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:
$$\frac{1}{4\pi\varepsilon_0} 2\pi z \left( \frac{1}{\sqrt{R^2 + z^2}} \right)$$

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: $5\varepsilon_0 kr^2$, $4\pi\varepsilon_0 kR^5$.)

4.) 2.10 (answer: $q/(24\varepsilon_0)$).

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 $r < R$:
$$\frac{q}{4\pi\varepsilon_0} \frac{1}{2R} \left( 3 - \frac{r^2}{R^2} \right)$$

9.) 2.28

10.) 2.29

11.) 2.32; do parts a) and b) only. Answer:
$$\frac{1}{4\pi\varepsilon_0} \left( \frac{3q^2}{5R} \right)$$

12.) 2.35. Answer to part b):
$$\frac{1}{4\pi\varepsilon_0} \left( \frac{q}{b} + \frac{q}{R} - \frac{q}{a} \right)$$

13.) 2.37 (answer: $Q^2/(2\varepsilon_0 A^2)$).

14.) 2.46