FREQUENTLY ASKED QUESTIONS
UNIT I
ELECTROSTATICS
2 MARKS

1) Force of attraction between two point charges placed at a distance of 'd' is 'F'. What distance apart they are kept in the same medium, so that, the force between them is 'F/3'?
2) Define electric field intensity. Write its S.I unit. Write the magnitude and direction of electric field intensity due electric dipole of length 2a at the midpoint of the line joining the two charges.
3) Define electric field intensity. Write its S.I unit. Write the magnitude and direction of electric field intensity due to an electric dipole of length 2 a at the midpoint of the line joining the two charges.
4) Sketch the electric lines of force due to point charges $q > 0$, $q < 0$ and for uniform field.
5) Define electric flux. Give its S.I unit and dimensional formula.
6) Two point charges 4μc and -2μc are separated by a distance of 1 m in air. At what point on the line joining the charges is the electric potential zero?
7) Depict the equipotential surfaces for a system of two identical positive point charges placed at distance d apart.
8) Deduce the expression for the potential energy of a system of two point charges q_1 and q_2 brought from infinity to that points r_1 and r_2.

3 MARKS

9) Derive an expression for electric field intensity at a point on the axial line and on the equatorial line of an electric pole.
10) Derive an expression for torque acting on an electric dipole in a uniform electric filed.
11) Derive an expression for total work done in rotating an electric dipole through an angle 'θ' in uniform electric field.
12) A sphere 'S_1' of radius 'r_1' encloses a charge 'Q'. If there is another concentric sphere S_2 of the radius r_2 ($r_2 > r_1$) and there be no additional charges between S_1 and S_2, find the ratio of electric flux through S_1 and S_2.
13) State Gauss's Theorem in electrostatics. Using this theorem, find the electric field strength due to an infinite plane sheet of charge.
14) State Gauss' theorem. Apply this theorem to obtain the expression for the electric field intensity at a point due to an infinitely long, thin, uniformly charged straight wire.

15) Using Gauss's theorem, show mathematically that for any point outside the shell, the field due to a uniformly charged thin spherical shell is the same as if the entire charge of the shell is concentrated at the centre. Why do you expect the electric field inside the shell to be zero according to this theorem?

16) Deduce an expression for the electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric of a dipole at a point as compared to that due to single charge.

17) Define dielectric constant in terms of the capacitance of a capacitor.

5 MARKS

18) Give the principle and working of a Van de Graff generator. With the help of a labelled diagram, describe its construction and working. How is the leakage of charge minimised from the generator?

19) Briefly explain the principle of a capacitor. Derive an expression for the capacitance of a parallel plate capacitor, whose plates are separated by a dielectric medium.

20) Derive an expression for the energy stored in a parallel plate capacitor with air between the plates. How does the stored energy change if air is replaced by a medium of dielectric constant 'K'? ; Also show that the energy density of a capacitor is.

21) A parallel-plate capacitor is charged to a potential difference V by a dc source. The capacitor is then disconnected from the source. If the distance between the plates is doubled, state with reason how the following change

(i) Electric field between the plates

(ii) Capacitance, and

(iii) Energy stored in the capacitor

22) Explain the underlying principle of working of a parallel plate capacitor. If two similar plates, each of area 'A' having surface charge densities '+ σ' & '-σ' are separated by a distance 'd' in air, write expressions for (i) the electric field at points between the two plates, (ii) the potential difference between the plates & (iii) the capacity of the capacitor so formed

23) A parallel plate capacitor is charged by a battery and the battery remains connected, a dielectric slab is inserted in the space between the plates. Explain what changes if any , occur in the values of

(I) Potential difference between the plates

(II) Electric field between the plates

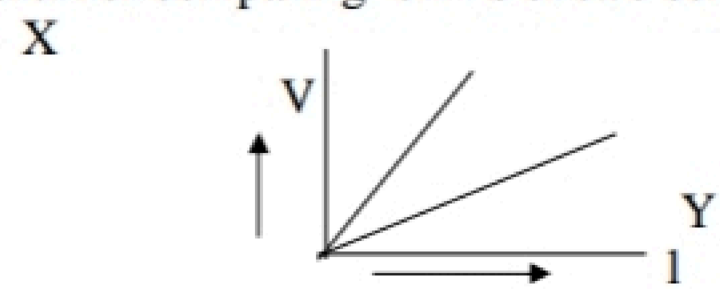
(III) Energy stored in the capacitor.

UNIT II

CURRENT ELECTRICITY

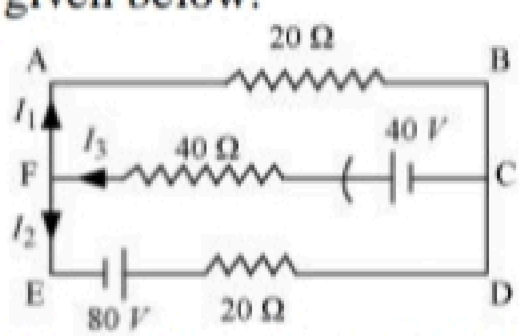
2 MARKS

1. Two wires 'A' & 'B' are of the same metal and of the same length. Their areas of cross-section are in the ratio of 2:1. if the same potential difference is applied across each wire in turn, what will be the ratio of the currents flowing in 'A' & 'B'?
2. Explain, with the help of a graph, the variation of conductivity with temperature for a metallic conductor.
3. Draw V-I graph for ohmic and non-ohmic materials. Give one example for each.
4. Explain how does the resistivity of a conductor depend upon (i) number density 'n' of free electrons, & (ii) relaxation time't'.
5. Define the term 'temperature coefficient of resistivity'. Write its SI unit. Plot a graph showing the variation of resistivity of copper with temperature.
6. A cell of emf (E) and internal resistance (r) is connected across a variable external resistance (R) Plot graphs to show variation of (i) E with R (ii) terminal p.d. of the cell (V) with R.
7. Explain how electron mobility changes from a good conductor (i) when temperature of the conductor is decreased at constant potential difference and (ii) applied potential difference is doubled at constant temperature.
8. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in: (i) an electrolyte, & (ii) an ionised gas.
9. Define drift velocity. Establish a relation between current & drift velocity.
10. Define the term current density of a metallic conductor. Deduce the relation connecting current density 'J' & the conductivity 'σ' of the conductor when an electric field 'E' is applied to it.
11. Why do we prefer potentiometer to compare the e.m.f of cells than the voltmeter. Why?
12. State Kirchhoff's rules of current distribution in an electric network.
13. The variation of potential difference "V' with length 'l' in the case of two potentiometers 'X' & 'Y' is as shown in figure. Which one of these two will you prefer for comparing 'emf's of two cells and why?



3 MARKS

14. Draw a circuit diagram using a metre bridge and write the necessary mathematical relation used to determine the value of an unknown resistance. Why cannot such an arrangement be used for measuring very low resistance?
15. With the help of a circuit diagram, explain in brief the use of a potentiometer for comparison of 'emf's of two cells.
16. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.
17. A number of identical cells, n, each of emf E, internal resistance r connected in series are charged by a d.c. source of emf E′, using a resistor R.
    (i) Draw the circuit arrangement.
    (ii) Deduce the expressions for (a) the charging current and (b) the potential difference across the combination of the cells.
18. Derive the principle of wheatstone bridge using Kirchoff's law.
19. State Kirchhoff's rules of current distribution in an electrical network. Using these rules determine the value of the current I1 in the electric circuit given below.



20. Write the mathematical relation for the resistivity of material in terms of relaxation time, number density and mass and charge of charge carriers in it. Explain,using this relation, why the resistivity of a metal increases and that of semi-conductor decreases with rise in temperature.
21. Calculate the value of the resistance R in the circuit shown in the figure so that the current in the circuit is 0·2 A. What would be the potential difference between points A and B?

UNIT III

MAGNETIC EFFECTS OF CURRENT AND MAGNETISM

2 MARKS

1. A circular coil of radius 'R' carries a current 'I'. Write the expression for the magnetic field due to this coil at its centre. Find out the direction of the magnetic field.
2. Write the expression for the force on the charge moving in a magnetic field. Use this expression to define the SI unit of magnetic field.
3. Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and the other having negative susceptibility. What does negative susceptibility signify?
4. Define the term magnetic dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed around an orbit of radius in hydrogen atom..
5. Explain with the help of a diagram the term 'magnetic declination' at a given place.
6. Define the term 'angle of dip'. What is the value of the angle of dip at the magnetic equator? What does it mean?
7. Two wires of equal lengths are bend in the form of two loops. One of the loop is square shaped where as the other loop is circular. These are suspended in a uniform magnetic field and the same current is passed through them. Which loop will experience greater torque? Give reasons.
8. Explain why steel is preferred for making permanent magnets while soft iron is preferred for making electromagnets.
9. Draw diagram to show behavior of magnetic field lines near a bar of 1) copper 2) aluminum and 3) mercury cooled at a very low temperature (4.2K)
10. How will the magnetic field intensity at the centre of the circular coil carrying current will change, if the current through the coil is doubled and radius of the coil is halved?
11. What do you mean by current sensitivity of a moving coil galvanometer? On what factors does it depend?
12. Derive an expression for the force experienced by a current carrying straight conductor placed in a magnetic field. Under what condition is this force maximum?

3 MARKS

13. Obtain the force per unit length experienced by two parallel conductors of infinite length carrying current in the same direction. Hence define one ampere.

14. A) If χ -stands for the magnetic susceptibility of a given material, identify the class of materials for which (a) $-1 \geq \chi < 0$, and (b) $0 < \chi < \varepsilon$ [ε is a small positive number]. Write the range of relative magnetic permeability of these materials.

    B) Draw the pattern of the magnetic field lines when these materials are placed on a strong magnetic field.

15. Derive an expression for the force acting on a current carrying conductor in a magnetic field. Under what conditions this force is maximum and minimum?

16. Define the term magnetic moment of current loop. Derive the expression for the magnetic moment when an electron revolves at a speed 'v' around an orbit of radius r in hydrogen atom. Also calculate the value of Bohr'smagnetic moment.

17. With the help of diagram explain how a galvanometer can be converted into an ammeter and a voltmeter.

18. To increase the current sensitivity of a moving coil galvanometer by 50%, its resistance is increased so that the new resistance becomes twice its initial resistance. By what factor does its voltage sensitivity change?

5 MARKS

19. Write an expression for force experienced by a charged particle moving in a uniform magnetic field? With the help of labeled diagram, explain principle and working of a cyclotron. Show that cyclotron frequency does not depend upon the speed of particles. Write its two limitations.

20. State Ampere's Circuital Law. Derive an expression for the magnetic field at a point due to straight current carrying conductor.

21. Derive an expression for the magnetic field at a point along the axis of an air cored solenoid using a Ampere's circuital law.

22. Derive an expression for torque acting on a rectangular current carrying loop kept in a uniform magnetic field B. Indicate the direction of torque acting on the loop.

23. With neat diagram, describe the principle, construction and working of a moving coil galvanometer. Explain the importance of radial field.

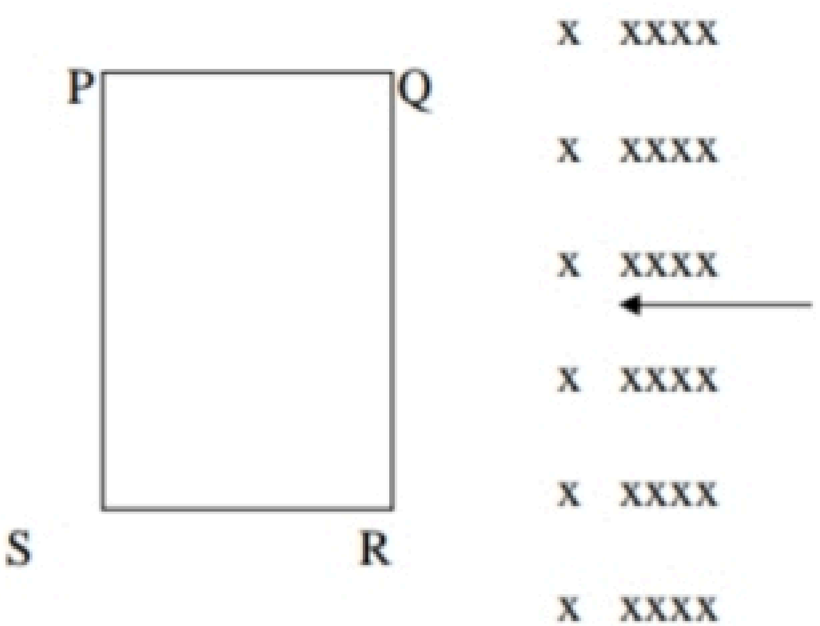
24. State Biot Savart Law. Use this law to obtain a formula for magnetic field at the centre of a circular loop of radius R, number of turns N carrying current I. Sketch the magnetic field lines for a current loop clearly indicating the direction of the field.

UNIT IV

ELECTROMAGNETIC INDUCTION & ALTERNATING CURRENT

2 MARKS

1. How does the self-inductance of an air core coil change, when (i) the number of turns in the coils is decreased & (ii) an iron rod is introduced in the coil.
2. What is the effect on the mutual inductance between the pair of coil when (i) the distance between the coils is increased? (ii) the number of turns in each coil is decreased? Justify your answer in each case.
3. State Lenz's law. Show that it is in accordance with the law of conservation of energy.
4. The closed loop PQRS is moving into a uniform magnetic field acting at right angles to the plane of the paper as shown. State the direction of the induced current in the loop.



5. Define mutual inductance and give its S.I. unit.Write two factors on which the mutual-inductance between a pair of coil depends.
6. What is the power dissipated in an ac circuit in which voltage & current are given by $V = 230 \sin(\omega t + \pi/2)$ and $I = 10 \sin \omega t$?
7. The instantaneous current & voltage of an ac circuit are given by:
   $i = 10 \sin 314t$ ampere, & $V = 50 \sin 314t$ volt.
   What is the power dissipation in the circuit?
8. The coils in certain galvanometers have fixed core made of a non-magnetic material. Why does the oscillating coil come to rest so quickly in such a core?

9. What are eddy currents? How are these produced? In what sense are eddy currents considered undesirable in a transformer and how are these reduced in such a device?
10. Prove that average power consumed over a complete cycle of ac through an ideal inductor is zero.
11. Prove that an ideal capacitor in an ac circuit does not dissipate power.
12. Distinguish resistance, reactance and impedance.
13. What is an induced emf? Write Faraday's law of electromagnetic induction Express it mathematically.
14. Two identical loops, one of copper and the other of aluminum, are rotated with the same angular speed in the same magnetic field. Compare (i) the induced emf and (ii) the current produced in the two coils. Justify your answer.

3 MARKS

15. Derive an expression for: (i) induced emf & (ii) induced current when, a conductor of length is moved into a uniform velocity v normal to a uniform magnetic field B. Assume resistance of conductor to be R.
16. Derive an expression for average power consumed over a complete cycle of ac through an LCR circuit.
17. Define mutual inductance and give its SI unit. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound over the other.
18. Define self-inductance and give its S. I. Unit. Derive an expression for self-inductance of a long, air-cored solenoid of length l, radius r, and having N number of turns

5 MARKS

19. Explain the term 'capacitive reactance'. Show graphically the variation of capacitive reactance with frequency of the applied alternating voltage. Ana. c. voltage $E=E_0\sin\omega t$ is applied across a pure capacitor of capacitance C. Show mathematically that the current flowing through it leads the applied voltage by a phase angle of $\pi/2$. .
20. Explain the term 'inductive reactance'. Show graphically the variation of inductive reactance with frequency of the applied alternating voltage.
    An a.c. voltage $E=E_0\sin\omega t$ is applied across a pure inductor of inductance L. Show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\pi/2$.
21. An AC source of voltage $V = V_m \sin \omega t$ is applied across a series LCR circuit. Draw the phasor diagrams for this circuit, when:

a) Capacitive impedance exceeds the inductive impedance AND
b) Inductive impedance exceeds capacitive impedance.

UNIT V

ELECTROMAGNETIC WAVES

2 MARKS

1. A plane monochromatic light wave lies in the visible region. It is represented by sinusoidal variation with time by the following components of electric field:
   $E_X = 0$, $E_Y = 4 \sin [2\pi/\lambda (x - vt)]$, $E_z = 0$
   Where, $v = 5 \times 10^{14}$ Hz and λ is the wave length of light.
   (i) What is the direction of propagation of the wave?
   (ii) What is its amplitude? And
   (iii) Compute the components of magnetic field.
2. Give two characteristics of electromagnetic waves. Write the expression for the velocity of electromagnetic waves in terms of permittivity and magnetic permeability of free space.
3. Find wavelength of electromagnetic waves of frequency 5×10^{19} Hz in free space. Give its two applications.
4. Name the characteristics of e. m. waves that: (i) increases, & (ii) remains constant in e. m. spectrum as one moves from radiowave region towards ultraviolet region.

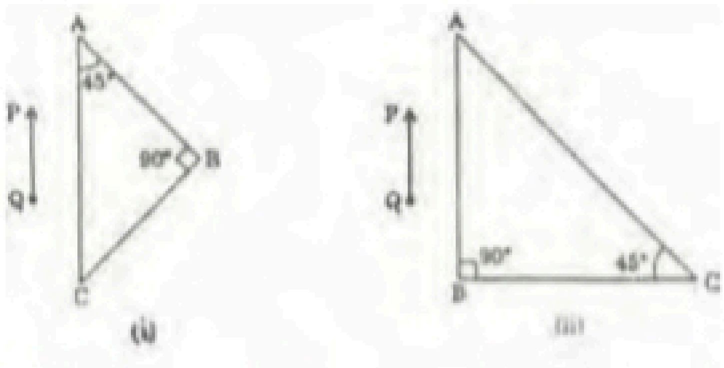
UNIT VI

OPTICS

2 MARKS

1. What is the geometrical shape of the wavefront when a plane wave passes through a convex lens?
2. What is total internal reflection? Under what condition does it take place.
3. A convex lens made up of a material of refractive index n_1, is immersed in a medium of refractive index n_2. Trace the path of a parallel beam of light passing through the lens when: (i) (i) $n_1 > n_2$, (ii) $n_1 = n_2$, & (iii) $n_1 < n_2$. Explain your answer.
4. A concave lens made of material of refractive index n_1 is kept in a medium of refractive index n_2. A parallel beam of light is incident on the lens. Complete the path of rays of light emerging from the concave lens if: (i) $n_1 > n_2$, (ii) $n_1 = n_2$, & (iii) $n_1 < n_2$.
5. Draw a ray diagram to show how an image is formed by a compound microscope. ?
6. A microscope is foucssed on a dot at the bottom of a beaker. Some oil is poured into the beaker to a height of 'y' cm & it is found necessary to raise microscope through a vertical distance of 'x' cm to bring the dot again into focus. Express refractive index of oil in terms of 'x' & 'y'.
7. How does the (i) magnifying power & (ii) resolving power of a telescope change on increasing the diameter of its objective? Give reasons for your answer.
8. How will magnifying power of a "refracting type astronomical telescope" be affecting on increasing for its eye piece: (i) the focal length, & (ii) the aperture. Justify your answer.
9. Draw a labelled ray diagram showing the formation of image of a distant object using an astronomical telescope in the 'normal adjustment position'
10. Draw a labelled ray diagram showing the formation of image of a distant object using an astronomical telescope in the near point adjustment.
11. Draw a ray diagram to illustrate image formation by a Cassegrain type reflecting telescope.
12. Explain with reason, how the resolving power of an astronomical telescope will change when (i) frequency of the incident light on objective lens is

15. Stating the assumptions and sign conventions, derive expression for lens maker's formula.
16. A right-angled crown glass prism with critical angle 41° is placed before an object, 'PQ' in two positions as shown in the figures (i) & (ii). Trace the paths of the rays from 'P' & 'Q' passing through the prisms in the two cases.



17. (a) Draw a labelled ray diagram to show the formation of an image by a compound microscope. Write the expression for its magnifying power.
18. (b) Define resolving power of a compound microscope.
How does the resolving power of a compound microscope change, when (i) refractive index of the medium between the object and the objective lens increases and (ii) Wavelength of the radiation used is increased?
19. Define the term wave front? Using Huygen's construction draw a figure showing the propagation of a plane wave reflecting at the interface of the two media. Show that the angle of incidence is equal to the angle of reflection.
20. Define the term 'wavefront'. Draw the wavefront and corresponding rays in the case of a (i) diverging spherical wave (ii) plane wave. Using Huygen's construction of a wavefront, explain the refraction of a plane wavefront at a plane surface and hence deduce Snell's law.
21. What is meant by 'interference of light'? Write any two conditions necessary for obtaining well-defined and sustained interference pattern of light.

22. What is the effect on the interference fringes in a Young's double slit experiment due to each of the following operations? Give reason for your

UNIT VII
DUAL NATURE OF MATTER
2 MARKS

1. When a monochromatic yellow coloured light beam is incident on a given photosensitive surface, photoelectrons are not ejected, while the same surface gives photoelectrons when exposed to green coloured monochromatic beam. What will happen if the surface is exposed to: (i) red coloured, monochromatic beam of light? Justify your answer.
2. What is meant by work function of a metal? How does the value of work function influence the kinetic energy of electrons liberated during photoelectric emission?
3. Define the terms: (i) work function, (ii) threshold frequency & (iii) stopping potential with reference of photoelectric effect.
4. The work function of lithium is 2.3 eV. What does it mean? What is the relation between the work function 'ω_o' and threshold wavelength 'λ_o' of a metal?
5. Red light, however bright, cannot cause emission of electrons from a clean zinc surface. But, even weak ultraviolet radiations can do so. Why?
6. An electron and a proton have same kinetic energy. Which of the two has a greater wavelength? Explain.
7. Define the term threshold frequency & work function in relation to photoelectric effect.
8. An electron and a proton are moving in the same direction and possess same kinetic energy. Find the ratio of de-Broglie wavelengths associated with these particles.
9. In the photoelectric effect experiment, the graph between the stopping potential 'V' and frequency 'v' of the incident radiation on two different metal plates P and Q are shown in the figure. (i) Which of the two metal plates, P & Q has greater value of work function? & (ii) What does the slope of the line depict?

UNIT IX

ELECTRONIC DEVICES

2 MARKS

1. How is a p-type semiconductor formed? Name the majority carriers in it. Draw the energy band diagram of a p-type semiconductor.
2. How is an n-type semiconductor formed? Name the majority carriers in it. Draw the energy band diagram of a n-type semiconductor.
3. With the help of a diagram, show the biasing of a light emitting diode (LED). Give its two advantages over conventional incandescent lamps.
4. Draw a circuit diagram to show how a photodiode is biased. Draw its characteristic curves for two different illumination intensities.

3 MARKS

5. What is rectification? How can a diode valve be used as half wave rectifier and full wave rectifier?

6. Explain how the depletion layer and the barrier potential are formed in a p-n junction diode.

7. What is a Zener diode? How it is symbolically represented? With the help of a circuit diagram, explain the use of Zener diode as a voltage stabilizer.

8. With the help of a suitable diagram, explain the formation of depletion region in a p-n junction. How does its width change when the junction is: (i) forward biased? & (ii) reverse biased?

5 MARKS

9. Explain briefly with the help of a circuit diagram how V-I characteristics of a p-n junction diode are obtained in: (i) forward bias & (ii) reverse bias.

10. Draw the energy bands of p-type and n-type semiconductors. Explain with a circuit diagram the working of a full wave rectifier.