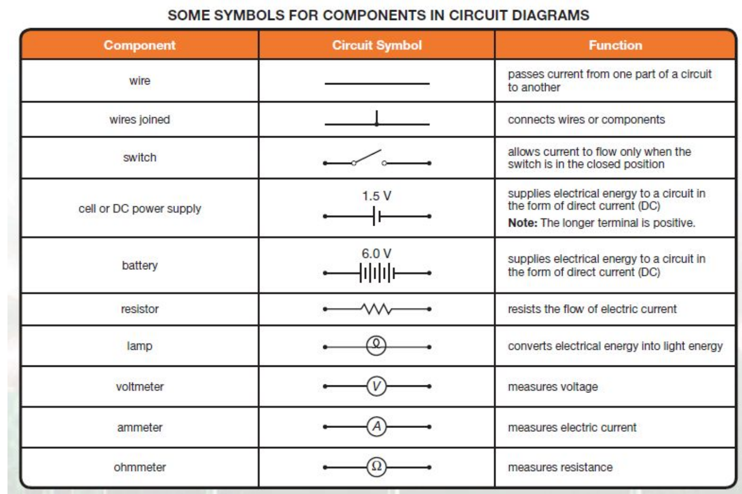
Science 30	Unit C: Physics
Lesson 5 - Electric Circuits and Resistance	84 mins

Circuit Diagrams

- Easy to read
  - Straight Lines

Draw an Example



SOME SYMBOLS FOR COMPONENTS IN CIRCUIT DIAGRAMS

Component	Circuit Symbol	Function
wire		passes current from one part of a circuit to another
wires joined		connects wires or components
switch		allows current to flow only when the switch is in the closed position
cell or DC power supply	1.5 V	supplies electrical energy to a circuit in the form of direct current (DC) **Note:** The longer terminal is positive.
battery	6.0 V	supplies electrical energy to a circuit in the form of direct current (DC)
resistor		resists the flow of electric current
lamp		converts electrical energy into light energy
voltmeter	V	measures voltage
ammeter	A	measures electric current
ohmmeter	Ω	measures resistance

Using Voltmeters/Ammeters/Ohmmeters

Voltmeters and Ohmmeters measure a potential quantity. This quantity is ALWAYS present

- Must be measured at the object you are wanting the quantity of (In parallel)

DRAW

Ammeters measure a kinetic quantity (movement of electrons). This quantity is only present with a running circuit.

- Must be measured in where you want to know the amount of electrons moving (series)

DRAW

Calculating Total Resistance

In Series
Draw Three light bulbs

$V_{total} = V_1 + V_2 + V_3 + ...$ (all resistors have to share the same voltage as there is only 1 route)

Ohms Law (V = IR)

$I_{total} * R_{total} = I_1R_1 + I_2R_2 + I_3R_3$

$I_{total} = I_1 = I_2 = I_3 = ...$ (all resistors have to share the same electron as there is only 1 route)

Therefore

$R_{total} = R_1 + R_2 + R_3 + ...$ (resistance INCREASES, bulbs dim)

In Parallel
DRAW three light bulbs

$I_{total} = I_1 + I_2 + I_3 + ...$ (every resistor can have a different electron)

Ohms law (I = V/R)

$$\frac{V_{total}}{R_{total}} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} + ...$$

$V_{total} = V_1 = V_2 = V_3 = ...$(every resistor can have a different electron from the same source aka same pressure)

Therefore

$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$ (resistance DECREASES, bulbs great brighter)

Examples

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Voltage: The amount of energy in a single charged particle ($\mathrm{Volt} = \mathrm{V}$)

Current: The rate at which electrons flow (1) Amperes (Amp = A))

Resistance: the ability of a substance to allow electrons to pass through ($\mathrm{Ohms}\ (\Omega)$)
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Ohm's Law				
Quantity	Symbol	Unit	Formula	Measured With
Voltage	V	Volts (V)	V = IR	Voltmeter
Current	I	Amperes (A)	I = V/R	Ammeter
Resistance	R	Ohms(Ω)	R = V/I	Ohmmeter

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Ohm's Law

Using Ohm's Law

Electric Stove is connected to a 240-V outlet. The current is 20A, What is the resistance of the heating element?

Steps to solving the Problem	Information and Solution
1. Identify known	Current (I) = 20 A Voltage (V) = 240 V
2. Identify unknown	Resistance (R)
3. Use Correct formula	R = V/I
4. Solve	R = V/I = 240 V/20 A R = 12 Ω

Maximum/Minimum Resistance (100% depends on voltage)

Maximum Resistance	Minimum Resistance
- Too much work to move through… therefore NO current, think dam	- Resist enough electrons so they slow to do work, think short circuit, or burnt out bulbs)

Science 30 - Lesson 29 - Unit C - Resistance

Name: ______________________________________

1. Strings of small, colourful lights are often used for holiday decorating and other occasions. An inexpensive string of these lights consists of 8 bulbs connected in series. The resistance of each bulb in the set is 64.0 W.
    a. Draw a schematic diagram of this circuit.

    b. If the set of lights is plugged into a 120-V outlet, determine the current that will flow through the set.

    c. Use your answer to part a. to determine the current that will flow through the third bulb in the string of lights.

    d. If the third bulb in the set fails, determine the effect on the other lights in the string.

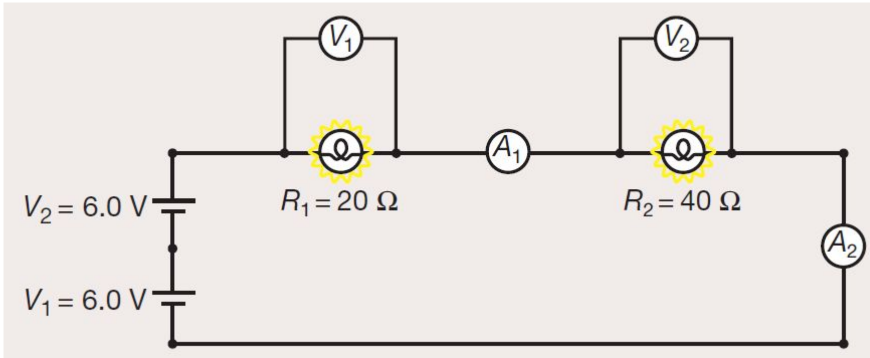
2. A group of students is setting up for a high school dance. They work to set up some spotlights and other types of specialty lighting to help set the mood. Five spotlights are plugged into a heavy-duty power strip, each light in its own outlet. Each of the spotlights has a resistance of 96 W.
    a. Explain why a power strip must allow parallel connections to each of the devices that plug into it.

    b. Draw a schematic diagram of this circuit.

    c. If the fourth spotlight has 120 V available to it, determine the voltage available to each of the other spotlights.

d. Determine the total amount of current that the power strip requires to power all five spotlights.

3. Use the following schematic diagram to answer the next questions



a. Determine the total voltage available to this circuit.

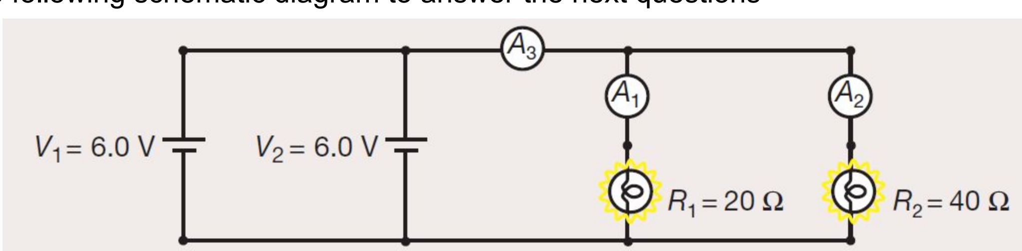
b. Calculate the total resistance of the two bulbs.

c. Calculate the current flowing through each of the bulbs.

d. Calculate the readings of voltmeters 1 and 2.

e. Explain what happens if one of the bulbs burns out.

4. Use the following schematic diagram to answer the next questions



a. Determine the total voltage available to this circuit.

b. Calculate the total resistance of the two bulbs.

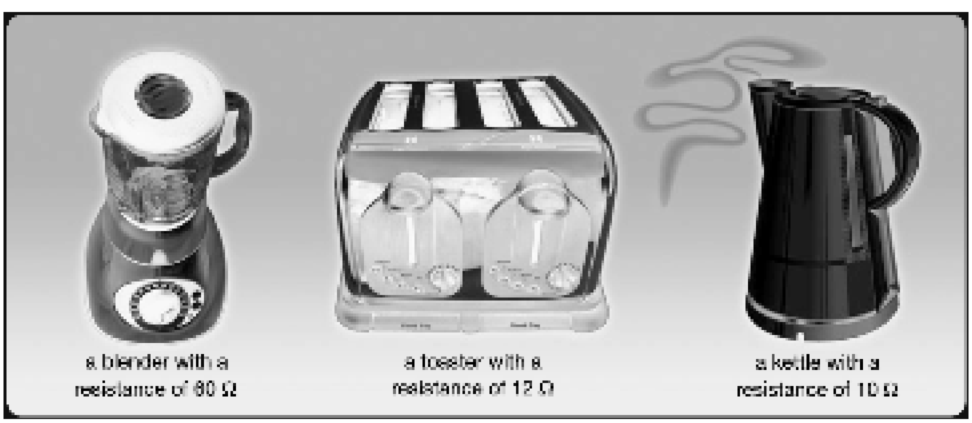
c. Calculate the current flowing through the whole circuit.

d. Calculate the readings of ammeters 1, 2, and 3.

e. Explain why the sum of the readings of ammeters 1 and 2 equal the reading of ammeter 3.

f. Explain what happens if one of the bulbs burns out.

5. A standard 120-V AC household circuit consists of parallel connections of a number of electrical outlets, which are all in series with the circuit breaker for that circuit. Suppose the following devices are all plugged in and switched on at the same time.



a. Apply Ohm’s law to each device and determine the current flowing through each one.

b. Use your answer to question a. to determine the total current required by the operation of all three devices.

c. Determine the total resistance of all three devices.

d. Use your answer to question c. to determine the total current required by the operation of all three devices. Did you get the same value as you did in question b.?

e. Use your answer to questions b. and d. to determine the outcome of switching on all three devices at once.

f. Each time another device is switched on in the kitchen circuit, another source of resistance is added to the circuit, but the overall total resistance of the entire circuit is reduced. Although this statement sounds contradictory, it does make sense. Use your knowledge of circuits to explain why there is no contradiction here.

g. Why would a breaker be needed in this situation? What is the danger? A typical breaker only allows 15.0A. What would happen in this situation?