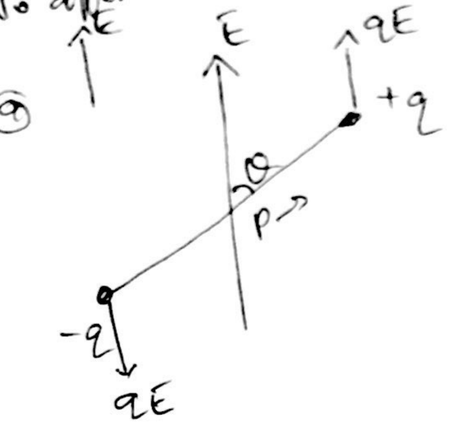
SECOND YEAR HSE - MARCH 2020
PHYSICS

1. (c) doubled $\left(C = \frac{\varepsilon_0 A}{d}\right)$
2. (c) straight line
3. $e = N\frac{dI}{dt} = 1 \times \frac{(5-4)}{10^{-3}s} = 1000V$
4. (a) denser to rarer
5. (b) TIR
6. No difference

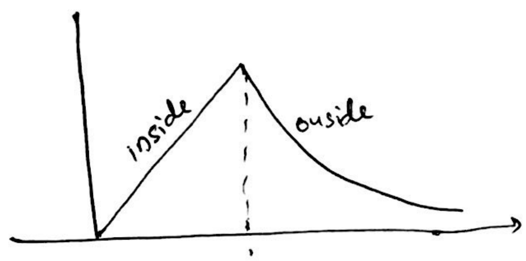
7. (a)



(b) $\vec{\tau} = \vec{p} \times \vec{E}$

8. (a) $\oint \vec{B}.\vec{dl} = \mu_0 \Sigma I$

(b)



9. The magnetic moment induced in the nail experiences a non-uniform magnetic field ~~with~~ which produces torque (rotational motion) as well as translational motion (Net force)

~~(10) E_{axial} = ...~~

10. $B_{axial} = \frac{\mu_0}{4\pi}\frac{2M}{r^3}$

$= 10^{-7} \times \frac{2 \times 0.4}{0.5^3}$

$= 6.4 \times 10^{-7}$ T

$B_{eq} = \frac{\mu_0}{4\pi}\frac{M}{r^3} = \frac{B_{axial}}{2}$

$= 3.2 \times 10^{-7}$ T

(11) (a) $n = 1.47$

(b) No, $n_{water} = \frac{4}{3} = 1.33$

12. ~~During day time~~ According to Rayleigh, Intensity of scatered light $I \propto \frac{1}{\lambda^4}$.

during day time, sun rays has to travel less distance through atmosphere and lower wave-lengths like violet, indigo, blue scatered more and have high intensity. The combination of these seems like blue.

13. (i) Nuclear fission - Nuclei with high atomic Number

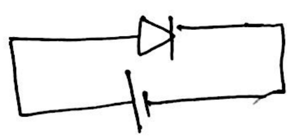
(ii) Nuclear fusion - Nuclei with low atomic No.

(iii) Transition ... - H-spectrum

(iv) e-emission from Nucleus - β decay

14. (a)

(b)



15. (a) A - ground wave

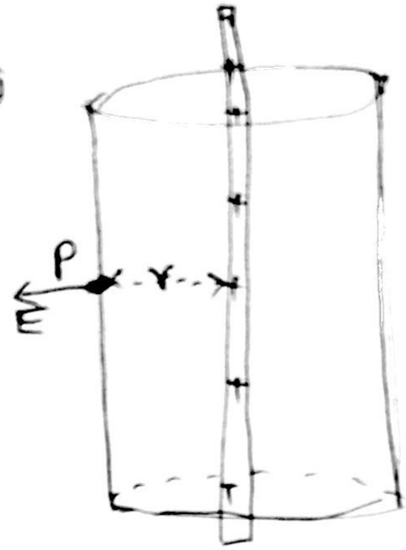
B - space wave

C - sky wave

(b) The frequencies below 40 MHz only is reflected by ionosphere. Fresuency of TV signals is above 54 MHz and they passes through ionosphere

(2)

(16) (a)



(b) Derivation of $E = \frac{1}{4\pi\varepsilon}\frac{2\lambda}{r}$

(17) (a) Fig 1 - Parallel
Fig 2 - series

(b) parallel

(c) Derivation, $\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

(18) (a) statement of laws

(b) $U_{mag} = \frac{1}{2}LI^2$

~~$U_{ele} = \frac{1}{2}CV^2$~~

$= \frac{1}{2}L\left(\frac{B}{\mu_0 n}\right)^2$

$= \frac{1}{2\mu_0^2 n^2}LB^2$

$U_{ele} = \frac{1}{2}CV^2$

$= \frac{1}{2}C \times (Ed)^2$

$= \frac{1}{2}Cd^2E^2$

or any relation btw U_{mag} and B and, U_{ele} and E

(19) (a) $E_x = E_0 \sin(\omega t - kz)$

$B_y = B_0 \sin(\omega t - kz)$

(b) (1) Radiowaves - Accelerated motion of charges in conducting wires.

uses - mobile communication
- radio and TV broadcasting

(2) Microwaves - produced by Special vacuum tubes

uses - Radar

(20) (a) U - OQ

V = OQ_1

(b) Derivation of $M = \frac{D}{4}$

(21) A) Lymann

B) Balmer

C) Paschen

(22) (a) $^{Z}_{A}D \xrightarrow{\beta^-} {}^{Z+1}_{A}D_1 \xrightarrow{\alpha} {}^{Z+1-2}_{A-4}D_2$

$A - 4 = 172$

$A = 176$

$Z+1-2 = Z-1 = 71$

$Z = 72$

(b) $\frac{dN}{dt} \propto N$ OR $\frac{dN}{dt} = -\lambda N$

(c) $T_{mean} = \frac{T_h}{0.693}$

23 (a) Definition of modulation

(b) (1) Impractical length of antenna

(2) Mixing up of signals from different transmitter

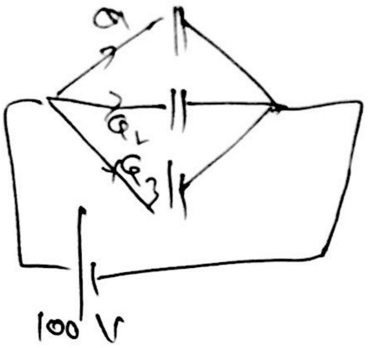
24 (a) Farad

(b) $C_1 = 2pF$

$C_2 = 3pF$

$C_3 = 4pF$

$C_p = C_1 + C_2 + C_3 = 9pF$



$Q_1 = C_1V = 2pF \times 100$
$= 2 \times 10^{-10} C$

$Q_2 = C_2V = 3pF \times 100$
$= 3 \times 10^{-10} C$

$Q_3 = C_3V = 4 \times 10^{-10} C$

25 (a) Derivation of $\tau = MB\sin\theta$

$\vec{\tau} = \vec{M} \times \vec{B}$

(b) $S_V = \frac{S_I}{R}$ and $S_I = \frac{NAB}{C}$

If we increase the value of S_I by increasing either N or A, ~~which~~ increases the length of the coil, in turn increase the value of R

So, $S_V = \frac{S_I}{R}$ will not change

26 (a) Definition of work function

26 (b) $\phi_0 = 2.14 eV$

$E_i = h\nu$

$= \frac{6.6 \times 10^{-34} \times 6 \times 10^{14}}{1.6 \times 10^{-19}} eV$

$= 2.475 eV$

$KE_{max} = E_i - \phi_0$

$= 2.475 - 2.14$

$= 0.335 eV$

$= 0.536 \times 10^{-19} J$

(c) $KE_{max} = eV_0$

$V_0 = \frac{KE_{max}}{e}$

$= $ ~~$\frac{0.536 \times 10^{-19}}{1.6}$~~

$= \frac{0.335 eV}{e}$

$= 0.335 V$

27 (a) Derivation, $\frac{R_1}{R_2} = \frac{R_3}{R_4}$

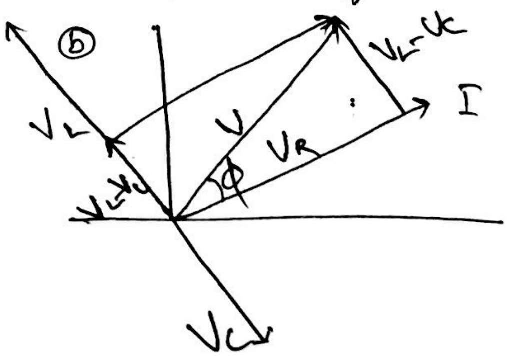
OR any correct relation.

(b) Metre bridge

28 (a) (1) Values of L and R

(2) phase difference

(b)



power factor = $\cos\phi$

$$= \frac{V_R}{V}$$

$$= \frac{V_R}{\sqrt{V_R^2+(V_L-V_C)^2}}$$

$$= \frac{R}{\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}$$

(c) $V_0 = 283V$

$f = 50$

$\omega = 2\pi f = 314$

$$Z = \sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}$$

$$= \sqrt{3^2+\left(25.48\times10^{-3}\times314-\frac{1}{796\times10^{-6}\times314}\right)^2}$$

$$= \sqrt{9+(8-4)^2}$$

$$= \sqrt{9+16}$$

$$= 5\Omega$$

(29) (a) Decreases

(b) $\omega = \frac{2\lambda \beta}{a}$

$\lambda_b < \lambda_y$, $W_y > W_b$.

width increases.

(c) $n\beta = 4\beta = 10^{-2}m$

$$\beta = \frac{10^{-2}}{4}$$

$D = 1.5m$

$d = 0.03cm$

$= 3\times10^{-4}m$

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

$$\lambda = \frac{\beta d}{D} = \frac{\frac{1}{4}\times10^{-2}\times3\times10^{-4}}{1.5}$$

$$= 0.5\times10^{-6}M$$

(d) It is the minimum distance of separation btw two objects, so that we can see them clearly and distinctly.

(30) (a) I - Cut off

II - Active

III - Saturation

(b) Region I

(c) $\beta = 100$

$V_0 = \Delta I_C R_C$

$$\Delta I_C = \frac{V_0}{R_C}$$

$$= \frac{2}{2\times10^3} = 10^{-3}A$$

$$\beta = \frac{\Delta I_C}{\Delta I_B}$$

$$\Delta I_B = \frac{\Delta I_C}{\beta} = \frac{10^{-3}}{100} = 10^{-5}A$$

(d) When a current flows through EB junction, a current also flows through collector. The I_C is larger as compared to I_B. The transistor connect in this way only for amplification purpose. (The Qn is not complete or clear).

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