QUARTERLY EXAMINATION -2024

PHYSICS - KEY ANSWER (DHARMAPURI)

(V.V. MATRIC. HR. SEC. SCHOOL) - M SATHRIYAN M.Sc., B

PART-A

CHOOSE THE CORRECT ANSWER:- 10×1=10

1. b) 8mC (B.B)
2. c) More than before (B.B)
3. b) infinite resistance. (U-3)
4. d) 240 W. (B.B)
5. b) 0.5 Ω (B.B)
6. b) yellow - violet - orange - silver (B.B)
7. b) 45° (B.B)
8. ~~a)~~ 1 H (B.B)
9. d) 0 (unit - 4)
10. c) 1.414×10^{-8} T (B.B)
11. d) in vacuum, it travels with different speeds which depends on their frequency (unit - 5)
12. c) 2×10^{8} ms^{-1} (unit - 6 Ex)
13. c) refraction (B.B)
14. a) 30° (B.B)
15. a) zero. (unit - 1)

4. $P = V^2/R$ R:
$= \frac{240 \times}{24}$
P = 240

8. E = ...
E = -L $\frac{dI}{dt}$
8 = L 2+...

9. tan φ = X
$X_L = X_C$
tan φ = X
tan φ = ...

12. n = c/v
v = c/n
$= \frac{3\times10^{8}}{1.5}$
$v = 2\times10^{8}$

21.

PART - B. (2 MARKS)

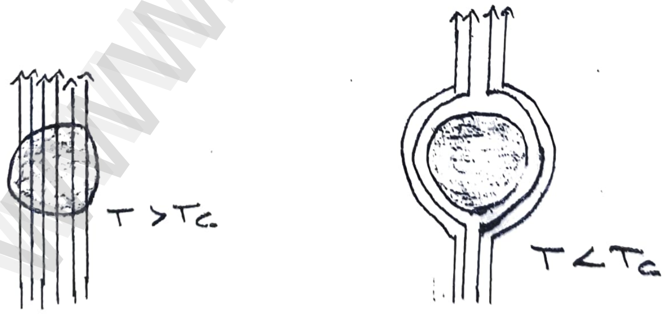
ANSWER

16. Conservation of charge:
Total charge in the universe is constant. charge neigther be created nor be destroyed.

17. The metal body of the car providing "electrostatic shielding". So, the electric field inside the car is 'zero' 2

18. Joule's Heating law: 1
$H = I^2 R t$
$\Rightarrow$ Heat directly proportional to square of current (I^2) 1
$\Rightarrow H \propto R$
$\Rightarrow H \propto t$

19. Meissner effect:
The expulsion of magnetic flux from a superconductor, during it's transistion to the superconducting state. 1



(Meissner effect) 1

20. Formula:- $v = \frac{1}{\sqrt{\varepsilon \mu}}$

$c = 3 \times 10^8 \, ms^{-1}$ $\quad v = \frac{1}{\sqrt{\varepsilon_0 \varepsilon_r \mu_0 \mu_r}}$ 1

$\varepsilon_r = 2.25$ (or)

$\mu_r = 1.0$ $\quad v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$

Q - factor:

21. $Q = \frac{\text{Voltage across L (or) C at resonance}}{\text{applied voltage}}$ 2

Displacement current
22. As the current which comes into play in the region in which the electric field (or) (electric flux) is change with time. 1½

$i_d = \varepsilon_0 \, d\phi_E/dt$ ½

$\oint \vec{B} \cdot \vec{dl} = \mu_0 [i_c + i_d]$

2

23. Violet, blue colour has shortest wavelength, compare than other colours 1

shorter wavelength colours has more scattered. 1

2

Wattless current:
24. I_{RMS} resloved in two components

$I_{rms} \cos\phi \rightarrow$ active component $= 0°$ 1

$I_{rms} \sin\phi \rightarrow$ reactive component $= \pi/2$

In that reactive component power consumed is 'zero'. It's called wattless current. 1

(or)

The current in an AC circuit is said to be wattless current if the power consumed by it's zero

PART - III (6 × 3 = 18)

Energy stored in capacitor:
25. Workdone is stored as electrostatic potential energy in

$$W = \int_0^Q Q/C \, dQ = Q^2/2C.$$

$$U_E = Q^2/2C = 1/2 \, CV^2$$

$Q = CV$ $C = \varepsilon_0 A/d$ $V = Ed$

$$U_E = 1/2 \, \varepsilon_0 (Ad) E^2$$ 1/2

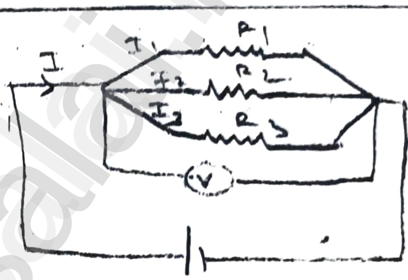
energy density $u_E = U_E/V$

$V = Ad$

$u_E = 1/2 \, \varepsilon_0 E^2$ 1/2

3

26. Diagram & explanation 1



$$I_P = I_1 + I_2 + I_3$$ 1/2

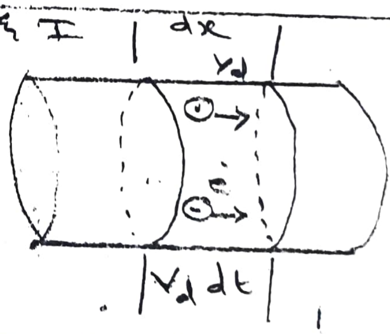
$$V/R_P = V/R_1 + V/R_2 + V/R_3$$ 1/2

$1/R_P = 1/R_1 + 1/R_2 + 1/R_3$ (or) Equivalent statement 1

3

27. relation b/n Drift velocity & I

Diagram & explanation



1/2

Drift velocity:

The average velocity acquired by the electron inside the Conductor when it's subjected to an electric field 1/2

$$\vec{v_d} = \vec{a}\tau$$

$$v_d = dx/dt$$

$$dx = v_d \, dt$$

$$dQ = e A v_d dt \, n$$ 1

$$I = dQ/dt$$

$I = neAv_d$

28 $C = \frac{\varepsilon_r \varepsilon_0 A}{d}$ ½ ½

$C = 4.425$ pF ½

$Q = CV$ ½

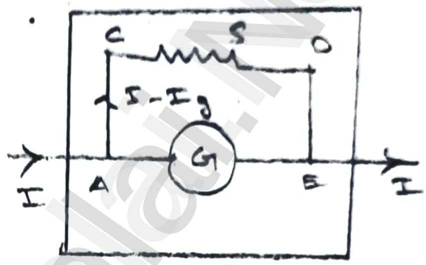
$Q = 44.25$ pC ½

$U = \frac{1}{2} C V^2$ ½

$U = 2.21 \times 10^{-10}$ J. ½

3

29 Galvanometer into ammeter diagram & explanation.



→ A Galvanometer is converted into an ammeter by connecting low resistance in parallel with Galvanometer. 1 ½

$V_{galvanometer} = V_{shunt}$ ½

$I_g R_g = (I - I_g) S$

$S = \left(\frac{I_g}{I - I_g} \right) R_g$ (or)

$I_g = \left(\frac{S}{S + R_g} \right) I$ 1

$\theta = \frac{1}{G} I_g$

$\theta \propto I_g$

$\theta \propto I$

3

30. Types of losses. 1

(i) core loss (or) iron loss.

* It's known as Hysteresis loss and eddy current loss

* when transformer core is

Heat

(ii) copper loss

(iii) Flux leakage

It's correct statements

31. any six properties :- (Electromagnetic wave)

(i) Electromagnetic waves are produced by any accelerated charge

(ii) Electromagnetic waves do not require any medium for propogation.

iii) Electromagnetic waves transverse in nature

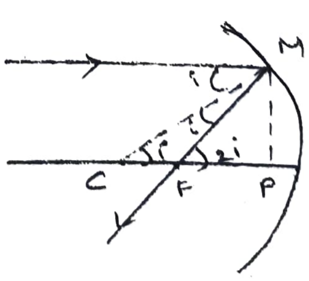
iv) This waves not deflected by E and B fields

v) It can exhibit interference, diffraction, polarization

vi) It's also carry the energy like energy, P, L

3

32. Any one diagram 1



$\tan i = PM/PC$, $\tan 2i = PM/PF$

$\tan i \approx i$, $\tan 2i \approx 2i$ 1

$i = PM/PC$, $2i = PM/PF$

$2PF = PC$

$2f = R$ (or) $f = R/2$ 1

3

35 b) page no: 221 & 222 (UNIT-4) (PART-D)

* coil rotated anticlockwise direction ($\theta = \omega t$)
* B resolved in two components
$B \cos\theta$ $B \perp n$ (plane)
* $B \sin\theta$ parallel to plane no induced current

$N\phi_B = NBA \cos\theta = NBA \cos\omega t$ 1

According to Faraday's law 1½

$$\varepsilon = -\frac{d}{dt}(N\phi_B) = -\frac{d}{dt}(NBA\cos\omega t)$$

$\varepsilon = NBA\omega \sin\omega t$

Induced emf $\varepsilon = \varepsilon_m \sin\omega t$ ½

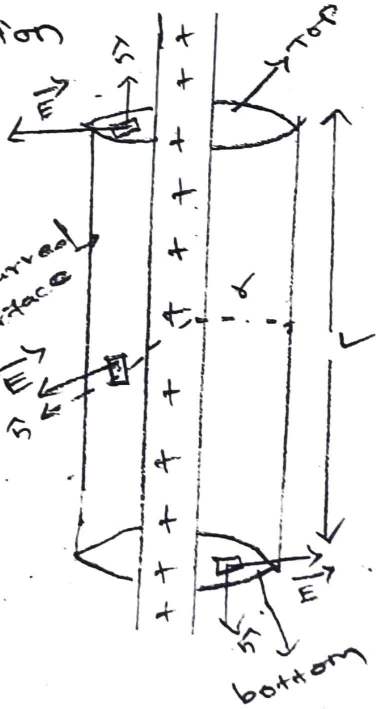
alternating Current $i = I_m \sin\omega t$

5

PART – D $5 \times 5 = 25$

34 a) Application of Gauss law: 1

Diagram with explanation



$\phi_E = \oint \vec{E} \cdot \vec{dA}$ 1

$= \int_{\text{curve surface}} \vec{E} \cdot \vec{dA} + \int_{\text{top}} \vec{E} \cdot \vec{dA} + \int_{\text{bot}} \vec{E} \cdot \vec{dA}$

$\vec{E}$ parallel to $\vec{A} = E\,dA$ 1

$\vec{E} \perp \vec{A} = 0$

$\theta = 0°$ $\theta = 90°$

$\phi_E = \int_{\text{curve}} E \cdot dA = \frac{Q_{en}}{\varepsilon_0}$

$\int_{\text{curve}} dA = 2\pi r L$

$Q = \lambda L$ λ → linear charge density 1

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

Comparison of emf of two cells

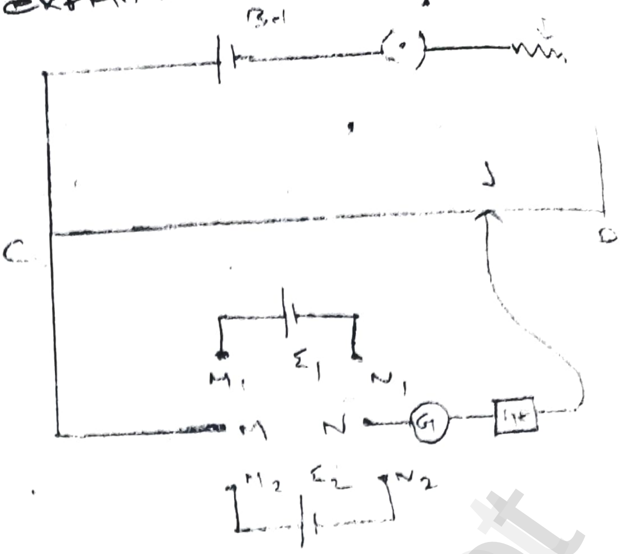
b. Diagram with explanation

$\varepsilon_1 = I r l_1$

$\varepsilon_2 = I r l_2$

$\frac{\varepsilon_1}{\varepsilon_2} = \frac{I r l_1}{I r l_2}$

$\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}$



1

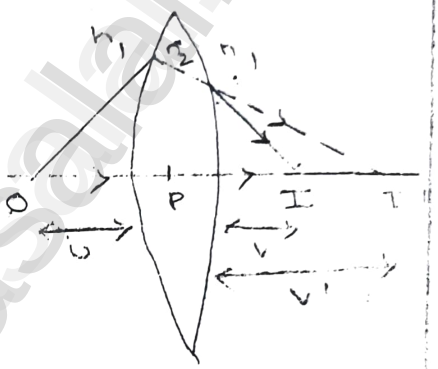
5

35 a Lens maker formula:

1

Diagram & explanation

$\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$ ½



$\frac{n_2}{v'} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1}$ ½

$\frac{n_1}{v} - \frac{n_2}{v'} = \frac{n_1 - n_2}{R_2}$ ½

$\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$u = \infty \quad v = f$

$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 1½

$n_1 = 1 \quad n_2 = n$

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 1

5

36. a) Wheatstone's bridge:

Diagram with explanation 1

Apply Kirchhoff's current rule:

Junction B & D

$I_1 - I_G - I_3 = 0 \rightarrow (1)$

$I_2 + I_G - I_4 = 0 \rightarrow (2)$ ½

$I_1P + I_G G - I_2R = 0 \rightarrow (3)$

Loop ABCDA

$I_1P + I_3Q - I_4S - I_2R = 0 \rightarrow (4)$ ½

(no potential difference b/n B & D) ½

$I_G = 0$

$I_1 = I_3, \quad I_2 = I_4, \quad I_3Q = I_4S$ 1½

$P/Q = R/S$ 1

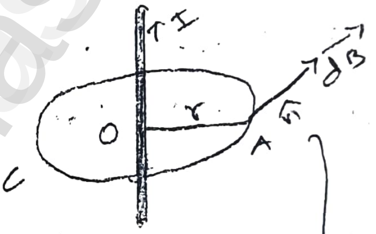
5

36 b) Ampere's circuital law:

The line integral of magnetic field over a closed loop is μ_0 times net current enclosed by the loop 2.

$$\oint \vec{B}.\vec{dl} = \mu_0 I_{enclosed}.$$

Diagram & explanation 1.



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

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

circumference of a current loop $2\pi r$ 1½

$$B \int_0^{2\pi r} dl = \mu_0 I$$

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

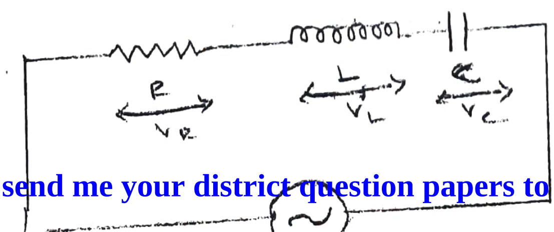
$$B = \mu_0 I / 2\pi r$$ ½

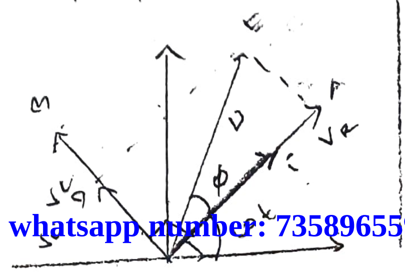
$$\vec{B} = \mu_0 I / 2\pi r \ \hat{n}$$

5

37 a) RLC circuit: 1½

Diagram & explanation





 drawn

$V_L > V_C$ net voltage
L-C combination $(V_L - V_C)$

$V_m^2 = V_R^2 + (V_L - V_C)^2$

$V_m = \sqrt{(I_m R)^2 + (I_m X_L - I_m X_C)^2}$

$= I_m \sqrt{R^2 + (X_L - X_C)^2}$

$V_m / I_m = Z$

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

phase angle.

$\tan\phi = \frac{V_L - V_C}{R} = \frac{X_L - X_C}{R}$

b) Emission spectra:-

Only three types of emission spectra

Emission spectra It's statement self luminous source is taken we get emission spectrum

(i) Continuous emission spectrum

It's consist of wavelengths containing all visible colours ranging from violet to red (ex) carbon arc, Incandescent solid.

(ii) Line emission spectrum:-

→ light from hot gas is allowed to pass through prism, line spectrum is observed.

→ It's also known discontinuous spectra

→ It' consist of sharp lines of definite wavelengths (or) frequency

(ex) spectra of H_2, He

(iii) Band emission spectrum

which overlap together forming

Specific band which are seperated

by dark spaces 1/2

(ex) Spectra of ammonia gas discharge

in the tube etc... 5

---

38 a) Integral form of maxwell equation :- 3

only four equations

(i) First equation (Gauss law of electricity) 1

$\oint_S E \cdot d\vec{A} = \frac{Q_{enclosed}}{\varepsilon_0}$ & statement

(ii) $\oint_S \vec{B} \cdot d\vec{A} = 0$ (Gauss law of magnetism) 1

with statement

(iii) $\oint_l \vec{E} \cdot \vec{dl} = -\frac{d}{dt}\phi_B$ (Faraday's law) 1

with statement

(iv) $\oint_l \vec{B} \cdot \vec{dl} = \mu_0 i_c + \mu_0 \varepsilon_0 \frac{d}{dt} \oint_S \vec{E} \cdot \vec{dA}$ 2

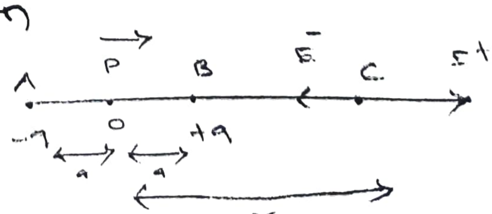
(ampere - maxwell law)

with statement 5

---

b) electric field due to a dipole on it's axial line :- 1

Diagram & explanation



$$\left.\begin{aligned} \vec{E_+} &= \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}\hat{p} \\ \vec{E_-} &= -\frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}\hat{p} \end{aligned}\right\}$$ 1

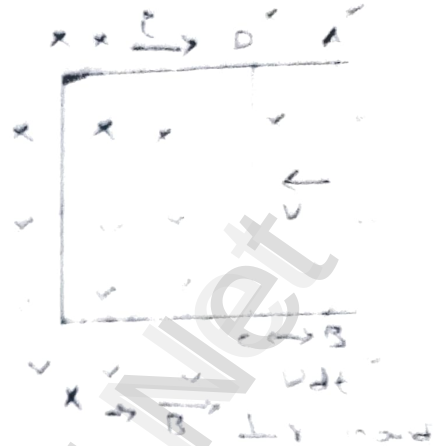
$$\left.\begin{aligned} \vec{E}_{total} &= \vec{E_+} - \vec{E_-} \\ \vec{E}_{tot} &= \frac{1}{4\pi\varepsilon_0} q \left(\frac{4ra}{(r^2-a^2)^2}\right)\hat{p} \end{aligned}\right\}$$ 1

$(r^2-a^2)^2 \approx r^4$ 1/2

38 PART – C

Induce an emf by changing area enclosed by the coil.

Diagram & explanation



$d\phi_B = B \times$ change in area (dA)

Area(ABCD) = $l(v\,dt)$

$d\phi_B/dt = Blv$

$\varepsilon = d\phi_B/dt$

$\varepsilon = Blv$

(Induced emf ε is called motional emf 3