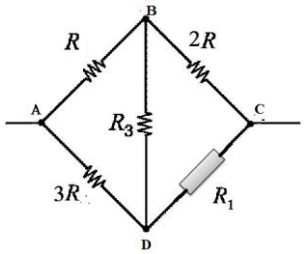
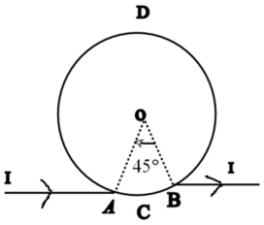
HOLIDAY HOMEWORK

1. In a Wheatstone's bridge shown, the balance point is achieved when a carbon resistor with a colour code brown, red, orange is connected across the arm CD. Find the value of R. The resistors in the arms AD and CD are now exchanged and the resistor across AB is replaced with a carbon resistor to obtain bridge balance condition. Find the colour code of the resistor connected across AB, when the bridge is in balanced condition.



2. (a) Two cells of e m f ε_1 and ε_2 with internal resistances r_1 and r_2 are connected in parallel. Derive an expression for (i) the equivalent e m f and (ii) equivalent internal resistance of the combination.

(b) A wire of resistance 24Ωis bent in the form of a circle of radius *R*. A current *I* entersthe ring through *A* and leaves the ring through *B*. If $\angle AOB = 45°$, where *O* is the center of the ring, calculate the equivalent resistance of the ring . If the battery connected between A and B has an e m f of 12 V, calculate the current through the circuit.

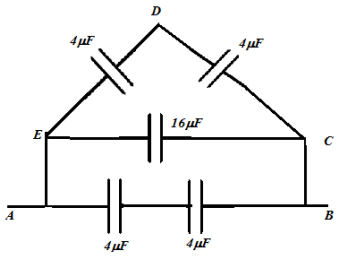


3, (a) A thin spherical metallic shell of radius *R* has a charge *Q* uniformly distributed over its surface. Use Gauss's law to determine the electric field intensity at a point *P* located at a distance *r* from the center of the sphere, when (i) $r > R$ and (ii) $r < R$.

(b) Plot a graph showing the variation of electric field intensity as a function of *r*.

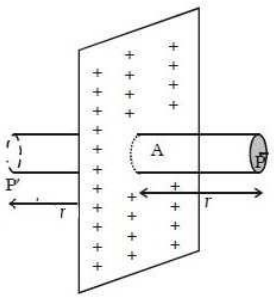
(c) If the sphere has a charge density of 100 μC/m$_2$ and a diameter 2 m, find (i) the charge enclosed by the sphere (ii) total flux through the surface.

4. Find the equivalent capacitance of the given combination. If a battery of e m f 5V is applied across the terminals A and B, find the charge on the 16μ *F* capacitor.

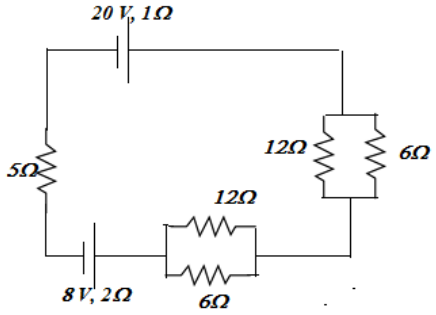


5. (a) State Gauss's law in electrostatics.

(b) The figure shows a cylindrical Gaussian surface for an infinitely long plane charged sheet of uniform charge density σ , placed in air.



6. In the circuit shown calculate (i) the total resistance (ii) current and (iii) the terminal potential difference across the two batteries.



7. An electric dipole is of dipole moment p_ is held at an angle q to the direction of a uniform electric field E directed along the positive x direction. If the dipole is released, how will it move? Explain with suitable diagrams, the forces on the dipole when q varies from 0° to 180°. Derive an expression for the energy of the dipole placed in the electric field and discuss the conditions for (i) stable equilibrium (ii) unstable equilibrium. If the electric field is constant in direction but decreases in magnitude along the $+x$ direction, what additional forces would the dipole experience?

8. a) A rectangular loop ABCD carrying current I is placed between the pole pieces of a strong magnet which produces a uniform magnetic field B. If the normal to the plane of the coil makes an angle θ with the direction of the magnetic field, deduce an expression for the torque experienced by the coil. At what position of the coil, is the torque (i) maximum (ii) minimum? (b) An ammeter of resistance 100Ω can measure currents up to 1 mA. What adjustments need to be made in the circuit of the ammeter so that it may read currents up to 1 A?

9. (a) A conductor of length l, area of cross section A carries a current I. It is placed in a magnetic field B such that the current element makes an angle θ with the direction of the magnetic field. Find the magnitude and the direction of the force acting on the conductor. Determine the positions of the conductor in the magnetic field when the force on it is (i) maximum (ii) minimum. Represent graphically, the relation between the force and the length of the conductor.

(b) A straight wire of mass 200 g and length 1.5 m carries a current of 2A. It is suspended in mid air by a uniform horizontal magnetic field B. What is the magnitude of the magnetic field? 10. In the meter bridge circuit shown, the null point is obtained at a distance of 45 cm from A. When a resistance of 6Ω is connected in parallel to S, the null point is obtained at 55 cm from A. Find the values of R and S. If the 6Ω resistance be connected in series to S, where will the null point shift?