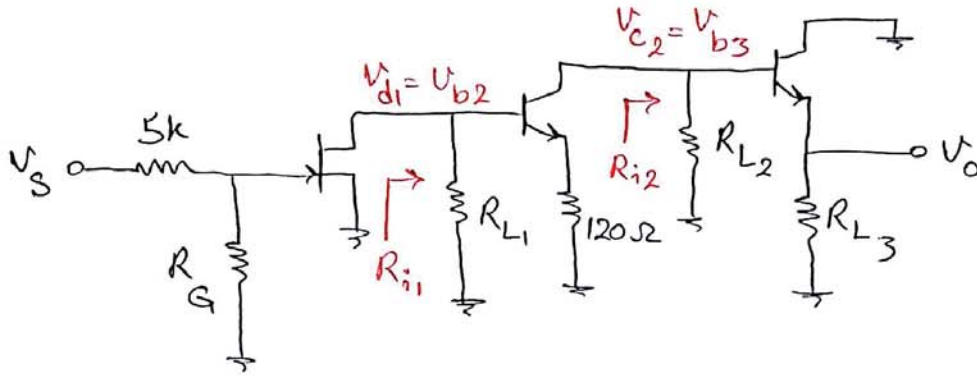


(1) مدار معادل AC به صورت زیر است.



$$R_G = 680k \parallel 220k = 166k \quad , \quad R_{L1} = 2.2k \parallel 47k \parallel 12k = 1.8k$$

$$R_{L2} = 5.6k \parallel 100k \parallel 100k \approx 5k \quad , \quad R_{L3} = 3.3k \parallel 1.5k \approx 1k$$

$$I_{C2} = 1.73mA, \quad g_{m2} = 69.2mS, \quad \beta = g_{m2} r_{\pi 2} = 138, \quad r_{e2} = 14.5\Omega$$

$$I_{C3} = 4.33mA, \quad g_{m3} = 173mS, \quad \beta = g_{m3} r_{\pi 3} = 173, \quad r_{e3} = 5.8\Omega$$

حال داریم:

$$V_g = \frac{R_G}{R_G + R_S} V_s = 0.97V_s$$

$$R_{i1} = R_{L1} \parallel [r_{\pi 2} + (\beta_2 + 1)120\Omega] = 1.8k \parallel 18.7k \approx 1.64k$$

$$V_{d1} = -g_{m1} R_{i1} V_g = -24.63V_g$$

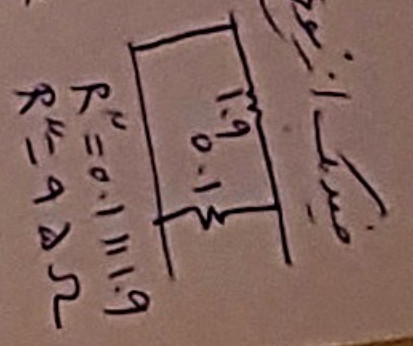
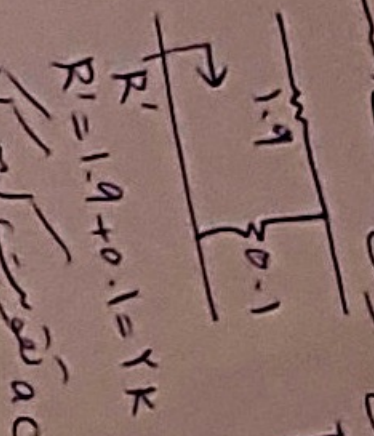
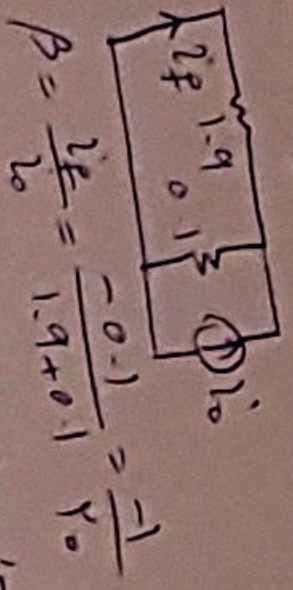
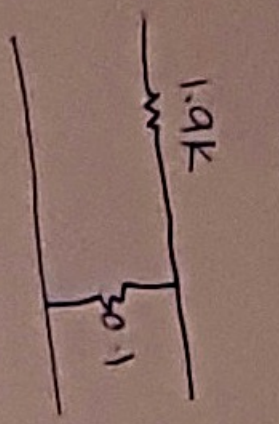
$$R_{i2} = R_{L2} \parallel [r_{\pi 3} + (\beta_3 + 1)R_{L3}] = 5k \parallel 175k \approx 4.86k$$

$$V_{C2} = -\frac{R_{i2}}{r_{e2} + 120\Omega} V_{b2} = -36.1 V_{b2}$$

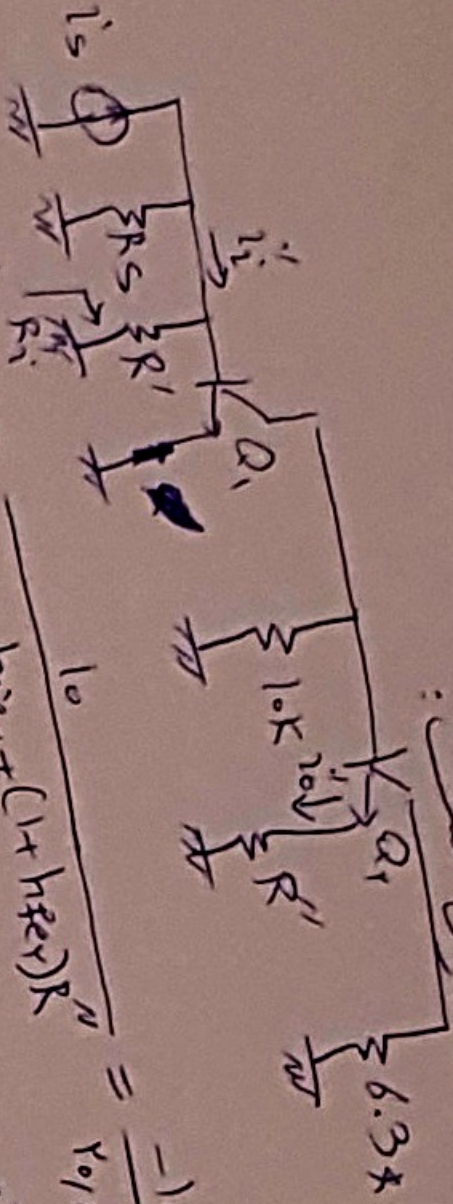
$$\frac{V_o}{V_{b3}} = \frac{R_{L3}}{R_{L3} + r_{e3}} = 0.99$$

$$\Rightarrow \frac{V_o}{V_s} = 0.97 \times (-24.63) \times (-36.1) \times (0.99) = 857.5$$

$h_{ie} = \frac{\eta V_T \beta}{I_{C1}} \rightarrow h_{ie1} = 1k\Omega$ و $h_{ier} = 500\Omega$



جستار است:



$\frac{i_{o1}}{i_{i1}} = 100$
 $\frac{i_{o2}}{i_{i2}} = -19/1k$
 $A_{i1} = \frac{i_{o1}}{i_{i1}} = 100$
 $A_{i2} = \frac{i_{o2}}{i_{i2}} = -19/1k$

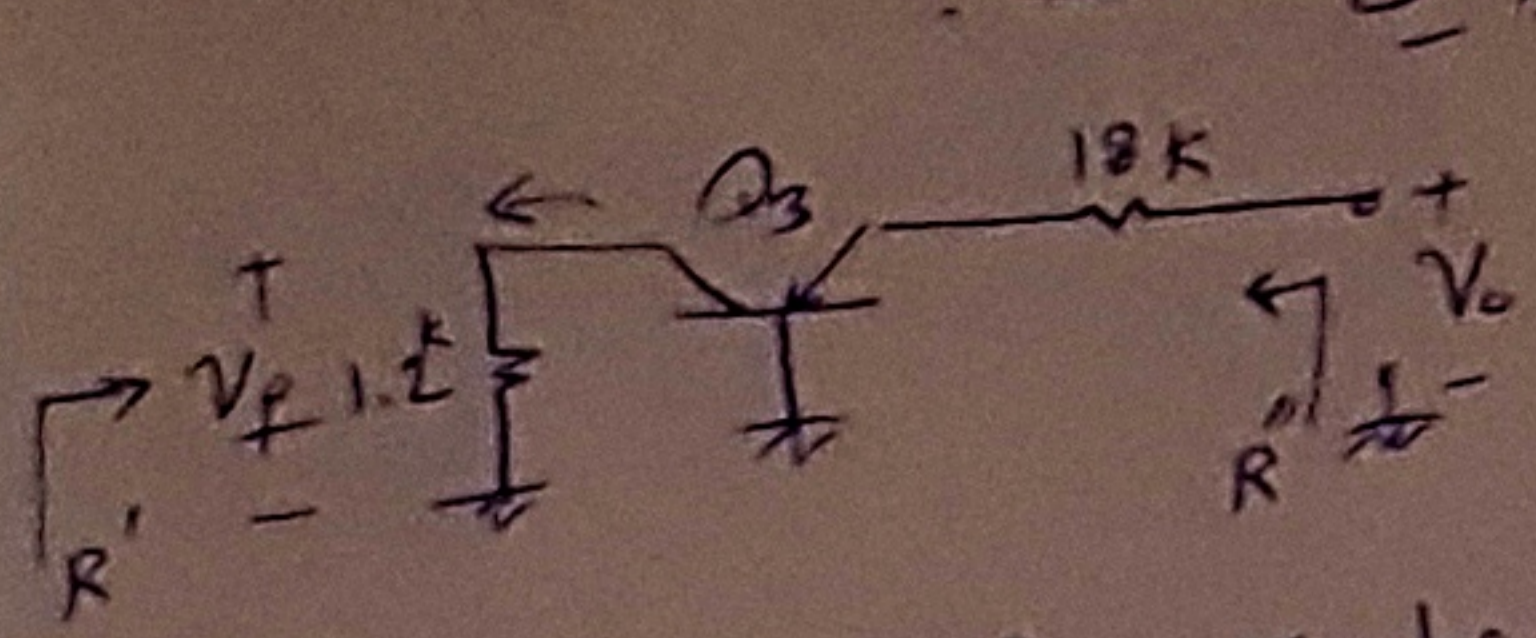
$R_{i1} = R_1 \parallel h_{ie1} = \frac{1}{2} k\Omega$
 $R_{i2} = R_2 \parallel h_{ie2} = \frac{1}{2} k\Omega$

$A_{v1} = \frac{v_{o1}}{v_{i1}} = \frac{-\beta i_{b1} R_{c1}}{i_{b1} (R_1 + h_{ie1})} = \frac{-\beta R_{c1}}{R_1 + h_{ie1}} = \frac{-20 \cdot 6.3k}{1k + 1k} = -6.3$
 $A_{v2} = \frac{v_{o2}}{v_{i2}} = \frac{-\beta i_{b2} R_{c2}}{i_{b2} (R_2 + h_{ie2})} = \frac{-\beta R_{c2}}{R_2 + h_{ie2}} = \frac{-20 \cdot 6.3k}{1k + 1k} = -6.3$

$A_v = \frac{v_o}{v_s} = \frac{-6.3 \cdot -6.3}{1k + 1k} = 4.2$

$R_o = 4.2 k\Omega$

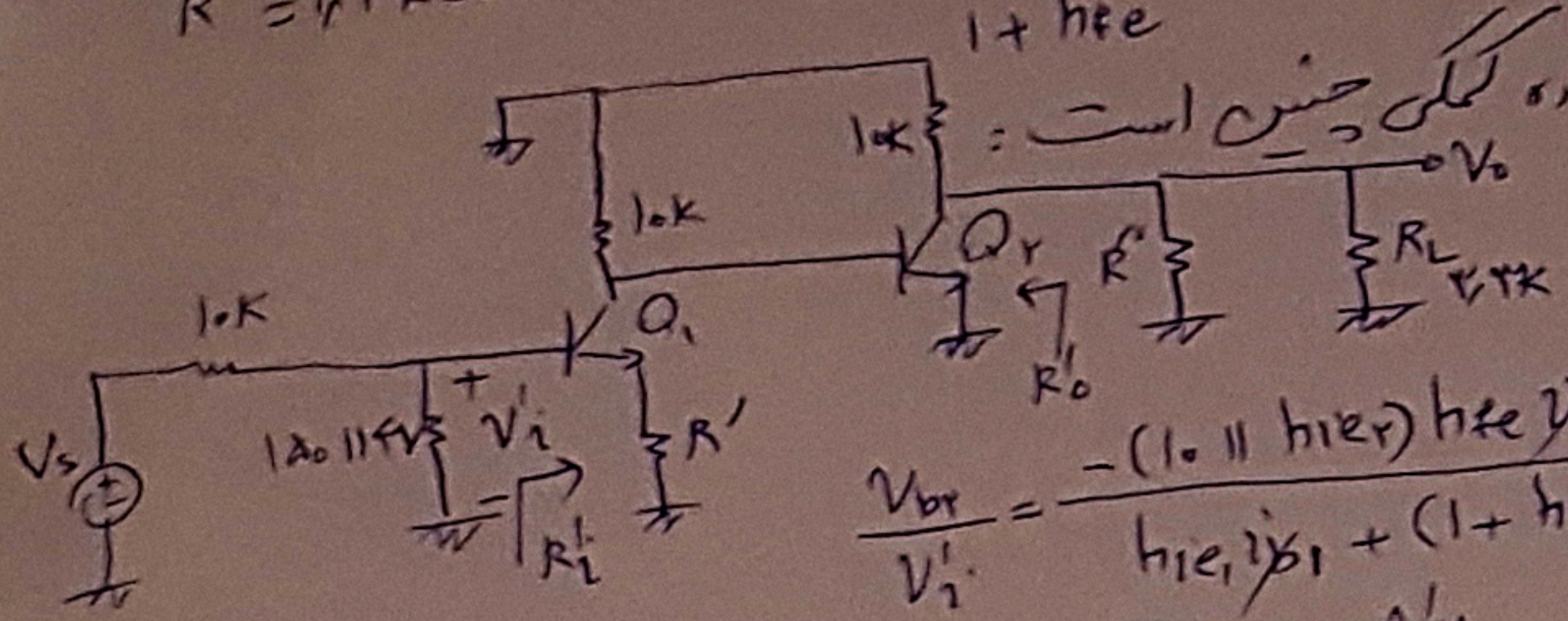
۳- فیدبک از نوع ولتاژ سری است. شکل فیدبک چنین است:



$$\beta = \frac{V_f}{V_o} = \frac{1.2 h_{fe} I_{Bc}}{18(1+h_{fe})I_{Bc} + h_{fe} I_{Bc}}$$

$$\beta = \frac{1.2}{18 \times 20} = \frac{9}{91}$$

$$R' = 1.2 K\Omega \quad R' = \frac{18(1+h_{fe}) + h_{fe} r_e}{1+h_{fe}} = 18 + \frac{h_{fe} r_e}{1+h_{fe}} = 18.02 K\Omega$$



با مدار معادل ac تقویت کننده گسیل چنین است:

$$\frac{V_o}{V_{br}} = \frac{-h_{fe}(R_L \parallel R'' \parallel 10) I_{B1}}{h_{fe} I_{B1}} = -19.52$$

$$\frac{V_{br}}{V_i} = \frac{-(10 \parallel h_{fe} r_e) h_{fe} I_{B1}}{h_{fe} I_{B1} + (1+h_{fe}) R' I_{B1}} = -1.35$$

$$A'_V = \frac{V_o}{V_i} = +120.185 \rightarrow A_{Vf} = \frac{V_o}{V_i} = \frac{A'_V}{1+\beta A'_V} = 13.48$$

$$R'_i = h_{ie} + (1+h_{fe}) R' = 123.2 K\Omega \rightarrow R_{if} = R'_i (1+\beta A'_V) = 1104.87 K\Omega$$

امپدانس ورودی بین از مقاومت های پایین

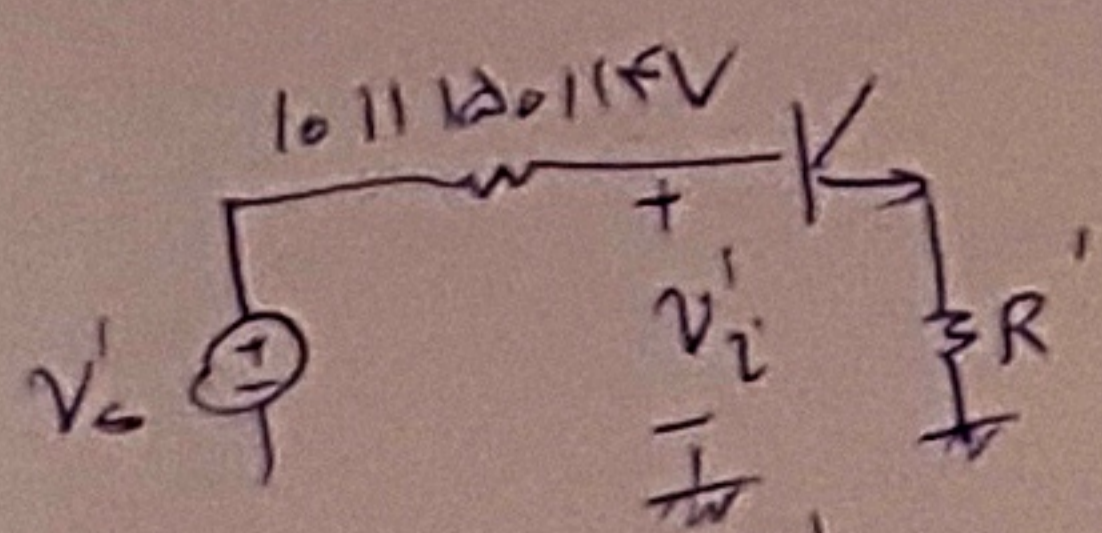
$$R_i = R_{if} \parallel 10K \parallel 150 = 34.44 K\Omega$$

امپدانس ورودی کل برابر

$$A_{Vs} = \frac{V_o}{V_s} = \frac{V_o}{V_i} \cdot \frac{V_i}{V_s} = A_{Vf} \cdot \frac{R_i}{R_i + 10K}$$

امپدانس خروجی تقویت کننده

تقویت کننده گسیل در ورودی آن را بصورت زیر تغییر می دهیم تا \$A_{Vs-NL}\$ را محاسبه کنیم همچنین در خروجی آن \$R_L\$ و \$R'\$ را حذف می کنیم.



$$\frac{V_o}{V_{br}} = \frac{-h_{fe}(10) I_{B1}}{h_{fe} I_{B1}} = -500$$

تغییر نمی کند.

$$\frac{V_i}{V_s} = \frac{R_i}{R'_i + 10K \parallel 150 \parallel 10K} = 0.94 \quad A_{Vs-NL} = \frac{V_o}{V_{br}} \cdot \frac{V_{br}}{V_i} \cdot \frac{V_i}{V_s} = 434.73$$

$$R_{of} = R'' \parallel \frac{R'_o}{1+\beta A_{Vs-NL}} = 230.49 \Omega$$