# Homework 7

Due: Friday, September 9

## 1

For the circuit of Figure 1, write a single node equation in $G_1$, $G_2$, $G_3$, $V_{s1}$, and $V_{s2}$. For a fixed $R > 0$, $R_1 = R$, $R_2 = 1.5\ R$, $R_3 = 3\ R$. Compute $V_1$ in terms of $R$ and $V_{s1}$ if $V_{s2} = 3\ V_{s1}$

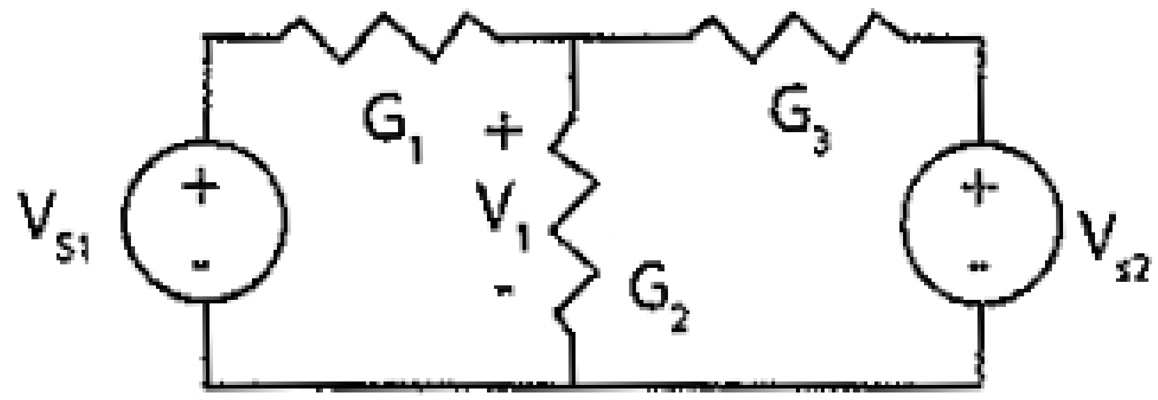


Figure 1: Model circuits for Problem 1.

## 2

The purpose of this problem is to write the nodal equations directly by inspection of the circuit diagram of Figure 2. Recall that when the network has only independent current sources and resistors, the nodal equation matrix is symmetric and the entries can be written down by inspection as per discussion following the textbook Example 3.2. Construct the nodal equations in matrix form for the circuit of Figure 2 by inspection.

## 3

The circuit of Figure 3 is an experimental measurement circuit for determining temperature inside a cavern underneath the Polar ice cap. The cavern is heated by

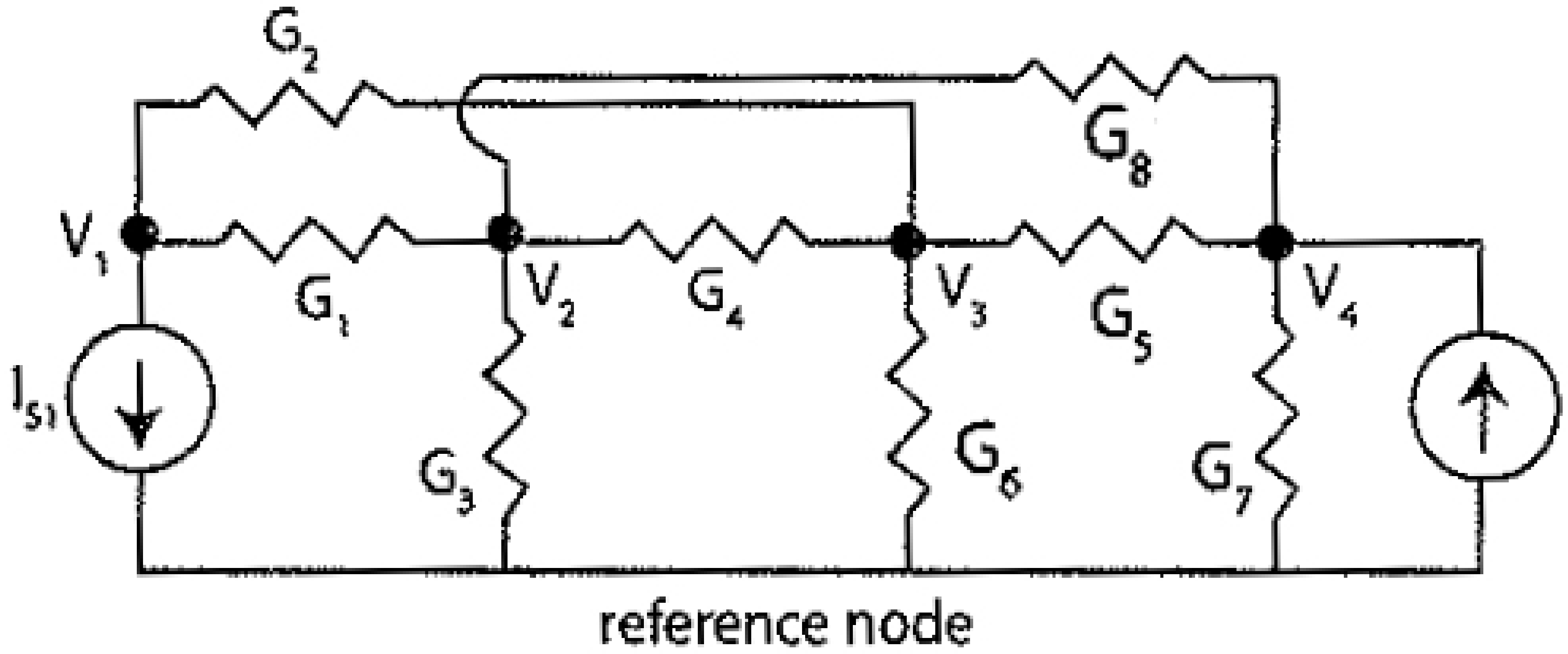


Figure 2: Model circuit for Problem 2

a fissure leading to some volcanic activity deep in the earth. The resistor $R_{sensor}$ changes its value linearly from 30 $k\Omega$ to 130 $k\Omega$ as a function of temperature over the range $-25°$ C to $+25°$ C. The nominal temperature of the cavern is 0° C. In this type of circuit, the voltage $V_C - V_B$ is a measure of how the temperature changes. Suppose that $V_s = 50$ V, and in $k\Omega$, $R_1 = 40$, $R_2 = 88$, $R_3 = 40$ and $R_4 = 25$. Note that the 88 $k\Omega$ resistor is a result of manufacturing tolerances that often permit deviations from a nominal of, say, 90 $k\Omega$, by as much as 20%. As usual, it is cost versus precision.

(a) Write a set of nodal equations in the variables $V_B$ and $V_C$.

(b) Assuming $R_{sensor} = 80$ $k\Omega$ at 0° C, put the nodal equations in matrix form and solve for the node voltages, $V_B$ and $V_C$.

(c) Determine the power delivered by the source.

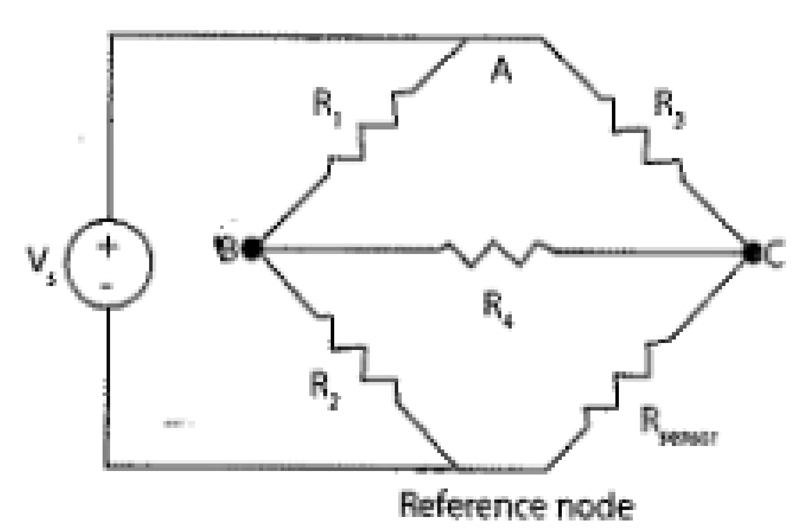


Figure 3: Model circuit for Problem 3.