Topics for Exam 1
Math 112, Spring 2006

General information. Exam 1 will be a timed test of 50 minutes, covering 1.1–1.5 and 2.1 of the text, along with 5.2–5.5 as review. 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 1.1. Vectors in 2 and 3 dimensions: algebraic definition, geometric picture. Adding, subtracting, and scalar multiplying vectors, algebraically and in pictures. Notation, standard basis vectors. Point-direction form of a line (vector notation, parametric).

Section 1.2. Inner product (dot product): algebraic definition, geometric meaning (angle between vectors). Lengths; inner product, length, and distance. Orthogonality: definition, meaning. Orthogonal projection: idea, computation. Physical applications.

Section 1.3. Definitions: 2×2 and 3×3 matrices and determinants. Cross product: algebraic definition, geometric meaning (including right-hand rule). Point-normal form of the equation of a plane: what it means, computation.

Section 1.4. Cylindrical coordinates: Basic idea; conversion formulas $x = r\cos\theta$, $y = r\sin\theta$, $z = z$. Spherical coordinates: Basic idea; conversion formulas $x = \rho\sin\varphi\cos\theta$, $y = \rho\sin\varphi\sin\theta$, $z = \rho\cos\varphi$. Non-constant unit coordinate vectors $\mathbf{e}_\theta$, $\mathbf{e}_\rho$, etc.

Section 1.5. In n dimensions: vectors, dot products, lengths, angles. Multiplying arbitrary matrices.

Section 2.1. Notation: mappings $f : \mathbb{R}^k \to \mathbb{R}^n$ and functions $f(x_1, \ldots, x_k) = (y_1, \ldots, y_n)$. Pictures of functions of 2 variables $f(x, y)$: graph $z = f(x, y)$ (picture of function of 2 variables in 3-D), level curves, contour diagram of $f(x, y)$ (picture of function of 2 variables in 2-D — term is not defined in text). Visualizing surfaces: Method of sections. Important examples (know graph and contour diagram for all): paraboloid $f(x, y) = x^2 + y^2$, saddles $f(x, y) = x^2 - y^2$ and $f(x, y) = xy$. Visualizing $f(x, y, z)$: level surfaces.

Review topics. (5.2) Calculating double integrals over rectangles. (5.3) Calculating double integrals over non-rectangles. (5.4) Changing the order of integration. (5.5) Triple integrals.

Not on exam. (1.1) Point-point form of a line. (1.2) Cauchy-Schwarz inequality, triangle inequality. (1.3) Geometry of determinants, distances from a point to a plane. (1.5) Cauchy-Schwarz inequality, triangle inequality; algebraic properties of matrices. Section 2.3 (which will be on exam 2 instead).