

# Final Exam Take Home Problem, Math 324 Summer 2011

Please read all instructions carefully.

## Solution Format

- Use 8.5 by 11-inch paper for your solution.
- Limit your writing area to  $188 \text{ in}^2$  (one double-sided page or two single-sided pages).
- Write neatly or type your solution.
- I highly recommend solving the problem first using scratch paper and then rewriting the solution so that it is clean, concise, and complete.

## Rules

- You may use your book, class notes, and any calculator.
- You may not discuss the specifics of this problem with anyone besides me.
- You may not search the internet looking for ideas, hints, or answers.

**Due at the beginning of class on Friday, August 19.**

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Let  $\mathbf{F} = \frac{\langle x, y, z \rangle}{(x^2 + y^2 + z^2)^{3/2}}$ . This vector field represents the electric field created by a certain charge centered at the origin.

- Calculate  $\iint_S \mathbf{F} \cdot d\mathbf{S}$ , where  $S$  is the sphere of radius  $a$  centered at the origin.
- Find  $\text{curl } \mathbf{F}$  and  $\text{div } \mathbf{F}$  at every point except the origin.
- Use the Divergence Theorem to explain why your answer to Part (a) doesn't depend on  $a$ .
- Use Stokes' Theorem to explain why line integrals of  $\mathbf{F}$  are independent of path (see p. 1047 for an explanation of path independence).