EXPERIMENT # 4

CURRENT AND VOLTAGE DIVIDER RULES

OBJECTIVE:

To experimentally verify the current divider rule (CDR) for parallel circuits and the voltage divider rule for series circuits.

Pre-Lab Assignment

For the circuit shown in Figure 2a and Figure 2b, calculate:

1- The unknown voltages and currents shown. Vs=10V.
2- The equivalent resistance seen by V_s.

Hint: Read through this experiment.

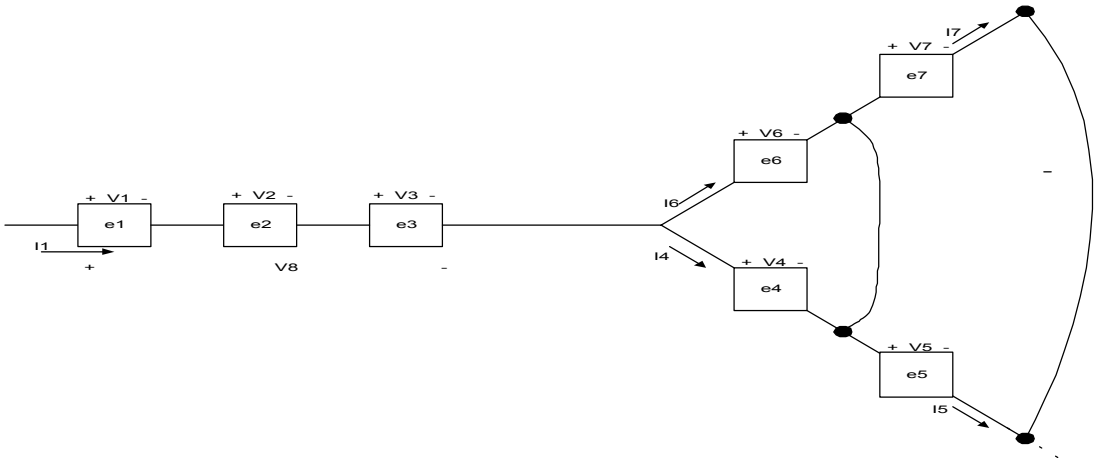
APPARATUS: DC Power Supply
Digital Multimeter
Carbon Resistors: 100 Ω , 250 Ω ,220 Ω and 330 Ω .

THEORY:

- **Series Connections:**

By definition, a series connection between any two electrical elements is such that the same current passes through both elements. For example element e1, e2, and e3 in Figure 1 are in series since the same current I1 passes through them.

Figure 1



Parallel Connections:

By definition, a parallel connection between any two electrical elements is such that the voltage is the same across both the elements. For example, elements e4 and e6 in Figure 1 are in parallel, since the same voltage ($V_4 = V_6$) is across both of them. Also, element e5 and e7 are in parallel for a similar reason.

Voltage Divider Rule (VDR) :

For a discussion of VDR, refer to your textbook. As an example of VDR, in Figure 1, if e1 =R1, e2 = R2, and e3 =R3, then:

$$V_1 = \frac{R_1}{R_1 + R_2 + R_3} V_s \qquad (1)$$

$$V_2 = \frac{R_2}{R_1 + R_2 + R_3} V_s \qquad (2)$$

Current Divider Rule (CDR):

For a discussion of CDR, refer to your textbook. As an example of CDR in Figure 1, If e4=R4 and e6 = R6, then:

$$I_4 = \frac{R_6}{R_4 + R_6} I_1 \qquad (3)$$

For I5 and I7, CDR can be applied as

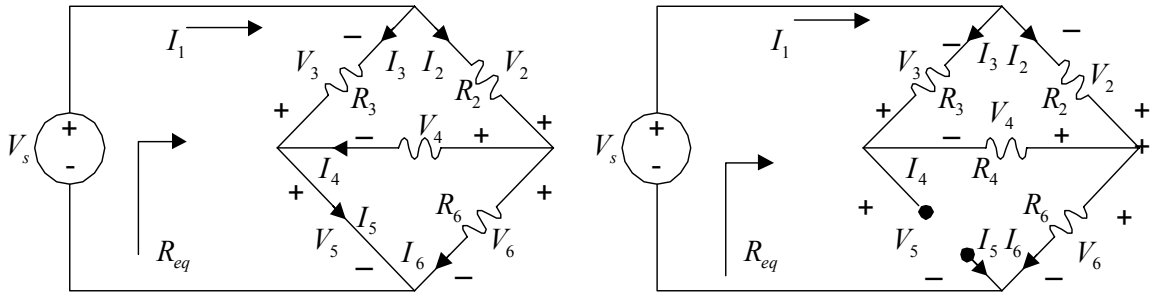
$$I_5 = \frac{R_7}{R_5 + R_7} (I_4 + I_6) \qquad (4)$$

$$I_7 = \frac{R_5}{R_5 + R_7} (I_4 + I_6) \qquad (5)$$

This is valid, since I4 + I6 is the total current passing though the parallel combination in this case.

Procedure:

1- Check the values of resistors used in the circuit of Figure 2, using the multimeter. Record the values in Table 1.



(a) (b)

Figure2

1. Connect the circuit of Figure 2a and adjust the supply voltage Vs to 10 V, using the DC voltmeter.
2. Measure the entire unknown voltages and currents shown. Record their values in Table 2.
3. Measure R_{eq} using an Ohmmeter and record its values in Table 2.
4. Connect the circuit of Figure 2b and adjust the supply voltage Vs to 10 V, using the DC voltmeter.
5. Measure the entire unknown voltages and currents shown. Record their values in Table3 (recall that when measuring current by an ammeter, the ammeter should be placed in series with the element in which the current passes. Keep this fact in mind when measuring I5.
6. Measure R_{eq}. and record its value in Table 3.

Report:

1- Compare the theoretical and experimental values of voltages and currents and the equivalent resistance of both circuits. Calculate the percent errors.
2- Give reasons for any discrepancies.

Questions:

Referring to the circuit of Figure 2a:

1- Are R4 and R6 in parallel or in series?
2- Are R3 and R4 in parallel or in series?
3- Are Vs and R6 in series or in parallel?
4- Is VDR applicable for applicable for R3 and R4?
5- Is CDR applicable for R4 and R6?
6- Is the parallel combination of R4 and R6 in series or in parallel with R2?

Justify your answer in each case by referring to the experimental results.

TABLE 1

Resistor Values:

Resistor	R2	R3	R4	R6
Nominal Value (Ohm)	100	220	150	330
Ohmmeter reading				

TABLE 2

Circuit of Figure 2a:

Unknown	I_1	I_2	I_3	I_4	I_5	I_6	V_2	V_3	V_4	V_5	V_6	R_{eq}
Theory												
Experiment												
% Error												

TABLE 3

Circuit of Figure 2b

Unknown	I_1	I_2	I_3	I_4	I_5	I_6	V_2	V_3	V_4	V_5	V_6	R_{eq}
Theory												
Experiment												
% Error												