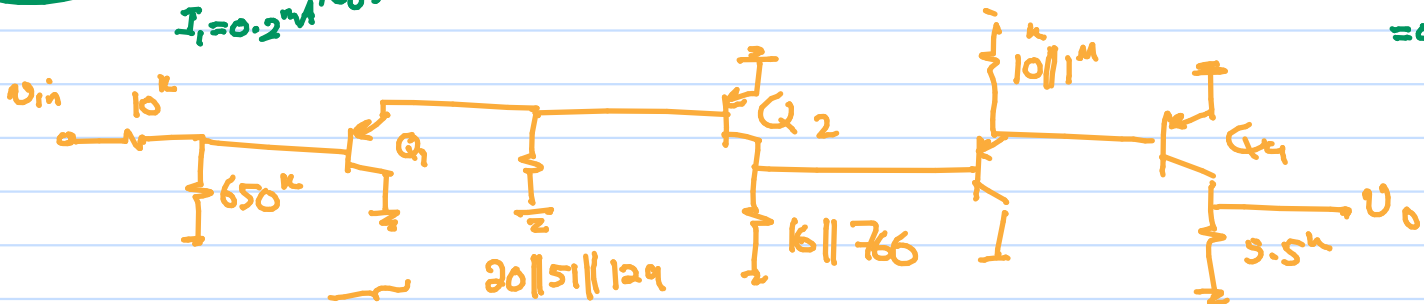


$$6 - 0.7 = I_1 \left( 20^k + \frac{650^k}{100} \right)$$

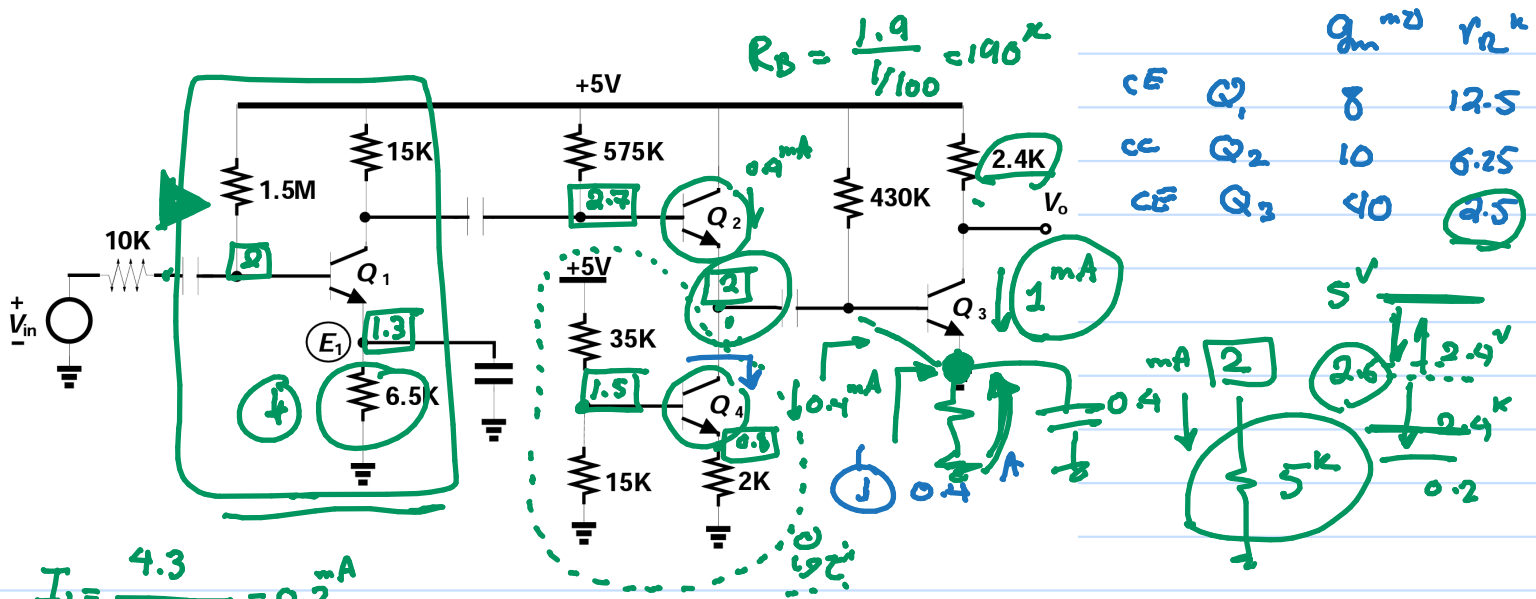
$$I_1 = 0.2 \text{ mA}$$

$$I_3 = \frac{5.3}{10 + 7.6} = 0.3 \text{ mA}$$

$$I_4 = \frac{5.3}{10} = 0.53 \text{ mA}$$



✓  
( $I_C, V_{CE}$ )



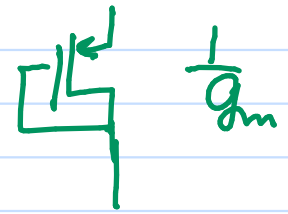
$$I_1 = \frac{4.3}{65^k + 15^k} = 0.2^{\text{mA}}$$

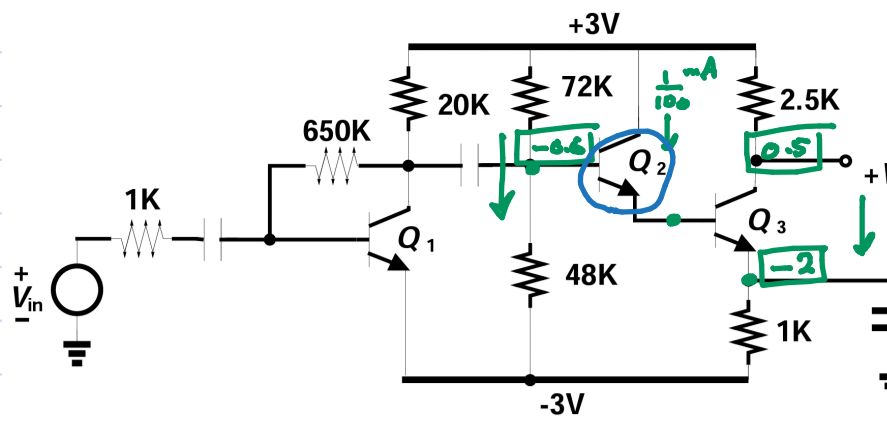
$$R_{in} = 1.5^k \parallel r_{\pi 1} = 12.5^k \quad r_{\pi 2} + \beta(r_{\pi 3} \parallel 15^k)$$

او این  $\frac{1}{0.55} \approx 1.8$

$$\frac{v_o}{v_{in}} = \frac{R_{in}}{R_{in} + 10^k} \times \left( -g_{m1} \times (15^k \parallel 575^k \parallel (r_{\pi 2} + \beta(r_{\pi 3} \parallel 15^k))) \right) \times \left( \frac{r_{\pi 3} \parallel 5^k}{r_{\pi 3} + r_{m2}} \right) \times \left( \frac{-g_{m3} \times 2.4^k}{\beta \times 96} \right)$$

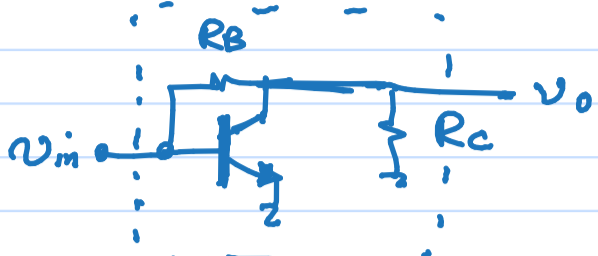
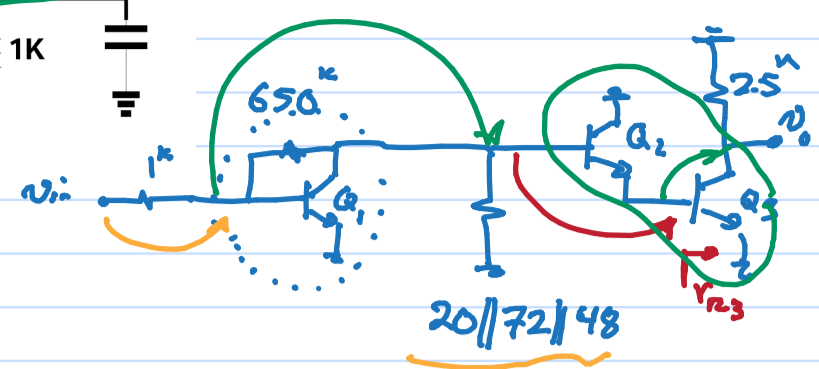
$\frac{0.55}{0.55} \times (-106) \times (-120) \times 0.97 \times (-96) = 6300$





3V	$Q_1$	$g_m = 8$	$r_{\pi} = 12.5k$
2.5V	$Q_2$	0.4	250
0.5V	$Q_3$	40	2.5

$$I_1 = \frac{5.3}{20 + 6.5} = 0.2 \text{ mA}$$



$$\frac{v_o}{v_{in}} = \frac{R_{in}}{R_{in} + 1} \times (-g_m) \times \frac{r_{e3}}{r_{e3} + r_{e2}} \times \left( -\frac{g_m}{3} \times 2.5 \right)$$

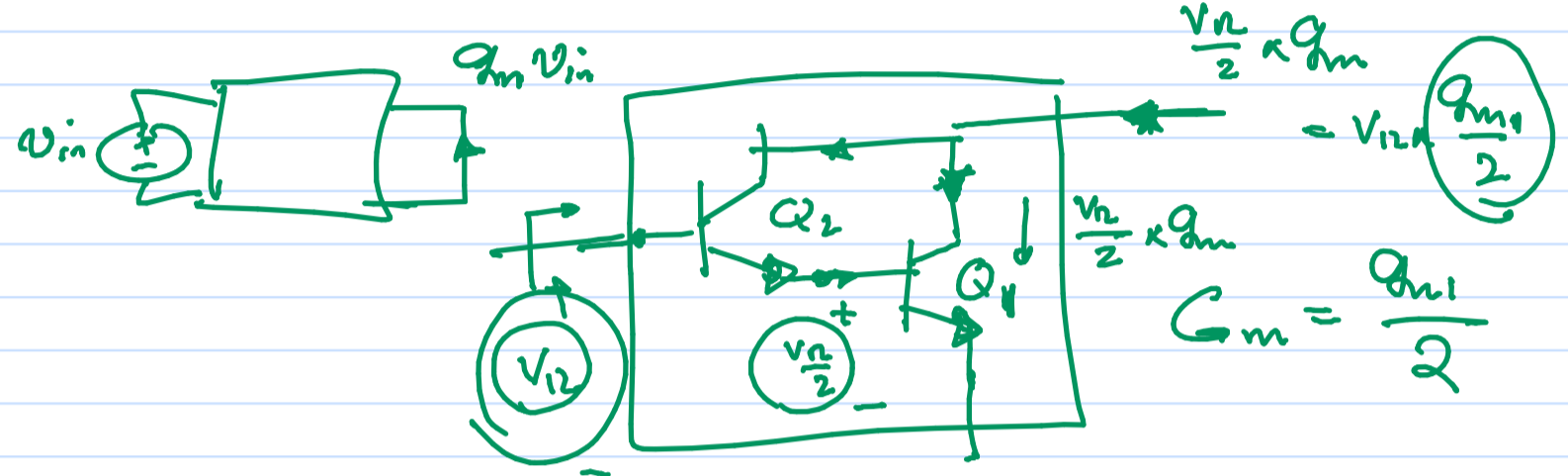
$\frac{4.5}{5.5} = \frac{1.0k}{0.5} \times \frac{100}{100}$

$$A_v = - \left( g_m - \frac{1}{R_B} \right) \left( R_C \parallel R_B \right) = -g_m R_C$$

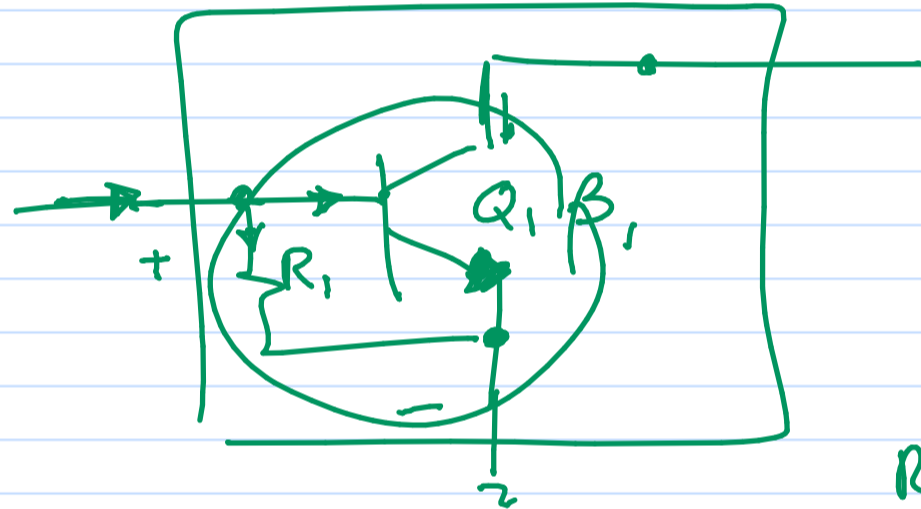
$$I_{in} = \frac{v_{in}}{r_{\pi}} + \frac{(v_{in} - v_o)}{R_B} \times g_m (1 - A_v)$$

$$R_{in} = \frac{v_{in}}{I_{in}} = r_{\pi} \parallel \frac{R_B}{1 - A_v} = r_{\pi} \parallel \frac{R_B}{1 + |A_v|} = 12.5k \parallel \frac{650}{93} = 4.5k$$

$$= -8 \times (11.8 \parallel 650) = -92$$

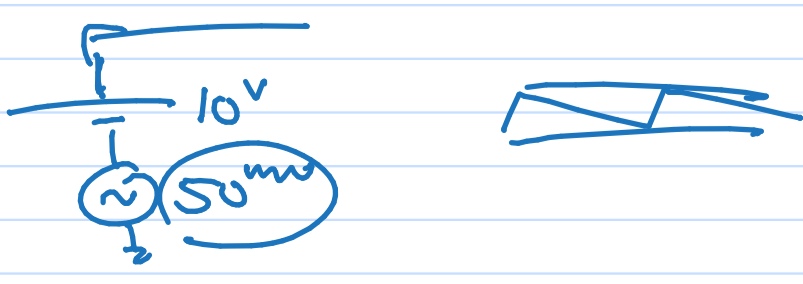
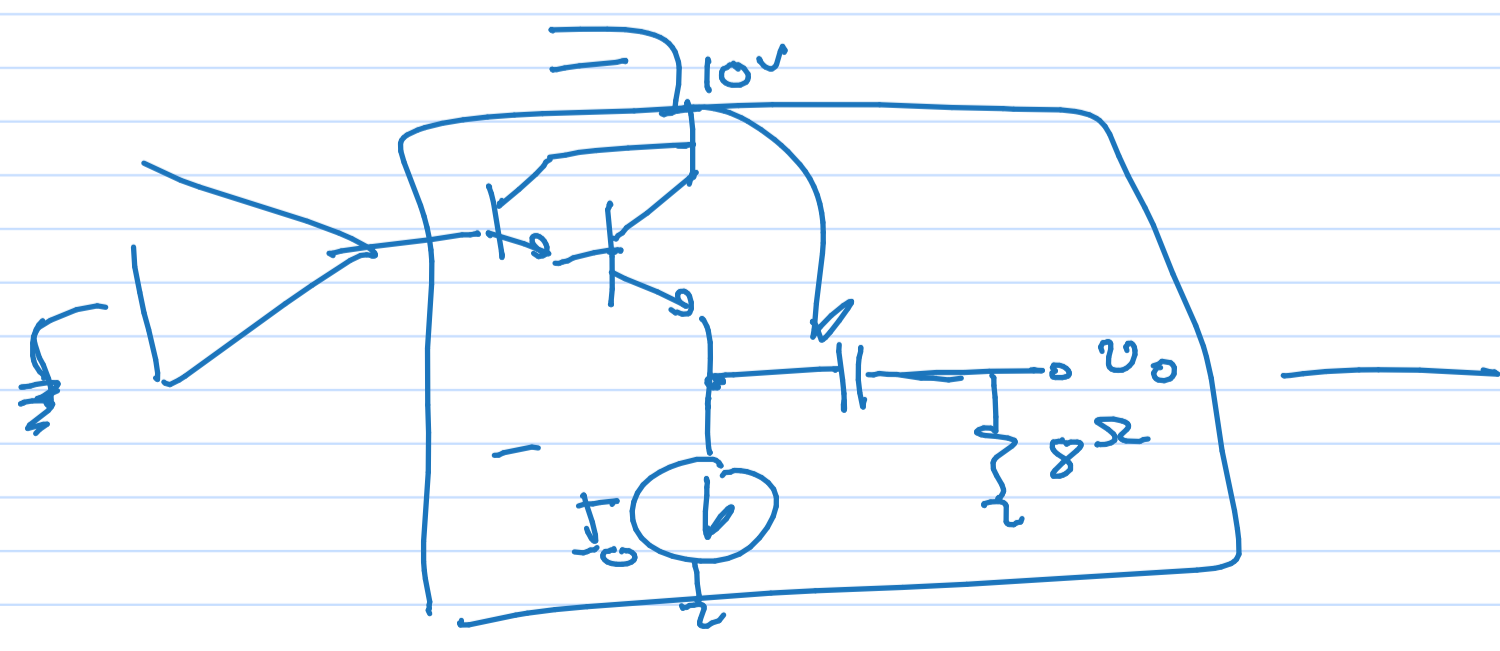
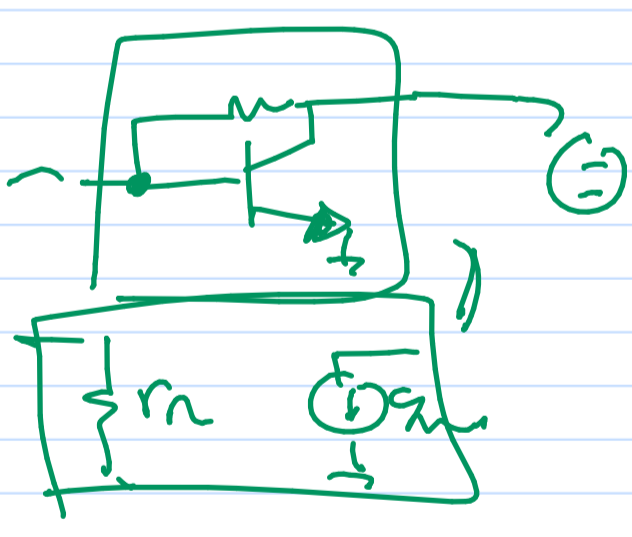
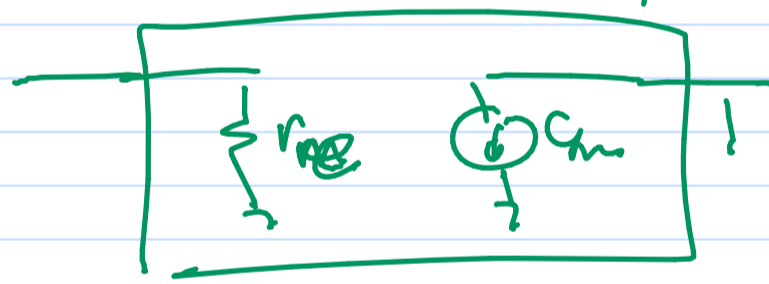


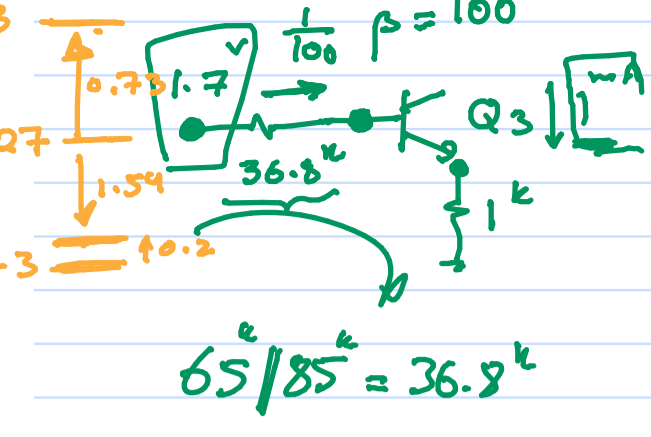
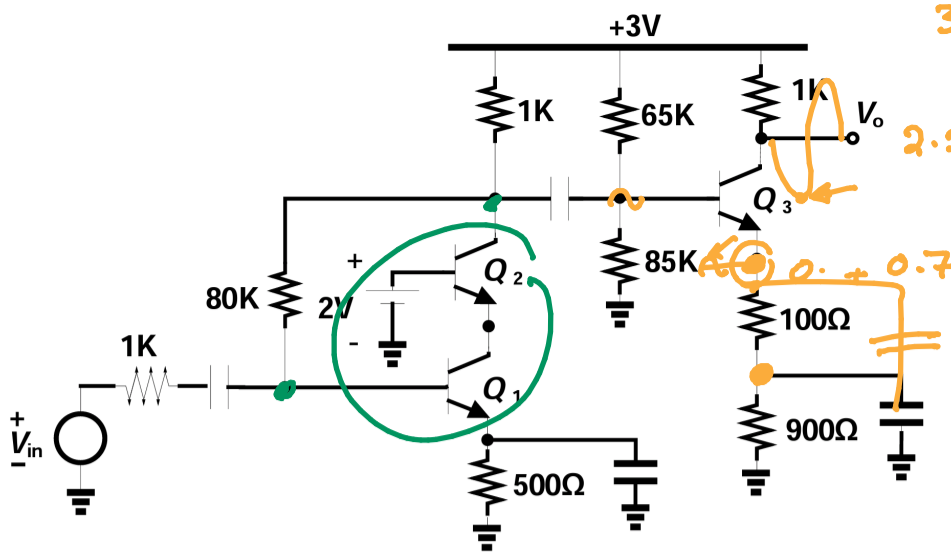
$$r_{\pi} = r_{\pi 2} + \beta r_{\pi 1} = 2 r_{\pi 2}$$



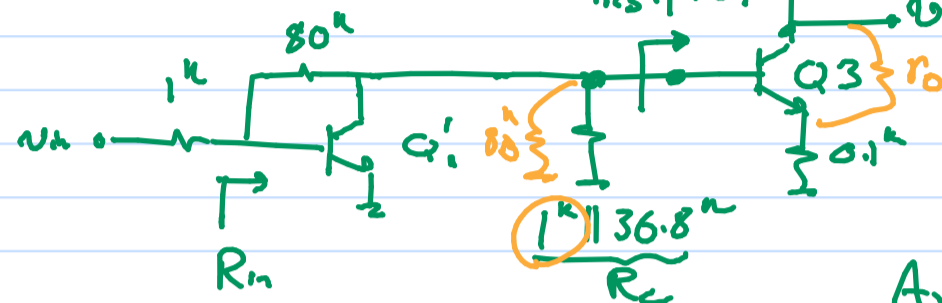
$$R_i = r_{\pi 2}$$

$$\beta = \beta_1 \times \frac{R_i \parallel r_{\pi 1}}{r_{\pi 1}} \Rightarrow \left\{ \begin{array}{l} r_{\pi} = R_i \parallel r_{\pi 1} \\ g_m = g_{m1} \end{array} \right.$$





$$I = \frac{2.3}{1.5 + 0.8} \text{ mA}$$

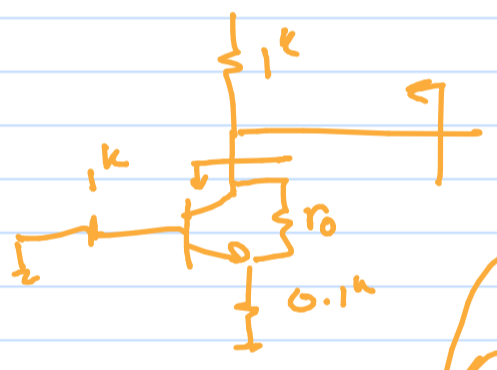


$$R_{in} = r_{\pi 1} \parallel \frac{80}{1 + |A_{v1}|} = 2.5 \parallel 2.1 = 1.14 \text{ k}$$

	$g_m$	$r_{\pi}$
$Q_2, Q_1$	40	2.5
$Q_3$	0.2	3.42

$$A_{v1} = -\left(g_m - \frac{1}{R_B}\right) (R_C \parallel R_B) = -36$$

$$\frac{V_o}{V_{in}} = \frac{R_{in}}{R_{in} + 1 \text{ k}} \times \underbrace{A_{v1}}_{-36} \times \frac{-1 \text{ k}}{0.1 \text{ k} + \underbrace{r_{\pi 3}}_{7.45}} = 143$$



$$1 \text{ k} \parallel r_o \left(1 + \frac{\beta R_E}{R_E + r_{\pi 2} + R_B}\right)$$

