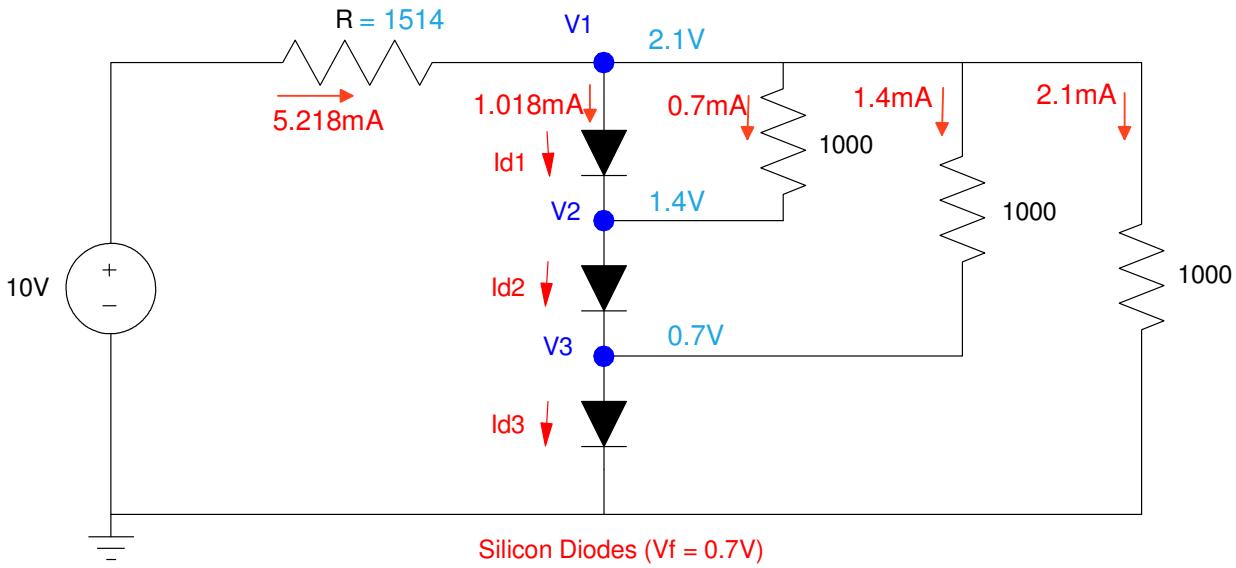
ECE 320 - Quiz #3 - Name _____

Ideal Diodes, LEDs, AC to DC Converters - Spring 2021

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

- Ideal silicon diodes (Vf = 0.7V).
- R is 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)

V1	V2	V3	Id1	Id2	Id3
2.1V	**1.4V**	**0.7V**	**1.018mA**	**1.718mA**	**3.118mA**



To find Id1, do a voltage node equation at V1

Current In = Current Out

$$\left(\frac{10V-2.1V}{1514}\right) = I_{d1} + \left(\frac{2.1V-1.4V}{1000}\right) + \left(\frac{2.1V-0.7V}{1000}\right) + \left(\frac{2.1V}{1000}\right)$$

$$5.218mA = I_{d1} + 0.7mA + 1.4mA + 2.1mA$$

$$I_{d1} = 1.018mA$$

At node V2,

Current In = Current Out

Id2 = Id1 + 0.7mA

At node V3,

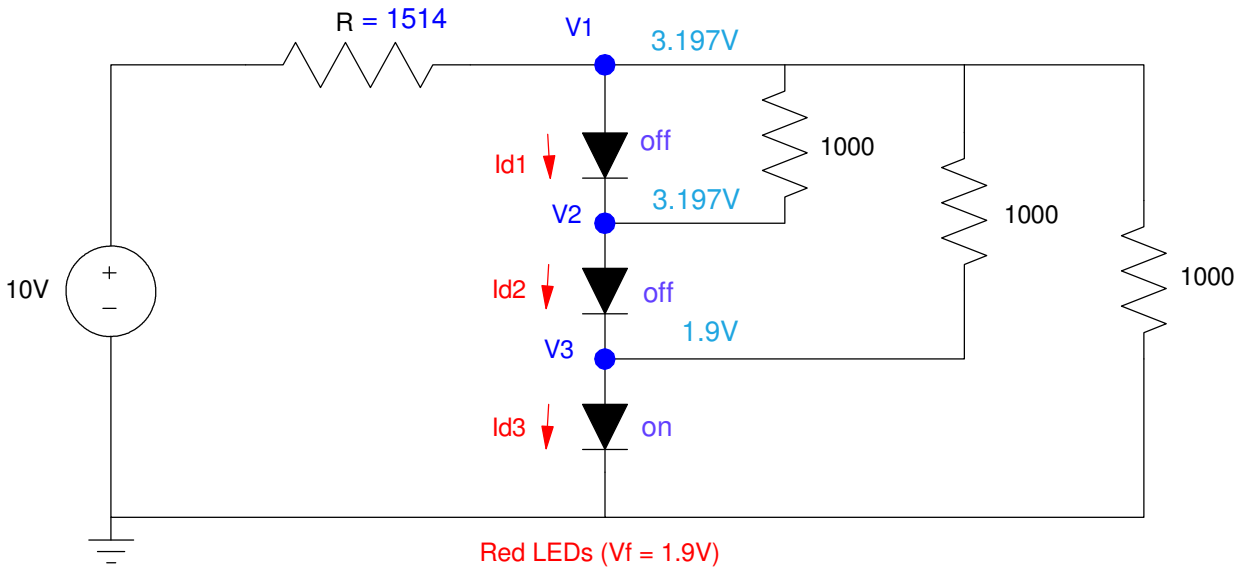
Current In = Current Out

Id3 = Id2 + 1.4mA

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

- Ideal red diodes (Vf = 1.9V).
- R is 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)

V1	V2	V3	Id1	Id2	Id3
3.198V	**3.197V**	**1.9V**	**0**	**0**	**1.297mA**



Assume diode #1 is off

$$\left(\frac{10-V_1}{1514}\right)=\left(\frac{V_1-3.8}{1000}\right)+\left(\frac{V_1-1.9}{1000}\right)+\left(\frac{V_1}{1000}\right)$$

$$V_1 = 3.362V$$

can't be: V1 must be greater than 3.8V for diode #2 to be on

Assume diode #1 and #2 are off

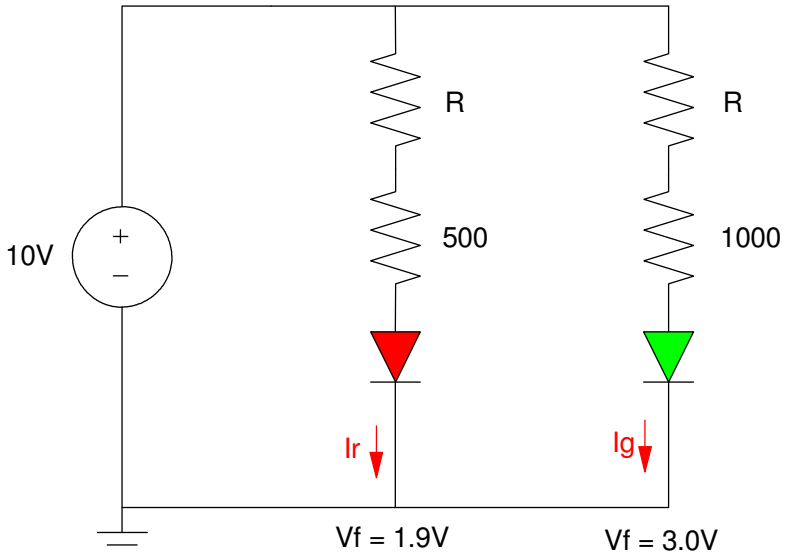
$$\left(\frac{10-V_1}{1514}\right)=\left(\frac{V_1-1.9}{1000}\right)+\left(\frac{V_1}{1000}\right)$$

$$V_1 = 3.197V$$

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

- R is 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)
- Red LED: Vf = 1.9V @ 20mA, 3,000mcd @ 20mA
- Green LED: Vf = 3.0V @ 20mA, 3,000mcd @ 20mA

R	Red LED		Green LED	
	Ir	mcd(red)	Ig	mcd(green)
1514	**4.022mA**	**603.3**	**2.784mA**	**417.7**

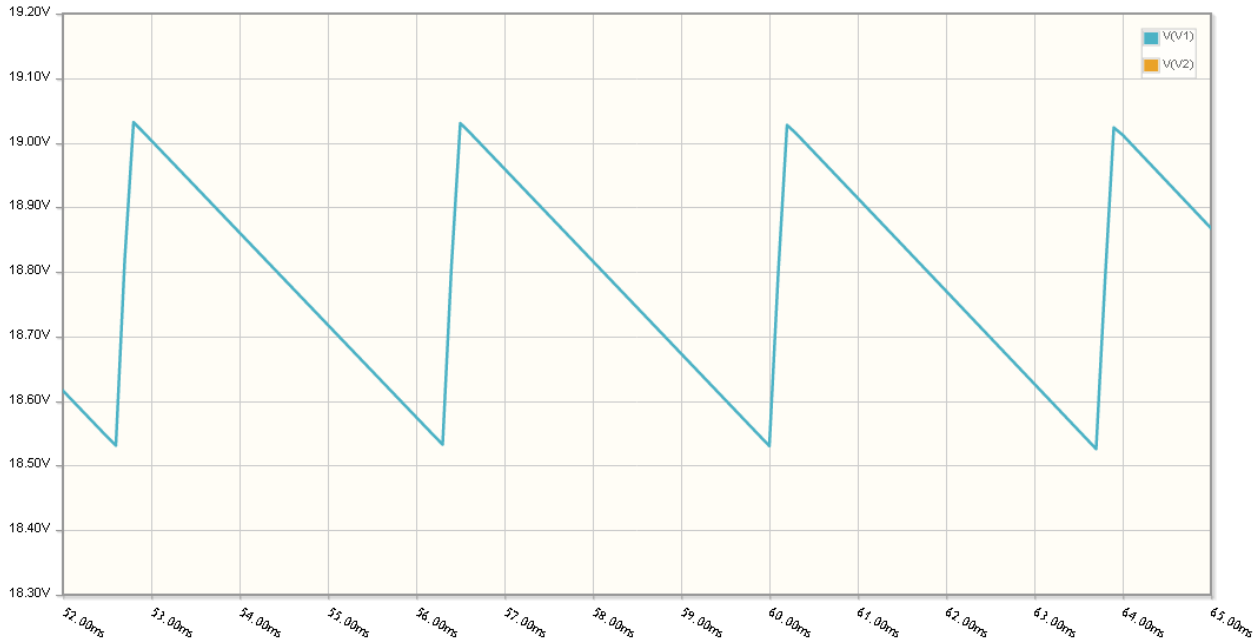


$$I_r = \left(\frac{10V-1.9V}{R+500}\right) = 4.022mA \qquad I_g = \left(\frac{10V-3.0V}{R+1000}\right) = 2.784mA$$

$$\left(\frac{4.022mA}{20mA}\right)3000mcd = 603.3mcd \qquad \left(\frac{2.784mA}{20mA}\right)3000mcd = 417.7mcd$$

4) The following waveforms are found using CircuitLab for V1 for an AC to DC converter. Determine the following

Frequency (Hz)	V1 (blue waveform)	
	DC (average)	AC (Vpp)
270 Hz	**18.78 V**	**490mVpp**



Period = (56.3ms) - (52.6ms) = 3.7ms

freq = 1 / Period = 270Hz

max = 19.02V

min = 18.53V

DC = (max + min) / 2 = 18.78V

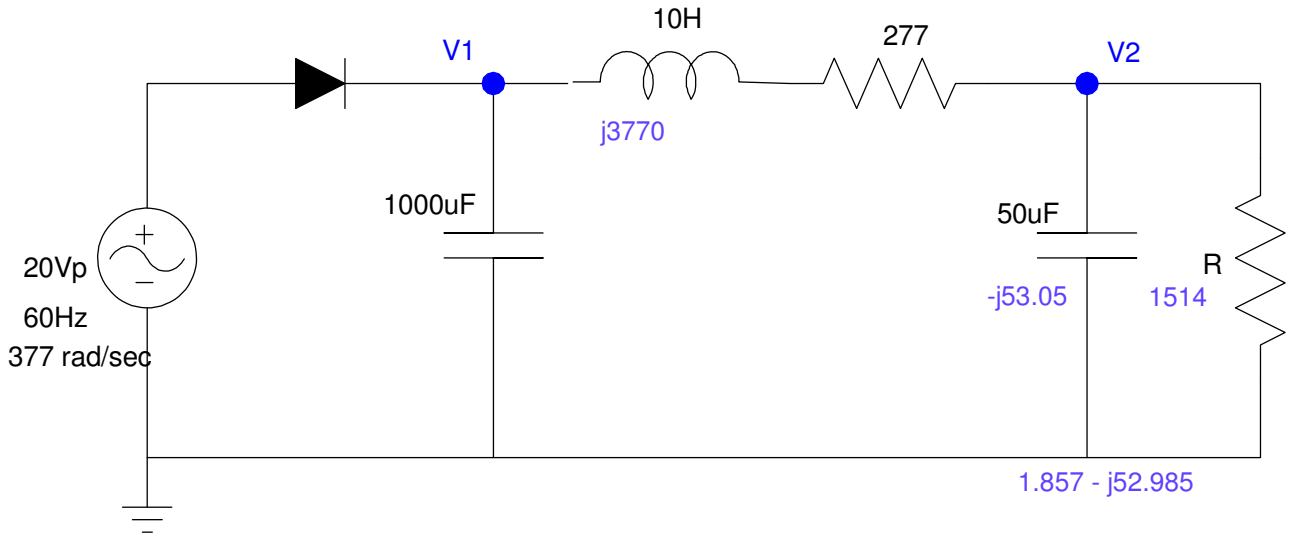
AC = (max - min) = 0.490Vpp

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

- Ideal silicon didoes (Vf = 0.7V)
- R is 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)

V1		V2	
DC (mean(V1))	AC (V1pp)	DC (mean(V2))	AC (V2pp)
19.21V	**179mVpp**	**16.24V**	**2.519mVpp**

all answers cary with R



max(V1) = 19.3V

$$I \approx \left(\frac{19.3V}{1514+277}\right) = 10.78mA$$

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

$$10.78mA = 1000\mu F\,\frac{dV}{1/60s}$$

$$dV = 179.6mV \qquad = V1pp$$

$$V_1(DC) = 19.3V - \tfrac{1}{2}179mV = 19.21V$$

$$V_2(DC) = \left(\frac{1514}{1514+277}\right)\cdot 19.21V = 16.24V$$

$$V_2(AC) = \left(\frac{(1.857-j52.985)}{(1.857-j52.985)+(277+j3770)}\right)(0.1796V_{pp})$$

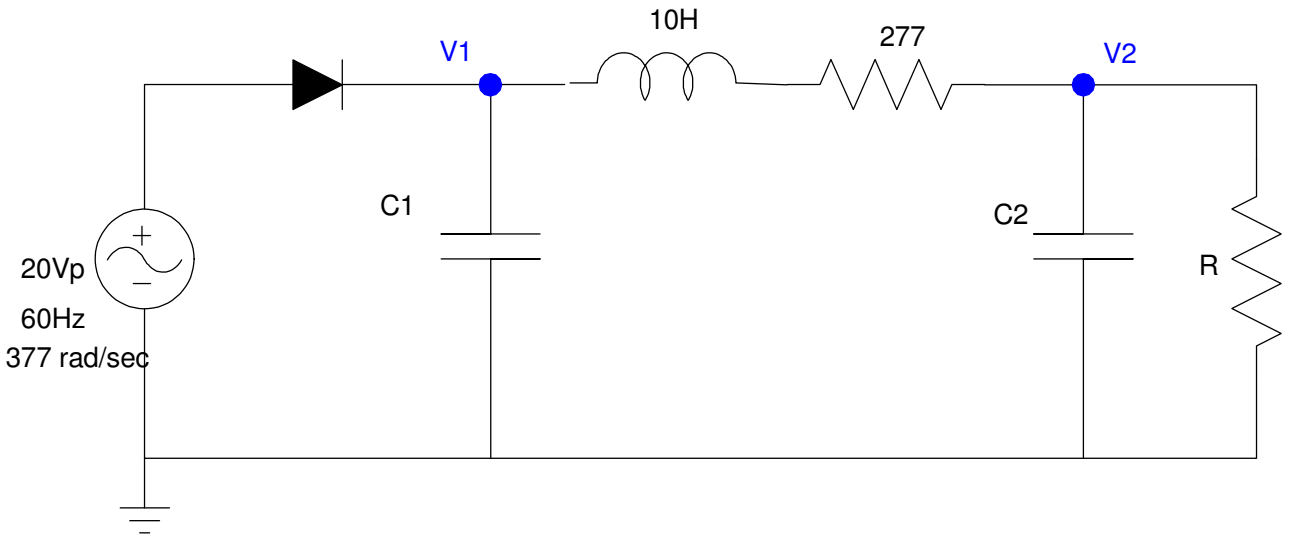
$$V_2(AC) = 2.519mV_{pp}$$

6) Determine C1, and C2 so that

- The ripple at V1 is 4Vpp and
- The ripple at V2 = 200mVpp

Let R be 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)

R	C1	C2
1514	**40.25uF** *varies with R*	**12.7uF** *varies with R*



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

$$I = \left(\frac{17.3V}{1514+277}\right) = 9.6594mA$$

$$I = C_1\frac{dV}{dt}$$

$$9.6594mA = C_1\left(\frac{4V}{1/60s}\right)$$

$$C_1 = 40.25\mu F$$

If C2 = 0

$$V_2 = \left(\frac{1514}{1514+(277+j3770)}\right)4V_{pp} = 1.451V_{pp}$$

$$\left|\frac{1}{j\omega C_2}\right| = \left(\frac{0.2V_{pp}}{1.451V_{pp}}\right)1514\Omega = 208.7\Omega$$

$$C_2 = 12.7\mu F$$