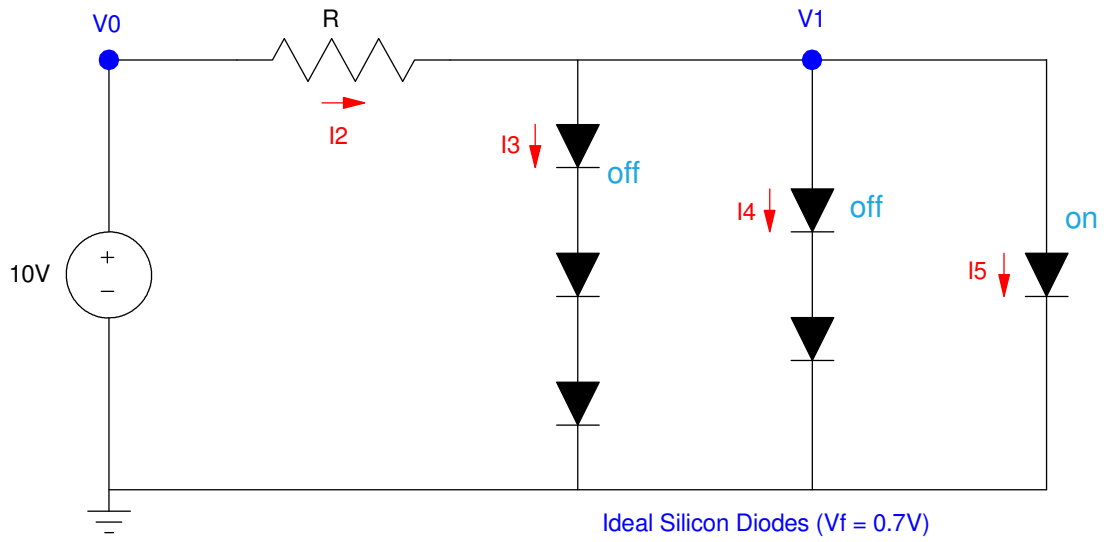
ECE 320 - Quiz #3 - Name _____

Ideal Diodes, LEDs, AC to DC Converters - Spring 2022

1) Determine the voltages and currents for the following circuit. Assume

- R is 900 + 100*(your birth month) + (your birthday). For example, May 14 = 1414 Ohms)

R 900 + 100*mo + day	V1	I2	I3	I4	I5
1414	**0.7V**	**6.577mA**	**0**	0	**6.577mA**

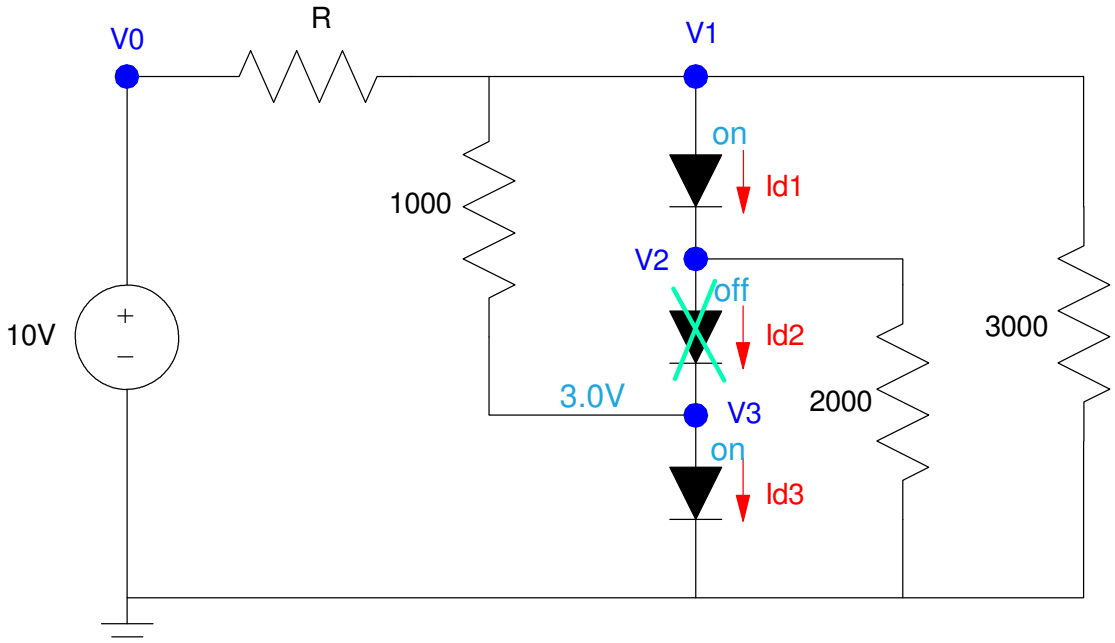


$$I_2 = \left(\frac{10V - 0.7V}{1414\Omega}\right) = 6.577mA$$

2) Determine the voltages and currents for the following circuit. Assume

- Ideal green LEDs (Vf = 3.0V).
- R is 900 + 100*(your birth month) + (your birthday).

V1	V2	V3	Id1	Id2	Id3
4.555V	**1.555V**	**3.0V**	**0.778mA**	**0**	**1.555mA**



If all three diodes are on

V3 = 3V, V2 = 6V, V1 = 9V

Current in doesn't match current out

$$\text{Current in} = \left(\frac{10V-9V}{1414\Omega}\right) = 707\mu A$$

$$\text{Current Out} = \left(\frac{9V}{3k\Omega}\right) + \ldots = 3mA + \ldots$$

At least one diode is off.

- If V0 = 0V, all three diodes are off
- Once V1 rises above 3V, Diode 1 turns on and Diode 3 turns on
- Assume diodes 1 and 3 are on

V1 is then

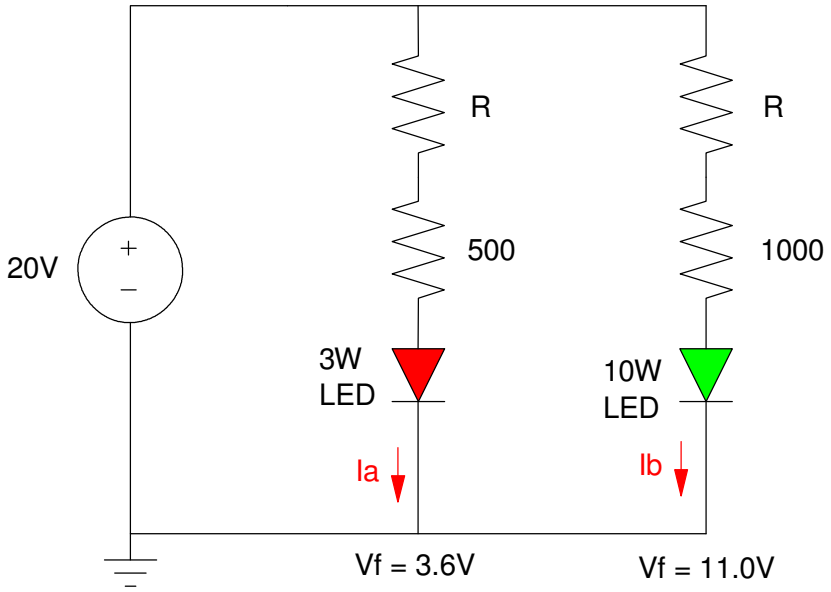
$$\left(\frac{V_1-10}{1414}\right) + \left(\frac{V_1-3}{1000}\right) + \left(\frac{V_1}{3000}\right) + \left(\frac{V_1-3}{2000}\right) = 0$$

$$V_1 = 4.555V$$

3) A green and white LED are connected to a 10V source. Determine the current and brighness of each LED. Assume

- R is 900 + 100*(your birth month) + (your birthday).
- 3W LED: Vf = 3.6V @ 750mA 180 Lumens @ 750mA
- 10W LED Vf = 11.0V @ 1000mA 650 Lumens @ 1000mA

R 900 + 100*mo + day	3W LED		10W LED	
	Ia	Lumens	Ib	Lumens
1414	**8.568mA**	**2.056**	**3.728mA**	**2.423**



$$I_a = \left(\frac{20-3.6}{1414+500}\right) = 8.568mA$$

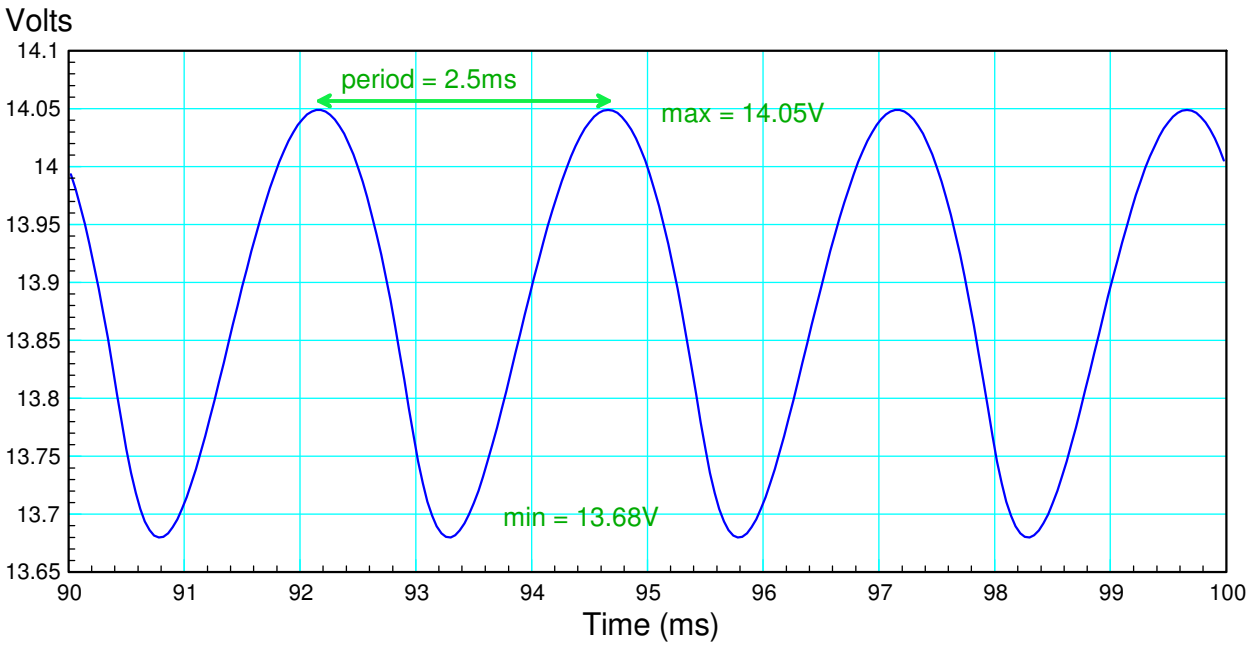
$$\left(\frac{8.568mA}{750mA}\right) 180\ Lumens = 2.056\ Lumens$$

$$I_b = \left(\frac{20V-11.0V}{1414\Omega+1000\Omega}\right) = 3.728mA$$

$$\left(\frac{3.728mA}{1000mA}\right) 650\ Lumens = 2.423\ Lumens$$

4) The following waveform is found using CircuitLab for an AC to DC converter. Determine the following

Frequency (Hz)	V2	
	DC (average)	AC (Vpp)
400 Hz	**13.87V**	**370mVpp**



$$f = \frac{1}{period} = \frac{1}{2.5ms} = 400Hz$$

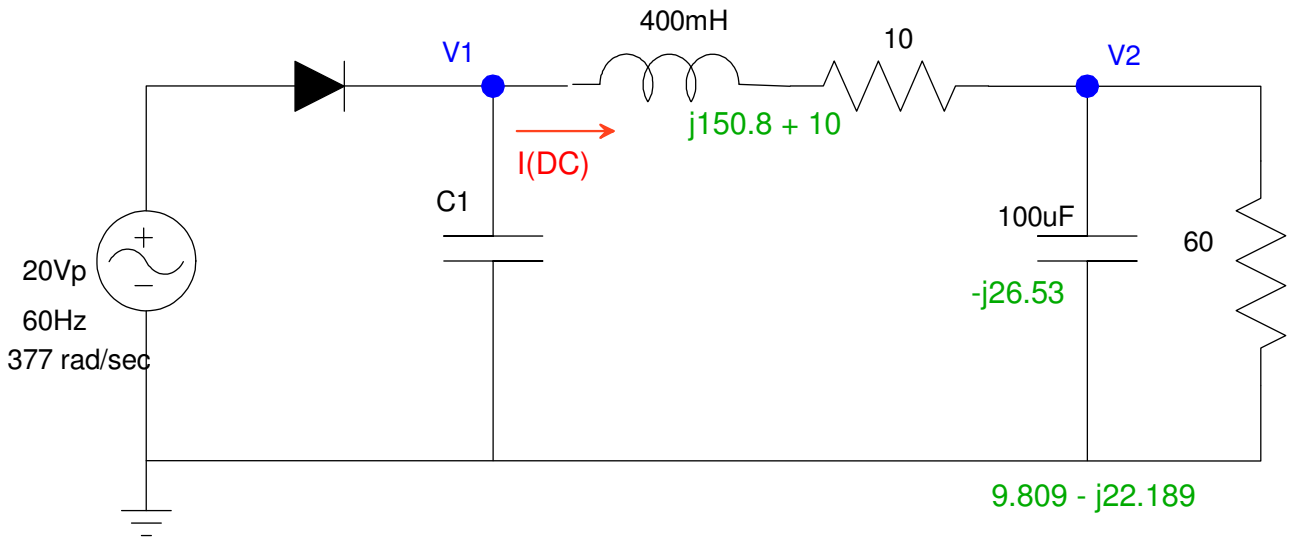
$$AC = \max - \min = 370mV_{pp}$$

$$DC \approx \left(\frac{\max + \min}{2}\right) = 13.87V$$

5) Determine the voltages V1 and V2 (both DC and AC). Assume

- Ideal silicon didoes (Vf = 0.7V)
- C1 = (900 + 100*(your birth month) + (your birthday))uF.

C1 (uF) 900 + 100*mo + day	V1		V2	
	DC	AC (V1pp)	DC	AC (V2pp)
1414uF	**17.68V**	**3.250Vpp**	**15.154V**	**0.606Vpp**



$$\max(V_1) = 19.3V$$

$$I \approx \left(\frac{19.3V}{70\Omega}\right) = 275.7mA \qquad \text{worst case}$$

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

$$275.7mA = 1414\mu F \cdot \frac{dV}{1/60s}$$

$$dV = 3.250V_{pp} = V_1(AC)$$

$$V_1(DC) = 19.3V - \tfrac{1}{2}V_1(AC) = 17.68V$$

$$V_2(DC) = \left(\frac{60}{60+10}\right) V_1(DC) = 15.154V$$

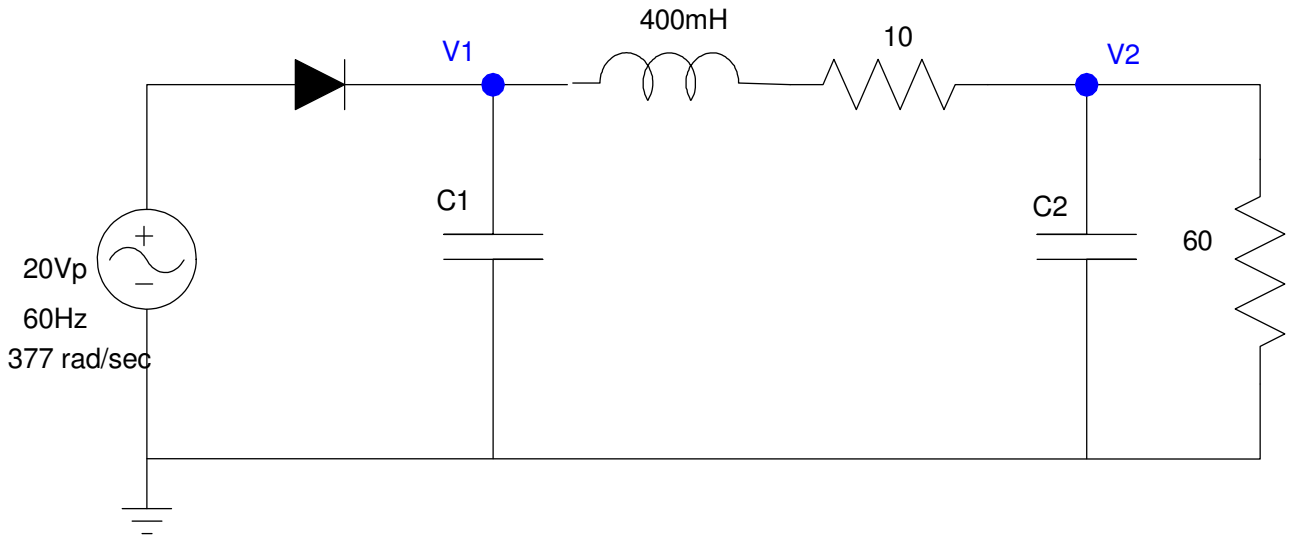
$$V_2(AC) = \left(\frac{(9.809 - j22.189)}{(9.809 - j22.189)+(10+j150.8)}\right) V_1(AC)$$

$$V_2(AC) = 0.606V_{pp}$$

6) Determine C1, and C2 so that

- The ripple at V1 is 4Vpp and
- The ripple at V2 = 500mVpp

C1	C2
1030uF	**127.6uF**



$$V_1(DC) = 19.3V - \tfrac{1}{2} \cdot 4V_{pp} = 17.3V$$

$$I = \left(\frac{17.3V}{70\Omega}\right) = 247mA$$

$$247mA = C_1 \cdot \frac{4V}{1/60s}$$

$$C_1 = 1030\mu F$$

Assume C2 = 0

$$V_2(AC) = \left(\frac{60}{60+(10+j150.8)}\right) 4V_{pp} = 1.444V_{pp}$$

$$\left|\frac{1}{j\omega C_2}\right| = \left(\frac{0.5V_{pp}}{1.444V_{pp}}\right) 60\Omega = 20.782\Omega$$

$$C_2 = 127.6\mu F$$