ECE 320 - Quiz #6 - Name _____

H Bridges, DC to DC Converters

H-Bridge Analysis:

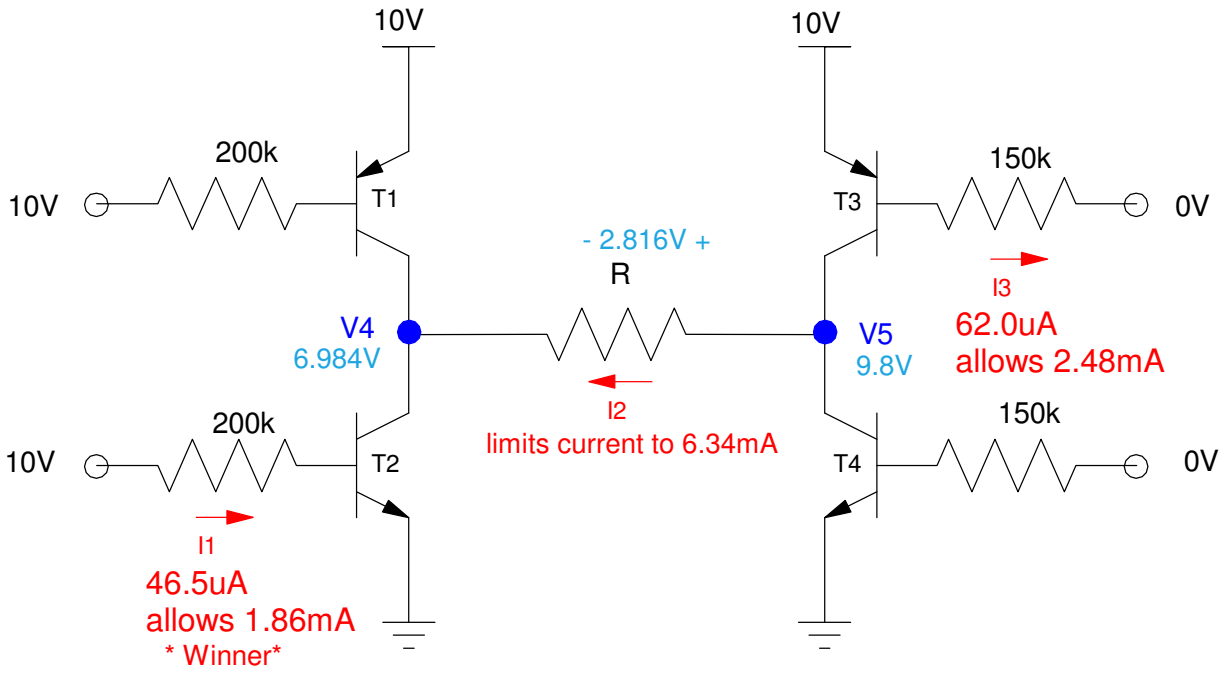
1) Determine the voltages and currents for the following H-bridge. Assume ideal transistors:

- |Vbe| = 0.7V
- |Vce| = 0.2V
- Current Gain = β = 40

Let R = 1000 + 100*(Birth Month) + Birth Day. May 14th would give R = 1514 Ohms.

Determine the voltages and currents

R	I1	I2	I3	V4	V5
1514	**46.5uA**	**1.86mA**	**62.0uA**	**6.98V**	**9.8V**



H-Bridge Analysis:

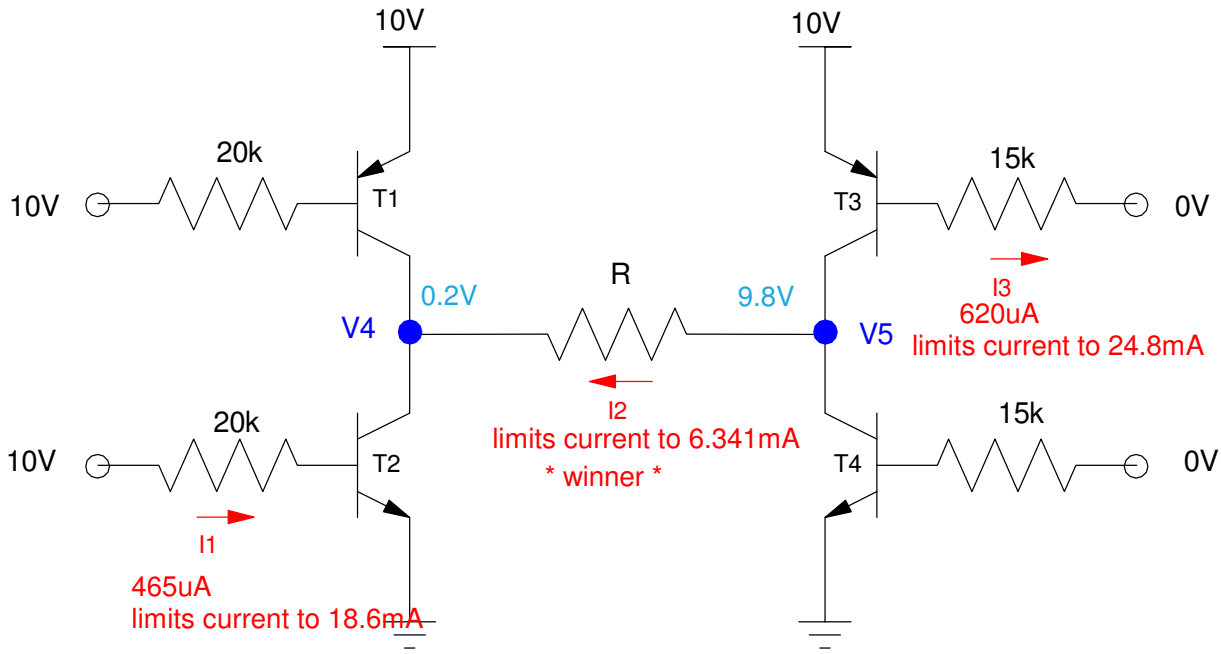
2) Determine the voltages and currents for the following H-bridge. Assume ideal transistors:

- |Vbe| = 0.7V
- |Vce| = 0.2V
- Current Gain = β = 40

Let R = 1000 + 100*(Birth Month) + Birth Day. May 14th would give R = 1514 Ohms.

Determine the voltages and currents

R	I1	I2	I3	V4	V5
1514	**465uA**	**6.341mA**	**620uA**	**0.2V**	**9.8V**

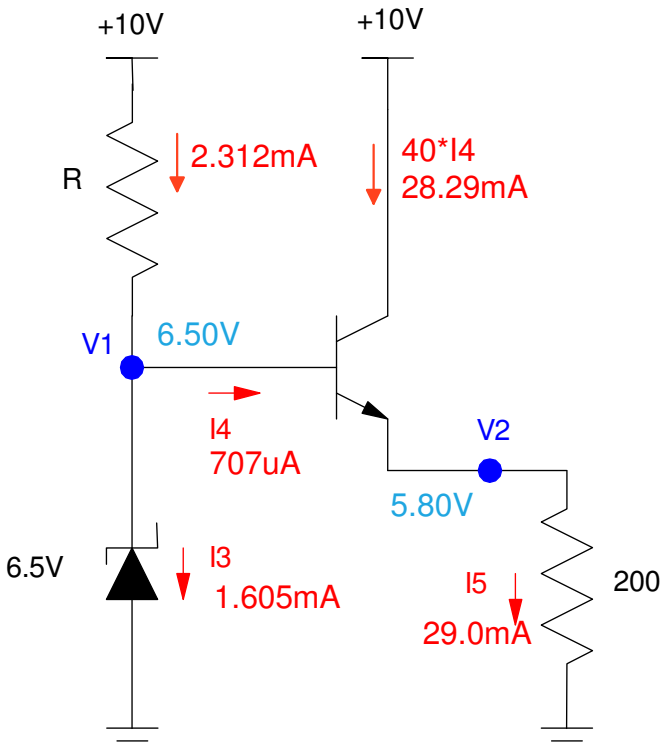


DC to DC Converter: (7805)

3) Determine the voltages and currents for the following DC to DC converter with a 6.5V zener diode. Assume

- |Vbe| = 0.7V
- |Vce(sat)| = 0.2V
- Current Gain = β = 40
- R = 1000 + 100*(Birth Month) + Birth Day. May 14th would give R = 1514 Ohms.

R	V1	V2	I3	I4	I5
1514	**6.50V**	**5.80V**	**1.605mA**	**0.707mA**	**29.0mA**



The zener diode sets V1 = 6.50V

The diode in the transistor sets V2 = 5.80V

Transistor is in the active region (Vce > 0.2V)

$$I_c = 40 I_b$$

$$I_c + I_b = 29.0mA$$

$$I_b = \frac{29.0mA}{41} = 0.707mA$$

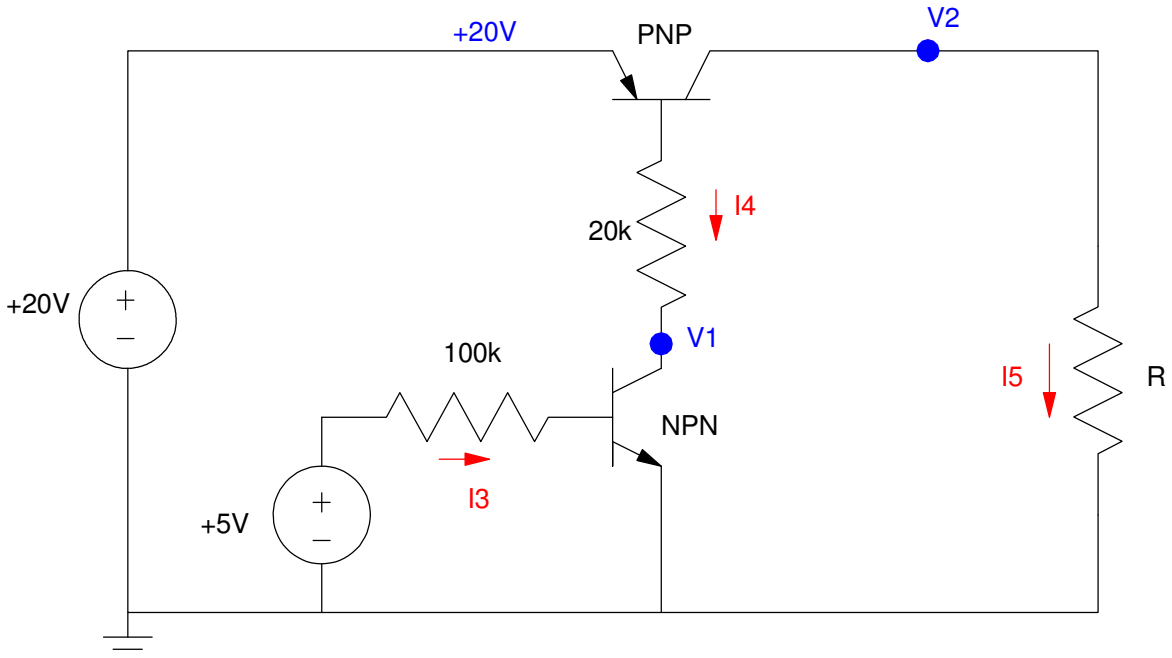
$$I_3 = 2.312mA - 0.707mA = 1.605mA$$

DC to DC Converter (take 2):

4) The following circuit implements the switch used on a Buck converter. Determine the voltages and currents. Assume

- |Vbe| = 0.7V
- |Vce(sat)| = 0.2V
- Current Gain = β = 40
- R = 1000 + 100*(Birth Month) + Birth Day. May 14th would give R = 1514 Ohms.

R	V1	V2	I3	I4	I5
1514	**0.2V** NPN is saturated	**19.8V** PNP is saturated	**43uA** 4.3V / 100k	**955uA** 19.1V / 20k	**13.08mA** 19.8V / R



Guess that the transistors are saturated

V1 = 0.2V (NPN is saturated)

V2 = 19.8V (PNP is saturated)

$I_3 = \frac{5V-0.7V}{100k} = 43.0uA$ *allows 1.72mA*

$I_4 = \frac{20V-0.7V-0.2V}{20k} = 0.955\mu A$ *check: 40*I3 > I4* *allows 38.2mA*

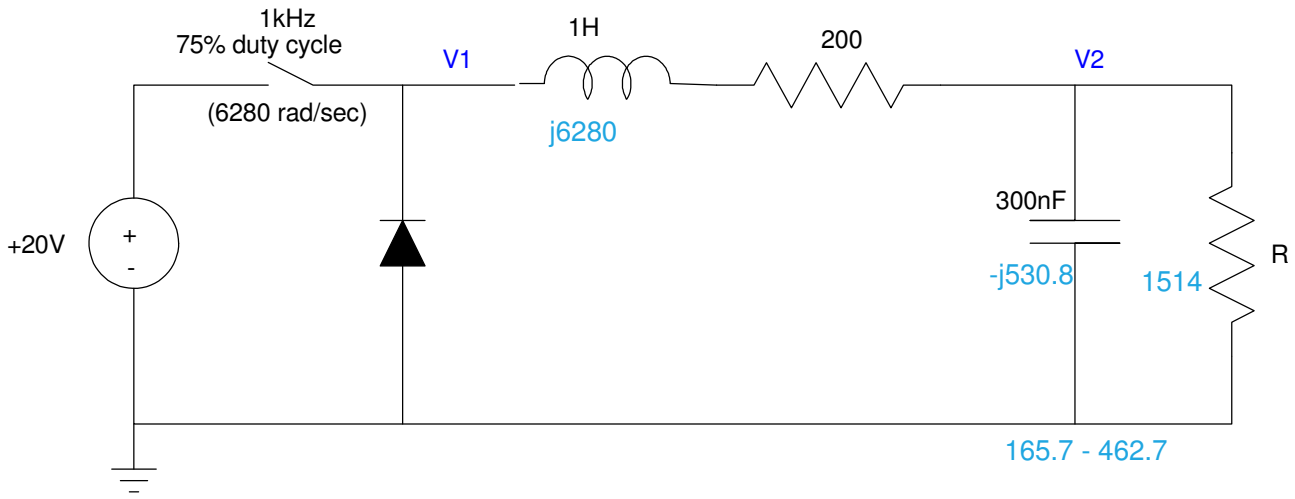
$I_5 = \frac{19.8V}{1514\Omega} = 13.08mA$ *check: 40*I4 > I5*

DC to DC Converter (take 3)

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

- R = 1000 + 100*(Birth Month) + Birth Day. May 14th would give R = 1514 Ohms.

R	V1		V2	
1514	V1(DC)	V1(AC)	V2(DC)	V2(AC)
	14.83V	**20.7Vpp**	**13.10V**	**1.782Vpp**



$$V_1(DC) = 0.75 \cdot 20V + 0.25 \cdot (-0.7V) = 14.83V$$

$$V_1(AC) = 20.7V_{pp}$$

$$V_2(DC) = \left(\frac{1514}{1514+200}\right) 14.83V$$

$$V_2(DC) = 13.10V$$

$$V_2(AC) = \left(\frac{(165.7-j462.7)}{(165.7-j462.7)+(200+j6280)}\right) 20.7V_{pp}$$

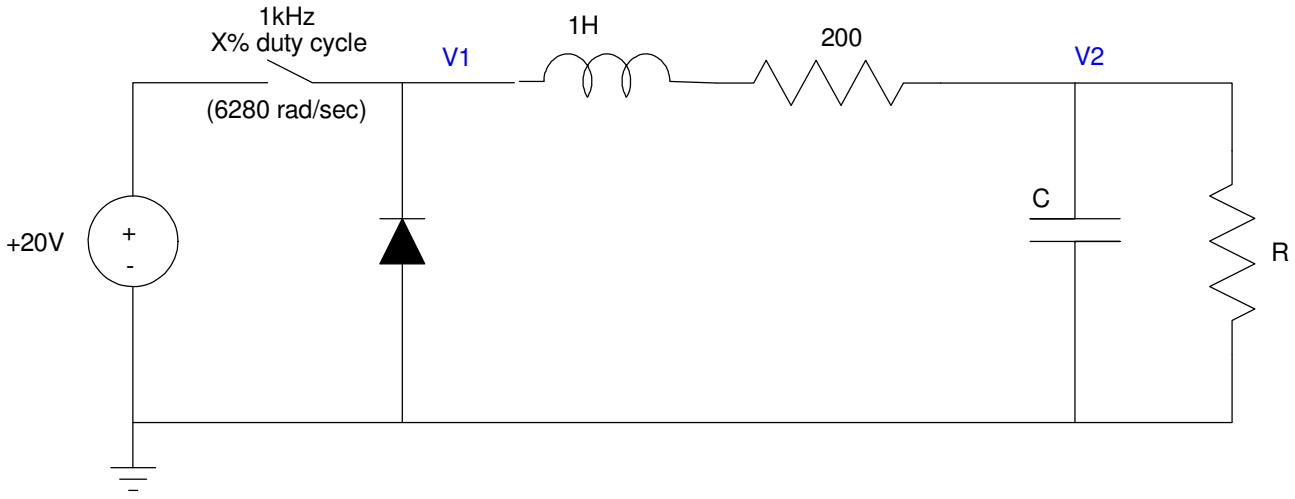
$$V_2(AC) = 1.782V_{pp}$$

DC to DC Converter: Design

6) Determine the duty cycle and C so that

- V2(DC) is 7.50V
- V2(AC) = 1.00Vpp
- R = 1000 + 100*(Birth Month) + Birth Day. May 14th would give R = 1514 Ohms.

X% (duty cycle) V2(DC) = 7.50V	C V2(AC) = 1.00Vpp	R 1000 + 100*Mo + Day
44.40%	**509nF**	**1514**



DC

$$V_1 = \left(\frac{1514+200}{1514}\right)7.5V = 8.49V$$

$$8.49V = X \cdot 20V + (1-X)(-0.7V)$$

$$X = \left(\frac{8.49+0.7}{20+0.7}\right) = 44.40\%$$

C: (method #1) Assume C = 0. The AC voltage at V2 will be

$$V_2 = \left(\frac{1514}{1514+(200+j6280)}\right)20.7V_{pp} = 4.814V_{pp}$$

For 1Vpp at V2

$$Z_c = \left|\frac{1}{j\omega C}\right| = \left(\frac{1V_{pp}}{4.814V_{pp}}\right)1514\Omega = 314.5\Omega$$

$$C = 509nF$$

C: Method #2

$$\left(\frac{(R||C)}{(R||C)+(200+j6280)}\right)20.7V_{pp} = 1V_{pp}$$

solving using numerical methods (trial and error)

$$C = 539.12nF$$