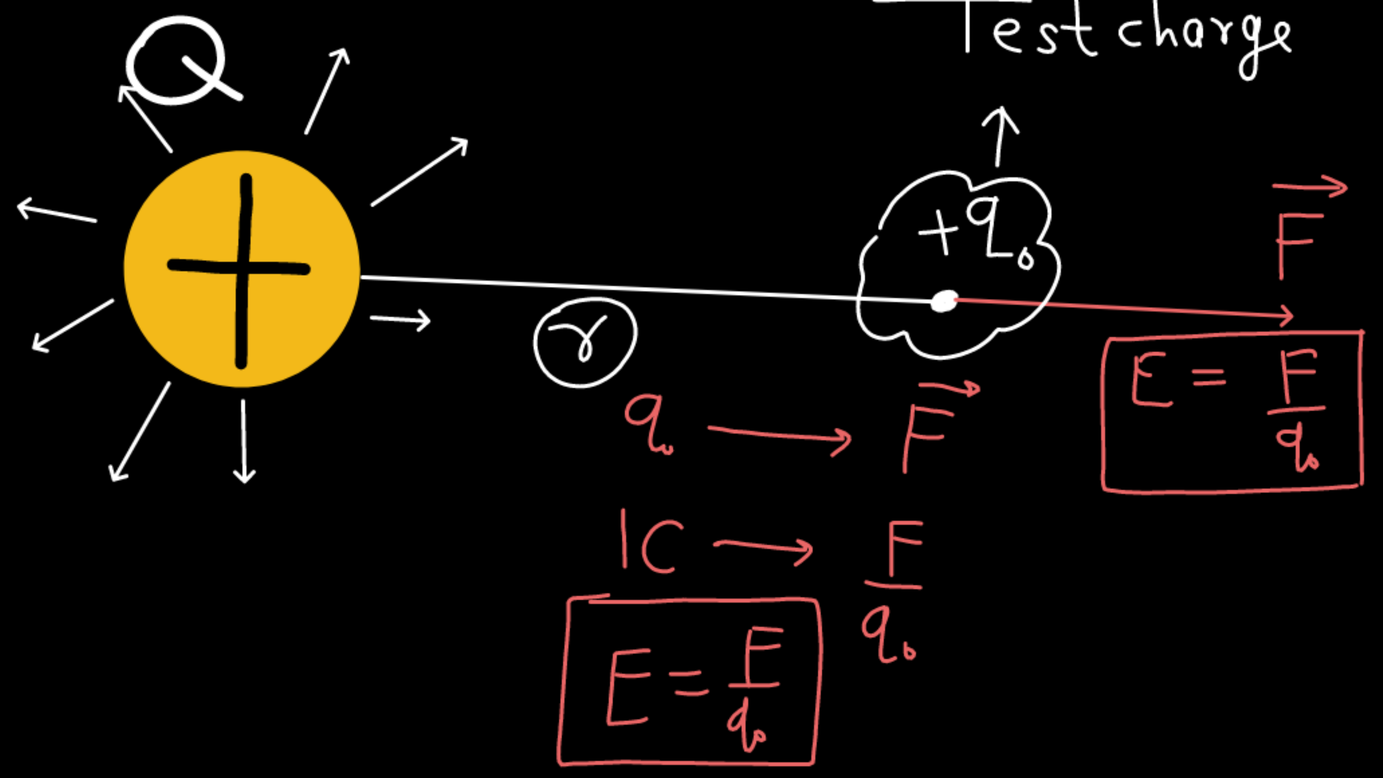
Calculation Electric field intensity

बिन्दु आवेश के कारण विद्युत क्षेत्र
Electric field due to point charge.

$$F = \frac{kQq_0}{r^2}$$

$$E = \frac{F}{q_0} = \frac{kQq_0}{r^2 \cdot q_0}$$

Point charge



$$E = \frac{kQ}{r^2} \rightarrow |E \propto Q|$$

* यदि Q नियत हो।

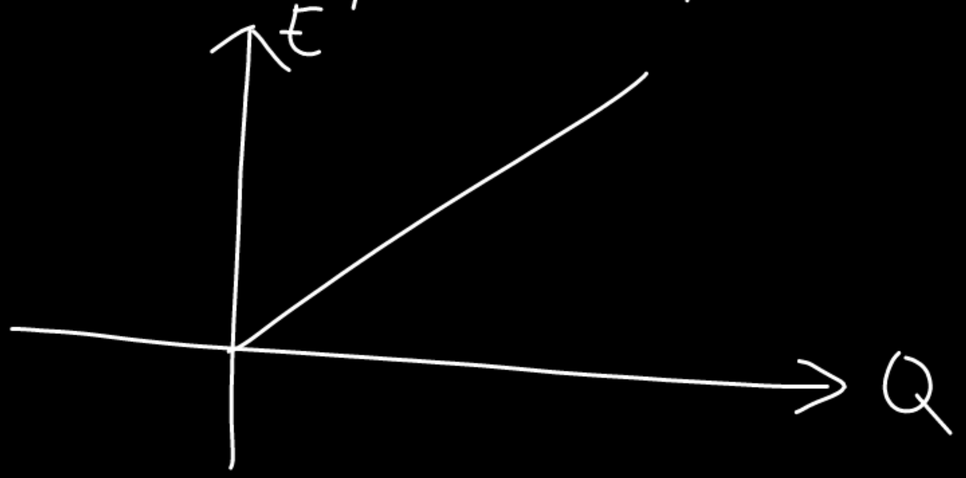
$$E \propto \frac{1}{r^2}$$

$\Rightarrow E = \frac{kQ}{r^2}$ $k = 9 \times 10^9 \ Nm^2/C^2$

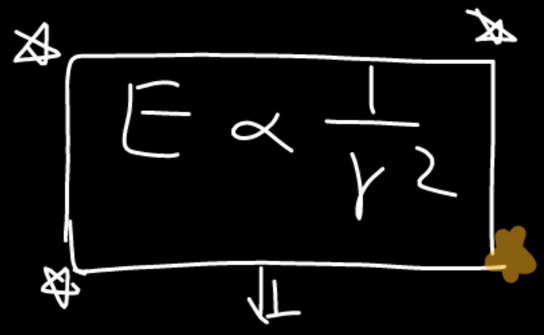
Case (1) यदि r = नियत हो :

$E \propto Q$

* आवेश ↑ → E ↑



Case (2) यदि Q = नियत

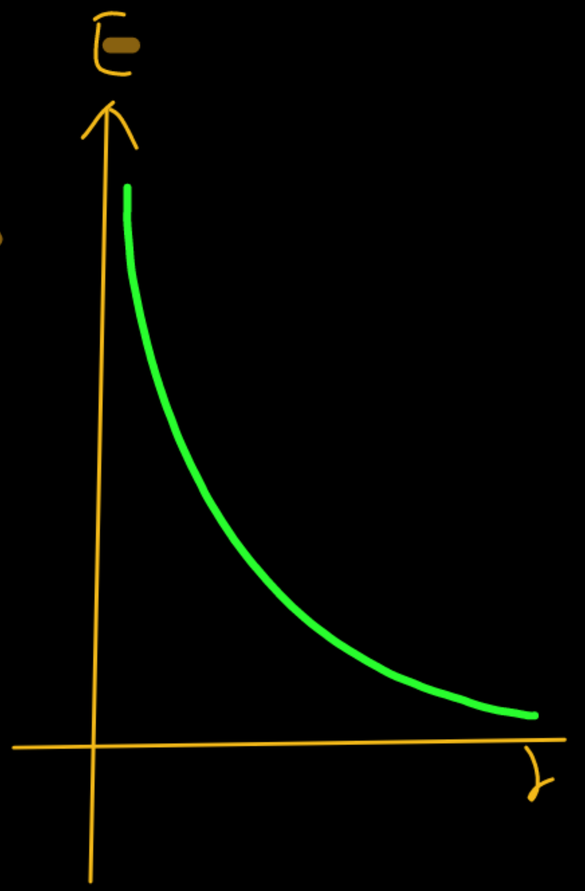


$E \propto \frac{1}{r^2}$

$E_1 \propto \frac{1}{r_1^2}$

$E_2 \propto \frac{1}{r_2^2}$

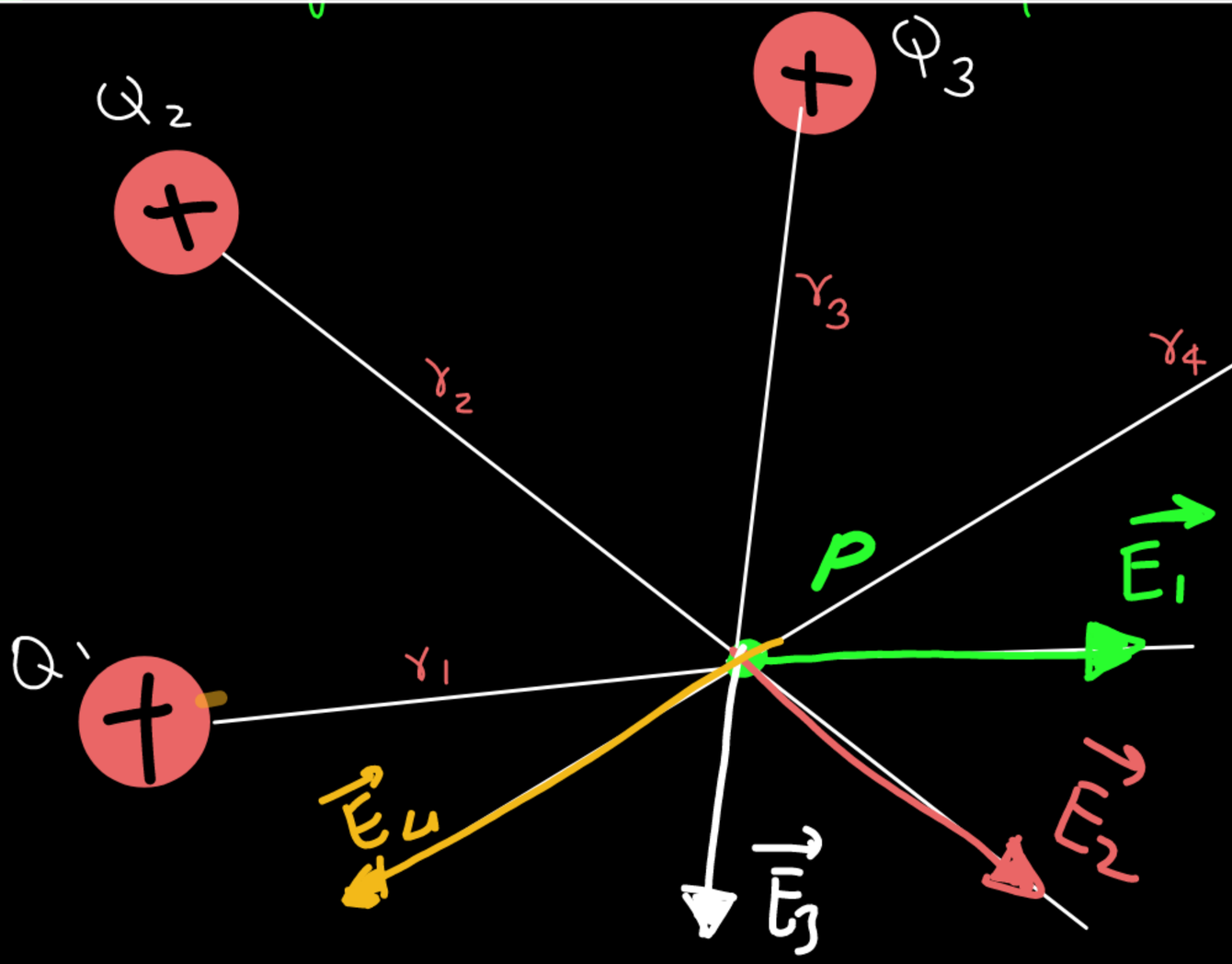
$$\frac{E_1}{E_2} = \left(\frac{r_2}{r_1}\right)^2$$



अनेक आवेशों के कारण विद्युत क्षेत्र

Electric field due to Several / multiple point charges

→ अध्यारोपण का सिद्धान्त



$$\vec{E}_{net} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 + \vec{E}_4 + \cdots + \vec{E}_n$$

$$\vec{E}_1 = \frac{kQ_1}{r_1^2}\hat{r}_1$$

$$\vec{E}_2 = \frac{kQ_2}{r_2^2}\hat{r}_2$$

$$\vec{E}_3 = \frac{kQ_3}{r_3^2}\hat{r}_3$$

$$\vdots$$

$$\vec{E}_n = \frac{kQ_n}{r_n^2}\hat{r}_n$$

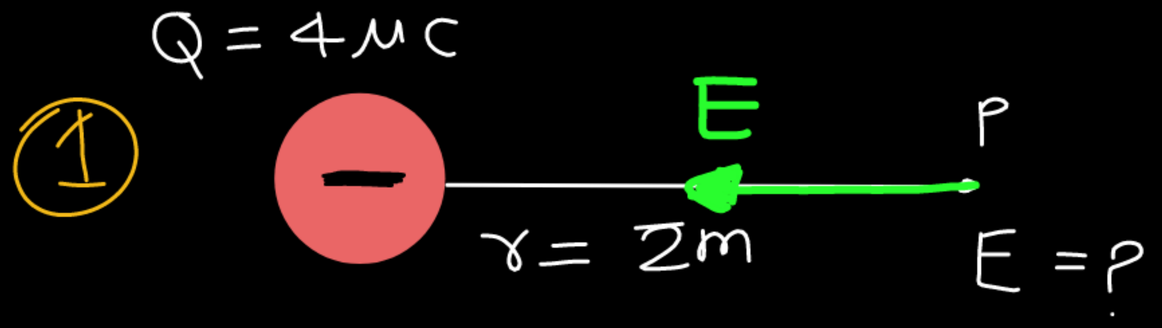
$$\vec{E}_{net} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 + \cdots\cdots + \vec{E}_n$$

$$= \frac{kQ_1}{r_1^2}\hat{r}_1 + \frac{kQ_2}{r_2^2}\hat{r}_2 + \frac{kQ_3}{r_3^2}\hat{r}_3 + \cdots\cdots$$

$$\cdots + \frac{kQ_n}{r_n^2}\hat{r}_n$$

$$= k\sum_{i=1}^{n}\frac{Q_i}{r_i^2}\hat{r}_i$$

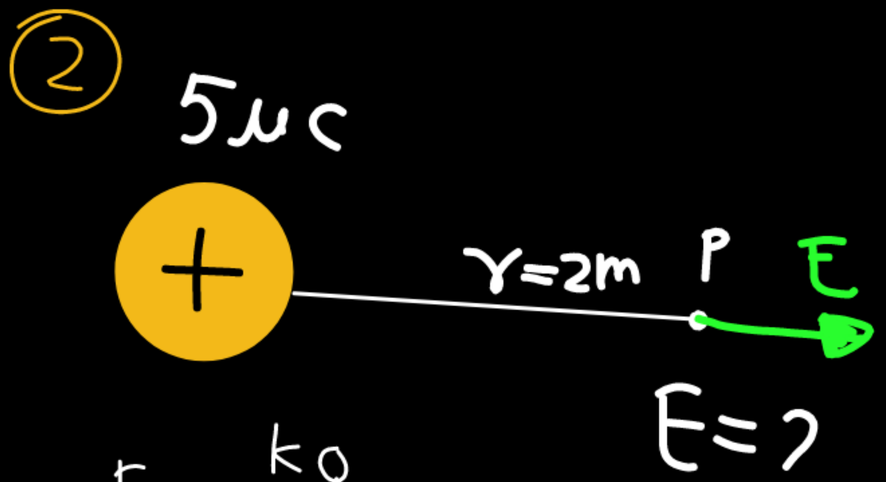
प्रश्न: दिए गए आकृति में बिन्दु 'P' पर विद्युत क्षेत्र का मान ज्ञात करे
Calculate electric field at point 'P' are given following fig.



$$E = \frac{kQ}{r^2} = \frac{9\times10^{9}\times 4\times10^{-6}}{(2)^2}$$

$$= \frac{36\times10^{3}}{4}$$

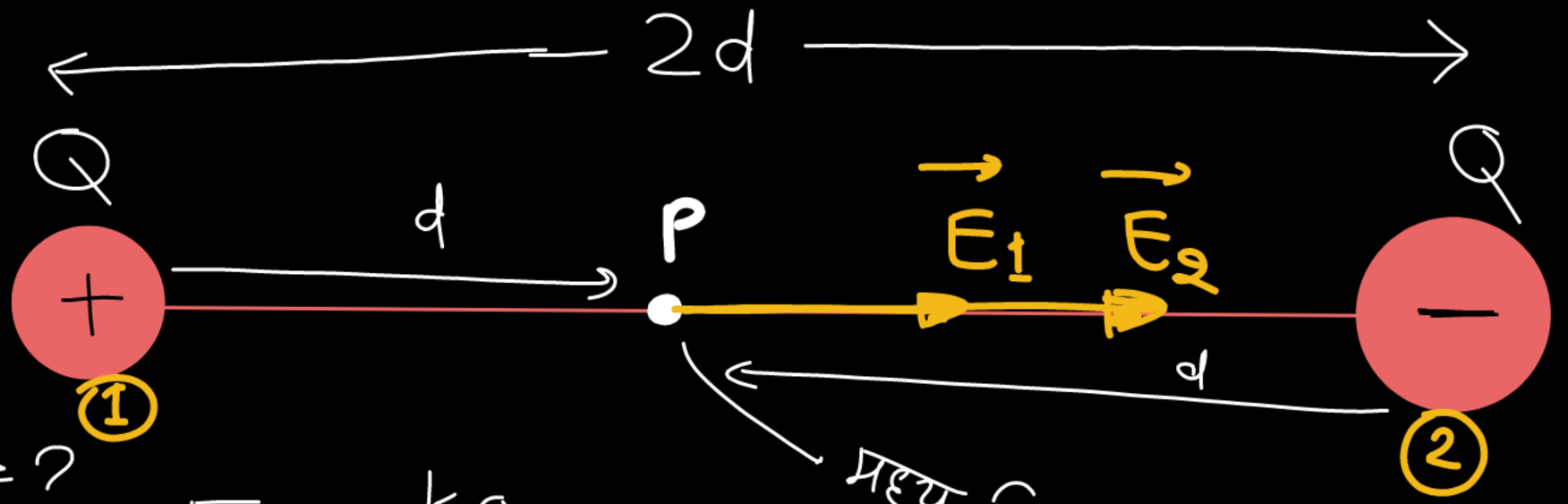
$$= 9\times10^{3}\ N/C \quad \text{OR} \quad \frac{Volt}{m}$$



$$E = \frac{kQ}{r^2}$$

$$= \frac{9\times10^{9}\times5\times10^{-6}}{2^2} = \frac{45}{4}\times10^{3}$$

③

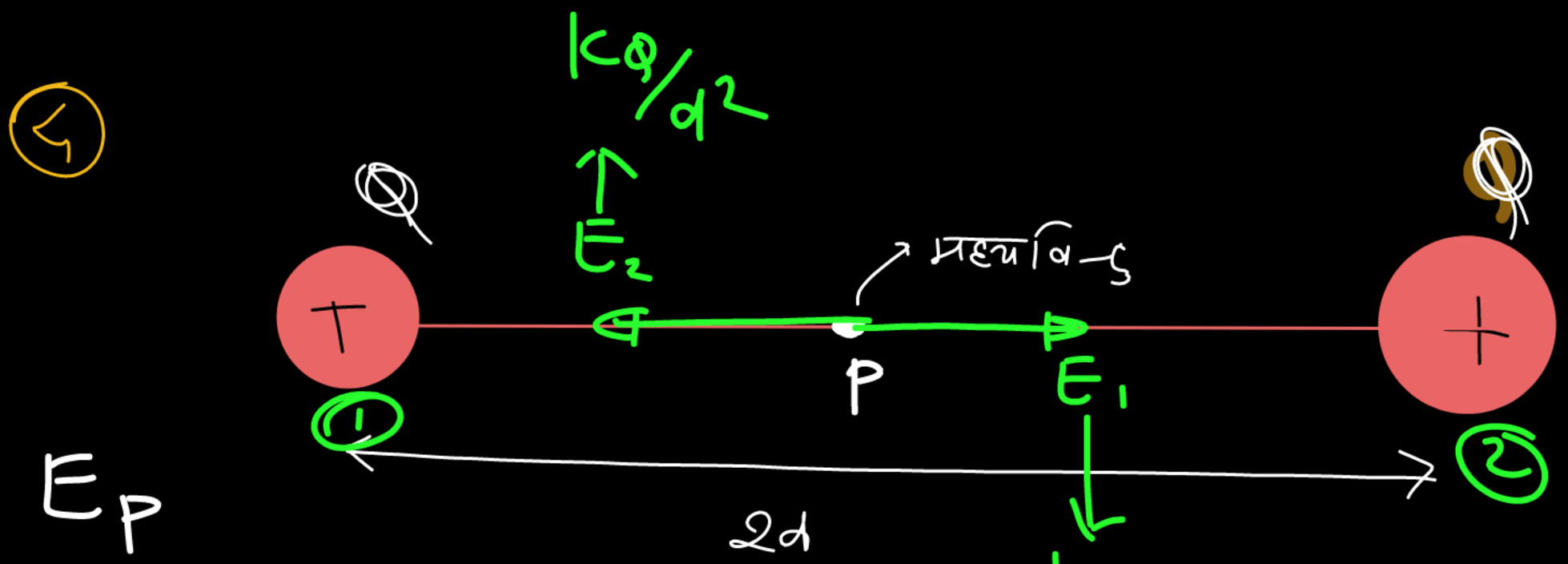


$E_P = ?$

$$E_1 = \frac{kQ}{d^2}$$

$$E_2 = \frac{kQ}{d^2}$$

$$E_T = E_1 + E_2 = \frac{kQ}{d^2} + \frac{kQ}{d^2} = \frac{2kQ}{d^2}$$

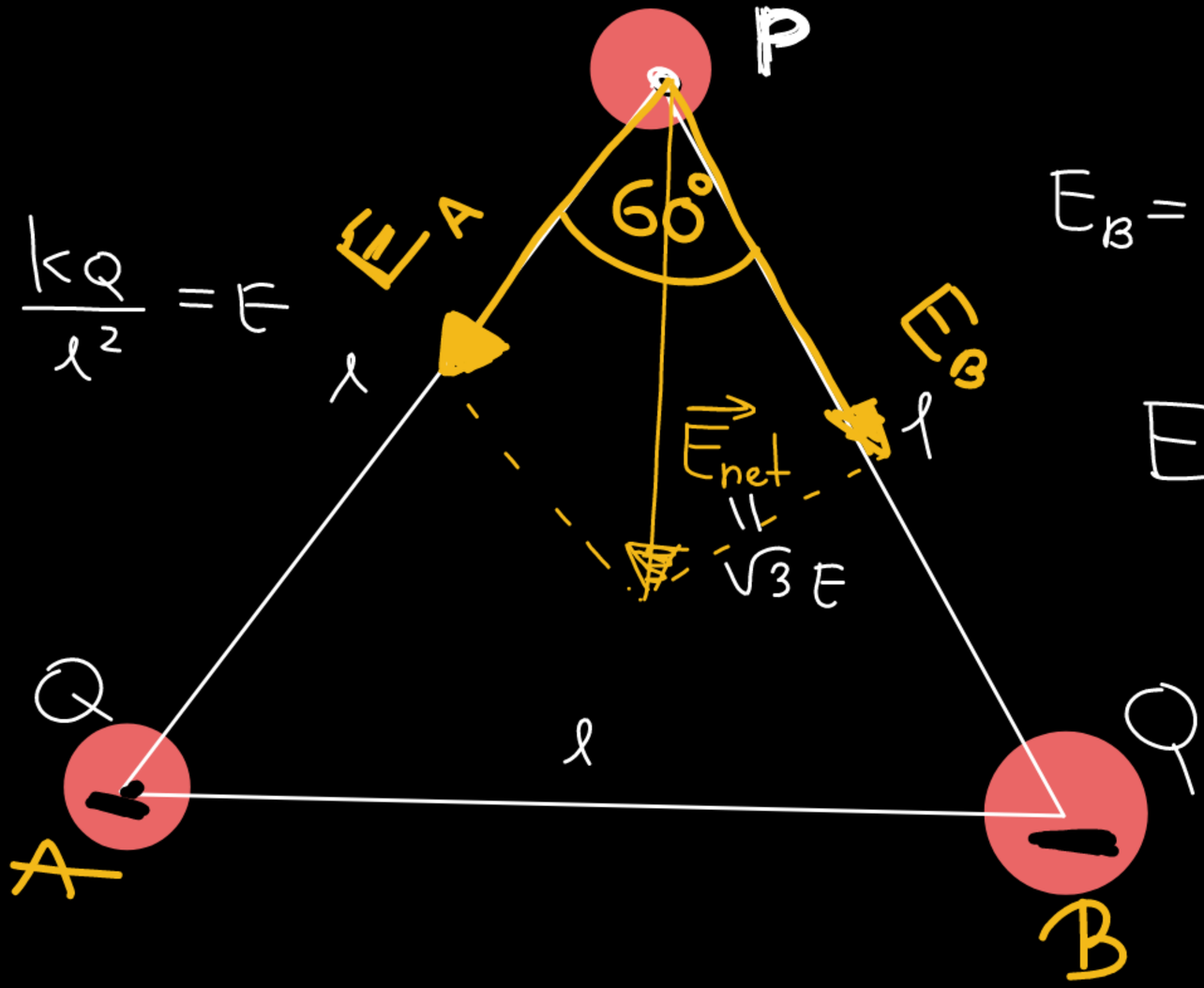


E_p

$$E_p = E_1 - E_2 \qquad \frac{kQ}{d^2}$$

$$= \frac{kQ}{d^2} - \frac{kQ}{d^2} = 0$$

(3)

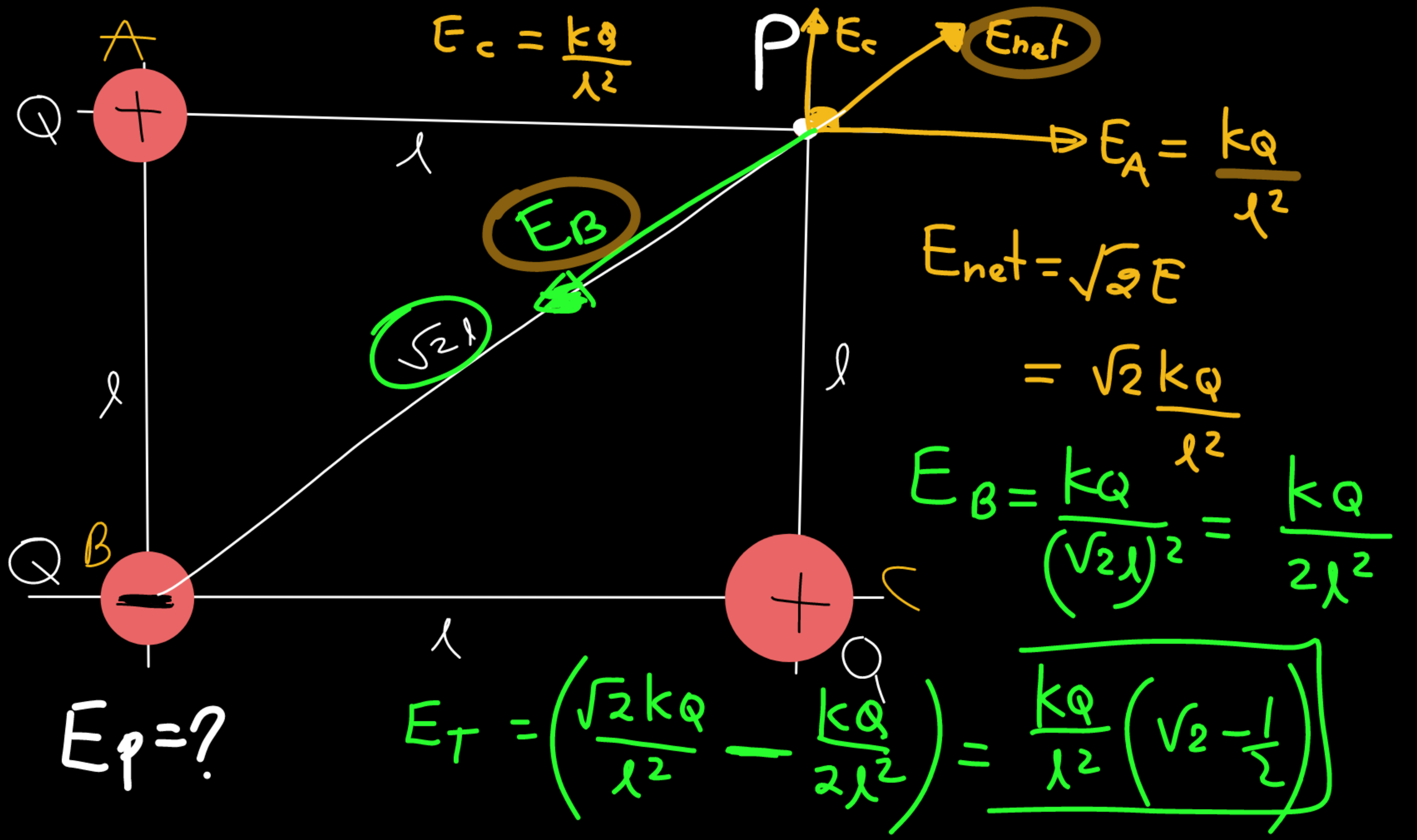


$$E_A = \frac{kQ}{l^2} = E$$

$$E_B = \frac{kQ}{l^2} = E$$

$$E_{net} = \sqrt{3}\,E$$

$$= \sqrt{3} \cdot \frac{kQ}{l^2}$$


A
Q
B
Q
C
P
$E_C = \frac{kQ}{l^2}$
E_C
E_{net}
$E_A = \frac{kQ}{l^2}$
E_B
$\sqrt{2}l$
l
l
l
$E_{net} = \sqrt{2}E$
$= \sqrt{2}\frac{kQ}{l^2}$
$E_B = \frac{kQ}{(\sqrt{2}l)^2} = \frac{kQ}{2l^2}$
$E_T = \left(\frac{\sqrt{2}kQ}{l^2} - \frac{kQ}{2l^2}\right) = \frac{kQ}{l^2}\left(\sqrt{2} - \frac{1}{2}\right)$
$E_P = ?$