

ONE MARK QUESTIONS AND SOLUTIONS OF LAST TEN YEARS

(2004-2014)

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Q1 Why is shortwave band used for long distance radio broadcast?

Solution:- The shortwave band radio-waves are used for long distance broadcast because they are easily reflected back to earth by the ionosphere.

Q2 Two metals A and B have work functions 2 eV and 5 eV respectively. Which metal has lower threshold wavelength?

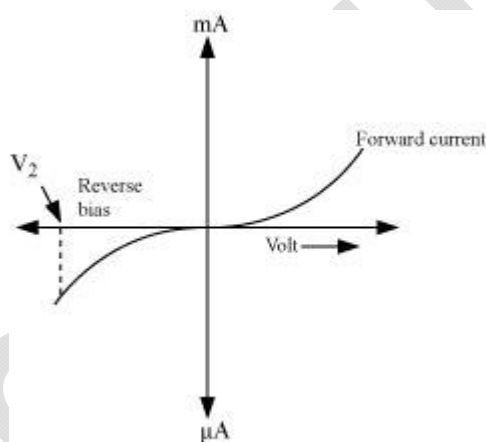
Solution:

$$W = h\nu_0 = \frac{hc}{\lambda_0} \quad \text{i.e.} \quad \lambda_0 \propto \frac{1}{W}$$

Therefore, metal B with higher work function has lower threshold wavelength.

Q3 Draw the voltage-current characteristic of a zener diode.

Solution:- V-I characteristic for a zener diode is given below:



Q4 A solenoid with an iron core and a bulb is connected to a d.c. source. How does the brightness of the bulb change when the iron core is removed from the solenoid?

Solution:- The brightness of the bulb remains unchanged because inductive reactance in a d.c. circuit is zero.

Q5 Peak value of e.m.f of an a.c. source is E_0 . What is its r.m.s value?

$$E_{\text{rms}} = \frac{E_0}{\sqrt{2}}$$

Solution:-

Q6 An electric dipole of dipole moment 20×10^{-6} Cm is enclosed by a closed surface. What is the net flux coming out of the surface?

Solution:- Net flux coming out of the closed surface is zero because the net charge on the electric dipole is zero.

Q7 An electron beam, projected along + X-axis, experiences a force due to a magnetic field along the + Y-axis. What is the direction of the magnetic field?

Solution: The magnetic field is along the + Z-axis.

Q8 The power factor of an AC circuit is 0.5. What will be the phase difference between voltage and current in this circuit?

Solution: Power factor,

$$\cos \phi = 0.5 = \frac{1}{2} = \cos 60^\circ$$

$$\therefore \phi = 60^\circ$$

Phase difference is 60° .

Q9 Electrons are emitted from a photosensitive surface when it is illuminated by

(i) red light (ii) blue light.

Solution:

(i) Electrons are not emitted with red light.

(ii) Electrons are emitted with blue light.

Q10 What should be the length of the dipole antenna for a carrier wave of frequency 3×10^8 Hz?

Solution: Length of the dipole antenna = $\frac{\lambda}{2} = \frac{C}{2\nu}$

$$= \frac{3 \times 10^8}{2 \times 3 \times 10^8} \text{ m} = 0.5 \text{ m}$$

Q11 Define 'electric line of force' and give its two important properties.

Solution:- An electric field line is a path, straight or curved, such that tangent to it at any point gives the direction of electric field intensity at that point.

Properties of field lines:

(i) Tangent to the electric field line at any point gives the direction of electric intensity at that point.

(ii) No two electric lines of force can intersect each other.

Q12 State Lenz's law.

Solution: Lenz's law:

It states that the direction of induced current or *emf* in a circuit is always such that it opposes the cause which produces it.

Q13 Why is convex mirror used as driver's mirror?

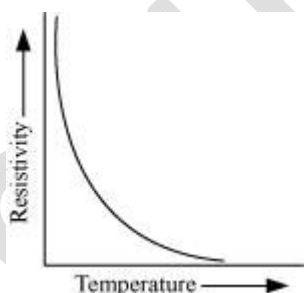
Solution:- Convex mirror is used as driver's mirror because field of view of a convex mirror is large.

Q14 Define the term 'dielectric constant' of a medium in terms of capacitance of a capacitor.

Solution:- Dielectric constant of a medium is defined as the ratio of the capacitance of a capacitor with dielectric in between the plates to the capacitance of the same capacitor with vacuum or air in between the plates.

Q15 Sketch a graph showing variation of resistivity of carbon with temperature.

Solution: The resistivity of carbon decreases with increasing temperature as shown in the figure given below.



Q16 The vertical component of Earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component. What is the value of angle of dip at this place?

Solution:

$$\tan \delta = \frac{B_V}{B_H} = \frac{\sqrt{3}B_H}{B_H} = \sqrt{3}$$

$$\therefore \text{Angle of dip, } \delta = 60^\circ$$

Q17 With what purpose was famous Davisson–Germer experiment with electrons performed?

Solution:- Davisson and Germer experiment confirmed the wave nature of electrons.

Q18 Name the type of communication in which the signal is a discrete and binary coded version of the message or information.

Solution:- Digital communication

Q19 What are the laws of reflection?

Solution:

(i) The incident ray, the reflected ray, and the normal lie in the same plane.

(ii) The angle of incidence (i) is always equal to the angle of reflection (r).

$$\therefore \angle i = \angle r$$

Q20 Name the physical quantity, whose SI unit is Newton coulomb.

Solution:- Newton coulomb is the SI unit of electric field intensity.

Q21 State two factors by which the range of Transmission of signals by a T.V. tower can be increased.

Solution:

(i) By increasing the height of the tower

(ii) By increasing the height of the receiving antenna, so that it may directly intercept the signal from the transmitting antenna

Q22 Is the force acting between two point electric charges q_1 and q_2 , kept at some distance apart in air, attractive or repulsive, when (i) $q_1q_2 > 0$ (ii) $q_1q_2 < 0$?

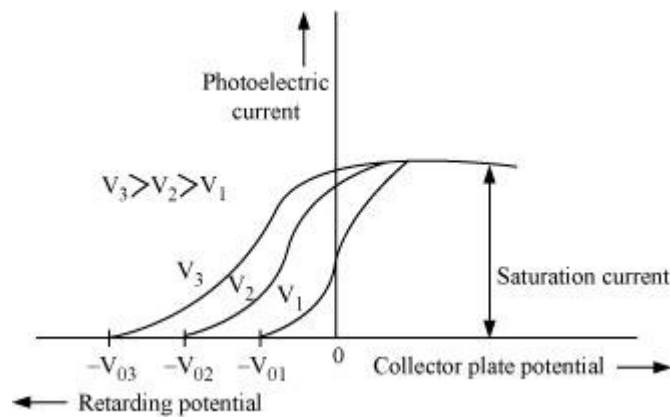
Solution:

(i) The force is repulsive. When $q_1q_2 > 0$, it means that charges are either both positive or both negative. This implies that the force between them is indeed repulsive.

(ii) The force is attractive. When $q_1q_2 < 0$, it means that one of the charges is negative and the other is positive. This implies that the force between them is indeed attractive.

Q23 Show graphically how the stopping potential for a given photosensitive surface varies with the frequency of incident radiations.

Solution:



Q24 A TV tower has a height of 71 m. What is the maximum distance up to which TV transmission can be received? Given that the radius of the earth = 6.4×10^6 m.

Solution:

We know that:

$$d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

Where,

d_M = Maximum distance between the transmitting and receiving antenna

h_T = Height of transmitting antenna

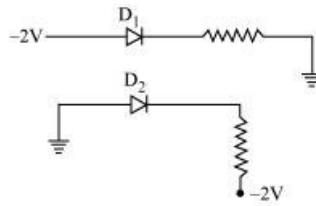
Therefore,

$$d_M = \sqrt{2Rh_T} = \sqrt{2 \times 6.4 \times 10^6 \times 71} = 30146 \text{ m}$$

Hence, the maximum distance up to which TV transmission can be received is 30146 m.

Q25 Which one of the two diodes D1 and D2 in the given figures is (i) forward biased,

(ii) reverse biased ?



Solution:

- (i) In the given figure, D₂ is forward biased.
- (ii) In the given figure, D₁ is reverse biased.

Q26 Suggest a possible communication channel for the transmission of a message signal which has a bandwidth of 5 MHz.

Solution:- A communication channel for the transmission of message signal, which has a bandwidth of 5 MHz, is FM radio frequency.

Q27 What is the direction of the force acting on a charged particle q , moving with a velocity \vec{v} in a uniform magnetic field \vec{B} ?

Solution:- The force \vec{F} acting on a charged particle q moving in a uniform magnetic field \vec{B} with velocity V is given by the relation:

$$\vec{F} = q(\vec{v} \times \vec{B})$$

This relation involves the cross product of V and \vec{B} . Hence, magnetic force is always normal to both V and \vec{B} .

Q28 Name the part of the electromagnetic spectrum of wavelength 10^{-2} m and mention its one application.

Solution:- The part of the electromagnetic spectrum which ranges from 0.1 m to 10^{-3} m is known as microwave. Microwaves are used in radar systems for aircraft navigation.

Q29 An electron and alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other?

Solution:- Kinetic energy of a particle of mass m and velocity v is given as:

$$K = \frac{1}{2}mv^2 = \frac{1}{2}m\frac{p^2}{m^2} = \frac{p^2}{2m} \quad [\because p = mv]$$

$$p^2 = 2mK$$

$$p = \sqrt{2mK} \quad (1)$$

de-Broglie wavelength associated with a particle of momentum p is given as:

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK}} \quad (2)$$

It is given that an electron and an alpha particle have the same de-Broglie wavelength. Hence, we can write:

$$\begin{aligned} \lambda_e &= \lambda_\alpha \\ \frac{h}{\sqrt{2m_e K_e}} &= \frac{h}{\sqrt{2m_\alpha K_\alpha}} \\ m_e K_e &= m_\alpha K_\alpha \\ \frac{K_e}{K_\alpha} &= \frac{m_\alpha}{m_e} \\ \because m_\alpha &> m_e \\ \therefore \frac{K_e}{K_\alpha} &= \frac{m_\alpha}{m_e} > 1 \\ K_e &> K_\alpha \end{aligned}$$

Hence, the kinetic energy of the electron is greater than that of the alpha particle.

Q30 A glass lens of refractive index 1.5 is placed in a trough of liquid. What must be the refractive index of the liquid in order to make the lens disappear?

Solution:- The lens will not be visible if no refraction occurs at the liquid-glass interface. This means that the incident ray should go through the glass without any deviation. For this condition to be fulfilled, the refractive index of the liquid must be equal to 1.5.

Q31 A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points on the square.

Solution:- The 500 μC charge is placed at the centre of a square. This charge is, therefore, at the same distance from all the corners of the square. The opposite corners, say A and C, will have the same potential i.e., $V_A = V_C$.

Work done in moving a charge q between points A and C is given as:

$$W = q(V_C - V_A) = q \times 0 = 0$$

Hence, no work is done in moving the charge between two diagonally opposite points on the square.

Q32 State the reason, why heavy water is generally used as a moderator in a nuclear reactor.

Solution:- In nuclear reactors, heavy water is generally used as a moderator because unlike normal water, which absorbs neutron, it slows down neutron without absorbing it.

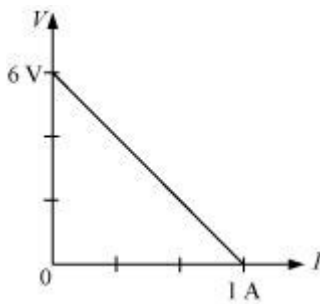
Q33 How does the fringe width of interference fringes change, upon the whole apparatus of Young's experiment is kept in a liquid of refractive index 1.3?

Solution:- The fringe width will decrease.

$$\text{Fringe width} = \frac{\lambda D}{d}$$

When light enters a denser medium, its wavelength decreases by a factor 1.3 and hence the fringe width also decreases by a factor 1.3.

Q34 The plot of the variation of potential difference across a combination of three identical cells in series versus current is as shown below. What is the emf of each cell?



Solution:- It can be inferred from the given graph that for zero current, equivalent *emf* is 6 V. Since three cells are connected in series, *emf* of each cell will be

$$\frac{6}{3} = 2 \text{ V}$$

Q35 What is sky wave propagation?

Solution:- They type of propagation in which radio waves are transmitted towards the sky and are reflected by the ionosphere towards the desired location on earth is called sky wave propagation.

Q36 Write the following radiations in ascending order with respect to their frequencies: X-rays, microwaves, UV rays and radio waves.

Solution:- The given radiations can be arranged in ascending order with respect to their frequencies as:

Radio waves < Microwaves < UV rays < X-rays

Q37 Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?

Solution:- Magnetic field lines form closed loops around a current-carrying wire. The geometry of a straight solenoid is such that magnetic field lines cannot loop around circular wires without spilling over to the outside of the solenoid. The geometry of a toroid is such that magnetic field lines can loop around electric wires without spilling over to the outside. Hence, magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid.

Q38 You are given following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope?

Lens	Power (P)	Aperture (A)
L1	3D	8 cm
L2	6D	1 cm
L3	10D	1 cm

Solution:- For constructing an astronomical telescope, the objective should have the maximum diameter. Of the three lenses given, L1 has the maximum diameter.

The eyepiece should have the highest power for better magnification. Therefore, we use lens L3.

Q39 If the angle between the pass axis of polarizer and the analyser is 45° , write the ratio of the intensities of original light and the transmitted light after passing through the analyser.

Solution:- $I = I_m \cos^2 \theta$

Where,

I is the transmitted intensity

I_m is the maximum value of the transmitted intensity

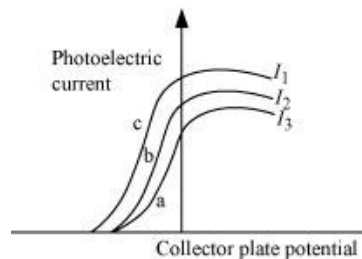
θ is the angle between the two polarising directions

$$\frac{I}{I_m} = \cos^2 \theta$$

$$\frac{I}{I_m} = \cos^2 45^\circ = \left(\frac{1}{\sqrt{2}}\right)^2$$

$$\frac{I}{I_m} = \frac{1}{2}$$

Q40 The figure shows a plot of three curves a, b, c, showing the variation of photocurrent vs collector plate potential for three different intensities I_1 , I_2 and I_3 having frequencies ν_1 , ν_2 and ν_3 respectively incident of a photosensitive surface. Point out the two curves for which the incident radiations have same frequency but different intensities.



Solution:- Curves *a* and *b* have the same frequency but different intensities.

Q41 What type of wavefront will emerge from a (i) point source, and (ii) distance light source?

Solution:

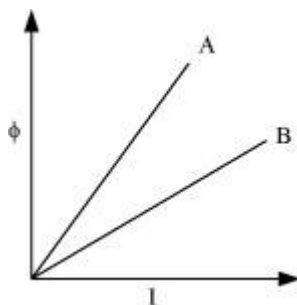
(i) For point source, wavefront will be spherical.

(ii) For a distant light source, the wavefronts will be plane wavefronts.

Q42 Two nuclei have mass numbers in the ratio 1: 2. What is the ratio of their nuclear densities?

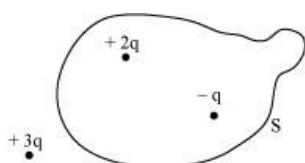
Solution:- Nuclear density is independent of mass number. Hence, both the atoms have the same nuclear density.

Q43 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?



Solution:- Inductor A has the larger value of self-inductance.

Q44 Figure shows three point charges $+2q$, $-q$ and $+3q$. Two charges $+2q$ and $-q$ are enclosed within a surface 'S'. What is the electric flux due to this configuration through the surface 'S'?



Solution:- The net electric flux through the surface 'S' is $\frac{q}{\epsilon_0}$, where ϵ_0 is the permittivity of free space.

Q45 In which orientation, a dipole placed in a uniform electric field is in (i) stable, (ii) unstable equilibrium?

Solution:- A dipole placed in a uniform electric field is in

- i. Stable equilibrium when the electric field is directed along the direction of the dipole i.e., when \vec{E} is parallel to \vec{P} .
- ii. Unstable equilibrium when the electric field is directed at an angle of 180 degrees with the direction of the dipole, i.e., when \vec{E} is anti-parallel to \vec{P} .

Q46 Which part of electromagnetic spectrum is used in radar systems?

Solution:- The microwave range of electromagnetic spectrum is used in radar systems.

Q47 Calculate the speed of light in a medium whose critical angle is 30° .

Solution:

$$\text{Speed of light in the medium} = \frac{\text{Speed of light in air}}{\text{Refractive index of the medium with respect to air}}$$

$$= \frac{3 \times 10^8 \text{ m/s}}{\left(\frac{1}{\sin 30^\circ} \right)}$$

$$= \frac{3 \times 10^8 \text{ m/s}}{2}$$

$$= 1.5 \times 10^8 \text{ m/s}$$

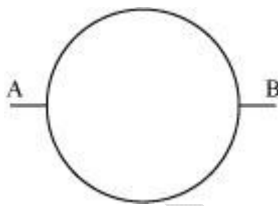
Q48 A glass lens of refractive index 1.45 disappears when immersed in a liquid. What is the value of refractive index of the liquid?

Solution:- The refractive index of the liquid is 1.45.

Q49 Write the expression for Bohr's radius in hydrogen atom.

Solution:- The expression for Bohr's radius in hydrogen atom is $a_0 = \frac{h^2 \epsilon_0}{\pi m e^2}$.

Q50 A wire of resistance $8R$ is bent in the form of a circle. What is the effective resistance between the ends of a diameter AB?



Solution:- The effective resistance between the ends of diameter AB is.

$$\frac{1}{\frac{1}{4R} + \frac{1}{4R}} = \frac{1}{\frac{1}{2R}} = 2R$$

Q51 A hollow metal sphere of radius 10 cm is charged such that the potential on its surface is 5 V. What is the potential at the centre of the sphere?

Solution:

We know

$$E = -\frac{dv}{dr} \text{ and for hollow shell electric field at center} = 0$$

$$\Rightarrow -\frac{dv}{dr} = 0 \Rightarrow dv = 0$$

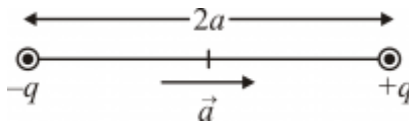
Hence $V_c = 5V$

Q52 How are X-rays produced?

Solution:- X-rays are produced when inside a vacuum tube high energy electrons emitted by the cathode collides with the anode (usually made of tungsten, copper, etc.)

Q53 Define electric dipole moment. Write its S.I. unit.

Solution:



Electric dipole moment is the product of the magnitude of the either charge and the distance between the charges (this distance is also called the displacement vector). It is a vector quantity with direction pointing from pointing from the negative charge to the positive charge. SI unit of electric dipole moment is coulomb meter (Cm).

Q54 Where on the surface of Earth is the angle of dip zero?

Solution:- At equator the angle of dip of a magnetic compass is zero.

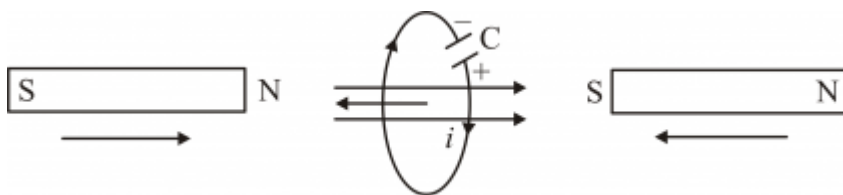
Q55 Define the term 'stopping potential' in relation to photo-electric effect.

Solution:- If we increase the negative potential of the collector, the photoelectric current decreases rapidly. At a certain critical value of the negative potential of the collector, the photoelectric current becomes zero. This potential is called stopping potential or cut-off potential and it depends on the frequency of the incident radiation, but independent of its intensity.

Q56 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.



Solution:



Red lines represent the magnetic lines due to the magnets. Blue line represents the magnetic line due to the current induced in the loop.

Polarity of the capacitor: lower plate is positive; upper plate is negative.

Q57 Write any two characteristic properties of nuclear force.

Solution:

Characteristic properties of nuclear force are

- (i) It does not depend on the electric charge.
- (ii) It is the strongest force in nature.
- (iii) It is a very short range force.
- (iv) The nuclear force is only felt among hadrons. At much smaller separations between nucleons the force is very powerfully repulsive, which keeps the nucleons at a certain average separation. Beyond about 1.7 femtometer (fm) separation, the force drops to negligibly small values.

Q58 What happens to the width of depletion layer of a p-n junction when it is (i) forward biased, (ii) reverse biased?

Solution:

- (i) In forward bias, the width of the depletion layer decreases.
- (ii) In reverse bias, the width of the depletion layer increases.

Q59 When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction?

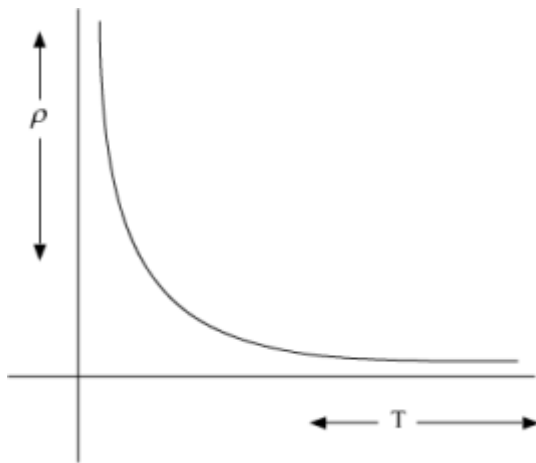
Solution:- No, when electric field applied the electrons will have net drift from lower to higher field but locally electrons may collide with ions and may change its direction of motion.

Q60 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?

Solution:- On the equator, the values of both angle of dip (δ) and vertical component of earth's magnetic field is zero. So, in this case, $B_v = 0$.

Q61 Show on a graph, the variation of resistivity with temperature for a typical semiconductor.

Solution:- The following curve shows the variation of resistivity with temperature for a typical semiconductor.



This is because, for a semiconductor, resistivity decreases rapidly with increasing temperature.

Q62 Why should electrostatic field be zero inside a conductor?

Solution:- Charge on conductor resides on its surface. So if we consider a Gaussian surface inside the conductor to find the electrostatic field,

$$\phi = \frac{q}{\epsilon_0} \text{ Where, } q = \text{charge enclosed in Gaussian surface.}$$

$q = 0$, inside the conductor, hence the electrostatic field inside the conductor is zero.

$$\begin{aligned} \phi &= \oint \vec{E} \cdot d\vec{s} = \frac{q}{\epsilon_0} \\ \oint E ds \cos \theta &= \frac{q}{\epsilon_0} \\ \Rightarrow E &= \frac{q}{4\pi \epsilon_0 r} = (\text{Since } q = 0) \end{aligned}$$

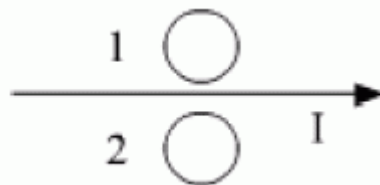
Q63 Name of physical quantity which remains same for microwaves of wavelength 1 mm and UV radiations of 1600 Å in vacuum.

Solution:- Both microwaves and UV rays are a part of the electromagnetic spectrum. Thus, the physical quantity that remains same for both types of radiation will be their speeds, equal to c .

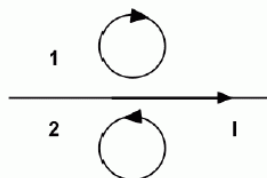
Q64 Under what condition does a biconvex lens of glass having a certain refractive index act as a plane glass sheet when immersed in a liquid?

Solution:- A biconvex lens will act like a plane sheet of glass if it is immersed in a liquid having the same index of refraction as itself. In this case, the focal length $1/f = 0$ or $f \rightarrow \infty$.

Q65 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.



Solution:- Using Lenz's law we can predict the direction of induced current in both the rings. Induce current oppose the cause of increasing of magnetic flux. So,



It will be clockwise in ring 1 and anticlockwise in ring

2

Q66 State de-Broglie hypothesis.

Solution:- de-Broglie Hypothesis states that—

Moving object sometimes acts as a wave and sometimes as a particle; or a wave is associated with the moving particle, which controls the particle in every respect. This wave associated with the moving particle is called matter wave or de Broglie wave, its wave length is given as

$$\lambda = \frac{h}{mv}$$

Where

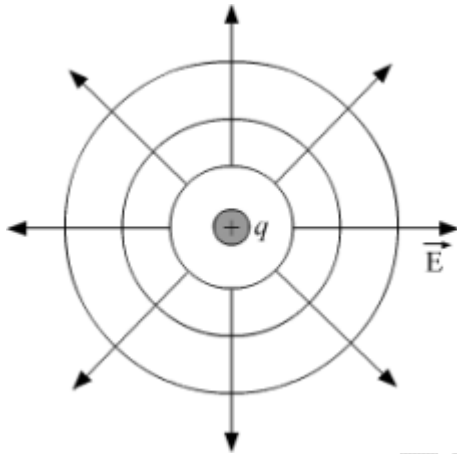
$h \rightarrow$ planck's constant

$m \rightarrow$ mass of the object

$v \rightarrow$ velocity of the object

Q67 What is the geometrical shape of equipotential surfaces due to a single isolated charge?

Solution:- For an isolated charge the equipotential surfaces are co-centric spherical shells and the distance between the shells increases with the decrease in electric field.



Q68 Write the relationship between angle of incidence 'i', angle of prism 'A' and angle of minimum deviation for a triangular prism.

Solution:- The relation between the angle of incidence i , angle of prism, A and the angle of minimum deviation, Δ_m for a triangular prism is given as is given by

$$i = \frac{A + \Delta_m}{2}$$

Q69 A capacitor has been charged by a dc source. What are the magnitude of conduction and displacement current, when it is fully charged?

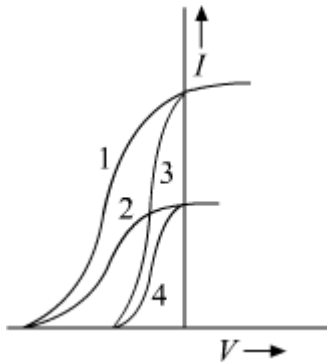
Solution:- Electric flux through plates of capacitor, $\phi_E = \frac{q}{\epsilon_0}$

Here, $q =$ constant, the capacitor is fully charged.

$$\text{Displacement current, } I_D = \epsilon_0 \frac{d\phi_E}{dt} = \epsilon_0 \frac{d\left(\frac{q}{\epsilon_0}\right)}{dt} = 0$$

Conduction current, $I = C \frac{dV}{dt} = 0$ as voltage becomes constant when the capacitor becomes fully charged.

Q70 The given graph shows the variation of photo-electric current (I) versus applied voltage (V) for two different photosensitive materials and for two different intensities of the incident radiations. Identify the pairs of curves that correspond to different materials but same intensity of incident radiation.



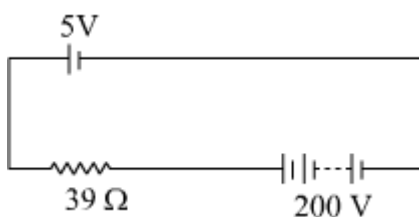
Solution:- Curves 1 and 2 correspond to similar materials while curves 3 and 4 represent different materials, since the value of stopping potential for the pair of curves (1 and 2) & (3 and 4) are the same. For given frequency of the incident radiation the stopping potential is independent of its intensity.

So, the pairs of curves (1 and 3) and (2 and 4) correspond to different materials but same intensity of incident radiation.

Q71 Which of the following waves can be polarized (i) Heat waves (ii) Sound waves? Give reason to support your answer.

Solution:- Heat waves can be polarized because heat waves are transverse waves whereas sound waves cannot be polarized because sound waves are longitudinal waves.

Q72 A 5 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of 39Ω as shown in the figure. Find the value of the current in circuit.



Solution:

Let I be the current flowing in the circuit.

Using Kirchoff's law,

$$39I = 200 - 5$$

$$I = \frac{195}{39} = 5 \text{ A}$$

Q73 Which of the following substances are para-magnetic?

Bi, Al, Cu, Ca, Pb, Ni

Solution:- Paramagnetic substances are Aluminum (Al) and Calcium (Ca).

Q74 A heating element is marked 210 V, 630 W. Find the resistance of the element when connected to a 210 V dc source.

Solution:

$$\because \text{Power is given as, } P = \frac{V^2}{R}, \therefore R = \frac{V^2}{P} = \frac{210^2}{630} = 70 \Omega$$

Q75 Define the term 'Mobility' of charge carriers in a conductor. Write its S.I. unit.

Solution:- Mobility of charge carriers in a conductor is defined as the magnitude of their drift velocity per unit applied electric field.

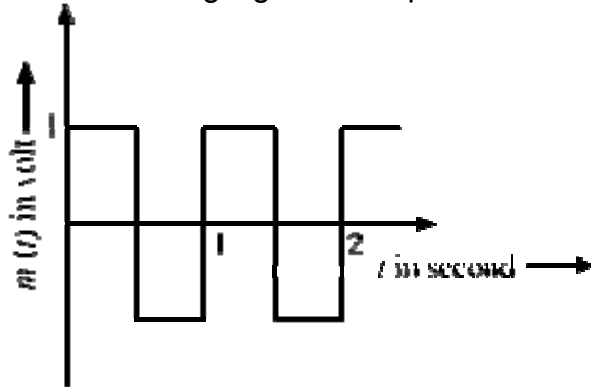
Mobility, $\mu = \frac{\text{Drift velocity}}{\text{Electric field}}$

$\mu = \frac{V_d}{E}$ (S.I. unit of mobility is $\text{m}^2\text{V}^{-1}\text{s}^{-1}$ or $\text{ms}^{-1}\text{N}^{-1}\text{C}$).

Q76 The carrier wave is given by

$$C(t) = 2\sin(8\pi t) \text{ volt.}$$

The modulating signal is a square wave as shown. Find modulation index.



Solution:- Modulation index (μ) is the ratio of the amplitude of the modulating signal to the amplitude of the carrier wave.

The generalised equation of a carrier wave is given below:
 $c(t) = A_c \sin \omega_c t$

The generalised equation of a modulating wave is given below:

$$m(t) = A_m \sin \omega_m t$$

Here, μ is defined as A_m/A_c .

On comparing this with the equations of carrier wave and modulating wave, we get:

Amplitude of modulating signal, $A_m = 1 \text{ V}$

Amplitude of carrier wave, $A_c = 2 \text{ V}$

$$\therefore \mu = \frac{A_m}{A_c} = \frac{1}{2} = 0.5$$

Q77 "For any charge configuration, equipotential surface through a point is normal to the electric field." Justify.

Solution:- We know that the work done (W) in moving a test charge along an equipotential surface is zero. This is because an equipotential surface is a surface with a constant value of potential at all the points on the surface.

$$\therefore W = F s \cos \theta = 0$$

Here, F is the electric force and s is the magnitude of displacement of the charge.

For non-zero displacement, this is possible only when $\cos \theta$ is equal to 0.

$$\begin{aligned} \text{i.e. } \cos \theta &= 0 \\ \Rightarrow \theta &= 90^\circ \end{aligned}$$

Thus, the force acting on the point charge is perpendicular to the equipotential surface. We know that the lines of force or the electric field lines indicate the direction of electric force on a charge. Thus, for any charge configuration, equipotential surface through a point is normal to the electric field.

Q78 Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why?_

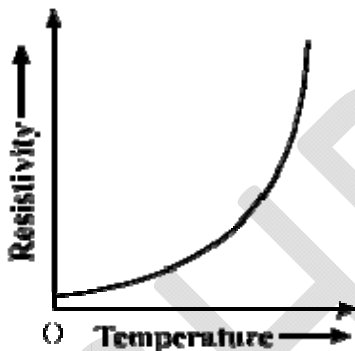
Solution:- A glass bob is non-conducting, while a metallic bob is conducting. Due to the non-conducting nature of the glass bob, it will only experience the Earth's gravitational pull. So, the glass bob will reach the ground earlier.

Because of its conducting nature, Eddy current is induced in the metallic bob as it falls through the magnetic field of the Earth.

By Lenz's law, the current induced is such that it opposes the motion of the metallic bob. So, the metallic bob will experience a force in the upward direction. This will slow down the metallic bob by some extent. Hence, it will reach the Earth after the glass bob.

Q79 Show variation of resistivity of copper as a function of temperature in a graph._

Solution:- The variation of resistivity of copper with temperature is parabolic in nature. This is shown in the following graph:



Q80 A convex lens is placed in contact with a plane mirror. A point object at a distance of 20 cm on the axis of this combination has its image coinciding with itself. What is the focal length of the lens?_

Solution:- Here, the convex lens is in contact with a plane mirror and the image distance is equal to the object distance. This is possible only when the point object is placed at the centre of the curvature of the lens.

We use the relation $f=R/2$, where R is the distance between the centre of the curvature and the pole and f is the focal length.

Here, $R = 20$ cm

∴ Focal length of the lens = $20/2 = 10$ cm

Q81 Write the expression, in a vector form, for the Lorentz magnetic force \vec{F} due to a charge moving with velocity \vec{V} in a magnetic field \vec{B} . What is the direction of the magnetic force?

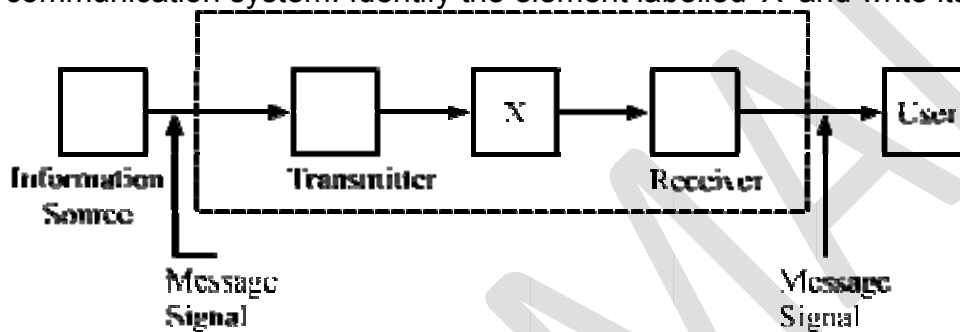
Solution:- The Lorentz magnetic force is given by the following relation:

$$\vec{F} = q\vec{V} \times \vec{B}$$

Here, q is the magnitude of the moving charge.

The direction of the magnetic force is perpendicular to the plane containing the velocity vector \vec{V} and the magnetic field vector \vec{B} .

Q82 The figure given below shows the block diagram of a generalized communication system. Identify the element labelled 'X' and write its function.



Solution:- The element labelled 'X' is called 'channel'. The function of the channel is to connect the transmitter and the receiver. A channel may either be wireless or in the form of wires connecting the transmitter and the receiver.

Q83. Why sound wave cannot be polarized?

Solution: Transverse waves can oscillate in the direction perpendicular to the direction of its propagation but longitudinal waves like sound waves oscillate only along the direction of its propagation. So, longitudinal waves cannot be polarized.

Q84. If you stand 1m in front of flat mirror, how far away from you is your image ?

Solution:-2m

Q85. What is fundamental difference between a real image and a virtual image

Solution:-Light actually converge to form a real image. There is no light at a location of a virtual image. Only real image can be projected on to screen.

Q86. What would be colour of sky in the absence of atmosphere

Solution:-Sunlight will not scattered so sky will appear dark

Q87. Two slits in Young double slit experiment are in the ratio of 1:16 . What will be ratio of intensity of light 1/16

Q88. Two metals X and Y when illuminated with appropriate radiations emit photoelectrons. The work function of X is higher than that of Y. Which metal has a higher value of threshold frequency and why?

Solution:-Work function $W = h\nu_0$ hence it shows W is directly proportional to threshold frequency hence X has more threshold frequency

Q89. A 100 ohm resistor connected to a 220V, 50 Hz ac supply then what will be rms value of current?

Solution:- $220/100 = 2.2$ A

Q90. An arbitrary surface enclose a dipole. What is electric flux through this surface

Solution:-Net charge on a dipole is zero hence flux is also zero

Q91. Why photodiode is usually operated in reverse bias?

Solution:-The fraction change due to incident light on the minority charge carriers in reverse bias is much more than that over the majority charge carriers in forward bias so photodiodes are used to measure the intensity in reverse bias condition.

Q92. Name the important process that occur during the formation of P-N junction

Solution:-Diffusion and Drift

Q93 Give two Examples of communication system which use space wave mode

Solution:-

- (i) LOS(line of Sight Communication)
- (ii) Satellite Communication

Q94 A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation Index of 75%

Solution:-Modulation index = $E_m / E_c = 75\% = 75/100$

$$E_m = 0.75 \times 12 = 9 \text{ V}$$

Q95 Two Stable Isotopes of lithium have respective abundances of 7.5% and 92.5%. these isotopes have masses 6.01512 amu 7.01600 amu respectively. Find the atomic weight of lithium

Solution:-Average atomic mass = $P_1m_1 + P_2m_2 / (P_1 + P_2)$

$$= 6.941 \text{ amu}$$

Q96 The ground state energy of hydrogen atom is -13.6eV . What is the kinetic energy ? (13.6eV)

Q97 When current is passed through a spring, it contracts, why?

Solution:-When current is passed through a spring , the current in any two adjacent loops is in same direction so they experience attractive magnetic interaction and so come closer. That is why when current is passed through a spring it contracts.

Q98. Name the carriers of electric current in silver bar and germanium semiconductor

Solution:-In silver bar free electrons whereas in semiconductor electrons and holes

Q99. Why do we prefer a potentiometer to measure the emf of a cell rather than a voltmeter?

Solution:-A potentiometer draws current from a cell while potentiometer does not draw any current from the cell so the cell remain in open circuit and potentiometer reads the actual value of emf.

Q100. How much work is done in moving a 500micro coulomb charge between two points on an equipotential surface?

Solution:-Zero

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