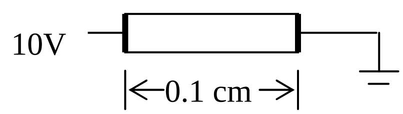
ECSE-2210 Microelectronics Technology
Fall 2005
Class Activity 6

1. Short Answer Questions.

(a) What is the electric field inside the Si bar shown below? What is its direction?



(b) How long does it take on average for an electron to drift 1 μm in pure Si with an applied electric field of 100 V/cm?

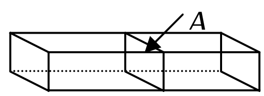
(c) Repeat (b) for 10^5 V/cm. Explain why you cannot use the relationship $v_d = \mu \mathcal{E}$ here.

(d) An average hole drift velocity of 10^3 cm/s results when 2 V are applied across a 1 cm long semiconductor bar. What is the hole mobility inside the bar?

(e) For a given semiconductor the carrier mobilities in the intrinsic material are (choose one: higher than, lower than, the same as) those in heavily doped material. Explain why?

(f) Name two dominant carrier scattering mechanisms in don-degenerately doped semiconductor of device quality.

(g) In the diagram below, 100 million electrons cross the marked area *A* from left to right every 1 microsecond. What is the value of the current in A, and its direction?



2. Show that the units of $1/(q\mu n)$ are Ohm cm

3. A lightly doped (< 10^{14}cm^{-3}) Si sample is heated up from room temperature to 100 ^{o}C. $N_D >> n_i$ at both room temperature and at 100 ^{o}C. Is the resistivity of the sample expected to increase or decrease? Explain.

4. Determine the resistivity of Si doped with 2×10^{16} cm^{-3} of phosphorous and 1×10^{16} cm^{-3} of boron.

5. Determine the resistivity of Si doped with $N_D = 2 \times 10^{18}$ cm^{-3} and $N_A = 10^{18}$ cm^{-3}.