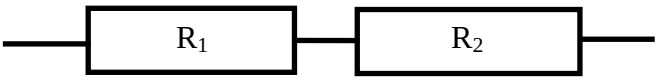
Circuits

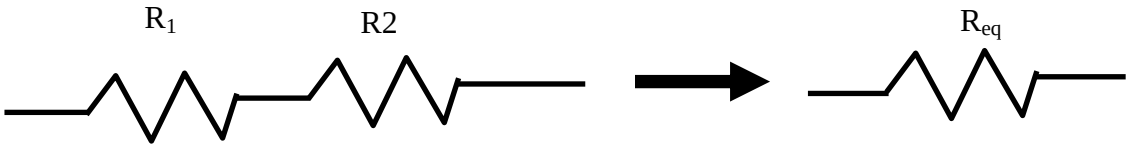
I. Combining Resistors in Parallel and Series

A. **Series –** Placing resistors in series makes a

_____ resistor.

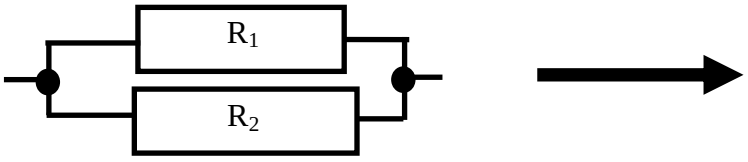


Analogous to making the length _____!!!

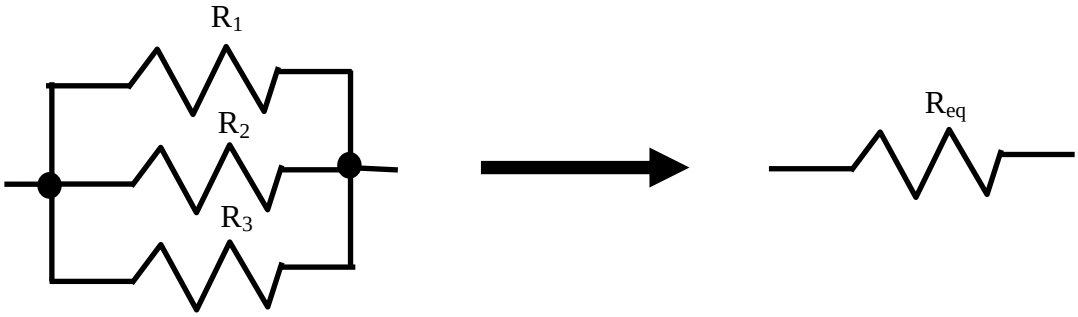


B. Parallel -

Placing resistors in parallel creates a _____ resistor.



Analogous to making the area _____!!!

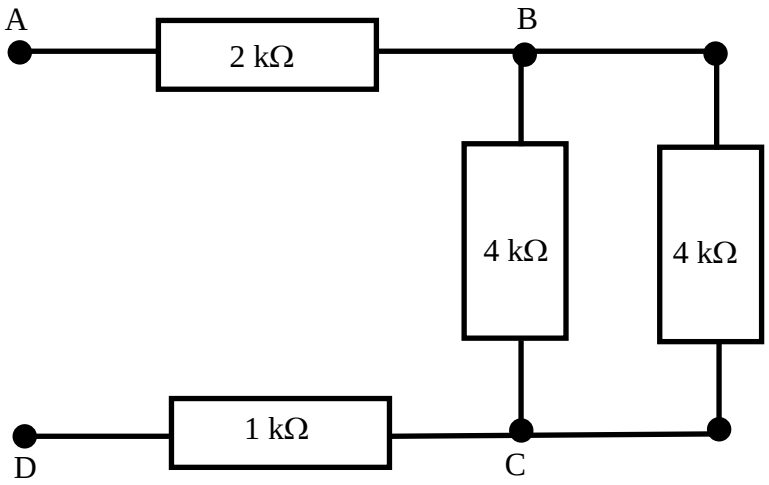


C. Special Cases - Short Cuts

1. For **TWO** resistors in **<u>parallel</u>**, we have

2. For **N** <u>identical</u> resistors in **<u>parallel</u>**, we have

EXAMPLE 1: What is the resistance between the terminals A and D in the following circuit?



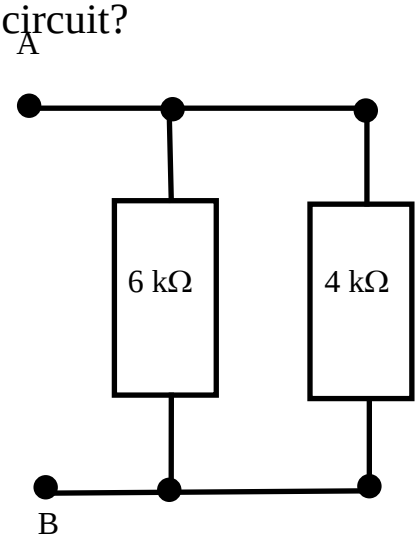
SOLUTION:

The two 4 kΩ resistors are in _____.

Thus, we have

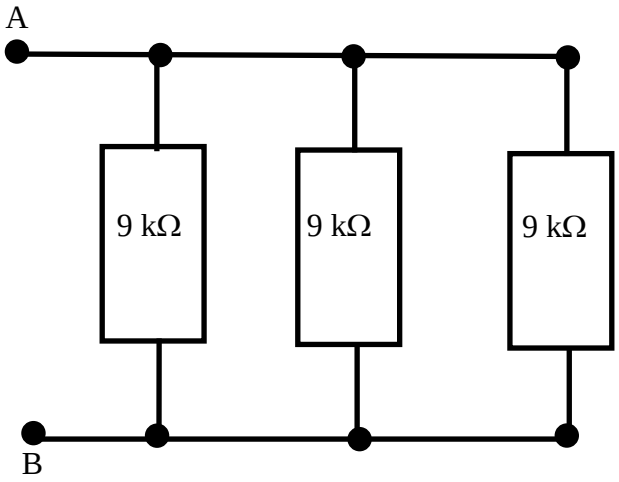
These three resistors are now in _____.
Thus, we have

EXAMPLE 2: What is the resistance between terminals A and B in the following circuit?



SOLUTION:

EXAMPLE 3: What is the resistance between terminals A and B in the following circuit?



SOLUTION:

II. Short and Open Circuits

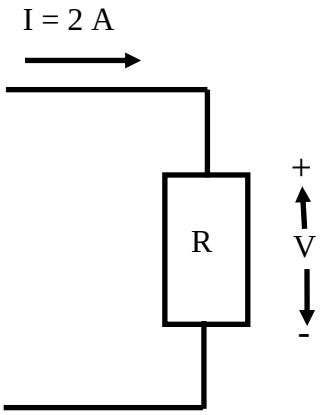
A. Definition of a Short Circuit:

A short circuit is when _____ _____ is dropped across a circuit element.

B. Special Case (Resistor):

For a resistive element, a short circuit also implies by ohm's law that there is _____ _____.

EXAMPLE:



V = I R

C. Definition of an Open Circuit:

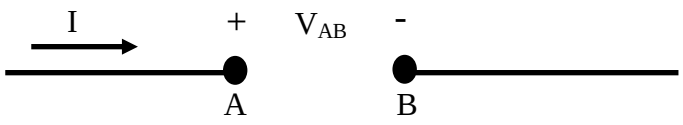
An open circuit is when _____ _____

flows through a circuit element.

D. Special Case (Resistor):

For a resistive element, an open circuit also implies by ohm's law that there is _____ _____.

EXAMPLE:



$$I = \frac{V_{AB}}{R}$$

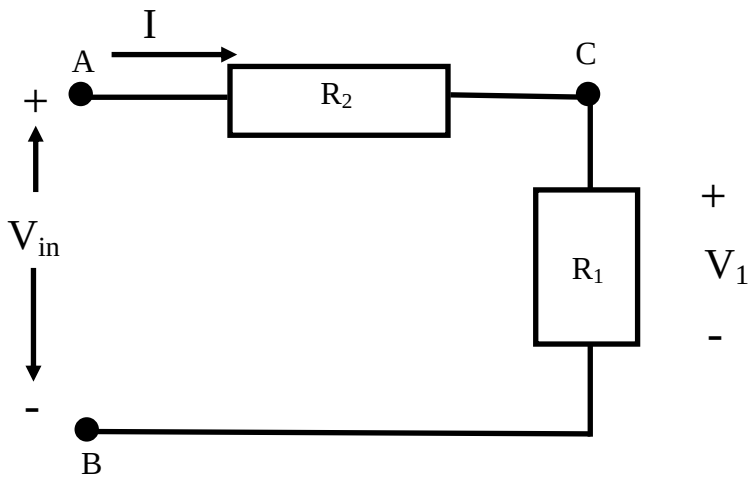
III. Voltage and Current Divider Circuits

Knowledge of the voltage divider and current divider circuits can be extremely useful both in designing and analyzing electronic circuits because:

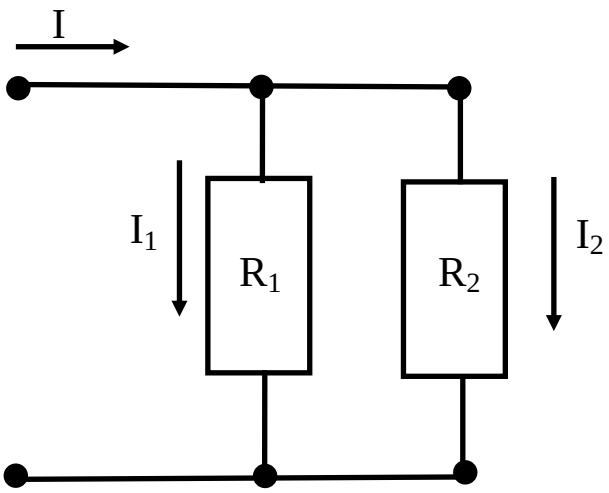
1) They often allow us to use a single voltage or current supply to all the necessary voltages and currents required;

2) These circuits are so common that knowledge of their formulas can greatly improve both our understanding and speed in analyzing electric circuits.

A. Voltage Divider Circuit (Series)



B. Current Divider Circuit (Parallel)



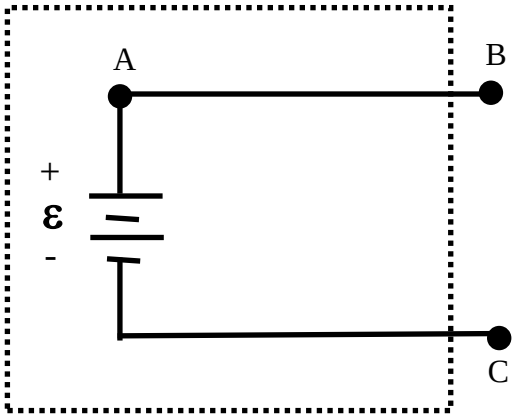
IV. Battery or Power Supply – Source of EMF

A. A battery is a _____ of _____

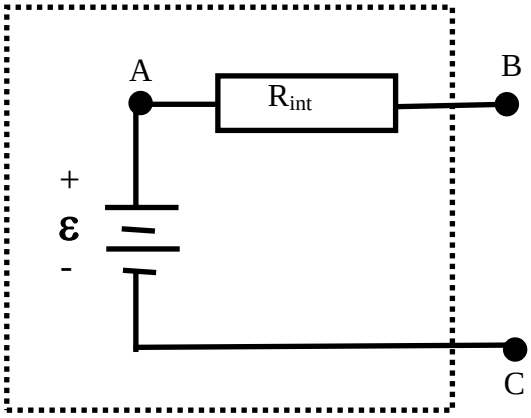
_____. It is a _____ _____

with its own energy supply.

B. Schematic Symbol for Ideal Battery



C. Schematic Symbol for a Real Battery



NOTE: Any circuit (no matter how complex) can be reduced to a single voltage source in series with a resistor as long as we generalize resistance to include complex numbers (called impedance). This is known as the Thevinen's equivalent circuit and is extremely powerful in solving more complicated circuits and in design.

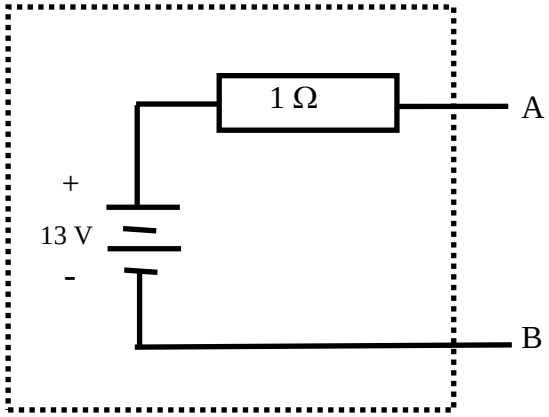
D. Effect of Internal Resistance – R_{int}

In an electrical circuit, it is important for the **internal resistance** of a battery to be **much smaller** than the **load resistance** connected to the battery. This is to ensure that most of the energy is supplied to the load and not wasted as heat inside the battery. The following example should demonstrate this point.

EXAMPLE: For a 13 volt battery with an internal resistance of 1 Ω, what voltage will you measure at the batter terminals when a) the battery terminals are left open; b) a 12 Ω resistor is connected between the terminals.

SOLUTION:

a)



b)