MARINE INSTITUTE

Electrotechnology 1100

Experiment 5
Series/Parallel Circuits

SAMPLE CALCULATIONS:

Using your own data, provide one worked sample of each formula used in this Lab.

BASIC INFORMATION

As the name implies, a series/parallel or combination circuit has components that are connected in series and parallel.

To simplify this circuit, the series sub-circuits and parallel sub-circuits must be replaced by their equivalent resistance until the circuit is simply series or parallel.

Once the circuit is simplified and total current has been calculated, the branch currents and voltage drops must be calculated using: Ohm's Law and Series and Parallel rules; or Current Division.

In this experiment, we will attempt to perform the appropriate calculations to calculate and measure all currents and voltages in a series/parallel circuit.

Voltage is measured in **PARALLEL** and proper **POLARITIES** must be used.

Figure 5-1 shows a voltmeter connected to measure the voltage drop V_2.

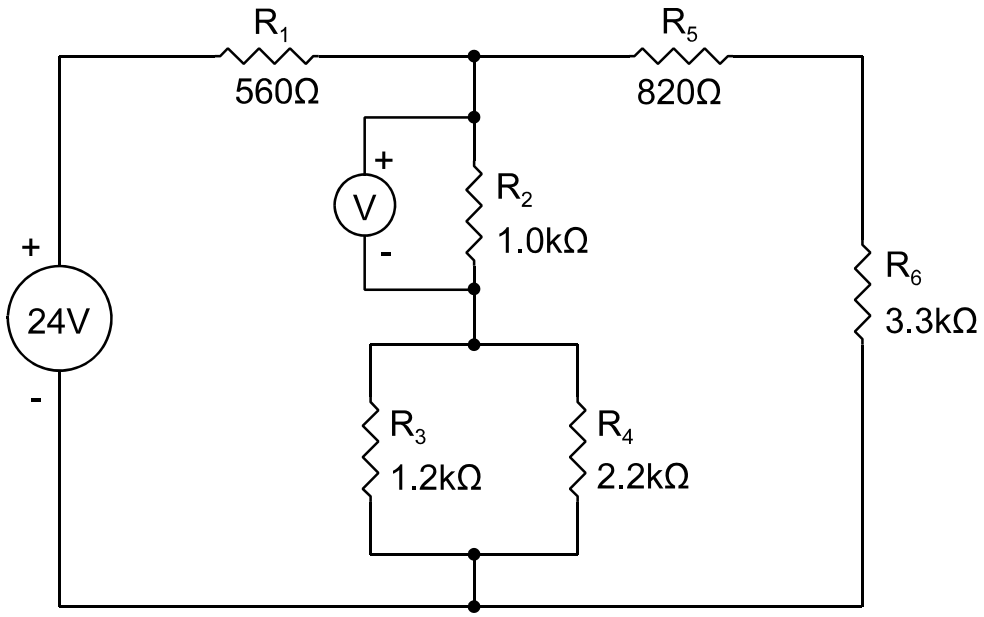

Figure 5-1

Figure 5-2 shows a pictorial of how to measure V_2.

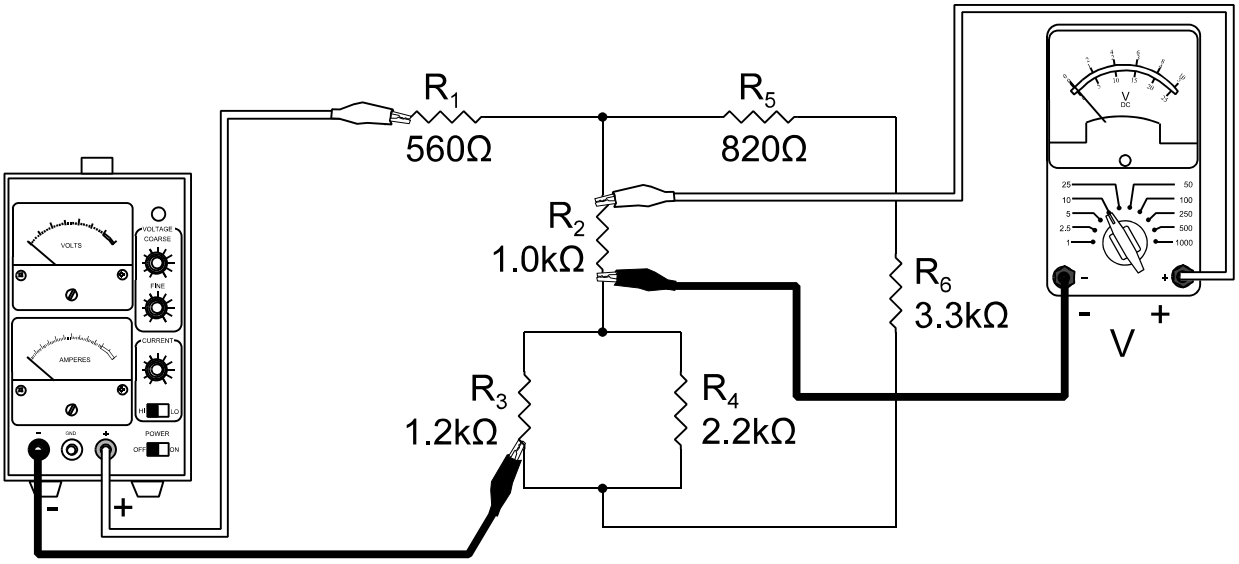

Figure 5-2

If you examine Figure 5-2, you will see that the positive terminal of the voltmeter is connected on the most positive side of the resistor and the negative terminal on the most negative.

Figure 5-3 shows how the voltmeter is connected to measure the voltage drop across each resistor.

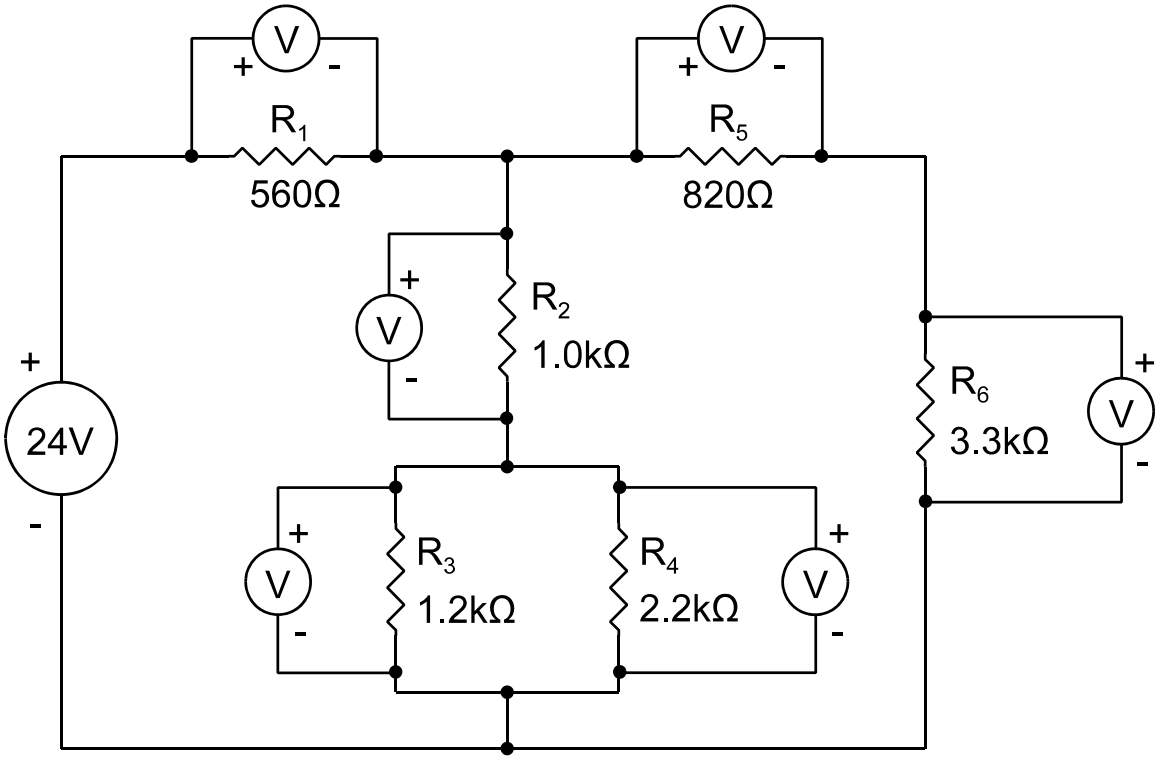

Figure 5-3

Current is measured in **SERIES** and proper **POLARITIES** must be used.

Figure 5-4 shows an ammeter connected to measure the current I_2.

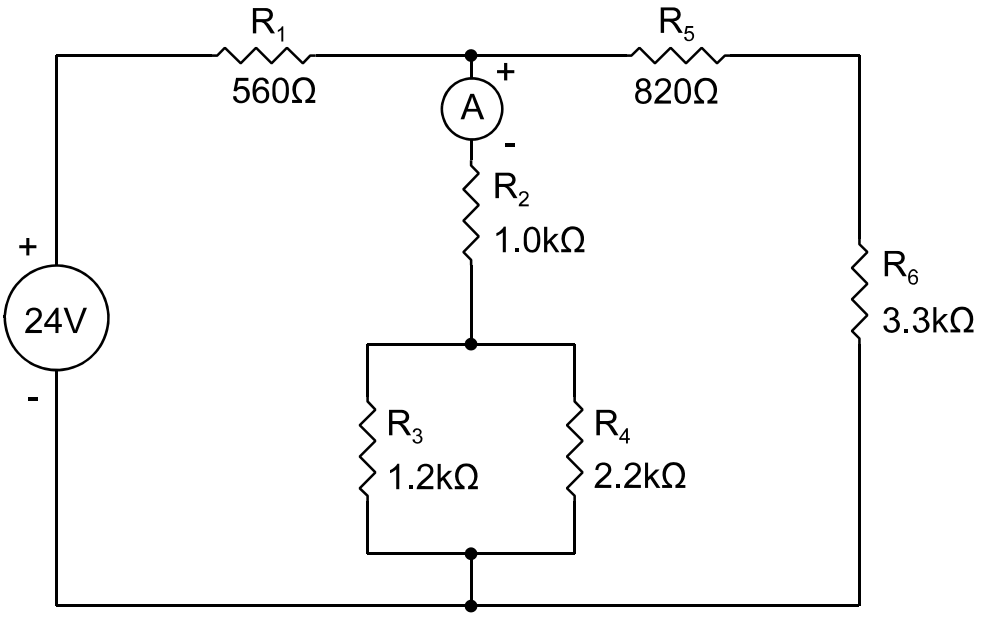

Figure 5-4

Figure 5-5 shows a pictorial of the same measurement.

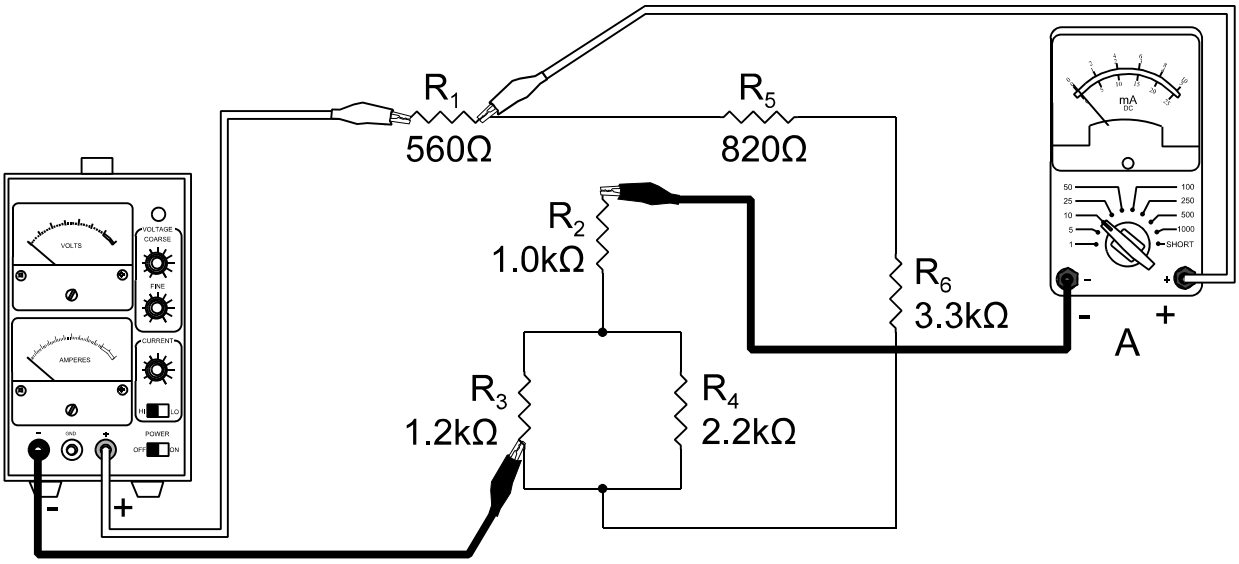

Figure 5-5

If you examine Figure 5-5, you will see that the positive terminal of the ammeter is connected towards the positive terminal of the power supply and the negative terminal towards the negative.

The ammeter is harder than the voltmeter because you must disconnect one side of the resistor to be measured and reconnect the resistor with the ammeter.

As shown in Figure 5-6, to measure I_2, the ammeter may be placed before or after the resistor, but note how the polarities change.

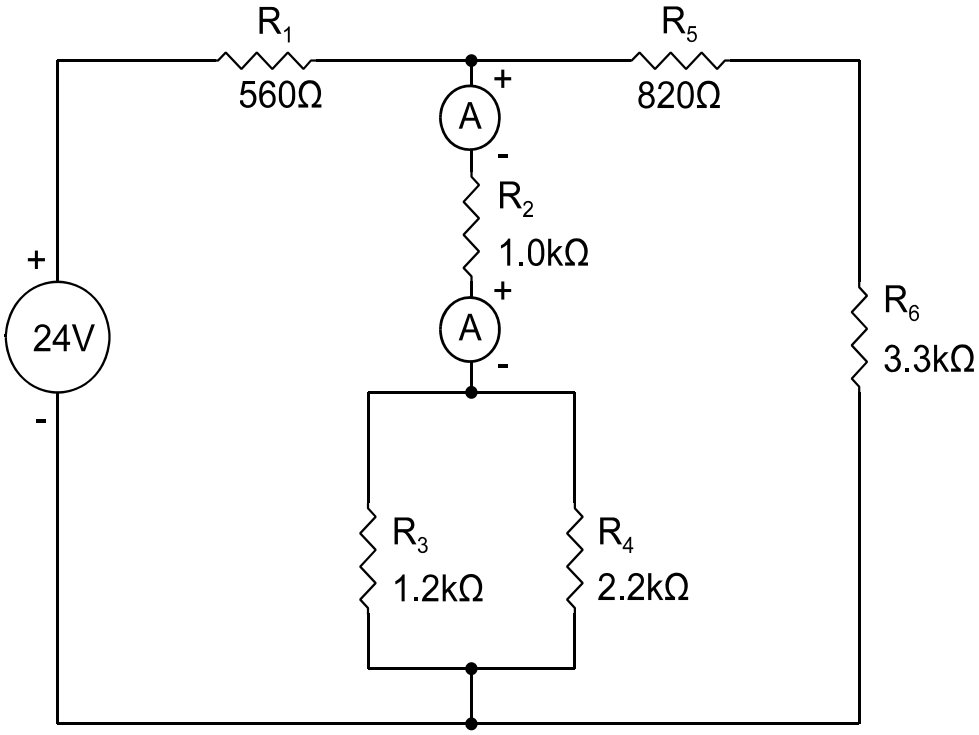

Figure 5-6

Finally, Figure 5-7 shows how the ammeter is connected to measure each current.

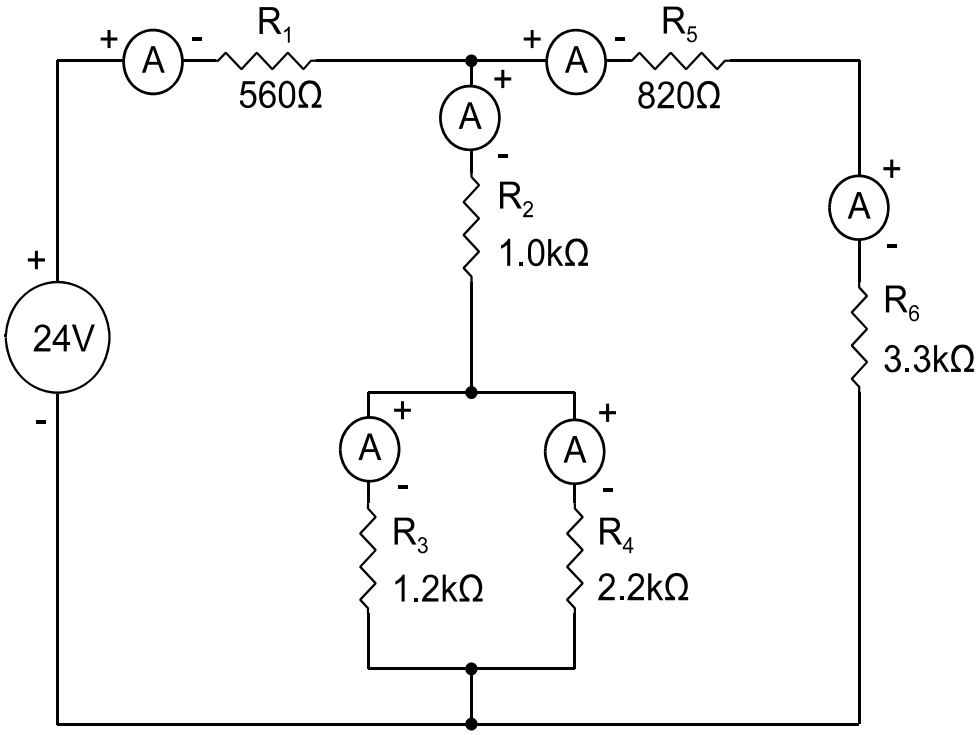

Figure 5-7

OBJECTIVES:

When you have completed this experiment, you should be able to:

- Measure the total resistance of a series/parallel circuit.
- Measure voltages of a series/parallel circuit.
- Measure currents of a series/parallel circuit.

EQUIPMENT & MATERIALS REQUIRED:

Power Supply:	0-60/70V dc.
Instruments:	Analog Ohmmeter.
	Analog Voltmeter.
	Analog Milliammeter.
Resistors:	560Ω.
	820Ω.
	1.0kΩ.
	1.2kΩ.
	2.2kΩ.
	3.3kΩ.
Miscellaneous:	Orange board.
	3 Black Alligator Clip to Banana Plug test leads.
	3 Red Alligator Clip to Banana Plug test leads.
	Quick clips.

WHAT YOU SHOULD KNOW

In the previous Experiments, ammeters and voltmeters to measure specific or total current and voltage were added to schematic diagrams. This was done to give you experience without forcing you to learn how to connect meters correctly.

But as illustrated by this Experiment's Basic Information, you will be moving ammeters and voltmeters around the circuit to measure not only totals, but individual resistor's currents and voltages. Adding individual meters to the schematic diagrams would increase complexity without helping learning.

So from this point, ammeters and voltmeters will be left off of schematic diagrams. If you need to, you can always go back and look at the earlier Experiments.

Remember: Ammeters must be connected in **SERIES**. Current through.
Voltmeters must be connected in **PARALLEL**. Voltage across.

PROCEDURE:

1. Using the **CODED** values of resistors, calculated the total resistance and the voltage and current of each resistor for the circuit shown in Figure 5-5 and record them in Table 5-1.

   Use at least two significant figures in your calculations (0.009A is only one significant figure). Record your currents in mA.

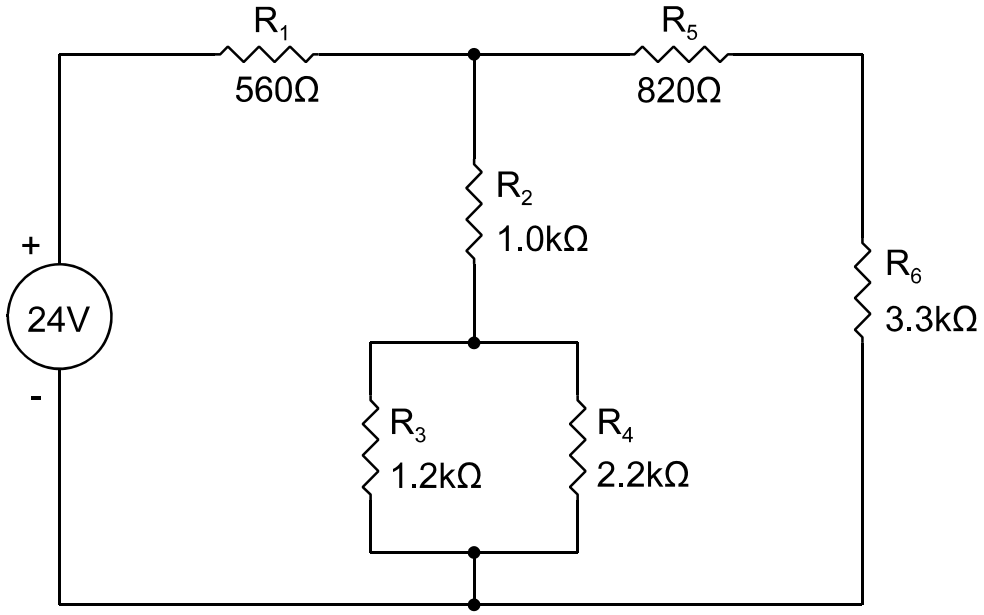

Figure 5-8

2. Measure the actual resistance of your resistors and record the results in Table 5-2.

3. Connect the series/parallel circuit shown in Figure 5-8, but do not connect the power supply.

4. Measure the total resistance of the circuit and record in Table 5-2.

5. Connect the power supply to the circuit. Set up the voltmeter to measure V_T.

6. Turn on the power supply and adjust the applied voltage to 24V using the voltmeter.

7. Measure all voltages and record the results in Table 5-2. Use your calculated values in Table 5-1, to select scales and ensure your measurements are accurate.

8. Measure all currents and record the results in Table 5-2. Use your calculated values in Table 5-1, to select scales and ensure your measurements are accurate.

9. **Have a demonstrator check your results before disconnecting the circuit.**

10. Disconnect your circuit and return all equipment to it's proper place.

RESULTS:

Table 5-1 Calculated Values

Resistor	Voltage (V)	Current (mA)	Resistance (Ω)
Totals	**24**		
R_1			**560**
R_2			**1k**
R_3			**1.2k**
R_4			**2.2k**
R_5			**820**
R_6			**3.3k**

Table 5-2 Measured Values

Resistor	Voltage (V)	Current (mA)	Resistance (Ω)
Totals			
R_1			
R_2			
R_3			
R_4			
R_5			
R_6			

QUESTIONS:

1. How do you calculate the total resistance of a series/parallel circuit?

2. How do you connect a voltmeter to measure the voltage drop of a resistor in any circuit?

3. How do you connect an ammeter to measure the current flowing through a resistor in any circuit?

4. If no ammeter was available, what measurements could you make to determine the current in each resistor of any circuit?

As preparation for next week's lab, you can complete Table 6-1 in Experiment 6.

See Step 1 (p54).

Calculation Checkpoints:
$R_T = 2300\Omega$, $V_3 = 14.8V$, $I_6 = 5.41mA$