



## Precalculus – Part 2

### Michigan State Mathematics Content Expectations

#### Course Description

Precalculus Part 2 will work to develop a students' problem solving skills in many areas of mathematics. The main topics that will be emphasized in this course are counting principles, probability, systems of equations, and inequalities. There will be an extension of the trigonometric topics taught in Part 1 to include trigonometric identities and Law of Sine and Cosine. The students will also be introduced to vectors and conics.

#### Text Book

Larson/Hostetler *Precalculus, Sixth Edition*, Houghton Mifflin Company, 2004.

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#### Unit 1 Description

Unit 1 will introduce the students to trigonometric identities. This unit will have the student solve trigonometric equations that involve quadratic types and multiple angles. The unit will also stress evaluating trigonometric functions by using trigonometric formulas (sum and difference, multiple-angle, etc.). This unit also uses the Law of Sine and Law of Cosine to solve oblique triangles and application problems with oblique triangles.

#### Essential Content and Skills

The learner will:

- Recognize and write the fundamental trigonometric identities.
- Verify trigonometric identities.
- Use the fundamental trigonometric identities to evaluate trigonometric functions, simplify trigonometric expressions, and rewrite trigonometric expressions.
- Plan a strategy for verifying trigonometric identities.
- Use standard algebraic techniques to solve trigonometric equations.
- Solve trigonometric equations of quadratic type.
- Solve trigonometric equations involving multiple angles.
- Use inverse trigonometric functions to solve trigonometric equations.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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- Use sum and difference formulas to evaluate trigonometric functions, verify identities, and solve trigonometric equations.
  - Use multiple-angle formulas to rewrite and evaluate trigonometric functions.
  - Use power-reducing formulas to rewrite and evaluate trigonometric functions.
  - Use half-angle formulas to rewrite and evaluate trigonometric functions.
  - Use product-to-sum and sum-to-product formulas to rewrite and evaluate trigonometric functions.
  - Use the Law of Sines to solve oblique triangles.
  - Find the areas of oblique triangles.
  - Use the Law of Sines to model and solve real-life problems.
  - Use the Law of Cosines to solve oblique triangles.
  - Use the Law of Cosines to model and solve real-life problems.
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### Unit 1 Michigan State Content Expectations

[Click here to view the Michigan DOE Curriculum Content Standards.](#)

#### Unit 1 Lesson 1: Using Fundamental Identities

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double-angle and half-angle formulas).

#### Unit 1 Lesson 2: Verifying Trigonometric Identities

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double-angle and half-angle formulas).

#### Unit 1 Lesson 3: Solving Trigonometric Equations

State Standard	Description
P.6.5	Solve trigonometric equations using basic identities and inverse trigonometric functions.
P6.6	Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 1 Lesson 4: Sum and Difference Formulas

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P6.6	

### Unit 1 Lesson 5: Multiple-Angle and Product-to-Sum Formulas

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P6.6	

### Unit 1 Lesson 6: Chapter 5 Review

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Solve trigonometric equations using basic identities and inverse trigonometric functions. Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P.6.5	
P6.6	

### Unit 1 Lesson 7: Law of Sines

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Solve trigonometric equations using basic identities and inverse trigonometric functions. Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P.6.5	
P6.6	

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 1 Lesson 8: Law of Cosines

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Solve trigonometric equations using basic identities and inverse trigonometric functions. Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P.6.5	
P6.6	

### Unit 1 Lesson 9: Law of Sine and Cosine Applications

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Solve trigonometric equations using basic identities and inverse trigonometric functions. Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P.6.5	
P6.6	

### Unit 1 Lesson 10: Review and Open-Ended Questions

State Standard	Description
P6.4	Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double- angle and half-angle formulas). Solve trigonometric equations using basic identities and inverse trigonometric functions. Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).
P.6.5	
P6.6	

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 2 Description

This unit will include solving systems of equations and inequalities. Application problems that deal with linear programming will also be covered in detail. Students will get an introduction to sequences and series, both arithmetic and geometric.

### Essential Content and Skills

The learner will:

- Use the method of substitution to solve systems of equations in two variables.
- Use a graphical approach to solve systems of equations in two variables.
- Use systems of equations to model and solve real-life problems.
- Use the method of elimination to solve systems of linear equations in two variables.
- Interpret graphically the numbers of solutions of systems of linear equations in two variables.
- Use systems of equations in two variables to model and solve real-life problems.
- Use back-substitution to solve linear systems in row-echelon form.
- Use Gaussian elimination to solve systems of linear equations.
- Solve nonsquare systems of linear equations.
- Use systems of linear equations in three or more variables to model and solve application problems.
- Sketch the graphs of inequalities in two variables.
- Solve systems of inequalities.
- Use systems of inequalities in two variables to model and solve real-life problems.
- Use summation notation to write sums.
- Find the sum of an infinite series.
- Find the partial sum of an arithmetic sequence.
- Recognize and write geometric sequences.
- Find the sum of geometric series.

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### Unit 2 Michigan State Content Expectations

#### Unit 2 Lesson 1: Systems of Equations

State Standard	Description
A1.2.8	Solve an equation involving several variables (with numerical or letter coefficients) for a designated variable. Justify steps in the solution.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 2 Lesson 2: Two-Variable Linear Systems

State Standard	Description
A3.1.1	Write the symbolic forms of linear functions (standard, point-slope, and slope-intercept) given appropriate information, and convert between forms. Graph lines (including those of the form $x = h$ and $y = k$ ) given appropriate information. Relate the coefficients in a linear function to the slope and $x$ - and $y$ -intercepts of its graph. Find an equation of the line parallel or perpendicular to given line, through a given point; understand and use the facts that non-vertical parallel lines have equal slopes, and that non-vertical perpendicular lines have slopes that multiply to give $-1$ .
A3.1.2	
A3.1.3	
A3.1.4	

### Unit 2 Lesson 3: Multivariable Linear Systems

State Standard	Description
P7.7	Write systems of two and three linear equations in matrix form. Solve such systems using Gaussian elimination or inverse matrices.

### Unit 2 Lesson 4: Systems of Inequalities

State Standard	Description
P7.8	Represent and solve systems of inequalities in two variables and apply these methods in linear programming situations to solve problems.

### Unit 2 Lesson 5: Linear Programming

State Standard	Description
P7.8	Represent and solve systems of inequalities in two variables and apply these methods in linear programming situations to solve problems.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 2 Lesson 6: Review for Chapter 7

State Standard	Description
A1.2.8	Solve an equation involving several variables (with numerical or letter coefficients) for a designated variable. Justify steps in the solution.
A3.1.1	Write the symbolic forms of linear functions (standard, point-slope, and slope-intercept) given appropriate information, and convert between forms.
A3.1.2	Graph lines (including those of the form $x = h$ and $y = k$ ) given appropriate information.
A3.1.3	Relate the coefficients in a linear function to the slope and $x$ - and $y$ -intercepts of its graph.
A3.1.4	Find an equation of the line parallel or perpendicular to given line, through a given point; understand and use the facts that non-vertical parallel lines have equal slopes, and that non-vertical perpendicular lines have slopes that multiply to give $-1$ .
P7.7	Write systems of two and three linear equations in matrix form. Solve such systems using Gaussian elimination or inverse matrices.
P7.8	Represent and solve systems of inequalities in two variables and apply these methods in linear programming situations to solve problems.

### Unit 2 Lesson 7: Sequences and Series

State Standard	Description
P8.1	Know, explain, and use sigma and factorial notation.
P8.2	Given an arithmetic, geometric, or recursively defined sequence, write an expression for the $n$ th term when possible. Write a particular term of a sequence when given the $n$ th term.
P8.3	Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.

### Unit 2 Lesson 8: Arithmetic Sequences and Series

State Standard	Description
P8.1	Know, explain, and use sigma and factorial notation.
P8.2	Given an arithmetic, geometric, or recursively defined sequence, write an expression for the $n$ th term when possible. Write a particular term of a sequence when given the $n$ th term.
P8.3	Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.

### Unit 2 Lesson 9: Geometric Sequences and Series

State Standard	Description
P8.1	Know, explain, and use sigma and factorial notation.
P8.2	Given an arithmetic, geometric, or recursively defined sequence, write an expression for the $n$ th term when possible. Write a particular term of a sequence when given the $n$ th term.
P8.3	Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 2 Lesson 10: Review for Unit 2 and Open-Ended Questions

State Standard	Description
A1.2.8	Solve an equation involving several variables (with numerical or letter coefficients) for a designated variable. Justify steps in the solution.
A3.1.1	Write the symbolic forms of linear functions (standard, point-slope, and slope-intercept) given appropriate information, and convert between forms.
A3.1.2	Graph lines (including those of the form $x = h$ and $y = k$ ) given appropriate information.
A3.1.3	Relate the coefficients in a linear function to the slope and $x$ - and $y$ -intercepts of its graph.
A3.1.4	Find an equation of the line parallel or perpendicular to given line, through a given point; understand and use the facts that non-vertical parallel lines have equal slopes, and that non-vertical perpendicular lines have slopes that multiply to give $-1$ .
P7.7	Write systems of two and three linear equations in matrix form. Solve such systems using Gaussian elimination or inverse matrices.
P7.8	Represent and solve systems of inequalities in two variables and apply these methods in linear programming situations to solve problems.
P8.1	Know, explain, and use sigma and factorial notation.
P8.2	Given an arithmetic, geometric, or recursively defined sequence, write an expression for the $n$ th term when possible. Write a particular term of a sequence when given the $n$ th term.
P8.3	Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 3 Description

This unit will give students an introduction into mathematical induction. Counting principles along with permutations, combinations and probability will be discussed. The students will also have a look at vectors to include properties of vectors, computing angles between vectors and application problems where vectors are used.

### Essential Content and Skills

The learner will:

- Use mathematical induction.
- Find the sums of powers of integers.
- Use finite differences to help write formulas or equations.
- Use the Binomial Theorem to expand binomial expression.
- Solve counting problems.
- Find the probabilities of events.
- Graph vectors and find the component forms.
- Find the magnitude and the direction angles of a vector.
- Find the dot products and use the dot product to find an angle between two vectors.
- Find the work done in moving particles.

### Unit 3 Michigan State Content Expectations

#### Unit 3 Lesson 1: Mathematical Induction

State Standard	Description
P8.5	Understand and explain the principle of mathematical induction and prove statements using mathematical induction.

#### Unit 3 Lesson 2: Finite Differences

State Standard	Description
P8.3	Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.

#### Unit 3 Lesson 3: Binomial Theorem

State Standard	Description
P8.6	Prove the binomial theorem using mathematical induction. Show its relationships to Pascal's triangle and to combinations. Use the binomial theorem to find terms in the expansion of a binomial to a power greater than 3.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 3 Lesson 4: Counting Principles

State Standard	Description
P8.1 P8.2	Know, explain, and use sigma and factorial notation. Given an arithmetic, geometric, or recursively defined sequence, write an expression for the $n$ th term when possible. Write a particular term of a sequence when given the $n$ th term.

### Unit 3 Lesson 5: Probability

State Standard	Description
S3.1 S3.2	Know the subjective and relative frequency interpretations of probabilities, including an informal understanding of the law of large numbers. Use basic probability rules such as the addition rule, law of total probability, and complement rule to compute probabilities in a variety of models.

### Unit 3 Lesson 6: Vector Operations

State Standard	Description
P7.1	Perform operations (addition, subtraction, and multiplication by scalars) on vectors in the plane. Solve applied problems using vectors.

### Unit 3 Lesson 7: Direction Angles and Applications for Vectors

State Standard	Description
P7.1	Perform operations (addition, subtraction, and multiplication by scalars) on vectors in the plane. Solve applied problems using vectors.

### Unit 3 Lesson 8: Vector and Dot Products

State Standard	Description
P7.2	Know and apply the algebraic and geometric definitions of the dot product of vectors.

### Unit 3 Lesson 9: Projections and Work

State Standard	Description
P7.1	Perform operations (addition, subtraction, and multiplication by scalars) on vectors in the plane. Solve applied problems using vectors.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 3 Lesson 10: Vector Review and Open Ended Questions

State Standard	Description
P7.1	Perform operations (addition, subtraction, and multiplication by scalars) on vectors in the plane. Solve applied problems using vectors. Know, explain, and use sigma and factorial notation.
P7.2	Know and apply the algebraic and geometric definitions of the dot product of vectors.
P8.1	Given an arithmetic, geometric, or recursively defined sequence, write an
P8.2	expression for the $n$ th term when possible. Write a particular term of a sequence when given the $n$ th term.
P8.3	Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.
P8.5	Understand and explain the principle of mathematical induction and prove statements using mathematical induction.
P8.6	Prove the binomial theorem using mathematical induction. Show its relationships to Pascal's triangle and to combinations. Use the binomial theorem to find terms in the expansion of a binomial to a power greater than 3.
S3.1	Know the subjective and relative frequency interpretations of probabilities, including an informal understanding of the law of large numbers.
S3.2	Use basic probability rules such as the addition rule, law of total probability, and complement rule to compute probabilities in a variety of models.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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### Unit 4 Description

This unit will introduce the student to conics. The study will include circles, ellipses, parabolas, and hyperbolas. There will also be an introduction to parametric equations and sketching the graphs of the parametric equations.

### Essential Content and Skills

The learner will:

- Find the inclination of a line.
- Find the angle between two lines.
- Find the distance between a point and a line.
- Recognize a conic as the intersection of a plane and a double-napped cone.
- Write the standard form of the equation of a parabola.
- Use the reflexive property to solve problems.
- Write the standard form of the equation of the ellipse.
- Identify the axes and find the length of the major and minor axes.
- Solve real-life problems dealing with ellipses.
- Find the eccentricity of an ellipse.
- Write the standard form of the equation of a hyperbola.
- Find the asymptotes of a hyperbola.
- Use properties of hyperbolas to solve real-life problems.
- Classify a conic from its general equation.
- Use rotation of axes for a hyperbola.
- Use rotation of axes for an ellipse.
- Classify conics by using the discriminant.
- Graph conics with a graphics calculator.

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### Unit 4 Michigan State Content Expectations

#### Unit 4 Lesson 1: Lines

State Standard	Description
P6.2	Graph transformations of the sine and cosine functions (involving changes in amplitude, period, midline, and phase) and explain the relationship between constants in the formula and transformed graph.

#### Unit 4 Lesson 2: Conics-Introduction

State Standard	Description
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## Course Name - Part

Michigan State Curriculum Content Standards (continued)

P9.7	Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations. Algebra and Functions
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### Unit 4 Lesson 3: Applications for Parabolas

State Standard	Description
P9.7	Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations. Algebra and Functions

### Unit 4 Lesson 4: Ellipse

State Standard	Description
P9.7	Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations. Algebra and Functions

### Unit 4 Lesson 5: Application of Ellipse

State Standard	Description
P9.7	Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations. Algebra and Functions

### Unit 4 Lesson 6: Hyperbolas

State Standard	Description
P9.7	Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations. Algebra and Functions

### Unit 4 Lesson 7: Applications of Hyperbolas

State Standard	Description
P9.7	Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations. Algebra and Functions

### Unit 4 Lesson 8: Rotations of Conics

State Standard	Description
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## Course Name - Part

Michigan State Curriculum Content Standards (continued)

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P9.9	Derive the equation for a conic section from given geometric information (e.g., find the equation of an ellipse given its two axes). Identify key characteristics (e.g. foci and asymptotes) of a conic section from its equation or graph.
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### Unit 4 Lesson 9: Rotation of Invariants

State Standard	Description
P9.9	Derive the equation for a conic section from given geometric information (e.g., find the equation of an ellipse given its two axes). Identify key characteristics (e.g. foci and asymptotes) of a conic section from its equation or graph.

### Unit 4 Lesson 10: Parametric Equations

State Standard	Description
P9.3	Evaluate parametric equations for given values of the parameter.
P9.4	Convert between parametric and rectangular forms of equations.
P9.5	Graph curves described by parametric equations and find parametric equations for a given graph.
P9.6	Use parametric equations in applied contexts (e.g., orbits and projectiles) to model situations and solve problems.