Register Number

**Class : 12**

# FIRST REVISION EXAMINATION - JANUARY - 2025

## PHYSICS

Time Allowed : 3.00 Hours] [Max. Marks : 70

### PART - I

**Choose the correct answer.** 15x1=15

1. A parallel plate capacitor stores a charge Q at a voltage V. Suppose the area of the parallel plate capacitor and the distance between the plates are each doubled then which is the quantity that will change?
   (a) Capacitance (b) Charge (c) Voltage (d) Energy density
2. Non polar molecule is ------------
   (a) $H_2O$ (b) $N_2O$ (c) $HCl$ (d) $CO_2$
3. In Joule's heating law, when R and t are constant, if the H is taken along the y axis and $I^2$ along the x axis, the graph is
   a) straight line (b) parabola c) circle d) ellipse
4. The potential energy of magnetic dipole whose dipole moment is $\vec{P}_m = (-0.5\hat{i} + 0.4\hat{j})$ Am² kept in uniform magnetic Field $\vec{B} = 0.2\hat{i}$ T
   (a) -0.1J (b) -0.8J (c) 0.1J (d) 0.8J
5. The value of gyro-magnetic ratio is..................
   (a) $8.78 \times 10^{10}$ C $Kg^{-1}$ (b) $7.87 \times 10^{10}$ C $Kg^{-1}$
   (c) $8.78 \times 10^{-10}$ C $Kg^{-1}$ (d) $1.6 \times 10^{-19}$ C $Kg^{-1}$
6. An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf V = 10 sin 340 t. The power loss in AC circuit is
   (a) 0.76 W (b) 0.89 W (c) 0.46 W (d) 0.67 W
7. A 400 mH coil of negligible resistance is connected to an AC circuit in which an effective current of 6 mA is flowing. Find out the inductive reactance if the frequency is 1000 Hz.
   (a) 24000 Ω (b) 314 Ω (c) 5212 Ω (d) 2512 Ω
8. Which of the following is an electromagnetic wave?
   (a) α - rays (b) β – rays (c) γ - rays (d) all of them
9. The speed of light in an isotropic medium depends on,
   (a) its intensity (b) its wavelength
   (c) the nature of propagation (d) the motion of the source w.r.t medium
10. The transverse nature of light is shown in,
    (a) interference (b) diffraction (c) scattering (d) polarization
11. A light of wavelength 500 nm is incident on a sensitive metal plate of photoelectric work function 1.235 eV. The kinetic energy of the photo electrons emitted is (Take $h = 6.6 \times 10^{-34}$ Js)
    (a) 0.58 eV (b) 2.48 eV (c) 1.24 eV (d) 1.16 eV
12. The charge of cathode rays particle is
    (a) positive (b) negative (c) neutral (d) not defined
13. According to quark model, the number of up quarks and down quark in proton is ------------
    (a) 2, 1 (b) 1, 2 (c) 3, 1 (d) 1, 3
14. The zener diode is primarily used as
    a) Rectifier (b) Amplifier (c) Oscillator (d) Voltage regulator
15. Which one of the following is the natural nanomaterial.
    (a) Peacock feather (b) Peacock beak
    (c) Grain of sand (d) Skin of the Whale

## PART - II

**II. Answer any 6 questions and question No.24 is compulsory.** **6×2=12**

16. Define electric dipole moment. Give its unit.
17. Why current is a scalar?
18. List the properties of dia magnetic materials.
19. Define displacement current.
20. Differentiate between Fresnel and Fraunhofer diffraction.
21. Give the application of photo cells.
22. What is isotope? Give an example.
23. Why steels are preferred to make robots?
24. A circular antenna of area 3 $m^2$ is installed at a place in Madurai.The plane of the area of antenna is inclined at $47^o$ with the direction of Earth's magnetic field. If the magnitude of Earth's field at that place is $4.1 \times 10^{-5}$ T find the magnetic flux linked with the antenna.

Ex: 4.1

## PART - III

**III. Answer any 6 questions and question No. 33 is compulsory** **6×3=18**

25. Derive the expression for resultant capacitance, when capacitors are connected in parallel.
26. Explain the principle of potentiometer.
27. Discuss the conversion of galvanometer into an voltmeter.
28. Mention the various energy losses in a transformer.
29. Obtain equation for snell' window.
30. State and prove Brewster's law.
31. Derive an expression for de Broglie wavelength of electrons.
32. Transistor functions as a switch.Explain.
33. Calculate the time required for 60% of a sample of radon undergo decay. Given $T_{1/2}$ of radon=3.8 days.

Ln:9 EXR.8

## PART - IV

**IV. Answer all the questions.** **5×5=25**

34. (a) Obtain Lens maker formula and metion its significance. **(OR)**
    (b) Obtain the law of radioactivity (radioactive decay)
35. (a) State Gauss law.Obtain an expression for electric field due to an infinitely long charged wire.
    **(OR)**
    (b) Obtain the equation for band width in young's double slit method.
36. (a) Derive an expression for phase angle between the applied voltage and current in a series RLC circuit. **(OR)**
    (b) What is rectification. Explain the construction and working of a half wave rectifier.
37. (a) Deduce the relation for the magnetic field at a point due to an infinitely long straight conductor carrying current using Biot-Savart law. **(OR)**
    (b) Describe briefly Davisson – Germer experiment which demonstrated the wave nature of electrons.
38. (a) (i) Explain the determination of the internal resistance of a cell using voltmeter.
    (ii) A battery has an emf of 12 V and connected to a resistor of 3Ω. The current in the circuit is 3.93A.Calculate terminal voltage and the internal resistance of the battery.
    Ex: 2.17 (2)
    **(OR)**
    (b) (i) Give the properties of electromagnetic waves.
    (ii) The relative magnetic permeability of the medium is 2.5 and the relative electrical permittivity of the medium is 2.25. Compute the refractive index of the medium. ✓
    Ex: 5.2

## Ans key



### PART - I

1m

1). d). Energy density → (BB - Ln: 1)

2). d). $CO_2$ → (BI) Ln: 1

3). a) Straight line → (BB - Ln 2)

4). c). 0.1 J → (BB) → Ln: 3

5). a). $8.78 \times 10^{10}$ $C kg^{-1}$ (BI) Ln: 3

6). c). 0.46 W (BB) Ln: 4

7). d). 2512 Ω (Ex 4.20)

8). c). γ-rays (BB) Ln: 5

9). b). its wavelength (BB) Ln: 6

10). d). Polarization (BB) Ln: 7

11). c). 1.24 eV (BB) Ln: 8

12). b). Negative (BB) Ln: 9

13). a). 2, 1 (BI) Ln: 9

14). d). Voltage regulator (BB) Ln: 10

15). a). peacock feather (BB) Ln: 11

### PART - II

16). Electric dipole moment, & unit

$|\vec{p}| = 2qa$ unit Cm

magnitude of electric dipole moment = product of magnitude of one of charges and distance between them.

17). Why current is scalar?

Current has specific direction and magnitude. But "it does not obey law of vector addition."

18). Properties of dia magnetic material.

(i). Magnetic Susceptibility → Negative

(ii). Relative permeability → slightly less than unity.

(iii). magnetic field lines are repelled → when placed in magnetic field.

(iv). Susceptibility is nearly temperature independent

Ex: Bi, Cu, $H_2O$ etc.

19). Displacement Current:

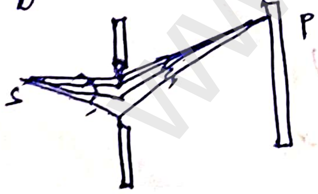
Current which comes into play in the region in which the electric field (or electric flux) is changing with time.

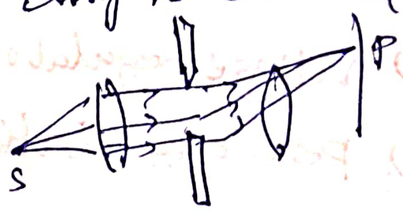
$$i_d = \frac{dq}{dt}$$

20).

| Fresnel diffraction | Fraunhofer diffraction |
| --- | --- |
| (i). Spherical (or) Cylindrical wavefront | Plane wavefront |
| (ii). Source at finite distance | Source at infinity |
| (iii). Convex lens not use | Convex lenses can be use |
| (iv). Difficult to observe & analyse | Easy to observe & Analyse |

(v).




21). Application photo cells.

(i). Switches & sensors – Automatic light control.

(ii). Reproduction of sound in motion picture

(iii) time measurement during athletes race.

(iv). light Intensity measurement – exact time of exposure.

22). Isotope ? Example:

Same element

Same Atomic Number

Different Mass number.

Ex: $_1H^1$, $_1H^2$, $_1H^3$

23). Steel preferred to make robots ?

Steel is several times stronger, due to inherent strength of metal, robot bodies can be made using sheet, bar, rod, channel, and other shapes.

24). Example: 4.1.

Circular antenna area $A = 3m^2$

$\theta = 90 - 47^\circ = 43^\circ$

$B = 4.1 \times 10^{-5} T$

magnetic flux $\phi_B = BA \cos\theta$

$\phi_B = 4.1 \times 10^{-5} \times 3 \times \cos 43^\circ$

$= 4.1 \times 10^{-5} \times 3 \times 0.7314$

$\boxed{\phi_B = 89.96 \, \mu Wb.}$

PART - III

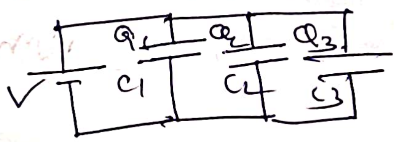
25). Resultant capacitance - parallel.

~~charge Q - Same~~ Charge Q - not same.

Voltage same

$Q = Q_1 + Q_2 + Q_3$

$\boxed{C_P = C_1 + C_2 + C_3}$,

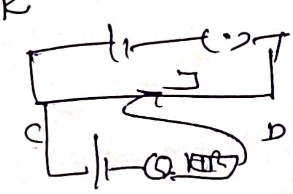


26). Principle of Potentiometer.

uses: Accurate determination V, I, R

Explanation (Construction (Working

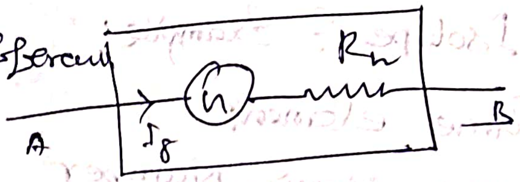
$\varepsilon$ = Emf



27. Conversion of Galvanometer → Voltmeter.

measurement : potential difference

Conversion → Connecting $R_H$ in Series with galvanometer.




Voltmeter

$$I = I_g = \frac{\text{potential difference}}{\text{total Resistance}}$$

$$R_V = R_g + R_H.$$

$$I_g = \frac{V}{R_g + R_h}$$

$$R_h = \frac{V}{I_g} - R_g$$

$$I_g \propto V$$

28. Transformer - Various energy losses:-

1. Core loss (or) Iron loss :- Eddy Current loss (or) Iron loss.

magnetized and demagnetized repeatedly.

(Heat) Energy lost → Hysteresis takes place

minimized - steel or iron → core

Eddy current loss → minimized by thin lamination core.

2. Copper loss

I → Energy dissipated (Joule heating)

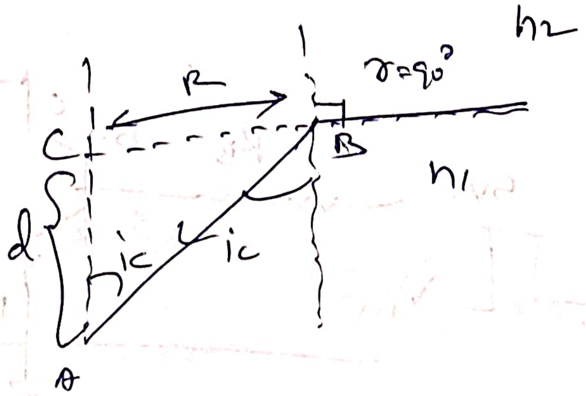
minimized by large diameter wire.

3. Flux leakage:

magn lines → Primary coil not completely linked second coil

(Flux leakage) minimized by winding coil over the other

## 29) Snell's window:




$n_1 \sin i_c = n_2 \sin 90°$

$\sin i_c = \frac{n_2}{n_1}$

$\sin i_c = \frac{R}{\sqrt{d^2+R^2}}$

$\frac{R}{\sqrt{d^2+R^2}} = \frac{n_2}{n_1}$

Squaring on both sides

$\frac{R^2}{R^2+d^2} = \frac{n_2^2}{n_1^2}$

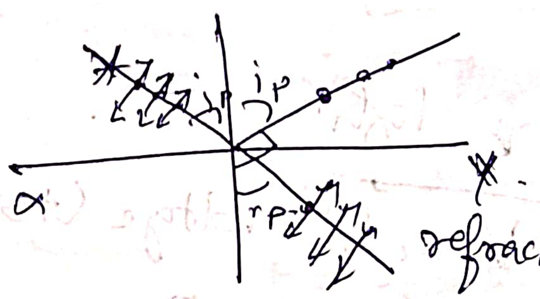
$\frac{d^2}{R^2} = \frac{n_1^2}{n_2^2} - 1$

$$R = d\sqrt{\frac{n_2^2}{(n_1^2 - n_2^2)}}$$

If $n_2 = 1$, $n_1 = n$

$$R = \frac{d}{\sqrt{n^2-1}}$$

## 30) Brewster's law:



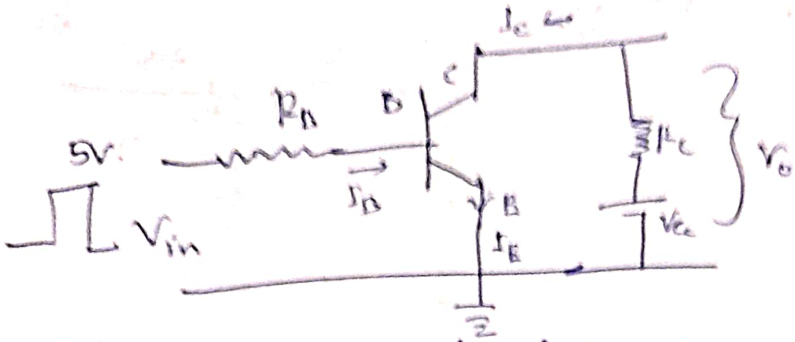

$r_p = 90° - i_p$

$\frac{\sin i_p}{\sin r_p} = n$

$\frac{\sin i_p}{\cos i_p} = n$

$$\tan i_p = n$$

32) Transistor as a switch:




Saturation region → closed switch
Cut off region → open switch.

Input is low

$I_B = 0$

Transistor → Not Forward Biased

Cut off region.

$I_c = 0$

Voltage drop across $R_c = 0$

$V_o$ = high ($V_{cc}$)

"No current flows through transistor" (Switched off)

(open switch)

Input is high.

$V_i$ = high voltage (+5V).

$I_B \uparrow$ $I_c \uparrow$

Transistor → Saturation region

$I_c \uparrow$ $R_c$ ($V_o \approx 0$) $V_o = V_{cc} - I_c R_c$

max current flows through transistor (Switched on)

(Closed Switch)

Transistor can be used as Inverter (NOT gate)

31) De Broglie wavelength of electron:

$\frac{1}{2}mv^2 = eV$

$v = \sqrt{\frac{2eV}{m}}$

$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2emV}} = \frac{6.626\times10^{-34}}{\sqrt{2\times1.6\times10^{-19}\times9.11\times10^{-31}V}}$

$= \frac{12.27\times10^{-10}}{\sqrt{V}}$ m

$\lambda = \frac{12.27}{\sqrt{V}}$ Å

$\lambda = \frac{h}{\sqrt{2mK}}$ $\because K = eV$

32). Time required for 60% of sample of radon undergo decay.. Given $T_{1/2}$ of radon = 3.8 days

$N_0 = 100\%$. $N = 100 - 60 = 40\%$. $T_{1/2} = 3.8$ days

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

$40 = 100 e^{-\lambda t}$

$\frac{40}{10} = e^{-\lambda t}$ (or) $e^{\lambda t} = 2.5$

$\lambda t = \log_e 2.5$

$\lambda t = 2.303 \times \log_{10} 2.5$

$t = \frac{1}{\lambda} \times 2.303 \times 0.3979$

$t = \frac{T_{1/2}}{0.6931} \times 2.303 \times 0.3979$

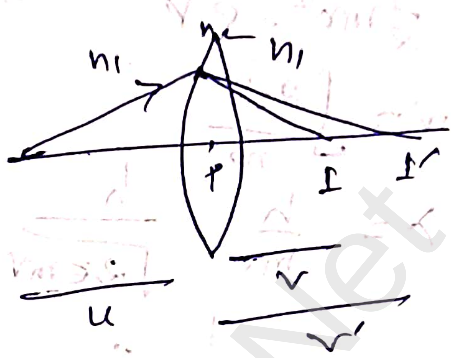
$t = \frac{3.8}{0.6931} \times 2.303 \times 0.3979$

$t = 5.025$ days

# PART-IV

34' (a). Lens makers formula, significance.

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




$$\frac{n_2}{v'} - \frac{n_1}{u} = \frac{(n_2-n_1)}{R_1} \rightarrow (1)$$

$$\frac{n_1}{v} - \frac{n_2}{v'} = \frac{(n_1-n_2)}{R_2} \rightarrow (2)$$

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

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

$u = \infty, v = f$

$$\frac{1}{f} = \left[\frac{n_2}{n_1} - 1\right]\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$n_1 = 1 \quad n_2 = n$

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

Significance: Curvature – particular n for desire focal length

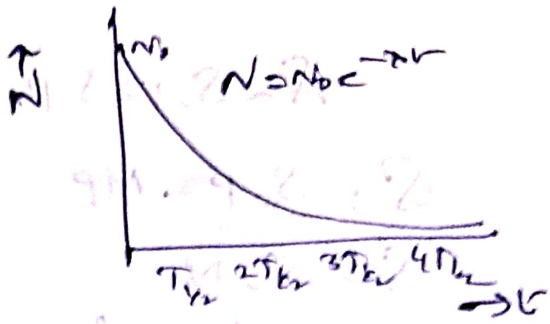
$$\boxed{\frac{1}{v} - \frac{1}{u} = \frac{1}{f}}$$

34(b). Law of radioactivity:

$$\frac{dN}{dt} \propto N$$

$$\frac{dN}{dt} = -\lambda N \rightarrow (1)$$

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




Integrating

$$[\ln N]_{N_0}^{N} = -\lambda [t]_0^t$$

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

Activity

$$R = \left|\frac{dN}{dt}\right|$$

$$\boxed{R = R_0 e^{-\lambda t}}$$

$$\boxed{R = \lambda N}$$

1 Bq = one decay/second

1 Ci = $3.7 \times 10^{10}$ Bq

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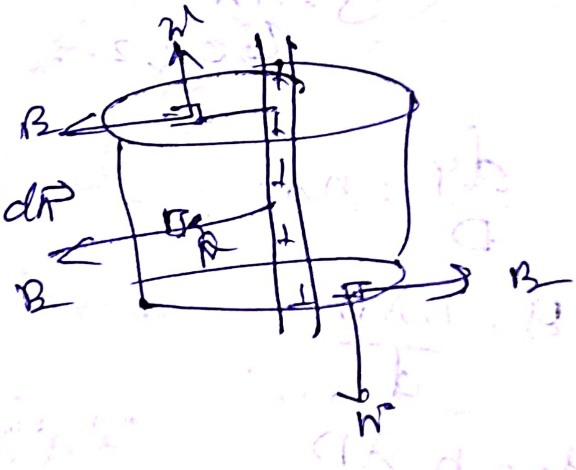
35). Gauss law → ∞ long charged wire

(a)

$$\phi_E = \oint \vec{E} \cdot d\vec{A}$$




$$\phi_E = \int \vec{E} \cdot d\vec{A} + \int \vec{E} \cdot d\vec{A} + \int \vec{E} \cdot d\vec{A}$$

Curved Top Bottom

$E\,dA$ 0 0

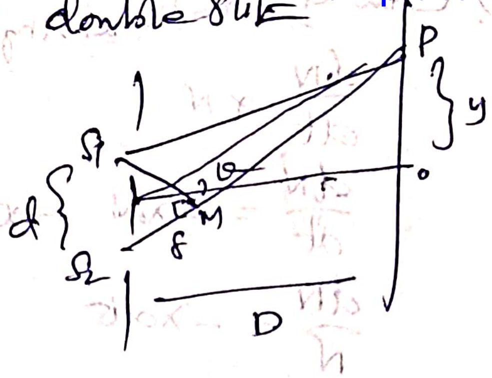
$$\phi_E = \int E\,dA = \frac{Q_{en}}{\varepsilon_0} = \frac{\lambda L}{\varepsilon_0}$$

↳ $2\pi r l$

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

→ vector $\vec{E} = \frac{\lambda}{2\pi r \varepsilon_0} \hat{r}$

35(b) Bandwidth – Young's double slit




$\delta = S_2P - S_1P$

$\delta = S_2P - MP$

$\delta = S_2M$

↳ $d\sin\theta$

$\boxed{\delta = d\sin\theta}$

↳ $\tan\theta = \frac{y}{D}$

Path difference $\delta = \frac{dy}{D}$

**Bright fringe condition**

$\delta = n\lambda$

↳ 0, 1, 2 . . .

$\frac{dy}{D} = n\lambda$

$y = \frac{n\lambda D}{d}$

$y_n = \frac{n\lambda D}{d}$

**Dark fringe condition**

$\delta = (2n-1)\frac{\lambda}{2}$

↳ 1, 2, 3 . . .

$\frac{dy}{D} = (2n-1)\frac{\lambda}{2}$

$y = \frac{(2n-1)\lambda D}{2d}$

$y_n = \frac{(2n-1)\lambda D}{2d}$

**Equation for Bandwidth**

↳ Distance b/w any two consecutive bright (or) dark fringes.

$\beta = y_{n+1} - y_n$ (for bright)

$\boxed{\beta = \frac{D\lambda}{d}}$

$\beta = y_{n+1} - y_n$ (for dark)

$\boxed{\beta = \frac{D\lambda}{d}}$

36) (a). RLC


$v = V_m \sin\omega t$

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

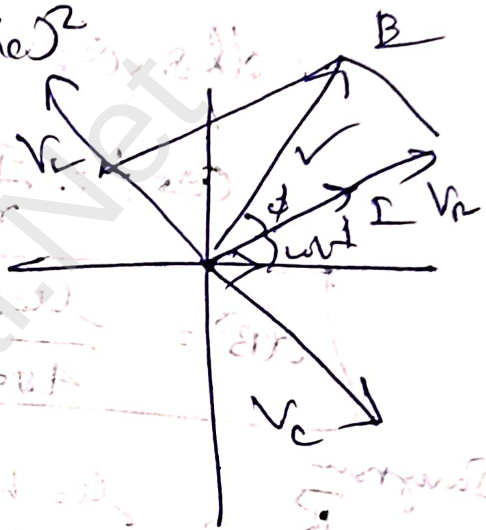
$V_m = \sqrt{(I_m R)^2 + (I_m X_L - I_m X_C)^2}$

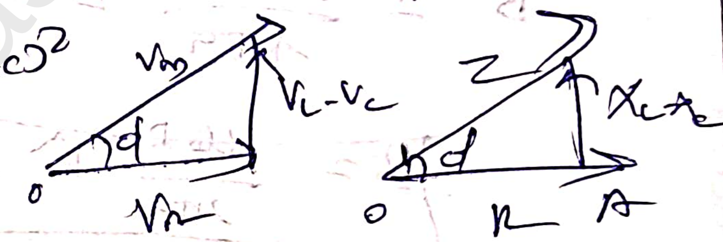
$= I_m \sqrt{R^2 + (X_L - X_C)^2}$

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

$I_m = \dfrac{V_m}{Z}$

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

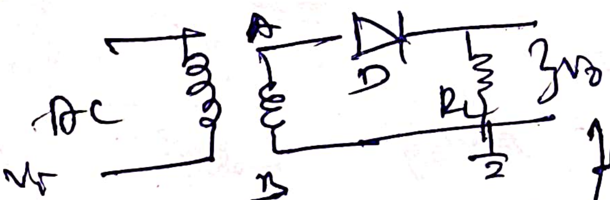


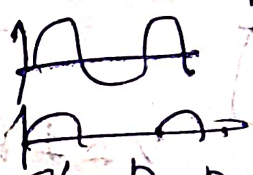




$\tan\phi = \dfrac{V_L - V_C}{V_R} = \dfrac{X_L - X_C}{R}$

36(b). Rectification, Half wave Rectifier.

AV conv AC → DV conv DC



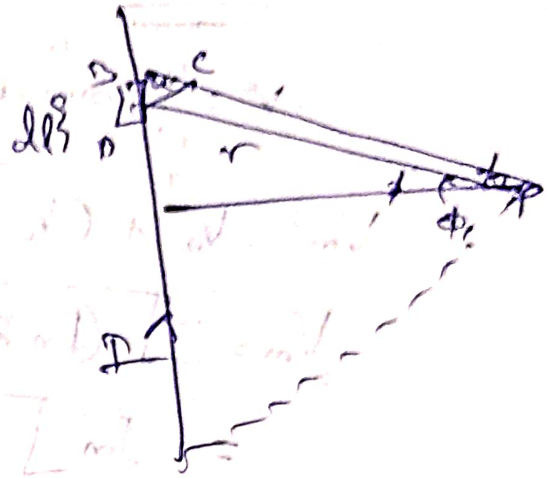



A + | A −
B − | B +
D → FB | B → RB
$V_o$ ✓ | $V_o$ ✗

Efficiency $\eta = \dfrac{\text{O/P DC power}}{\text{I/P AC power}} = 40.6\%$

37 (a) Magnetic field → long straight conductor

$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I\,dl \sin\theta}{r^2} \hat{n}$



$AC = dl \sin\theta$

$AC = r\,d\phi$

$dl \sin\theta = r\,d\phi$

$\cos\phi = \frac{a}{r}$ $r = \frac{a}{\cos\phi}$

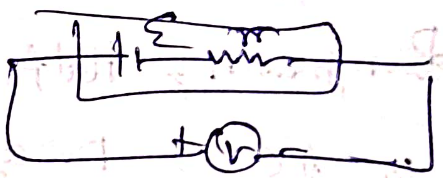
$$d\vec{B} = \frac{\mu_0 I}{4\pi a} \cos\phi \, d\phi \, \hat{n}$$

Integration

$\vec{B} = \frac{\mu_0 I}{4\pi a} [\sin\phi]_{-\phi_1}^{\phi_2} \hat{n}$

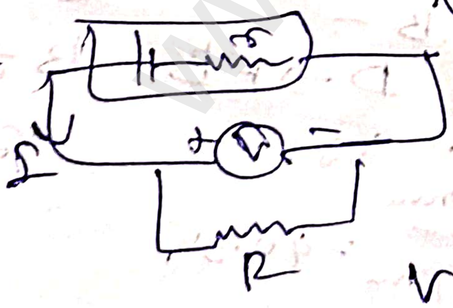
$$\vec{B} = \frac{\mu_0 I}{2\pi a} \hat{n}$$

38) (b), (i) Internal Resistance – Voltmeter



* Open Circuit
very little current → deflection
$V \to \varepsilon$

*



$V = IR \longrightarrow (1)$

$V = \varepsilon - Ir$

$Ir = \varepsilon - V \longrightarrow (2)$

$r = \left[\frac{\varepsilon - V}{V}\right] R$

Power $P = I^2 R + I^2 r$

38(a) Problem

(ii). Given $I = 3.93 A$

$\varepsilon = 12 V$

$R = 3 \Omega$

$V = IR = 3.93 \times 3 = 11.79 V$

$r = \left[\frac{\varepsilon - V}{V}\right] R = \left[\frac{12 - 11.79}{11.79}\right] \times 3 = 0.05 \Omega$

38(b)

i. EM wave properties (5 points)

(ii). $\varepsilon_r = 2.25$ $\mu_r = 2.5$

$n = \sqrt{\varepsilon_r \mu_r} = \sqrt{2.25 \times 2.5} = 2.37$