Problem 2.32 Find the energy stored in a uniformly charged solid sphere of radius R and charge q. Do it three different ways:

(a) Use Eq. 2.43. You found the potential in Prob. 2.21.

(b) Use Eq. 2.45. Don't forget to integrate over *all space.*

(c) Use Eq. 2.44. Take a spherical volume of radius a. Notice what happens as $a \to \infty$.

Problem 2.33 Here is a fourth way of computing the energy of a uniformly charged sphere: Assemble the sphere layer by layer, each time bringing in an infinitesimal charge dq from far away and smearing it uniformly over the surface, thereby increasing the radius. How much work dW does it take to build up the radius by an amount dr? Integrate this to find the work necessary to create the entire sphere of radius R and total charge q.

$$W = \frac{1}{2}\int \rho V \, d\tau. \tag{2.43}$$

$$W = \frac{\epsilon_0}{2}\left(\int_{\mathcal{V}} E^2 \, d\tau + \oint_{\mathcal{S}} V\mathbf{E}\cdot d\mathbf{a}\right). \tag{2.44}$$

$$\boxed{W = \frac{\epsilon_0}{2}\int_{\text{all space}} E^2 \, d\tau.} \tag{2.45}$$