

MATH 141: PRECALCULUS

MIDTERM 2: **POLYNOMIAL, RATIONAL, EXPONENTIAL, AND LOG FUNCTIONS** **(CHAPTERS 2 AND 3)**

DISCLAIMER: This may or may not be a comprehensive list, but it's a very good start!
Know all aspects of these topics; I may go beyond listed subtopics.

CHAPTER 2: POLYNOMIAL AND RATIONAL FUNCTIONS

Quadratic Functions and Parabolas (2.1)

Leading Coefficients and "Opening" Direction

Finding the Vertex, Intercepts, and Axis of Symmetry

The Form $y = a(x - h)^2 + k$: Obtaining by Completing the Square (CTS); Using
Given points, find an equation of the connecting parabola

Polynomial Functions of Higher Degree (2.2)

Limits and $\pm\infty$

"Long Run" Right-hand and Left-hand Behaviors

Bowls and Snakes

"Zoom Out" Dominance Property of Leading Terms

Turning Points: finding the possible number of TPs

Factor Theorem and Zeros

Intermediate Value Theorem

Long and Synthetic Polynomial Division (2.3)

Obtaining the Form: (polynomial) + (proper rational expression)

Remainder Theorem: $f(k) = r$

Zeros, Factoring, and Division

Complex Numbers (2.4)

Simplifying Radicals and Using i

Complex Plane

Powers of i

Adding, Subtracting, and Multiplying Complex Numbers

Dividing and Complex Conjugates

Complex Zeros of Functions

Zeros of Polynomial Functions (2.5)

Rational Zero Test

Factoring over **Z**, **Q**, **R**, and **C**

Linear Factorization Theorem (LFT): Complete factorization over **C**

Finding Zeros

Multiplicity of Repeated Zeros; Factors

Methods include:

Factoring (remember GCFs)

Recognizing Quadratic Form

Quadratic Formula (QF)

Rational Zero Test

Long or Synthetic Division

Complex Conjugate Pairs Theorem

Fundamental Theorem of Algebra (FTA)

LFT Form

Factoring over **R** Theorem

Aids for Finding Zeros

Descartes's Rule of Signs

Upper and Lower Bound Rules for Zeros

Rational Functions (2.6)

Asymptotes: Vertical, Horizontal, and Slant

"Zoom Out" Property

Holes and Cancellations

Nonlinear Inequalities (2.7)

Methods of Solution

Sign Chart Method

Parabola Method (for Quadratic Inequalities)

Test Value Method

Solving Nonlinear Inequalities to help answer Domain questions

CHAPTER 3: EXPONENTIAL AND LOG FUNCTIONS

Exponential Functions (3.1)

Graph of b^x when $b > 1$ vs. when $0 < b < 1$

e and the Natural Exponential Function, $f(x) = e^x$

Graphs, Domain, Range, Intercepts, and Asymptotes

Compound and Continuous Compound Interest

Log Functions (3.2)

Evaluating Logs and Basic Log Properties

Common Logs (base 10) and Natural Logs (base e)

b^x and $\log_b x$ are Inverse Functions; Inverse Properties

Graphs, Domain, Range, Intercepts, and Asymptotes

Log Properties (3.3)

Product, Quotient, and Power Rules (can use in both directions)

Know when the Power Rule applies, and when it doesn't!

Expanding and Condensing Log Expressions

Change-of-Base Formula

Solving Exponential and Log Equations (3.4)

One-to-One and Inverse Properties of Log and Exponential Functions can be used to solve equations.

Isolating exponential or log expressions

Inserting or deleting the same base or log on both sides of an equation

Using Log Properties when solving Exponential and Log Equations, notably the Power Rule for the former

Rewriting a log equation in exponential form

Models (3.4 and 3.5)

Solving equations for applications in, for example, Continuous Compound Interest and Malthusian Population Growth

Doubling Time Formula for the above models

Fitting an Exponential Model