EE 112 (MBP): HW 6 (March 6, 2017)

1. For a half-wave rectifier with $V_m = 15\,\text{V}$, $f = 50\,\text{Hz}$, the maximum load current is given to be $i_L = 30\,\text{mA}$. What is the minimum value of the filter capacitance which will ensure that the ripple voltage V_R is less than 1 V? With this capacitance value, find the average and peak diode currents, and the maximum reverse bias that appears across the diode for the following cases.

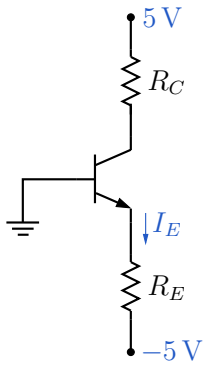
   (a) $i_L = 30\,\text{mA}$.

   (b) $i_L = 10\,\text{mA}$.

   (Assume the diode to be ideal, with $V_{\text{on}} = 0\,\text{V}$.)

2. Answer Q-1 for a full-wave rectifier with the same specs.

3. For the circuit shown in the figure, assume that the BJT has a large β (i.e., $\alpha \approx 1$).

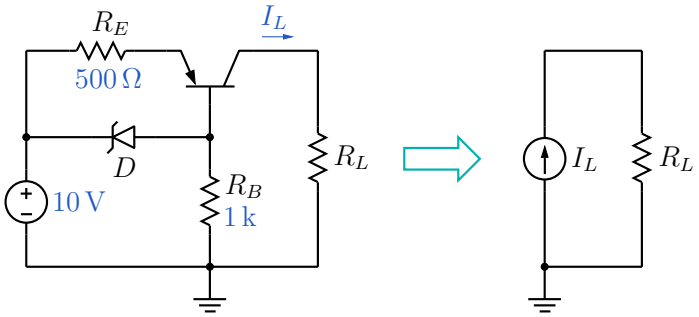


   (a) What is R_E for $I_E = 1.5\,\text{mA}$?

   (b) With $I_E = 1.5\,\text{mA}$, what value of R_C will ensure a reverse bias of 2 V across the B-C junction?

   (c) What is the maximum value of R_C for which the BJT operates in the active region (for the same value of I_E, viz., 1.5 mA)?

4. A current source circuit is shown in the figure. It provides a constant current to the load resistance R_L (i.e., I_L independent of R_L) as long as $R_L < R_L^{\max}$. Assume that the Zener diode, with $V_Z = 5.1\,\text{V}$, operates under reverse breakdown.



   (a) What is I_L for $R_L = 100\,\Omega$?

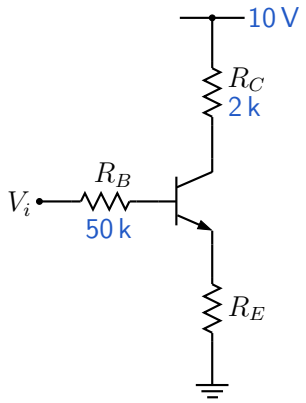
   (b) What is the reverse bias across the B-C junction for $R_L = 100\,\Omega$?

   (c) What is $R_L^{\max}$?

5. Consider an *npn* transistor operating in the active mode. Let $I_C = 1\,\text{mA}$ for some $V_{BE} = V_{BE}^0$. We want to change V_{BE} from V_{BE}^0 to $V_{BE}^0 + \Delta V_{BE}$ to obtain $I_C = 2\,\text{mA}$. What is ΔV_{BE}? (Take $V_T = 26\,\text{mV}$.)

6. Consider an *npn* transistor operating in the active mode. If V_{BE} is reduced by 40 mV, by what factor will the collector current decrease? (Take $V_T = 26\,\text{mV}$.)

7. In the circuit shown in the figure, the BJT has $\beta = 150$. For $R_E = 1\,\text{k}\Omega$, what is the input voltage V_i required to obtain $V_{CE} = 5\,\text{V}$? (Hint: Since β is large, $I_E \approx I_C$.)



8. Consider the circuit of Q-7. With $V_i = 4\,\text{V}$, what is the value of R_E required to obtain $V_{CE} = 4\,\text{V}$?