

18. Define mobility (μ).

OR

What is called superconductivity ?

19. Why a small soft iron cylindrical core is placed in galvanometer ?

20. State the Gauss's law for magnetism.

21. What are eddy currents ?

22. How much current is lagging behind the voltage in phase in an a.c. circuit with only inductor ?

23. What would be charge on nucleus of ${}_8O^{16}$ atom ? Charge of proton = $1.6 \times 10^{-19} C$.

24. What is Hertzian dipole ?

25. Two lens of power 2.5 D and 1.5 D are joined together. Calculate the power of new lens formed.

OR

What are coherent sources ?

26. State the Brewster's law.

27. On which factor the maximum energy of emitted photoelectron depends in photoelectric effect ?

OR

Define threshold frequency.

28. Which laws of conservation are obeyed in nuclear reactions ?

OR

Write full form of MASER.

29. Which negative sign means in equation $A_v = -g_m \cdot R_L$?

30. Name any two fundamental gates.

31. What do you mean by depletion barrier ?

32. The maximum electron density of a layer of the ionosphere is $\frac{1}{9} \times 10^{12} m^{-3}$. Calculate the critical frequency of this layer.

Section - C

Question Nos. 33 to 48 are short answer type questions, each question carries **two** marks. **32**

33. Derive an expression of torque $\vec{\tau} = \vec{P} \times \vec{E}$ on an electric dipole when placed in an uniform electric field.
34. Define : Static electric potential. Derive an expression for electric potential at a point due to a point charge.
35. Accepting single valuedness of electric potential and with necessary diagram, derive Kirchhoff's second law for a closed loop.

OR

Explain the principle of it with a necessary circuit diagram.

36. Give appropriate circuit diagram for charging process of a secondary cell. Obtain an expression of charging current.
37. What is a toroid ? Using Ampere's circuital law, obtain an expression for magnetic field inside the toroid.

OR

Obtain an expression for magnetic force acting on two very long parallel and straight conducting wires carrying currents.

38. Draw the graph of $B \rightarrow H$ (Hysteresis cycle) and explain in brief for any ferromagnetic material.
39. On what factors does self inductance of coil depend ? From $L = \frac{N\phi}{I}$ derive $\mathcal{E} = -L \cdot \frac{dI}{dt}$. Using that formula define self inductance and also its unit.

40. Write a note on Green house effect. Explain the function of ozone layer.
41. Obtain the differential equation for charge Q , when voltage applied to an A.C. circuit with L - C - R in series in $V = V_m \cos \omega t$.
42. Obtain an expression for equivalent focal length of a combination of two thin convex lenses. Also write formula for equivalent focal length for combination of more lenses.

43. For Fraunhofer diffraction by single slit, explain first order maximum and derive necessary condition for it.
44. Explain how a wave theory fails to explain the photoelectric effect.

OR

Explain experimental arrangement of Davison-Germer's experiment.

45. Using exponential law of radioactive decay, obtain the expressions for mean lifetime and half life time.
46. Give limitations of the Bohr Model.
47. Draw the circuit diagram of 'NOT' gate using transistor and also circuit symbol. Discuss any one case and give Boolean equation.

OR

Draw a circuit diagram for NPN transistor as CE amplifier. Discuss input circuit.

48. Which are (any four) the advantages of optical fibre communication ?

Section - D

Question Nos. 49 to 60 are short answer type questions, each question carries **36** three marks.

49. Two spheres having same radius and mass are suspended by two strings of equal length from the same point, in such a way that their surfaces touch each other. On depositing total $4 \times 10^{-7} C$ charge on them, they repel each other in such a way that in equilibrium the angle between their strings becomes 60° . If the distance from the point of suspension to the center of sphere is 20 cm, find the mass of each sphere $k = 9 \times 10^9 SI$, $g = 10ms^{-2}$.

OR

- i) A 900 pf magnitude of capacitor is charged with the help of 100 V battery. Calculate the steady electric energy on it.
- ii) The above capacitor is disconnected from the battery and is connected to another identical capacitor. What will be the total energy of the system ?

50. 0.366 A current is obtained when 4Ω resistor is connected with an unknown battery having r as an internal resistance. 0.149 A current is obtained if the above battery is connected to 10Ω resistor. Calculate the *emf* and the internal resistance of the battery.
51. A battery having an *emf* E and an internal resistance r is connected with a resistor R . Prove that the power in the external resistance is maximum when $R = r$.
52. A very long straight wire is carrying a current of 10 A. If an electron is moving parallel to this wire in a direction opposite to the current at a distance of 40 cm from the wire, with a velocity of $5 \times 10^5 \text{ ms}^{-1}$, find the force of attraction experienced by the electron. ($e = 1.6 \times 10^{-19} \text{ C}$, $\mu_0 = 4\pi \times 10^{-7} \text{ SI}$)
53. The region inside a current carrying toroidal winding is filled with tungsten of susceptibility 7×10^{-5} . What is the percentage increase in the magnetic field in presence of material with respect to the magnetic field without it?
54. A conducting loop of radius r is placed concentric with another loop of a much larger radius R , so that both loops are coplanar. Find the mutual inductance of the system of two loops. Take $R \gg r$.

OR

Prove that the average value of an AC voltage source given by

$V = V_m \sin \omega t$ is equal to $\frac{2V_m}{\pi}$ for half period of its cycle.

55. A narrow beam of light is incident at 53° angle made with the normal on a glass plate of refractive index 1.6. If the thickness of plate is 20 mm, calculate the lateral shift of the beam when it emerges out from the plate. ($\sin 53^\circ = 0.8$)

OR

An object is moving towards concave mirror along its principal axis with uniform velocity V_0 . Prove that when the object is at distance

U from concave mirror, velocity of image is $V_i = -\left(\frac{R}{2U - R}\right)^2 V_0$.

R is the radius of curvature of the mirror.

56. In Young experiment width of one slit is 3 times that of another. If we assume that the intensity of light is proportional to the width of the slit, find the ratio of maximum to minimum intensity.
57. Find the energy of photon in each of the following :
- Microwaves of wavelength 1.5 cm.
 - Red light of wavelength 660 nm.
 - Radiowaves of frequency 96 MHz.
58. Calculate the quantum number for which the radius of the orbit of electron in Be^{3+} would be equal to that for the ground state of electron in a hydrogen atom. Also compare the energy of the two states.
59. If the activity of 1g of Ra^{226} sample is 3.7×10^{10} Bequerel, calculate its half life. Take Avogadro number = $6.02 \times 10^{23} mol^{-1}$.
60. The current gain of a Common Base (CB) circuit is equal to α and current gain of a Common Emitter (CE) circuit is equal to β . Find the relationship between α and β .

OR

In a tuned collector oscillator circuit an output signal of 1 MHz frequency is obtained. The value of capacitance $C = 100 pF$, what should be the value of the capacitor if a signal of 2 MHz frequency is to be obtained ?