PHYSICS 110A – HOMEWORK SET 2

Due Wednesday 1/27/10. Ten points per problem. Answers provided where appropriate.

Reading: Griffiths, Chapter 2.

1.) A line of length D separates two point charges, each of magnitude Q. A third point charge, of magnitude q, is carried from infinity to the point midway between the two charges of magnitude Q, along a path which is perpendicular to the line connecting the two charges. At what distance from its final resting place (midway between the two charges Q) does q experience the maximum electrostatic repulsion? What is the magnitude of this repulsion, in Newtons? (Answer: distance is $D/(2\sqrt{2})$)

2.) 2.6. Answer:

$$\frac{1}{4\pi\epsilon_0} 2\pi\sigma z(\frac{1}{z} - \frac{1}{\sqrt{R^2+z^2}})\hat{z}$$

The two limiting cases should have answers you are familiar with.

3.) 2.9; the two methods should be direct integrations and Gauss's law. (Answers: $5\epsilon_0 k r^2$, $4\pi\epsilon_0 k R^5$.)

4.) 2.10 (answer: $q/(24\epsilon_0)$).

5.) 2.16

6.) 2.17. Also, find the potential everywhere also, assuming $V = 0$ at $y = 0$.

7.) 2.20

8.) 2.21. Answer for $r < R$:

$$\frac{q}{4\pi\epsilon_0}\frac{1}{2R}(3 - \frac{r^2}{R^2})$$

9.) 2.28

10.) 2.29

11.) 2.32; do parts a) and b) only. Answer:

$$\frac{1}{4\pi\epsilon_0}(\frac{3}{5}\frac{q^2}{R})$$

12.) 2.35. Answer to part b):

$$\frac{1}{4\pi\epsilon_0}(\frac{q}{b} + \frac{q}{R} - \frac{q}{a})$$

13.) 2.37 (answer: $Q^2/(2\epsilon_0 A^2)$).

14.) 2.46