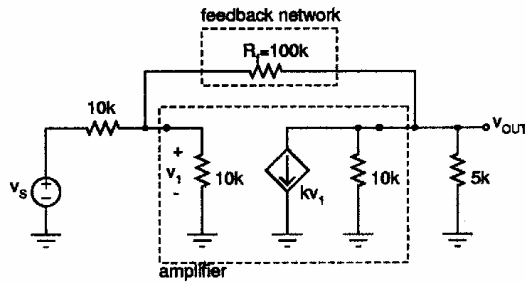


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 University of Puerto Rico - Mayaguez, P.R.  
 Electronics II - INEL 4202 - SPRING 2002 - Exam 2B - Prof. Manuel Toledo  
 THERE ARE THREE PROBLEMS - WORK CLEARLY OR LOOSE POINTS

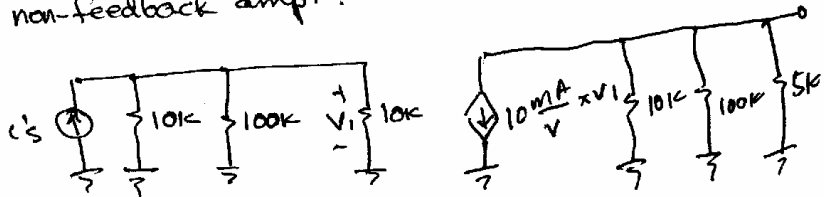
1. Use feedback theory to find  $A_v = v_{out}/v_s$  for the amplifier shown below. (50 points)

shunt-shunt  
 $i_1$   $100k$   $i_2$   
 $v_1$   $v_2$   
 $R_{11} = 100k$   
 $R_{22} = 100k$   
 $\beta = -\frac{1}{100k}$



$k = 10 \text{ mA/V}$

non-feedback amp.:



$$v_o = \left(-10 \frac{\text{mA}}{\text{V}} v_1\right) (5k \parallel 100k \parallel 100k) = -32.3 v_1$$

$$v_1 = i_s (10k \parallel 10k \parallel 100k) = 4762 i_s$$

$$R_M = \frac{v_{out}}{i_s} = -153,810 \Omega$$

$$R_{MF} = \frac{-153,810}{1 + \frac{153,810}{100k}}$$

$$A_v = \frac{v_{out}}{v_s} = \frac{v_{out}}{i_s R_s} = \frac{R_{MF}}{10k}$$

$$= \frac{-153,810}{1 + 1.5381} = -60601 \Omega$$

$$A_v = -36 \text{ V/V}$$

2. An amplifier with poles at 10Hz and 100,000Hz will be used in a feedback configuration. The value of  $\beta$  that would yield a phase margin  $\phi_m = 60^\circ$  is 0.01. Find the non-feedback amplifier's d.c. gain. (20 points) Do not approximate  $A_f$  as  $1/\beta$ . ~~0.01~~

Since  $\beta = 0.01$  gives  $\phi_M = 60^\circ$

$$A = 20 \log 1/\beta = 40 \text{ dB} \quad \text{when } \phi = 120^\circ$$

because the two poles are far apart

$$\tan^{-1} \frac{f}{100 \text{ kHz}} = 120^\circ - 90^\circ = 30^\circ$$

$$f = (\tan 30^\circ)(100 \text{ kHz}) = 57.7 \frac{\text{kHz}}{\text{kHz}}$$

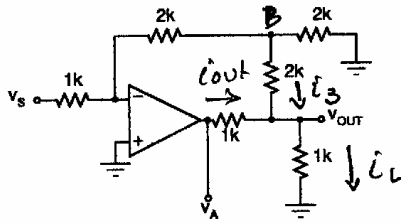
at this freq.  $|A| = \frac{A_0}{\sqrt{\left(\frac{57,700}{10}\right)^2 + 1} \sqrt{.577^2 + 1}}$

$$= A_0 / (5770 \times 1.16) = \frac{A_0}{6662} = 100$$

$$\therefore A_0 = 666200 = 116.5 \text{ dB}$$

and  $A_f = \frac{666200}{1 + .01(666200)} = 99.985$

3. Find  $v_A$  when  $v_S = 100\text{mV}$  for the amplifier shown below. Assume that the opamp is ideal. (30 points)



$$v_{out} = -6 v_S \quad (\text{see exam A})$$

$$i_L = \frac{v_{out}}{1k} \quad ; \quad i_3 = \frac{2v_S}{1k}$$

$$\therefore i_{out} = i_L - i_3 = \frac{-6v_S}{1k} - \frac{2v_S}{1k} = -\frac{8v_S}{1k}$$

$$\text{and } v_A = v_{out} + i_{out}(1k)$$

$$= -6v_S + -8v_S$$

$$= -14v_S$$

$$\therefore \boxed{v_A = -1.4V}$$