B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

TERM-1 EXAMINATION 2025-26

PHYSICS (SET-2)

MARKING SCHEME

Class: XII **Time: 3hr**
Date: 31.08.26 **Max Marks: 70**

Section A (16 x 1M)

1. (b) V/m
2. (b) Increase in plate area
3. (a) Temperature remains constant
4. (c) 4: 3
5. (c) Fleming's left-hand rule
6. (c) Negative and small
7. (b) Four times
8. (c) Pure resistive circuit
9. (d) Leads the voltage
10. (c) Less than unity
11. (b) X-rays
12. (b) 443 nm
13. (a)
14. (a)
15. (c)
16. (d)

Section B (5 X 2M)

17. (a) In the outer region of plate, I, electric field intensity E is zero. ½

(b)Electric field intensity E in between the plates is given by relation

$$\therefore E = \frac{17.7\ x\ 10^{-22}}{8.85\ x\ 10^{-1}}$$ 1

Therefore, electric field between the plates is 2.0 x 10^{-10} N/C ½

18.

$$W = \int_0^q V.dq$$

$$\text{or } W = \int_0^q \frac{q}{C}.dq \quad (\because V = \frac{q}{C})$$

$$\text{or } W = \frac{1}{C}\int_0^q q\,.\,dq$$

$$\text{or } W = \frac{1}{C}\left[\frac{q^2}{2}\right]_0^q$$

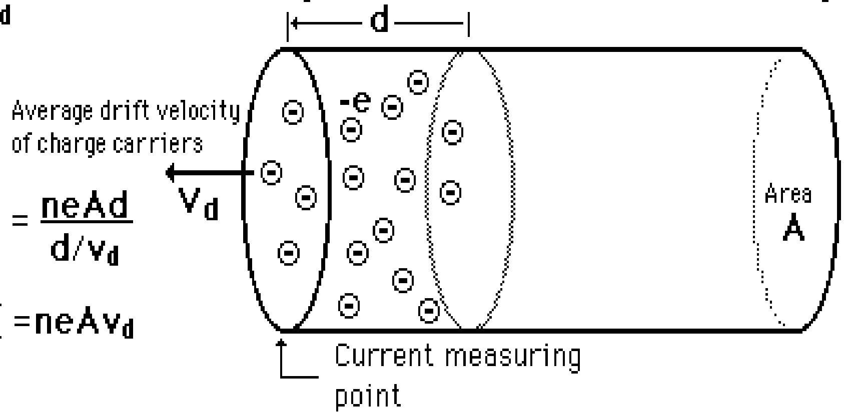
$$\text{or } W = \frac{1}{C}\left(\frac{q^2}{2} - 0\right) = \frac{q^2}{2C}$$

19. Drift velocity: It is the average velocity acquired by the free electrons superimposed over the random motion in the direction opposite to electric field and along the length of the metallic conductor. 5

n = number of charges e per unit volume

$Q = neAd$ = total mobile charge in length d of the conductor

$t = \frac{d}{v_d}$ = time for this charge to sweep past the current measuring point



$$I = \frac{Q}{t} = \frac{neAd}{d/v_d}$$

$$I = neAv_d$$

(a) Material A is paramagnetic, and Material B is ferromagnetic.

(b) Material B has a larger susceptibility because ferromagnetic materials exhibit strong domain alignment and high magnetization compared to paramagnetic materials for a given field.

Or

Specimen A is diamagnetic, and specimen B is paramagnetic.

Diamagnetic materials have a small negative magnetic susceptibility, while paramagnetic materials have a small positive magnetic susceptibility.

20. (i) They are transverse waves, meaning the electric and magnetic fields oscillate perpendicular to each other and to the direction of wave propagation

(ii) They can travel through a vacuum (empty space) without needing a medium like air or water.

21. Angular width $2\varphi = 2\lambda/d$ ½

Given λ = 6000 Å

In Case of new λ (assumed λ’ here), angular width decreases by 30%

New angular width = 0.70 (2 φ) ½

2 λ’/d = 0.70 X (2 λ/d) ½

∴λ’ = 4200 Å ½

Or

A **wavefront** is an imaginary surface joining all points of a wave that vibrate in the exact same phase (such as all crests or all troughs at the same time). The three main types—**spherical**, **cylindrical**, and **plane.**

Spherical wavefronts are concentric spheres with the point source at the center. Amplitude decreases as the distance from the source increases.

Cylindrical wavefronts coaxial cylinders where all points equidistant from the linear line source lie on the curved surface.

Plane wavefronts formed when a spherical or cylindrical wavefront travels a very large distance (at infinity) from the source.

SECTION-C (7 X 3M)

22.

Flux $\phi = \frac{q_{enclosed}}{\varepsilon_0}$

Total charge enclosed

= Linear charge density $\times l$

$= \lambda l$

$\phi = \frac{\lambda L}{\varepsilon_0}$ ....(ii)

Using Equations (i) & ii

$E \times 2\pi r l = \frac{\lambda l}{\varepsilon_0}$

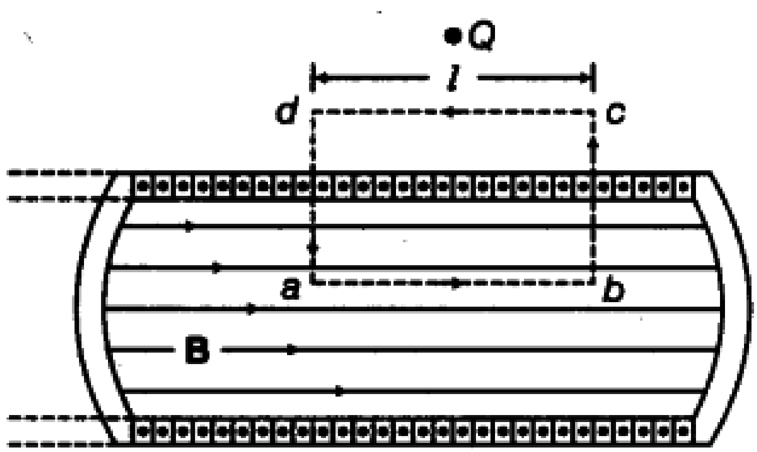
$E = \frac{\lambda}{2\pi\varepsilon_0 r}$

In vector notation

$\bar{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\ \hat{n}$

(where $\hat{n}$ is a unit vector normal to the line charge)

23.



$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 \times \text{(total current passes through loop } abcd)$$

$$\int_a^b \mathbf{B} \cdot d\mathbf{l} + \int_b^c \mathbf{B} \cdot d\mathbf{l} + \int_c^d \mathbf{B} \cdot d\mathbf{l} + \int_d^a \mathbf{B} \cdot d\mathbf{l} = \mu_0 \left[\left(\frac{N}{L} \right) li \right]$$

where, $\frac{N}{L}$ = number of turns per unit length,

$ab = cd = l$ = length of rectangle.

$$\int_a^b Bdl \cos 0^\circ + \int_b^c Bdl \cos 90^\circ + 0 + \int_d^a Bdl \cos 90^\circ = \mu_0 \left(\frac{N}{L} \right) li$$

$$[\because \cos 0^\circ = 1 \text{ and } \cos 90^\circ = 0]$$

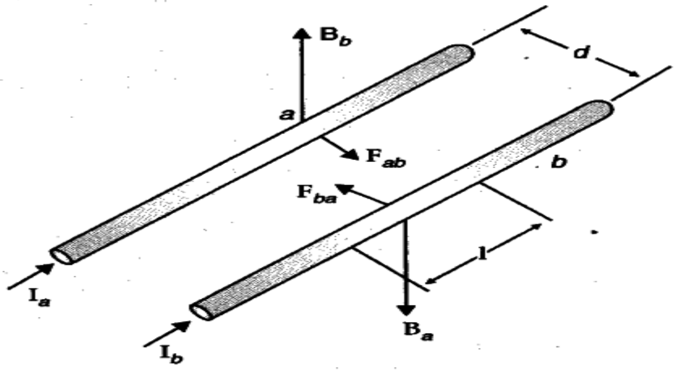
$$B \int_a^b dl = \mu_0 \left(\frac{N}{L} \right) li \quad \Rightarrow \quad Bl = \mu_0 \left(\frac{N}{L} \right) li$$

$$\Rightarrow \quad B = \mu_0 \left(\frac{N}{L} \right) i \quad \text{or} \quad B = \mu_0 ni$$

Or

Similarly,

$$\mathbf{F}_{ab} = \mathbf{I}_1 . l \frac{\mu_0 \mathbf{I}_2}{2\pi d}$$



$$\mathrm{B}_a = \frac{\mu_0 \mathrm{I}_a}{2\pi d}$$

since $$\vec{F} = i(\vec{l} \times \vec{B})$$

$$\mathrm{F}_{ba} = \mathrm{I}_1 . l \frac{\mu_0 \mathrm{I}_2}{2\pi d}$$

Similarly,

$$\mathrm{F}_{ab} = \mathrm{I}_1 . l \frac{\mu_0 \mathrm{I}_2}{2\pi d}$$

1 ½

The ampere is the value of that steady current which, when maintained in each of the two very long, straight, parallel conductors of negligible cross-section, and placed one metre apart in vacuum, would exert on each of these conductors a force equal to 2×10^{-7}newtons per metre of length.

1

24. **Given**

$m = 0.32\,JT^{-1}$
$B = 0.15\ T$

Stable Orientation: $\theta = 0°$.

$U = -0.32 \times 0.15 \times \cos 0°$
$U = -0.048\ J$

Unstable Orientation: $\theta = 180°$.

$U = -0.32 \times 0.15 \times \cos 180°$
$U = +0.048\ J$

25.

$$d\varepsilon = B\frac{dA}{dt} = B\,v\,dx$$

But $v = x\omega$

$\therefore$ $$d\varepsilon = B\,x\,\omega\,dx$$

$\therefore$ The emf induced across the rod

$$\varepsilon = \int_0^l B\,x\omega\,dx = B\omega\int_0^l x\,dx$$

$$= B\omega\left[\frac{x^2}{2}\right]_0^l = B\omega\left[\frac{l^2}{2} - 0\right] = \frac{\mathbf{1}}{\mathbf{2}}\,\boldsymbol{B\,\omega\,l^2}$$

Current induced in rod $I = \frac{\varepsilon}{R} = \frac{1}{2}\frac{B\omega l^2}{R}$.

It circuit is closed, power dissipated,

$$= \frac{\varepsilon^2}{R} = \frac{B^2\omega^2 l^2}{4R}$$

26.

Area of the circular loop = πr^2

$$= 3.14 \times (0.12)^2 \text{ m}^2 = 4.5 \times 10^{-2} \text{ m}^2$$

$$E = -\frac{d\varphi}{dt} = -\frac{d}{dt}(\text{BA}) = -\text{A}\frac{dB}{dt} = -\text{A} \cdot \frac{B_2 - B_1}{t_2 - t_1}$$

For $0 < t < 2$s

$$E_1 = -4.5 \times 10^{-2} \times \left\{\frac{1-0}{2-0}\right\} = -2.25 \times 10^{-2} \text{ V}$$

$$\therefore \quad I_1 = \frac{E_1}{R} = \frac{-2.25 \times 10^{-2}}{8.5} \text{ A} = -2.6 \times 10^{-3} \text{ A} = -2.6 \text{ mA}$$

For $2\text{s} < t < 4\text{s}$,

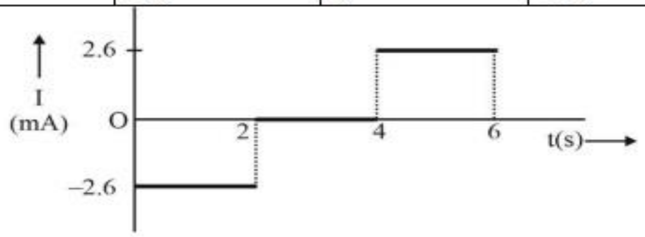
$$E_2 = -4.5 \times 10^{-2} \times \left\{\frac{1-1}{4-2}\right\} = 0$$

$$\therefore \quad I_2 = \frac{E_2}{R} = 0$$

For $4\text{s} < t < 6\text{s}$,

$$I_3 = -\frac{4.5 \times 10^{-2}}{8.5} \times \left\{\frac{0-1}{6-4}\right\} \text{A} = 2.6 \text{ mA}$$

	0<t<2s	2<t<4s	4<t<6s
E(V)	-0.023	0	+0.023
I(mA)	-2.6	0	+2.6



27.

(a) XL = 2πf L L = XL /2πf L = 20/(2 × 3.14 × 100) = 0.032 H

(b) A battery is a source of direct current and thus f = 0 Hz. As XL = 2πfL, the inductive reactance of the inductor becomes zero.

(c) Power dissipated in an LCR circuit is maximum when XL= XC f = 1/2π√(LC) f = 0.398 × 10^3 Hz f = 398 Hz Under this condition of resonance, the circuit behaves as a pure resistive circuit. Hence phase difference between current and voltage is 0°.

28.

Formulation in SI units

Name	Integral equations	Differential equations	Meaning
Gauss's law	$\oiint_{\partial\Omega} \mathbf{E} \cdot d\mathbf{S} = \frac{1}{\varepsilon_0} \iiint_{\Omega} \rho \, dV$	$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}$	The electric field leaving a volume is proportional to the charge inside.
Gauss's law for magnetism	$\oiint_{\partial\Omega} \mathbf{B} \cdot d\mathbf{S} = 0$	$\nabla \cdot \mathbf{B} = 0$	There are no magnetic monopoles; the total magnetic flux piercing a closed surface is zero.
Maxwell–Faraday equation (Faraday's law of induction)	$\oint_{\partial\Sigma} \mathbf{E} \cdot d\boldsymbol{\ell} = -\frac{d}{dt} \iint_{\Sigma} \mathbf{B} \cdot d\mathbf{S}$	$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$	The voltage accumulated around a closed circuit is proportional to the time rate of change of the magnetic flux it encloses.
Ampère's circuital law (with Maxwell's addition)	$\oint_{\partial\Sigma} \mathbf{B} \cdot d\boldsymbol{\ell} = \mu_0 \iint_{\Sigma} \mathbf{J} \cdot d\mathbf{S} + \mu_0\varepsilon_0 \frac{d}{dt} \iint_{\Sigma} \mathbf{E} \cdot d\mathbf{S}$	$\nabla \times \mathbf{B} = \mu_0 \left(\mathbf{J} + \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t}\right)$	Electric currents and changes in electric fields are proportional to the magnetic field circulating about the area they pierce.

SECTION-D (Case Study Based Questions) (2 X 4M)

29. (i) (b) Frequency of visible light is less than that for ultraviolet light I 1

(ii) (a)For non-metals the work function is high 1

(iii) (a)Photoelectric current increases 1

(iv) (b) Frequency 1

Or

(b) It decreases as the work function increases 1

30. (i) (c) 1.6 mm/s

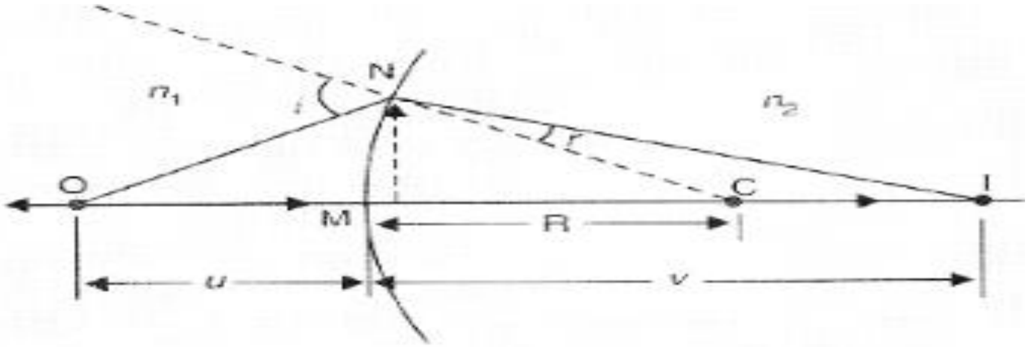
(ii) (d) tripled

(iii) (a) 4:1

(iv) (b) 2 mm/s Or (a) Current

SECTION-E (3 X5M)

31. (a)



From the given diagram, for small angles :

$$\tan \angle NOM = \frac{MN}{OM} = \angle NOM$$

$$\tan \angle NCM = \frac{MN}{MC} = \angle NCM$$

$$\tan \angle NIM = \frac{MN}{MI} = \angle NIM$$

For Δ NOC, $\angle i$ is the exterior angle.

$$\Rightarrow \quad \angle i = \angle NOM + \angle NCM$$

$$= \frac{MN}{OM} + \frac{MN}{MC}$$

Similarly,

$$\Rightarrow \quad \angle r = \angle NCM + \angle NIM$$

$$r = \frac{MN}{MC} + \frac{MN}{MI}$$

2

$$n_1 \sin i = n_2 \sin r$$

$$n_1 i = n_2 r$$

$$\Rightarrow n_1 \left(\frac{MN}{OM} + \frac{MN}{MC} \right) = n_2 \left(\frac{MN}{MC} - \frac{MN}{MI} \right)$$

1

(n_2/v)- (n_1/v) = $(n_2$-$n_1)/R$

(b) Lens maker's formula,

1f=(μ−1)(1/R1−1/R2) 1

Here, f = 20 cm, μ = 1.55, R1 = R, R2 = -R

120=(1.55−1)(1/R−1/(−R)) or 120 = 0.55×2R

⇒R=1.1×20=22cm 1

Or

(a) Using Lens Formula

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$ 1

$$-\frac{1}{20}=\frac{1}{v}+\frac{1}{12}$$

$$\frac{1}{v}=\frac{3}{60}-\frac{5}{60}=-\frac{1}{30}$$ ½

V=-30 cm 1

(b)

$$m=\frac{\text{fo}}{\text{fe}}$$

$$=\frac{144}{6.0}$$ 1

= 24 ½

Separation= f_o + f_e= 144+6= 150 cm 1

32.

$$V=-\int_{\infty}^{R}\vec{E}\,\vec{dr}$$

But $$\vec{E}=\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$$

∴ $$V=-\int_{\infty}^{R}\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}\,\vec{dr}$$

$$=-\int_{\infty}^{R}\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\,dr$$

because $\hat{r}\,\vec{dr}=dr$

$$=-\frac{q}{4\pi\varepsilon_0}\int_{\infty}^{R}\frac{1}{r^2}\,dr$$

$$=-\frac{q}{4\pi\varepsilon_0}\left[-\frac{1}{r}\right]_{\infty}^{R}=\frac{q}{4\pi\varepsilon_0}\left[\frac{1}{R}-\frac{1}{\infty}\right]$$

or $$V=\frac{1}{4\pi\varepsilon_0}\frac{q}{R}$$

(i) Inside the shell potential will be constant and same as at the surface V=kq/R

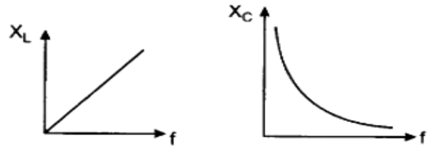
(ii) Outside the shell V= kq/r

Or

(a) C_{13}= 12μF
C_{213}= 4 μF
C_{4213}= 10 μF

(b) q_{C4} = C x V= 6 x10^{-6} X10= 6 X 10^{-5} C
q_{C1}= 4 X 10^{-5}/2= 2x 10^{-5} C

33. (a)



$\therefore \quad X_L \propto f$

Capacitive reactance $(X_C) = \dfrac{1}{2\pi f C}$

$\therefore \quad X_C \propto \dfrac{1}{f}$

(b)

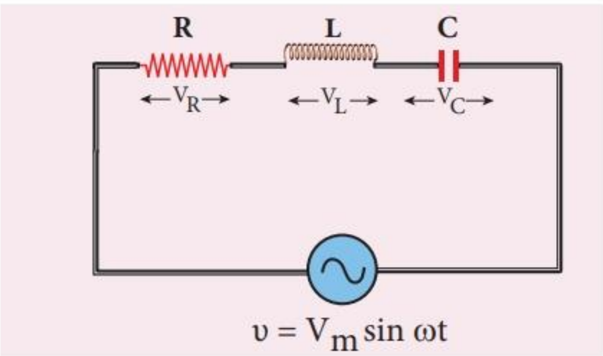


Figure AC circuit containing R, L and C

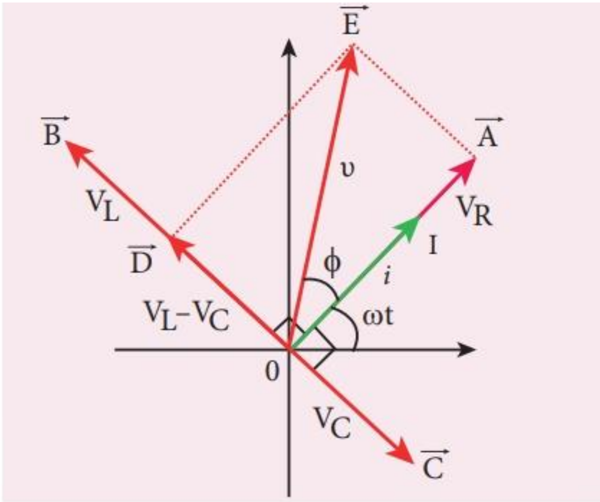
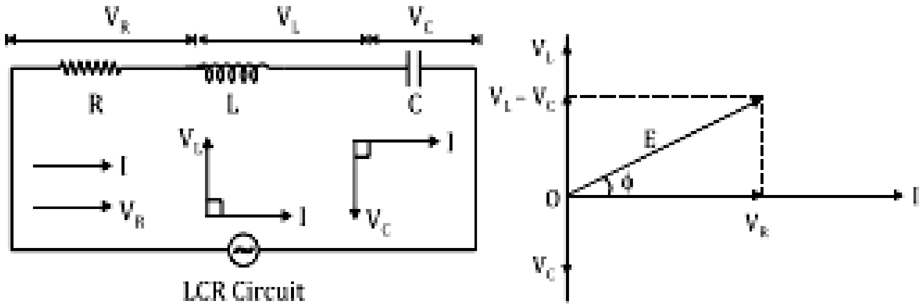


Figure Phasor diagram for a series RLC – circuit when $V_L > V_C$

(c) (i) X- Inductor, Y- Resistor
(ii) I= √2/8 A

Or

(a)



$$V^2 = V_R^2 + (V_C - V_L)^2 \Rightarrow V = \sqrt{V_R^2 + (V_C - V_L)^2} \qquad ...(i)$$

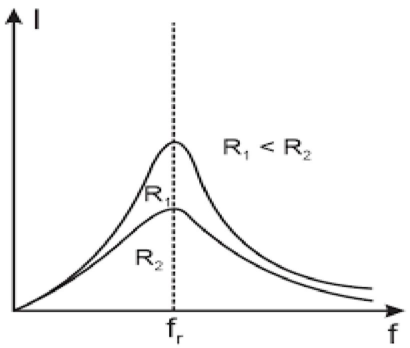
But $\quad V_R = R\,i,\; V_C = X_C\,i \quad$ and $\quad V_L = X_L\,i \qquad ...(ii)$

where $X_C = \dfrac{1}{\omega C}$ = capacitance reactance and $X_L = \omega L$ = inductive reactance

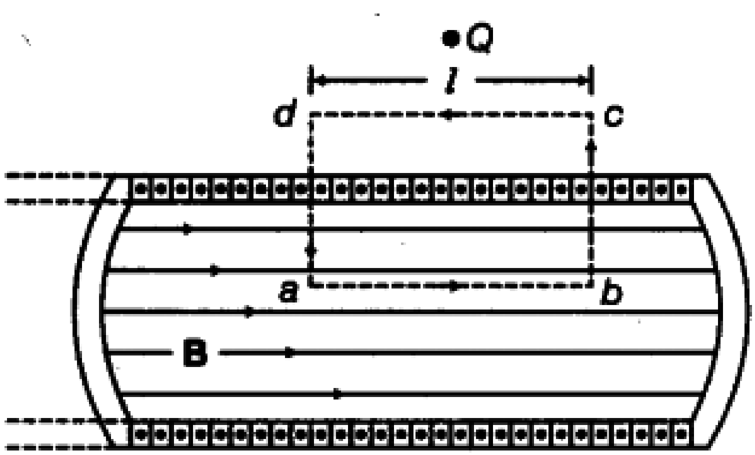
$$\therefore \qquad V = \sqrt{(R\,i)^2 + (X_C\,i - X_L\,i)^2}$$

$\therefore$ Impedance of circuit, $\quad Z = \dfrac{V}{i} = \sqrt{R^2 + (X_C - X_L)^2}$

(b)



31. (a)



$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 \times$ (total current passes through loop *abcd*)

$$\int_a^b \mathbf{B} \cdot d\mathbf{l} + \int_b^c \mathbf{B} \cdot d\mathbf{l} + \int_c^d \mathbf{B} \cdot d\mathbf{l} + \int_d^a \mathbf{B} \cdot d\mathbf{l} = \mu_0 \left[\left(\frac{N}{L} \right) li \right]$$

where, $\frac{N}{L} =$ number of turns per unit length,

$ab = cd = l =$ length of rectangle.

$$\int_a^b Bdl \cos 0^\circ + \int_b^c Bdl \cos 90^\circ + 0 + \int_d^a Bdl \cos 90^\circ = \mu_0 \left(\frac{N}{L} \right) li$$

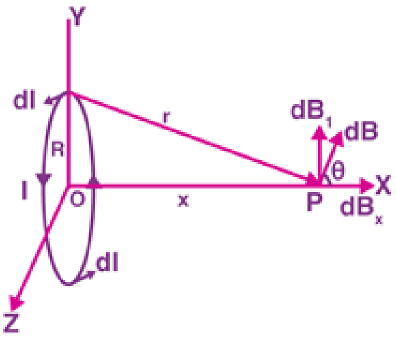
$[\because \cos 0^\circ = 1 \text{ and } \cos 90^\circ = 0]$

$$B \int_a^b dl = \mu_0 \left(\frac{N}{L} \right) li \Rightarrow Bl = \mu_0 \left(\frac{N}{L} \right) li$$

$$\Rightarrow B = \mu_0 \left(\frac{N}{L} \right) i \quad \text{or} \quad B = \mu_0 ni$$

(b)To make the magnetic field inside a solenoid stronger, we can increase the current flowing through the coil or increase the number of turns of wire in the solenoid. Additionally, inserting a ferromagnetic core (like iron) into the solenoid can significantly amplify the magnetic field.

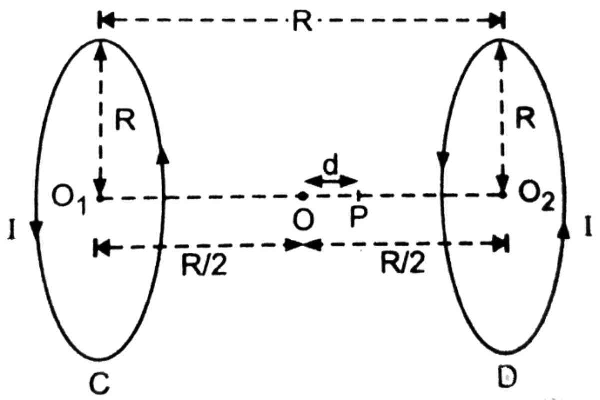
Or



$$B = \frac{\mu_0 I R^2 N}{2(x^2 + R^2)^{\frac{3}{2}}}$$

At the centre x=0

B= μ_0 I/2R



$$B = B_1 + B_2$$

$$= \frac{\mu_0 I R^2}{2}\left[\left\{\left(\frac{R}{2}-d\right)^2 + R^2\right\}^{-\frac{3}{2}} + \left\{\left(\frac{R}{2}+d\right)^2 + R^2\right\}^{-\frac{3}{2}}\right]$$

$$= \frac{\mu_0 I R^2}{2}\left[\left(\frac{5R^2}{4}+d^2-Rd\right)^{-\frac{3}{2}} + \left(\frac{5R^2}{4}+d^2+Rd\right)^{-\frac{3}{2}}\right]$$

$$= \frac{\mu_0 I R^2}{2}\times\left(\frac{5R^2}{4}\right)^{-\frac{3}{2}}\left[\left(1+\frac{4}{5}\frac{d^2}{R^2}-\frac{4}{5}\frac{d}{R}\right)^{-\frac{3}{2}} + \left(1+\frac{4}{5}\frac{d^2}{R^2}+\frac{4}{5}\frac{d}{R}\right)^{-\frac{3}{2}}\right]$$

For $d << R$, neglecting the factor $\frac{d^2}{R^2}$, we get:

$$\approx \frac{\mu_0 I R^2}{2}\times\left(\frac{5R^2}{4}\right)^{-\frac{3}{2}}\times\left[\left(1-\frac{4d}{5R}\right)^{-\frac{3}{2}} + \left(1+\frac{4d}{5R}\right)^{-\frac{3}{2}}\right]$$

$$\approx \frac{\mu_0 I R^2 N}{2R^3}\times\left(\frac{4}{5}\right)^{\frac{3}{2}}\left[1-\frac{6d}{5R}+1+\frac{6d}{5R}\right]$$

$$B = \left(\frac{4}{5}\right)^{\frac{3}{2}}\frac{\mu_0 I N}{R} = 0.72\left(\frac{\mu_0 I N}{R}\right)$$

______________________________END OF MARKING KEY__________________________