

- (1) Suppose you have the following charge configuration:  $(x,y,q): (-a,0,-q),(a,0,+q),(-b,0,+q),(b,0,-q)$ . Find (1)  $\mathbf{E}$  at points along the  $y$ -axis and (2) how  $\mathbf{E}$  behaves as  $y \rightarrow \infty$ .  $b < a$
- (2) Suppose you have the following charge configuration:  $(x,y,q): (-a,0,-q), (a,0,+q)$  where  $a=0.1$  m and  $q=1\mu\text{C}$ . Find (1) The magnitude and sign of the electric field at  $x=+1.0$  m. (2) Suppose a charge  $q_1=3\mu\text{C}$  is placed at  $x=+1.0$  m. Find the force on the charge. (3) Suppose the charge was attached to a mass  $m=1 \times 10^{-20}$  kg. Find the acceleration of the mass. Note:  $k=8.987 \times 10^9 \text{ N m}^2/\text{C}^2=1/(4\pi\epsilon_0)$
- (3) A sphere of radius  $a$  has a total charge  $+Q$  uniformly distributed over its volume so that  $\rho=f(r)$ . Use Gauss's law to find the vector  $\mathbf{E}$  inside the sphere and outside the sphere. Show all details here.
- (4) You have a parallel plate capacitor with plates of area  $A$  and separation  $d$ . Suppose one of the plates has a charge  $Q$  while the other plate has a charge  $-Q$ . (1) If  $A=1.0 \text{ m}^2$ ,  $d=0.5$  m and  $Q=1.0 \mu\text{C}$ , provide numerical answers (together with correct SI units) for the following:  $C_{\text{geo}}$ ,  $E$ ,  $\Delta V$ ,  $U$  (the work required to charge this capacitor) and  $u$  (the energy density). (2) Now, suppose a material of dielectric constant  $k=100$  were inserted into the space between the plates of the capacitor so that it completely filled the volume. Find  $C$ .
- (5) Suppose that in one region of space, the electric potential varies as  $V(x,y,z)=ax+bx^3+cx+y^7+z^2$ . Find the **electric field vector** in this region of space.