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 length2a 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

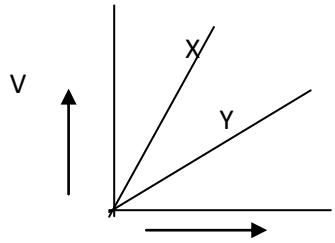
22) Explain the underlying principle of working of a parallel plate capacitor. If two similar plates, each of area 'A' having surface charge densities '+ σ' & '-σ' are separated by a distance 'd' in air, write expressions for (i) the electric field at points between the two plates, (ii) the potential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

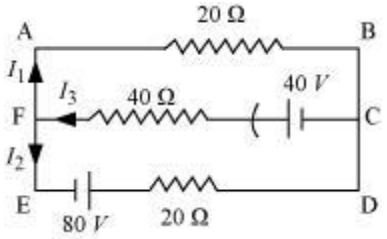
2 MARKS

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?

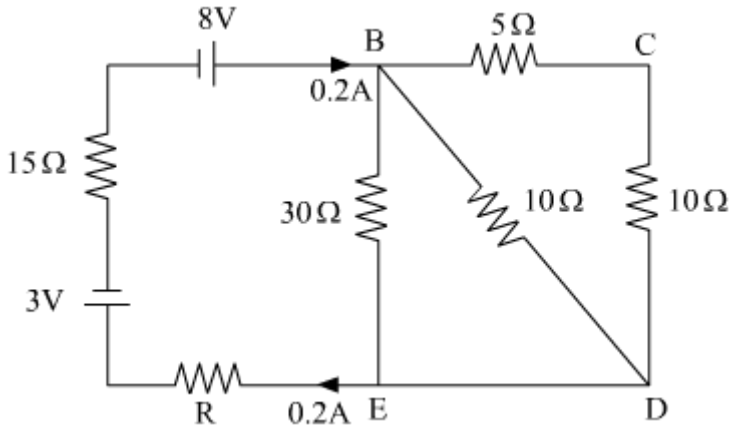


3 MARKS

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)copper2)aluminum and3)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 X_m -stands for the magnetic susceptibility of a given material, identify the class of materials for which (a) $-1 \geq X_m < 0$, and (b) $0 < X_m < \acute{\varepsilon}$ [$\acute{\varepsilon}$ 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's magnetic 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..

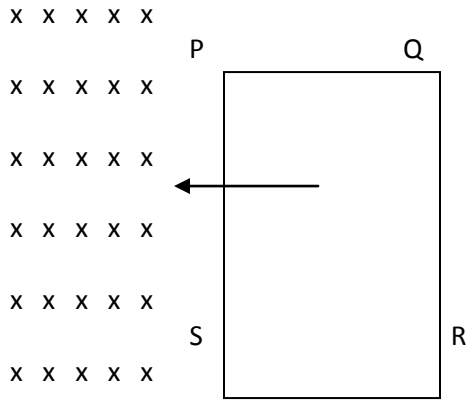
22. Derive an expression for torque acting on a rectangular current carrying loop kept in a uniform magnetic field B. Indicate the direction of torque acting on the loop.
23. With neat diagram, describe the principle, construction and working of a moving coil galvanometer. Explain the importance of radial 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.
25. Distinguish the magnetic properties of dia, para- and ferro-magnetic substances interms of (i) susceptibility, (ii) magnetic permeability and (iii) coercivity. Give one example of each of these materials.Draw the field lines due to an external magnetic field near a (i) diamagnetic,(ii) paramagnetic substance.

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.An a.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 theapplied 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.
22. A coil of inductance 'L', a capacitor of capacitance 'C', & a resistor of resistance 'R' are all put in series with an alternating source of emf $E = E_0 \sin \omega t$. Write expressions for a) total impedance of circuit, and (b) frequency of source emf for which circuit will show resonance.

23. A circular coil of N-turns & radius 'R' is kept normal to a magnetic field, given by: $B = B_0 \cos \omega t$. Deduce an expression for the emf induced in this coil. State the rule which helps to detect the direction of induced current.
24. Discuss a series resonant circuit. Derive an expression for resonant frequency and show a graphical variation between current and angular frequency of applied ac. Define quality factor and derive an expression for it.
25. Explain with help of a labelled diagram the principle, construction and working of a transformer. Mention the various energy losses in a transformer? Explain the role of transformer in long distance transmission of power ?
26. With the help of a neat diagram, explain the principle construction and working of an a.c generator.

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.

3 MARKS

5. Which constituent radiation of electromagnetic spectrum is used: (i) in radar? (ii) To photograph internal parts of human body? & (iii) for taking photographs of the sky during night and foggy condition? Give one reason for your answer in each case.
6. Write any four characteristics of e. m. waves. Give two uses of: (i) Radio waves & (ii) Microwaves.
7. Name the following constituent radiations of e. m. spectrum which, (i) produce intense heating effect? (ii) is absorbed by the ozone layer, &(iii) is used for studying crystal structure.
8. Experimental observations have shown: (i) that X-rays travel in vacuum with a speed of 3×10^8 m s^{-1}, & (ii) the phenomenon of diffraction and can be polarized. What conclusion is drawn about the nature of X-rays from each of these observations?
9. Why are infrared radiations referred to as heat waves? Name the radiations which are next to these radiations in e. m. spectrum having: (i) shorter wavelength, & (ii) longer wavelength.
10. The oscillating magnetic field in a plane electromagnetic wave is given by:
    $B_y = 8 \times 10^{-6} \sin [2 \times 10^{11} t + 300 \pi x]$ T
    (i) Calculate the wavelength of the electromagnetic wave &
    (ii) Write down the expression for oscillating electric filed.
11. Identify the following electromagnetic radiation as per the wavelengths given below:
    (a) 10^{-3} nm, & (b) 10^{-3} m, & (c) 1 nm; Write one application of each.
12. Name the constituent radiation of electromagnetic spectrum which
    (a) is used in satellite communication.
    (b) is used for studying crystal structure.
    (c) is similar to the radiations emitted during decay of radioactive nuclei.
    (d) has its wavelength range between 390 nm and 770 nm.
    (e) is absorbed from sunlight by ozone layer.
    (f) produces intense heating effect.
13. What is meant by the transverse nature of electromagnetic waves? Drawdiagram showing the propagation of the an electromagnetic wave along X direction, indicating clearly the directions of oscillating electric and magnetic fields associated with it.

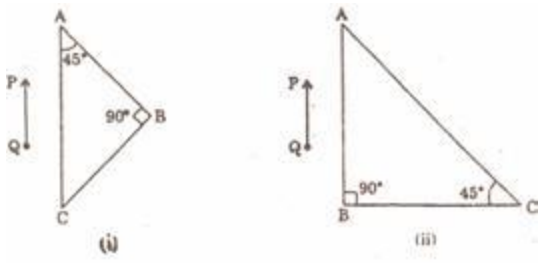
UNIT VI
OPTICS

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 increased (ii) the focal length of the objective lens is increased & (iii) aperture of the objective lens is halved.
13. Draw a graph to show variation of angle of deviation 'D' with that of angle of incidence 'i' for a monochromatic ray of light passing through a glass prism of reflecting angle 'A'.

3 MARKS

14. Derive lens/mirror formula in case of a convex/concave mirror.
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 answer: (i) Separation between two slits is increased & (ii) monochromatic source is replaced by a source of white light.

23. Draw the curve depicting variation of intensity in the interference pattern in Young's double slit experiment. State conditions for obtaining sustained interference pattern of light.

24. In a single slit diffraction pattern, how is angular width of central bright maximum changed when (i) the slit width is decreased, (ii) the distance between the slit and the screen is increased, & (iii) light of smaller wavelength is used? Justify your answers.

25. Why is diffraction of sound waves easier to observe than diffraction of light waves? What two main changes in diffraction pattern of a single slit will you observe when the monochromatic source of light is replaced by a source of white light?

26. In a single slit diffraction experiment, if the width of the slit is doubled, how does the (i) intensity of light and (ii) width of the central maximum change? Give reason for your answer.

27. What is wavefront? What is the geometrical shape of a wavefront emerging from a convex lens when point source is placed at the focus?

28. What is wavefront? Distinguish between a plane wavefront and a spherical wavefront. Explain with the help of a diagram, the refraction of a plane wavefront at a plane surface using Huygens's construction.

29. Using Huygens's principle show that for parallel beam incident on a reflecting surface the angle of reflection is equal to the angle of incidence.

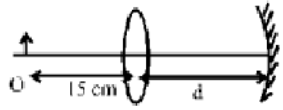
30. Distinguish between unpolarised and plane polarised light. An unpolarised light is incident on the boundary between two transparent media. State the condition when the reflected wave is totally plane polarised. Find out the expression for the angle of incidence in this case.

31. The following data was recorded for values of object distance and the corresponding values of image distance in the experiment on study of real image formation by a convex lens of power +5D. One of the observations is incorrect. Identify the observation and give reason for your choice.

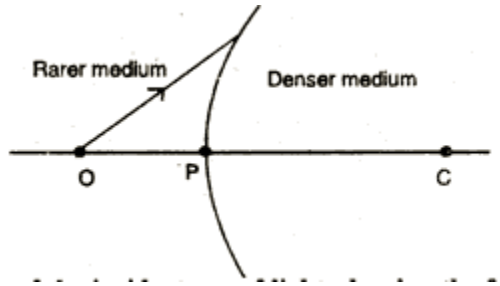
S. No.	1	2	3	4	5	6
Object distance (cm)	25	30	35	45	50	55
Image distance (cm)	97	6	37	35	32	30

5 MARKS

32. (i) Derive the mirror formula which gives the relation between f, v and u. What is the corresponding formula for a thin lens? (ii) Calculate the distance d, so that a real image of an object at O, 15cm in front of a convex lens of focal length 10cm be formed at the same point O. The radius of curvature of the mirror is 20cm. Will the image be inverted or erect?



33. A spherical surface of radius of curvature 'R' separates a rarer and a denser medium as shown in the figure.



Complete the path of the incident ray of light, showing the formation of real image. Hence derive the relation connecting object distance 'u', image distance 'v' radius of curvature 'R' and the refractive indices 'n_1' & 'n_2' of the media.

Briefly explain how the focal length of a convex lens changes with Increase in wavelength of incident light.

34. State the assumptions and sign conventions in deriving the Lens maker's formula and also derive an expression for it.

35. Derive an expression for thin lens formula.

36. (a) In Young's double slit experiment, deduce the conditions for: (i) constructive and (ii) destructive interference at a point on the screen. Draw a graph showing variation of the resultant intensity in the interference pattern against position 'x' on the screen.

(b) Compare and contrast the pattern which is seen with two coherently illuminated narrow slits in Young's experiment with that seen for a coherently illuminated single slit producing diffraction.

37. State Huygens principle. Using the geometrical construction of secondary wavelets, explain the refraction of a plane wavefront incident at a plane surface. Hence verify Snell's law of refraction. Illustrate with the help of diagrams the action of: (i) convex lens and (ii) concave mirror on a plane wavefront incident on it.

38. What is interference of light? Write two essential conditions for sustained interference pattern to be produced on the screen. Draw a graph showing the variation of intensity versus the position on the screen in Young's experiment when (a) both the slits are opened and (b) one of the slit is closed. What is the effect on the interference pattern in Young's double slit experiment when: (i) Screen is moved closer to the plane of slits? (ii)Separation between two slits is increased. Explain your answer in each case.

39. What are coherent sources of light? Two slits in Young's double slit experiment are illuminated by two different sodium lamps emitting light of the same wavelength. Why is no interference pattern observed?

(b) Obtain the condition for getting dark and bright fringes in Young's experiment. Hence write the expression for the fringe width.

(c) If S is the size of the source and its distance from the plane of the two slits, what should be the criterion for the interference fringes to be seen?

40. What do we understand by 'polarization of wave'? How does this phenomenon help us to decide whether a given wave is transverse or longitudinal in nature?

41. Light from an ordinary source (say, a sodium lamp) is passed through a Polaroid sheet 'P_1'. The transmitted light is then made to pass through a second Polaroid sheet P_2 which can be rotated so that the angle θ between the two Polaroid sheets varies from 0° to 90°. Show graphically the variation of intensity of light, transmitted by P_1& P_2 as a function of the angle

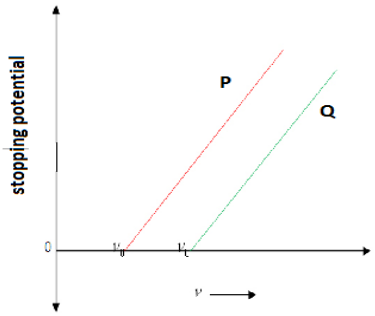
θ. Take the incident beam intensity a I_0. Why does the light from a clear blue portion of the sky, show a rise and fall of intensity when viewed through a Polaroid which is rotated?

42. (a) Draw a ray diagram to show the refraction of light through a glass prism. Hence obtain the relation for the angle of deviation in terms of the angle of incidence, angle of emergence and the angle of the prism. (b) A right angled isosceles glass prism is made from glass of refractive index 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.

UNIT VII
DUAL NATURE OF MATTER

2 MARKS

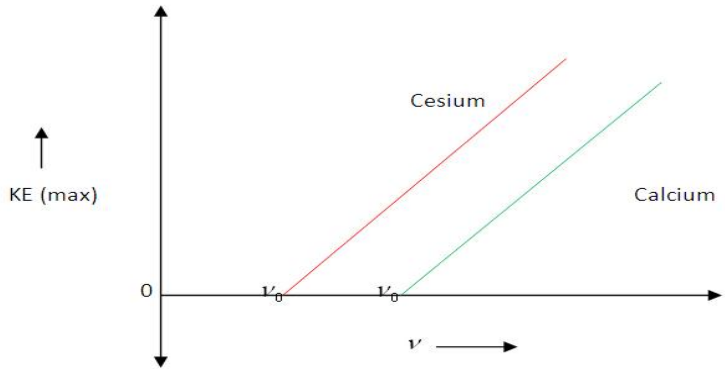
1. When a monochromatic yellow coloured light beam is incident on a given photosensitive surface, photoelectrons are not ejected, while the same surface gives photoelectrons when exposed to green coloured monochromatic beam. What will happen if the surface is exposed to: (i) red coloured, monochromatic 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?



3 MARKS

10. What is photoelectric effect? Write Einstein's photoelectric equation and use it to explain: (i) independence of maximum energy of emitted photoelectrons from the intensity of incident light. (ii) Existence of a threshold frequency for the emission of photoelectrons.
11. Draw the variation of maximum kinetic energy of emitted electrons with frequency of the incident radiation on a photosensitive surface. On the graph drawn, what do the following indicate: (i) slope of the graph & (ii) intercept on the energy axis.

12. Obtain Einstein's photoelectric equation. Explain how it enables us to understand the (i) linear dependence of the maximum kinetic energy of the emitted electrons, on the frequency of the incident radiation & (ii) existence of a threshold frequency for a given photo emitter.
13. Given below is the graph between frequency (v) of the incident light and maximum kinetic energy (E) of emitted photoelectrons. Find the values of: (i) threshold frequency and (ii) work function from the graph.



14. Sketch a graph between frequency of incident radiations and stopping potential for a given photosensitive materials. What information can be obtained from the value of intercept on the potential axis? A source of light of frequency greater that the threshold frequency is replaced at a distance of 1 m *from* the cathode of a photo cell. The stopping potential is found to be V. If the distance of the light source from the cathode is reduced, explain giving reason, what change you will observe in the (I0 photoelectric current & (ii) stopping potential.
15. Explain the laws of photoelectric emission on the basis of Einstein's photoelectric equation. Write one feature of the photoelectric effect which cannot be explained on the basis of wave theory of light.
16. Draw graphs showing the variation of photoelectric current with anode potential of a photocell for (i) the same frequency but different intensities $I_1 > I_2 > I_3$ of incident radiation, & (ii) the same intensity but different frequencies $v_1 > v_2 > v_3$ of incident radiation. Explain why the saturation current is independent of the anode potential?

UNIT VIII
ATOMS & NUCLEI

2 MARKS

1. Define disintegration constant and mean life of a radioactive substance. Give the unit of each.
2. What is impact parameter? What is the value of impact parameter for a head on collision? The sequence of the stepwise decays of radioactive nucleus is:

$$D \xrightarrow{\alpha} D1 \xrightarrow{\beta} D2 \xrightarrow{\alpha} D3 \xrightarrow{\alpha} D4.$$

If the nucleon number and atomic number for D2 are respectively 176 & 71, what are the corresponding values for D and D4 nuclei? Justify your answer.

3. Draw a diagram to show the variation of binding energy per nucleon with mass number for different nuclei. Explain with the help of this plot the release of energy in the processes of nuclear fission and fusion?
4. The value of ground state energy of hydrogen atom is: -13.6 eV; (i) What does the negative sign signify? & (ii) How much energy is required to take an electron in this atom from the ground state to the first excited state?

5. Give one point of difference between 'nuclear fission' & 'nuclear fusion'. Will neutron to proto ratio increase or decrease in a nucleus when: (i) an electron, (ii) a positron is emitted?
6. Sketch the graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Write three characteristic properties of nuclear force which distinguish it from the electrostatic force.
7. State two characteristics of nuclear force. Why does the binding energy per nucleon decrease with increase in mass number for heavy nuclei like ^{235}U?
8. State the condition for controlled chain reaction to occur in a nuclear reactor. Heavy water is often used as a moderator in thermal nuclear reactors. Give reason.
9. Define activity of a substance. State its S.I unit. Derive an expression for activity of a substance.
10. Define average or mean value of a radioactive substance, and derive an expression for it.

3 MARKS

11. State the basic postulates of Bohr's atomic model & derive an expression for the energy of an electron in any orbit of hydrogen atom.
12. Derive an expression for the radius of stationary orbit. Prove that the various stationary orbits are not equally spaced.
13. Derive mathematical expressions for: (i) kinetic energy, & (ii) potential energy of an electron revolving in an orbit of radius 'r'; how does the potential energy change with increase in principal quantum number (n) for the electron and why?
14. Define the decay constant for a radioactive sample. Which of the following radiations α, β, & λ rays are: (i) similar to X-rays? (ii) easily absorbed by matter? & (iii) similar in nature to cathode rays?
15. Define the terms: half life period and decay constant of a radioactive sample. Derive the relation between these terms.
16. In Rutherford's scattering experiment, mention two important conclusions which can be drawn by studying the scattering of α particles by an atom. Draw the schematic arrangement of Geiger and Marsden experiment showing the scattering of α particle by a thin foil of gold. How does one get the information regarding the size of the nucleus in this experiment?
17. Sketch the energy level diagram for hydrogen atom. Mark the transitions corresponding to Lyman and Balmer series.
18. Prove that the instantaneous rate of change of the activity of a radioactive substance is inversely proportional to the square of its half life.

(3)

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.
5. Give the logic symbol for an AND gate. Draw the output wave form for input wave forms for this gate.

3 MARKS

6. What is rectification? How can a diode valve be used as half wave rectifier and full wave rectifier?
7. Explain how the depletion layer and the barrier potential are formed in a p-n junction diode.

8. Draw a circuit diagram for use of NPN transistor as an amplifier in common emitter configuration. The input resistance of a transistor is $1000\,\Omega$ On changing its base current by $10\mu A$, the collector current increases by 2 m A. If a load resistance of $5K\,\Omega$ is used in the circuit, calculate (i) the current gain & (ii) voltage gain of the amplifier
9. The output of an AND gate is connected to both the inputs of a NAND gate. Draw the logic circuit of this combination of gates and write its truth table.

10. 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.

11. 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

12. With the help of a circuit diagram explain the working of a transistor as an oscillator.

13. 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.
14. Explain the function of base region of a transistor. Why this region is made thin and lightly doped? Draw a circuit diagram to study the input and the output characteristics of n-p-n transistor in a common emitter (CE) configuration. Show these characteristics graphically. Explain how current amplification factor of the transistor is calculated using output characteristics.
15. Draw the energy bands of p-type and n-type semiconductors. Explain with a circuit diagram the working of a full wave rectifier.
16. Explain with the help of a circuit diagram the use of an n-p-n transistor as an amplifier in common emitter configuration. Draw the input and output wave forms of the signal. Write the expression for its voltage gain.
17. What is an n-p-n transistor? How does it differ from p-n-p transistor? Give their symbols. Explain transistor action.
18. Explain the working of transistor as a switch. Draw transfer characteristic curve by showing 1) Cutoff region 2) Active region and 3) Saturation region.

UNIT X
COMMUNICATION SYSTEMS

2MARKS

1. Draw a block diagram of communication system.

2. Distinguish between point to point and broadcast communication modes. Give one example of each.

3. Explain the following terms.

a) Ground waves b) Space waves and c) sky waves.

4. What does the term LOS communication mean? Name the types of waves that are used for this communication. Give typical examples, with the help of a suitable figure, of communication systems that use space wave mode propagation.
5. Write the function of 1) Transducer and 2) repeater in the context of communication system.
6. What is modulation? Explain the need of modulating a low frequency information signal.
7. We do not choose to transmit an audio signal by just directly converting it to an E.M wave of the same frequency. Give two reasons for the same.

8. Explain briefly with the help of diagrams the terms (i) amplitude modulation and (ii) Frequency modulation. Which of these (i) gives better quality transmission? (ii) Has a larger coverage
9. Why is short wave bands used for long distance transmission of signals?
10. Optical and radio telescope are built on the ground but x-ray astronomy is possible only from satellite?
11. Draw a block diagram for a transmitter and a receiver of AM wave.

3 MARKS

12. Define the term modulation index for an AM wave. What would be the modulation index for an AM wave for which the maximum amplitude is 'a' and the minimum amplitude is b'
13. A TV tower has a height 'h'. Derive an expression for maximum distance up to which the signal can be received from the earth.
14. What is meant by the term modulation? Explain with the help of a block diagram, how the process of modulation is carried out in AM broadcasts?
15. What is meant by 'production' of a modulated carrier wave? Describe briefly the essential steps with block diagram production.
16. What is meant by 'detection' of a modulated carrier wave? Describe briefly the essential steps with block diagram detection.