1. The electric charge density in a $5\,\mu m$ thick, infinite layer is $+3C/m^3$. One of the surfaces of the layer is covered by a layer of infinitely thin negative surface charge rendering the total charge of the system zero. The relative permittivity of the medium is 8.5. Determine the potential of the outside surface of the surface charge layer with respect to the outside surface of the positive layer.

2. Two electrons and two protons (charge $\mp e = \mp 1.6 \times 10^{-19} C$) are distributed among four corners of a square of $2\,\overset{\circ}{A}$ side in such manner that charges of the same sign are located at the opposite ends of the two diagonals.

    (i) Determine the magnitude and direction of the force acting on one of the electrons and,

    (ii) calculate the energy of the configuration.

3. A proton (charge $e = +1.6 \times 10^{-19} C$) is surrounded by a spherical surface charge layer of radius $0.5\,\overset{\circ}{A}$ and total charge $-e$. Determine the energy of the system.

4. The EMF of a DC source is 5 volt, its internal resistance is 10^4 Ohm. The source terminals are connected through an on-off switch to a $10^{-10} F$ capacitor. Following the closing of the switch the source charges the capacitor which initially held no charge.
    Determine:
    (i) the final charge on the capacitor and,

    (ii) the total energy dissipated in the 10^4 Ohm resistance.

5. The magnetic field at the center of a circular current loop of 10 cm radius is employed to cancel the magnetic field produced by an infinite, straight 5A current strand at a point 10 cm away from it (the current. Determine:
    (i)   the plane of the current loop,

    (ii) the current in the loop and,

    (iii) indicate by means of a sketch the relative directions of the loop current and the 5A current. Comment on the relative magnitudes of the two currents.

6. Two solenoids, 10 cm long with $1cm^2$ cross-section areas are wound on a common core of relative permeability 10. The number of turns in one solenoid is 32, that in the other is 16. The EMF and internal resistance of a DC generator are 24 volt and 8 Ohm. The generator is connected through an on-off switch to the terminals of the 32 turn solenoid. The terminals of the 16 turn solenoid are open. Following the closing of the switch the generator will drive the current through the series combination of the internal resistance and the 32 turn solenoid. Determine:

    (i) the ultimate (infinite delay time) current delivered by the generator and,

    (ii) the instant of time and the value of the maximum voltage appearing across the terminals of the 16 turn solenoid.