3.A.3 - Electric Fields Review

Magic Water!!

Electric Fields

Charges create regions of space called electric fields, which exert a force on other charges.

The strength and orientation of these fields depends on the charges, and distance between them.

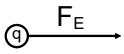
Electric Field Equation 1

If the electric force (F_E) acting on charge q is known:

AP Equation

$\vec{E} = \frac{\vec{F}_E}{q}$	Electric Field: Units N/C F_E = Electric Force (N) q = point charge (C)

Note: electric fields can be positive or negative, depending on the direction of the force, and if the charge is positive or negative.



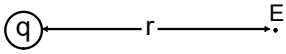
Electric Field Equation 2

To determine electric field strength due to a point charge at a distance from q:

AP Equation

$\left\vec{E}\right = k\frac{\left q\right }{r^2}$	k (Coulomb's Constant) = 9.0 E 9 N•m²/C² q = point charge (C) r = radius (m)

NOTE: In AP Resources, k is replaced by vacuum permittivity relation: $k = \frac{1}{4\pi\varepsilon_0}$



Electric Field Example

What is the electric field strength 25 cm away from a point charge of 4.4 E -10 C?

$$E = \frac{kq}{r^2} = \frac{9.0E9\,Nm^2/C^2 \bullet 4.4E{-}10C}{(0.25m)^2} = 63\frac{N}{C}$$

How does field strength change if distance doubles?

It decreases to 1/4 the original (15.8 N/C).

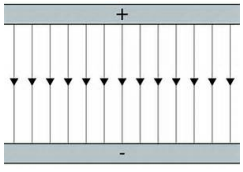
Squaring a doubled radius (in denominator) yields 1/4.

Parallel Plate Fields

The even distribution of charge across plates yields a uniform field between them (not at edges).

$E = \frac{4\pi kQ}{A}$	k = 9.0 E 9 N•m²/C² Q = Charge on ONE plate (C) A = Area of ONE plate (m²).

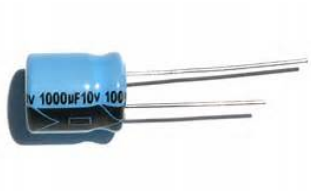
This factors in next unit: capacitors.



Parallel Plate Example:

A capacitor stores 1.2 E -10 C on one of its 0.56 m^2 plates. What's the electric field magnitude between the coils?

$$E = \frac{4\pi kQ}{A} = \frac{4\pi k \bullet 1.2E-10C}{0.56m^2} = 24\frac{N}{C}$$



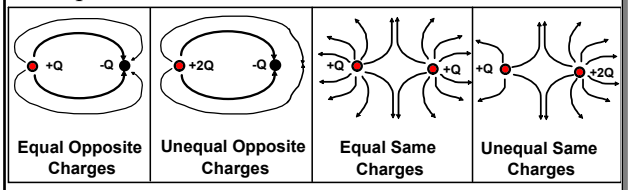
Electric Field Drawing Review

Mapping electric fields uses a hypothetical 'positive test charge' placed in the field, which responds to electric forces present.

Rules:

1. Electric field direction is tangent to field lines.
2. Field lines start at positive charges, end at negative.
3. Lines leaving/entering a charge is proportional to the charge.
4. Field lines never cross.

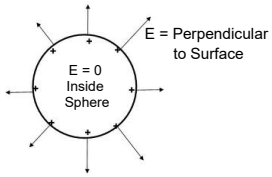
Examples:



Some Conductor Rules

Electrostatic Field: Charges resting on a charged conductor exert force on other charged particles.

1. Electric field inside a charged conductor is zero.
2. Excess charges on a conductor are on its surface.
3. The electric field at the surface of a charged conductor is perpendicular to the surface.



Van De Graaf Generator Demo

Electric charges build up on the dome, and discharge when they reach a certain level.

If there's a point on the generator, charges accumulate there, and are discharged more readily.

Homework

3.A.3 Problems

Finish Unit 3.A Review Problems