MIDTERM 1 TOPICS

(1) Inverse functions
   (a) Given a function, compute its inverse.
   (b) Domain/range.
   (c) Graphs.
   (d) $\frac{d}{dx} f^{-1}(x) = 1/(f'(f^{-1}(x)))$.
(2) Special functions.
   (a) Exponentials and logs: $\ln(x), \log_a(x), e^x, a^x$.
       Know: definitions, limits, graphs, derivatives.
   (b) Inverse trig functions.
       Know: definitions, domain/ranges, limits, graphs, derivatives.
       In particular, know how to derive the derivatives, including how to simplify expressions like $\sin(\cos^{-1}(x))$.
   (c) Hyperbolic functions.
       Know: definitions, identities, domain/ranges, limits, graphs, derivatives.
(3) Exponential growth/decay.
   (a) Main examples: population growth, radioactive decay, heating/cooling.
   (b) Know how to set up and what the solutions look like.
   (c) Use general solutions to solve for specific solutions (solve for all the unknowns).
   (d) Long term behavior.
(4) Limits.
   (a) Basic limits, using all our new special functions.
   (b) L'Hopital's rule.
   (c) Indeterminate forms, and how to transform each into ∞/∞ or $0/0$.
(5) Integrals.
   (a) Basic integrals using all our new special functions.
       In particular, $\tan^{-1}(x)$ and how to complete the square to get into the $a/(1+u^2)$ form.
   (b) Integration by parts.
       In particular,
       (i) integrate inverse functions like $\tan^{-1}(x)$ by letting $f = \tan^{-1}(x)$ and $g' = 1$, and
       (ii) integrate things like $e^x \cos(x)$ by letting $I = \int e^x \cos(x) \, dx$, doing IBP a couple times, seeing I appear again, and solving algebraically for I. (Note: this is how you do $\int \sec^3(x) \, dx$, letting $f = \sec(x)$ and $g' = \sec^2(x)$.)
   (c) Trig integrals.
       In particular, all the relevant trig identities.
       Special integrals you want to know/specifically know how to compute: $\int \sec(x) \, dx$, $\int \csc(x) \, dx$, $\int \sec^3(x) \, dx$, and $\int \csc^3(x) \, dx$.
   (d) Trig sub.
   (e) Partial fractions decomposition.