

MATH117 PRE-CALCULUS for SCIENTISTS AND ENGINEERS
INSTRUCTOR: DR. CARLA C. MORRIS
TEXT: PRECALCULUS MATHEMATICS for CALCULUS
by Stewart, Redlin & Watson (Sixth edition)

The following list of objectives is designed to give you some guidance at what topics are important from the various sections we will cover from the book. These objectives are some of the key concepts that will be discussed for each section. When you take exams in this course you must show me your work to earn full credit for a problem. Correct answers with no work shown will be penalized. Partial credit will be given on problems therefore showing your work is vital to your grade and it also allows me to better determine where your weakness may be if you need assistance with any of the material.

MATH117 CHAPTER 1 FUNDAMENTALS OBJECTIVES

Section 1.1 Real Numbers

- 1) Know the subsets of the real numbers (irrational, rational, integer, natural, and whole)
- 2) Understand the properties of real numbers
- 3) Understand how to add/subtract/multiply/divide real numbers
- 4) Work with the number line
- 5) Work with union and intersection of sets and interval notation
- 6) Understand absolute value
- 7) Find distance between points on the real number line

Section 1.2 Exponents and Radicals

- 1) Be able to work with the laws of exponents
- 2) Be able to simplify exponential expressions
- 3) Convert between scientific and decimal notation
- 4) Work with radicals and properties of nth roots
- 5) Work with rational exponents
- 6) Be able to rationalize the denominator

Section 1.3 Algebraic Expressions

- 1) Determine the degree of a polynomial
- 2) Write a polynomial in either ascending or descending powers of the variable
- 3) Add or subtract polynomials
- 4) Multiply polynomials
- 5) Use the FOIL method
- 6) Use special product formulas
- 7) Find the GCF
- 8) Be able to factor using special formulas, grouping trial and error

Section 1.4 Rational Expressions

- 1) Understand domain and range
- 2) Simplify rational expressions
- 3) Add, subtract, multiply, or divide rational expressions
- 4) Simplify a complex rational expressions
- 5) Rationalize denominators or numerators

Section 1.5 Equations

- 1) Solve linear equations
- 2) Solve quadratic equations by factoring, completing the square, or using the quadratic formula
- 3) Solve radical equations (check for extraneous solutions)

Section 1.6 Modeling with Equations

- 1) Make and use a linear model
- 2) Work with simple interest model
- 3) Work with equations involving, area, distance, mixture, etc.

Section 1.7 Inequalities

- 1) Solve a linear inequality
- 2) Solve nonlinear inequalities
- 3) Use critical point tables
- 4) Solve absolute value inequalities
- 5) Model with inequalities

Section 1.8 Coordinate Geometry

- 1) Understand the Rectangular (Cartesian) Coordinate System
- 2) Work with distance and midpoint formulas
- 3) Graph a linear equation
- 4) Graph simple quadratic, absolute value, etc equations
- 5) Determine intercepts
- 6) Work with equations of circles
- 7) Understand the concept of symmetry when graphing

Section 1.10 Lines

- 1) Determine the slope of a line through two points
- 2) Use the point-slope formula
- 3) Use the slope-intercept formula
- 4) Work with equations of vertical or horizontal lines
- 5) Determine if lines are parallel, perpendicular or neither
- 6) Understand slope as a rate of change

Section 2.1 What is a Function?

- 1) Understand the definition of a function
- 2) Be able to evaluate a function at a given value
- 3) Determine the domain or range of a function
- 4) Work with Piecewise Functions and their graphs
- 5) Evaluate a difference quotient

Section 2.2 Graphs of Functions

- 1) Be able to graph a function by plotting points
- 2) Graph a piecewise graph
- 3) Use the vertical line test
- 4) Determine if an equation is a function

Section 2.3 Getting Information from the Graph of a Function

- 1) Use a graph to determine domain, range, or value of a function
- 2) Determine intervals where a graph is increasing or decreasing
- 3) Determine local (relative) extrema of a graph

Section 2.4 Average Rate of Change of a Function

- 1) Determine the average rate of change for a function
- 2) Show the average rate of change for a linear function is a constant

Section 2.5 Transformations of Functions

- 1) Recognize graphs of some common functions
- 2) Recognize when graphs shift vertically
- 3) Recognize when graphs shift horizontally
- 4) Use reflection to graph a function
- 5) Graph functions involving more than one transformation
- 6) Use symmetry to aid in graphing (even or odd functions)

Your graphs should adhere to the following guidelines:

- *The x and y axis is to be labeled (or whatever variables are used)*
- *A scale is to be included even if you mean for each block to count as one unit*
- *Linear equations should be determined by at least three points (the third being a double check of your work).*
- *Quadratics should include a vertex, axis of symmetry, y intercept, x intercepts, and have at least five points on the graph*
- *Otherwise plot a sufficient number of key points to determine the appearance of the graph*

Section 2.6 Combining Functions

- 1) Understand the arithmetic operations (+, −, ·, ÷) with two functions $f(x)$ and $g(x)$
- 2) Work with composite functions such as $f(g(x))$
- 3) Write a function as a composition of functions

Section 2.7 One-to-One Functions and Their Inverses

- 1) Determine if two functions are inverses of one another
- 2) Determine the inverse of a function
- 3) Determine if the graph of a function is one-to-one by applying the horizontal line test

Section 3.1 Quadratic Functions and Models

- 1) Graph a quadratic function in standard form
- 2) Graph quadratic functions by finding the axis of symmetry, vertex, y intercept, x intercepts, and using symmetry to include five points on the graph
- 3) Determine for what x value a minimum or maximum is obtained
- 4) Determine the minimum or maximum value of a quadratic
- 5) Work with word problems involving maximization or minimization of a quadratic

Section 3.2 Polynomial Functions and Their Graphs

- 1) Determine whether a given graph is that of a polynomial of specified degree
- 2) Use factoring to find zeroes of polynomials (x – intercepts)
- 3) Graph polynomial functions by determining their behavior near each x intercept and its end behavior

Note: polynomials should be smooth (no cusps), unbroken curves with at most $n-1$ turning points where n is the degree of the polynomial. It should also approach + or - infinity at the extreme values of x .

Section 3.3 Dividing Polynomials

- 1) Use long division of polynomials.
- 2) Use the remainder theorem to find the value of a polynomial
- 3) Find a polynomial with specified zeroes

Section 3.4 Real Zeroes of Polynomials

- 1) Use the rational zeroes theorem
- 2) Use Descartes rule of signs
- 3) Use algebra or quadratic formula to solve polynomial equations

Section 3.5 Complex Numbers

- 1) Understand the definition of “i”
- 2) Determine the real and imaginary parts of complex numbers
- 3) Add, subtract, multiply, and divide complex numbers
- 4) Determine square roots of negative numbers
- 5) Determine a complex solution to a quadratic equation

Section 3.6 Complex Zeroes and the Fundamental Theorem of Algebra

- 1) Use the fundamental Theorem Of Algebra, Complete Factorization Theorem, and the Zeroes Theorem
- 2) Understand multiplicities
- 3) Understand the Conjugate Zeroes Theorem
- 4) Understand the Linear and Quadratic Factors Theorem

Section 3.7 Rational Functions

- 1) Be able to use transformations of $y = 1/x$ to aid in graphing rational functions
- 2) Find the vertical asymptotes of a rational function
- 3) Find the horizontal asymptotes of a rational function
- 4) Determine whether the graph will cross the horizontal asymptote
- 5) Determine a slant asymptote

Section 4.1 Exponential Functions

- 1) Understand what an exponential function is and its domain and range
- 2) Graph exponential functions of the form a^x
- 3) Work with compound interest formulas

Section 4.2 The Natural Exponential Function

- 1) Graph exponential functions of the form e^x
- 2) Work with interest compounded continuously

Section 4.3 Logarithmic Functions

- 1) Convert logarithms to exponential form and vice versa
- 2) Evaluate logarithms
- 3) Graph logarithmic functions
- 4) Work with common or natural logarithms
- 5) Work with some of the basic properties of logarithms

Section 4.4 Laws of Logarithms

- 1) Use the laws of logarithms
 $\log PQ = \log P + \log Q$, $\log P/Q = \log P - \log Q$, $\log P^n = n \log P$
- 2) Express simple logarithms involving sums differences or coefficients as a single logarithm and vice versa
- 3) Use the change of base formula

Section 4.5 Exponential and Logarithmic Equations

- 1) Use like bases to solve exponential equations
- 2) Use definition of logarithms to solve logarithmic equations (watch out for the possibility of an extraneous solution)

Section 4.6 Exponential Growth and Decay; Modeling Data

- 1) Model exponential growth doubling time
- 2) Model exponential growth (relative growth rate)
- 3) Model radioactive decay
- 4) Use Newton's Law of Cooling
- 5) Logarithmic scales for Richter scale, pH levels and decibel scale

Section 5.1 The Unit Circle

- 1) Draw angles in standard position
- 2) Find terminal points on the unit circle
- 3) Determining the reference number
- 4) Use a reference number to find terminal points

Section 5.2 Trigonometric Functions of Real Numbers

- 1) Understand the definition of the six basic trigonometric functions
- 2) Learn the domains of these trigonometric functions
- 3) Evaluate trigonometric functions using reference numbers and quadrants as guides
- 4) Learn the fundamental identities (reciprocal and Pythagorean) for trigonometry
- 5) Use even-odd properties of trigonometric functions
- 6) Write trigonometric functions in terms of each other

Section 5.3 Trigonometric Graphs

- 1) Learn the periodic properties of sine and cosine functions to aid in graphing them
- 2) Graph sine and cosine functions and their transformations
- 3) Use amplitude, period, and phase shifts to graph sine and cosine functions

Section 5.4 More Trigonometric Graphs

- 1) Learn the periodic properties tangent, cotangent, secant and cosecant functions to aid in graphing them
- 2) Graph tangent, cotangent, secant, and cosecant functions and their transformations
- 3) Use amplitude, period, and phase shifts to graph sine and cosine functions

Section 5.5 Inverse Trigonometric Functions and Their Graphs

- 1) Learn about the inverse sine function and be able to evaluate expression using it
- 2) Learn about the inverse cosine function and be able to evaluate expression using it
- 3) Learn about the inverse tangent function and be able to evaluate expression using it
- 4) Learn about the other inverse trigonometric functions

Section 5.6 Modeling Harmonic Motion

- 1) Learn about simple harmonic motion
- 2) Learn about damped harmonic motion

Section 6.1 Angle Measure

- 5) Convert degrees to radians or radians to degrees
- 6) Determine arc lengths
- 7) Determine area of a circular sector
- 8) Work with linear and angular speed

Section 6.2 Trigonometry of Right Triangles

- 1) Use the Pythagorean Theorem
- 2) Determine the six trigonometric functions using opposite, adjacent, hypotenuse as guides (SOH CAH TOA)
- 3) Evaluate the trigonometric functions for special angles (30, 45, and 60 degrees)
- 4) Understand angle of elevation(depression) problems

Section 6.3 Trigonometric Functions of Angles

- 1) Work with trigonometric functions that need not be on a unit circle
- 2) Work with reference angles
- 3) Use reference angles to evaluate trigonometric functions
- 4) Determine areas of triangles

Section 6.4 Inverse Trigonometric Functions and Right Triangles

- 1) Work with arcsine, arccosine, and arctangent functions
- 2) Solve for angles in right triangles
- 3) Solve a basic trigonometric equation on an interval

Section 6.5 The Law of Sines

- 1) Use the Law of Sines with a SAA triangle
- 2) Use the Law of Sines with an ASA triangle
- 3) Use the Law of Sines with an SSA triangle
- 4) Use the Law of Sines with an SSS triangle
- 5) Use the Law of Sines with an SAS triangle

Section 6.6 The Law of Cosines

- 1) Use the Law of Cosines with a SAS triangle
- 2) Solve a SS triangle with both Laws
- 3) Learn about Heron's Formula

Section 7.1 Trigonometric Identities

- 1) Learn to simplify trigonometric expressions
- 2) Learn to prove trigonometric identities

Section 7.2 Addition and Subtraction Formulas

- 1) Learn about the addition and subtraction formulas for sine, cosine, and tangent
- 2) Evaluate expressions involving the inverse trigonometric functions
- 3) Work with expressions of the form $A\sin x + B\cos x$

Section 7.3 Double-Angle, Half-Angle, and Product-Sum Formulas

- 1) Learn about the Double-Angle Formulas
- 2) Learn about the Half -Angle Formulas
- 3) Learn formulas for lowering powers
- 4) Learn Product-to-Sum Formulas
- 5) Learn about Sum-to-Product Formulas

Section 7.4 Basic Trigonometric Equations

- 1) Learn to solve basic trigonometric Equations
- 2) Solve trigonometric equations by factoring

Section 7.5 More Trigonometric Equations

- 1) Solve trigonometric equations using identities

Section 10.1 Systems of Linear Equations in Two Variables

- 1) Solve systems of linear equations by using substitution
- 2) Solve systems of linear equations by using elimination
- 3) Solve systems of linear equations by graphing
- 4) Determine the number of solutions of a linear system in two variables
- 5) Model with systems of linear equations

Section 10.7 Partial Fractions

- 1) Determine the partial fraction decomposition of a rational function $r(x) = P(X)/Q(x)$

Section 10.8 Systems of Nonlinear Equations

- 1) Learn techniques to solve systems of nonlinear equations