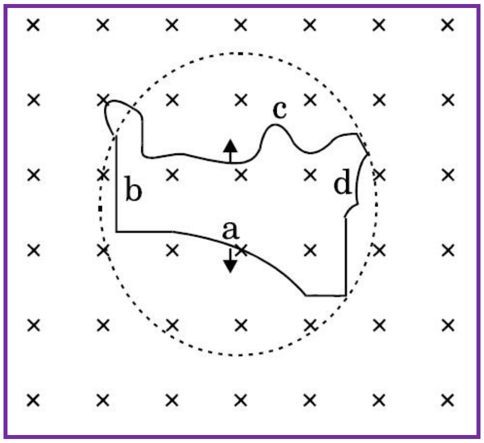
2014

Question: 1 – 30 ii-xxii

Question 1
A flexible wire of irregular shape, abcd, as shown in the figure, turns into a circular shape when placed in a region of magnetic field which is directed normal to the plane of the loop away from the reader. Predict the direction of the induced current in the wire. [1]



Answer:
The wire is expanding to form a circle, which means that force is acting outwards on each part of the wire because of the magnetic field (acting in the downwards direction). The direction of the induced current should be such that it will produce magnetic field in upward direction (towards the reader). Hence, the force on the wire will be towards inward direction, i.e., induced current is flowing in anticlockwise direction in the loop from c-b-a-d-c.

Question 2
Why must electrostatic field at the surface of a charged conductor be normal to the surface at every point? Give reason. [1]

Answer:
Electric field is defined to be the gradient of potential and the surface of a conductor has a constant potential. Therefore, there is no field along the surface of the conductor and, hence, the electrostatic field at the surface of a charged conductor should be normal to the surface at every point.

Question 3
Define one tesla using the expression for the magnetic force acting on a particle of charge 'q' moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$. [1]

Answer:
One tesla is the defined as the magnitude of magnetic field which produces a force of 1 newton when a charge of 1 coulomb moves perpendicularly in the region of the magnetic field at a velocity of 1 m/s.

$$F=qvB \Rightarrow B = Fqv \Rightarrow 1\ T = 1\ N(1\ C)(1\ \frac{m}{s})$$

Question 4
In both β^- and β^+ decay processes, the mass number of a nucleus remains same whereas the atomic number Z increases by one in β^- decay and decreases by one in β^+ decay. Explain, giving reason. [1]

Answer:

In β^- decay, a β particle of zero mass and −1 charge is emitted. The decay process is shown below:

XzA→YZ+1A+β−10+v

Since the mass of β^- particle is negligibly small, the mass number of the nucleus remains the same and the atomic number increases by 1 due to the loss of 1 negative charge. Similarly, for a β+ decay, a β particle of negligibly small and +1 charge is emitted. The decay process is shown below:

XzA→YZ+1A+β+10+v

The mass number remains the same, but here, the atomic number decreases by 1 due to the loss of 1 positive charge.

Question 5

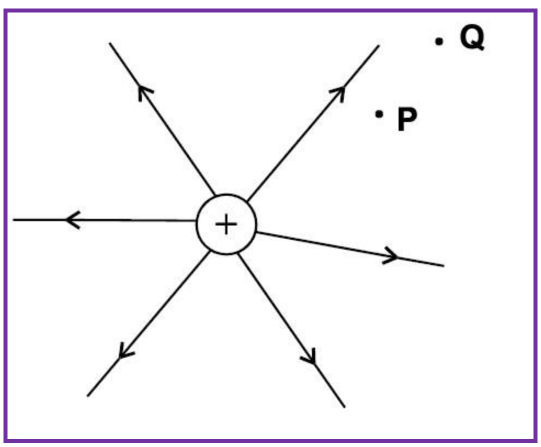
Arrange the following electromagnetic waves in order of increasing frequency:
γ -rays, microwaves, infrared rays and ultraviolet rays. [1]

Answer:

Microwaves < infrared rays < ultraviolet rays < γ-rays.

Question 6

Figure shows the field lines on a positive charge. Is the work done by the field in moving a small positive charge from Q to P positive or negative? Give reason. [1]



Answer:

Work done = *q*.(potential at Q − potential at P), where *q* is the small positive charge
The electric potential at a point distant *r* due to the field created by a positive charge Q is given by
V=14πε0qr
∵rP<rQ⇒VP>VQ
∴ Work done will be negative.

Question 7

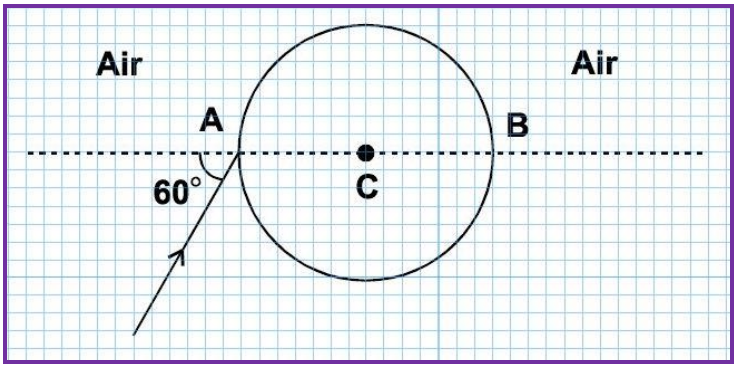
In photoelectric effect, why should the photoelectric current increase as the intensity of monochromatic radiation incident on a photosensitive surface is increased? Explain. [1]

Answer:

Photoelectric effect is a one photon-one electron phenomenon. Therefore, when the intensity of radiation incident on the surface increases, the number of photons per unit area per unit time increases (since intensity of incident radiation ∝ no. of photons). Hence, the photoelectrons ejected will be large, which, in turn, will contribute to the increase in photoelectric current.

Question 8

A ray of light falls on a transparent sphere with centre C as shown in the figure. The ray emerges from the sphere parallel to the line AB. Find the angle of refraction at A if refractive index of the material of the sphere is $\sqrt{3}$ [1]



Answer:

From Snell's law, we have:

sin(i)sin(r)=μ

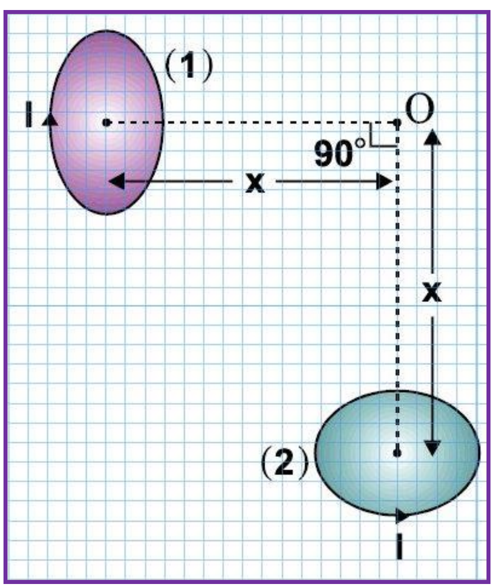
At A, *i* = 60° (given)

Now*, μ* = √3

⇒sin(r)=sin(i)μ⇒sin(r)=sin(60°)3√=12⇒r=sin−1(12)∴r=30°

Question 9

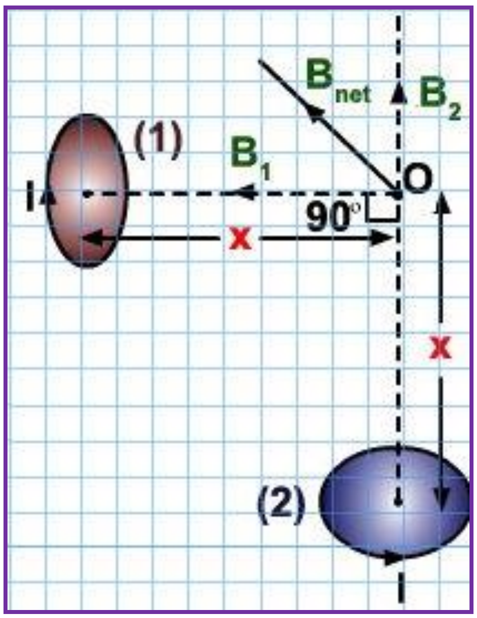
Two very small identical circular loops, (1) and (2), carrying equal currents I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point O. [2]



Answer:

The magnetic field at a point due to a circular loop is given by
$B=\mu 04\pi.2\pi Ia2(a2+r2)3/2$
where,
I = current through the loop
a = radius of the loop
r = distance of O from the centre of the loop

Since *I* , *a* and *r* = *x* are the same for both the loops, the magnitude of *B* will be the same and is given by
$B_1=B_2=\mu 04\pi.2\pi Ia2(a_2+x_2)\frac{3}{2}$
The direction of magnetic field due to loop (1) will be away from O and that of the magnetic field due to loop (2) will be towards O as shown. The direction of the net magnetic field will be as shown below:



The magnitude of the net magnetic field is given by
$Bnet=B_{12}+B_{22}---------\sqrt{}\Rightarrow Bnet=\mu 04\pi.22\sqrt{}\pi Ia2(a_2+x2)\frac{3}{2}$

Question 10

Show that the current leads the voltage in phase by $\frac{\pi}{2}$ in an ac circuit containing an ideal capacitor. [2]

Answer:
Let us consider a capacitor C connected to an AC source as shown below.

Let the AC voltage applied be

$v = v_m \sin\omega t$

$\therefore v = \frac{q}{c}$

Applying Kirchhoff's loop rule, we have:

$v_m \sin\omega t = \frac{q}{c}$

$i = \frac{dq}{dt}$

$\therefore i = \frac{d}{dt}(v_m \sin\omega t)$

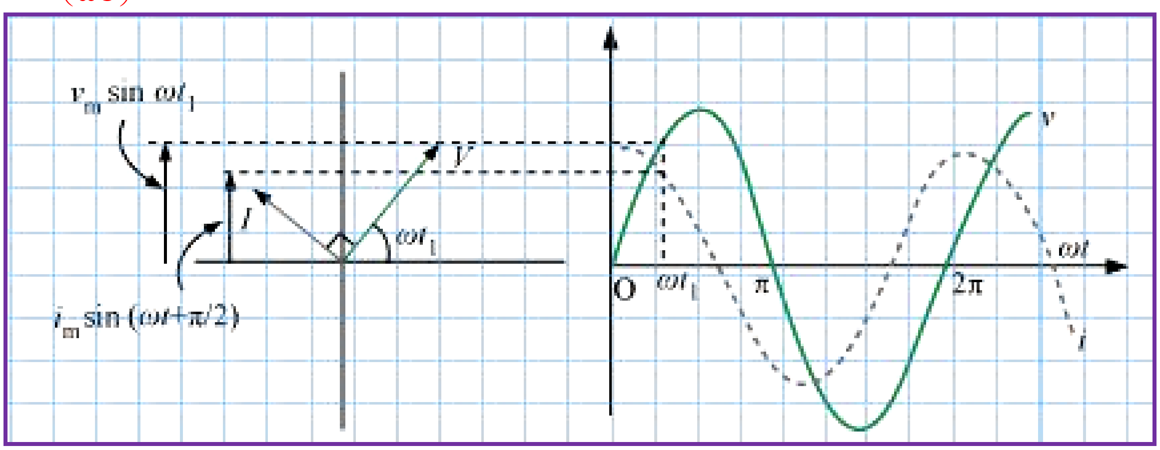
$= \omega C v_m \sin\omega t$

$\cos\omega t = \sin\omega t + \frac{\pi}{2}$

$\therefore i = i_m \sin\left(\omega t + \frac{\pi}{2}\right)$

$i_m = \omega C v_m$

$m = \frac{v_m}{\left(\frac{1}{\omega C}\right)}$



Hence, the current leads the voltage in phase by $\frac{\pi}{2}$

Question 11

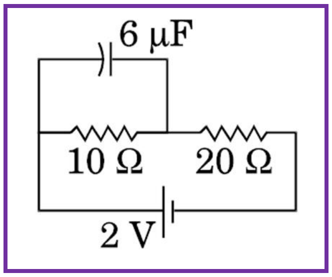
Give two points to distinguish between a paramagnetic and a diamagnetic substance. [2]

Answer:

Paramagnetic substance	**Diamagnetic substance**
A paramagnetic substance is feebly attracted by a magnet.	A diamagnetic substance is feebly repelled by a magnet.
For a paramagnetic substance, the intensity of magnetisation has a small positive value	For a diamagnetic substance, the intensity of magnetisation has a small negative value.

Question 12

Find the charge on the capacitor as shown in the circuit. [2]



Answer:

Total current *I* through the circuit is given by

I=VR

Here, *V* = 2 V

R = (10+20) Ω = 30 Ω

∴ I=230=115 A

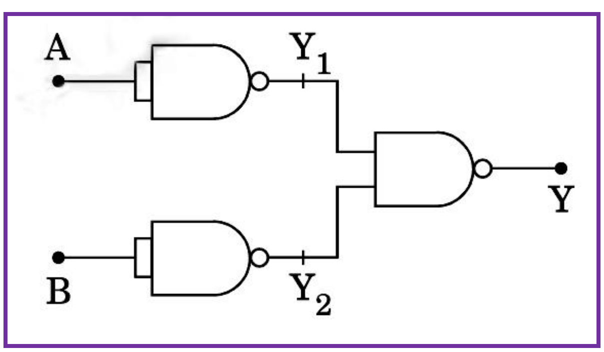
Voltage across 10 Ω resistor = I(10)=1015=23 V

∴ Charge on the capacitor is given by

Q=CV=(6×10−6)(23)=4 μC

Question 13

Identify the equivalent gate represented by the circuit shown in the figure. Draw its logic symbol and write the truth table. [2]

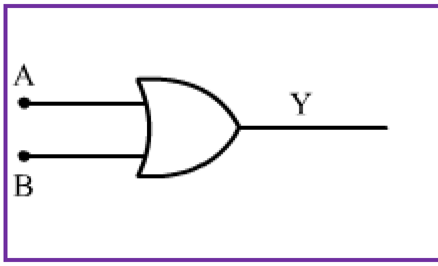


Answer:

Truth table for the given circuit:

A	B	Y_1	Y_2	Y
0	0	1	1	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	1

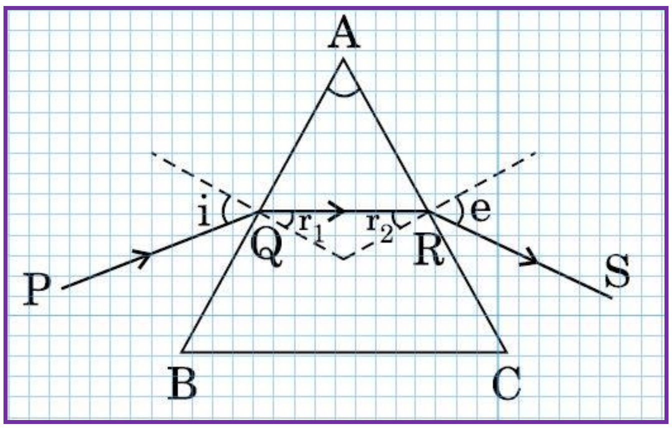
From the table, we can conclude that the given circuit represents an OR gate. The logic symbol and truth table for an OR gate is given below:



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Question 14

Figure shows a ray of light passing through a prism. If the refracted ray QR is parallel to the base BC, show that [2]



i. $r_1 = r_2 = \frac{A}{2}$

Answer:

When QR is parallel to the base BC, we have:

i = e

$\Rightarrow r_1 = r_2 = r$

We know that

$r_1 + r_2 = A \Rightarrow r + r = A$

$\therefore r = \frac{A}{2}$

ii. Angle of minimum deviation, $D_m = 2i - A$.

Answer:

Also, we have:

A + D= i + e

Substituting, D = D_m and e = i

A + D_m= i + i

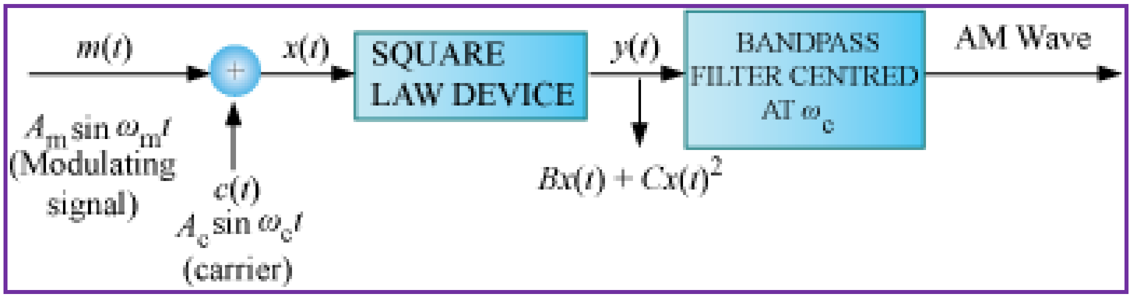
∴ D_m =2i - A

Question 15

Define the term modulation. Draw a block diagram of a simple modulator for obtaining AM signal. [2]

Answer:

Modulation is the process in which low frequency message signal is superimposed on high frequency carrier wave so that they can be transmitted over long distances. The block diagram for a simple modulator for obtaining AM signal is shown below:



Question 16

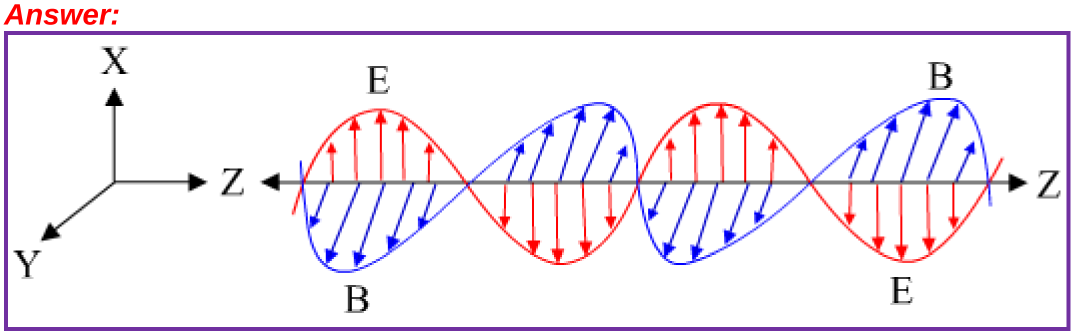
a. How does oscillating charge produce electromagnetic waves?

Answer:

A moving charge produces a magnetic field and an oscillating charge, therefore produces an oscillating magnetic field, which, in turn, produces an oscillating emf. An oscillating voltage (emf) produces an oscillating electric field. In this way, an oscillating charge produces an electromagnetic wave.

b. Sketch a schematic diagram depicting oscillating electric and magnetic fields of an em wave propagating along + z-direction. [2]

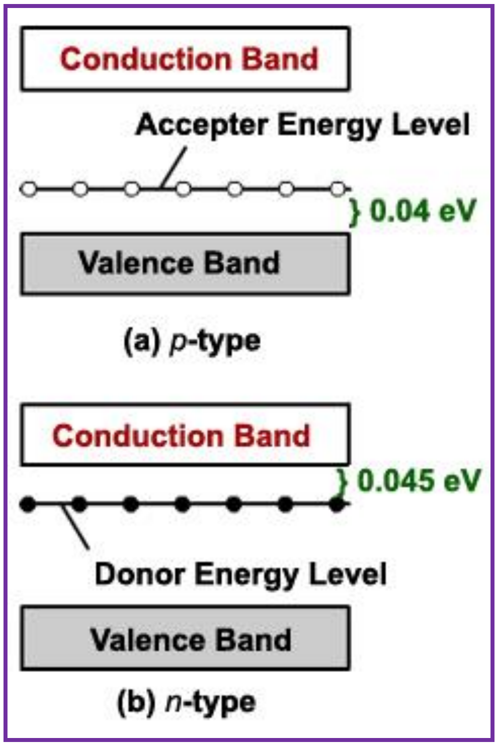
Answer:



Question 17

Draw energy band diagrams of an n-type and p-type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy levels with their energies. [2]

Answer:

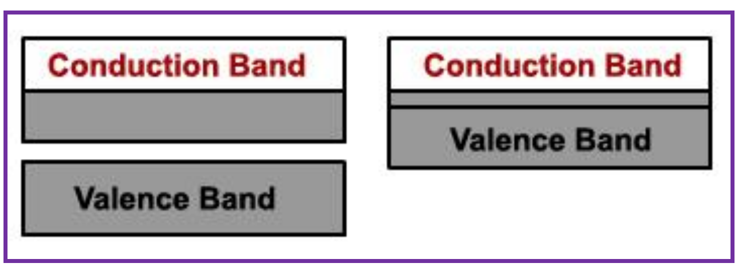


OR

Distinguish between a metal and an insulator on the basis of energy band diagrams.

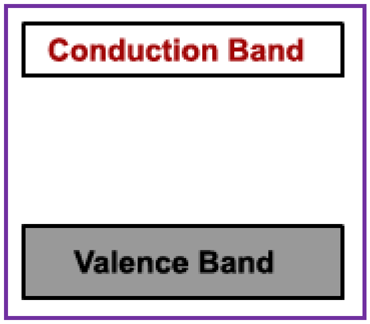
Answer:

(i) For metals, the valence band is completely filled and the conduction band can have two possibilities—either it is partially filled with an extremely small energy gap between the valence and conduction bands or it is empty, with the two bands overlapping each other as shown below:



(ii) On applying an small even electric field, metals can conduct electricity.

Insulators: (i) For insulators, the energy gap between the conduction and valence bands is very large. Also, the conduction band is practically empty, as shown below:



(ii) When an electric field is applied across such a solid, the electrons find it difficult to acquire such a large amount of energy to reach the conduction band. Thus, the conduction band continues to be empty. That is why no current flows through insulators.

Question 18

In a series LCR circuit, obtain the conditions under which (**)

i. The impedance of the circuit is minimum

Answer:

The impedance of a series LCR circuit is given by

$Z=R_2+(\omega L-1\omega C)_2$

Z will be minimum when $\omega L=1\omega C$, i.e., when the circuit is under resonance. Hence, for this condition, Z will be minimum and will be equal to R.

ii. Wattles current flows in the circuit. [2]

Answer:

Average power dissipated through a series LCR circuit is given by

$Pav=EvIvcos(\phi)$

where, E_v = rms value of alternating voltage

I_v = rms value of alternating current

Φ = phase difference between current and voltage

For wattless current, the power dissipated through the circuit should be zero.

i.e., $\cos(\phi)=0\Rightarrow\phi=\pi 2$

Hence, the condition for wattless current is that the phase difference between the current and voltage should be $\frac{\pi}{2}$ and the circuit is purely inductive or purely capacitive.

Question 19

The currents flowing in the two coils of self-inductance L_1 = 16 mH and L_2 = 12 mH are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of

i. Induced voltages

Answer:

Induced voltage, $V=LdIdt$

$V_1V_2=L_1L_2$ (as dIdt is same)$\Rightarrow V_1V_2=1612=43$

ii. The currents

Answer:

Power, $P=IV$

$I_1I_2=V_2V_1$ (as P is same)$\Rightarrow I_1I_2=34$

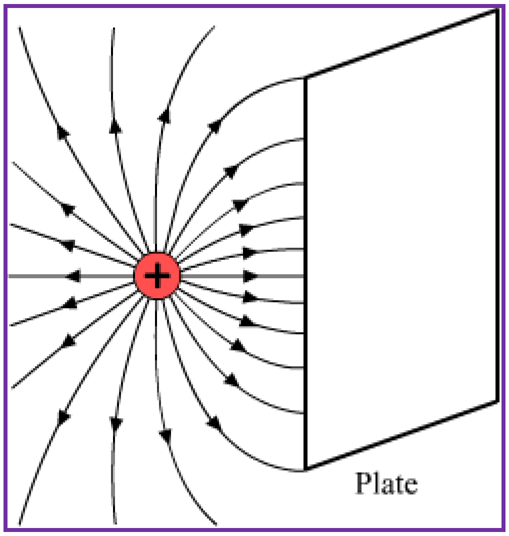
iii. The energies stored in the two coils at a given instant. [3]

Answer:
Energy stored, E=12LI2
$E_1E_2=L_1I1_2L_2I22=1612\times916=34 \Rightarrow E_1E_2=34$

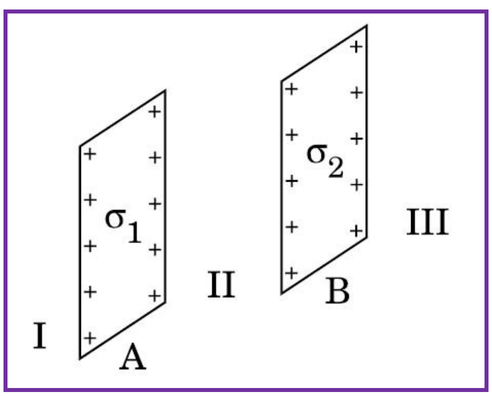
Question 20

a. A point charge (+Q) is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate.

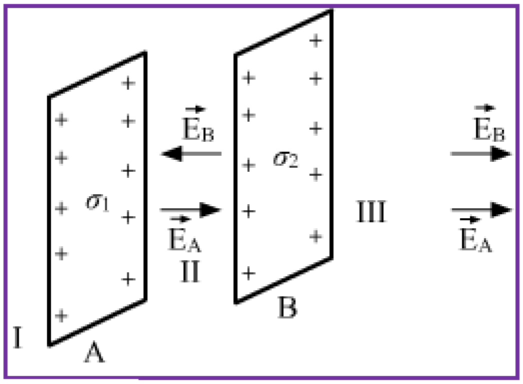
Answer:



b. Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked II and III. [3]



Answer:



In region II

The electric field due to the sheet of charge A will be from left to right (along the positive direction) and that due to the sheet of charge B will be from right to left (along the negative direction). Therefore, on region II, we have:

$E=\sigma_1\varepsilon_0+(-\sigma_2\varepsilon_0)\Rightarrow E=1\varepsilon_0(\sigma_1-\sigma_2)$

In region III

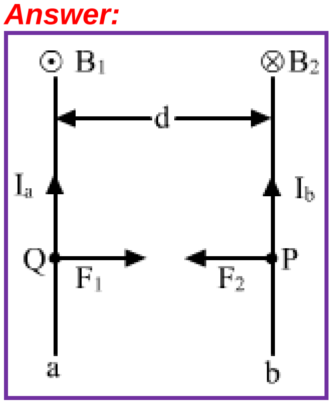
The electric fields due to both the charged sheets will be from left to right, i.e., along the positive direction. Therefore, in region III, we have:

$E=\sigma_1\varepsilon_0+\sigma 2\varepsilon_0\Rightarrow E=1\varepsilon_0(\sigma_1+\sigma_2)$

Question 21

a. Two long straight parallel conductors ‘a’ and ‘b’, carrying steady currents I_a and I_b are separated by a distance d. Write the magnitude and direction of the magnetic field produced by the conductor ‘a’ at the points along the conductor ‘b’. If the currents are flowing in the same direction, what is the nature and magnitude of the force between the two conductors?

Answer:



Let a and b be long straight parallel conductors. I_a and I_b are the current flowing through them and are separated by a distance d.

Magnetic field induction at a point P on a conductor b due to current I_a passing through a is

$B1=\mu02Ia4\pi d$

Now, unit length of b will experience a force as

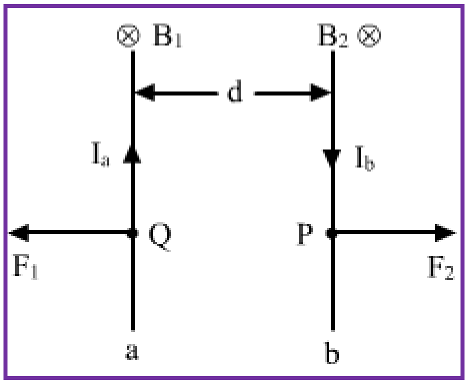
$F_2=B_1Ib\times1=B_1Ib$

$\therefore F_2=\mu04\pi2IaIbd$

Conductor a also experiences the same amount of force, directed towards b. Hence, a and b attract each other.

b. Show with the help of a diagram how the force between the two conductors would change when the currents in them flow in the opposite directions. [3]

Answer:



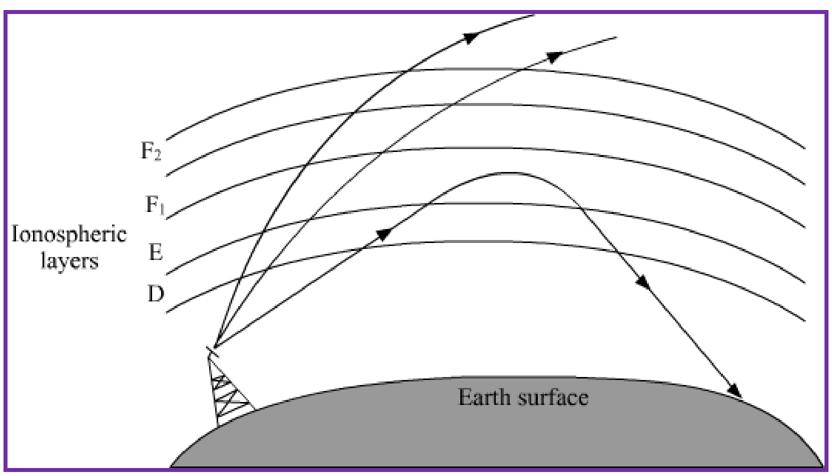
Now, let the direction of current in conductor b be reversed. The magnetic field B_2 at point P due to current I_a flowing through a will be downwards. Similarly, the magnetic field B_1 at point Q due to current I_b passing through b will also be downwards as shown. The force on *a* will be, therefore, towards the left. Also, the force on b will be towards the right. Hence, the two conductors will repel each other as shown.

Question 22

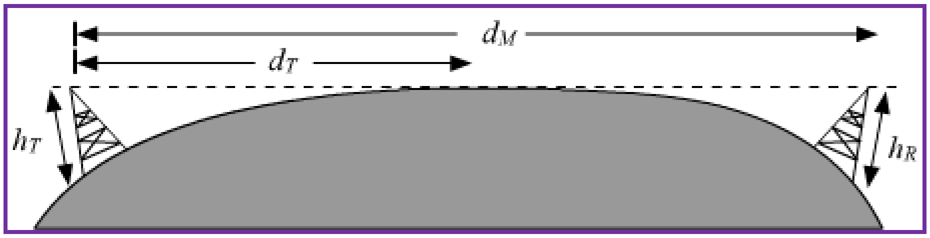
Describe briefly, by drawing suitable diagrams, the (i) sky wave and (ii) space wave modes of propagation. Mention the frequency range of the waves in these modes of propagation. [3]

Answer:

i. In the frequency range from a few MHz up to 30-40 MHz, long distance communication can be achieved by ionospheric reflection of radio waves back towards the earth. This mode of propagation is called sky wave propagation. The ionosphere consists of large number of ions or charged particles due to ionisation in the presence of ultraviolet rays. The degree of ionisation varies with height. At a certain height, there occurs a peak of ionisation density which acts as a reflector of certain range of frequencies. This phenomenon is shown in the figure below:



ii. A space wave travels in straight line from a transmitting antenna to a receiving antenna. They are used for transmitting frequency signals above 40 MHz. Space waves are used for line of sight communication as well as satellite communication. The propagation of signal through space wave is shown below:



Question 23

a. Describe briefly how Davisson – Germer experiment demonstrated the wave nature of electrons.

Answer:

See topics on 'Davisson-Garmer discovery'.

b. An electron is accelerated from rest through a potential V. Obtain the expression for the de-Broglie wavelength associated with it. [3]

Answer:

Energy of electron, E = *eV*
Momentum, p=2mE−−−−√=2meV−−−−−√,
de-Broglie wavelength, λ=hp=h2meV√

∴ λ=h2meV√

Question 24

When Puja, a student of 10th class, watched her mother washing clothes in the open, she observed colored soap bubbles and was curious to know why the soap bubbles appear colored. In the evening when her father, an engineer by profession, came home, she asked him this question. Her father explained to her the basic phenomenon of physics due to which the soap bubbles appear colored. [3]

a. What according to you are the values displayed by Puja and her father?

Answer:

Puja displayed the values of great observation and curiosity to learn. Her father displayed the values of being a good father by considering her doubts serious and explaining them well to her.

b. State the phenomenon of light involved in the formation of colored soap bubbles.

Answer:

The phenomenon of light involved in the formation of coloured soap bubbles is interference of light on a thin film.

Question 25

a. Why is zener diode fabricated by heavily doping both p- and n-sides of the junction?

Answer:

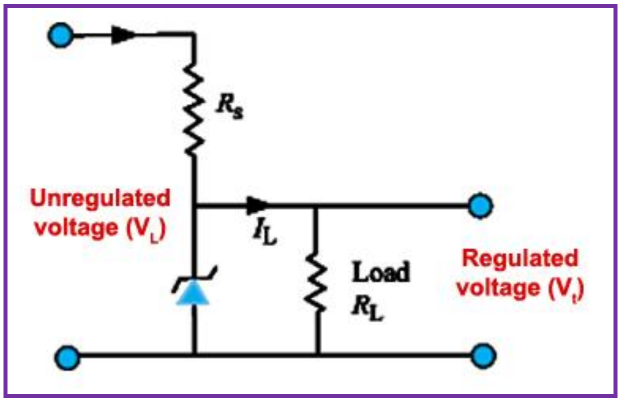
A zener diode is fabricated by heavily doping both p- and n-sides of the junction so that itsdepletion region formed is very thin and the electric field of the junction is extremely high, even for a small reverse bias voltage.

b. Draw the circuit diagram of zener diode as a voltage regulator and briefly explain its working.

[3]

Answer:

Zener diode as voltage regulator



- After the break down voltage, a small change in the voltage across the zener diode produces a large change in the current through the circuit.
- If the voltage is increased beyond the zener voltage, then the resistance of the zener diode drops considerably.
- A zener diode and a resistor are connected to a fluctuating DC supply such that the zener diode is reverse biased.

When the voltage across the diode tends to increase, the current through the diode rises out of proportion and causes a sufficient increase in voltage drop across the resistor. Therefore, the O/P voltage lowers back to normal.

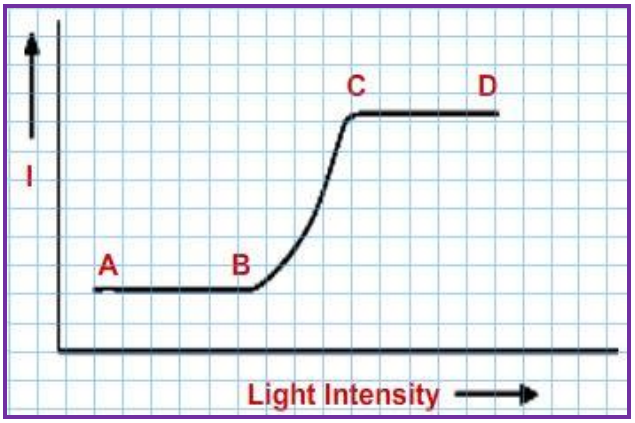
OR

a. How is a photodiode fabricated?

Answer:
A photodiode is fabricated by allowing light to fall on a diode through a transparent window. It is fabricated such that the generation of *e-h* pairs take place near the depletion region.

b. Briefly explain its working. Draw its V – I characteristics for two different intensities of illumination.

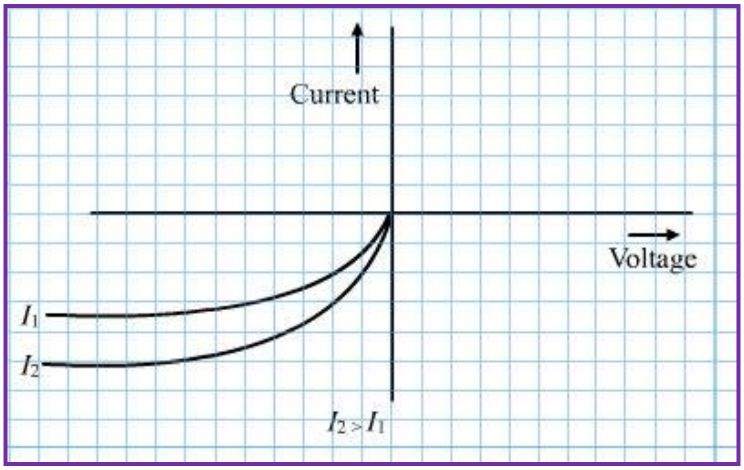
Answer:



- Current AB that flows when no light is incident is called dark current.

- When photons of light having energy *hv* fall on the photodiode, more electrons from the valence band move to the conduction band, provided *hv* is greater than the forbidden energy gap.
- The current in the circuit increases. As the intensity of light is increased, the current goes on increasing (represented by the part BC).
- When the current does not increase with the increase in intensity of light, the photodiode is said to be saturated. The portion CD of the graph represents the saturated current.

V-I characteristics:



Question 26 [3]

a. Distinguish between unpolarised and linearly polarised light.

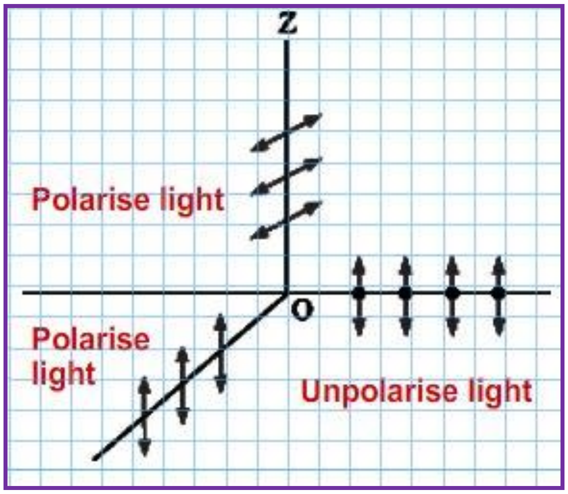
Answer:
In unpolarised light, light waves vibrate in more than one plane; whereas in linearly polarised light, vibrations of light waves occur in a single plane.

b. What does a Polaroid consist of? How does it produce a linearly polarised light?

Answer:
A polaroid consists of long-chain molecules aligned in a particular direction. The electric vectors (associated with the propagating light wave) along the direction of the aligned molecules get absorbed. Thus, if an unpolarised light wave is incident on such a polaroid, then the light wave will get linearly polarised with the electric vector oscillating along a direction perpendicular to the aligned molecule.

c. Explain briefly how sunlight is polarised by scattering through atmospheric particles.

Answer:
Unpolarized light scattering from air molecules shakes their electrons perpendicular to the direction of the original ray. The scattered light therefore has a polarisation perpendicular to the original direction and none parallel to the original direction.



Question 27 [3]

a. Calculate the capacitance of the capacitor.

Answer:

Capacitance, C=ε0Ad=8.85×10−12×6 × 10−33× 10−4=17.7× 10−11 F

b. If this capacitor is connected to 100 V supply, what would be the charge on each plate?

Answer:

Charge, Q=CV=17.7×10−11×100=17.7×10−9 C

c. How would charge on the plates be affected, if a 3 mm thick mica sheet of K = 6 is inserted between the plates while the voltage supply remains connected?

Answer:

Now, $C' = KC$

$\therefore Q' = KQ = 10.62 \times 10^{-8}$ C

Question 28 [5]

a. Using Bohr's postulates, derive the expression for the total energy of the electron in the stationary states of the hydrogen atom.

Answer:

b. Using Rydberg formula, calculate the wavelengths of the spectral lines of the first member of the Lyman series and of the Balmer series.

Answer:

The Rydberg formula for the spectrum of the hydrogen atom is given below:

1λ = R[1n12 − 1n22]

Here, λ is the wavelength and R is the Rydberg constant.

R = 1.097 × 107 m^{-1}

For the first member of the Lyman series:

n1 = 1 n2 = 2

Now, 1λ = 1.097 × 107 [112 − 122]

⇒λ = 1215 Ao

For the first member of the Balmer series:
n1 = 2 n2 = 3

Now, 1λ = 1.097 × 107[122 − 132]

⇒λ = 6563 Ao

OR

a. Define the terms (i) half-life ($T_{\frac{1}{2}}$) and (ii) average life (τ). Find out their relationships with the decay constant (λ). (**)

Answer:

b. A radioactive nucleus has a decay constant λ = 0.3465 (day)$^{-1}$. How long would it take the nucleus to decay to 75% of its initial amount? (**) [5]

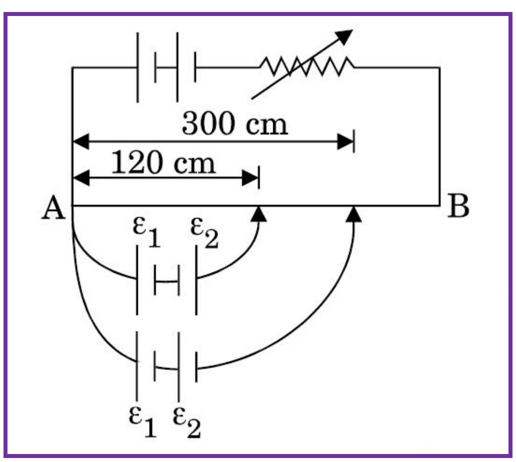
Answer:

Question 29 [5]

a. State the principle of a potentiometer. Define potential gradient. Obtain an expression for potential gradient in terms of resistivity of the potentiometer wire.

Answer:
See topics on 'Potentiometer'.

b. Figure shows a long potentiometer wire AB having a constant potential gradient. The null points for the two primary cells of emfs ε_1 and ε_2 connected in the manner shown are obtained at a distance of l_1 = 120 cm and l_2 = 300 cm from the end A. Determine (i) $\frac{\varepsilon_1}{\varepsilon_2}$ and (ii) position of null point for the cell ε_1 only.



Answer:

i. Let x be the resistance per unit length of the potentiometer wire and I be the constant current flowing through it. Then from the figure, we have:
$\varepsilon_1 - \varepsilon_2 = (120x)I$ ...(1)
and
$\varepsilon_1 + \varepsilon_2 = (300x)I$ ...(2)
Dividing both equations, we get:

$\frac{\varepsilon_1 - \varepsilon_2}{\varepsilon_1 + \varepsilon_2} = \frac{120}{300} \Rightarrow 180\varepsilon_1 = 420\varepsilon_2 \Rightarrow \frac{\varepsilon_1}{\varepsilon_2} = \frac{7}{3}$

ii. Now adding equations (1) and (2), we get:

$2\varepsilon_1 = (420x)I \Rightarrow \varepsilon_1 = (210x)I$
Comparing with $\varepsilon = (Lx)I$, we get:

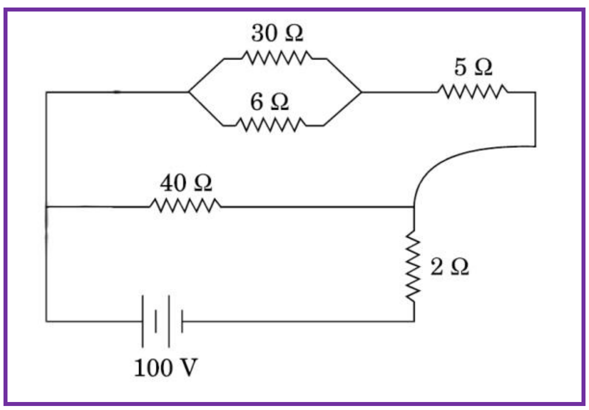
Length of balancing point, L = 210 cm for cell 1

OR

a. Define the term 'drift velocity' of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time.

Answer:
See topics on 'Drift velocity and mobility'.

b. A 100 V battery is connected to the electric network as shown. If the power consumed in the $2\,\Omega$ resistor is 200 W, determine the power dissipated in the $5\,\Omega$ resistor. (**) [5]

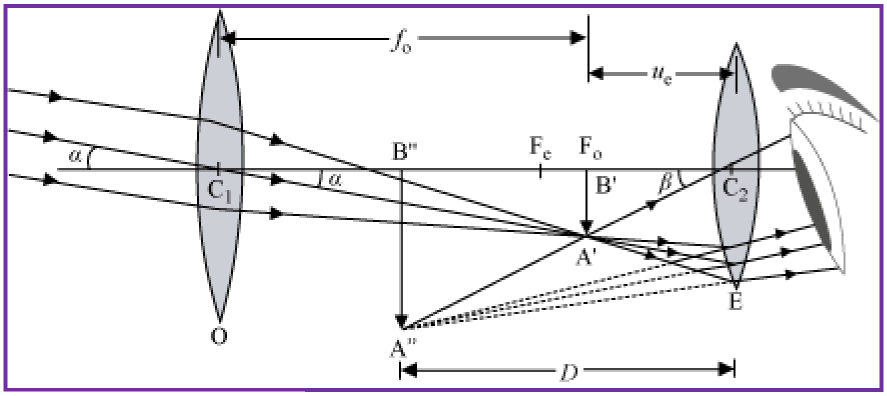


Answer:

Question 30 [5]

i. Draw a labelled ray diagram of an astronomical telescope to show the image formation of a distant object. Write the main considerations required in selecting the objective and eyepiece lenses in order to have large magnifying power and high resolution of the telescope.

Answer:
Astronomical telescope
When the final image is formed at the least distance of distinct vision:



Magnifying power, $M = \frac{\beta}{\alpha}$

Since α and β are small, we have:

$\therefore M = \frac{\tan\beta}{\tan\alpha}$ ....(i)

In $\Delta A'B'C2$, $\tan\beta = \frac{A'B'}{C_2B'}$

In $\Delta A'B'C_1$, $\tan\alpha = \frac{A'B'}{C_1B'}$

Form equation (i), we get:

$M = \frac{A'B'}{C_2B'} x \frac{C_1B'}{A'B'}$

Rightwards double arrow $M = \frac{C_1B'}{C_2B'}$

Here, $C_1B' = +f_0$

Rightwards double arrow $C_2B' = -\mu c$

Rightwards double arrow $M = \frac{f_0}{-u_c}$ ....(ii)

Using the lens equation $\left(\frac{1}{v} - \frac{1}{u} = \frac{1}{f}\right)$ for the eyepieces $\frac{1}{-D} - \frac{1}{-u_c} = \frac{1}{f_c}$, we get:

$\frac{1}{-D} - \frac{1}{-u_c} = \frac{1}{f_c}$

$\Rightarrow \frac{1}{-u_c} = \frac{1}{f_c} + \frac{1}{D}$

Rightwards double arrow $\frac{-f_o}{u_c} - \frac{-f_o}{-f_c} = \left(1 + \frac{f_c}{D}\right)$

Or, $\boxed{M = -\frac{f_0}{f_c}\left(1 + \frac{f_c}{D}\right)}$

In order to have a large magnifying power and high resolution of the telescope, its objective lens should have a large focal length and the eyepiece lens should have a short focal length.

ii. A compound microscope has an objective of focal length 1.25 cm and eyepiece of focal length 5 cm. A small object is kept at 2.5 cm from the objective. If the final image formed is at infinity, find the distance between the objective and the eyepiece.

Answer:
u subscript 0 equals minus 2.5 space cm space and space f subscript 0 equals 1.25 space cm Now comma space minus 1 over u subscript 0 plus 1 over v subscript 0 equals 1 over f subscript 0 To find v_0, we have:

u subscript 0 equals minus 2.5 space cm space and space f subscript 0 equals 1.25 space cm Now comma space minus 1 over u subscript 0 plus 1 over v subscript 0 equals 1 over f subscript 0
To find u_e, we have:
v subscript e equals infinity space and space f subscript e equals 5 space cm
Calculating using the same formula as above, we get:

u subscript e equals minus 5 space cm

∴ L = 2.5 + 5 = 7.5 cm

OR

a. Write three characteristic features to distinguish between the interference fringes in Young's double slit experiment and the diffraction pattern obtained due to a narrow single slit.

Answer:
1. Interference is the result of interaction of light coming from two different wavefronts originating from two coherent sources, whereas diffraction pattern is the result of interaction of light coming from different parts of the same wavefront.
2. In Interference, the fringes may or may not be of the same width; while in diffraction, the fringes are always of varying widths.
3. In Interference, the bright fringes are of the same intensity; while in diffraction, the bright fringes are of varying intensities.

b. A parallel beam of light of wavelength 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 a distance of 2.5 mm away from the center. Find the width of the slit. [5]

Answer:
Distance space of space first space straight minimum space y equals lambda over a rightwards double arrow slit space width space a equals lambda over y therefore space a equals fraction numerator 500 cross times 10 to the power of minus 9 end exponent over denominator 2.5 cross times 10 to the power of minus 4 end exponent end fraction equals 0.002 space straight m

** Out of syllabus. Answer will be provided up on request