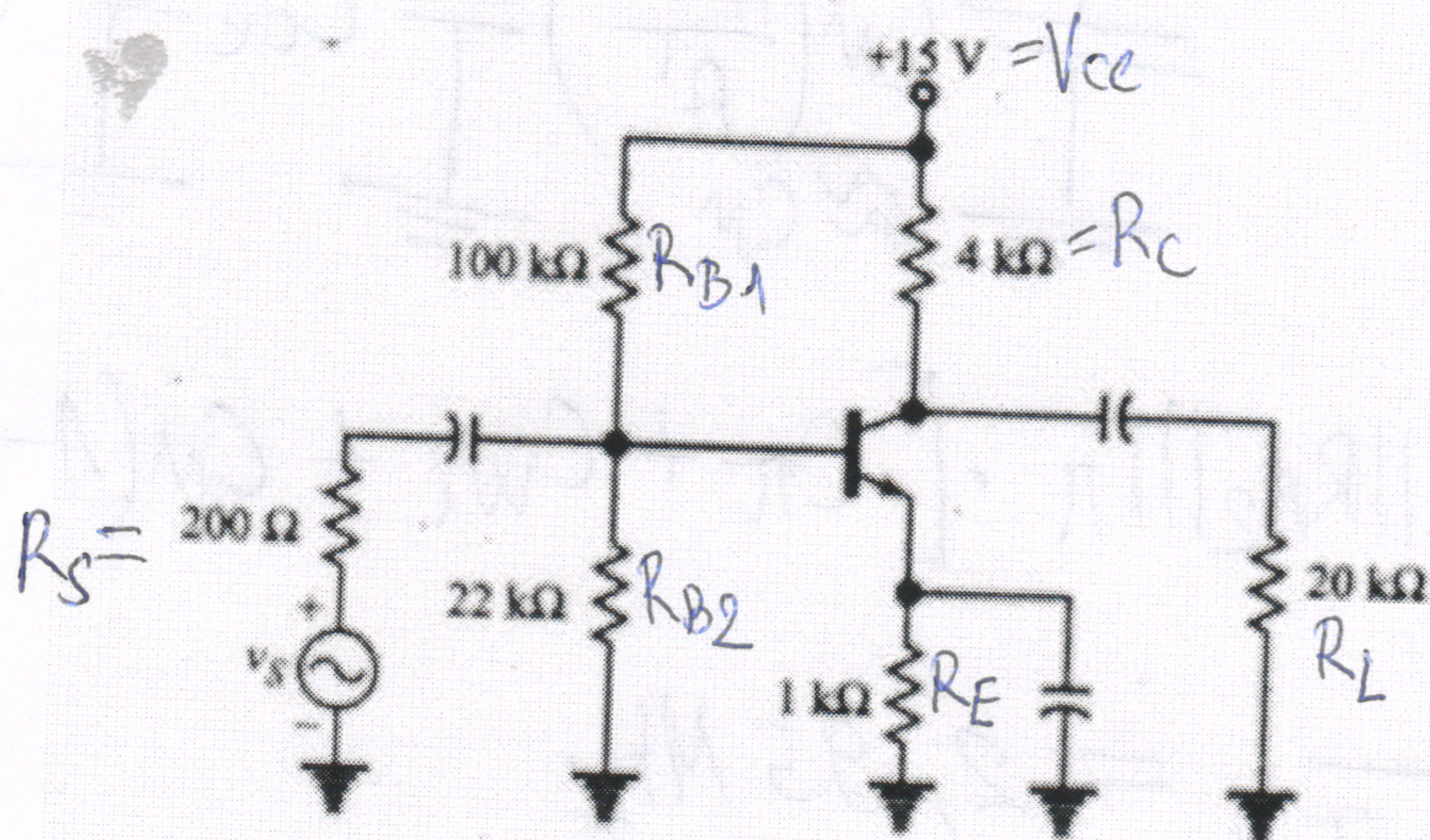


ŠIROKOPOJASNI POJAČAVAČI

1. Parametri tranzistora na slici su $\beta=120$, $r_0=100 \text{ k}\Omega$, $C_\pi=40 \text{ pF}$, $C_\mu=1.5 \text{ pF}$, $C_{CE}=1 \text{ pF}$. Postoje kapacitivnosti kontakata od 4 pF na ulaznom pristupu i 2 pF na izlaznom pristupu. Odrediti približnu vrednost gornje granične frekvencije.

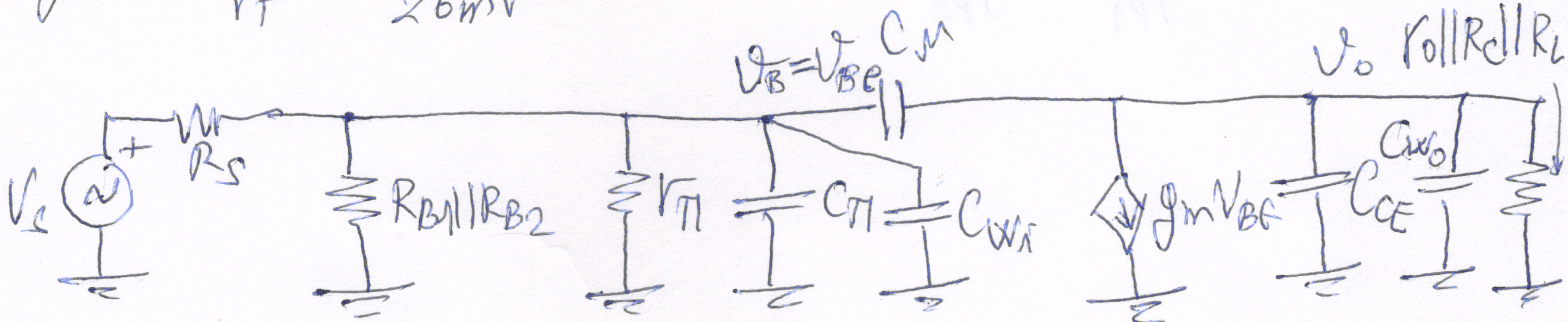


$$I_B = \frac{\frac{R_{B2}}{R_{B1}+R_{B2}} \cdot V_{CC} - V_{BE}}{R_{B1} \parallel R_{B2} + R_E(1+\beta)} = 10 \text{ nA}$$

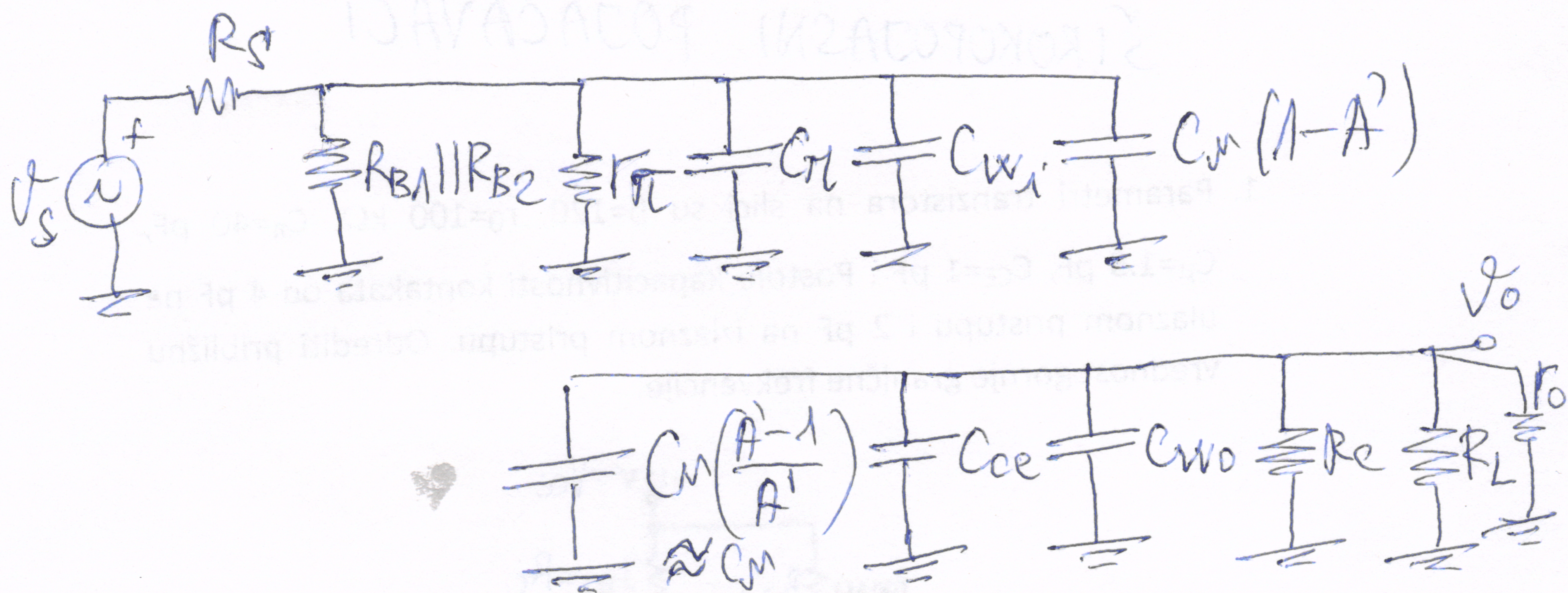
$$I_C = \beta \cdot I_B = 1.2 \text{ mA}$$

$$r_\pi = \frac{V_T}{I_B} = \frac{26 \text{ mV}}{10 \text{ nA}} = 2.6 \text{ k}\Omega$$

$$g_m = \frac{I_C}{V_T} = \frac{1.2 \text{ mA}}{26 \text{ mV}} = 46.2 \text{ mS}$$



$$A' = \frac{V_o}{V_{BE}} = -g_m \cdot R_C \parallel R_L = -154$$



$$\tau_1 = R_s \parallel R_{B1} \parallel R_{B2} \parallel r_{\pi} \cdot [C_{\pi} + C_{wi} + C_m(1-A')]$$

$$f_{p1} = \frac{1}{2\pi \cdot \tau_1} = 2,95 \text{ MHz}$$

$$\tau_2 = (C_{ce} + C_{wo} + C_m) R_c \parallel R_L \parallel r_o$$

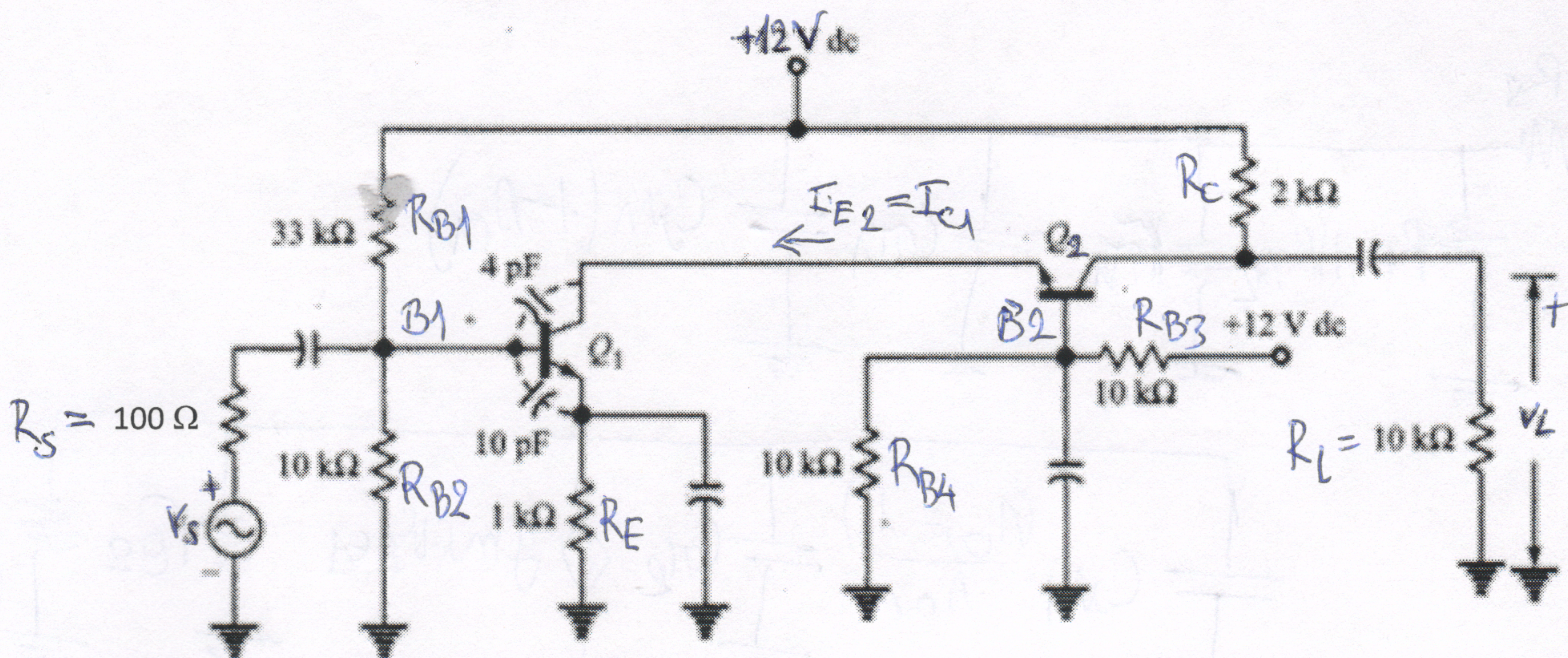
$$f_{p2} = \frac{1}{2\pi \cdot \tau_2} = 11,1 \text{ MHz}$$

$$A(s) = A_0 \frac{1}{(1 + \frac{s}{\omega_{p1}})} \frac{1}{(1 + \frac{s}{\omega_{p2}})}$$

$$f_{3dB} \approx \frac{1}{\frac{1}{f_{p1}} + \frac{1}{f_{p2}}} = 2,33 \text{ MHz}$$

2. Parametri tranzistora u kaskodnom pojačavaču na slici su:

$\beta_1 = \beta_2 = 100$, $r_0 \rightarrow \infty$, $C_{\pi 1} = C_{\pi 2} = 10 \text{ pF}$, $C_{\mu 1} = C_{\mu 2} = 4 \text{ pF}$. Odrediti približnu vrednost gornje granične frekvencije.



$$V_{B1} = \frac{R_{B2}}{R_{B1} + R_{B2}} \cdot V_{CC} = \frac{10}{43} \cdot 12 = 2,79 \text{ V}$$

$$I_{B1} = \frac{V_{B1} - V_{BE}}{R_E (1 + \beta)} = 20,7 \mu\text{A}$$

$$I_{C1} = 2,07 \text{ mA}$$

$$g_{m1} = \frac{I_{C1}}{V_T} = \frac{2,07 \text{ mA}}{26 \text{ mV}} = 79,6 \text{ mS}$$

$$r_{\pi 1} = \frac{V_T}{I_{B1}} = \frac{26 \text{ mV}}{20,7 \mu\text{A}} = 1,25 \text{ k}\Omega$$

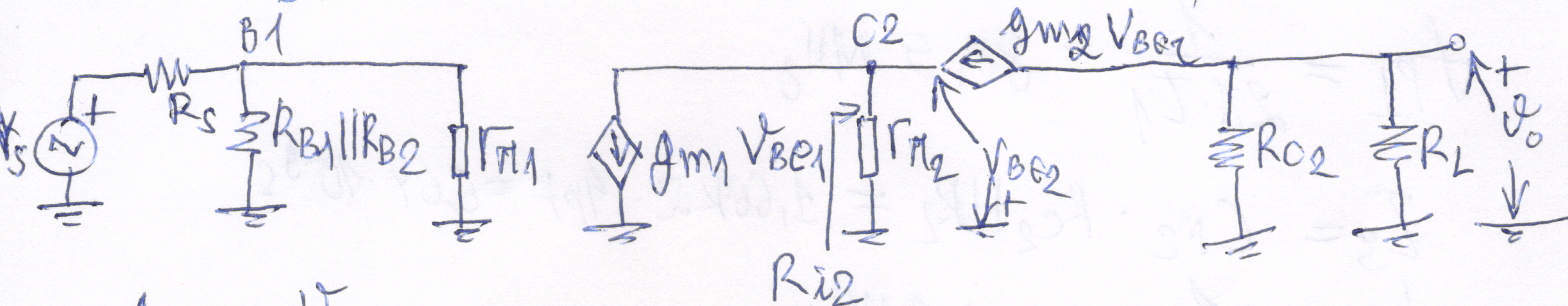
$$V_{B2} = \frac{R_{B4}}{R_{B3} + R_{B4}} \cdot V_{CC}$$

$$V_{B2} = 6 \text{ V}$$

$$I_{C2} = I_{C1} \frac{(1 + \beta_1)}{\beta_1} \approx I_{C1}$$

$$g_{m2} = \frac{I_{C2}}{V_T} = 79,6 \text{ mS}$$

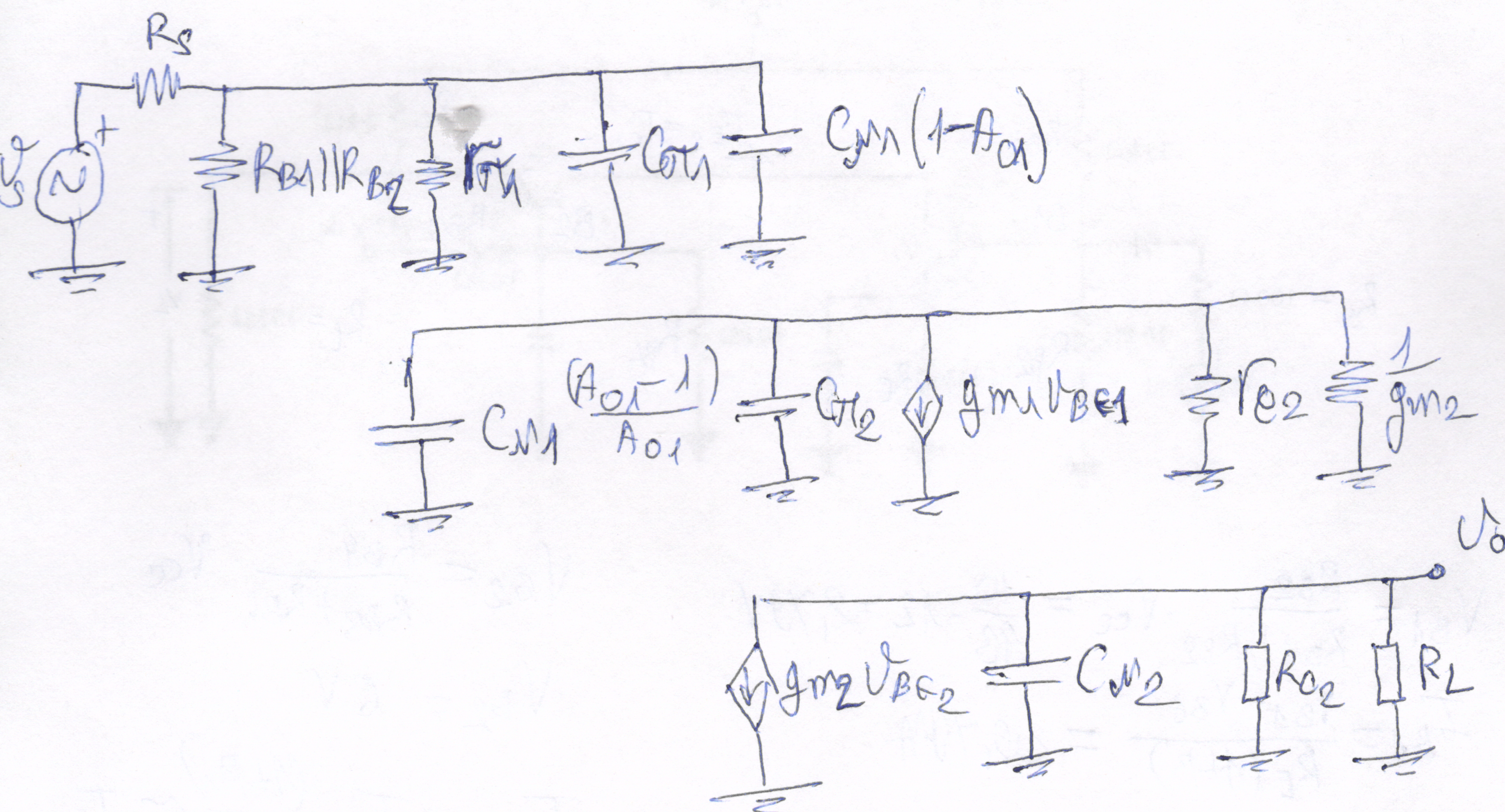
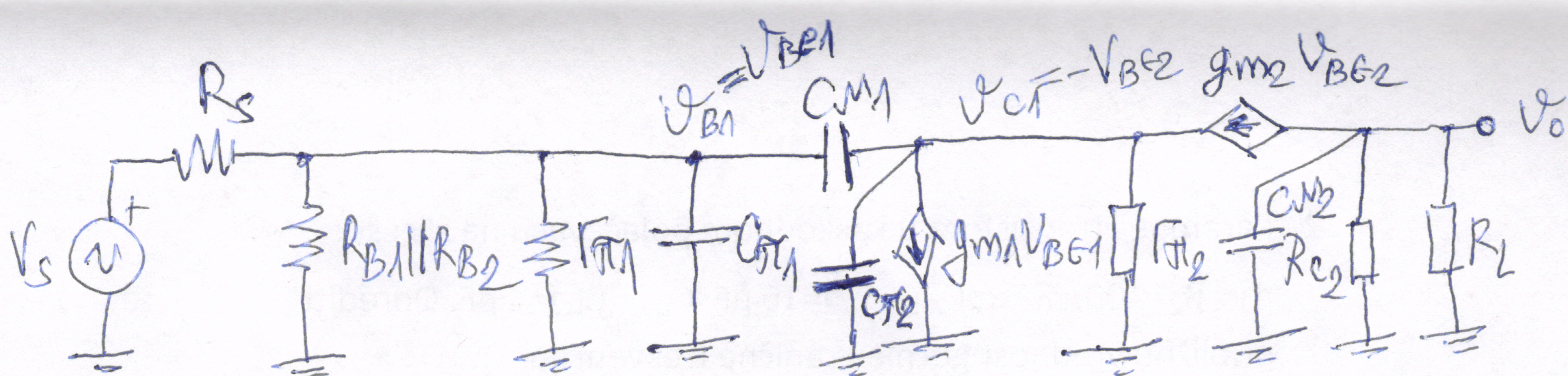
$$r_{\pi 2} = \frac{26 \text{ mV}}{20,7 \mu\text{A}} = 1,25 \text{ k}\Omega$$



$$A_{01} = \frac{V_{C2}}{V_{B1}} = -g_{m1} \cdot R_{i2}$$

$$R_{i2} = \frac{1}{\frac{1}{r_{\pi 2}} + g_{m2}} = \frac{r_{\pi 2}}{1 + g_{m2} r_{\pi 2}} = \frac{r_{\pi 2}}{1 + \beta}$$

$$A_{01} = -g_{m1} \cdot \frac{r_{\pi 2}}{1 + \beta} = 0,98$$



$$T_1 = R_s || R_{B1} || R_{B2} || r_{\pi 1} \cdot [C_{\pi 1} + C_{M1}(1 - A_{o1})]$$

$$T_1 \approx R_s \cdot [C_{\pi 1} + 2C_{M1}] = 1,8 \cdot 10^{-9} \text{ s}$$

$$f_{p1} = \frac{1}{2\pi \cdot T_1} = 88,5 \text{ MHz}$$

$$T_3 = C_{M2} \cdot R_{o2} || R_L = 1,66 \text{ k}\Omega \cdot 4 \text{ pF} = 6,64 \cdot 10^{-9} \text{ s}$$

$$f_{p3} = \frac{1}{2\pi T_3} = 23,9 \text{ MHz}$$

$$T_2 = (C_{\pi 2} + 2C_{M1}) \cdot \frac{1}{g_{m2}} \ll T_1, T_3 \quad f_{p2} \gg f_{p1}, f_{p3}$$

$$f_{3dB} \approx \frac{1}{\frac{1}{f_{p1}} + \frac{1}{f_{p3}}} = 18,81 \text{ MHz}$$