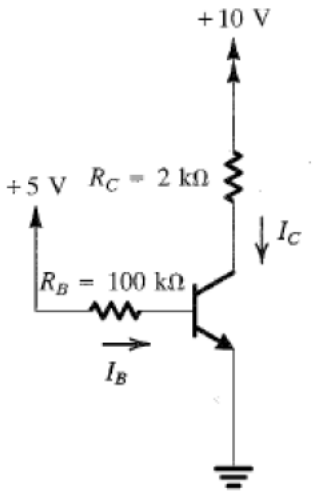
Yanda gösterilen devrede transistörde β=100 ve V_{BE}=0.7 V dir. Transistör üzerindeki akım ve gerilimleri bulunuz.



Çözüm

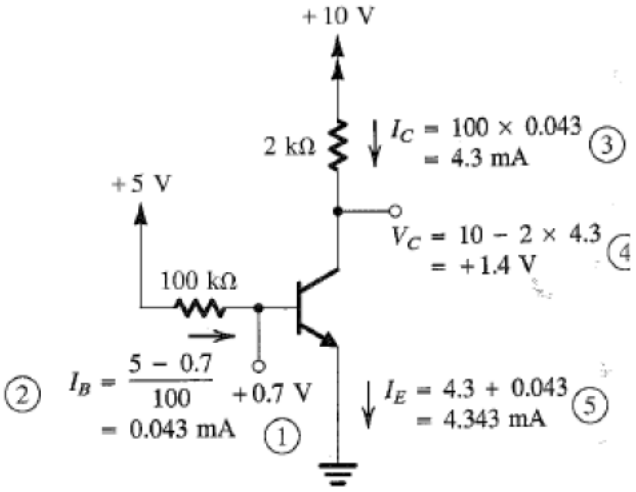
$$I_B = \frac{+5 - V_{BE}}{R_B} \simeq \frac{5 - 0.7}{100} = 0.043 \text{ mA}$$

$$I_C = \beta I_B = 100 \times 0.043 = 4.3 \text{ mA}$$

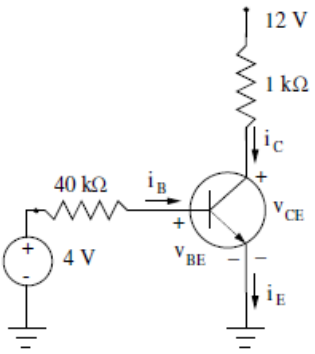
$$V_C = +10 - I_C R_C = 10 - 4.3 \times 2 = +1.4 \text{ V}$$

$$V_B = V_{BE} \simeq +0.7 \text{ V}$$

$$I_E = (\beta + 1) I_B = 101 \times 0.043 \simeq 4.3 \text{ mA}$$



Example 1: Compute the parameters of this circuit ($\beta = 100$).



Following the procedure above:

BE-KVL: $\quad 4 = 40 \times 10^3 i_B + v_{BE}$

CE-KVL: $\quad 12 = 10^3 i_C + v_{CE},$

Assume BJT is in cut-off. Set $i_B = 0$ in BE-KVL:

BE-KVL: $\quad 4 = 40 \times 10^3 i_B + v_{BE} \quad \rightarrow \quad v_{BE} = 4 > v_\gamma = 0.7$ V

So BJT is not in cut off and BJT is ON. Set $v_{BE} = 0.7\ V$ and use BE-KVL to find i_B.

BE-KVL: $\quad 4 = 40 \times 10^3 i_B + v_{BE} \quad \rightarrow \quad i_B = \dfrac{4 - 0.7}{40,000} = 82.5\ \mu$A

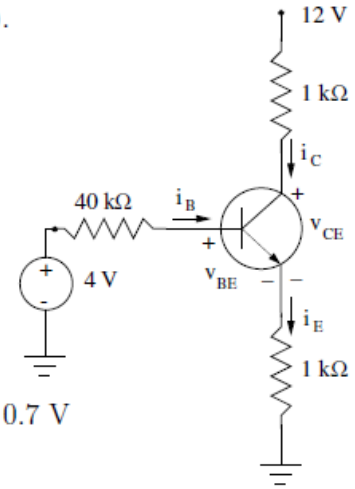
Assume BJT is in active linear, Find $i_C = \beta i_B$ and use CE-KVL to find v_{CE}:

$i_C = \beta i_B = 100 i_B = 8.25$ mA

CE-KVL: $\quad 12 = 1,000 i_C + v_{CE}, \quad \rightarrow \quad v_{CE} = 12 - 8.25 = 3.75$ V

As $v_{CE} = 3.75 > v_\gamma$, the BJT is indeed in active-linear and we have: $v_{BE} = 0.7$ V, $i_B = 82.5\ \mu$A, $i_E \approx i_C = 8.25$ mA, and $v_{CE} = 3.75$ V.

Example 2: Compute the parameters of this circuit ($\beta = 100$).



Following the procedure above:

BE-KVL: $\quad 4 = 40 \times 10^3 i_B + v_{BE} + 10^3 i_E$

CE-KVL: $\quad 12 = 1,000 i_C + v_{CE} + 1,000 i_E$

Assume BJT is in cut-off.
Set $i_B = 0$ and $i_E = i_C = 0$ in BE-KVL:

BE-KVL: $\quad 4 = 40 \times 10^3 i_B + v_{BE} + 10^3 i_E \quad \rightarrow \quad v_{BE} = 4 > 0.7$ V

So BJT is not in cut off and $v_{BE} = 0.7$ V and $i_B > 0$. Here, we cannot find i_B right away from BE-KVL as it also contains i_E.

Assume BJT is in active linear, $i_E \approx i_C = \beta i_B$:

$$\begin{aligned}
\text{BE-KVL:} \quad & 4 = 40 \times 10^3 i_B + v_{BE} + 10^3 \beta i_B \\
& 4 - 0.7 = (40 \times 10^3 + 10^3 \times 10^2) i_B \\
& i_B = 24\ \mu\text{A} \quad \rightarrow \quad i_E \approx i_C = \beta i_B = 2.4\ \text{mA} \\
\text{CE-KVL:} \quad & 12 = 1,000 i_C + v_{CE} + 1,000 i_E, \quad \rightarrow \quad v_{CE} = 12 - 4.8 = 7.2\ \text{V}
\end{aligned}$$

As $v_{CE} = 7.2 > v_\gamma$, the BJT is indeed in active-linear and we have: $v_{BE} = 0.7$ V, $i_B = 24\ \mu$A, $i_E \approx i_C = 2.4$ mA, and $v_{CE} = 7.2$ V.