GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course ECE 2040

Circuit Analysis

Assigned: February 4, 2000
Due: February 11, 2000

Problem Set #4

Reading: Read the following sections from the class notes:
Chapter 3, Sections 3.1, 3.2.1, 3.2.2
Reading: Read the following sections from Irwin and Wu:
Chapter 2, Sections 2.5 (resistors in series and parallel)

Problem 4.1: Find the $v - i$ relation of the two-terminal network shown in Figure 1.

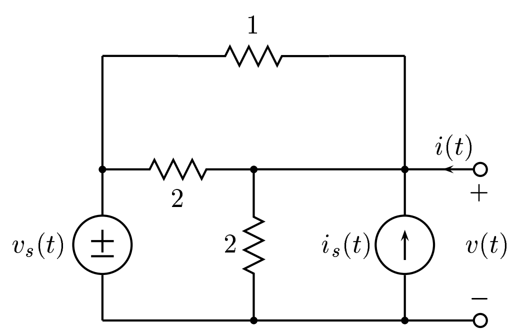

Figure 1: Two-port network for Problem 4.1.

Problem 4.2: You have a box containing an unlimited number of 10KΩ resistors. Show how to connect some of these together to construct equivalent resistances with the following values:

(a) 20KΩ

(b) 25KΩ

(c) 6667Ω

Problem 4.3: Consider a one-port network consisting of two capacitors with capacitances C_1 and C_2 connected in series, as shown in Figure 2.

(a) Show that this network is equivalent to a single capacitor.

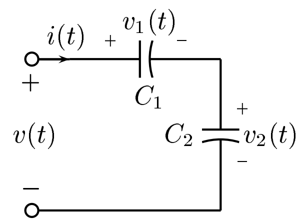

Figure 2: Two capacitors connected in series.

(b) Derive a formula for the equivalent capacitance C_{eq} in terms of C_1 and C_2.

(c) Derive expressions for the voltage $v_1(t)$ measured across capacitor C_1 and the voltage $v_2(t)$ measured across C_2 in terms of the voltage $v(t)$ appearing across the series connection.

Problem 4.4: Two two-terminal networks, N_1 and N_2, have the $v - i$ relations

$$N_1: \quad v(t) = R_1 i(t) + v_{T1}$$
$$N_2: \quad v(t) = R_2 i(t) + v_{T2}.$$

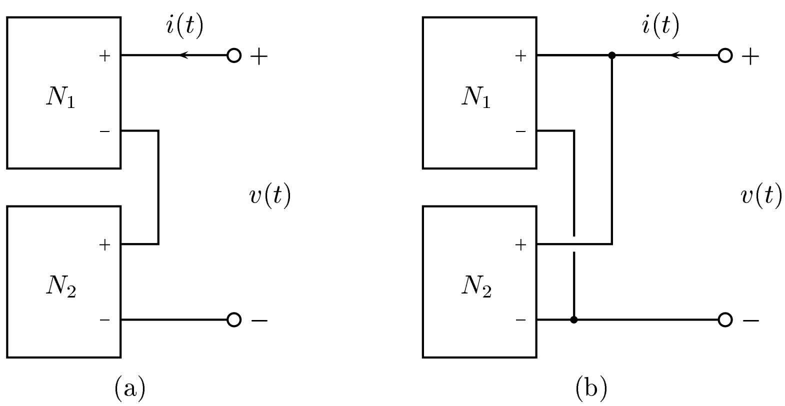

Figure 3: (a) A series connection of two two-terminal networks. (b) A parallel connection of two two-terminal networks.

(a) The two networks are connected in series if the same current passes through both, as illustrated in Figure 3a. Determine the $v - i$ characteristic for the series connection of N_1 and N_2.

(b) The two networks are connected in parallel if the same voltage appears across the terminals of both networks, as illustrated in Figure 3b. Determine the $v - i$ characteristic for the parallel connection of N_1 and N_2.

Problem 4.5: Express $v(t)$ as a function of $i(t)$ and $i_s(t)$ for the circuit in Figure 4.

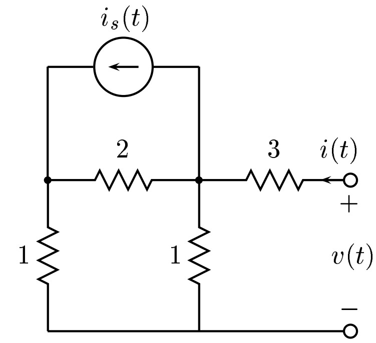

Figure 4: Circuit for Problem 4.5.