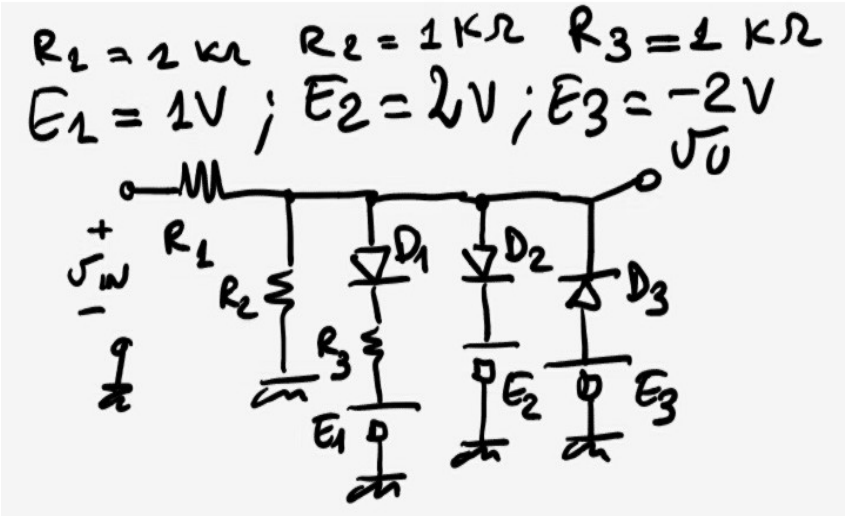
SCHEDA **A15_07**		Data: 23 **luglio 2015**
Cognome	Nome	Matricola

ESERCIZIO N°1

5 punti (4)

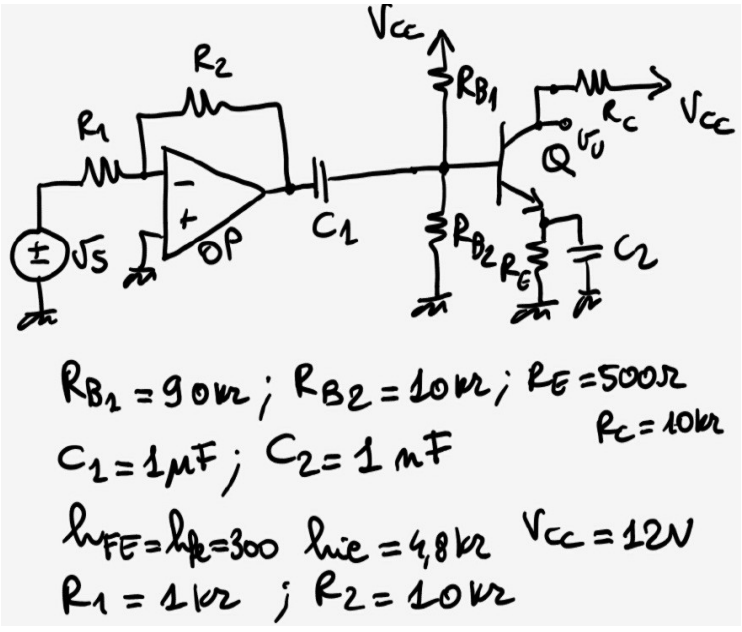
Ricavare l'espressione analitica della caratteristica ingresso-uscita del circuito mostrato in figura per un intervallo di tensioni di ingresso pari a [-10V, 10V], discutendo il funzionamento dei diodi. Si considerino i diodi ideali.



ESERCIZIO N°2

8 punti (4)

Con riferimento al circuito in figura, determinare il punto di riposo del transistore Q. Si consideri l'amplificatore operazionale ideale.



ESERCIZIO N°3

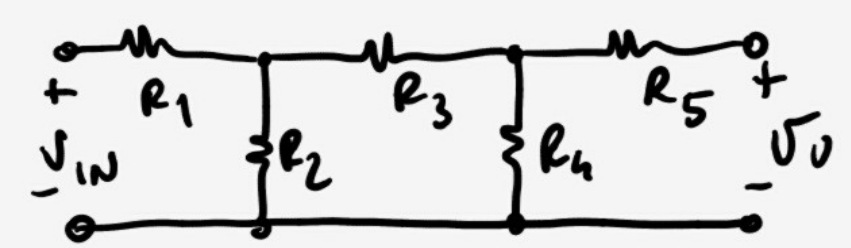
9 punti (4)

Nel circuito mostrato nell'esercizio precedente, si ricavi la funzione di trasferimento $A_f(s)=V_U/V_{IN}$ e si disegni il diagramma di Bode del modulo.

ESERCIZIO N°4

5 punti (4)

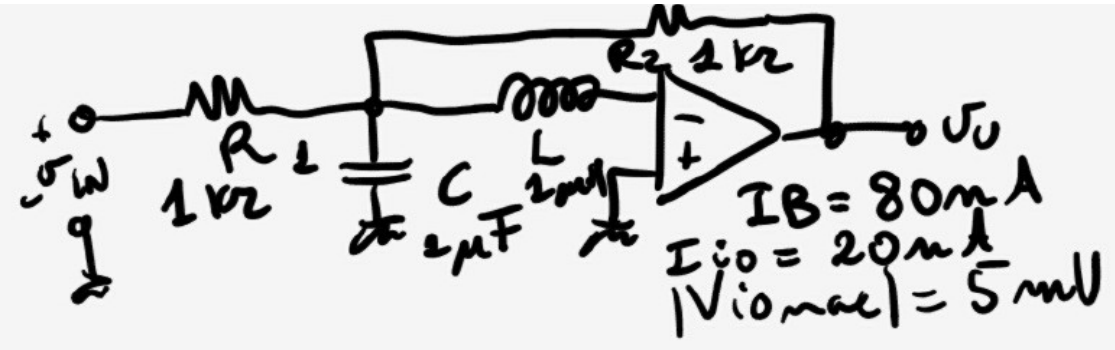
Si ricavino i parametri *f* del circuito mostrato in figura.



ESERCIZIO N°5

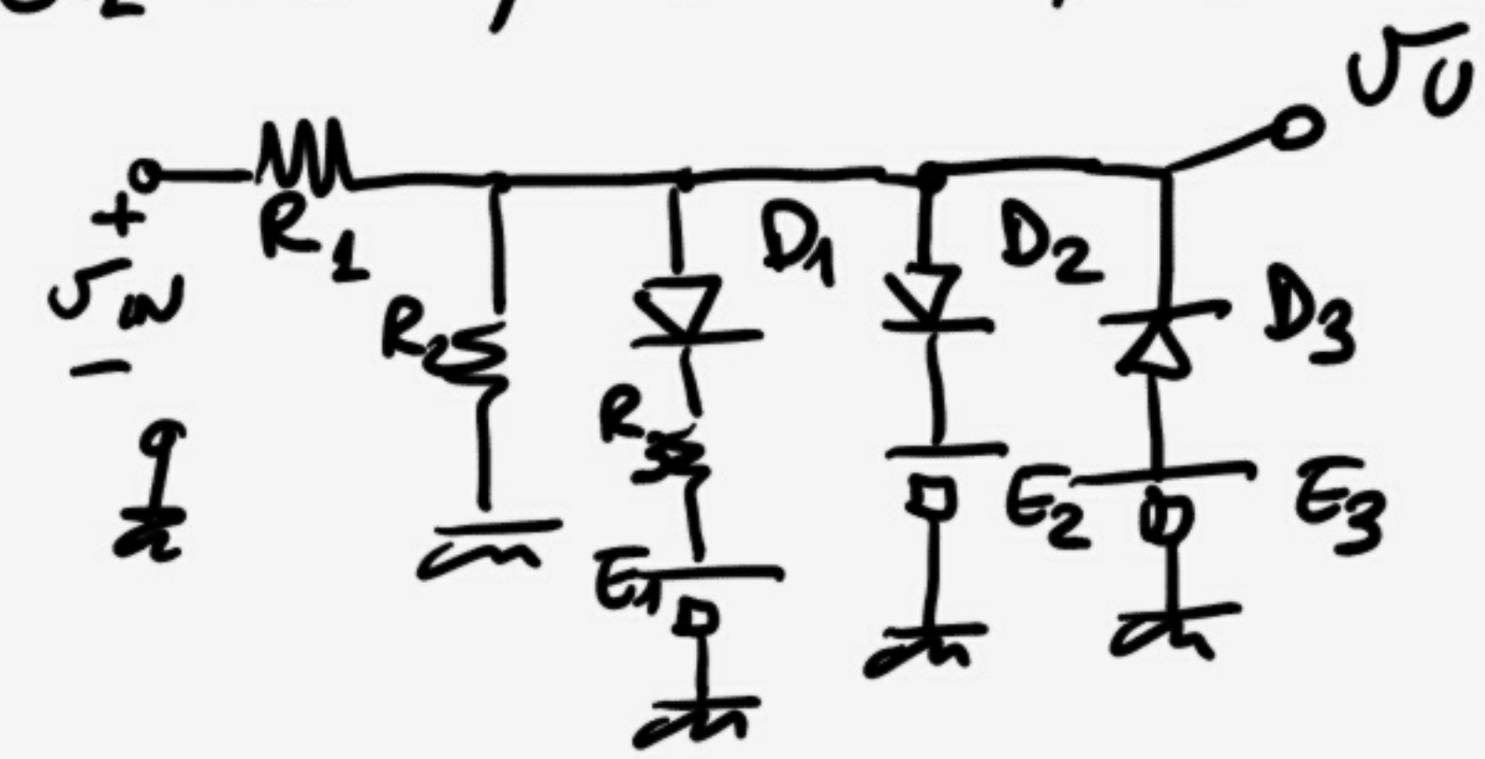
6 punti (4)

Nel circuito mostrato in figura, si ricavi la tensione di massimo sbilanciamento in uscita.

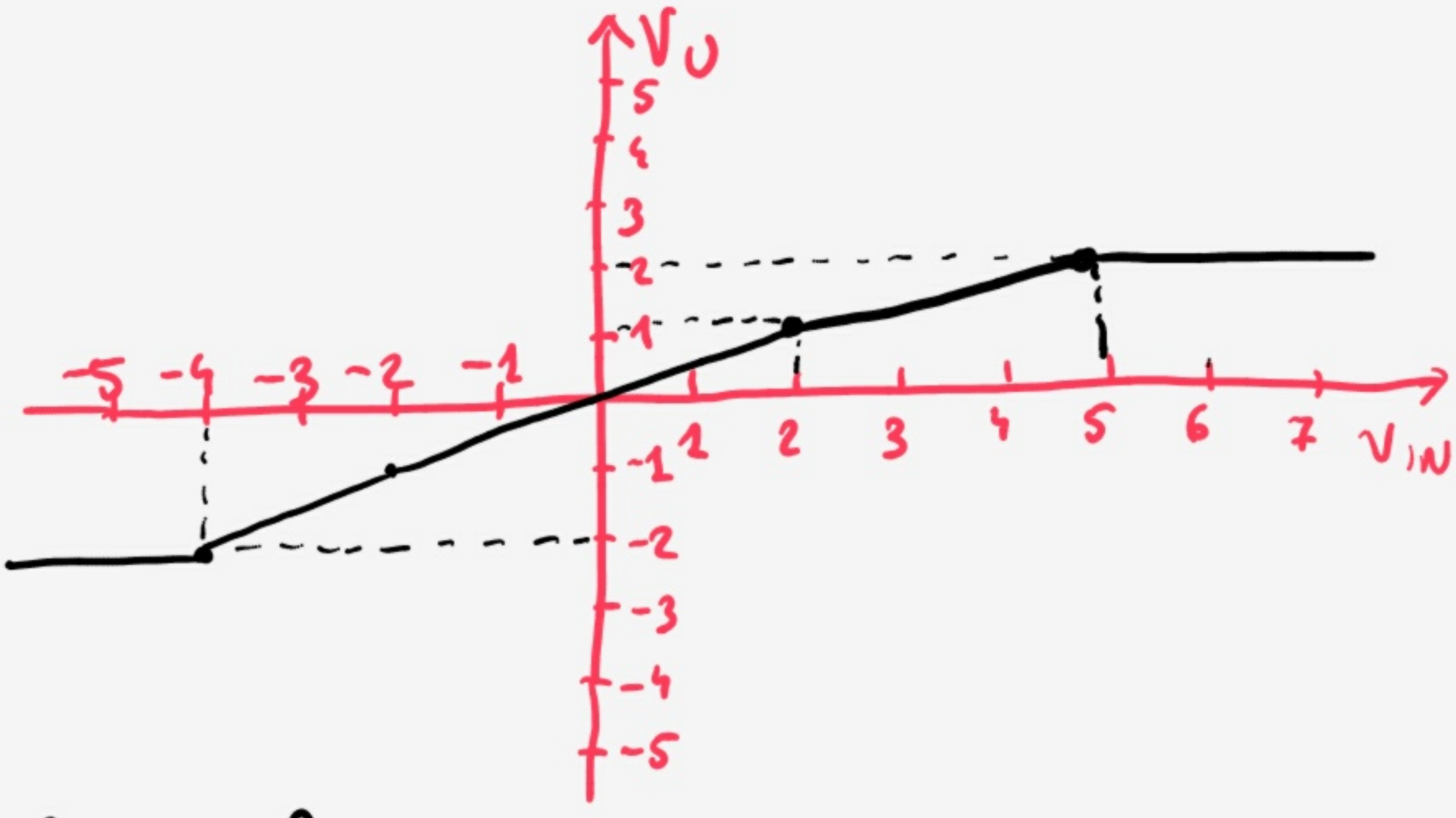


2) $R_1 = 2\,k\Omega$ $R_2 = 1\,k\Omega$ $R_3 = 1\,k$

$E_1 = 1V$; $E_2 = 2\,V$; $E_3 = -2V$



Disegniamo la caratteristica di uscita



Visto che

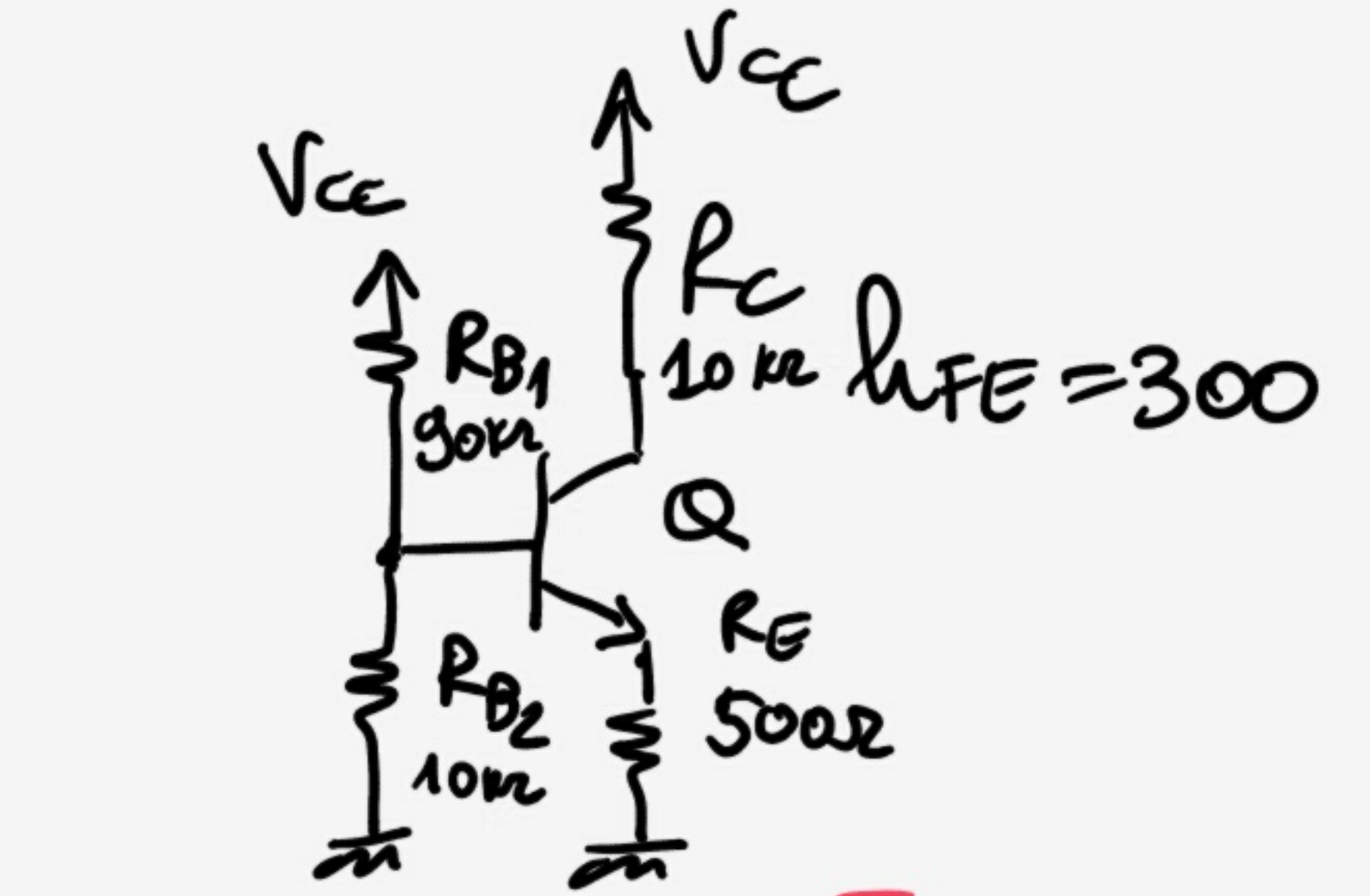
$V_U = -4$; $V_{IN} < -4V$

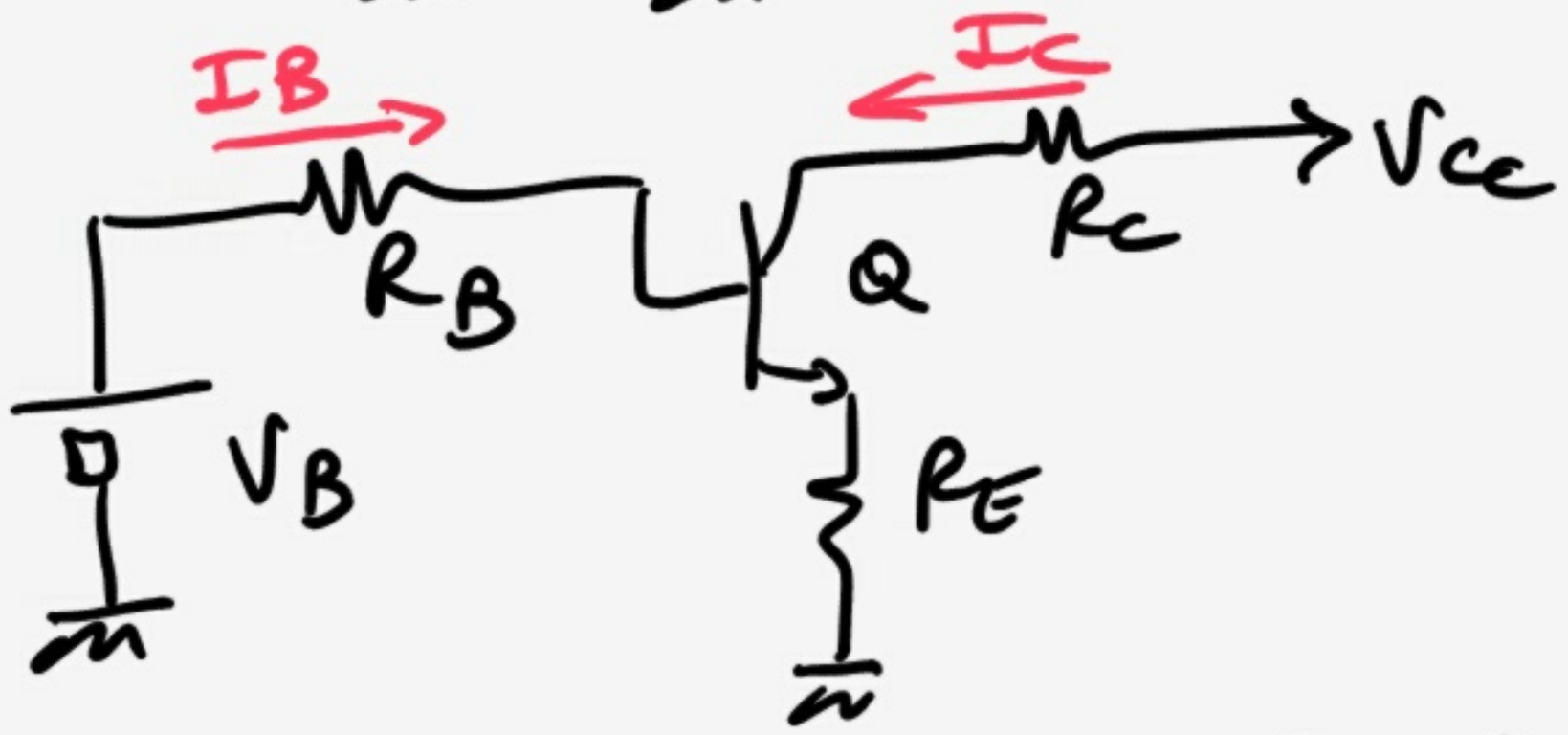
$V_U = \dfrac{V_{IN}\,R_2}{R_1+R_2} = \dfrac{V_{IN}}{2}$: $-4V \leq V_{IN} < \underbrace{2V}_{V_{IN}'}$

$V_U = \dfrac{R_2 \| R_3}{R_2 \| R_3 + R_1}(V_{IN} - V_{IN}') + E_1$: $2V < V_{IN} \leq 5V$

$V_U = 2V$; $V_{IN} > 5V$

2)





$$V_B = \frac{R_{B2}}{R_{B1}+R_{B2}} V_{CC} = 1{,}2\,V \qquad R_B = R_{B1} \,||\, R_{B2} = 9\,k\Omega$$

$$I_B = \frac{V_B - V_{BEON}}{R_B + R_E(h_{FE}+1)} = 3{,}135\,\mu A$$

$$I_C = h_{FE} I_B = 0{,}94\,mA$$

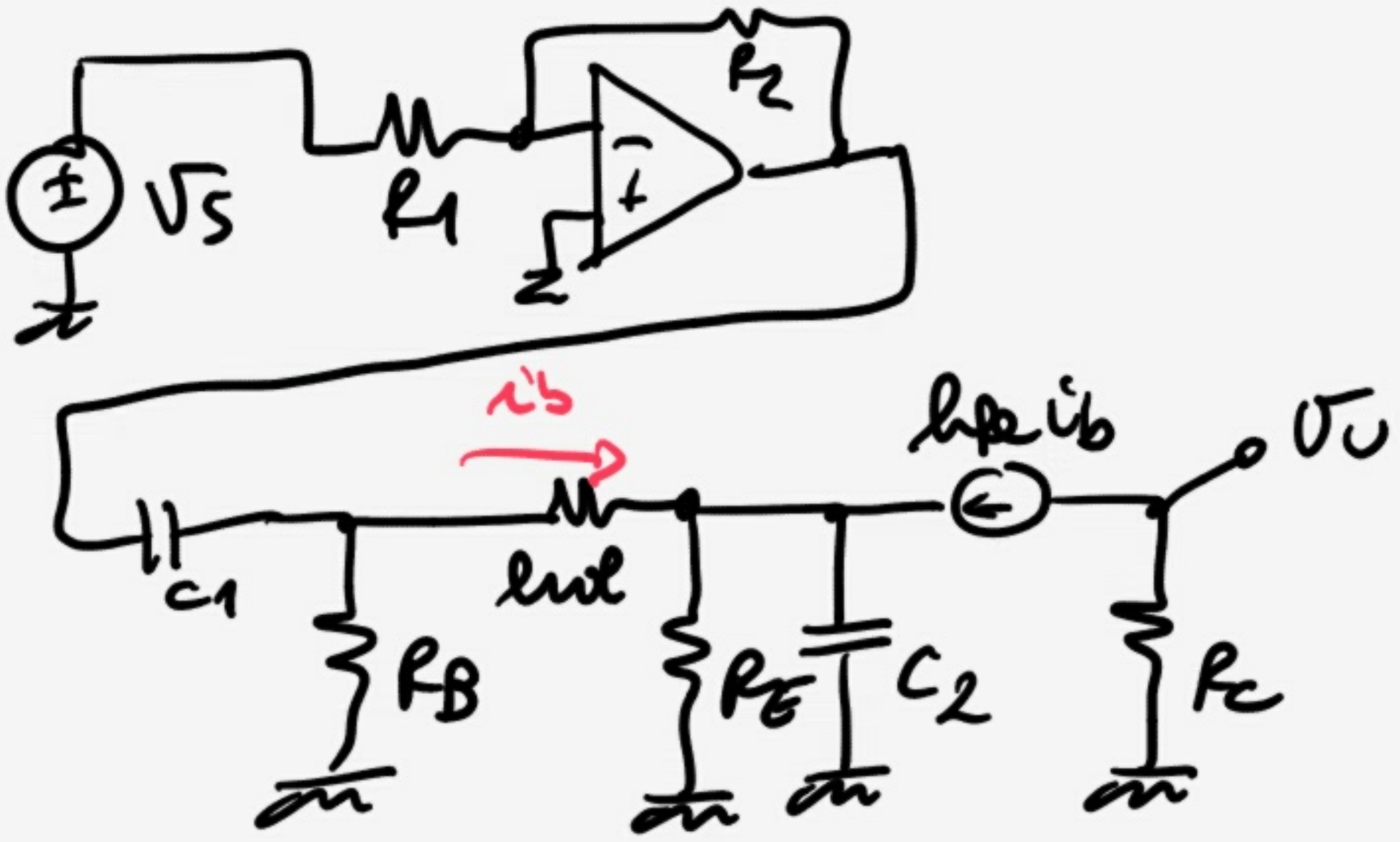
$$V_E = R_E(h_{FE}+1) I_B = 0{,}472\,V$$

$$V_C = V_{CC} - R_C h_{FE} I_B = 2{,}595\,V$$

$$V_{CE} = 2{,}123\,V > V_{CEsat}$$

Quindi Q è in zona attiva diretta.

3)



$$A_V(s) = \frac{A_{V0}\, s\,(s+\omega_{o2})}{(s+\omega_{p1})(s+\omega_{p2})}$$

$$A_{V\infty} = \frac{R_C\, h_{fe}}{h_{ie}} \frac{R_2}{R_1} = 6{,}25 \cdot 10^3$$

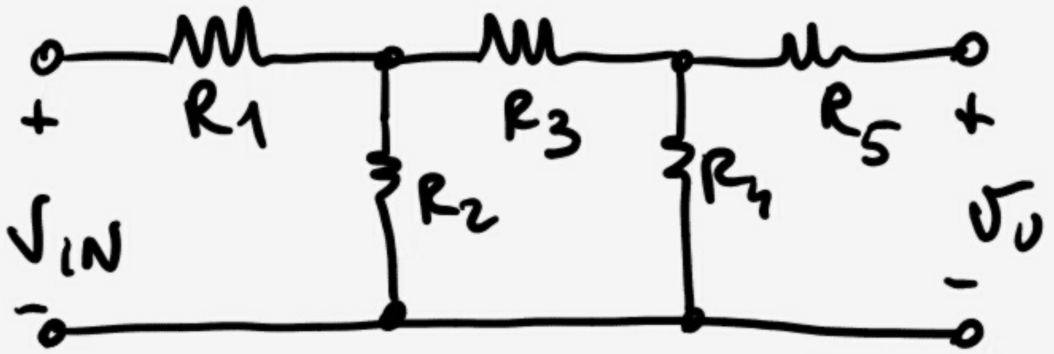
$$\omega_{o2} = \frac{1}{R_E C_2} = 2\ \text{Mrad/s}$$

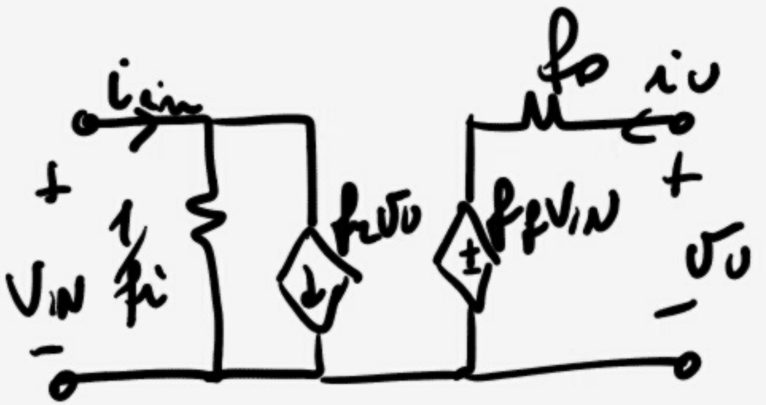
$$\omega_{p2} = \frac{1}{(R_E \| h_{ie}) \cdot C_2} = 2{,}2\ \text{Mrad/s}$$

$$\omega_{p1} = \frac{1}{C_1\left(R_B \| \left[h_{ie} + R_E (h_{fe}+1)\right]\right)} =$$

$$= 117{,}55\ \text{rad/s}$$

4)





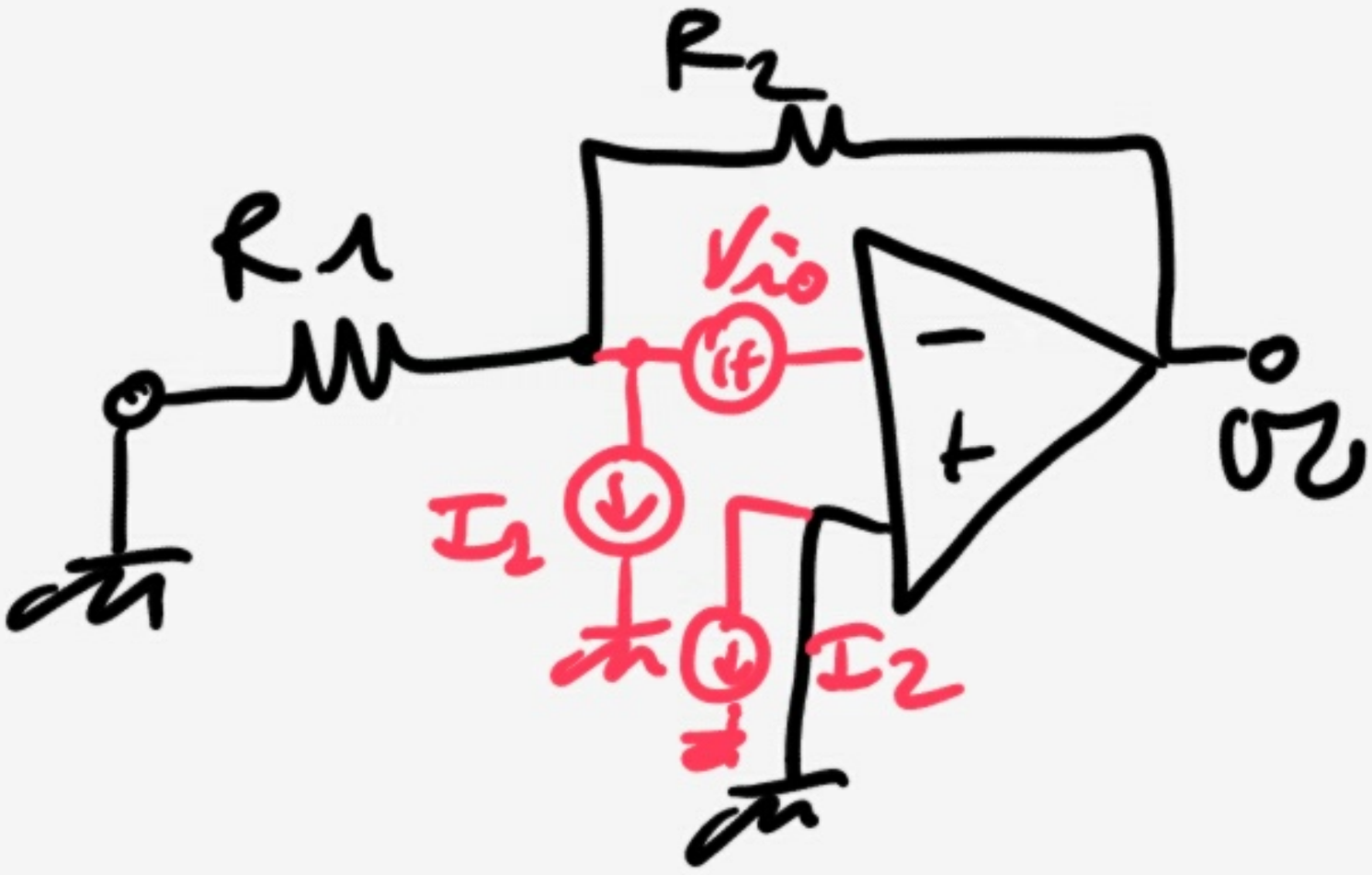
$$\begin{cases} V_U = f_f V_{IN} + f_o i_U \\ i_{in} = f_i V_{in} + f_r i_U \end{cases}$$

$$f_f = \left.\frac{V_U}{V_{in}}\right|_{i_U=0} \Rightarrow \frac{R_4}{R_4+R_3+R_1\|R_2} \cdot \frac{R_2}{R_1+R_2}$$

$$f_i = \left.\frac{i_{in}}{V_{in}}\right|_{i_U=0} \Rightarrow \frac{1}{R_1 + R_2 \| (R_3+R_4)}$$

$$f_o = \left.\frac{V_U}{i_U}\right|_{V_{in}=0} = R_5 + R_4 \| \left(R_3 + R_2 \| R_1\right)$$

$$f_r = \left.\frac{i_{in}}{i_U}\right|_{V_{in}=0} = \frac{R_4}{R_3+R_1\|R_2+R_4} \cdot \frac{R_2}{R_1+R_2}$$



$$V_O = -\left(1+\frac{R_2}{R_1}\right)V_{io} + R_2 I_1$$

$$|V_{O\,MAX}| = 10{,}09\ mV$$

Prendendo $V_{io} = -5\,mV$ e

$$I_1 = 90\,mA$$