Topics for Final Exam
Math 112, Spring 2006

The final exam will be a timed test of 2 hours and 15 minutes (Fri May 19, 9:45am–noon). You are allowed to use a calculator and notes on **ONE** 3×5 note card (both sides).

The final exam will be comprehensive, and will therefore involve both the topics on this sheet and **all previous topics**. There will be some emphasis on the topics listed here, but everything we have covered is fair game.

Your first priority should be to understand the homework and the principles behind it. Besides the list below, you should also be familiar with everything specially emphasized in the text (i.e., the red boxes), and all the examples in the text. If time permits, try to do the example problems in the text by yourself. If you can do all of the homework assigned this semester, and you know and understand all of the ideas behind it, you should be in good shape.

Section 8.1. Green's Theorem for an arbitrary region in $\mathbb{R}^2$ (statement only, not proof). The Little Man Left rule for orienting the boundary of a region. Vector (curl) form of Green's Theorem. Main practical use of Green's Theorem: Computing line integrals (circulation) around closed curves (examples).

Section 8.2. Green's Theorem for an arbitrary surface in $\mathbb{R}^3$ (statement only, not proof). The Little Man Left rule for orienting the boundary of a surface. Physical interpretation of curl: circulation per unit area. Main practical use of Green's Theorem: Computing line integrals (circulation) around closed curves (examples).

Section 8.3 and supplements. Equvalence of $\mathbf{F}$ gradient, $\mathbf{F}$ circulation-free, and $\mathbf{F}$ path-independent. Simply connected regions. $\mathbf{F}$ gradient implies $\operatorname{curl} \mathbf{F} = \mathbf{0}$ always; $\operatorname{curl} \mathbf{F} = \mathbf{0}$ and domain of $\mathbf{F}$ simply connected implies $\mathbf{F}$ gradient. Computing f such that $\mathbf{F} = \nabla f$.

Section 8.4. Gauss' Theorem for an arbitrary region in $\mathbb{R}^3$ (statement only, not proof). Outward normal orientation for surface bounding a region in $\mathbb{R}^3$. Physical interpretation of divergence: flux per unit volume. Main practical use of Divergence Theorem: Computing flux through surfaces bounding a region (examples).

Supplements to 8.4: The fundamental theorems of calculus, SA25, paragraph HW 10. Fundamental theorems of calculus in $\mathbb{R}^1$, $\mathbb{R}^2$, and $\mathbb{R}^3$: general form (generalized Stokes' theorem), specific examples. Chains where consecutive derivatives give 0. Gauss' Law for electric charges and applications (SA25, P10).

Not on exam. (8.1) Areas using Green's theorem; divergence theorem in the plane. (8.2) Grad, div, and curl in cylindrical and spherical coordinates; Faraday's Law; supplements (falling cats, astronauts, non-Euclidean geometry). (8.3) Be careful of Theorem 7 (a less precise version of equivalence theorems in handout). (8.4) Divergence in spherical coordinates. (Supp. 8.4) Aerodynamics/Joukowski's Law/the Aerobie.