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Electrostatic Potential and Capacitance

2.1 Electrostatic Potential

Imagine a world where every charge has a special superpower called "potential energy." This superpower is like a secret energy that's stored in the charge, waiting to be released. The more powerful the charge, the more potential energy it has. Now, let's say we have a positive charge, like a little superhero. We want to bring another positive charge, like a tiny sidekick, close to our superhero. As we bring the sidekick closer, we have to do some work against the superhero's superpower. This work is like pushing against a strong force, and it's stored as potential energy in the sidekick. The amount of potential energy the sidekick gains depends on how powerful the superhero is (its charge) and how close we bring the sidekick (the distance between them). The closer we bring the sidekick, the more potential energy it gains.

2.2 Potential Due to a Point Charge

Just like a superhero's superpower, the potential energy of a charge creates a special area around it called an "electric field." The electric field is like a force field, and it gets stronger as we get closer to the charge. The potential energy of a charge at a particular point in the electric field is called the "electrostatic potential." It's like the amount of potential energy a sidekick would gain if we brought it to that point. The formula for electrostatic potential due to a point charge is: $V = (1/4\pi\varepsilon_0) * (Q/r)$, where Q is the charge, r is the distance from the charge, and ε_0 is a special number called the permittivity of free space.

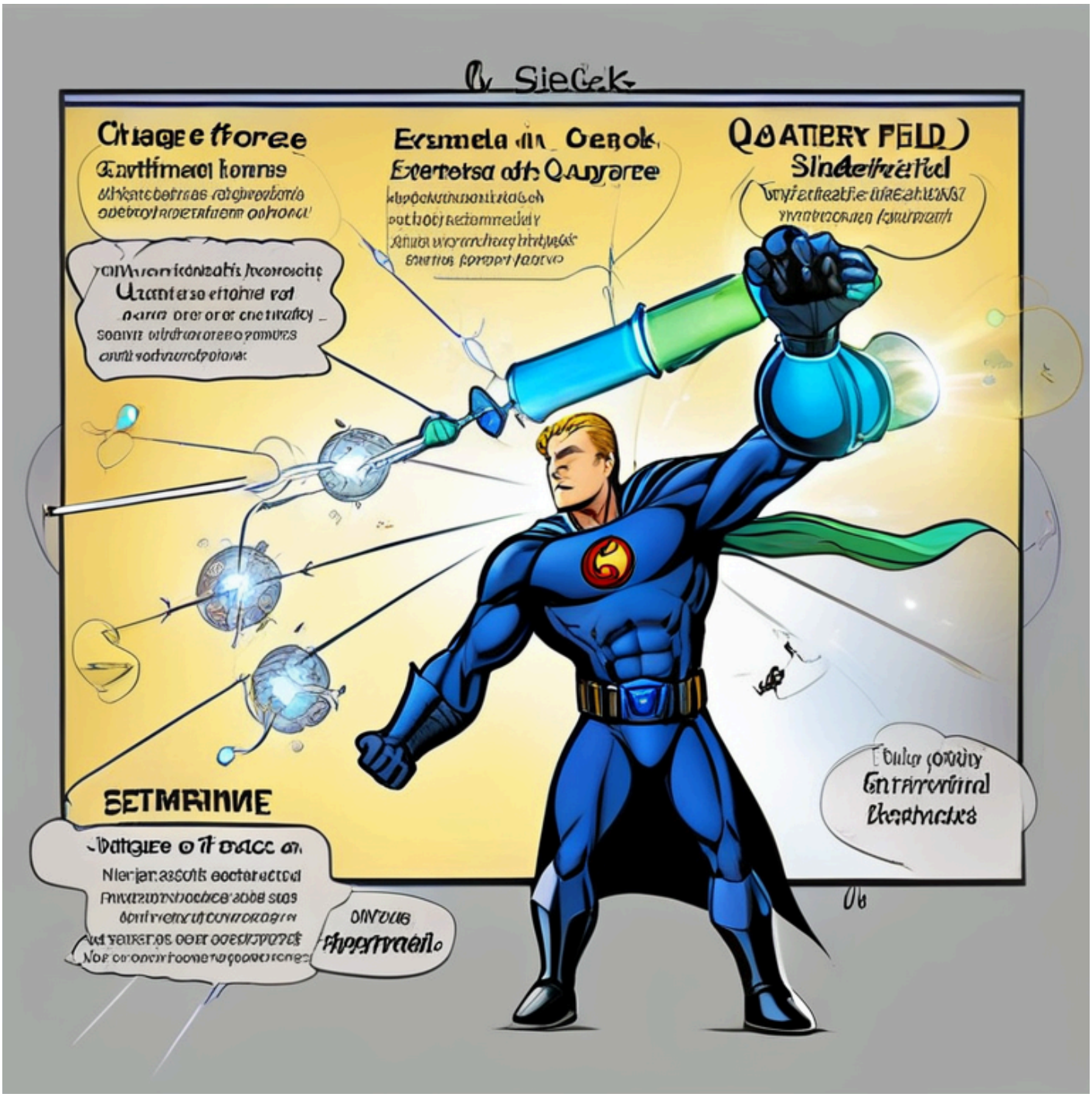
2.3 Potential Due to a System of Charges

Now, let's imagine we have a bunch of superheroes and sidekicks, all with different powers. The potential energy of each superhero and sidekick creates their own electric fields. The total potential energy of all the charges in the system is the sum of the potential energies due to each individual charge. This is like adding up the superpowers of all the superheroes and sidekicks.

2.4 Potential Energy of a System of Charges

The potential energy of two superheroes or sidekicks with different powers depends on the strength of their powers and the distance between them. The formula for potential energy between two charges is: U = k * q1 * q2 / r, where q1 and q2 are the charges, r is the distance between them, and k is another special number called the Coulomb constant.

2.5 Potential Energy of a Charge in an External Field



Sometimes, our superheroes and sidekicks find themselves in a special force field created by an external source, like a battery. This force field can affect their potential energy. The potential energy of a charge in an external force field is the product of the charge and the potential at that point in the force field. The formula for potential energy in an external field is: U = q * V, where q is the charge and V is the potential.