**Chapter 2: Basic Laws**

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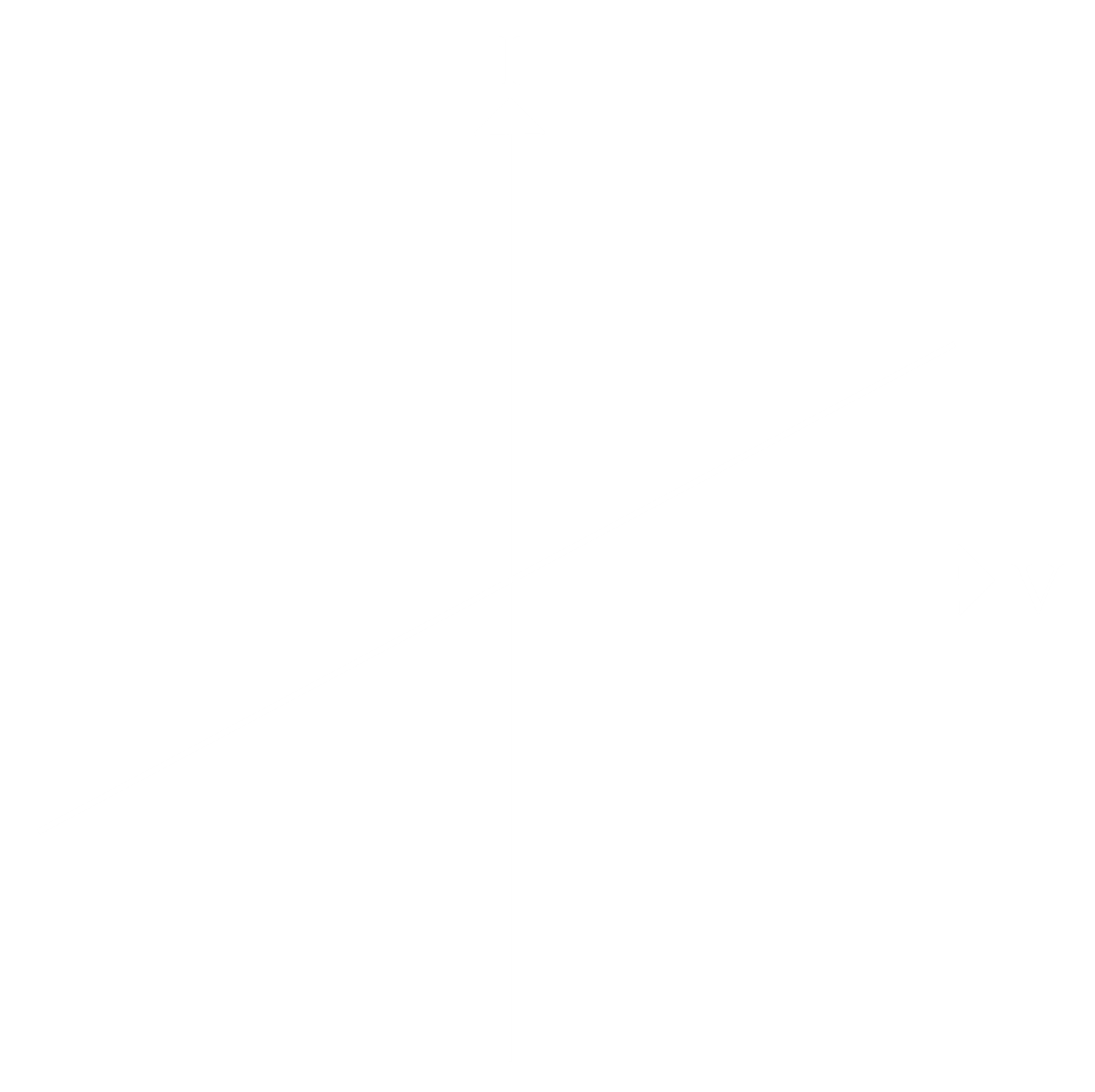
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## 2.2 Ohm’s Law

At constant temperature, the flow of current through a conductor is directly proportional to the potential difference between the two terminals.

where is conductance

where is resistance



where is the length of the conductor

is the cross-sectional area

is the resistivity of the material of the resistor

The unit of resistance is ohm (Ω).

An open circuit is an incomplete circuit. Since current does not flow, , meaning .

A short circuit is when there is no potential difference between two points. Here .

Power,

Practice Problem 2.3

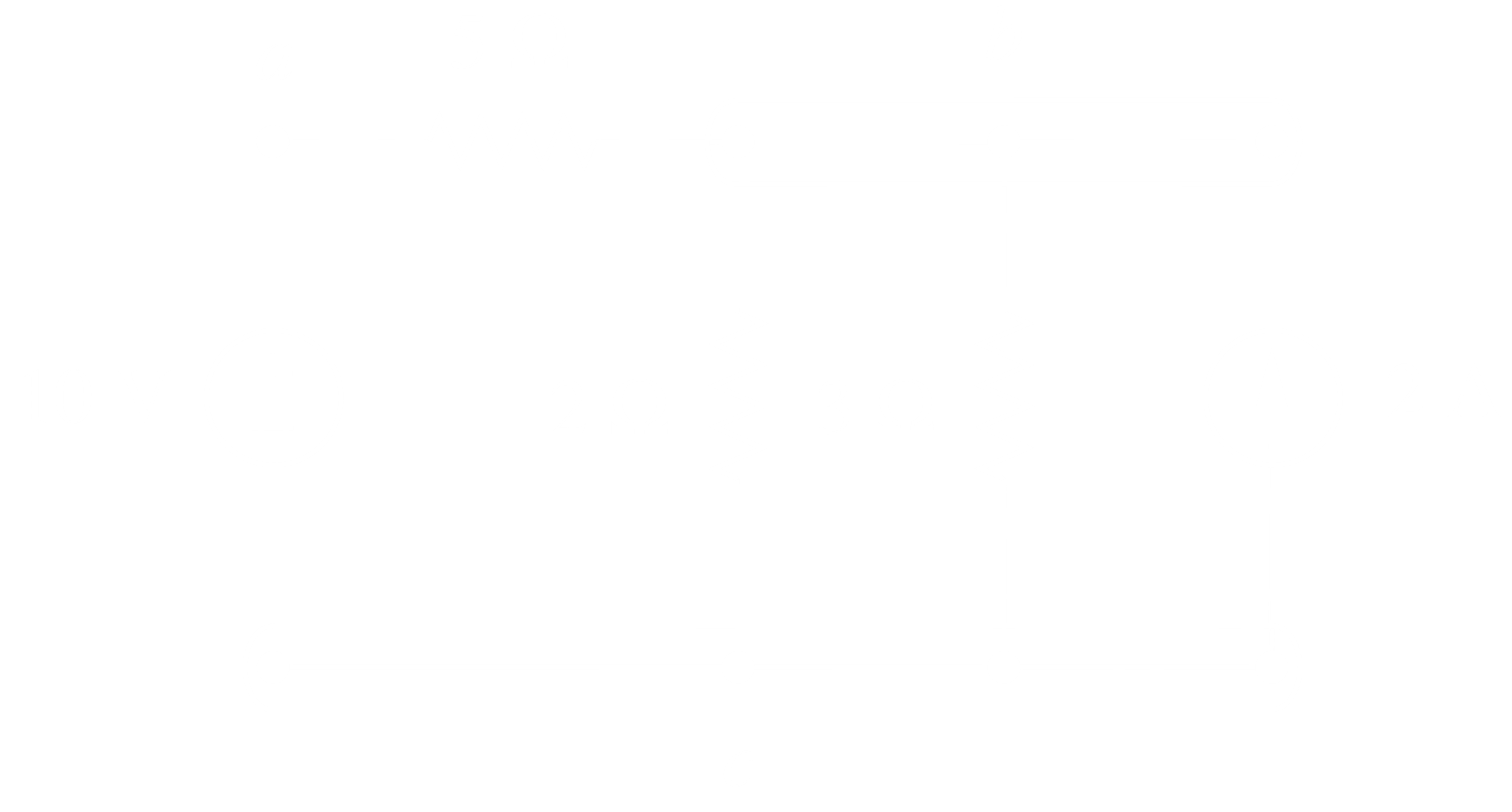
## 2.3 Nodes, Branches, Loops and Meshes

A branch represents a single element, like a voltage source.

A node is the point of connection in between two or more branches.

A loop is any closed path in a circuit.

A mesh is a non-overlapping loop.



In the diagram, there are:

3 nodes (labelled in diagram)

5 branches

6 loops

3 meshes

In general,

## 2.4 Kirchhoff’s Laws

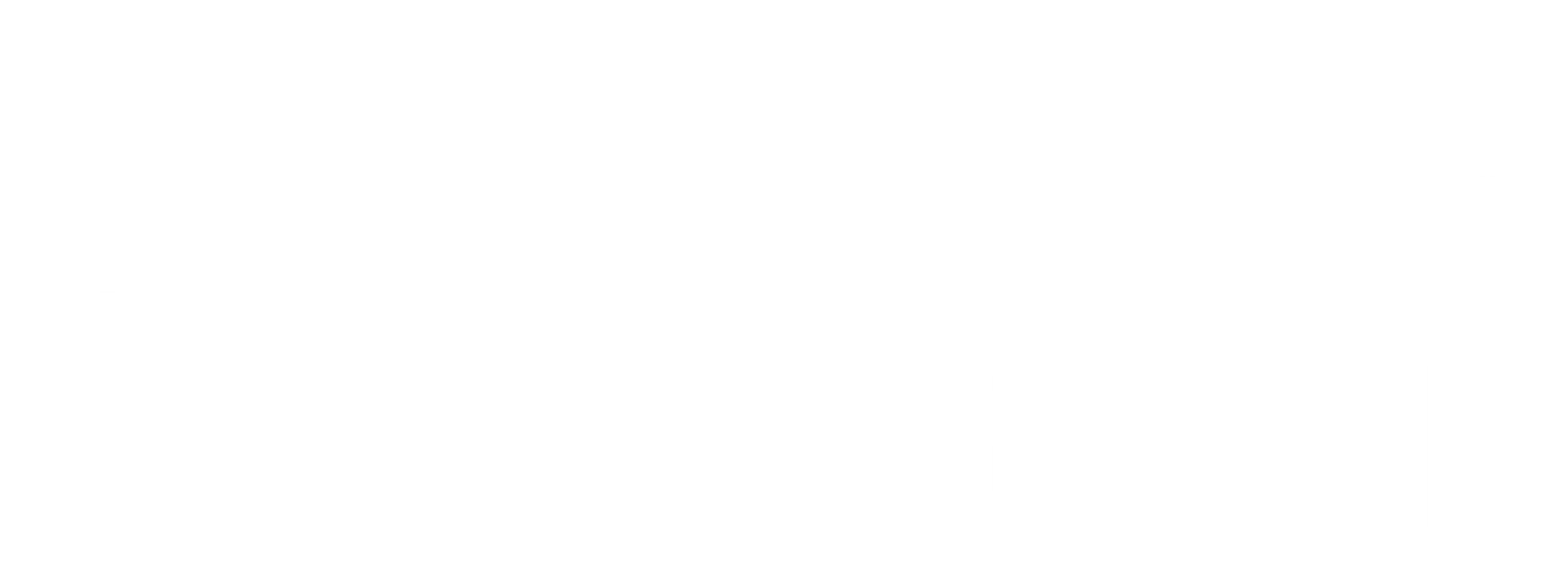
Kirchhoff’s Current Law (K.C.L.)

The current entering a node is equal to the current leaving it.

Kirchhoff’s Voltage Law (K.V.L.)

In a closed loop, the total voltage rise is equal to the total voltage drop.

Practice Problem 2.7



We also know,

## 2.5 Series Resistors and Voltage Divisions

For series connections, the end node of one branch should be the starting node of another branch, and there should not be any other multiple paths in between.



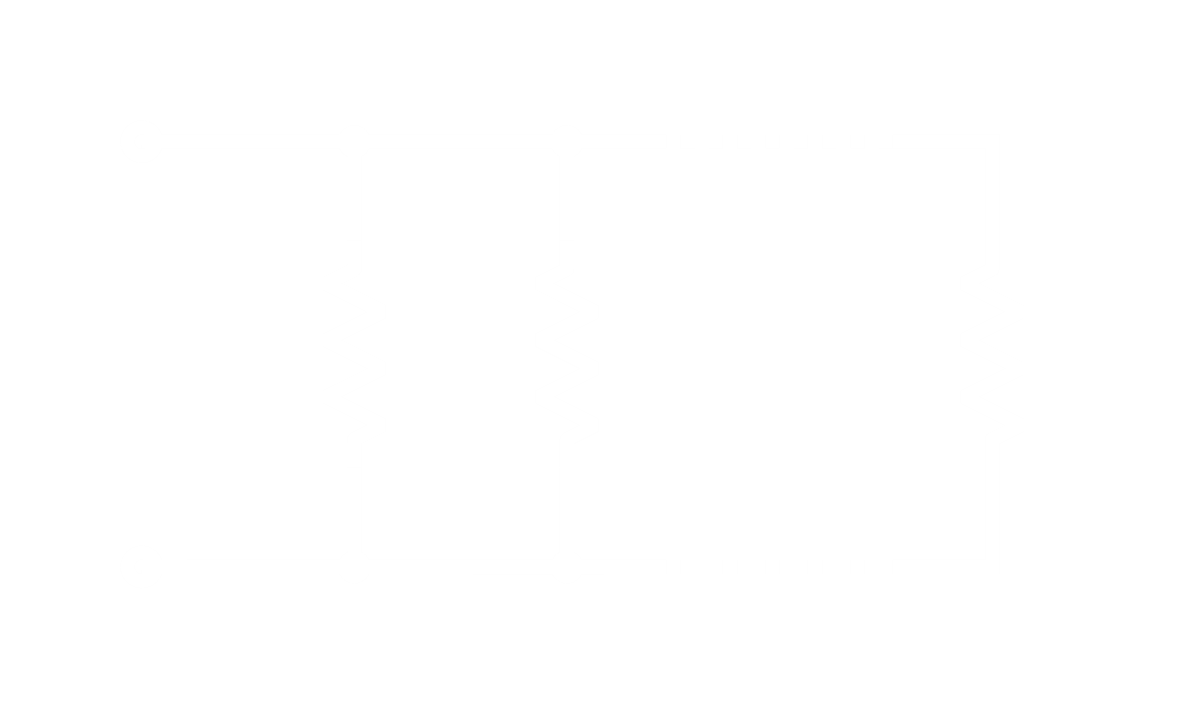
The current in a series connection is the same, since there is only one path.

Voltage Divisions:

The ratio of total voltage to total resistance is equal to the ratio of voltage across a single component to the resistance of that component, for series connections. This is known as the voltage divisor rule.

## 2.6 Parallel Resistors and Current Divisions

For parallel connections, the starting and ending nodes of two or more branches should be the same and there should not be any other multiple paths in between.



Different paths will cause different rates of flow of current. This means current in parallel paths are different, but voltages are the same.

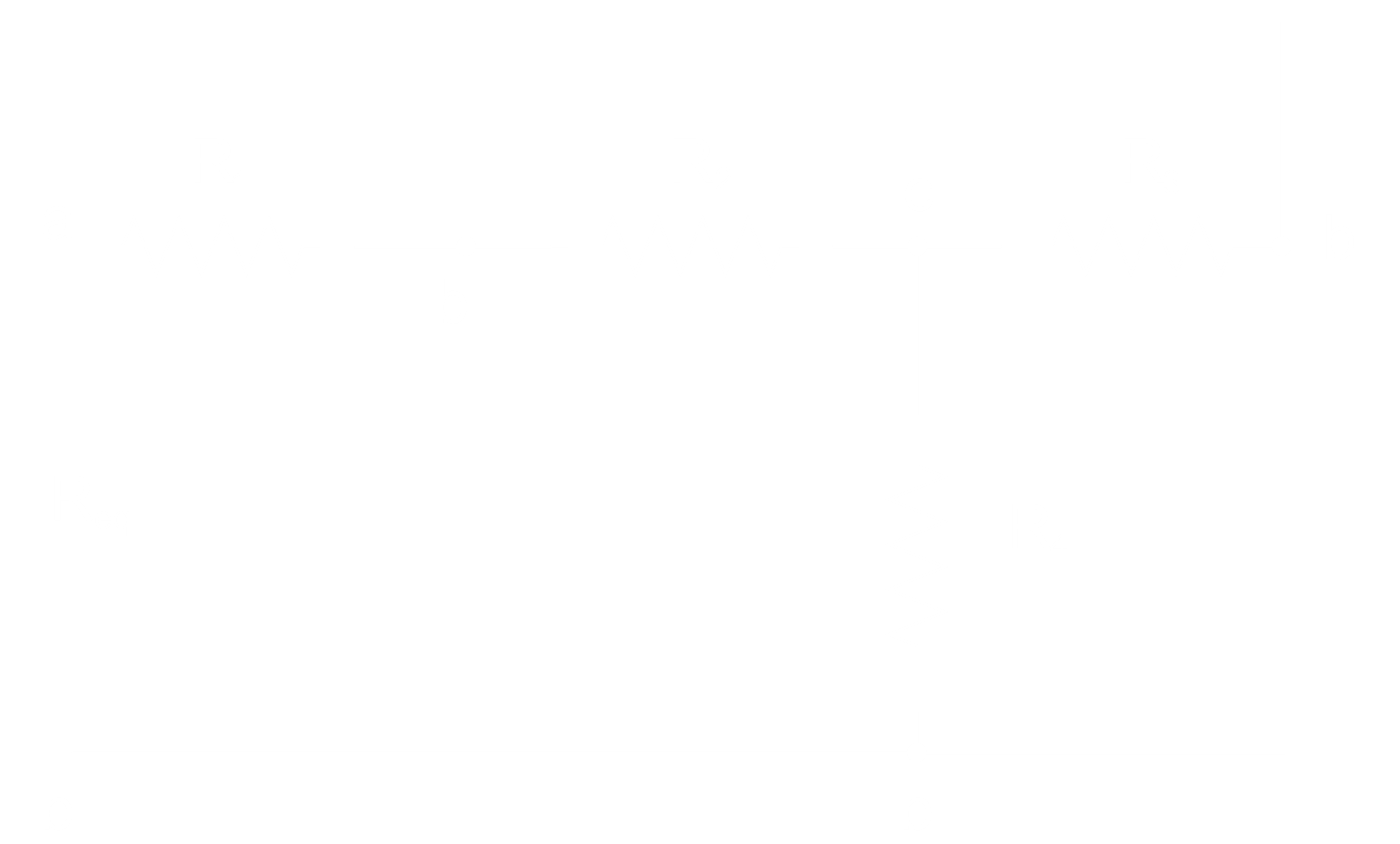
Current Divisions:

This is known as the current divisor rule.

For conductance (), the equations are flipped.

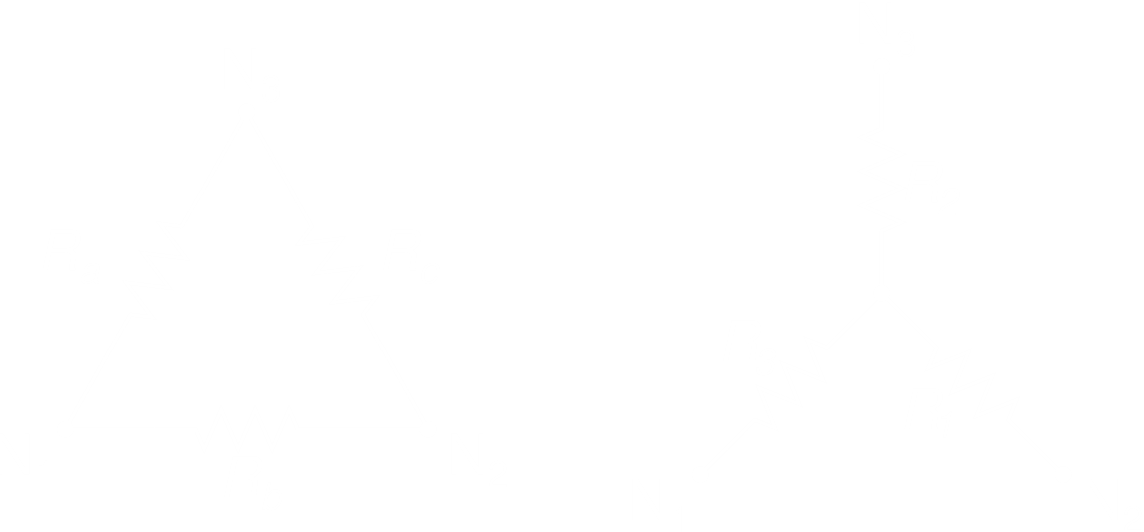
For series connections, .

For parallel connections, .



Between and , there is branch. Between and there are branches. The total resistance is the same as that between nodes and .

## 2.7 Wye – Delta



Delta Connection Wye Connection

Converting from Delta to Wye or vice versa can make circuits easier to solve.

