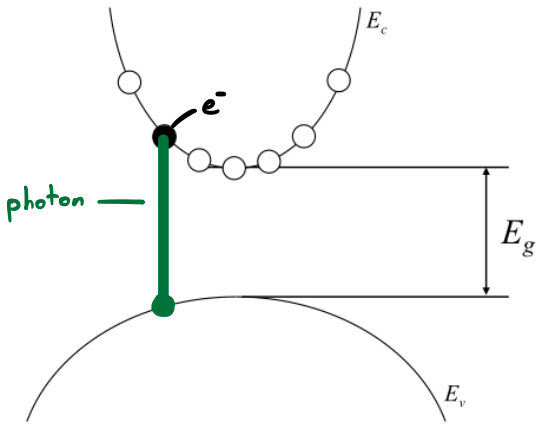
Momentum (k) Conservation

- Periodicity in valence and conduction band must match (For transition to occur)

- For a rate > 0, $\mathbf{k_2 = k_1}$

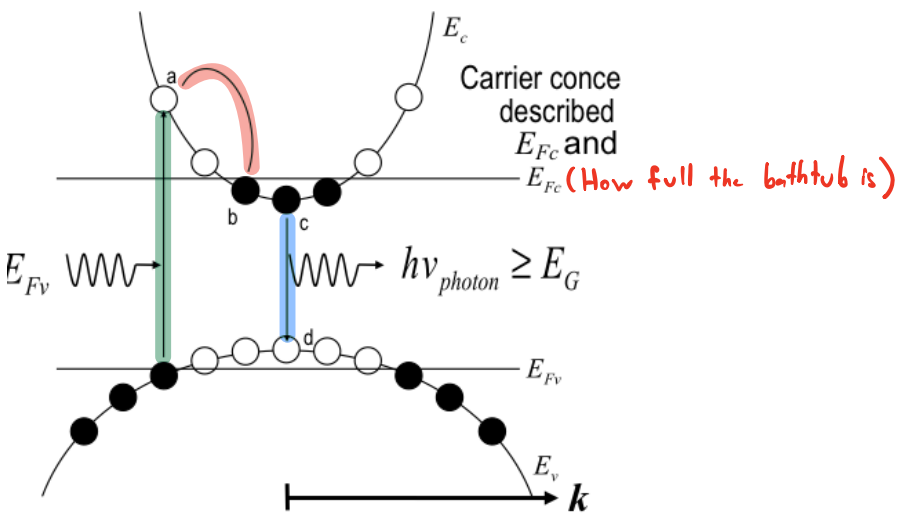
- Band Gap + Ec + Ev = Photon energy
- AND k(Ec) = k(Ev)

Optical Emission [Stimulated or Spontaneous]



- Sweeping k to find where $k_1 = k_2$ and rate > 0
- otherwise photon passes right by without interacting with the e⁻

Photo-excitation Process



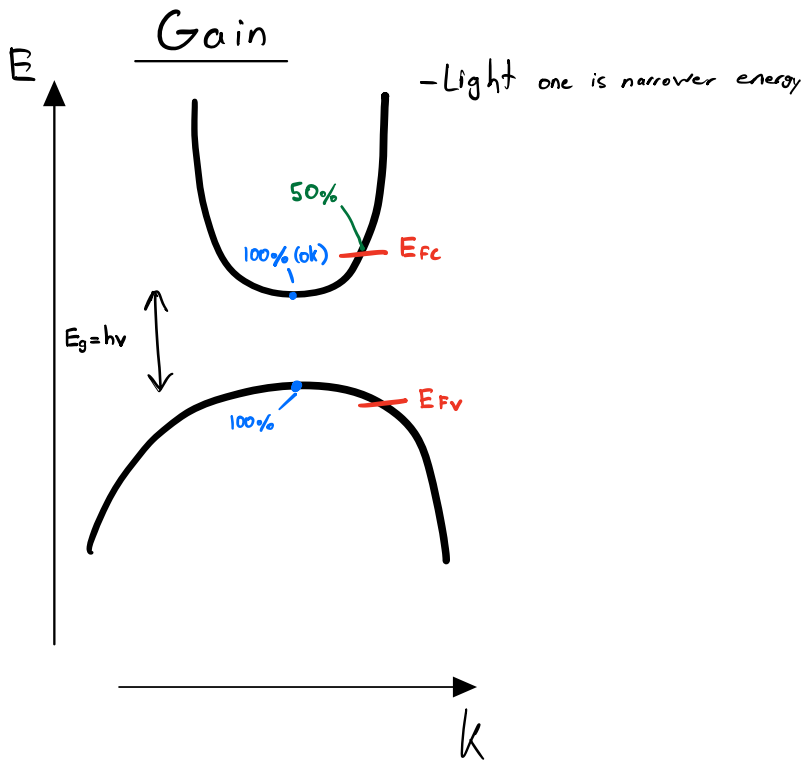
Questions

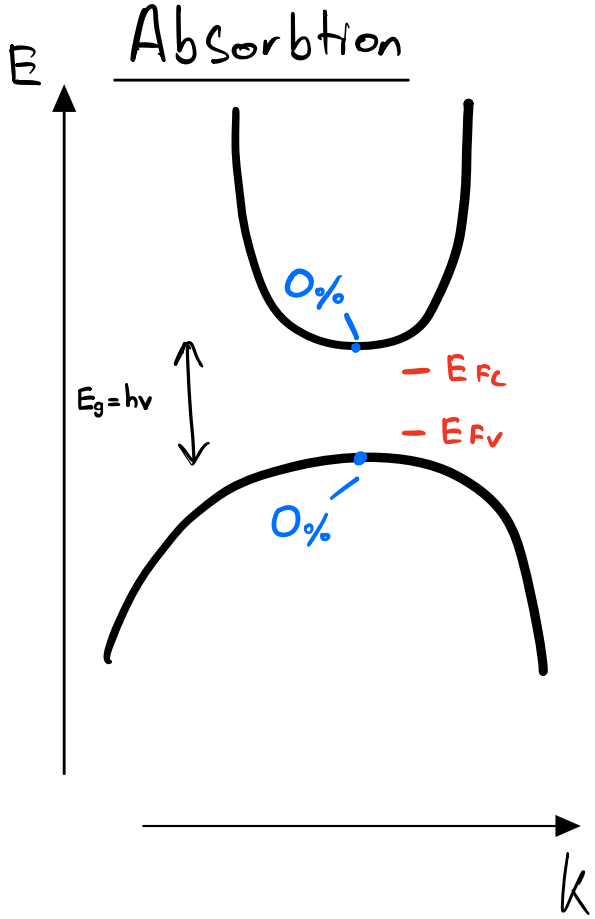
1. hole effective mass?
2. UV light to move e⁻ to the lowest energy level at the bandgap?
3. Emission and Absorbtion inversely proportional Slide 38
4. 2 sol'ns at fixed photon energy

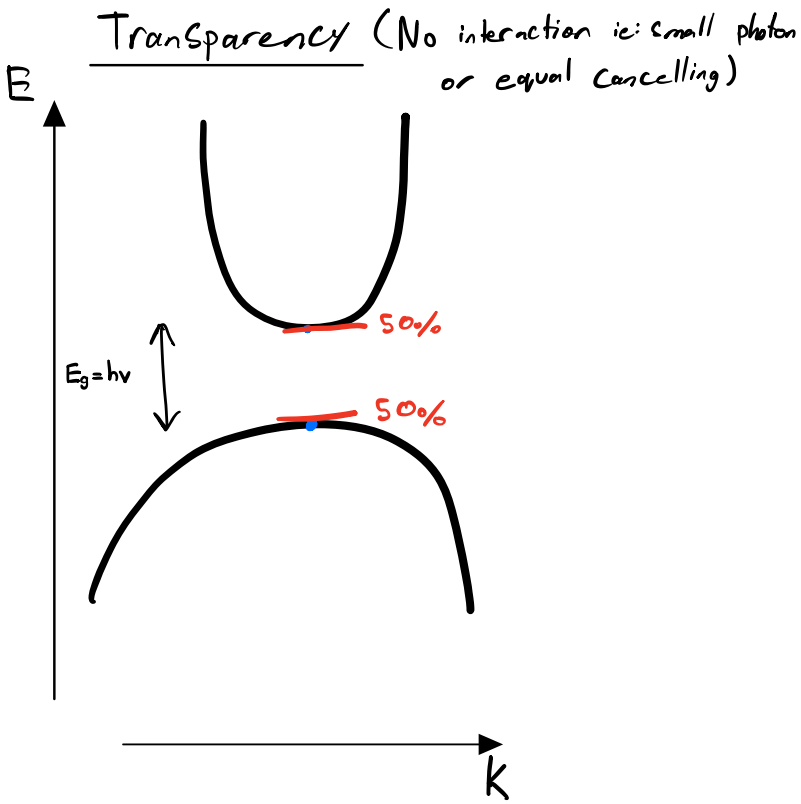
Question

A direct bandgap semiconductor has:
a band-gap of $E_g = 1eV$
$m_c = m_v/4$

- 1. Sketch the E-k diagram.
- 2. Assuming that the injected electron and hole carrier concentrations are equal, sketch the location of the quasi-Fermi energy levels, when the semiconductor is optically transparent (for a weak incident light of energy E_g).







Questions:

① $E_{Fc} + E_{Fv}$ vs.

$f_c(v) + f_v(v)$