

$$\mu_e = \frac{V_d}{E}$$

$$\mu_e = \frac{350}{1000} = 0.35$$

$$\sigma = n e \mu_e$$

$$= (5 \times 10^{12}) (1.6 \times 10^{19}) (0.35)$$

$$= 0.028$$

$$N = \frac{N_A \rho}{A}$$

$$6.022 \times 10^{23} - N_A$$

$$N_{Ge} = \frac{N_A \rho_{Ge}}{A_{Ge}}$$

$$= \frac{(6.023 \times 10^{23}) (5.32) (1 \times 10^6)}{72.59}$$

$$= 4.41 \times 10^{28} \text{ atoms m}^{-3}$$

$$N_{Si} = \frac{N_A \rho_{Si}}{A_{Si}}$$

$$= \frac{(6.023 \times 10^{23}) (2.33) (1 \times 10^6)}{28.09}$$

$$= 5 \times 10^{28} \text{ atoms m}^{-3}$$

$$(5 \times 10^{19} \text{ electrons/m}^3)$$

$$(5 \times 10^{19} \text{ electrons/m}^3)$$

$$N_{\text{Fe}} = 4.4 \times 10^{28} \text{ atoms/m}^3$$

$$\frac{\text{electrons}}{\text{m}^3}$$

$$\frac{\text{atoms}}{\text{m}^3}$$

$$\frac{\text{electrons}}{\cancel{\text{m}^3}} \times \frac{\cancel{\text{m}^3}}{\text{atoms}}$$

$$\frac{N_i(\text{Fe})}{N_{\text{Fe}}} = \frac{5 \times 10^{19}}{4.4 \times 10^{28}} = 1.1 \times 10^{-9}$$

$$\frac{N_i(\text{Si})}{N_{\text{Si}}} = \frac{7 \times 10^{16}}{5 \times 10^{28}} = 1.4 \times 10^{-12} \text{ electron/atom}$$

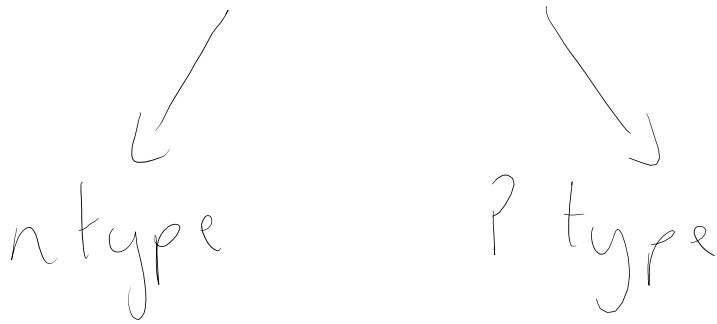
$$\sigma = n|e|\mu_e + p|e|\mu_h$$

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Intrinsic Semiconductor

$$n = p$$

Extrinsic Semiconductors

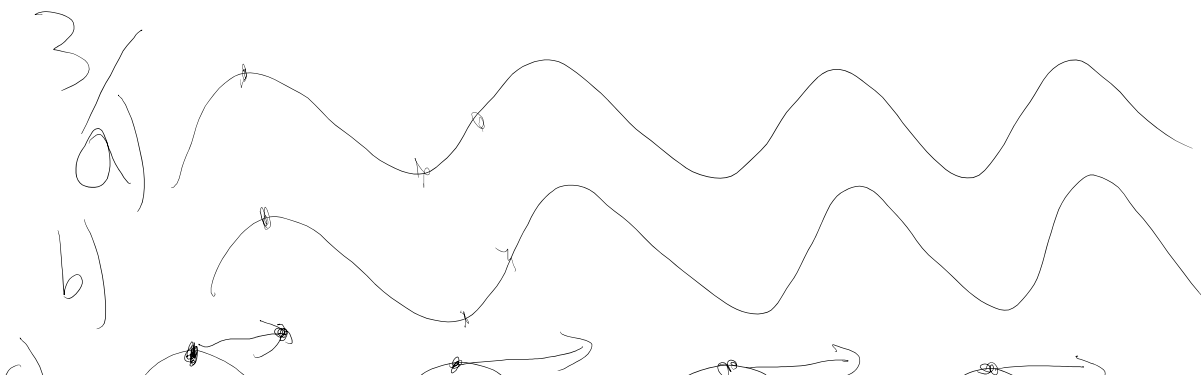


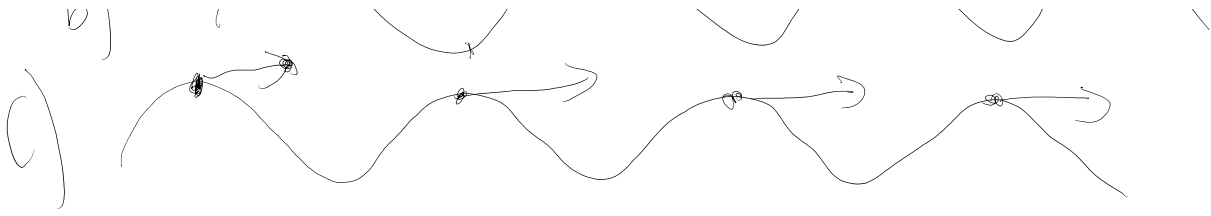
$$n \gg p \quad p \gg n$$

$$\sigma = n|e|\mu_e$$

$$= (1 \times 10^{24})(1.6 \times 10^{-19})(0.1)$$

$$= 1.6 \times 10^4$$





bi) Stimulated emission

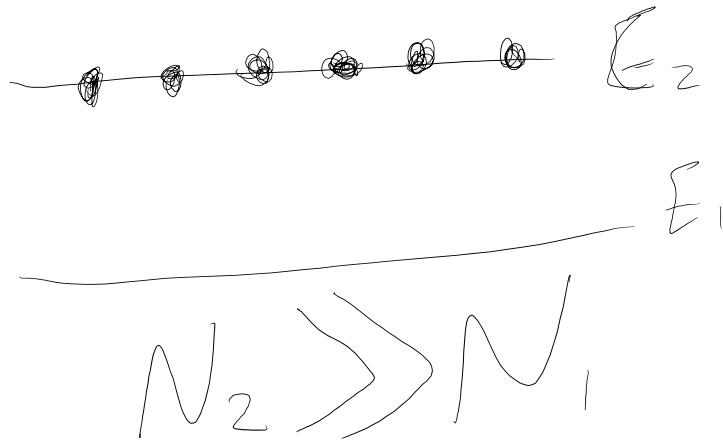
$$E = hf = \frac{hc}{\lambda}$$



- photon causes an upper level electron to decay
- Energy of incoming photon is equal to $E_2 - E_1$
- Emitted photon is in the same direction as the incoming photon and the same energy
- Incoming photon is NOT absorbed and so continues

absorbed and so continues
to move through.

ii)



$$N_2 > N_1$$

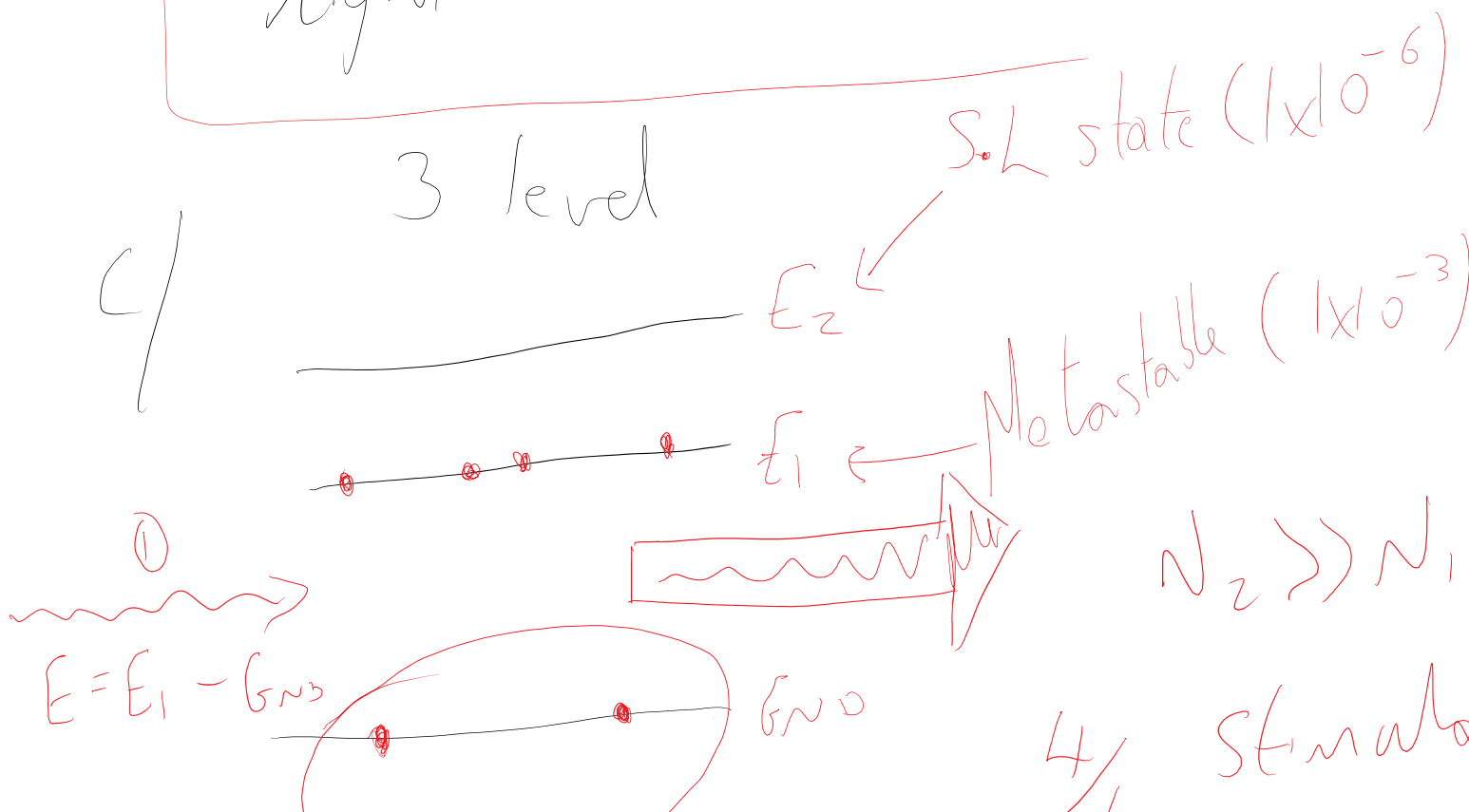
Revision Note

Definitions

- ↳ Absorption
- Stimulated emission
- Spontaneous emission
- Pumping

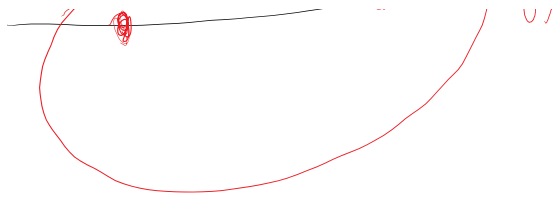
Population Inversion

- Population Inversion
- Short lived state
- Metastable state
- Advantages of 4 level system over 3 level system.
- Characteristics of LASER light



100%

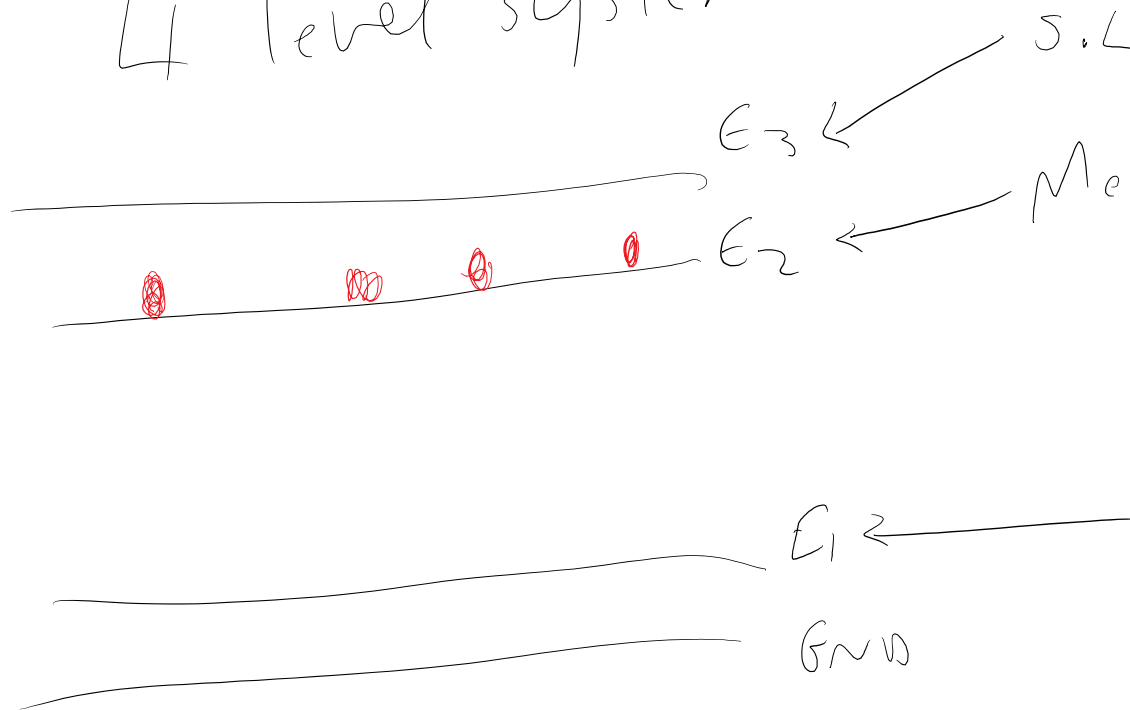
ated emission ✓



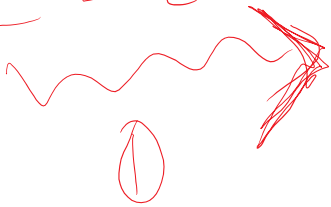
$\frac{4}{6}$ Stimulated

$\frac{2}{6}$ absorption

4 level system



$$E = E_2 - E_1$$



$\frac{4}{4}$

$$d/ E = 12.9 - 10.14$$

$$= 2.76 \text{ eV}$$

Wavelength (nm)

www . ✓

X

tastable

$$N_2 \gg N_1$$

SOL

Wavelength

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

$\uparrow$ (J)

$$eV \rightarrow J$$

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

$$E = (2.76)(1.6 \times 10^{-19})$$

$$= 4.416 \times 10^{-19} J$$

$$h = 6.63 \times 10^{-34} Js$$

$$c = 3 \times 10^8 ms^{-1}$$

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

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

$$= \frac{(6.63 \times 10^{-34}) / (3 \times 10^8)}{4.416 \times 10^{-19}}$$

$$= 4.5 \times 10^{-7} \text{ m}$$

$$= 450 \text{ nm}$$

$$= \text{Glas / Bleu}$$

