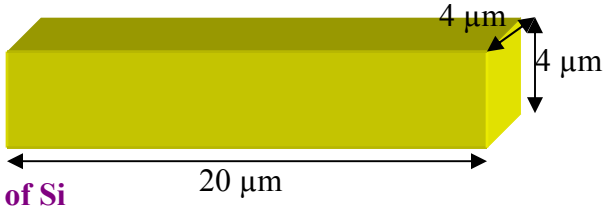
COE 360 – 1st Assignment – Dr. Muhammad Elrabaa

1) The following piece of Si is doped with 10^{16} cm^{-3} acceptors and $2x10^{15}$ cm^{-3} donors:

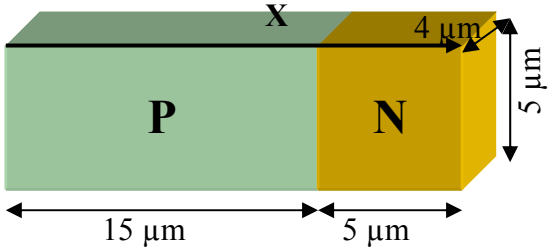
   a. Calculate the electron and hole concentrations, what is the type of this semiconductor?



   b. Calculate the resistance of this piece of Si

   c. What is the type of doping and its concentration required to invert the type of this piece of Si while keeping the resistance the same?

2) A P-N junction is made of a piece of Silicon that was originally doped with 10^{16} cm^{-3} acceptors. Then in one side, donors were added at a concentration of $2x10^{16}$ cm^{-3} to form the N-Side as shown in the figure below:



   a. Calculate the diode's series resistance

   b. Calculate the built-in potential

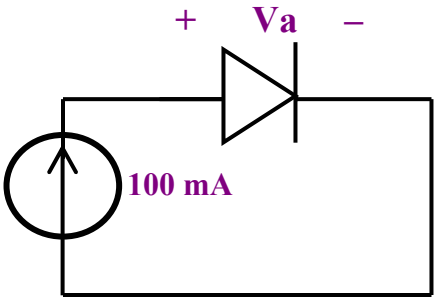
   c. If this diode is used in a circuit where a forward current of 100 mA is forced through it, estimate the voltage across its terminal?

      What would happen to the voltage if the temperature is increased (while the current through the diode is kept the same)?

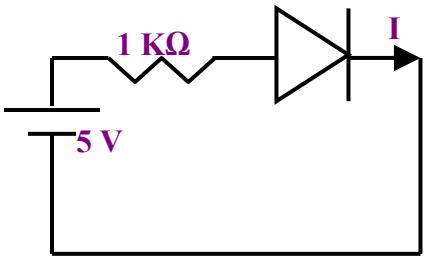
   d. If this diode is placed in series with a 10KΩ resistance and a 5V forward bias is applied to both, how much current would flow through the diode, and what will happen to this current if the temperature is increased?

   e. Draw the Energy Band Diagrams (along the x direction) showing the amount of bending and the relative width of the depletion region under the following bias:

      i. 0V ii. -0.5V reverse bias iii. 0.5V forward bias.



Circuit for part (c)



Circuit for part (d)