

ECE 320 - Homework #2

Semiconductors, PN Junction. Due Monday, Jan 25th

Please make the subject "ECE 320 HW#2" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

Semiconductors

- 1) Why does the resistance of silicon decrease as temperature goes up?
- 2) What doping of Boron (p-type) do you need to make an 1206 resistor have a resistance of 7500 Ohms? The dimensions of an 1206 resistor are

$$L = 3.20\text{mm}, W = 1.60\text{mm}, H = 0.95\text{mm}$$

- 3) A thermistor has the following resistance - voltage relationship

$$R = 1000 \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right) \Omega$$

where T is the temperature in degrees C. What is the resistance you'll read at

- -70C Dry ice
- 0C Freezing point of water
- +650F Temperature of a soldering iron

PN Junction

- 4) Why can current flow p to n but not n to p?

Diode VI Characteristics

Assume the VI characteristics for a diode are

$$V_d = 0.052 \cdot \ln\left(\frac{I_d}{10^{-8}} + 1\right)$$

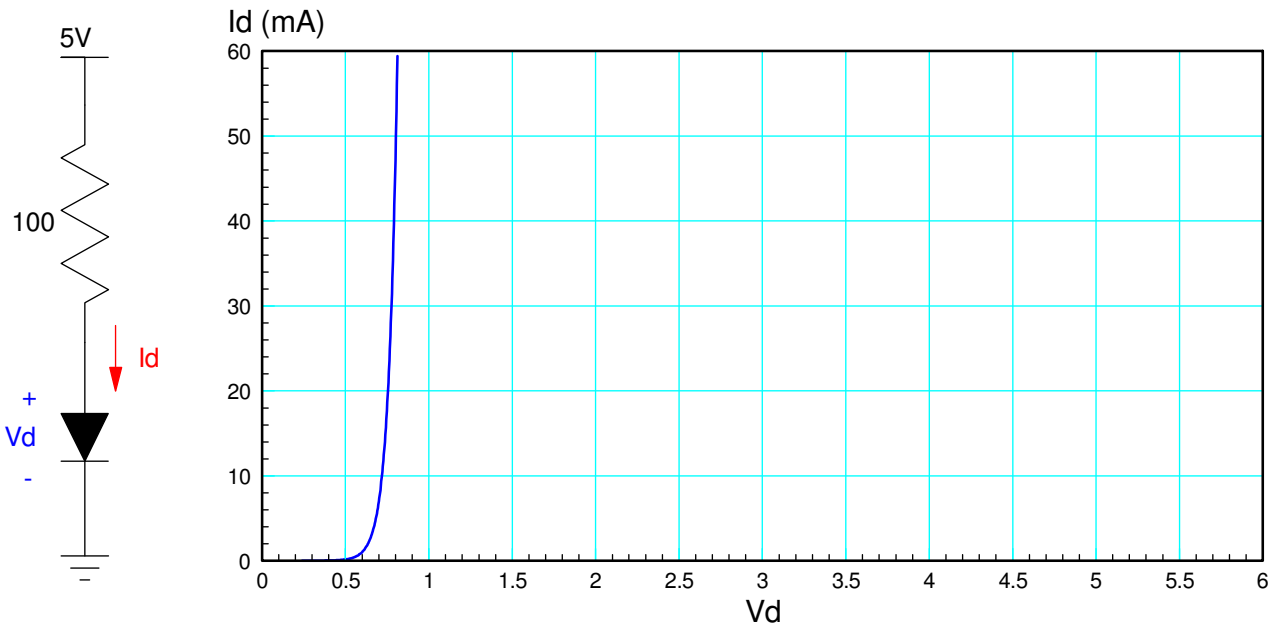
$$I_d = 10^{-8}\left(\exp\left(\frac{V_d}{0.052}\right) - 1\right)$$

- 5) For the 1-diode circuit next page)
- 5a) Draw the load-line for the following circuit (next page). Determine Vd and Id from the graph.
 - 5b) Write the voltage node equations and solve for Vd and Id assuming the VI equations above
 - 5c) Write the voltage node equations and solve for Vd and Id assuming ideal diodes (Vf = 0.7V)

6) Build this circuit in CircuitLab and solve for Vd and Id. (Use a 1N4004 diode)

7) Build this curcuit on your breadboard and measure Vd. From this, compute Id

| | Vd | Id |
|----------------------------|---------|---------|
| 5a) Graphical solution | | |
| 5b) Numeric Solution | | |
| 5c) Ideal Diode Solution | Week #3 | Week #3 |
| 6) Simulation (CircuitLab) | | |
| 7) Lab (experimental) | | |



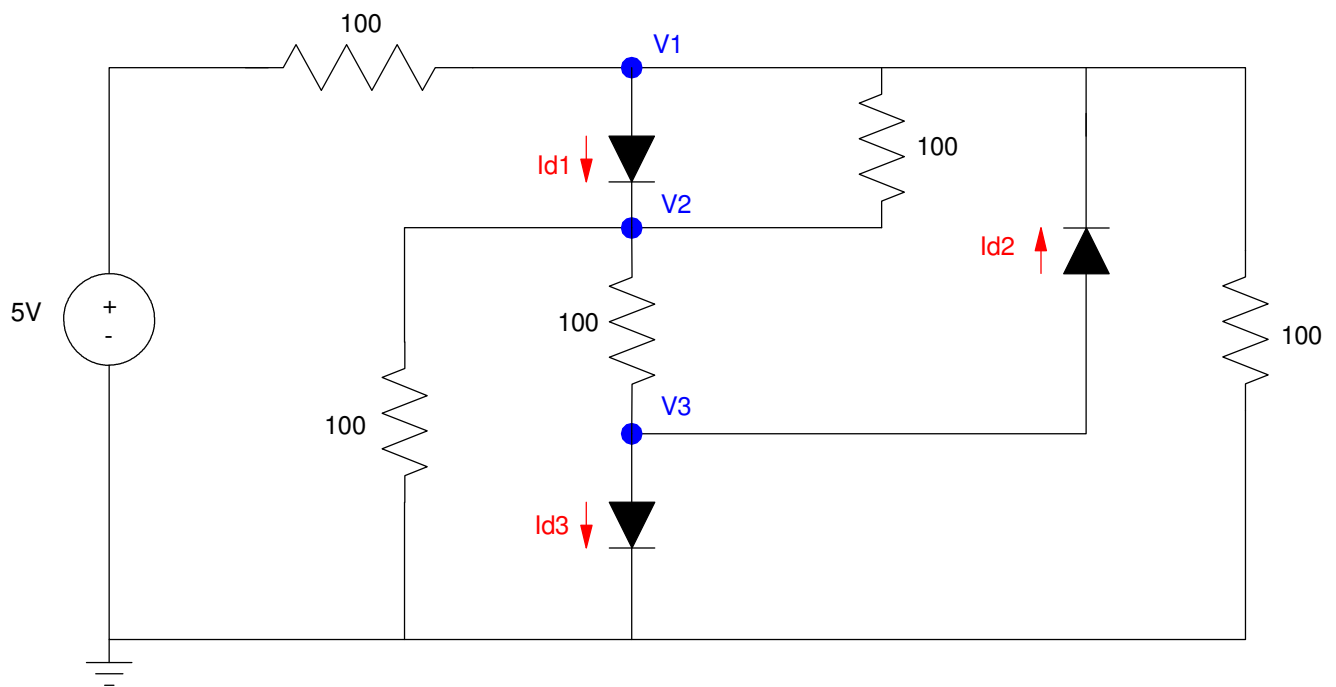
Problem 8 - 10: For the following circuit...

8) Write the voltage node equations assuming nonlinear diodes. Solve for $\{V1, V2, \text{ and } V3\}$ using Matlab.

9) Simulate this circuit in CircuitLab. From this, determine $\{V1, V2, \text{ and } V3\}$

10) Build this circuit with your breadboard and measure $\{V1, V2, V3\}$

| | V1 | V2 | V3 |
|----------------------------|-----------|-----------|-----------|
| 8a) Numeric Solution | | | |
| 8b) Ideal Diode Solution | next week | next week | next week |
| 9) Simulation (CircuitLab) | | | |
| 10) Lab (experimental) | | | |



Problem 8-10