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Electrostatics - Introduction to Electric Charges and Fields

Objective: To understand the basics of electric charges, the electric field concept, and Coulomb's Law.

1. Electric Charges

Definition: Electric charge is a fundamental property of matter that causes it to experience a force when placed in an electromagnetic field. There are two types of electric charges: positive (+) and negative (−).

Properties: Like charges repel each other, and unlike charges attract each other. Charge is conserved: the total charge is the same before and after any interaction.

2. Electric Fields

Definition: An electric field is a region around a charged object where the object's electric charge exerts a force on other charged objects.

Representation: Electric fields are represented by electric field lines starting from positive charges and ending at negative charges.

3. Coulomb's Law
Statement: Coulomb's Law quantifies the amount of force between two stationary, electrically charged particles. The formula is:

$$F = k \, |q1 \,.\, q2|/r^2$$

where F is the force between charges, q1 and q2 are the amounts of the charges, r is the distance between the centers of the two charges, and k is Coulomb's constant (8.987 × 10^9 Nm^2/C^2)

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In-Class Problems

Problem 1: Charge Interaction

Question: Two charges, +3μC and −3μC, are placed 2 meters apart. Determine the force exerted on each other. Are they attracted or repelled?

Problem 2: Electric Field Concept

Question: If a positive test charge is placed near a negative charge, in which direction will the electric field at the point of the test charge point?

Problem 3: Applying Coulomb's Law

Question: Calculate the force between two electrons placed 1 angstrom (10^{-10} m) apart. Use the charge of an electron ($−1.6×10^{−19}$ C).