Homework 2

Jacob Taylor Cassady

Semiconductor Development Fundamentals

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# Name one acceptor dopant element for silicon.

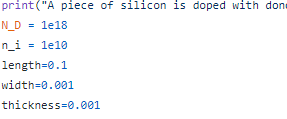
**boron (B)**

# Name two donor dopant elements for silicon.

**phosphorus (P)**

**arsenic (As)**

# A piece of Silicon is doped with donor atoms at a concentration of 𝑁𝐷=10^18cm-3. The piece is 1 mm long, 10 micro-m wide, and 10 micro-m thick.



## What is the electron concentration?



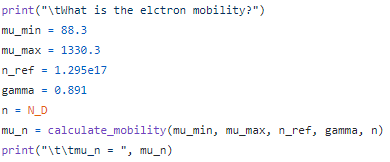
**no = 10^18 cm^-3**

## What is the hole concentration?



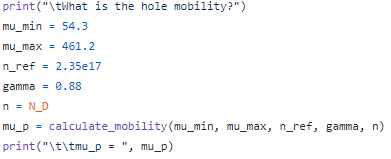
**po = 10^20 / 10^18 = 10^2 cm^-3**

## What is the electron mobility?



**261.2876456325601**

## What is the hole mobility?



**143.210411376502**

## What is the resistivity?

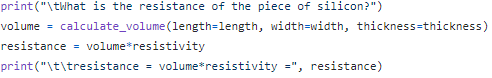


**436420783930902.25 Ohms/cm^3**

## Where is the Fermi level located relative to the middle of the bandgap?

**The Fermi level is above (closer to Ec) the middle of the bandgap.**

## What is the resistance of the piece of silicon?



**43642078.393090226 Ohms**

## 1V is applied across the length. How much current flows?



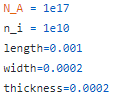
**2.2913665820240317e-08 Amps**

## 1000V is applied across the length. How much current flows?



**2.2913665820240317e-05 Amps**

# A piece of silicon is doped with acceptor atoms at a concentration of 𝑁𝐴=10^17cm-3. The piece is 10 micro-m long, 2 micro-m wide, and 2 micro-m thick.



## What is the electron concentration?



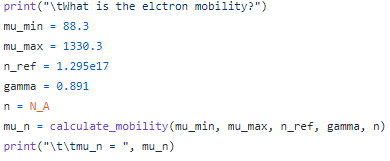
**1e+17 cm^-3**

## What is the hole concentration?



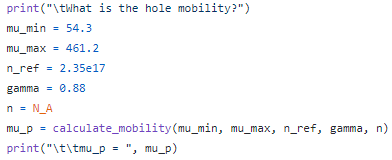
**1000.0 cm^-3**

## What is the electron mobility?



**780.5038835154212**

## What is the hole mobility?



**330.82492639961237**

## What is the resistivity?

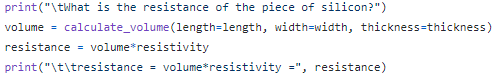


**0.18892167733608006 Ohms/cm^3**

## Where is the Fermi level located relative to the middle of the bandgap?

**The fermi level is located below (closer to Ev) the middle of the band gap.**

## What is the resistance of the piece of silicon?



**7.556867093443203e-12 Ohms**

## 1V is applied across the length. How much current flows?



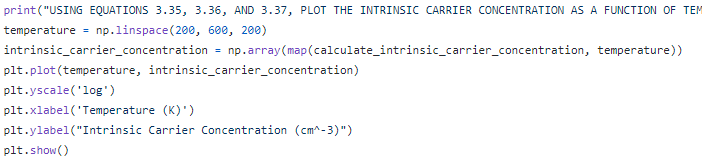
**132329970559.84494 Amps**

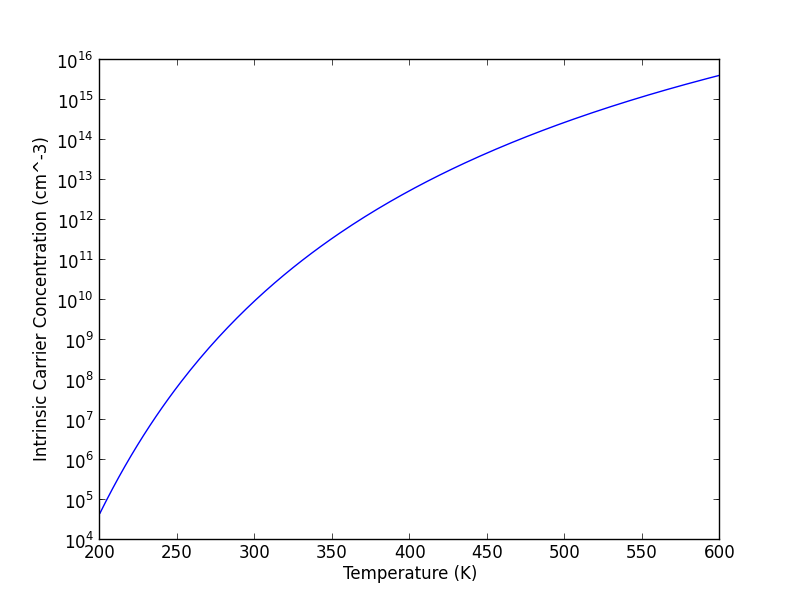
## 1000V is applied across the length. How much current flows?



**132329970559844.94 Amps**

# Using equations 3.35, 3.36, and 3.37, plot the intrinsic carrier concentration as a function of temperature for silicon. The temperature should range from 200K to 600K. The y-axis (intrinsic carrier concentration) should be a log scale. Use a computer to generate the plot and turn in your code.





# Appendix

## Additional Source Code

