Microelectronics Circuit Analysis and Design Homework(8th)

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5.24 (a) For the circuit in Figure P5.24, determine V_B and I_E such that $V_B = V_C$. Assume $\beta = 90$.
(b) What value of V_B results in $V_{CE} = 2\text{V}$?

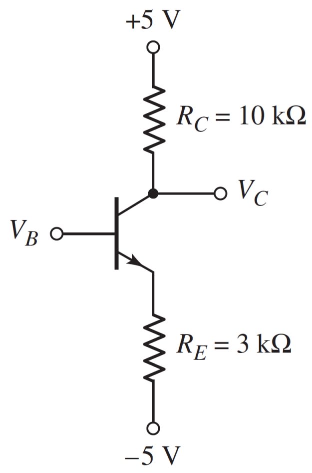

Figure 1: Problem 5.24

Solution:

(a)Assume the BJT works in the forward-active region:

$$\begin{cases} I_C = \dfrac{5 - V_C}{R_C} \\ I_E = \dfrac{V_B - V_{BE(on)-(-5)}}{R_E} \\ I_E = \dfrac{1+\beta}{\beta} I_C \\ V_B = V_C \end{cases} \Rightarrow \begin{cases} V_B = -2.14\text{V} \\ I_E = 0.72\text{mA} \end{cases}$$

(b)Obviously, the BJT work in the active region, so we have equation:

$$\begin{cases} V_C - V_B + V_{BE(on)} = V_{CE} \\ I_C = \dfrac{5 - V_C}{R_C} \\ I_E = \dfrac{V_B - V_{BE(on)-(-5)}}{R_E} \\ I_E = \dfrac{1+\beta}{\beta} I_C \end{cases} \Rightarrow \begin{cases} V_B = -2.44\text{V} \\ I_E = 0.62\text{mA} \end{cases}$$

5.43 The common-emitter current gain of the transistor in Figure P5.43 is $\beta = 80$. Plot the voltage transfer characteristics over the range $0 \leq V_I \leq 5\text{V}$.

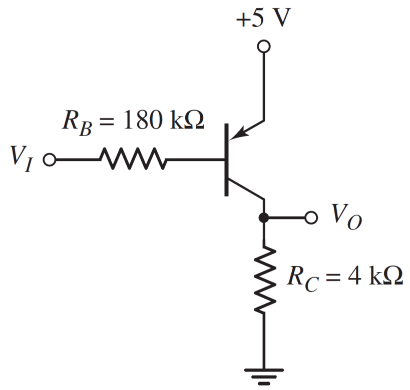

Figure 2: Problem 5.43

Solution:

It's a PNP BJT

case 1: $V_I \in (4.3, 5), V_{EB} < 0.7\text{V}$, the B-E junction isn't conducted, $I_E = 0, V_O = 0$

case 2: When BJT works in saturation region(at sat-point), $V_{EC} = 0.2\text{V}$, $V_O = 4.8\text{V}$, $V_I = 5 - V_{EC(ON)} - \dfrac{V_O}{\beta R_C} R_B = 1.6\text{V}$, so when $V_I < 1.6\text{V}$, $V_O = 4.8\text{V}$

case 3: $V_I \in [1.6, 4.3]$, the BJT works in the active region:

$$\frac{V_O}{R_C} = \beta \frac{5 - V_{BE(ON)} - V_I}{R_B} \Rightarrow V_O = -\frac{16}{9} V_I + \frac{344}{45}$$

5.70 For the circuit in Figure P5.70, let $R_C = 2.2\text{k}\Omega$, $R_E = 2\text{k}\Omega$, $R_1 = 10\text{k}\Omega$, $R_2 = 20\text{k}\Omega$, and $\beta = 60$. (a) Find R_{TH} and V_{TH} for the base circuit. (b) Determine I_{BQ}, I_{CQ}, V_E , and V_C.

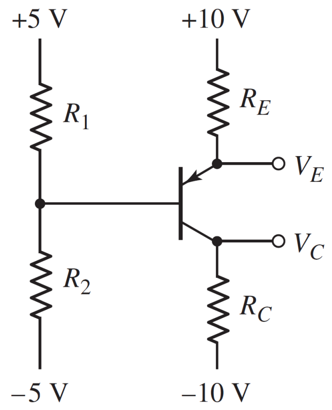

Figure 3: Problem 5.70

6.8 The parameters of each transistor in the circuits shown in Figure P6.8 are $\beta = 130$, $V_A = 80$V, and $I_{CQ} = 0.2$mA. Determine the output resistance R_o for each circuit.

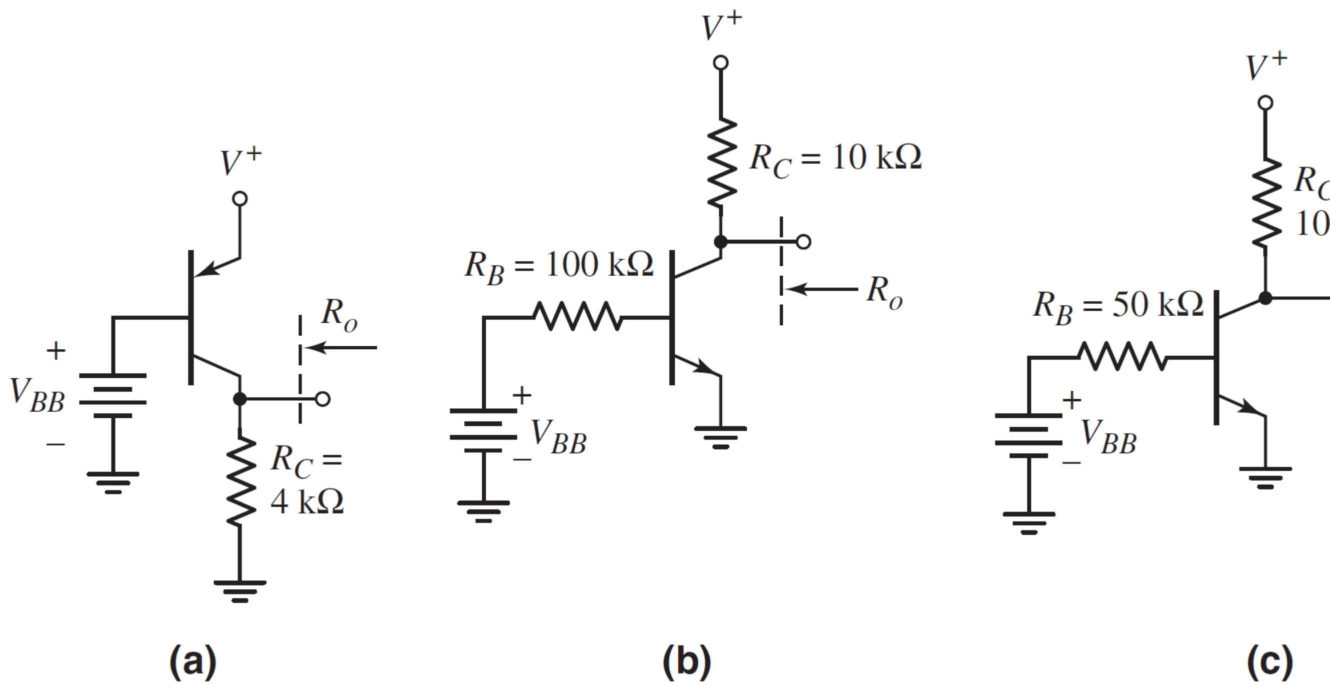

Figure 4: Problem 6.8

6.18 The signal source in Figure P6.18 is $v_s = 5 \sin \omega t$mV. The transistor parameters are

$\beta = 120$ and $V_A = \infty$. (a) (i) Design the circuit such that $I_{CQ} = 0.25$mA and $V_{CEQ} = 3$V. (ii) Find the small-signal voltage gain $A_v = v_o/v_s$. (iii) Find $v_o(t)$. (b) Repeat part (a) for $R_S = 0$.

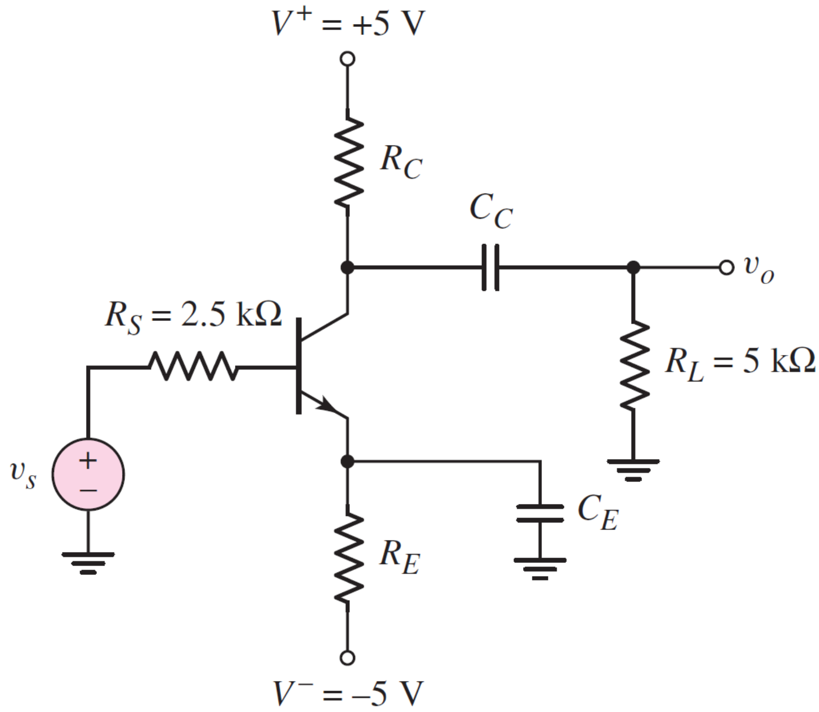

Figure 5: Problem 6.18

6.33 For the circuit in Figure P6.15, let $\beta = 100$, $V_A = \infty$, $R_E = 12.9$kΩ, and $R_C = 6$kΩ. Determine the maximum undistorted swing in the output voltage if the total instantaneous C–E voltage is to remain in the range $1 \leq v_{CE} \leq 9$V and if the total instantaneous collector current is to remain greater or equal to 50μ A.

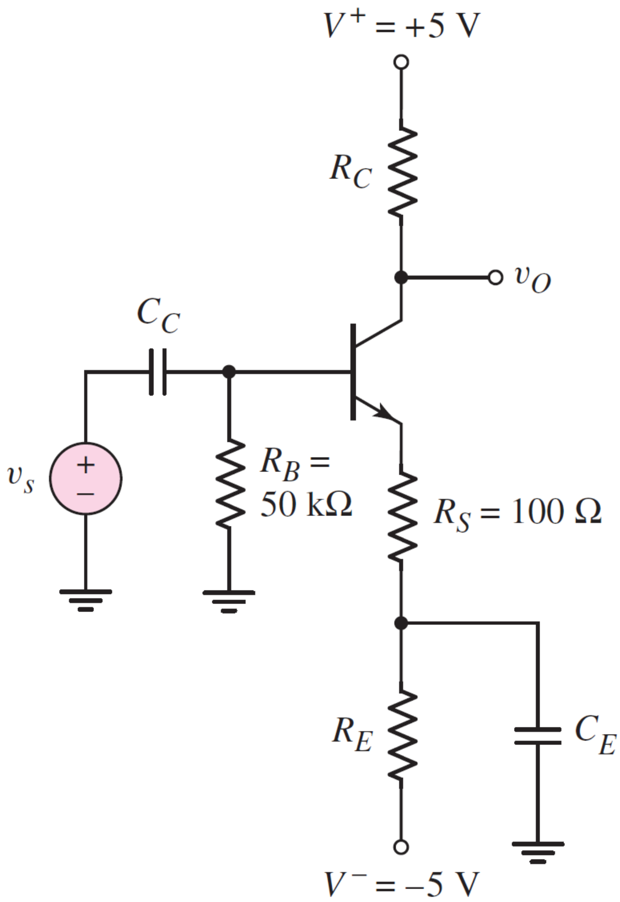

Figure 6: Problem 6.33

6.39 For the circuit in Figure P6.24, the transistor parameters are $\beta = 100$ and $V_A = \infty$. (a) Determine the maximum undistorted swing in the output voltage if the total instantaneous E–C voltage is to remain in the range $1 \leq v_{EC} \leq 9$V. (b) Using the results of part (a), determine the range of collector current.

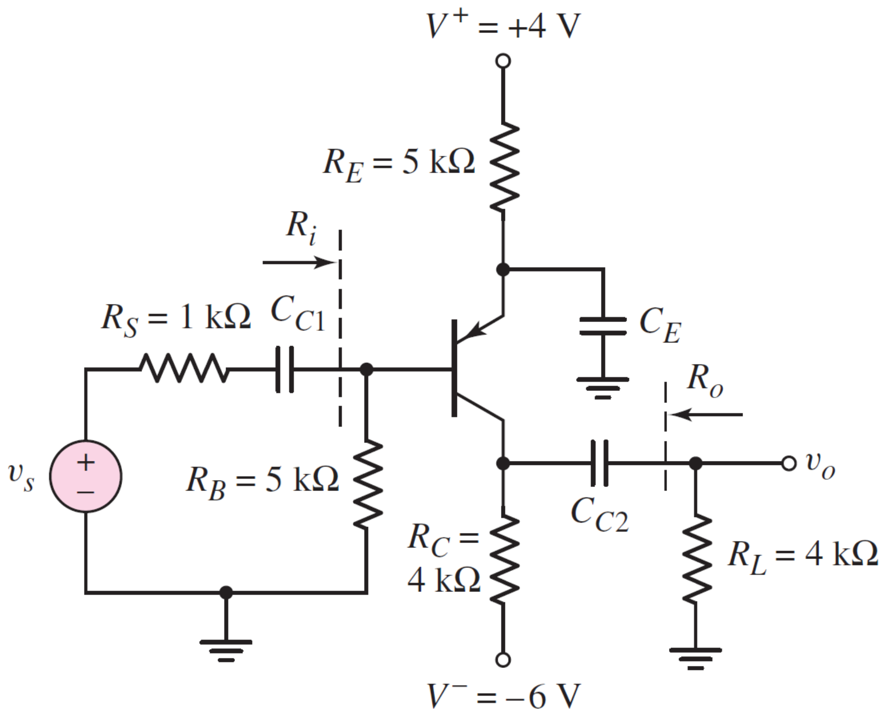

Figure 7: Problem 6.39

6.65 Consider the circuit shown in Figure P6.69. The transistor has parameters $\beta = 60$ and $V_A = \infty$. (a) Determine the quiescent values of I_{CQ} and V_{CEQ}. (b) Determine the small-signal voltage gain $A_v = v_o/v_s$.

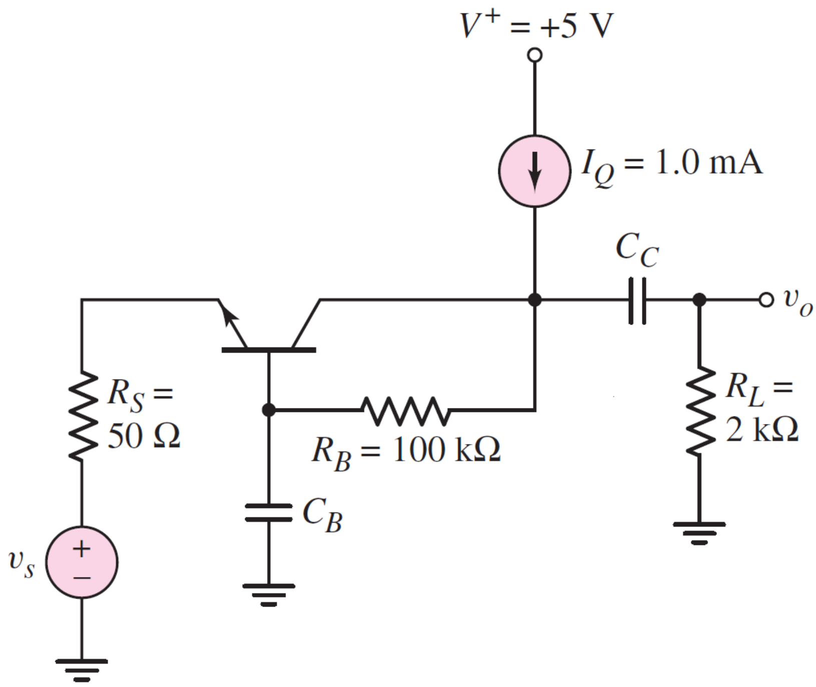

Figure 8: Problem 6.69