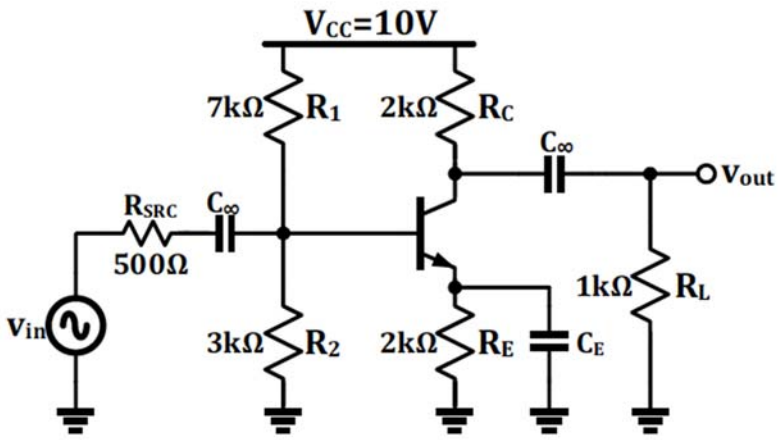
ECE 342: Electronic Circuits **Summer 2024**
Problem Set #8 **Professor Schutt-Aine**
Due Date: 5pm, Tue, Jul 16, 2024

1. Given $V_{BE(on)} = 0.7V, \beta = 50, V_A = -20V$, determine the voltage gain $A_v = \frac{v_{out}}{v_{in}}$. Assume $V_T = 25mV$ and $C_E \to \infty$.



a) Determine the DC bias point $Q = (V_B, V_C, V_E, I_C)$. Is the transistor in Forward-Active (FA) mode?

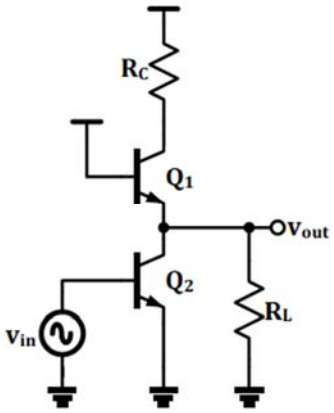
b) Draw the small-signal model of this circuit, and derive expressions for G_m, input resistance R_i, the output resistance R_o, the small-signal voltage v_{be} (in terms of v_{in}), and the voltage gain $A_v = \frac{v_{out}}{v_{in}}$.

c) Using the answers to part a) and b), assuming $v_{in} = 5mV$, determine numerical values for G_m, input resistance R_i, the output resistance R_o, the small-signal voltage v_{be}, and the voltage gain $A_v = \frac{v_{out}}{v_{in}}$.

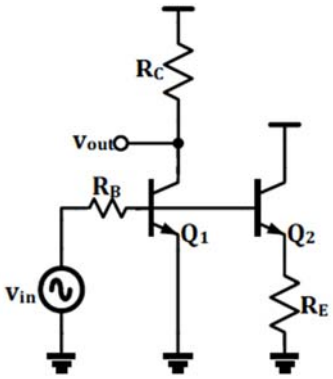
d) If $v_b = 5mV$, determine the value of the small-signal collector current i_c.

2. Repeat Problem 1 but this time assume $C_E = 0$. Compare the results of part b)-d) with that of Problem 1.

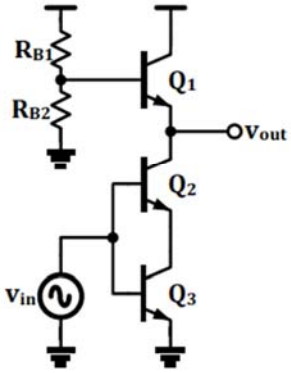
3. Determine expressions for $G_m, R_i, and\ R_o$ for the following circuits by parsing the circuit appropriately and using the concept of BJT driving point (terminal) resistances. Assume $\beta \gg 1$ and FA-mode.



(a)



(b)



(c)