Topics for Exam 1
Math 31, Spring 2006

General information. Exam 1 will be a timed test of 70 minutes, covering 5.1–5.5 and 6.1–6.2 of the text, along with selected review topics. Most of the exam will be based on the homework assigned for those sections. If you can do all of that homework, and you know and understand all of the ideas behind it, you should be in good shape.

You are allowed to use a calculator and notes on **ONE** 3×5 note card (both sides).

As mentioned above, your first priority should be to understand the homework and quizzes and the ideas behind them. Besides the list of things you should know, below, you should also be familiar with everything specially emphasized in the text. If time permits, try to do some of the problems that have answers in the back of the book.

Section 5.1. The area problem. Solution through limits of left endpoint and right endpoint Riemann sums. Overestimates versus underestimates. The distance problem. Distance and area problems have the same solution (Fundamental Theorem of Calculus 2).

Section 5.2. Definition of the definite integral as a limit of Riemann sums. Terminology: integral sign, integrand, limits of integration, upper/lower limit. Types of Riemann sums: left endpoint L_n, right endpoint R_n, midpoint M_n. Properties of the definite integral: algebraic (props. 1–4), area-based (props. 5–8).

Section 5.3. What the function $g(x) = \int_0^x f(t)\,dt$ means. Fundamental Theorem of Calculus, parts 1 and 2. Reconstructing a function from its derivative and an initial value. Using FTC 2 to calculate definite integrals through antidifferentiation. (Careful: when definite integrals do not exist.)

Section 5.4. Indefinite integrals: definition (most general antiderivative of $f(x)$), notation. Definite integral is a number, indefinite integral is a class of function; when to use the $+C$ and when not to. Basic rules for indefinite integrals (p. 406). Applications: FTC 2 in terms of change ("the definite integral of the rate of change is the net change").

Section 5.5. The substitution rule. Applying substitution in practice: Guess u, differentiate to get $du = \frac{du}{dx}dx$, try to substitute to make integrand a function of u only (no x). Substitution with definite integrals: pick your favorite of 3 methods (convert back to x before evaluating limits, convert limits to limits in u, do indefinite integral and apply FTC 2). Symmetry tricks (odd, even functions).

Section 6.1. Calculating areas between curves.

Section 6.2. THE METHOD: Cut a problem into pieces, solve on each pieces, add up pieces in an integral. Finding volumes: solids of revolution (disks and washers), other solids (square slices, other slices).

Review topics. THE BOX. Local maxima and minima; first and second derivative tests. Finding global maxima and minima.

Not on exam. (5.2) Evaluating integrals through complicated algebra (pp. 383–386).