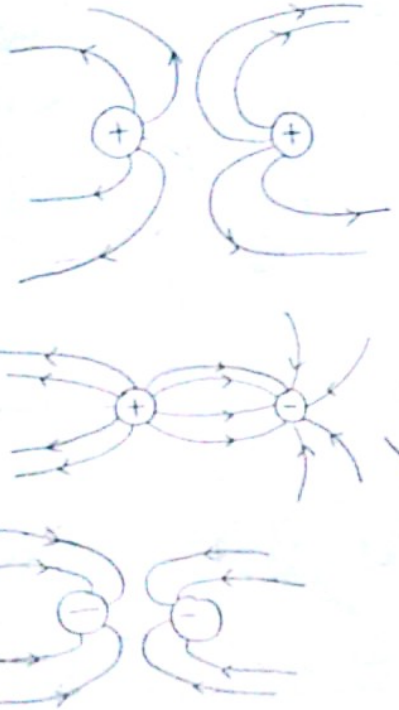
Joycelyn Su
Enyu Hsu

Electric Field ($\vec{E}$)



$k = 9 \times 10^9\ N \cdot m^2/C^2$ — mass of $e^- = 9.11 \times 10^{-31}\ kg$

constants

$$\vec{E} = \frac{\vec{F}}{q} = \frac{ma}{q}$$

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

of one point charge: $\frac{kq}{r^2}$

Proximity of lines ↑, field strength ↑

SUPERPOSITION PRINCIPLE

$$\Sigma E = E_1 + E_2 + E_3 + \dots E_n$$

$$= k\left(\frac{q_1}{r_1^2} + \frac{q_2}{r_2^2} + \frac{q_3}{r_3^2} \dots \frac{q_n}{r_n^2}\right)$$

OPPOSITE CHARGES ATTRACT!

LIKE CHARGES REPEL!!

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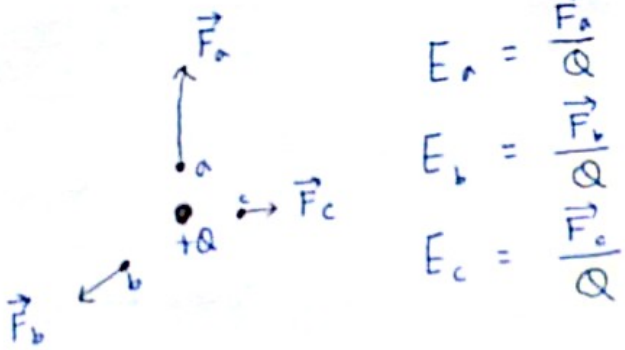
section 7

III. ELECTRICITY AND MAGNETISM
A. Electrostatics
2. Electric field and electric potential (including point charges)
a) Students should understand the concept of electric field, so they can:
(1) Define it in terms of the force on a test charge.

electric field ($\vec{E}$):

force ($\vec{F}$) exerted on a tiny positive test charge placed at that point divided by the magnitude of the test charge (q)

$$\vec{E} = \frac{\vec{F}}{q}$$



$$E_a = \frac{\vec{F}_a}{Q}$$

$$E_b = \frac{\vec{F}_b}{Q}$$

$$E_c = \frac{\vec{F}_c}{Q}$$

III. ELECTRICITY AND MAGNETISM
A. Electrostatics
2. Electric field and electric potential (including point charges)
a) Students should understand the concept of electric field, so they can:
(2) Describe and calculate the electric field of a single point charge

Electric field due to one point charge

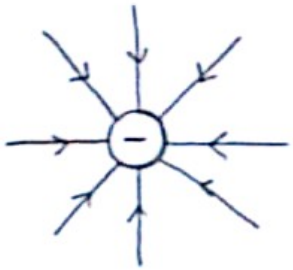
$$E = k\frac{Q}{r^2}$$

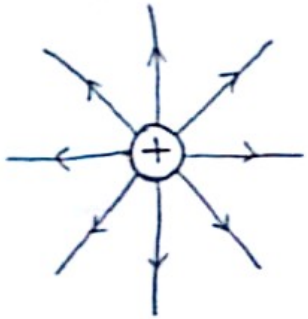
Derivation

$$\vec{E} = \frac{\vec{F}}{q} \qquad \vec{F} = \frac{kqQ}{r^2}$$

$$= \frac{kqQ/r^2}{q}$$

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





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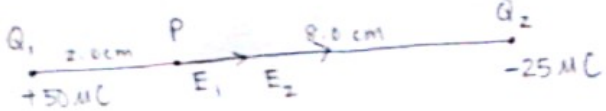
III. ELECTRICITY AND MAGNETISM

A. Electrostatics

2. Electric field and electric potential (including point charges)

a) Students should understand the concept of electric field, so they can:

(3) Calculate the magnitude and direction of the electric field produced by two or more point charges.



(opposite attracts, like repels)

Superposition principle

$$E = E_1 + E_2 + E_3 \dots E_n$$

$$= \Sigma E$$

$$= k\left(\frac{Q_1}{r_1^2} + \frac{Q_2}{r_2^2} + \dots \frac{Q_n}{r_n^2}\right)$$

$$E = E_1 + E_2$$

$$= k\frac{Q_1}{r_1^2} + k\frac{Q_2}{r_2^2}$$

$$= k\left(\frac{Q_1}{r_1^2} + \frac{Q_2}{r_2^2}\right)$$

$$= 9.0\times10^9\left[\left(\frac{50\times10^{-6}}{[2\times10^{-2}]^2}\right) + \left(\frac{25\times10^{-6}}{[8\times10^{-2}]^2}\right)\right]$$

$$= 9.0\times10^9\,[0.125 + 0.0039]$$

$$= 1.16\times10^9\ \text{N/C}$$

towards Q_2

III. ELECTRICITY AND MAGNETISM
A. Electrostatics
2. Electric field and electric potential (including point charges)
a) Students should understand the concept of electric field, so they can:
(4) Calculate the magnitude and direction of the force on a positive or negative charge placed in a specified field.

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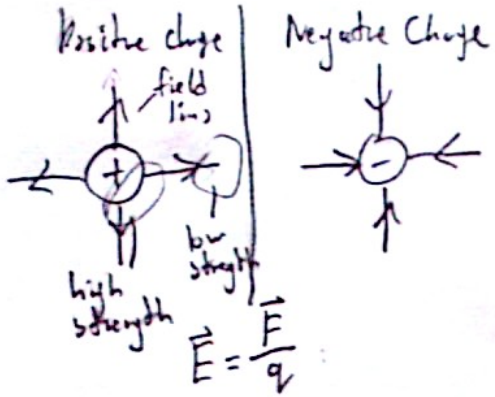


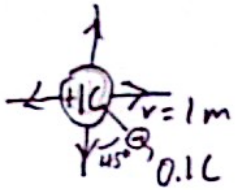
$\vec{E} = \frac{\vec{F}}{q}$

E-field due to a point charge(Q).

$E = k\frac{Q}{r^2}$

more than one charge

$\vec{E} = \vec{E}_1 + \vec{E}_2 \ldots$



$E = k\frac{Q}{r^2} = (9\times10^9\ N\cdot m^2/C^2)\frac{(1C)}{(1m)^2}$

$= 9\times10^9\ N/C$

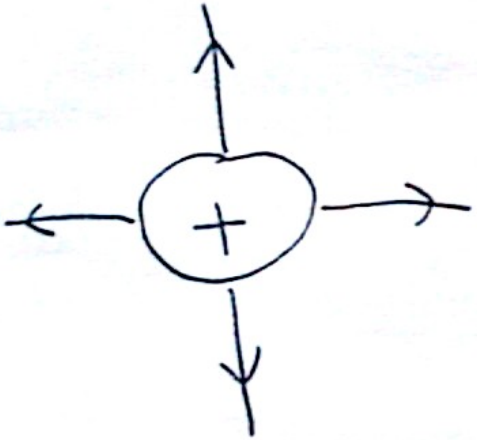
$\vec{E} = \frac{\vec{F}}{q}$ $\quad \vec{F} = \vec{E}q = (9\times10^9\ N/C)(0.1C)$

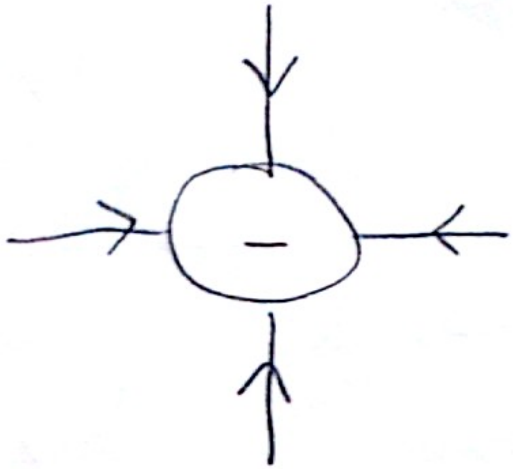
$= 9\times10^8\ N$

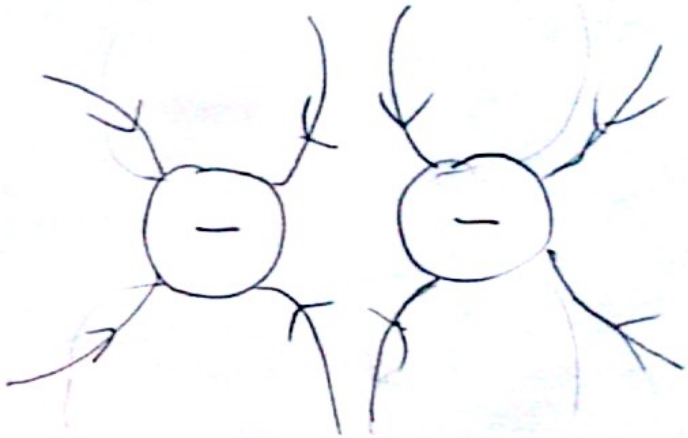
III. ELECTRICITY AND MAGNETISM
A. Electrostatics
2. Electric field and electric potential (including point charges)
a) Students should understand the concept of electric field, so they can:
(5) Interpret an electric field diagram.

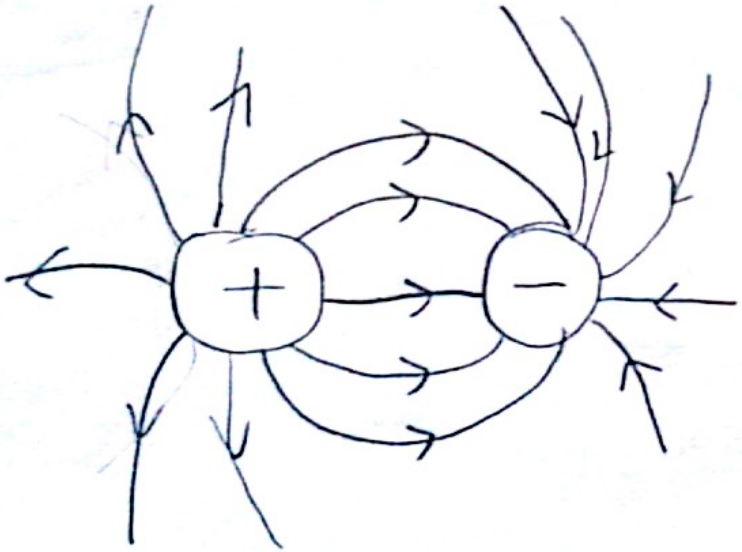
$E = \frac{F}{q} = \frac{kQ}{r^2}$

It can go to infinity.

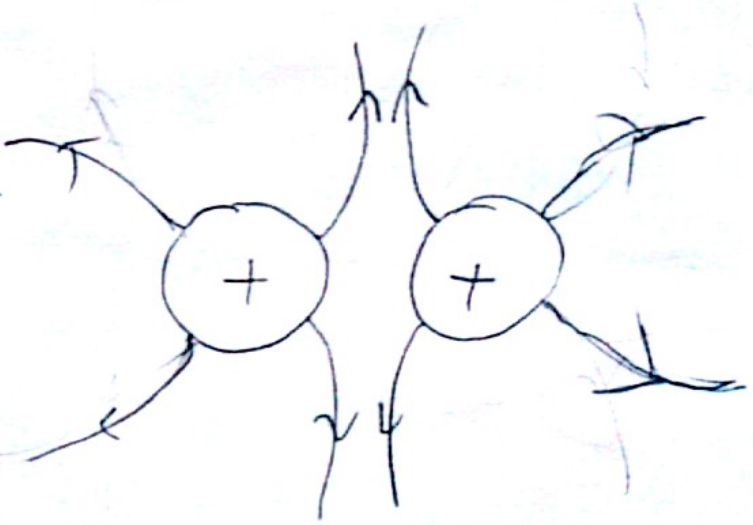








Density of the lines means the strength of the electric field.
Lines don't cross.



Ch. 16

Section 7

III. ELECTRICITY AND MAGNETISM

A. Electrostatics

2. Electric field and electric potential (including point charges)

a) Students should understand the concept of electric field, so they can:

(6) Analyze the motion of a particle of specified charge and mass in a uniform electric field.

mass of electron = 9.11×10^{-31} kg

$F = k\frac{q_1 q_2}{r^2}$

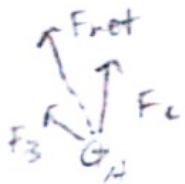
$E = \frac{F}{q} = k\frac{q}{r^2}$

$F_q = F = ma$

So $m = \frac{E_q}{q}$ (acceleration needed to get known)

opposite charges attract

like charges repel



2 main instances