Ch. 17 Welcome to the Wonderful World of ElectroMagnetism!

7th Physical Science

17.1 ElectroStatics

- Atom (Pg. 10)
  - + charge on _____
  - - charge on _____
  - 0 charge on _____

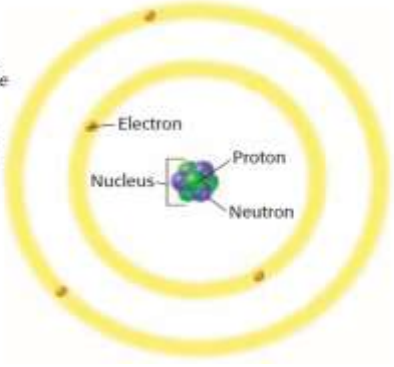


Figure 1 *Protons and neutrons make up the center of the atom, the nucleus. Electrons are found outside the nucleus.*

17.1 ELECTROSTATICS

- Pg. 9 #1
  a) + charge on an object by [gaining][losing] electrons
  b) - charge on an object by [gaining][losing] electrons

#2 Like charges _____. Opposites _____

- What is the unit for electric charge?

Coulomb

17.1 ELECTROSTATICS

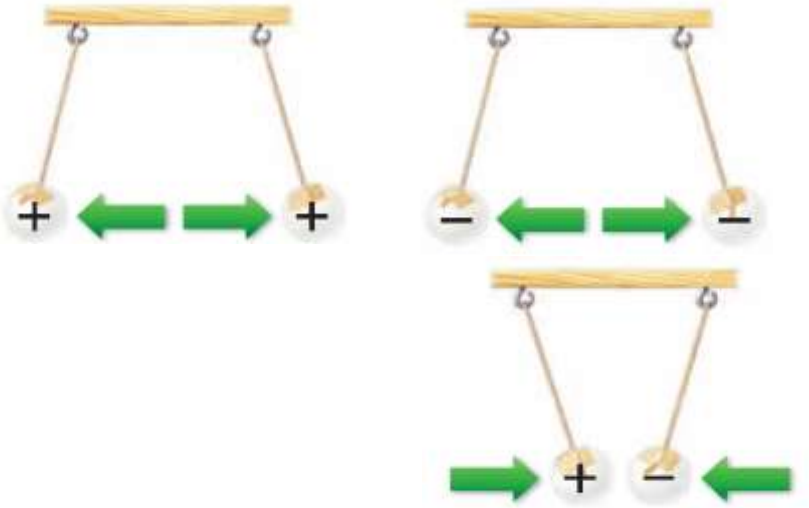
Coulomb's Law

For

Electric Force

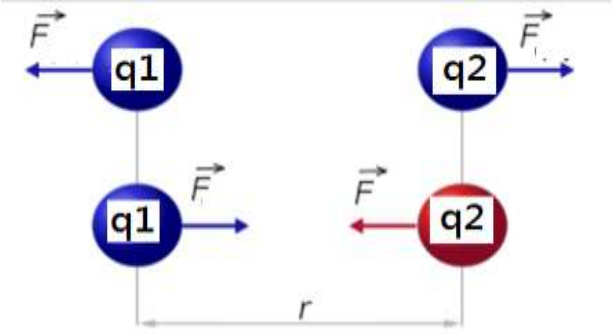
(pg. 1)

- **Electric (Coulomb) force**



- Coulomb's Law for **Electric Force**

$$F = k_e \frac{q_1 q_2}{r^2}$$



- Coulomb's constant

  $k_e = 8.987551 \times 10^9\ Nm^2/C^2$

17.1 ELECTROSTATICS (PG. 1)

- Electric force (unit ____) = ?
- Electric field (unit _____) = ?
- Static electricity = ?

17.1 ELECTROSTATICS

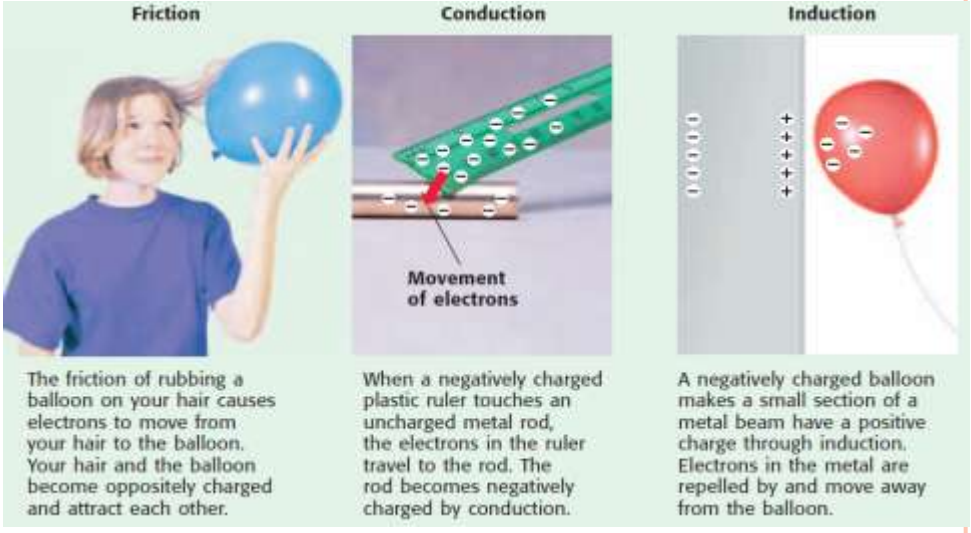
- Electric force (unit N) = push/pull between charges
- Electric field (unit N/C) = space around a charged object
- Static electricity = charges that are <u>not moving</u>

17.1 ELECTROSTATICS: PG. 9

How to charge up ?

17.1 ELECTROSTATICS

- **How to charge up** ?



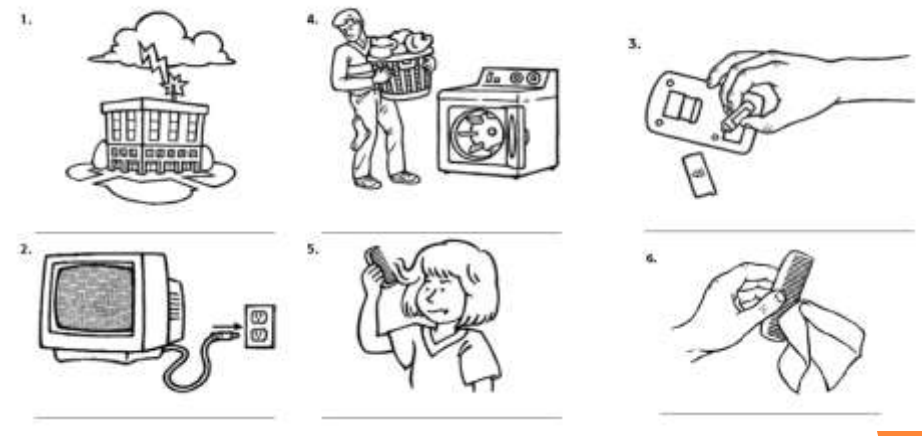
Methods of Charging Up

- Describe the methods you observe in this clip:
- http://www.youtube.com/watch?v=EURZLiQfM7k&NR=1&feature=fvwp (Mr. Bean static electricity)

17.1 ElectroStatics

- Pg. 10

Q) Label the following pictures as examples of *conduction*, *induction*, *friction*, or *electric discharge*.



17.1 ELECTROSTATICS

Charge is *conserved*

17.1 ELECTROSTATICS

- How to **detect** charge: ***electroscope***
- Can the electroscope detect if the charge is positive or negative? [yes][no]

17.1 ELECTROSTATICS

- Charges can move
- - charged metal rod. Touch another metal rod. What happens?
- + charged metal rod. Touch another metal rod. What happens?
- Some materials are better at letting charges move than others.
- This is good at letting charges move: [conductor][insulator]
- This is bad at letting charges move: [conductor][insulator]

17.1 ELECTROSTATICS

CONDUCTOR	INSULATOR

17.1 ELECTROSTATICS

- Which parts are conductors? Insulators?

17.1 ELECTROSTATICS

- Earth is a big ***sink*** for electric charge

17.1 ELECTROSTATICS

- How does static electricity build up?
- Puppy: http://www.youtube.com/watch?v=HDeFBAT1IEo

:_electricity.asp

17.1 ELECTROSTATICS

- Why do static shocks happen on hot dry days?

17.1 ELECTROSTATICS

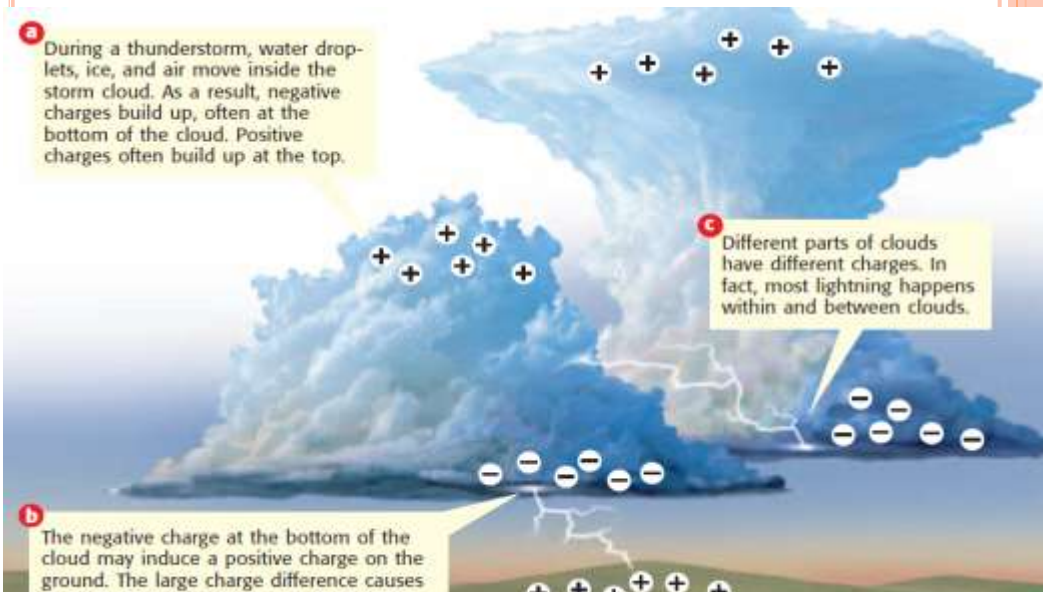
- How to avoid static cling of socks in the dryer?

17.1 ELECTROSTATICS

- What kind of shoes should people at grain silos wear? [conductive][insulating]

17.1 ELECTROSTATICS

- How does lightning happen?



17.1 ELECTROSTATICS

- How do lightning rods work?

HW

- Read 17.1
- Page 3 (17.1 questions)
- Page 10 (induction, conduction, friction, or electric discharge)
- ~~Crossword (Pg. 6) – preview all the vocabulary words~~

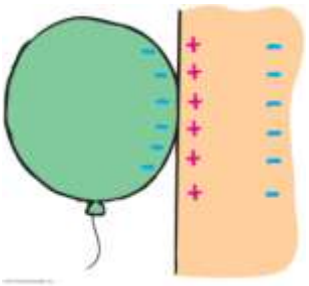
- Mini-lab on Wednesday – making static electricity

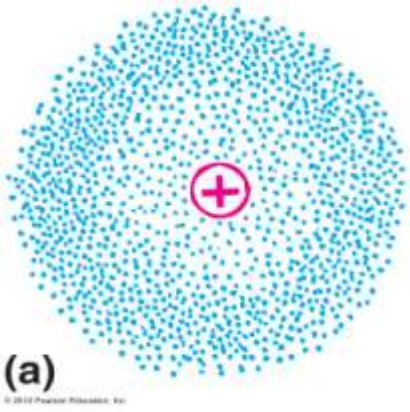
CROSSWORD (PG. 6) – PREVIEW ALL THE VOCABULARY WORDS

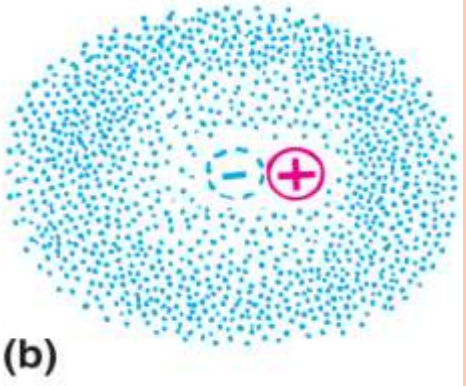
- Word bank

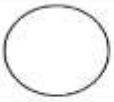
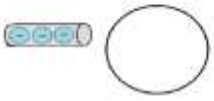
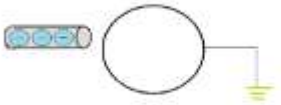
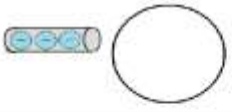
insulator	**power**	**load**
conductor	**voltage**	**battery**
insulator	**resistance**	**switch**
static	**current**	**photocell**
induction	**potential**	**series**
conduction	**force**	**circuit**
discharge	**charge**	**cell**
	field	**thermocouple**

Q) How does the balloon induce charge on the wall?







Close up look	A metal sphere and charged rod
	
	
	
	
	

ACTIVITY (PG. 7~8)– MAGIC WAND LAB

- Activity #1: Balloon
- Activity #2: Pith Balls
- Activity #3: Van de Graaf Generator Video

17.1 ELECTROSTATICS

- Van-de-Graaff

- http://www.youtube.com/watch?v=WS9ISUXBsa8&feature=related
- http://www.youtube.com/watch?v=hh8PqQDOAb8

17.1 ELECTROSTATICS

- Electric field

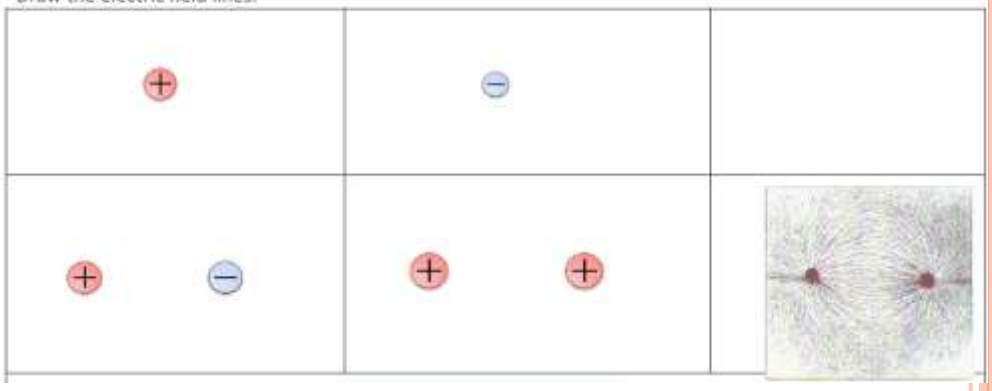
  Fill in Page 10

Electric Field: Pg. 11

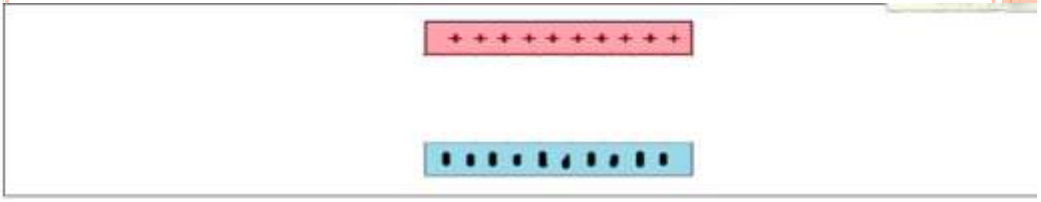
III. Electric Field = _____ = _____

SI Unit = _____

Draw the electric field lines.



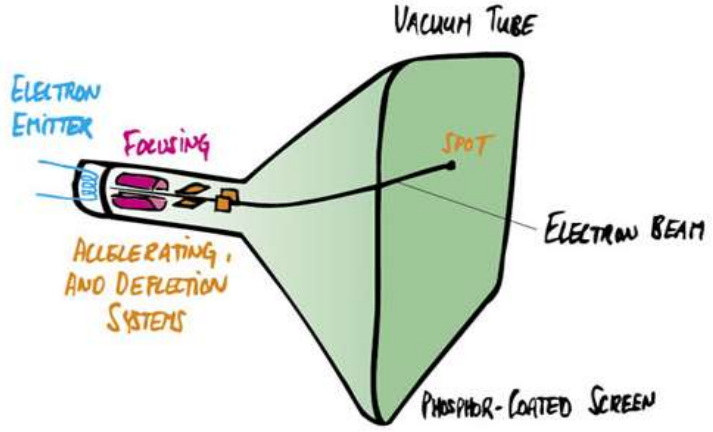
Electric Field



Q) How does a CRT work?

17.1 ELECTROSTATICS

- How a cathode-ray tube (CRT) works



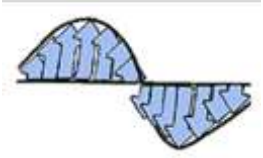
GUIDE A PG. 1

Name	Equation	SI Unit	Meaning	Picture
electric force				
electric field				

17.1 Electrical Applications

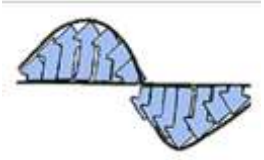
- How a microwave works
- http://www.colorado.edu/physics/PhysicsInitiative/image-bin/old_images/microWaveCartoon/page1.htm





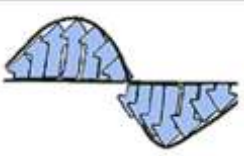

17.1 Electrical Applications

- How a microwave works



17.1 Electrical Applications

- How a microwave works



II. More on Electrostatics: Applications (Page 11)

- In an elevator: Conductor in electrostatic equilibrium

IV. Conductor with Static Electricity

-
-

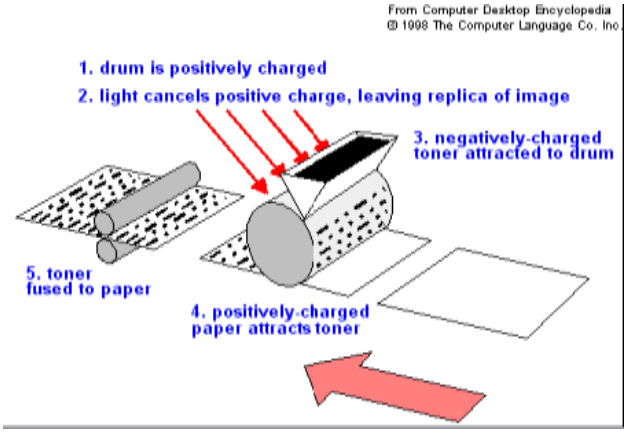
Q) Wrap your cell phone in aluminum foil (without touching the antenna). Will you be able to receive calls? Why is it hard to get calls in a basement or elevator?

Static Electricity applications

- Q) How do cosmetics stick?

II. More on Electrostatics: Applications

- How does a Xerox machine work?



17.2 Circuit Vocabulary

- Electric Charge
- Electric Force
- Electric Field

- Voltage
- Current
- Resistance

17.2 Flowing Charges

- Electrical energy = energy of electric charge
  - Potential energy
  - Kinetic energy
- Electric current
  - How fast charges flow
  - Amperes

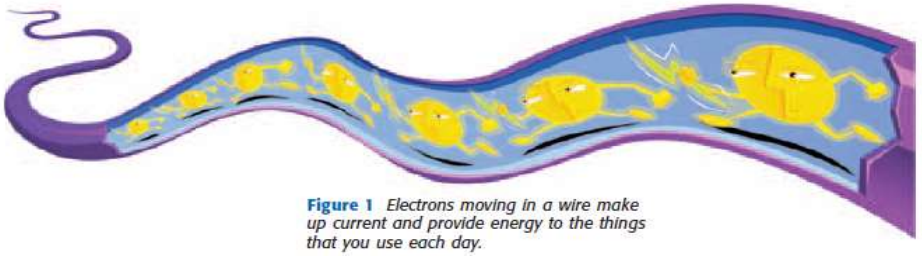


Figure 1 *Electrons moving in a wire make up current and provide energy to the things that you use each day.*

17.2 Flowing Charges

- When you flip the switch, the light turns on ***instantly***.
  - Does the electron from the switch run all the way to the light bulb?
  - A single electron takes _____ to move 1 meter

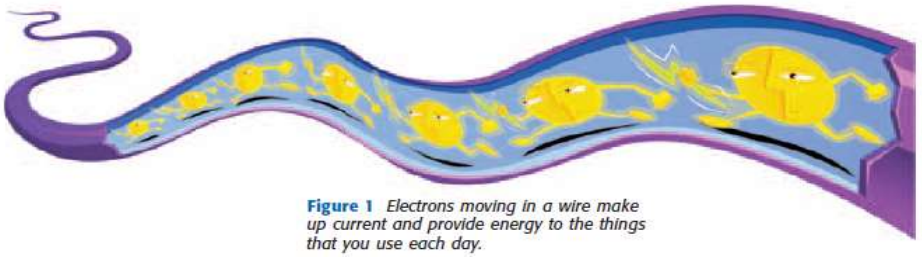


Figure 1 *Electrons moving in a wire make up current and provide energy to the things that you use each day.*

17.2 Flowing Charges

- When you flip the switch, the light turns on ***instantly***.
  - Does the electron from the switch run all the way to the light bulb?

No

An ***electric field*** is set up at the speed of light

A single electron takes over an hour to move 1 meter

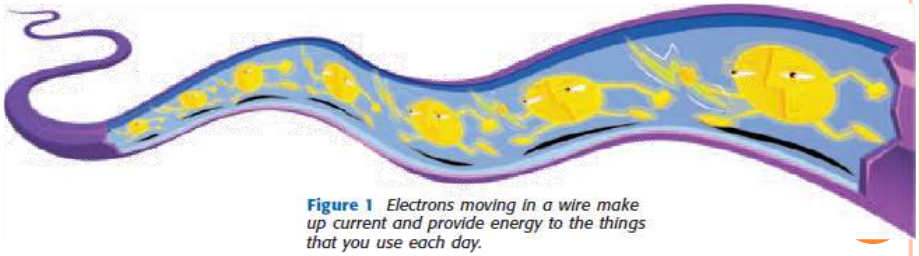
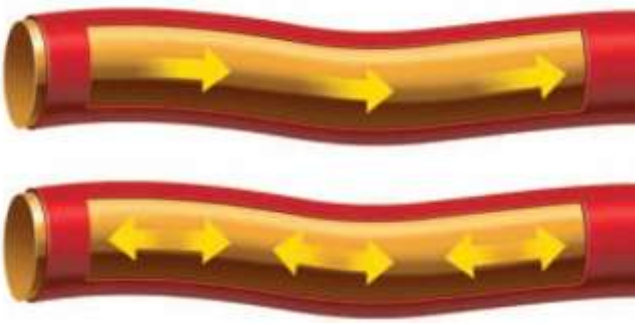


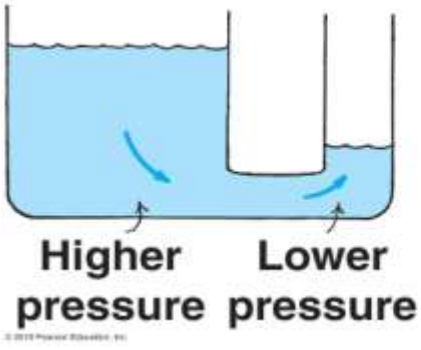
Figure 1 *Electrons moving in a wire make up current and provide energy to the things that you use each day.*

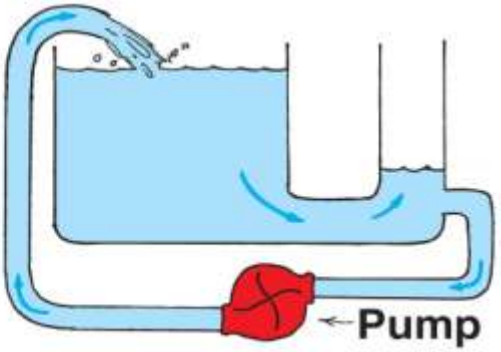
17.2 2 TYPES OF CURRENT



- A battery sets up [AC][DC] .
- The mains (outlet) sets up [AC][DC].
- The power company makes [AC][DC] at _____ V, _____ Hz.

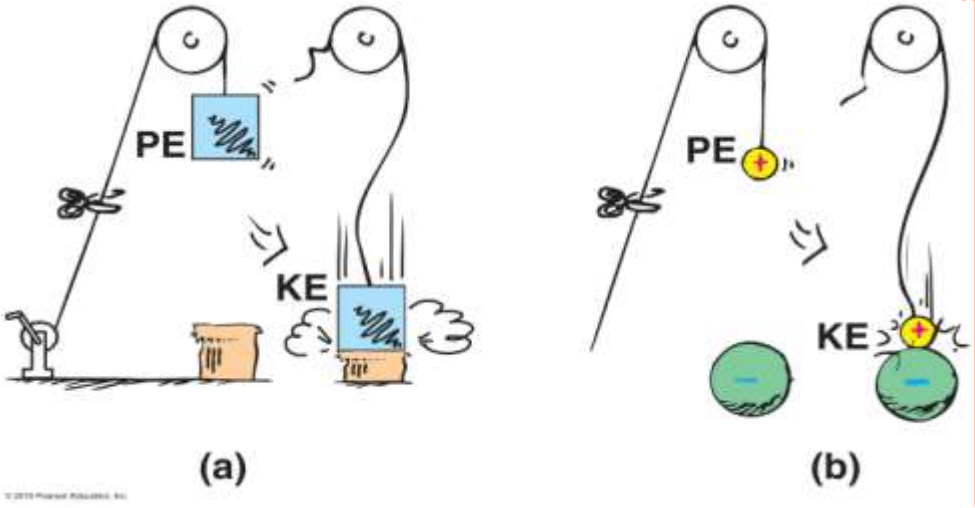
17.2 VOLTAGE = ELECTRICAL PRESSURE



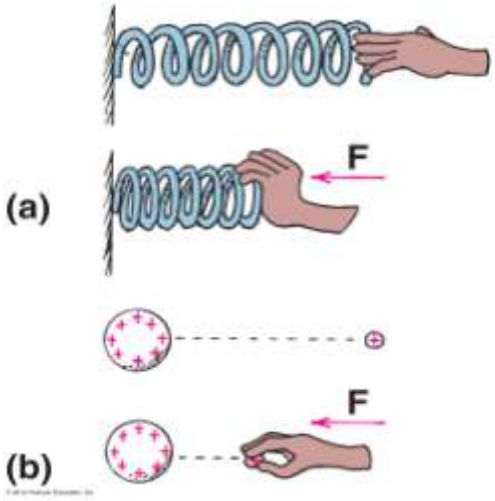


17.2 VOLTAGE = ELECTRICAL PRESSURE

- Charge can move → charge does work = force x distance
- Voltage = Work/charge = change in PE/ charge



17.2 VOLTAGE = ELECTRICAL PRESSURE



17.2 Voltage = electrical PRESSURE

- Which one will set up a larger current? Why?
- Which one will make charges do more work?

17.2 Resistance = electrical OPPOSING 'friction'

- HIGH voltage → [low][high] current
- HIGH resistance → [low][high] current

- Resistance depends on the wire's
  - Material
  - Length
  - Cross-sectional Area (thickness)
  - Temperature

17.2 [HIGH][LOW] R??

17.2 [HIGH][LOW] R??

- A superconductor wire's current can stay _____
- Superconductor at room temperature?

17.2 Resistance = electrical OPPOSING 'friction'

- Resistance depends on the wire's

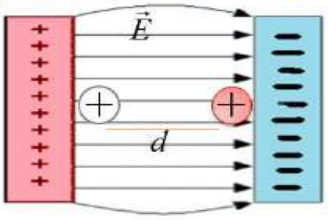
	HIGH R	LOW R
Material		
Length		
Thickness		
Temperature		

17.2 A closer look at: V, I, R (Pg. 1)

Name	Equation	SI Unit	Meaning	Picture
voltage				
current				
resistance				

17.2 A CLOSER LOOK AT: V, I, R (PG. 12)

V. Voltage What is the voltage across the metal plates?



Q) Voltage: Think _____. Have _____, will _____.

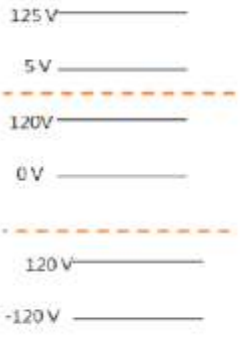
Which causes damage: current or voltage?

To have current, we need 2 things

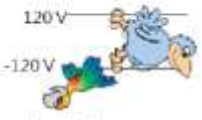
1) _____ 2) _____

17.2 A CLOSER LOOK AT: V, I, R

Q) Draw the Electric field lines and current, if any.

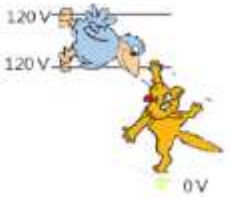


- Is the bird safe?



- Is the gray bird safe?
- Is the parrot safe?

- Is the bird safe?



- Is the cat safe?

17.2 A CLOSER LOOK AT: V, I, R

Name	Equation	SI Unit	Meaning	Picture
Power				

17.3 ELECTRICAL CALCULATIONS

- Ohm's Law
- Power
- Calculating household energy use

- Watt
- Kilowatt
- Kilowatt-hour

17.3 OHM'S LAW Ω

- More voltage → [more][less] current
- More resistance → [more][less] current

- What is Ohm's Law?

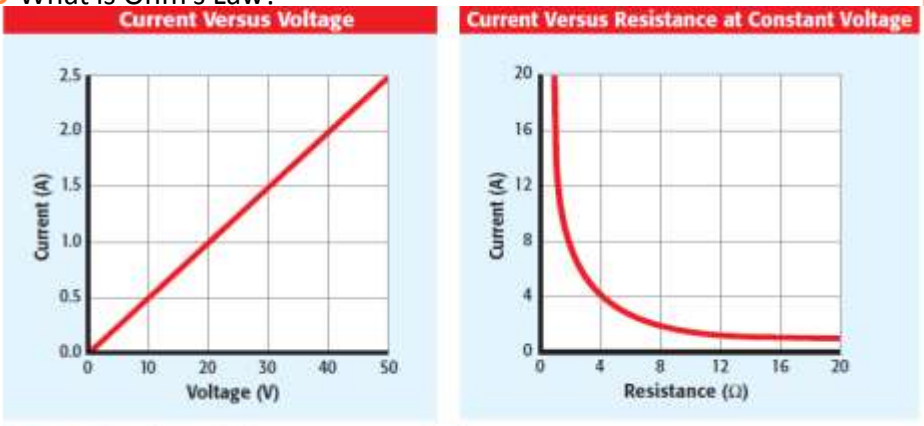


Figure 1 The relationship between current and voltage is

17.3 OHM'S LAW Ω

MATH FOCUS

Using Ohm's Law What is the voltage if the current is 2 A and the resistance is 12 Ω?

Step 1: Write the equation for voltage.

$$V = I \times R$$

Step 2: Replace the current and resistance with the measurements given in the problem, and solve.

$$V = 2\ \text{A} \times 12\ \Omega$$

$$V = 24\ \text{V}$$

Now It's Your Turn

1. Find the voltage if the current is 0.2 A and the resistance is 2 Ω.
2. The resistance of an object is 4 Ω. If the current in the object is 9 A, what voltage must be used?
3. An object has a resistance of 20 Ω. Calculate the voltage needed to produce a current of 0.5 A.

17.3 ELECTRIC **POWER**

- Guide (Pg. 13)

Ohm's Law :

Power : SI Unit:

$$\text{Power} = \frac{\text{work}}{\text{time}} = \text{\_\_\_\_\_}$$

17.3 ELECTRIC **POWER**

- Which bulb is brightest?

17.3 ELECTRICAL **ENERGY**

Energy = [ ]

@ You use 100W lightbulb for 24 hours. How much energy in kilowatt-hours did you consume?

17.3 ELECTRICAL **ENERGY**

@ How do you read an electric meter? (Pg. 492 Figure 3)

17.3 ELECTRICAL **ENERGY**

MATH FOCUS

Power and Energy A small television set draws a current of 0.42 A at 120 V. What is the power rating for the television? How much energy is used if the television is on for 3 h?

Step 1: Write the equation for power.

$$P = V \times I$$

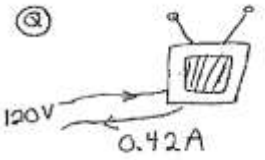
Step 2: Replace the voltage and current with the measurements given in the problem, and solve.

$$P = 120 \text{ V} \times 0.42 \text{ A}$$

$$P = 50.4 \text{ W, or } 0.0504 \text{ kW}$$

Step 3: Write the equation for electrical energy.

$$E = P \times t$$



(a) Power (watts) = _____

(b) Energy (kWh) = _____

17.3 ELECTRICAL **ENERGY**

MATH FOCUS

Power and Energy A small television set draws a current of 0.42 A at 120 V. What is the power rating for the television? How much energy is used if the television is on for 3 h?

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Step 3: Write the equation for electrical energy.

$$E = P \times t$$

Step 4: Replace the power and time with the measurements given in the problem and solve.

$$E = 0.0504 \text{ kW} \times 3 \text{ h}$$

$$E = 0.1512 \text{ kWh}$$

Now It's Your Turn

1. A computer monitor draws 1.2 A at a voltage of 120 V. What is the power rating of the monitor?
2. A light bulb draws a 0.5 A current at a voltage of 120 V. What is the power rating of the light bulb?
3. How much electrical energy does a 100 W light bulb use if it is left on for 24 h?

17.4 ELECTRICAL **CIRCUITS**

Electric Circuit = _____

There must be

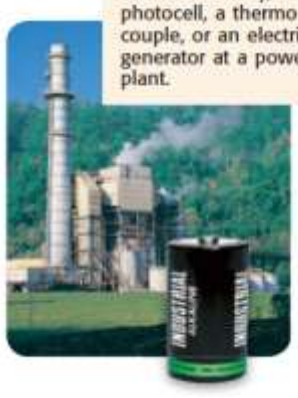
1)

2)

17.4 ELECTRICAL **CIRCUITS**

- **3** parts of a circuit

Figure 1 Necessary Parts of a Circuit



The **energy source** can be a battery, a photocell, a thermocouple, or an electric generator at a power plant.

Wires connect the other parts of a circuit. Wires are made of conducting materials that have low resistance, such as copper.

Examples of **loads** are light bulbs, appliances, televisions, and motors.

17.4 ELECTRICAL **CIRCUITS**

@ Label the parts

@ ★ Why must there be resistance in the circuit?

17.4 ELECTRICAL **CIRCUITS**

- Electrical Calculations:
- Ohm's Law: _____
- Power calculation: _____

17.4 ELECTRICAL **CIRCUITS** - **HW: FINISH THIS**

PRACTICE

ⓐ I = V=4V R=2Ω P=

ⓑ 0.5A 6V R= R = P=

ⓒ 30Ω 0.2A V = P =

ⓓ 60 Watt bulb 120V I = R =

ⓔ 100 watt-bulb 120V I= R =

less power ⇒ _____ current ⇒ _____ resistance

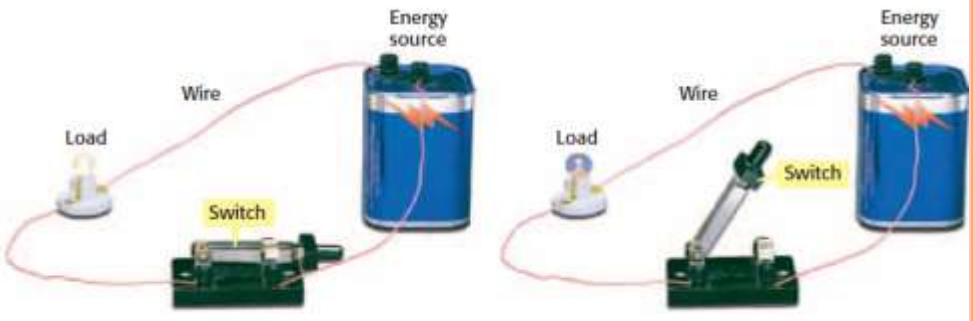
17.4 ELECTRICAL **CIRCUITS**

- What is a **SWITCH**?

Figure 2 **Using a Switch**

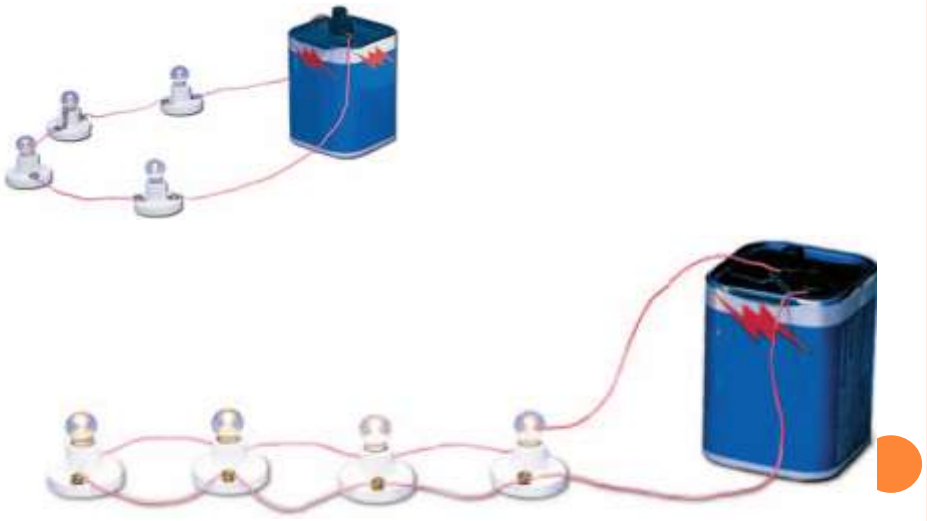
When the **switch is closed**, the two pieces of conducting material touch, which allows the electric charges to flow through the circuit.

When the **switch is open**, the gap between the two pieces of conducting material prevents the electric charges from traveling through the circuit.



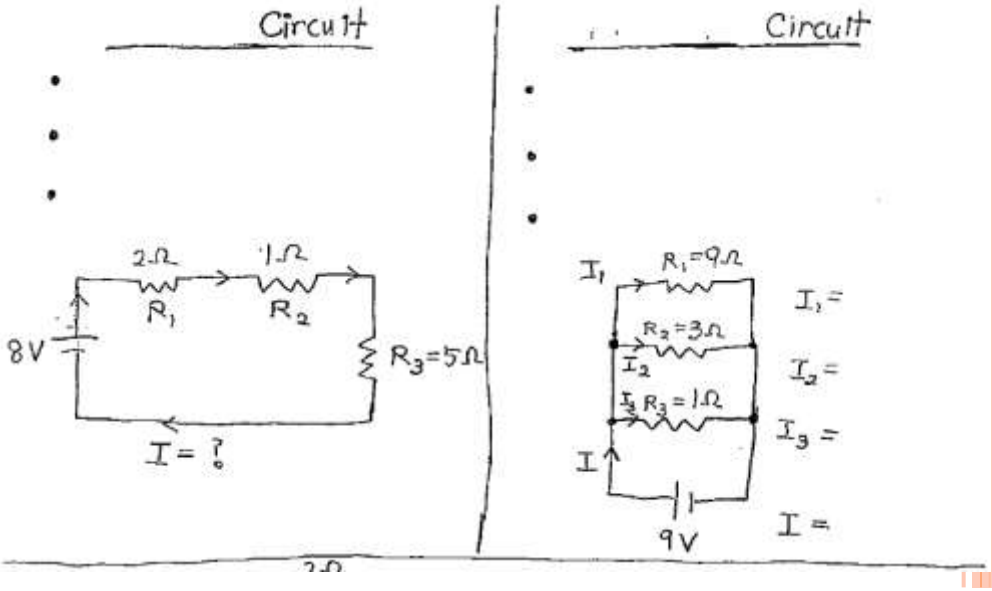
17.4 Electrical **CIRCUITS**

- 2 Types of Circuits



17.4 Electrical **CIRCUITS:** Pg. 14

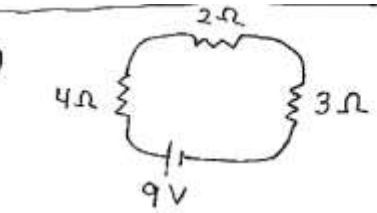
- 2 Types of Circuits



17.4 ELECTRICAL **CIRCUITS**

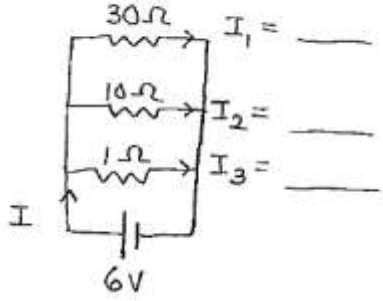
- 2 Types of Circuits – Your Turn

ⓐ



- Series / Parallel Circuit?
- I = _____

ⓑ



I_1 = _____

I_2 = _____

I_3 = _____

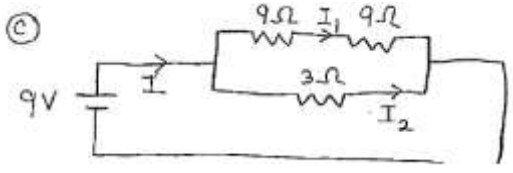
I = _____

Series / Parallel ?

17.4 ELECTRICAL **CIRCUITS**

- 2 Types of Circuits – **HW: Finish this**

ⓒ

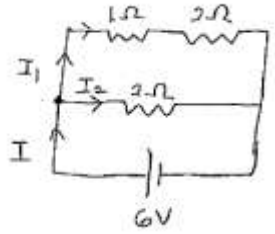


I_1 = _____

I_2 = _____

I = _____

ⓓ



I_1 = _____

I_2 = _____

I = _____

17.4 ELECTRICAL **CIRCUITS**

- 2 Types of Circuits in the

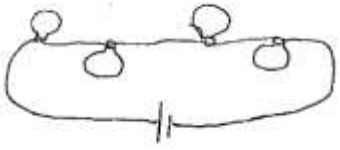
17.4 ELECTRICAL **CIRCUITS**

- 2 Types of Circuits in

17.4 ELECTRICAL **CIRCUITS**: PG. 14

- 2 Types of Circuits in

(a) Christmas Tree Lights



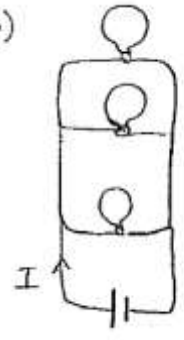
Circuit Type: _____

Advantage	Disadvantage

17.4 ELECTRICAL **CIRCUITS**

- 2 Types of Circuits

(b)

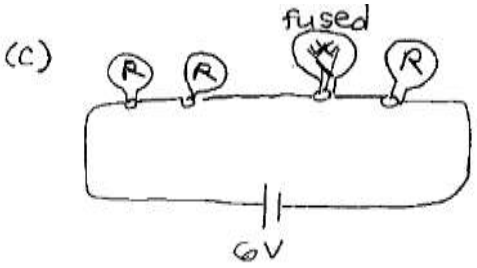


Circuit Type: _____

Advantage	Disadvantage

17.4 ELECTRICAL **CIRCUITS**

- 2 Types of Circuits



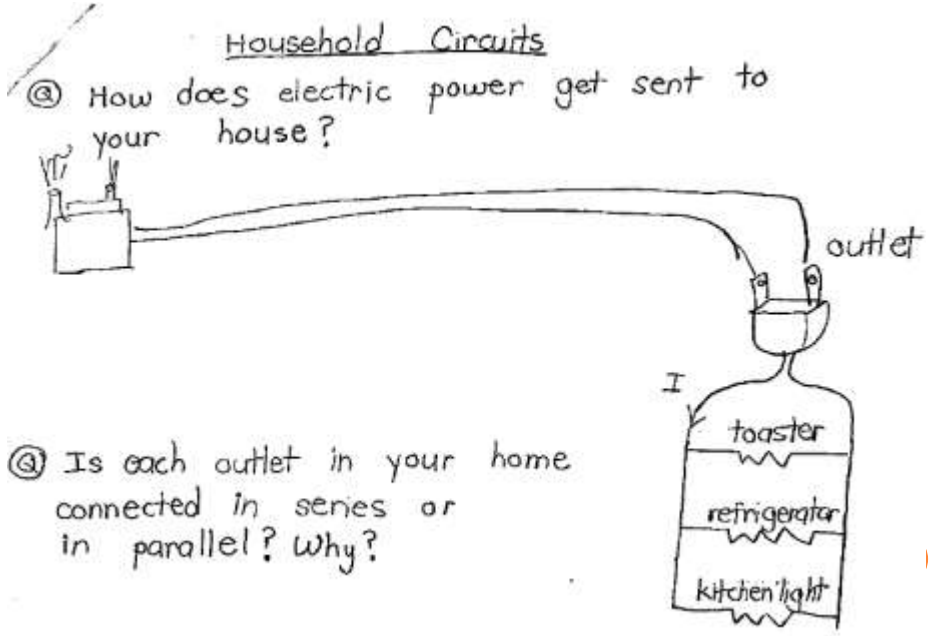
Circuit Type: _____

Advantage	Disadvantage

17.4 ELECTRICAL **CIRCUITS**

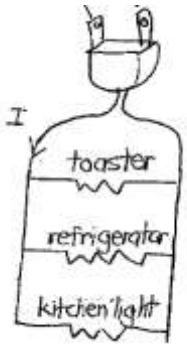
- 2 Types of Circuits

17.4 ELECTRICAL **CIRCUITS:** PG. 15



17.4 **SAFETY**

- @ What's a circuit breaker? What's circuit overload?



17.4 SAFETY

- @ Why does a ground wire make things safer?

17.4 SAFETY

- @ What's a GFCI ?

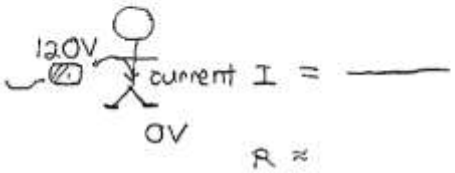
17.4 SAFETY

- @ Safety

Current	Effect

17.4 SAFETY

- _____ = dangerous!



R ≈

- Page 2 – Circuits
- Page 6 – Crossword
- Page 15 – Home appliance
- Page 16 – Bonus: electricity bill (see my example)

III. Circuits

- Voltage

I. ELECTROSTATICS

- Worksheet on Static Electricity

  http://www.youtube.com/watch?v=JzSF8iZTPBw&feature=related

I. Electrostatics

- Worksheet on Static Electricity: Van de Graaf Generator

http://www.youtube.com/watch?v=WS9ISUXBsa8&feature=related

http://www.youtube.com/watch?v=hh8PqQDOAb8

7TH Science Monday

- Preview crossword 17.1 due
- Balloon, magic wand, electrostat mini-lab
- More on electric field, voltage
- Crt
- Bird + bonus worksheet
- Van-de-graaff descriptions, video
- Elevator and aluminum foil

- Safety http://www.tva.gov/power/homesafety.htm

7TH SCIENCE - WEDNESDAY

- Basic circuits
- New packet 17b
- Collect device information over the break
- V=IR module over break
- 17a due after break
- Ch. 19 – each student writes 1 page on different device in own words. Present on a Wednesday.

- Ohm's law lab (1 class) +
- Household circuit activity (take-home)

- http://www.youtube.com/watch?v=EURZLiQfM7k&NR=1&feature=fvwp (Mr. Bean static electricity)

- http://www.engineeringinteract.org/resources/siliconspies.htm (electricity interactive games)
- http://www.engineeringinteract.org/ (Cambridge)
- http://www.engineeringinteract.org/resources/siliconspies.htm


Engineering Interact - Interactive science & engineering for 9-11 year olds - Windows Internet Explorer
SILICON SPIES
Score Board
Name:
Stage:
Spy
Your Score
Mistake?
AC DC 5 cheated!
DI Ode 5 cheated!
Chip 5 cheated!
Max Wells 5 MISTAKE!
Running Total:
Max Wells was chosen! (Click to hide cheat.)
Teacher Page
Buzz Says...
Congratulations! You've solved the puzzle!
MISSION COMPLETE: Dr. Volt's evil plans have been found. Silicon City is saved!
Buzz has prepared a report on your work.
Click the button below to find out how you did and to display your certificate.
Max Wells was a double-agent!
Your final score: 20
Engineering Interact
© 2004 University of Cambridge Author: Peter Rithell


Engineering Interact - Interactive science & engineering for 9-11 year olds - Windows Internet Explorer
SILICON SPIES
Final Report
Agent Name: YOUR NAME
Final Score: 20 out of 40
Agent Knowledge Rating: 50%
Agent Investigation Rating: 100%
Buzz has promoted you to chief spy!
Thank you for playing!
Print Certificate
Continue
Engineering Interact
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