**Assignment # 2 for Electricity and Magnetism: Physics 334**
**Introduction to Electrodynamics (Third Edition) David 1. Griffiths**

1. Griffiths : Chapter 2 # 2.4.
2. Griffiths : Chapter 2 # 2.5.
3. Griffiths : Chapter 2 # 2.6.
4. Griffiths : Chapter 2 # 2.7.
5. Griffiths : Chapter 2 # 2.8.
6. Griffiths : Chapter 2 # 2.9.
7. Griffiths : Chapter 2 # 2.10.
8. Using the epsilon notation and the Einstein summation convention, prove that for vectors **A**, **B** and a scalar $\varphi$, we have

   (a)
   $$\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) = (A \cdot \mathbf{C})\mathbf{B} - (\mathbf{A} \cdot \mathbf{B})\mathbf{C}$$

   (b)
   $$\nabla \times (\mathbf{A} \times \mathbf{B}) = (\mathbf{B} \cdot \nabla)\mathbf{A} - (\mathbf{A} \cdot \nabla)\mathbf{B} + \mathbf{A}(\nabla \cdot \mathbf{B}) - \mathbf{B}(\nabla \cdot \mathbf{A})$$

   (c)
   $$\nabla \times \left(\frac{\mathbf{A}}{\varphi}\right) = \frac{1}{\varphi^2}\left(\varphi(\nabla \times \mathbf{A}) + A \times (\nabla\varphi)\right)$$

   (d)
   $$\nabla \times (\nabla\varphi) = 0; \qquad \nabla \cdot (\nabla \times \mathbf{A}) = 0 \ .$$

   (e)
   $$\nabla \times (\nabla \times \mathbf{A}) = \nabla(\nabla \cdot \mathbf{A}) - \nabla^2\mathbf{A}$$

   where $\nabla^2$ is called the Laplacian.

9. A static charge distribution produces a radial electric field

$$\mathbf{E}(r) = A\,\frac{e^{-kr}}{r^2}\ , \tag{1}$$

where $A$ and $k$ are constant.

(a) What is the charge distribution $\rho(r)$?

(b) Sketch $\rho(r)$ as a function of $r$.

(c) What is the total charge $Q$ in all space?

10. Suppose that instead of the Coulomb force law, the force between two point charges $q_1$ and $q_2$ was

$$\mathbf{F}_{12} = \frac{q_1 q_2}{4\pi\epsilon_0}\,\frac{\left(1-\sqrt{\alpha r_{12}}\right)}{r_{12}}\,\hat{r}\ , \tag{2}$$

where $\alpha$ is a constant.

(a) What is the appropriate electric field $\mathbf{E}$ surrounding a point charge?

(b) Choose a path around the point charge and calculate the line integral

$$\oint \mathbf{E}\cdot d\ell\ .$$

Compare with the Coulomb result.

(c) Find

$$\oint \mathbf{E}\cdot d\mathbf{a}$$

for a spherical surface of radius $R$ with the charge at the center. Compare with the Coulomb result.

(d) Repeat (c) at radius $R+\Delta$ and find $\nabla\cdot\mathbf{E}$ at distance $R$ from the point charge.