

ELECTROSTATICS

Important Points and Notes

- ❖ If the net charge is zero in the object, it is said to be electrically neutral.
- ❖ A negatively charged rubber rod is attracted to a positively charged glass rod.
- ❖ A negatively charged rubber rod is repelled by another negatively charged rubber rod.
- ❖ Charging the objects through rubbing is called triboelectric charging.
- ❖ The total electric charge in the universe is constant and charge can neither be created nor be destroyed. In any physical process, the net change in charge will always be zero.
- ❖ The strength of the force between the two charges in water is reduced by 80 times compared to the force between the same two charges in vacuum.
- ❖ When common salt (NaCl) is taken in water, the electrostatic force between Na and Cl ions is reduced due to the high relative permittivity of water ($\epsilon_r = 80$). This is the reason water acts as a good solvent.
- ❖ Without the superposition principle, Coulomb's law will be incomplete when applied to more than two charges. Both the superposition principle and

Coulomb's law form fundamental principles of electrostatics and explain all the phenomena in electrostatics. But they are not derivable from each other.

- ❖ The total force acting on a given charge is equal to the vector sum of forces exerted on it by all the other charges.
- ❖ Two equal and opposite charges separated by a small distance constitute an electric dipole.
- ❖ Microwave oven works on the principle of torque acting on an electric dipole. The food we consume has water molecules which are permanent electric dipoles. Oven produces microwaves that are oscillating electromagnetic fields and produce torque on the water molecules. Due to this torque on each water molecule, the molecules rotate very fast and produce thermal energy. Thus, heat generated is used to heat the food.
- ❖ The electric potential at a point P is equal to the work done by an external force to bring a unit positive charge with constant velocity from infinity to the point P in the region of the external electric field \vec{E} .
- ❖ An equipotential surface is a surface on which all the points are at the same potential.
- ❖ The number of electric field lines crossing a given area kept normal to the electric field lines is called electric flux.

- ❖ Gauss law is a powerful technique whenever a given charge configuration possesses spherical, cylindrical or planer symmetry, then the electric field due to such a charge configuration can be easily found. If there is no such symmetry, the direct method (Coulomb's law and calculus) can be used. For example, it is difficult to use Gauss law to find the electric field for a dipole since it has no spherical, cylindrical or planar symmetry.
- ❖ When the external electric field applied to a dielectric is very large, it tears the atoms apart so that the bound charges become free charges. Then the dielectric starts to conduct electricity. This is called dielectric breakdown.
- ❖ The capacitance C of a capacitor is defined as the ratio of the magnitude of charge on either of the conductor plates to the potential difference existing between the conductors.
- ❖ While deriving an expression for capacitance of the parallel plate capacitor, the expression of the electric field for infinite plates is used. But for finite sized plates, the electric field is not strictly uniform between the plates. At both edges, the electric field is bent outwards. This is called "fringing field". However under the condition ($d^2 \ll A$), this effect can be ignored.

- ❖ Sometimes we notice that the ceiling fan does not start rotating as soon as it is switched on. But when we rotate the blades, it starts to rotate as usual. Why it is so? We know that to rotate any object, there must be a torque applied on the object. For the ceiling fan, the initial torque is given by the capacitor widely known as a condenser. If the condenser is faulty, it will not give sufficient initial torque to rotate the blades when the fan is switched on.
- ❖ Computer keyboard keys are constructed using capacitors with a dielectric. When the key is pressed, the separation between the plates decreases leading to an increase in the capacitance. This in turn triggers the electronic circuits in the computer to identify which key is pressed.
- ❖ Van de Graff generator works on the principle of electrostatic induction and action at points.