

Phy250 Unquiz 01

Note: $k=8.99 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$

Consider the following charges: 1:($+2\mu\text{C}$;2,3),2:($-3\mu\text{C}$;1,5)

(a) Find \vec{E} and $|\vec{E}|$ at (7,2) with correct SI units.

(b) If a charge $Q=-3\mu\text{C}$ is located at (7,2), find \vec{F} and $|\vec{F}|$ with correct SI units.

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Write down what you want to calculate: $\vec{E} = \sum_{i=1}^{i=2} k \frac{q_i}{r_{ip}^2} \hat{r}_{ip}$

Make a table

#	Q	x	y
1	2	2	3
2	-3	1	5
p		7	2

Identify the following vectors: $\vec{r}_p; \vec{r}_1; \vec{r}_2$

$\vec{r}_p = 7\hat{x} + 2\hat{y}; \vec{r}_1 = 2\hat{x} + 3\hat{y}; \vec{r}_2 = 1\hat{x} + 5\hat{y}$

Calculate the following vectors: $\vec{r}_{1p}; \vec{r}_{2p}$

$$\vec{r}_{1p} = \vec{r}_p - \vec{r}_1 = (7\hat{x} + 2\hat{y}) - (2\hat{x} + 3\hat{y}) = (7-2)\hat{x} + (2-3)\hat{y} = 5\hat{x} - 1\hat{y}$$

$$\vec{r}_{2p} = \vec{r}_p - \vec{r}_2 = (7\hat{x} + 2\hat{y}) - (1\hat{x} + 5\hat{y}) = (7-1)\hat{x} + (2-5)\hat{y} = 6\hat{x} - 3\hat{y}$$

Write down the electric field:

$$\vec{E}_p = k \mu \left[(+2) \frac{5\hat{x} - 1\hat{y}}{[5^2 + 1^2]^{3/2}} + (-3) \frac{6\hat{x} - 3\hat{y}}{[6^2 + 3^2]^{3/2}} \right]$$

simplify:

$$\vec{E}_p = k \mu \left[\frac{10\hat{x} - 2\hat{y}}{26^{3/2}} + \frac{-18\hat{x} + 9\hat{y}}{45^{3/2}} \right] = k \mu [(0.0754 - 0.0596)\hat{x} + (-0.0151 + 0.0298)\hat{y}]$$

$$\vec{E}_p = k \mu [0.0158\hat{x} + 0.0147\hat{y}] = 142.0\hat{x} + 132.2\hat{y} \frac{\text{N}}{\text{C}}$$

Note $k\mu=8990$

Find \vec{F} from $\vec{F} = q_p \vec{E}$

$$\vec{F} = -3 \times 10^{-6} \times [142.0\hat{x} + 132.2\hat{y}] = -0.000426\hat{x} - 0.000397\hat{y}$$

$$\vec{F} = [-4.26 \times 10^{-4}\hat{x} - 3.97 \times 10^{-4}\hat{y}] \text{N}$$