**GRADE XII** **PHYSICS**

# LONG ANSWER QUESTIONS

1. Find the expression for the electric field intensity and the electric potential, due to a dipole at a point on the equatorial line. Would the electric field be necessarily zero at a point where the electric potential is zero?
2. (a) Obtain the expression for the potential due to a point charge. (b) Use the above expression to show that the potential, due to an electric dipole (length 2a), varies as the 'inverse square' of the distance r of the 'field point' from the centre of the dipole for r>> a.

3. Define the term electric dipole moment. Derive an expression for the total work done in rotating the dipole through an angle θ in uniform electric field E .
4. Derive an expression for the potential energy of an electric dipole placed in a uniform electric field. Hence discuss the conditions of its stable and unstable equilibrium.
5. (a) Explain why, for any charge configuration, the equipotential surface through a point is normal to the electric field at that point. Draw a sketch of equipotential surfaces due to a single charge (-q), depicting the electric field lines due to the charge.
   (b) Obtain an expression for the work done to dissociate the system of three charges placed at the vertices of an equilateral triangle of side 'a' as shown here.

6. 6. (a) Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in terms of plate area A and separation d between the plates.
(b) A slab of material of dielectric constant κ has the same area as the plates of a parallel plate capacitor but has a thickness 3d/4. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

7. (i) Distinguish, with the help of a suitable diagram, the difference in the behaviour of a conductor and a dielectric placed in an external electric field. How does polarised dielectric modify the original external field ?
(ii) If two similar large plates, each of area A having surface charge densities + σ and –σ are separated by a distance d in air, find the expressions for (a) field at points between the two plates and on outer side of the plates. Specify the direction of the field in each case (b) the potential difference between the plates (c) the capacitance of the capacitor so formed.

8. Obtain the expression for the capacitance of a parallel plate capacitor.Three capacitors of capacitances C1, C2 and C3 are connected (i) in series, (ii) in parallel. Show that the energy stored in the series combination is the same as that in the parallel combination.
(a) Derive the expression for the energy stored in a parallel plate capacitor. Hence obtain the expression for the energy
density of the electric field.
(b) A fully charged parallel plate capacitor is connected across an uncharged identical capacitor. Show that the energy stored in the combination is less than that stored initially in the single capacitor.

9. Define the terms (i) capacitance of a capacitor (ii) dielectric strength of a dielectric. When a dielectric is inserted between the plates of a charged parallel plate capacitor, fully occupying the intervening region, how does the polarization of the dielectric medium affect the net electric field ? For linear dielectrics, show that the introduction of a dielectric increases its capacitance by a factor κ, characteristic of the dielectric.

10. 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 t and (ii) a metallic slab of thickness t, where (t < d) are

introduced one by one between the plates of the capacitor. In which case would the capacitance be more and why ?

11. What is a dielectric ? A dielectric slab of thickness t is kept between the plates of a parallel plate capacitor separated by distance d. Derive the expression for the capacitance of the capacitor for t << d.