Model Examination - HSE February 2019
PHYSICS

(1) (i) plane

(2) Net magnetic flux through any closed surface is zero, $\Sigma B \cdot \Delta S = 0$

(3) (ii) q_1 and q_2 are +ve

(4) (iii) $E_n = \frac{-13.6}{n^2}$ eV

(5) (i) and (iii)

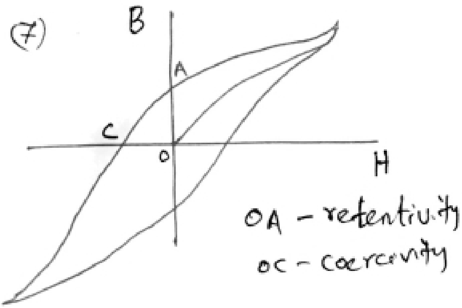
(6) (a) $F = qvB \sin\theta$ or $\vec{F} = q(\vec{v} \times \vec{B})$

(b) $B = \frac{F}{qv\sin\theta}$

$= \frac{N}{C \times \frac{m}{s}}$

$= NS/Cm$

(7)



OA - retentivity

OC - coercivity

(8) Anticlockwise.

when the loop is moving ⊥r to the magnetic field, mag. flux changes and induced current will flow accordingly to produce a field opposite to the present field.

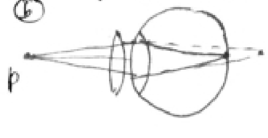
(9) (a) Eddy current

(b) (i) Induction furnace

(ii) Induction breaking

(10) (a) Long sight / farsightedness

(b)



(11) (a) $^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$

(b) $^{210}_{83}Bi \longrightarrow {}^{210}_{84}Po + \beta^-$

(12) (a) $C_s = \frac{C_1C_2}{C_1+C_2} = \frac{C \times 3C}{C+3C} = \frac{3}{4}C$ | $C_1 = C$, $C_2 = KC = 3C$

$q = CV$

$= \frac{3}{4}C \times 18$

$= \frac{27}{2}C$

$V_1 = \frac{q}{C_1} = \frac{27C}{2 \times C} = \frac{27}{2}V = 13.5V$

$V_2 = \frac{q}{C_2} = \frac{27C}{2 \times 3C} = \frac{9}{2}C = 4.5V$

(13) (a) $V = \frac{1}{\sqrt{\mu\varepsilon}}$

(b) (1) γ-ray — emitted by radio active nuclei

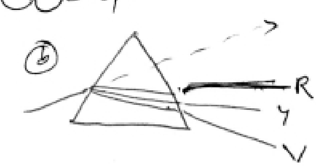
(2) Visible — λ from 700–400nm

(3) X-ray — Bombarding metal target by e's

(4) Microwave — Radar system

(14) (a) Dispersion

(b)



(c) Violet < Blue < Yellow

(15) (a) Lymann, Balmer, Paschen, Brackette, Pfund series (2)

(b) $E = h\nu$ — (1)

$E = 2.3\,eV$

$= 3.3 \times 1.6 \times 10^{-19}\,J$

$\nu = \frac{E}{h}$

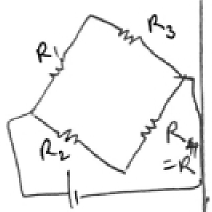
$= \frac{3.3 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}}$

$= 0.8 \times 10^{15}\,Hz$

(16) Statement / $\frac{dN}{dt} \propto N$ / $\frac{dN}{dt} = -\lambda N$

Derivation of $N_t = N_0 e^{-\lambda t}$

(17) (a) $\frac{R_1}{R_2} = \frac{R_3}{R_4}$



$\frac{20}{40} = \frac{40}{R}$

$R = 80\Omega$

(b) $R_{eff} = (R_1 + R_3) \| (R_3 + R)$

$R_{eff} = \frac{60 \times 120}{60 + 120} = 40\Omega$

$I = \frac{V}{R_{eff}} = \frac{20}{40} = 0.5A.$

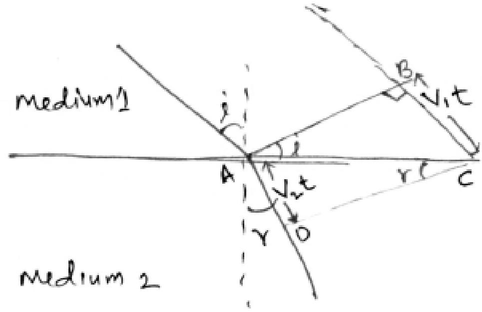
(18) (a) Nm^2/C OR Vm.

(b) Derivation of $E = \frac{1}{4\pi\epsilon_0} \times \frac{2\lambda}{r}$

(19) (a) Ampere circuital theorem.

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

(20)



$\sin i = \frac{BC}{AC} = \frac{V_1 t}{AC}$ — (1)

$\sin r = \frac{AD}{AC} = \frac{V_2 t}{AC}$

$\frac{\sin i}{\sin r} = \frac{V_1}{V_2}$ = Constant

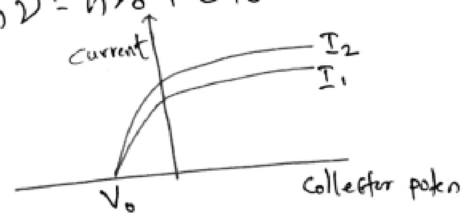
(21) ~~KEmax = φ0~~

(a) $h\nu = \phi_0 + KE_{max}$

OR $h\nu = h\nu_0 + KE_{max}$

OR $h\nu = h\nu_0 + eV_0$

(b)



(c) $\nu = 1.5\nu_0$

when frequency reduced to half

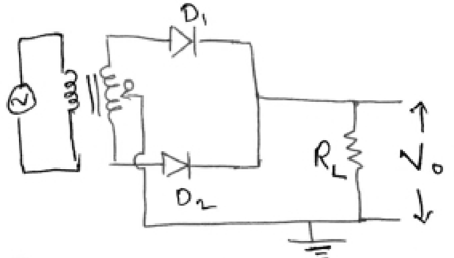
$\nu = 0.75\nu_0$ which means

$\nu < \nu_0$.

No photoelectric emission

$\therefore I' = 0$.

(22)



Explanation of FW rectifier

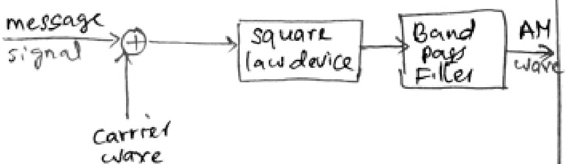
(23) ⓐ Amplitude of the carrier wave is varied in accordance with the instantaneous value of message signal.

ⓑ $\mu = \frac{A_m}{A_c}$

$= \frac{10}{20}$

$= 0.5$

(c)



(24) (a) Circuit diagram

$E \propto l$.

$\frac{E_1}{E_2} = \frac{l_1}{l_2}$

ⓑ Internal resistance

$r = \frac{R(l_1 - l_2)}{l_2}$

$= \frac{9.5\,(76.3 - 64.8)}{64.8}$

$= \frac{9.5 \times 11.5}{64.8} = 1.686\,\Omega$

(25) ⓐ Tuning of radio

ⓑ Since the circuit is in resonance,

$Z = R$

$X_L = X_C$

$\therefore I = \frac{V}{Z} = \frac{110}{48} = 2.29\text{ A}$

$f_r = \frac{1}{2\pi\sqrt{LC}}$

$= \frac{1}{2 \times 3.14\sqrt{0.38 \times 27 \times 10^{-6}}}$

$= 49.7\text{ Hz}$

(c) capacity changes (increases)

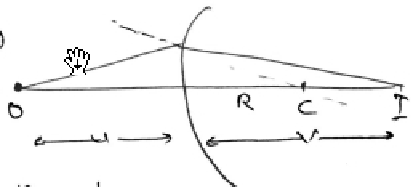
$X_L \neq X_C$

$Z > R$

current decreases.

(26) ⓐ Derivation of $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$

ⓑ



$n_1 = 1$

$n_2 = 1.5$

$v = +100$ cm

$R = +20$ cm

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

$\frac{1.5}{100} - \frac{1}{u} = \frac{0.5}{20}$

$\frac{1}{u} = \frac{1.5}{100} - \frac{5}{200} \Rightarrow u = -100\text{ cm}$