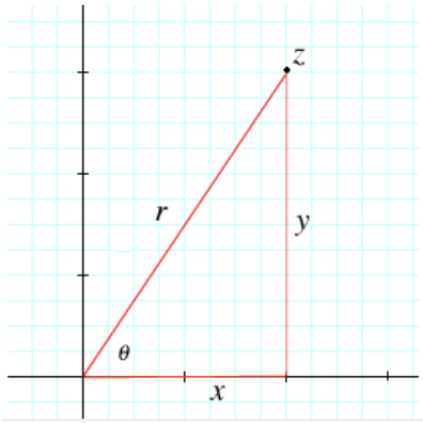
Curriculum Sample Template
Max. 8 Pages

Grade Level	12th Grade	**Content Area**	Math
Course Title (grades 9-12 Only)	Senior Math		
Expected Prior Knowledge *The knowledge/skills mastered earlier in the year foundational to the mastery of the required Standard in the current sample.*	• Students understand how to work in precision partnerships effectively. • Students know how to use their math journals effectively. • Students are familiar with, and have used, the 8 CCSS Mathematical Practices. • Students will have mastered the use of the Pythagorean theorem and trigonometric ratios. • Students will be familiar with simplifying expressions that include the imaginary number i.		
Alignment to Program of Instruction *Briefly outline methods of instruction found in this sequence of lessons that align to the Program of Instruction described in A.3.*	This unit is built on the framework of the SIOP Model and incorporates all 8 of the SIOP Model components. Sentence framing and precision partnering are instructional strategies which promote the use and mastery of academic language. Instructional technology is incorporated by teacher and students. The core curriculum is implemented with fidelity.		
Standard Number and Description *List the Number* and the full description for the Required Standard or Science Performance Objective listed in section A.6.*	Number and Quantity Domain: The Complex Number System Standard: #4: Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.		
Materials/Resources Needed	Chrome Books SMART Board Wolfram CDF Player download found at http://demonstrations.wolfram.com/index.html		

* ***Standard Number****: For English Language Arts (Reading and Writing), use Grade, Strand, Standard (e.g., 3.RI.2). For K-8 Math, use Grade, Domain, Standard (e.g., 6.EE.7). For HS Math, use Conceptual Category-Domain, Standard (e.g., A-REI.6). For Science, use Grade, Strand, Concept, PO (e.g., 4.1.3.1).*

Lesson (add as needed)	Instructional Strategies	Student Activities
1	**Vocab:** **Rectangular coordinate plane, real number axis, imaginary number axis** • Teacher will share information about the rectangular coordinate plane and its axis. • Teacher will facilitate a whole-class discussion regarding how a complex number in the form a+bi can be graphed. • Teacher will provide student pairs with practice for graphing real and imaginary numbers written in complex form on Chromebooks at: http://demonstrations.wolfram.com/PolarAndRectangularCoordinates/ • Teacher will check for understanding and guide students with scaffolding questions while partners are documenting information about the points and making conclusions. • Teacher will facilitate whole-class discussion regarding the comparisons made by student pairs while practicing the graphing on a rectangular plane. • Teacher will provide and collect exit tickets to be used for intervention the following day.	• Students add vocabulary definitions, pictures, and sentences/examples into their vocabulary journals. • Students will participate in a whole-class discussion regarding how a complex number can be graphed on rectangular coordinate plane. • Students will work with precision partners to graph the complex numbers on the Chromebooks. • Students will reason with partners and write a brief conclusion comparing Cartesian coordinate graphing and rectangular coordinate graphing. • Students will participate in a whole-class discussion to share their comparisons. • Students will add additional examples and explanations to their vocabulary journals. • Students will complete a formative 'exit ticket' to demonstrate their understanding of
2	**Vocab** **Polar coordinate plane, magnitude, and angle of argument** • Teacher will allow students to complete bell ringer and pulls selected students to provide intervention based on the students' exit ticket from the previous day. • Teacher will share with whole-class the picture or a similar one to that below and ask students what they notice is familiar, and what types of math might be	• Students add vocabulary definitions, pictures, and sentences/examples into their vocabulary journals. • Students will complete bell ringer activity related to previous days tasks regarding graphing complex numbers in a rectangular plane. • Students will complete the provided practice with their precision partners and compare and write briefly about

	used in this type of problem and how do they know?  • Teacher will introduce how to determine the magnitude of a complex number found in the rectangular plane by using the Pythagorean theorem, and how to calculate the angle of argument by using trigonometric properties. • Teacher will provide practice for students to graph using the same graphing resource to graph complex numbers using the polar coordinate plane. http://demonstrations.wolfram.com/PolarAndRectangularCoordinates/ • Teacher will check for understanding and guide students with scaffolding questions while partners are graphing their points. • Teacher will facilitate whole-class discussion regarding the comparisons made by student pairs while practicing the graphing on a polar plane. • Teacher will provide and collect exit tickets to be used for intervention the following day.	the methods of graphing using rectangular coordinates and polar coordinates. • Students will participate in a whole-class discussion to share their graphs and comparisons and will refine and draw additional conclusions regarding graphing complex numbers. • Students will complete a formative 'exit ticket' to demonstrate their understanding of graphing complex numbers in the polar coordinate plane.
3	• Teacher will allow students to complete bell ringer and pulls selected students to provide intervention based on the students' exit ticket from previous day. • Teacher will provide practice problems for students to graphically represent a complex number in rectangular	• Students will complete bell ringer activity related to previous day's tasks which includes graphing complex numbers on the polar coordinate plane. • Students will participate in a whole-class discussion to evaluate and compare the methods used to graphing

	and polar form using: http://demonstrations.wolfram.com/PolarAndRectangularCoordinates/ • Teacher will facilitate a whole-class discussion to guide students to an understanding that graphing complex points using either polar or rectangular is equivalent. • Teacher will check for understanding and guide students with scaffolding questions while they are working on their solutions and graphs. • Teacher will facilitate whole-class discussion regarding the solutions completed by students and allow students to evaluate different methods. If students have not given satisfactory solutions teacher will provided an additional example. • Teacher will facilitate students reading and summarizing the brief explanation in the sections "Complex Numbers using Polar Form", and "Converting between Rectangular Form and Polar Form" given at http://www.electronics-tutorials.ws/accircuits/complex-numbers.html • Teacher will provide and collect exit tickets to be used for intervention the following day.	complex numbers in both polar and rectangular planes. • Students will solve practice problems with their precision partners by devising a plan for each problem and determining a solution. • Students will participate in a whole-class discussion to evaluate the solutions given by the students and refine their strategies for graphing complex numbers in a polar coordinate plane. • Students will participate in reading and then summarize the given articles. • Students will complete a formative 'exit ticket' to demonstrate their understanding of the different methods to graphing complex numbers.
4	• Teacher will allows students to complete bell ringer and pulls selected student to provide intervention based on the students completed tasks from previous day. • Teacher will provide additional review if needed. • Teacher will allow students to complete summative assessment.	• Students will complete bell ringer activity related to previous day's tasks related to the applications • Students will complete the summative assessment.

Summative Assessment Items: *Attach here.* For each summative assessment item, include an answer key or scoring rubric describing how points are to be awarded.

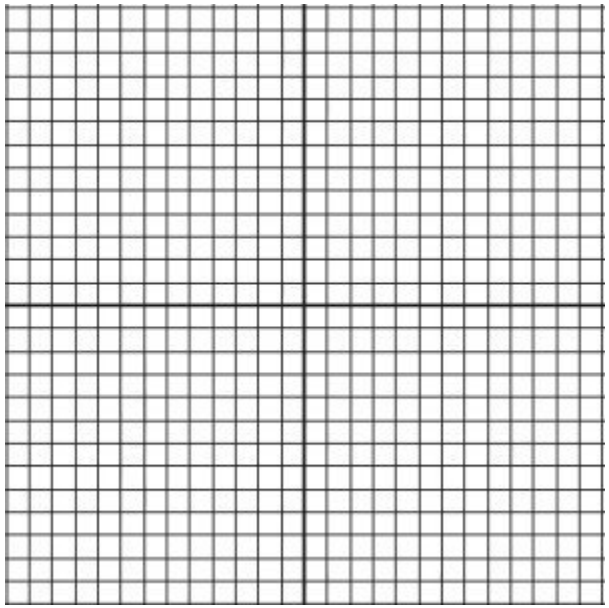
Graphing Complex Numbers Quiz

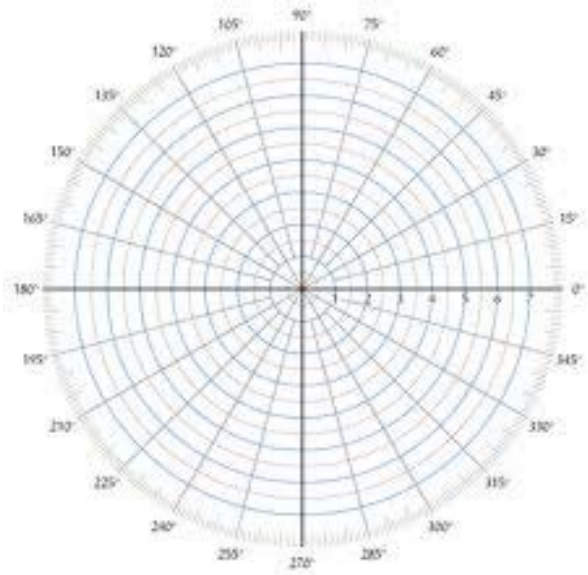
Domain: The Complex Number System

Standard: #4: Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

Essential Student Question: How do rectangular and polar coordinate point relate to one another?

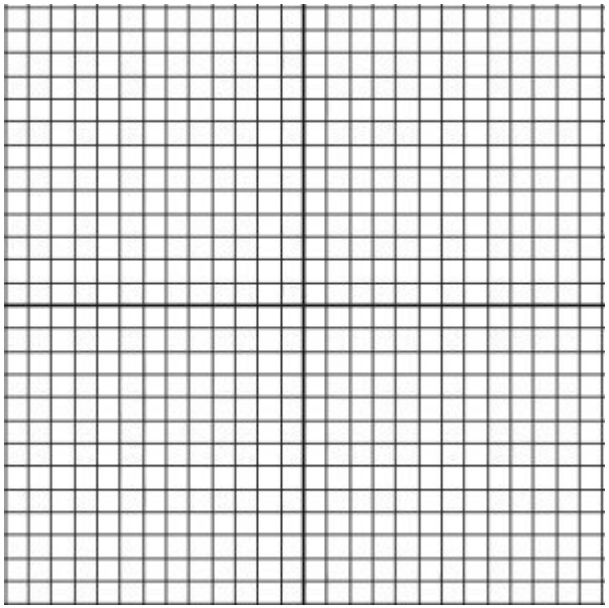
1. Graph the point Z = -5 + 8i using both a rectangular and a polar coordinate plane and compare the graphs.

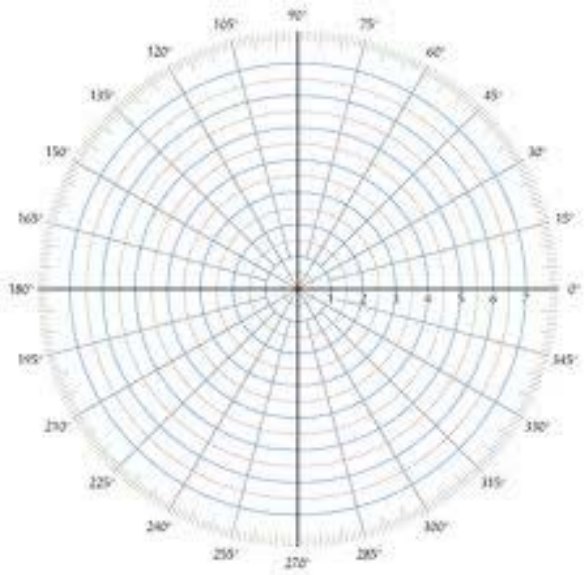




2. Write a brief comparison for the two graphs above.

3. Graph the point Z = -7 - 3i using both a rectangular and a polar coordinate plane and compare the graphs.



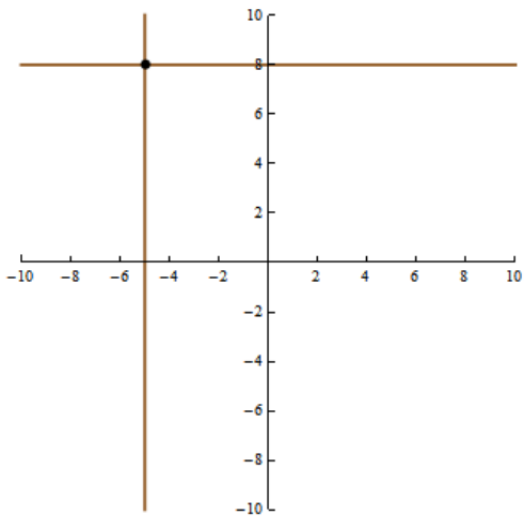


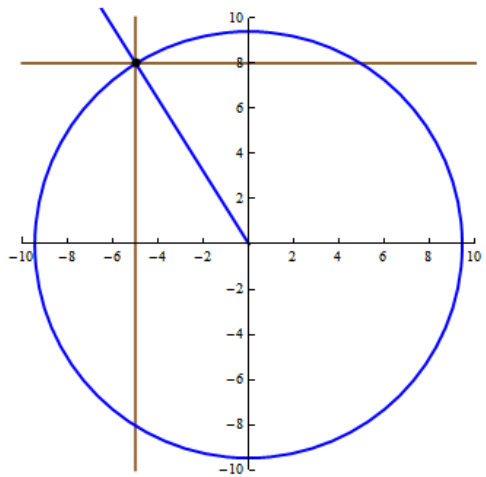
4. Explain how the trigonometric ratios are related to and applied to the complex number Z = a + bi.

5. Use the trigonometric ratios to prove how Z=a + bi is equal to Z= $|r|$ (Cos Θ + i Sin Θ)

Graphing Complex Numbers Quiz Answer Key

1.



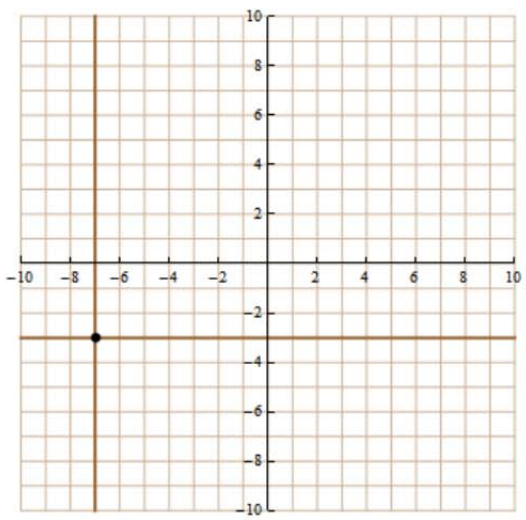


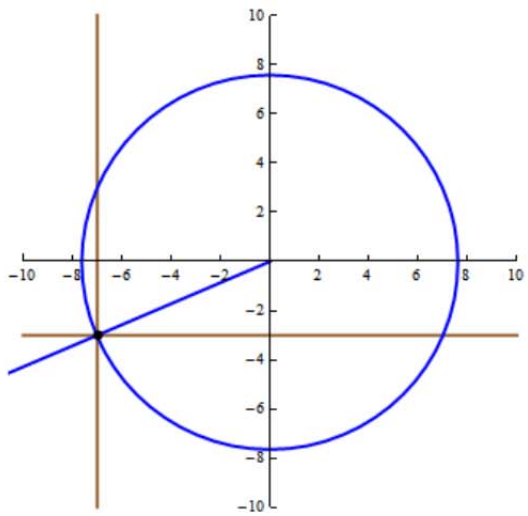
$x = -5$
$y = 8$

$r = \sqrt{89} = 9.43398$
$\theta = \pi - \tan^{-1}\left(\frac{8}{5}\right) = 0.677808\,\pi$

2. The graphs contain the same point Z = a +bi in the same location but the first graph uses rectangular coordinates where the x-axis is the real number related to a, and the y-axis is related to the imaginary value b. In the second graph the polar coordinates are used by determining the magnitude r = $\sqrt{(-3)^2 + (8)^2}$ = 9.43 and the argument of the angle Θ =180 + $\tan^{-1}\left(\frac{8}{-3}\right)$= 122°.

3.





$x = -7$
$y = -3$

$r = \sqrt{58} = 7.61577$
$\theta = \pi + \tan^{-1}\left(\frac{3}{7}\right) = 1.12888\,\pi$

4. Since Z = a + bi and a is graphed on the x-axis then a = r (cos Θ) where r is the hypotenuse or the magnitude in polar coordinates, and because b is graphed on the y-axis then b = r (sin Θ).
5. By substitution then Z = r (cos Θ) + ri (sin Θ) = r(Cos Θ + i Sin Θ), which proves that the polar and the rectangular coordinates are the same point.

Graphing Complex Numbers Quiz Scoring Guide

5 questions weighted at 1 points each **5 points total**

Raw score X 20 = _____/100 points

The 100 points possible assessment will reflect the school's grading scale:
90 -100 = A – Mastery
80 – 89 = B - Mastery
70 – 79 = C – Needs Screening for Remediation
60 – 69 = D – Needs Remediation
0 – 59 = F – Needs Intensive Remediation