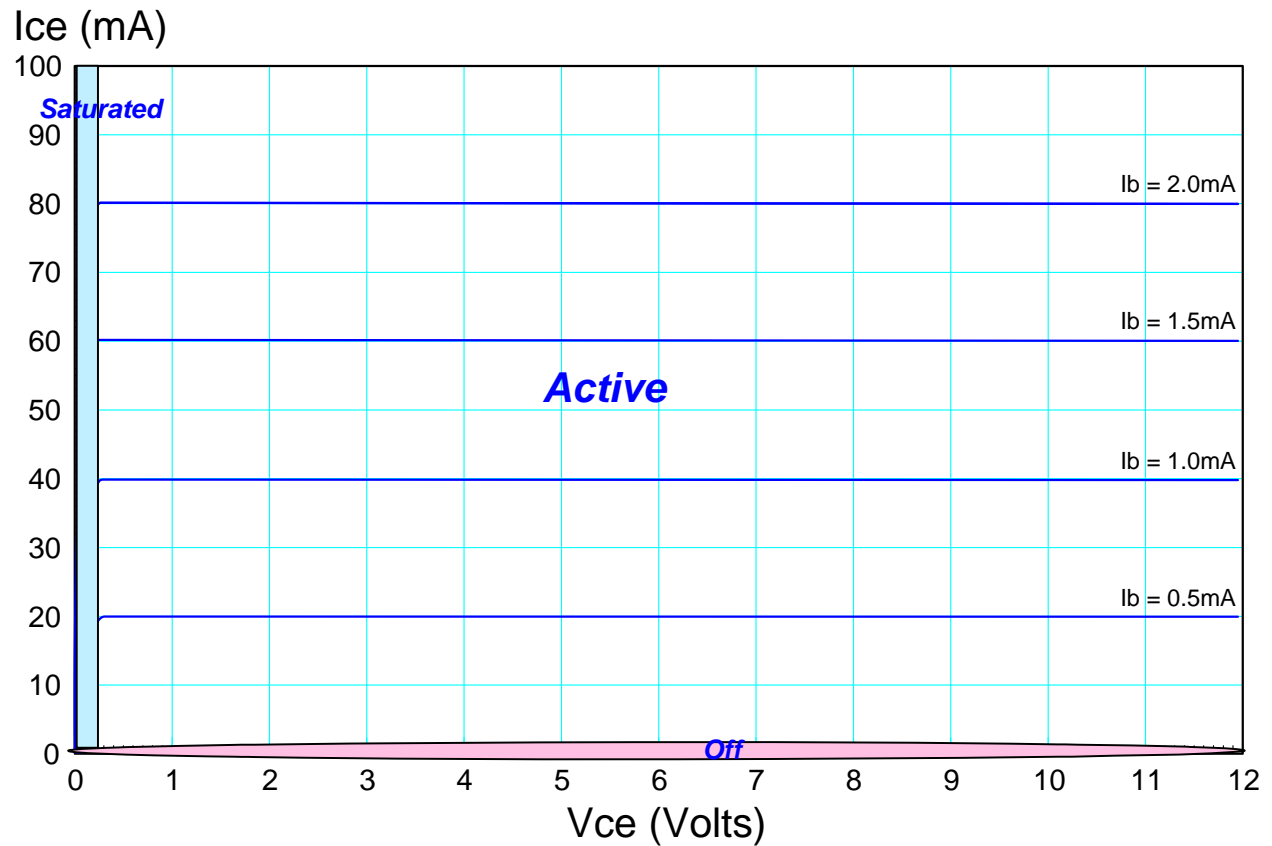


ECE 320: Quiz #5 Name _____

Transistors, H-Bridges, AC to DC Converters - February 25, 2016

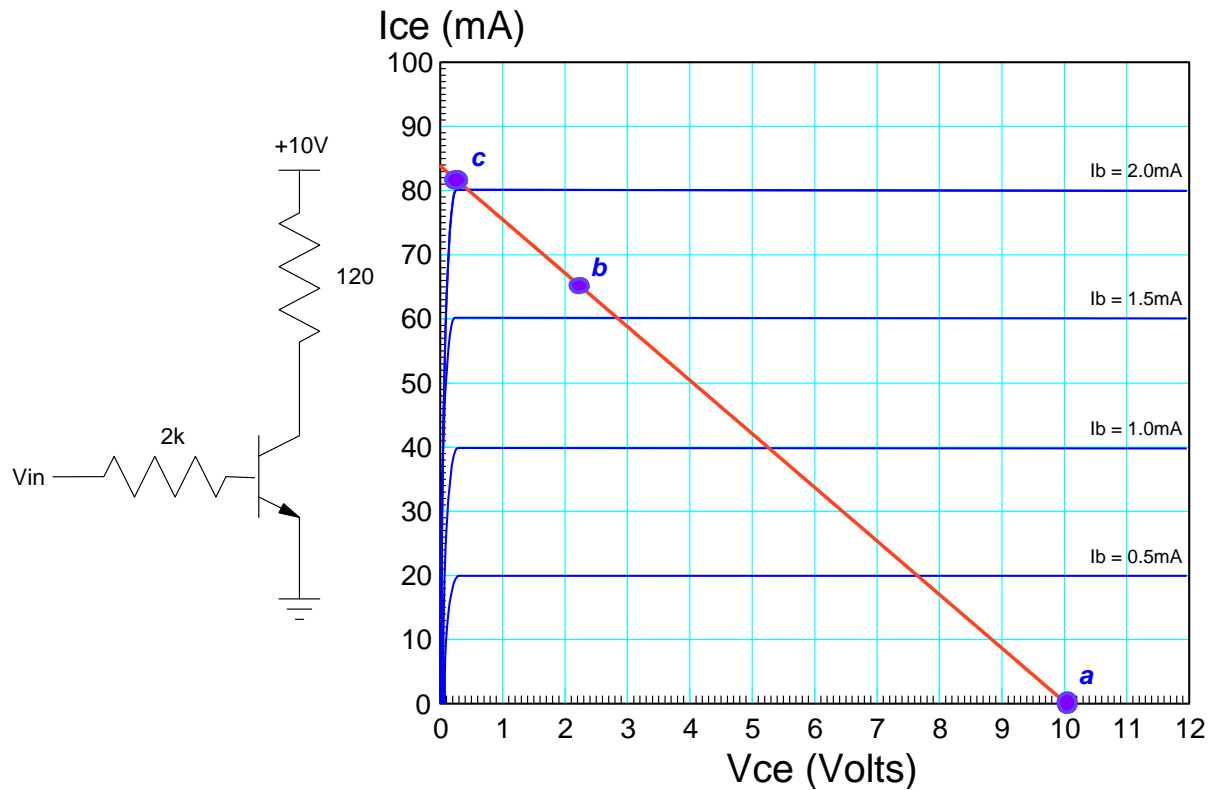
1) For the following transistor, determine the current gain, β and label the regions

Off / Active / Saturated Regions	Current Gain
Show on graph	40



2) Assume ideal silicon diodes ($V_f = 0.7V$). Draw the load line for the following circuit and show the operating point for V_{in}

Load Line	I_c for $V_{in} = 0.5V$	I_c for $V_{in} = 4V$	I_c for $V_{in} = 8V$
show on graph	0 mA	66mA	81.7mA



a) $V_{in} < 0.7V$, so $I_b = 0$, $I_c = 0$

b) $V_{in} = 4V$

$$I_b = \left(\frac{4V - 0.7V}{2k} \right) = 1.65mA$$

$$I_c = \beta I_b = 40 I_b = 66mA$$

c) $V_{in} = 8V$

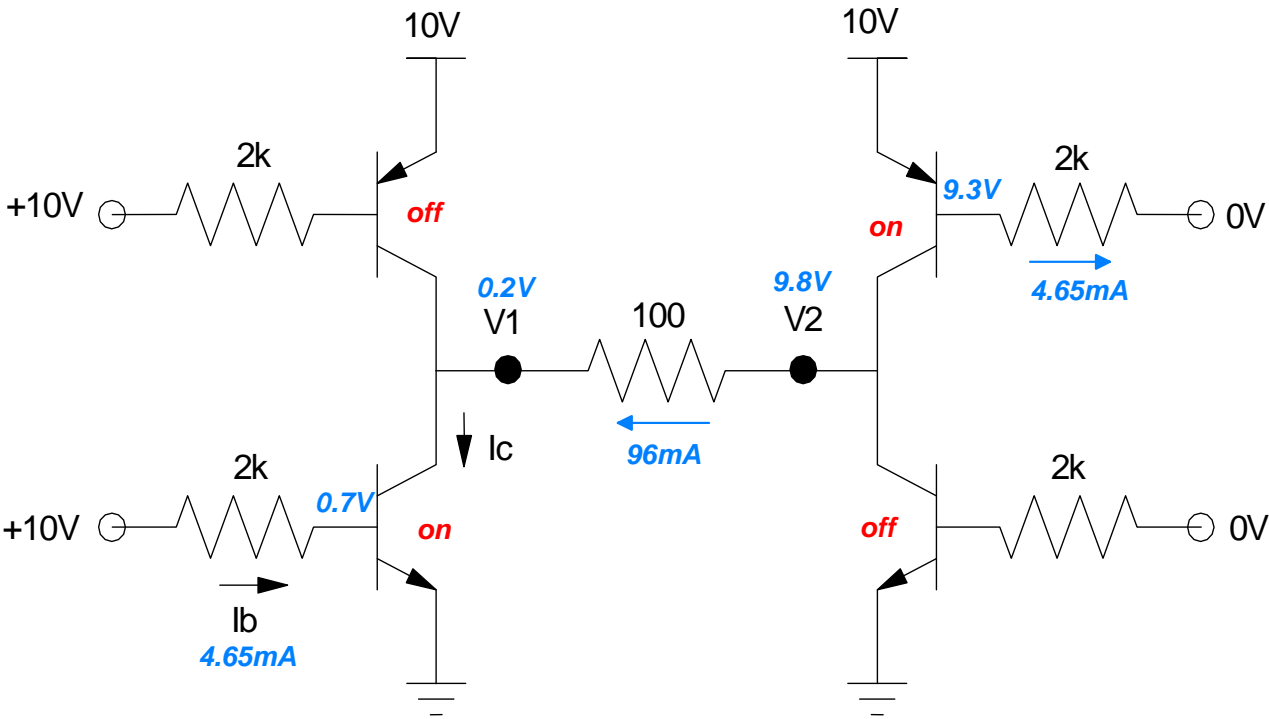
$$I_b = \left(\frac{8V - 0.7V}{2k} \right) = 3.65mA$$

$$\beta I_b = 40 I_b = 146mA$$

$$\max(I_c) = \left(\frac{10 - 0.2}{120} \right) 81.6mA$$

3) H-Bridge. Determine the voltages and currents for the following H-bridge. Assume transistors with a current gain of 100.

V1	V2	Ib	Ic
0.2V	9.8V	4.65mA	96mA

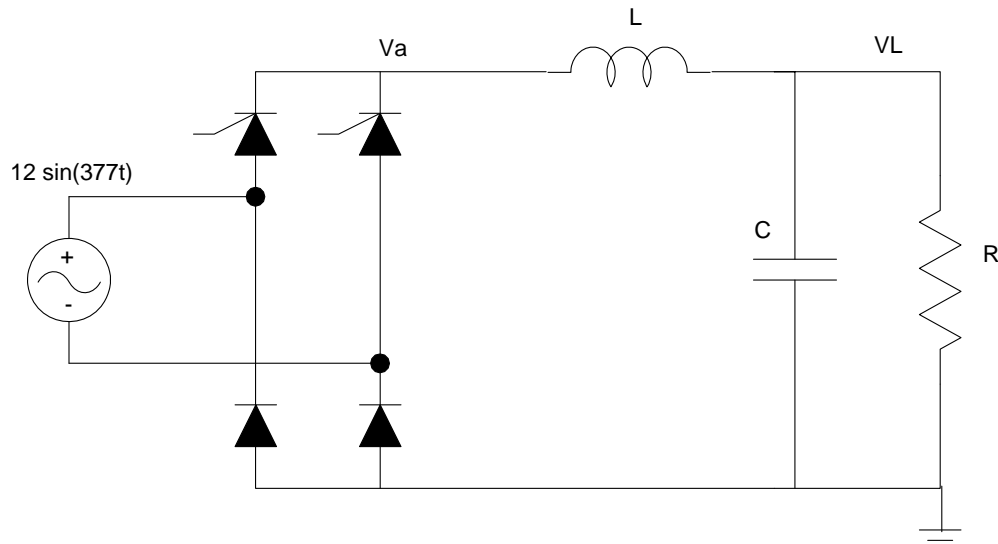


4) The average voltage at V_a is equal to

$$V_a = \frac{1}{\pi} \int_{\theta}^{\pi+\theta} 10.6 \sin(t) dt$$

Find the firing angle, θ , so that this average is 3.0 Volts and the resulting peak-to-peak ripple at V_a

Firing Angle	Resulting peak-to-peak voltage at V_a
63.6 degrees	20.09V



a) $3 = \frac{1}{\pi} \int_{\theta}^{\pi+\theta} 10.6 \sin(t) dt$

$$\frac{3\pi}{10.6} = (-\cos(t))_{\theta}^{\pi+\theta}$$

$$\frac{3\pi}{10.6} = 2 \cos(\theta)$$

$$\theta = 63.6^\circ$$

b)

$$\max(V_a) = 10.6V$$

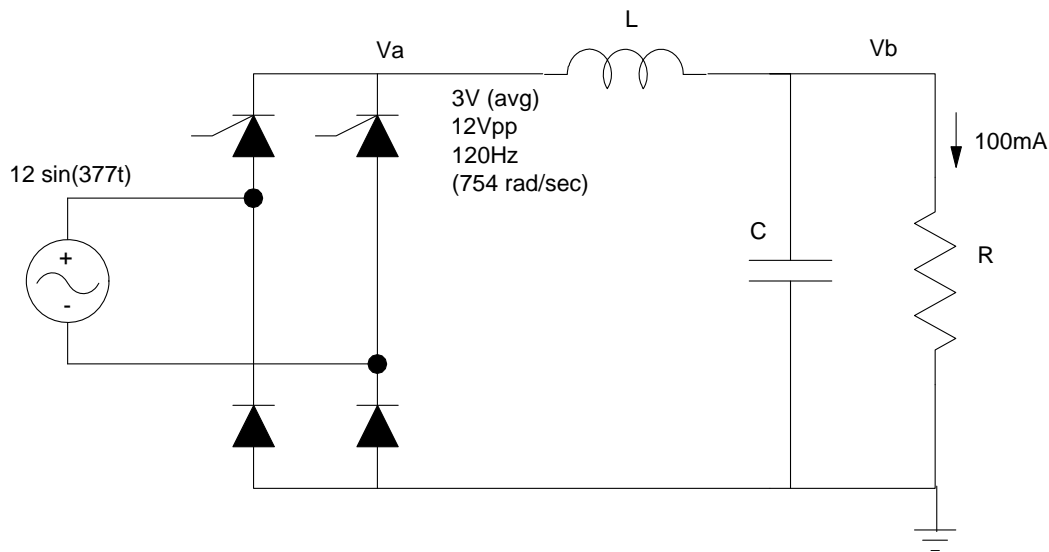
$$\min(V_a) = 10.6 \sin(\pi + 63.6^\circ) = -9.49V$$

$$V_{app} = 10.6 - (-9.49) = 20.09V_{pp}$$

5) Assume the peak-to-peak ripple at V_a is 12.0V and the average of V_a is 3.00V. Determine

- R so that the current to the load is 100mA
- L so that the ripple at V_b is 1.00Vpp if $C = 0$
- C to reduce the ripple at V_b to 100mVpp

R for 100mA to the load	L for 1.00Vpp ripple at V_b (assuming $C = 0$)	C for 100mVpp ripple at V_b (using L just computed)
30 Ohms	0.475 H	442 uF



$$R = \frac{3V}{100mA} = 30\Omega$$

$$R = 30\Omega$$

$$1V_{pp} = \left| \frac{R}{R+j\omega L} \right| 12V_{pp}$$

for 1/10 of the ripple

$$|30 + j\omega L| = 12R = 360$$

$$R \left| \frac{1}{j\omega C} \right| \approx 3\Omega$$

$$30^2 + (\omega L)^2 = 360^2$$

$$\frac{1}{\omega C} \approx 3\Omega$$

$$\omega L = 358.7$$

$$C = 442\mu F$$

$$L = 0.475$$

Bonus: Is income inequality a problem?

Does having a large amount of a country's wealth concentrated in a few people help or hurt the economy? Why?

Republican Answer: Income inequality helps the economy.

(16 responses) *Trickle Down Economics, a.k.a. Reaganomics.* The wealthy are the job creators. By giving them more money, they have the resources and incentive to create even more jobs. These jobs stimulate the economy, creating even more wealth. This in turn generates more income for the government through income taxes.

Hence,

- Reducing taxes increases revenue for the government.
- The more income inequality you have, the healthier the economy is.
- It is in everyone's interest for us to reduce taxes on the rich
- It is in everyone's interest for most of the wealth generated to go to the top 1%

Democrat Answer: Income inequality hurts the economy.

(4 responses) Robert Reich: *Inequality for All:* Understand that 70% of our economy is based upon the consumer. Ask yourself a question:

What has a bigger impact on the economy:

A single person having an income of \$50 million, or

A thousand people having an income of \$50,000?

A thousand people will buy a thousand houses, 3000 beds, 2000 cars, send 2000 kids to schools, buy groceries for a thousand meals every evening. Far more than a single person will buy, even with \$50 million. When you concentrate the wealth in a few hands, you strip the middle class of their purchasing power. This in turn results in an anemic economy which can't grow and a loss of income for the government.

If Trickle Down Economics worked, we should have the healthiest, most prosperous system in history today. Instead, the economy is stagnant, in spite of massive stimulus from the government in terms of near-zero interest rates and massive deficit spending.

Hence,

- To grow the economy, you need to see that the wealth generated gets distributed to the middle class, for the middle class is which drives this economy.
- The rich are not job creators, they are actually job killers.
- Giving more money to the top 1% only benefits the top 1%. It hurts everyone else.