

PHYSICS 110A – HOMEWORK SET 4

Due Monday 2/22/10. Ten points per problem. Answers provided where appropriate.

Reading: Griffiths, Chapter 4.

Note that the problems jump around a bit in terms of their order in the book. There's even one from Chapter 2.

1.) 4.1 (Answers: 4.6×10^{-6} , $\sim 10^8$ V).

2.) 4.4; is the force attractive or repulsive?

$$F = 2\alpha \left(\frac{q}{4\pi\epsilon_0} \right)^2 \frac{1}{r^5}$$

3.) 4.6

$$N = \frac{p^2 \sin(2\theta)}{4\pi\epsilon_0 16z^3}$$

4.) 4.7 (Hint: Begin by bringing dipole in from infinity in way that requires no work.)

5.) 4.10 (An answer: $\vec{E} = -(k/\epsilon_0)\vec{r}$).

6.) 4.15

7.) 4.32; selected answers:

$$\vec{E} = \frac{q}{4\pi\epsilon_0(1 + \chi_e)} \frac{\hat{r}}{r^2}$$

$$\rho_b = -q \frac{\chi_e}{1 + \chi_e} \delta^3(\vec{r})$$

8.) 4.18 (Some answers: c) $P_2 = \sigma/3$; d) $V = 7\sigma a/6\epsilon_0$).

9.) 2.39

$$\frac{2\pi\epsilon_0}{\ln(b/a)}$$

10.) 4.21

$$\frac{2\pi\epsilon_0}{\ln(b/a) + (1/\epsilon_r) \ln(c/b)}$$

11.) 4.24 (Another involved BV problem. Please try to get all the way through it.)

$$E = \kappa \left[\left(1 + \frac{2a^3}{r^3}\right) \cos \theta \hat{r} - \left(1 - \frac{a^3}{r^3}\right) \sin \theta \hat{\theta} \right]$$

$$\kappa = \frac{3E_0}{2[1 - (a/b)^3] + \epsilon_r[1 + 2(a/b)^3]}$$

12.) Consider your answer to the previous problem. Start at the center of the sphere and go parallel to \vec{E}_0 until you get into the dielectric. What is the angle between \vec{E} and \vec{E}_0 ? Answer the same question for the point gotten by starting at the center and travelling perpendicular to \vec{E}_0 . Finally, answer the same question for the point gotten by starting at the center and travelling at an angle of 45 degrees (counterclockwise) relative to \vec{E}_0 .

13.) 4.26

$$W = \frac{Q^2}{8\pi\epsilon_0(1 + \chi_e)} \left(\frac{1}{a} + \frac{\chi_e}{b} \right)$$