Summary of chapter 23

I. Objective:

1. Calculate the electrostatic force between charged particles.

2. Calculate the electric field **E** (magnitude and direction) at a specific region close to a group of point charges.

3. Calculate the electric field due to a continuous charge distribution.

4. Describe the motion of charged particle in a uniform electric field.

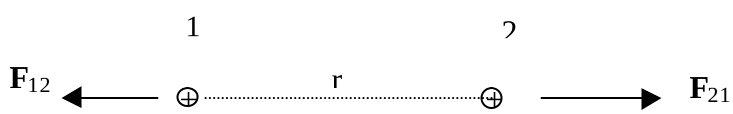
II. Summary of major points:

1. Coulomb's Law state that the electrostatic force between two charged particles separated by a distance *r* is given by:

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

Where $k = 9\times10^9\ N.m^2/C^2$ is Coulomb constant, q_1 and q_2 are the charges of the two particles and *r* is the distance between the two charges.

* If the two charges have same signs, there is **repulsion** between them.



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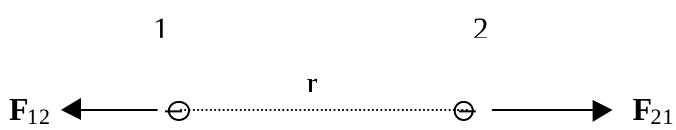
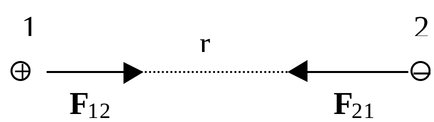


- If the two charges have opposite signs, there is **attraction** between them.



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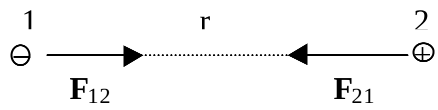
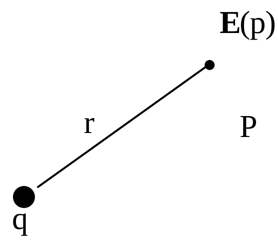


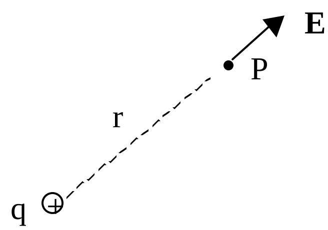
2. The electric field due to a point charge q at a distance r from the charge is given by:

$$E = \frac{kq}{r^2}$$

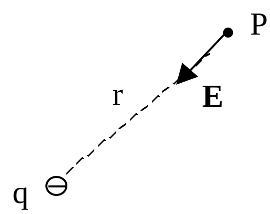


The electric field is a **VECTOR** and r is the distance between the charge and the point P where we would like to calculate the electric field.

* If the charge is **positive,** the electric is directed radially outward from the charge.



* If the charge is **negative,** the electric field is directed radially inward.



3. For a continuous charge distribution, the electric field is given by

$$\vec{E} = k\int \frac{dq}{r^2}\hat{r}$$

* For a line charge (one dimensional problem) see example 23.10 in the textbook.

* For a ring charge see example 23.11 in the textbook.

* For a disk charge (two dimentional problem) see example 23.12 in the textbook.

- For an infinite sheet $E = \dfrac{\sigma}{2\in_o}$, where charge density, $\sigma = \dfrac{Q}{A}$.

In a one dimensional problem : $dq = \lambda dl$ where λ is the linear charge density with units of (C/m)

In a two dimensional problem: $dq = \sigma\, dA$ where s is the surface charge density with units (C/m^2)

In a three dimensional problem: $dq = \rho\, dV$ where ρ is the volume charge density with units (C/m^3)

4. A charge particle of mass m and charge q experiences a **constant acceleration in a uniform electric field**. The acceleration is given by;

$$\vec{a} = \frac{q\vec{E}}{m}$$

because the electric force $\vec{F} = m\vec{a} = q\vec{E}$ (From Newton's second law).

5. If the charge is positive, the electric force and the electric field are in the same Direction (The charge will move in the direction of the electric field).

If the charge is negative, it will move opposite to the direction electric field.