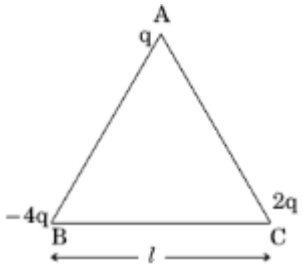
GALAXY ACADEMY

CHAPTERWISE TEST SERIES 1234 CHAP

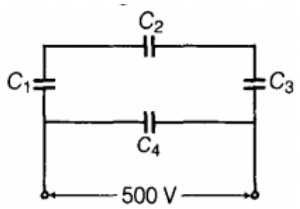
Class 12 - Physics

Time Allowed: 2 hours **Maximum Marks: 45**

1. A point charge is placed at the centre of the spherical Gaussian surface. How will electric flux ϕ_E change if **[2]**
   i. the sphere is replaced by a cube of the same or different volume,
   ii. a second charge is placed near, and outside, the original sphere,
   iii. a second charge is placed inside the sphere, and
   iv. the original charge is replaced by an electric dipole?
2. Using Gauss's law in electrostatics, deduce an expression for electric field intensity due to a uniformly charged infinite plane sheet. If another identical sheet is placed parallel to it, show that there is no electric field in the region between the two sheets. **[3]**
3. i. Three point charges q, – 4q and 2q are placed at the vertices of an equilateral triangle ABC of side l as shown in the figure. Obtain the expression for the magnitude of the resultant electric force acting on the charge q. **[5]**

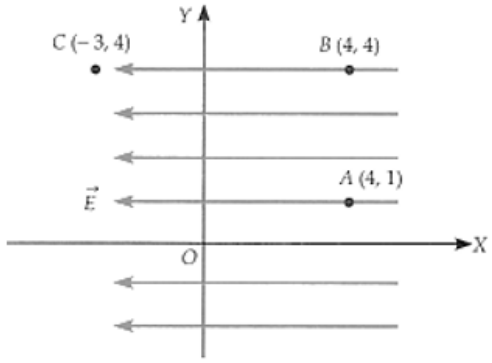


   ii. Find out the amount of the work done to separate the charges at infinite distance.
4. The electric field due to a point charge at a distance r depends according to the inverse square law $\left(\propto \frac{1}{r^2}\right)$. **[2]**
   State how the following quantities depend upon r:
   i. potential due to a point charge
   ii. potential at a distance r from the centre of a charged metallic sphere of radius R (r < R).
5. A network of four capacitors each of 12 μF capacitance, if connected to a 500V supply as shown in the figure **[3]**



   Determine
   i. the equivalent capacitance of the network and
   ii. the charge on each capacitor.
6. A uniform electric field $\vec{E}$ of 300 NC^{-1} is directed along the negative X-axis. A, B and C are three points in the field, having x and y coordinates (in metre), as shown in Fig. Find the potential differences ΔV_{BA}, ΔV_{CB} and **[3]**

ΔV_{CA}.



7. i. A. Why does the electric field inside a dielectric slab decrease when kept in an external electric field? **[5]**
   B. Derive an expression for the capacitance of a parallel plate capacitor filled with a medium of dielectric constant K.
   ii. A charge q = 2 μC is placed at the centre of a sphere of radius 20 cm. What is the amount of work done in moving 4 μC from one point to another point on its surface?
   iii. Write a relation for polarisation $\vec{P}$ of a dielectric material in the presence of an external electric field.
8. What is the difference between resistance and resistivity? **[2]**
9. i. Two cells of emf E_1 and E_2 have their internal resistances r_1 and r_2, respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other. **[3]**
   ii. In case the two cells are identical, each of emf E = 5 V and internal resistance r = 2Ω, calculate the voltage across the external resistance R = 10Ω.
10. Two squares ABCD and BEFC have the side BC in common. The sides are of conducting wires with resistances as follows: AB, BE, FC and CD each 2Ω; AD, BC, EF each 1Ω. A cell of emf 2 V and internal resistance 2 Ω is joined across AD. Find the currents in various branches of the circuit. **[5]**
11. Two like magnetic poles of strengths 5 Am and 20 Am are situated 1.0 m apart. At what point on the line joining the two poles, will the magnetic field be zero? **[2]**
12. A proton, a deutron and an alpha particle, after being accelerated through the same potential difference, enter a region of uniform magnetic field $\vec{B}$, in a direction perpendicular to $\vec{B}$. Compare their kinetic energies. If the radius of proton's circular path is 5 cm, what will be the radii of the paths of deutron and alpha particle? **[2]**
13. Deduce the expression for the torque experienced by a rectangular loop carrying a steady current I and placed in a uniform magnetic field B. Indicate the direction of the torque acting on the loop. **[3]**
14. i. State and explain the law used to determine magnetic field at a point due to a current element. Derive the expression for the magnetic field due to a circular current carrying loop of radius R at its centre. **[5]**
   ii. A long wire with a small current element of length 1 cm is placed at the origin and carries a current of 10 A along the X-axis. Find out the magnitude and direction of the magnetic field due to the element on the Y-axis at a distance 0·5 m from it.