PH4210 Short Exercises
Fall 2007

Due Monday 11/5

Derive equation 5.51 in the book by inserting Eqn. 5.50 into 5.49.

EXAM REDMPTION: (DUE 10/29)

Rework any missed problems on the exam for 50% credit. Turn in your exam booklets and rework in class on Monday 10/29.

HW Extra Credit: DUE Monday 10/29

Using Cartesian or Cylindrical coordinates, find the electric field for z>0, and the surface charge density for a conductor on the x-y plane with a charge +q a distance d above the conductor. Then integrate the charge density to show the net induced charge on the surface of the conductor is –q. Note: The answers are in the book in section 4.4.2- you need to show the work!

Extra Credit; no deadline:

Show that $\vec{\nabla}\frac{1}{\mathscr{r}} = \frac{-\hat{\mathscr{r}}}{\mathscr{r}^2}$, where $\vec{\mathscr{r}} = \vec{r} - \vec{r}\,'$ using spherical coordinates.

Due Friday 10/05

Consider an infinite sheet of charge on the x-y plane, with surface charge density σ. Give symmetry arguments to simplify the form of

$$\vec{E}(x,y,z) = E_x(x,y,z)\hat{x} + E_y(x,y,z)\hat{y} + E_z(x,y,z)\hat{z}\,.$$

Such symmetry arguments should involve making some kind of "operation" like rotation, reflection, translation taking advantage of the physical symmetry of the charge distribution, and then making a conclusion about the electric field in terms of its components, or in terms of how any of its components may or may not vary with x, y, z.

Due Monday 9/24

Show that $\vec{\nabla}\frac{1}{\mathscr{r}} = \frac{-\hat{\mathscr{r}}}{\mathscr{r}^2}$, where $\vec{\mathscr{r}} = \vec{r} - \vec{r}\,'$ in the notation from class; or, using the text's notation, $\vec{\nabla}\frac{1}{r} = \frac{-\hat{r}}{r^2}$, where $r = \vec{x} - \vec{x}\,'$.

Due Friday 9/14

1. If α, β are scalars and A_i, B_i are vectors, show that $C_i = \alpha A_i + \beta B_i$ is also a vector by showing C_i transforms correctly under an orthonormal coordinate transformation $\vec{A} \to \vec{A}' = R\vec{A}, \quad \vec{B} \to \vec{B}' = R\vec{B}$.
2. Starting from the observation that

$$\varepsilon_{ijk}\varepsilon_{klm} = A\delta_{il}\delta_{jm} + B\delta_{im}\delta_{jl} + C\delta_{ij}\delta_{lm} \quad ,$$

show that C=0, A=1, and B= −1 so that

$$\varepsilon_{ijk}\varepsilon_{klm} = \delta_{il}\delta_{jm} - \delta_{im}\delta_{jl},$$