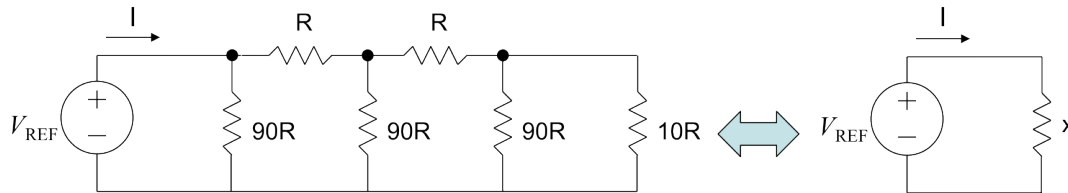


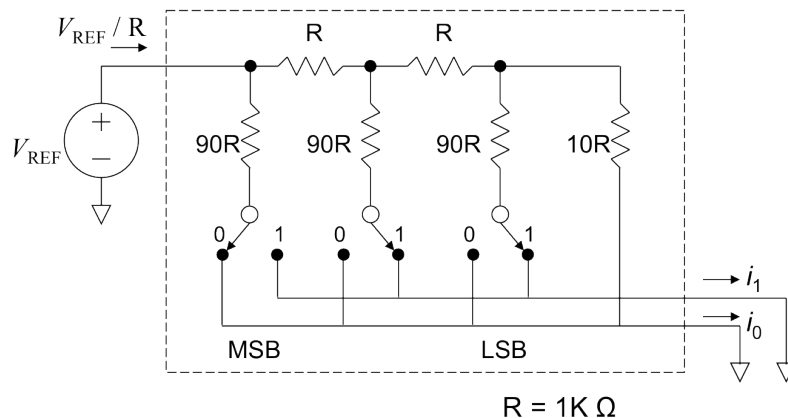
ECE 301  
Fun with “R-2R” Ladder Problems  
Dr. Wilde

Problems 1-3 analyze an “R-90R” ladder instead of an “R-2R” ladder.

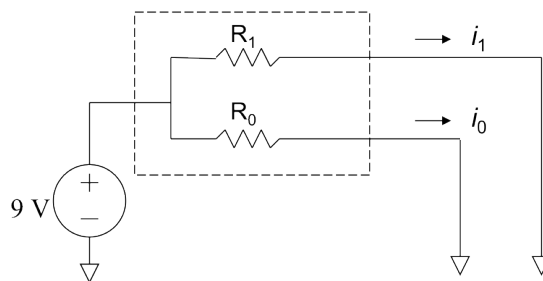
1. The “R-90R” ladder below is equivalent to the voltage source and resistor circuit to the right. What is the resistance  $x$  as a function of  $R$ ? What is the current  $I$  as a function of  $R$  and  $V_{\text{REF}}$ ?



2. You connect up your “R-90R” ladder to a  $V_{\text{REF}} = 9\text{V}$  voltage source and input the digital code ‘011’ (see switches). If  $R = 1\text{K}$  ohms, what are the currents  $i_0$  and  $i_1$  that exit the ladder? (Hint: Use current division.) To check yourself, do they sum up to the current  $I$  entering the ladder that you computed in problem 1?

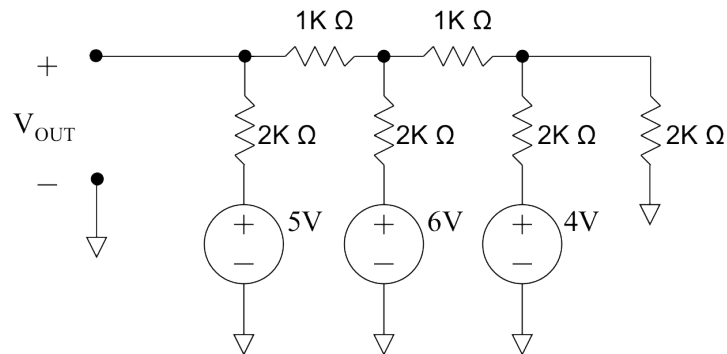


3. Using the currents you computed in the previous problem, develop the simple model for the above circuit as shown below. What is the resistance  $R_1$  from  $V_{\text{REF}}$  to ground leading through the  $i_1$  current path? What is the resistance  $R_0$  from  $V_{\text{REF}}$  to ground leading through the  $i_0$  current path?

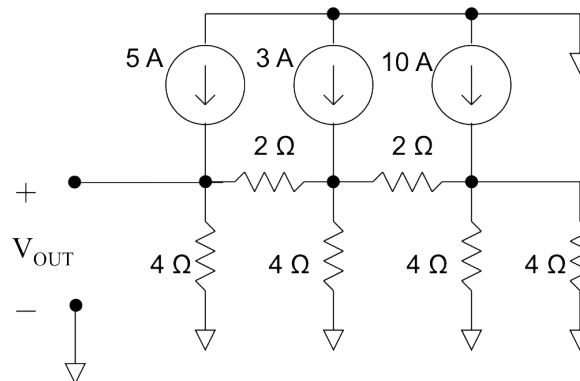


Problems 4 and 5 are applications of “R-2R” ladders.

4. Use source transformations to find  $V_{OUT}$  in the circuit below.



5. Use superposition and source transformations to find  $V_{OUT}$  in the circuit below.



Answers:

1.  $9R$ ,  $V_{REF}/9R$
2. 829  $\mu\text{A}$ , 171  $\mu\text{A}$ , 1 mA checks
3. 52.6 Kohm, 10.9 Kohm
4. 4.5 V
5. 18V