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 suplement 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]