B.K. BIRLA CENTRE FOR EDUCATION

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

TERM-1 EXAMINATION 2025-26

PHYSICS

MARKING SCHEME

Class: XII **Time: 3hr**
Date: 03.09.25 **Max Marks: 70**

Section A (16 x 1M)

1. (d) Both a and b
2. (a) Distance
3. (b) Increase in plate area
4. (a) Temperature remains constant
5. (d) Circular
6. (c) Fleming's left-hand rule
7. (a) Lenz's law is a consequence of
8. (b) Zero
9. (d) Leads the voltage
10. (b) Transverse
11. (b) X-rays
12. (a) 3×10^8 m/s
13. (a)
14. (c)
15. (a)
16. (a)

Section B (5 X 2M)

17.

$$F = \frac{1}{4\pi\varepsilon_0}.\frac{q_1q_2}{r^2}$$

Where, ε_0 = Permittivity of free space and $\frac{1}{4\pi\varepsilon_0} = 9\times10^9\ \mathrm{Nm^2C^{-2}}$

Therefore, force

$$\mathrm{F} = \frac{9\times10^9\times2\times10^{-7}}{(0.3)^2} = 6\times10^{-3}\mathrm{N}$$

18.

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

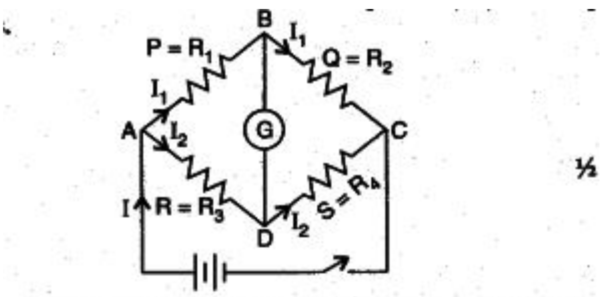
$$\text{or } W = \int_0^q \frac{q}{C}.dq \quad (\because V = \frac{q}{C})$$

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

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

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

19.



½

Applying kirchhoff's loop rule to closed loop ADBA

$-I_1R_1 + 0 + I_2R_2 = 0 \ (I_g = 0)$ ...(i) ½

For loop CBDC,

$-I_2R_4 + 0 + I_1R_3 = 0$ ...(ii)

⇒ from equation (i)

$$\frac{I_1}{I_2} = \frac{R_1}{R_2}$$

From equation (ii)

$$\frac{I_1}{I_2} = \frac{R_4}{R_3}$$ ½

$$\therefore \frac{R_1}{R_2} = \frac{R_4}{R_3}$$ ½

20. (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.

21. (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.

SECTION-C (7 X 3M)

22. Electric field intensity due to point charge at any point is defined as the force experienced by a unit positive charge at that point due to the point charge
Let a point charge +q is at origin 'O'.
To find electric field intensity at a point P at distance 'r' from the 'O', consider a + ve charge q_0 is kept at 'P'.
Force experience by the charge q_0 is $F= kqq_0/r^2$
$E=F/q_0$
$E= (kqq_0/r^2)/ q_0$
$E= kq/r^2$

Or

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

Total charge enclosed
= Linear charge density $\times l$
$= \lambda l$

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

Using Equations (i) & ii

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

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

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. (a)

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Here, $R_1 = 2\ \Omega$, $R_2 = 3\ \Omega$ and $R_3 = 6\ \Omega$

So,

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$$

$$= \frac{3+2+1}{6} = \frac{6}{6}$$

$$\Rightarrow R = \frac{6}{6} = 1\ \Omega$$

(b) I=V/R= 12/1=12A
(c) $P= V^2/R=144/1=144W$

24. (a)The electric field should be directed downwards, perpendicular to the magnetic field and the direction of motion.

(b) (i) Electric and magnetic forces will act in the opposite directions. No deflection of proton.

(ii) Both Electric and magnetic forces will act in the same direction (downwards), causing the electron to be deflected strongly.

25.

Since, θ is small.

So, $\sin\theta \approx \theta$

$\therefore$ $\tau = -MB\theta.$

But $\tau = I\alpha$

where, α = **angular acceleration**

M = **magnetic moment of dipole.**

$$\Rightarrow I\alpha = -MB\theta \Rightarrow \alpha = -\left(\frac{MB}{I}\right)\theta \Rightarrow \alpha \propto -\theta$$

$\Rightarrow$ **Angular acceleration $\propto$ – Angular displacement**

$\Rightarrow$ **Therefore, the needle executes SHM.**

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{MB}{I}}} \text{ or } T = 2\pi\sqrt{\frac{I}{MB}}$$

26.

Area of the circular loop $= \pi r^2$

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

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

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

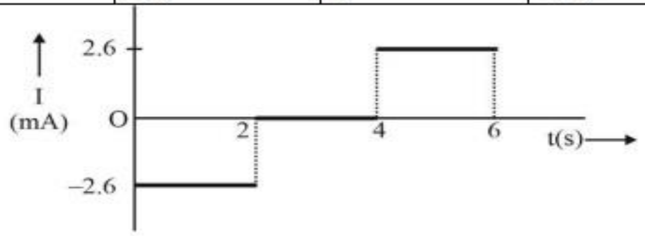
$$E_2 = -4.5 \times 10^{-2} \times \left\{\frac{1-1}{4-2}\right\} = 0$$

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

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) (c) 1.6 mm/s

(ii) (d) tripled

(iii) (a) 4:1

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

30. (i) X-Rays, radiowaves

(ii) Radiowaves

(iii) X-rays have much shorter wavelengths than radio waves, which allows them to penetrate materials more effectively and carry more energy. Radio waves, with their longer wavelengths, are used for communication and have less penetrating power.

SECTION-E   (3 X5M)

31.

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

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

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

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

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

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

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

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

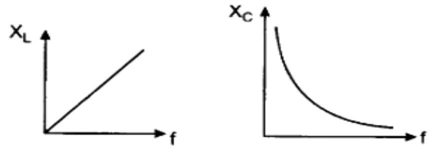
(i) Inside the shell potential will be constant and same as at the surface V=kq/R

(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

32. (a)



$\therefore \quad X_L \propto f$

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

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

(b)

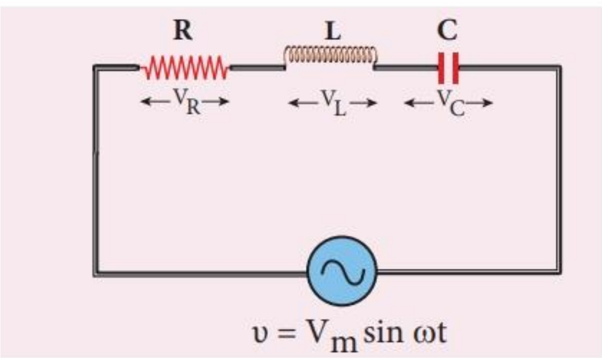


Figure AC circuit containing *R*, *L* and *C*

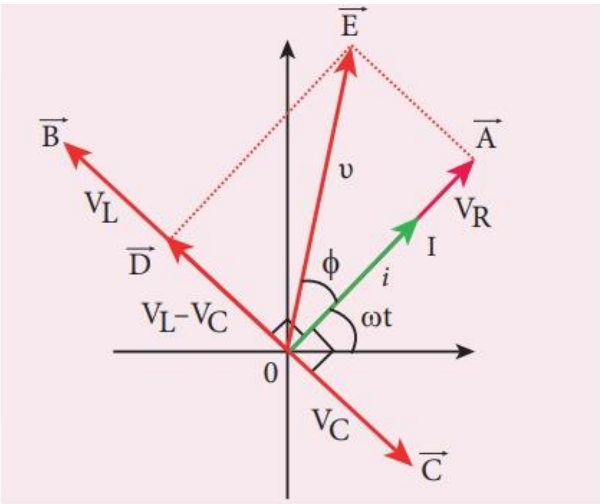
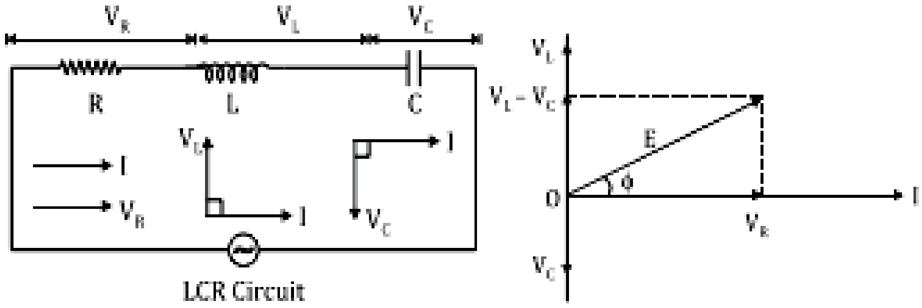


Figure Phasor diagram for a series *RLC* – circuit when $V_L > V_C$

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

Or

(a)



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

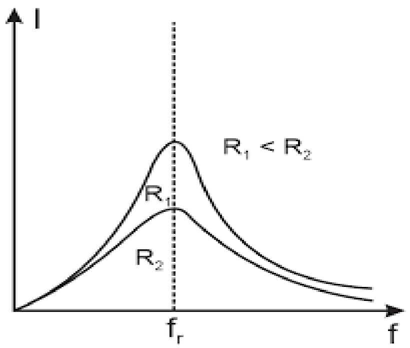
But $\quad V_R = Ri, V_C = X_C\, i \quad$ and $\quad V_L = X_L\, i \qquad ...(ii)$

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

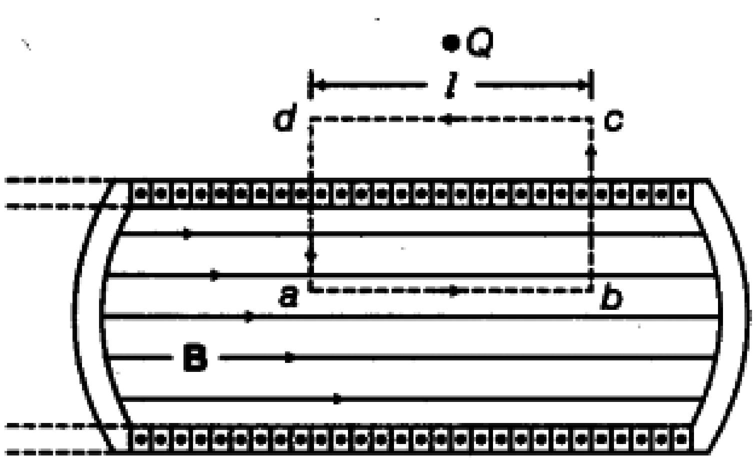
$$\therefore \qquad V = \sqrt{(R\,i)^2 + (X_C\, i - X_L\, i)^2}$$

$\therefore$ 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.

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

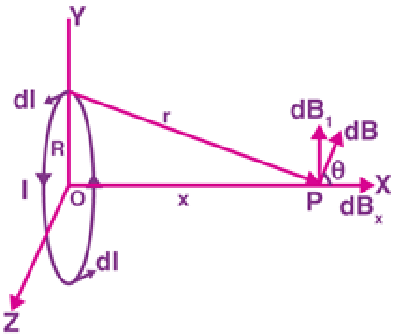
$[\because \cos 0^\circ = 1 \text{ and } \cos 90^\circ = 0]$

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

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

(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.

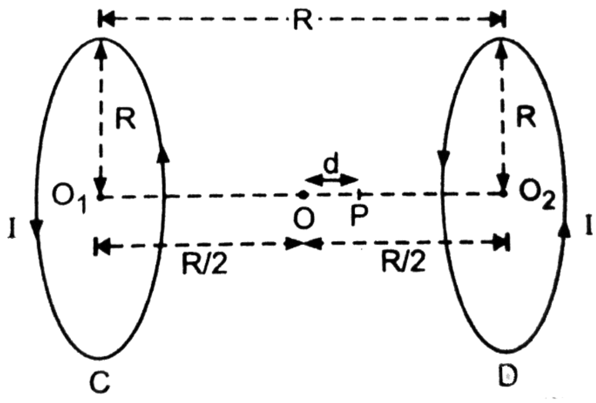
Or



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

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__________________________