Recitation January 19
Physics 2 Recitation Notes
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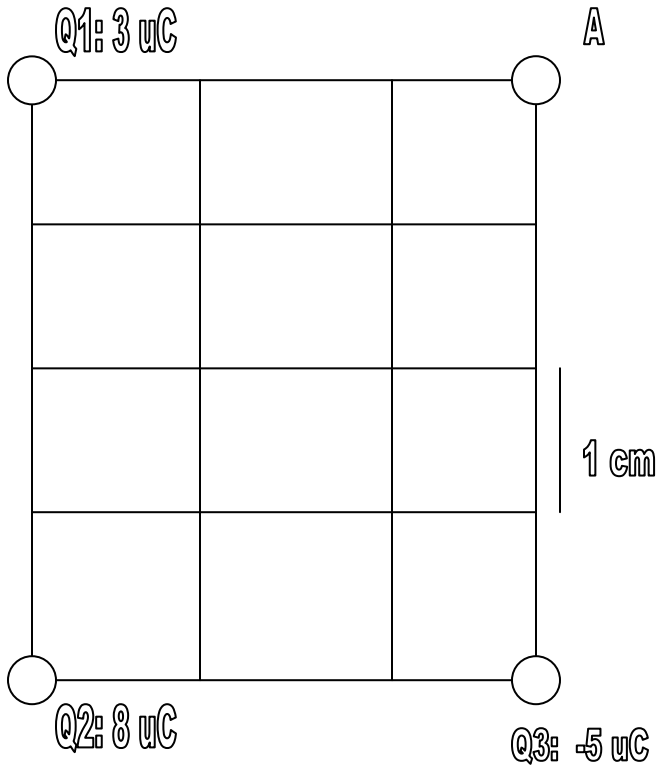
Problem 13.4

At a particular moment, one negative and two positive charges are located as shown in Figure 13.46. Your answers to each part of this problem should be vectors.



(a) Find the electric field at the location of Q_1 due to the other two charges.

(b) Use the electric field you calculated in part (a) to find the force on Q_1

$$\vec{E} = \frac{q}{4\pi\varepsilon_0 d^3}\vec{r} = \frac{q}{4\pi\varepsilon_0 d^2}\hat{r}$$

$$\vec{E} = \frac{8\mu C}{4\pi\varepsilon_0\left((0.04m)^2\right)^{\frac{3}{2}}}\langle 0,0.04\rangle m + \frac{-5\mu C}{4\pi\varepsilon_0\left((0.04m)^2 + (0.03m)^2\right)^{\frac{3}{2}}}\langle -0.03,0.04\rangle m$$

$$\vec{E} = \langle 0,4.4\cdot 10^7\rangle\frac{N}{C} + \langle 1.0\cdot 10^7,-1.4\cdot 10^7\rangle\frac{N}{C}$$

$$\vec{F} = 3\mu C\cdot\langle 1.0\cdot 10^7,3.0\cdot 10^7\rangle\frac{N}{C} = \langle 30,90\rangle N$$

(c) Find the electric field at location A due to all three charges.

$$\vec{E} = \frac{\frac{3\mu C}{4\pi\varepsilon_0\left((0.03m)^2\right)^{\frac{3}{2}}}\langle 0.03,0\rangle m + \frac{8\mu C}{4\pi\varepsilon_0\left((0.03m)^2+(0.04m)^2\right)^{\frac{3}{2}}}\langle 0.03,0.04\rangle m + \frac{-5\mu C}{4\pi\varepsilon_0\left((0.04m)^2\right)^{\frac{3}{2}}}\langle 0,0.04\rangle m}{}$$

$$= \left\langle 3\cdot 10^7,0\right\rangle \frac{N}{C} + \left\langle 1.7\cdot 10^7,2.3\cdot 10^7\right\rangle \frac{N}{C} - \left\langle 0,2.8\cdot 10^7\right\rangle \frac{N}{C}$$

$$= \left\langle 4.7\cdot 10^7,-0.5\cdot 10^7\right\rangle \frac{N}{C}$$

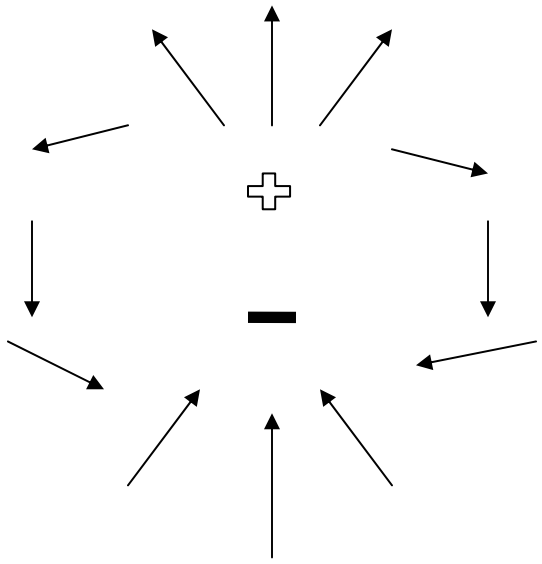
(d) An alpha particle is released from rest at location A. Determine the initial acceleration of the alpha particle.

$$\vec{F} = m\vec{a} = q\vec{E} \quad \vec{a} = \frac{q}{m}\vec{E}$$

$$\frac{1.6\cdot 10^{-19}\,C}{4\cdot 1.7\cdot 10^{-27}\,kg}\left\langle 4.7\cdot 10^7,-0.5\cdot 10^7\right\rangle \frac{N}{C} = \left\langle 1.1\cdot 10^{15},-1.2\cdot 10^{14}\right\rangle \frac{m}{s^2}$$

RQ13.7

Where could you place one positive and one negative charge to produce the pattern of electric field shown in figure 13.42?



This is a diagram of the electric field due to a dipole.