List of Topics for Math 130

Brief review of necessary algebra, including—but not limited to—the following topics.

- Fractions, rational expressions and equations involving rationals.

- Proper cancellation in fractions.

- Scientific notation.

- Absolute value expressions and equations.

- Solving formulas for variable letters.

- Operations with polynomials, including special products and squares of binomials.

- Solving quadratic equations in one variable.

- Word problems: algebraic representation and subsequent solution.

- Rules of exponents and their application, including simplifying fractional exponents.

- Finding the additive inverse of an algebraic expression.

The Cartesian coordinate system, including the distance and midpoint formulas.

Lines: slope, the point-slope and slope-intercept equations, horizontal, vertical, parallel and perpendicular lines.

The graph of an equation: creating a table of points, techniques of graphing.

Circles: the general and standard equations of a circle, completing the square for a circle, the unit circle.

Reflections and symmetry from geometric and algebraic perspectives.

Functions. The vertical line test. Domain and range. The notation $f(x)$. Functions defined graphically. The difference quotient.

Functions defined by input-output pairs or a table. Functions defined by a formula and a domain. Functions defined verbally with a domain specified or implied.

Transformations: translations, expansions, and compressions of a graph and the associated substitutions in its formula.

Even and odd functions.

Graphing the fundamental quadratic equation: $y = x^2$; and graphing simple transformations of it.

Completing the square of a quadratic equation that was given in general form, finding the vertex and intercepts, and sketching the graph.

Max/min examples that simplify to quadratics.

Algebra of functions and compositions of two functions.

What's an inverse? Invert: a relation, a verbal string.

Inverses: (1) graph the inverse relation, (2) one to one, (3) find a formula for f^{-1}, (4) fundamental composition rule, (5) is f its own inverse? (6) implicit definition.

Exponents, exponent functions and their graphs. Extended domain.

The logarithm function and its graph. Its implicit definition.

The logarithm function: a closed-form algebraic formula? just a rule?

Log estimation, fundamental log identities.

Historical derivation of log values.

Log rules. Selected entries from a log table that illustrate the pattern of log rules.

Log Equations.

The value e.

Change of Base.

Exponential growth and decay: the roles of the initial value and base. The base as the 1-unit growth factor, doubling time.

The relation between the base, the elapsed time, and the ratio of the outputs.

Angles.

Angular velocity, and linear velocity of rotation. (Optional)

Trig ratios in a right triangle.

Triangles. Right triangle trig. Trig ratio values. Derive some identities. Solve a right triangle.

Review of the unit circle.

Standard Position on the Unit Circle.

Definition of the circular sine and cosine.

What do the input and output of the sine and cosine represent in the unit-circle picture?

Trigonometric identities on the unit circle. Odd/even identities. Pattern of whole-π identities, including supplementary, add or subtract π, add 2π. Complementary identities. Add or subtract $\pi/2$.

Reference angles, special values of trig functions. 3 methods:

- Write as $n\pi/12$, then start with closest axis point.
- Use whole-pi identities on 1st-quadrant reference arc.
- Long trig table where all $\sin\theta$, $\cos\theta$ equal $\pm\sqrt{n}/2$.

Graphs of the circular sine and cosine functions. Distinction between the graph of the unit circle and the graph of $\sin x$.

Transformed Trig Graphs (period; amplitude; midline; vertical shift; phase fraction; phase and horizontal shifts).

Inverse sine and cosine functions.

Identities: addition, double-/half-angle.

Verifying trig identities.

Trig equations: graphic and algebraic solutions.

Law of Cosines. (Optional)

Graphing the tangent and the inverse tangent functions.