An abrupt junction is formed by Boron and Arsenic as shown below. List any assumptions you make and answer the following.

\[ \begin{align*} 
N_d &= 10^{16} \text{cm}^{-3} \\
N_a &= 5 \times 10^{17} \text{cm}^{-3} 
\end{align*} \]

(a) Draw to scale the Conduction band (EC), Valence band (EV), and intrinsic (Ei) and Fermi Level (EF) versus position

(b) Draw the same figure again to scale with 0.8V forward bias.

(c) With 0.8V forward bias, draw to scale the minority carrier distributions (outside the space charge region)
PhD Qualifying exam: Solid State Devices (Question 2)

(a) Draw to scale the Energy versus wave vector $k$ for a direct (GaAs) and indirect (Si) semiconductor. Label the band gap. Make sure you capture in the drawing that GaAs has higher electron mobility then Si.

(b) Why are direct transitions with accompanying photon emission more likely in GaAs?

(c) When an electron and hole recombine in GaAs and in Si how is energy conserved?