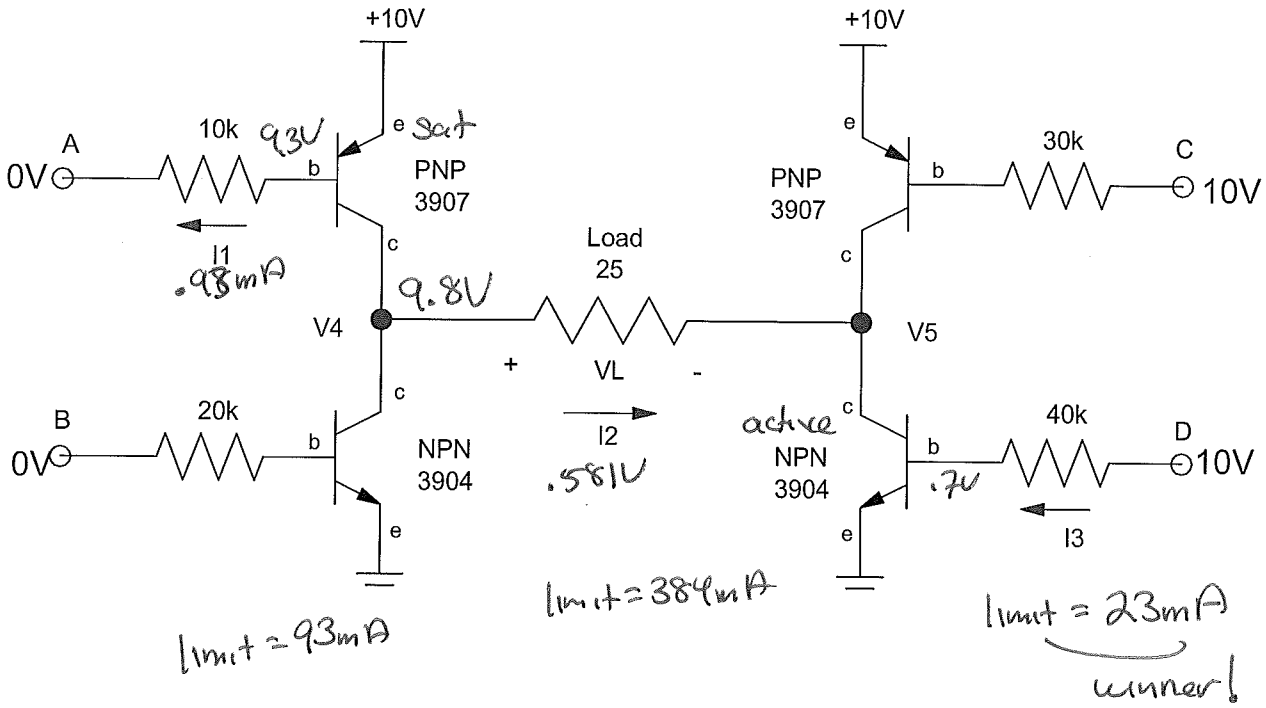
ECE 320: Quiz 6: Name _____

H-Bridges, DC to DC Converters. October 5, 2017

1) Determine the voltages and currents for the following H-bridge. Assume ideal silicon transistors with
   - $|V_{be}| = 0.7V$
   - $|V_{ce(sat)}| = 0.2V$
   - $\beta = 100$

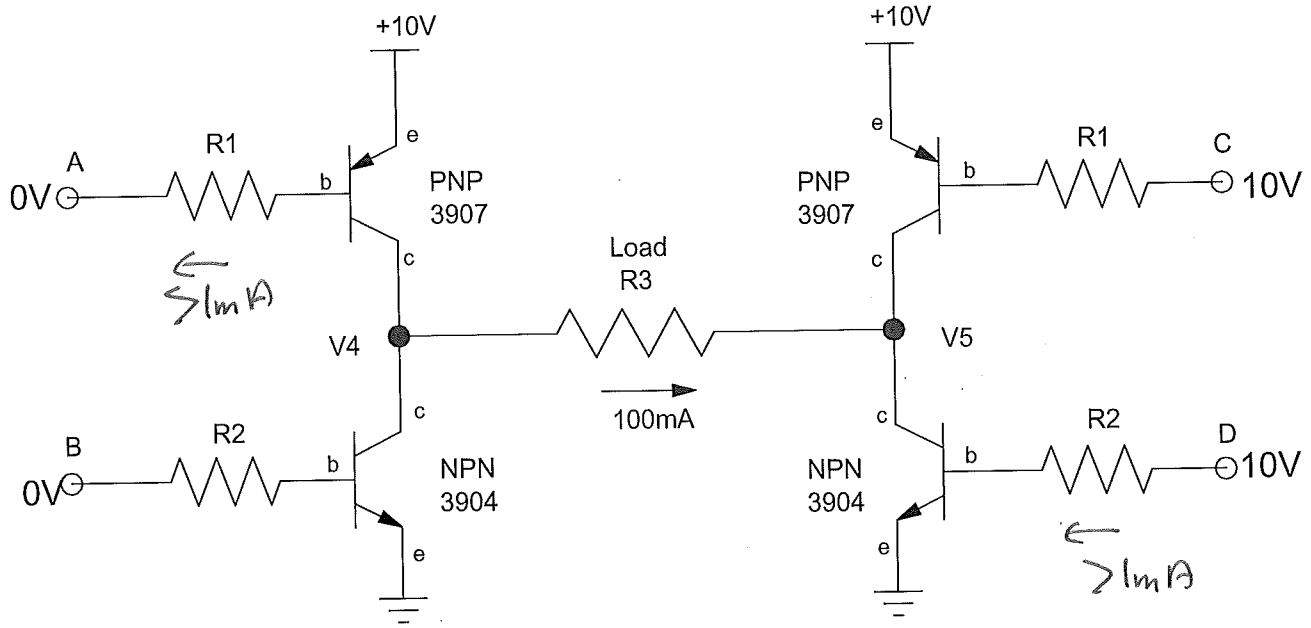
I1	I2	I3	V4	V5
.93mA	.23mA	23mA	9.8V	~~.78V~~ 9.02V



2) Find the value of R so that the following H-bridge delivers 100mA to the load. Also determine the resulting voltages at V4 and V5. Assume ideal silicon transistors with

- $|V_{be}| = 0.7V$
- $|V_{ce(sat)}| = 0.2V$
- $\beta = 100$

R1	R2	R3	V4	V5
465Ω	465Ω	96Ω	9.8V	0.2V



$\frac{9.6V}{100mA} = 96\Omega$

Let $I = 2mA$

$R = \frac{9.3V}{2mA} = 4650\Omega$

$372 < R < 9.3k$

↑ 25mA ↑ 1mA

3) A half H-bridge is shown below (it's mirror image would be to the right). To drive a 20V load with a 5V source, a second NPN transistor is used to turn on and off the PNP transistor. Determine the values of R1 and R2 required to turn on (saturate) the PNP transistor for a 100mA load and the resulting voltage you'll see at V3. Assume

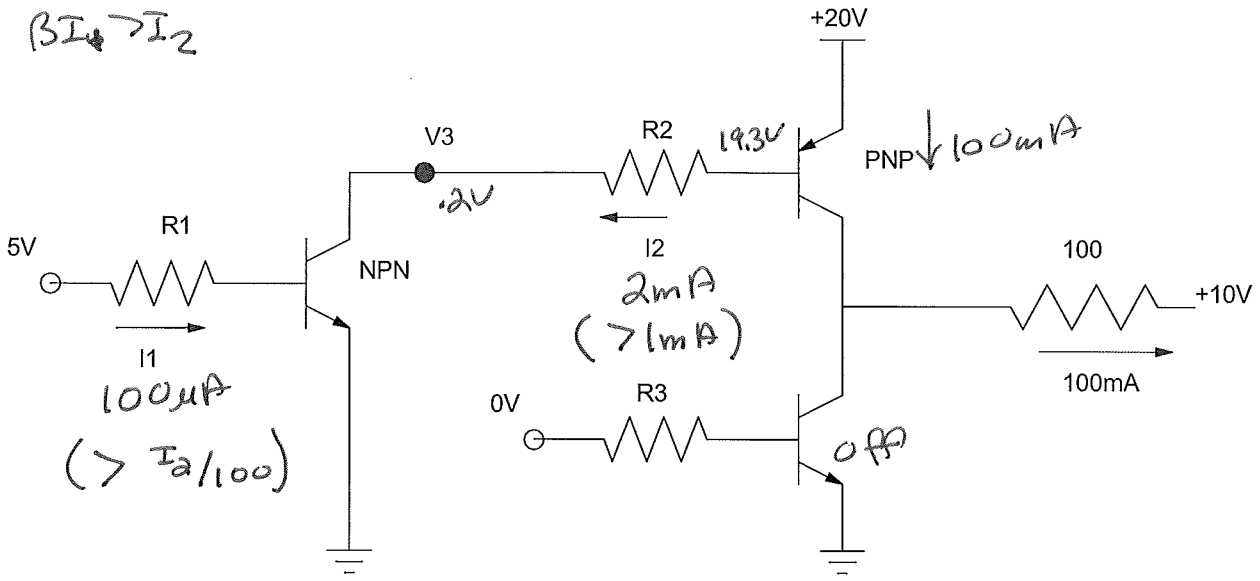
- $|Vbe| = 0.7V$
- $|Vce(sat)| = 0.2V$
- $\beta = 100$

R1	R2	V3
43k	9.5k	0.2V

depends on R_2

$\beta I_1 > I_2$

$372 < R_2 < 19.1k$



$I_2 > 1mA$

Let $I_2 = 2mA$

$R_2 = \frac{19.3V - .2V}{2mA} = 9.5k$

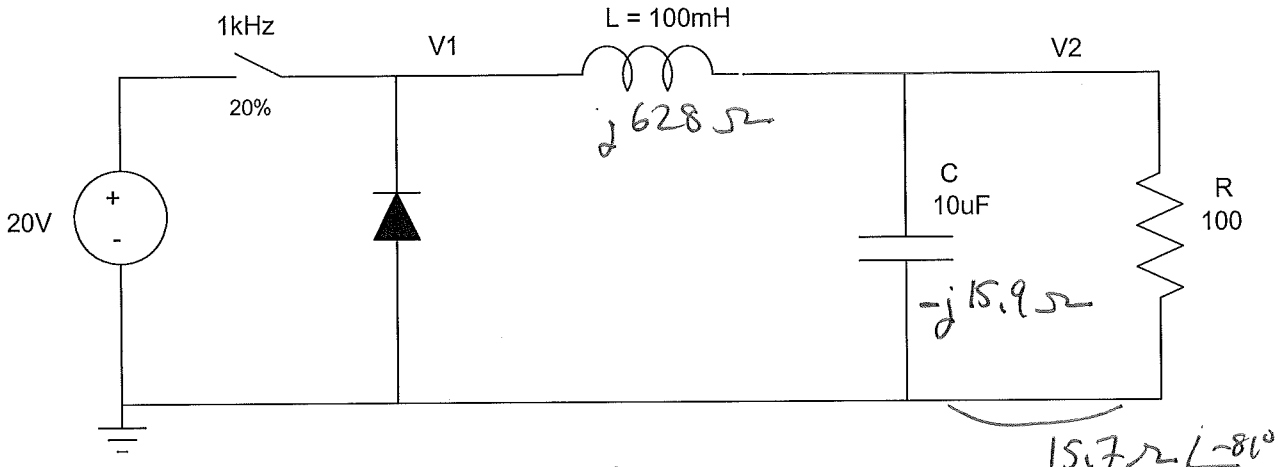
$I_1 > \frac{2mA}{\beta} = 20\mu A$

Let $I_1 = 100\mu A$

$R_1 = \frac{5 - .7}{100\mu A} = 43k$

4) Determine the voltages (DC and AC) at V1 and V2 for the following Buck converter. Assume the switch closes at
   - A frequecy of 1kHz
   - With a duty cycle of 20% (it's closed 20% of the time, open 80% of the time)

V1		V2	
V1 (DC) mean voltage at V1	V1 (AC) peak-to-peak votlage at V1	V2 (DC) mean voltage at V2	V2 (AC) peak-to-peak votlage at V2
3.44V	$20.7V_{pp}$	3.44V	$52mV_{pp}$



$V_{avg} = (.2)20 + (.8)(-0.7) = 3.44V$

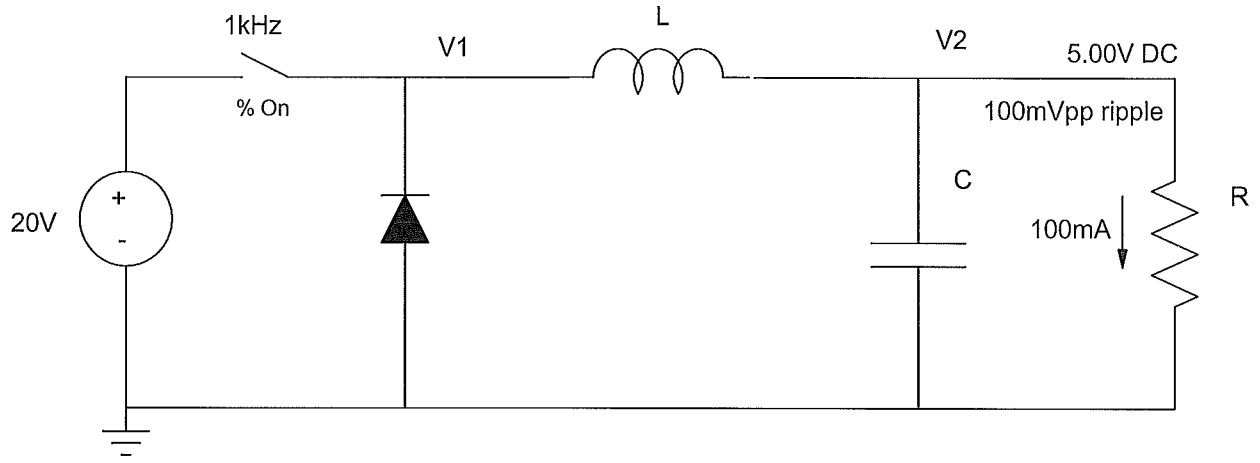
$$V_2 = \left(\frac{-j15.9 \parallel 100}{-j15.9 \parallel 100 + j628}\right) 20.7$$

$$= .052$$

5) Design a Buck converter to drop 20Vdc to 5Vdc so that

- V2(dc) = 5.00V on average
- V2(ac) = 100mVpp
- While driving 100mA to the load.

Duty Cycle % On	L	C	R
27.5%	79μH	65μF	50Ω



$$\text{duty cycle} = \frac{5.7}{20.7} = 27.5\%$$

$$V_{1pp} = 20.7V_{pp}$$

~~Let $\omega L = 10R = 10$.~~

Let $\omega L = 10R = 500$

$$L = \frac{500}{6280} = 79\mu H$$

$$\left(\frac{.1}{2.07}\right) = \left(\frac{2.07V_{pp}}{.1V_{pp}}\right) = 20.7$$

$$\frac{1}{\omega C} = \frac{R}{20.7} = 2.4\Omega$$

$$C = 65\mu F$$

Bonus! You don't have to reach +10C in to notice the effects of global warming. What effect corresponds to what temperature increase?

source: http://globalwarming.berrens.nl/globalwarming.htm

+4° d Spain becomes a desert. Mass migration to Northern latitudes. Rain forests burn up

+2° b Oceans absorb less CO2 (too hot) and soils start to release CO2. Vacations to the Mediterranean in the summer are just too hot. Crop failures in Africa and Central America cause mass migration. Coastal cities flood. 1/3rd of species face extinction.

+6° e) Ice caps are gone. Methane hydrates become unstable raising temperatures in a positive-feedback loop. Ocean circulation stops. Hydrogen sulfide producing bacteria flourish poisoning the air. The Ozone layer dissipates leaving the land sterilized with UV radiation. End-Permian-like conditions make life nearly impossible.

+1° a) Summers like 2003 where a heat wave in France caused 10,000 deaths become the norm. Flows of the Po and Rhine river decrease. Crop production drops.

+3° c Crop failures in China cause the migration of more than 1 billion people. Collapse of equatorial governments.

a) 1 degree C

b) 2 degreesC

c) 3 degrees C

d) 4 degrees C

e) 6 degrees C