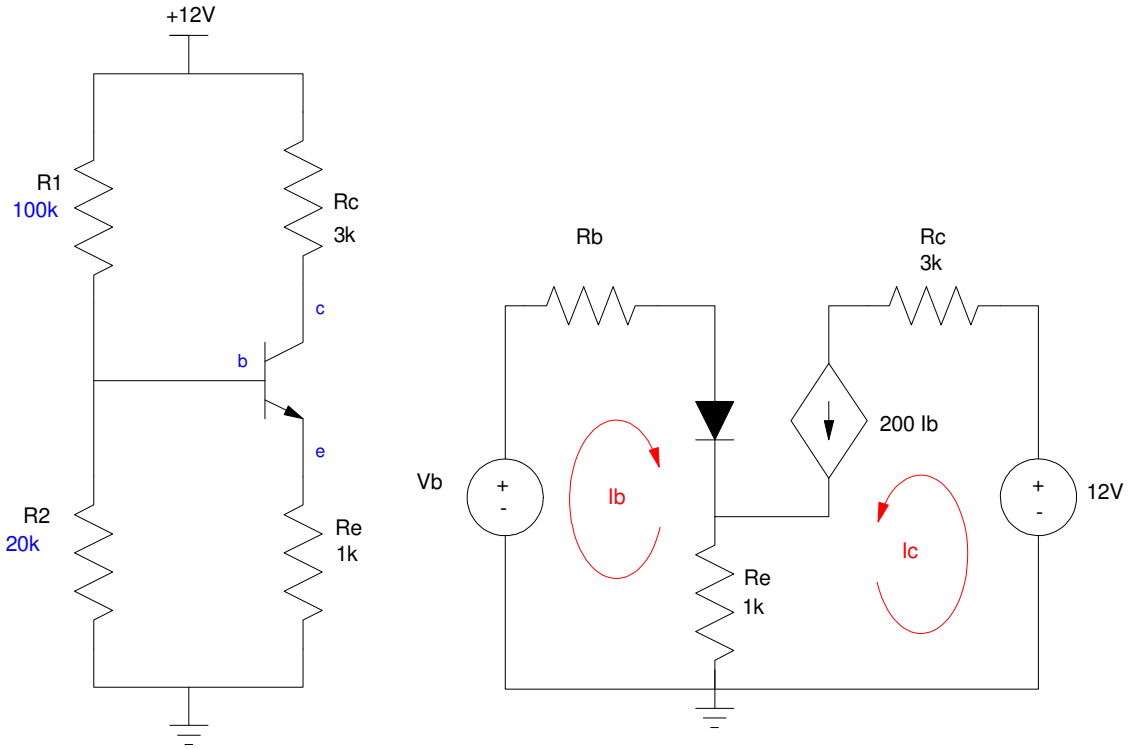
ECE 321: Handout #12

DC Analysis of Common Emitter Amplifiers

1) Determing the Q-point for the following CE amplifier. Assume 3904 transistors
   - β = 200



2) Find R1 and R2 so that
   - The Q-point is Vce = 6.0V, and
   - The Q-point is stabilized for variations in β

Soluition

1) Determing the Q-point for the following CE amplifier.

Step 1: Determine the Thevenin equivalent for R1 & R2:

$$V_b = \left(\frac{20k}{20k+100k}\right)12V = 2.00V$$

$$R_b = 20k \,||\, 100k = 16.667k\Omega$$

Ib is then

$$2.00V = R_b I_b + 0.7V + R_e(I_b + 200I_b)$$

$$I_b = \left(\frac{2.00V-0.70V}{16.67k+(1+200)1k}\right) = 5.972\mu A$$

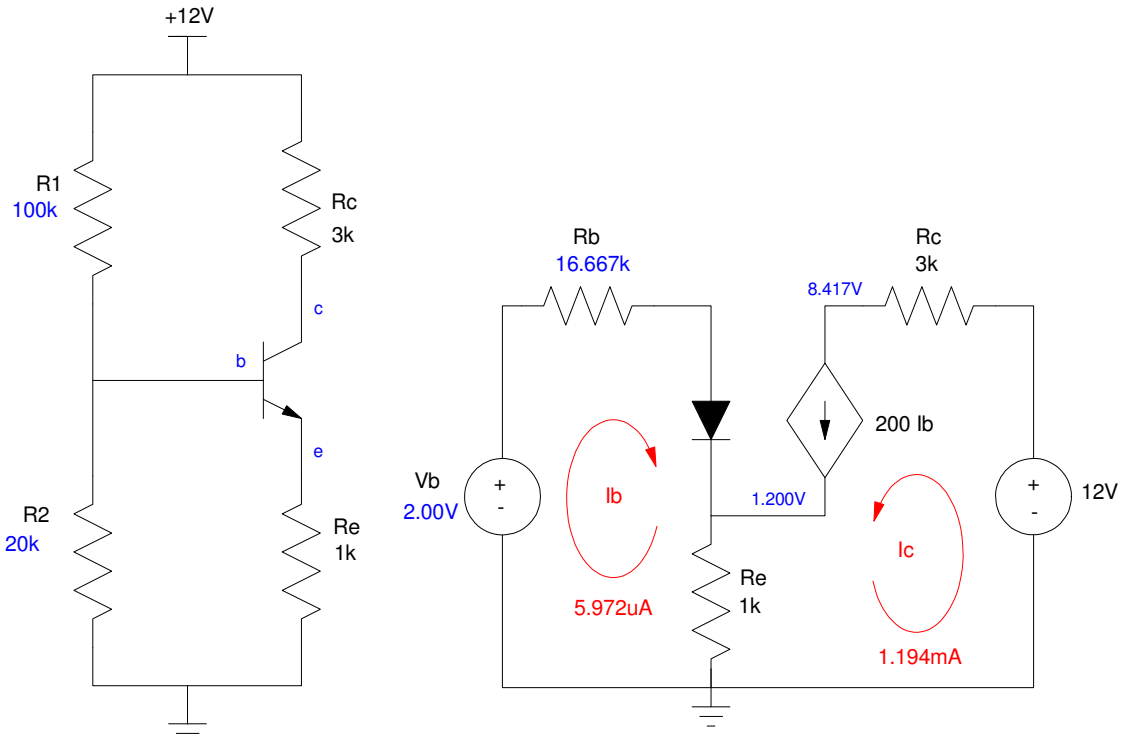
$$I_c = 200I_b = 1.194mA$$

Vce is then

$$V_e = (I_b + I_c)R_e = 1.200V$$

$$V_c = 12 - R_c I_c = 8.417V$$

$$V_{ce} = V_c - V_e = 7.217V$$



Problem 2: Determine R1 and R2 so that

- Vce = 6.00V
- The Q point is stabilized for variations in β

To stabilize the Q-point

$$(1+\beta)R_e >> R_b$$

$$201k >> R_b$$

Let Rb = 20k

For Vce = 6.00V

$$12 - I_c R_c - (I_b + I_c)R_e = 6.00V$$

$$I_c = 1.498mA$$

$$I_b = \frac{I_c}{200} = 7.491\mu A$$

$$V_b = I_b R_b + 0.7 + (I_b + I_c)R_e$$

$$V_b = 2.355V$$

Now solve for R1 and R2

$$\left(\frac{R_1 R_2}{R_1 + R_2}\right) = 20k\Omega$$

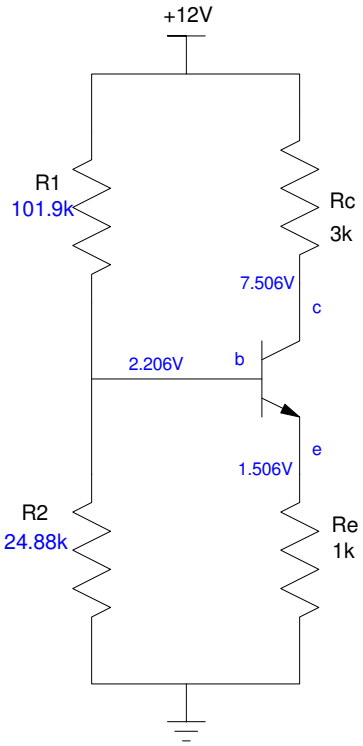
$$\left(\frac{R_2}{R_1 + R_2}\right) 12V = 2.355V$$

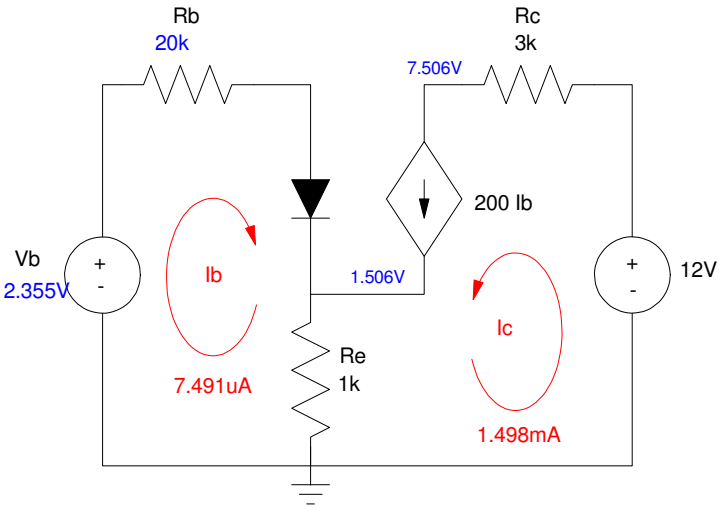
This gives

$$R_1 = \left(\frac{12V}{2.355V}\right) 20k = 101.9k$$

$$R_1 \,||\, R_2 = 20k$$

$$R_2 = 24.88k$$


+12V
R1
101.9k
Rc
3k
7.506V
c
2.206V
b
e
1.506V
R2
24.88k
Re
1k


Rb
20k
Rc
3k
7.506V
200 Ib
Vb
2.355V
+
-
Ib
7.491uA
1.506V
Re
1k
Ic
1.498mA
+
-
12V