EE 112-2016 Tutorial 2 (MBP/JJ)

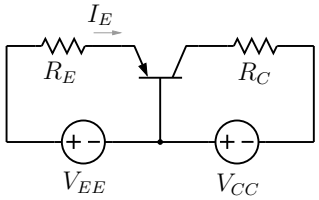
Note: For *npn* transistors, assume $V_{BE} = 0.7\,\text{V}$ in active and saturation regions, and $V_{CE}^{\text{sat}} = 0.2\,\text{V}$. For *pnp* transistors, the same numbers correspond to V_{EB} and V_{EC}^{sat}, respectively.

1. In the circuit shown in the figure, V_{CC} and V_{EE} are 5 V each. Assume that the transistor is in the active region, and $\alpha \approx 1$.

   (a) Find R_E such that $I_E = 2\,\text{mA}$.

   (b) Given that $I_E = 2\,\text{mA}$, find R_C such that $V_{BC} = 1\,\text{V}$.

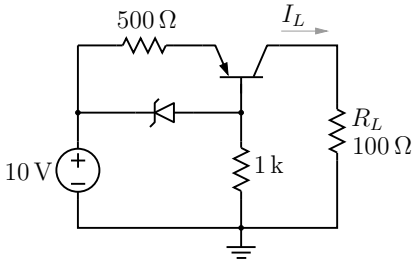
   (c) Given that $I_E = 2\,\text{mA}$, find the maximum value of R_C such that the transistor is in the active region. (Reference: Bobrow)



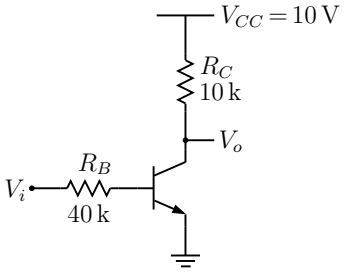
2. In the current source circuit shown in the figure, $V_Z = 5.1\,\text{V}$.

   (a) Find I_L (neglect base current).

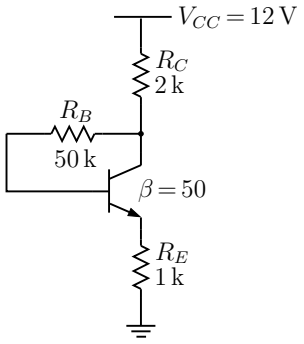
   (b) What is the range of R_L for which the current delivered to the load is I_L?



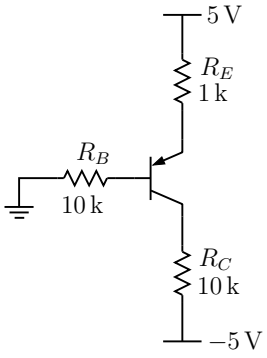
3. A BJT inverter is shown in the figure. Sketch V_o versus V_i for $0 < V_i < 10\,\text{V}$ with (a) $\beta = 40$, (b) $\beta = 80$.



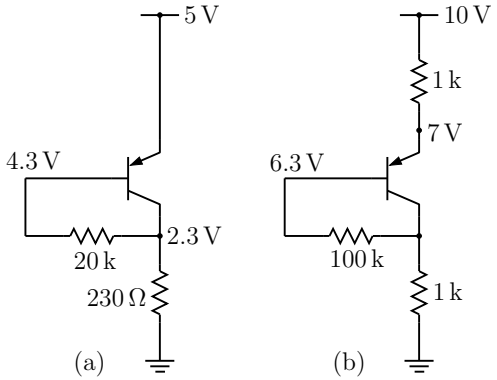
4. For the BJT circuit shown in the figure, find I_C and V_{CE}. What is the special feature of this circuit?



5. Find all voltages and currents if $\beta = 30$. (Reference: Sedra/Smith)



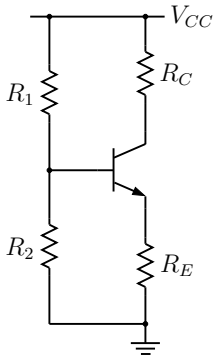
6. Measured voltages are shown. Find β in each case. (Reference: Sedra/Smith)



7. The transistor in the circuit shown in the figure has $\beta = 100$. The other parameters are $R_1 = 60\,\text{k}\Omega$, $R_2 = 30\,\text{k}\Omega$, $R_C = 1\,\text{k}\Omega$, $R_E = 100\,\Omega$, $V_{CC} = 6\,\text{V}$.

   (a) Assuming that the transistor is operating in the active mode, find I_B, I_C, and V_{CE}. Check if the assumption of active mode is correct.

   (b) What is the minimum value of R_E for the BJT to operate in the active mode? (Reference: Bobrow)



8. The transistor of P-7 has $\beta = 100$. Given $R_1 = 60\,\text{k}\Omega$, $R_2 = 30\,\text{k}\Omega$, $V_{CC} = 6\,\text{V}$, find R_C and R_E such that the BJT is biased in the active region with $I_C = 2\,\text{mA}$, $V_{CE} = 2.1\,\text{V}$. (Reference: Bobrow)

9. A common-emitter amplifier is shown in the figure.

   (a) Draw the midband equivalent circuit.

   (b) Find v_o/v_i, v_o/v_s, R_{in}, R_{out}, assuming $\beta = 50$, $V_T = 26\,\text{mV}$.

   (c) Repeat if the bypass capacitor C_E is removed.