

PHYS-1200 PHYSICS II
HOMEWORK #23 SOLUTIONS

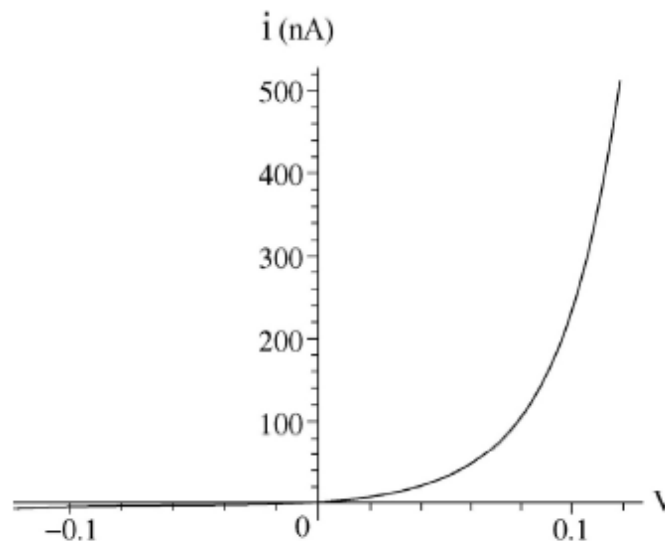
36. (a) *n*-type, since each phosphorus atom has one more valence electron than a silicon atom.

(b) The added charge carrier density is

$$n_P = 10^{-7} n_{Si} = 10^{-7} (5 \times 10^{28} \text{ m}^{-3}) = 5 \times 10^{21} \text{ m}^{-3}.$$

(c) The ratio is $(5 \times 10^{21} \text{ m}^{-3})/[2(5 \times 10^{15} \text{ m}^{-3})] = 5 \times 10^5$. Here the factor of 2 in the denominator reflects the contribution to the charge carrier density from *both* the electrons in the conduction band *and* the holes in the valence band.

40. (a) The vertical axis in the graph below is the current in nanoamperes:



(b) The ratio is

$$\frac{i|_{v=+0.50\text{V}}}{i|_{v=-0.50\text{V}}} = \frac{i_0 \left[e^{+0.50\text{eV}/[(8.62 \times 10^{-5} \text{ eV/K})(300\text{K})]} - 1 \right]}{i_0 \left[e^{-0.50\text{eV}/[(8.62 \times 10^{-5} \text{ eV/K})(300\text{K})]} - 1 \right]} = 2.5 \times 10^8.$$