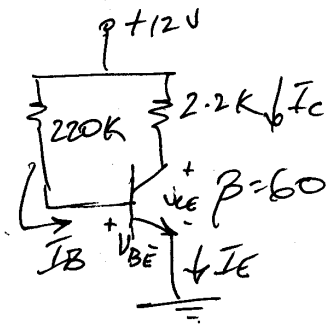
(1)



Applying KVL to B-E loop

$V_{CC} - I_B(220K) - V_{BE} = 0$

$12 - (220K)I_B - 0.7 = 0$

$I_B = 51.36\,\mu A$

$I_C = \beta I_B = 3.082\,mA$

Applying KVL to C-E loop

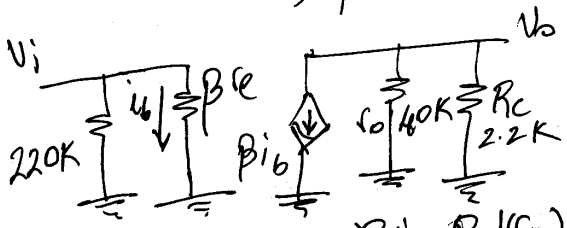
$V_{CC} - I_C R_C - V_{CE} = 0$

$12 - (3.082\,mA)(2.2K) - V_{CE} = 0$

$V_{CE} = 5.22V$

Q point $\equiv$ (5.22 V, 3.082 mA)

$r_e = \frac{26mV}{I_C} = 8.44\Omega$



$A_V = \frac{V_O}{V_i} = \frac{-\beta i_b (R_C \| r_o)}{\beta i_b r_e}$

$= -\frac{(2.2K \| 40K)}{8.44\Omega}$

$= -247.63$

$Z_i = 220K \| (60)(8.44)$

$= 0.5055K\Omega$

$Z_o = R_C \| r_o$

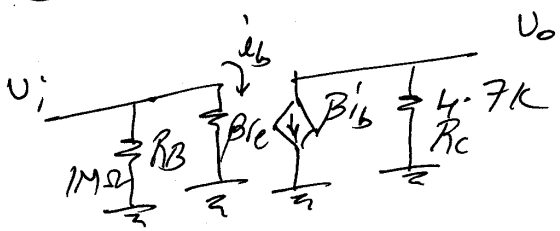
$= 2.2K \| 40K$

$= 2.09K\Omega$

$A_i = -\frac{A_V Z_i}{R_C} = +\frac{247.63(0.5055K)}{2.2K}$

$= 56.84$

② $A_V = -200$



$$A_V = \frac{V_o}{V_i} = \frac{-\beta i_b R_C}{\beta r_e i_b}$$

$$A_V = -\frac{4.7k}{r_e}$$

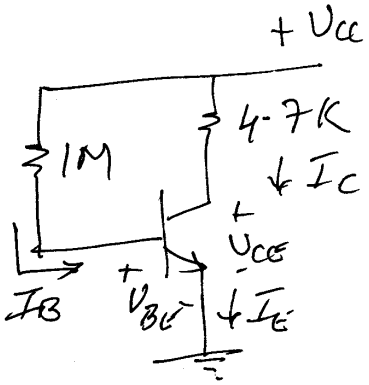
$$-200 = -\frac{4.7k}{r_e}$$

$$r_e = 23.5\Omega$$

$$\frac{26mV}{I_C} = 23.5$$

$$I_C = 1.11mA$$

$$I_B = \frac{I_C}{\beta} = 12.29\mu A$$



Applying KVL to B-E loop

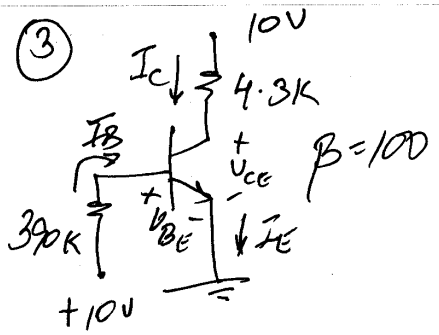
$$V_{CC} - I_B(1M) - V_{BE} = 0$$

$$V_{CC} - (12.29\mu A)(1M) - 0.7 = 0$$

$$V_{CC} = 13V$$

Abhishek Navlak

③



Applying KVL to B-E loop

$10 - I_B(390K) - 0.7 = 0$

$I_B = 23.85\ \mu A$

$I_C = \beta I_B = 2.385\ mA$

Applying KVL to C-E loop.

$10 - (4.3K)I_C - V_{CE} = 0$

$V_{CE} = -0.256\ V$

$Q \equiv (-0.256,\ 2.385\ mA)$

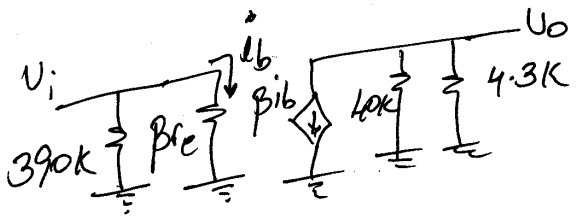
$r_e = \frac{26mV}{I_C} = 10.9\Omega$

$Z_i = 390K \,//\, \beta r_e$

$= 0.087K\Omega$

$Z_o = 40K // 4.3K$

$= 3.88K\Omega$

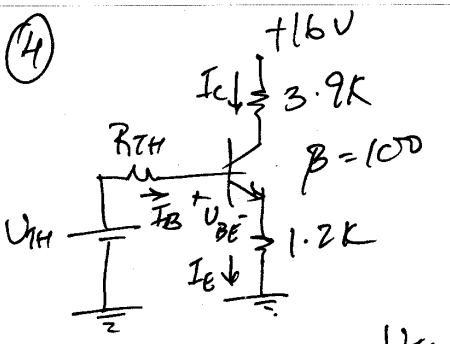


$$A_V = \frac{V_o}{V_i} = \frac{-\beta i_b (40K // 4.3K)}{i_b \beta r_e}$$

$A_V = -356.2$

$A_i = -\frac{A_V Z_i}{4.3K} = 90.04$

(4)



$$V_{TH} = \left(\frac{4.7}{4.7+39}\right) \cdot 16 = 1.72V$$

$$R_{TH} = 39K // 4.7K = 4.195K\Omega$$

Applying KVL to B-E loop.

$$V_{TH} - I_B R_{TH} - V_{BE} - I_E R_E = 0$$

$$1.72 - I_B(4.195K) - 0.7 - (1+100) I_B\, 1.2K = 0$$

$$I_B = 8.134\mu A$$

$$I_C = \beta I_B = 0.813mA$$

Applying KVL to C-E loop.

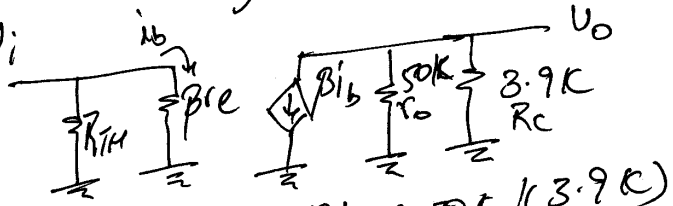
$$V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$$

$$16 - (0.813mA)(3.9K) - V_{CE} - (101)(8.134\mu A)(1.2K) = 0$$

$$V_{CE} = 11.84V$$

$$Q = (11.84V,\ 0.813mA)$$

$$r_e = \frac{26mV}{I_C} = 32\Omega$$



$$A_V = \frac{V_o}{V_i} = \frac{-\beta i_b (50K // 3.9K)}{i_b \beta r_e}$$

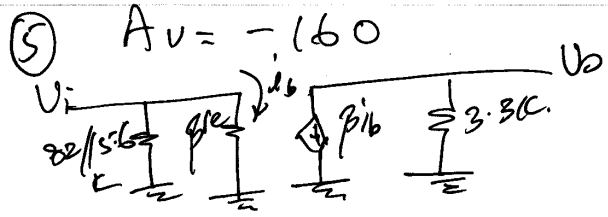
$$A_V = -113.06$$

$$Z_i = R_{TH} // \beta r_e = \frac{1.815K\Omega}{}$$

$$Z_o = 50K // 3.9K = 3.618K\Omega$$

$$A_i = -\frac{A_V Z_i}{R_C} = 52.62$$

(5) $A_V = -160$



$$A_V = \frac{V_o}{V_i} = \frac{-\beta i_b (3.3K)}{\beta r_e i_b}$$

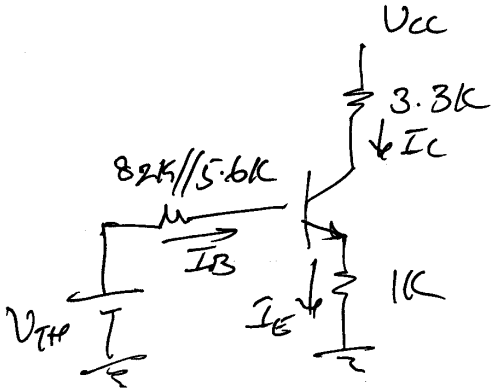
$$-160 = -\frac{3.3K}{r_e}$$

$$r_e = 20.625\ \Omega$$

$$\frac{26mV}{I_E} = 20.625\ \Omega$$

$$I_C = 1.26mA$$

$$I_B = \frac{I_C}{\beta} = 12.6\mu A$$



$$V_{TH} = \left(\frac{5.6}{5.6+82}\right) V_{CC}$$

Applying KVL to B-E loop

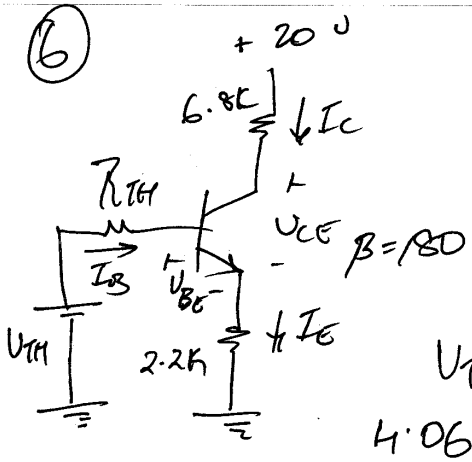
$$V_{TH} - I_B R_{TH} - V_{BE} - I_E R_E = 0$$

$$\left(\frac{5.6}{5.6+82}\right) V_{CC} - (12.6\mu A)(82K//5.6K) - 0.7 - (101)(12.6\mu A)(1K) = 0$$

$$0.064\, V_{CC} - 0.066 - 0.7 - 1.2726 = 0$$

$$V_{CC} = 31.85\ V$$

(6)



$R_{TH} = 220K // 56K = 44.64K\Omega$

$V_{TH} = \left(\frac{56}{56+220}\right)20 = 0.203 \times 20$

$= 4.06\ V$

Applying KVL to B-E loop.

$V_{TH} - I_B R_{TH} - V_{BE} - I_E R_E = 0$

$4.06 - I_B(44.64K) - 0.7 - (181) I_B (2.2K) = 0$

$I_B = 7.59\ \mu A$

$I_C = \beta I_B = 1.366\ mA$

Applying KVL to C-E loop.

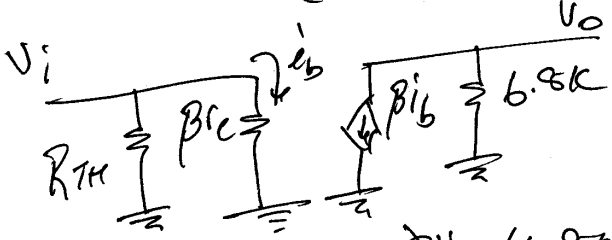
$V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$

$20 - (1.366mA)(6.8K) - V_{CE} - (181)(7.59\mu A)(2.2K) = 0$

$V_{CE} = 7.7V$

$Q \equiv (7.7V, 1.366mA)$

$r_e = \frac{26mV}{I_C} = 19.03\Omega$



$Z_i = R_{TH} // \beta r_e$

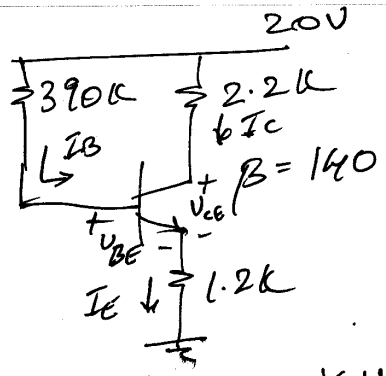
$= 3.18K\Omega$

$Z_o = 6.8K\Omega$

$A_V = \frac{V_o}{V_i} = \frac{-\beta i_b (6.8K)}{i_b \beta r_e} = -357.33$

$A_i = -\frac{A_V Z_i}{6.8K} = 167.157$

(7)



Applying KVL to BE loop

$V_{cc} - I_B R_B - V_{BE} - I_E R_E = 0$

$20 - (390K) I_B - 0.7 - (1.2K)(141) I_B = 0$

$I_B = 34.51 \mu A$

$I_C = \beta I_B = 4.832 mA$

Applying KVL to C-E loop.

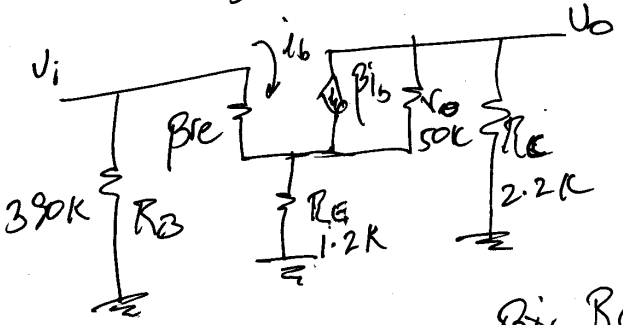
$V_{cc} - I_C R_C - V_{CE} - I_E R_E = 0$

$20 - (4.832 mA)(2.2K) - V_{CE} - (141)(34.51 \mu A)(1.2K) = 0$

$V_{CE} = 3.53V$

$Q \equiv (3.53V, 4.832 mA)$

$r_e = \frac{26mV}{I_E} = 5.38\Omega$



$Z_b = \beta r_e + (1+\beta) R_E$

$= 170 K\Omega$

$Z_i = R_B \parallel Z_b = 118.37K$

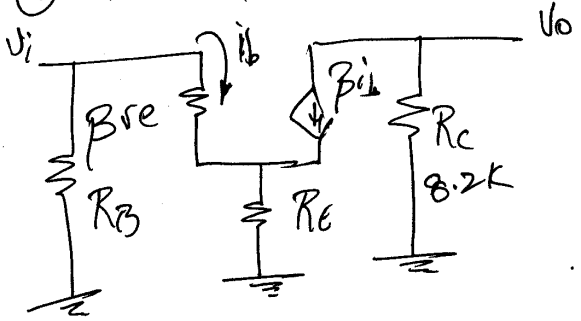
$Z_o \cong R_C = 2.2K\Omega$

$A_V = \frac{V_o}{V_i} \cong \frac{-\beta i_b R_C}{\beta r_e i_b + (1+\beta) R_E i_b} = -1.81$

$A_i = -\frac{A_V Z_i}{2.2K} = 97.5$

NOTE: The reduced A_V (voltage gain) is because of unbypassed R_E.

(8) $A_V = -10$ $r_e = 3.8\,\Omega$



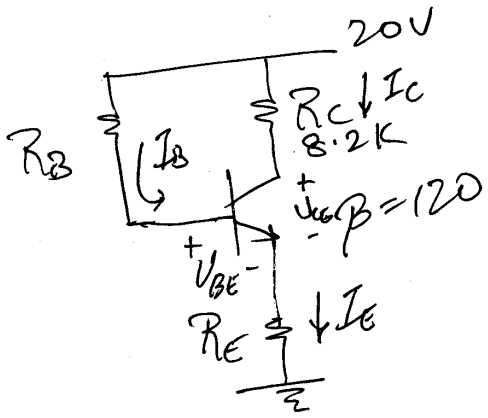
$$A_V = \frac{V_o}{V_i} = \frac{-\beta i_b R_C}{i_b \beta (r_e + R_E)}$$

$$-10 = \frac{-8.2K}{3.8\Omega + R_E}$$

$$R_E = 0.816\,K\Omega$$

$$r_e = \frac{26mV}{I_e}$$

$$I_C = 6.842mA \qquad I_B = \frac{I_C}{\beta} = 57.02\mu A$$



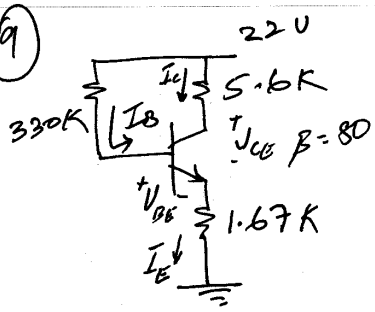
Applying KVL to B-E loop

$$20 - I_B R_B - V_{BE} - I_E R_E = 0$$

$$20 - (57.02\mu A) R_B - 0.7 - (121) I_B (0.816K) = 0$$

$$R_B = 239.74\,K\Omega$$

(9)



Applying KVL to B-E loop.

$22 - (330K) I_B - 0.7 - (1.67K) I_E = 0$

$22 - (330K) I_B - 0.7 - (1.67k)(81) I_B = 0$

$I_B = 45.78 \mu A$

$I_C = \beta I_B = 3.66 mA$

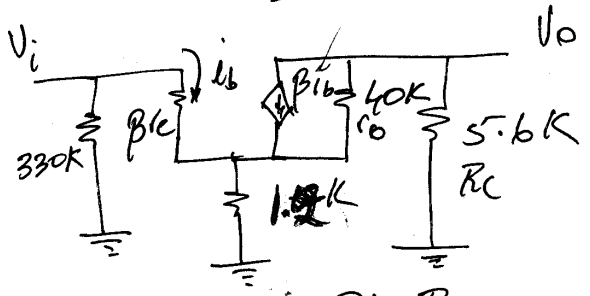
Applying KVL to C-E loop.

$22 - I_C(5.6K) - V_{CE} - (1.67K) I_E = 0$

$V_{CE} = -4.69 V$

$Q \equiv (-4.69 V, 3.66 mA)$

$r_e = \frac{26mV}{I_C} = 7.1\Omega$



$Z_i = 330K // Z_b$

$Z_b = \beta r_e + (1+\beta)(1.2K)$

$= 97.77K\Omega$

$Z_i = 75.42 K\Omega$

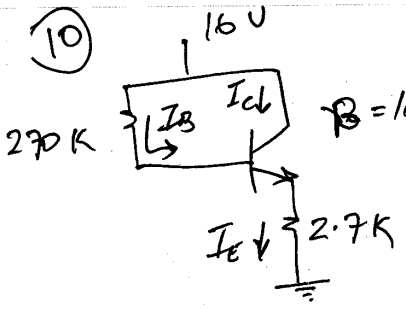
$Z_o \cong R_C = 5.6 K\Omega$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b R_C}{i_b Z_b}$

$A_v = -4.58$

$A_i = \frac{-A_v Z_i}{R_C} = 61.71$

(10)



Applying KVL to B-E loop

$16 - (270K) I_B - V_{BE} - (2.7K) I_E = 0$

$I_B = 26.86\ \mu A$

$I_C = \beta I_B = 2.95\ mA$

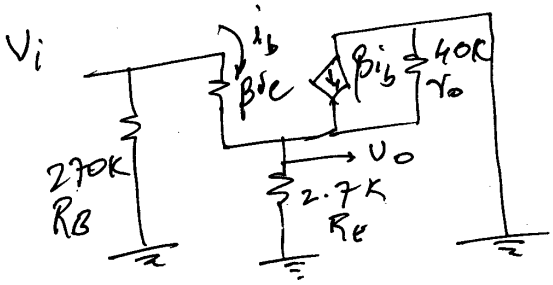
Applying KVL to C-E loop.

$16 - V_{CE} - I_E (2.7K) = 0$

$V_{CE} = 7.95\ V$

$r_e = \frac{26mV}{I_c} = 8.81\ \Omega$

$Q = (7.95\ V, 2.95\ mA)$



$Z_i = 270K \,//\, Z_b$

$Z_b = \beta r_e + (1+\beta)(R_E // r_o)$

$= 981.72\ K\Omega$

$Z_i = 137.86\ K\Omega$

$A_v = \frac{V_o}{V_i} = \frac{+i_b (1+\beta)(R_E // r_o)}{i_b Z_b}$

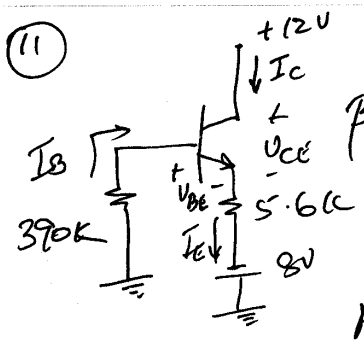
$= 0.997$

$Z_o = \frac{\beta r_e}{1+\beta} // R_E // r_o$

$= 8.7\ \Omega$

$A_i = -\frac{A_v Z_i}{R_E} = -50.88$

(11)



Applying KVL to B-E loop

$-(390K)I_B - V_{BE} - (5.6K)I_E + 8V = 0$

$I_B = 6.84\mu A$

$I_C = \beta I_B = 0.821\ mA$

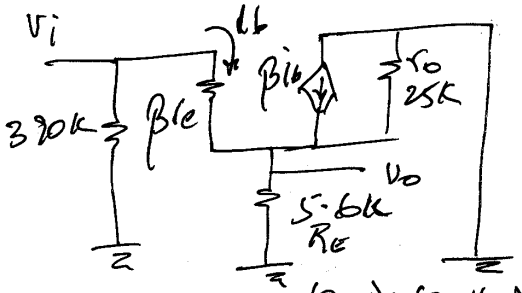
Applying KVL to C-E loop.

$12 - V_{CE} - I_E(5.6K) + 8 = 0$

$V_{CE} = 15.365\ V$

$Q \equiv (15.37\ V,\ 0.821\ mA)$

$r_e = \frac{26mV}{I_E} = 31.67\ \Omega$



$Z_i = 390K \| Z_b$

$Z_b = \beta r_e + (1+\beta)(R_E \| r_o)$

$= 557.4K\Omega$

$Z_i = 229.45K\Omega$

$A_V = \frac{V_o}{V_i} = \frac{(\beta+1)i_b(R_E \| r_o)}{i_b Z_b}$

$A_V = 0.993$

$Z_o = \frac{\beta r_e}{1+\beta} \| R_E \| r_o$

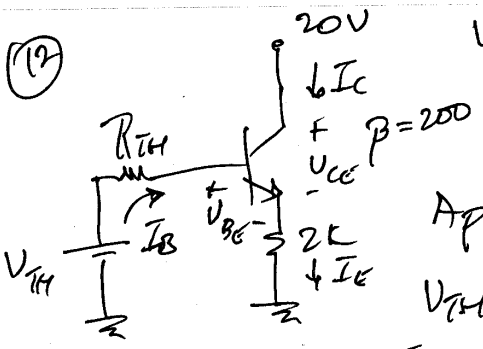
$= 31.2\ \Omega$

$A_i = -\frac{A_V Z_i}{R_E} = -40.69$

$A_V = \frac{V_o}{V_i}$

$0.993 = \frac{V_o}{1mV}$ $\quad \therefore V_o = 0.993\ mV$

(17)



$V_{TH} = \left(\frac{8.2}{8.2+56}\right)20 = 2.55V$

$R_{TH} = 56K \,//\, 8.2K = 7.15K\Omega$

Applying KVL to B-E loop

$V_{TH} - I_B R_{TH} - V_{BE} - (1+\beta) I_B (2K) = 0$

$I_B = 4.52\,\mu A \quad I_C = \beta I_B = 0.90\,mA$

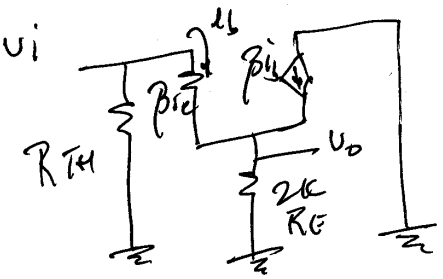
Applying KVL to C-E loop.

$20 - V_{CE} - I_E(2K) = 0$

$V_{CE} = 18.18\,V$

$Q \equiv (18.18V, 0.90mA)$

$r_e = \frac{26mV}{I_C} = 28.89\Omega$



$Z_i = R_{TH} \,//\, Z_b$

$Z_b = \beta r_e + (1+\beta) R_E$

$= 407.78K\Omega$

$Z_i = \underline{7.03K\Omega}$

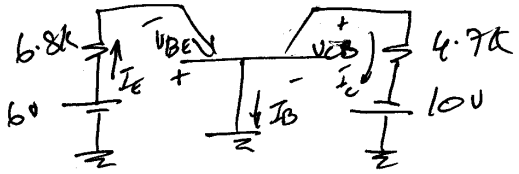
$Z_o = \frac{\beta r_e}{1+\beta} \,//\, R_E = \underline{28.34\Omega}$

$A_v = \frac{V_o}{V_i} = \frac{(1+\beta) i_b R_E}{i_b Z_b}$

$A_v = \underline{0.986}$

$A_i = -\frac{A_v Z_i}{R_E} = \underline{-3.465}$

(13)



Applying KVL to BE loop

$6v - 6.8k(I_E) + V_{BE} = 0$

$6 - (6.8k)I_E - 0.7 = 0$

$I_E = 0.779mA$

$I_C = \alpha I_E = 0.778mA$

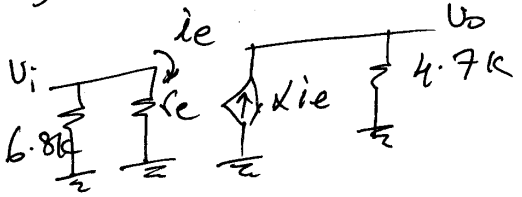
Applying KVL to C-B loop

$-10 + (4.7k)I_C - V_{CB} = 0$

$V_{CB} = -6.34V$

$Q \equiv (-6.34V, 0.778mA)$

$r_e = \frac{26mV}{I_C} = 33.42\Omega$



$Z_i = 6.8k \,||\, r_e$

$= 33.26\Omega$

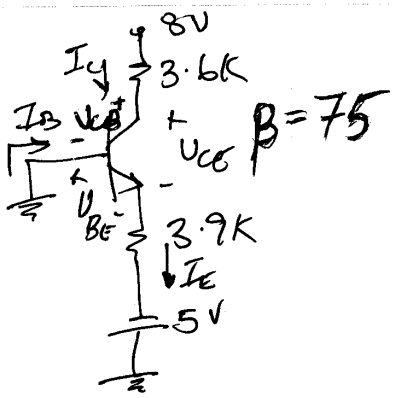
$Z_o = 4.7k\Omega$

$A_v = \frac{V_o}{V_i} = \frac{\alpha ie (4.7k)}{ie\, re}$

$= 140.35$

$A_i = -\frac{A_v Z_i}{R_c} = -0.993$

(14)



Applying KVL to B-E loop

$-V_{BE} - I_E(3.9K) + 5 = 0$

$-0.7 - (1+\beta)(3.9K) I_B + 5 = 0$

$I_B = \frac{5 - 0.7}{(76)(3.9K)} = 14.51 \mu A$

$I_C = \beta I_B = 1.09 mA$

Applying KVL to C-B loop

$8 - I_C(3.6K) - V_{CB} = 0$

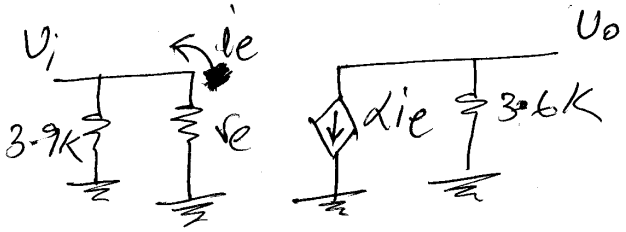
$V_{CB} = 4.076 V$

$Q \equiv (4.076 V, 1.09 mA)$

$r_e = \frac{26mV}{I_C} = 23.85 \Omega$

$\beta = \frac{\alpha}{1-\alpha}$

$\alpha = \frac{\beta}{1+\beta} = 0.9868$



$A_V = \frac{V_o}{V_i} = \frac{-\alpha i_e (3.6K)}{i_e r_e}$

$= 148.95$

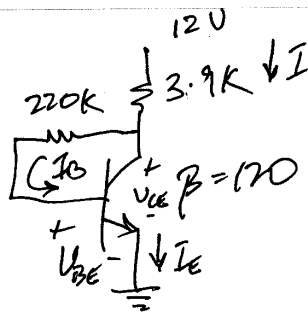
$Z_i = 3.9K // r_e$

$= 23.71 \Omega$

$Z_o = 3.6K.$

$A_I = \frac{-A_V Z_i}{R_C} = 0.981$

(15)



Applying KVL to B-E loop

$12 - 3.9K(I_C') - (220K)I_B - V_{BE} = 0$

$12 - (3.9K)(121)I_B - (220K)I_B - 0.7 = 0$

$I_B = 16.33\ \mu A$

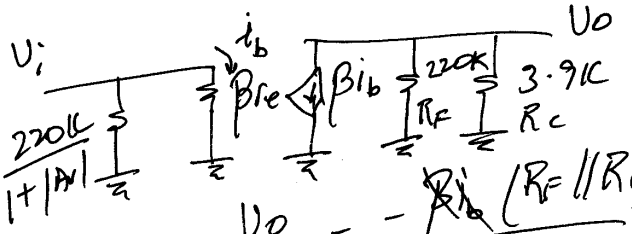
$I_C = \beta I_B = 1.96\ mA$

Applying KVL to C-E loop

$12 - (3.9K)I_C' - V_{CE} = 0$

$V_{CE} = 4.29\ V$

$Q \equiv (4.29V, 1.96mA)$ $r_e = \frac{26mV}{I_C} = 13.27\Omega$



$A_V = \frac{V_o}{V_i} = -\frac{R_i'(R_F \| R_C)}{X_b \quad \beta r_e}$

$A_V = -288.78$

$A_i = -\frac{A_V Z_i}{R_C}$

$= 38.07$

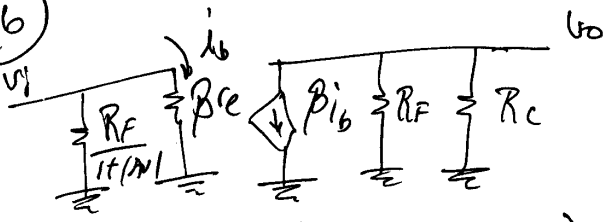
$Z_i = \frac{220K}{1+|A_V|} \| \beta r_e$

$= 514.1\ \Omega$

$Z_o = R_C \| R_F$

$= 3.83K\Omega$

(16)



$$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_F // R_C)}{i_b \beta r_e}$$

$$A_i = -\frac{A_v Z_i}{R_C}$$

$$19 = \frac{160\left(2000 // \frac{R_F}{161}\right)}{R_C}$$

$$1/(160 \times 10) = \left(\frac{1}{R_F} + \frac{1}{R_C}\right)$$

$$\frac{1}{R_C} = \frac{19}{160\left(2000 // \frac{R_F}{161}\right)} \quad (2)$$

$$\frac{1}{R_C} = \frac{1}{1600} - \frac{1}{R_F} \quad (1)$$

From (1) & (2)

$$\therefore \frac{1}{1600} - \frac{1}{R_F} = \frac{19(2000 R_F)}{160(R_F + 2000 \times 161)}$$

$$\frac{R_F - 1600}{1600 R_F} = \frac{38000 R_F}{(R_F + 322000)160}$$

$$R_F^2 + 320400 R_F - 5152 \times 10^5 = 38000 R_F^2$$

$$37999 R_F^2 - 320400 R_F + 5152 \times 10^5 = 0$$

$$R_F^2 - 8.432 R_F + 13558.25 = 0$$

$$\frac{1}{1600} - \frac{1}{R_F} = \frac{19(R_F + 2000 \times 161)}{160(2000 R_F)}$$

$$\frac{R_F - 1600}{1600 R_F} = \frac{19(R_F + 322000)}{160(2000 R_F)}$$

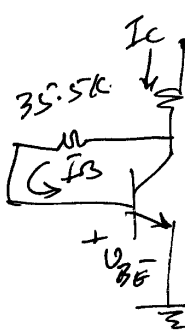
$200R_F - 320000 = 19R_F + 6118000$

$R_F = 35.57\,K\Omega$

Sub in ①

$\frac{1}{R_C} = \frac{1}{1600} - \frac{1}{35.57K}$

$\therefore R_C = 1.675\,K\Omega$



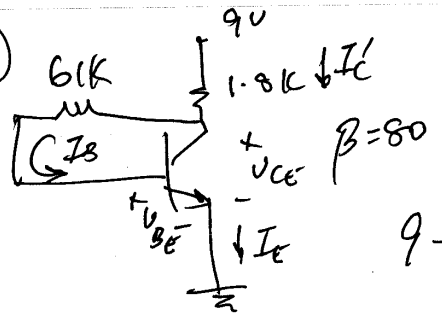
Applying KVL to B-E loop

$V_{CC} - I_C(1.675K) - I_B(35.57K) - V_{BE} = 0$

$V_{CC} - \frac{26mV}{r_e}(1.675K) - \frac{26mV}{\beta r_e}(35.57K) - 0.7 = 0$

$V_{CC} = 5.52\,V$

(17)



Applying KVL to B-E loop

$9-(1.8K)I_C'-(61K)I_B-V_{BE}=0$

$9-(1.8K)(81)I_B-(61K)I_B-0.7=0$

$I_B = 40.14\ \mu A$

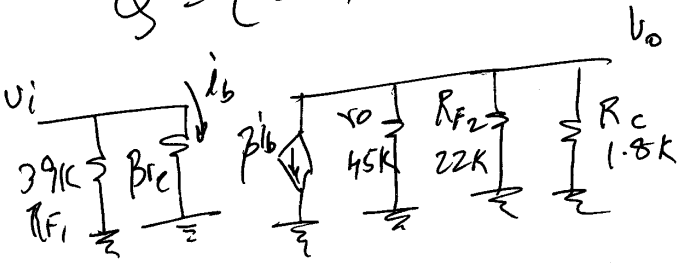
$I_C = \beta I_B = 3.21\ mA$

Applying KVL to C-E loop.

$9-(1.8K)I_C'-V_{CE}=0$

$V_{CE} = 3.148\ V$

$Q \equiv (3.148\ V, 3.21\ mA)$ $r_e = \frac{26mV}{I_C} = 8.1\Omega$



$Z_i = R_{F1} // \beta r_e$

$= 637.4\Omega$

$Z_o = 45K // 22K // 1.8K$

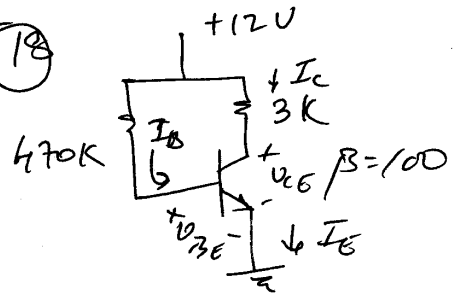
$= 1.60\ K\Omega$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (r_o // R_{F2} // R_C)}{\beta r_e}$

$= -198.1$

$A_i = \frac{-A_v Z_i}{R_C} = 70.15$

(18)



Applying KVL to B-E loop

$12-(470K)I_B - V_{BE} = 0$

$I_B = 24.04\,\mu A$

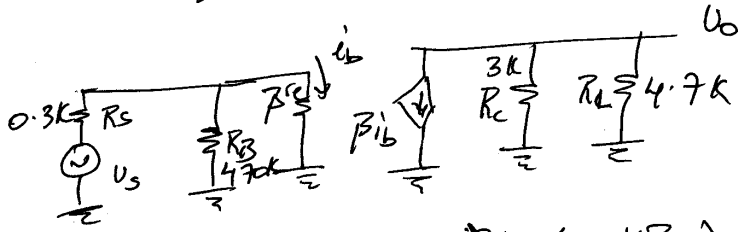
$I_C = \beta I_B = 2.404\,mA$

Applying KVL to C-E loop.

$12-(3K)I_C - V_{CE} = 0$

$V_{CE} = 4.788\,V$

$Q = (4.788\,V,\ 2.404\,mA)$ $\quad r_e = \frac{26mV}{I_C} = 10.82\,\Omega$



$Z_i = R_B \| \beta r_e$

$= 1.08\,K\Omega$

$Z_o = R_C = 3K$

$A_V = \frac{V_o}{V_i} = -\frac{\beta (R_C \| R_L)}{\beta r_e}$

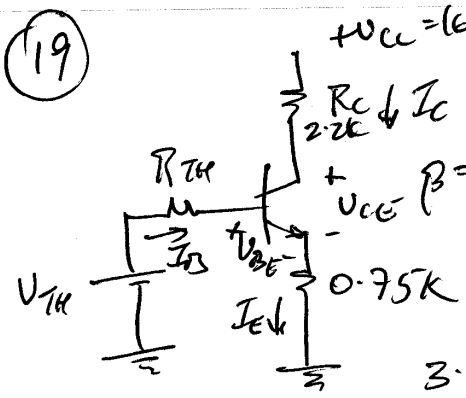
$A_V = -169.24$

$A_i = \frac{-A_V Z_i}{R_L} = 38.89$

$A_{VS} = \frac{Z_i}{Z_i + R_S} \cdot A_V = -132.45$

$A_{iS} = \frac{-A_{VS}(Z_i + R_S)}{R_L} = 38.89$

(19)



$R_{TH} = 68K // 16K = 12.95K\Omega$

$V_{TH} = \left(\frac{16}{16+68}\right)16 = 3.05V$

Applying KVL to B-E loop

$V_{TH} - I_B R_{TH} - V_{BE} - (1+\beta) I_B R_E = 0$

$3.05 - I_B(12.95K) - 0.7 - (101)(0.75K) I_B = 0$

$I_B = 26.5\,\mu A$

$I_C = \beta I_B = 2.65mA$

Applying KVL to C-E loop

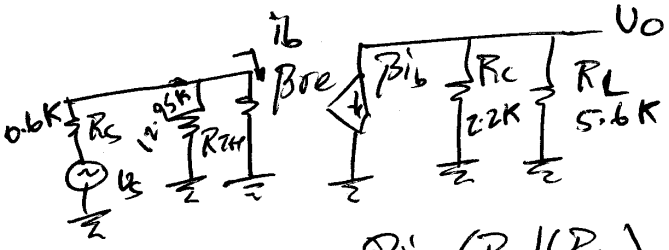
$V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$

$16 - (2.65mA)(2.2K) - V_{CE} - (101)(26.5\mu A)(0.75K) = 0$

$V_{CE} = 8.16\,V$

$Q \equiv (8.16V, 2.65mA)$

$r_e = \frac{26mV}{I_C} = 9.81\Omega$



$Z_i = 12.95K // \beta r_e$

$= 911.92\,\Omega$

$Z_o = R_C = 2.2K\Omega$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_C // R_L)}{i_b \beta r_e}$

$A_v = -161$

$A_i = -\frac{A_v Z_i}{R_L} = 26.22$

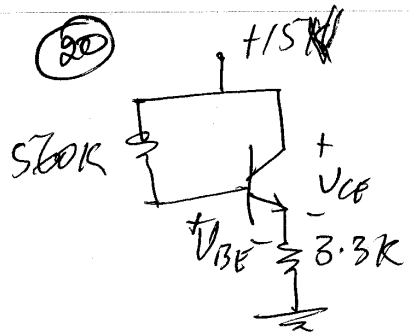
$A_{vs} = \frac{Z_i}{Z_i + R_s} A_v$

$= -97.11$

$A_{is} = -\frac{A_{vs}(Z_i + R_s)}{R_C}$

$= 26.22$

(30)



Applying KVL to B-E loop

$15 - 560K I_B - V_{BE} - 3.3K I_E = 0$

$15 - 560K I_B - 0.7 - 3.3K(1+\beta) I_B = 0$

$I_B = \frac{15 - 0.7}{560K + (66)(3.3K)}$

$I_B = 18.39\,\mu A$

$I_C = \beta I_B = 1.195\,mA$

Applying KVL to CE loop

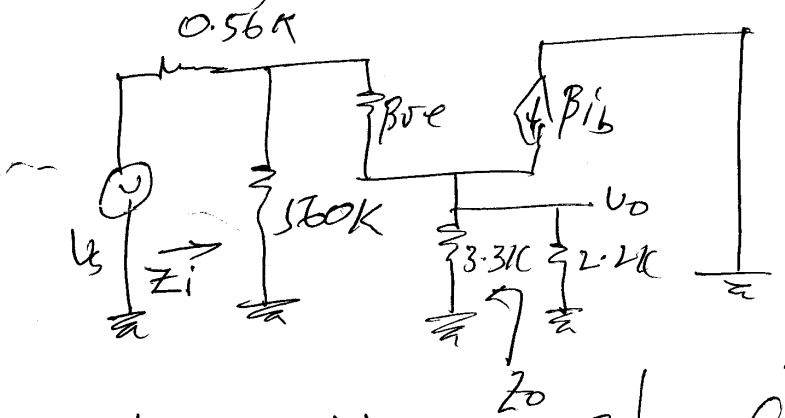
$15 - V_{CE} - I_E(3.3K) = 0$

$V_{CE} = 11V$

$Q = (11V, 1.195\,mA)$

$r_e = \frac{26mV}{I_C}$

$= 21.76\,\Omega$



$Z_i = 560K \,//\, [\beta r_e + (1+\beta)(3.3K//2.2K)]$

$Z_i = 76.45K\,\Omega$

$A_V = \frac{V_o}{V_i} = \frac{(1+\beta) i_b [3.3K//2.2K]}{i_b [\beta r_e + (1+\beta)(3.3K//2.2K)]}$

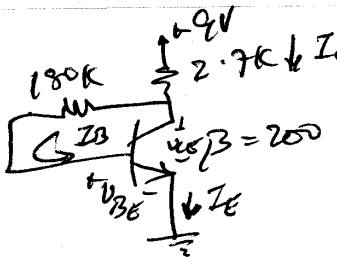
$A_V = 0.984$

$A_i = -\frac{A_V Z_i}{2.2K} = -34.19$

$Z_o = \left(\frac{0.56K // 560K + \beta r_e}{1+\beta}\right) // 3.3K$

$Z_o = 29.56\,\Omega$

(21)



Applying KVL to B-E loop

$9 - (2.7K) I_C' - (180K) I_B - V_{BE} = 0$

$I_B = 11.48\ \mu A$

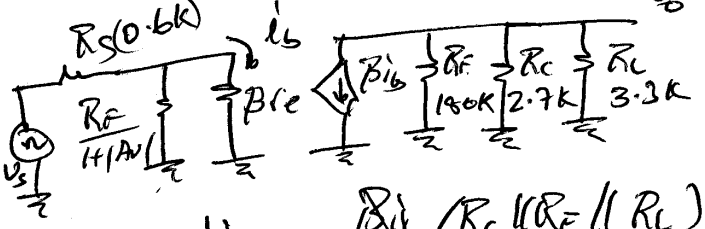
$I_C = \beta I_B = 2.3\ mA$

Applying KVL to C-E loop.

$9 - (2.7K) I_C' - V_{CE} = 0$

$V_{CE} = 2.77\ V$

$Q = (2.77V, 2.3mA)$ $r_e = \frac{26mV}{I_C} = 11.3\Omega$



$Z_o = R_C \| R_F$

$= 2.66\ K\Omega$

$A_V = \frac{V_O}{V_i} = \frac{-\beta i_b (R_C \| R_F \| R_L)}{\beta r_e}$

$A_V = -130.34$

$Z_i = \frac{R_F}{131.34} \| \beta r_e$

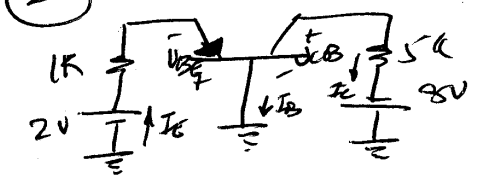
$Z_i = 853.14\Omega$

$A_i = \frac{-A_V Z_i}{R_L} = 33.7$

$A_{VS} = \frac{Z_i}{Z_i + R_S} \cdot A_V = -76.52$

$A_{iS} = \frac{-A_{VS}(Z_i + R_S)}{R_L} = 33.7$

(22)



Applying KVL to B-E loop

$2 - I_E(1K) + V_{BE} = 0$

$2 - (1K) I_E - 0.7 = 0$

$I_E = 1.3mA$

$I_C = \alpha I_E = 1.3mA$

Applying KVL to C-B loop.

$-8 + I_C(5K) - V_{CB} = 0$

$V_{CB} = -1.5V$

$Q \equiv (-1.5V, 1.3mA)$ $r_e = \frac{26mV}{I_C} = 20\Omega$

$Z_i = 1K // r_e = 19.6\Omega$

$Z_o = R_C = 5K\Omega$

$A_V = \frac{V_o}{V_i} = \frac{\alpha ie (5K // 8.2K)}{ie\, r_e}$

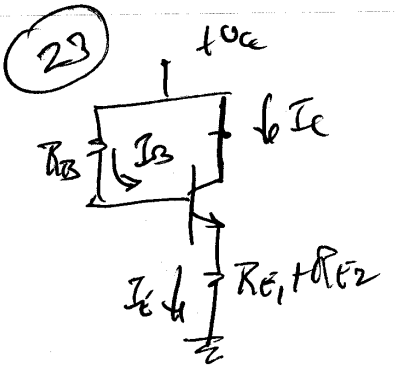
$A_V = 155.3$

$A_i = -\frac{A_V Z_i}{8.2K} = -0.37$

$A_{VS} = \frac{Z_i}{Z_i + R_S} A_V = 13.86$

$A_{iS} = -\frac{A_{VS}(Z_i + R_S)}{8.2K} = -0.37$

(23)



Applying KVL to BE loop

$V_{CC} - I_B R_B - V_{BE} - (1+\beta) I_B (R_{E1}+R_{E2}) = 0$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B + (1+\beta)(R_{E1}+R_{E2})}$$

$I_{CQ} = \beta I_B$

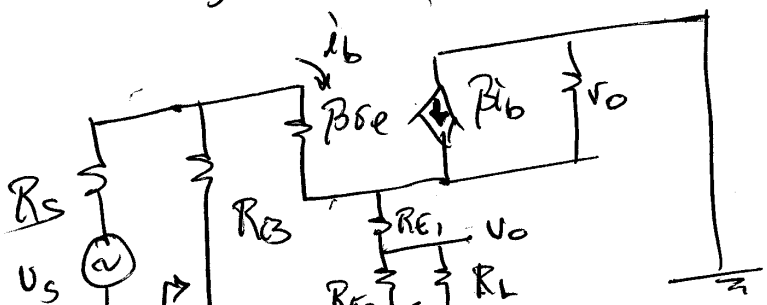
Applying KVL to C-E loop

$V_{CC} - V_{CEQ} - I_E (R_{E1} + R_{E2}) = 0$

$V_{CEQ} = V_{CC} - (1+\beta) I_B (R_{E1}+R_{E2})$

$r_e = \frac{26mV}{I_{CQ}}$

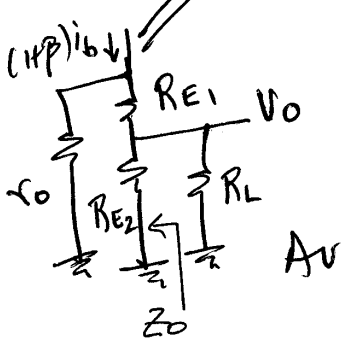
$Q \equiv (V_{CEQ}, I_{CQ})$



$Z_i = R_B \| Z_b$

$Z_b = \beta r_e + (1+\beta)\left[(R_{E2} \| R_L) + R_{E1} \| r_o\right]$

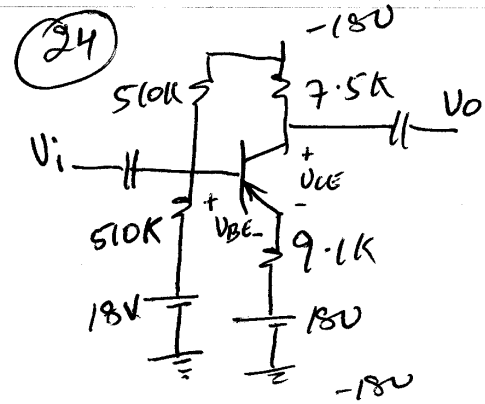
$Z_o = \left\{\left[\frac{(R_S \| R_B) + \beta r_e}{1+\beta}\right] \| r_o + R_{E1}\right\} \| R_{E2}$

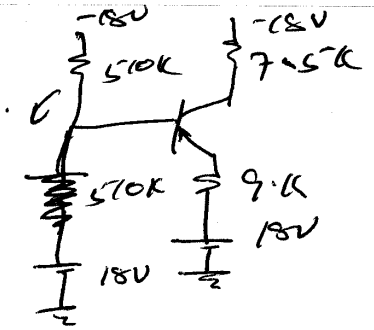


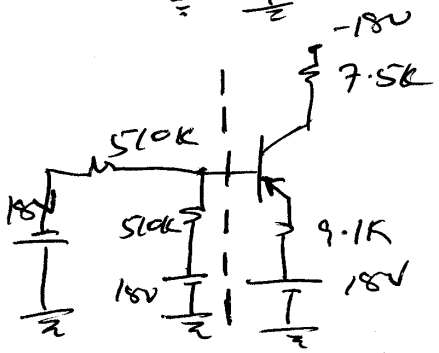
$A_V = \frac{V_o}{V_i} \simeq \frac{(1+\beta) i_b \left[(R_L \| (R_{E2}) \right]}{i_b Z_b}$

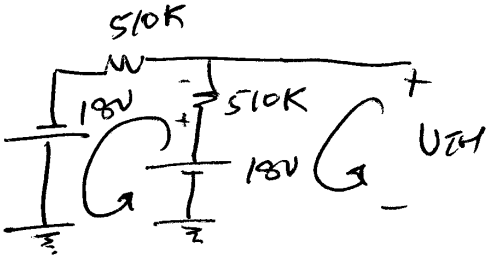
$A_i = \frac{-A_V Z_i}{R_L}$ $\quad A_{VS} = \frac{Z_i}{Z_i + R_S} A_V$ $\quad A_{iS} = \frac{-A_{VS}(Z_i + R_S)}{R_L}$

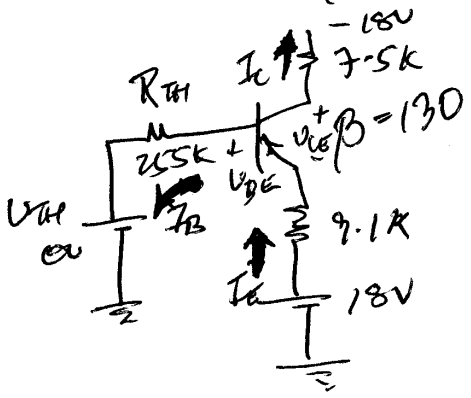
(24)











$$18-(510K)I-(510K)I+18=0$$
$$I=0.035A$$
$$V_{TH}+(510K)I-18=0$$
$$V_{TH}=0V$$
$$R_{TH}=255K$$

Applying KVL to B-E loop

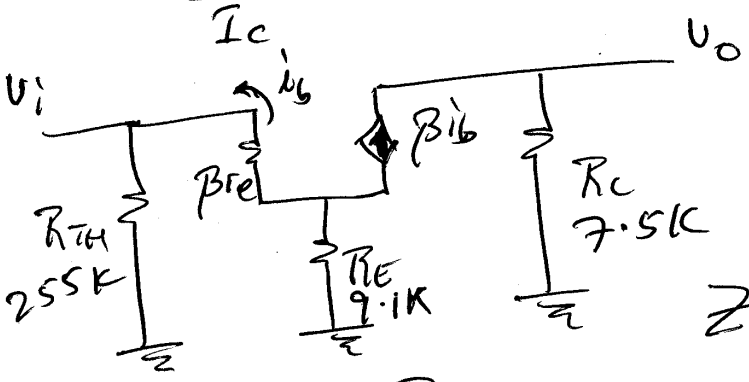
$$18-I_E(9.1K)+V_{BE}-I_B(255K)=0$$
$$18-(131)I_B(9.1K)-0.7-(255K)I_B=0$$
$$I_B=11.95\mu A$$
$$I_C=\beta I_B=1.55mA$$

Applying KVL to C-E loop

$$-18+I_C(7.5K)-V_{CE}+I_E(9.1K)-18=0$$
$$V_{CE}=-10.13V$$
$$Q\equiv(-10.13V,\ 1.55mA)$$

Abhishek Navlakhi

$r_e = \frac{26mV}{I_C} = 16.77\ \Omega$ $\quad \beta_{ac} = 150$



$Z_o = 7.5\ k\Omega$

$Z_i = R_{TH} \| Z_b$

$Z_b = \beta r_e + (1+\beta) R_E$

$= 1.38\ M\Omega$

$A_V = \frac{V_o}{V_i} = \frac{\beta i_b R_C}{-i_b Z_b}$

$Z_i = 215.15\ K\Omega$

$A_V = -0.815$

$A_i = -\frac{A_V Z_i}{R_C} = 23.39$