10.1 – Static Electricity

Name: Teacher SNC1P/D Date:______________

~~Remember from the last unit that all matter is made up of atoms.~~ All atoms are made of these three kinds of particles:

protons (+)	electrons (−)	neutrons (neutral)

e⁻ ______ can move from one atom to the next. Protons and neutrons can not.

Electricity is:
- form of energy
- caused by movement of charged particles (electrons & ions)

Static electricity is:
charged particles building up in 1 place

Current electricity is:
movement of charged particles through a circuit

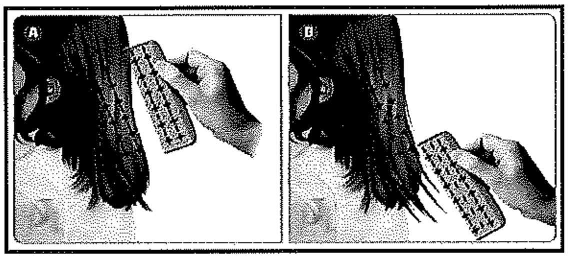
Static charge builds up when one material transfers its electrons to another material. Often times this happens when two objects rub together – this is:
charging by friction

One object has a stronger affinity (or pull) for electrons and pulls them from the other objects.

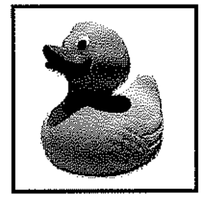
Neutral: # of protons = # of electrons
Negative charge: more electrons
Positive charge: more protons

An electrostatic series is:
list of materials arranged according to their ability to hold electrons.

Material	Strength of Hold on Electrons
Glass	weak
Human hair	
Nylon	↓
Wool	
Fur	
Silk	
Cotton	
Lucite	
Rubber Balloon	
Polyester	
Foam	
Grocery bags	
Ebonite	strong

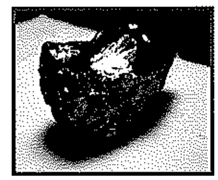


Since the comb has a stronger affinity for electrons, it builds up a negative static electric charge.



Insulators:

- electrons do not move easily through
- most non-metals



Resistors or Semiconductors:

- e^- move fairly well through
- some metalloids (silicon)

Conductors:

- electrons easily flow through
- metals

A ground is an object that can:

- supply e^- to a positively charged object
- remove e^- from a negatively charged object

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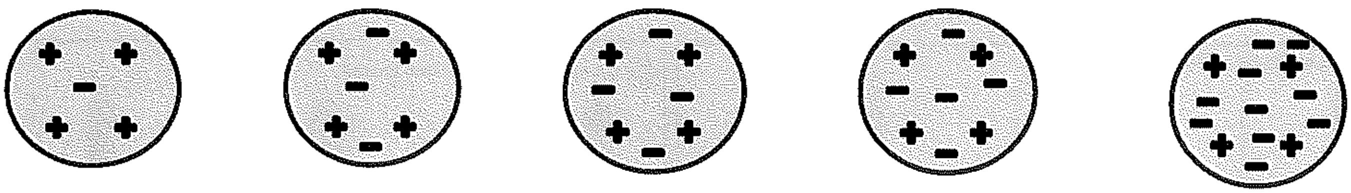
10.2 Charging by Contact and by Induction

Quick Review: If an object has more electrons than protons it will be negative.
If an object has more protons than electrons it will be positive.

The greater the difference between electrons and protons the more charged an object is.



large (+) charge	small (+) charge	neutral	small (−) charge	large (−) charge

An **electric field** is the area around a charged object, where the effect of the charge can still be felt. The size of the electrical field depends on how charged the object is.

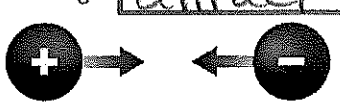
The closer you are to the object the stronger the effects of the charge will be.

Laws of Electric Charge: describes how two objects interact when one or both are electrically charged.

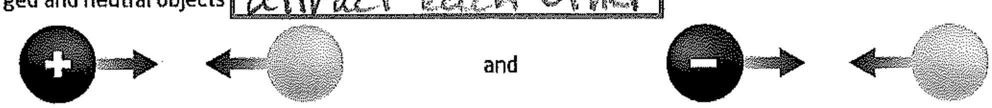
Laws of Electric Charges

1. Like charges repel

2. Opposite charges attract

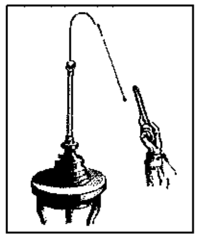


3. Charged and neutral objects attract each other

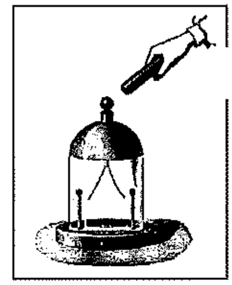


An electroscope is a device that can detect an electrical charge

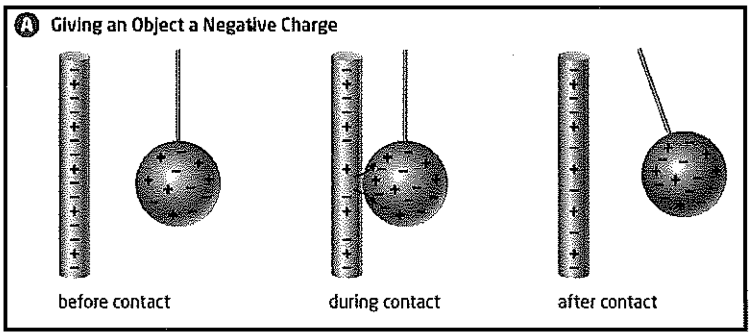
Pith Ball Electroscope: Pith ball moves when it comes in contact with a charge object

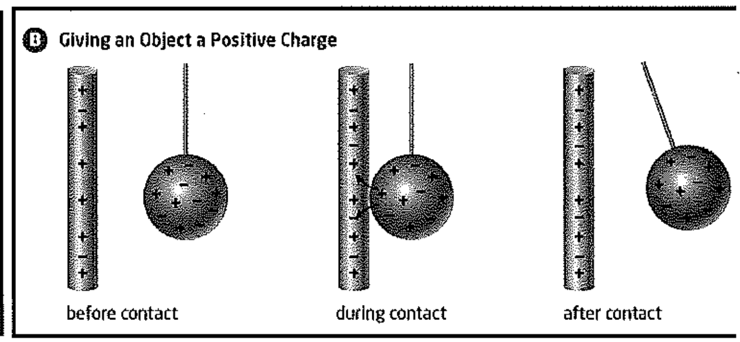


Metal leaf Electroscope: Metal leaves spread when electroscope comes in contact with a charged object.

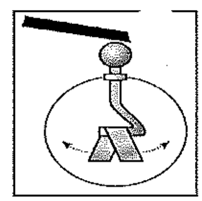


Charging by contact: is the generating of a charge on a neutral object by touching it to a charged object. The newly charged object always has the same charge as the object that touched it.



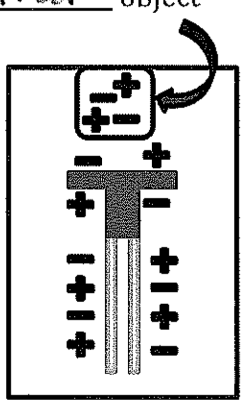


Charging by Induction: Induced Charge Separation: movement of electrons in a substance caused by the electric field of a nearby charged object; this is done without direct contact.

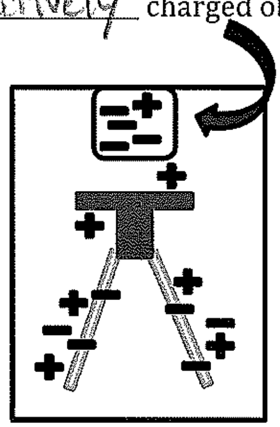


Using a metal leaf electroscope:

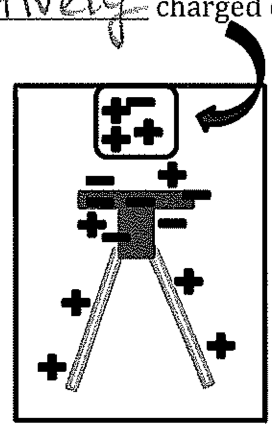
Neutral object



Negatively charged object



Positively charged object



The metal leaves in the electroscope get charged. This charge only lasts while the charged object stays near. Why? You take away the charged object, you take away the electric field.

SNC1D/P TEACHER

Charging by Friction, Induction and by Contact – Worksheet

1. Use the electrostatic series on p. 405 or in your notes to answer these questions:
   a. If a rubber balloon was rubbed against hair, the hair will more likely lose its electrons because the balloon holds onto its electrons more strongly. Therefore, the balloon will have a negative charge and the hair will have a positive charge.

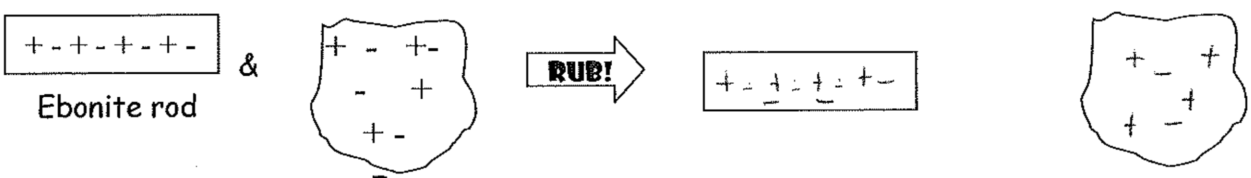
   b. Which will likely produce a greater amount of static charge: a wool sweater worn under a cotton jacket, or a wool sweater worn under a rubber rain coat? Why?

   wool - cotton 4 steps apart
   wool - rubber 5 or more steps ⇒ greater difference so stronger pull on electrons; ∴ greater static charge

2. Use the electrostatic series to determine what kind of charges (positive or negative) will be found on each object when they are rubbed together:

Material	Positive	Negative
Glass and wool	glass	wool
Ebonite and plastic	plastic	ebonite
Ebonite and fur	fur	ebonite
Human hair and silk	hair	silk

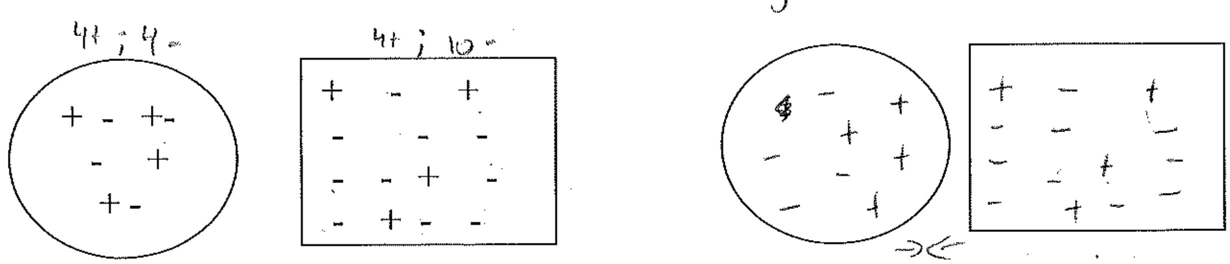
3. Show how the electrons will move when the two items below are rubbed together.



Fur

4. A. What overall charge is on the "before" ball below? Neutral (Hint: count them to be sure)

   What overall charge is on the "before" square below? negative

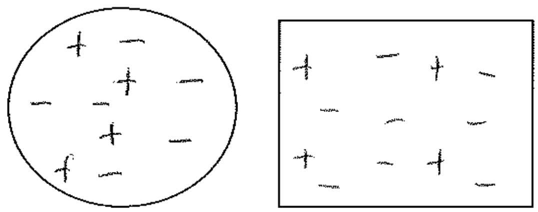


"Before" ball "Before" square "After" ball and square come close

Draw the two "after" they would come close to each other without touching. ✓

Would the two attract or repel each other? Attract

B. Now draw the ball and square after they have touched one another and then separated.



After contact, what overall charge is on the ball? neg. What about the square? neg.

Do they attract or repel each other now? repel

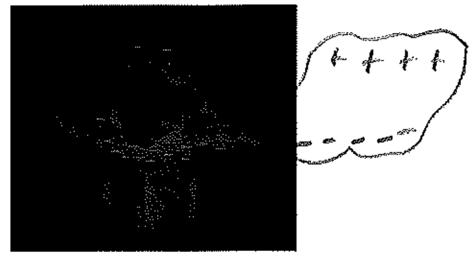
C. In 4 A. above, the ball is said to be charged by induction

D. In 4 B. above, the ball is said to be charged by contact

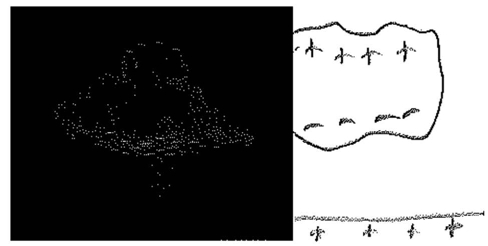
10.3 – Charges at Work

Name:________________ SNC1P/D Date:________________

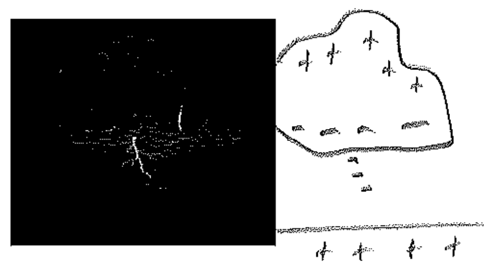
Lightning:



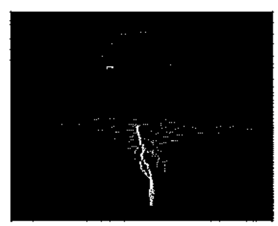
1) Air currents/particles in a storm cloud cause induced charge separation: The top of the cloud becomes __positive__ the bottom of the cloud becomes __negative__.



2) Negative charge in the cloud induces a __positive__ charge on the ground.

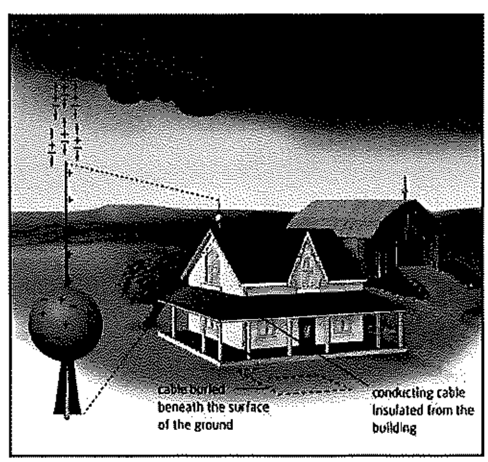


3) When too much negative charge builds up, the __electrons__ will begin to move towards the __ground__.



4) When electrons get close enough they attract positive ions from the Earth that complete the connection and form the lightning flash.

Lightning Rod

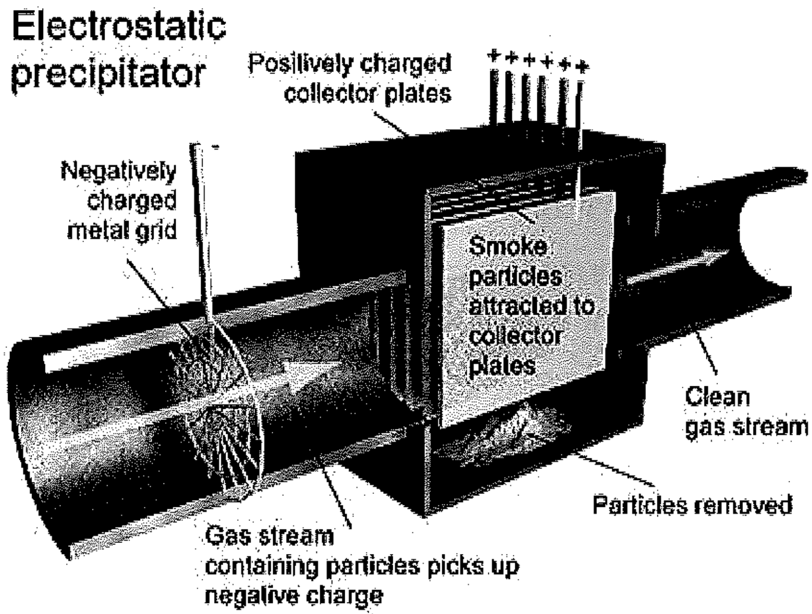


A lightning rod is a __metal__ sphere or point that is attached to the __highest__ part of a __building__ and connected to the __ground__.

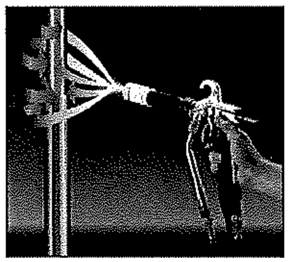
Lightning is more likely to hit the __rod__ than the __building__.

Electric Precipitator

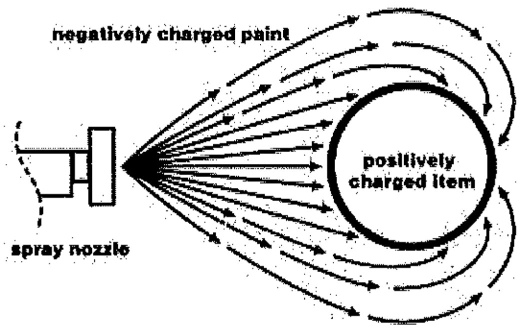
This is found in smoke stacks or ventilation filters. It uses contact charges to control pollutants.



Electrostatic Spray Painting



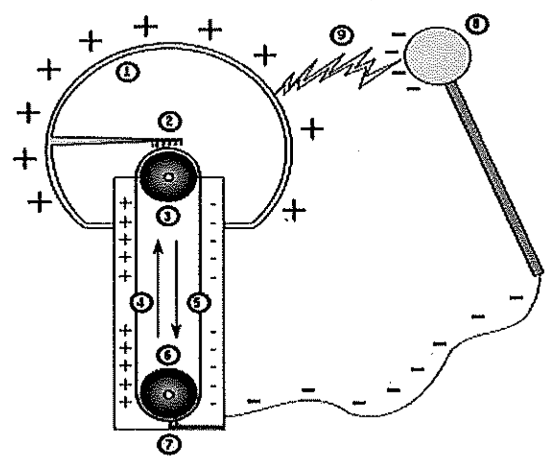
The paint leaving the spray gun is given one charge; the object being painted is given the opposite charge. This ensures maximum paint coating and minimum waste.



electrostatic painting process

Van de Graff Generator

A device that accumulates very large charges by friction. Used for atom smashers and to make electronic circuits.



Photocopier

In the dark, selenium is only a fair conductor. When exposed to light it is a good conductor. Selenium drums are used in photocopiers, laser printers and scanners.

Chapter 10 Key Terms

Match each key term in the left column with its definition in the right column.

Term		Definition
electricity	E	A. a material in which electrons cannot move easily from one atom to another
static charge	R	B. a small device that detects and measures exposure to radiation
charging by friction	J	C. generating a charge on a neutral object by touching it with a charged object
electrostatic series	G	D. a material in which electrons can move fairly well between atoms
insulator	A	E. a form of energy that results from the interaction of charged particles
conductor	I	F. a device for detecting the presence of an electric charge
semiconductor	D	G. a list of materials that have been arranged according to their ability to hold on to electrons
ground	Q	H. a device that accumulates very large charges
electroscope	F	I. a material in which electrons can move easily from one atom to another
charging by contact	C	J. a process in which objects made from different materials rub against each other, producing a net static charge on each
laws of electric charges	K	K. laws that describe how two objects interact electrically when one or both are charged
electric field	M	L. the movement of electrons in a substance, caused by the electric field
induced charge separation	L	M. a property of the space around a charged object, where the effect of its charge can be felt by other objects
ion	N	N. a charged atom or group of atoms
lightning rod	P	O. a type of cleaner that removes unwanted particles and liquid droplets from a flow of gas
electrostatic precipitator	O	P. a metal sphere or point, attached to the highest part of a building and connected to the ground
Van de Graaf generator	H	Q. an object that can supply a very large number of electrons to, or remove from, a charged object, thus, neutralizing the object
radiation dosimeter	B	R. an electric charge that tends to stay on the surface of an object, rather than flowing away

11.1 – Cells and Batteries

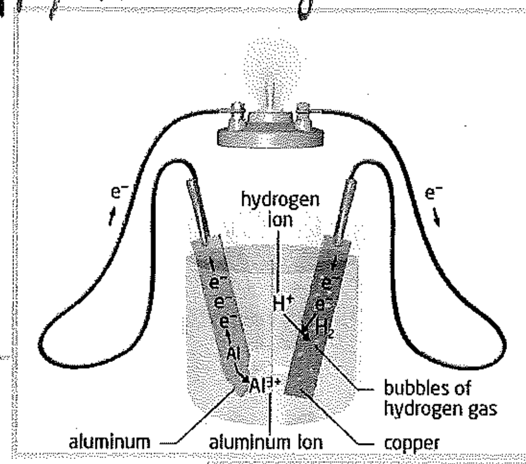
Name:________________ SNC1P/D Date:________________

What is an **electric circuit**? A closed path that electrons flow through.

Voltaic Cells (Wet Cell) – Energy source to supply electricity

A voltaic cell (wet cell) generates current by:

Chemical reactions btw 2 different metals (electrodes), placed in a conducting solution (electrolyte)



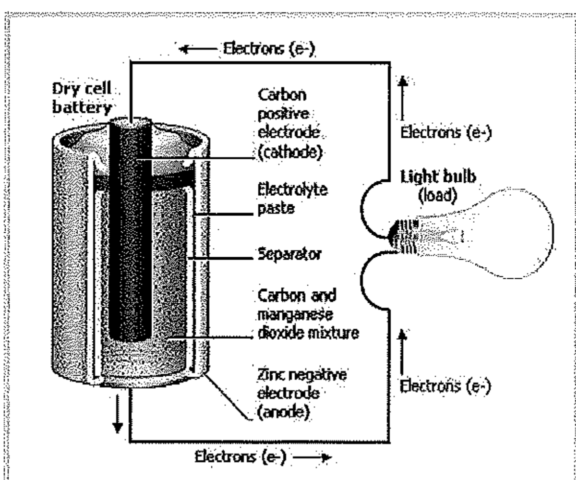
The electrolyte reacts with one electrode:

- forms (+) ions that go into the solution.
- releases e− (travel through conducting wires.

Batteries

A battery is: connection of 2 or more cells

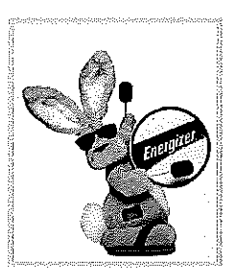
A car battery is made up of many wet cells



Dry Cell

Dry cells: same as wet cells but with an electrolyte paste

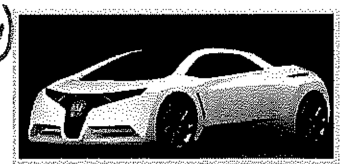
Dry cell batteries include the following:



Secondary Cell	Primary Cell
• can be recharged	• only used once

To **recharge a secondary cell**:

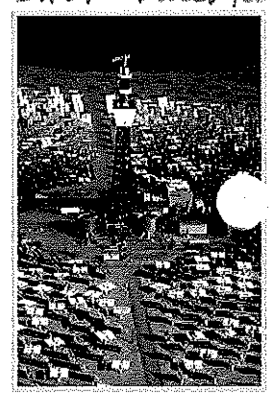
An electric current is passed through the cell in the opposite direction, from an outside source (eg wall plug). This reverses the chemical reactions and restores to its full (mostly) capacity



Fuel Cells

Fuel cells generate electricity through:

chemical reactions of fuel stored outside the cell. (Expensive; maybe better environmentally)



Solar Cells

These convert solar energy into electrical energy. Solar cells are made from: semi-conductors that lose e^- when struck by UV rays.

11.2 – Electric Circuits

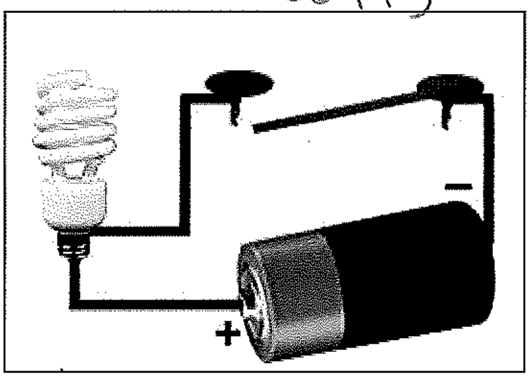
Name:________________ SNC1P/D Date:________________

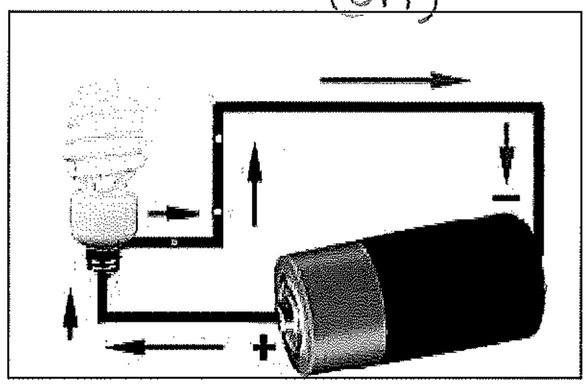
What is an **electric circuit**? Closed path for e^- to flow

The terminals are the two locations where the cell is connected to the other components.
Electrons flow from the neg. (−) terminal to the pos. (+) terminal.

A switch is: A device that can break the circuit & ∴ flow of e^- (open circuit).

The circuit below is open (off). The circuit below is closed (on).

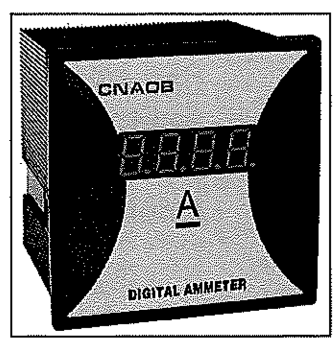




Current is:

Charge is measured in coulombs (C), which is: 6.25×10^{18} electrons

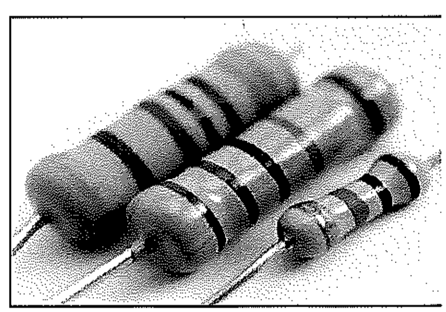
River Analogy for charge (coulombs): amount of water



Current is measured in amperes (A). A current of 1 ampere means that: 1 coulomb is passing

An ammeter is: a device to measure current (amperes)

River Analogy for Current (amperes): How fast the water is moving



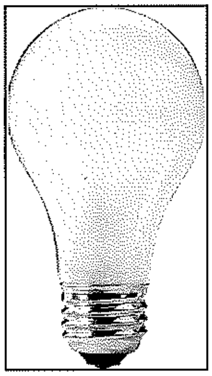
Resistance is: property of substance that hinders e^- flow.

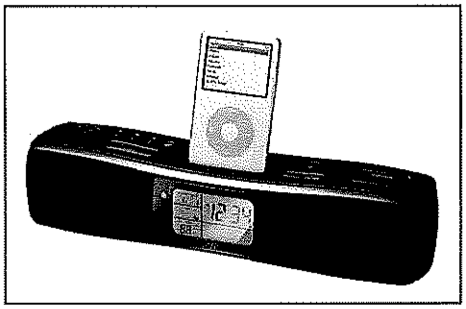
A resistor is: causes decrease in current.

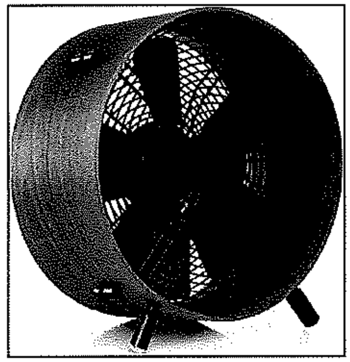
A load is: a resistor that converts electron energy to another form (and heat)

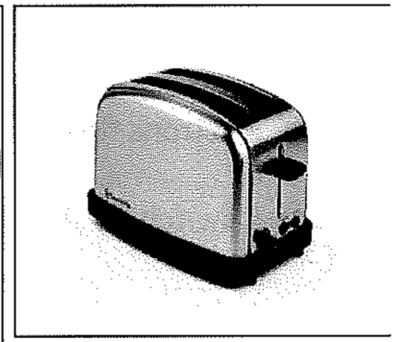
Examples include the following:

light | sound | motion | heat









Potential Difference (Voltage) is:

It's unit is the Volt (V).

A voltmeter: a device that measures voltage (potential difference)

$$\text{Potential Difference} = \frac{\text{difference in Potential Energy (J)}}{\text{Charge (C)}}$$

An electric charge does not lose energy if it were to move along a conductor with no resistance.

Homework:

Read 11.2

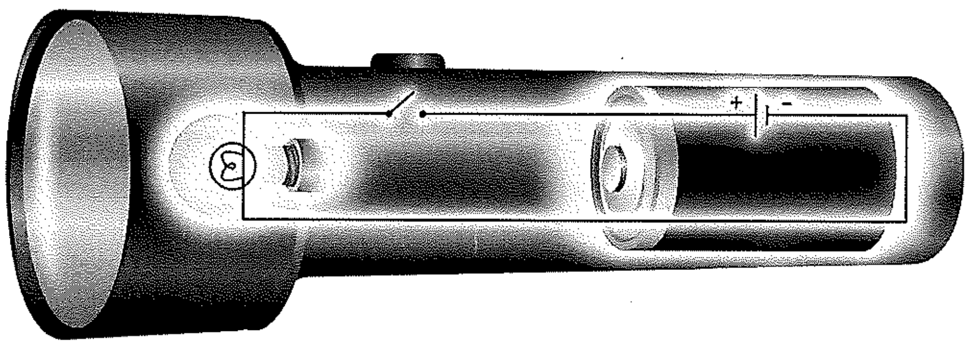
Answer pg. 451 #4, pg 454 #2-8

If done early, read 11.3

11.3, 11.4, 11.5
Properties of Circuits, Resistance and Measurement

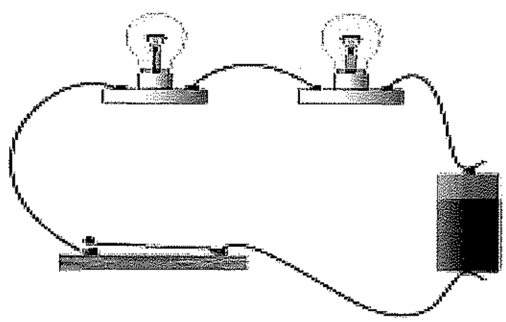
Name: Teacher SNC1P/D Date:________________

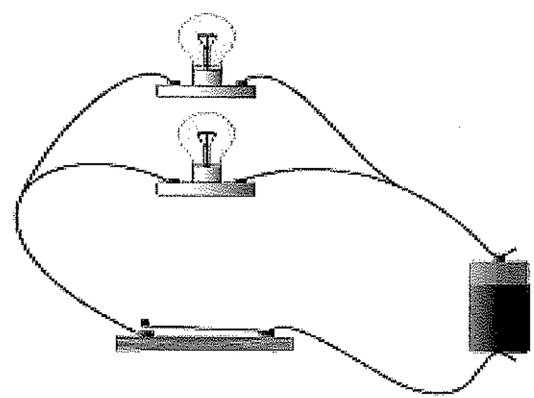
Circuit diagrams use standard symbols to represent the components of electrical circuits and their connections. Below is the circuit diagram of a flashlight.

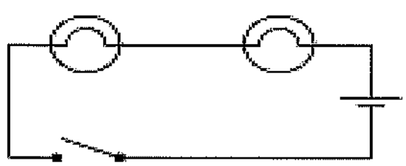


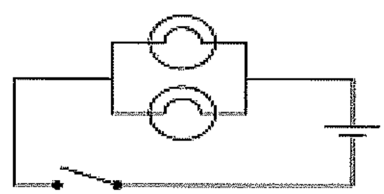
A **series circuit** has:
only one path in which electrons can flow

A **Parallel circuit** has:
has more than 1 path in which electrons can flow









An **Ammeter**:	A **Voltmeter**:
• measures current • connects in series	• measures potential difference • connects in parallel

A multimeter can measure both current and potential difference.

11.4 - All materials, even conductors, impede the flow of electrons to some extent. The ability to do so is called resistance.

Factors that Affect Resistance:

1. Type of Material: For example, a copper wire has less resistance compared to an iron wire of the same length and diameter. (Remember, less resistance means it's easier for electrons to move)
2. Length of Wire: A shorter wire has less resistance than a longer wire that is the same diameter and made from the same material.
3. Diameter of Wire: A thicker wire has less resistance than a thinner wire that is the same length and made from the same material.
4. Temperature of Wire: Resistance increases with temperature. A cold filament has less resistance then a hot filament.

You can find resistance by using Ohm's Law

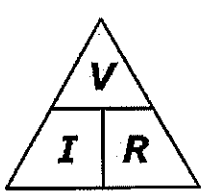
- Resistance is equal to the potential difference of the circuit divided by the circuit's current
- Resistance remains constant for most conductors
- Resistance is measured in ohms (Ω)
- The larger the resistance the smaller the current

$$R = \frac{V}{I}$$

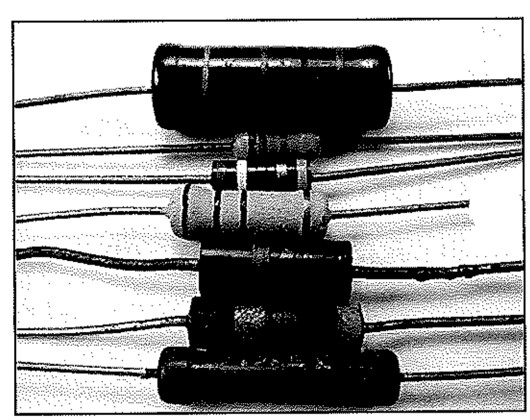
Resistance (Ω) → R

Potential Difference (V) → V

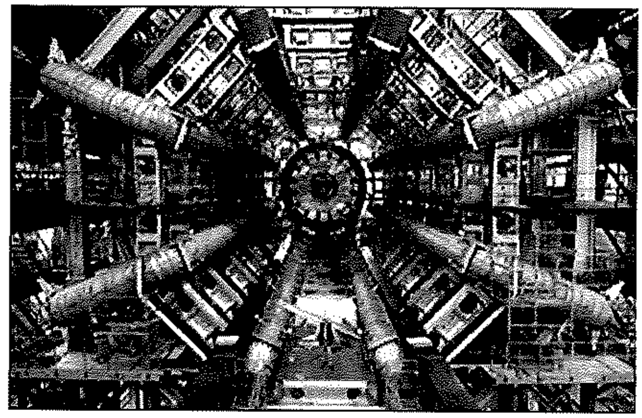
Electric Current (A) → I



A resistor is an electrical component that reduces the current in a circuit. Resistors are designed to reduce current by a specific amount.

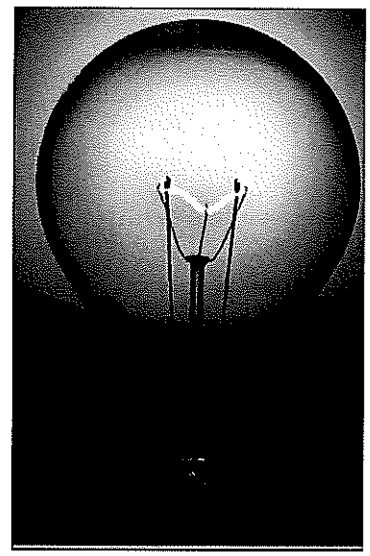


A <u>superconductor</u> is a material which electricity can flow with no <u>resistance</u>. Only some metals act as superconductors when they are <u>very cold</u>.



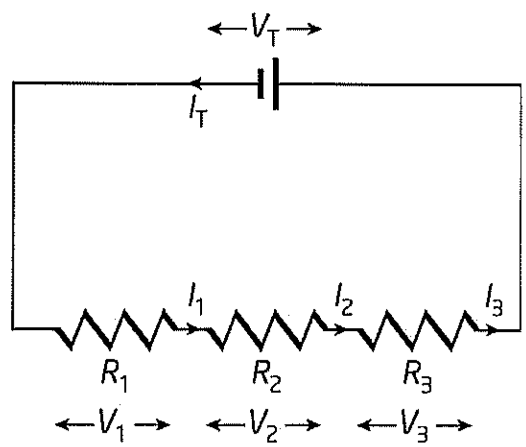
A <u>non-ohmic conductor</u> does not follow ohms law. This is because they do not have <u>constant resistance</u>.

Example: A <u>light bulb filament</u> has more resistance as it's temperature rises.



<u>11.5 - Series Circuits</u>

Current is the <u>same</u> at every point, but the potential difference and total resistance <u>depend</u> on the number of resistors.

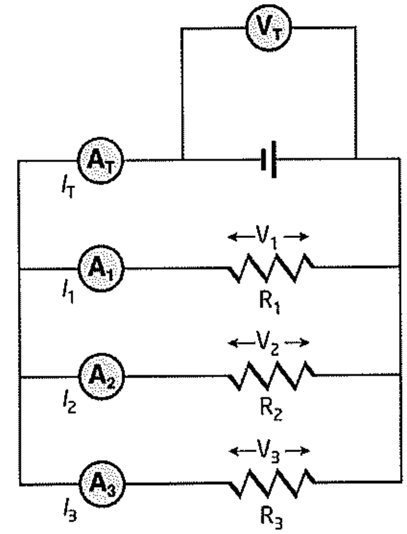


$$I_{total} = I_1 = I_2 = I_3$$
$$V_{total} = V_1 + V_2 + V_3$$
$$R_{total} = R_1 + R_2 + R_3$$

Adding more loads is like increasing the length of the wire, which increases the resistance.

Parallel Circuits

In a parallel circuit the current entering a parallel connection divides. The total current is equal to the sum of current in each parallel connection.



$$I_t = I_1 + I_2 + I_3$$

The potential difference in a parallel circuit is the same across each resistor.

$$V_{total} = V_1 = V_2 = V_3$$

To find the total resistance for a parallel circuit, we need to use the following formula:

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Not on test

DATE: NAME: CLASS:

CHAPTER 11

Designing Circuits

BLM 11-6

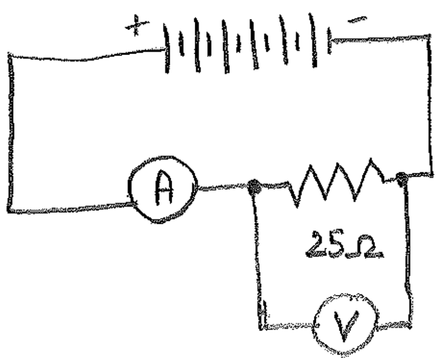
Goal • To help you draw circuit diagrams.

What to Do

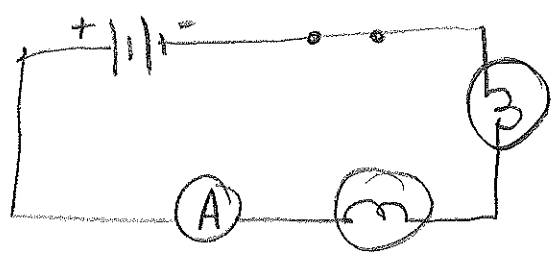
Use information from section 11.3 to help you draw the circuit diagrams described below.

Be sure to use the proper circuit symbols and label your drawings, including the positive and negative terminals of the battery, ammeter, and voltmeter. In each diagram, include an arrow to indicate the direction in which the current flows.

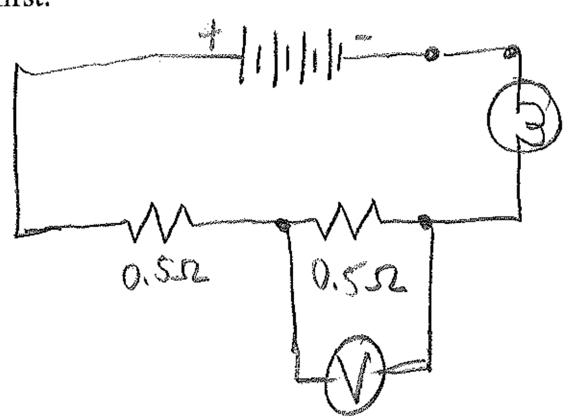
1. Draw a diagram of a circuit that consists of a 9 V battery, an ammeter, and a 25 Ω resister in series. Include a voltmeter that is measuring the potential difference across the resistor.



2. Draw an electric circuit consisting of a battery made up of two 1.5 V cells, a switch, two lamps, and an ammeter in series.



3. Draw an electric circuit consisting of a battery made up of four 1.5 V cells, one switch, one lamp, two 0.50 Ω resistors in series, and a voltmeter connected across the resistor that the current flows through first.



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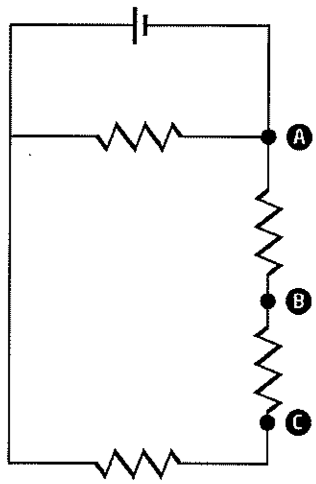
CHAPTER 11

Section 11.3 Review

BLM 11-7

1. Label each connection as either series or parallel.

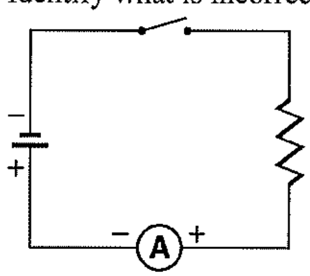


A Parallel

B Series

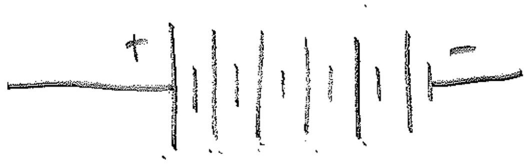
C Series

2. Identify what is incorrect about this circuit diagram.

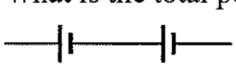


Ammeter is hooked up backwards

3. Draw the circuit symbol for a 9 V battery using 1.5 V cells in series.



4. What is the total potential difference in the battery below?



3.5 V

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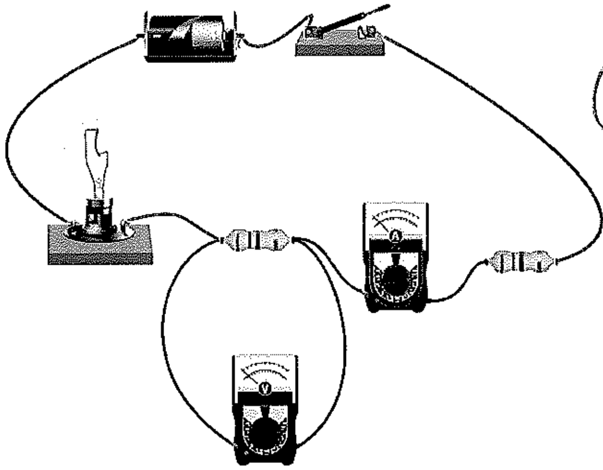
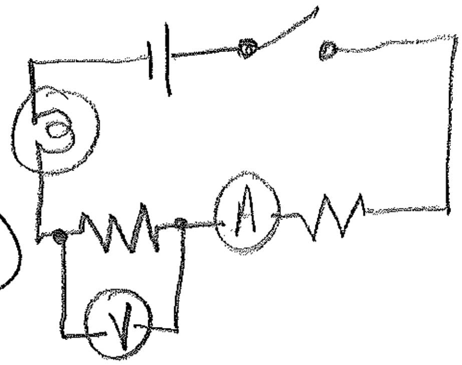
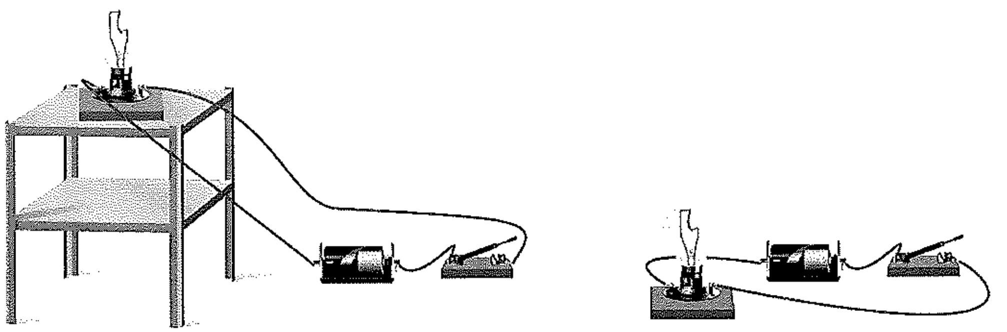
5. Draw the circuit diagram for this circuit.

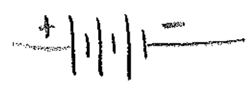




6. A light bulb is put on a table and another one is put on the ground. The light bulbs are identical. Does one bulb need a greater voltage to operate, or does gravity have no effect?

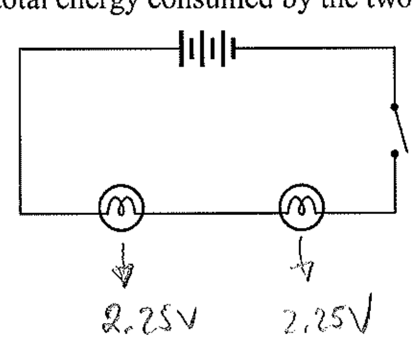


7. a. Draw a 6 V battery using:

1.5 V Cells	2.0 V Cells
	

4.5V

8. If each cell is 1.5 V, what is the total energy consumed by the two identical bulbs in the circuit below?



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Relates to p.471

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CHAPTER 11

Section 11.5 Review

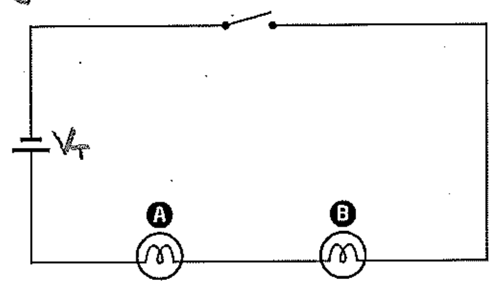
BLM 11-12

Assuming identical bulbs then yes

1. Using the diagram on the right, does $V_A = V_B$?

Does $I_A = I_B$?

↳ yes



Note $V_T = V_A + V_B$

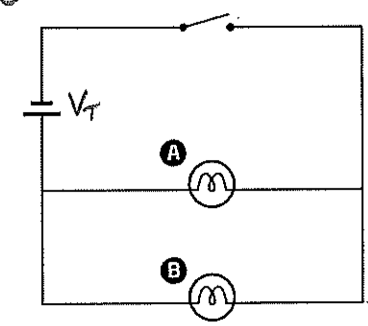
$I_T = I_A = I_B$

Assuming identical bulbs then yes

2. Using the diagram on the right, does $V_A = V_B$?

Does $I_A = I_B$?

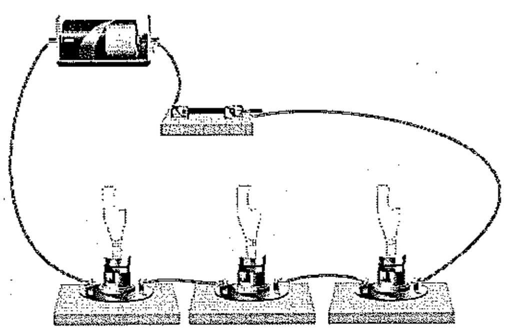
↳ Assuming identical bulbs then yes.

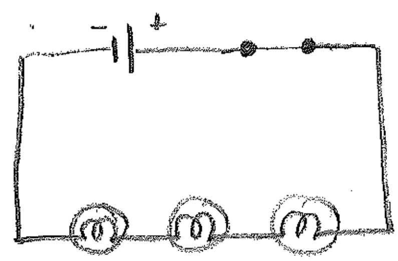


Note $V_T = V_A = V_B$

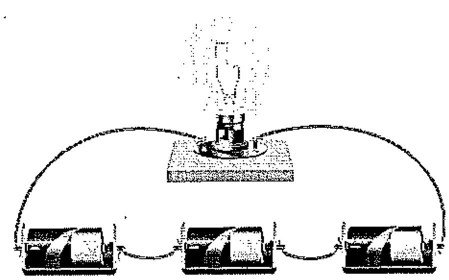
$I_T = I_A + I_B$

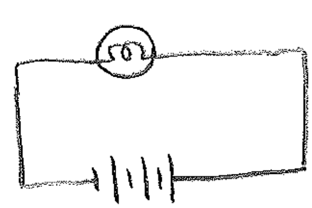
3. Draw the circuit diagram for the figure below.





4. a. Draw the circuit diagram for the figure below.





b. If each cell is 1.5 V, what is the potential difference at the light? 4.5 V

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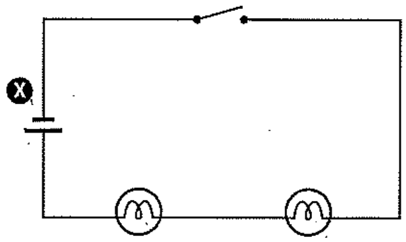
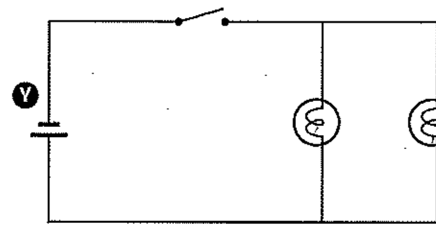
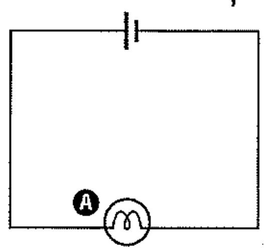
5. In the diagrams below, the cells are the same and the bulbs are identical. Is the current greater at point X or at point Y?

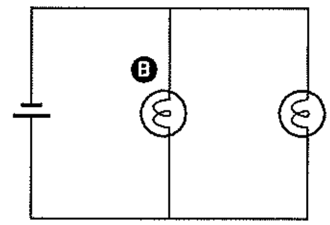
Assuming the current through each bulb is the same then Y has more current.





6. In the diagrams below, the cells are the same and the bulbs are identical. Will B be as bright as A? Yes B will be as bright as A. (Same amount of NRG to "spend")

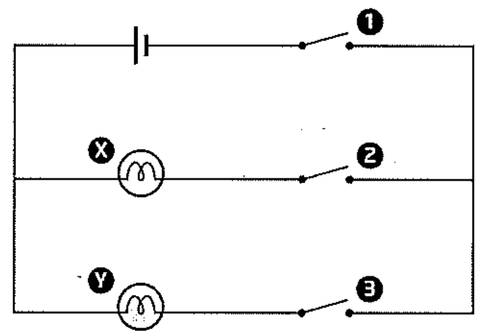




7. A string of holiday lights will stay on even if a bulb burns out. Explain how.

They are in parallel

8. Use the diagram to fill in the chart.



Switch 1	Switch 2	Switch 3	Bulb X	Bulb Y
Closed	Open	Open	Off	Off
Closed	Closed	Open	On	Off
Open	Closed	Closed	Off	Off
Closed	Open	Closed	Off	On
Closed	Closed	Closed	On	On

Does the intensity of the light bulb ever change when it is on? No - Bulbs are in parallel

Ask if the lightbulbs would shine w/ the same brightness (intensity) [struck-out text] whenever one, or both is on.

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DATE: NAME: Teacher CLASS:

CHAPTER 11 BLM 11-8

Calculating Resistance, Voltage or Current

Goal • To help you calculate resistance.

What to Do

Read the Sample Problem on page 463 in your textbook. Use it as a sample to help you calculate answers to the following questions. For each problem, write the equation you will use, and then solve it. The first one is done for you.

1. Only 2.5×10^{-3} A of current pass through a portable CD player. If the CD player is operated by a 9 V battery, what is the resistance within the circuit?

Calculations: Current, $I = 2.5 \times 10^{-3}$ A

Potential difference, $V = 9$ V

$$V = IR$$

$$9 = 2.5 \times 10^{-3} R$$

$$\frac{9}{2.5\times10^{-3}} = \frac{2.5\times10^{-3}}{2.5\times10^{-3}} R$$

OR

$$V = IR$$

$$\frac{V}{I} = \frac{IR}{I}$$

$$\frac{V}{I} = R$$

$$\frac{9}{2.5\times10^{-3}} = R$$

$$R = 3600\Omega$$

2. An automobile headlight has an average resistance of 24 Ω. Car batteries provide a potential difference of 12 V. What amount of current passes through the headlight?

G. $R = 24\Omega$
$V = 12$ V

R. $A = ?$

A. $V = IR$
$I = \frac{V}{R}$

S. $I = \frac{12}{24}$
$= 0.5$

P. The current is 0.5 A

3. In a portable radio, 0.5 A of current are flowing through a conductor that provides 18 Ω of resistance. What potential difference is provided by the battery?

G I = 0.5 A
R = 18 Ω
R V = ?

A. V = IR

S. V = 0.5(18)
= 9

P. Battery is 9V

4. A clothes dryer uses a 220 V power source. The coils of the heater provide an average resistance of 12 Ω. What amount of current is flowing through the heating coils?

G. V = 220
R = 12
R I = ?

A. V = I R
I = V/R

S. I = 220/12
= 18.3

P. 18.3 A

5. A 9 V battery maintains a current of 3 A through a portable radio. What is the resistance of the conductor?

G V = 9
I = 3
R R = ?

A. V = IR
R = V/I

S. R = 9/3
= 3

P The resistance is 3 Ω

6. An automobile headlight has a resistance of 40 Ω when attached to a standard 12 V battery. How much current flows through the headlight?

G. R = 40 Ω
V = 12
R I = ?

A. V = IR
I = V/R

S. I = 12/40

I =

7. A portable CD player, operating with four 1.5 V batteries connected in series, provides a resistance of 15 000 Ω. What amount of current is flowing through the CD player?

G V = 4 × 1.5
= 6 V
R = 15000 Ω
R I = ?

A. V = IR
I = V/R

S I = 6/15 000
=

8. An electric motor has an operating resistance of 25 Ω when a 4.8 A current is flowing through it. What is the potential difference of the outlet the motor is plugged into?

G R = 12
I = 4.8
R V = ?

A V = IR

S V = 4.8(25)
= 120 V

P 120 V is being provided by the outlet

SNC1D/P Name: ____________________ Date: __________

Solving Series and Parallel Circuits Worksheet

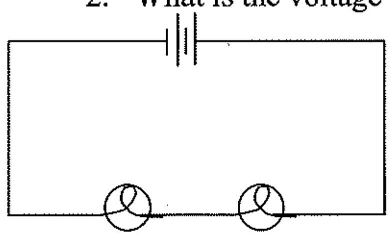
Don't forget to include units with your answers.

1. State the three mathematical equations for **series circuits** that explain how current, voltage and resistance in one part of the circuit is related to the total current, voltage or resistance (i.e. use V_1, V_2 for A); I_1, I_2 for B); and R_1, R_2 for C) :

A) $V_T =$ $V_1 + V_2 + V_3 \ldots$ B) $I_T =$ $I_1 = I_2 = I_3 \ldots$

C) $R_T =$ $R_1 + R_2 + R_3 \ldots$

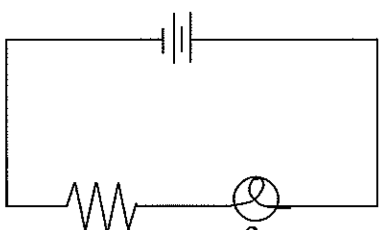
2. What is the voltage of light bulb 1(V_1)?



1 2

$V_T =$ 6 V $V_1 =$ 4 V $V_2 =$ 2 V

3. What is the total voltage (V_T) for the circuit? What is the current at the resistor (I_1)?



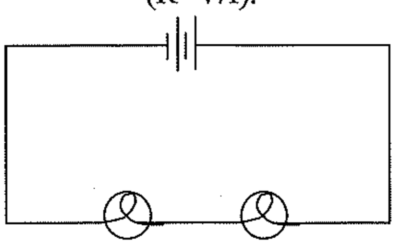
1 2

$V_T =$ 4 V $V_1 =$ 3 V $V_2 =$ 1 V

$I_T =$ 6 A $I_1 =$ 6 A $I_2 =$ 6 A

4. Calculate the total resistance using the information given and your Ohm's Law equations (R=V/I).

$I_T = I_1 = I_2$



1 2

$V_T =$ 10 V $V_1 =$ 6 V $V_2 =$ 4 V

$I_T =$ 5A

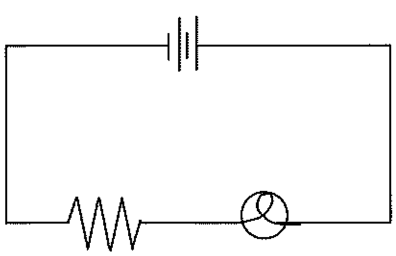
$R_T =$ 2 Ω

$R_1 = \frac{V_1}{I_1} = \frac{6}{5}$ $R_2 = \frac{V_2}{I_2} = \frac{4}{5}$

$R_T = R_1 + R_2 = \frac{6}{5} + \frac{4}{5} = \frac{10}{5} = 2$

5. Solve for all of the missing values. Use your Ohm's Law equations (R=V/I) to solve for resistance.

$I_T = I_1 = I_2$



1 2

$V_T =$ 8V $V_1 =$ 5 V $V_2 =$ 3 V

$I_T =$ 2A

$R_T =$ 4 Ω

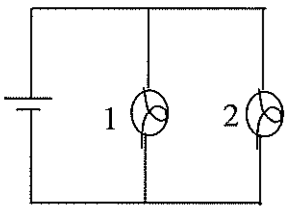
$R_1 = \frac{V_1}{I_1} = \frac{5}{2}$ $R_2 = \frac{V_2}{I_2} = \frac{3}{2}$

$R_T = R_1 + R_2 = \frac{5}{2} + \frac{3}{2} = \frac{8}{2} = 4$

6. State the two equations for **parallel circuits** that explain how current and voltage in one part of the circuit is related to the total current and voltage for the circuit (i.e. use V_1, V_2 for A); and I_1, I_2 for B) :

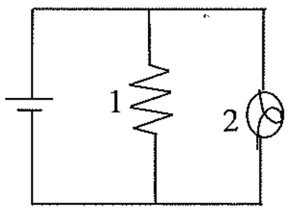
A) $V_T =$ $V_1 = V_2 = V_3 \ldots$ B) $I_T =$ $I_1 + I_2 + I_3 \ldots$

7. What is the voltage for light bulb 2 (V_2)? What is the current at light bulb 1 (I_1)?



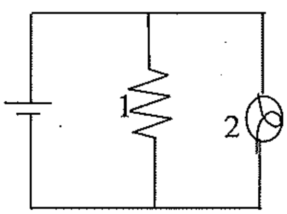
V_T = 6 V	V_1 = 6 V	V_2 = 6V
I_T = 12 A	I_1 = 5A	I_2 = 7 A

8. Solve for all of the missing values.



V_T = 120 V	V_1 = 120 V	V_2 = 120V
I_T = 26 A	I_1 = 16 A	I_2 = 10 A

9. Solve for all of the missing values. Use your Ohm's Law equations (R=V/I) to solve for total resistance.



V_T = 11 V	V_1 = 11 V	V_2 = 11 V
I_T = 12 A	I_1 = 4 A	I_2 = 8 A
R_T = 0.92 Ω		

$R_T = \frac{V_T}{I_T} = \frac{11}{12}$

or $R_1 = \frac{V_1}{I_1} = \frac{11}{4}$ $R_2 = \frac{V_2}{I_2} = \frac{11}{8}$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_T} = \frac{4}{11} + \frac{8}{11}$

$\frac{1}{R_T} = \frac{12}{11}$

$12 R_T = 11$

$R_T = \frac{11}{12}$

SNC1D/P Date: ___________

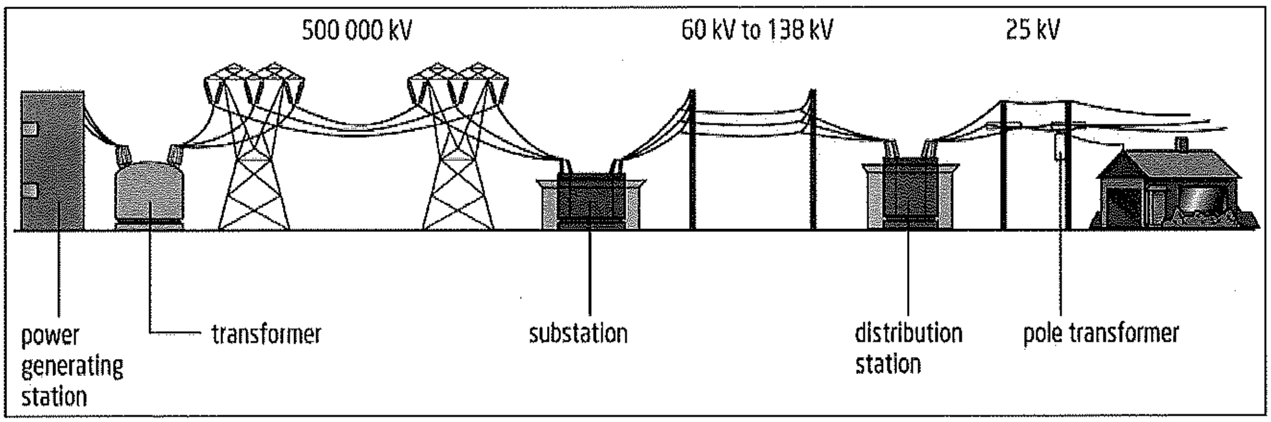
12.1 Electricity At Home

Direct Current (DC): current that allows charged particles to only flow in - one direction.

Alternating current (AC): current where charged particles move back & forth in both directions.

- This type of current alternates about 60 x per second.

Alternating current is generated when a magnet and a coil of wire are moved relative to one another in a power generating station. The electrical wires in your home are part of a giant circuit connected to the station.



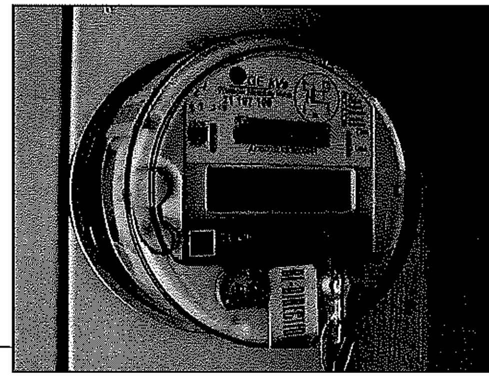
Electricity must have a high voltage and low current to travel many Km from a station to a house. Household appliances, on the other hand, require much lower voltage. A **transformer** is a device that can change the potential difference of an alternating current.

Step down transformers: decrease Voltage

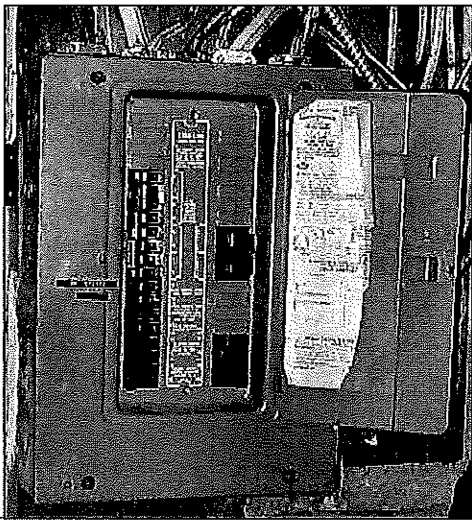
Step up transformers: increase Voltage

Electricity entering your home from outside power lines has __3__ wires.

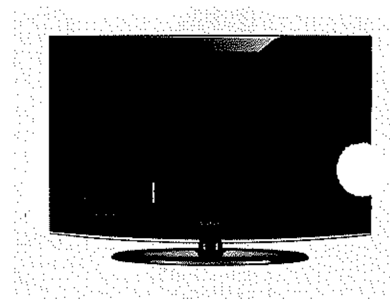
- __2__ live wires
- __1__ ground wire



Electricity then passes through a __meter__ which monitors electricity consumption



Next is the distribution __panel__ which consists of circuit __breakers__ and fuses.



Electrical __loads__

Circuit Breakers: A __safety__ device that will automatically __stop__ the flow of electricity if the circuit becomes stressed (__overloaded__).

DATE: NAME:

CHAPTER 12

Section 12.1 Review

BLM 12-4

1. In direct current, electrons flow in a circuit from negative to positive.
   In alternating current, instead of flowing, electrons move back & forth.

2. Andy's microwave oven requires 2400 V to operate. He plugs it into a 120 V wall outlet. How is the potential difference obtained?
   A. The microwave takes 20 times as long to work.
   (B.) The microwave contains a step-up transformer.
   C. The microwave contains a step-down transformer.
   D. The microwave uses batteries as well.

3. Select the material that correctly answers each question.

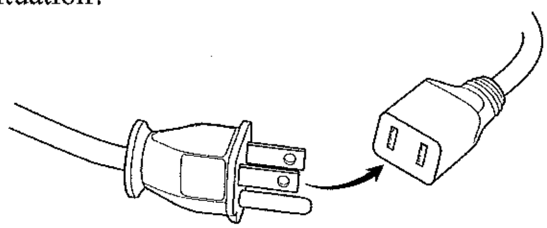
Which material are older transmission lines are made from?	(copper)	aluminum
Which material are newer transmission lines are made from?	copper	(aluminum)
Which material is a better conductor?	(copper)	aluminum
Which material is denser?	copper	aluminum
Which material costs less?	copper	(aluminum)

4. Refer to **Table 12.1** on page 490. A circuit breaker is better than a fuse because
   It can be reset ... reused

5. Complete the table of electrical hazards and safety tips. List two different situations that could result in a large current in a household circuit.

Electrical Issue	Hazard	Safety Tips
appliance gets wet	electric shock	remove from wet area dry area
overload	electrical fire damage devices	Limit the number of appliances on the same circuit.
loose wires	electrical fire	replace wire tape/secure
lightning	power surge damages electronic devices	lightning rod; unplug; power bar

6. What is unsafe about this situation?



If an overload accurs, no ground protection

7. A bird can rest safely on a 230 000 V transmission line. If someone is trimming a tree and touches the same line, they will be electrocuted. Explain why. Use a diagram if you like.

closed circuit; e^- to ground

12.2 Using Electrical Energy Wisely (p. 492)

Choosing appliances carefully and choosing how and when you use them can make a big difference in the financial and environmental cost of electrical energy.

The cost of electricity depends on the amount of energy that is used and the price that is charged for it.

The amount of electricity used in your home depends on three factors:

- the power rating of the appliance
- the setting on the appliances (such as high, medium, or low)
- the amount of time that each appliance is used

Power Ratings

The power rating of an appliance represents the amount of energy that appliance uses in a particular amount of time. Electrical power is the rate at which an appliance uses electrical energy. The unit for electrical power is the watt (W). (The kilowatt (kW) is a more practical unit for buying or selling power. 1 kW = 1000 W) The power ratings for a variety of electrical devices are shown on page 493.

Amount of Use

The electrical energy used by an appliance at a given setting is determined by multiplying its power rating by the length of time it is used. The practical unit for electrical energy is the kilowatt-hour (kW·h).

1 kW·h = 1kW × 1h

EnerGuide labels give details about how much energy an appliance uses in one year of normal use.

The joule (which is the unit for any form of energy) is equal to:

Energy (J) = Power (W) × time (s) or (E = P × t)

Power can also be calculated using the equation:

Power (W) = Current (A) × Potential Difference (V) (P = I × V)

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$$

(what you actually get) — useful energy output

(what you are suppose to get) — total energy input

Cost of Electrical Energy

The cost of electrical energy depends on the ___amount___ of energy used and the ___price___ that is charged for it. The price of the electricity is set by the local utility company that is providing electrical service to a home or business.

Prices are usually stated in ___cents___ per kilowatt-hour (¢/kW·h).

To calculate the cost of electricity, multiply the kilowatt power rating for an appliance by the number of hours the appliance was used for by the price per kilowatt-hour that the utility company is charging.

Cost of Electrical Energy (¢) = kW × h × ¢/kW·h

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Smart Meters

Smart meters are electrical meters that record the ___electrical energy___ used hour by hour. They send this information to the utility company ___automatically___. If consumers have a smart meter installed in their home, they will be billed based on time of use pricing.

Time of use pricing is a system of pricing in which the cost of each kW·h of energy used is different at different ___times___ of the ___day___.

Smart meters encourage ___energy conservation___ by making people think about ___when___ and ___how long___ they use electricity. In order to save money, consumers may wish to reduce electricity use during ___peak___ periods.

Phantom Loads

Many appliances are in ___Stand-by___ mode when they are not switched on. The electricity that is consumed by an appliance or device when it is turned off is called a ___Phantom load___. Phantom loads are most common in appliances with clocks and lights that ___stay on___ at all times, and in external power adapters that are ___plugged___ into wall outlets and change electricity into low voltage AC or DC currents.

Meters can be used to test appliance or devices in order to determine their phantom loads.