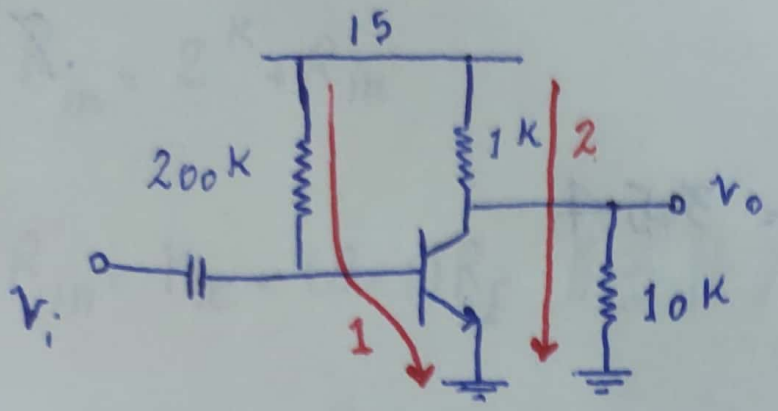


DC analysis:

KVL @ 1: $-15 + 200 I_B + 0.7 = 0 \longrightarrow I_B = 0.07$

$I_C = \beta I$

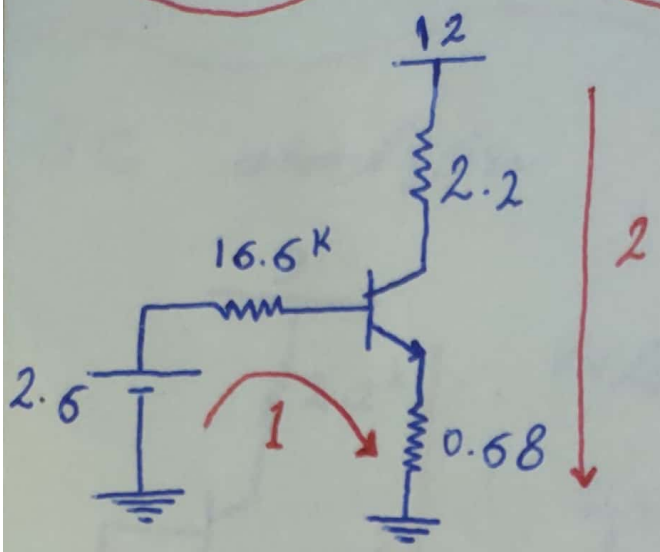
KVL @ 2: $-15 + 7 + V_{CE} = 0 \longrightarrow V_{CE} = 8\ V$

S.S analysis:

$A_v = -g_m (R_C \| R_\ell \| r_o)$

$g_m = 280 \qquad r_\pi = 0.35 \qquad r_o = \infty$

$A_v = -280 \qquad R_{in} = 0.35K \| 200K \simeq 0.35K \qquad R_{out} = 1K \| 10K \simeq 1K$



KVL @ 1: $-2.6 + 16.6 I_B + 0.7 + 0.68 I_E = 0$

$I_C = I_E = 2.25$

KVL @ 2: $-12 + 2.2(2.25) + V_{CE} + 0.68(2.25) = 0$

$V_{CE} = 5.52$

S.S analysis:

$g_m = 90$ $\quad r_\pi = 1.1K$ $\quad r_o = \infty$

$$\frac{i_o}{i_{in}} = \frac{\frac{v_o}{R_\ell}}{\frac{v_{in}}{R_{in}}} = \underbrace{\frac{v_o}{v_{in}}}_{A_v} \times \frac{R_{in}}{R_\ell}$$

$$A_V = - \frac{R_C \parallel R_\ell}{\frac{1}{g_m} + R_E} = -2.6 \frac{V}{V}$$

$$R_{in} = (r_{\pi C} + (\beta + 1) R_E) \parallel 75^K \parallel 22^K = 13.65^K$$

$$R_\ell = 10^K$$

$$A_i = -3.5 \frac{mA}{mA}$$

$$A_V = -g_m (R_C \| R_\ell)$$

$$V_C = R_C I_C$$

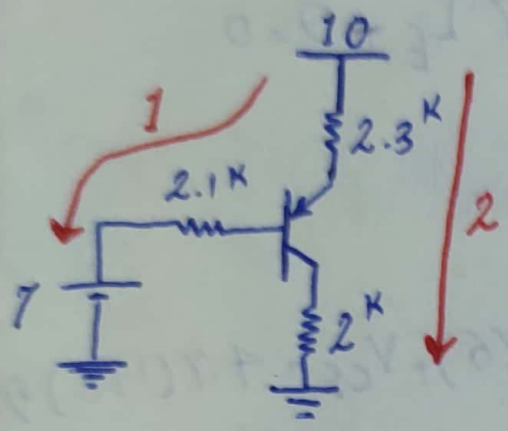
$$g_m = 40 I_C$$

$$48 = 40 I_C (R_C \| R_\ell) \longrightarrow 1.2 = I_C (R_C \| R_\ell)$$

$$1.2 = I_C \left(\frac{R_C}{R_C + 1} \right) \longrightarrow 1.2 = \frac{R_C I_C}{R_C + 1}$$ 3

$$R_C = 1.5\ K\Omega$$

DC analysis:



KVL @ 1: $-10 + 2.3 I_E + 0.7 + 2.1 I_B + 7 = 0$

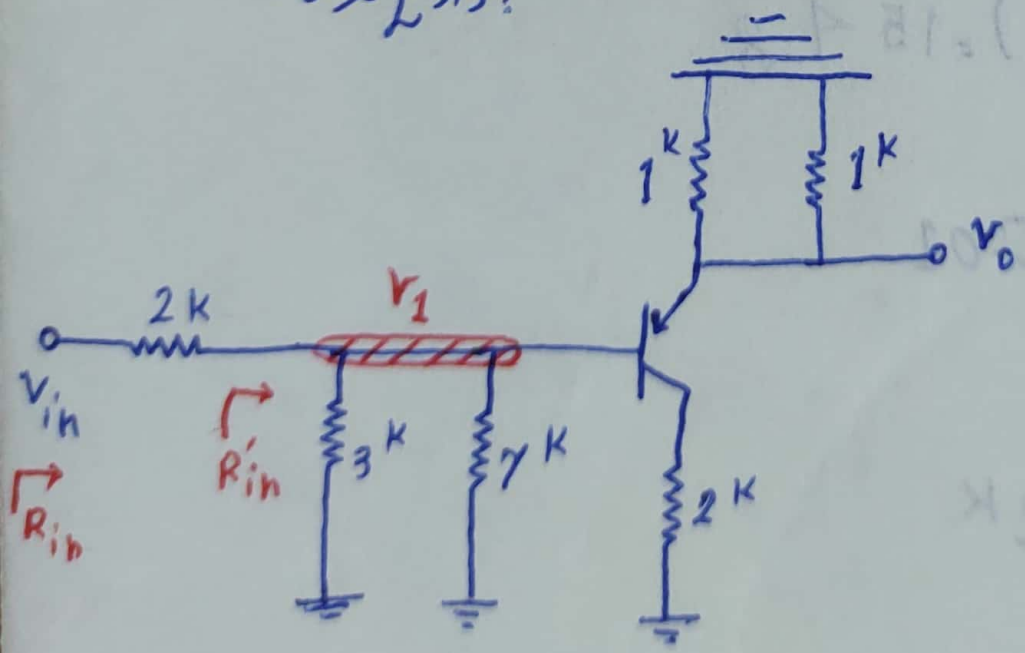
$I_C = 1 mA$

KVL @ 2: $-10 + 2.3 + V_{CE} + 2 = 0$

$V_{CE} = 5.7$

$g_m = 40 \frac{mA}{V}$ $\quad r_{\pi} = 2.5 K$

S.S analysis:



$$R_{in} = 2^K + R'_{in}$$

$$R'_{in} = r_\pi + (\beta+1) R_E \parallel 3^K \parallel 7^K = 2.01^K$$

$$R_{in} = 4.01^K$$

$$R_{out} = R_\ell \parallel R_E \parallel \left(\frac{1}{g_m} + \frac{R_B}{\beta} \right) \simeq 0.032\,K\Omega$$

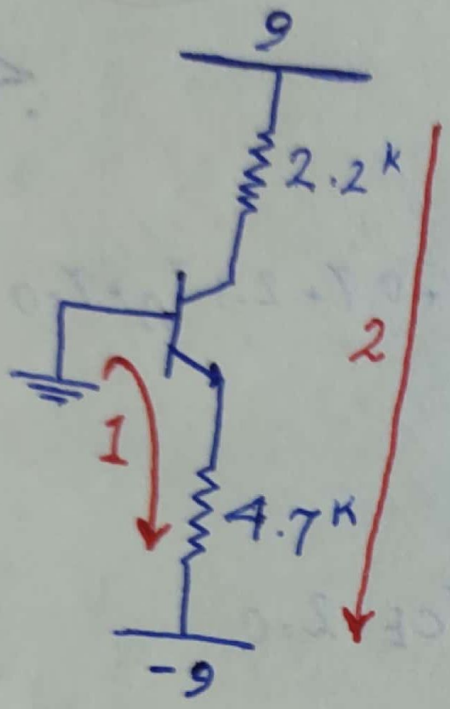
$$A_V = \frac{v_{out}}{v_1} \times \frac{v_1}{v_{in}}$$

$$\frac{v_{out}}{v_1} = \frac{R_E}{R_E + \frac{1}{g_m}} = 0.95$$

$$\frac{v_1}{v_{in}} = \frac{R'_{in}}{2 + R'_{in}} = 0.5$$

$$A_V = 0.48\ V/V$$

DC analysis.



KVL@1: $0.7 + 4.7 I_E - 9 = 0$

$I_E = 1.76\ mA$

KVL@2: $-9 + 2.2(1.76) + V_{CE} + 4.7(1.76) - 9$

$V_{CE} = 5.85$

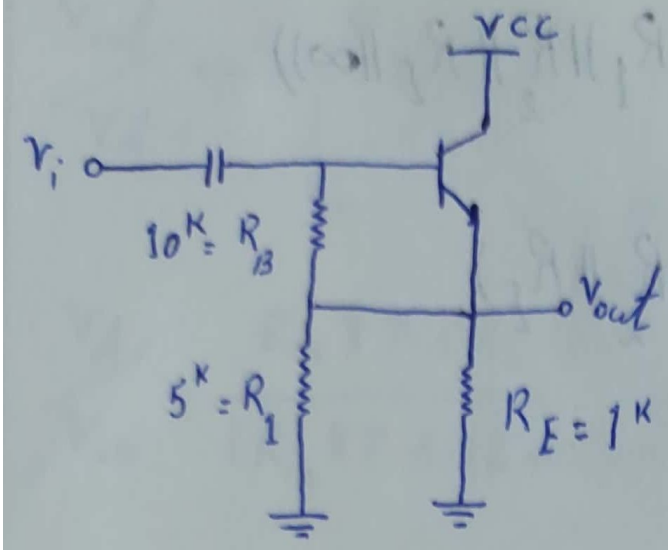
$g_m = 70.4\ \frac{mA}{V}$

$r_{\pi} = 1.42$

$A_V = g_m (R_C \| R_\ell \| r_o) = 154.8$

$R_{in} = \frac{1}{g_m} \| R_E = 0.01$

$R_{out} = r_o \| R_C = 2.2K$



$r_{rc} = 5K$

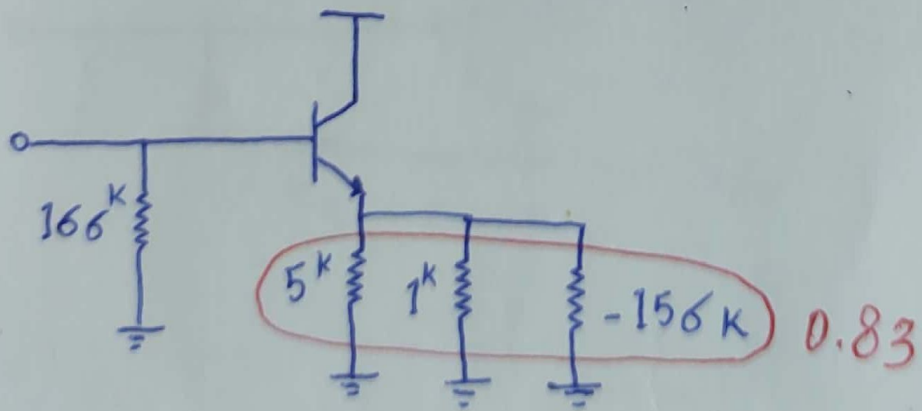
$\beta = 100$

$V_A = \infty$

$$Z_1 = \frac{Z}{1 - A_V} \qquad Z_2 = \frac{Z}{1 - A_V^{-1}}$$

$$A_V = \frac{R_E}{\frac{1}{\frac{1}{L_m}} + R_E} = \frac{1 \| 5}{\frac{1}{20} + 1 \| 5} = 0.94$$

$Z_1 = 166 \qquad Z_2 = -156$



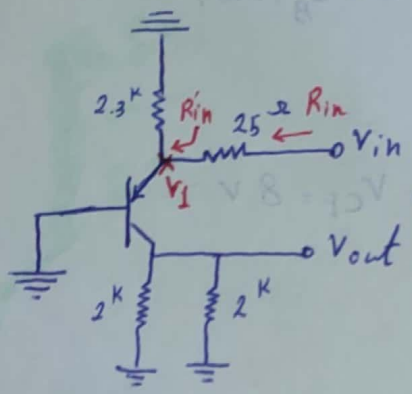
$$R_{in} = 166^K \| r_{rc} + (\beta + 1) R_E = 57.5\,K$$

DC analysis:

$I_E = 1\ mA$ $\quad V_{CE} = 5.7$

$g_m = 40$

S.S analysis:



$R_{in} = R'_{in} + 25\Omega$

$R'_{in} = \frac{1}{g_m} \| 2.3^K \simeq 25\Omega$

$R_{in} = 50\Omega$

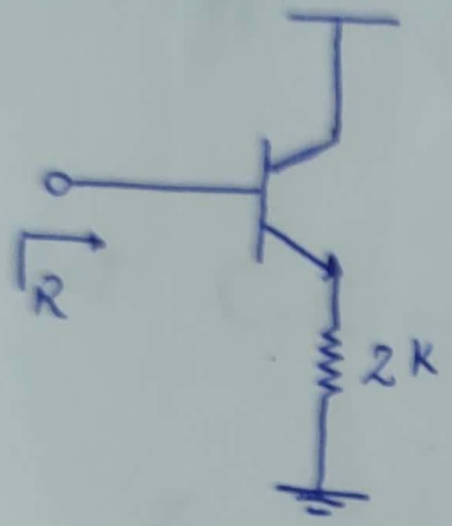
$R_{out} = R_C \| R_\ell \| r_o = 1^K$

$A_V = \frac{V_{out}}{V_1} \times \frac{V_1}{V_{in}}$

$\frac{V_{out}}{V_1} = g_m (R_C \| R_\ell) = 40$

$\frac{V_1}{V_{in}} = \frac{R'_{in}}{R'_{in} + R_S} = 0.5$

$A_V = 20 \quad V/V$



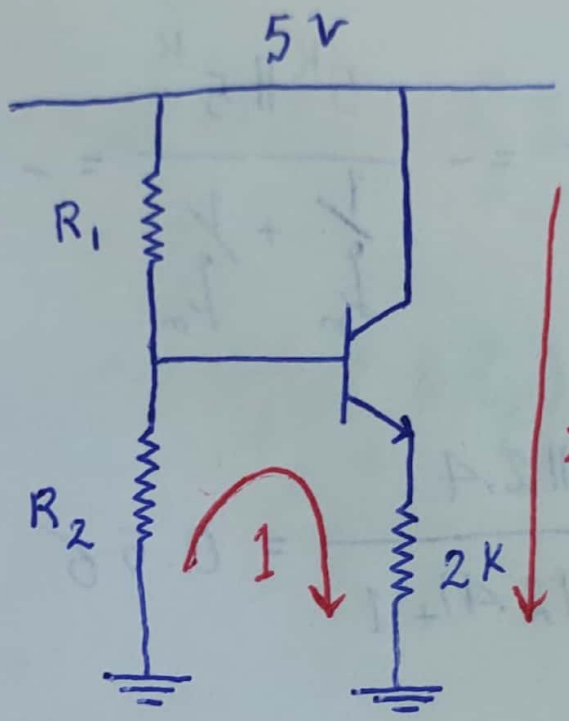
$\beta = 100$

$I_C = 1mA$

$\gamma_m = 40$

$r_{\pi} = 2.5$

$R = r_{\pi} + (\beta + 1) R_E \longrightarrow R = 2.5 + (101)2 = 204.5\ K$



$V_{BE} = 0.7$

$\beta = 100$

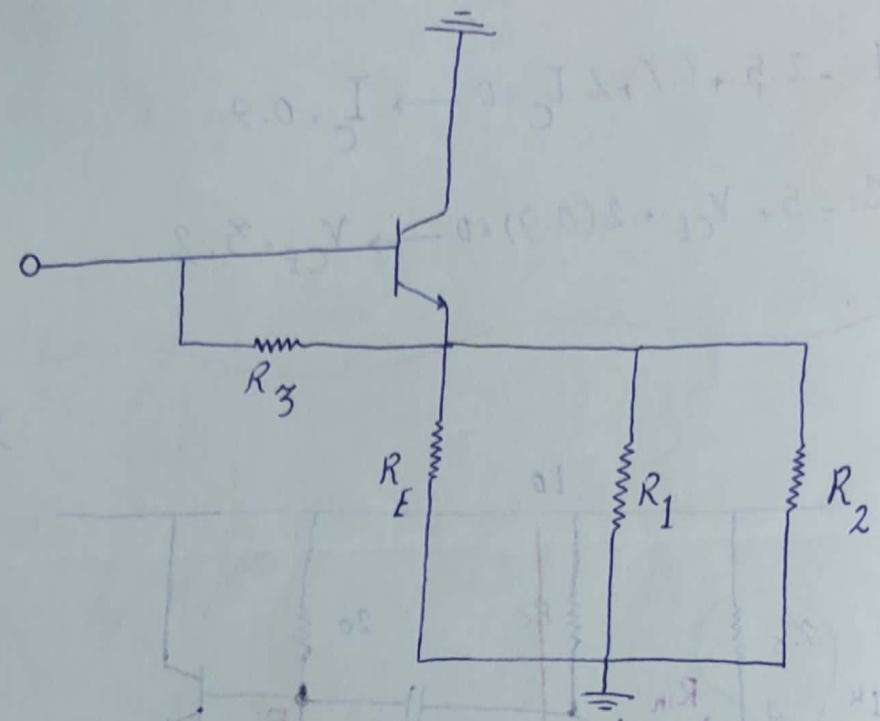
$R_E > 10 \dfrac{R_{th}}{\beta}$

$2 > 10 \dfrac{R_{th}}{100} \longrightarrow R_{th} < 20K$

$R_1 = R_2 = 20K$

KVL @1: $-2.5 + 0.7 + 2I_C = 0 \longrightarrow I_C = 0.9$

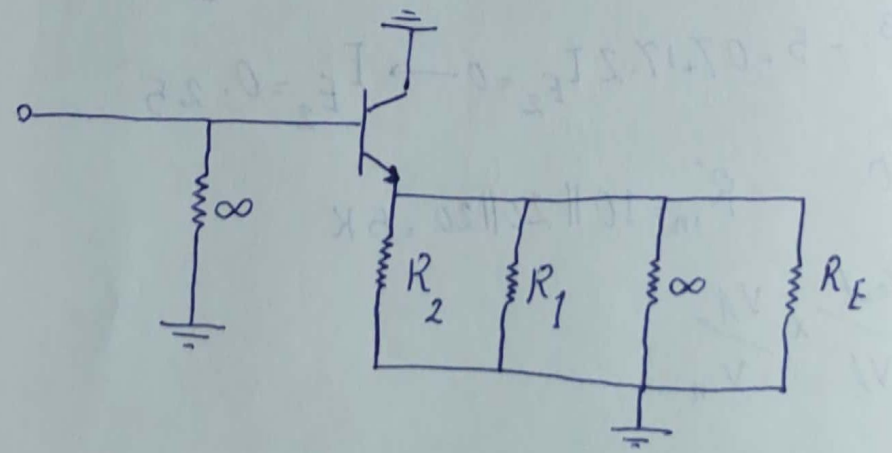
KVL @2: $-5 + V_{CE} + 2(0.9) = 0 \longrightarrow V_{CE} = 3.2$



$$Z_1 = \frac{Z}{1 - A_V} \qquad Z_2 = \frac{Z}{1 - A_V^{-1}}$$

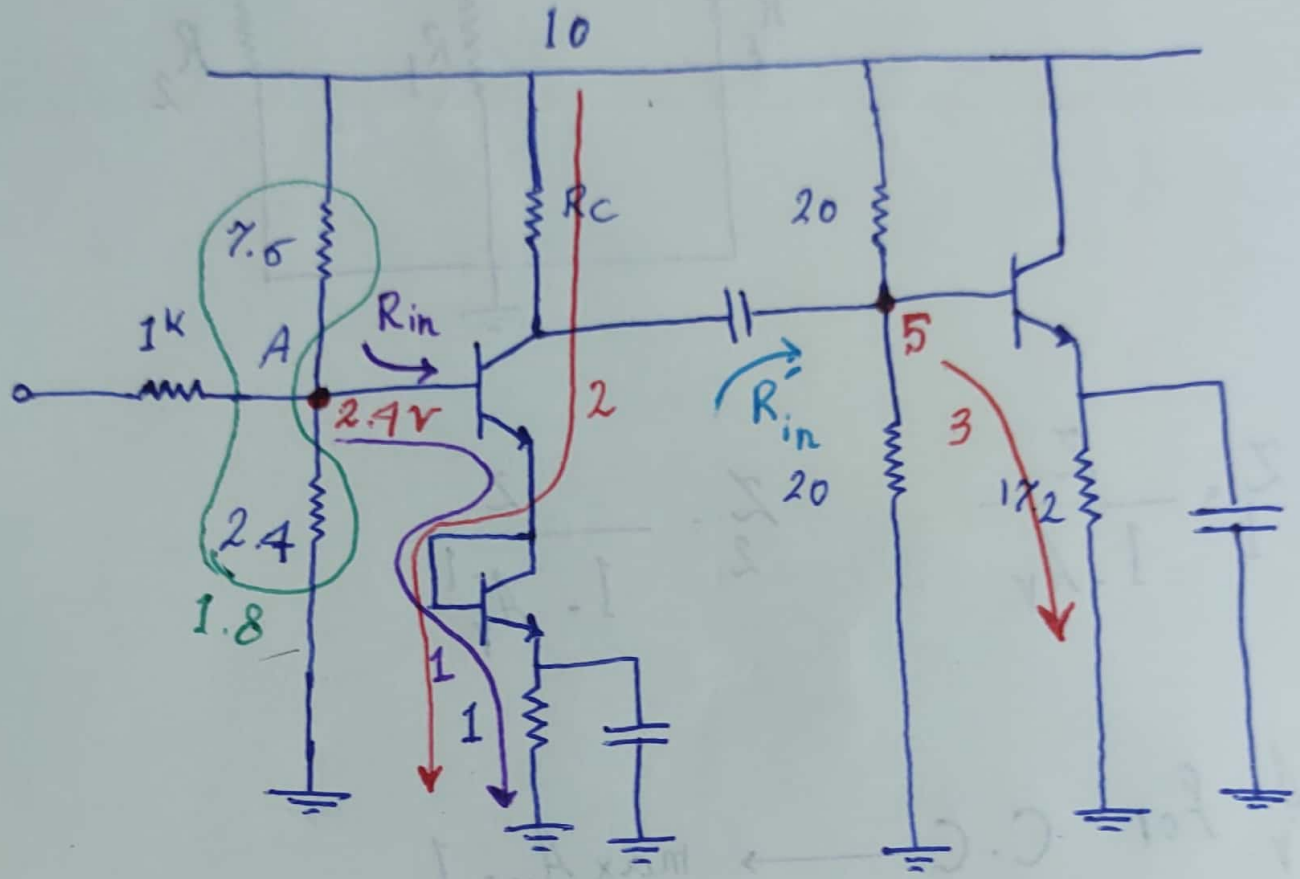
A_V for C.C $\longrightarrow$ $\max A_V = 1$

$$Z_1 = \frac{Z}{0} = \infty \qquad Z_2 = \frac{Z}{0} = \infty$$



$$R_{in} = \infty \parallel (r_{\pi} + (\beta+1)(R_1 \parallel R_2 \parallel R_E \parallel \infty))$$

$$R_{in} = r_{\pi} + (\beta+1)(R_1 \parallel R_2 \parallel R_E)$$



KVL@1: $-2.4 + 0.7 + 0.7 + I_E = 0 \longrightarrow I_E = 1\,mA$

KVL@2: $-10 + R_C + 3.3 + 0.7 + 1 = 0 \longrightarrow R_C = 5\,K$

KVL@3: $-5 + 0.7 + 17.2\,I_{E_2} = 0 \longrightarrow I_{E_2} = 0.25$

$r_{re_2} = 10$ $\qquad R'_{in} = 10 \parallel 20 \parallel 20 = 5\,K$

$$A_V = \frac{V_{out}}{V_A} \times \frac{V_A}{V_{in}}$$

$$\frac{V_{out}}{V_A} = -\frac{R_C}{\frac{1}{g_m} + R_E} = -\frac{5^K \| 5^K}{\frac{1}{g_m} + \frac{1}{g_m}} = -50$$

$$\frac{V_A}{V_{in}} = \frac{R_{in} \| 7.6 \| 2.4}{(R_{in} \| 7.6 \| 2.4) + 1} = 0.56$$

$$R_{in} = r_{\pi} + (\beta + 1) R_E = 2.5 + (101) \frac{1}{40} = 5^K$$

$$A_V = -28.2 \frac{V}{V}$$