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 = 3.20mm, W = 1.60mm, H = 0.95mm

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

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

5) For the 1-diode circuit next page)

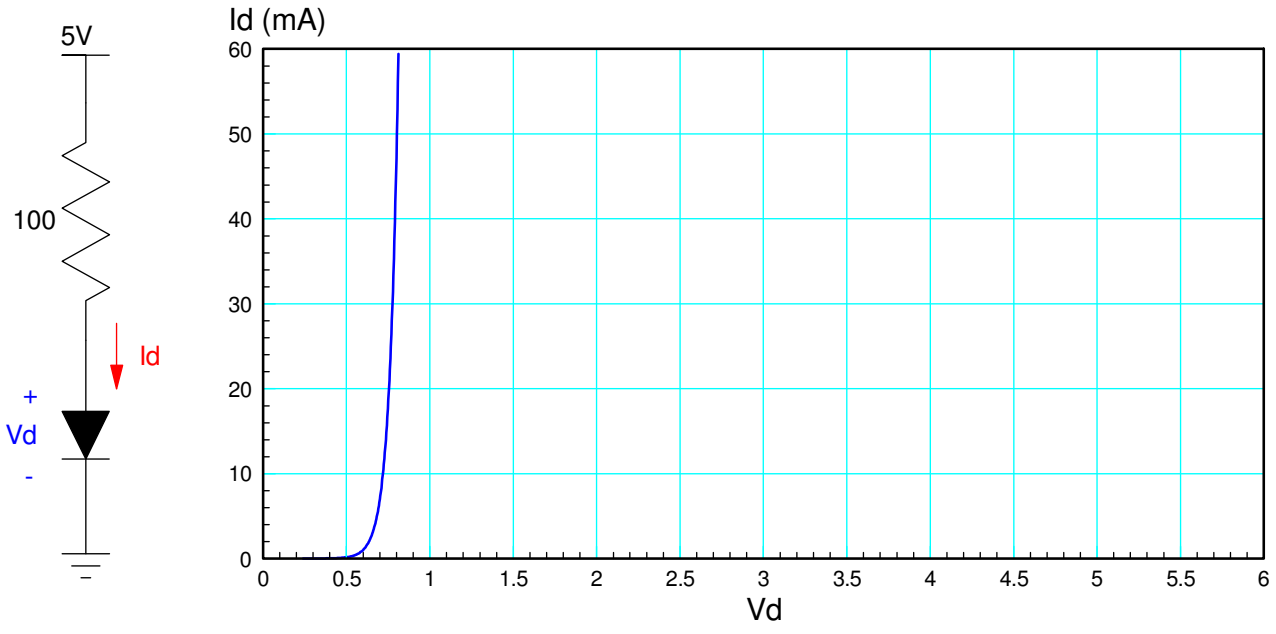
- 5a) Draw the load-line for the following circuit (next page). Determine Vd and Id from the graph.
- 5b) Write the voltage node equations and solve for Vd and Id assuming the VI equations above

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

- Include a photo to receive credit for this problem

	Vd	Id
5a) Graphical solution		
5b) Numeric Solution		
6) Simulation (CircuitLab)		
7) Lab (experimental)		



Problem 8 - 10: *Note: If you don't have five 100 Ohm resistors (brown - black - brown), replace the resistors with five resistors you *do* have - ideally all the same and close to 100 Ohms. Do problems 8 - 10 using the resistors you use for the experimental results (problem #10).*

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

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

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

- Include a photo to receive credit for problem #10
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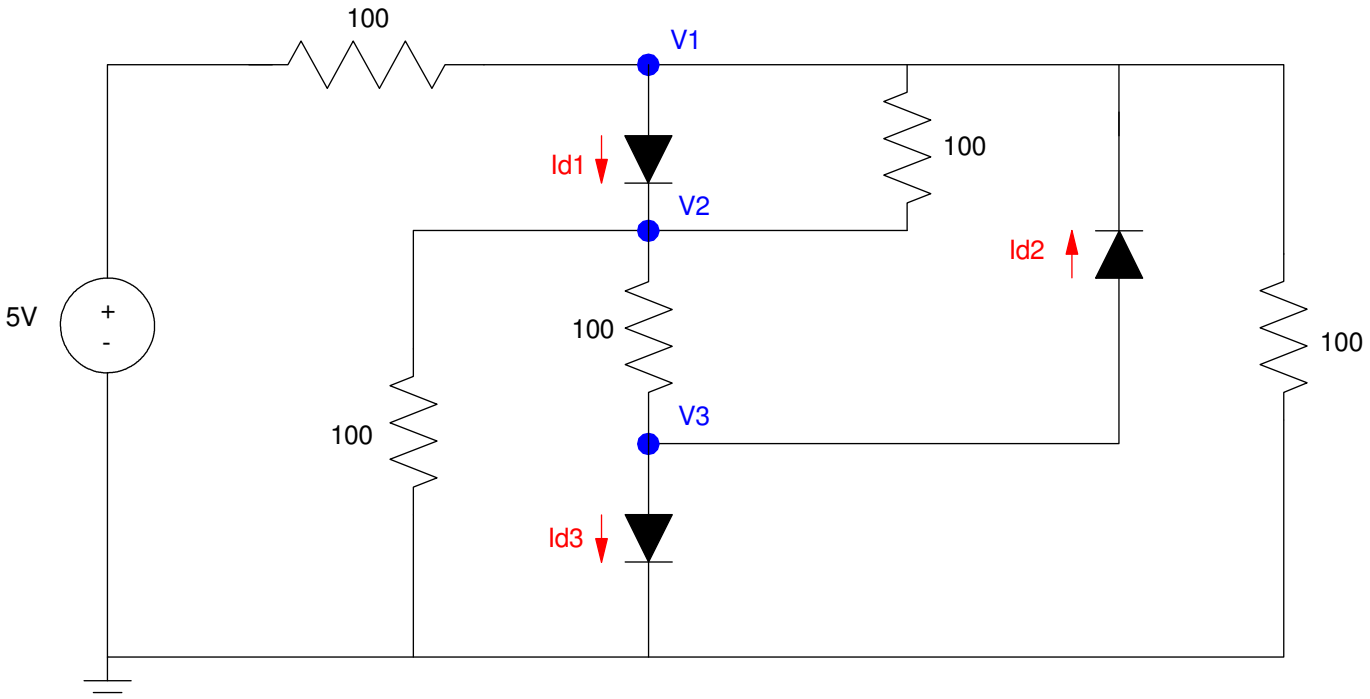
	V1	V2	V3
8) Numeric Solution			
9) Simulation (CircuitLab)			
10) Lab (experimental)			



Problem 8-10. Change the resistors if you don't have five 100 Ohm resisotrs available (all 220 Ohm, 330 Ohm, 1k, etc)