Write your name at the top right corner of every page (including this cover page).

Copy everything you want counted towards your grade onto the pages that I provided.

Write with a pen that cannot be erased!

No books or calculators are allowed!

Write down all the steps that lead to your result.

Identify new variables that you may introduce in the circuit diagrams that I provided.

Read all the problems before you start so that you can begin with those that seem easiest to you.

To get smooth calculations please use the following values for the magnitude forward voltage drop between base and emitter when calculating the large signal response of bias of a BJT: **0.7 V** if active, or **0.8 V** if in saturation. $V_T = 26$ mV.

Problem 1 (9 pts):

Draw the straight line sketch for the Bode plots (magnitude and phase) of the following transfer function:

$H = \frac{200s}{(s+2)(s+10)}$

What kind of filter would that be?

(continuation of problem 1)

Problem 2 (8 pts):

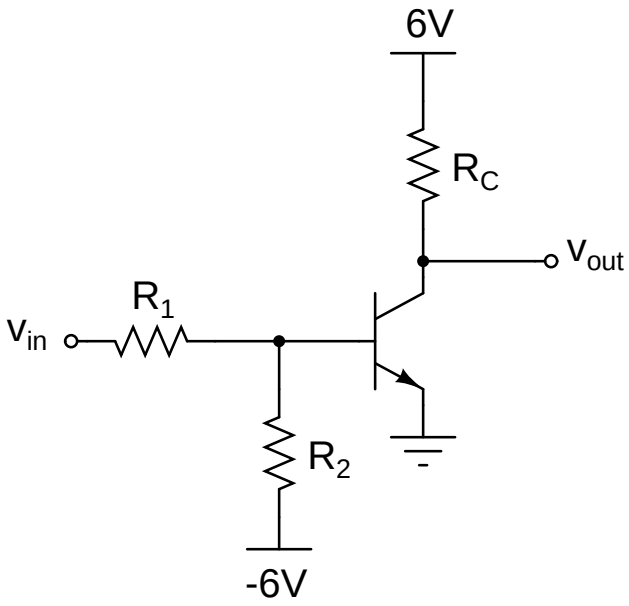
Draw the straight line sketch for the Bode plots (magnitude and phase) of the following transfer function:

$H = \frac{5(s+2)}{s(s+10)}$

(continuation of problem 2)

Problem 3 (8 pts):

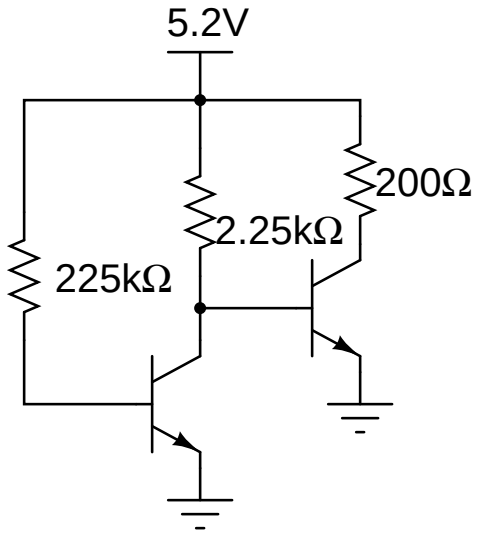
The resistor values in the following inverter logic circuit are: $R_1 = 1k\Omega$, $R_2 = 1.36k\Omega$, and $R_C = 580\Omega$. The voltage for LOW is defined as 0.2 V and the voltage for HIGH is defined as 6 V. Examine the HIGH input state to determin the minimum β the transistor in the following circuit must have for the circuit to work as an inverter. Show qualitatively that the circuit will work as advertised for LOW input.



(continuation of problem 3)

Problem 4 (8 pts):

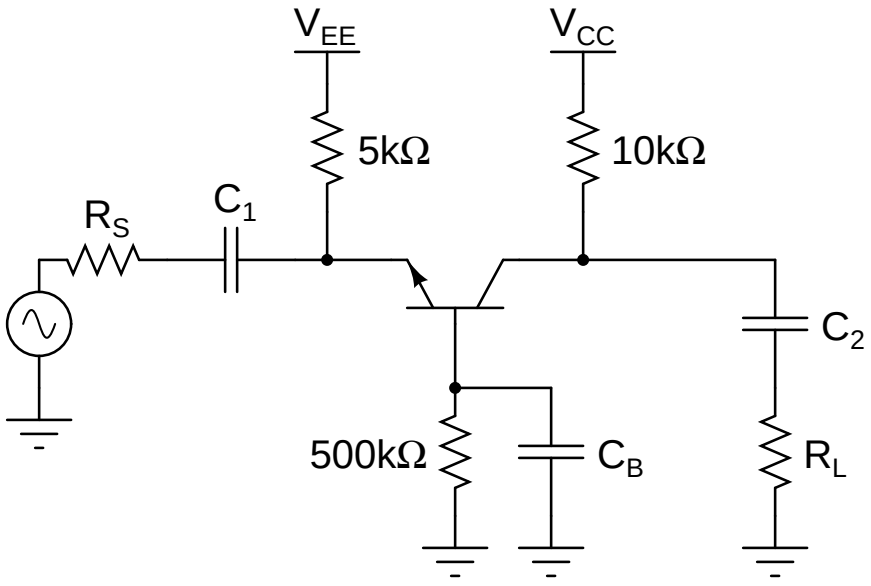
Both transistors have $\beta = 99$. Calculate V_{CE} for each transistors and show that both transistors are in the active region.



(continuation of problem 4)

Problem 5 (7 pts):

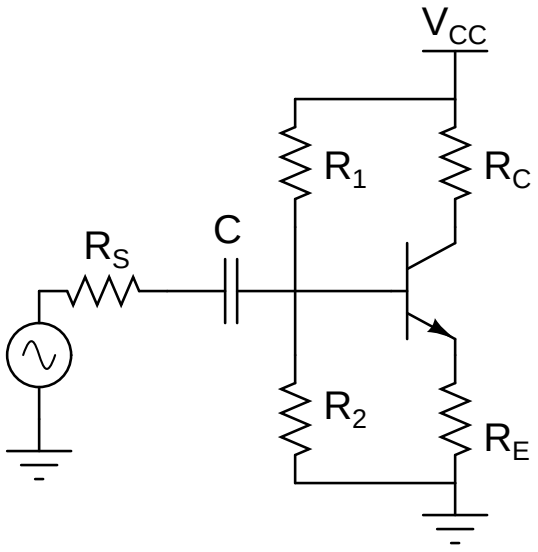
In the circuit below R_L is chosen such that 10k$\Omega||R_L$ is 5.05kΩ. $V_{CC} = -V_{EE}$ is chosen such that $I_{CQ} = 1.04$ mA. $h_{fe} = 100$. Calculate the voltage gain v_c/v_e for small ac-signals. Draw the corresponding ac-equivalent circuit with your small signal BJT model. Make sure to label all circuit elements and explain any new labels that you may choose to introduce.



(continuation of problem 5)

Problem 6 ONLY 6610 students !!! (8 pts):

Using the corresponding ac-equivalent circuit and small signal BJT model, find formulas for the dependence of $R_b = v_b/i_b$ and $A_v = v_c/v_b$ on the model parameters r_π and h_{fe} as well as the relevant other circuit elements. Draw the ac-equivalent circuit with that small signal BJT model (the one with r_π). Make sure to label all circuit elements and explain any new labels that you may choose to introduce.



(continuation of problem 6)