

ELECTRIC POTENTIAL AND CAPACITANCE

Class 12 - Physics

Time Allowed: 1 hour

Maximum Marks: 20

General Instructions:

All questions are Compulsory

Draw diagram where necessary.

Write all assumptions

1. No work is done in moving test charge over an equi-potential surface. Why? [1]
2. What is electrostatic shielding? How is this property used in actual practice? Is the potential in the cavity of a charged conductor zero? [2]
3. The electric field due to a point charge at a distance r depends according to the inverse square law $\left(\propto \frac{1}{r^2}\right)$. State how the following quantities depend upon r : [2]
 - i. potential due to a point charge
 - ii. potential at a distance r from the centre of a charged metallic sphere of radius R ($r < R$).
4. Prove that a closed equipotential surface with no charge within itself must enclose an equipotential volume. [2]
5. Obtain the expression for the potential due to an electric dipole of dipole moment p at a point d on the axial line. [2]
6. Show that the capacitance of a spherical conductor is $4\pi\epsilon_0$ times the radius of the spherical conductor. [2]
7. An electric dipole is held in a uniform electric field $\vec{E}$. [3]
 - a. Show that the net force acting on it is zero.
 - b. The dipole is aligned with its dipole moment $\vec{p}$ parallel to the field $\vec{E}$

Find:

 - i. the work done in turning the dipole till its dipole moment points in the direction opposite to $\vec{E}$.
 - ii. the orientation of the dipole for which the torque acting on it becomes maximum.
8. i. Show that in a parallel plate capacitor, if the medium between the plates of a capacitor is filled with an insulating substance of dielectric constant K , its capacitance increases. [3]
 - ii. Deduce the expression for the energy stored in a capacitor of capacitance C with charge Q .
9. Find the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if (i) a dielectric slab of thickness f and (ii) a metallic slab of thickness f , where ($t < d$) by one between the plates of the capacitor. In which case would the capacitance be more and why? [3]