Model Examination - Feb. 2018

XII

PHYSICS

1) $E = \frac{\sigma}{\varepsilon_0}$

(2) Ωm.

(3) (d) All the above

(4) $E = h\nu = hc/\lambda$

$p = \frac{h}{\lambda} = \frac{h\nu}{c}$

(5) $\mu_r < 1$ or $\mu_r = 0$

(6) $E_0 = 15 V/m$

$B_0 = E_0/c = \frac{15}{3\times10^8} = 5\times10^{-8} T$

(7) (b) diverging

(8) (a) If E is not normal, there is a component along the tangent to the surface. Then free charge on the surface experience force and will move. But E should have no tangential component in static situation.

OR

V is constant on the surface, therefore E should be normal

(b) $E = 0$, $V = 10 V$

(9) $G = 12\Omega$, $I_g = 2.5\times10^{-3} A$

$I = 7.5 A$

shunt, $S = \frac{I_g G}{I - I_g} = \frac{2.5\times10^{-3}\times12}{(7.5 - 0.0025)}$

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

(10) (a) A

(b) C

(11) $V_0 = I_0\sqrt{R^2+\left(\frac{1}{C\omega}\right)^2}$

$I_0 = \frac{V_0}{\sqrt{R^2+\left(\frac{1}{C\omega}\right)^2}}$

(a) ε_r introduced, $C\uparrow$ $\frac{1}{C\omega}\downarrow \Rightarrow I_0\uparrow$

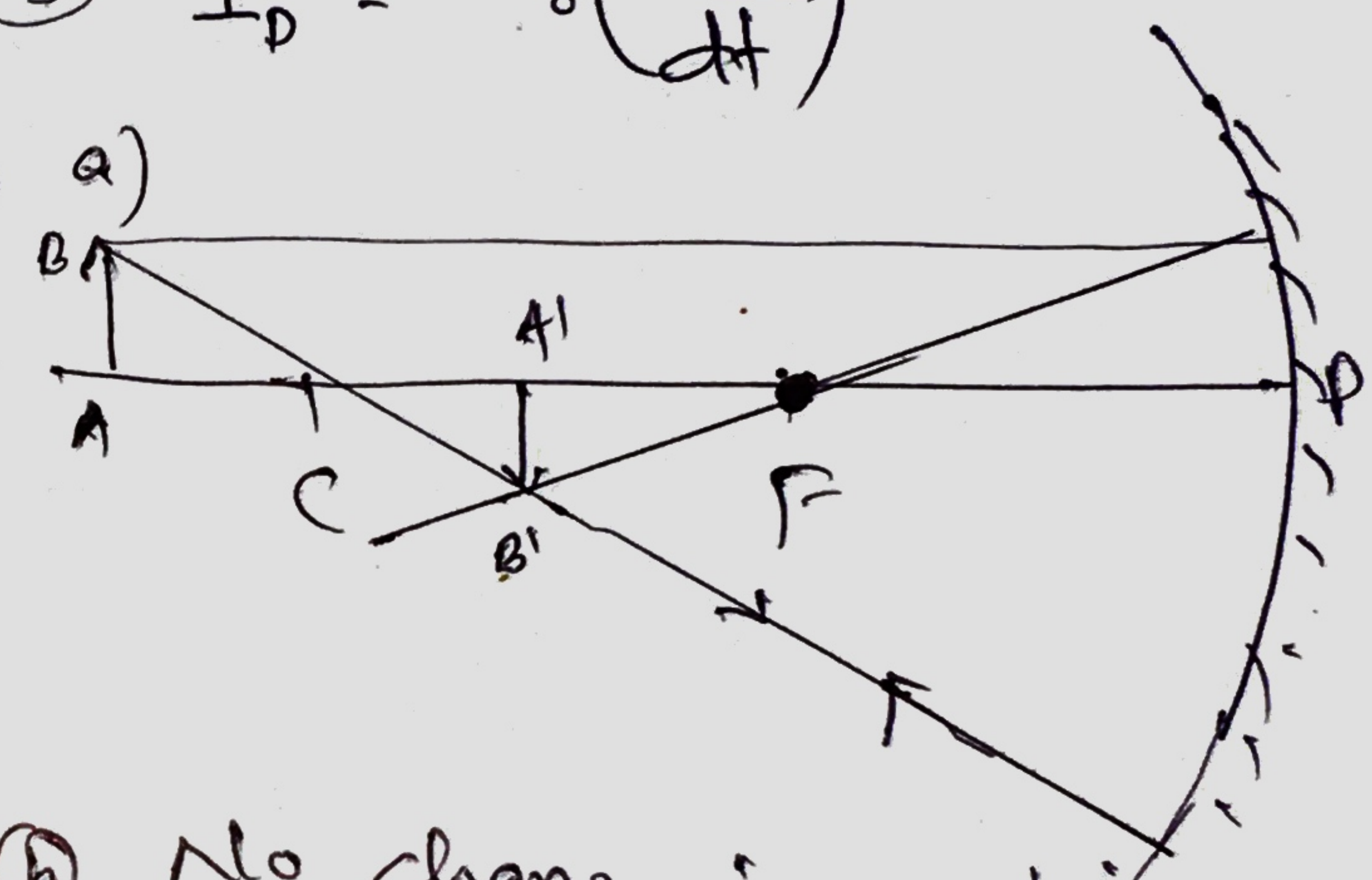
$\Rightarrow$ brightness $\uparrow$

(b) $R\uparrow$, $I_0\downarrow$ brightness $\downarrow$

(12) (a) Displacement current is current due to time varying electric field.

(b) $I_D = \varepsilon_0\left(\frac{d\phi_E}{dt}\right)$

(13) a)



(b) No change in position

Intensity halved/reduced

(14) D_2 RB does not conduct

D_1 FB conduct

$R = 3 + 2.5 = 5.5$

$V = 10V$

$I = \frac{V}{R} = \frac{10}{5.5} = 1.82 A$

(15) (a) (i) Convert energy from one form to another

(ii) Convert message signal to modulated signal for transmission

(b) X → modulator

Y → power Amplifier

(16) (a) $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

$= \frac{1}{2} + \frac{1}{3} + \frac{1}{4}$

$= \frac{6+4+3}{12}$

$= \frac{13}{12}$

$\therefore C_s = \frac{12}{13} \mu F = 0.92 \mu F$

(b) $U = \frac{1}{2} C V^2$

$C = \frac{\varepsilon_0 A}{d} = \frac{8.85 \times 10^{-12} \times 20 \times 10^{-4}}{2.5 \times 10^{-3}}$

$U = \frac{1}{2} \times \frac{8.85 \times 10^{-12} \times 20 \times 10^{-4}}{2.5 \times 10^{-3}} \times (400)^2$

$= 56.64 \times 10^{-8}$ J

(17) $E \propto l$

Case 1 → $E = E_1 + E_2 \propto l_1$

Case 2 → $E' = E_2 - E_1 \propto l_2$

(a) $\frac{E_1 + E_2}{E_2 - E_1} = \frac{l_1}{l_2} = \frac{400}{240} = \frac{5}{3}$

$3E_1 + 3E_2 = 5E_2 - 5E_1$

$8E_1 = 2E_2$

$\frac{E_1}{E_2} = 2/8 = 1/4$

(b) we have $\frac{E_1}{E_2} = \frac{1}{4}$

$E_2 = 4E_1$

Case 1 → $5E_1 \propto l_1$

Case 2 $3E_1 \propto l_2$

$E_1 \propto \frac{l_2}{3}$

$\propto \frac{240}{3}$

$\propto 80$ cm

for E_1 only, $l = 80$ cm

(18) (a) Derivation $e = Blv$

(b) $I = \frac{e}{R} = \frac{Blv}{R}$ clockwise / Q to P

(19) (a) $V_L = V_C$ / $X_L = X_C$ / $L\omega = \frac{1}{C\omega}$

(b) I_0 is maximum at resonance

$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2 \times 3.14 \sqrt{0.1 \times 10^{-5}}}$

$= 159.2$ Hz

(20) Derivation of Lens makers formula

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

(21) (a) $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mqV}}$

(b) $\lambda = \frac{h}{\sqrt{2mE_K}}$

$\lambda \propto \frac{1}{\sqrt{m}}$

Since ~~$m_p > m_e$~~ $m_e < m_p$

$\lambda_e > \lambda_p$

(22) $BE = E_b = \Delta m c^2$

$= (Z M_p + (A-Z) M_n - M) c^2$

$= (20 \times 1.00783 + 20 \times 1.00867 - 39.962589) \times \frac{931}{c^2} \times c^2$ MeV

$= 0.367411 \times 931$ MeV

$= 342.06$ MeV

$\therefore$ BE/nucleon, $E_{bn} = \frac{E_b}{A}$

$= \frac{342.06 \text{ MeV}}{4}$

$= 8.55$ MeV

(23) (a) $\phi = \oint E \cdot ds = \frac{1}{\varepsilon_0} q$

(b) Derivation $E = \frac{\sigma}{2\varepsilon_0}$

ie, E independant of distance

24 (a) $I = neAV_d$ — (1)

$V_d = \frac{eE}{m}\tau$

$\therefore I = \frac{ne^2A\tau \times E}{m}$ — (2) $E = \frac{V}{l}$

$I = \frac{ne^2A\tau}{m}\frac{V}{l}$ — (3)

$V = \frac{ml}{ne^2A\tau} I$ — (3)

$V = \frac{ml}{ne^2\tau} J$ — (4)

(3) $\Rightarrow V = \frac{m}{ne^2\tau}\frac{l}{A} I$

$V = \rho \frac{l}{A} I$ — (5)

24 (b) $R_t = R_0(1+\alpha t)$

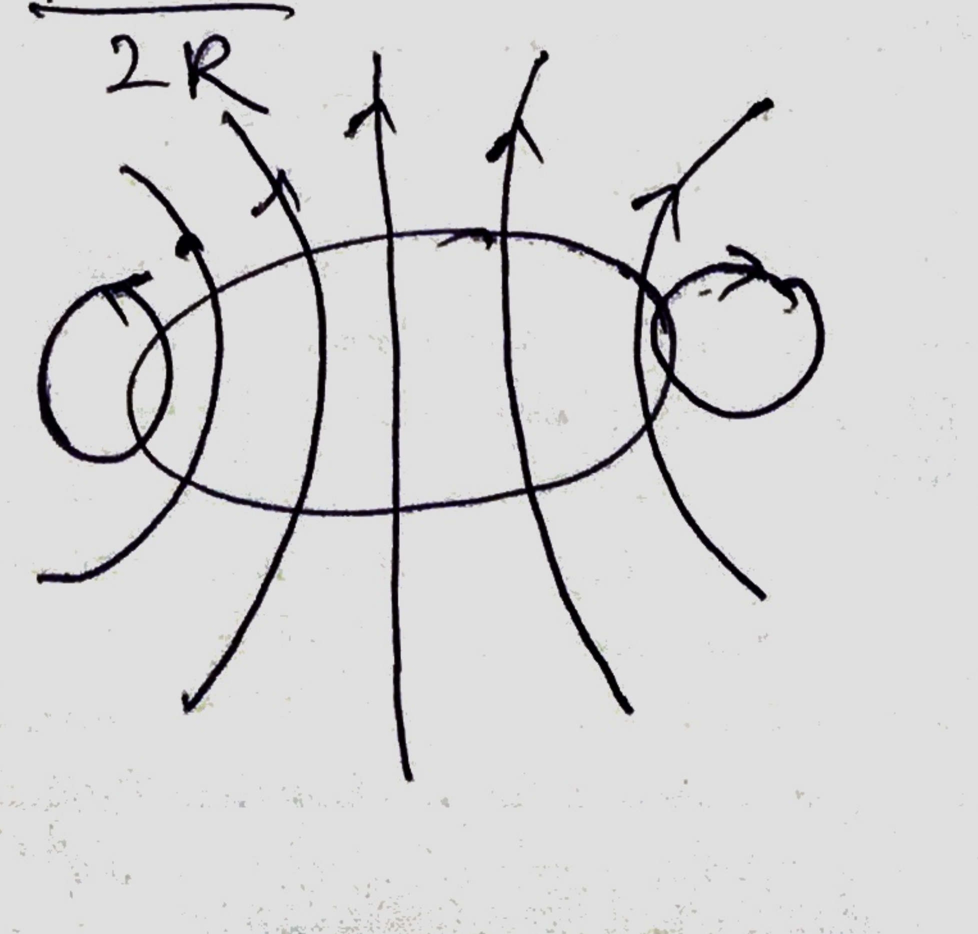
α is -ve for semiconductor. Resistance decreases with temperature.

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

(b) At centre $x = 0$

$B_0 = \frac{\mu_0 I}{2R}$

(c)



26 (a) Zener diode

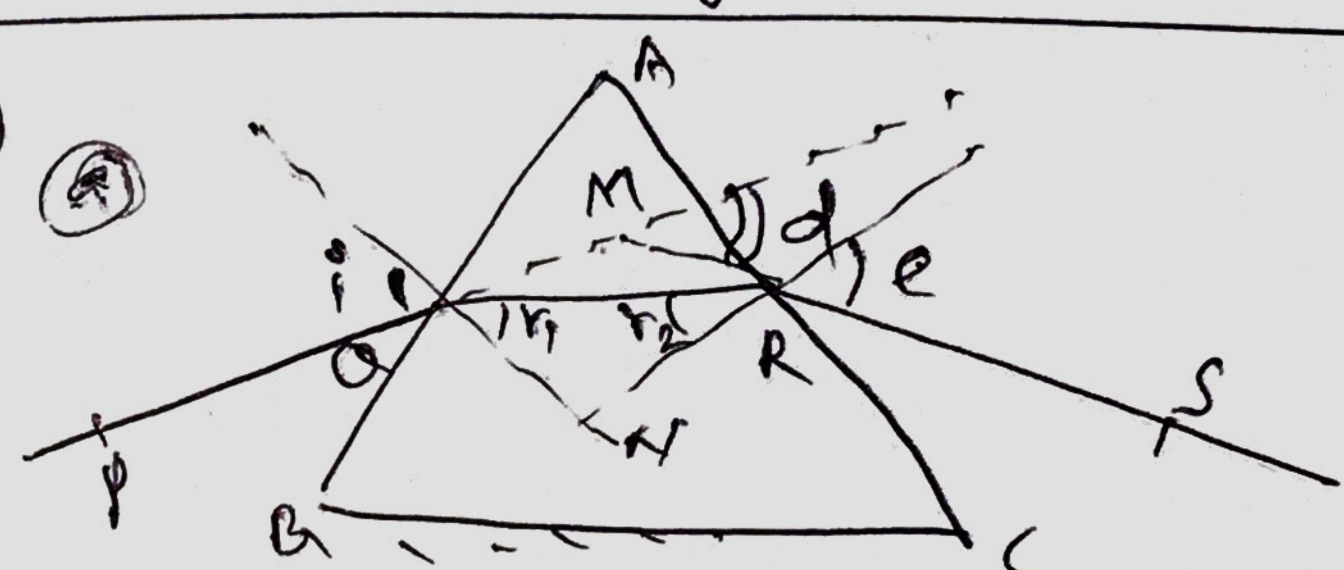
Any change in input voltage results in change in voltage drop across R_s without any change in voltage across Zener diode

(b) when V_i increases, main current increases, I_z increases with no change in load current I_L, so that $V_0 = V_z = I_L R_L$.

when V_i decreases, I_z decreases with no change in I_L.

(c) Reverse biasing

27 (a)



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

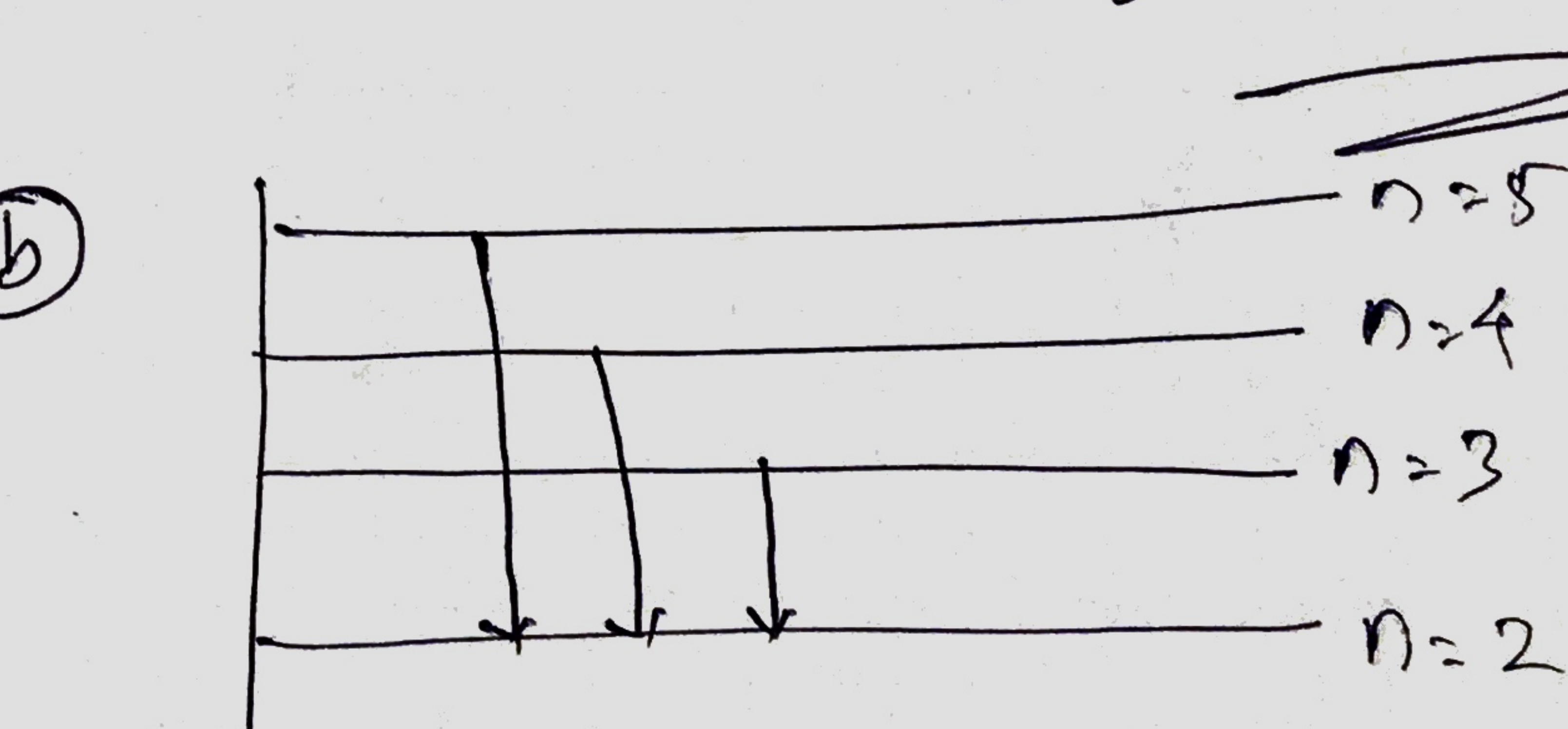
28 (a) cylindrical

(b) diagram + derivation $\beta = \frac{\lambda D}{d}$

29 (a) $r_n = \frac{n^2h^2\varepsilon_0}{\pi m e^2}$

$E_n = \frac{-e^2}{8\pi\varepsilon_0 r_n} = \frac{-me^4}{8\varepsilon_0^2h^2n^2} J$

(b)



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