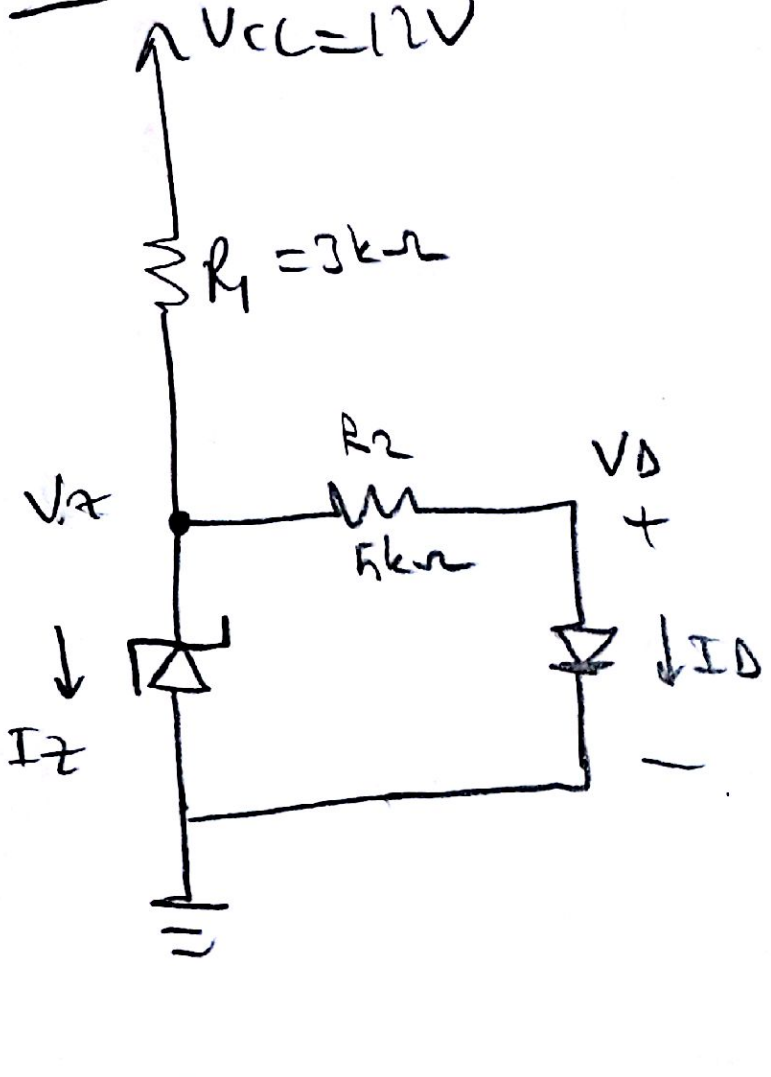
Uygulama



$V_T = 0,026\,V$

$\Rightarrow$ $V_{cc} = 12V$, $R_1 = 3k\Omega$, $R_2 = 5k\Omega$

$V_Z = 5,6V$, $I_S = 10^{-15}\,A$

find I_D, I_Z and V_D

① $I_D = \dfrac{V_Z - V_D}{R_2}$

② $I_D = I_S\left(e^{V_D/V_T} - 1\right)$

} But this is not a linear equation system

Therefore we must do iterations for solution.

from equation 1 and 2 we can write

$$V_D = V_T \ln\left(\frac{(V_Z - V_D)^{I_D}}{R_2 \cdot I_S} + 1\right) \quad ③$$

first we choose a reasonable V_{D1} and the write it to eq. ③ and we get the second value for V_{D2} Then we write V_{D2} into the right sight of the

eq. 3 - - -

$$V_{D_{i+1}} = V_T \ln\left(\frac{V_Z - V_{Di}}{R_2 \quad I_S} + 1\right)$$

$V_{D1} = 0,7 \longrightarrow V_{D2} = 0,7178$

$V_{D2} = 0,7178 \longrightarrow V_{D3} = 0,7177$

$V_{D3} = 0,717 \longrightarrow V_{D4} = 0,7172$ → so we must take $V_D = 0,7177$

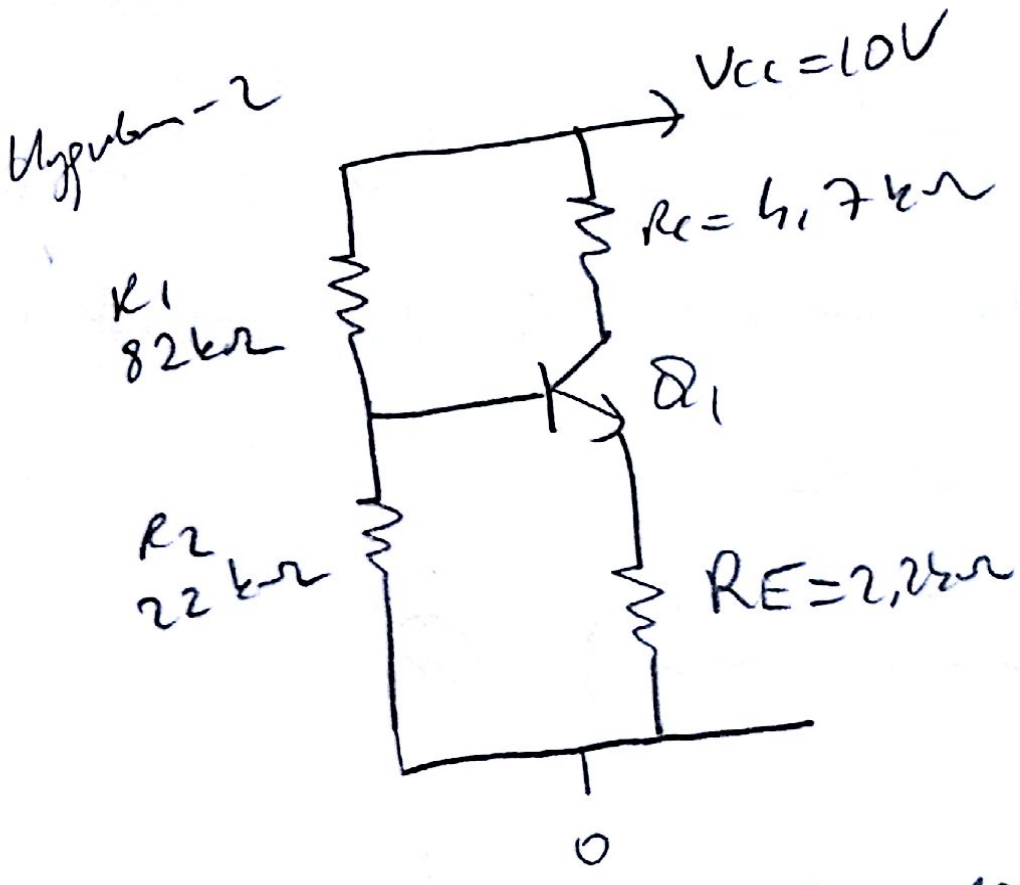
And then

$$I_D = \frac{5,6 - 0,717}{5k\Omega} = 0,976mA$$

$$I_{R_1} = \frac{V_{CC} - V_Z}{R_1} = \frac{12 - 5,6}{3k} = 2,13mA$$

$$\Rightarrow I_Z = I_{R_1} - I_D \cong 1,15mA$$

Uygulama-2



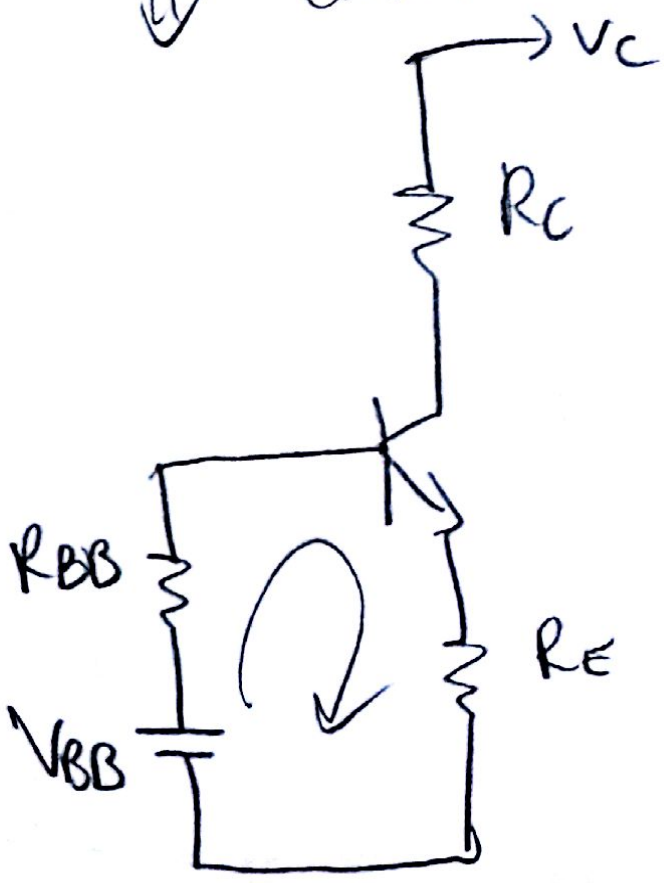
$\beta_f = 200$

$V_{BE} = 0,7V$

$I_C = ?$

Assuming Q_1 is in forward active region

$\Downarrow$ Circuit is equivalent to; (I_{BQ_1} is very small)

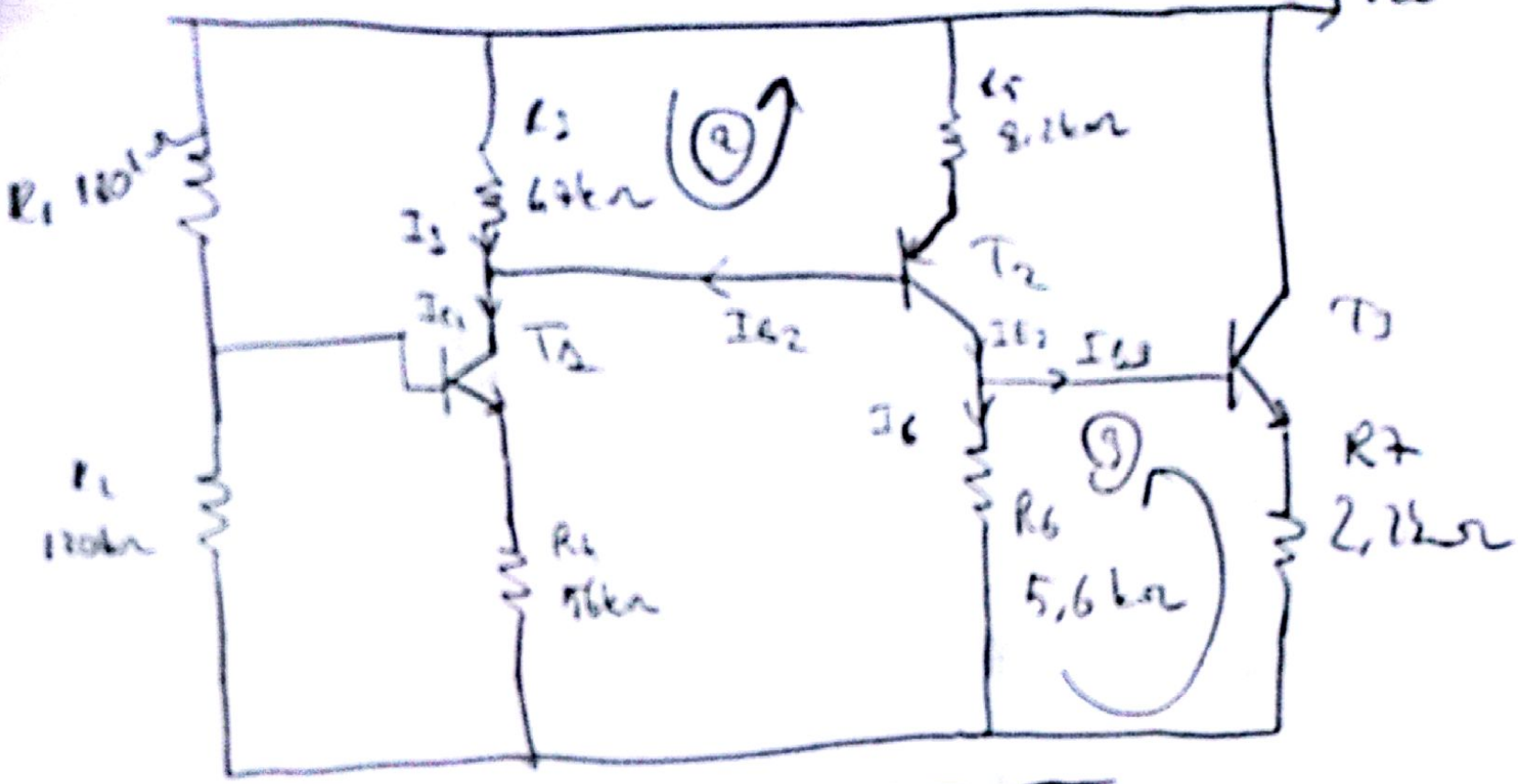


$$R_{BB} = R_1 // R_2 = \frac{R_1 R_2}{R_1 + R_2} = 17,34$$

$$V_{BB} = V_{CC} \cdot \frac{R_2}{R_2 + R_1} = 2,12V$$

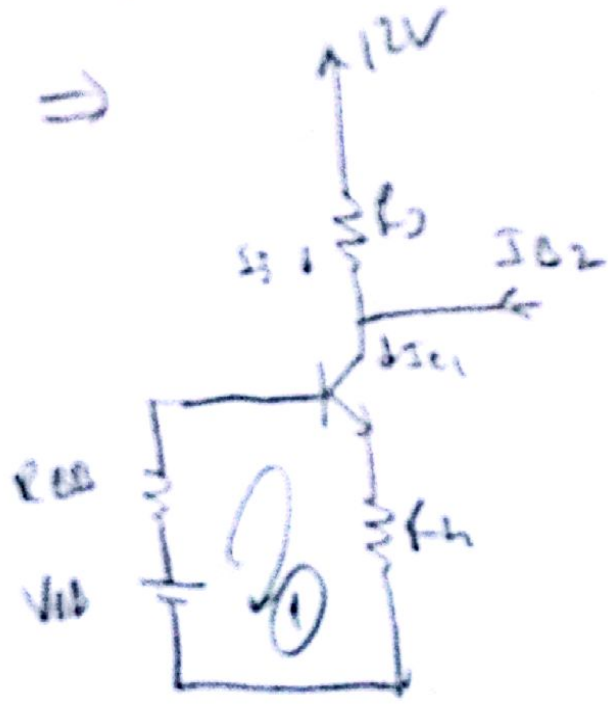
$$\Rightarrow V_{BB} - \frac{I_C}{\beta_F} \cdot R_{BB} - 0,7V - I_C\left(1 + \frac{1}{\beta_F}\right) \cdot R_E =$$

$$\Rightarrow I_C = \frac{V_{BB} - 0,7V}{\frac{R_{BB}}{\beta_F} + \left(1 + \frac{1}{\beta_F}\right) R_E} = 0,62mA$$



$\beta = 300$ for all BJT's and $|V_{BE}| = 0,6V$

first part ⇒



$$V_{BB} = V_{cc} \cdot \frac{R_2}{R_1+R_2} = 8V$$

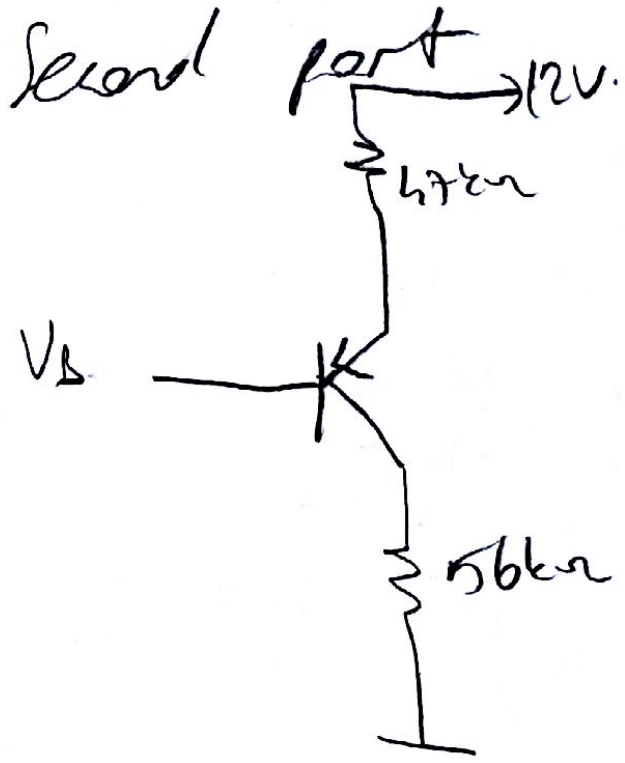
$$R_{BB} = R_1 // R_2 = 72k\Omega$$

Then we can assume $I_{c1} = I_3$

and $V_{BB} - \frac{I_c}{\beta+1} R_{BB} - V_{BE} - \frac{I_c}{\beta+1}(\beta+1) \cdot R_4 = 0$

$\Rightarrow I_{c1} = 0,131 mA$

Second part



writing equation in the direction of loop 2

$$R_3 (I_{C1} - I_{B2}) = R_5 \cdot I_{E2} + V_{BE2}$$

$I_{B2} \rightarrow \frac{I_{C2}}{\beta f}$; $I_{E2} \rightarrow \frac{I_{C2}}{\beta f}(\beta f + 1)$

$$\Rightarrow I_{C2} = 0{,}670\ mA$$

Writing equation in the direction of loop-3

$$R_6 (I_{E2} - I_{B3}) = V_{BE3} + R_7 I_{E3}$$

$I_{E2} \rightarrow \frac{I_{C2}(\beta f + 1)}{\beta f}$; $I_{B3} \rightarrow \frac{I_{C3}}{\beta f}$; $I_{E3} \rightarrow \frac{\beta f + 1}{\beta f} \cdot I_{C3}$

$$\Rightarrow I_{C3} = 1{,}441\ mA$$

For simplicity, you can take all emitter currents are equal to collector currens!!!