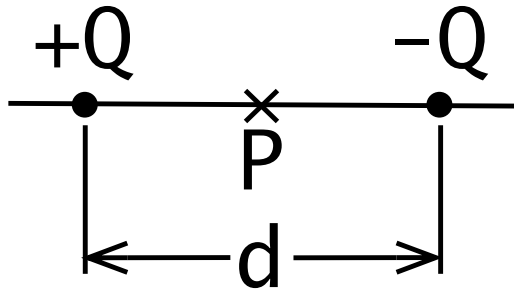


Lecture 3

Super Position Principle

An exercise:

Given electron-proton pair, with charge $-Q$, $+Q$, where $Q = e$, separated by distance d . Find d .



At center P:

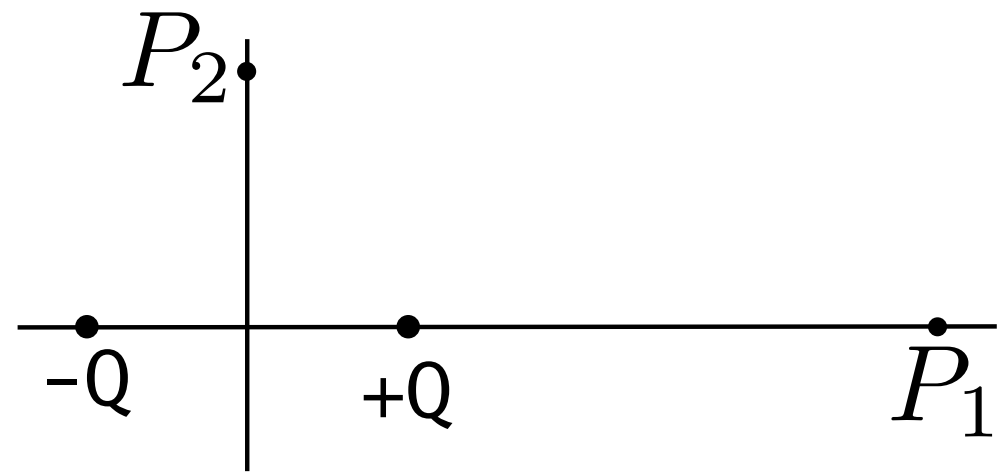
$$\vec{E} = 10 \text{ N/C}$$

Superposition principle: the field at any point equals to the sum of the fields contributed by individual charges. $\vec{E}_P = \vec{E}_P^{\text{proton}} + \vec{E}_P^{\text{electron}}$

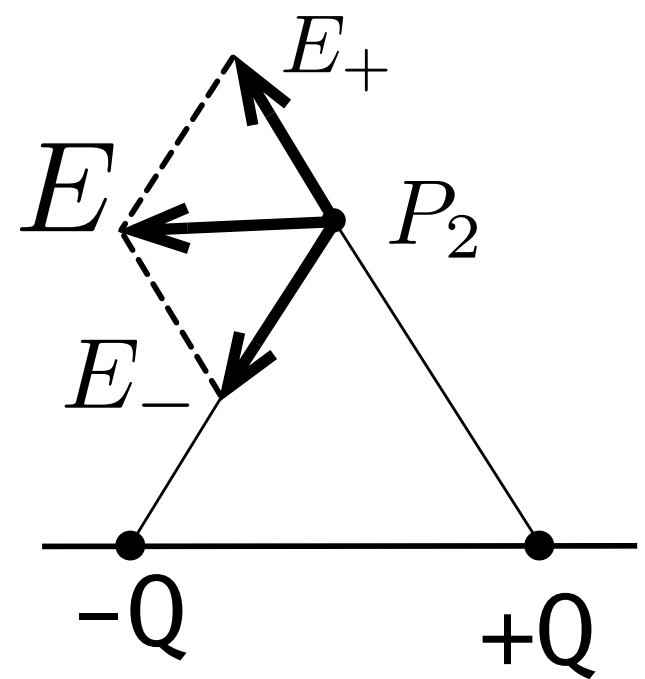
$$\begin{aligned} |E_P^p| &= \frac{ke}{\left(\frac{d}{2}\right)^2} & \text{direction} & \longrightarrow \\ |E_P^{el}| &= \frac{ke}{\left(\frac{d}{2}\right)^2} & \text{direction} & \longrightarrow \end{aligned} \quad \left. \begin{array}{l} \text{ } \\ \text{ } \end{array} \right\} |E_P| = \frac{2kq}{\left(\frac{d}{2}\right)^2} \quad \text{direction} \longrightarrow \quad d^2 = \frac{8ke}{10}$$

Dipole Field Pattern

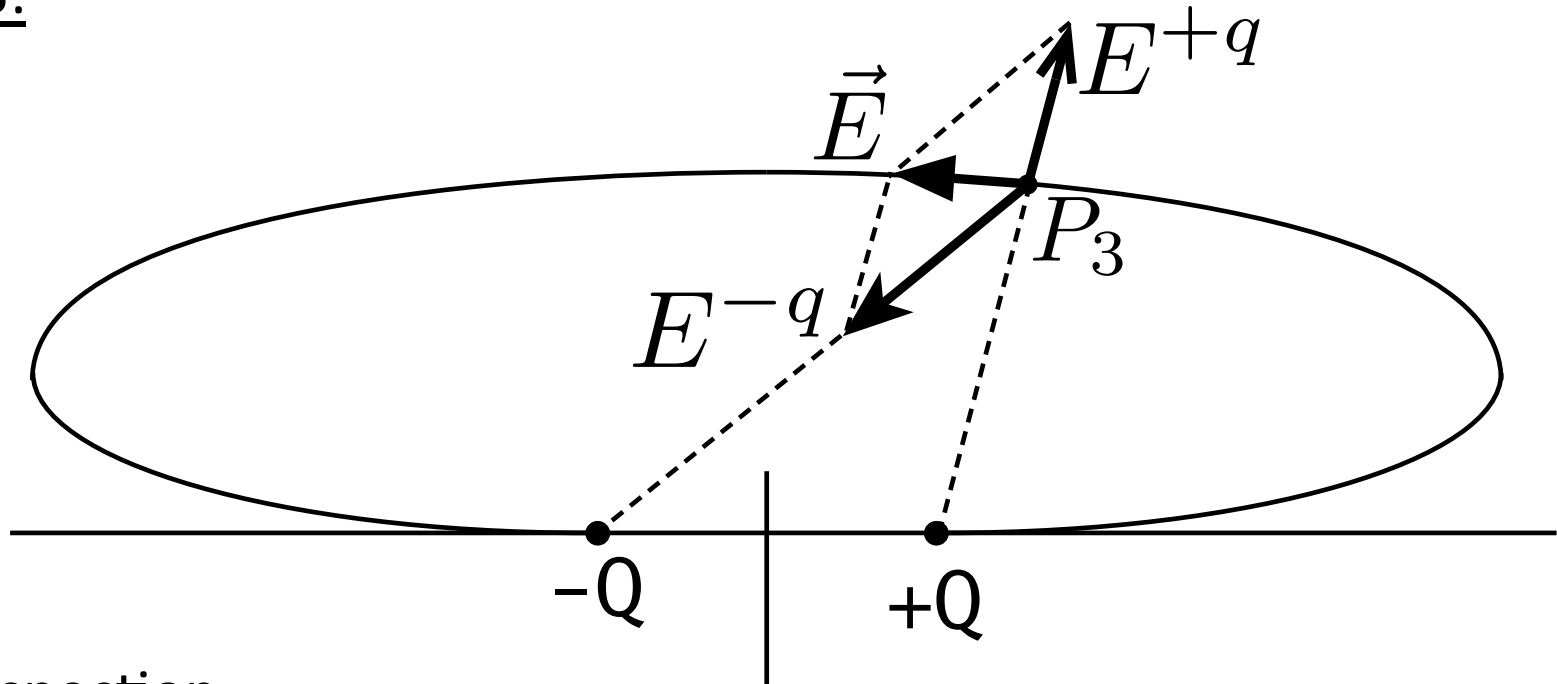
At P1: +Q is closer, $E \longrightarrow$



At P2: $E \longleftarrow$



At P3:



By inspection:

Direction of $\vec{E}_{P_3}^{+q}$   Exercise: Based on the superposition principle, E is produced along an elliptical curve

Direction of $\vec{E}_{P_3}^{-q}$

Clicker 3-1

Force between two charges

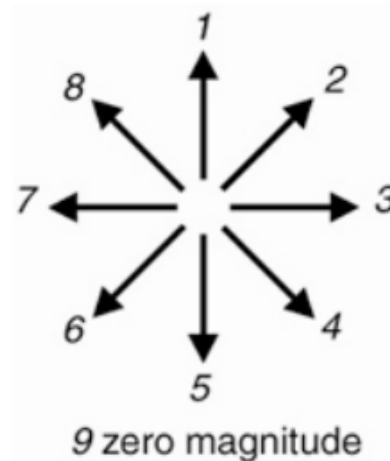
Force on q_1 due to q_2

Q13.3e

An electron is placed at location A. What is the direction of the electric field at location B, due to the electron?

$A^{\times}$

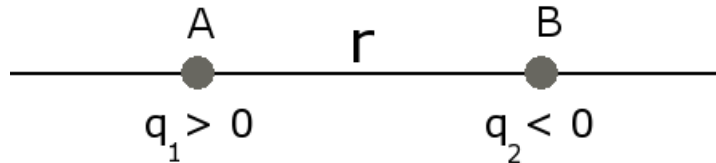
$B^{\times}$



Clicker 3-1: Force due to q_1 on q_2

Problem statement: Given $q_1 > 0$ and $q_2 < 0$ separated by a distance r ,

fig3.2



a. Determine the directions

Choice	$F_{\text{on } q_1}^{\text{due to } q_2}$	$F_{\text{on } q_2}^{\text{due to } q_1}$
1	Left	Left
2	Right	Left
3	Left	Right
4	Right	Right

b. Determine the magnitude of the self-force

Choice	$F_{\text{on } q_2}^{\text{due to } q_2}$
1	∞ (Infinity)
2	$(kq_1q_2)/r^2$
3	0