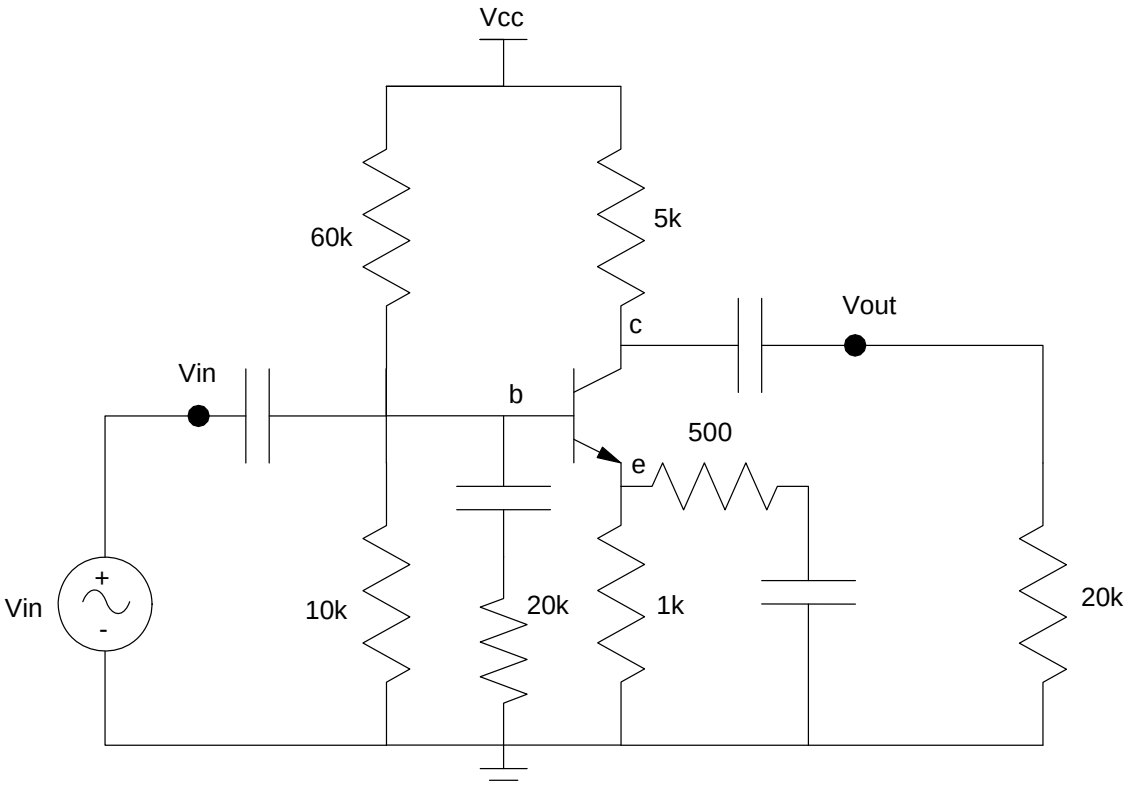
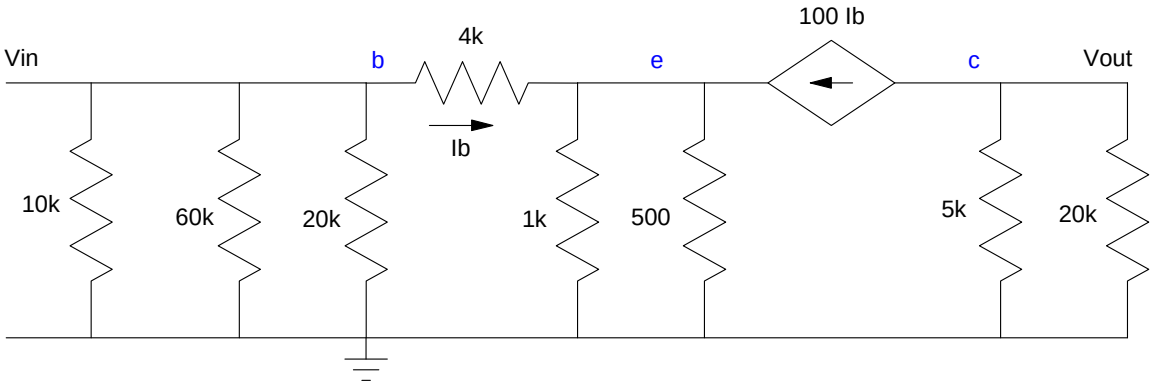
ECE 321: Quiz #4 Name _____ 9:00 / 11:00

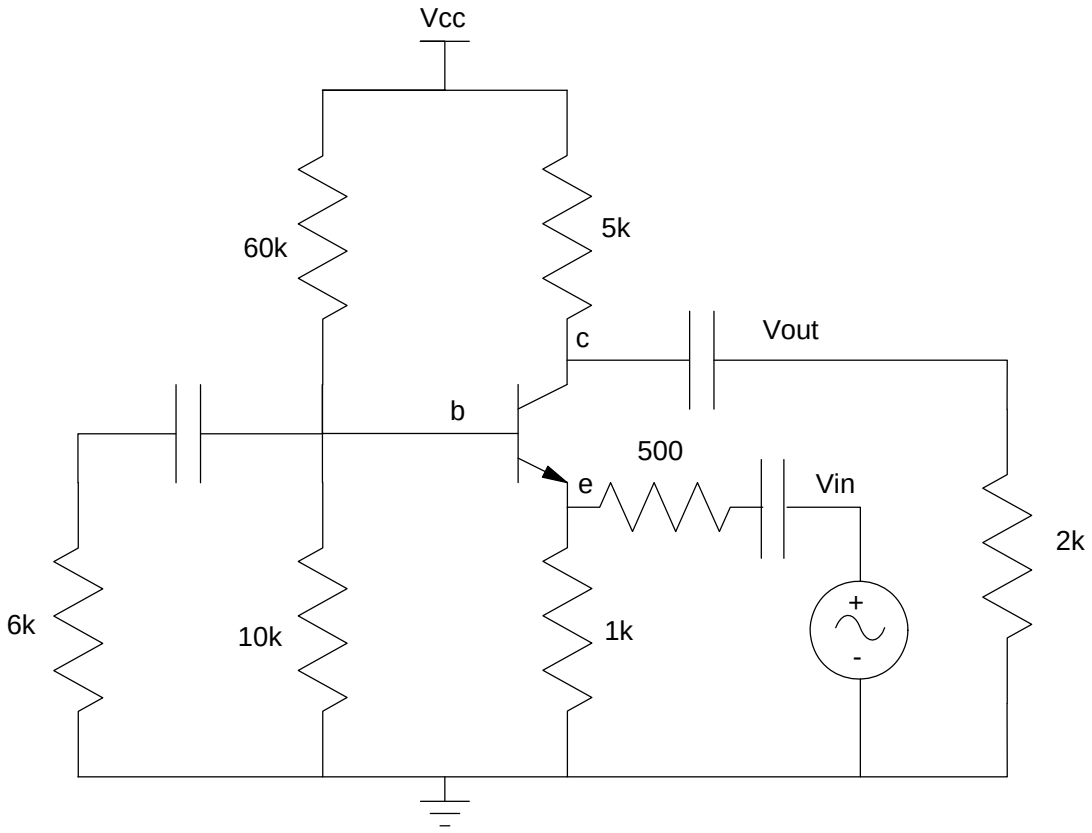
BJT Amplifiers: AC Analysis - May 4, 2017

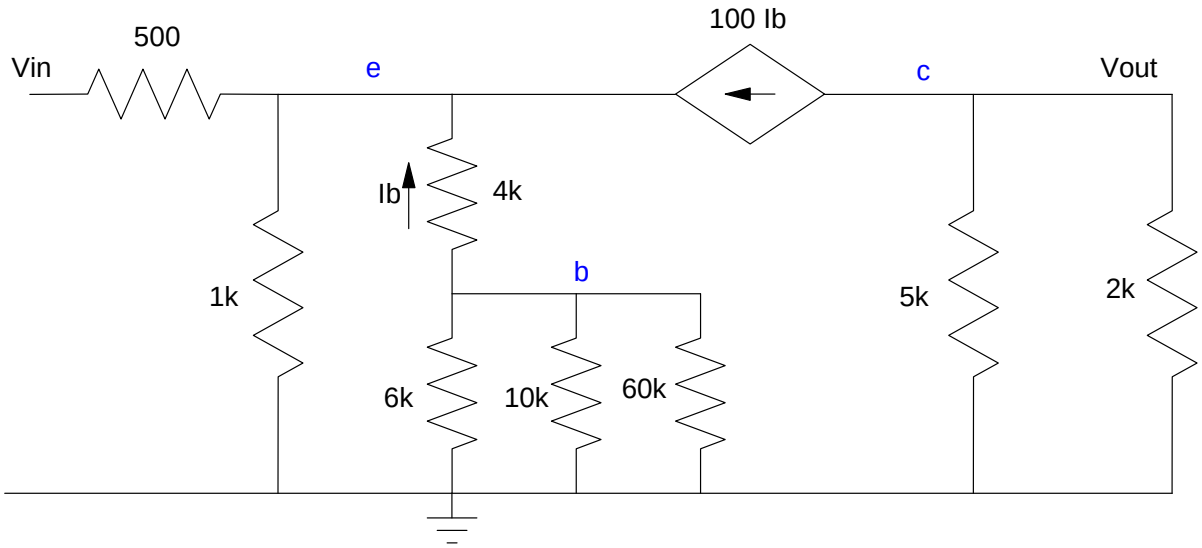
1) Assume the DC operating point is $I_b = 13\mu A$ (meaning $r_f = 4000\Omega$). Draw the small signal model for the following common emitter amplifier:





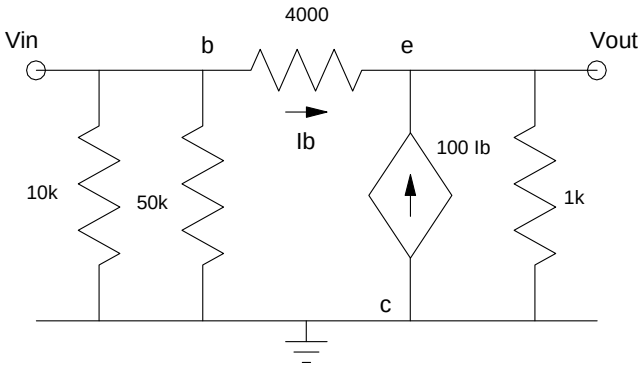
2) Assume the DC operating point is $I_b = 13\mu A$ (meaning $r_f = 4000\Omega$). Draw the small signal model for the following common emitter amplifier:

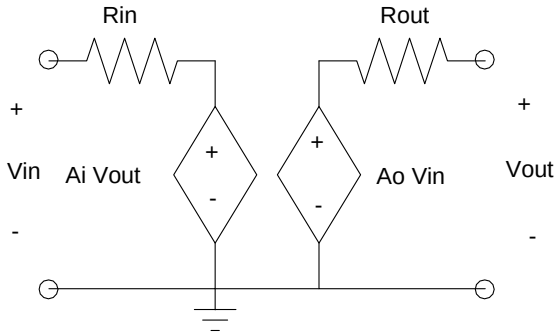




3) Find the 2-port parameters for the following circuit:

Rin	Ai	Rout	Ao
2.7k	**0.6757**	**38**	**0.9619**





Rin: Short Vout, Measure the resistance at the input

$$R_{in} = 10k||50k||4k = 2.7k$$

Ai: Apply 1V to Vout. Measure Vin

$$A_i = \left(\frac{8333}{8333+4000}\right) = 0.6757$$

Rout: Short Vin. Apply 1V at Vout.

$$R_{out} = 1k||4k||\frac{4k}{100} = 38\Omega$$

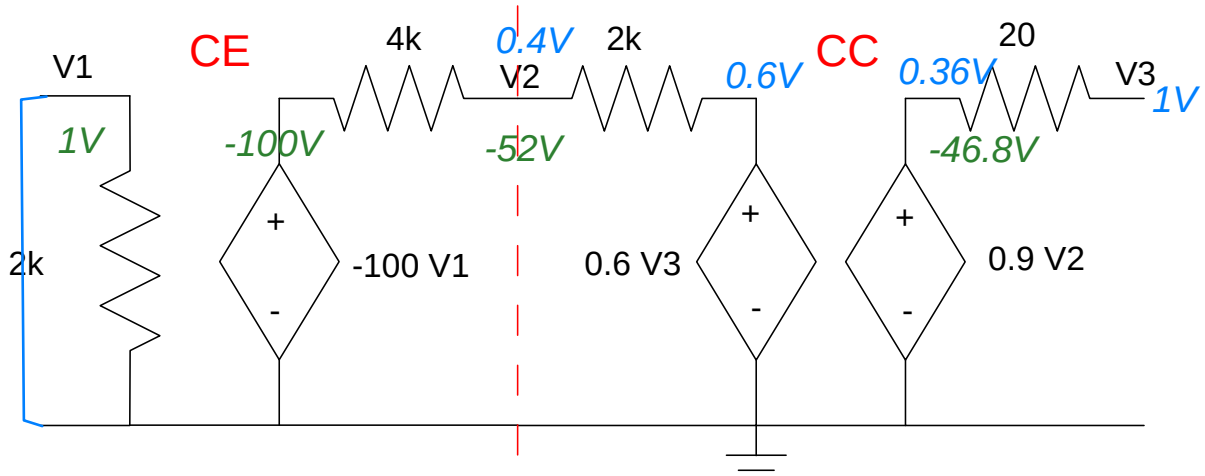
Aout: Apply 1V at Vin. Measure Vout. To do this, compute X = Vout

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

$$X = \left(\frac{\frac{101}{4k}}{\frac{101}{4k}+\frac{1}{1k}}\right) = 0.9610$$

4) Find the 2-port parameters for the following circuit:

Rin	Ai	Rout	Ao
2k	**0**	**31.2**	



Rout: Short Vin. Apply 1V to Vout. Measure the current (shown in blue)

$$I = \left(\frac{1-0.36}{20}\right)$$

$$R_{out} = \frac{1}{I} = \left(\frac{20}{1-0.36}\right) = 31.2\Omega$$

Aout: Apply 1V to Vin. Measure Vout (shown in green)

$$V_2 = \left(\frac{2k}{2k+4k}\right)(-100V) + \left(\frac{4k}{2k+4k}\right)(0.6V_3)$$

$$V_2 = \left(\frac{2k}{2k+4k}\right)(-100V) + \left(\frac{4k}{2k+4k}\right)(0.6)(0.9V_2)$$

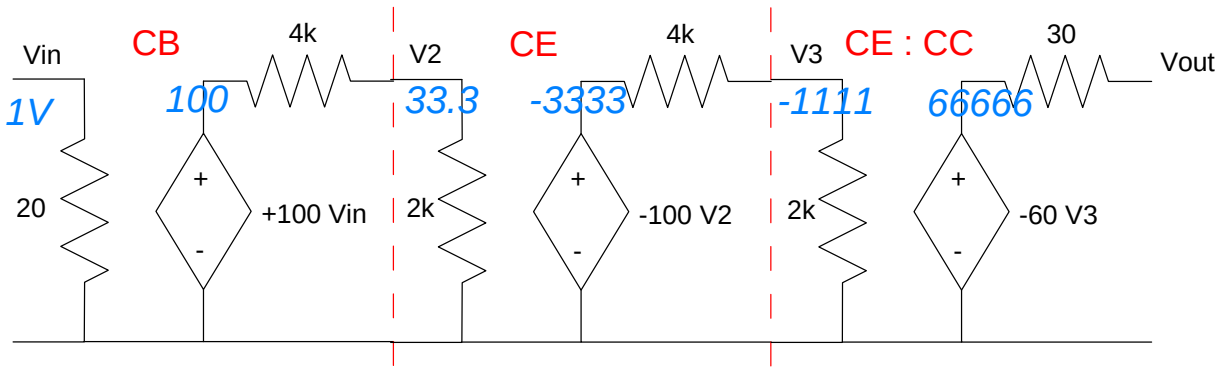
$$V_2 = -33.33 + 0.36V_2$$

$$V_2 = \left(\frac{-33}{1-0.36}\right) = -52$$

$$V_3 = 0.9V_2 = -46.8$$

5) Find the 2-port parameters for the following circuit:

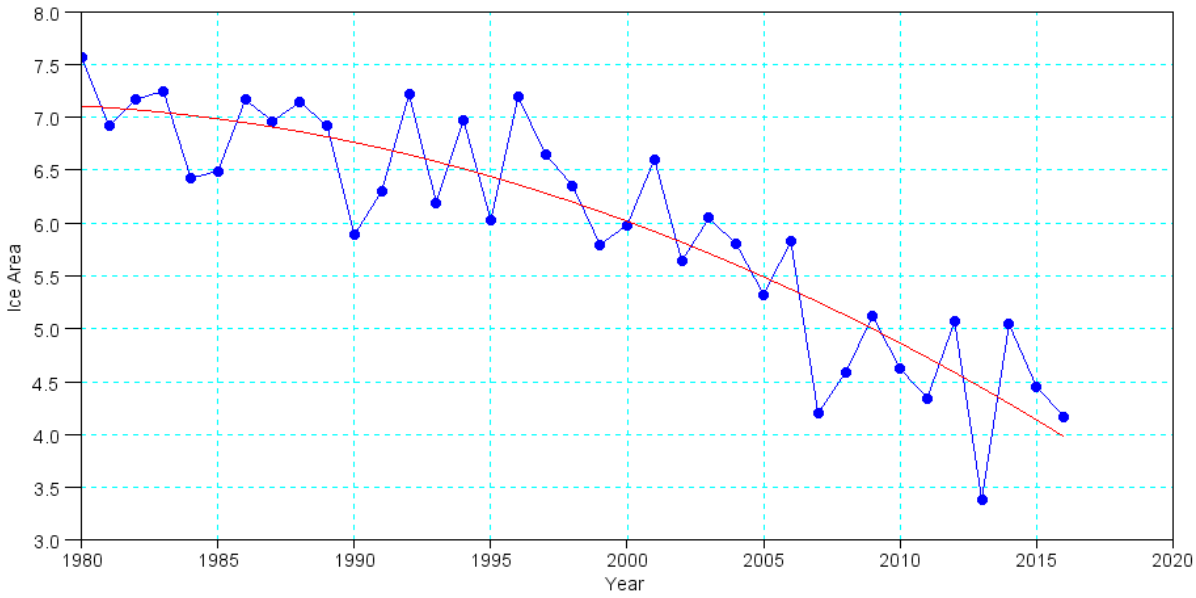
Rin	Ai	Rout	Ao
20	**0**	**30**	**66,666**



Ao: Apply 1V at the input

Bonus! The amount of Arctic sea ice at its minimum each year is measured by the National Snow and Ice Data Center (shown below).

The Arctic has been covered by ice for somewhere between 5 and 15 million years. When will the arctic ocean be ice free again?



Minimum Arctic Sea Ice Area in million km^2. (National Snow and Ice Data Center)

Linear Curve Fit:

$$Ice = 7.1 - 0.0861(year - 1980)$$

Ice = 0 in the year 2062

Polynomial Curve Fit (shown)

Ice = 0 in the year 2033