Name: ______________________________ (please print)

Signature: ___________________________

ECE 3455
Quiz #1
September 11, 2007

Quiz duration: 25 minutes

1. You may have one 8 ½ x 11 in. "crib" sheet, written on both sides, during the quiz. You may have any calculator you choose, but no computers. No other notes or materials will be allowed.
2. Show all work necessary to complete the problem on these pages. A solution without the work shown will receive no credit.
3. Show units in intermediate and final results, and in figures.
4. If your work is sloppy or difficult to follow, points will be subtracted.

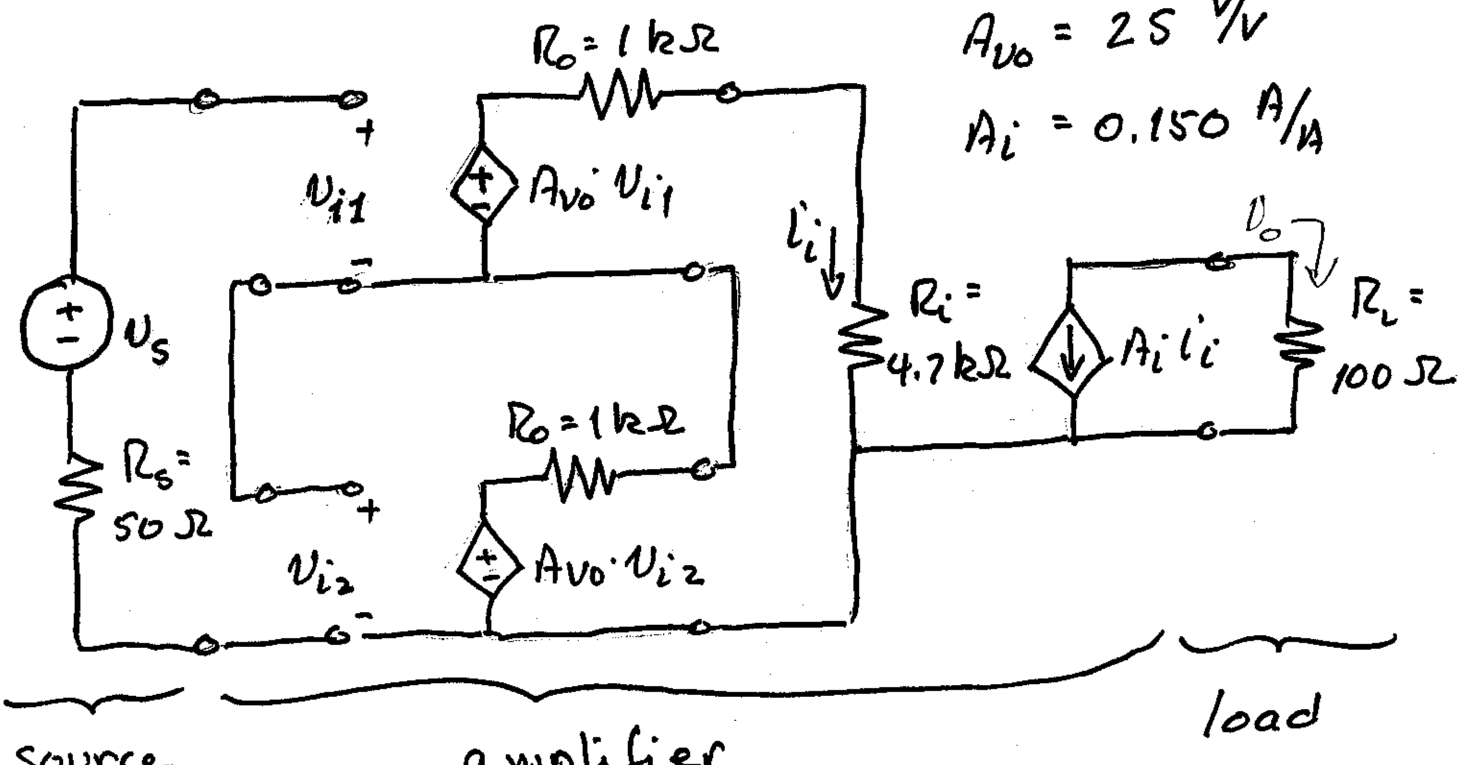
________________/20

The figure below shows a source, amplifier, and load. For this circuit, do the following.

+14 i) Find a single equivalent amplifier that could be used to replace the amplifier section. Be sure to specify input and output resistance, as well as any appropriate gain parameter.

+13 ii) Based on the equivalent amplifier, and for an input voltage $v_s = 1$ V, what is the power delivered to the load?

+3 iii) What is the power gain of your equivalent amplifier?



KVL around the loop containing the dependent voltage sources gives

$$i_i (R_o + R_i + R_o) - A_{vo} v_{i2} - A_{vo} v_{i1} = 0$$

$$i_i = \frac{A_{vo}(v_{i1} + v_{i2})}{2R_o + R_i}$$

Room for Extra Work

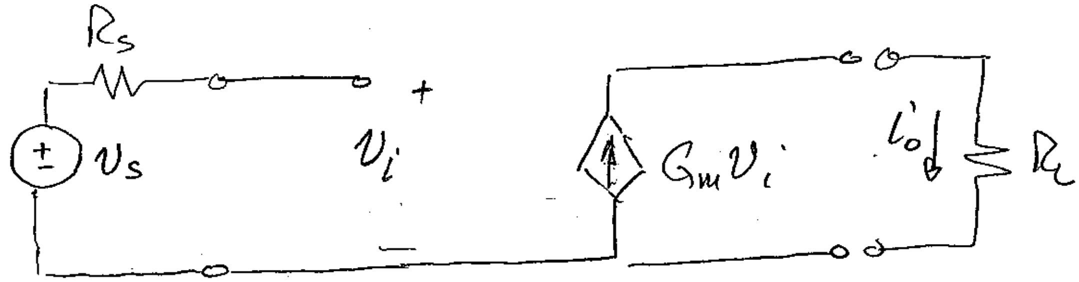
Interesting point: We cannot say what v_{i1} and v_{i2} are; we only know their sum is v_s. But as the last equation shows, we don't need the individual values. So...

$$i_i = \frac{A_{vo} \cdot v_s}{2R_o + R_i}$$

Then i_o, which has been defined in the figure, is

$$i_o = -A_i \cdot i_i = -\frac{A_{vo} \cdot v_s A_i}{2R_o + R_i}$$

Clearly our equivalent should be a transconductance amplifier:



$$G_m = \frac{i_o}{v_i} = \frac{i_o}{v_s} = \frac{-A_{vo} A_i}{2R_o + R_i} = \frac{-25 \cdot (0.15)}{2k + 4.7k} = -5.6 \times 10^{-4} \ A/V$$

$$R_i = R_o = \infty$$

Room for Extra Work

ii) For $v_s = 1\,V$, $\quad i_o' = -G_m v_i = -5.6 \times 10^{-4}\,A$

$$\therefore \quad P_{R_L} = i_o'^2 \cdot R_L = 31.3\ \mu W$$

iii) Power delivered by the source is clearly 0,

so $$A_p = \frac{P_{RL}}{P_s} = \infty \;!$$