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Physics Tutorial - 2

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Q.1 Wavelength of Photon

$$\lambda = \frac{h}{mv} = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$$

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E} = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{4.5 \times 1.6 \times 10^{-19}}$$

$$= \frac{19.878 \times 10^{-26+19}}{7.2}$$

$$= \frac{2.760 \times 10^{-7}}{} \text{ m}$$

$$= 2760 \times 10^{-10} = 2760 \text{ Å}$$

Q.2 Hall Effect

$$\mu = \sigma R_H$$

$$R_H = 3.6 \times 10^{-4} \text{ m}^3/\text{C}$$

$$\sigma = 100 / \Omega\text{m}$$

$$\mu = 100 \times 3.6 \times 10^{-4}$$

$$= 3.6 \times 10^{-2} \text{ m}^3/\text{Vs}$$

Q.3 Conductivity of Si

Conc. $= 1.6 \times 10^{10} / cm^3$

$\mu_e = 1500 \ cm^2/Vs$

$\mu_H = 500 \ cm^2/Vs$

$n_i = 1.6 \times 10^{10} / cm^3$

$e = 1.6 \times 10^{-19}$

$\sigma_i = (\mu_e + \mu_n) \cdot e \cdot n_i$

$= (500 + 1500) \times 1.6 \times 10^{-19} \times 1.6 \times 10^{10}$

$= 5120 \times 10^{-9}$

$= 5.120 \times 10^{-6}$ mho/cm

Q.4 3 states of e^-

Ex: $E = \frac{n^2 h^2}{8mL^2}$

$E_1 = \frac{1 \times (6.626 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (10 \times 10^{-10})^2}$

$= \frac{43.9 \times 10^{-68}}{72.8 \times 10^{-31} \times 10^{-18}}$

$= \frac{0.603 \times 10^{-19}}{1.6 \times 10^{-19}} = 0.37 eV$

$$E_2 = \frac{4 \times 0.603 \times 10^{-19}}{}$$

$$= \frac{2.412 \times 10^{-19}}{1.6 \times 10^{-19}}$$

$$= 1.5 \text{ eV}$$

$$E_3 = 9 \times 0.603 \times 10^{-19}$$

$$= \frac{5.427 \times 10^{-19}}{1.6 \times 10^{-19}}$$

$$= 3.39 \text{ eV}$$

0.5 ~~ΔE~~ [5 Å $n_2 - n_1$]
e-well.

$$\Delta E = E_2 - E_1 = \frac{3h^2}{8mL^2}$$

$$= \frac{3 \times (6.626 \times 10^{-34})^2}{8 \times (9.1 \times 10^{-31}) \times (5 \times 10^{-5})^2}$$

$$= \frac{131.751 \times 10^{-64}}{3.34 \times 10^{-22} \times 10^{-30}}$$

$$= 0.3344 \times 10^{-7}$$

$$= \frac{131.751 \times 10^{-64}}{1220 \times 10^{-51}}$$

$$= 0.723 \times 10^{-13} \text{ J}$$

$$= \frac{0.723}{1.6} \times 10^{6}$$

$$= 4.5 \text{ eV}$$

Q. 6.

$\mu_e = 1700 \ cm^2/V_s$

$\sigma = 10 \ m^{-1} \Omega^{-1}$

$\sigma = \frac{1}{\rho} = n_e \cdot \mu_e \cdot e$

$n_e = \frac{\sigma}{\mu_e \cdot e} = \frac{10}{1700 \times 1.6 \times 10^{-19}}$

$= \underline{3.67 \times 10^{19}}$

Q. 7.

$I = \frac{I}{A} = \frac{75}{(2 \times 10^{-3}) \times 1.5 \times 10^{-2}}$

$= 2.5 \times 10^{6} \ A/m$

$E = \frac{V}{d} = \frac{0.81}{1.5 \ (10^{-2})} \times 10^{-6} V = 5.4 \times 10^{-5}$

Now, since

$n_q = \frac{-J \times B_y}{E_z}$

$n = \frac{-J_x B_y}{q \cdot E_z} = \frac{-2.5 \times 10^{6} \ A/m^2 \times 0.405}{-1.6 \times 10^{-19} C \times 5.4 \times 10^{-5} \ V/m}$

$= 11.6 \times 10^{28} \ m^{-3}$ or $1.16 \times 10^{29} \ m^{-3}$