

MATH 1113: Precalculus

MATH 1113 is a combination of the curricula from MATH 1111 (College Algebra) and MATH 1112 (Trigonometry). Bullet points without links are works-in-progress.

Chapter 1: Prerequisites

1.1 REAL NUMBERS: ALGEBRA ESSENTIALS

- [Classifying Real Numbers](#)
- [Perform Calculations Using Order of Operations](#)
- [Using the commutative, associative, distributive, associative, inverse, and identity properties](#)
- [Evaluating algebraic expressions](#)
- [Simplify algebraic expressions](#)

1.2 EXPONENTS AND SCIENTIFIC NOTATION

- [Use the product rule of exponents](#)
- [Use the quotient rule of exponents](#)
- [Use the power rule of exponents](#)
- [Use the zero exponent rule of exponents](#)
- [Use the negative rule of exponents](#)
- [Find the power of a product and a quotient](#)
- [Simplify exponential expressions](#)
- [Use scientific notation](#)

1.3 RADICALS AND RATIONAL EXPRESSIONS

- [Evaluate Square roots](#)
- [Use the product rule to simplify square roots](#)
- [Use the quotient rule to simplify square roots](#)
- [Add and subtract square roots](#)
- [Rationalize denominators](#)
- [Use rational exponents](#)

1.4 POLYNOMIALS

- Identify the degree and leading coefficient of polynomials
- Add and subtract polynomials
- Multiply polynomials
- Use FOIL to multiply binomials

1.5 FACTORING POLYNOMIALS

- Factor the greatest common factor of a polynomial
- Factor a trinomial
- Factor by grouping
- Factor a perfect square trinomial
- Factor a difference of squares
- Factor a sum and difference of cubes
- Factor expressions using fractional or negative exponents

Chapter 2: Equations and Inequalities

2.1 THE RECTANGULAR COORDINATE SYSTEMS AND GRAPHS

- Plot ordered pairs in a Cartesian coordinate system
- Graph equations by plotting points
- Graph equations with a graphing utility
- Find x-intercepts and y-intercepts
- Use the distance formula
- Use the midpoint formula

2.2 LINEAR EQUATIONS IN ONE VARIABLE

- Solve equations in one variable algebraically
- Solve a rational equation
- Find a linear equation (point and slope / two points)
- Given the equations of two lines, determine whether their graphs are parallel or perpendicular
- Write the equation of a line parallel or perpendicular to a given line

2.3 MODELS AND APPLICATIONS

- Set up a linear equation to solve a real-world application
- Use a formula to solve a real-world problem

2.4 COMPLEX NUMBERS

- Add and subtract complex numbers
- Multiply and divide complex numbers
- Simplify powers of i

2.5 QUADRATIC EQUATIONS

- Solve quadratic equations by factoring
- Solve quadratic equations by the square root property
- Solve quadratic equations by completing the square
- Solve quadratic equations by using the quadratic formula
- Solve quadratic equations with complex numbers

2.6 OTHER TYPES OF EQUATIONS

- Solve equations involving radicals (single radical, multiple radicals)
- Solve equations using factoring
- Solve radical equations
- Solve absolute value equations
- Solve other types of equations (rational)

2.7 LINEAR INEQUALITIES AND ABSOLUTE VALUE INEQUALITIES

- Use interval notation
- Use properties of inequalities (addition, multiplication)
- Solve inequalities in one variable algebraically
- Solve absolute value inequalities
- Compound Inequalities (and inequalities / or inequalities)

11.1 SYSTEMS OF LINEAR EQUATIONS: TWO VARIABLES

- Solve systems of equations by graphing
- Solve systems of equations by substitution
- Solve systems of equations by addition (elimination)
- Identify inconsistent systems of equations containing two variables
- Express the solution of a system of equations containing two variables

11.3 SYSTEMS OF NONLINEAR EQUATIONS AND INEQUALITIES: TWO VARIABLES

- Solve a system of nonlinear equations using substitution
- Solve a system of nonlinear equations using elimination
- Graph a nonlinear inequality (Quadratic)
- Graph a system of nonlinear inequalities

Chapter 3: Functions

3.1 FUNCTIONS AND FUNCTION NOTATION

- Determining whether a relation represents a function
- Find the value of a function
- Determine whether a function is one-to-one
- Use the vertical line test to identify functions
- Use the horizontal line test to identify one-to-one functions
- Graph the functions in the library of functions

3.2 DOMAIN AND RANGE

- Find the domain of a function identified by an equation
- Find the range of a function
- Domain and Range with a graph
- Graph piecewise-defined functions

3.3 RATES OF CHANGE AND BEHAVIOR OF GRAPHS

- Find the average rate of change of a function on an interval

- Use a graph to determine where a function is increasing, decreasing, or constant
- Analyzing the library of functions for increasing and decreasing intervals
- Use a graph to locate the absolute maximum and absolute minimum

3.4 COMPOSITION OF FUNCTIONS

- Combine functions using algebraic operations (addition, subtraction, multiplication, division)
- Create a function by composition of functions
- Evaluate composite functions (formula, table, graph)
- Find the domain of a composite function
- Decomposing a composite function into its component functions

3.5 TRANSFORMATION OF FUNCTIONS

- Graph functions using horizontal and vertical shifts
- Graph functions using reflections about the axes
- Graph functions using stretches and compressions
- Perform a sequence of transformations

3.6 ABSOLUTE VALUE FUNCTIONS

- Graph the absolute value function

3.7 INVERSE FUNCTIONS

- Verify that two functions are inverses
- Find domain and range of inverse functions
- Find and evaluate inverse functions (linear, quadratic, radical, rational)
- Find inverse functions and their graphs

Chapter 4: Linear Functions

4.1 LINEAR FUNCTIONS

- Represent a linear function
- Determine whether a linear function is increasing, decreasing, or constant
- Interpret slope as a rate of change
- Write and interpret an equation for a linear function
- Model real-world problems with linear functions
- Graph linear functions
- Write the equation for a function from the graph of a line

4.2 MODELING WITH LINEAR FUNCTIONS

- Build linear models from verbal descriptions

4.3 FITTING LINEAR MODELS TO DATA

- Draw and interpret scatter diagrams
- Use a graphing utility to find the line of best fit
- Distinguish between linear and nonlinear relations
- Fit a regression line to a set of data and use the linear model to make predictions

Chapter 5: Polynomial and Rational Functions

5.1 QUADRATIC FUNCTIONS

- Recognize characteristics of parabolas
- Find domain and range of a quadratic function
- Determine a quadratic function's maximum or minimum value

5.2 POWER FUNCTIONS AND POLYNOMIAL FUNCTIONS

- Identify polynomial functions
- Identify the degree and leading coefficient of a polynomial function

5.3 GRAPHS OF POLYNOMIAL FUNCTIONS

- Use factoring to find zeros of polynomial functions

- Identify zeros and their multiplicities
- Determine end behavior for polynomial functions
- Graph polynomial functions
- Use the intermediate value theorem

5.4 DIVIDING POLYNOMIALS

- Use long division to divide polynomials
- Use synthetic division to divide polynomials

5.5 ZEROS OF POLYNOMIAL FUNCTIONS

- Evaluate a polynomial using the remainder theorem
- Use the factor theorem to solve a polynomial equation
- Use the rational zero theorem to find rational zeros
- Find the zeros of polynomial functions
- Use the Fundamental Theorem of Algebra
- Use the linear factorization theorem to find polynomials with given zeros
- Use Descartes' Rule of Signs

5.6 RATIONAL FUNCTIONS

- Use arrow notation (local behavior)
- Find domain of rational functions
- Identify vertical asymptotes of rational functions
- Identify horizontal asymptotes of rational functions
- Identify slant (oblique) asymptotes of rational functions
- Graph rational functions
- Write rational functions

5.7 INVERSES AND RADICAL FUNCTIONS

- Find the inverse of a polynomial function (linear, quadratic)
- Restrict the domain to find the inverse of a polynomial function

5.8 MODELING USING VARIATION

- Solve direct variation problems
- Solve inverse variation problems
- Solve problems involving joint variation

Chapter 6: Exponential and Logarithmic Functions

6.1 EXPONENTIAL FUNCTIONS

- Identify exponential functions
- Evaluate exponential functions
- Find equations of exponential functions
- Apply compound interest formula
- Continuous growth/decay

6.2 GRAPHS OF EXPONENTIAL FUNCTIONS

- Graph exponential functions
- Graph transformations of exponential graphs

6.3 LOGARITHMIC FUNCTIONS

- Convert from logarithmic to exponential form
- Convert from exponential to logarithmic form
- Use common logarithms
- Use natural logarithms

6.4 GRAPHS OF LOGARITHMIC FUNCTIONS

- Find the domain of a logarithmic function
- Graph logarithmic functions
- Graph transformations of logarithmic functions

6.5 LOGARITHMIC PROPERTIES

- Use the product rule for logarithms
- Use the quotient rule for logarithms

- Use the power rule for logarithms
- Expand logarithmic expressions
- Condense logarithmic expressions
- Use the change of base formula for logarithms

6.6 EXPONENTIAL AND LOGARITHMIC EQUATIONS

- Use like bases to solve exponential equations
- Solve exponential equations using logarithms
- Use the definition of logarithm to solve logarithmic equations
- Use one-to-one property of logarithms to solve logarithmic equations
- Solve applied problems using exponential and logarithmic equations

6.7 EXPONENTIAL AND LOGARITHMIC MODELS

- Model exponential growth and decay
- Use logistic growth models
- Choose an appropriate model for data

6.8 FITTING EXPONENTIAL MODELS TO DATA

- Build an exponential model from data
- Build a logarithmic model from data
- Build a logistic model from data

MATH 1112: Trigonometry/MATH 1113: Precalculus

Chapter 7: The Unit Circle: Sine and Cosine Functions

7.1 ANGLES

- Draw angles in standard position
- Introduction to radians
- Radians and Quadrants
- Converting between radians and degrees (introduction)
- Converting degrees to radians
- Add angles in DMS form
- Subtract angles in DMS form
- Find coterminal Angles using degrees (example 1 and 2)
- Find coterminal angles using radians
- Length of an arc that subtends a central angle
- Area of a sector given a central angle

7.2 RIGHT TRIANGLE TRIGONOMETRY

- SOHCAHTOA – Part 1 (Introduction), Part 2 (More examples)
- Solve for a side in a right triangle
- Basic cofunction identities
- The Trigonometric Pythagorean Identity (derivation)
- Finding the six trigonometric functions of an angle in a right triangle
- Application (Find the height of a tree)
- Application (A ladder problem)

7.3 UNIT CIRCLE

- Introduction to the unit circle
- Trigonometric values of 45 degree angles
- Use the trigonometric Pythagorean identity
- Find reference angles using degrees
- Find reference angles using radians
- Use reference angles to evaluate sine, cosine and tangent

7.4 THE OTHER TRIGONOMETRIC FUNCTIONS

- Recognize and use fundamental identities
- Even-odd properties of trigonometric functions
- Use reference angles to evaluate secant and cosecant

Chapter 8: Periodic Functions

8.1 GRAPHS OF THE SINE AND COSINE FUNCTIONS

- Graph of sine function
- Find the amplitude and period
- Find the amplitude, period (plus graphing)
- Graph basic sinusoidal functions without translations
- Graph a sinusoidal function

8.2 GRAPHS OF THE OTHER TRIGONOMETRIC FUNCTIONS

- Analyze the graph of $y=\tan(x)$
- Graph a tangent function
- Analyze the graphs of $y=\csc(x)$ and $y=\sec(x)$
- Graph a secant function
- Graph a cosecant function
- Graph a cotangent function

8.3 INVERSE TRIGONOMETRIC FUNCTIONS

- Introduction to inverse trigonometric functions
- Evaluate inverse trigonometric functions
- Example of solving a right triangle given one side and an angle
- Example of solving a right triangle given two sides
- Find exact values of composite functions with inverse trig functions
- More examples of finding exact values of composite functions with inverse trig functions

Chapter 9

9.1 SOLVING TRIGONOMETRIC EQUATIONS WITH IDENTITIES

- Simplifying trigonometric expressions

9.2 SUM AND DIFFERENCE IDENTITIES

- Use the sum and difference formulas for cosine, sine and tangent

9.3 DOUBLE-ANGLE, HALF-ANGLE, AND REDUCTION FORMULAS

- Use the half-angle formulas
- Use double angle formulas
- Use reduction formulas

9.4 SUM-TO-PRODUCT AND PRODUCT-TO-SUM IDENTITIES

- Express products as sums and sums as products

9.5 SOLVING TRIGONOMETRIC EQUATIONS

- Solving trigonometric equation using identities and factoring
- Solve a trigonometric equation in sine or cosine
- Solve a trigonometric equation in tangent

Chapter 10

10.1 NON-RIGHT TRIANGLES: LAW OF SINES

- Use Law of Sines to solve for a side or an angle
- Find the area of an oblique triangle using the sine function

10.2 NON-RIGHT TRIANGLES: LAW OF COSINES

- Use Law of Cosines to solve for a side or an angle
- Use Heron's formula to find the area of a triangle

10.3 POLAR COORDINATES

- Plotting polar coordinates and converting between polar and rectangular coordinates

10.5 POLAR FORM OF COMPLEX NUMBERS

- Plot complex numbers in the complex plane
- Find the absolute value of a complex number
- Write complex numbers in polar form
- Find product and quotient of complex numbers in polar form
- Finding powers of complex numbers in polar form
- Finding roots of complex numbers in polar form

10.8 VECTORS

- View vectors geometrically and algebraically
- Find magnitude and direction of a vector
- Find vector addition, scalar multiplication and dot product
- Find the unit vector in the direction of a given vector