ECE 320 - Quiz #3 - Name _____

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

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

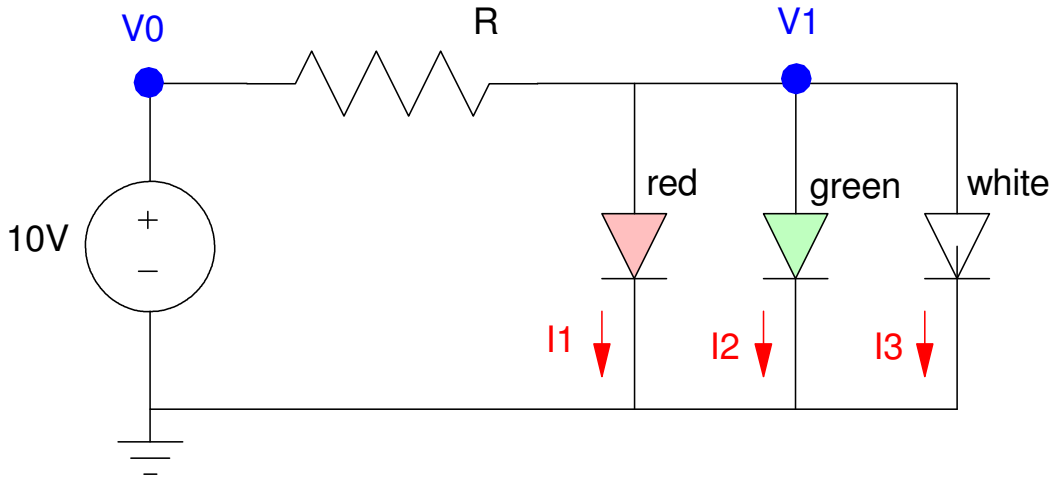
- R is 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)
- Red LED: Vf = 1.9V @ 20mA 8000 mcd @ 20mA
- Green LED: Vf = 3.0V @ 20mA 8000 mcd @ 20mA
- White LED: Vf = 5.2V @ 20mA 8000 mcd @ 20mA

R 1000 + 100*mo + day	V1	I1 (red LED)	I2 (green LED)	I3 (white LED)
1514	**1.9V** red LED wins	**5.25mA**	**0** off	**0** off

Only one LED can be on (V1 can't have three different values)

- The smallest Vf wins (this is a min() funciton)
- V1 = 1.9V

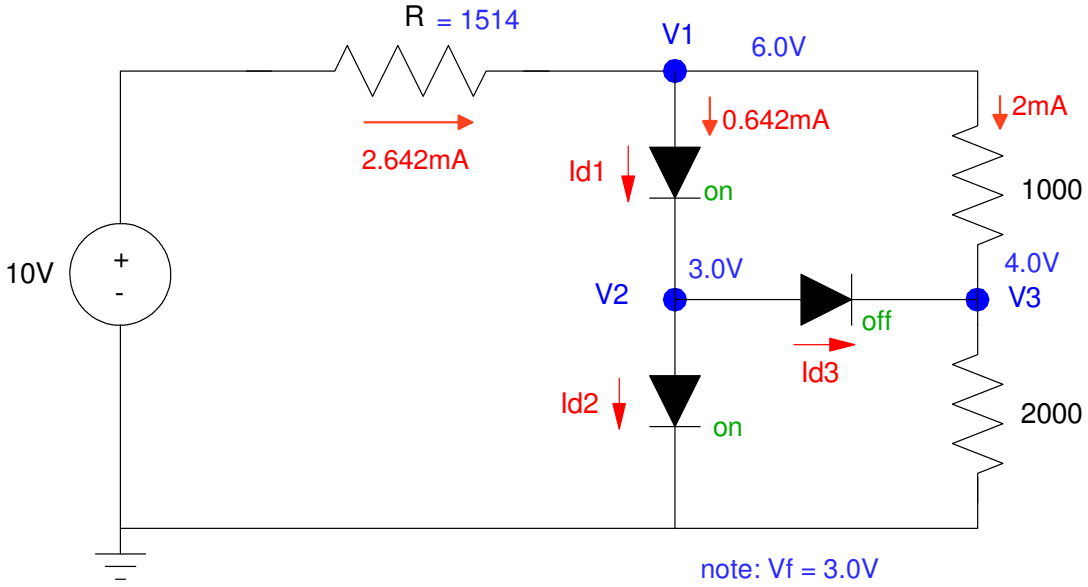
$$I_r = \left(\frac{10V - 1.9V}{1514\Omega}\right) = 5.35mA$$



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

- Ideal green LEDs (Vf = 3.0V).
- R is 1000 + 100*(your birth month) + (your birthday). For example, May 14 = 1514 Ohms)

V1	V2	V3	Id1	Id2	Id3
6.0V	**3.0V**	**4.0V**	**0.642mA**	**0.642mA**	**0** off



3) A green and white 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)
- Green LED: Vf = 3.0V @ 20mA, 8000mcd @ 20mA
- White LED: Vf = 5.2V @ 20mA, 8000mcd @ 20mA

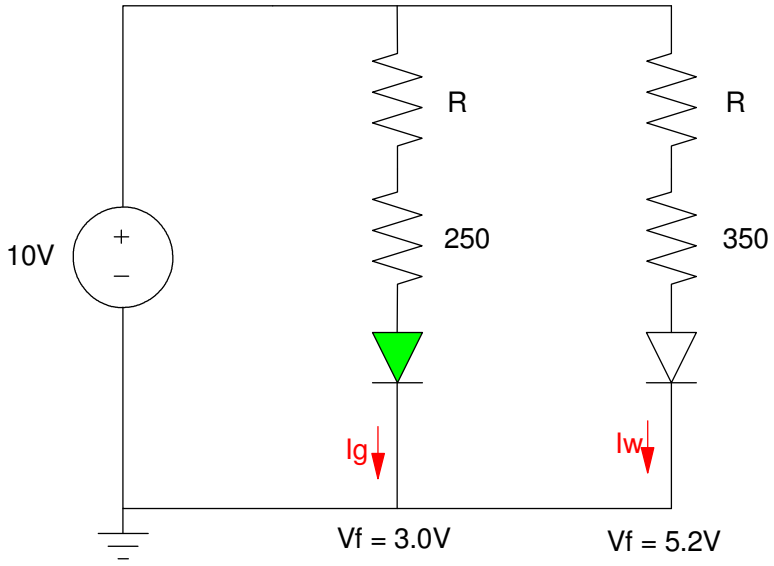
R	Green LED		White LED	
	Ig	mcd(green)	Iw	mcd(white)
1514	**4.084mA**	**1634 mcd**	**2.575mA**	**1073mcd**

$$I_g = \left(\frac{10V-3.0V}{1514+200}\right) = 4.084mA$$

$$\text{light}=\left(\frac{4.084mA}{20mA}\right)8000mcd = 1634mcd$$

$$I_w = \left(\frac{10-5.2}{1514+350}\right) = 2.6824mA$$

$$\text{light}=\left(\frac{2.6824mA}{20mA}\right)8000mcd = 1073mcd$$



4) The following waveforms are found using CircuitLab for V2 for an AC to DC converter. Determine the following

Frequency (Hz)	V2 (blue waveform)	
	DC (average)	AC (Vpp)
40 Hz	**13.80 V**	**0.90 Vpp**

Period = (180ms - 155ms) = 25ms

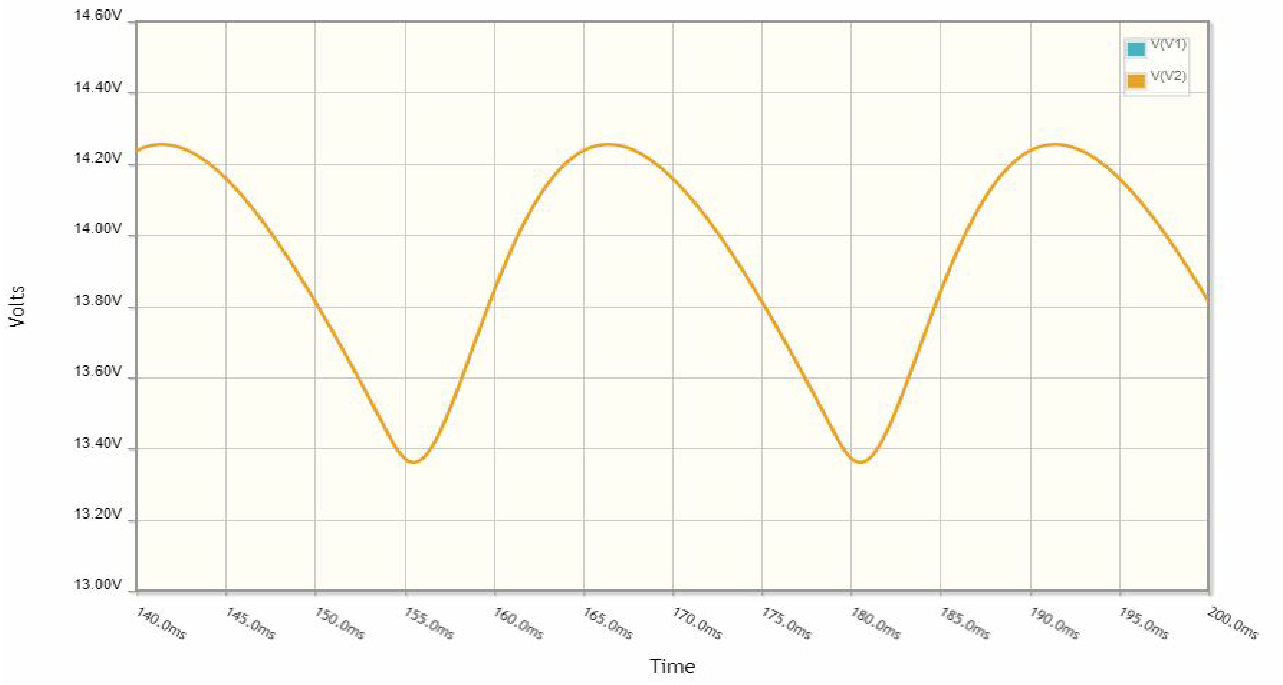
f = 1 / Period = 40Hz

max = 14.25V

min = 13.35V

DC = (max + min) / 2 = 13.80V

AC = max - min = 0.90Vpp



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)
18.89V	**0.8227Vpp**	**18.28V**	**0.2887Vpp**

V1

max(V1) = 20V - 0.7V (diode) = 19.3V

$$I \approx \left(\frac{19.3V}{1514+50}\right) = 12.34mA$$

$$I = C\left(\frac{dV}{dt}\right)$$

$$12.34mA = 250\mu F\left(\frac{dV}{1/60s}\right)$$

$$dV = 0.8227V = V_{1pp}$$

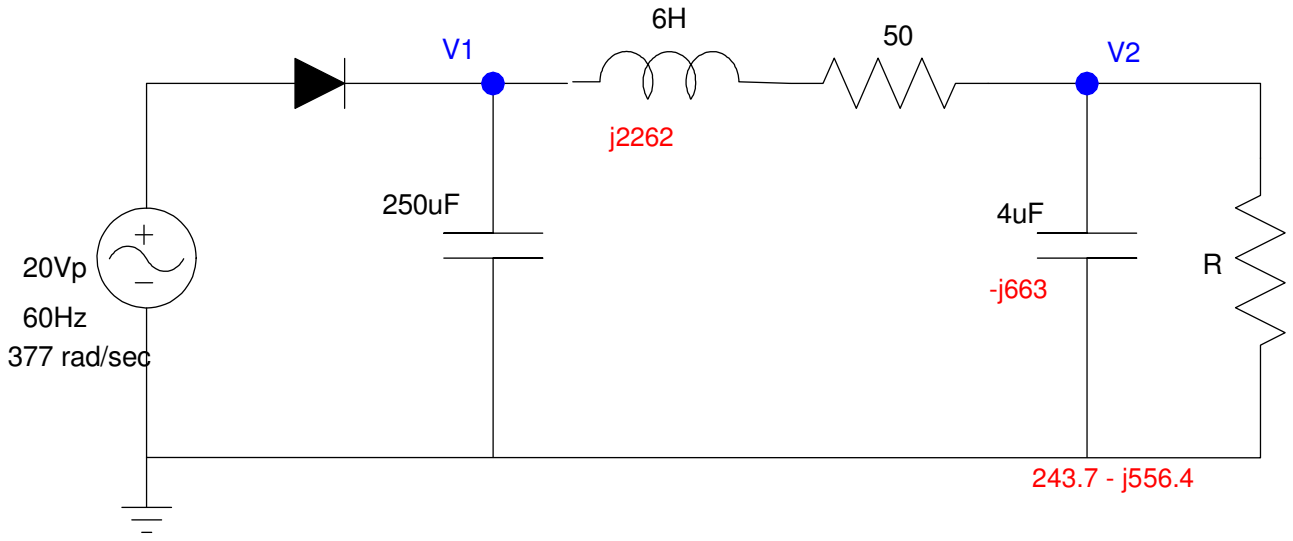
$$V_1(DC) = 19.3V - \frac{1}{2}(0.8227V) = 18.89V$$

V2:

$$V_2(DC) = \left(\frac{1514}{1514+50}\right)18.89V = 18.28V$$

$$V_2(AC) = \left(\frac{(243.7-j556.4)}{(243.7-j556.4)+(50+j2262)}\right)(0.8227V_{pp})$$

$$|V_2(AC)| = 0.2887V_{pp}$$

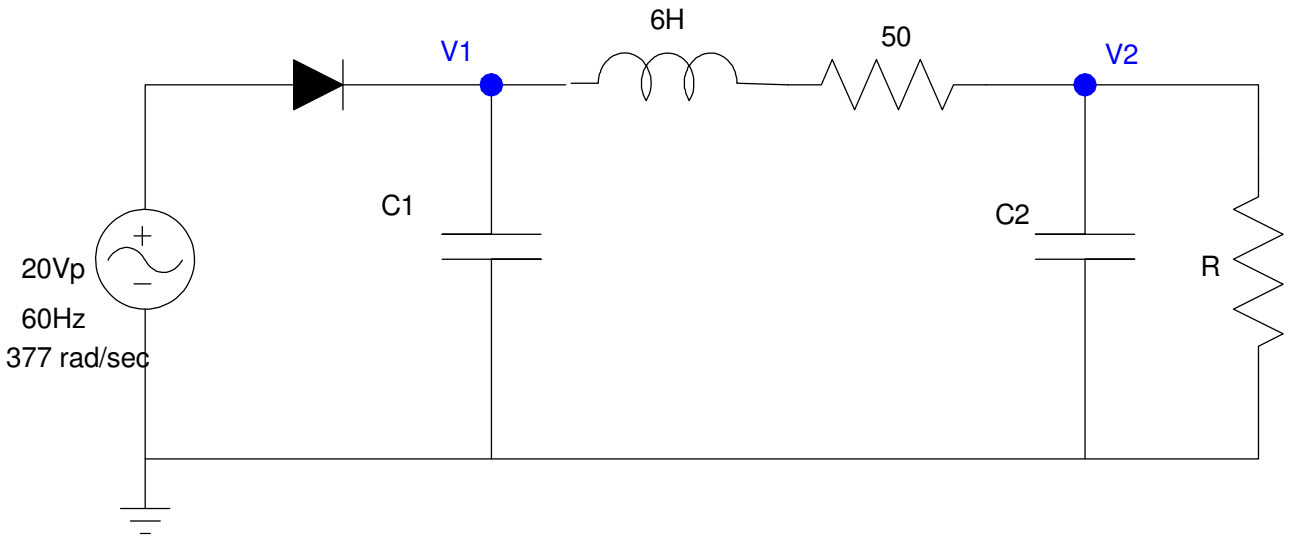


6) Determine C1, and C2 so that

- The ripple at V1 is 3Vpp and
- The ripple at V2 = 500mVpp

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

R	C1	C2
1514 Ohms	**63.23uF**	**5.787uF**



$$V_1(DC) = 19.3V - \tfrac{1}{2}(3V_{pp}) = 17.80V$$

$$I = \left(\frac{17.80V}{1514+50}\right) = 11.38mA$$

$$I = C_1\left(\frac{dV}{dt}\right)$$

$$11.38mA = C_1\left(\frac{3V_{pp}}{1/60s}\right)$$

$$C_1 = 63.23\mu F$$

Assume C2 = 0. The ripple a V2 is then

$$V_2(AC) = \left(\frac{1514}{(1514)+(50+j2262)}\right)(3V_{pp}) = 1.652V_{pp}$$

To reduce this to 0.5Vpp, C2 needs to have an impedance of

$$\left|\frac{1}{j\omega C_2}\right| = \left(\frac{0.5V_{pp}}{1.652V_{pp}}\right)1514\Omega = 458\Omega$$

$$C_2 = 5.787\mu F$$