2015

Set: I

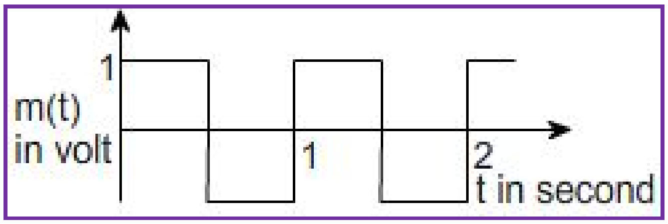
Question: 1 – 30 ii - xviii

Set I

Question: 1
Define the term 'Mobility' of charge carriers in a conductor. Write its S.I. unit. [1]

Answer:
Mobility of a charge carrier is defined as the drift velocity of the charge carrier per unit electric field. $\mu = \frac{\upsilon d}{E}$ It is generally denoted by μ. The SI unit of mobility is $m^2V^{-1}\ s^{-1}$. It is 10^4 of the mobility in practical units ($cm^2V^{-1}\ s^{-1}$).

Question: 2
The carrier wave is given by C(t):2 sin (8zrt) volt. The modulating signal is a square wave as shown. Find modulation index. [1]



Answer:
It can be observed from the given modulating signal that the amplitude of the modulating signal is *Am*= 1 V.
The carrier wave is given by c(t) = 2 sin 8πt.
Amplitude of the carrier wave is A_C = 2V.
Modulation index is μ: $\frac{A_m}{A_C} = \frac{1}{2} = 0.5$

Question: 3
"For any charge configuration, equipotential surface through a point is normal to the electric field." Justify. [1]

Answer:
On an equipotential surface $V_B - V_A = 0 = -\int \vec{E} \times \vec{dl}$

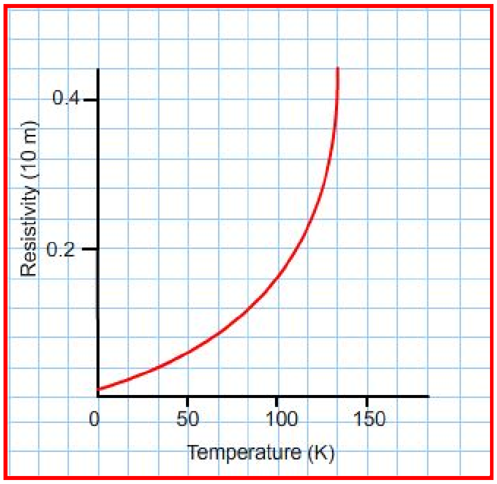
$\vec{E} \times \vec{dl} = 0$ hence $\vec{E} \perp \vec{dl}$

Question: 4
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? [1]

Answer:
Glass bob would reach earlier on ground as a= g
No induced current is develop in it due earth's magnetic field.

Question: 5
Show variation of resistivity of copper as a function of temperature in a graph. [1]

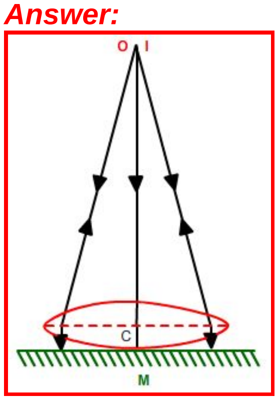
Answer:



Question: 6
Fig. shows a convex lens placed in contact with a plane mirror. An axial point object is placed at O at a distance OC = 20 cm. As the image I of the object coincides with O, the rays refracted first from the lens and then reflected by the plane mirror must be retracing their path.

This would happen when rays refracted by the convex lens fall normally on the mirror, i.e., the refracted rays form a beam parallel to principal axis of the lens. Hence the object O must be at the focus of the convex lens. f = CO = 20 cm. [1]

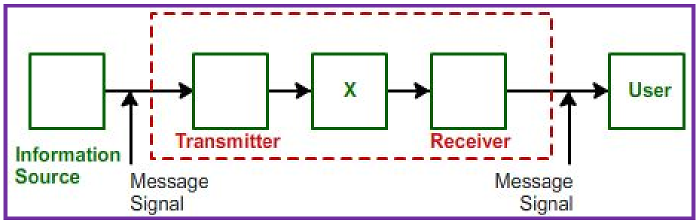
Answer:



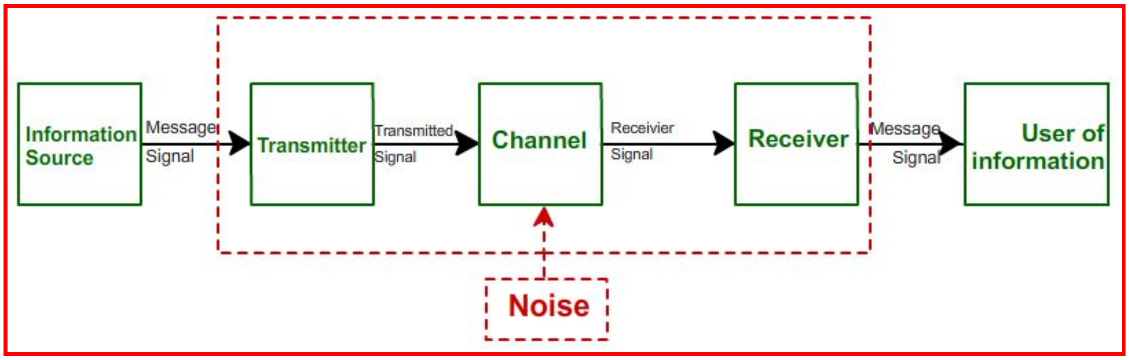
Question: 7
Write the expression, in a vector form, for the Lorentz magnetic force $\vec{F}$ due to a charge moving with velocity $\vec{V}$ in a magnetic field $\vec{B}$. What is the direction of the magnetic force? [1]

Answer:
$\vec{F} = q\left(\vec{V} \times \vec{B}\right)$ where $\vec{F}$ is $\perp$ to the plane containing $\vec{V}$, and $\vec{B}$.

Question: 8
The figure given below shows the block diagram of a generalized communication system. Identify the element labelled 'X' and write its function. [1]



Answer:



Basic communication system

X is channel Function

The channel is the physical medium that connects the transmitter and the receiver. The signal from the transmitter is carried to the receiver by the communication channel.

Question: 9

Out of the two magnetic materials, 'A' has relative permeability slightly greater than unity while 'B' has less than unity. Identify the nature of the materials 'A' and `B'. Will their susceptibilities be positive or negative? [2]

Answer:

A is paramagnetic χ_m = positive, B is diamagnetic χ_m = positive

Question: 10

Given a uniform electric field $\vec{E} = 5 \times 10^3 \hat{i}$, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the y-z plane. What would be the flux through the same square if the plane makes a 30° angle with the x-axis? [2]

Answer:

$\vec{E} = 5 \times 10^3 \hat{i}$, A = (0.1)2 = 0.01 m^2 in Y-Z plane

$\vec{E}$ is $\perp$ to surface

ϕ = EA = 5 x 10^3 x 0.01 = 50 Nm^2 / C

If $\theta = 60^0$, $\phi = EA\cos\theta = 5 \times \frac{1}{2} = 25\ Nm^2 / C$

Question: 11

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 $\frac{\lambda}{a}$. At the same angle of $\frac{\lambda}{a}$ we get a maximum for two narrow slits separated by a distance "a". Explain. [2]

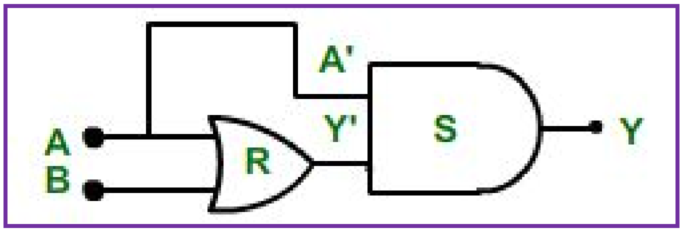
Answer:

In diffraction angular position $\theta = \frac{\Delta x}{a}$ for first minima $\Delta x = \lambda$

Hence, $\theta = \frac{\lambda}{a}$. In interference given d = a, and angular position $\theta = \frac{\Delta x}{d}$. Angular position of first Maxima $(\Delta x = \lambda)$ $\theta = \frac{\lambda}{a}$

Question: 12

Write the truth table for the combination of the gates shown. Name the gates used. [2]



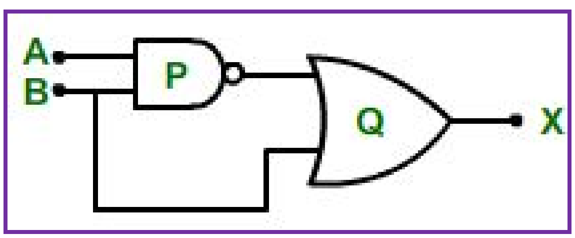
Answer:

R is OR, and S is AND

A	B	Y' = (A+B)	Y = A.(A+B)
0	0	0	0
0	1	1	0
1	0	1	1
1	1	1	1

OR

Identify the logic gates marked 'P' and `Q' in the given circuit. Write the truth table for the combination.



Answer:

P is NAND, and OR

A	B	A.B	$\overline{A.B}$	X = B+ $\overline{A.B}$
0	0	0	1	1
0	1	0	1	1
1	0	0	1	1
1	1	1	0	1

Question: 13

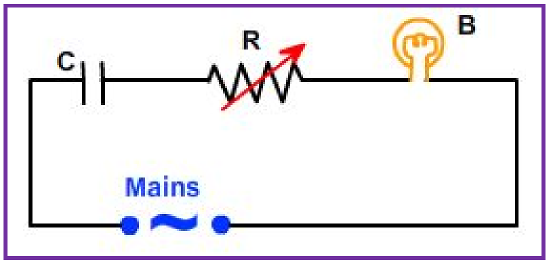
State Kirchhoff s rules. Explain briefly how these rules are justified.

Answer:

See topics on “Kirchhoff’s rule’.

Question: 14

In our following diagram a capacitor 'C', a variable resistor ‘R’, and a bulb ‘B’ are connected in series to the ac mains in circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change in following two instances? [2]



i. A dielectric slab is introduced between the plates of the capacitor, keeping resistance R to be the same;

Answer:

Due to dielectric C increases $X_C = \frac{1}{\omega C}$ decreases $Z = \sqrt{R^2 + X_C^2}$ decreases.

$I_{rms} = \frac{V_{rms}}{Z}$ increases, brightness of bulb increases.

ii. The resistance R is increased keeping the same capacitance?

Answer:

R increases Z increases I_{rms} decreases brightness decreases.

Question: 15

State the underlying principle of a cyclotron. Write briefly how this machine is used to accelerate charged particles to high energies. [2]

Answer:

Cyclotron

It is a device used to accelerate positively charged particles like protons, deutrons, α-particles, etc., to very high energies.

Principle

A charged particle can be accelerated to very high energies with the help of smaller values of oscillating electric field. A perpendicular magnetic field which throws the charged particle into a circular motion, repeatedly brings the charge into the oscillating electric field such that repeated acceleration can happen.

Construction

- It consists of two D-shaped hollow evacuated metal chambers D_1, and D_2 called the dees.
- An alternating voltage of the order of 104 volts is applied across the gap between the two
- dees. The dees are placed between the poles of a strong electro-magnet. A source of charged particles or ions is placed near the center of the dees.

- The whole assembly is evacuated to minimize collisions between the ions, and the air molecules.

Working

- Suppose the positive ion enters the gap between the two dees & finds D_1 to be negative, and it gets accelerated towards D_1. As it enters D_1 it doesn't experience any electric field due to shielding effect of the metallic dee.
- The perpendicular magnetic field throws it into a circular path. At the instant the ion comes out of D_1, it finds D_1 to be +ve, and D_1 –ve. It now gets accelerated towards dee D_2.
- It now moves faster through D_2 describing a larger semicircle than before. Thus, the +ve ion will go on accelerating every time it comes into the gap between the dees, and will go on describing circular path of greater and greater radius with greater speed, and finally acquire a sufficiently high energy.
- The accelerated ion is ejected through a window by a deflecting voltage and hits the target.

Theory behind

q = charge of particle
m = mass of particle
Magnetic force on charge q = Centripetal force on charge q

$$qvB\sin 90^0 = \frac{mv^2}{r} \qquad r = \frac{mv}{qB}$$

Period of revolution of the charged particle is given by, $T = \frac{2\pi r}{v} = \frac{2\pi}{v} \times \frac{mv}{qB} = \frac{2\pi m}{qB}$

Frequency of revolution of the particle is $fc = \frac{1}{T} = \frac{qB}{2\pi m}$

Question: 16

An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of $4\sqrt{3}$ Nm. Calculate the potential energy of the dipole, if it has charge ±8 nC. [2]

Answer:

$2a = 4\times1^{-2}$ m, $\theta = 60^o$, $\tau = 4\sqrt{2}$, $q = 8\ 10^{-9}$ C

$$t = q(2a)\ Esinq = q(2a)\ x\ E\ x \frac{\sqrt{3}}{2} = 4\sqrt{2}$$

$$E = \frac{8\sqrt{2}}{q(2a)\sqrt{3}}$$

Potential Energy: $-PE\ cosq - q(2a)Ecosq = q(2a)\ x \left(\frac{8\sqrt{2}}{q(2a)\sqrt{3}}\right) \times \left(\frac{1}{2}\right) = \frac{4\sqrt{2}}{\sqrt{3}} J$

Question: 17 [2]

A proton and a deuteron are accelerated through the same accelerating potential. Give reasons to justify your answer for,

a. greater value of de-Broglie wavelength associated with it

Answer:

$\lambda = \left(\frac{h}{\sqrt{2mV0q}}\right) \alpha \left(\frac{1}{\sqrt{m}}\right)$ V_0,and q same for both; m is more for proton so λ is more,

b. less momentum ?

Answer:

$\lambda = \frac{h}{p} \Rightarrow p = \frac{h}{\lambda}$, hence both have same momentum.

Question: 18 [2]

i. Monochromatic light of frequency 6.0 × 1014 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.

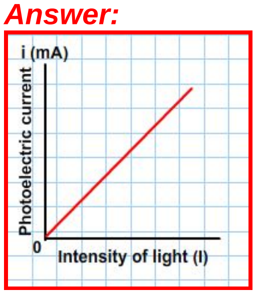
Answer:

$$\text{Power} = \frac{\text{energy}}{\text{second}} = \frac{nh\nu}{\text{sec}}$$

$$n/\text{sec.} = \frac{\text{Power}}{h\nu} = \frac{2 \times 10^{-3}}{6.6 \times 10^{-34} \times 6 \times 10^{14}} = 0.05 \times 10^{17}$$

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

Answer:



Question: 19

A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. Up to which energy level the hydrogen atoms would be excited? Calculate the wavelengths of the first member of Lyman and first member of Balmer series. [3]

Answer:

E_1 = -13.6eV, E_2 = -3.4V, E_3 = -1.51eV, E_4 = -0.85eV

$E_3 - E_1$ = 12.09eV, $E_4 - E_1$ = 12.75eV

$1 \rightarrow 2$ (10.2)

$1 \rightarrow 3$ (12.09)

$1 \rightarrow 4$ (12.75)

$1 \rightarrow 5$ (13.06)

$1 \rightarrow 6$ (13.12)

First member of lyman $\left(\frac{1}{\lambda 1}\right) : RH(1)^2 \times \left(\frac{1}{1^2} - \frac{1}{2^2}\right)$

First member of Balmer $\left(\frac{1}{\lambda 12}\right)$: $RH(1)^2 \times \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

Question: 20 [3]

When Sunita, a class XII student, came to know that her parents are planning to rent out the top floor of their house to a mobile company she protested. She tried hard to convince her parents that this move would be a health hazard. Ultimately her parents agreed

i. In what way can the setting up of transmission tower by a mobile company in a residential colony prove to be injurious to health?

Answer:

Mobile tower requires giant structure at the top level of any building. All through the year it will be an action point where link will be made with mobiles. In case of large scale wind, there is a fear of fall of the structure. Also, the signals wavering around may affect all human life in the neighborhood.

ii. By objecting to this move of her parents, what value did Sunita display?

Answer:

By objecting to this move of her parents, Sunita displaced the values that she is concerned about large scale damage caused by cyclone/high speed wind with probable loss of life.

- She is keeping track (knowledgeable) of the research that is going on in the influence of these signals on human life when exposed for long duration.
- She has foresight of the problems that they may face at large.
- She is concerned about the welfare of the community.

iii. Estimate the range of e.m. waves which can be transmitted by an antenna of height 20 m. (Given radius of the earth = 6400 km)

Answer:

Range = R = $\sqrt{2hRe} = \sqrt{2 \times 20 \times 6400 \times 10^3} = \sqrt{4 \times 64 \times 10^6}$ = 2 x 8 x 10^3 = 16 Km.

Question: 21

A potentiometer wire of length 1 m has a resistance of 10Ω. It is connected to a 6 V battery in series with a resistance of 5Ω. Determine the emf of the primary cell which gives a balance point at 40 cm. [3]

Answer:

l = 1 m = 100 cm, R = 10 Ω, E0 = 6 Volt, R1 = 5 Ω

$$I = \frac{E_0}{R + R'} = \left(\frac{6}{10 + 5}\right) = \frac{6}{15} A$$

$$V_{AB} = IR = \left(\frac{6}{15} \times 10\right) = \left(\frac{60}{15}\right) = 4 Volt$$

$$\frac{V_{AB}}{l} = \left(\frac{4}{100}\right) = 0.04$$

$$E_0 = \frac{V_{AB}}{l} x x = 0.04 x 40 = 1.6 Volt$$

Question: 22 [3]

a. Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.

Answer:

$m = m_0.m_e$

$20 = m_0 \times 5$

$m_0 = 4$

$$\frac{-v_0}{\mu_0} = 4 \Rightarrow v_0 = -4\mu 0$$

$$\frac{1}{\mu_0} + \frac{1}{-4V_0} = \frac{1}{70}$$

$$\frac{-\mu - 1}{4\mu_0} = \frac{-5}{4\mu_0} = \frac{1}{f_0}$$

$$me = 1 + \frac{D}{f_e} \Rightarrow 5 = 1 + \frac{20}{f_e}$$

$$4 = \frac{D}{f_e} \Rightarrow f_e = 5$$

b. The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focused on a certain object. The distance between the objective and eyepiece, is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece.

Answer:

$$\frac{1}{u_e} = \left(-\frac{1}{20} - \frac{1}{5}\right) = \left(\frac{-1-4}{20}\right) = -\left(\frac{1}{4}\right)$$

$$u_e = -4$$

$$L = v_0 + |u_e|$$

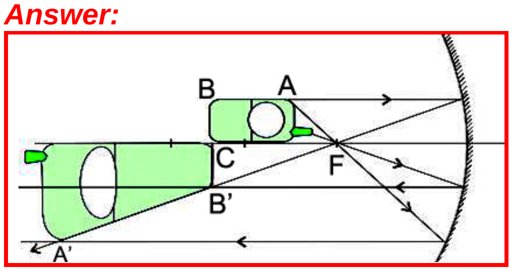
$$14 = v_0 + u \Rightarrow v_0 = 10 \Rightarrow \frac{v_0}{-4} - 2.5$$

$$\text{Hence}, f_0 = -\frac{uv_0}{5} = \left\{\frac{4}{5} \times (-2.5)\right\} = 2\text{cm}$$

Question: 23 [3]

a. A mobile phone lies along the principal axis of a concave mirror. Show, with the help of a suitable diagram, the formation of its image. Explain why magnification is not uniform**.**

Answer:



u will be different for different points on object.

b. Suppose the lower half of the concave mirror's reflecting surface is covered with an opaque material. What effect this will have on the image of the object? Explain.

Answer:

Intensity $\times \frac{1}{2}$, complete image is formed.

Question: 24 [3]

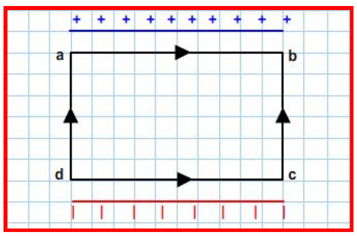
a. Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.

Answer:

$$U = \frac{1}{2}CV2 = \frac{1}{2} \times \left(\frac{\varepsilon_0 A}{d}\right)(Ed)^2$$

$$\frac{U}{Ad} = \text{Energy density} = \frac{1}{2} \times \varepsilon_0 E^2$$

b. The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop abed a.



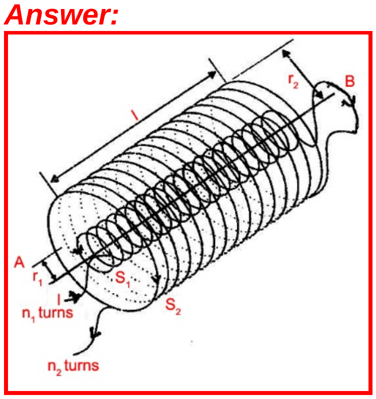
Answer:

Cyclic path, conservative field, net work done = 0.

Question: 25 [3]

a. State Ampere's circuital law, expressing it in the integral form.

Answer:



b. Two long coaxial insulated solenoids, S_1, and S_2 of equal lengths are wound one over the other as shown in the figure. A steady current "I" flow through the inner solenoid S_1 to the other end B, which is connected to the outer solenoid S_2 through which the same current "I" flows in the opposite direction so as to come out at end A.

If n_1 and n_2 are the number of turns per unit length, find the magnitude and direction of the net magnetic field at a point (i) inside on the axis and (ii) outside the combined system.

Answer:
Inside Bnet = $B_1 - B_2 = \mu_0 n_1 I - \mu_0 n_2 I$ B to A
Out side Bnet = 0

Question: 26
a. Name the em waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves. [1]

Answer:
Microwaves

b. If the earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain. [1]

Answer:
Temperature would decreases (No greenhouse effect)

c. An em wave exerts pressure on the surface on which it is incident. Justify. [1]

Answer:
em waves carry momentum $= \frac{\text{energy}}{C}$ hence exerts pressure.

Question: 27 [3]
Deduce the expression, N = No e--λt, for the law of radioactive decay.

i. Write symbolically the process expressing the β+ decay of 11Na22. Also write the basic nuclear process underlying this decay.

Answer:
$_{11}Na^{22} \rightarrow _{10}Y^{22} + ^{0}_{1}e + v + Q$

ii. Is the nucleus formed in the decay of the nucleus 11Na12, an isotope or isobar ?

Answer:
V is an Isobar.

Question: 28 [3]
a.

i. 'Two independent monochromatic sources of light cannot produce a sustained interference pattern'. Give reasons.

Answer:
In independent monochromatic sources phase difference changes at a rate of 108 Hz. Hence, the interference pattern obtained also fluctuates with 108 Hz, and therefore, it is not sustainable as result of persistence of vision.

ii. Light waves each of amplitude "a", and frequency "ω", emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by y1 = a cos ωt, and y_2 = a cos(ωt + ϕ) where ϕ is the phase difference between the two, obtain the expression for the resultant intensity at the point.

Answer:

$y_1 = a\cos\omega t;\ y_2 = a\cos(\omega t + \phi)$

$R = \sqrt{a^2 + b^2 + 2a^2\cos\phi}$ using parallogram law

$R = \sqrt{a^2 + a^2 + 2a^2\cos\phi} = \sqrt{2a^2 + 2a^2 + \cos\phi} = \sqrt{2a^2 + (1+\cos\phi)} = \sqrt{2a^2 \times 2 \times \cos 2\frac{\phi}{2}} = 2\cos\frac{\phi}{2}$

$I_1 \propto a^2, I_2 \propto a^2$

$I_{net} \propto R^2$

$\frac{I_{net}}{I} = \left(\frac{R}{2}\right)^2 = \left(2\cos\frac{\phi}{2}\right)^2$

$I_{net} = 4I\cos 2\frac{\phi}{2}$

b. In Young's double slit experiment, using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is λ units. Find out the intensity of light at a point where path difference is, $\frac{\lambda}{3}$.

Answer:

Intensity I = $4I_0\cos^2\frac{\phi}{2}$

Path difference of λ, is equivalent to phase difference of 2π.

I = $4I_0\cos^2$ λ, is equivalent to phase difference of 2π

When path difference, $\Delta x = \frac{\lambda}{3}$, the phase difference,

$\phi' = \left(\frac{2\pi}{\lambda} \times \Delta x\right) = \left(\frac{2\pi}{\lambda} \times \frac{\lambda}{3}\right) = \frac{2\pi}{3}$Radian

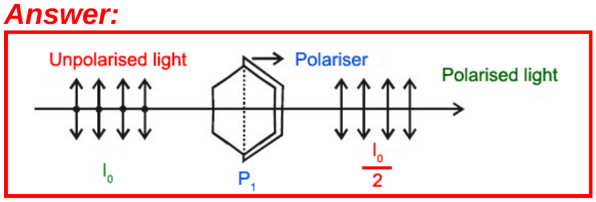
$\therefore I = 4I_0\cos^2\frac{\pi}{3}$

$\therefore I = K\cos^2\frac{\pi}{3} = K\left(\frac{1}{2}\right)^2 = \frac{1}{4}K$

OR

a. How does one demonstrate, using a suitable diagram, that un-polarized light when passed through a Polaroid gets polarized?

Answer:



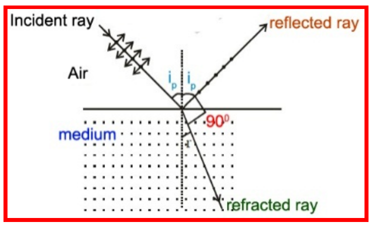
Polarizer has a pass axis along which if any electric field vector lies, it will get transmitted to the other side. If an electric field vector which is perpendicular the pass axis, falls on the polariser then, it gets absorbed.

We know that an un-polarized light has two components of electric field vector, one of which is parallel to the pass axis and the other which is perpendicular to the pass axis. Since, the perpendicular component gets absorbed; the output light obtained is a polarized light whose electric field vector is parallel to the pass axis.

b. A beam of un-polarized light is incident on a glass-air interface. Show, using a suitable ray diagram, that light reflected from the interface is totally polarized, when μ= tan iB, where) μ is the refractive index of glass with respect to air and iB is the Brewster's angle.

Answer:

When un-polarized light is incident on the interface of two transparent media the reflected light is polarized. If the un-polarized light is incident at the angles 0° or 90°, the reflected ray remains un-polarized. When the reflected wave is perpendicular to the refracted wave, the reflected wave is totally polarized. The angle of incidence in this case is called polarizing angle or Brewster's angle (i_p).



Brewster's Law says that when an un-polarized light is incident on a transparent surface of refractive index (*n*) at the polarizing angle (*ip*) such that the reflected ray and the refracted ray are perpendicular to each other, the reflected light is totally plane polarized and in that condition *n* = tan *ip*.

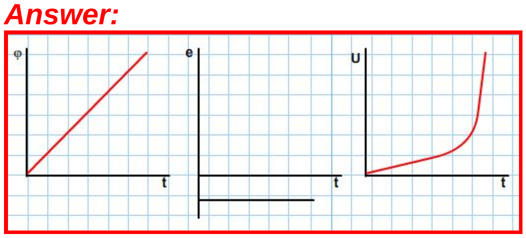
From the diagram,
$i_p + 90° + r = 180°$
$i_p + r = 90°$
$r = 90 - i_p$

$$\mu = \left(\frac{\sin i_p}{\sin r}\right) = \left\{\frac{\sin i_p}{\sin\left(90 - i_p\right)}\right\} = \left(\frac{\sin i_p}{\cos i_p}\right) = \tan i_p$$

Question: 29 [5]

a. Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.

Answer:



$$e = -L \times \frac{dI}{dt} \quad \frac{dI}{dt} = \text{positive}$$

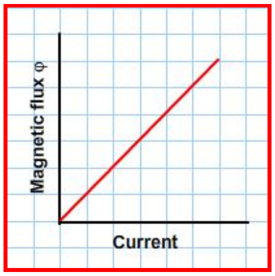
$$U = \frac{1}{2}LI^2 \Rightarrow U \propto I^2$$

Hence e is negative and constant.

b. The current flowing through an inductor of self-inductance L is continuously increasing. Plot a graph showing the variation of

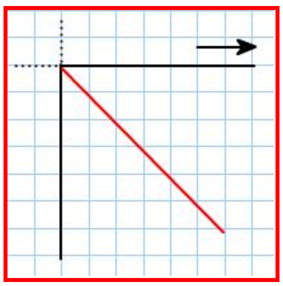
i. Magnetic flux versus the current

Answer:

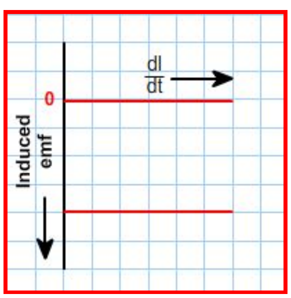


ii. Induced einf vs. dI/dt 16

Answer:



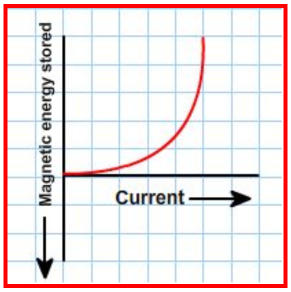
Alternatively



When I is increasing at constant value.

iii. Magnetic potential energy stored versus the current.

Answer:

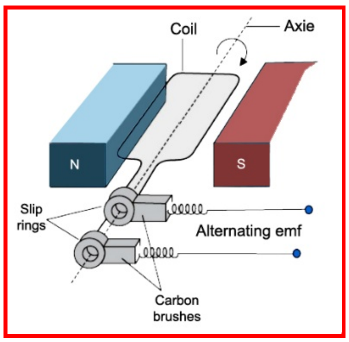


OR

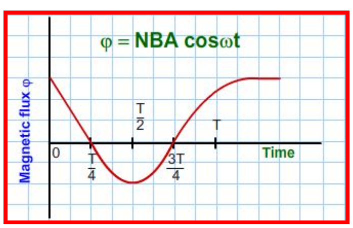
a. Draw a schematic sketch of an AC generator describing its basic elements. State briefly its working principle. Show a plot of variation of,

i. Magnetic flux

Answer:



It works on the process of electromagnetic induction, i.e., when a coil rotates continuously in a magnetic field, the effective area of the coil, linked (normally) with the magnetic field lines, changes continuously with time. This variation of magnetic flux with time results in the production of an (alternating) emf in the coil.

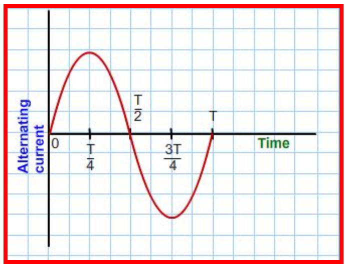


ii. Alternating emf versus time generated by a loop of wire rotating in a magnetic field.

Answer:

Alternating emf vs. time

$E = NAB\omega \sin\omega t = e_0 \sin\omega t$



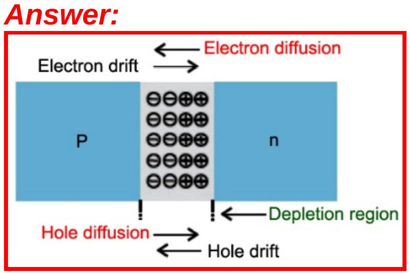
b. Why is choke coil needed in the use of fluorescent tubes with ac mains ?

Answer:

Question: 30

a. Write the expression for the force, F, acting on a charged particle of charge 'q', moving with a velocity v in the presence of both electric fields E, and magnetic field B. Obtain the condition under which the particle moves un-deflected through the fields. State briefly the processes involved in the formation of p-n junction explaining clearly how the depletion region is formed.

Answer:

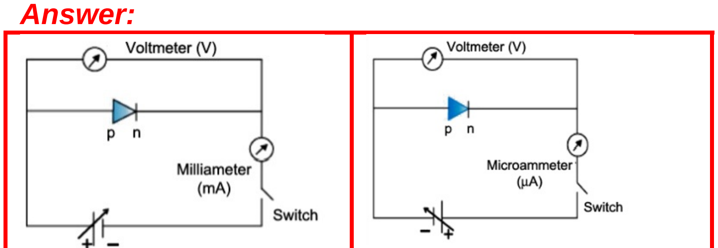


Two processes involved during the formation of p-n junction are diffusion and drift. Due to the concentration gradient, across p, and n sides of the junction, holes diffuse from p → n, and electrons from n→ p. This movement of charge carriers leaves behind ionized acceptors on the p-side and donors on the n- side of the junction. This space charge region on either side of the junction, together, is known as depletion region.

b. Using the necessary circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in
(i) Forward biasing
(ii) Reverse biasing

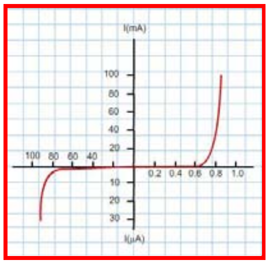
How are these characteristics made use of in rectification?

Answer:



(a) (b)

Using the circuit arrangements shown in fig (a), and fig (b), we study the variation of current with applied voltage to obtain the V-I characteristics shown below.



From the V-I characteristics of a junction diode. it is clear that it allows the current to pass only when it is forward biased. So when an alternatively voltage is applied across the diode, current flows only during that part of the cycle when it is forward biased.

OR

a. Differentiate between three segments of a transistor on the basis of their size and level of doping.

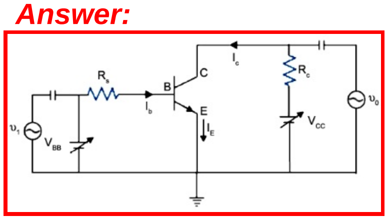
Answer:
Emitter: It is of moderate size and heavily doped
Base: It is very thin and lightly doped
Collector: It is moderately doped and larger in size

b. How is a transistor biased to be in active state? [5]

Answer:
Transistor is said to be in active state when its emitter-base junction is (suitably) forward biased and base-collector junction is (suitably) reverse biased.

c. With the help of necessary circuit diagram, describe briefly how n-p-n transistor in CE configuration amplifies a small sinusoidal input voltage. Write the expression for the ac current gain.

Answer:



When a small sinusoidal voltage is superposed on the dc base bias, the base current will have sinusoidal variation superimposed on the value of I_B. As a consequence, the collector current also will have sinusoidal variations, superimposed on the value of I_C, producing corresponding (amplified)changes in the value of V_0.

ac current gain $\beta ac = \left(\frac{\Delta I_c}{\Delta I_b}\right)_{V_{CE}}$