



- 5) A Si wafer is uniformly doped with  $2 \times 10^{17} \text{ cm}^{-3}$  of Phosphorous and  $4 \times 10^{17} \text{ cm}^{-3}$  of Boron. Assuming full ionization, calculate the following quantities at room temperature ( $T = 300 \text{ K}$ ).
- The equilibrium hole concentration,  $p$ . (start with the charge-neutrality condition).
  - The equilibrium electron concentration,  $n$ .
  - The position of the Fermi level ( $E_F$ ) relative to the intrinsic level ( $E_i$ ). Draw the band diagram show these to levels.
  - Which one of the two quantities  $p$  or  $n$  has the strongest temperature dependence near 300 K? Explain.
  - Suppose you now add  $1 \times 10^{13} \text{ cm}^{-3}$  of Arsenic to the Si sample. What will be the equilibrium concentration of holes ( $p$ ) at 300K? (Don't have to go through the whole math again. Make an educated guess with justification).