

1. Derive an expression for the Electric field at a point on the (i) axial line and (ii) equatorial line of an electric dipole
2. Describe the principle construction and working of Van de Graff Generator.
3. State Gauss' theorem and apply it to find the electric field at a point due to
 1. A point charge
 2. A line of charge
 3. A plane sheet of charge
 4. A charged spherical conducting shell
4. Derive expression for the potential energy of a system of point charges.
5. Derive expression for the torque on a dipole in a uniform electric field.
6. Derive expression for the work done in turning a dipole in a uniform electric field.
7. Derive an expression for the potential energy of a dipole in a uniform electric field.
8. Explain the principle of a parallel plate capacitor
9. Derive an expression for the capacitance of a parallel plate capacitor.
10. Derive an expression for the effective capacitance when three [capacitors](#) are connected in (i) series (ii) parallel
11. Derive an expression for the energy stored in a parallel plate [capacitor](#).
12. Derive an expression for the loss of energy when two [conductors](#) at different potentials are brought into electrical contact. Account for this energy.
13. Derive and expression for the energy density of a parallel plate capacitor.
14. Derive $I = nAeV_d$
15. Define drift velocity and derive an expression for it.
16. Deduce Ohm's law from elementary concepts.
17. State Biot Savart's Law and apply it to find the magnetic field at a point due to long straight conductor carrying current
18. State Ampere's circuital theorem and apply it to find the magnetic field inside a (i) solenoid (ii) toroid
19. State the Principle of a [potentiometer](#) and Explain how is it used (i) to determine the internal resistance of a primary cell (ii) to compare the emfs of two primary cells
20. State Kirchhoff's laws and apply it to derive Wheatstone's bridge principle.
21. Explain how will you use a metre bridge to find the resistance of a given resistor wire?
22. Describe the elements of earth's magnetic field.
23. Compare the properties of para dia and ferromagnetic substances.
24. Derive an expression for the effective resistance when three resistors are connected in (i) series (ii) parallel
25. Describe the principle construction and working of CYCLOTRON. Derive an expression for cyclotron frequency. Why electrons cannot be accelerated in a cyclotron?

26. Derive an expression for the force between two straight long parallel conductors carrying constant current and hence define one ampere.
27. Describe the principle construction and working of [Moving Coil Galvanometer](#).
28. Derive an expression for the torque on a current carrying loop kept in a uniform magnetic field
29. Explain how will you convert a galvanometer into (i) an ammeter (ii) a voltmeter
30. Define motional emf and derive an expression for it.
31. What are eddy currents? Explain its applications
32. What is self induction and self inductance? Derive an expression for the self inductance of a long solenoid carrying current
33. Define mutual induction and mutual inductance. Derive an expression for the mutual inductance of a pair of solenoids. What are the factors affecting the mutual inductance of a pair of solenoids?
34. Derive an expression for the average value of ac for a half cycle.
35. Derive an expression for the RMS value of ac
36. Explain the principle and construction of a transformer and the various losses in a transformer.
37. Derive an expression for impedance of a series LCR circuit. Define resonance in series LCR circuit and derive an expression for resonant frequency.
38. Derive an expression for average power in an AC circuit. Define power factor and show that the average power consumed in a pure inductor or a pure capacitor is zero.
39. Define Q factor of resonance. Derive an expression for Q factor.
40. Derive lens maker's formula
41. Derive mirror formula
42. Derive a relation connecting object distance and image distance when a point object kept in front of a convex refracting surface forms a real image inside the denser medium. (Also practice other similar cases for real images and virtual images as well as for convex interface and concave interface)
43. Derive an expression relating angle of prism, angle of incidence, angle of emergence and angle of deviation when light is refracted by a prism
44. Derive $n = \frac{\sin(A+D)}{2} / \sin(A/2)$ for refraction through a prism.
45. Derive an expression for the effective [focal length](#) of the combination of two lenses in contact.