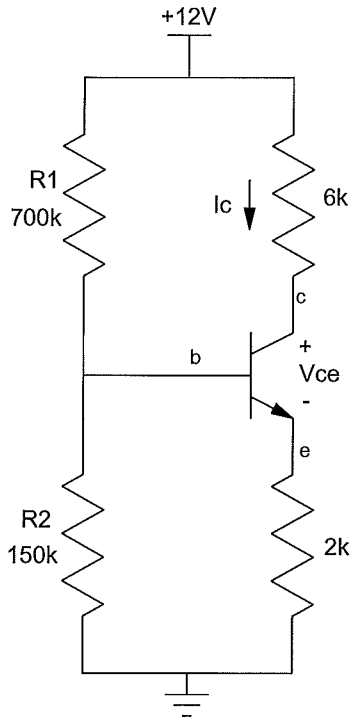
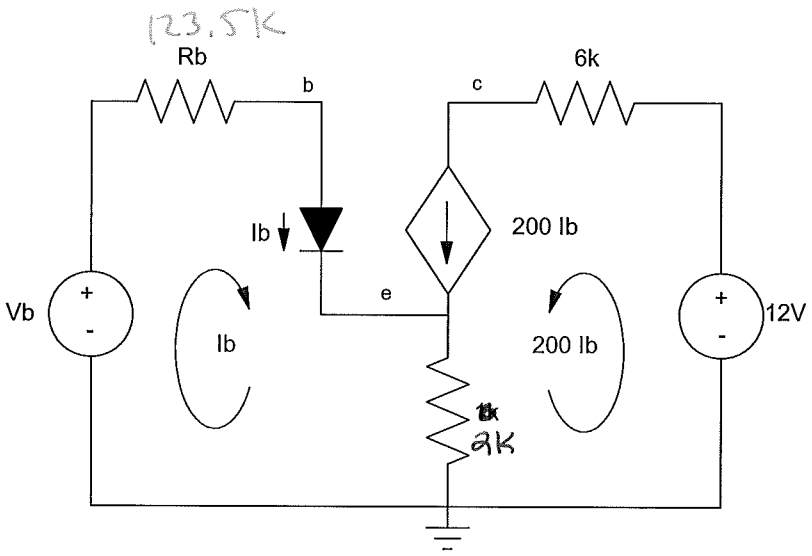
ECE 321 - Quiz #4 - Name _____

Transistor Amplifiers. Fall 2019

1) Determine the Thevenin equivalent of R1, R2, +12V and the Q-point. Assume
   - Vbe = 0.7V
   - β = 200

Vce	Ic	Vth (Vb)	Rth (Rb)
7.679V	539.5μA	2.118V	123.5k





$R_b = 700k \| 150k = 123.5k$

$V_b = \left(\frac{150}{150+700}\right) 12 = 2.118V$

$I_b = \frac{2.118 - .7}{123.5k + (1+\beta)\, 2k} = 2.698\mu A$

$I_c = \beta I_b = 539.5\mu A$

$V_e = 2k(I_b + I_c) = 1.084V$

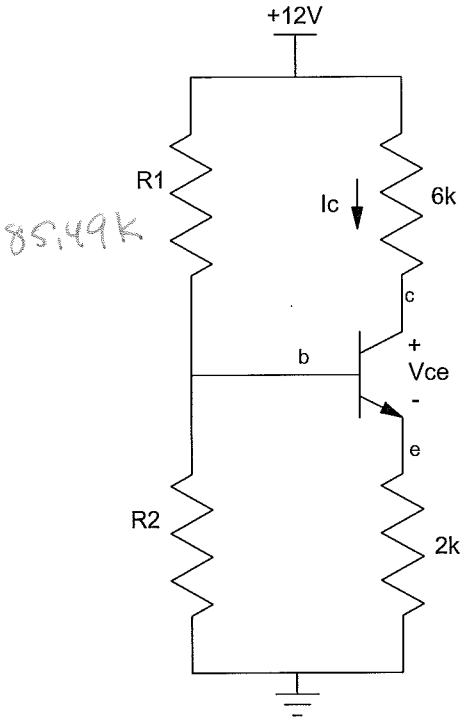
$V_c = 12 - 6k I_c = 8.763V$

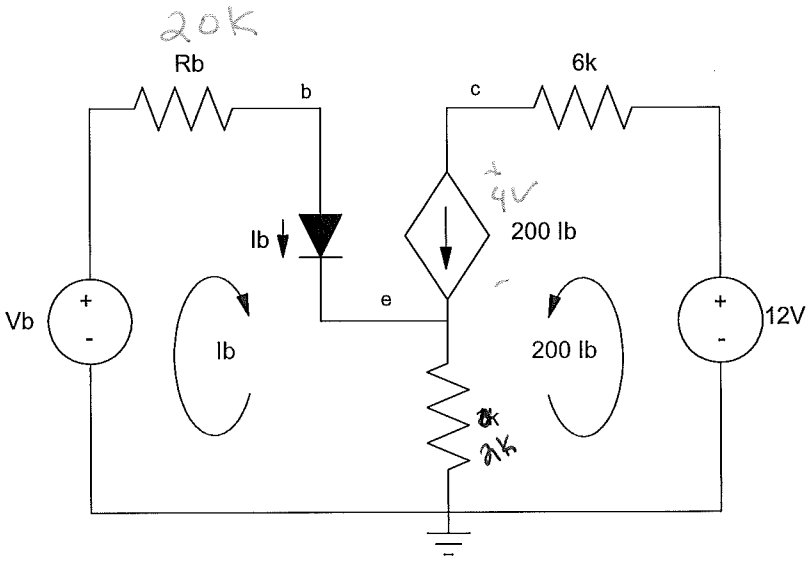
2) Determine R1 and R2 so that

- The Q-point is stabilized for variations in β (i.e. $(1+\beta)R_e >> R_b$)
- The Q-point is Vce = 4.0V

Assume Vbe = 0.7V and β=200

R1	R2	Vth (Vb)	Rth (Rb)
85.49k	26.11k	2.807V	20k





$R_b = \frac{1}{10}(1+\beta)R_e = 20k$

$I_c = \frac{8V}{6k + \left(\frac{20}{201}\right)2k} = 998.8\mu A$

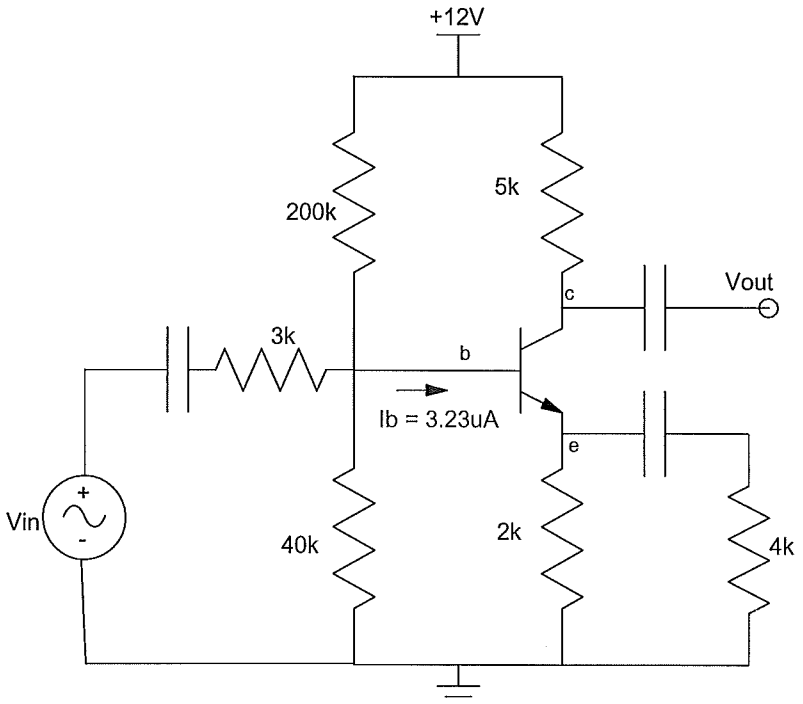
$I_b = \frac{I_c}{\beta} = 4.994\mu A$

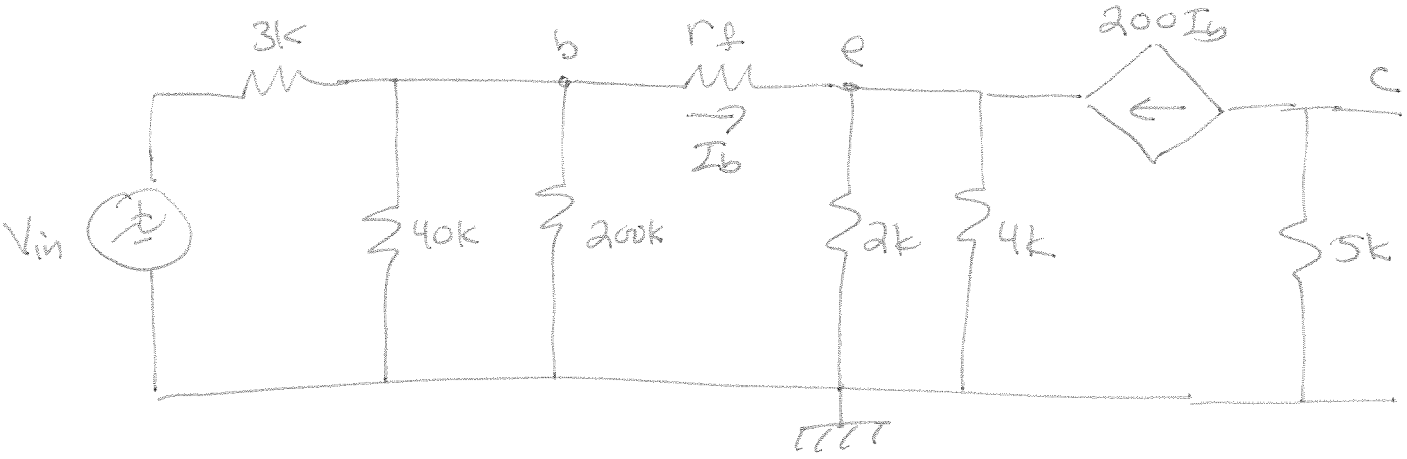
$V_b = R_b I_b + .7 + R_e(I_b + I_c)$

$V_b = 2.807V$

3) Small Signal Model. Draw the small signal model for the following amplifier. Assume

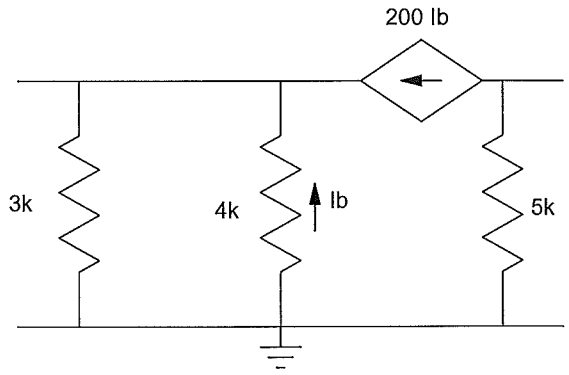
- $\beta = 200$
- $r_f = 16k\Omega$ (Ib = 3.23 uA)

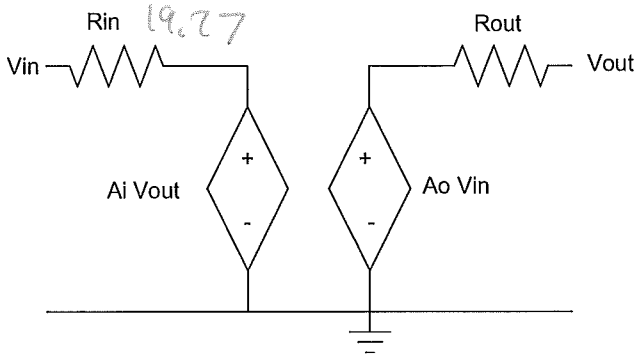




4) Determine the 2-port model for the following circuit

Rin	Ai	Rout	Ao
19.77	0	5k	+250





R_{in}: $I = \frac{1}{3k} + \frac{1}{4k} + \frac{2\Omega}{4k} = 50.58mA$

$R_{in} = 1V/50.58mA = 19.77\Omega$

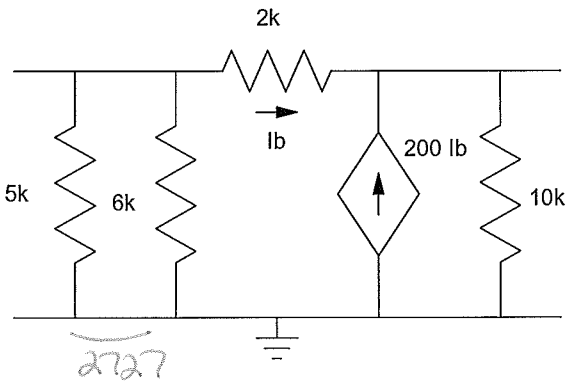
$A_i = 0$

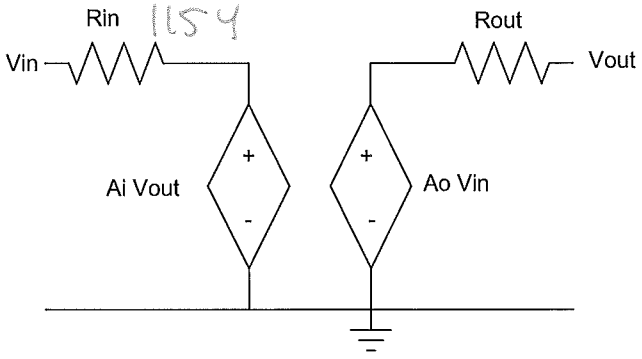
$R_{out} = 5k$

$A_o = \frac{200 \cdot 5k}{4k} = 250$

5) Determine the 2-port model for the following circuit

Rin	Ai	Rout	Ao
1154	.5769	9.94	.9990





Rin: $I = \frac{1}{5k} + \frac{1}{6k} + \frac{1}{2k} = 1154$

$A_i = \frac{2727}{2727+2000} = .5769$

Rout: $I = \frac{1}{10k} + \frac{1}{2k} + \frac{2v2}{2k} = .1006A$

$R_{out} = \frac{1V}{.1006A} = 9.940\Omega$

Ao: $\frac{X-1}{2k} + 200\left(\frac{X-1}{2k}\right) + \frac{X}{10k} = 0$

$X = \frac{1.004}{.9990}$

$\left(\frac{1}{2k} + \frac{200}{2k} + \frac{1}{10k}\right)X = \left(\frac{1}{2k} + \frac{200}{2k}\right)$

Bonus!!! What was the purpose of the Reconstitute-Inator?

- Turn dinosaur bones back into dinosaurs because Dr. Doofenschmirtz always wanted a pet T-rex
- Restore the dried out coursage that Dr. Doofenschmirtz's girlfriend gave him back in high-school
- Turn raisins back into grapes.
- Turn orange-juice back into orange trees to fill Dr. Doofenschmirtz's new green house