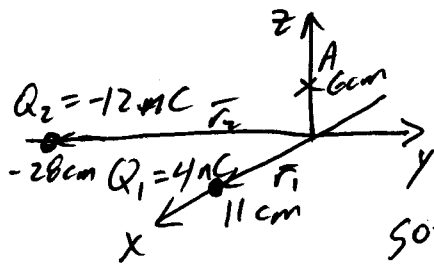


EE 381 Electric and Magnetic Fields Quiz #7 (Fall 2025)

Name Key AInstructions: **Open book & notes.** Place answers in indicated spaces and show all work for full/partial credit.

In free space, there are two point charges of 4 nC at (11 cm, 0, 0) and -12 nC at (0, -28 cm, 0). Find the vector electric field generated by these charges at point A(0, 0, 6 cm). Also, find the force that a 24 μ C point charge would experience if placed at point A.



Per (4.12), $\vec{E} = \frac{1}{4\pi\epsilon_0} \sum_{k=1}^N \frac{Q_k (\vec{r} - \vec{r}_{ik})}{|\vec{r} - \vec{r}_{ik}|^3}$

Sources $\left\{ \begin{array}{l} \text{Choose } Q_1 = 4 \text{ nC w/ } \vec{r}_1 = 0.11 \hat{a}_x \text{ (m)} \\ Q_2 = -12 \text{ nC w/ } \vec{r}_2 = -0.28 \hat{a}_y \text{ (m)} \end{array} \right.$

field position vector $\vec{r} = \vec{r}_A = 0.06 \hat{a}_z \text{ (m)}$

distance vectors $\vec{r} - \vec{r}_1 = -0.11 \hat{a}_x + 0.06 \hat{a}_z \text{ (m)}$

& distances $|\vec{r} - \vec{r}_1| = \sqrt{(-0.11)^2 + (0.06)^2} \text{ (m)}$

$\vec{r} - \vec{r}_2 = +0.28 \hat{a}_y + 0.06 \hat{a}_z \text{ (m)}$ $|\vec{r} - \vec{r}_2| = \sqrt{0.28^2 + 0.06^2} \text{ (m)}$

$$\vec{E}_A = \frac{1}{4\pi(8.8542 \times 10^{-12})} \left\{ \frac{4 \times 10^{-9} (-0.11 \hat{a}_x + 0.06 \hat{a}_z)}{(0.11^2 + 0.06^2)^{3/2}} + \frac{-12 \times 10^{-9} (0.28 \hat{a}_y + 0.06 \hat{a}_z)}{(0.28^2 + 0.06^2)^{3/2}} \right\}$$

$$= 18274.77 (-0.11 \hat{a}_x + 0.06 \hat{a}_z) - 4593.057 (0.28 \hat{a}_y + 0.06 \hat{a}_z)$$

$$\vec{E}_A = -2010.225 \hat{a}_x - 1286.056 \hat{a}_y + 820.903 \hat{a}_z \text{ (V/m)}$$

Per (4.10), $\vec{F}_A = Q \vec{E} = 24 \times 10^{-6} (-2010 \hat{a}_x - 1286 \hat{a}_y + 821 \hat{a}_z)$

$$\vec{F}_A = -0.048245 \hat{a}_x - 0.030865 \hat{a}_y + 0.019702 \hat{a}_z \text{ (N)}$$

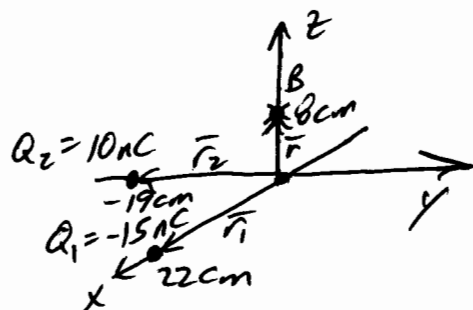
electric field at point A = $-2010.2 \hat{a}_x - 1286.1 \hat{a}_y + 820.9 \hat{a}_z \text{ (V/m)}$

force on 24 μ C point charge @ pnt A = $-48.2 \hat{a}_x - 30.9 \hat{a}_y + 19.7 \hat{a}_z \text{ (mN)}$

EE 381 Electric and Magnetic Fields Quiz #7 (Fall 2025)

Name Key BInstructions: **Open book & notes.** Place answers in indicated spaces and show all work for full/partial credit.

In free space, there are two point charges of -15 nC at $(22 \text{ cm}, 0, 0)$ and 10 nC at $(0, -19 \text{ cm}, 0)$. Find the vector electric field generated by these charges at point $B(0, 0, 8 \text{ cm})$. Also, find the force that a $27 \mu\text{C}$ point charge would experience if placed at point B .



$$(4.12) \quad \vec{E} = \frac{1}{4\pi\epsilon_0} \sum_{k=1}^N \frac{Q_k(\vec{r} - \vec{r}_k)}{|\vec{r} - \vec{r}_k|^3}$$

Sources $\left\{ \begin{array}{l} \text{choose } Q_1 = -15 \text{ nC w/ } \vec{r}_1 = 0.22 \hat{a}_x (\text{m}) \\ Q_2 = 10 \text{ nC w/ } \vec{r}_2 = -0.19 \hat{a}_y (\text{m}) \end{array} \right.$

Field position vector $\vec{r} = \vec{r}_B = 0.08 \hat{a}_z (\text{m})$

distance vectors $\vec{r} - \vec{r}_1 = -0.22 \hat{a}_x + 0.08 \hat{a}_z (\text{m})$

+ distances $|\vec{r} - \vec{r}_1| = \sqrt{(-0.22)^2 + 0.08^2} = \sqrt{0.22^2 + 0.08^2}$

$\vec{r} - \vec{r}_2 = +0.19 \hat{a}_y + 0.08 \hat{a}_z (\text{m})$ + $|\vec{r} - \vec{r}_2| = \sqrt{0.19^2 + 0.08^2}$

$$\vec{E}_B = \frac{1}{4\pi 8.8542 \times 10^{-12}} \left\{ \frac{-15 \times 10^{-9}(-0.22 \hat{a}_x + 0.08 \hat{a}_z)}{(0.22^2 + 0.08^2)^{3/2}} + \frac{10 \times 10^{-9}(0.19 \hat{a}_y + 0.08 \hat{a}_z)}{(0.19^2 + 0.08^2)^{3/2}} \right\}$$

$$= -10,509.01(-0.22 \hat{a}_x + 0.08 \hat{a}_z) + 10,257.89(0.19 \hat{a}_y + 0.08 \hat{a}_z)$$

$$= \underline{2311.982 \hat{a}_x + 1948.999 \hat{a}_y - 20.0897 \hat{a}_z (\text{V/m})}$$

Per (4.10), $\vec{F}_B = Q \vec{E} = 27 \times 10^{-6} (2312 \hat{a}_x + 1949 \hat{a}_y - 20.1 \hat{a}_z)$

$$= \underline{0.0624235 \hat{a}_x + 0.052623 \hat{a}_y - 0.000542 \hat{a}_z (\text{N})}$$

electric field at point $B = \underline{2312 \hat{a}_x + 1949 \hat{a}_y - 20.1 \hat{a}_z (\text{V/m})}$

force on $27 \mu\text{C}$ point charge @ pnt $B = \underline{62.4 \hat{a}_x + 52.6 \hat{a}_y - 0.54 \hat{a}_z (\text{mN})}$