

MSE 2002, Spring 2009
Homework Assignment 4, Due at start of class, Thursday, April 9

Solve Questions 18.5, 18.11, 18.21, 18.28, 18.30, 18.49, 18.56
AND solve the following additional questions:

Problem I) Sketch the band diagram for a pnp transistor:

- a) at equilibrium
- b) with a forward bias applied at one edge (the left p-type edge) AND a reverse bias applied at the other edge (the right p-type edge)

NOTE: As always, include E_c , E_v , and E_f in each diagram. Note the applied voltages as well (they may be equal or not, you choose, but make sure you identify which is which).

Problem II) Calculate the conductivity at 300K for:

- a) an unspecified insulator with a bandgap of 6 V, an electron mobility of $0.1 \text{ m}^2/(\text{Volt}\cdot\text{s})$, and a hole mobility of $0.02 \text{ m}^2/(\text{Volt}\cdot\text{s})$
- b) a Si wafer doped with $10^{24} \text{ Al atoms/m}^3$, (you may assume they are all ionized if you wish), a bandgap of 3 V, and conveniently the same electron and hole mobilities as the insulator in part a.
- c) a metal with 10^{29} e/m^3 and an electron mobility of $0.001 \text{ m}^2/(\text{Volt}\cdot\text{s})$
- d) ALSO, sketch a plot of the relative conductivity for each of these samples as a function of temperature, all on the same graph (i.e. approximately which are greater at what temperatures)?