The **electrostatic force** is the force of attraction or repulsion between two charged objects due to their electric charges. It is a fundamental force in nature and is described by **Coulomb's Law**. Here's a breakdown of the key concepts:

Coulomb's Law

Coulomb's Law states that the electrostatic force (F) between two point charges is directly proportional to the product of their charges (q_1 and q_2) and inversely proportional to the square of the distance (r) between them. Mathematically:

$$F = k_e \frac{|q_1 q_2|}{r^2}$$

Where:

F = electrostatic force (in Newtons, N)

q_1, q_2 = magnitudes of the charges (in Coulombs, C)

r = distance between the charges (in meters, m)

k_e = Coulomb's constant ()

Key Properties of Electrostatic Force

. **Direction**: The force is attractive if the charges are of opposite signs (one positive, one negative) and repulsive if the charges are of the same sign (both positive or both negative).

. **Inverse-square law**: The force decreases with the square of the distance between the charges.

. **Conservative force**: The work done by the electrostatic force in moving a charge between two points is independent of the path taken.

. **Superposition principle**: The total force on a charge due to multiple charges is the vector sum of the individual forces exerted by each charge.

Comparison with Gravitational Force

Electrostatic force is much stronger than gravitational force (about 10^{36} times stronger for elementary particles).

Gravitational force is always attractive, while electrostatic force can be attractive or repulsive.

Applications of Electrostatic Force

. **Atomic structure**: Holds electrons in orbit around the nucleus.

. **Electric circuits**: Drives the movement of electrons in conductors.

. **Electrostatic precipitators**: Used to remove particles from air in industrial settings.

. **Inkjet printers**: Use electrostatic forces to direct ink droplets onto paper.

. **Van de Graaff generators**: Generate high voltages using electrostatic principles.

Example Calculation

Calculate the electrostatic force between two charges of $1\ \mathrm{C}$ each, separated by a distance of $1\ \mathrm{m}$.
Using Coulomb's Law:

$$F = (8.99 \times 10^9) \frac{(1)(1)}{1^2} = 8.99 \times 10^9\ \mathrm{N}$$

This is an enormous force, illustrating why charges in everyday situations are typically much smaller (e.g., microcoulombs, μC).