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Test Cities for ResoNET - 2016

Test Dates: 20.03.2016, 08.05.2016, 19.06.2016 & 26.06.2016

Resonance Study Centres (29) [State: City]: Rajasthan: Kota, Ajmer, Jaipur, Jodhpur, Sikar, Udaipur; **Bihar:** Patna; **Chattisgarh:** Raipur; **Delhi; Gujarat:** Ahmedabad, Surat, Rajkot, Vadodara; **Jharkhand:** Ranchi; **Madhya Pradesh:** Bhopal, Gwalior, Indore, Jabalpur; **Maharashtra:** Aurangabad, Mumbai, Nagpur, Nanded, Nashik, Chandrapur; **Odisha:** Bhubaneswar; **Uttar Pradesh:** Agra, Allahabad, Lucknow; **West Bengal:** Kolkata;

Test Dates: 10.04.2016, 15.05.2016 & 05.06.2016

Resonance Study Centres (29) [State: City]: Rajasthan: Kota, Ajmer, Jaipur, Jodhpur, Sikar, Udaipur; **Bihar:** Patna; Chattisgarh: Raipur; **Delhi; Gujarat:** Ahmedabad, Surat, Rajkot, Vadodara; **Jharkhand:** Ranchi; **Madhya Pradesh:** Bhopal, Gwalior, Indore, Jabalpur; **Maharashtra:** Aurangabad, Mumbai, Nagpur, Nanded, Nashik, Chandrapur; **Odisha:** Bhubaneswar; **Uttar Pradesh:** Agra, Allahabad, Lucknow; **West Bengal:** Kolkata;

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JEE (Advanced)

Selections (from 2002-2015)	Students in TOP 100 AIR (from 2002-2015)
23182	**153**
(YCCP: 14864 | DLP+eLP: 8318)	(YCCP: 101 | DLP+eLP: 52)

Highest selections in JEE (Adv) 2015 in India from any single institute of Kota

JEE (Main)

Selections (from 2009-2015)	Students in TOP 100 AIR (from 2009-2015)
93915	**65**
(YCCP: 66288 | DLP+eLP: 27627)	(YCCP: 25 | DLP+eLP: 40)

Highest selections in JEE (Main) 2015 in India from any single institute of Kota

PRE-MEDICAL

Selections in AIIMS (from 2012-2015)	Selections in AIPMT (from 2012-2015)
66	**1559**
(YCCP: 51 | DLP+eLP: 15)	(YCCP: 1128 | DLP+eLP: 431)

Selection of every 3rd student from classroom coaching program in AIPMT 2015

Resonance Eduventures Limited

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Reg. Office: J-2, Jawahar Nagar Main Road, Kota (Raj.) - 05 | **Tel. No.:** 0744-3192222, 3012222, 6635555 | **Fax :** 022-39167222 | **CIN:** U80302RJ2007PLC024029

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SOLUTION-2015-16
CBSE 12th Board (Physics) SET-1

SECTION - A

Ans 1. Potential difference between any two point on circumference of circle is zero. So work done (w = qV) will be zero.

Ans 2. It is defined as drift velocity per unit electric field

$$\mu = \frac{V_d}{E} = \frac{eE\tau}{mE} = \frac{e\tau}{m}$$

Ans 3. When there is an angle between velocity of charge particle and magnetic field, then the vertical component of velocity (V sin θ) will rotate the charge particle on circular path, but horizontal component (V cos θ) will move the charge particle in straight line So path of the charge particle becomes helical.

Ans 4. When light falls on fog then scattering take place so the particles of fog becomes visible and light crossed the fog and will not reach the object.

Ans 5. maximum frequency = 5KHz + 2 MHz = $5 \times 10^3 + 2 \times 10^6 = 10^3 (5 + 2000)$

$2005 \times 10^3 = 2.005 \times 10^6$ Hz

minimum frequency = 2MHz – 5KHz = $2 \times 10^{46} - 5 \times 10^3 = (2000 - 5) \times 10^3$

$= 1995 \times 10^3 = 1.995 \times 10^6$ Hz

SECTION - B

Ans 6. We know $I = neAv_d$ and $I = \frac{V}{R}$

So $\frac{V}{R} = neAv_d$

$$\frac{V}{nev_d \ell} = \frac{RA}{\ell} \Rightarrow \rho = \frac{V}{nev_d \ell}$$

$$\rho = \frac{5}{8 \times 10^{28} \times 1.6 \times 10^{-19} \times 2.5 \times 10^{-4} \times 0.1} = 1.5625 \times 10^{-5}\ \Omega m$$

Ans 7. (i) We know $\lambda_\alpha = \frac{0.1012}{\sqrt{V}} A^\circ$, $\lambda_p = \frac{0.2863}{\sqrt{V}} A^\circ$

λ will be greater for porton for same V

(ii) ∵ k.E. = qV

So, $(k.E.)_P = eV$

and, $(K.E.)_\alpha = 2eV$

K.E. of proton will be less.

Ans 8. When electon move from n = 2 energy level to n = 1 energy level then we obtain H_α line in H-spectrum.

$$E = E_{n_2} - E_{n_1}$$

$$= \frac{-13.6}{2^2} + \frac{+13.6}{1^2}$$

$$= \frac{-13.6}{4} + \frac{13.6}{1}$$

$$= 13.6\left[1 - \frac{1}{4}\right]$$

$$= \frac{3}{4}(13.6)$$

$$\boxed{E = 10.2 \text{ eV}}$$

we know $E = h\upsilon$

$$h\upsilon = 10.2 \times 1.6 \times 10^{-19}$$

$$\upsilon = \frac{10.2 \times 1.6 \times 10^{-19}}{6.62 \times 10^{-34}} = \frac{10.2 \times 1.6 \times 10^{15}}{6.62}$$

$$\upsilon = \frac{16.32}{6.62} \times 10^{15}$$

$$\upsilon = 2.46 \times 10^{15} \text{ Hz}$$

OR

we know, $$\frac{1}{\lambda} = R_h\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda} = R_h\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$

$$\frac{1}{\lambda} = R_h$$

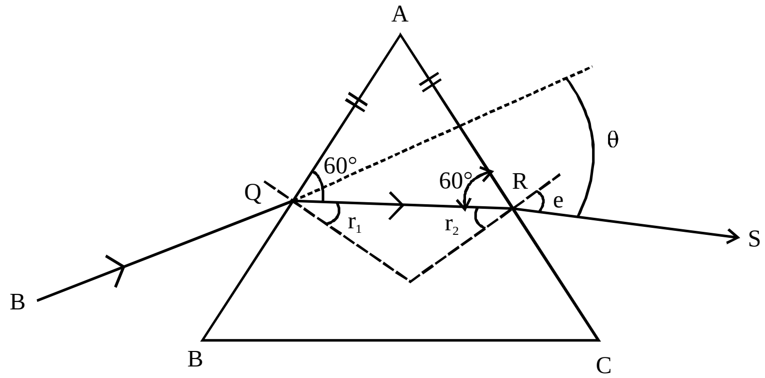
$$\lambda = \frac{1}{R_h} = 911.6 \times 10^{-10} \text{m}.$$

Ans 9. Base band signal not transmitted directly because

(1) due to higher wavelength (low frequency) antenna or aerial size required for transmission will very high

(2) For linear antenna (length l), the power radiated is proportional to $\left(\frac{1}{\lambda}\right)^2$ hence the effective radiated by a long wavelength baseband signal would be small.

Ans 10.



$\because$ $\angle A = 60°$, but AQ = AR So, $\angle AQR = \angle ARQ = 60°$,

So, $r_1 = r_2 = 30°$

and, i = e Now

$$\mu = \frac{\sin i}{\sin r_1}$$

$$\sqrt{3} = \frac{\sin i}{\sin 30°} \quad \text{or} \quad \sin i = \frac{\sqrt{3}}{2}$$

$$i = 60°$$

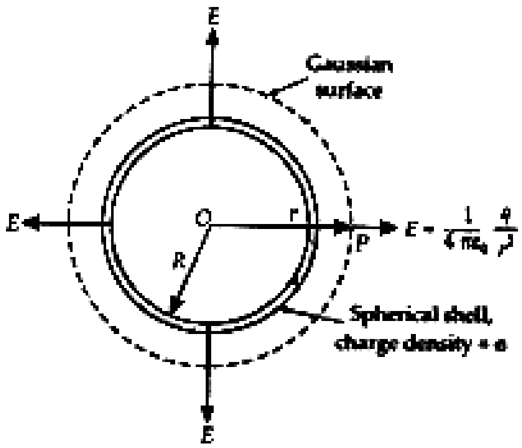
or $\theta = i + e - (r_1 + r_2)$

$\theta = 60° + 60° - (60°)$

$\theta = 60°$

SECTION - C

Ans 11.



When point P lies outside the spherical shell →
then, Flux through the Gaussian surface,

$\phi_E = E \times 4\pi r^2$ and

By Gauss's theorem,

$$\phi_E = \frac{q}{\varepsilon_0}$$

$\therefore$ $E \times 4\pi r^2 = \frac{q}{\varepsilon_0}$

or $E = \frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{r^2}$

When point P lies inside the spherical shell$\rightarrow$ then charge enclosed by the Gaussian surface is zero, i.e.,

$$q = 0$$

Flux through the Gaussian surface,

$$\phi_E = E \times 4\pi r^2$$

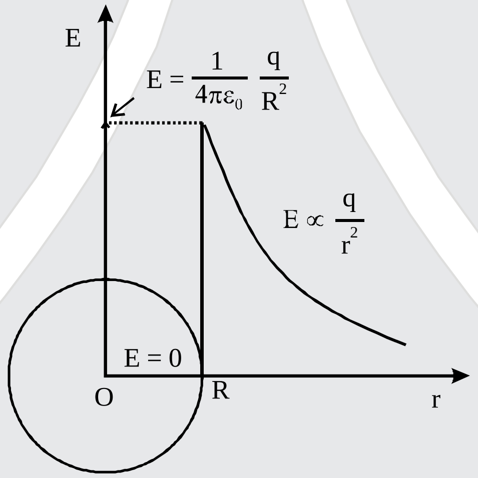
Applying Gauss's theorem,

$$\phi_E = \frac{q}{\varepsilon_0}$$

$$E \times 4\pi r^2 = 0$$

or $E = 0$ [For r < R]

Hence electric field due to a uniformly charged spherical shell is zero at all points inside the shell.



Ans 12. $\varepsilon = 1.5$ V $V = 1.4$V

Total $R = \frac{7\times7}{7+7} = \frac{49}{14} = 3.5\ \Omega$

Let r' is total internal resistance then

$$r' = \left(\frac{\varepsilon - V}{V}\right)R = \left(\frac{1.5-1.4}{1.4}\right)\times 3.5 = 0.25\Omega$$

So, Internal resistance of each cell

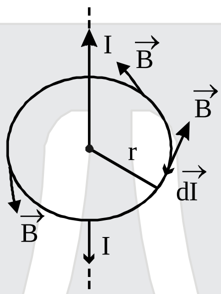
$r' = \frac{r}{2}$ or $r = 2r' = 0.25 \times 2 = 0.5\Omega$

Ans 13. Ampere's circuital law $\rightarrow$ states that the line integral of the magnetic field $\vec{B}$ around any closed circuit is equal to μ_0 (permeability constant) times the total current I threading or passing through this closed circuit. Mathematically,

$$\oint \vec{B}.\vec{dl} = \mu_0 I$$

magnetic field due to straight infinite current carrying wire $\rightarrow$

Fig. shows a circular loop of radius r around an infinitely long straight wire carrying current I. As the field lines are circular, the field $\vec{B}$ at any point of the circular loop is directed along the tangent to the circle at that point. By symmetry, the magnitude of field $\vec{B}$ is same at every point of the circular loop. Therefore,



$$\oint \vec{B}\,.\,\vec{dl} = \oint B\, dl \cos 0° = B \oint dl = B.2\pi r$$

From Ampere's circuital law,

$$B.2\pi r = \mu_0 I$$

$$\therefore \qquad B = \frac{\mu_0 I}{2\pi r}$$

OR

Principle of cyclotron$\rightarrow$ A charged particle can be accelerated to very high energies by making it pass through a moderate electric field a number of times. This can be done with the help of a perpendicular magnetic field which thrown the charged particle into a circular motion, the frequency of which does not depend on the speed of the particle and the radius of the circular orbit.

Time period of revolution$\rightarrow$ Let a particle of charge q and mass m enter a region of magnetic field $\vec{B}$ with a velocity $\vec{v}$, normal to the field $\vec{B}$. The particle follows a circular path, the necessary centripetal force being, provided by the magnetic field. Therefore,

Magnetic force on charge q

= Centripetal force on charge q

or $\quad q\,v\,B \sin 90° = \dfrac{mv^2}{r}$

or $\quad r = \dfrac{mv}{qB}$

Period of revolution of the charged particle is given by

$$T = \frac{2\pi r}{v} = \frac{2\pi}{v}.\frac{mv}{qB} = \frac{2\pi m}{qB}$$

Clearly Time period is independent on the velocity of the particle.
It is necessary for the operation of cyclotron so that freq^n of revolution must will be equal to the freq^n of AC source.

Ans 14. (i) we know

$P_{av} = E_{rms} I_{rms} \cos \phi$

For capacitive circuit phase angle between current and voltage is $\frac{\pi}{2}$

So

$P_{av} = E_{rms} \; I_{rms} \cos \frac{\pi}{2}$

$P_{av} = 0$

(ii) Reducing the capacitance implies $\left(X_c = \frac{1}{\omega C} \right)$ increase in X_c and consequently current decrease in circuit so the glow of the bulb decrease.

Ans 15. EM wave produced by oscillating charged particle.
Mathematical expression for electromagnetic wave travel along z – axis $\rightarrow$

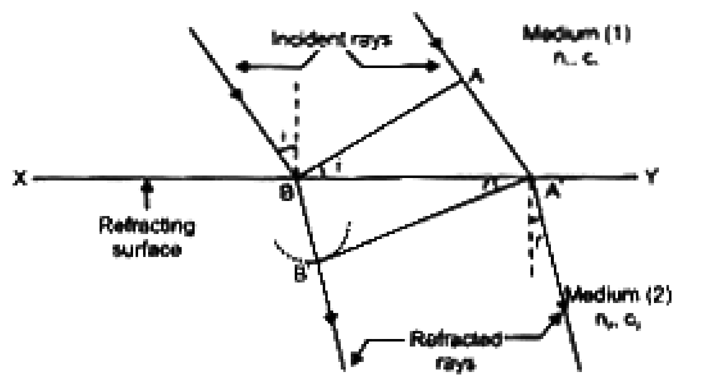
$E_x = E_0 \sin (Kz - wt)$ and

$By = B_0 \sin (Kz - wt)$

Properties of EM waves $\rightarrow$

(i) They are produced by accelerate charge particle.
(ii) They does not required medium for their propagation.

Ans 16. (i) Verification of laws of refraction $\rightarrow$



Let AB be the plane wavefront incident on a refracting surface XY at an angle of incidence i. Let medium (1) be the rarer medium where the speed of light is C_1, and medium 2 be the denser medium where the speed is C_2.

First of all, the disturbance from wavefront AB strikes at the point B. By the time $\left(t = \frac{AA'}{C_1} \right)$ disturbance from A reaches A', disturbance from B would have spread in the second medium in the form of hemispherical wavelet of radius BB' $\left(=C_2 t = C_2 \times \frac{AA'}{C_1}\right)$. Tangent from A' on this wavelet gives refracted wavefront A'B'.

Wavefront A'B' makes an angle r with refracting surface.

In Δ BAA', sin i = $\frac{AA'}{BA'}$

In Δ BB'A', sin r = $\frac{BB'}{BA'}$

$$\frac{\sin i}{\sin r} = \frac{AA'/BA'}{BB'/BA'}$$

$$= \frac{AA'}{BB'} = \frac{C_1\,t}{C_2\,t} = \frac{C_1}{C_2} = \text{constant}$$

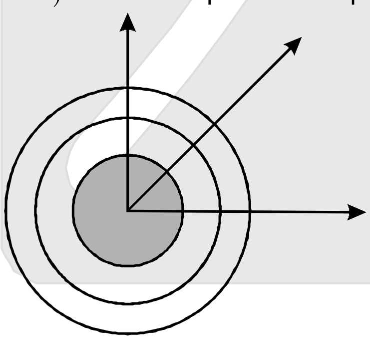
$$\frac{\sin i}{\sin r} = \text{constant} = n_{21}$$

= refractive index of second medium with respect to first medium.

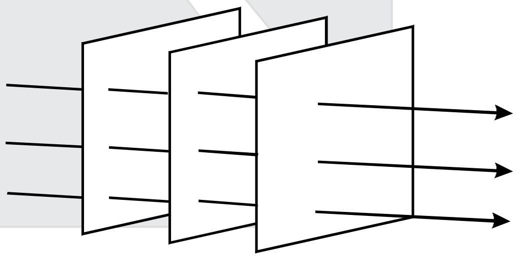
This is Snell's law or first law of refraction.

Second law: The incident wavefront AB, the refracting surface XY and the refracted wavefront A'B' are all perpendicular to plane of paper. So the incident ray $(\perp AB)$; the normal $(\perp XY)$ and the refracted ray $(\perp A'B')$ all lie in the plane of the paper i.e., the same plane. This is second law of refraction.

(ii)



Spherical wave front



Plane wave front

Ans 17. Properties of photon $\rightarrow$

(i) The rest mass of Photon is 0

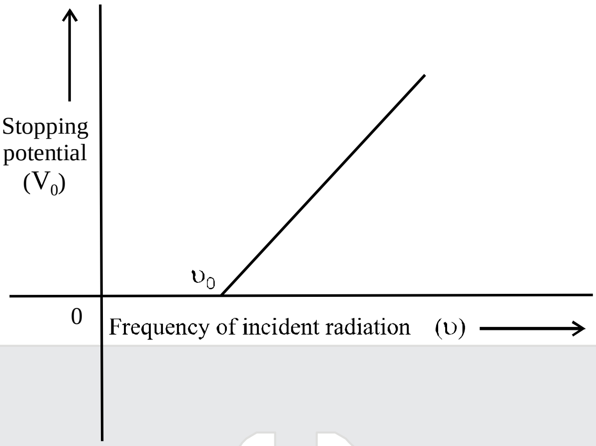
(ii) energy of Photon is given by E = hυ

$$= \frac{hc}{\lambda}$$

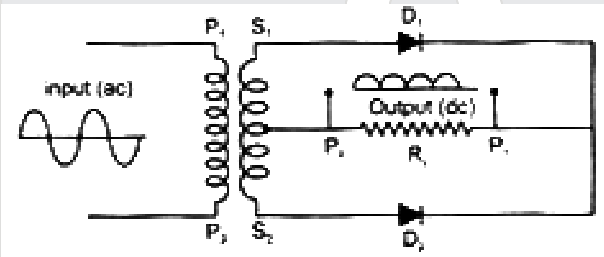
Stopping Potential $\rightarrow$

The value of negative potential at which. Photoelectric emission stop is called stopping Potential.

Threshold freq^n $\rightarrow$ The minimum freq^n. required to eject the electron from metal surface is called threshold frequency.



Ans 18. (i) Two important processes occur during the formation of a p-n junction are diffusion and drift.

(ii) 

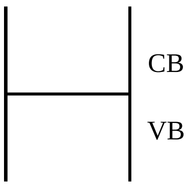
The ac to be transformed is connected as shown across primary P_1P_2 of a transformer.

In 1st half of ac cycle, suppose P_1 is negative and P_2 is positive. This make S_1 positive and S_2 negative. As a result, D_1 is forward biased and hence conducting. The current flows through D_1 and form P_1 to P_2 through R_1 and we get an output. D_2 does not conduct in this half as it is reverse biased. Similarly in second half, D_1 does not conduct but D_2 conducts being forward biased making the current flow form P_1 to P_2 again.

Ans 19. (i) Conductor $\rightarrow$

(A) In conductor valance band is partially filled (eg. Li, K, Na) or completely filled. (eg. B, Mg, Zn)

(B) Forbidden energy gap between conduction band and valance band is 0.

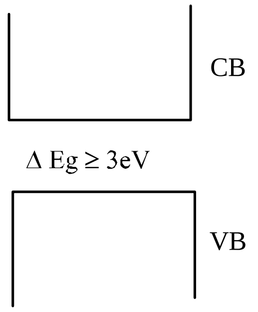
(C) 

Insulator $\rightarrow$

(A) In insulator valance band is completely filled and conduction band is empty.

(B) Forbidden energy gap between conduction band and valance band is 3eV.

(C)



(ii) gate is NAND gate

Truth Table

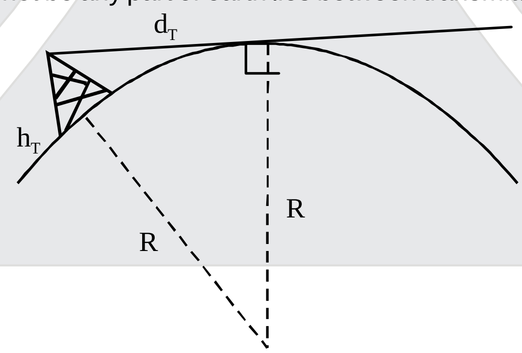
A	B	AB	$Y = \overline{AB}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

Ans 20. Space wave travels in a straight line from transmitting antenna to the receiving antenna.

Range of propagation will be limited due to following factors

(1) At high frequency waves scatter more easily

(2) There should not be any part of earth lies between transmitter and receiver



From Figure

$(h_T + R)^2 = R^2 + d_T^2$

$R^2 + 2Rh_T + h_T^2 = R^2 + d_T^2$

but $h_T^2 <<< 2Rh_T$

So $d_T^2 = 2Rh_T$

$\Rightarrow \quad d_T = \sqrt{2Rh_T}$

Simillarly

$d_R = \sqrt{2Rh_R}$

So $d_m = d_T + d_R = \sqrt{2Rh_R} + \sqrt{2Rh_R}$

Ans 21. (a) The number of nuclei undergoing the decay per unit time is proportional to the total number of nuclei in the sample. If N is the number of nuclei in the sample and ΔN undergo decay in time Δt then $\frac{\Delta N}{\Delta t} \propto N$

or, $\Delta N / \Delta t = -\lambda N$,

where λ is called the radioactive decay constant or disintegration constant.

(in the limit $\Delta t \to 0$)

$$\frac{dN}{dt} = -\lambda N$$

or, $$\frac{dN}{N} = -\lambda dt$$

Now, integrating both sides of the above equation, we get,

$$\int_{N_0}^{N} \frac{dN}{N} = -\lambda \int_0^t dt$$

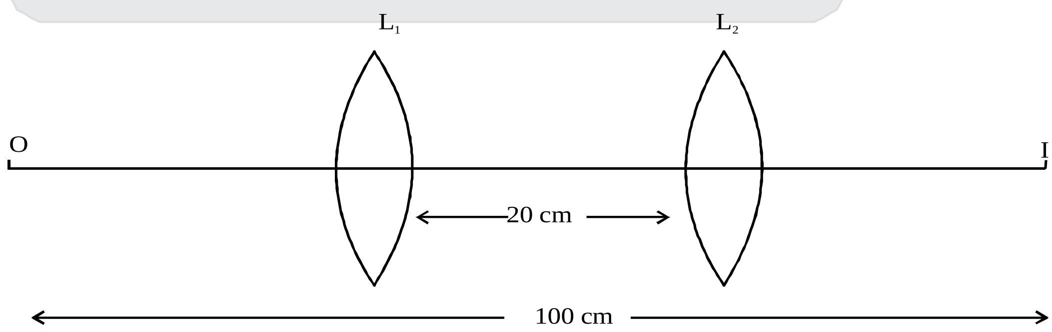
or, $\ln N - \ln N_0 = -\lambda t$

$N = N_0 e^{-\lambda t}$

(b) $$\tau = \frac{\lambda N_0 \int_0^\infty t e^{-\lambda t} dt}{N_0} = \lambda \int_0^\infty t e^{-\lambda t} dt$$

One can show by performing this integral that $\tau = 1/\lambda$

Ans 22. (i)



$$\frac{1}{f} = \frac{1}{(100-u)} + \frac{1}{u} \qquad \to (1)$$

$$\frac{1}{f} = \frac{1}{(80-u)} + \frac{1}{(u+20)} \qquad \rightarrow (2)$$

on solving equation (1) & (2)

u = 40 cm

So, v = 100 – 40 = 60 cm.

Now, from len's formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{f} = \frac{1}{60} + \frac{1}{40} = \frac{4+6}{240}$$

f = 24 cm.

(ii) Let focal length of two lens are f then from formula

$$\frac{1}{f_{equ}} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{f_{equ}} = \frac{1}{f} - \frac{1}{f}$$

So, $f_{equ} = \infty$

SECTION - D

Ans 23. (a) (i) Presence of mind. High degree of general awareness. Ability to take prompt decisions. Concern for his uncle

(b) For MRI a conducting material have the unique property (Super conductor) recquried. which is very expensive

(c) Maximum force = qvB_{max} sin 90° $\left(when\ \vec{v} \perp \vec{B}\right)$

= $(1.6 \times 10^{-19})(10^4)(1)$

= 1.6×10^{-15} N

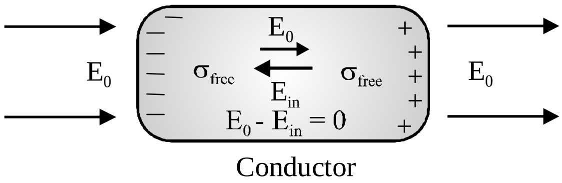
Minimum force = Zero

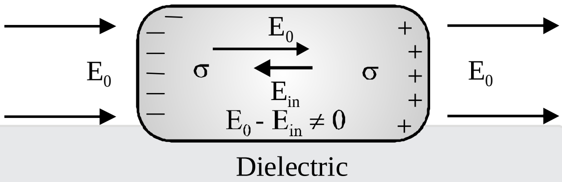
When the proton moves parallel or antiparallel to the magnetic field direction.

SECTION - E

Ans 24.

(a)





When Polarised dielectric slab is placed in external electric field (E_0) then due polarisation. Polarised electric field (E_p) inside the dielectric slab in the opposite direction of that of external field. So net electric field inside the dielectric slab decrease.

(b) (i) Charge stored by the capacitor remain same because charge is conserve.

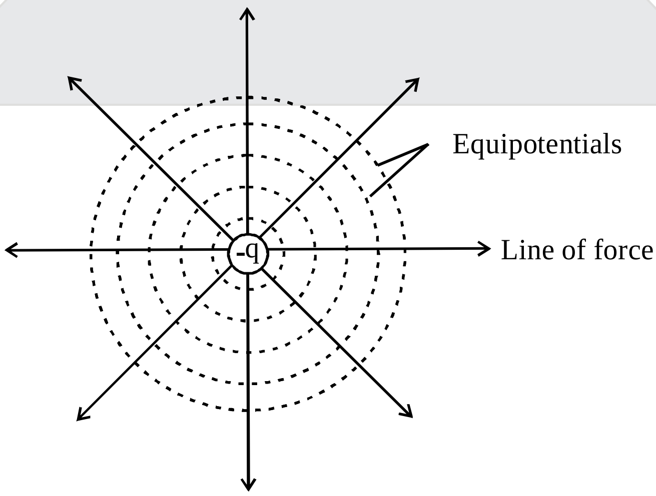
(ii) Field strength remain same because E = $\frac{\sigma}{\varepsilon_0} = \frac{Q}{A\varepsilon_0}$

and it does not depends on the distance between the plate.

(iii) energy stored by the capacitor is double because on increasing distance bet^n the plate two times capacitance between the plate reduced to half, so energy stored $\left(\frac{Q^2}{2c}\right)$ increase two times

OR

(a) because if electric line of force is not perpendicular to the equipotential surface then there are two component of electric field. The component which is parallel to the surface set up electric current in equilibrium state. which is not possible for negative charge equipotential surface are as



(b) W $= \dfrac{Kq(-4q)}{a} + \dfrac{Kq \times 2q}{a} + \dfrac{K \times (-4q)\,2q}{a}$

$= -\dfrac{4Kq^2}{a} + \dfrac{2Kq^2}{a} - \dfrac{8Kq^2}{a}$

$= -\dfrac{10Kq^2}{a}$

So, work done to dissociate the system of three charges is w = $\dfrac{10Kq^2}{a}$

Ans 25. (a) electromagnetic Induction.

Factors on which strength of induced electric current and direction depends.

(i) Speed of magnet

(ii) Polarity

Faraday's Law of Induction

First Law $\rightarrow$

Whenever magnetic flux linked with the coil change then emf induced in it.

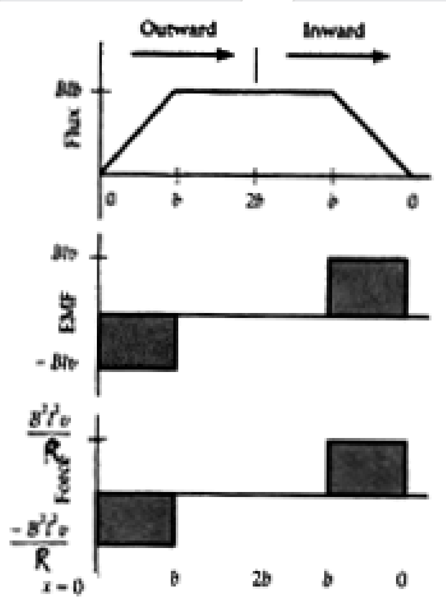
Second Law $\rightarrow$

The magnitude of the induced emf in a circuit is equal to the time rate of change of magnetic flux through the circuit.

Lenz's Law

The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produced it.

(b)



We first consider the forward motion from x = 0 to x = 2b.

Flux, ϕ = Blx for $0 \le x < b$

= Blb for $b \le x < 2b$

Induced emf, $\varepsilon = \dfrac{d\phi}{dt}$

$\therefore \quad \varepsilon = \dfrac{d}{dt}(\text{B}l\text{x}) = -\text{B}l\dfrac{dx}{dt} = -\text{B}l\text{v}$ for $0 \le x < b$

and $\quad \varepsilon = \dfrac{d}{dt}(\text{B}l\text{b}) = 0$ for $b \le x < 2b$

When the induced emf is non-zero, the magnitude of the induced current is

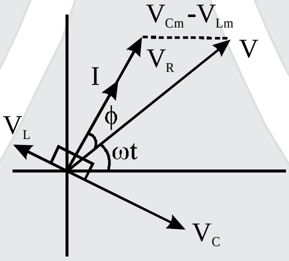
$\text{I} = \dfrac{Blv}{R}$ [R = resistance of conductor PQ]

The force required to keep the arm PQ in constant motion is IlB. Its direction is to the left. In magnitude,

$\text{F} = \dfrac{B^2 l^2 v}{R}$ For $b \le x < b$

$= 0$ For $b \le x < 2b$

OR



The phasor relation whose vertical component gives the above equation is

$V_L + V_R + V_C = V$

This relation is represented in Fig. Since V_C and V_L are always along the same line and in opposite directions.

$v_m^2 = v_{Rm}^2 + (v_{Cm}\ v_{Lm})^2$

Substituting the values of v_{Rm}, v_{Cm}, and v_{Lm} from Eq. into the above equation. we have

$$v_m^2 = (i_m R)^2 + (i_m X_C - i_m X_L)^2$$
$$= i_{Rm}^2 \left[R^2 + (X_C - X_L)^2\right]$$

or, $\quad i_m = \dfrac{v_m}{\sqrt{R^2 + (X_C - X_L)^2}}$

By analogy to the resistance in a circuit, we introduce the impedance Z in an ac circuit :

$i_m \quad = \dfrac{v_m}{Z}$

where Z = $\sqrt{R^2 + (V_C - X_L)^2}$

Power In LCR Circuit $\rightarrow$

The instantaneous power p supplied by the source is

$p = vi = (v_m \sin wt) \times [i_m \sin(\omega t + \phi)]$

$= \dfrac{v_m i_m}{2} [\cos \phi - \cos(2\omega t + \phi)]$

The average power over a cycle is given by the average of the two terms in R.H.S. of Eq. It is only the second term which is time-dependent. Its average is zero (the positive half of the cosine cancels the negative half). Therefore.

$P = \dfrac{v_m i_m}{2} \cos \phi = \dfrac{v_m}{\sqrt{2}} \dfrac{i_m}{\sqrt{2}} \cos \phi$

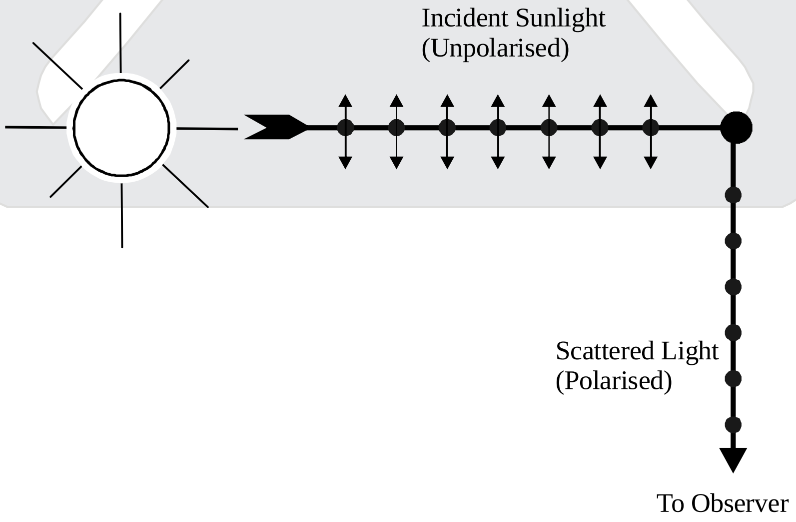
$= V\, I \cos \phi$

This can also be written as,

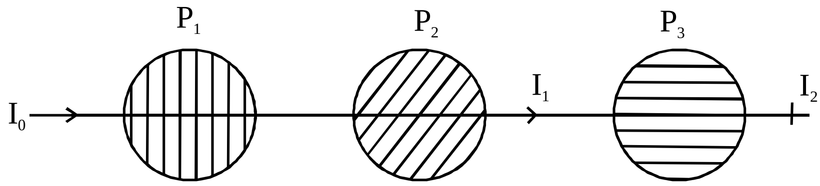
$P = I^2 Z \cos \phi$.

Power dissipated at resonance in LCR circuit : At resonance $X_C - X_L = 0$. and $\phi = 0$. Therefore. $\cos \phi = 1$ and $P = I^2Z = I^2 R$. That is, maximum power is dissipated in a circuit (through R) at resonance.

Ans 26. (a) A polaroid consists of long chain molecules. aligned in a particular direction. The electric vectors along the direction of aligned molecules get absorbed. Thus if the unpolarised light from a source passes through a polaroid, its intensity is reduced by half. Rotating the polaroid has no effect on the transmitted beam and transmitted. intensity remains constant.



(b)



Intensity of light passes through polaroid P_2

$I_1 = \frac{I_0}{2}\cos^2 60°$

$= \frac{I_0}{2} \times \left(\frac{1}{4}\right)$

$= \frac{I_0}{8}$

(i) when Polaroid (P_3) rotated by 30° angle then intensity of light passes through polaroid P_3

$I_2 = I_1 \cos^2 60°$

$= \frac{I_0}{8} \times \frac{1}{4} = \frac{I_0}{32}$

(ii) when Polaroid (P_3) rotated by 60° angle then intensity of light passes through polaroid P_3

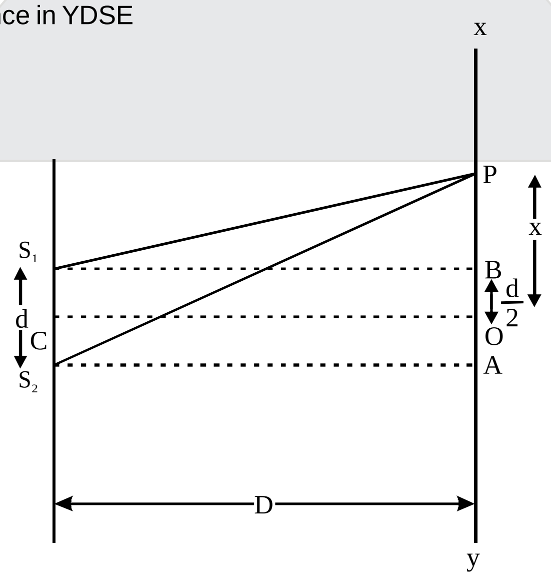
$I_2' = I, \cos_2 90°$

$= \frac{I_0}{8} \times 0$

$= 0$

OR

(a) Path difference in YDSE



In fig. S_1 and S_2 are two narrow closely spaced slits illuminated by monochromatic light of wavelength λ, XY is the screen on which interference pattern is observed, If S, and S_2 emit light in same phase, then for point O, on right bisector of S_1S_2 the path difference receives light in same phase. The superposition at O is constructive producing a bright point, called the central maxima.
The intensity at any point P at a distance x from O depends on the path difference between light reaching P from S_1 and S_2.
We have path difference $p = S_2P - S_1P$
We have $S_2P^2 = S_2A^2 + AP^2$

$$= D^2 + (AO + OP)^2$$

$$= D^2 + \left(x + \frac{d}{2}\right)^2$$

Similarly $S_1P^2 = D^2 + \left(x - \frac{d}{2}\right)^2$

$(S_2P + S_1P)(S_2P - S_1P) = 4.x.\frac{d}{2} = 2 \text{ x d}$

If P is very closed to O then

$S_2P + S_1P = 2D$ and $S_2P - S_1P = p$

$\therefore$ 2D.p = 2 xd

or $p = \frac{xd}{D}$

condition for constructive interference $\rightarrow$
The resultant intensity at a point is maximum when the phase difference between the two superposing waves is an even multiple of π or path difference is an integral multiple of wavelength λ.
condition for distructive interference $\rightarrow$
The resultant intensity at a point is minimum when the phase difference between the two superposing waves is an odd multiple of π or the path difference is an odd multiple of wavelength $\lambda/2$.

(b) $I = I_1 + I_2 + 2\sqrt{I_1I_2}\cos\phi$

when $\phi = 0$, then Intensity is I_0

and, $I_1 = I_2 = I$

So, $I_0 = \left(\sqrt{I+} + \sqrt{I}\right)^2$

$I_0 = 4I \Rightarrow I = \frac{I_0}{4}$

(i) when path difference is $\frac{\lambda}{6}$

then $\phi = \frac{\pi}{3}$

So, $I = I_1 + I_2 + 2\sqrt{I_1I_2}\cos\frac{\pi}{3}$

$= I_1 + I_2 + \sqrt{I_1 I_2}$

But $I_1 = I_2 = \frac{I_0}{4}$

So, $I = \frac{I_0}{4} + \frac{I_0}{4} + \frac{I_0}{4}$

$I = \frac{3I_0}{4}$

(ii) when path difference is $\frac{\lambda}{4}$

then $\phi = \frac{\pi}{2}$

So, $I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \frac{eE\tau}{mE} = \frac{e\tau}{m}$

$= I_1 + I_2$

But $I_1 = I_2 = \frac{I_0}{4}$

So, $I = \frac{I_0}{4} + \frac{I_0}{4}$

$I = \frac{I_0}{2}$

(ii) when path difference is $\frac{\lambda}{3}$

then $\phi = \frac{2\pi}{3}$

So, $I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \frac{2\pi}{3}$

$= I_1 + I_2 - \sqrt{I_1 I_2}$

But $I_1 = I_2 = \frac{I_0}{4}$

So, $I = \frac{I_0}{4} + \frac{I_0}{4} - \frac{I_0}{4}$

$I = \frac{I_0}{4}$