MODEL EXAMINATION MARCH - 2021

PHYSICS

1) de Broglie wave

2) Geographic meridian

3) (a) bends towards the normal

4) Angular momentum.

(5) (c) Microwave & visible

(6) λ decreases (Note: no change in frequency)

(7) $q = Ne \Rightarrow N = \frac{q}{e} = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$

(8) Lyman

9) a) work done to bring unit +ve charge from infinity to a point.

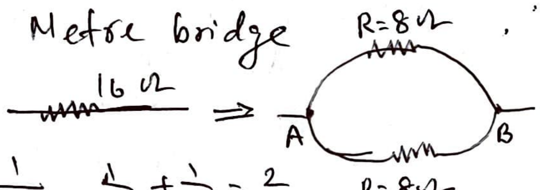
$V = W/q$

b) $E = -\frac{\Delta V}{\Delta x}$ (Intensity is -ve gradient of potential)

10) a) $V \propto l$ or $E \propto l$.

b) Metre bridge

11)



$\frac{1}{R_{AB}} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R}$

$R_{AB} = \frac{R}{2} = \frac{8}{2} = 4\Omega$

(12) a) false

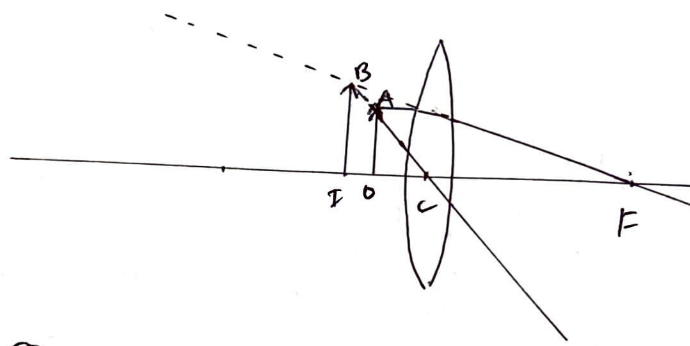
b) $F = qvB\sin\theta$ OR $\vec{F} = q(\vec{v} \times \vec{B})$

(13) a) It is the measure of extent of magnetisation

b) $B = \mu_0 H$

14) statement

15)



(16) (i) Angular momentum $L = \frac{nh}{2\pi}$

(ii) $h\nu = E_2 - E_1$

OR

Any two complete postulate

17) a) $\frac{dN}{dt} \propto N$ OR $\frac{dN}{dt} = -\lambda N$

b) No. of protons $= Z = 92$

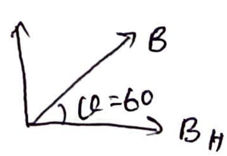
No. of neutrons, $= A - Z$

$= 238 - 92$

$= 146$

18) $B_H = 0.26G$

$\theta = 60°$



$B_H = B\cos\theta$

$B = \frac{B_H}{B\cos 60} = \frac{0.26G}{0.5} = 0.52G$

$= 0.52 \times 10^{-4} T$

19) a) Mutual induction

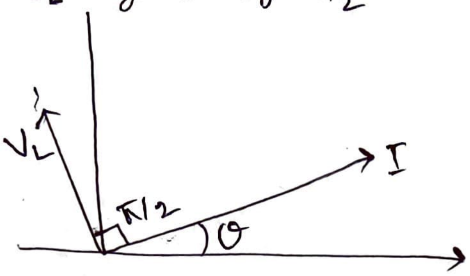
b) Copper loss

eddy current loss

flux leakage loss

Heat loss

20) a) V_L lags I by $\pi/2$



b) $\pi/2$

21) (i) Fusion is the process of combining smaller nuclei.

Fission – splitting of heavy nucleus into lighter nuclei

(ii) Fusion is controlled reaction

Fission is generally an uncontrolled reaction.

22) a) It is the energy gap between Valance band and Conduction band,

b) Voltage regulation

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23) a) statement or $\Phi_E = \frac{q}{\epsilon_0}$

b) $\Phi = \vec{E} \cdot \vec{\Delta S}$

$= E \Delta S \cos 45$

$= \frac{E \Delta S}{\sqrt{2}}$

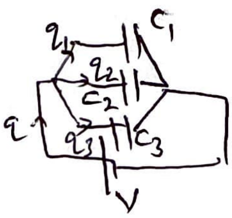
c) If the surface is parallel to the lines, $\theta = 90°$

$\Phi_E = 0$

24) For parallel combination, V is same, but charge q is divided among the capacitors

$q = q_1 + q_2 + q_3$

$CV = C_1V + C_2V + C_3V$



$C = C_1 + C_2 + C_3$

25) $l = 0.5$ m

$r = 1$ cm

$N = 500$

$I = 5$ A

$B = \mu_0 n I$

$= \mu_0 \frac{NI}{l}$

$= \frac{4\pi \times 10^{-7} \times 500 \times 5}{0.5}$

$= 6.28 \times 10^{-3}$ T

26) a) dip angle

b) i) Inclination – Angle between magnetic and geographic maredian

(ii) dip

(iii) Horizontal intensity – It is the component of earth's magnetic field in the horizontal direction

27) a) electromagnetic induction

b) If N is the number of turns of the coil,

Total magnetic flux $(\omega = \theta/t)$

$\Phi_B = N \vec{B} \cdot \vec{A}$

$= NBA \cos\theta$

$= NBA \cos\omega t$

Induced emf,

$E = -\frac{d\Phi}{dt}$

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

$= -NBA\omega \times -\sin\omega t$

$= NBA\omega \sin\omega t$

$E_t = E_0 \sin\omega t$

28) (a) (i) Velocity equal to velocity of light

(ii) Medium not required for propagation

(b) Radio communication
TV transmission
mobile phone communication

29) Tangent of angle of polarisation is equal to refractive index of the medium.

$\tan\theta_p = \mu$

$\tan\theta_p = 1.60$

$\theta_p = \tan^{-1}(1.60)$

$= 58^\circ$

30) $\lambda = 6800\times10^{-10}$ m.

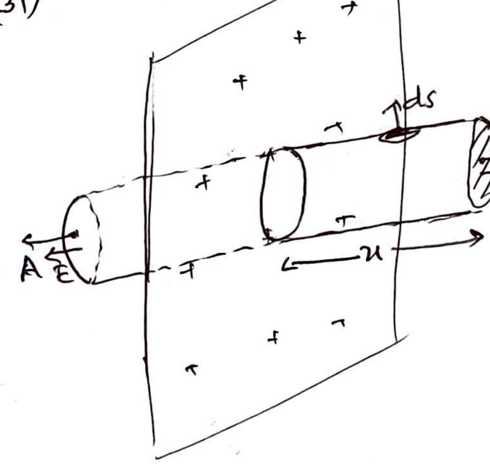
$\phi_0 = h\nu_0$

$= \frac{hc}{\lambda_0}$

$= \frac{6.63\times10^{-34}\times3\times10^{8}}{6800\times10^{-10}}$

$= 2.925\times10^{-19}$ J $= 1.89$ eV

(31)



Consider an infinite sheet of surface charge density $\sigma = \frac{q}{A}$.

~~Electric flux~~ The gaussian surface is a cylinder of length $2x$ and base area A

The curved surface does not contribute of flux as $E \perp r\ ds$

For the two end flat surface,

$\phi_1 = \phi_2 = \vec{E}\cdot\vec{A}$

$= EA$

Total flux $\phi = \phi_1 + \phi_2$

$= 2EA$

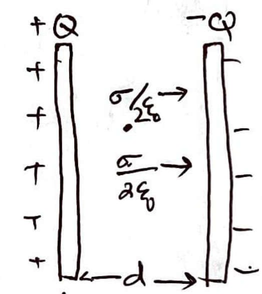
According to Gauss law

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

$2EA = \frac{\sigma A}{\varepsilon_0}$

$E = \frac{\sigma}{2\varepsilon_0}$

32)



Surface charge density $\sigma = Q/A$

charge $Q = \sigma A$ —(1)

Electric field between plates,

$E = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$

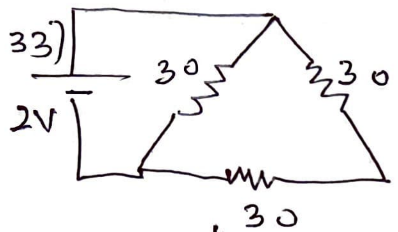
potential difference, $V = Ed$

$= \frac{\sigma}{\varepsilon_0} d$ —(2)

Capacitance, $C = \frac{Q}{V} = \frac{\sigma A}{\frac{\sigma d}{\varepsilon_0}}$

$C = \frac{\varepsilon_0 A}{d}$

33)



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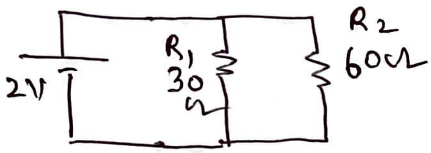

$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{30 \times 60}{30 + 60} = 20\,\Omega$$

$$I = \frac{V}{R} = \frac{2}{20} = 0.1\,A$$

34) a) $\int \vec{B} \cdot \vec{dl} = \mu_0 I_{enclosed}$ or statement

b) Derivation of $B = \mu_0 n I$

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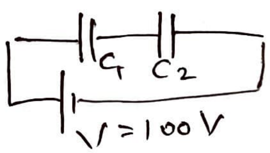
35) a) Farad (F)

b) $C_1 = 2\mu F = 2 \times 10^{-6} F$

$C_2 = 4\mu F = 4 \times 10^{-6} F$



~~$Q = C_1 V$~~ = $V = V_1 + V_2$

$V_1 = \frac{Q}{C_1}$; $V_2 = \frac{Q}{C_2}$

$$C = \frac{C_1 C_2}{C_1 + C_2} = \left(\frac{4 \times 2}{6}\right) \times 10^{-6} F$$

$$= \frac{8}{6} \times 10^{-6} F$$

$$Q = CV$$

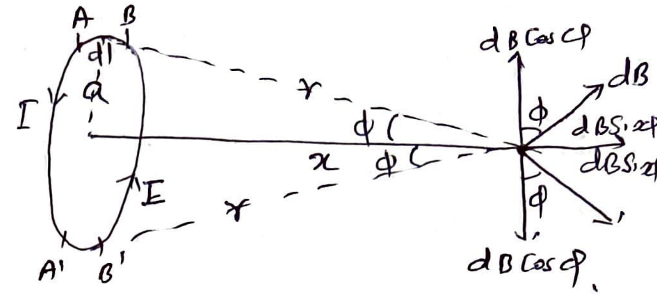
$$= \frac{8}{6} \times 10^{-6} \times 100$$

$$= \frac{8}{6} \times 10^{-4} C$$

$$V_1 = \frac{\frac{8}{6} \times 10^{-4}}{2 \times 10^{-6}} = 66.67 V$$

$$V_2 = V - V_2 = 33.33 V$$

36)



Magnetic field due to AB of length dl,

$$dB = \frac{\mu_0}{4\pi} \frac{I\,dl}{r^2} \quad -(1) \quad \left|\ \sin\theta = \sin 90 = 1\right.$$

Magnetic field components due to AB and A'B' are $dB \sin\phi$ and $dB \cos\phi$, two each. The vertical components $dB\cos\phi$'s cancel out, and horizontal components $dB \sin\phi$ adds up.

Total magnetic field,

$\therefore B = \int dB \sin\phi$ $\qquad \sin\phi = \frac{a}{r}$

$$= \int \frac{\mu_0}{4\pi} \frac{I\,dl}{r^2} \frac{a}{r} \qquad r^3 = (x^2 + a^2)^{3/2}$$

$$= \frac{\mu_0}{4\pi} \frac{Ia}{(x^2 + a^2)^{3/2}} \times \int dl$$

$$= \frac{\mu_0}{4\pi} \frac{Ia}{(x^2 + a^2)^{3/2}} \times 2\pi a$$

$$= \frac{\mu_0 I \times 2\pi a^2}{4\pi (x^2 + a^2)^{3/2}} \qquad \pi a^2 = A, \text{area}$$

$$\boxed{B = \frac{\mu_0}{4\pi} \frac{2IA}{(x^2 + a^2)^{3/2}}}$$

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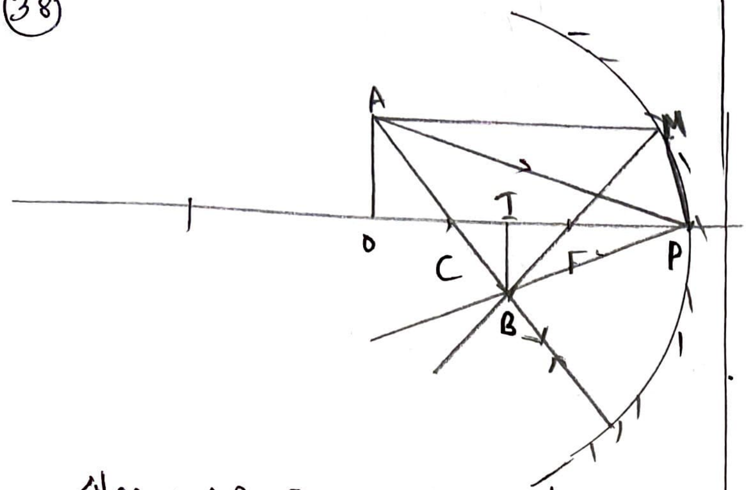
37) a) It is the ~~magnetic field~~ induced emf produced in a conductor when it is moving in a magnetic field.

b) Derivation of $e = Blv$

(38)



Δles OAP & IBP are similar

$$\frac{IB}{OA} = \frac{IP}{OP} = \frac{v}{u} \quad \text{— (1)}$$

Δles PMF and IBF are similar

$$\frac{IB}{PM} = \frac{IF}{FP} = \frac{IP-FP}{FP} = \frac{v-f}{f}$$

But PM = OA

$$\therefore \frac{IB}{OA} = \frac{v-f}{f} \quad \text{— (2)}$$

(1) & (2) ⇒ $\frac{v-f}{f} = \frac{v}{u}$

~~uv = uv − vf~~

$uv - uf = vf$

÷ing by uvf

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

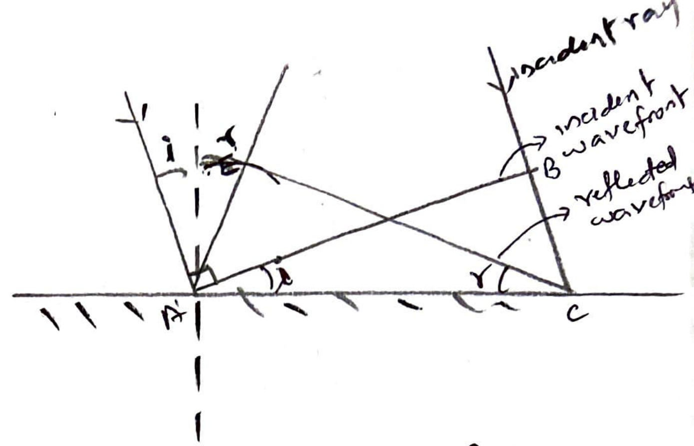
$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

Applying signs, u, v, and f −ve

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

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

(39) a) Statement.



Timetaken by the wave front to move from B to C is τ, then

BC = Velocity × time

= v × τ — (1)

~~Time~~ draw a ~~two~~ reflected wavefront of radius BC = vτ, and let CE be the tangent plane at C.

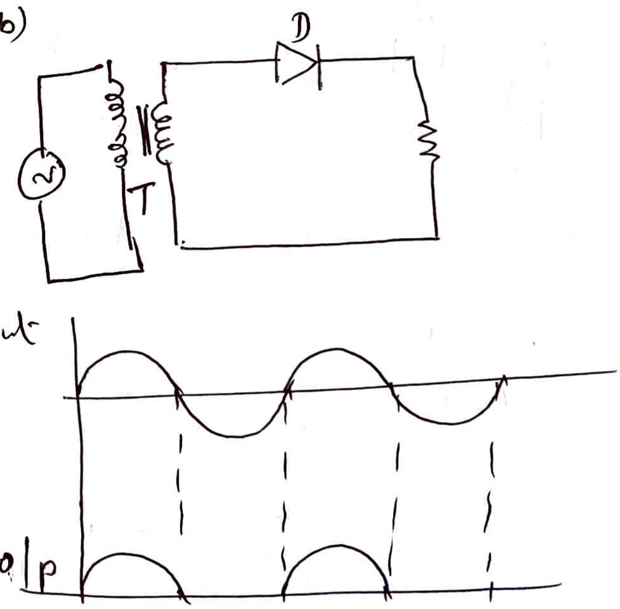
∴ AE = B = vτ.

Then Δles EAC and BAC are congruent

implies, $i = r$

40) a) It is used to convert AC into unidirectional current. (OR) AC to DC

b)



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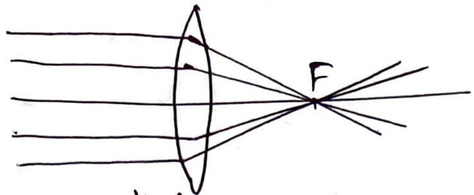
Explanation.

41) (a)



When parallel beam of light incident on a convex lens parallel to principal axis, they converges to a point on the principal axis ⇒ principal focus.

b) Refraction

c) $f_1 = +10cm$

$f_2 = -15cm.$

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$f = \frac{f_1 f_2}{f_1 + f_2} = \frac{10 \times -15}{10 + -15}$$

$$= \frac{-150}{-5}$$

$$= +30cm.$$

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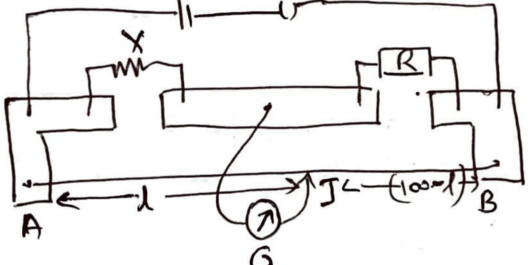
42) $p = q \times 2l$.

Derivation of $E_{axial} = \frac{1}{4\pi\varepsilon_0} \frac{2p}{r^3}$

43)



When the bridge is balanced at
AJ = l,

Wheatstone's principle

$\frac{R_1}{R_2} = \frac{R_3}{R_4}$ becomes

$$\frac{X}{R_{AJ}} = \frac{R}{R_{BJ}} \quad \text{---(1)}$$

$$R_{AJ} = \frac{\rho l}{A}$$

$$R_{BJ} = \frac{\rho(100-l)}{A}$$

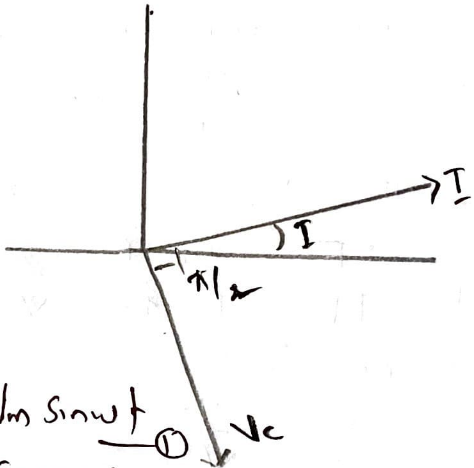
$$\frac{R_{AJ}}{R_{BJ}} = \frac{l}{100-l}$$

(1) ⇒ $X = \frac{R_{AJ}}{R_{BJ}} \times R$

$$X = \frac{l}{(100-l)} \times R$$

44) a) $I_{rms} = \frac{I_0}{\sqrt{2}} = 0.707 I_0$

b)



Let

$V = V_m \sin\omega t$ ---(1)

For Capacitor, $V = q/C$ ---(2)

$V_m \sin\omega t = q/C$

then

$$I = \frac{dq}{dt} = \frac{d}{dt}(V_m C \sin\omega t)$$

$$= V_m C\omega \times \cos\omega t$$

$$= \frac{V_m}{(1/C\omega)} \times \sin(\omega t + \pi/2)$$

$$I = I_m \sin(\omega t + \pi/2) \quad \text{---(3)}$$

(1) & (2) ⇒ I leads V by phase $\pi/2$

45) Derivation,

$$n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin(A/2)}$$

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