Curriculum Sample Template
Max. 8 Pages

Grade Level	High School	**Content Area**	Mathematics
Course Title (grades 9-12 Only)	Pre-Calculus		
Expected Prior Knowledge *The knowledge/skills mastered earlier in the year foundational to the mastery of the required Standard in the current sample.*	Students will already understand the existence and form of complex numbers. They will also know how to write a point in two-dimensional space in polar form.		
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.*	The school's program of instruction for mathematics combines an alignment with Hunter's Essential Elements of Instruction and the Socratic method as outlined and described by The Great Books program and Michael Strong's text The Habit of Thought. Instruction during this unit will include direct instruction of key points and examples, guided practice including practice problem sets and partner activities, independent practice, and daily formative assessments conducted at the end of each class period.		
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 Conceptual Category: Number and Quantity Domain: The Complex Number System (N-CN) 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	One large (4'X8') whiteboard, one small (2'X2') whiteboard, one meter stick, one protractor, two whiteboard markers, and one eraser for every two students.		

**** 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).*

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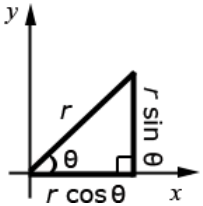
Lesson (add as needed)	**Instructional Strategies**	**Student Activities**
1	This is a 3 day lesson. Day 1 The teacher will initiate a discussion by asking how one may identify a point on a plane. Once the students have identified ordered pairs and polar coordinates as two methods, then introduce the complex plane and how the notation *a + bi* appears on the complex plane. Then ask the students to discuss any triangles that can be created using the point and the origin. Once they have identified the hypotenuse, discuss the meaning of absolute value being a distance and how the Pythagorean formula is useful.	Do Now: Students will review the basic vocabulary of complex numbers and the polar form of coordinates. Guided Practice: Students (working in pairs) will draw a Cartesian coordinate graph to represent the complex plane and randomly select a point. They will then represent the point using the complex number (*a* + *bi*) form. Student pairs will then calculate the distance from the origin of their selected point using proper notation and demonstrating proper technique. A board meeting will be used to check answers. Independent Practice: The student pairs will repeat the above *Guided Practice* process using a point in a different quadrant. **Summative Assessment #1**: Students will participate in four 2-minute *Expert* talks: twice as a learner and twice as an expert.
2	Day 2 Using the previous day's examples examine with the students the line (hypotenuse) connecting the origin with the point. Discuss the uniqueness of the angle made with the positive x-axis. Then ask the students to discuss how the coordinates of a	Do Now: Students will review the previous day's work and the basic vocabulary of the three primary trigonometric definitions: sine, cosine, and tangent. Guided Practice: Students (working in pairs) will draw a Cartesian coordinate graph to represent the complex plane and randomly select a point. They will then represent the point using the complex number (*a* + *bi*) form and convert it to polar form. Student pairs will

	point in complex and polar form are equivalent. $a + bi = r(\cos\theta + i\sin\theta)$  	then select a point in a different quadrant and convert it from polar to complex form. A board meeting will be used to check answers. Independent Practice: The student pairs will repeat the above *Guided Practice* process using a new set of points in the other two quadrants. **Summative Assessment #2**: Students will participate in four 2-minute *Expert* talks: twice as a learner and twice as an expert.
3	Day 3	**Summative Assessment #3** (see Unit Quiz).

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

Summative Assessments #1 and #2 represent activities that are approved and used by the top liberal arts academies in the Phoenix area. They are designed to be aligned with the philosophy of the school and fulfill the mission of the Socratic Method which requires the active engagement of students with each other even though they may be evaluated independently. Furthermore, this style of evaluation is cross-aligned with the evaluation system used in other classes at the school, particularly Humane Letters, in order to create a consistency across the entire curriculum.

Summative Assessments #1 and #2 - The "Expert Talks" will be evaluated according to the Socratic discussion rubric outlined below.

	1	2	3	4
White Board Preparation	Student contributes little to white board presentations and relies heavily on partner(s) to complete the work.	Student contributes somewhat to the white board preparation, but is unable to adequately explain the final results.	Student is actively involved in the white board preparation but struggles to provide an accurate explanation of the results.	Student actively contributes to the preparation of the white board and is able to very accurately explain its results.
"Learner" Mode for Expert Talks	Student is uncertain of what questions need to be asked and how to ask them.	Students attempts to ask questions but has significant difficulty in properly phrasing them.	Students asks good questions.	Student not only asks good questions, but leads classmates to better understanding of the material.
"Expert" Mode for Expert Talks	Student displays little understanding of white board material.	Student exhibits some understanding of white board material but is unable to clearly communicate answers to questions.	Student demonstrates competence in answering questions about white board material.	Student demonstrates a sophisticated understanding of white board material and leads the class to in-depth discussions.
Peer Interaction	Student does not engage in discussion with peers.	Student seems more comfortable speaking directly to the teacher and not with peers.	Student generally speaks to peers, but occasionally looks to the teacher for affirmation.	Student speaks directly to peers and rarely to the teacher, except when necessary.
Civil Discourse	Student is generally disrespectful of peers.	Student is respectful but can be prone to showing momentary irritation, hostility, or condescension.	Student is generally polite and respectful.	Student is exceptionally courteous and respectful even during debates and disagreements.

Total Points Possible: 20
Mastery: 17 points (85%)

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Summative Assessment #3

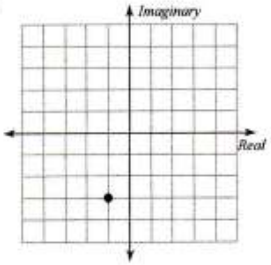
Summative Assessment

Name_____

N-CN4

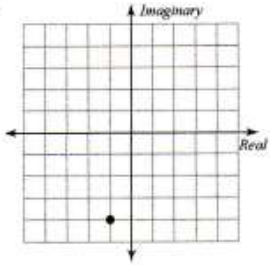
Identify each complex number graphed.

1)



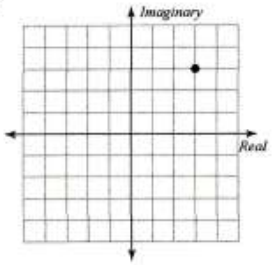
A) $-3 - i$ B) $-1 - 3i$
C) $-1 + 3i$ D) $1 - 3i$

2)



A) $-1 + 4i$ B) $-4 - i$
C) $1 - 4i$ D) $-1 - 4i$

3)

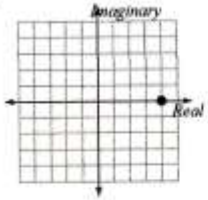


A) $3 - 3i$ B) $-3 + 3i$
C) $3 + 3i$ D) $-3 - 3i$

Graph each number in the complex plane.

4) $4 + 5i$

A)



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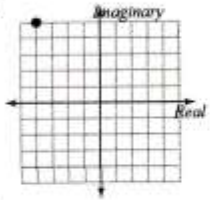

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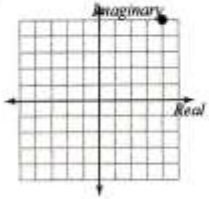

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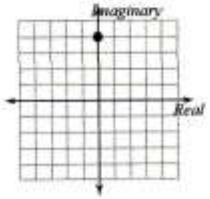
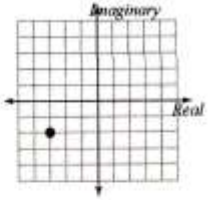


5) $3 + 2i$

A)



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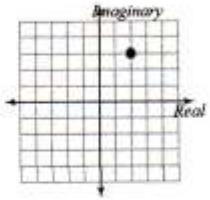

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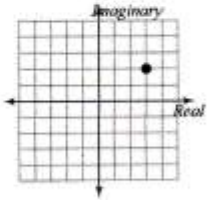

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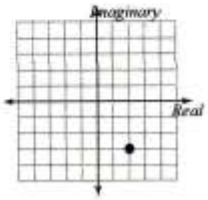
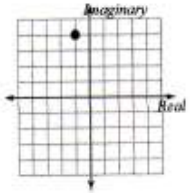


6) $-4 - i$

A)



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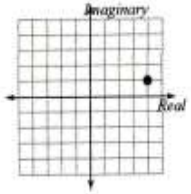

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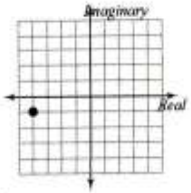
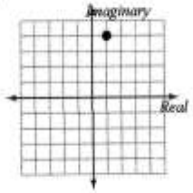


D)



Find the absolute value of each complex number.

7) $|1+7i|$

A) $3i\sqrt{7}$ B) $5\sqrt{2}$
C) 8 D) $\sqrt{65}$

8) $|-8-4i|$

A) $2\sqrt{21}$ B) $3\sqrt{10}$
C) $\sqrt{97}$ D) $4\sqrt{5}$

9) $|10-7i|$

A) $\sqrt{157}$ B) $\sqrt{149}$
C) $\sqrt{170}$ D) $6\sqrt{2}$

10) $|4+i|$

A) $\sqrt{17}$ B) $\sqrt{10}$
C) 3 D) $\sqrt{5}$

Answers to N-CN4

1) B	2) D	3) C	4) C
5) C	6) C	7) B	8) D
9) B	10) A		

Each correct answer is worth two points.
Total Points Possible: 20
Mastery: 18 points (≈85%)

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