Ch 1: 43ab, 44abcd
Ch 2: 1, 3, 6, 9, 12(with plot of E vs r), 16 - due THU-10/02 11am

Problem 1.43 Evaluate the following integrals:

(a) $\int_2^6 (3x^2 - 2x - 1)\,\delta(x - 3)\,dx$.

(b) $\int_0^5 \cos x\,\delta(x - \pi)\,dx$.

Problem 1.44 Evaluate the following integrals:

(a) $\int_{-2}^{2} (2x + 3)\,\delta(3x)\,dx$.

(b) $\int_0^2 (x^3 + 3x + 2)\,\delta(1 - x)\,dx$.

(c) $\int_{-1}^{1} 9x^2 \delta(3x + 1)\,dx$.

(d) $\int_{-\infty}^{a} \delta(x - b)\,dx$.

Problem 2.1

(a) Twelve equal charges, q, are situated at the corners of a regular 12-sided polygon (for instance, one on each numeral of a clock face). What is the net force on a test charge Q at the center?

(b) Suppose *one* of the 12 q's is removed (the one at "6 o'clock"). What is the force on Q? Explain your reasoning carefully.

(c) Now 13 equal charges, q, are placed at the corners of a regular 13-sided polygon. What is the force on a test charge Q at the center?

(d) If one of the 13 q's is removed, what is the force on Q? Explain your reasoning.

Problem 2.3 Find the electric field a distance z above one end of a straight line segment of length L (Fig. 2.7), which carries a uniform line charge λ. Check that your formula is consistent with what you would expect for the case $z \gg L$.

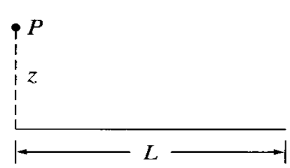

Figure 2.7

Problem 2.6 Find the electric field a distance z above the center of a flat circular disk of radius R (Fig. 2.10), which carries a uniform surface charge σ. What does your formula give in the limit $R \to \infty$? Also check the case $z \gg R$.

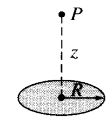

Figure 2.10

Problem 2.9 Suppose the electric field in some region is found to be $\mathbf{E} = kr^3\hat{\mathbf{r}}$, in spherical coordinates (k is some constant).

(a) Find the charge density ρ.

(b) Find the total charge contained in a sphere of radius R, centered at the origin. (Do it two different ways.)

Problem 2.12 Use Gauss's law to find the electric field inside a uniformly charged sphere (charge density ρ). Compare your answer to Prob. 2.8.

and plot $|\vec{E}|$ vs. $|\vec{r}|$.

! **Problem 2.7** Find the electric field a distance z from the center of a spherical surface of radius R (Fig. 2.11), which carries a uniform charge density σ. Treat the case $z < R$ (inside) as well as $z > R$ (outside). Express your answers in terms of the total charge q on the sphere. [*Hint:* Use the law of cosines to write $\mathscr{r}$ in terms of R and θ. Be sure to take the *positive* square root: $\sqrt{R^2 + z^2 - 2Rz} = (R - z)$ if $R > z$, but it's $(z - R)$ if $R < z$.]

Problem 2.8 Use your result in Prob. 2.7 to find the field inside and outside a sphere of radius R, which carries a uniform volume charge density ρ. Express your answers in terms of the total charge of the sphere, q. Draw a graph of $|\mathbf{E}|$ as a function of the distance from the center.

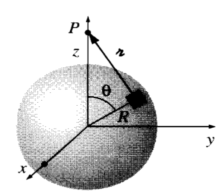

Figure 2.11

Problem 2.16 A long coaxial cable (Fig. 2.26) carries a uniform *volume* charge density ρ on the inner cylinder (radius a), and a uniform *surface* charge density on the outer cylindrical shell (radius b). This surface charge is negative and of just the right magnitude so that the cable as a whole is electrically neutral. Find the electric field in each of the three regions: (i) inside the inner cylinder ($s < a$), (ii) between the cylinders ($a < s < b$), (iii) outside the cable ($s > b$). Plot $|\mathbf{E}|$ as a function of s.

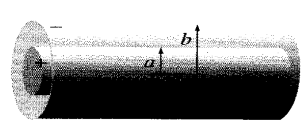

Figure 2.26