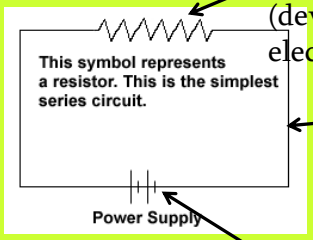
# Electrical Circuits

**Section 7.3**

## Components of a circuit

- Source of voltage difference (provided by a battery or an outlet)
- At least one device that uses electrical energy (radio, microwave, clock, fan, etc)
- Conductor (like wire) that connects the device to the source of voltage difference

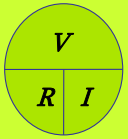
## Simple Series Circuit




*R* (devices that use electrical energy)

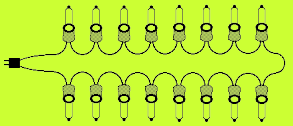
*I* (current in conductor)

V (voltage difference provided by a power source)



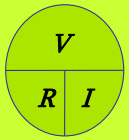

## Open Series Circuit

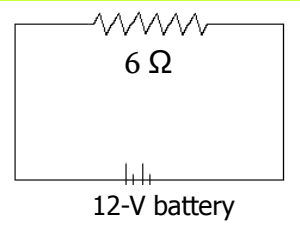
- Parts are wired one after another with the same current running through every part
- If one part of a series circuit is disconnected, then no current will flow through the circuit
- String of Christmas lights



## Simple Series Circuit

Calculate the flow of current through the following circuit.

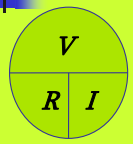


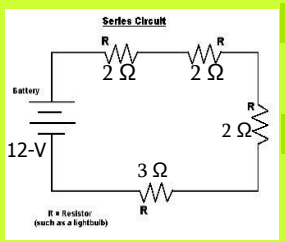




I = 12 Volts
6 ohms

I = **2 amps**

## Simple Series Circuit




Calculate the total resistance of the circuit.

$R_{total} = R_1 + R_2 + R_3 + R_4$

$R_{total} = 2\ \Omega + 2\ \Omega + 2\ \Omega + 3\ \Omega$ **$R_{total} = 9\ \Omega$**

Calculate the current leaving the battery.

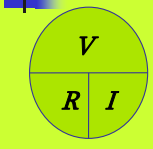
I = 12 Volts / 9 ohms  I = **1.33 amps**

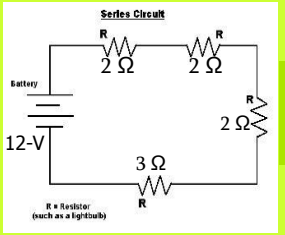
Calculate the current through each resistor.

I = **1.33 amps**

**"same current running through every part"**

## Simple Series Circuit




Calculate the voltage drop through each resistor.

For $R_1$, $R_2$,$R_3$: V=(2Ω)(1.33 amps) V = **2.67 volts**

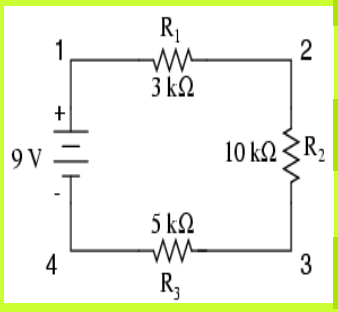
For $R_4$: V=(3Ω)(1.33 amps) V = **3.99 volts**

Check:
The sum of the voltage drops equals the voltage total supplied by the power source.

$V_{total}$ = 2.67 V + 2.67 V + 2.67 V + 3.99 V

$V_{total}$ = **12 volts**

## Practice



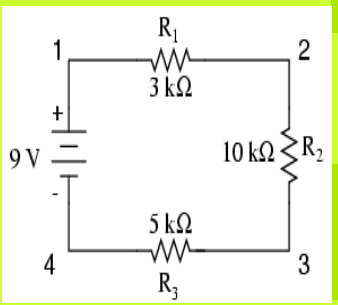

Calculate the total resistance of the circuit.

Calculate the current leaving the battery.

Calculate the current through each resistor.

## Practice

Calculate the voltage drop through each resistor.




Check:
The sum of the voltage drops equals the voltage total supplied by the power source.

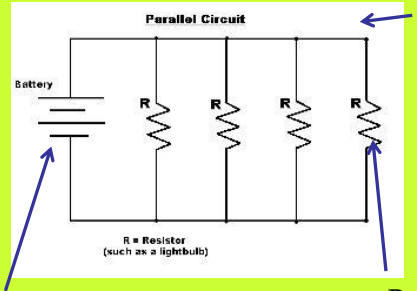
## Parallel Circuits

- A type of circuit that has more than one path for current is called a parallel circuit.
- Contains two or more branches for the current to move through

## Parallel Circuit Advantages

- If one part of the path is removed, the current continues to flow through the other paths of the circuit.
- If you turn off the light the current continues to flow through the other branches.
- If you add resistance it doesn't affect the flow of current to the other branches

## Parallel Circuit

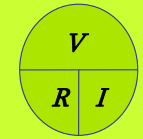


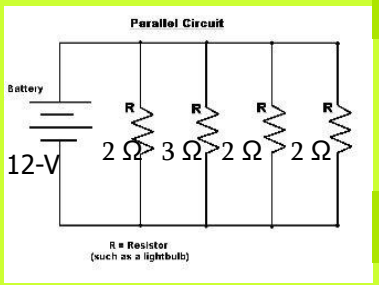

$I$
(current in conductor)

V
(voltage difference provided by a power source)

$R$
(devices that use electrical energy)

# Parallel Circuit




Calculate the current through each resistor.

For $R_1$, $R_3$,$R_4$

$I = \frac{12 \text{ Volts}}{2 \text{ ohms}}$

$I =$ **6 amps**

For $R_2$

$I = \frac{12 \text{ Volts}}{3 \text{ ohms}}$

$I =$ **4 amps**

Calculate the total current of the circuit.

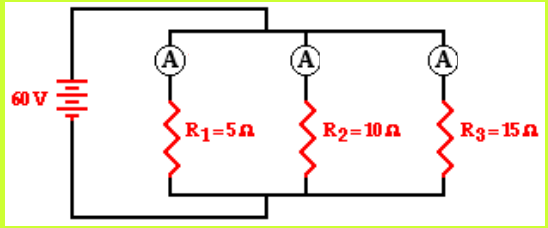
$I_{total} = I_1 + I_2 + I_3 + I_4$

$I_{total}$= 6amps+4amps +6amps+6amps

$I_{total} =$ **22 amps**

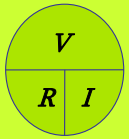
# Practice

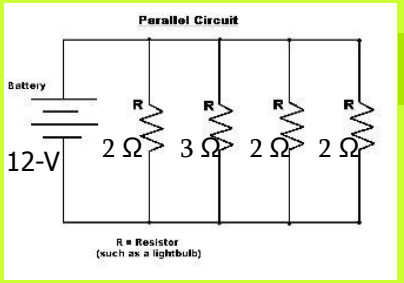
**Calculate the current for each of the different resistors.**




**You should notice that the current is greatest where the resistance is least and the current is least where the resistance is greatest.**

## Parallel Circuit

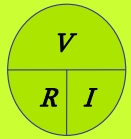


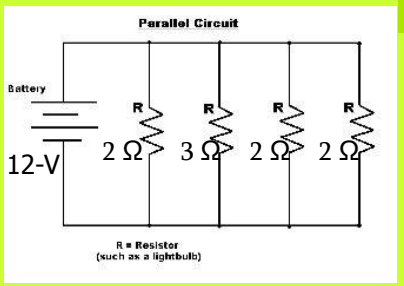




Calculate the voltage drop through each resistor.

There is no voltage drop, each branch is the same (equal to the total voltage difference of 12 volts.

## Parallel Circuit




Calculate the Equivalent Resistance

Since the circuit offers four pathways for charge flow, only a portion of the charge will *pass* through a given branch.

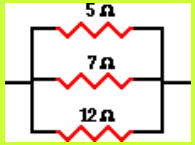
$$R_{eq} = \frac{V}{I_{total}}$$

$$R = \frac{12 \text{ volts}}{22 \text{ amps}}$$

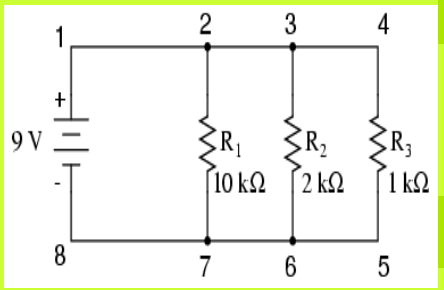
$$R_{eq} = 0.55 \text{ ohms}$$

## Practice

A 5.0 Ω 7.0 Ω and 12 Ω resistor are placed in parallel, calculate the equivalent resistance.



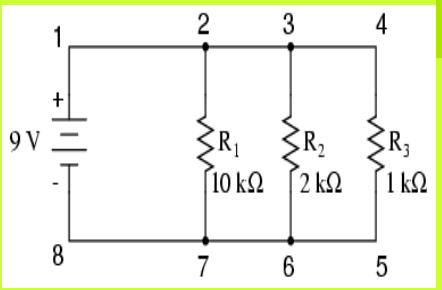

## Practice




Calculate the current through each resistor.

Calculate the total current of the circuit.

# Practice




Calculate the Equivalent Resistance