Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

6.002 - Electronic Circuits
Spring 2007

Homework #5
Handout F07-028

Issued 3/8/2007 - Due 3/16/2007

Helpful Readings for this Homework: Agarwal & Lang Chapter 7.1 - 7.6
Exercise 5.1: Do Exercise 7.1 in Agarwal & Lang, page 390.

Exercise 5.2: Do Exercise 7.3 in Agarwal & Lang, page 391.

Problem 5.1: Determine the Thevenin equivalent of the following circuit. Note that it contains a dependent voltage source, and that the parameter α has units of Ohms.
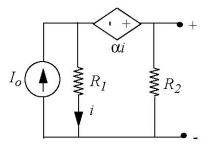

Figure for Problem 5.1

Problem 5.2: This problem studies the two amplifiers shown on the other side of the page. Amplifier A is a single-stage amplifier implemented with a voltage-dependent current source and a pull-up resistor. Assume that the current source parameters G and V_T satisfy $G > 0$ and $V_s > V_T > 0$. Also assume that $RG < \dfrac{V_S}{V_S - V_T}$. Amplifier B is a two-stage amplifier in which each stage is identical to Amplifier A.

(A) Determine v_{OUT} as a function of v_{IN} for Amplifier A.

(B) Sketch and clearly label a graph of the input-output relation found in Part (A).

(C) Determine v_{OUT} as a function of v_{IN} for Amplifier B.

(D) Sketch and clearly label a graph of the input-output relation found in Part (C).

(E) Consider Amplifier A again. Show that the dependent current source sinks power for $v_{OUT} > 0$ and sources power for $v_{OUT} < 0$.

(F) Unlike the expression for the current in Amplifier A given with the figure on the next page, real-world devices do not supply additional current when $v_{OUT} < 0$. Instead the device saturates and the dependent current source supplies a constant current, given by V_S / R. Redo parts (A) and (B) in light of this fact. What change (if any) occurs in the input-output relation of Amplifier B?
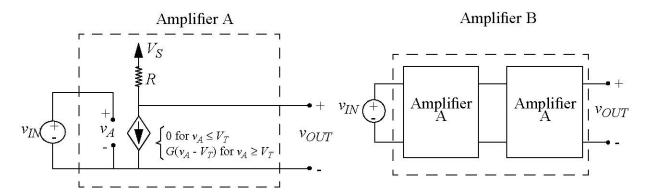
Amplifier A

$$\begin{cases} 0 \text{ for } v_A \le V_T \\ G(v_A - V_T) \text{ for } v_A \ge V_T \end{cases}$$

Amplifier B

Figure for P.5.2.