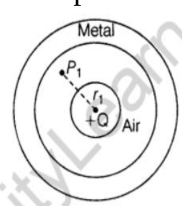
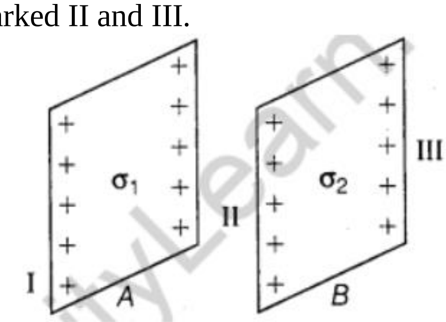
PHYSICS CLASS-XII

ELECTRIC CHARGES AND FIELDS

1. Why do the electric field lines never cross each other?
2. Why must the electrostatic field at the surface of a charge be normal to the surface? Give reason.
3. Define dipole moment of an electric dipole. Is it a scalar quantity or a vector quantity?
4. In which orientation, a dipole placed in a uniform electric field is in (i) stable (ii) unstable equilibrium?
5. A metallic sphere is placed in a uniform electric field as shown in the figure. Which path is followed by electric field lines and why?
6. A dipole of dipole moment p is present in a uniform electric field E. Write the value of the angle between p and E for which the torque experienced by the dipole is minimum.
7. An electric dipole of length 2 cm when placed with its axis making an angle of 60° with a uniform electric field experiences a torque. Calculate the potential energy of the dipole if it has charge of ± 4 nC.
8. An electric dipole of length 1 cm which is placed with its axis making an angle of 60° with a uniform electric field experiences a torque. Calculate the potential energy of the dipole if it has charge of ± 2 nC.
9. Two point charges q and –2q are kept d distance apart. Find the location of the point relative to charge q at which potential due to this system is zero.
10. An electric dipole is placed in a uniform electric field E with its dipole moment p parallel to the field. Find (i) the work done in turning the dipole till its dipole moment points in the direction opposite to E. (ii) the orientation of the dipole for which the torque acting on it becomes maximum.
11. A small metal sphere carrying a charge +Q is located at the center of a spherical cavity in a large uncharged metallic spherical shell. Write the charges on the inner and outer surfaces of the shell. Write the expression for the electric field at the point P.

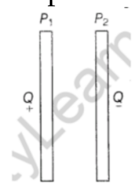


12. (i)Point charge (+Q) is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines between the charge and the plate. (ii) Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figures. Write the magnitude and directions of net fields on the marked II and III.



13. Calculate the amount of work done in turning an electric dipole of dipole moment 3×10^{-8} C m from its position of unstable equilibrium to its position of stable equilibrium in a uniform electric field of intensity 10^3 N/C.
14. Two identical metallic spherical shells A and B having charges +40Q and -10Q are kept a certain distance apart. A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B. Then spheres A and B are brought in contact and then separated. Find the charge on the spheres A and B.

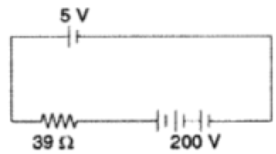
15. A dipole with a dipole moment of magnitude p is in stable equilibrium in an electrostatic field of magnitude E. Find the work done in rotating this dipole to its position of unstable equilibrium.
16. A dipole is present in an electrostatic field of magnitude 10^6 N/C. If the work done in rotating it from its position of stable equilibrium to its position of unstable equilibrium is 2×10^{-23} J, then find the magnitude of the dipole moment of this dipole.
17. Deduce the expression for the electric field E due to a system of two charges q_1 and q_2 with position vectors r_1 and r_2 at a point r with respect to common origin.
18. The sum of two point charges is 7 μC. They repel each other with a force of 1 N when kept 30 cm apart in free space. Calculate the value of each charge.
19. Figure shows two large metal plates P_1 and P_2 tightly held against each other and placed between two equal and unlike point charges perpendicular to the line joining them. (i) What will happen to the plates when they are released? (ii) Draw the pattern of the electric field lines for the system.



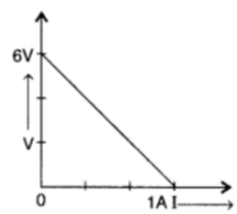
20. Two charges +Q and -Q are kept at points (-x/2,0) and (x, 0) respectively, in the XY-plane. Find the magnitude and direction of the net electric field at the origin (0,0).
21. Two point charges 4Q and Q are separated by 1 m in air. At what point on the line joining of charges is the electric field intensity zero?
22. Two point charges +q and -2q are placed at the vertices B and C of an equilateral triangle ABC of side a. Obtain the expression for (i) the magnitude and (ii) the direction of the resultant electric field at the vertex A due to these two charges.
23. Define the term electric dipole moment. Is it a scalar or vector? Deduce an expression for the electric field at a point on the equatorial plane of an electric dipole of length 2a.
24. Sketch the pattern of electric field lines due to (i) a conducting sphere having negative charge on it. (ii) an electric dipole.
25. A positive point charge (+q) is kept in the vicinity of an uncharged conduction plate. Sketch electric field lines originated from the point onto the surface of the plate.
26. Deduce the expression for the torque acting on a dipole of dipole moment p in the presence of a uniform electric field E.
27. An electric dipole moment p is held in a uniform electric field E.
   (i)Prove that no translation force acts on the dipole.
   (ii) Hence, prove that the torque acting on the dipole is given by pE sin θ indicating the direction along which it acts.

CURRENT ELECTRICITY

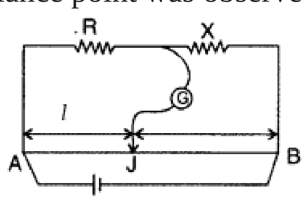
1. Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker?
2. A 5 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of 39 Ω as shown in the figure. Find the value of the current.



3. Define the term 'Mobility' of charge carriers in a conductor. Write its S.I. unit.
4. Define the term 'drift velocity' of charge carriers in a conductor and write its relationship with the current flowing through it.
5. Write the expression for the drift velocity of charge carriers in a conductor of length T across which a potential difference 'V' is applied.
6. I – V graph for a metallic wire at two different temperatures, T_1 and T_2 is as shown in the figure. Which of the two temperatures is lower and why?
7. The plot of the variation of potential difference A across a combination of three identical cells in series, versus current is shown along the question. What is the emf and internal resistance of each cell?

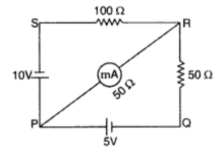


8. Two metallic wires of the same material have the same length but cross-sectional area is in the ratio 1 : 2. They are connected
   (i) in series and
   (ii) in parallel. Compare the drift velocities of electrons in the two wires in both the cases (i) and (ii).
9. Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons.
10. A cell of emf 'E' and internal resistance V is connected across a variable resistor 'R'. Plot a graph showing the variation of terminal potential 'V' with resistance R.
    Predict from the graph the condition under which 'V' becomes equal to 'E'.
11. A wire of 20 Ω resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a 4.0 volt battery. Find the current drawn from the battery.
12. In the given circuit, assuming point A to be at zero potential, use Kirchhoff's rules to determine the potential A at point B.
13. In the meter bridge experiment, balance point was observed at J with AJ = l.

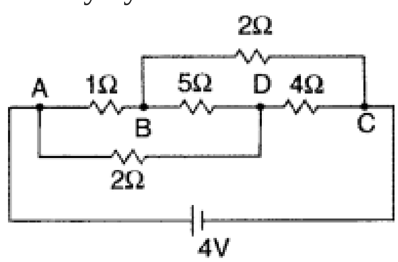


    (i) The values of R and X were doubled and then interchanged. What would be the new position of balance point?
    (ii) If the galvanometer and battery are interchanged at the balance position, how will the balance point get affected?

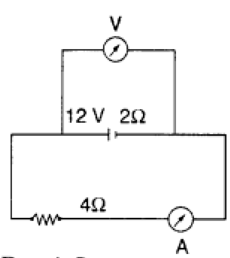
14. The network PQRS, shown m the circuit diagram, has the batteries of 5 V and 10 V and negligible internal resistance. A milliammeter of 50Ω resistance is connected between P and R. Calculate the reading in the milliammeter.



15. Write the expression for the current in a conductor of cross-sectional area A in terms of drift velocity.
16. Define mobility of a charge carrier. Write the relation expressing mobility in terms of relaxation time. Give its SI unit.
17. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 2.5×10^{-7} m^2 carrying a current of 1.8 A. Assume the density of conduction electrons to be 9×10^{28} m^{-3}.
18. Draw a plot showing the variation of resistivity of a
    (i) conductor and
    (ii) semiconductor, with the increase in temperature.
    How does one explain this behaviour in terms of number density of charge carriers and the relaxation time?
19. Use Kirchhoff's rules to obtain conditions for the balance condition in a Wheatstone bridge.
20. Calculate the current drawn from the battery by the network of resistors shown in the figure.



21. A battery of emf 12V and internal resistance 2 Ω is connected to a 4 Ω resistor as shown in the figure.
    (a) Show that a voltmeter when placed across the cell and across the resistor, in turn, gives the
    (b) To record the voltage and the current in the circuit, why is voltmeter placed in parallel and ammeter in series in the circuit?

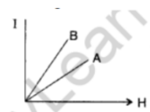


MOVING CHARGES AD MAGNETISM

1. Why should the spring/suspension wire in a moving coil galvanometer have low torsional constant?
2. Write two factors by which voltage sensitivity of a galvanometer can be increased.
3. Write two factors by which current sensitivity of a moving coil galvanometer can be increased.
4. A rectangular coil of sider I and b carrying a current I is subjected to a uniform magnetic field B acting perpendicular to its plane. Obtain the expression for the torque acting on it.
5. A steady current I1 flows through a long straight wire. Another wire carrying steady current I_2 in the same direction is kept close and parallel to the first wire. Show with the help of a diagram, how the magnetic field due to the current I_r exert a magnetic force on the second wire. Deduce the expression for this force.
6. How is a moving coil galvanometer converted into a voltmeter? Explain giving the necessary circuit diagram and the required mathematical relation used.
7. A square coil of side 10 cm consists of 20 turns and carries a current of 12 A. The coil is suspended vertically and the normal to the plane of the coil makes an angle of 30∘ with the direction of a uniform horizontal magnetic field of magnitude 0.80 T. What is the magnitude of torque experienced by the coil?
8. Define current sensitivity and voltage sensitivity of galvanometer. Increasing the current sensitivity may not necessarily increase the voltage sensitivity of a galvanometer, justify your answer.
9. A rectangular loop of wire of size 2.5cm×4cm carries a steady current of 1A. A straight long wire carrying 2 A current is kept near the loop as shown. If the loop and the wire are coplanar, find (i) the torque acting on the loop and (ii) the magnitude and direction of the force on the loop due to the current carrying wire.
10. Draw a labelled diagram of a moving coil galvanometer and explain its working. What is the function of radial magnetic field inside the coil?
11. Depict the magnetic field lines due to two straight, long, parallel conductors carrying currents 1\ and 1_2 in the same direction. Hence, deduce an expression for the force per unit length acting on one of the conductors due to the other. Is this force attractive or repulsive?
12. Find the expression for magnetic dipole moment of a revolving electron. What is Bohr magneton?
13. State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer cannot be used as such to measure the current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends.
14. Deduce the expression for the torque experienced by a rectangular loop carrying a steady current I and place'[4] in a uniform magnetic field B. Indicate the direction of the torque acting on the loop.
15. (i) State using a suitable diagram, the working principle of a moving coil galvanometer. What is the function of a radial magnetic field and the soft iron core used in it? (ii) For converting a galvanometer into an ammeter, a shunt resistance of small value is used in parallel, whereas in the case of a voltmeter a resistance of large value is used in series. Explain why?
16. A rectangle loop of size l × b carrying a steady current I is placed in a uniform magnetic field B. Prove that the torque τ acting on the loop is given by τ = m × B , where m is the magnetic moment of the loop.
17. (i) Derive an expression for the force between two long parallel current carrying conductors.
    (ii) Use this expression to define SI unit of current.
    (iii) A long straight wire AB carries a current /. A proton P travels with a speed v, parallel to the wire at a distance d from it in a direction opposite to the current as shown in the figure. What is the force experienced by the proton and what is its direction?

MAGNETISM AND MATTER

1. The susceptibility of a magnetic material is – 4.2 × 10^-6. Name the type of magnetic materials it represents.
2. The horizontal component of the earth's magnetic field at a place is B and angle of dip is 60°. What is the value of vertical component of earth's magnetic field at equator?
3. Current flows through a circular loop. Depict the north and south pole of its equivalent magnetic dipole.
4. A straight wire extending from east to west falls with a speed v at right angles to the horizontal component of the Earth's magnetic field. Which end of the wire would be at the higher electrical potential and why?
5. At a place, the horizontal component of earth's magnetic field is B and angle of dip is 60°. What is the value of horizontal component of the earth's magnetic field at the equator?
6. Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and the other having negative susceptibility. What does negative susceptibility signify?
7. The figure shows the variation of intensity of magnetisation versus the applied magnetic field intensity, H, for two magnetic materials A and B: (a) Identify the materials A and B. (b) Why does the material B have a larger susceptibility than A, for a given field at constant temperature?

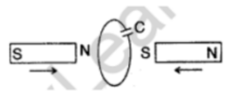


8. (i) Write two characteristics of a material used for making permanent magnets. (ii) Why is the core of an electromagnet made of ferromagnetic materials?
9. A coil of 'N' turns and radius 'R' carries a current 'I'. It is unwound and rewound to make a square coil of side 'a' having the same number of turns (N). Keeping the current 'I' the same, find the ratio of the magnetic moments of the square coil and the circular coil.
10. A circular coil of N turns and diameter 'd' carries a current 'I'. It is unwound and rewound to make another coil of diameter '2d', current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.
11. Depict the behavior of magnetic field lines near (i) diamagnetic and (ii) paramagnetic substances. Justify, giving reasons.
12. (a) A small compass needle of magnetic moment 'm' is free to turn about an axis perpendicular to the direction of uniform magnetic field 'B'. The moment of inertia of the needle about the axis is 'I'. The needle is slightly disturbed from its stable position and then released. Prove that it executes simple harmonic motion. Hence deduce the expression for its time period.

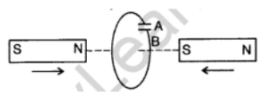
ELECTROMAGNETIC INDUCTION

1. A plot of magnetic flux (ϕ) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value of self inductance?

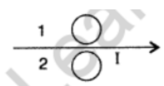
2. Define self-inductance of a coil. Write its S.I. unit.
3. Two bar magnets are quickly moved towards a metallic loop connected across a capacitor ‘C’ as shown in the figure. Predict the polarity of the capacitor.



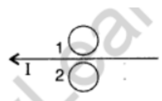
4. Predict the polarity of the capacitor when the two magnets are quickly moved in the directions marked by arrows.



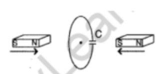
5. Predict the directions of induced currents in metal rings 1 and 2 lying in the same plane where current I in the wire is increasing steadily.



6. Predict the directions of induced current in metal rings 1 and 2 when current I in the wire is steadily decreasing?



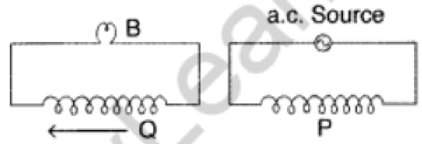
7. How does the mutual inductance of a pair of coils change when(i) distance between the coils is increased and(ii) number of turns in the coils is increased
8. How does the mutual inductance of a pair of coils change when (i) distance between the coils is decreased and (ii) number of turns in the coils is decreased?
9. Predict the polarity of the capacitor in the situation described in the figure.



10. Define the term ‘self-inductance’ of a coil. Write its S.I. Unit.
11. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of the induced current in each coil

12. Derive an expression for the self-inductance of a long air-cored solenoid of length l and number of turns N.
13. (i) When primary coil P is moved towards secondary coil S (as shown in the figure) the galvanometer shows momentary deflection. What can be done to have larger deflection in the galvanometer with the same battery? (ii) State the related law.

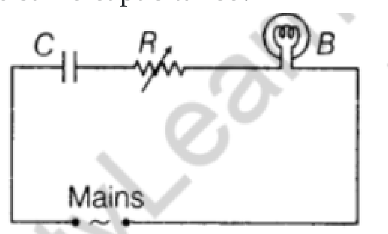
14. A coil Q is connected to low voltage bulb B and placed near another coil P as shown in the figure. Give reasons to explain the following observations (a) The bulb ‘B’ lights. (b) Bulb gets dimmer if the coil Q is moved towards left.



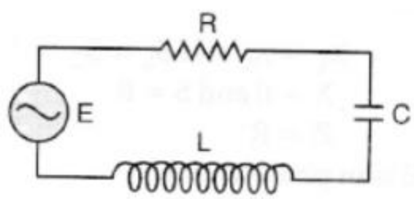
15. What are eddy currents? Write any two applications of eddy currents.
16. Define self-inductance of a coil. Show that magnetic energy required to build up the current I in a coil of self inductance L is given by $-(1/2)l^2$
17. Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.
18. A metallic rod of ‘L’ length is rotated with angular frequency of ‘ω’ with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring.
19. State Lenz’s Law. A metallic rod held horizontally along east-west direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer.
20. A rectangular loop PQMN with movable arm PQ of length 10 cm and resistance 2 Ω is placed in a uniform magnetic field of 0.1 T acting perpendicular to the plane of the loop as is shown in the figure. The resistances of the arms MN, NP and MQ are negligible. Calculate the (i) emf induced in the arm PQ and (ii) current induced in the loop when arm PQ is moved with velocity 20 m/s.
21. An inductor 200 mH, capacitor 500 µF, resistor 10 Ω are connected in series with a 100 V variable frequency a.c. source. Calculate the (i) frequency at which the power factor of the circuit is unity (ii) current amplitude at this frequency (iii) Q-factor
22. (i)State Faraday’s law of electromagnetic induction. (ii) A jet plane is travelling towards west at a speed of 1800 km/h. What is the voltage difference developed between the ends of the wing having a span of 25 m, if the Earth’s magnetic field at the location has a magnitude of $5 \times 1^{0-4}$ T and the dip angle is 30°?
23. Starting from the expression for the energy $w = \frac{1}{2} LI^2$, stored in a solenoid of self-inductance L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length l of the solenoid having n number of turns per unit length. Hence show that the energy density is given by $B^2/2\mu_0$.

ALTERNATING CURRENT

1. A reactive element in an AC circuit causes the current flowing (i) to lead in phase by π/2 (ii)to lag in phase by π/2 w.r.t to applied voltage. Identify the element in each phase.
2. A capacitor C, a variable resistor R and a bulb B are connected in series to the AC mains in the circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change if (i) a dielectric slab is introduced between the plates of the capacitor keeping resistance R to be the same (ii) the resistance R is increased keeping the same capacitance?



3. The figure shows a series LCR circuit connected to a variable frequency of 200 V source with L = 50 mH, C = 80 μF and R = 40Ω find. (i) the source frequency which drives the circuit in resonance; (ii) the quality factor (Q) of the circuit.



4. State the principle of working of a transformer. Can a transformer be used to step up or step down a d.c. voltage? Justify your Answer.
5. An alternating voltage given by V = 140 sin 314 t is connected across a pure resistor of 50 Ω. Find
   (i) the frequency of the source.
   (ii) the rms current through the resistor.
6. An inductor of unknown value, a capacitor of 100 μF and a resistor of 10 Ω are connected in series to a 200 V. 50 Hz a.c. source. It is found that the power factor of the circuit is unity. Calculate the inductance of the inductor and the current amplitude.
7. Explain using phasor diagram LCR series circuit and its resonance. Also explain the sharpness of resonance curve
8. An alternating voltage given by V = 140 sin 314 t is connected across a pure resistor of 50 Ω. Find
   (i) the frequency of the source.
   (ii) the rms current through the resistor.
9. An alternating voltage given by V = 280 sin 50πt is connected across a pure resistor of 40 Ω. Find
   (i) the frequency of the source.
   (ii) the rms current through the resistor.

ELECTROMAGNETIC WAVES

1. Write the following radiations in ascending order in respect of their frequencies ;X-rays, Microwaves, UV rays and radiowaves.
2. 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 the oscillating electric field.
3. How does a charge q oscillating at certain frequency produce electromagnetic waves? Sketch a schematic diagram depicting electric and magnetic fields for an electromagnetic wave propagating along the Z-direction.
4. Draw a sketch of a plane electromagnetic wave propagating along the z-direction. Depict clearly the directions of electric and magnetic fields varying sinusoidally with z.
5. A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized to incorporate the effect due to the displacement current.
6. (a) An em wave is travelling in a medium with a velocity $\vec{v} = v\hat{i}$. Draw a sketch showing the propagation of the em wave, indicating the direction of the oscillating electric and magnetic fields.
   (b) How are the magnitudes of the electric and magnetic fields related to the velocity of the em wave?
7. (a) How are electromagnetic waves produced?
   (b) How do you convince yourself that electromagnetic waves carry energy and momentum?
8. Name the types of e.m. radiations which
   - are used in destroying cancer cells
   - cause tanning of the skin and
   - maintain the earth's warmth

Write briefly a method of producing any one of these waves.

9. An e.m. wave, Y_1, has a wavelength of 1 cm while another e.m. wave, Y_2, has a frequency of 10^{15} Hz. Name these two types of waves and write one useful application for each.
10. Identify the following electromagnetic radiations as per the wavelengths given below. Write one application of each. (All India 2008)
    (a) 10^{-3} nm
    (b) 10^{-3} m
    (c) 1 nm
11. Identify the following electromagnetic radiations as per the wavelengths given below. Write one application of each.
    (a) 1 mm
    (b) 10^{-12} m
    (c) 10^{-8} m
12. (a) When the oscillating electric and magnetic fields are along the x- and indirection respectively
    (i)point out the direction of propagation of electromagnetic wave.
    (ii)express the velocity of propagation in terms of the amplitudes of the oscillating electric and magnetic fields.
    (b) How do you show that the em wave carries energy and momentum?

13. Answer the following :

(a) Name the em waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.

(b) If the Earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain.

(c) An em wave exerts pressure on the surface on which it is incident. Justify.

14. Answer the following :

(a) Name the em waves which are used for the treatment of certain forms of cancer. Write their frequency range.

(b) Thin ozone layer on top of stratosphere is crucial for human survival. Why?

(c) Why is the amount of the momentum transferred by the em waves incident on the surfrace so small?

15. Answer the following questions:

(i) Show, by giving a simple example, how em waves carry energy and momentum.

(i) How are microwaves produced? Why is it necessary in microwave ovens to select the frequency of microwaves to match the resonant frequency of water molecules?

(iii) Write two important uses of infrared waves.

RAY OPTICS

1. A converging lens of refractive index 1.5 is kept in a liquid medium having same refractive index. What would be the focal length of the lens in this medium?
2. How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced with red light?
3. How does the angle of minimum deviation of a glass prism of refractive index 1.5 change, if it is immersed in a liquid of refractive index 1.3?
4. Two thin lenses of power + 4D and – 2D are in contact. What is the focal length of the combination?
5. A glass lens of refractive index 1.45 disappears when immersed in a liquid. What is the value of refractive index of the liquid?
6. State the conditions for the phenomenon of total internal reflection to occur.
7. A converging lens is kept coaxially in contact with a diverging lens — both the lenses being of equal focal lengths. What is the focal length of the combination?
8. When monochromatic light travels from one medium to another its wavelength changes but frequency remains the same. Explain.
9. For the same value of angle of incidence, the angles of refraction in three media A, B and C are 15°, 25° and 35° respectively. In which medium would the velocity of light be minimum
10. Two thin lenses of power -4D and 2D are placed in contact coaxially. Find the focal length of the combination.
11. A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging or a diverging lens? Give reason.
12. A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens?
13. Why must both the objective and the eye piece of a compound microscope have short focal lengths?'
14. Draw a ray diagram of a reflecting type telescope. State two advantages of this telescope over a refracting telescope.
15. Draw a ray diagram of an astronomical telescope in the normal adjustment position. State two drawbacks of this type of telescope.
16. Draw a ray diagram of a compound microscope. Write the expression for its magnifying power.
17. Draw a labelled ray diagram of an astronomical telescope in the near point position. Write the expression for its magnifying power.
18. Draw a ray diagram for the formation of image in a compound microscope. Write the expression for its magnifying power.
19. A ray of light passing through an equilateral triangular glass prism from air undergoes minimum deviation when angle of incidence is $3/4^{th}$ of the angle of prism
20. Define refractive index of a transparent medium. A ray of light passes through a triangular prism. Plot a graph showing the variation of the angle of deviation with the angle of incidence.
21. Find the radius of curvature of the convex surface of a plano-convex lens, whose focal length is 0.3 m and the refractive index of the material of the lens is 1.5.
22. Two convex lenses of same focal length but of aperture Ar and A2 (A2 < A-,), are used as the objective lenses in two astronomical telescopes having identical eyepieces. What is the ratio of their resolving power? Which telescope will you prefer and why? Give reason.
23. A ray of light, incident on an equilateral glass prism ($\mu_g = \sqrt{3}$) moves parallel to the base line of the prism inside it. Find the angle of incidence for this ray.
24. Draw a labelled ray diagram of a reflecting telescope. Mention its two advantages over the refracting telescope.

WAVE OPTICS

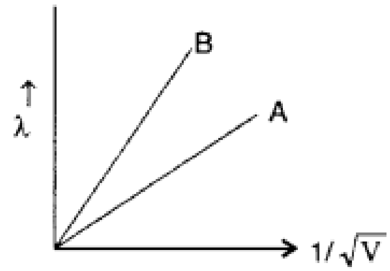
1. How does the fringe width of interference fringes change, when the whole apparatus of Young's experiment is kept in a liquid of refractive index 1.3?
2. How does the angular separation of interference fringes change in Young's experiment, if the distance between the slits is increased?
3. Draw a diagram to show refraction of a plane wave front incident in a convex lens and hence draw the refracted wave front.
4. How would the angular separation of interference fringes in Young's double slit experiment change when the distance between the slits and screen is doubled?
5. How does the fringe width, in Young's double-slit experiment, change when the distance of separation between the slits and screen is doubled?
6. In a single slit diffraction experiment, the width of the slit is reduced to half its original width. How would this affect the size and intensity of the central maximum?
7. Draw the shape of the wavefront coming out of a convex lens when a plane wave is incident on it.
8. Draw the shape of the wavefront coming out of a concave mirror when a plane wave is incident on it.
9. State one feature by which the phenomenon of interference can be distinguished from that of diffraction. A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 'a'. If the distance between the slits and the screen is 0.8 m and the distance of 2^{nd} order maximum from the centre of the screen is. 15 mm, calculate the width of the slit.
10. (i) State the principle on which the working of an optical fiber is based.
    (ii) What are the necessary conditions for this phenomenon to occur?
11. (a) Why are coherent sources necessary to produce a sustained interference pattern?
    (b) In Young's double slit experiment using mono-chromatic light of wavelength X, the intensity of light at a point on the screen where path difference is X, is K units. Find out the intensity of light at a point where path difference is $2\lambda/3$.
12. Laser light of wavelength 640 nm incident on a pair of slits produces an interference pattern in which the bright fringes are separated by 7.2 mm. Calculate the wavelength of another source of light which produces interference fringes separated by 8.1 mm using same arrangement. Also find the minimum value of the order 'n' of bright fringe of shorter wavelength which coincides with that of the longer wavelength.
13. Yellow light (λ = 6000Å) illuminates a single slit of width 1 x 10-4 m. Calculate
    (i) the distance between the two dark lines on either side of the central maximum, when the diffraction pattern is viewed on a screen kept 1.5 m away from the slit;
    (ii) the angular spread of the first diffraction minimum.
14. A parallel beam of light of 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen. Calculate the width of the slit.' A parallel beam of light of 600 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1.2 m away. It is observed that the first minimum is at a distance of 3 mm from the centre of the screen. Calculate the width of the slit. 'Write the distinguishing features between a diffraction pattern due to a single slit and the interference fringes produced in Young's double slit experiment?
15. a) Write the conditions under which light sources can be said to be coherent.
    (b) Why is it necessary to have coherent sources in order to produce an interference pattern?
16. (i) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W. Estimate the number of photons emitted per second on an average by the source.

(ii) Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface.

17. For a single slit of width "a", the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of λ/a .
    At the same angle of λ/a, we get a maximum for a two narrow slits separated by a distance "a".
18. Draw the intensity pattern for single slit diffraction and double slit interference. Hence, state two differences between interference and diffraction patterns.
19. How is a wavefront defined? Using Huygen's construction draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media. Hence verify Snell's law of refraction.
20. How is a wavefront defined? Using Huygen's construction draw a figure showing the propagation of a plane wave reflecting at the interface of the two media. Shpw that the angle of incidence is equal to the angle of reflection.
21. In a single slit diffraction experiment, when a tiny circular obstacle is placed in the path of light from a distance source, a bright spot is seen at the centre of the shadow of the obstacle. Explain why?
    State two points of difference between the interference pattern obtained in Young's double slit experiment and the diffraction pattern due to a single slit.
22. (a) In a single slit diffraction experiment, a slit of width 'd' is illuminated by red light of wavelength 650 nm. For what value of 'd' will
    (i) the first minimum fall at an angle of diffraction of 30°, and
    (ii) the first maximum fall at an angle of diffraction of 30°?
    (b) Why does the intensity of the secondary maximum become less as compared to the central maximum?
23. In Young's double slit experiment, the two slits 0.12 mm apart are illuminated by monochromatic light of wavelength 420 nm. The screeen is 1.0 m away from the slits.
    (a) Find the distance of the second
    (i) bright fringe,
    (ii) dark fringe from the central maximum.
    (b) How will the fringe pattern change if the screen is moved away from the slits?
24. Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression for the fringe width.

DUAL NATURE OF MATTER AND RADIATION

1. An electron and alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other?
2. Two lines, A and B, in the plot given below show the variation of de-Broglie wavelength, λ versus $1/\sqrt{V}$, Where V is the accelerating potential difference, for two particles carrying the same charge. Which one of two represents a particle of smaller mass? (All India 2008)



3. The stopping potential in an experiment on photoelectric effect is 1.5 V. What is the maximum kinetic energy of the photoelectrons emitted?
4. Show graphically, the variation of the de- Broglie wavelength (λ) with the potential (V) through which an electron is accelerated from rest.
5. A proton and an electron have same kinetic energy. Which one has greater de-Broglie wavelength and why?
6. A proton and an electron have same kinetic energy. Which one has smaller de-Broglie wavelength and why?
7. Find the ratio of de-Broglie wavelengths associated with two electrons accelerated through 25 V and 36 V.
8. An a-particle and a proton are accelerated from rest by the same potential. Find the ratio of their de-Broglie wavelengths.
9. Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photosensitive materials having work functions W_1 and W_2 ($W_1 > W_2$). On what factors does the
   (i) slope and
   (ii) intercept of the lines depend?
10. A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has
    (a) greater value of de-Broglie wavelength associated with it, and
    (b) less momentum?
    Give reasons to justify your answer.
11. (i) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W. Estimate the number of photons emitted per second on an average by the source.
    (ii) Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface.
12. Write three basic properties of photons which are used to obtain Einstein's photoelectric equation. Use this equation to draw a plot of maximum kinetic energy of the electrons emitted versus the frequency of incident radiation.
13. The Kinetic Energy (K.E.), of a beam of electrons, accelerated through a potential V, equals the energy of a photon of wavelength 5460 nm. Find the de Broglie wavelength associated with this beam of electrons.

14. Electrons are emitted from the cathode of a photocell of negligible work function, when photons of wavelength are incident on it. Derive the expression for the de Broglie wavelength of the electrons emitted in terms of the wavelength of the incident light.
15. An electromagnetic wave of wavelength X is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from this surface have the de-Broglie wavelength λ_1, prove that $\lambda=(2mc/h)\lambda_1^2$
16. (a) Using de-Broglie's hypothesis, explain with the help of a suitable diagram, Bohr's second postulate of quantization of energy levels in a hydrogen atom.

    (b) The ground state energy of hydrogen atom is -13.6 eV. What are the kinetic and potential energies of the state?
17. Write Einsten's photoelectric equation. State clearly how this equation is obtained using the photon picture of electromagnetic radiation. Write the three salient features observed in photoelectric effect which can be explained using this equation.
18. Define the terms

    (i) 'cut-off voltage' and

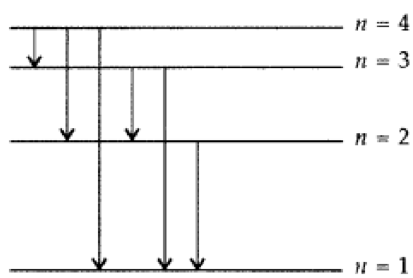
    (ii) 'threshold frequency' in relation to the pheno-menon of photoelectric effect.

    Using Einstein's photoelectric equation show how the cut-off voltage and threshold frequency for a given photosensitive material can be determined with the help of a suitable plot/graph.
19. (a) Describe briefly three experimentally observed features in the phenomenon of photoelectric effect.

    (b) Discuss briefly how wave theory of light cannot explain these features.

ATOMS

1. Define ionisation energy. What is its value for a hydrogen atom?
2. What is the ratio of radii of the orbits corresponding to first excited state and ground state in a hydrogen atom?
3. Find the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its
   (i) second permitted energy level to the first level, and
   (ii) the highest permitted energy level to the first permitted level.
4. The ground state energy of hydrogen atom is -13.6 eV. What are the kinetic and potential energies of electron in this state?
5. (i) In hydrogen atom, an electron undergoes transition from 2nd excited state to the first excited state and then to the ground state. Identify the spectral series to which these transitions belong.
   (ii) Find out the ratio of the wavelengths of the emitted radiations in the two cases.
6. In hydrogen atom, an electron undergoes transition from 3rd excited state to the first excited state and then to the ground state. Identify the spectral series to which these transitions belong.
   (ii) Find out the ratio of the wavelengths of the emitted radiations in the two cases.
7. Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?
8. Using Bohr's postulates of the atomic model, derive the expression for radius of nth electron orbit. Hence obtain the expression for Bohr's radius.
9. Show that the radius of the orbit in hydrogen atom varies as n^2, where n is the principal quantum number of the atom.
10. Calculate the shortest wavelength in the Balmer series of hydrogen atom. In which region (infra-red, visible, ultraviolet) of hydrogen spectrum does this wavelength lie?
11. he figure shows energy level diagram of hydogen atom



   (a) Find out the transition which results in the emission of a photon of wavelength 496 nm.
   (b) Which transition corresponds to the emission of radiation of maximum wavelength? Justify your answer.
12. In Rutherford scattering experiment, draw the trajectory traced by a-particles in the coulomb field of target nucleus and explain how this led to estimate the size of the nucleus.
13. Calculate the shortest wavelength of the spectral lines emitted in Balmer series.
   [Given Rydberg constant, $R = 10^7 \text{ m}^{-1}$]
14. An α-particle moving with initial kinetic energy K towards a nucleus of atomic number z approaches a distance 'd' at which it reverses its direction. Obtain the expression for the distance of closest approach 'd' in terms of the kinetic energy of α-particle K.
15. Define the distance of closest approach. An a-particle of kinetic energy 'K' is bombarded on a thin gold foil. The distance of the closest approach is V. What will be the distance of closest approach for an a-particle of double the kinetic energy?

16. Calculate the shortest wavelength of photons emitted in the Bracket series of hydrogen spectrum. Which part of the e.m. spectrum, does it belong? [Given Rydberg constant, $R = 1.1 \times 10^7\ m^{-1}$]
17. The ground state energy of hydrogen atom is -13.6 eV.
    (i) What is the kinetic energy of an electron in the 2^{nd} excited state?
    (ii) If the electron jumps to the ground state from the 2^{nd} excited state, calculate the wavelength of the spectral line emitted.
18. In the study of Geiger-Marsdon experiment on scattering of a particles by a thin foil of gold, draw the trajectory of a-particles in the coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study.
    From the relation, $R = R_0 A^{1/3}$, where R_0, is constant and A is the mass number of the nucleus, show that nuclear matter density is independent of A.

NUCLEI

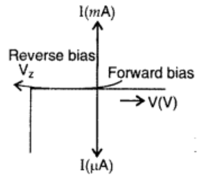
1. State two characteristic properties of nuclear force.
2. Two nuclei have mass numbers in the ratio 1: 2. What is the ratio of their nuclear densities?
3. Two nuclei have mass numbers in the ratio 27:125. What is the ratio of their nuclear radii?
4. (a) The mass of a nucleus in its ground state is always less than the total mass of its constituents – neutrons and protons. Explain.
   (b) Plot a graph showing the variation of potential energy of a pair of nucleons as a function of their separation.
5. Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions which you can draw regarding the nature of nuclear forces.
6. Draw a plot of the binding energy per nucleon as a function of mass number for a large number of nuclei, $2 \leq A \leq 240$. How do you explain the constancy of binding energy per nucleon in the range $30 < A < 170$ using the property that nuclear force is short-ranged?
7. Using the curve for the binding energy per nucleon as a function of mass number A, state clearly how the release of energy in the processes of nuclear fission and nuclear fusion can be explained.
8. Calculate the energy in fusion reaction

   $${}_1^2H + {}_1^2H \longrightarrow {}_2^3He + n,$$

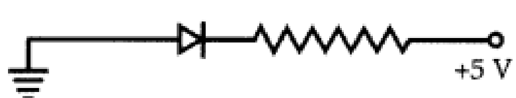
   where BE of ${}_1^2H$ = 2.23 MeV and of
   ${}_2^3He$= 7.73 MeV
9. Write two characteristic features of nuclear force.
   (b) Draw a plot of potential energy of a pair of nucleons as a function of their separation.

SEMI CONDUCTOR

1. The figure shows the V-I characteristic of a semi conductor device. Identify this device. Explain briefly, using the necessary circuit diagram, how this device is used as a voltage regulator.



2. How does the depletion region of a p-n junction diode get affected under reverse bias?
3. How does the width of depletion region of a p-n junction diode change under forward bias?
4. Explain how a depletion region is formed in a junction diode.
5. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier.
6. (i) With the help of circuit diagrams, distinguish between forward biasing and reverse biasing of a p-n junction diode.
   (ii) Draw V-I characteristics of a p-n junction diode in
   (a) forward bias,
   (b) reverse bias.
7. Explain with the help of a circuit diagram how a zener diode works as a DC voltage regulator. Draw its I – V characteristics.
8. Draw a labelled diagram of a full wave rectifier circuit. State its working principle. Show the input-output waveforms.
9. Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.
10. Distinguish between «-type and p-type semi-conductors on the basis of energy band diagrams. Compare their conductivities at absolute zero temperature and at room temperature.
11. Draw the energy band diagram of
    (i) n-type and
    (ii) p-type semiconductor at temperature, T > OK. In the case n-type Si semiconductor, the donor level is slightly below the bottom of conduction band. whereas in p-type semiconductor, the aceceptor energy level is slightly above the top of the valence band. Explain, what role do these energy levels play in conduction and valence bands.
12. Explain briefly with the help of necessary diagrams, the forward and the reverse biasing of a p-n junction diode. Also draw their characteristic curves in the two cases.
13. (a) In the given diagram, is the junction diode forward biased or reverse biased?



    (b) Draw the circuit diagram of a full wave rectifier and state how it work.