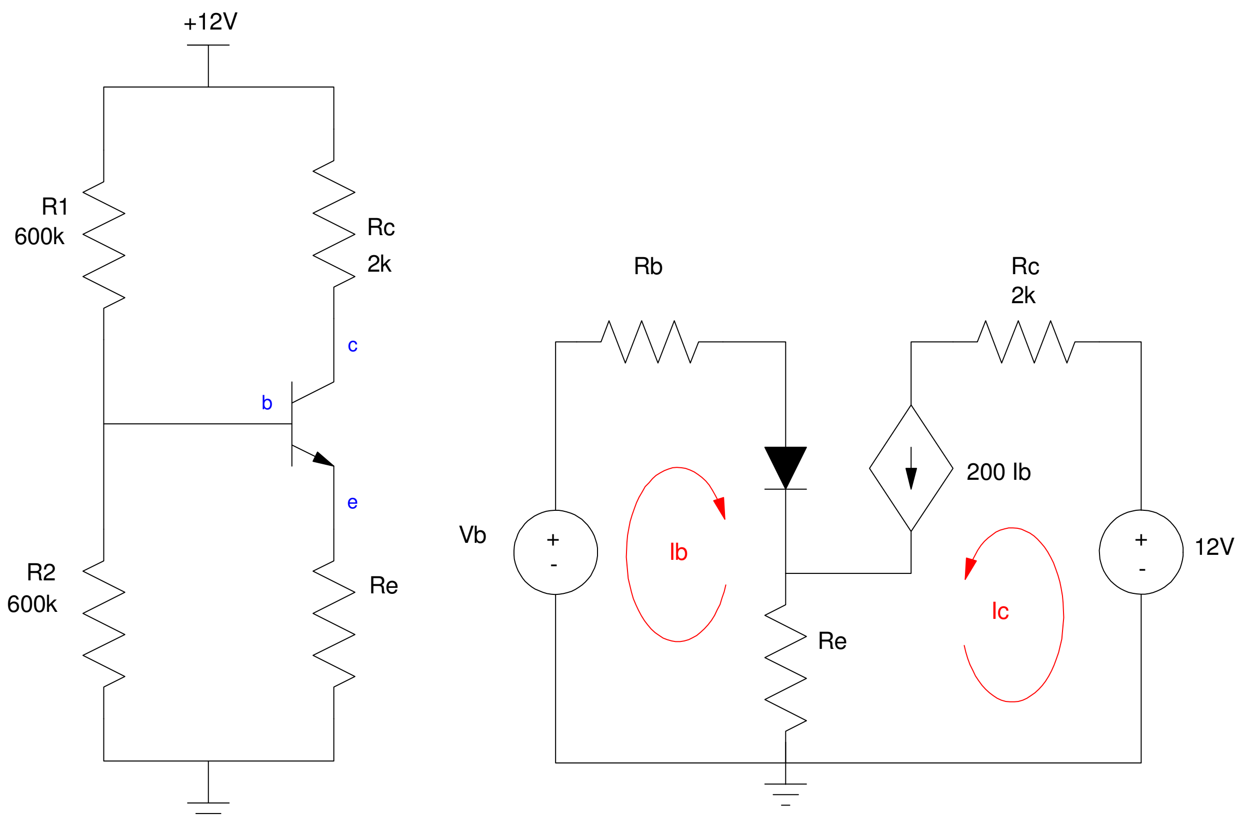
ECE 321 - Quiz #4 - Name ______________________

BJT Amplifiers. Spring 2023

1) BJT Amplifier: DC Analysis. Determine the Thevenin equivalent of R1 and R2 as well as the Q-point. Assume ideal silicon transistors:

- |Vbe| = 0.7V
- β = 200
- Re = 800 + 100*(your birth month) + (your birth day).

Re 800 + 100*mo + day	Vb	Rb	Vce	Ic
1314	**6.00V**	**300k**	**5.706V**	**1.165mA**



$$V_b = \left(\frac{R_2}{R_1+R_2}\right) 12V = 6.00V$$

$$R_b = 600k||600k = 300k$$

$$I_b = \left(\frac{V_b - 0.7}{R_b + R_e(1+\beta)}\right) = 9.395\mu A$$

$$I_c = 200 I_b = 1.879mA$$

$$V_{ce} = 12V - R_c I_c - R_e(I_c + I_b) = 5.706V$$

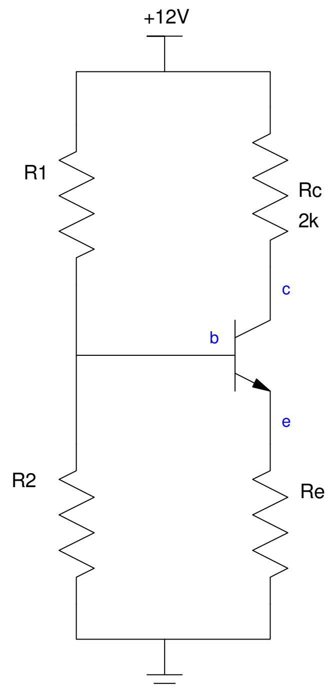
2) BJT Amplifier: DC Design. Determine R1 and R2 so that

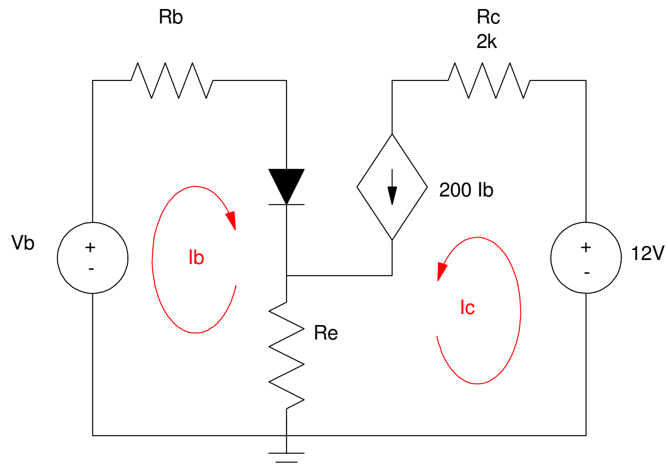
- The Q point is Vc = 8.00V and
- The Q point is stabilized for variations in β

Assume

- Ideal silicon transistors (Vbe = 0.7V, β = 200)
- Re = 800 + 100*(birth month) + (birth day).

Re 800 + 100*mo + day	R1	R2	Vb	Rb
1314	**67.77k**	**28.37k**	**3.541V**	**20k**





To stabilize the Q-point

$$R_b << (1+\beta)R_e = 261.4k$$

Let Rb = 20k

$$V_c = 8V = 12V - I_c R_c$$

$$I_c = 2.00mA$$

$$I_b = 10.0\mu A$$

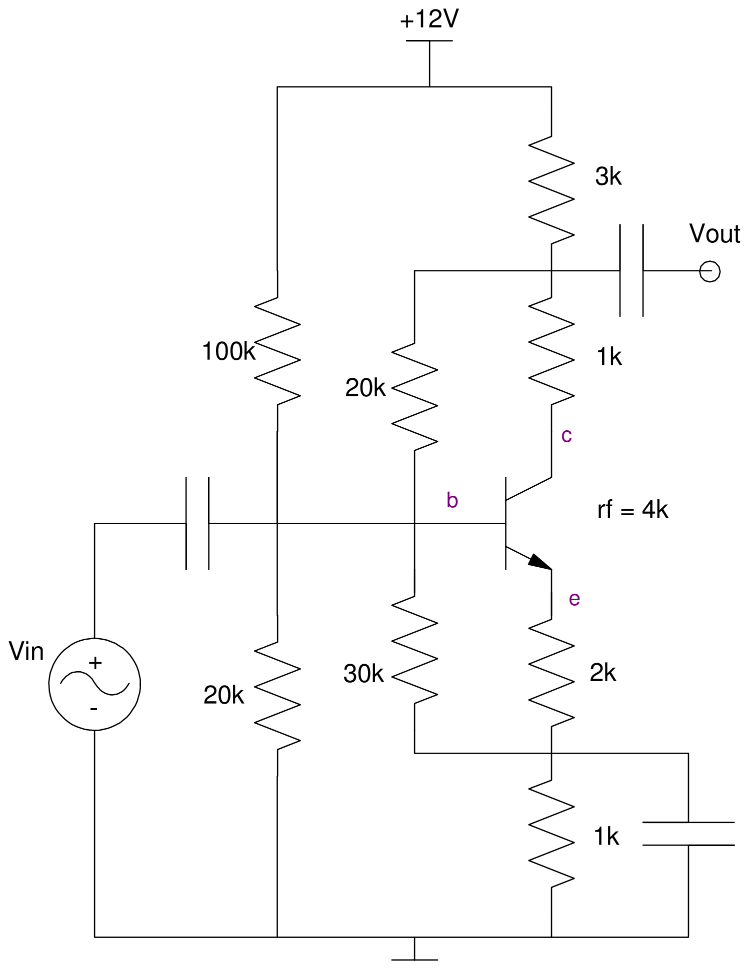
$$V_b = R_b I_b + 0.7 + R_e(I_b + I_c) = 3.541V$$

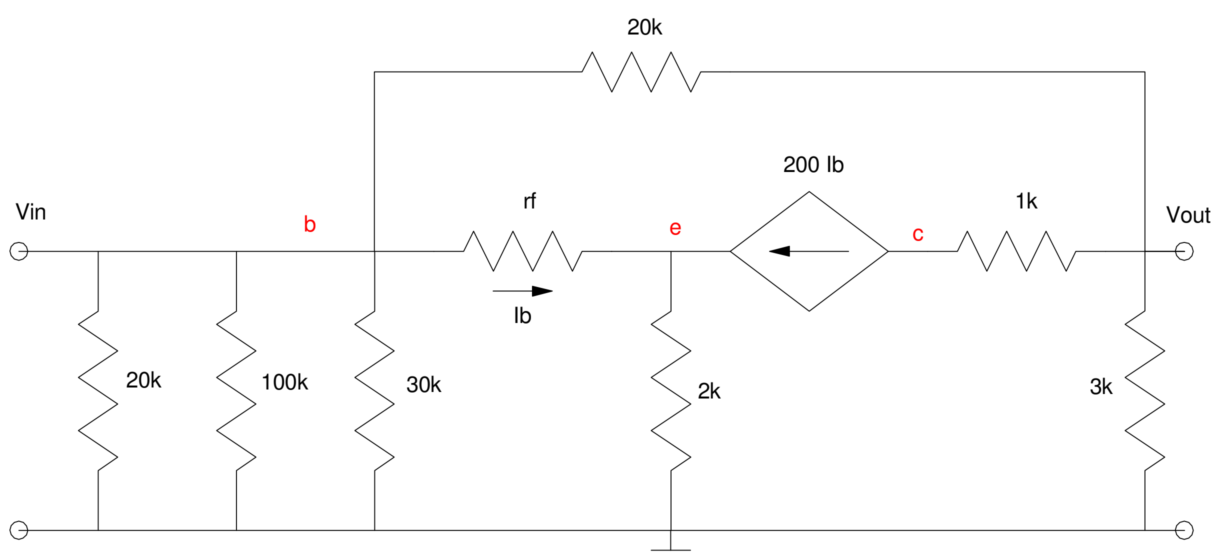
$$R_1 = \left(\frac{12V}{3.541V}\right) 20k = 67.77k$$

$$R_2 = 28.37k$$

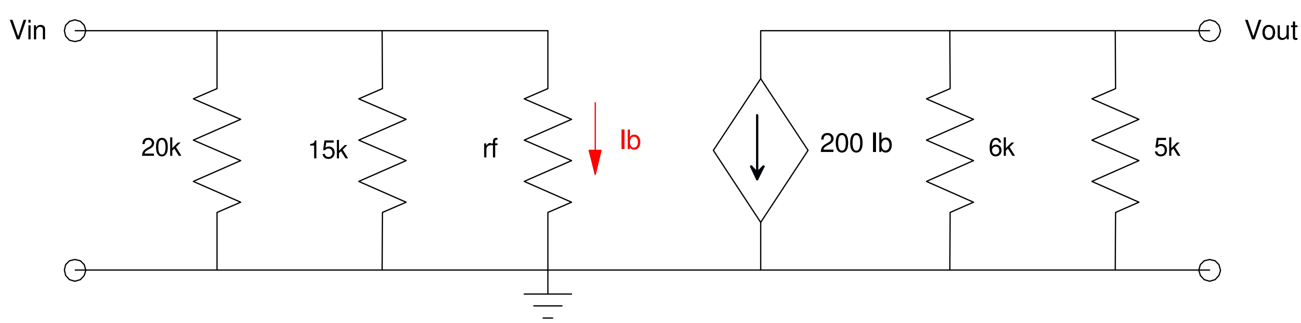
3) BJT: AC Analysis: Draw the small signal model for the following BJT amplifier. Assume

- $r_f = 4k\Omega$
- $\beta = 200$





4) BJT: AC Analysis: Determine the 2-port model for the following CE amplifer.



rf 800 + 100*mo + day	Rin	Ain	Rout	Ao
1314	**1139**	**0**	**2727**	**-415.1**

$$R_{in} = 20k||15k||1314 = 1139\Omega$$

$$A_{in} = 0$$

$$R_{out} = 5k||6k = 2727\Omega$$

$$A_o = -\left(\frac{1}{r_f}\right)(200)(2727\Omega) = -415.1$$

5) 2-Port model (experimental): Determine the 2-port parameters based upon the following experimental data:

Case 1:
- Vin = 1mV @ 1kHz
- R1 = 0 Ohms
- R2 = 10M Ohms

results in Vout = 230mV

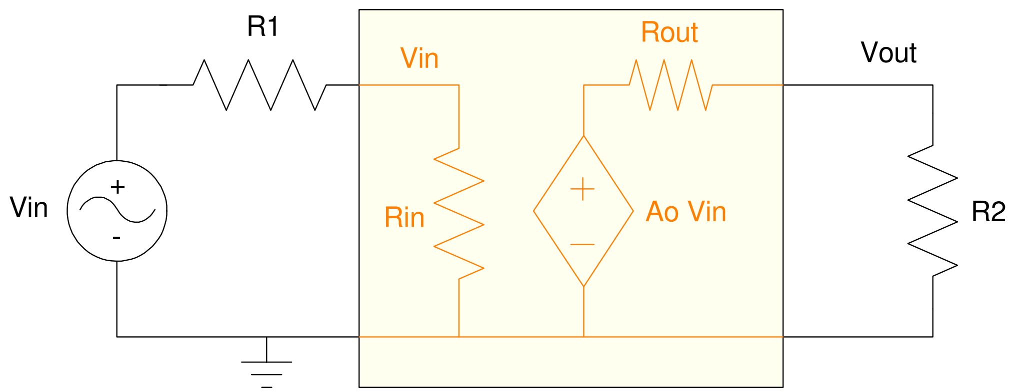
Case 2:
- Vin = 1mV @ 1kHz
- R1 = X Ohms
- R2 = 10M Ohms

results in Vout = 170mV

Case 3
- Vin = 1mV @ 1kHz
- R1 = 0 Ohms
- R2 = X Ohms

results in Vout = 130mV

Assume
- X = 800 + 100*(your birth month) + (your birth date) Ohms



X 800 + 100*mo + day	Rin	Ai	Rout	Ao
1314	**3723**	**0**	**1011**	**230** 230mV
1314	**0.9719**	**0**	**232,250**	**230,000** 230V

Case 1:

$$A_o = 230$$

Case 2:

$$\left(\frac{R_{in}}{R_{in}+1314}\right)230 = 170$$

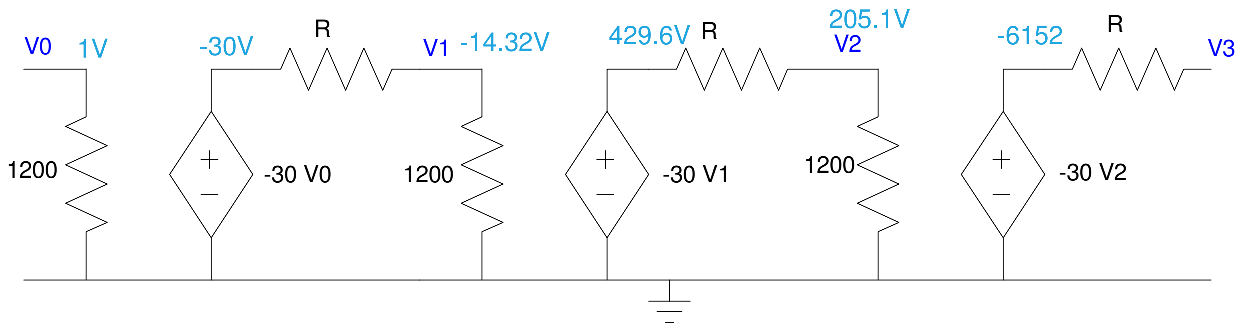
$$R_{in} = \left(\frac{170}{230-170}\right)1314\Omega = 3723\Omega$$

Case 3:

$$\left(\frac{1314}{1314+R_{out}}\right)230 = 130$$

$$R_{out} = \left(\frac{230-130}{130}\right)1314 = 1011\Omega$$

6) Determine the 2-port model for the following cascaded CE amplfier



R 800 + 100*mo + day	Rin	Ai	Rout	Ao
1314	**1200**	**0**	**1314**	**-6152**