Physics 106B: Classical Mechanics
Homework 5: Review of Electrostatics

DUE: Thursday, February 15 2001

Remember: Late homework will be granted 50% credit UNLESS PRIOR ARRANGEMENTS ARE MADE WITH ME OR A TA. If you have an extension, please indicate who granted it clearly on the top of the paper OR YOU WILL NOT GET FULL CREDIT.

Reading Assignment: Jackson Chapter 1 (sections 1.12, 1.13 optional)

Do Jackson problems 1.3, 1.5, 1.7, 1.11

Problem 5

In two dimensions we showed that solutions of Laplace's equation had the "averaging property":

$$\Phi(x,y) = \frac{1}{2\pi R}\oint_C \Phi dl \tag{1}$$

where the integral is taken around a circle of radius R centered on x, y. Write down the corresponding property in 3-D, and prove it. (hint: show it for a point charge, then argue why it is valid in general)

Presentation Problem 6- Assigned to group 6

For class Tuesday, Feb. 13.

Find the energy stored in a uniformly charged solid sphere of radius R and total charge q. Do it three different ways:

a) Use $W = \frac{1}{2}\int \rho\Phi dV$. Note you will have to find the potential first.

b) Use $W = \frac{\epsilon_o}{2}\int E^2 dV$

c) Use $W = \frac{\epsilon_o}{2}\left(\int_S \Phi\vec{E}\cdot d\vec{a} + \int_V E^2 dV\right)$ Take a spherical volume of radius a. What happens as a approaces ∞?