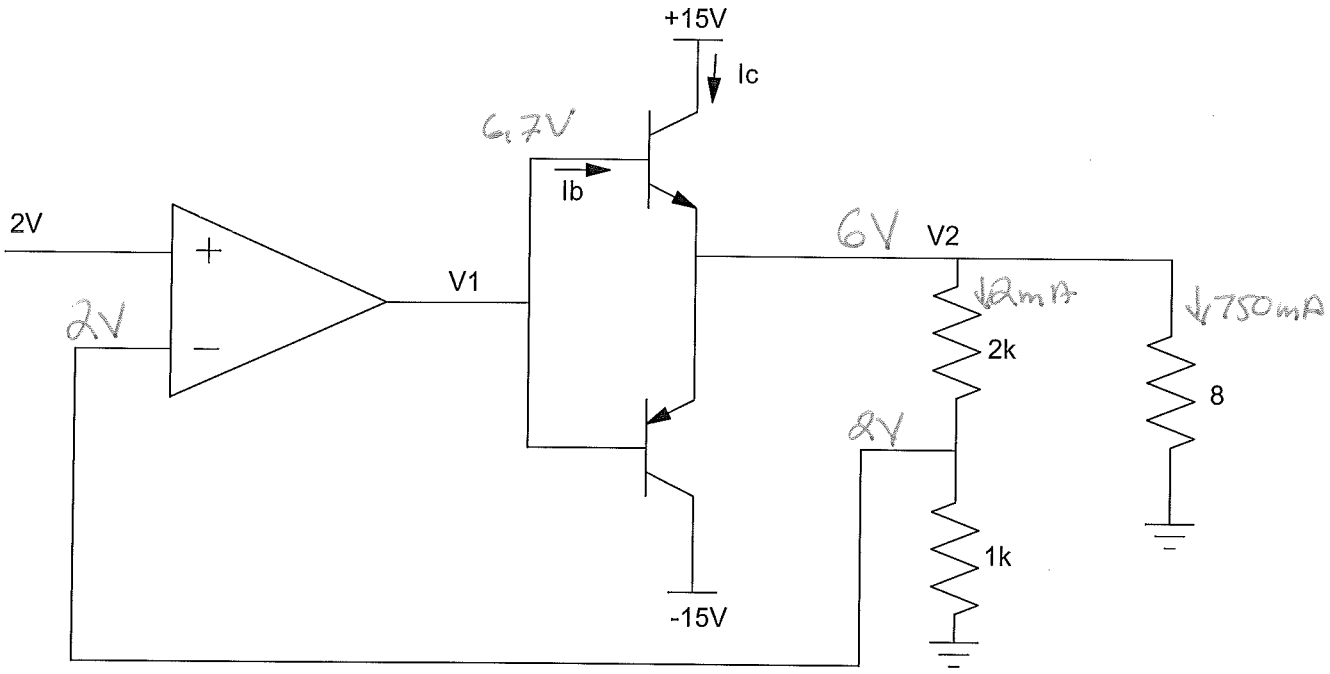
ECE 321: Final Exam Name _____

December 13, 2016

1) Determine the voltages and currents for the following push-pull amplifier with a +2V input. Assume

- $\beta = 100$
- $V_{be} = 0.7V$

V1	V2	Ib	Ic
6.7V	6V	7.446mA	744.6mA



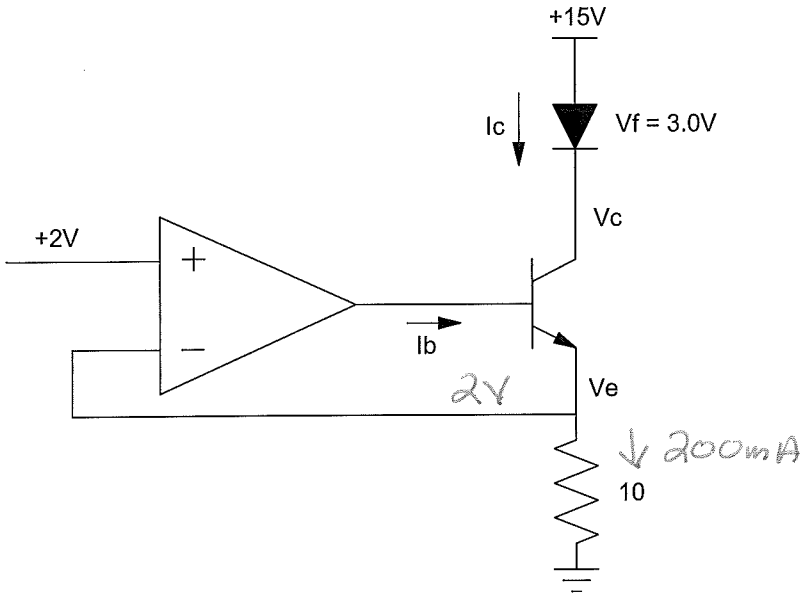
$I_b + I_c = 752mA$

$I_b = \frac{752}{101} = 7.446mA$

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

- $\beta = 100$
- $V_{be} = 0.7V$
- $V_f = 3.0V$ (a white LED)

Ib	Ic	Vc	Ve
1.98mA	198mA	12V	2V



$(1+\beta) I_b = 200mA$

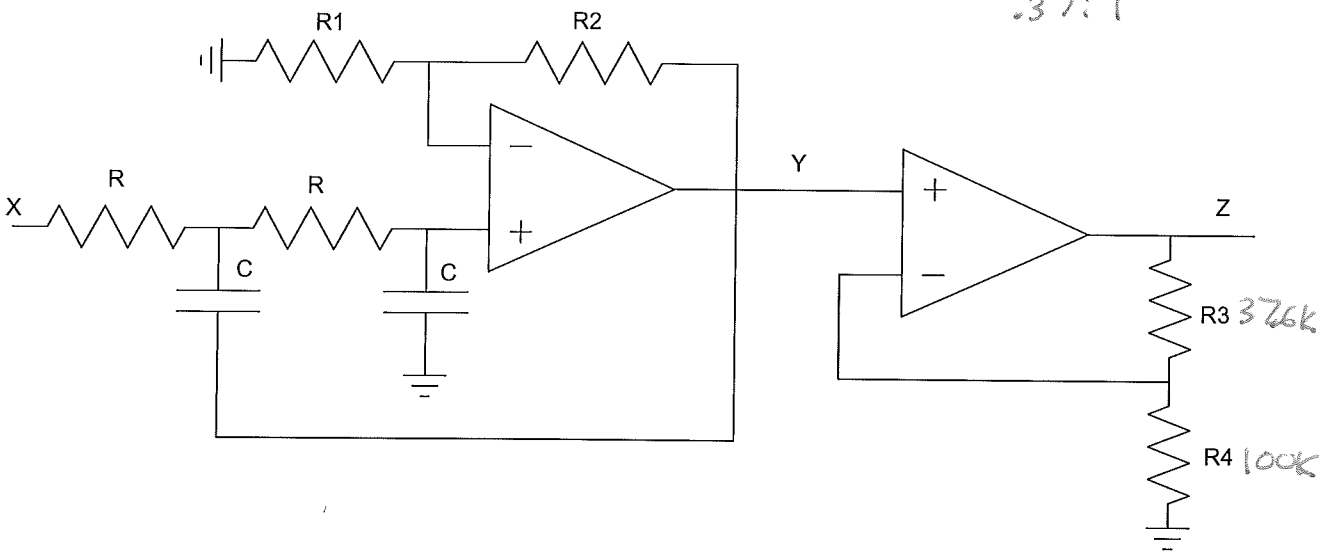
$I_b = 1.98mA$

3) Find R and C so the the following amplfier has the following transfer function

$$Y=\left(\frac{1000}{s^2+10s+300}\right)X$$

R	C	R1	R2	R3	R4
100k	.577μF	100k	142 k	37.6k	100k

$1/RC = 17.32$ gain = 2.423 .37 : 1



$$Y=\left(\frac{k\left(\frac{1}{RC}\right)^2}{s^2+\left(\frac{3-k}{RC}\right)s+\left(\frac{1}{RC}\right)^2}\right)X$$

$$k=1+\frac{R_2}{R_1}$$

$$\left(\frac{3-k}{RC}\right)=10$$

$$(3-k)=\frac{10}{\sqrt{300}}=.577$$

$k = 2.423$

$$Z=\left(1+\frac{R_3}{R_4}\right)Y$$

~~gain = 4.128~~

~~$(4.128)(2.423)=1$~~

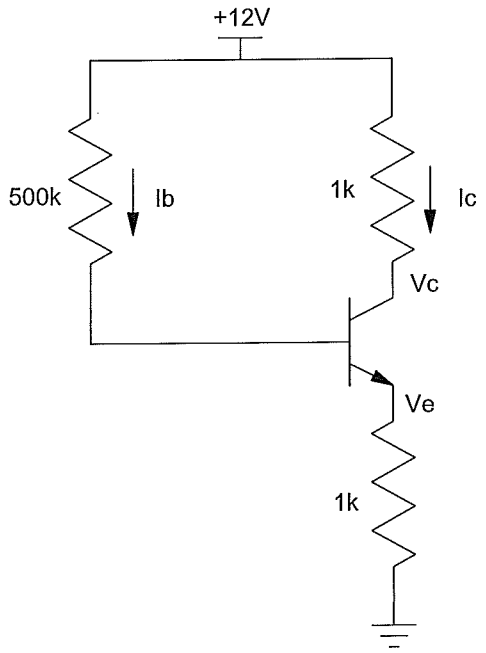
gain = 1.376

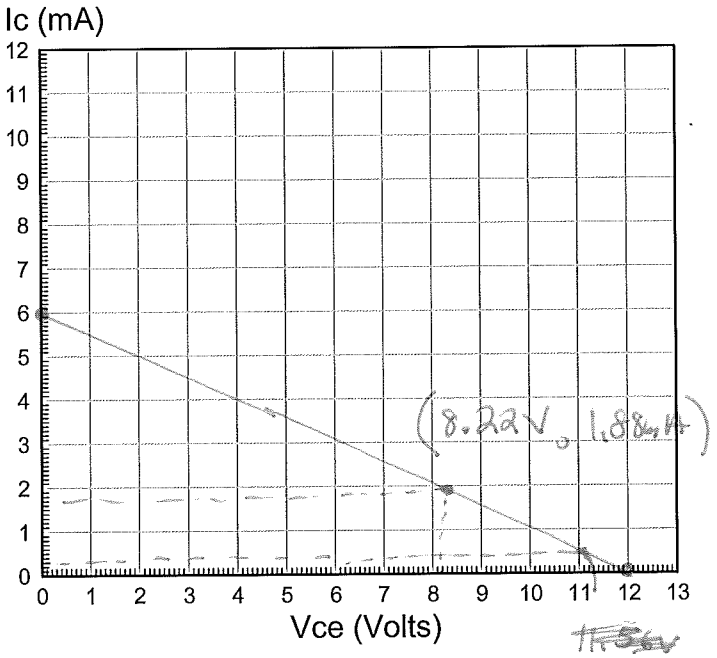
$(2.423)(1376) = \frac{1000}{300}$

4) BJT and Load Lines: Determine the voltages and currents for the following circuit. Also draw the load line and show the Q-point on the load-line. Assume $\beta = 100$

Ib	Ic	Vc	Ve	Load Line & Q-Point
~~2.16uA~~	~~216uA~~	~~11.78V~~	~~.218 V~~	show on graph

18.8uA 1.88mA 10.12V 1.9V





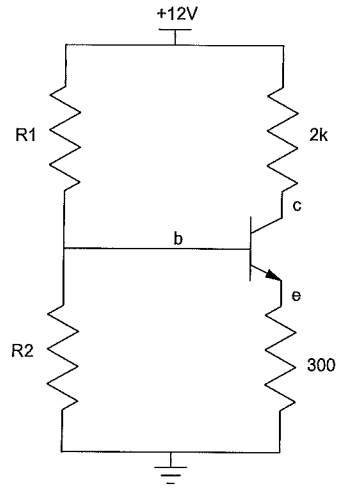
$I_b = \frac{12 - .7}{500k + 101k} = 216uA$

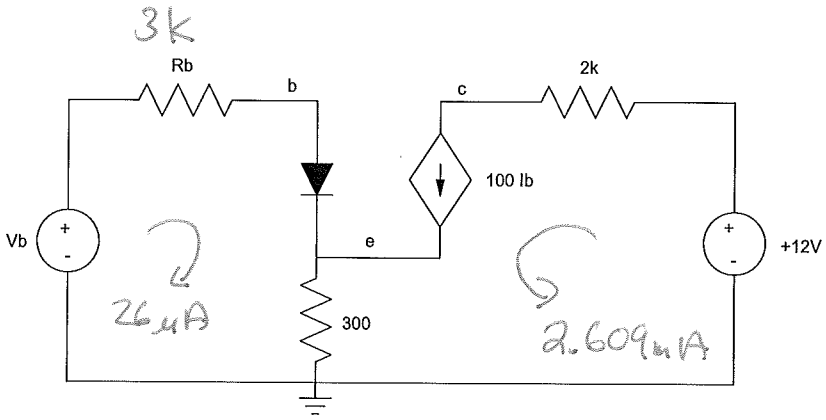
5) Find R1 and R2 so that

- The Q-point is stabilized for variations of β $((1+\beta)R_e >> R_b)$ and
- Vce = 6.0V

Assume $\beta = 100$

R1	R2	Vb	Rb
22.95k	3451	1.569V	3k





$(101)300 >> R_b$

$30k >> R_b$

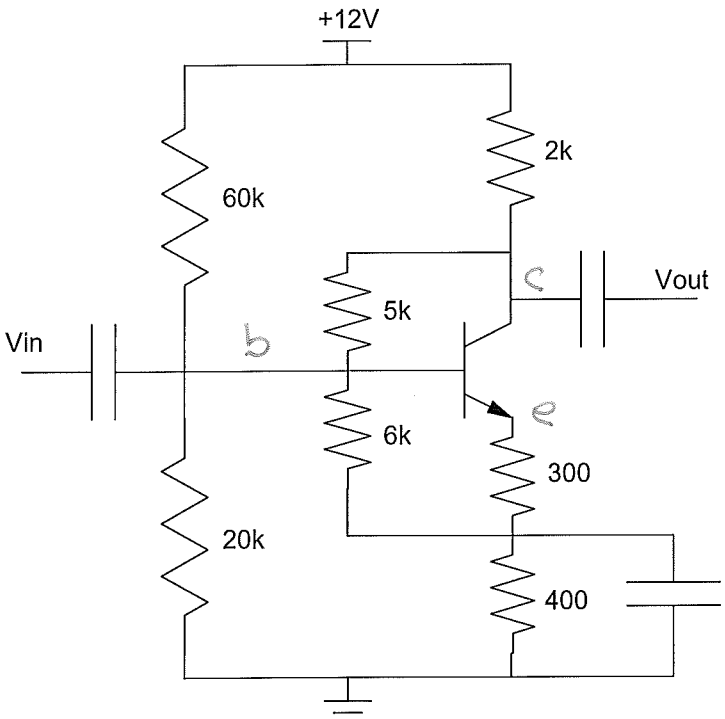
Let $R_b = 3k$

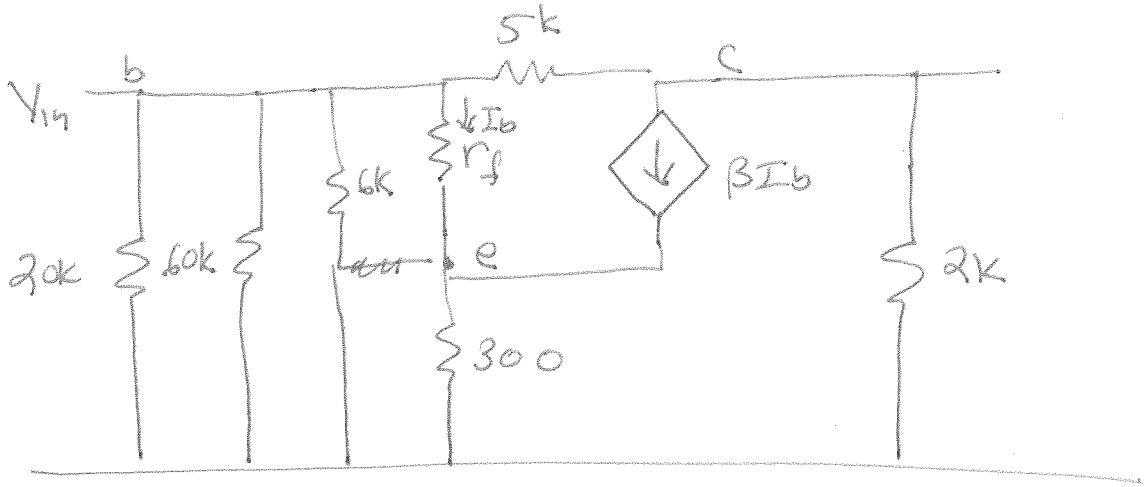
$V_b = 3k \cdot I_b + .7 + 300(I_b + I_c)$

$V_b = 1.569V$

6) Draw the small-signal model for the following amplifier. Assume

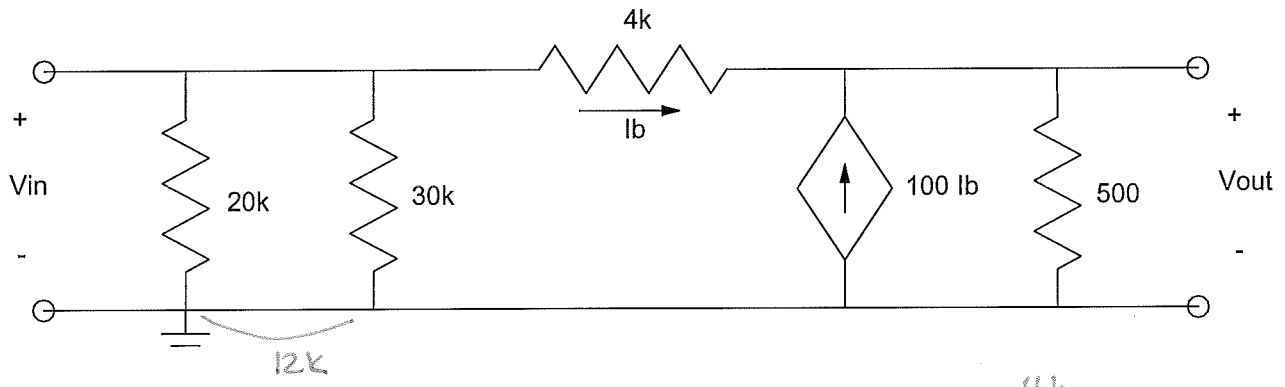
- $\beta = 100$
- $r_f = 1500\Omega$





7) Determine the 2-port model for the following amplifier

Rin	Ai	Rout	Ao
3k	.75	36.7	.9266



$R_{in} = 20k \| 30k \| 4k$

$= 3K$

$A_i = \frac{12k}{12k+4k}$

$= .75$

$R_{out} = 4k \| \frac{4k}{100} \| 500$

$= 36.7\Omega$

A_{oi} $\frac{X-1}{4k} + 100\left(\frac{X-1}{4k}\right) + \frac{X}{500} = 0$

$$X = \frac{\frac{1}{4k} + \frac{100}{4K}}{\frac{1}{4k} + \frac{100}{4k} + \frac{1}{500}}$$

$= .9266$

Bonus! If the electorial college refuses to elect either Trump or Clinton, who determines who is our next President?

The house of representatives votes - 1 vote per state.