

# ECE 320 - Final pt1. Name \_\_\_\_\_

Semiconductors & Diodes. March 22, 2018

- 1 a) What is the difference between an n-type and a p-type semiconductor?

n-type  $\#e^- \gg \#holes$

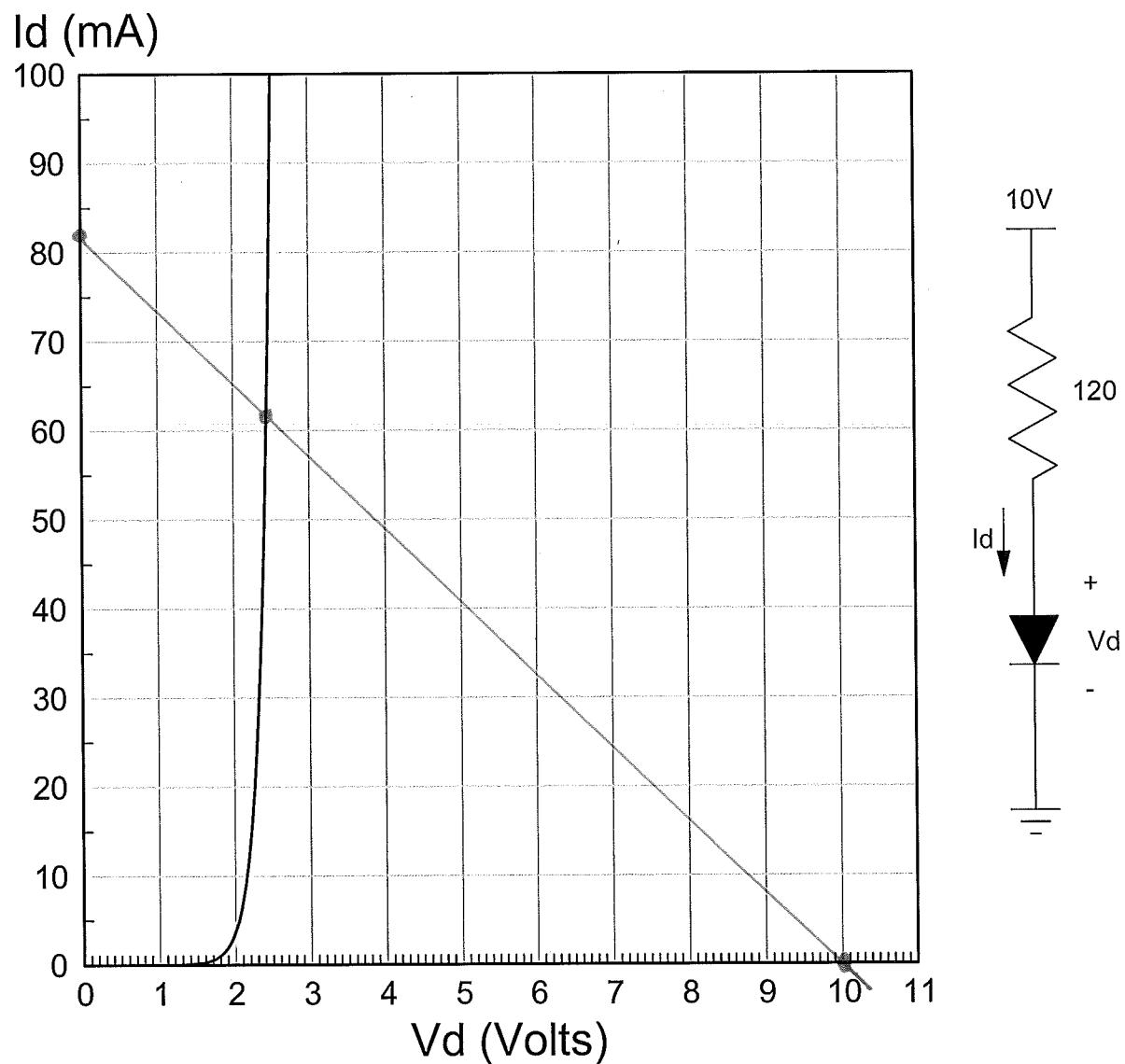
p-type  $\#holes \gg \#e^-$

- 1 b) Why current flow from p to n in a diode but not n to p?

- p to n uses majority carriers (low R)  
n to p uses minority carriers (high R)
- p to n drops the depletion zone to zero (conducts)  
n to p increases the depletion zone (no I)
- p to n overcomes the potential energy barrier  
n to p makes PE barrier larger

- 2) The VI characteristics of a diode are given below. Determine the operating point using load-line analysis:

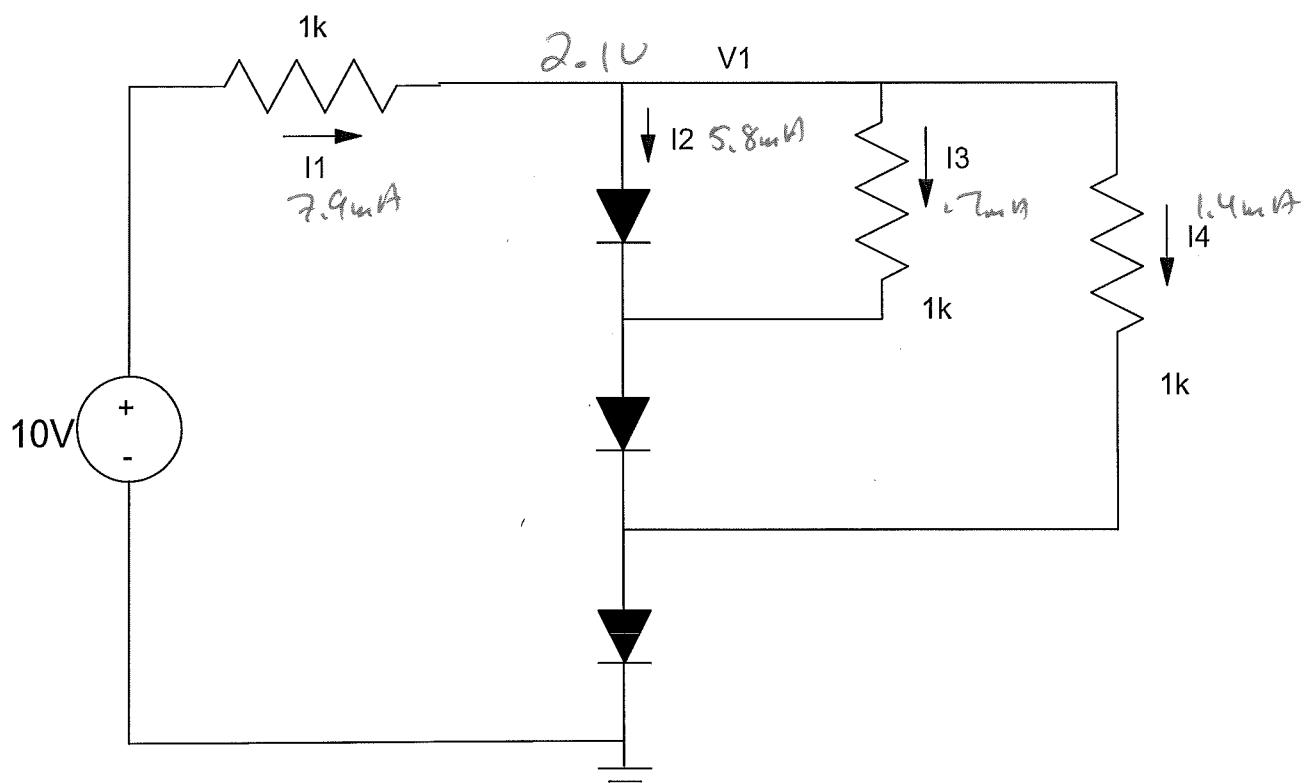
Load Line	$V_d$	$I_d$
show on the diagram	2.4V	62mA



3) Determine the voltages and currents for the following circuit. Assume ideal silicon diodes where

- $V_f = 0.7V$

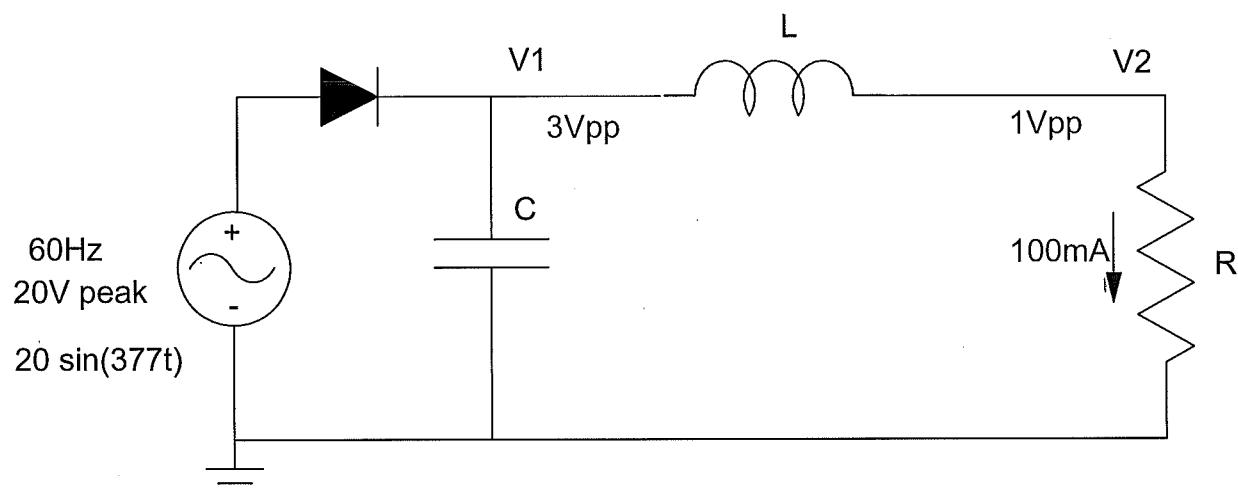
V1	I1	I2	I3	I4
2.1V	7.9mA	5.8mA	-7mA	1.4mA



4) For the following half-wave AC to DC converter, determine R, L, and C so that

- The average current to the load (R) is 100mA
- The ripple at V<sub>1</sub> is 3Vpp, and
- The ripple at V<sub>2</sub> is 1Vpp.

R Current = 100mA (DC)	C V <sub>1</sub> (AC) = 3Vpp	L V <sub>2</sub> (AC) = 1Vpp
178Ω	555μF	1.46H



AC Wall Transformer

$$R \approx \underline{19.3V}$$

$$V_1(\text{DC}) = \text{avg}(19.3, 16.3)$$

$$V_1(\text{DC}) = 17.8V$$

$$\omega L = 3R$$

$$L = \frac{3 \cdot 178}{377}$$

$$L = 1.46H$$

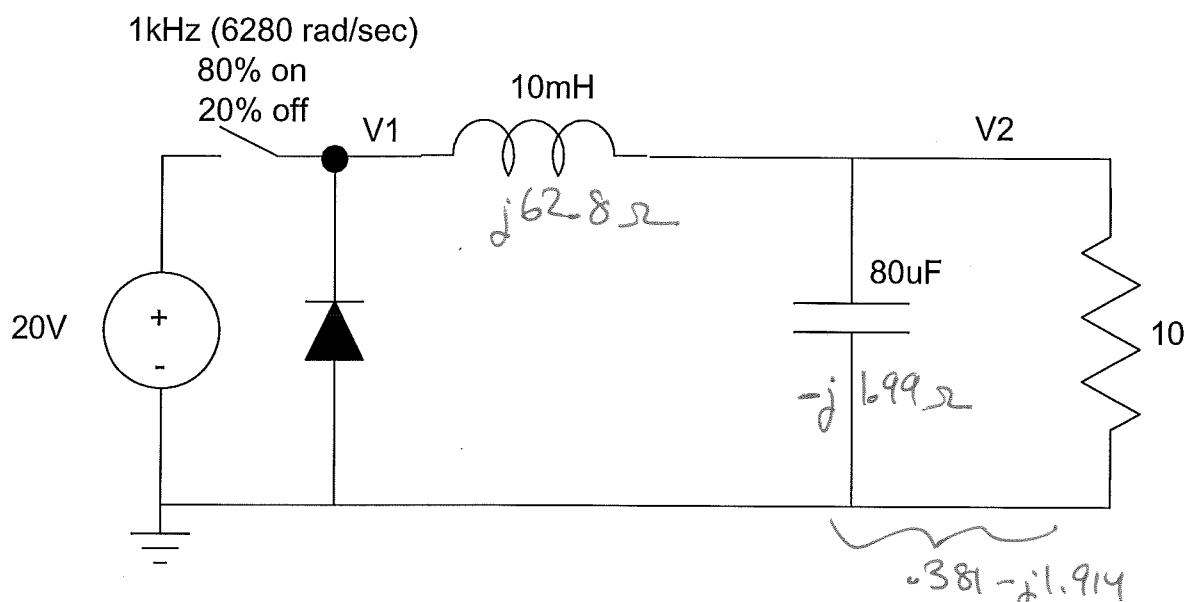
$$I = C \frac{dV}{dt}$$

$$\omega I = C \frac{3}{160}$$

$$C = 555\mu F$$

5) Determine the voltages for the following Buck converter. Assume ideal silicon diodes ( $V_f = 0.7V$ )

V1		V2	
V1 (max)	V1pp (AC)	V2(avg) ( DC )	V2pp (AC)
20V	20.7V <sub>pp</sub>	15.86V	.664V <sub>pp</sub>



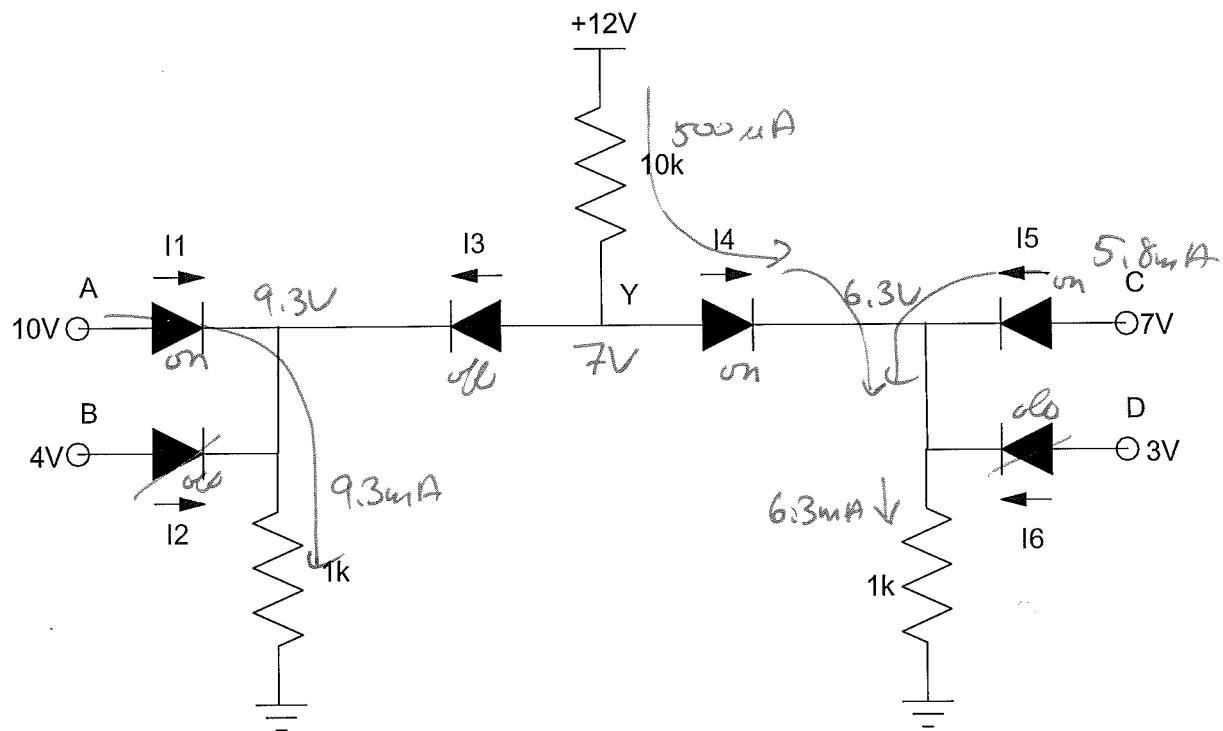
$$V_{2(\text{oc})} = -0.8 \times 20 + -2 \times (-0.7) = 15.86V$$

$$\left( \frac{(0.381 - j1.914)}{(0.381 - j1.914) + (j62.8)} \right) \cdot 20.7V_{pp}$$

$$.664V_{pp}$$

6) Determine the voltage and currents for the following max / min circuit

I1	I2	I3	I4	I5	I6
9.3mA	O	O	500μA	5.8mA	O



Bonus! Coal has an energy return of 80:1 (for every kWh of energy you put into mining coal, you get 80 kWh of energy back). What is the energy return of Alberta Tar Sands?

~~2010~~ 5.23:1 (2010 data)