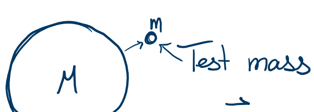
Lesson 6.2: Electric Fields

Unit 6: Electrostatics

A lit match is brought near a Van de Graaff generator. When the match gets close to the charged dome, it goes out. Why do you think this happens?

Considering Fields:

Fields are models that give framework for understanding how forces are transmitted from one object to another across empty space.

***Recall* Gravitational Field Strength**	**Electric Field Strength**
- objects with mass (m) have gravitational intensity as Force per unit mass (N/kg) $g = \frac{GM}{r^2}$  $\vec{g} = \frac{\vec{F}}{m}$	- Electric fields are regions in space in which charged objects are acted on by a force. Electric Field Strength $(\vec{E})$ is the force per unit charge acting on a test charge. so small, doesn't impact $\vec{E}$. $\vec{E} = \frac{\vec{F}}{Q}$

Example 1: Find the electric field strength if a 6.0 C charge experiences 12 N of force.

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

$$= \frac{12\,N}{6.0\,C}$$

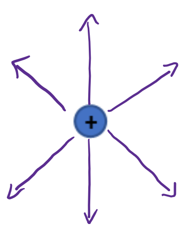
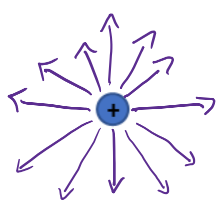
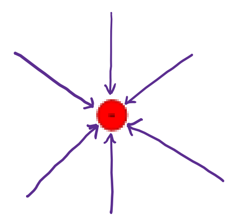
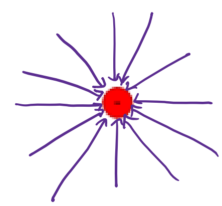
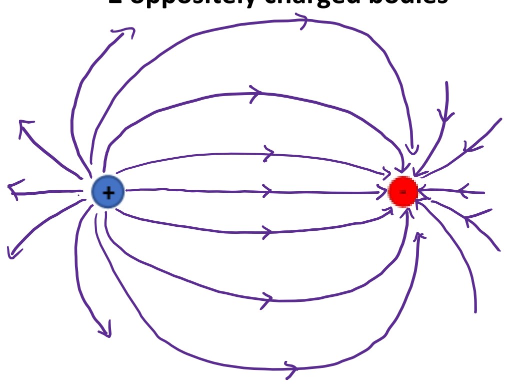
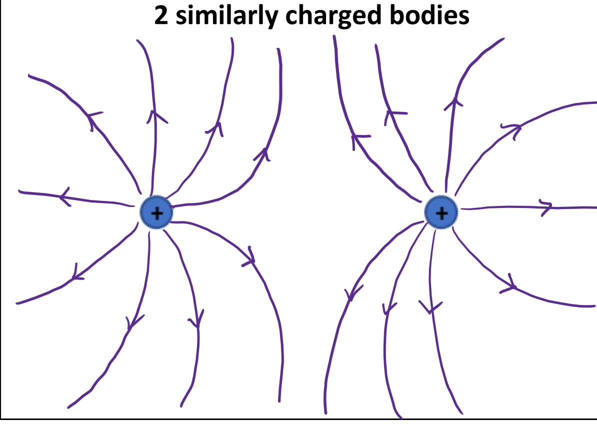
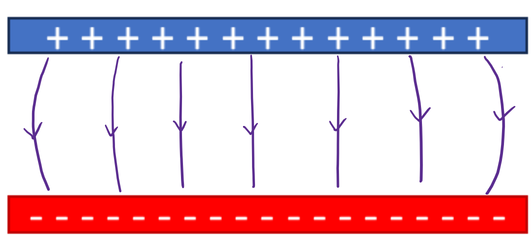
$$\boxed{\vec{E} = +2.0\,N/C}$$

+ so away from the charge
*We consider test charges to be (+) by convention.

Properties of Electric Field Lines:

1. Field lines indicate the direction of the electric field.
2. Field lines are drawn so that the magnitude of the electric field is proportional to the number of lines drawn. *The closer the lines are, the stronger the field.*
3. Electric field lines start on positive charges and end on negative charges. The greater the magnitude of charge, the greater the number of lines coming from or going to the charge.
4. Field lines never cross.

Representing Electric Field Lines:

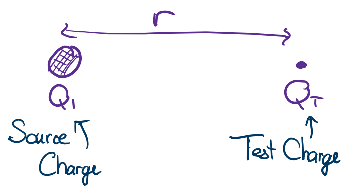
Fixed charges with different intensities:			
Low	**High**	**Low**	**High**
			
2 oppositely charged bodies		**2 similarly charged bodies**	
			
Two oppositely charged parallel metal plates			
			

Magnitude of the Electric Field Around a Source Charge:

* Keep track of the test charge

$\vec{E} = \frac{\vec{F}_e}{Q}$

$\vec{F}_e = k\frac{Q_1 Q_T}{r^2}$



$$\vec{E} = \frac{\vec{F}_e}{Q_T} = \frac{\frac{kQ_1\cancel{Q_T}}{r^2}}{\cancel{Q_T}}$$

* note that Q_T cancels so only source charge is considered.

$$\boxed{\vec{E} = \frac{kQ_1}{r^2}}$$

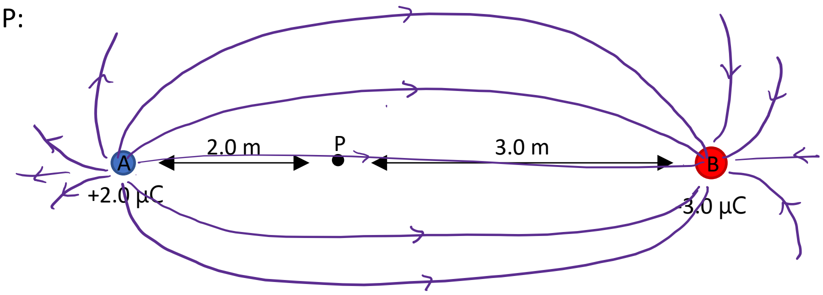
Example 2: Find the electric field strength 6.0 m from an +8.0 µC charge.

$$\vec{E} = \frac{kQ}{r^2} = \frac{(9.0\times10^9)(8.0\times10^{-6})}{(6)^2}$$

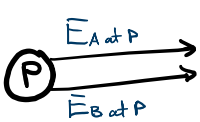
$$\boxed{= 2.0\times10^3 \ N/C}$$

Multiple Charges Creating Electric Fields:

Example 3: Calculate the net electric field at point P:



FBD: at P



* $\vec{E}$ is the same direction as $\vec{F}$ at P.

$$\vec{E}_{net} = \vec{E}_{A\ at\ P} + E_{B\ at\ P}$$

$$= \frac{kQ_A}{r_A^2} + \frac{kQ_B}{r_B^2}$$

$$= \frac{(9.0\times10^9)(2.0\times10^{-6})}{(2.0)^2} + \frac{(9.0\times10^9)(3.0\times10^{-6})}{(3.0)^2}$$

$$= 4.5\times10^3 \ N/C + 3.0\times10^3 \ N/C$$

$$\boxed{\vec{E}_{net} = 7.5\times10^3 \ N/C}$$

Assignment: Sander-Gore Pg. 178 #1-3 | Pg 179-180 #1-11