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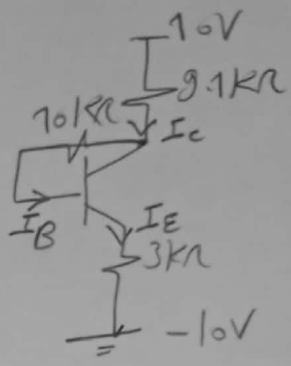
Assignment #6

Question ①:



$I_B = \frac{I_C}{\beta} = 0A$ as $\beta \uparrow\uparrow$

$V_{CB} = -I_B \cdot 10K = 0V$

$V_{CE} = V_{CB} + V_{BE} = 0.7V$

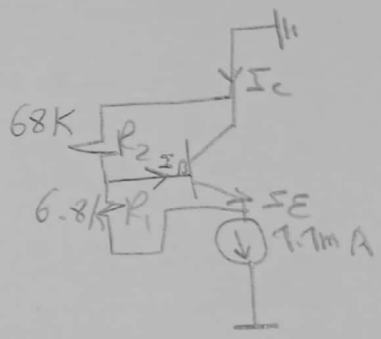
$10 - (-10) = I_C * 9.1 + 0.7 + I_E * 3 \leftrightarrow I_E = I_C + I_B$

$\therefore I_C = 1.595mA$ #

$I_6 = I_E = 1.595\ mA$ #

$V_C = V_7 = V_{CE} + 3 \cdot I_E - 10 = 4.515V$

Question②: $V_{BE} = 0.68V$ @ 25°C $\rightarrow I_E = 1mA$



$I_{R_1} = 1.1 - 1 = 0.1mA$

$I_C = \frac{\beta}{\beta+1} I_E = \frac{100}{101} * 1 = 0.99mA$

$I_B = I_E = I_C = 1 - 0.99 = 0.01mA$

$I_{R_2} = I_B + I_{R_1} = 0.1 + 0.001 = 0.11mA$

$V_{CB} = 68 * 10^3 * 0.11 * 10^{-3} = 7.48V$

$V_{CB} = V_C - V_B$ $\therefore V_B = -7.48V$

$V_B - V_E = 0.68 \rightarrow V_E = -7.48 - 0.68 = -8.16V$

$T_C = +(1 + \frac{R_2}{R_1}) * +2 = 2(1 + \frac{68}{6.8}) = 22mV/°C$

@ $T = 75°C \rightarrow V_E = -8.16 + 22 * 50 * 10^{-3} = -7.06V$

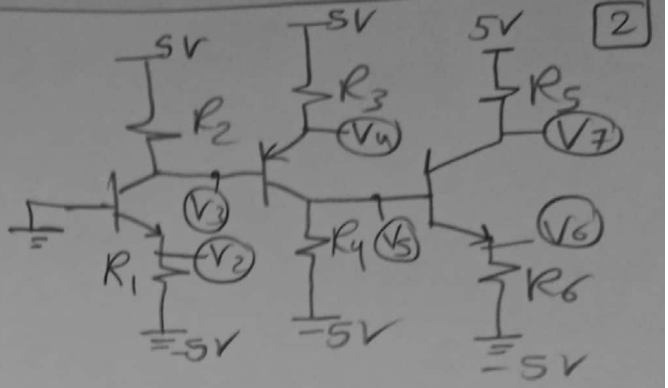
check

$I_E = \frac{V_{BE}}{R_1} = 0.94mA$

$I_E \approx 1mA$

$\therefore$ #

Question ③:



for $\beta = \infty$

$I_B = \frac{I_C}{\infty} = 0$ for all Transistors

assume $V_{BE_1} = 0.7V$

$V_E = 0.7V$

$R_1 = \frac{V_{E_1} - (-5)}{I_{E_1}} = 8.6k\Omega \Rightarrow 8.2k\Omega$

$I_B = 0 \quad \therefore I_C = I_E$

$R_2 = \frac{5-0}{0.5} = 10k\Omega \Rightarrow 10k\Omega$

$V_{BE_2} = 0.7V$

$I_{E_2} = I_{C_2}$

$V_4 = 0.7V$

$R_3 = 8.6k\Omega \Rightarrow 10k\Omega$

$R_4 = \frac{-2 - (-5)}{0.5} = 6k\Omega \Rightarrow 6.2k\Omega$

$V_6 = V_B - 0.7 = -2.7V$

$R_6 = \frac{-2.7+5}{1} = 2.3k\Omega \Rightarrow 2.4k\Omega$

$R_5 = \frac{5-1}{1} = 4k\Omega \Rightarrow 3.9k\Omega$

$\alpha = 0.99$

$V_2 = -0.7V$

$I_{E_1} = \frac{-0.7+5}{8.2} = 0.524mA$

$I_{C_1} = \alpha I_{E_1} = 0.52mA$

$I_1 = I_{C_1} - I_{B_2} = 0.52 - \frac{I_{E_2}}{101}$

$I_1 * 10 = 8.2 I_{E_2} + 0.7$

$\therefore I_{E_2} = 0.524mA$

$V_4 = 5 + 0.542 * 8.2 = 0.56V$

$V_3 = 0.56 - 0.7 = -0.14V$

$I_{C_2} = \alpha I_{E_2} = 0.537mA$

$I_2 = I_{C_2} - I_B = 0.537 - \frac{I_{E_3}}{101}$

$I_{E_3} = 1.07mA$

$V_6 = -5 + 1.07 * 2.4 = -2.43V$

$V_5 = V_6 + 0.7 = -1.73V$

$I_{C_3} = \alpha I_{E_3} = 1.06mA$

$V_7 = -3.9 + 1.06 = 0.87V$