Algebra II Curriculum Guide
Tier 1 & 2

Unit 4: Trigonometric functions
April 15 – May 31

ORANGE PUBLIC SCHOOLS 2018-2019

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Algebra II Unit 4

Contents

Unit Overview

Unit 5: Trigonometric function

Overview

This course uses Agile Mind as its primary resource, which can be accessed at the following URL:

- www.orange.agilemind.com

Each unit consists of 1-3 topics. Within each topic, there are "Exploring" lessons with accompanying activity sheets, practice, and assessments. The curriculum guide provides an analysis of teach topic, detailing the standards, objectives, skills, and concepts to be covered. In addition, it will provide suggestions for pacing, sequence, and emphasis of the content provided.

Essential Questions

- What does the number of solutions (none, one or infinite) of a system of linear equations represent?
- What are the advantages and disadvantages of solving a system of linear equations graphically versus algebraically?

Enduring Understandings

- Systems of equations are used to model situations involving interacting functions with the same variables.
- Systems of equations are useful for making informed choices when presented with more than one option.
- The solution to a system of equations is the ordered pair that satisfies both equations. In real world situations, it is typically the break-even point.

Common Core State Standards

1) A-CED A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
2) ACEDA3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non- viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
3) A-REI.6: Solve systems of equations 6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
4) A.REI.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle x2 + y2 = 3.
5) A.REI.11: Explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
6) G.SRT.C. 6: Define trigonometric ratios and solve problems involving right triangles 6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles
7) F.IF.B.4:. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

8) F.IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
9) F.BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
10) F.TF.1: Understand radian measure of an angle as the length of the unit circle subtended by the angle.
11) F.TF.2: Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
12) F.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
13) F.TF.8: Prove the Pythagorean identity sin2 (θ) + cos2 (θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle

Major Content
Supporting Content
Additional Content
~~Parts of standard not contained in this unit~~
Algebra I Content

Unit 4: Trigonometry (35 days)

- Trigonometric ratios (supplement materials)
- Radian to degree and vice versa
- Unit circle and the parent graph of sine, cosine.
- Key features of Trigonometric functions(Sine and cosine)
- Sketching trigonometric function (Sine and cosine)

Big Rock CCSS	Related Topic	Lesson Objective
F.TF.1: Understand radian measure of an angle as the length of the unit circle subtended by the angle. G.SRT.C. 6: Define trigonometric ratios and solve problems involving right triangles 6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles F.int 1 – 2: Given a verbal description of a polynomial, exponential, trigonometric, or logarithmic functional dependence, write an expression for the function and demonstrate various knowledge and skills articulated in the Functions category in relation to this function F.TF.2: Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. F.TF.5. Choose trigonometric functions to model periodic phenomena with specified	Trig Function	1.1(F.TF.1) Given the unit circle Students will • Understand the radian measure of an angel and convert degree to radian and vice versa • Use radian as unit to solve problems 2.1a (G.SRT.C. 6:) Given a right triangle students will • Understand and Find the trig ratios 2.1b: Given real world problems students will • Use angles of elevation and depression to solve problems • find the angle measure of elevation or depression for the given information 2.2 (F.TF.2) Given a unit circle students will • Draw angles and co terminal angles in standard position • Find reference angles • Understand the circular definition of trigonometric functions and the graphs of y =sinα and x = cosα 2.3a (F.IF.B.4 F.BF.3:) Given graphs and equations of sine and cosine Students will • Identify period, midline and amplitude of the function • Identify phase shift of the function 2.3b (F-IF.7e) Given and sine and cosine function • Students will graph the sine cosine function showing intercepts, period, amplitude, and midline.

amplitude, frequency, and midline. F.BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. F.IF.B.4:. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. F-IF.7e: Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. F.TF.8: Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle		2.4 (F.TF.8) Given the Pythagorean Identity Students will • Use the Pythagorean identity to find sin(θ), cos(θ), or tan(θ) and the quadrant of the angle

Algebra II Unit 4

Calendar

April 2019						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
	1	**2**	**3**	**4**	**5**	**6**
7	*8*	9	**10**	**11**	**12**	**13**
14	**15**	**16**	**17**	**18**	**19** **Good Friday** **No School**	**20**
21	**22** **Spring Break** **No School**	**23** **Spring Break** **No School**	**24** **Spring Break** **No School**	**25** **Spring Break** **No School**	**26** **Spring Break** **No School**	**27**
28	**29** **Review for PARCC**	**30** **Review for PARCC**				

May 2019 (PARCC Testing for 1 week)						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 Review for PARCC	2 Review for PARCC	3 Review for PARCC	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27 Memorial Day	28	29	30	31	

Assessment Framework

Assessment	Assignment Type	Grading	Source	Estimated in-class time	When?
Diagnostic Assessment *Unit 4 Diagnostic*	Test	Traditional (zero weight)	Curriculum Dept. created – see Dropbox	< ½ block	Beginning of unit
NWEA SPRING	Test	Online	MAP app in chrome book	1 block	April
MP4 Benchmark Assessment	Test	Online and Rubric	Edulastic	1 block	In MP 4
Teacher Created Assessments	Test	Traditional	Teacher Created	2 blocks	In MP4
Performance Task *Unit 4 Performance Task1*	Authentic Assessment	Rubric	Topic constructed response (also see Dropbox)	½ block	In topic 8
Performance Task *Unit 4 Performance Task2*	Authentic Assessment	Rubric	Topic constructed response (also see Dropbox)	½ block	In topic 9
Quizzes	Quiz	Rubric or Traditional	Teacher created or "Practice" in Agile Minds	< ½ block	Varies (must have 3 quizzes per MP)

Algebra II Unit 4

Scope and Sequence

Overview			
Topic	Name	Agile Mind "Blocks"*	Suggesting Pacing
N/A	**Transition lesson: Pythagorean Theorem**	**n/a**	**1 day**
N/A	**Transition lesson: Similarity**	**n/a**	**1 day**
15	**Geometry: Right Triangle and Trig Relationships**	**2 blocks**	**1 day**
20	**Algebra 2: Trigonometric function**	**6(including tangent)**	**3 days**
	Supplemental Resources		**4 days**

Diagnostic Assessment	**½ day**
Transition lesson	**½ - 1 day**
Mid Unit Assessment	**1 day**
End of Unit Assessment	**1 day**
Performance Task 1	**½ day**
Review	**1 day**
Total	**15 days**

*1 Agile Mind Block = 45 minutes

Geometry Topic 15: Right Triangle and trig relationships (Transition lesson)

Topic Objectives (Note: these are not in 3-part or SMART objective format)

1. Develop the side-length relationships for 45^0-45^0-90^0 and 30^0 – 60^0 - 90^0
2. Explore trigonometric ratios and use them to solve problems
3. Use Inverse trigonometric function to solve problems
4. Solve problems involving angles of elevation and depression;
5. Solve problems using similar triangle

Focused Mathematical Practices

6. MP 2: Reason abstractly and quantitatively
7. MP4: Model with mathematics
8. MP7: Look for and make sense of structure

Vocabulary: Right Triangle, Trigonometric ratios, slope, sine, cosine, tangent, Hypotenuse, Opposite, Adjacent

Fluency

9. Ratio
10. Similarity
11. Slope
12. Pythagorean Theorem

Suggested Topic Structure and Pacing

Day	Objective(s) covered	Agile Mind "Blocks" (see Professional Support for further lesson details)	MP	Additional Notes
1	1	*Block 1*	4, 2,7	Overview Explore: "Special Right Triangle" Page 1 -9
2	2	*Block 2*		Explore: "Trigonometric ratio" Page 1 - 8
3	2/3	*Block 3*		Explore: " Trigonometric ratio" Page 9 - 13
4	4/5	*Block 5*		Explore: "Indirect Measurement"

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/Resource
1) G.CO.13:. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle 2) G.SRT.C. 8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	***Day1 (Concept)*** ***Review:*** • Definition of right triangle, Equilateral triangle, Right Isosceles Triangle and Pythagorean theorem ***New*** • Special Right triangles 45^0-45^0-90^0 and 30^0 – 60^0 - 90^0	***Day 1 (Skills)*** ***Review*** • Applying Pythagorean theorem to find the missing side ***New*** • Developing the side lengths of special right triangles.	***Explore**: "Special right triangle" **Page 1 -9** Suggested assignment: SAS 2 10 – 11 and Constructed Response 1
3) G.SRT.C. 6: Define trigonometric ratios and solve problems involving right triangles 6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles	***Day2(Concept)*** ***Review:*** • Concept of similarity • Concept of ratios ***New*** • Definition of trig ratios(Sine cosine and tangent)	***Day 2 (Skills)*** ***Review*** • Identify similarity • Writing ratios ***New*** • Develop the concept of trig ratios using similarity • Write trig ratios of the special right triangles 45^0-45^0-90^0 and 30^0 – 60^0 - 90^0	***Explore**: "Trigonometric ratios" **Page 1 -8** Suggested assignment: SAS 3 21 – 22 *More practice* p6 – 8 Guided Practice P1-6 **Note: Skip the definition of unit circle. Students will see this in Algebra II Topic**
4) G.SRT.C. 8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	***Day3Concept)*** ***Review:*** • Definition of Pythagorean Theorem • Concept of ratios ***New*** *Inverse Trig function*	***Day 3 (Skills)*** ***Review*** • Apply Pythagorean Theorem • Writing ratios ***New*** • Apply the trig ratios to solve the right triangle. • Use inverse trig functions to solve problems	***Explore**: "Trigonometric ratios" **Page 1 -8** Suggested assignment: SAS 3 12 – 13 *More practice* p1-5

5) G.SRT.C. 8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	***Day4(Concept)*** ***Review:*** • Special right triangle • Similar triangles ***New*** • Definition of Angle of Elevation • Definition of Angle of Depression	***Day 4 (Skills)*** ***Review*** • Apply Pythagorean Theorem • Writing ratios ***New*** • Find missing sides using angle of elevation or depression	***Explore**: "Indirect measurement" **Page 1 -9** Suggested assignment: SAS 4 Guided Practice P 7 – 10 More practice P 9 -10 Constructed response 3

Algebra II Topic 20: Trigonometric Function

Topic Objectives (Note: these are not in 3-part or SMART objective format)

After completing the topic square root functions and equations, students will be able to

1. Explore Real world periodic situations
2. Draw angles and coterminal angles in standard position
3. Find reference angles
4. Introduce the circular definition of trigonometric functions and the graphs of y =sinα and x = cosα
5. Identify domain, range, symmetry, max min of sine and cosine functions
6. Transform sine and cosine function
7. Convert degree measure to radian measure

Focused Mathematical Practices

- MP 4: Model with mathematics
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary

Trig ratios, Sine, cosine, tangent, Periodic function, terminal side, coterminal, radian, degree, sinusoidal curve, sinusoidal axis, angle of rotation, periodic function, circular function, trigonometric function, unit circle, Pythagorean identity

Fluency

Right triangle trigonometry
Vertical asymptotes
Transformations of functions
Domain and Range
Line and point symmetry

Suggested Topic Structure and Pacing

Day	Objective(s) covered	Agile Mind "Blocks" (see Professional Spport for further lesson details)	MP	Additional Notes
1	1, 2, & 3	*Block 1 and 2*	4, 7	Overview Page 1 - 5 Exploring " Sine and Cosine" page 1 – 8
2	4, 5	*Block 3 and 4*		Exploring " Sine and Cosine" Page 9, 10, 11, and 14 (These pages cover the standard F.IF.4.) Note: • DO NOT review point of inflection. Go over max min of the trig functions. • Students will use the Pythagorean identity, but they don't need to prove it (proof will not be assessed in PARCC) Exploring "Transformation page 1 –6
3	6	*Block 5*		Exploring " radian" and "guided practice" Page 1 - 11

SKIP tangent

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/Resource
1) F.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. 2) F.TF.2: Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle	***Day1 (Concept)*** ***Review*** • Definition of median ***New*** • Periodic function • Trigonometric function • Sinusoidal curve • Unit circle • Circular function • Angle of rotation • Angle of rotation • Co terminal angles	***Day 1 (Skills)*** ***Review*** • Trig ratios ***New*** • Identifying period function and trigonometric functions • Determining midline, Amplitude and period of a sine cosine curve • Identify a unit circle, • Determine co terminal angles • Determine trig ratios of a circular function	**Day 1 (Material)** Agile Mind Topic 20 *** Overview** **Pgs. 1 -5** *** Exploring** "Sine and cosine " **Pgs. 1 – 8** Suggested assignment SAS 2 Q6,8 9, and Q17a-d *More practice* p1, and P2
1) F.IF.B.4:. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. 2) F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an*	***Day 2 (Concept)*** ***Review:*** • Max, min, rate of change, definition of x intercept and the concept of transformation ***New:*** • Transforming a trig function requires same concept as any other function • Phase shift is the same as horizontal shift	***Day 2 (Skills)*** ***Review*** • Solving systems of linear equations by substitution ***New*** • Transforming trig function • Find value of the parameters of the sine/cosine function given a graph and write the function	**Day 2 (Material)** Agile Mind Topic 20 *** Exploring** "Sine cosine " Pages: 10,11, and 14 "Transformation " Pages 1-6 Suggested assignment: SAS 2 Q24a-c *More practice* p3 SAS 3 Q6a-d, 7

appropriate domain for the function. * 3) F.BF.3: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. 4) F.TF.8: Prove the Pythagorean identity sin2 (θ) + cos2 (θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle			
1) F.TF.1: Understand radian measure of an angle as the length of the unit circle subtended by the angle.	***Day 3 (Concept)*** ***Review:*** • Definition of Arc length • Circumference of a circle • Unit circle • Radius of a circle ***New:*** • Definition of radian measure	***Day 3 (Skills)*** ***Review*** • Setting up proportion and solving proportion • Converting different measurement • conversion ***New*** • Use the definition of radian • write the sine and cosine function given a set of parameters	**Day 2 (Material)** Agile Mind Topic 20 *** Exploring** "Radians " Pages: 1-11

Ideal Math Block

The following outline is the department approved ideal math block for grades 9-12.

1) Fluency Practice (5 min) (see focused fluency skills in each curriculum unit plan)

2) Do Now (7-10 min)
    a. Serves as review from last class' or of prerequisite material
    b. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

3) Starter/Launch (5 min)
    a. Designed to introduce the lesson
    b. Uses concrete or pictorial examples
    c. Attempts to bridge the gap between grade level deficits and rigorous, on grade level content
    d. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

4) Mini-Lesson (15-20 min)
    a. Design varies based on content
    b. May include an investigative approach, direct instruction approach, whole class discussion led approach, etc.
    c. Includes CFU's
    d. Anticipates misconceptions and addresses common mistakes

5) Class Activity (25-30 min)
    a. Design varies based on content
    b. May include partner work, group work/project, experiments, investigations, game based activities, etc.

6) Independent Practice (7-10 min)
    a. Provides students an opportunity to work/think independently

7) Closure (5-10 min)
    a. Connects lesson/activities to big ideas
    b. Allows students to reflect and summarize what they have learned
    c. May occur after the activity or independent practice depending on the content and objective

8) DOL (5 min)
    a. Exit slip

MTSS MODEL

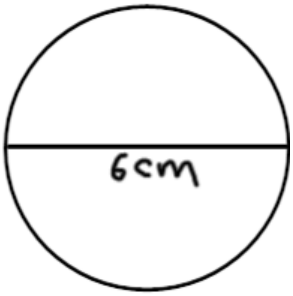
Whole Group Instruction	50 min	INSTRUCTION (Grades 9 – 12) Daily Routine: Mathematical Content or Language Routine Anchor Task: Anticipate, Monitor, Select, Sequence, Connect Collaborative Work* Guided Practice Independent Work (Demonstration of Student Thinking)		TOOLS Manipulatives RESOURCES Agile Mind
Rotation Stations (Student Notebooks & Chromebooks Needed)	1-2X 25 min	STATION 1: Focus on current Grade Level Content STUDENT EXPLORATION* Independent or groups of 2-3 Emphasis on MP's 3, 6 (Reasoning and Precision) And MP's 1 & 4 (Problem Solving and Application) TOOLS/RESOURCES Agile Mind Math Journals	STATION 2: Focus on Student Needs TECH STATION Independent TOOLS/ RESOURCES Khan Academy Approved Digital Provider Fluency Practice	TEACHER STATION: Focus on Grade Level Content; heavily scaffolded to connect deficiencies TARGETED INSTRUCTION 4 – 5 Students TOOLS/ RESOURCES Agile Homework Manipulatives
	5 min	INSTRUCTION Exit Ticket (Demonstration of Student Thinking) TOOLS/RESOURCES Notebooks or Exit Ticket Slips		

Sample Lesson Plan ccss T.FT.2

Objectives:

- Given the unit circle, students will
  - Understand the radian measure of an angle and convert degree to radian and vice versa
  - Use radian as a unit to solve problems

Do Now: Purpose is to address the pre-requisites: Geometric properties of circle
Find the area and the perimeter of the following circle



Summery:Define:
Radius of a circle: The distance from the center to the circumference of a circle

Circumference: Is the distance once around the circle. In other word Perimeter of a circle:

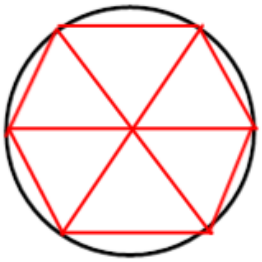
Diameter of a circle: A straight line going through the center of a circle connecting two points on the circumference. In other words, diameter of a circle is two times the radius measure.

Pi: ratio of circumference to diameter

How many degrees does the circle measure?

Intro to Radian – Prepare smart board slides

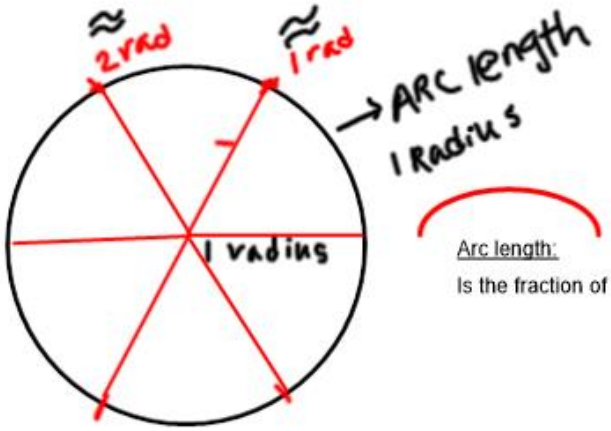
How did people come up with 360 degree? Well it's a human constructed measure. 360 degrees show up in our culture as a full rotation. Ancient calendar is based on 360 days in a year. Ancient astronomers realized that things seem to move 1/360 of the sky per day. Ancient Babylonian liked equilateral triangles so they had a base 60. We use base 10 now. Each equilateral triangle is divided into 60 sections.



Babylonian knew that the perimeter of a hexagon is exactly equal to six times the radius of the circumscribed circle.

What is radian?

Given a unit circle with a radius of 1 and an arc length that measures 1 radian



Arc length:

Is the fraction of the circumference and measured in length.

About How many radians is the circle above?

About How many radian is the half of the circle above?

What is the value of π

About how many pi radian is the half of the circle?

About how many pi radians are in the above circle?

How many degrees are in a circle?

One pi radian is equal to how many degrees?

Task

Part 1

Convert radians into degrees

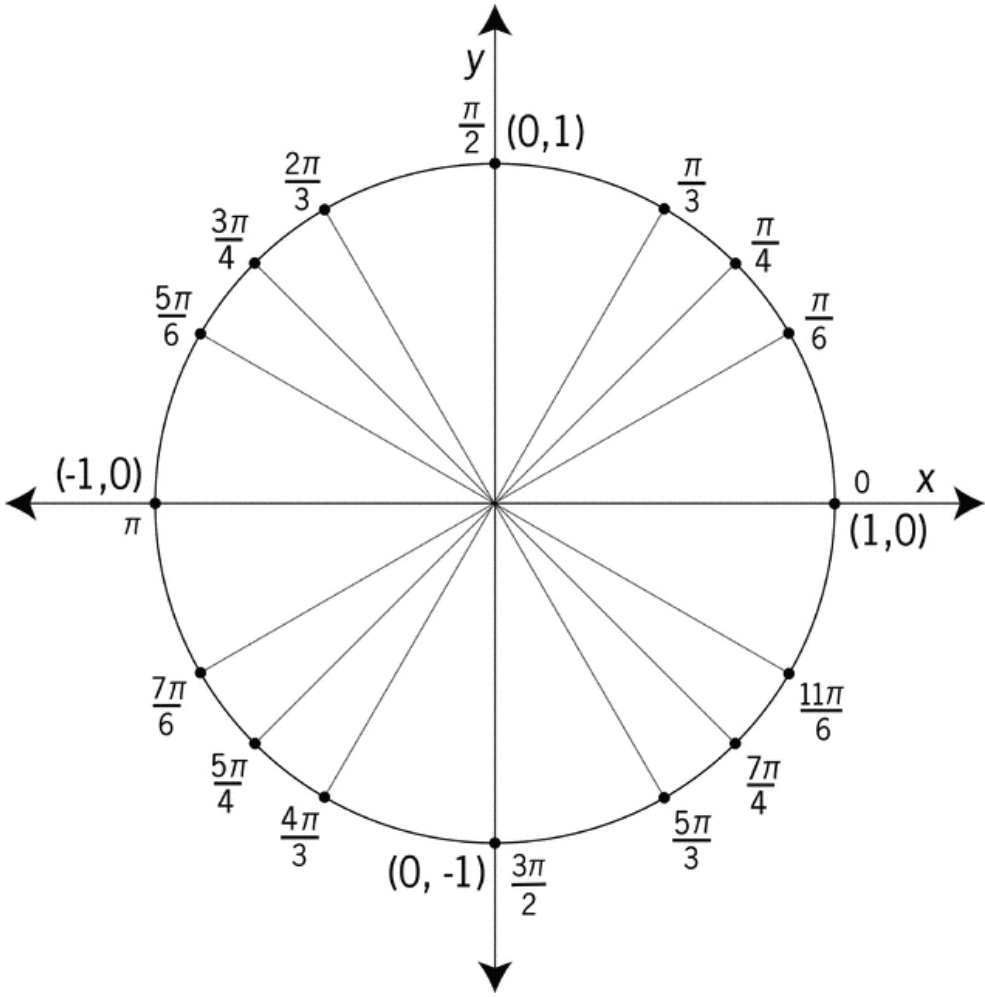
Determine the degrees of the following arc lengths and label them on the unit circle

a) $\frac{\pi}{6}$

b) $\frac{3\pi}{4}$

c) $\frac{4\pi}{3}$

d) $\frac{11\pi}{6}$



Algebra II Unit 4
Part 2
Convert radians into degrees

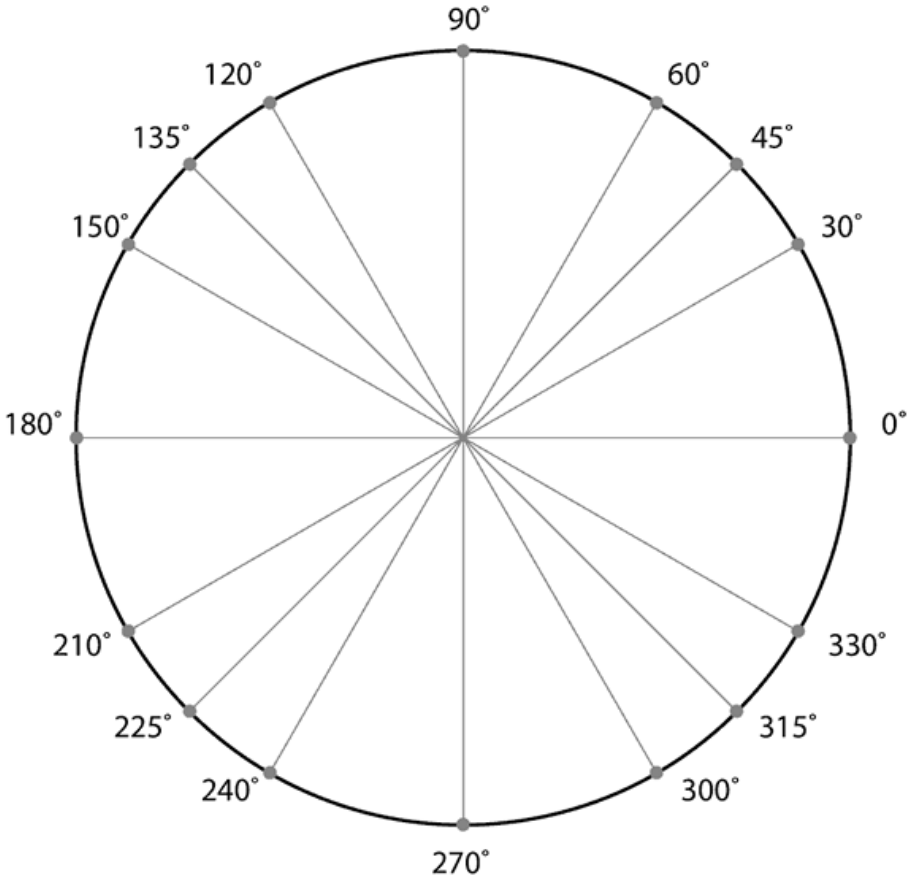
Determine the degrees of the following arc lengths and label them on the unit circle

a) 45°

b) 120°

c) 210°

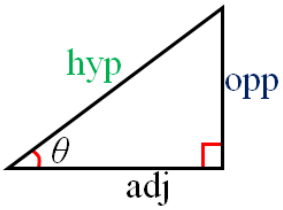
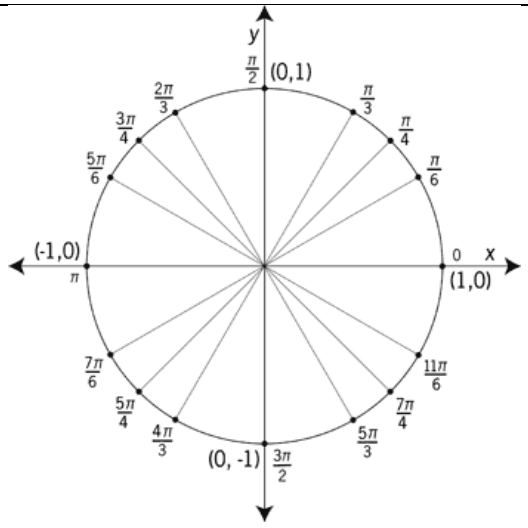
d) 315°

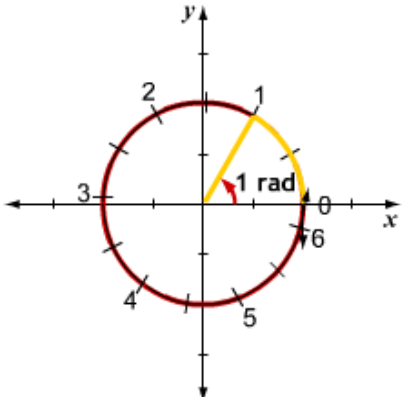


Supplement Materials

Tasks			
CCSS	SMP	Dropbox location and filename	Link (original task and answer key)

Multiple Representations

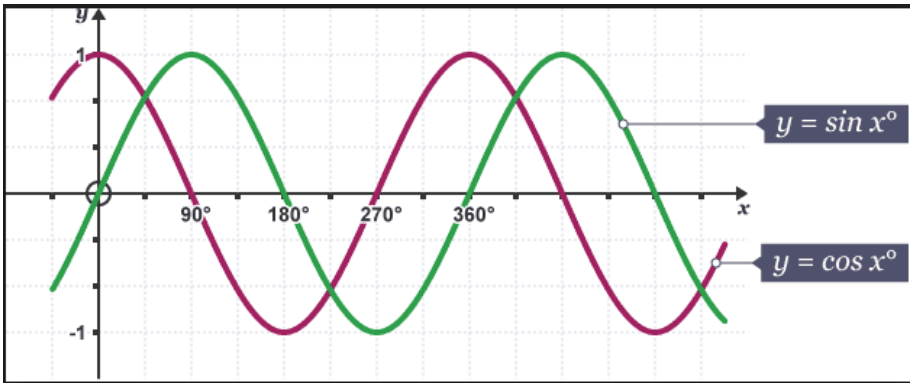
Trigonometric function	
Verbal description	Trigonometry is based upon ratios of the sides of right triangles **The three trigonometric functions of a right triangle, with an acute angle θ, are defined by ratios of two sides of the triangle.**
The right triangle	 The sides of the right triangle are: the side **opposite** the acute angle θ, the side **adjacent** to the acute angle θ and the **hypotenuse** of the right triangle When we are trying to find an **angle** we use $\sin^{-1}$, $\cos^{-1}$, or $\tan^{-1}$. $\sin\theta = \frac{opp}{hyp}$ $\cos\theta = \frac{adj}{hyp}$ $\tan\theta = \frac{Opp}{adj}$
Unit circle with radian measure	
Radian measure	



Radian measure = $\frac{\text{arc length}}{\text{radius}}$

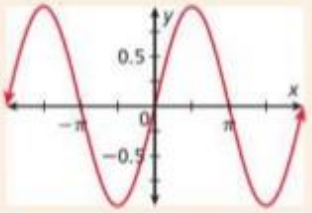
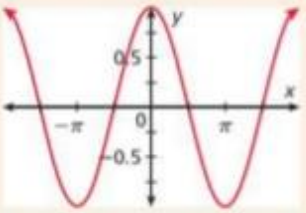
Degree to radian conversion: $\frac{360^0}{2\pi} = \frac{180^0}{\pi}$

Sine cosine graphs



Characteristics

Characteristics of the Graphs of Sine and Cosine

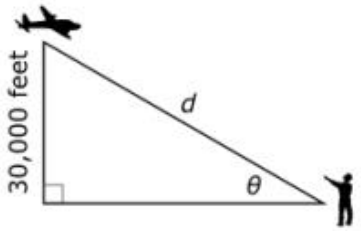
FUNCTION	$y = \sin x$	$y = \cos x$
GRAPH		
DOMAIN	$\{x \mid x \in \mathbb{R}\}$	$\{x \mid x \in \mathbb{R}\}$
RANGE	$\{y \mid -1 \le y \le 1\}$	$\{y \mid -1 \le y \le 1\}$
PERIOD	2π	2π
AMPLITUDE	1	1

Verbal description

PARCC Sample Item.

F.INT.1 -2 Given a verbal description of a polynomial, exponential, trigonometric, or logarithmic functional dependence, write an expression for the function and demonstrate various knowledge and skills articulated in the Functions category in relation to this function.

An airplane is flying at an altitude of 30,000 feet. The distance, d, in feet, from an observer on the ground to the plane is a function of the angle of elevation, θ, defined as the acute angle between the ground and the line between the observer and the plane, as shown in the figure.



Part A

Which equation gives d as a function of θ?

- A. $d(\theta) = \frac{30{,}000}{\sin\theta}$
- B. $d(\theta) = \frac{\sin\theta}{30{,}000}$
- C. $d(\theta) = \frac{30{,}000}{\cos\theta}$
- D. $d(\theta) = \frac{\cos\theta}{30{,}000}$

Part B

Within the context of the situation described, what is the domain of the function d? Enter the appropriate values, in degrees, in the inequality.

Enter your answer in the boxes.

$\square^\circ < \theta < \square^\circ$

Part C

When the angle of elevation is 75 degrees, what is the distance between the observer and the plane, to the nearest foot?

Enter your answer in the box.

$\square$ feet

Part D

For what value of θ will the distance between the observer and the plane be 60,000 feet?

Enter your answer in the box.

$\square$ degrees

F.TF.8: Use the Pythagorean identity $\sin^2\theta+\cos^2\theta = 1$ to find sin θ, cos θ, or tanθ, given sinθ, cosθ, or tanθ and the quadrant of the angle.

Suppose that θ is a second quadrant angle and that $\cos\theta = -\frac{4}{5}$. What is the value of $\sin\theta$ to the nearest tenth?

Enter your answer in the box.

F.INT.3: Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in F-TF.5, F-IF.B, F-IF.7, limited to trigonometric functions.

. The organizers of a community fair set up a small Ferris wheel for young children. The table shows the heights of one of the cars above the ground for different rotations of the wheel.

Angle of Rotation (radians)	Height above the Ground (feet)
0	1
$\frac{\pi}{2}$	7
π	13
$\frac{3\pi}{2}$	7
2π	1
$\frac{5\pi}{2}$	7
3π	13
$\frac{7\pi}{2}$	7
4π	1

Part A

The function $h(x) = a\ \sin\left(x - \frac{\pi}{2}\right) + b$, where *a* and *b* are constants, models the height of the Ferris wheel car at a rotation of *x* radians.

What are the values of *a* and *b*?

- A. $a = 1;\ b = 12$
- B. $a = 6;\ b = 7$
- C. $a = 7;\ b = 6$
- D. $a = 12;\ b = 1$

Part B

Consider the graph of $y = h(x)$ in the *xy*-coordinate plane. Which statements are true?

Select **all** that apply.

- A. The amplitude of the graph is 12.
- B. The period of the graph is 2π.
- C. The midline of the graph is at $y = 13$.
- D. The graph is increasing for $4\pi < x < 5\pi$.
- E. The graph is decreasing for $\frac{11\pi}{2} < x < \frac{13\pi}{2}$.