Alexandria University
Faculty of Engineering
Electrical Engineering Department

ECE: Principles and Applications of Electrical Engineering
Sheet 2

1) In the circuit shown in Figure 1, the source and node voltages are:
   $V_{S1} = V_{S2} = 110$ V $V_A = 103$ V $V_B = -107$ V
   Determine the voltage across each of the five resistors.

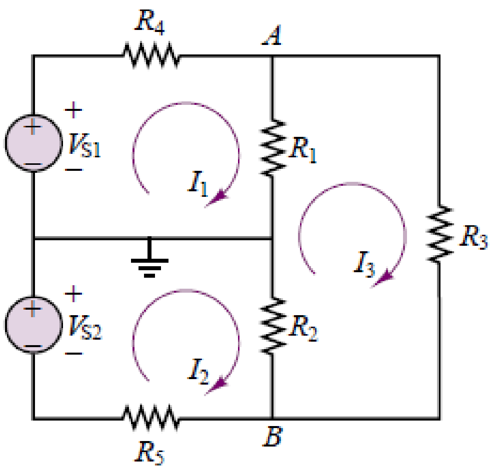

Figure 1

2) Using node voltage analysis in the circuit of Figure 2, find the currents i_1 and i_2.

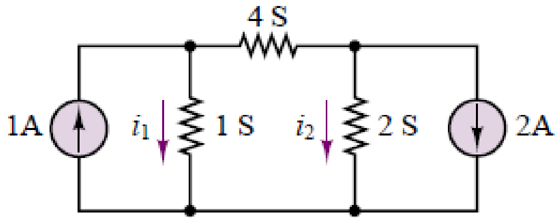

Figure 2

3) Using node voltage analysis in the circuit of Figure 3, find the voltage, v, across the 4-siemens conductance.

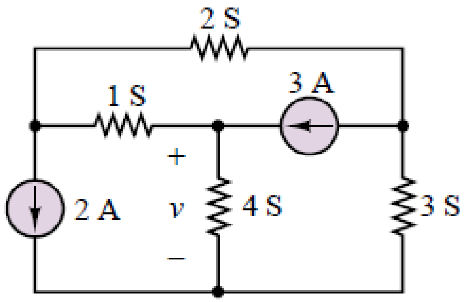

Figure 3

4) Using node voltage analysis in the circuit of Figure 4, find the three indicated node voltages.

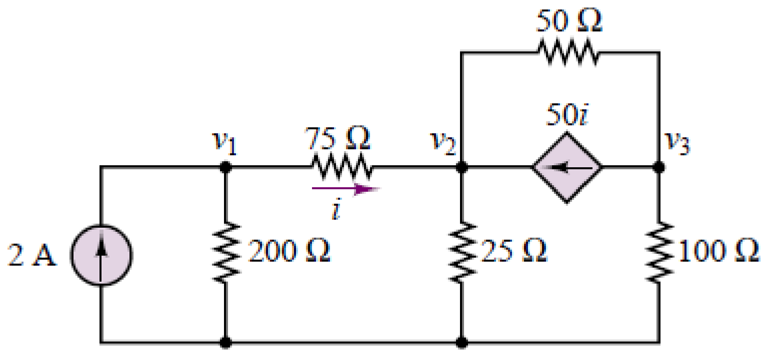

Figure 4

5) Using node voltage analysis in the circuit of Figure 5, find the current, i, drawn from the independent voltage source.

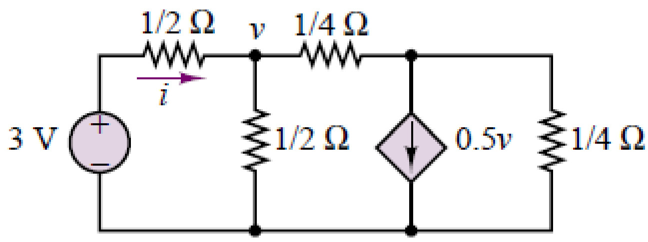

Figure 5

6) The circuit shown in Figure 6 is a Wheatstone bridge circuit. Use node voltage analysis to determine V_a and V_b, and thus determine $V_a - V_b$.

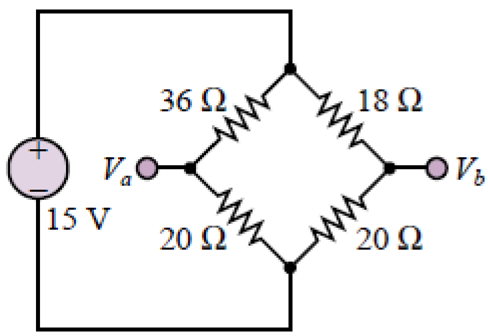

Figure 6

7) Using KCL, perform a node analysis on the circuit shown in Figure 7 and determine the voltage across R_4. Note that one source is a controlled voltage source!
$V_S = 5$ V $A_V = 70$ $R_1 = 2.2$ kΩ $R_2 = 1.8$ kΩ $R_3 = 6.8$ kΩ $R_4 = 220$Ω

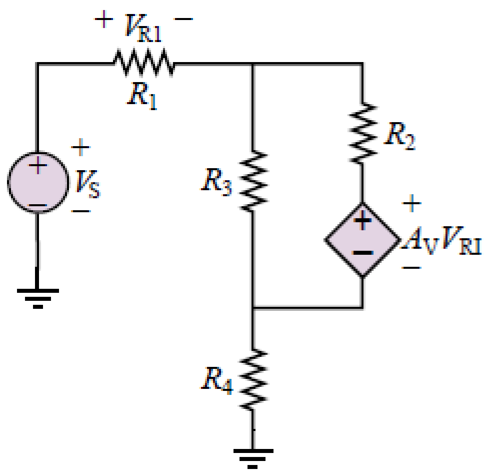

Figure 7

8) Using mesh current analysis, find the voltage, v, across the 3-Ω resistor in the circuit of Figure 8.

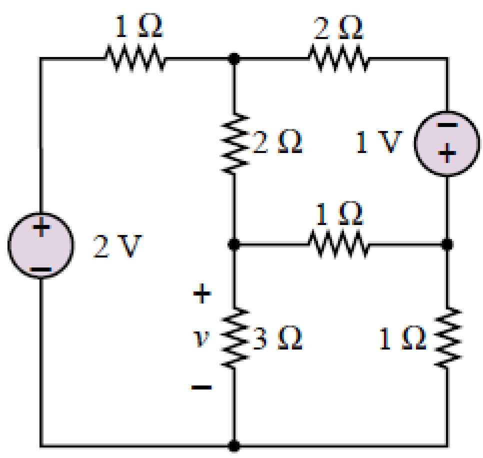

Figure 8

9) Using mesh current analysis, find the current, i, through the 2- Ω resistor on the right in the circuit of Figure 9.

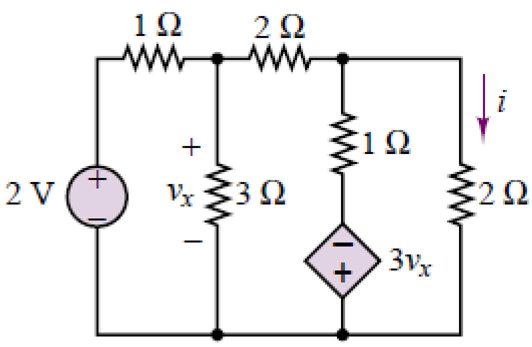

Figure 9

10) Using mesh current analysis, find the voltage, v, across the current source in the circuit of Figure 10.

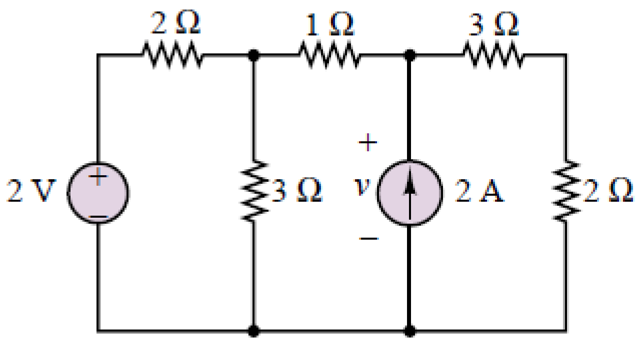

Figure 10

11) Using mesh current analysis, find the equivalent resistance, R = v/i, seen by the source of the circuit in Figure 11.

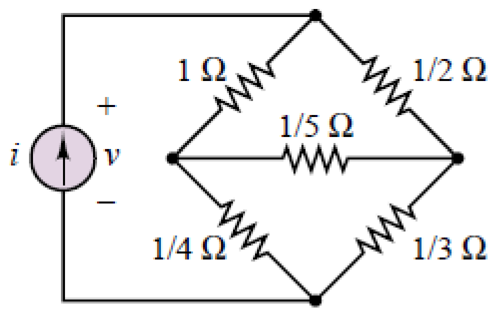

Figure 11

12) Using mesh current analysis, find the voltage gain, Av = v_2/v_1, in the circuit of Figure 12.

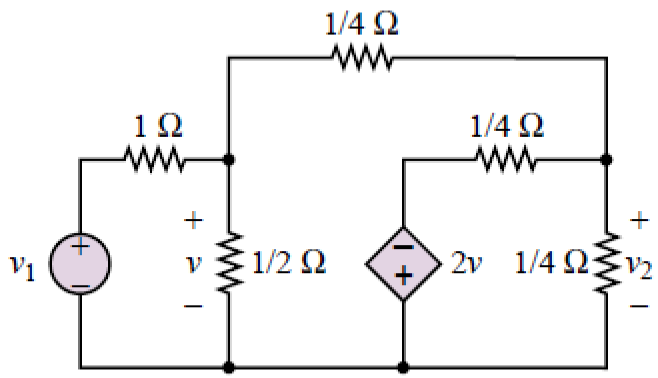

Figure 12

13) In the circuit shown in Figure 13:
$V_{S1} = V_{S2} = 450$ V $R_4 = R_5 = 0.25\ \Omega$ $R_1 = 8\ \Omega$ $R_2 = 5\ \Omega$ $R_3 = 32\ \Omega$
Determine, using KCL and a node analysis, the voltage across R_1, R_2, and R_3.

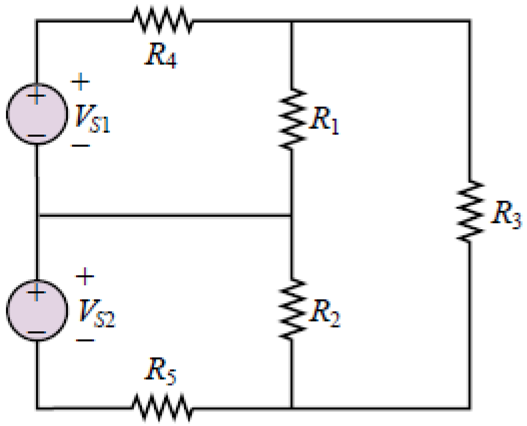

Figure 13

14) Find the Thévenin equivalent circuit as seen by the 3-Ω resistor for the circuit of Figure 14.

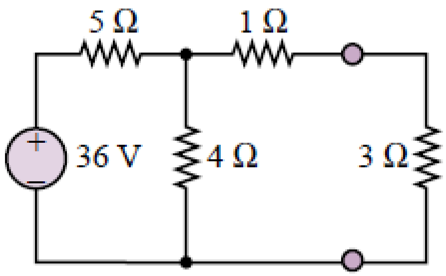

Figure 14

15) Find the Thévenin equivalent for the circuit of Figure 15.

16) Find the Norton equivalent of the circuit of Figure 15.

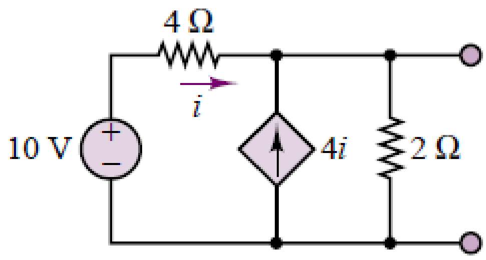

Figure 15

17) Find the Thévenin equivalent for the circuit of Figure 16.

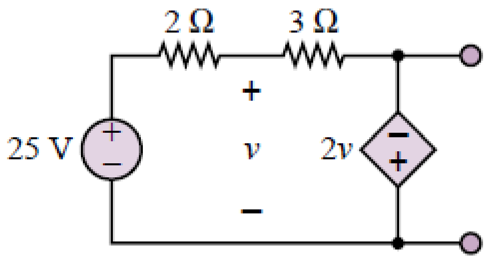

Figure 16

18) Find the Norton equivalent of the circuit of Figure 17.

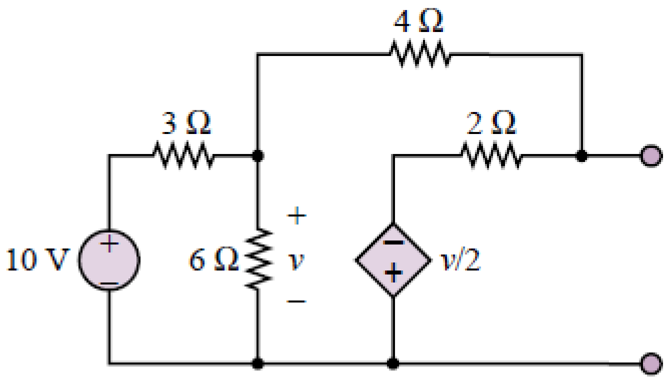

Figure 17

19) Find the Norton equivalent of the circuit to the left of the 2- Ω resistor in Figure 18.

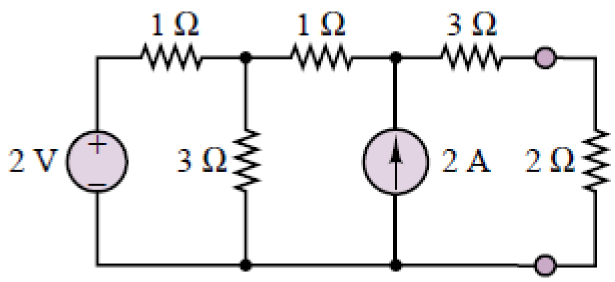

Figure 18

20) Find the Norton equivalent to the left of terminals a and b of the circuit shown in Figure 19.

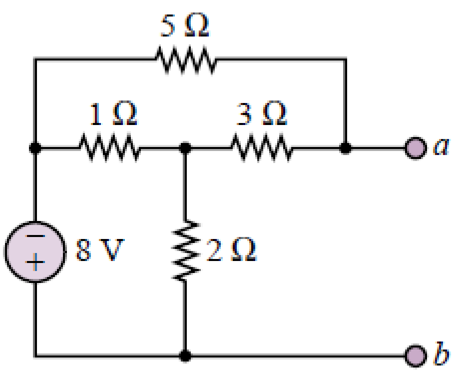

Figure 19

21) In the circuit shown in Figure 20, V_S models the voltage produced by the generator in a power plant, and R_s models the losses in the generator, distribution wire, and transformers. The three resistances model the various loads connected to the system by a customer. How much does the voltage across the total load change when the customer connects the third load R_3 in parallel with the other two loads?

V_S = 110 V R_s = 19 mΩ $R_1 = R_2$ = 930 mΩ R_3 = 100 mΩ

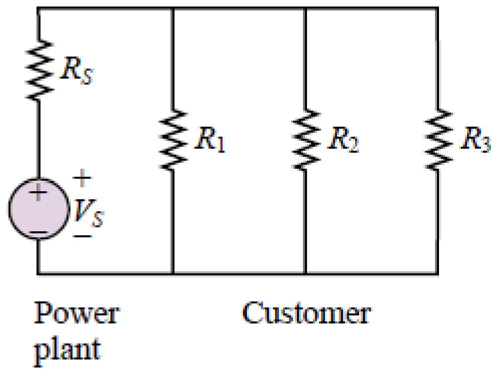

Figure 20

22) A non-ideal voltage source is modeled in Figure 21 as an ideal source in series with a resistance that models the internal losses; i.e., dissipates the same power as the internal losses. In the circuit shown in Figure 21, with the load resistor removed so that the current is zero (i.e., no load), the terminal voltage of the source is measured and is 20 V. Then, with R_L = 2.7 kΩ, the terminal voltage is again measured and is now 18 V. Determine the internal resistance and the voltage of the ideal source.

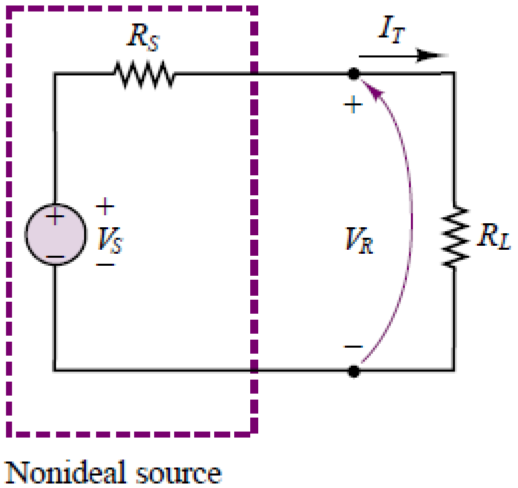

Figure 21

23) Find the Norton equivalent resistance of the circuit in Figure 22 by applying a voltage source v_o and calculating the resulting current i_o.

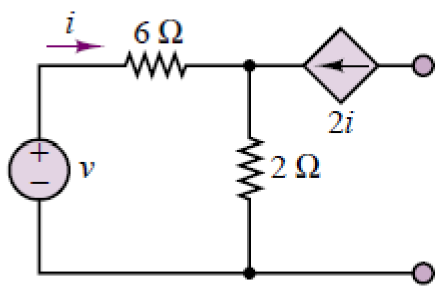

Figure 22

24) With reference to Figure 23, determine the current through R_1 due only to the source V_{S2}.

V_{S1} = 110 V V_{S2} = 90 V R_1 = 560 Ω R_2 = 3.5 k Ω R_3 = 810 Ω

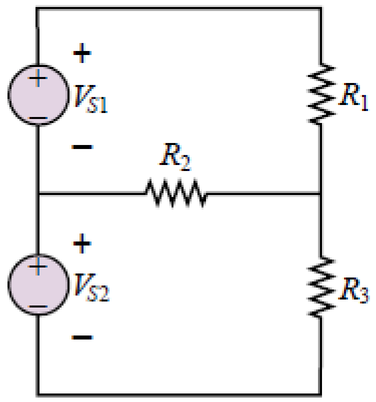

Figure 23

25) Determine, using superposition, the voltage across R in the circuit of Figure 24.

I_B = 12 A R_B = 1 Ω V_G = 12 V R_G = 0.3 Ω R = 0.23 Ω

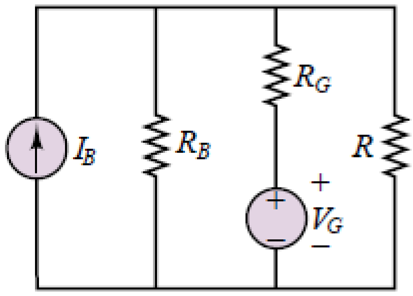

Figure 24

26) Using superposition, determine the voltage across R_2 in the circuit of Figure 25.

V_{S1} = V_{S2} = 12 V R_1 = R_2 = R_3 = 1 k Ω

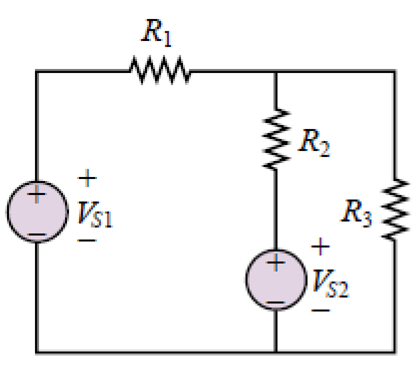

Figure 25

27) With reference to Figure 26, using superposition, determine the component of the current through R_3 that is due to V_{S2}.
$V_{S1} = V_{S2} = 450$ V $R_1 = 7\ \Omega$ $R_2 = 5\ \Omega$ $R_3 = 10\ \Omega$ $R_4 = R_5 = 1\ \Omega$

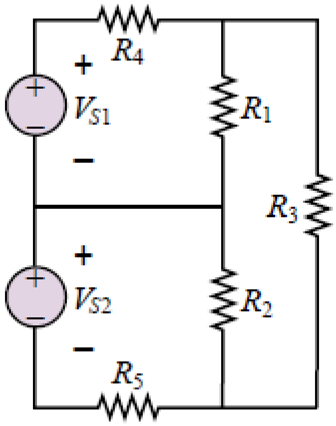

Figure 26

28) The equivalent circuit of Figure 27 has:
$V_{TH} = 12$ V $R_{eq} = 8\ \Omega$
If the conditions for maximum power transfer exist, determine:
a. The value of R_L.
b. The power developed in R_L.
c. The efficiency of the circuit, that is, the ratio of power absorbed by the load to power supplied by the source.

29) The equivalent circuit of Figure 27 has:
$V_{TH} = 35$ V $R_{eq} = 600$
If the conditions for maximum power transfer exist, determine:
a. The value of R_L.
b. The power developed in R_L.
c. The efficiency of the circuit.

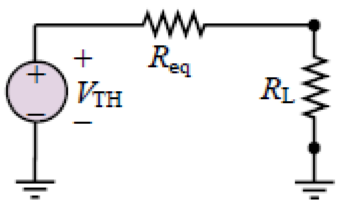

Figure 27