = $|a| = 10$

$$\text{Period} = \frac{2\pi}{\omega} = 4 \quad \Rightarrow \quad \omega = \frac{\pi}{2}$$

Consequently, the equation of motion is

$$d = 10 \sin \frac{\pi}{2} t.$$

4.8 Example 6 – *Solution* cont'd

Note that the choice of a = 10 or a = –10 depends on whether the ball initially moves up or down. The frequency is

$$\text{Frequency} = \frac{\omega}{2\pi} = \frac{\pi/2}{2\pi} = \frac{1}{4} \text{ cycle per second.}$$

Unit 5: Graphing Trig Functions & Applications Worksheet Omega

1. In a predator/prey model, the predator population is modeled by the function:

   $p = 900\cos\left(\frac{2\pi}{3}\right)t + 8000$ where t is measured in years.

   a. Find the length of time between successive periods of maximum population.
   b. Sketch a graph that represents the given population model.
   c. What is the minimum population? When does this occur in the first cycle?

2. A variable star is one whose brightness alternately increases and decreases. For the variable star Nittany Minor, the time between periods of maximum brightness is 5.4 days. The average brightness of the star is 4.0, and its brightness varies by a magnitude of 0.35.

   a. If Champion Major is at its brightest at t =0, find a function that models the brightness as a function of time.
   b. At what point will the star be at its dimmest? What is its magnitude?
   c. What is the magnitude of brightness after 2 weeks?

3. The height in cm of the tip of a second hand on a vertical clock face varies as a function of time in seconds. The second hand is 20 cm long, and the middle of the clock face is 225 cm above the ground.

   a. Find a function to model the height of the second hand as a function of time assuming the hand is at the 9 o'clock position to start.
   b. How far above the ground is the tip of the second hand after 15 seconds?
   c. How far above the ground is the second hand when it reaches the 8 o'clock mark?
   d. Find the first time that the hand is 212 cm above the ground.

4. Graph Two Cycles:

   A) $y = 8\tan\frac{5}{8}x - 3$

   B) $f(x) = -9\cot\frac{7}{11}x + 6$

5. Graph One Cycle:

   A) $y = 4\sin\left(\frac{2}{7}x + \frac{3\pi}{4}\right) - 2$

   B) $f(x) = 2\cos\frac{9}{4}\left(x - \frac{\pi}{3}\right) + 5$

6. Find the number of times the line **y = 5** intersects the graph of $y = 4\cos 20x + 3$ over the interval $[0, 2\pi]$.

7. Given the following information – write the equation of the positive sine function in standard form:

   ** y – maximum = 12 **y – minimum = 2 **Endpoints of one cycle: $\left[-\frac{3\pi}{5}, \frac{\pi}{10}\right]$

8. Indicate the range of the function: $y = 5\csc\frac{2}{3}x + 1$

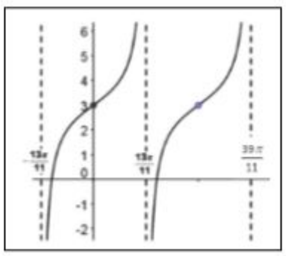
9. Explain the pattern for the location of the asymptotes for the graph of

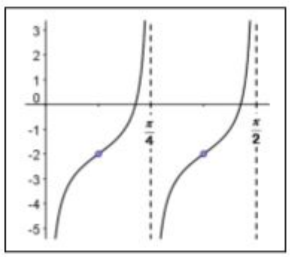
   (A) $g(x) = 2\sec\frac{6}{7}x + 2$ (B) $y = -2\cot\frac{\pi}{3}x + 6$

10. Describe the transformations required to obtain the graph of y_2 from the graph of y_1.

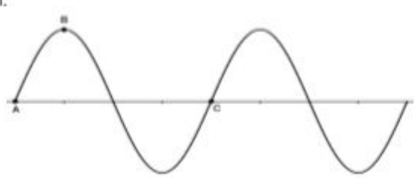
    $y_1 = 2\cos\left(x + \frac{\pi}{3}\right) - 1$ *and* $y_2 = \cos\left(x + \frac{\pi}{4}\right)$

11. Write the equation of the function in standard form for the given graphs. Assume no phase shift and no vertical stretch or compress.





In problems 12 & 13, the graphs of the sine and cosine functions are waveforms like the figure below. By correctly labeling the coordinates of points A, B, and C, you will get the graph of the function given.



12. *GIVEN*: $y = 3\cos 2x$ *and* $B = (0, 3)$.
    FIND the coordinates of A & C.

13. *GIVEN*: $y = 5\sin(3x - \pi)$ and A is the first x-intercept on the right of the y-axis.
    FIND the coordinates of A, B & C.

14. On the same set of axes, graph the two equations below over the interval $[0, \pi]$.
    All key information should be easily found looking at your graph.

    A) $y = 4\sin 4x$ B) $y = 3\cos 2x + 1$

    i. How many times do the graphs intersect over this interval?
    ii. Using your TI-Calc change the window settings so the graph resembles your work. Find the values of each intersection point.
    iii. Find the linear equation (y = mx + b) from the first local max on the sine function and the second local min on the sine function.

EARTH DAY 20

Earth Day was founded in 1970 as a day of education about environmental issues, and Earth Day 20 occurs on Wednesday, April 22—the holiday's 50th anniversary. The holiday is now a global celebration that's sometimes extended into Earth Week, a full seven days of events focused on green living. The brainchild of Senator Gaylord Nelson and inspired by the protests of the 1960s, Earth Day began as a "national teach-in on the environment" and was held on April 22 to maximize the number of students that could be reached on university campuses. By raising public awareness of pollution, Nelson hoped to bring environmental causes into the national spotlight.

Earth Day History

By the early 1960s, Americans were becoming aware of the effects of pollution on the environment. Rachel Carson's 1962 bestseller *Silent Spring* raised the specter of the dangerous effects of pesticides on the American countryside. Later in the decade, a 1969 fire on Cleveland's Cuyahoga River shed light on the problem of chemical waste disposal. Until that time, protecting the planet's natural resources was not part of the national political agenda, and the number of activists devoted to large-scale issues such as industrial pollution was minimal. Factories pumped pollutants into the air, lakes and rivers with few legal consequences. Big, gas-guzzling cars were considered a sign of prosperity. Only a small portion of the American population was familiar with–let alone practiced–recycling.

Did you know? A highlight of the United Nations' Earth Day celebration in New York City is the ringing of the Peace Bell, a gift from Japan, at the exact moment of the vernal equinox.

Who Started Earth Day?
Elected to the U.S. Senate in 1962, Senator Gaylord Nelson, a Democrat from Wisconsin, was determined to convince the federal government that the planet was at risk. In 1969, Nelson, considered one of the leaders of the modern environmental movement, developed the idea for Earth Day after being inspired by the anti-Vietnam War "teach-ins" that were taking place on college campuses around the United States. According to Nelson, he envisioned a large-scale, grassroots environmental demonstration "to shake up the political establishment and force this issue onto the national agenda."

Nelson announced the Earth Day concept at a conference in Seattle in the fall of 1969 and invited the entire nation to get involved. He later recalled:

"The wire services carried the story from coast to coast. The response was electric. It took off like gangbusters. Telegrams, letters and telephone inquiries poured in from all across the country. The American people finally had a forum to express its concern about what was happening to the land, rivers, lakes and air—and they did so with spectacular exuberance."
Denis Hayes, a young activist who had served as student president at Stanford University, was selected as Earth Day's national coordinator, and he worked with an army of student volunteers and several staff members from Nelson's Senate office to organize the project. According to Nelson, "Earth Day worked because of the spontaneous response at the grassroots level. We had neither the time nor resources to organize 20 million demonstrators and the thousands of schools and local communities that participated. That was the remarkable thing about Earth Day. It organized itself."

The First Earth Day: April 22, 1970
On the first Earth Day on April 22, 1970, rallies were held in Philadelphia, Chicago, Los Angeles and most other American cities, according to the Environmental Protection Agency. In New York City, Mayor John Lindsay closed off a portion of Fifth Avenue to traffic for several hours and spoke at a rally in Union Square with actors Paul Newman and Ali McGraw. In Washington, D.C., thousands of people listened to speeches and performances by singer Pete Seeger and others, and Congress went into recess so its members could speak to their constituents at Earth Day events.

The first Earth Day was effective at raising awareness about environmental issues and transforming public attitudes. According to the Environmental Protection Agency, "Public opinion polls indicate that a permanent change in national priorities followed Earth Day 1970. When polled in May 1971, 25 percent of the U.S. public declared protecting the environment to be an important goal, a 2,500 percent increase over 1969." Earth Day kicked off the "Environmental decade with a bang," as Senator Nelson later put it. During the 1970s, a number of important pieces of environmental legislation were passed, among them the Clean Air Act, the Water Quality Improvement Act, the Endangered Species Act, the Toxic Substances Control Act and the Surface Mining Control and Reclamation Act. Another key development was the establishment in December 1970 of the Environmental Protection Agency, which was tasked with protecting human health and safeguarding the natural environment—air, water and land.

What Do You Do For Earth Day?
Since 1970, Earth Day celebrations have grown. In 1990, Earth Day went global, with 200 million people in over 140 nations participating, according to the Earth Day Network (EDN), a nonprofit organization that coordinates Earth Day activities. In 2000, Earth Day focused on clean energy and involved hundreds of millions of people in 184 countries and 5,000 environmental groups, according to EDN. Activities ranged from a traveling, talking drum chain in Gabon, Africa, to a gathering of hundreds of thousands of people at the National Mall in Washington, D.C. Today, the Earth Day Network collaborates with more than 17,000 partners and organizations in 174 countries. According to EDN, more than 1 billion people are involved in Earth Day activities, making it "the largest secular civic event in the world."

The theme of Earth Day 2020 is "climate action." It will be celebrated with The Great Global Cleanup, a day dedicated to removing trash from green spaces and urban centers alike. EarthDay.org hopes will be the largest volunteer event in history.

THE TRUTH ABOUT PLASTIC:

If you are reading this online, it is likely that plastic is at your fingertips – on your keyboard. Your monitor will also be framed by plastic, and your mouse will likely contain plastic as well. And that is literally only what is at your fingertips.

On May 11th 2017, Boyan Slat, Founder and CEO of The Ocean Cleanup, the Dutch foundation developing advanced technologies to rid the oceans of plastic, announced a design breakthrough allowing for the cleanup of half the Great Pacific Garbage Patch in just 5 years.

The question then becomes what happens to the plastic that we throw away. The trays in which your meat comes, the plastic bottles of pop you have emptied, the packaging materials for any item you use. Where do these all go? There is no straightforward answer to this. Some are sent for recycling overseas, which leads to some questioning how effective recycling is, as the very process of shipping it requires plastic and costs a tremendous amount of resources. A great deal of the plastic we discard ends up on landfill sites. Unfortunately, lots of it becomes plastic pollution. Over time, this ends up in our waterways, where it affects all of nature.

Even if you are someone who believes in recycling and will do everything you can to properly dispose of the plastic you use, it is still not possible to escape the pollution. Did you know, for instance, that your toothpaste and facial scrubs contain thousands of tiny plastic beads, and that these all end up in our waterways? Look no further than the Great Lakes in our own country, the biggest group of freshwater bodies on the planet, where various pieces of plastic are now found. And perhaps even more worrying is the Great Pacific Garbage Patch.

The Great Pacific Garbage Patch

Somewhere in the middle of the Pacific Ocean, at a spot where there is almost no wind, lies a new continent. Estimated to be twice the size of our country, this continent is a huge swirling mass of plastic waste. Nothing lives there anymore, except plankton. But for every pound of plankton, there is at least six pounds of non-biodegradable plastic. This patch is perhaps the best representation of what we, as humans, are doing to our planet.

Plastic Pollution

Plastic pollution is frightening. Some people aren't frightened by the Great Pacific Garbage Patch, because they can't see it. But what you can't see will still affect you. The chemicals found in plastic, and particularly phthalates and BPA, have been found everywhere. It is in our breast milk, our saliva and our urine. These chemicals mess up many parts of our bodies and scientists have only just started to study just how damaging it is to our health. Judging from animal studies, these chemicals have the potential to be lethal.

CAN YOU DO ANYTHING?:

The million dollar question is what can be done. Unfortunately, you cannot escape plastic, because it really is all around us. You can, however, boycott plastic that contains phthalates and BPA (it will be labeled with the number 3 or the number 7). You should also stop heating plastic in microwaves, as this releases a number of toxic gases. Of course, recycling is hugely important. Some truly hardcore people have taken to trying to ban plastic altogether, even making their own toothpaste, but that is a life that is not for most of us. But by recycling properly, you are making a huge difference already.

There are many initiatives around the world that are looking at strategies to reduce plastic consumption. Public education and information, and making recycling more accessible and transparent, are two very important things. Banning plastic bags, particularly single-use ones, is something many countries have now committed to. Others also charge for thicker plastic bags. Regulations do work. In countries like Germany, for instance, 60% of all plastic is now recycled as a direct result of public education campaigns to which retailers have also signed up. Everybody has to accept their personal responsibility when it comes to reducing levels of plastic. You simply cannot wait for someone else to start, as the change must start with you, and it has to start now.

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Written and edited by ReusethisBag.com (RTB). RTB is one of the original U.S grown suppliers of eco-friendly wholesale reusable and recycled promotional product bags and totes available in custom sizes.

A LOOK AT THE NON-LETHAL EFFECTS OF PLASTIC ON SEABIRDS:

Environmental plastic debris pollution is a rapidly expanding and significant threat to biodiversity because of its durability, abundance and persistence. Present knowledge of the adverse effects of plastic on wildlife is greatly based on the readily observed consequences like starvation and entanglement. Many debris interactions, however, lead to poorly documented and less visible sublethal effects, and like consequences, plastic's real impact is underestimated.

Globally, seabirds ingest plastic and other marine debris more often than other animal species. Out of 140 examined seabird species, 82 have been found to have ingested plastic and other types of debris.

Why Do Seabirds Eat Plastic?

There are several reasons seabirds ingest plastic:

- **Plastic looks like food:** The small plastic particles that float around the ocean are often mistaken for prey
- **Plastic smells like food:** The scent of krill eating algae that coats the plastic debris smells similar to natural smells many seabirds follow when they hunt for food
- **Plastic floats:** Because of its lightweight nature, plastic floats. Albatross species, especially, skim low over the waters and mistakenly consume plastic

Although this is a worldwide problem, species close to home seems to suffer the worst of the effects. For instance, the flesh-footed shearwater, which commonly visits mainland Australia waters and breeds on Lord Howe Island, ingests more plastic than other marine creatures.

Winds and currents carry the plastic to these remote areas, where it's often carried over thousands of kilometers from where it entered into the ocean originally. This means what was once safe island breeding colonies now have become flooded with deadly waste.

Non-Lethal Effects of Plastic on Seabirds

One study observes the non-lethal effects plastic ingestion has on seabirds. Dr. Jennifer Lavers, from the Institute for Marine and Antarctic Studies (IMAS) led the study and journal Environmental Science & Technology published the study. Dr. Lavers found plastic ingestion could have a substantial adverse impact.

It's well-known wildlife and plastic pollution make a disastrous combination, but present knowledge today of the impact is typically limited to what can be observed; tragic pictures of entanglement and bellies emptied of plastic pieces. But, as researchers from IMAS explain, debris interactions lead to poorly documented and less visible sublethal effects, so nobody really knows the true impact plastic has on wildlife.

The researchers at IMAS teamed up with scientists from UK's Natural History Museum and the Lord Howe Island Museum, to analyze plastic and blood samples gathered on Lord Howe Island from flesh-footed shearwaters.

The IMAS made the decision to study how plastic ingestion has been harming the seabirds that were surviving.

There's a decline in flesh-footed shearwater populations across the Western Australia's south coast and the southwest Pacific Ocean, according to Dr. Lavers. Plastic ingestion has been blamed in the decline, however, how it affects shearwaters is still not clear and poorly understood.

The study found the seabirds that ingested plastic had declined:

- Body mass
- Blood calcium levels
- Bill and head length
- Wing length

Plastic's presence also had an adverse impact on the seabirds' kidney function, which is causing higher concentrations of uric acid, as well as a negative impact on their enzymes and cholesterol.

The study found plastic's presence was enough to cause adverse consequences, no matter how much. Data didn't show a substantial relationship between the health of individuals and the volume of ingested plastic, which suggests any plastic ingestion is enough to have an effect.

Until recently, there's been minimal information on the seabirds' blood composition. Many of these seabirds have been named a "threatened species."

Obtaining an understanding of how each seabird is affected is also complicated even further by the fact they don't spend a whole lot of time at breeding colonies or on land and most mortalities occur at sea, which leaves the reasons for death, frequently unknown. The complicated range of problems the seabirds face — from climate change and habitat loss to marine pollution and fishing — make it important to obtain a better understanding of the effect of particular challenges like plastic debris.

LETHAL EFFECTS OF PLASTIC ON SEABIRDS:

Along with “non-lethal” effects of plastic on seabirds, there are sadly “lethal” effects as well. It’s presently estimated that one million seabirds are dying each year as a result of plastic. And, when you consider how rapidly this issue is growing, this alarming statistic is even more concerning. In 1960, fewer than 5% of seabirds had plastic in their bellies and this number has actually increased in 1980 to 80%.

Based on contemporary studies and this research, by 2050, it’s expected that 99% of all species of seabirds will be ingesting plastic. This, combined with entanglement, is one of the top causes of death among birds that is related to plastic.

What Happens to Seabirds That Ingest Plastic?

The effect of plastic ingestion on seabirds depends on what they consume. In some cases, birds experience a quick death because of sharp plastics that puncture their internal organs. Others might starve to death because the plastic makes them feel full, and they don’t receive any nutritional benefit.

Growing evidence also shows birds have a higher risk of toxic effects of chemically-coated plastics due to how much they’re eating.

Sadly, adult birds that hunt and return to their nests with plastic they’ve mistaken as food end up feeding it to their babies. The chicks’ smaller bellies have an even harder time dealing with plastic’s effects, and many die before they reach adulthood.

Plastic debris has been found lining the nests of birds on remote islands and the plastic chokes the bellies of seabirds that fish thousands of miles from land in the middle of the Pacific. Some items that make the worst offenders are items individuals use each day like:

- Plastic caps and bottles
- Plastic stir sticks
- Styrofoam coffee cups
- Straws

And plastic items aren’t the only tangible cause of issues. When plastic starts breaking down in the oceans, it releases hazardous chemicals the seabirds are attracted to. Also, damaging chemicals are released by degrading plastics. These chemicals include dioxins and polychlorinated biphenyls (PCBs). Many plastics individuals use in everyday items like water bottles and shopping bags absorb great amounts of chemicals. When they degrade into small pieces, they frequently become nearly invisible, but remain toxic to the birds and other marine life that unknowingly ingest them.

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US Soldiers in the Philippines

Benchmark Standard	**History 3a**: Students will compare competing historical narratives, by contrasting different historians' choice of questions, use and choice of sources, perspectives, beliefs, and points of view, in order to demonstrate how these factors contribute to different interpretations.
Grade Band	11-12
Vocabulary / Key Concepts	**Hearings** - a meeting at which arguments or testimony is heard a court hearing **Guerillas** - a person who engages in irregular warfare especially as a member of an independent unit carrying out harassment and sabotage

~This is a SHEG lesson modified by CSD for use at home~

The United States in the Philippines 1898 - 1915

1898

February 15 The battleship *U.S.S. Maine* explodes in Havana Harbor.

April Filipinos resume their independence struggle against Spain.

April 19 Congress by a vote of 311 to 6 in the House, and 42 to 35 in the Senate, adopts a joint resolution for war with Spain. President McKinley signs it the next day and calls for 125,000 volunteers for 1 year of active duty.

May 1 Admiral Dewey destroys the Spanish fleet in Manila Bay.

May 25 The first U.S. volunteer troops leave San Francisco for the Philippines

June 15 Hundreds of citizens assemble in Boston to oppose the annexation of the Philippines and organize the Anti-Imperialist movement.

September 15 The Congress of the First Philippine Republic creates the first republican constitution in Asia.

December 10 In the Treaty of Paris, Spain frees Cuba, cedes Porto Rico and Guam to the U.S., and sells the Philippines to the U.S. for $20 million.

1899

February 4-5 U.S. troops fire the first shots of the war, killing three Filipino soldiers triggering fighting between U.S. troops and Filipino independence forces.

November 13 Filipinos switch from conventional to guerilla war.

1900

February There were over 1,000 engagements between U.S. and Filipino forces in the first year of war.

1901

February Mark Twain publishes "To the Person Sitting in Darkness", his satire on U.S. imperialism in the Philippines, in the *North American Review*.

1902

January 31 to June 28 Senate Committee on the Philippines chaired by imperialist Republican Henry Cabot Lodge conducts hearings on the war.

July 4 President Theodore Roosevelt declares victory in the Philippines but a guerrilla war continues until 1915.

ACTIVITY 1:

1. Read through the timeline.
2. What happened between January 31 to June 28, 1902? Why might this be a problem or a concern? Explain.

The United States Senate conducted hearings on the Philippine-American War because many Americana had become outraged at the reports of how American soldiers were treating Filipinos. Historians today are trying to figure out what causes some soldiers to behave brutally during war. Your task is to read these documents and figure out why many American soldiers were brutal to the Filipino insurgents.

NOTE: You are to assume that the soldiers are not sociopathic criminals to begin with.

ACTIVITY 2:

Read all of the Documents (A – D) and use the documents (pages 2 and 3) to complete the graphic organizer (page 4). In order to complete the graphic organizer (and make your own judgment), all of the documents should be read first. It is recommended that you…

1. Read through the graphic organizer before reading the documents. NOTE: these hypotheses do not represent all the possible explanations. If you have alternative hypotheses, you should write about them in the conclusion.
2. **Read through all the documents *before*** beginning to fill out the Graphic Organizer. ☺

Document Set A: Testimony from Senate Hearings (Modified)

Between January and June 1902, the U.S. Senate conducted hearings on the war in the Philippines. The excerpts below come from testimony given at those hearings

Testimony of Corporal Richard T. O'Brien

We entered the town. It was just daybreak. The first thing we saw was a boy coming down on a water buffalo, and the first sergeant . . . shot at the boy. . . . The boy jumped off the water buffalo and fled. . . . Everybody fired at him. . . .

That brought the people in the houses out, brought them to the doors and out into the street, and how the order started and who gave it I don't know, but the town was fired on. I saw an old fellow come to the door, and he looked out; he got a shot in the abdomen and fell to his knees and turned around and died. . . .

After that two old men came out, hand in hand. I should think they were over 50 years old, probably between 50 and 70 years old. They had a white flag. They were shot down.

Testimony of Corporal Daniel J. Evans

The first thing one of the Americans — I mean one of the natives who was a scout for the Americans— grabbed one of the men by the head and jerked his head back, and then they took a tomato can and poured water down his throat until he could hold no more, and during this time one of the scouts had a whip . . . and he struck him on the face and on the bare back, and every time they would strike him it would raise a large welt, and some blood would come. And when this native could hold no more water, then they forced a gag into his mouth; they stood him up and tied his hands behind him; they stood him up against a post and fastened him so he could not move. Then one man, an American soldier, who was over six feet tall, and who was very strong, too, struck this native in the pit of the stomach as hard as he could strike him, just as rapidly as he could. It seemed as if he didn't get tired of striking him.

Source: *Testimony to the U.S. Senate on the conduct of American soldiers in the Philippines. "Affairs in the Philippine Islands," Senate Committee on the Philippines, 57th Congress, 1st Session, April 1902.*

Document Set B: American Soldier's Letter Home

This excerpt is from a letter written by A. A. Barnes, an American soldier, to his brother on March 20, 1899.

The town of Titatia was surrendered to us a few days ago and two companies occupy the same. Last night one of our boys was found shot and his stomach cut open. Immediately orders were received from Gen. Wheaton to burn the town and kill every native in sight, which was done to a finish. About 1,000 men, women, and children were reported killed. I am probably growing hard-hearted, for I am in my glory when I can sight my gun on some dark skin and pull the trigger.

Source*: A. A. Barnes, published by The Standard, Greensburg, Indiana, May 8, 1899.*

Document C: Historian's Account

The guerillas, in violation of [Philippine President Emilio] Aguinaldo's orders and circulars, treated captured Americans with barbaric cruelty. Noses and ears were lopped off and the bleeding wounds seasoned with salt. In some cases, American prisoners were buried alive. Kicking, slapping, spitting at the faces of American prisoners were common, the hatred of the American being such that the guerillas forgot or conveniently forgot Aguinaldo's injunctions regarding the good treatment to be accorded the prisoners.

***Source**: Excerpt from Filipino historian Teodoro Agoncillo's book Malolos: The Crisis of the Republic, written in 1960.*

Document D: Frederick Funston

Frederick Funston fought in 19 battles in the Philippines in less than a year and was involved in an undercover operation that led him to the headquarters of Philippine President Emilio Aguinaldo. He earned a Medal of Honor and returned to the U.S. a national hero for his actions in the Philippines. Funston wrote and spoke often about the Philippine-American War in order to increase public support for American involvement in the conflict.

I am afraid that some people at home will lie awake [at] night worrying about the ethics of this war, thinking that our enemy is fighting for the right to self-government. . . . [The Filipinos] have a certain number of educated leaders – educated, however, about the same way a parrot is. They are, as a rule, an illiterate, semi-savage people who are waging war not against tyranny, but against Anglo-Saxon order and decency. . . . I, for one, hope that Uncle Sam will apply the chastening rod good, hard and plenty, and lay it on until they come in to the reservation and promise to be good "Injuns."

***Source:** Letter written by Frederick Funston that was published in the Kansas City Journal on April 22, 1899*.

ACTIVITY 3: After completing the Graphic Organizer, answer the following question.

Conclusion: Why do you think some American soldiers brutalized Philippine insurgents? Please use evidence from the documents to support your answer.

ACTIVITY 4: Debrief Questions

1. Is some of the evidence more or less believable? Explain why.
2. Based on the evidence, which hypothesis do you find most convincing for why some American soldiers brutalized Filipino insurgents? Explain.

Soldiers in the Philippines Graphic Organizer

	Hypothesis #1: American soldiers who brutalized Filipino insurgents were simply following orders.	**Hypothesis #2**: American soldiers who brutalized Filipino insurgents thought Filipinos were less than human.	**Hypothesis #3**: American soldiers who brutalized Filipino insurgents were getting revenge for how Filipinos treated American soldiers.
Evidence 1	Source: Quote:	Source: Quote:	Source: Quote:
Evidence 2	Source: Quote:	Source: Quote:	Source: Quote:
Based on this evidence, do you find this hypothesis convincing? Explain.			