Electronics: ECE 3355
Homework 2

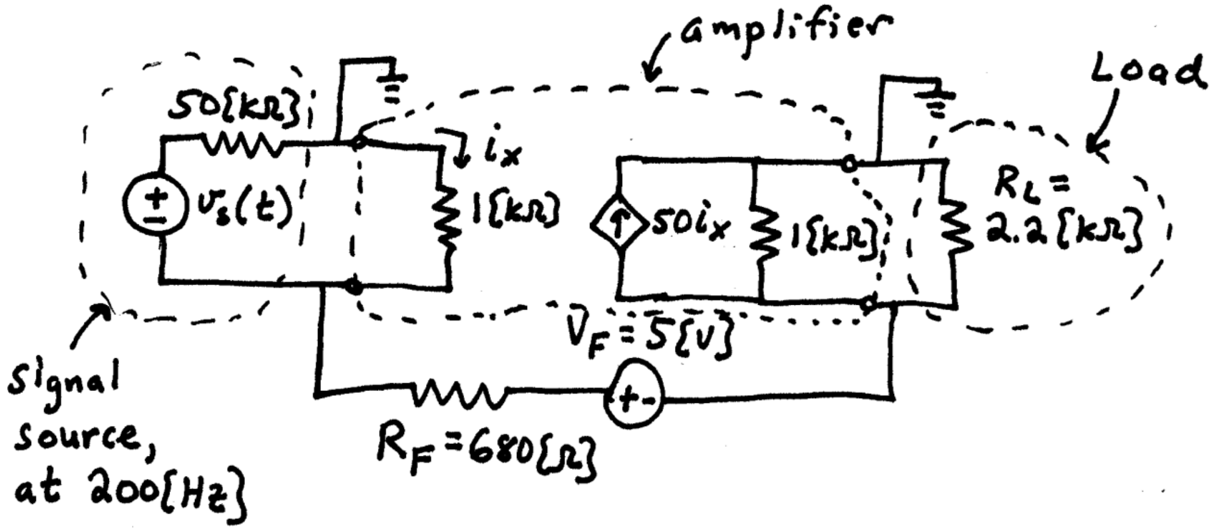
Sedra and Smith, 7th Ed., Chapter 1: Problems 1.43, 1.44, 1.47, 1.48, D1.50, 1.56, 1.58
From handout below: Problems E2.1, E2.2, E2.3, E2.4

E2.1. A compact disc (CD) player laser pick-up provides a signal output of $10[\text{mV}]_{pp}$ and has an output resistance of $10[\text{k}\Omega]$. The pick-up is to be connected to a speaker whose equivalent resistance is $8[\Omega]$.

a) Calculate the voltage that would be delivered to the speaker if the speaker were connected directly to the pick-up.

b) Assume that the speaker needs $20[\text{V}]_{pp}$ to deliver clear acoustical output. Design an equivalent circuit for an amplifier that would deliver this output when connected between the pick-up and the speaker.

E2.2. An amplifier has been connected as shown below, with a signal source and a load connected. In addition, a dc voltage source (V_F) and a resistor (R_F) have been attached to provide feedback. Find the input resistance seen by the signal source with the feedback in place.



E2.3. A device, shown in Figure 3.1, can be modeled by a current source in parallel with a resistance. The relationship between the current through the device, i_X, and the voltage across the device, v_X, is given in the plot in Figure 3.2.

a) Find a model for the device that would be valid when current is in the range $1[\text{mA}] < i_X < 5[\text{mA}]$. This model must have numerical values for the current and resistance, and the polarities with respect to v_X and i_X should be shown in a diagram.

b) A voltage source is applied across the device so that $v_X = 10[\text{V}]$. Find the power delivered by the device in this situation.

Remember to use lower-case variables for voltage and current.

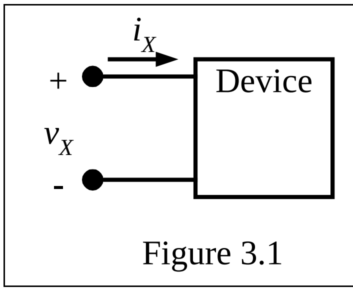


Figure 3.1

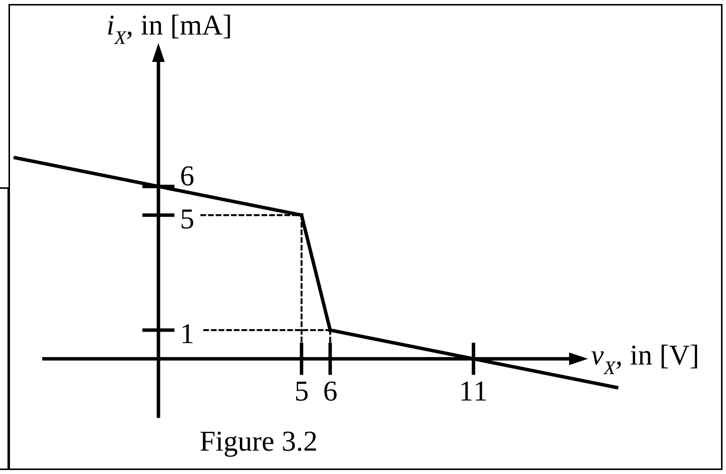


Figure 3.2

E2.4. A circuit is shown in Figure 1. The equivalent circuits for amplifiers A, B, and C, in this circuit are shown in Figures 2, 3, and 4, respectively. Find and draw a single amplifier equivalent circuit that could be used to replace amplifiers A, B, and C.

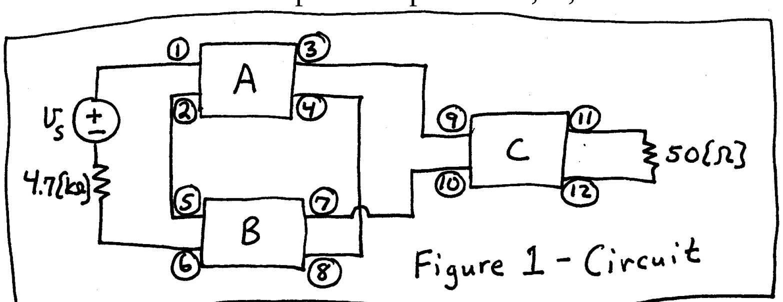


Figure 1 - Circuit

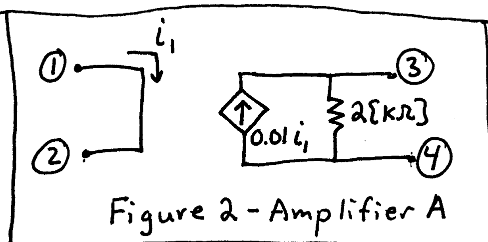


Figure 2 - Amplifier A

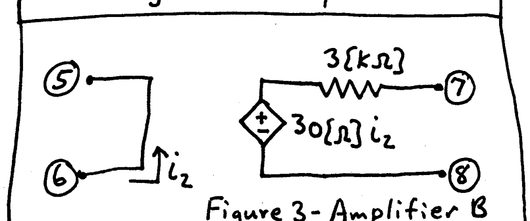


Figure 3 - Amplifier B

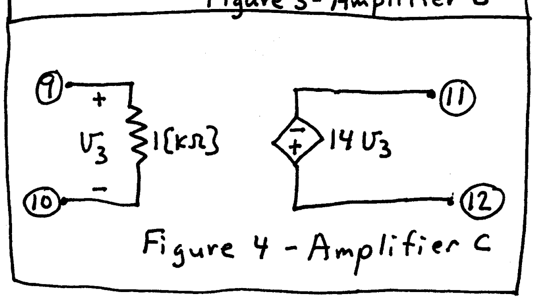


Figure 4 - Amplifier C

Selected Numerical Solutions:

1.43 a) 82.64 = 38.34[dB]; b) 25 = 27.96[dB]; c) 826.4×10^{-3} = -1.656[dB]

1.44 38.42[dB]; 71.43[dB]; 84.9[mV_{rms}]; 100[mW]

1.47 52.8[dB] vs 57.4[dB]

1.48 SABL

1.58 $R_i/(1+R_i g_m)$

E2.1. There are many possible solutions. One possible solution would be a transconductance amplifier with G_{msc} = 900[S]; R_i = 10[kΩ]; R_o = 10[Ω]

E2.2. –43[Ω]

E2.3. a) The solution is a Norton equivalent. The sign of the current source depends on the reference polarity chosen, but the magnitude is 25[mA]. The resistance is –250[Ω].
b) $p_{DEL,DEV}$ = -2[mW].

E2.4. Transresistance amplifier, with R_{IN} = 0, R_{OUT} = 0, and R_{MOC} = -117[Ω].