Curriculum Sample Template

Max. 8 Pages

Grade Level	12	**Content Area**	Mathematics
Course Title (grades 9-12 Only)	Pre-Calculus / Trigonometry		
Length of Unit	4 days	**Time of Year**	Block 4 of 10
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 have an understanding of complex numbers in the form z = x + y*i*, and how to graph them. Students will be able to use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Students will know what the modulus of complex numbers		
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.*	One question students have is how imaginary numbers are used in real-world situations. When the unit on imaginary and complex numbers is introduced, students will be told that the most common use of complex numbers in the real-world is when an engineer wants to use a complex number to represent two dimensions of the same object. This comes up in magnetic fields, electronics, mechanical motion, etc.... Also complex numbers are sometimes used to solve real-world problems. These problems can only be solved with complex numbers that will eventually give results of real numbers. At the end of this unit students will present a power point on how complex numbers are used in the real world – showing examples. In order to make sense of this they will need a background in how to work with complex numbers, and that is what this lesson focuses on. This fits the Program of Instruction because it requires students to take their skills learned in the classroom and apply it to real-world situations. Because of this lesson students will have a better understanding of complex numbers and how they are used by engineers.		
Standard Number and Description *List the Number* and full description for the required Standard.*	HS.N-CN.3. Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.		
Summative Assessment *Describe a cumulative and comprehensive activity, clearly separate from instruction and guided or independent practice, which allows each student to individually demonstrate mastery of the required Standard. A copy of the summative assessment must be attached to the curriculum sample.*	The summative assessment will have students use conjugates to find moduli and quotients of complex numbers.		
Scoring Scale and Mastery Level *Explain how the assessment is scored, to include points per question, how points are awarded, total points possible, criteria necessary to demonstrate mastery, and grading scale. A copy*	The assessment will have 6 questions each worth 2 points for a total of 12 points. Students will receive 1 point for setting up the problem correctly with the conjugate, and one point for solving the problem correctly. There will be 3 problems in which students will find moduli and 3 problems where students will find quotients. The grading scale will be 0-8 = No Grade (required retake), 9 = C, 10 = B, 11-12 = A. Students must score 9 or better to demonstrate		

of the answer key and scoring rubric (whichever applicable) must be attached to the curriculum sample.	mastery.
Materials/Resources Needed	Document camera and projector, white-boards

* ***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)	**Instruction**	**Student Activities**
1	For bell work students will simplify expressions with complex numbers in order to review the use of mathematic properties in dealing with complex numbers ($i^2 = -1$). After bell work students will be introduced to conjugates of complex numbers. Students will take notes and as a class practice making conjugates of complex numbers. Students will then have an assignment in which they will individually make conjugates of complex numbers. Teacher will circulate and give individual help. Students will demonstrate the conjugates they made on the document camera. As a check for understanding, students will create conjugates on white-boards. Students will be given homework in which they simplify expressions and create conjugates.	Students will simplify expressions with complex numbers example: $(4 + 3i)(-5 – 2i)$ $-20 – 23i – 6i^2$ $-20 – 23i + 6$ $-14 – 23i$ Students will take notes on conjugates Students will create conjugates example: $4 + 3i$ conjugate $4 -3i$ $7 – 2i$ conjugate $7 + 2i$
2	Students will create conjugate for their bell work. After bell work teacher will introduce how to use conjugates to solve for the modulus. Students will work with a partner to solve problems using conjugates to determine modulus. Students will demonstrate on the document camera how they determined the modulus using the conjugate. Students will then have individual problems that they will begin working on in class, and finish as homework	Students will create conjugates Students will take notes about using conjugates to find modulus Students will, with a partner, use conjugates to find modulus Students will find modulus individually example: $z = 4 + 2i$, Find the modulus of z $\|z\|$= modulus of z $\|z\|^2$ = (z)(conjugate of z) $= (4 +2i)(4- 2i)$ $= 16 – 4i^2$ $= 20$ square root of each side $\|z\|$ = 2 times the square root of 5 (could not write symbol with word processor)
3	Students will have a bell work in which they review how to find the modulus. After bell work students will be introduced to finding	Students will find modulus using conjugates

	quotients of complex numbers using conjugates. Students will work with a partner to find quotients of complex numbers. Teams will demonstrate how they solved the problems using the document camera. Students will be given individual work in finding quotients. Students will finish problems as homework	students will take notes on finding quotients using conjugates students will, in teams, find quotients of complex numbers Students will demonstrate solutions students will, as individuals, find quotients of complex numbers example: z= 4 + 2i; w = -3 + 4i what is the quotient of z and w $\frac{4 + 2i}{-3 + 4i}$ multiply top and bottom by the conjugate of w $\frac{(4 + 2i)(-3 -4i)}{(-3 + 4i)(-3 – 4i)} = \frac{-12 -6i – 16i - 8i^2}{9 – 16i^2}$ $\frac{-4 – 22i}{25}$
4	Students will start class by reviewing how to find modulus and quotient. Students will take the summative assessment in which they will have to find modulus and quotients of complex numbers	Students will take summative assessment

Paste Summative Assessment Here:

Quotient and Modulus using Conjugates

1. Find the modulus of z using the conjugate; z = -3 + 2i
2. Find the modulus of z using the conjugate; z = 6 – 3i
3. Find the modulus of z using the conjugate; z = 5 + 4i
4. Find the quotient of w and z using the conjugate; w = -3 + 3i z = 4 – 3i
5. Find the quotient of w and z using the conjugate; w = 4 + 2i z = -6 + 5i
6. Find the quotient of w and z using the conjugate; w = -2 – 4i z = 2 + 3i

Paste Answer Key/Scoring Rubric Here:

The assessment will have 6 questions each worth 2 points for a total of 12 points. Students will receive 1 point for setting up the problem correctly with the conjugate, and one point for solving the problem correctly. There will be 3 problems in which students will find moduli and 3 problems where students will find quotients. The grading scale will be 0-8 = No Grade (required retake), 9 = C, 10 = B, 11-12 = A. Students must score 9 or better to demonstrate mastery.

Quotient and Modulus Using Conjugates Answer Key

1. Find the modulus of z using the conjugate; $z = -3 + 2i$

For this problem I will show an example of a student's response. For 2 and 3 I will just provide the answer

$|z|^2 = (-3 + 2i)(-3 – 2i)$
$= 9 – 6i + 6i - 4i^2$
$= 9 – 4i^2$
$= 9 + 4$
$= 13$ take the square root of each side to find $|z|$
$|z|$ = square root of 13

2. Find the modulus of z using the conjugate; $z = 6 – 3i$

$|z|$ = 3 times the square root of 5

3. Find the modulus of z using the conjugate; $z = 5 + 4i$

$|z|$ = the square root of 41

4. Find the quotient of w and z using the conjugate; $w = -3 + 3i$ $z = 4 – 3i$

For this problem I will give an example of a student response. For 5 and 6 I will just provide the answer

$\frac{(-3 + 3i)(4 + 3i)}{} = \frac{-12 – 9i + 12i + 9i^2}{} = \frac{-21 + 3i}{}$

$(4 - 3i)(4 + 3i)$ $\quad$ $16 - 9i^2$ $\quad$ 25

5. Find the quotient of w and z using the conjugate; $w = 4 + 2i$ $\quad$ $z = -6 + 5i$

$$\frac{-14 - 32i}{11}$$

6. Find the quotient of w and z using the conjugate; $w = -2 - 4i$ $\quad$ $z = 2 + 3i$

$$\frac{-16 - 2i}{-5}$$