Math 130—Precalculus
Measurable Outcomes

Mathematics Department, UMass Boston

Reference text: Numbers in brackets refer to sections of Larson, Precalculus, A Concise Course, third edition.

Note: Outcomes marked (Optional) may appear on the final exam with the unanimous consent of all instructors.

A. Fundamental Concepts of Algebra

A(a) Simplify algebraic expressions containing minus signs, such as \(-ab\). [A.1]
A(b) Apply properties of exponents, including simplifying rational exponents. [A.2]
A(c) Use scientific notation. [A.2]
A(d) Perform operations with polynomials, including special products and squares of binomials. [A.3]
A(e) Factor polynomials, including those with special forms. [A.3]
A(f) Simplify rational expressions and arithmetic combinations of rational expressions. [A.4]
A(g) When simplifying fractions, divide out common factors, not terms. [A.4]
A(h) Solve equations involving fractional expressions. [A.5]
A(i) Recognize an extraneous solution. [A.5]
A(j) Solve quadratics in one variable by factoring, completing the square, or the quadratic formula. [A.5]
A(k) Find all real solutions of the equation \(x^2 = p\). [A.5]
A(l) Solve equations with absolute values. [A.5]
A(m) Word problems: algebraic representation and subsequent solution. [A.6]

1. Functions and their Graphs

1(a) Apply the Distance Formula and the Midpoint Formula. [1.1]
1(b) Graph an equation by making a table of points. [1.2]
1(c) Apply the Graphical and Algebraic Tests for Symmetry. [1.2]
1(d) Write the Standard Form of the Equation of a Circle with radius \( r \) and center \((h, k)\). [1.2]
1(e) For a given line: find the slope and the point-slope and slope-intercept equations. [1.3]
1(f) Describe the features and equations of horizontal and vertical lines. [1.3]
1(g) Use their slopes to determine whether two given lines are parallel, perpendicular, or neither. [1.3]
1(h) Recognize whether a given relationship is a function. [1.4]
1(i) Use the notation \( f(x) \) for a given function \( f \). [1.4]
1(j) Find the implied domain of a given function. [1.4]
1(k) Evaluate a difference quotient. [1.4]
1(l) Define a function graphically: the Vertical Line Test. [1.5]
1(m) Apply the Tests for Even and Odd Functions. [1.5]
1(n) Recognize the graphs of constant, identity, absolute value, square root, squaring, cube root, cubing, reciprocal, squared reciprocal, upper semicircle, and greatest integer functions. [1.6]
1(o) Describe vertical and horizontal shifts, noting how the graph and the equation were changed. [1.7]
1(p) Describe vertical and horizontal reflections, noting the change in the equation and the graph. [1.7]
1(q) Recognize vertical and horizontal stretches and compressions. [1.7]
1(r) Describe arithmetic combinations and compositions of two functions. [1.8]
1(s) Define an inverse function and show the relationship between the graphs of the original function and the inverse function. [1.9]
1(t) Describe the required relationship between the domains and ranges of the original and inverse functions. [1.9]
1(u) Define a one-to-one function and use the Horizontal Line Test for verification. [1.9]
1(v) Find an inverse function algebraically. [1.9]

2. Quadratic Functions

2(a) For a quadratic in the form \( f(x) = ax^2 + bx + c \), complete the square to get it into standard form. [2.1]
2(b) Graph a quadratic equation in standard form, finding the vertex, intercepts, and the equation of the axis of symmetry. [2.1]

2(c) (Optional) Solve quadratic inequalities. [Not in textbook, but is a small step beyond the material in 2.1.]

3. Exponential and Logarithmic Functions

3(a) Graph an exponential function. [3.1]
3(b) State the One-to-One Property of Exponents and use it to solve equations. [3.1]
3(c) Become familiar with the natural base $e$. [3.1]
3(d) Use the definition of the logarithmic function with base $a$ to evaluate logarithms. [3.2]
3(e) Use the one-to-one property of logarithms to solve a log equation and use the inverse properties of a logarithm function to sketch its graph. [3.2]
3(f) Evaluate and graph the natural logarithm function.
3(g) Apply the change of base formula for logarithms. [3.3]
3(h) Apply the Product, Quotient, and Power Properties of Logarithms. [3.3]
3(i) Solve logarithmic and exponential equations. [3.4]
3(j) Find the doubling time of a given exponential growth curve. [3.4]
3(k) Fit an exponential growth or decay curve to two given points. [3.5]

4. Trigonometry

4(a) Define radian measure and determine the radian equivalents of some common angles. [4.1]
4(b) Define and find the complement and supplement for certain angles. [4.1]
4(c) Convert between degrees and radians. [4.1]
4(d) Find arc length, given the radius and the central angle. [4.1]
4(e) Define and evaluate sin and cos on the unit circle, giving domain, period, and even/odd properties. [4.2]
4(f) Define and evaluate at special angles the six trigonometric functions of a right triangle. [4.3]
4(g) Express the tangent, cotangent, secant, and cosecant functions in terms of the sine and cosine functions. [4.3]
4(h) State the Pythagorean identities. [4.3]
4(i) Simplify the cofunction of the complementary angle. [4.3]
4(j) Solve a right triangle. [4.3]
4(k) Find the exact values of the six trigonometric functions at an arbitrary angle, given a point on the terminal side of the angle drawn in standard position. [4.4]
4(l) Find the exact values of the six trigonometric functions at special angles in arbitrary quadrants. [4.4]
4(m) Graph the sine and cosine, stating the maximum and minimum points and the intercepts. [4.5]
4(n) Transform the sine and cosine graphs, stating amplitude and period. [4.5]
4(o) (Optional) Describe the phase shift of a transformed sine or cosine function. [4.5]
4(p) Sketch the graph of the tangent function. [4.6]
4(q) Define and graph the inverse sine, cosine, and tangent functions. [4.7]
4(r) Evaluate the composition of a trig function with an inverse trig function or vice versa. [4.7]
4(s) Solve a right triangle to find a distance in a real-life application. [4.8]

5. **Analytic Trigonometry**

5(a) Use the fundamental trigonometric identities (page 372) to evaluate a function or simplify an expression. [5.1]
5(b) Verify a trigonometric identity. [5.2]
5(c) Solve trigonometric equations. [5.3]
5(d) Apply sum and difference and double-angle formulas for the sin and cos. [5.4–5.5]
5(e) Derive a half-angle formula for the sine or the cosine. [5.5]
5(f) (Optional) Derive a triple-angle formula for the sine or the cosine. [5.5]