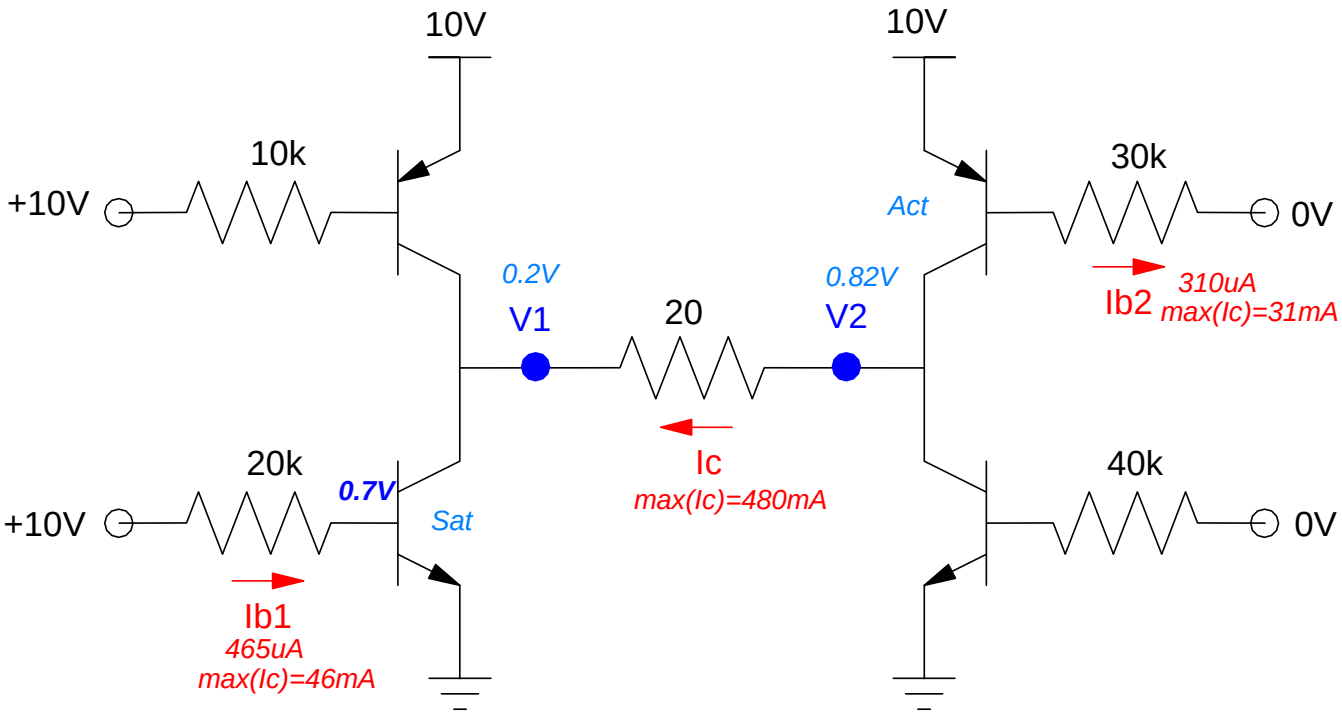
# ECE 320 - Quiz #6. Name _____

H-Bridges, Buck Converters, Frequency Content, February 15, 2018

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

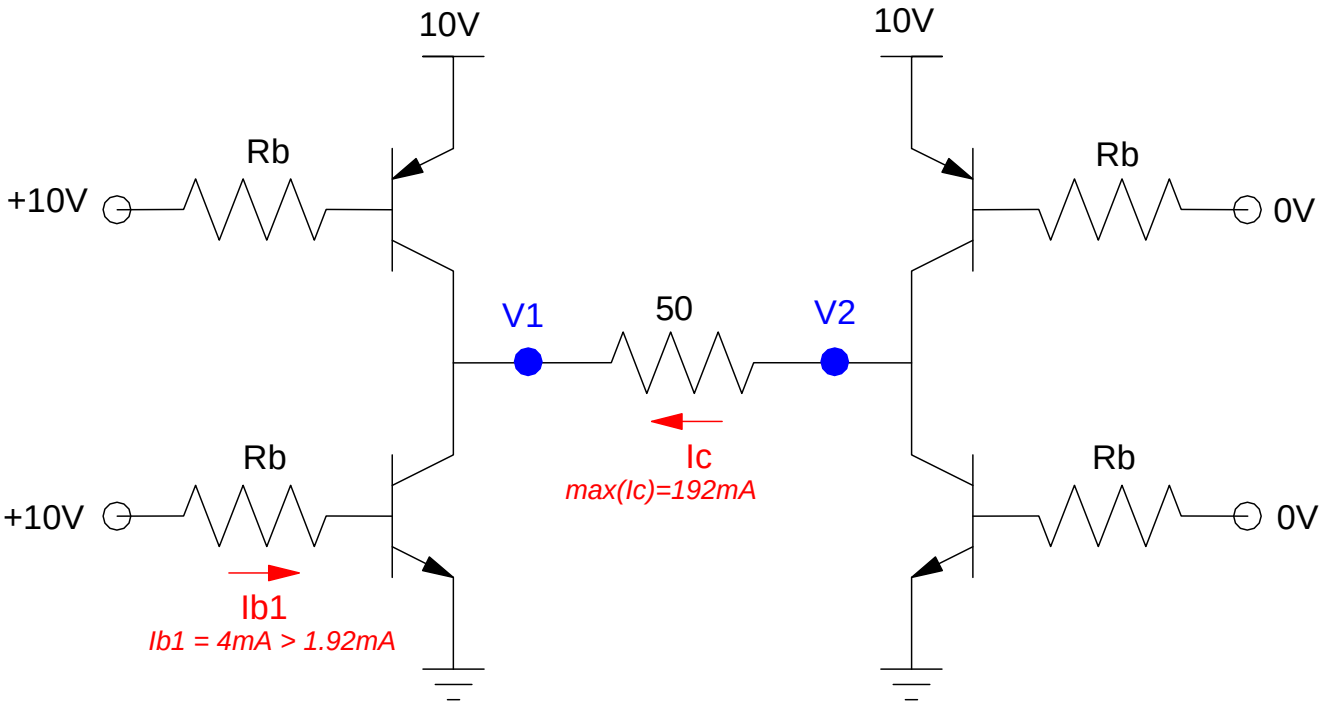
- $|V_{be}| = 0.7V$
- $|V_{ce(sat)}| = 0.2V$
- $\beta = 100$

| Ib1 | Ic | Ib2 | V1 | V2 |
|---|---|---|---|---|
| **465uA** | **31mA** | **310uA** | **0.2V** | **0.82V** |



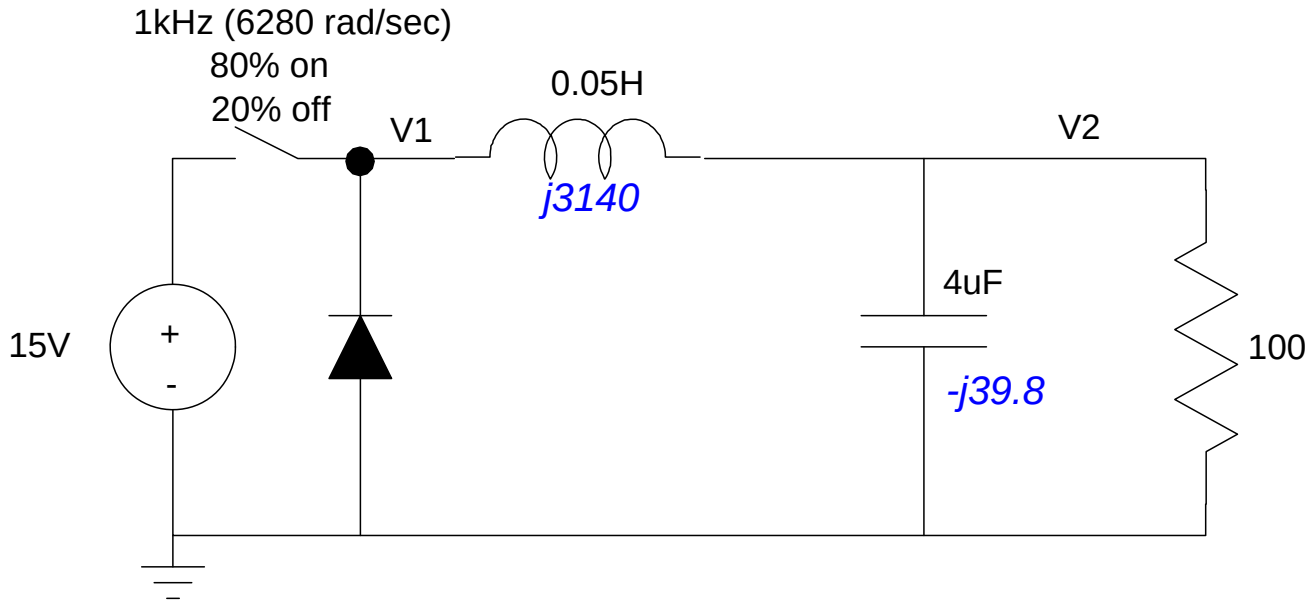
2) Design an H-bridge to drive a 50 Ohm load at 10V. Determine the resistors (Rb) and resulting currents and voltages

| Rb | Ib1 | Ic | V1 | V2 |
|---|---|---|---|---|
| **2425** | **4mA** | **192mA** | **0.2V** | **9.8V** |



3) Buck Converter. Determine the voltages at V1 and V2 (DC and AC) for the following Buck converter.

| V1 | | V2 | |
|---|---|---|---|
| V1 (DC) | V1pp (AC) | V2 (DC) | V2pp (AC) |
| **11.86V** | **15.7Vpp** | **11.86V** | **0.817Vpp** |




$$V_{1DC} = 0.8 \cdot (15V) + 0.2 \cdot (-0.7V)$$

$$V_{1DC} = 11.86V$$

$$-j39.8 || 100 = 13.67 - j34.36$$

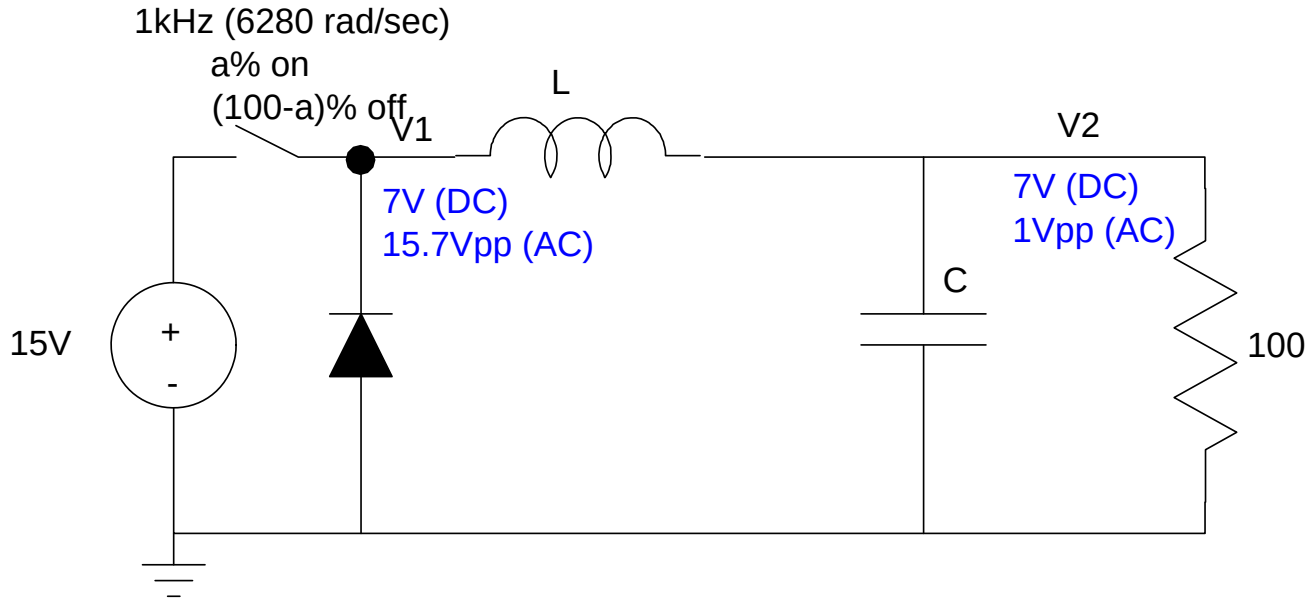
$$V_2 = \left( \frac{(13.67 - j34.36)}{(13.67 - j34.36) + (j3140)} \right) \cdot 15.7V_{pp}$$

$$V_2 = 0.817V_{pp}$$

4) Design a Buck converter so that

- The DC votlage at V2 is 7V
- The AC voltage at V2 is 3Vpp if C = 0
- The AC voltage at V2 is 1Vpp if C > 0

| Duty Cycle (a)<br>V1(DC) = 7V | L<br>V2(AC) = 3Vpp when C = 0 | C<br>V2(AC) = 1Vpp |
|---|---|---|
| **0.49** | **83.3 mH** | **4.78uF** |




$$\alpha = \left(\frac{7.7V}{15.7V}\right) = 0.49$$

$$\omega L = \left(\frac{15.7V_{pp}}{3V_{pp}}\right) \cdot 100\Omega \qquad \frac{1}{\omega C} = \frac{1V_{pp}}{3V_{pp}} \cdot 100\Omega$$

$$\omega L = 523\Omega \qquad \frac{1}{\omega C} = 33.3\Omega$$

$$L = 83.3mH \qquad C = 4.78\mu F$$

5) Find the DC and first harmonic for the Fourier transfirm for the following waveform which is periodic in $2\pi$

$$f(t) = f(t + 2\pi)$$

$$f(t) = \begin{cases} 10V & 0 < t < 2 \\ 0V & 2 < t < 2\pi \end{cases}$$

$$DC = \frac{1}{2\pi} \int f(t) \cdot dt$$

$$a_1 = \frac{1}{2\pi} \int_0^{2\pi} f(t) \cdot \cos(t) \cdot dt$$

$$b_1 = \frac{1}{2\pi} \int_0^{2\pi} f(t) \cdot \sin(t) \cdot dt$$

| DC | a1 | b1 |
|---|---|---|
| **3.183V** | **1.447** | **2.254** |

$$DC = \frac{1}{2\pi} \cdot \int_0^2 (10) \cdot dt$$

$$DC = \frac{20}{2\pi} = 3.183V$$

$$a_1 = \frac{1}{2\pi} \int_0^2 10 \cdot \cos(t) \cdot dt$$

$$a_1 = \frac{10}{2\pi} (\sin(t))_0^2$$

$$a_1 = \frac{5}{\pi} (\sin(2) - \sin(0))$$

$$a_1 = 1.447$$

$$b_1 = \frac{1}{2\pi} \int_0^2 10 \cdot \sin(t) \cdot dt$$

$$b_1 = \frac{10}{2\pi} (-\cos(t))_0^2$$

$$b_1 = \frac{5}{\pi} (1 - \cos(2))$$

$$b_1 = 2.254$$

note: angles are in radians