NAME: answers

U3:L2 ELECTRIC Fields

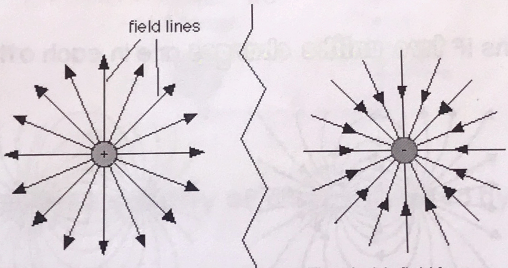
Electric fields are the region of space around a charge where a positive test charge experiences a force.

Remember that unlike forces attract, and like forces repel.

Our basic units of charge are:

- Protons (+)
- Electrons (-)

- Electrons can be easily transferred between objects.
- Something losing electrons will become more +
- Something gaining electrons will become more -
- Neutral objects have the same amount of + and -



The electric field from an isolated positive charge

The electric field from an isolated negative charge

Electric fields are drawn similarly to gravitational fields.

Direction of lines depend on the charge.

- Direction of field lines matches the direction of force.
- Field lines always start at the positive and point towards the negative charge.

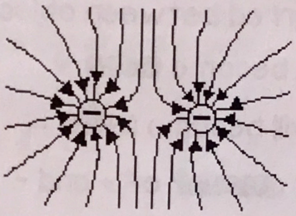
Action-at-a-Distance

Opposites can attract - even when held some distance apart.

When there is more than one charged object, we must consider the direction of field lines as they approach each other.

Action-at-a-distance forces are sometimes referred to as **field forces**. The concept of a field force is utilized by scientists to explain this rather unusual force phenomenon that occurs in the absence of physical contact. The space surrounding a charged object is affected by the presence of the charge; an electric field is established in that space.

What happens if two like charges are in each other's fields?



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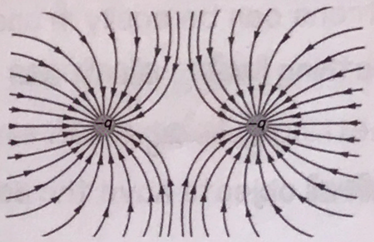
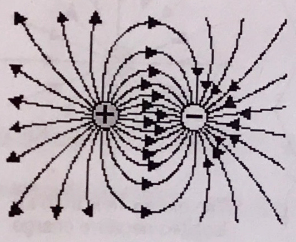


What happens if two unlike charges are in each other's fields?

☆ Remember... Force lines always start @ ⊕ and point towards ⊖



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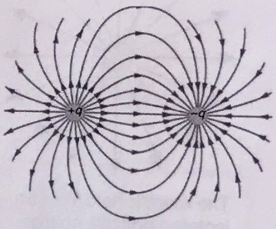
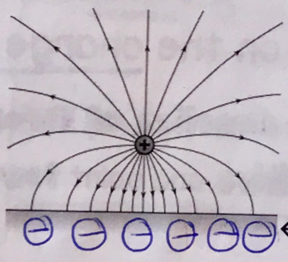


This concept also applied to charged surfaces or plates:



← **Negatively charged plate**

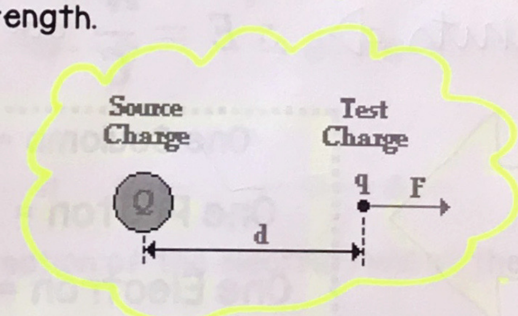
Electric Field Intensity

Electric field strength is a vector quantity; it has both magnitude and direction.

Charges are represented by the symbol **Q** in physics.

An electric charge creates an electric field; since **Q** is the source of the electric field, we will refer to it as the **source charge**.

The *strength* of the source charge's electric field could be measured by any other charge placed somewhere in its surroundings. The charge that is used to measure the electric field strength is referred to as a **test charge** since it is used to *test* the field strength.



The test charge has a quantity of charge denoted by the symbol **q**

When placed within the electric field, the test charge will experience an **electric force** - either attractive or repulsive.

As is usually the case, this force will be denoted by the symbol **F**.

Electric Field Strength → $$E = \frac{F}{q}$$ ← Force, ← Charge

Electric Field Strength → $E = \frac{F}{q}$ ← Force, Charge

This is similar to gravitational field!

$$g = \frac{F}{m} \quad and \; E = \frac{F}{q}$$

Looking at this formula, we can find the units for Electric Field Strength.

- **Force is measured in Newtons (N)**
- **Charge is measured in Coulombs (C)**

Units ⇨ $\therefore E = \frac{N}{C}$ ∘∘∘ $\frac{F}{q}$

IMPORTANT NUMBERS!!!

One Coulomb = $6.25 \times 10^{19} e^{-}$

One Proton = $+1.60 \times 10^{-19}\ C$

One Electron = $-1.60 \times 10^{-19}\ C$

Example:

What is the intensity of the electric field if a proton experiences $2.0 \times 10^{-16} N\ [W]$ at a point in a field? Draw a diagram with the answer.

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

$\mathcal{E} = \frac{2.0 \times 10^{-16}\ N\ [W]}{+1.60 \times 10^{-19}\ C}$

$\mathcal{E} = 1.25 \cdot 10^{3}\ N/C\ [W]$

Remember Exponent Laws when working with Scientific Notation

$\frac{a^m}{a^n} \Rightarrow a^{m-n}$