PUBLISHER:			
SUBJECT:		**SPECIFIC GRADE:**	
COURSE:		**TITLE**	
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NON-NEGOTIBLE EVALUATION CRITERIA

2018-2024
Group VI – Mathematics
High School Math IV – Trigonometry/Pre-calculus

Equity, Accessibility and Format

Yes	No	CRITERIA	NOTES
		1. INTER-ETHNIC The **instructional** materials meets the requirements of inter-ethnic: concepts, content and illustrations, as set by WV Board of Education Policy 2445.41	
		2. EQUAL OPPORTUNITY The instructional material meets the requirements of equal opportunity: concepts, content, illustration, heritage, roles contributions, experiences and achievements of males and females in American and other cultures.	
		3. FORMAT This resource includes an interactive electronic/digital component for students.	
		4. BIAS The instructional material is free of political bias.	
		5. COMMON CORE The instructional materials do not reference Common Core academic standards. (WV Code §18-2E-1b-1)	

GENERAL EVALUATION CRITERIA

2018-2024
Group VI – Mathematics
High School Math IV – Trigonometry/Pre-calculus

The general evaluation criteria apply to each grade level and are to be evaluated for each grade level unless otherwise specified. These criteria consist of information critical to the development of all grade levels. In reading the general evaluation criteria and subsequent specific grade level criteria, **e.g. means "examples of" and i.e. means that "each of" those items must be addressed**. Eighty percent of the general and eighty percent of the specific criteria must be met with I (in-depth) or A (adequate) in order to be recommended.

(Vendor/Publisher) SPECIFIC LOCATION OF CONTENT WITHIN PRODUCTS	**(IMR Committee) Responses**							
	I=In-depth, **A**=Adequate, **M**=Minimal, **N**=Nonexistent	**I**		**A**		**M**		**N**
	In addition to alignment of Content Standards, materials must also clearly connect to Learning for the 21st Century which includes opportunities for students to develop:							
Communication and Reasoning								
For student mastery of College- and Career-Readiness Standards, the instructional materials will include multiple strategies that provide students opportunities to:								
	1. Explain the correspondence between equations, verbal descriptions, tables, and graphs.							
	2. Make conjectures and build a logical progression of statements to explore the truth of their conjectures.							
	3. Distinguish correct logic or reasoning from that which is flawed.							
	4. Justify their conclusions, communicate them to others, and respond to the arguments of others.							
	5. Evaluate the reasonableness of intermediate results.							
	6. Communicate precisely to others using appropriate mathematical language. When more than one term can describe a concept, use vocabulary from the West Virginia College- and Career-Readiness Standards.							

	7. Articulate thoughts and ideas through oral, written, and multimedia communications.							
Mathematical Modeling								
For student mastery of College- and Career-Readiness Standards, the instructional materials will include multiple strategies that provide students opportunities to:								
	8. Apply mathematics to solve problems in everyday life.							
	9. Use concrete objects, pictures, diagrams, or graphs to help conceptualize and solve a problem.							
	10. Use multiple representations.							
	11. Use a variety of appropriate tools strategically.							
	12. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.							
	13. Interpret their mathematical results in the context of the situation.							
	14. Reflect on whether the results make sense, improving the model if it has not serve its purpose.							
	15. Explore careers which apply the understanding of mathematics.							
Seeing Structure and Generalizing								
For student mastery of College- and Career-Readiness Standards, the instructional materials will include multiple strategies that provide students opportunities to:								
	16. Look closely to discern a pattern or structure.							
	17. Look both for general methods and for shortcuts.							
	18. Make sense of quantities and their relationships in problem situations.							
	19. Assess and evaluate the type of mathematics needed to solve a particular problem.							

	20. Apply appropriate mathematical skills to unfamiliar complex problems.							
	21. Maintain the oversight of the process of solving a problem while attending to the details.							
Instructor Resources and Tools								
The instructional materials provide:								
	22. An ongoing spiraling approach.							
	23. Ongoing diagnostic, formative, and summative assessments.							
	24. A variety of assessment formats, including performance tasks, data-dependent questions, and open-ended questions.							
	25. Necessary mathematical content knowledge, pedagogy, and management techniques for educators to guide learning experiences.							
	26. Presentation tools for educators to guide learning.							
	27. Multiple research-based strategies for differentiation, intervention, and enrichment to support all learners.							

SPECIFIC EVALUATION CRITERIA

2018-2024
Group VI – Mathematics
High School Math IV – Trigonometry/Pre-calculus

All West Virginia teachers are responsible for classroom instruction that integrates content standards and mathematical habits of mind. Students in this course will generalize and abstract learning accumulated through previous courses as the final springboard to calculus. Students will take an extensive look at the relationships among complex numbers, vectors, and matrices. They will build on their understanding of functions, analyze rational functions using an intuitive approach to limits and synthesize functions by considering compositions and inverses. Students will expand their work with trigonometric functions and their inverses and complete the study of the conic sections begun in previous courses. They will enhance their understanding of probability by considering probability distributions and have previous experiences with series augmented. Students will continue developing mathematical proficiency in a developmentally-appropriate progressions of standards. Mathematical habits of mind, which should be integrated in these content areas, include: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively; constructing viable arguments and critiquing the reasoning of others; modeling with mathematics; using appropriate tools strategically; attending to precision, looking for and making use of structure; and looking for and expressing regularity in repeated reasoning. Continuing the skill progressions from previous courses, the following chart represents the mathematical understandings that will be developed:

Building Relationships among Complex Numbers, Vectors, and Matrices	Analysis and Synthesis of Functions
• Represent abstract situations involving vectors symbolically.	• Write a function that describes a relationship between two quantities. (e.g., if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.)
Trigonometric and Inverse Trigonometric Functions of Real Numbers	**Derivations in Analytic Geometry**
• Make sense of the symmetry, periodicity, and special values of trigonometric functions using the unit circle. • Prove trigonometric identities and apply them problem solving situations.	• Make sense of the derivations of the equations of an ellipse and a hyperbola.
Modeling with Probability	**Series and Informal Limits**
• Develop a probability distribution. (e.g., Find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.)	• Apply mathematical induction to prove summation formulas.

For student mastery of content standards, the instructional materials will provide students with the opportunity to

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Building Relationships among Complex Numbers, Vectors, and Matrices								
Perform arithmetic operations with complex numbers.								
	1. Find the conjugate of a complex number; use conjugates to find moduli (magnitude) and quotients of complex numbers. Instructional Note: In Math II students extended the number system to include complex numbers and performed the operations of addition, subtraction, and multiplication.							
Represent complex numbers and their operations on the complex plane.								
	2. 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.							
	3. Represent addition, subtraction, multiplication and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. (e.g., $(-1 + \sqrt{3}\,i)^3 = 8$ because $(-1 + \sqrt{3}\,i)$ has modulus 2 and argument 120°.							
	4. Calculate the distance between numbers in the complex plane as the modulus of the difference and the midpoint of a segment as the average of the numbers at its endpoints.							
Represent and model with vector quantities.								
	5. Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v). Instructional Note: This is the student's first experience with vectors. The vectors must be represented both geometrically and in component form with emphasis on vocabulary and symbols.							

	6. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.							
	7. Solve problems involving velocity and other quantities that can be represented by vectors.							
Perform operations on vectors.								
	8. Add and subtract vectors. a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. c. Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order and perform vector subtraction component-wise.							
	9. Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy). b. Compute the magnitude of a scalar multiple c**v** using $\|c\mathbf{v}\| = \|c\| \cdot \|\mathbf{v}\|$. Compute the direction of c**v** knowing that when |c|v ≠ 0, the direction of c**v** is either along **v** (for c > 0) or against **v** (for c < 0).							
Perform operations on matrices and use matrices in applications.								
	10. Use matrices to represent and manipulate data (e.g., to represent payoffs or incidence relationships in a network).							
	11. Multiply matrices by scalars to produce new matrices (e.g., as when all of the payoffs in a game are doubled.							
	12. Add, subtract and multiply matrices of appropriate dimensions.							

	13. Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. Instructional Note: This is an opportunity to view the algebraic field properties in a more generic context, particularly noting that matrix multiplication is not commutative.							
	14. Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.							
	15. Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.							
	16. Work with 2 × 2 matrices as transformations of the plane and interpret the absolute value of the determinant in terms of area. Instructional Note: Matrix multiplication of a 2 x 2 matrix by a vector can be interpreted as transforming points or regions in the plane to different points or regions. In particular a matrix whose determinant is 1 or -1 does not change the area of a region.							
Solve systems of equations.								
	17. Represent a system of linear equations as a single matrix equation in a vector variable.							
	18. Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater). Instructional Note: Students have earlier solved two linear equations in two variables by algebraic methods.							
Analysis and Synthesis of Functions								
Analyze functions using different representations.								
	19. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Instructional Note: This is an extension of graphical analysis from Math III or Algebra II that develops the key features of graphs with							

	the exception of asymptotes. Students examine vertical, horizontal, and oblique asymptotes by considering limits. Students should note the case when the numerator and denominator of a rational function share a common factor. Utilize an informal notion of limit to analyze asymptotes and continuity in rational functions. Although the notion of limit is developed informally, proper notation should be followed.							
Build a function that models a relationship between two quantities.								
	20. Write a function that describes a relationship between two quantities, including composition of functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.							
Build new functions from existing functions.								
	21. Find inverse functions. Instructional Note: This is an extension of concepts from Math III where the idea of inverse functions was introduced. a. Verify by composition that one function is the inverse of another. b. Read values of an inverse function from a graph or a table, given that the function has an inverse. Instructional Note: Students must realize that inverses created through function composition produce the same graph as reflection about the line y = x.) c. Produce an invertible function from a non-invertible function by restricting the domain. Instructional Note: Systematic procedures must be developed for restricting domains of non-invertible functions so that their inverses exist.)							
	22. Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.							
Trigonometric and Inverse Trigonometric Functions of Real Numbers								
Extend the domain of trigonometric functions using the unit circle.								
	23. Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number. Instructional Note:							

	Students use the extension of the domain of the trigonometric functions developed in Math III to obtain additional special angles and more general properties of the trigonometric functions.							
	24. Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.							
Model periodic phenomena with trigonometric functions.								
	25. Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.							
	26. Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. Instructional Note: Students should draw analogies to the work with inverses in the previous unit.							
	27. Solve more general trigonometric equations. (e.g., $2 \sin^2 x + \sin x - 1 = 0$ can be solved using factoring.							
Prove and apply trigonometric identities.								
	28. Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.							
Apply transformations of function to trigonometric functions.								
	29. Graph trigonometric functions showing key features, including phase shift. Instructional Note: In Math III, students graphed trigonometric functions showing period, amplitude and vertical shifts.)							
Derivations in Analytic Geometry								
Translate between the geometric description and the equation for a conic section.								
	30. Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant. Instructional Note: In Math II students derived the equations of circles and parabolas. These derivations provide meaning to the otherwise arbitrary constants in the formulas.)							

Explain volume formulas and use them to solve problems.								
	31. Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. Instructional Note: Students were introduced to Cavalieri's principle in Math II.							
Modeling with Probability								
Calculate expected values and use them to solve problems.								
	32. Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. Instructional Note: Although students are building on their previous experience with probability in middle grades and in Math II and III, this is their first experience with expected value and probability distributions.							
	33. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.							
	34. Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. (e.g., Find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.)							
	35. Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households? Instructional Note: It is important that students can interpret the probability of an outcome as the area under a region of a probability distribution graph.							
Use probability to evaluate outcomes of decisions.								
	36. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. (e.g., Find the							

	expected winnings from a state lottery ticket or a game at a fast food restaurant.) b. Evaluate and compare strategies on the basis of expected values. (e.g., Compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.)							
Series and Informal Limits								
Use sigma notations to evaluate finite sums.								
	37. Develop sigma notation and use it to write series in equivalent form. For example, write (3i + 7) as 3i + 71.							
	38. Apply the method of mathematical induction to prove summation formulas. For example, verify that i = . Instructional Note: Some students may have encountered induction in Math III in proving the Binomial Expansion Theorem, but for many this is their first experience.							
Extend geometric series to infinite geometric series.								
	39. Develop intuitively that the sum of an infinite series of positive numbers can converge and derive the formula for the sum of an infinite geometric series. Instructional Note: In Math I, students described geometric sequences with explicit formulas. Finite geometric series were developed in Math III.							
	40. Apply infinite geometric series models. For example, find the area bounded by a Koch curve. Instructional Note: Rely on the intuitive concept of limit developed in unit 2 to justify that a geometric series converges if and only if the ratio is between -1 and 1.							