Solutions to Selected Problems (Problem Set 4)

<u>Chapter 7:</u> 7.98, 7.99, 7.100.

7.98

$R_{id1} = (\beta+1)(R_{E1} + r_{e1})\,2$

$= 101 \times (100+100)\,2 = \underline{40.4\,k\Omega}$

increase!

$R_{id2} = (\beta+1)(2)(R_{E2} + r_{e2})$

$= 101 \times (25+25)\,2 = 10.1\,k\Omega$

$\therefore A_1 = \dfrac{2\,(20K) \| R_{id2}}{2(R_{E1}+r_{e1})} = \underline{20.2\ V/V}$ decrease

$A_2 = -\dfrac{R_3 \| R_{i3}}{2\,(R_{E2}+r_{e2})} = -29.6\ V/V$

observe that A_3 and A_4 are unchanged.

$A = A_1 A_2 A_3 A_4$

$= (20.2)(29.6)(6.42)(0.998)$

$= \underline{3823}\ V/V$ decrease.

7.99

$R_o \simeq \dfrac{R_5}{\beta+1} + r_{e8} = R_o'$

Thus R_5 affects R_o

We want $R_o' \| 3K = 76$

$\Rightarrow R_o' = 78\,\Omega$

$\Rightarrow R_5 = (78 - r_{e8})(\beta+1)$

$= \underline{7.37\,k\Omega}$

$A_3 = -\dfrac{R_5 \| R_{i4}}{r_{e4} + R_4}$; $R_{i4} \simeq 304\,k\Omega$

and $A_3 = -3.09\ V/V$

and $A = 8513 \cdot \dfrac{3.09}{6.42} = \underline{4104}\ V/V$

The gain has been reduced by a factor of 2.07 and can be restored by reducing R_4 by this same factor to increase A_3. Thus $R_4 = \underline{1.11\,k\Omega}$

(Note that this is a first order approximation).

7.100

(a) $A_3 = \frac{-R_{i4}}{2.325K\Omega} = -\frac{303.5}{2.325}$

$= -130.5$ V/V

i.e A_3 is increased by $\frac{130.5}{6.42}$

$= 20.33$

$\Rightarrow A = 8513 \times 20.33$

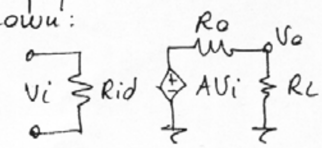
$= \underline{\underline{173.1 \times 10^3}}$ V/V

(b) Let the output resistance of the current source be $R \rightarrow \infty$

$R_o = 3K \,||\left(\frac{R}{\beta+1} + r_e\right)$

$= 3K$

The amplifier can be modelled as shown:



Thus,

$A_{LOAD} = \frac{A \cdot R_L}{R_L + R_o}$

$= 173.1 \times 10^3 \; \frac{100}{100+3000}$

$= \underline{\underline{5583}}$ V/V

For the original amplifier:

$A_{LOAD} = 8513 \times \frac{100}{100+152} = \underline{\underline{3378}}$ V/V