Curriculum Sample Template

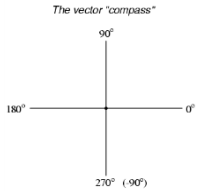
Max. 8 Pages

Grade Level	11th	**Content Area**	Math
Course Title (grades 9-12 Only)	Precalculus		
Expected Prior Knowledge *The knowledge/skills mastered earlier in the year foundational to the mastery of the required Standard in the current sample.*	Pythagorean Theorem. Cartesian Plane. Convert between degrees and radians. Calculate trigonometric ratios. Convert between trigonometric ratios. Create equation sentences from real world scenarios.		
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.*	Within this Pre-Calculus unit plan, a heavy emphasis is placed upon Blended Learning using videos. These blended activities have been carefully considered and come directly from the acclaimed website Khan Academy or credible YouTube teachers. These Blended Learning techniques apply to Tier 1 instruction but can further be applied to Tier 2. As a pre-calculus unit, the content itself is aligned to STEM. Kagan cooperative strategies (individual white boards, galley walks, centers) and Marzano high yield instruction strategies (objective driven vocabulary) are also built into these lessons.		
Standard Number and Description *List the Number* and the full description for the Required Standard or Science Performance Objective listed in section A.6.*	N-CN.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	Mimeo board. Individual whiteboard with expo markers. Painter's tape that sticks to ground for complex plane activity. Internet connection to watch the blended learning videos.		

* ***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	**Objective**: Represent complex numbers on the complex plane in rectangular form **Key Points**: • Complex plan means coordinate/Cartesian plane • Y axis = the imaginary axis • X axis = the real numbers axis • Rectangular Form = a + bi **Blended Learning**: https://www.khanacademy.org/math/algebra/complex-numbers/complex_numbers/e/the_complex_plane **Activation of Prior Knowledge**: Teacher will ("TW") draw a Cartesian plane on the board and ask student to label each axis. **Introduction to New Material ("INM")/Modeling**: TW introduce the key points and representing complex numbers on the complex plane. TW ask multiple checks for understanding ("CFUs"; call on non-volunteer to restate instructions, ask students to define key points in their own definitions, ask student to reteach their neighbor) to assess progress. **Guided Practice:** TW move all the desks to the corners of the room and lay two lines of tape on the floor. The classroom will be converted to a complex plane. Each student will have coordinates and must stand on their point on the complex plane. **Independent Practice:** TW draw three sample problems on the board of incorrectly graphed imaginary coordinates. SW write a short answer response to each question about why each coordinate is incorrectly graphed. **Assessment:** TW pass out a complex plane quiz. Students must score 80% or better. Each question is worth 1 point.	Students will ("SW") open their interactive notebooks to a new page and write the objective and key points. SW look up any unknown vocabulary in their math glossary, write the definitions, and rewrite the definitions in their own words. SW take notes during the blended activity and copy all examples in their interactive notebooks. SW actively reflect on the Cartesian plane used in prior algebra lessons. SW actively listen while the teacher introduces the key points and will make connections to Cartesian planes of the past. SW engage in the complex plane activity by moving to their assigned coordinate. SW answer all teacher questions, and make reference the key points in their answers. SW participate in the independent practice activity and justify answers while referencing the key points. SW complete the assessment activity and justify the answers using key points.
2	**Objective**: Represent complex numbers on the complex plane in polar form (including real and imaginary numbers) **Key Points**: • Polar form is where a complex number is denoted by the length • The vector compass is divided into four quadrants	SW open their interactive notebooks to a new page and write the objective and key points. SW look up any unknown vocabulary in their math glossary, write the definitions, and rewrite the definitions in their own words.

	 **Activation of Prior Knowledge**: TW draw a complex plane on the board and ask student to label each axis as either real numbers or imaginary. **INM/Modeling**: TW introduce the key points and representing polar complex numbers on the polar complex plane. TW ask multiple CFU's (call on non-volunteer to restate instructions, ask students to define key points in their own definitions, ask student to reteach their neighbor) to assess progress. **Guided Practice:** TW distribute white boards to students. TW put polar form numbers on the mimeo board, SW write which quadrant the vector will be located and draw an approximation of the polar graph. **Independent Practice:** TW pass out a sheet of polar form numbers. Students will graph each set of numbers and sit quietly until the independent practice is over. **Assessment:** SW reflect on the differences between polar coordinates and rectangular coordinates in a short paragraph.	SW actively reflect on the complex plane used in the prior lesson. SW actively listen while the teacher introduces the key points and will participate in answering checks for understanding. SW engage in the whiteboard activity. SW answer all teacher questions, and make reference the key points in their answers. SW participate in the independent practice activity and justify answers while referencing the key points. SW complete the assessment activity and justify the answers using key points. Students will use proper written conventions when describing the differences between polar and rectangular coordinates.
3	**Objective**: SW convert equations between rectangular and polar form **Key Points**: • $z = r(\cos\theta + isin\theta)$ • $r = \sqrt{a^2} + \sqrt{b^2}$ • To convert from rectangular to polar, find the polar magnitude through the use of the Pythagorean Theorem • The polar magnitude = the hypotenuse of a right triangle • The real and imaginary components are the adjacent and opposite sides, respectively. • Find the angle by taking the arctangent of the imaginary	SW open their interactive notebooks to a new page and write the objective and key points. SW look up any unknown vocabulary in their math glossary, write the definitions, and rewrite the definitions in their own words.

	component divided by the real component **Blended Learning:** http://www.youtube.com/watch?v=t2SvNC-3Q5Y **Activation of Prior Knowledge**: TW ask 6 students to the front of the class. Three students will write an equation in rectangular form, three students will write an equation in polar form. **INN/Modeling:** TW introduce the key points and how to convert between rectangular and polar form. TW reference the key points when going thorough the process. **Guided Practice**: TW distribute an answer sheet for students to use in the "gallery walk." TW model how to walk around the room to different locations and answer the questions about converting between rectangular and polar form. **Independent Practice:** TW list 10 problems on the Mimeo board that students will quietly convert between rectangular and polar form in their independent notebooks. **Assessment**: TW pass out stickie notes to students. Two questions will be on the Mimeo board (1 rectangular, 1 polar) and students will need to convert the equations to the other acceptable form. SW place the stickies on the teacher's door with their names on them when leaving class.	SW watch the YouTube video about converting between rectangular and polar form. SW write three questions they would ask the online teacher if they had the chance. SW participate or actively think about rectangular and polar coordinates from the last lesson. SW actively listen while the teacher introduces the key points and will participate in answering all teacher questions. SW engage in the gallery walk activity. SW answer all teacher questions, and make reference the key points in their answers. SW participate in the independent practice activity and justify answers while referencing the key points. SW complete the assessment activity and quietly place the stickie notes on the teacher's door when exiting class.
4	**Objective:** SW explain why the rectangular and polar forms of a given complex number represent the same number and what are the advantages to using either system? **Key Points** • Rectangular coordinates and polar coordinates are two different ways of using two numbers to locate a point on a plane. • Rectangular coordinates are in the form (x,y), where 'x' and 'y' are the horizontal and vertical distances from the origin: • Polar coordinates are in the form: (r,q), where 'r' is the distance from the origin to the point, and 'q' is the angle measured from the positive 'x' axis to the point: **Activation of Prior Knowledge**: TW ask students to reference the key points from the last three lessons. TW call upon students to read their reflections from the second lesson in this unit. **INN/Modeling:** TW introduce the key points and illustrate how polar	SW open their interactive notebooks to a new page and write the objective and key points. SW look up any unknown vocabulary in their math glossary, write the definitions, and rewrite the definitions in their own words. SW participate or actively think about the key points from earlier lessons in the unit. SW either reflect aloud or reflect silently when considering the key points from earlier lessons. SW actively listen while the teacher introduces the key points and will

	form and rectangular form represent the same number. TW reference the key points when going thorough the process and discuss which method is most advantageous in different situations. TW ask multiple CFU's (call on non-volunteer to restate instructions, ask students to define key points in their own definitions, ask student to reteach their neighbor) to assess progress. **Guided Practice**: TW distribute an answer sheet for students to use in the centers activity. TW model how to walk around the room to different centers and answer the questions about the advantages of polar form or rectangular form. **Independent Practice:** TW list 10 scenarios on the Mimeo board that students will decide which method is more advantageous. **Assessment**: TW pass out a short answer sheet. TW put questions on the Mimeo board and SW convert between rectangular and polar form. While converting between the two forms, SW write out every step of the process and note why the process is important and why the given number represents the same number they are converting to.	participate in answering checks for understanding. SW engage in the centers activity. SW answer all teacher questions, and make reference the key points in their answers. SW participate in the independent practice activity and justify answers while referencing the key points. SW complete the assessment activity and quietly write out every step of the process. SW note why the process is important and why the given number represents the same number they are converting to.
5	TW instruct students to complete the summative assessment.	SW 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.

***Two points each, round decimals to the nearest hundredth**

Graph the following complex numbers (shown in rectangular form) and draw a vector from the origin.

1. $3 + 3i$
2. $2 - 4i$
3. $4 + 2i$

Graph the following complex numbers (shown in polar form).

4. $z = 4\angle 40°$
5. $z = 6\angle 110°$

6. What are the **<u>equivalent forms</u>** of a complex number in polar form?

Convert between rectangular and polar form: If the given problem is in rectangular form, convert to polar. If the given problem is in polar form, convert to rectangular form.

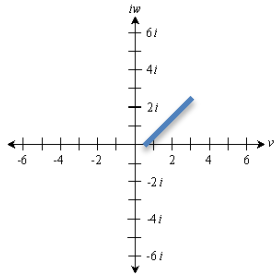
7. $5 \angle 36.87°$
8. $4 + 2i$

9. $5 + 3i$

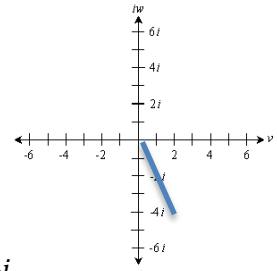
10. In general, when is it most appropriate to use polar coordinates?
11. As an aircraft pilot, is it more advantageous to use polar coordinates or rectangular coordinates? Why?
12. Give one example (other than navigation) that uses polar coordinates instead of rectangular coordinates because polar coordinates are more advantageous.

Answer Key:

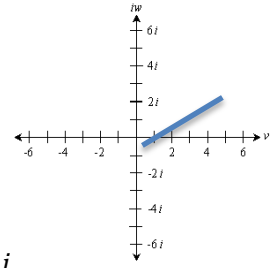
1. $3 + 3i$



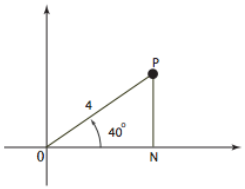
2. $2 - 4i$

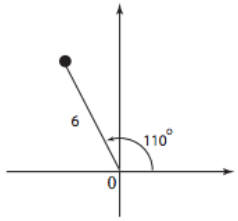


3. $4 + 2i$



4. $z = 4\angle 40°$





5. $z = 6\angle 110°$
6. What are the equivalent forms of a complex number in polar form?

   z = r∠θ = r(cosθ + isin θ)

7. $5 \angle 36.87°$ (Polar) = 4+3i **(Rectangular)**
8. $4 + 2i\ (Rectangular) = 4.47 \angle 26.57$ **(Polar)**
9. $5 + 3i\ (Rectangular) = 5.83 \angle 30.96$ (**Polar**)

10. In general, when is it most appropriate to use polar coordinates?

    Polar coordinates are most appropriate in any context where the phenomenon being considered is inherently tied to direction and length from a center point.

11. As an aircraft pilot, is it more advantageous to use polar coordinates or rectangular coordinates? Why?

    Pilots often use polar coordinates because the destination or direction of travel can be given as an angle and distance from the object being considered. It is this reason, the relationship between the starting point, the angle of motion, and the destination point, that most navigators use polar coordinates.

12. Give one example (other than navigation) that uses polar coordinates instead of rectangular coordinates because polar coordinates are more advantageous.

    Systems displaying radial symmetry provide natural settings for the polar coordinate system, like radio antennas or cell phone towers.

Total: _____/24; Grading Scale: 0-17=Incomplete; 18-19=C; 20-22=B; 23-24=A. 80%=Mastery.