

# ECE 320 - Quiz #2 - Name \_\_\_\_\_

Semiconductors, pn Junction, ideal diodes - Spring 2023

1a) What are holes and electrons?

1b) Why does the resistance of a semiconductor go down as temperature goes up?

*as opposed to metals where the resistance goes up with temperture*

2) An 0805 resistor has the following dimensions

- $L = 0.02\text{cm}$
- $W = 0.013\text{cm}$
- $H = 0.005\text{cm}$

Determine the doping required to make a resistance of R ohms where

- $R = 800 + 100 \cdot (\text{your birth month}) + (\text{your birth date})$ .
- For example, May 14th would give  $R = 1314$  Ohms

$R$ $800 + 100 \cdot (\text{your birth month}) + (\text{your birth date})$	Required Doping of Boron atoms / cc

Useful Equations (units cm):

$$R = \frac{\rho L}{A}$$

$$\sigma = \frac{1}{\rho} = n_p \cdot q_p \cdot \mu_p = n_p \cdot (1.6 \cdot 10^{-19}) \cdot (500)$$

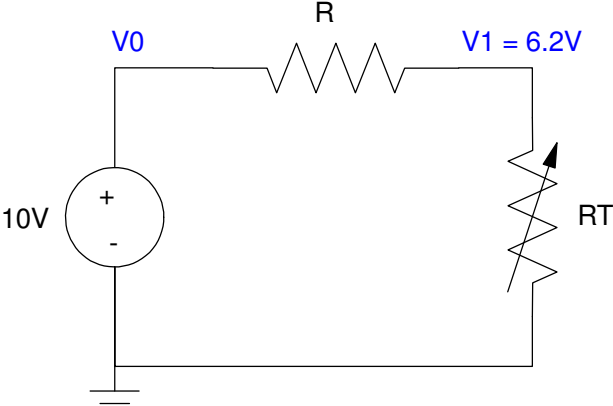
3) Thermistors: Assume the VI characteristics of a thermistor are

$$R_T = 1500 \exp\left(\frac{4000}{T+273} - \frac{4000}{298}\right) \Omega$$

where T is the temperature in degrees C. Determine RT and the temperature if V1 = 6.2V

- Let R be 800 + ( your birth month ) \* 100 + your birthday. ( March 14th would give R = 1314 Ohms )

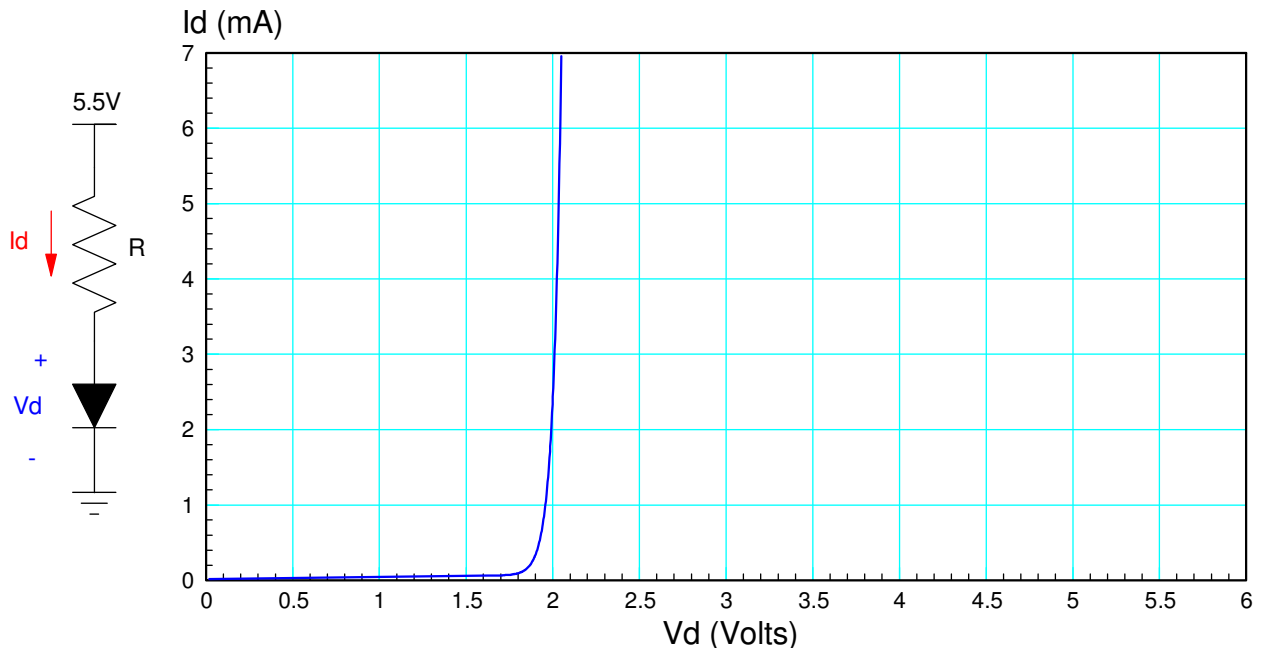
R 800 + 100*Month + Day	RT (Ohms) Thermistor	Temperature (C)



4) Load Lines: The VI characteristic for a diode is show on the graph below. Draw the load line for the following circuit and from the graph, determine  $V_d$  and  $I_d$

- Let  $R$  be  $800 + 100 * (\text{Birth Month}) + (\text{Birthday})$

$R$ $800 + 100 * \text{Month} + \text{Day}$	Load Line x-intercept	Load Line y-intercept	$V_d$	$I_d$

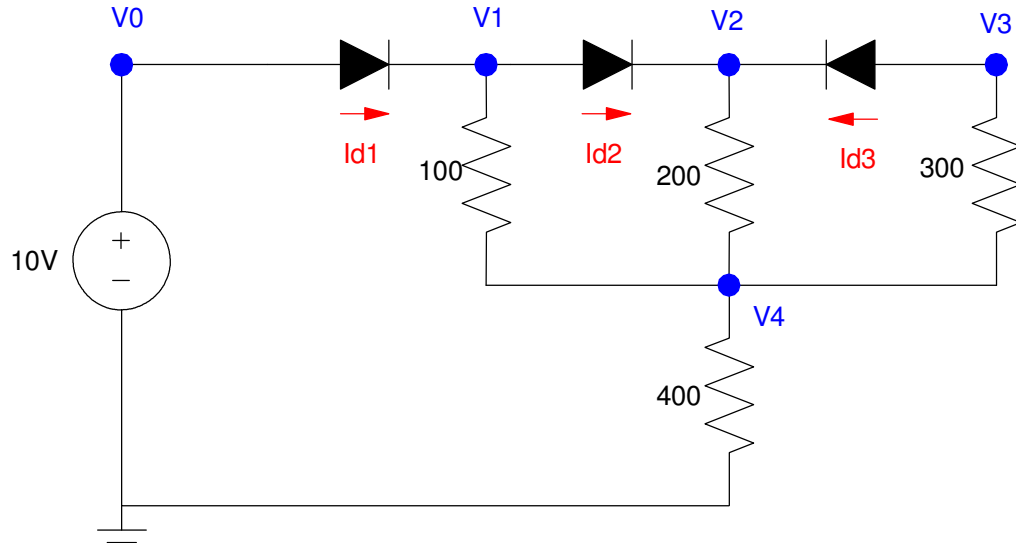


5) Diodes (nonlinear equations): Assume the VI characteristics of a diode are

$$I_d = 10^{-11} \cdot \left( \exp\left(\frac{V_d}{0.038}\right) - 1 \right)$$

Write 7 equations so solve for 7 unknowns: V1, V2, V3, V4, Id1, Id2, Id3

- note: don't solve.



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