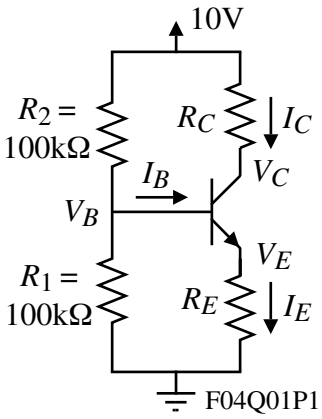
QUIZ NO. 1 - SOLUTION

(Average score = 9.1/10 of those taking the quiz.)

The npn BJT transistor shown has the parameter of $\beta_F = 100$
Assume that $V_{BEQ} = 0.6$V.



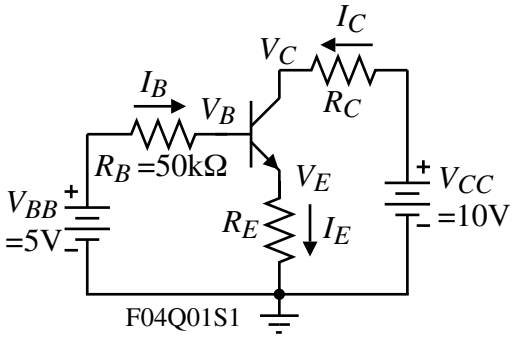
a.) Assume the BJT transistor is in the forward active region and find the value of R_E that gives a collector current of 1mA.

b.) What value of R_C will cause the base-collector junction to have zero volts (i.e., enter the saturation region for a BJT)?

Solution

(a.) The first step is to find a Thevenin equivalent circuit seen from the base to ground. This circuit is shown below where

$$V_{BB} = \frac{10 \cdot R_1}{R_1 + R_2} = 5\text{V} \quad (2) \qquad \text{and} \quad R_B = R_1 \| R_2 = 50\text{k}\Omega \quad (2)$$



A collector current of 1mA implies that the base current, $I_B = 10\mu$A. The equation for the base current can be found from the base-emitter voltage loop and used to solve for R_E.

$$V_{BB} = I_B R_B + V_{BEQ} + I_B (1+\beta_F) R_E \rightarrow (1+\beta_F) R_E = \frac{V_{BB} - 0.6}{I_B} - R_B$$

$$101 R_E = \frac{4.4\text{V}}{10\mu\text{A}} - 50\text{K} = 440\text{K} - 50\text{K} = 390\text{K} \qquad \rightarrow R_E = \frac{390\text{K}}{101} = \underline{3.86\text{k}\Omega} \quad (2)$$

(b.) Since $V_{BC} = 0$, $V_B = V_C$. Thus, we need to first find V_B.

$$V_B = V_{BB} - I_B R_B = 5\text{V} - 10\mu\text{A}(50\text{K}) = 4.5\text{V} \quad (2)$$

$$\therefore \; R_C = \frac{V_{CC} - V_C}{I_C} = \frac{10 - 4.5}{1\text{mA}} = \underline{5.5\text{k}\Omega} \quad (2)$$