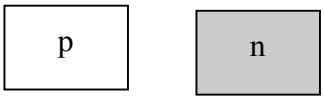
Applied Homework: PN-Junctions **Name**_____

Consider a pn-junction, a name given to joined material consisting of p-doped and n-doped semiconducting materials. In this situation, "p-doped" materials are ones in which holes (i.e. positive) are the charge carriers, "n-doped" the ones in which electrons (i.e. negative) are the charge carriers.

1. Consider two individual blocks of semiconductor, one p-doped, one n-doped. Compare the net charge of the two. Explain.



2. Consider that a p-doped and n-doped semiconductor are placed side by side (touching, see figure).

   a. Describe the flow of charge carriers within each substance. Explain what causes the charges to flow (describe the forces, etc).

   b. What happens when a hole and electron meet within the material? Explain.

3. Consider the region where holes and electrons are meeting.

   a. What is the net charge of this region in the n-doped semiconductor? Explain how you arrived at your answer.

   b. What is the net charge of this region in the p-doped semiconductor? Explain how you arrived at your answer.

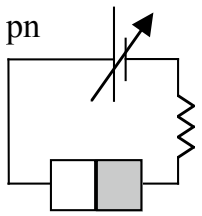
4. Consider the electric field created by the charge arrangement you described in your previous answer.

   a. What direction does this field point? Indicate it on the diagram above (in question 2).

   b. What effect does this have on the electrons in the n-doped region? on the holes in the p-doped region? Explain.

   c. Consider the term "depletion region" that is often used to describe this area of a pn-junction. Explain how this term is appropriate.

4. A pn-junction like the one you have described is placed in a circuit with a battery and resistor (see figure). A variable voltage battery is used. Consider the following situations:



   a. The voltage in the circuit (and across the pn-junction) is zero. Sketch the voltage vs. position graph (qualitatively only). Explain.

   b. The voltage of the battery is such that the n-doped material is grounded and the p-doped side is at positive voltage. How, if at all, would this change your previous graph. Explain.

   c. The voltage of the battery is such that the p-doped material is grounded and the n-doped side is at positive voltage. How, if at all, would this change your graph in part (a). Explain.

5. Consider the current flowing through the pn-junction in the three situations you described above. For which voltage is the current the highest? lowest? zero? Explain.

6. A pn-junction is often called a diode. Explain how a diode allows current to flow in only one direction and not another.

   The term "forward bias" is used to describe the situation where current flows through a diode. To which voltage arrangement does this correspond?