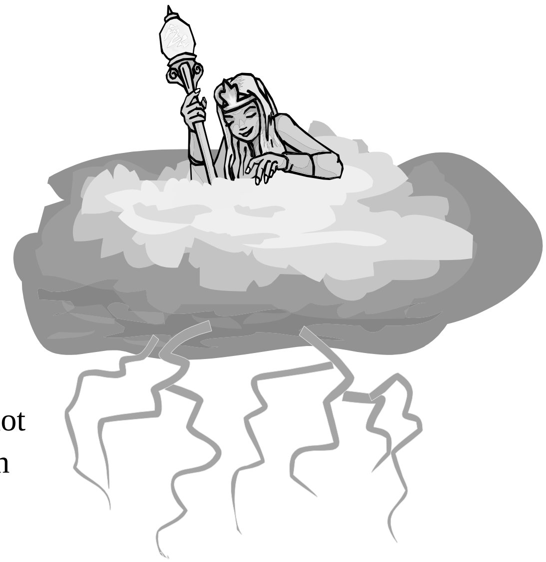
13. Static Electricity



A. Introduction The word *static* means stationary or not moving. While a light bulb is turned on and attached to a battery, the electrons are constantly moving. That's *not* static electricity, If, however, a bed sheet in the drier has acquired extra electrons, the electrons sit there, temporarily not moving out of the bed sheet, so we say that the sheet has been statically charged.

Example 1 Ions, as you recall, are charged atoms. In nature, where do you find ions?

Example 2 When heterogeneous or other large objects gain or lose electrons, we say they are *statically charged*. But basically they share the same characteristics with ions:

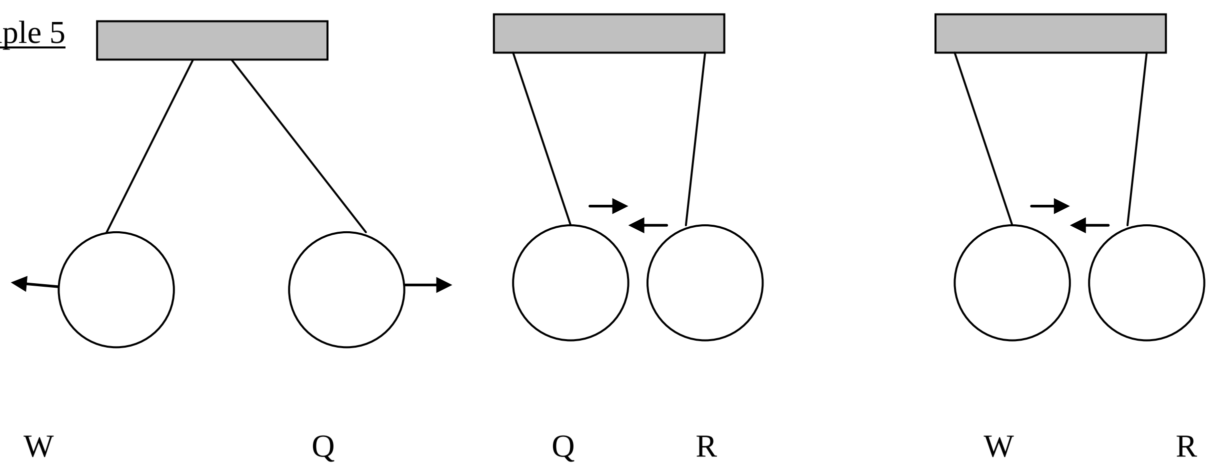
Static Charge	Characteristic
-	Too many electrons (electrons>protons)
+	Not enough electrons (protons >electrons)
0 (neutral)	# of protons = # of electrons

Example 3 The rules of attraction and repulsion that applied to ions also apply to objects that have gathered static electricity:

Charges	How They Behave Towards Each Other
+ , -	
+ , +	
- , -	
- , neutral	
+ , neutral	
neutral and neutral	

Example 4. On a dry day, rub a balloon against your hair. Then press it gently against a wall or place it near small bits of paper. What happens? Why?

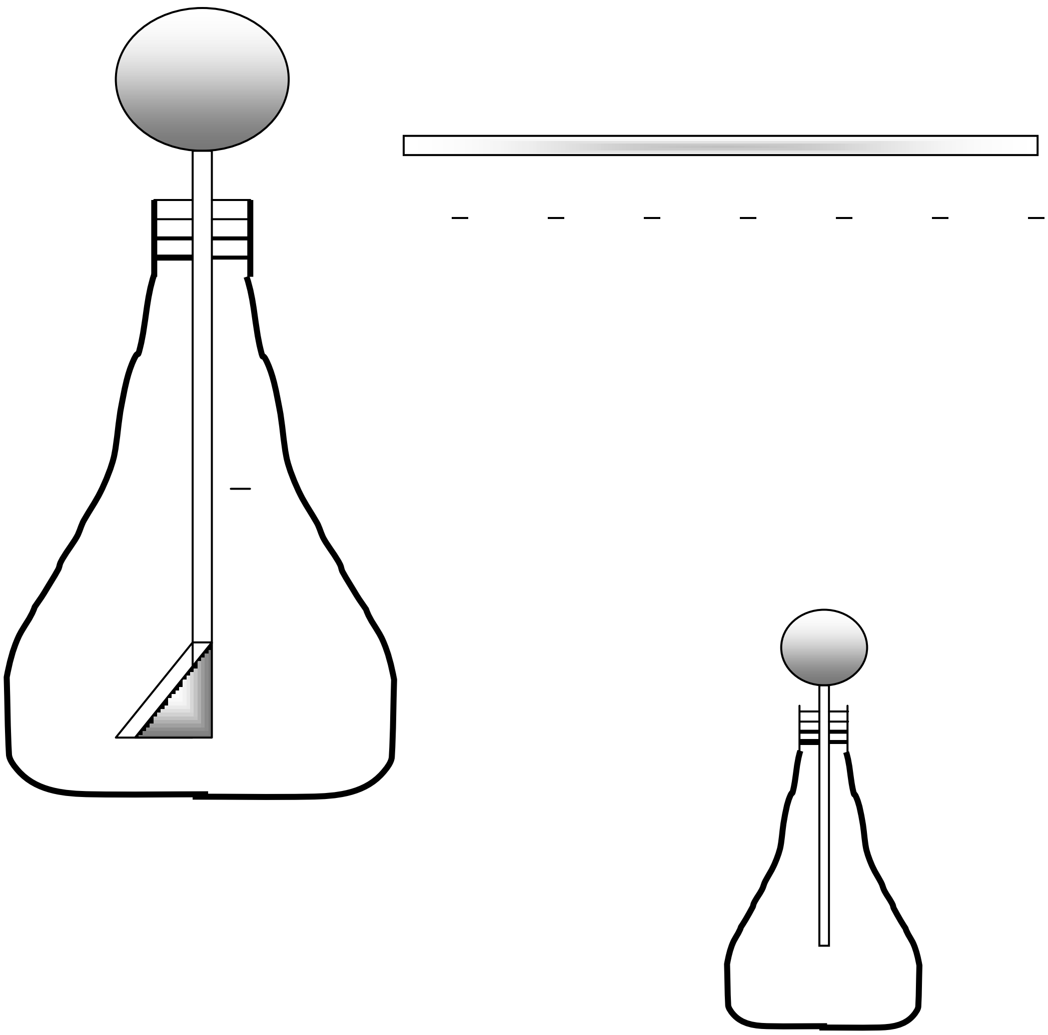
Example 5



What can you conclude about the charges of W, Q and R?

Example 6 A student brings a negatively charges glass rod toward the knob of an electroscope. The electroscope consists of metal knob attached to a long rod that slips through a hole in a rubber stopper, and at the end of the rod there are two thin sheets of silver referred to as "*leaves*".

What do you think will happen if she comes close to the knob but never touches it?



Before

After (complete diagram)

Exercises

1. For each of the questions below, choose one of the following possible charges for the object mentioned:

- Neutral
- Positive
- Negative

a. After rubbing her feet on the carpet, Graziella's body acquired the same charge as that of chloride________

b. A piece of plastic was repelled by a positive piece of plastic____________

c. When rubber is rubbed with silk, rubber gains electrons from silk. That leaves silk with this charge__________

d. This object has less protons than electrons____________

e. This object has the same charge as helium____________

f. Object A repels a positive charge. Object B attracts A. Object C repels B. C=_____________________

g. If little pieces of an object are attracted to a negatively charged comb, then the object can be either ______________ or _______________.

2. If you comb your hair repeatedly on a dry day, that comb will attract small neutral pieces of paper. Use a drawing to show why this happens.

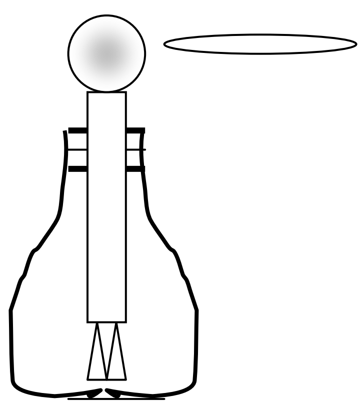
3. When any two of the substances from the following list are rubbed together, the one that is higher on the list becomes negatively charged.

- Rubber
- Silk
- Wool
- Glass

If you rub a rubber ball with a woolen sweater, how will the ball behave towards a glass ball that has been rubbed with a silk shirt?

4. a. Show what will happen to the electroscope if it is approached but not touched by a negatively charged object.

b. Repeat for a positively charged object.

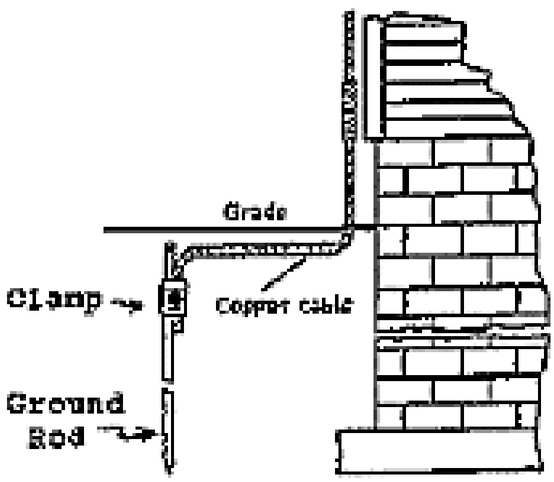


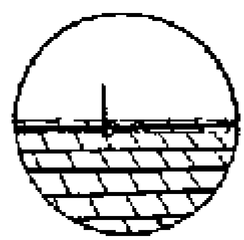
B. Grounding: is the process by which an object is allowed to discharge (get rid of its excess charge).

(1)If the object to be grounded is negatively charged, grounding lets excess electrons to flow from the object into the earth or other large substance, or

(2) If the object is positively charged, electrons flow from the earth or other large neutral substance into the object.

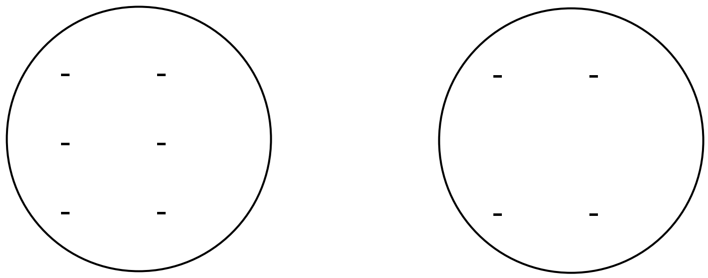
Example 1 *Why Does Grounding Happen?*





C. Charge Density (STE only)

Example 1 What would happen if the two spheres were in contact?



Area: 6 cm^2 6 cm^2.

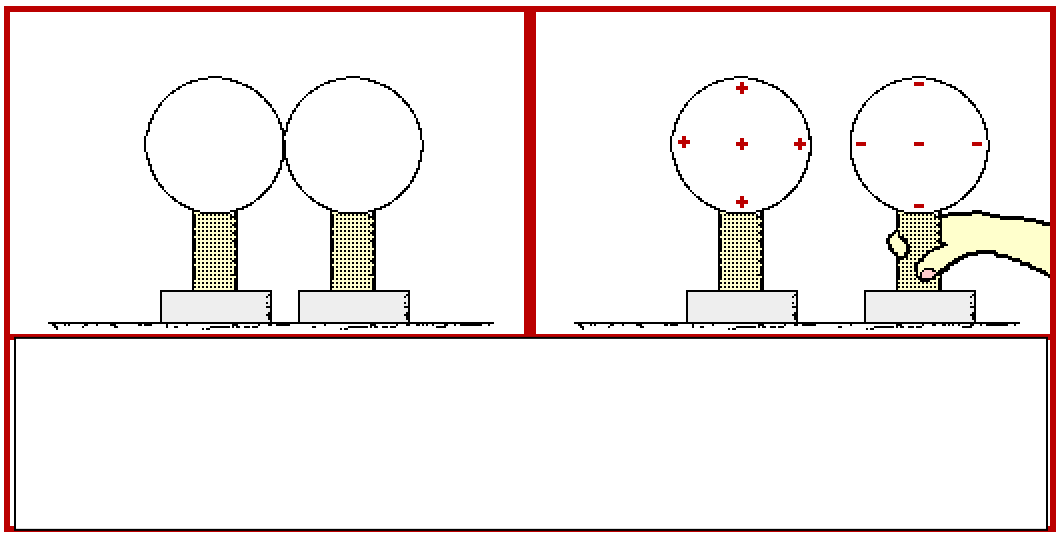
Example 2 Now imagine the same sphere in contact with the earth. What will happen to the charge? The earth's area is 4.69 X 10^{18} cm^2.

Example 3 Two spheres are in contact with one another. Each originally has the same charge. But one of the spheres is smaller (area = 9 cm^2), so it loses 4 units of charge to the less crowded and larger sphere (area = 18 cm^2).

How many units of charge did each sphere begin with?

Exercises

1. Study the situation below. What would cause the electrons to flow out of one sphere and into the other? Draw in the answer in the first picture.



2. Turntables, those ancient record-players that consisted of a needle at the tip of a mechanical arm which made contact with a turning vinyl record, had to be grounded to the amplifier. In other words, aside from the wires that brought in the current and sent the sound signals, there was a third ground wire connecting the back of the two components. Why?

3. You are asked to see if two electric charges have the same sign, using the following materials:

- two charged substances
- 1 plastic ruler

- 1 piece of string
- 1 ring stand
- 1 piece of wool

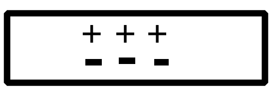
Explain the produce you would use to do this.

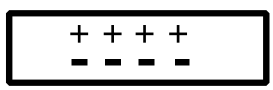
4. Two spheres are in contact with one another. Each originally has the same charge. But one of the spheres is smaller (area = 12 cm^2), so it loses 4 units of charge to the less crowded and larger sphere (area = 36 cm^2).

   a. How many units of charge did each sphere begin with?

   b. What is each sphere's charge density after the transfer?

5. Silk and glass are two electrically neutral materials. Silk can be represented by

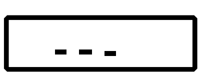


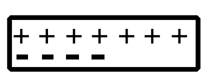
and glass by


.

After these materials are rubbed together, silk becomes negatively charged and glass becomes positively charged.

Which of the following models may represent silk and glass after these materials have been rubbed together?

A) silk


glass


B)

C)

D)

6. (STE only)

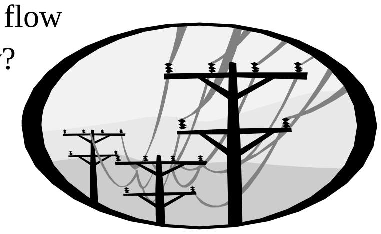
a. What happens to the force between two charges if the distance separating them triples?

b. If the repulsive force between two objects is to remain the same, and if one object's charge becomes sixteen times bigger, what distance should separate the charges?

7. Explain why it's safer to hook up a static generator to the sink before touching it for the hair-raising trick.

14. Conductance, Insulators and Resistance

A. A ***conductor*** in electricity is a material that allows electrons to flow through it easily. Metals, in general, are good conductors. Why?



The property of conductance (which measures how easily electrons are allowed to flow through) ,G, can be quantified. It is measured in Siemens (S).

B. An ***insulator*** is a material that is a poor conductor of electricity. Examples include plastic, wood, ceramic and glass.

What makes them poor conductors?

C. ***Resistance*** is the inverse of conductance. It measures how difficult it is for electrons to flow through a material. In plain English, an insulator, like ceramic, has high resistance and poor conductance. A metal has low resistance and high conductance.

$R = 1/G$.

Resistance is measured in ohms, Ω.

Something with high resistance wastes the energy of electrons and generates heat.

Example 1: If the conductance of a material is 0.20 S, what is its resistance?

Example 2: If the resistance of a ceramic resistor is 50 Ω, what is its conductance?

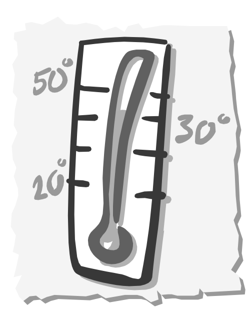
D. **Factors Affecting Resistance**

(1) The nature of the material

(2) The thickness of the wire

(3) The length of the wire

(4) The temperature



Example 1 How would you *lower* the resistance of the following wire?

Example 2 Two wires, both made of brand new copper, did not have the same conductance, even though the wires were of identical length, thickness and at the same temperature. What could have been different, leading to different measurements, assuming that the same quality equipment was used to measure conductance?

Exercises

1. A substance used in the manufacture of wire that will transport electrical energy should have two of the following properties:

    1. Good resistance to corrosion
    2. Poor resistance to corrosion
    3. Good ductility
    4. Poor ductility

    Which two properties are they?

2. Porcelain is used to support electrical wires on poles. Which two properties of porcelain make it desirable for this use?

    1. Is a good insulator
    2. Is non-ductile
    3. Does not rust
    4. Breaks easily

3. Name 4 factors that influence the resistance of a metal conductor.

4. There are six electrical wires made of the same substance and having the same length : three have a diameter of 1.5 mm while the other three have a diameter of 3.0 mm.

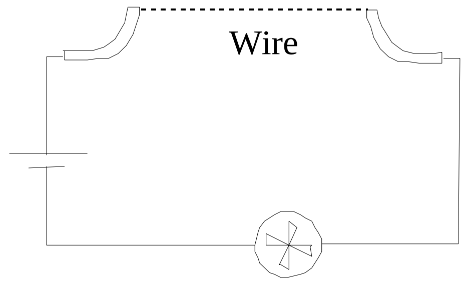
    They are placed either end to end to increase the length of the wire or parallel to one another to increase the surface area of the wire.

    Which three-wire arrangement offers the least resistance to the flow of electric current?

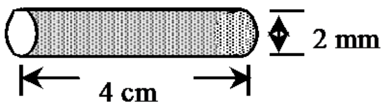
5. A device consists of a power supply, a fan and two connectors. You are to insert a piece of wire between these connectors.

Four nichrome wires are illustrated below. You insert each of these wires in turn. They are the same temperature, but of different sizes. These wires are not drawn to scale.

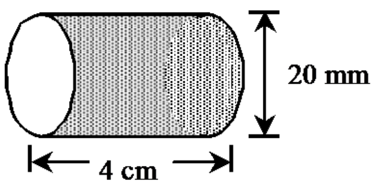
With which wire will the fan rotate the fastest? (see next page for rest of multiple choice)



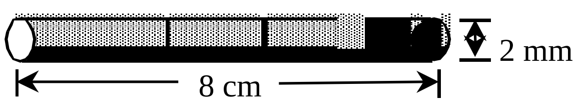
A)



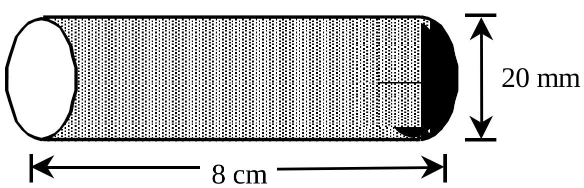
B)



C)



D)



6. Note the following substances:

1. Rubber

2. Plastic

3. Aluminum

4. Copper

5. Steel

Which of these substances are insulators?

7. Which of the following substances best conducts electricity?

A) Copper

B) Water

C) Nichrome

D) Plastic

8. Which of the following would increase the electrical conductivity of a circuit?

1- A thicker wire

2- A longer wire

3- A decrease in the temperature of the wire

4- The use of porcelain wire

A) 1 and 2

B) 1 and 3

C) 2 and 4

D) 3 and 4

9. What could be done to the temperature of a circuit in order to improve conductance?

10. Why does a wider wire conduct electricity better than a narrower one?

11. a. Of the following, which two metals are the best conductors?

Fe Cu Ag Au

b. Which of the above 4 is the worst?

12. In general, why do metals conduct electricity (Think of atomic structure.)

13. What is the unit of resistance? Give both word and the symbol.

14. What is the unit of conductance? Again, give both word and the symbol.

15. Convert the following. (Show your work)

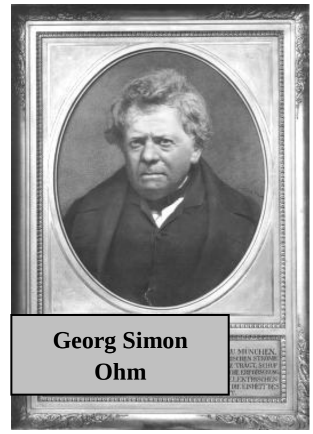
a. 50 S = _____Ω.

b. 0.100 Ω = ______________S.

c. If G = 1/R, then R = ___________.

d. R = 12 V/0.5 A. (don't worry about the units until we study Ohm's law)

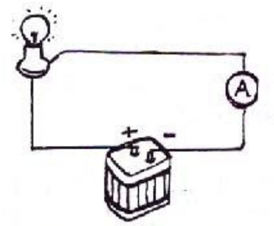
G = ___________S



Georg Simon Ohm

15. Ohm's Law

A. Deriving the Formula



a)Suppose you had the following circuit. If you started with a low voltage and gradually increased it (by changing the battery or turning the button on a power source), what would happen to the current?

____

b) What is current? ____

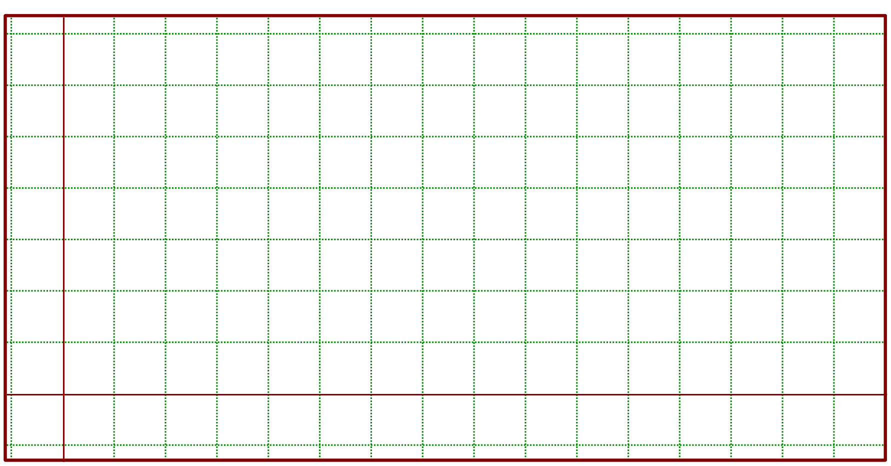
c) What is voltage____

____

<u>Example 1</u> What is the short hand way of drawing the above circuit? How would you measure the voltage of the battery?

<u>Example 2</u> Graph the following data.

Voltage (**V**olts)	0.0	1.5	2.0	2.5	3.0
Current Intensity (**A**mps)	0.0	2.0	2.7	3.3	4.0



The slope on a *current(y) versus voltage(x)* graph is known as conductance, G, which is measured in Siemens (S)

The electrical property more commonly used than conductance is **resistance**, which is measured in **ohms (Ω)**. Resistance is a measurement of how difficult it is for electrons to get through a substance. Resistance converts electrical energy into heat.

R = 1/G

Based on this, what is the relationship between V, I and R ?

Ohm's Law

Examples

1. A resistance of 10 **Ω** is placed across a 9 V battery. What current flows through the battery?

2. a. A resistor has a conductance of 0.100 **S**. What is its resistance?

What voltage is needed to cause a 500 mA current to flow through the circuit?

3. What is the overall resistance of a CD portable player if it is operated by a 3 V battery and 0.75 A flow through its circuitry?

Exercises

1. What current flows between a potential difference of 120 V through a resistance of 30 **Ω**?
2. A motor with an operating resistance of 30 **Ω** is connected to a voltage source**. 4.0 A** of current flow in the circuit. What is the voltage of the source?
3. If the conductance of a circuit is 0.25 S, and the current is 2.0 A, what is the overall voltage?
4. a) An ammeter measures current. What will the ammeter read when it is connected to a 90 V source and a 60 **Ω** resistor?

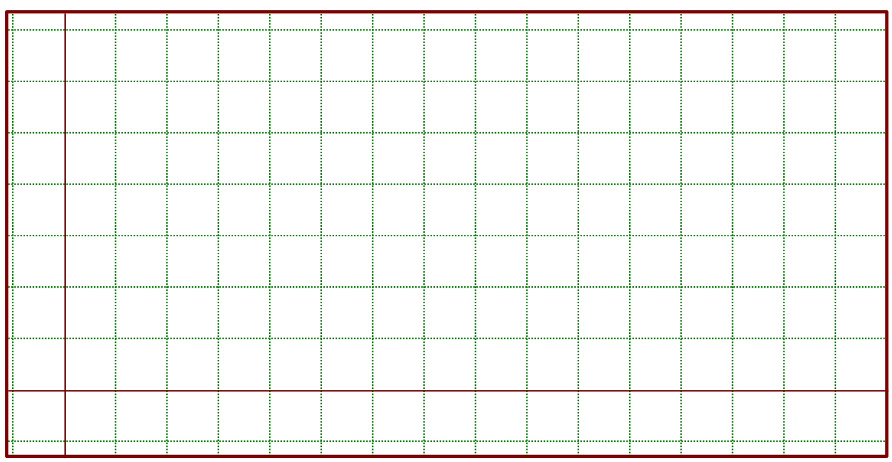
   b) Draw a diagram to illustrate this circuit. The symbol for an ammeter is the letter "A" within a circle.

5. a) Draw a circuit diagram that includes a 16 **Ω** resistor, a battery and an ammeter that reads 1.75 A.

   b) What will the voltmeter read when it is attached to the battery in the above circuit?

6. a) Draw a graph for the following and measure its slope.

Current Intensity (**A**mps)	0.0	1.5	2.0	2.5	4.0
Voltage (**V**olts)	0.0	1.0	1.3	1.6	3.0

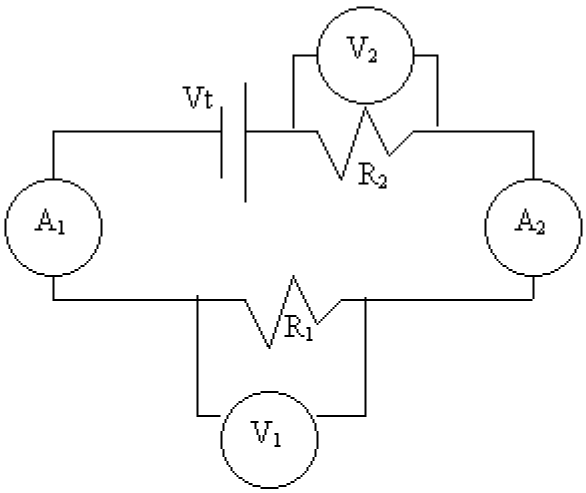


b) What does the slope represent?

16. Circuits and Switches

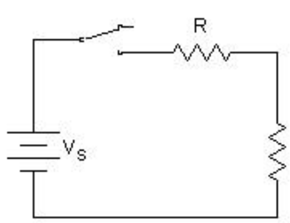
A Series Circuits

Imagine the current leaving a battery. If the resistors are connected in such a way that the current must entirely flow through every resistor before returning to the battery, then the circuit is a **series circuit**.



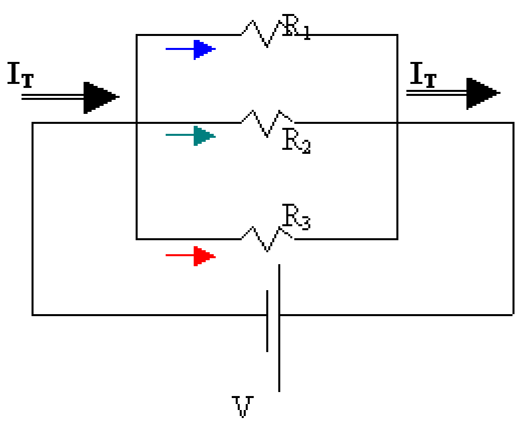
A_1 and A_2 represent two separate measurements of current intensity at two different points in the circuit. V_1 and V_2 represent two separate measurements of voltage or potential difference. *Note how we connect the voltmeter: one connection at each end of the resistor*.

Example 1 **a)** What will happen to this series circuit when a switch before the first resistor is turned off?



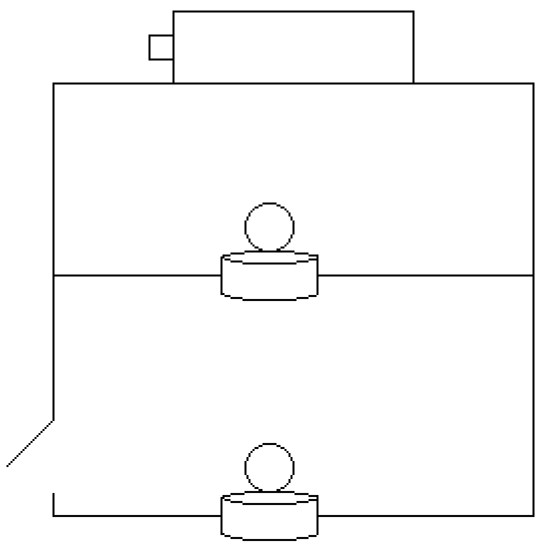
b) Draw the electron flow once you press down on the switch.

B- Parallel Circuits



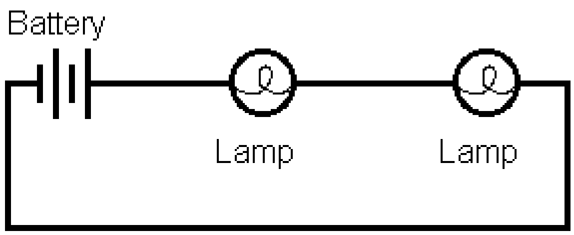
Imagine an electric current leaving a battery. If the resistors are connected in such a way that part of the current can go through one resistor and the rest of the current can go through another resistor, then the circuit is a **parallel circuit**.

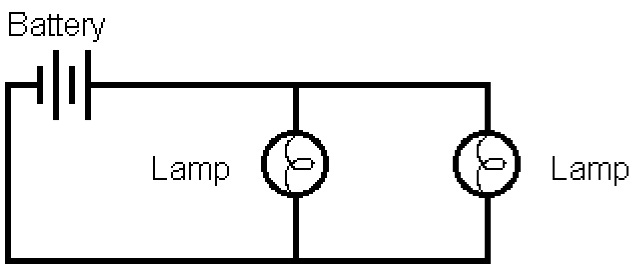
Example 1 a) If the circuit is left the way it is, which light, if any, will turn on?



b) Draw the electron flow once you press down on the switch.

Example 2 a) Which of the circuits is series?





b) Redraw the series circuit so that the laps face each other.

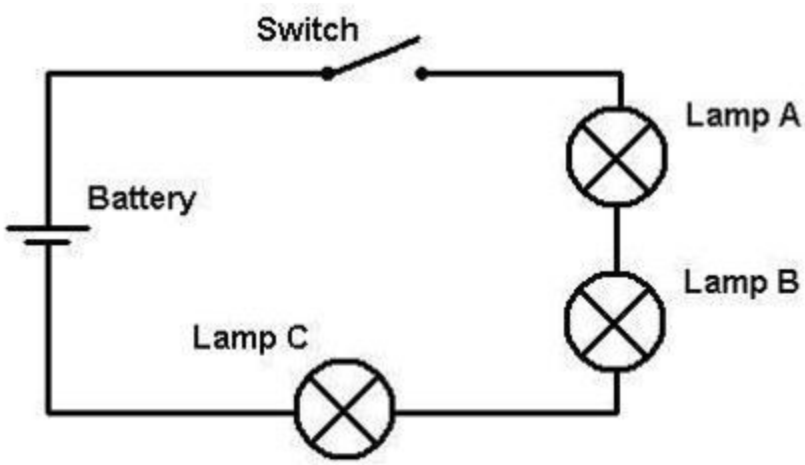
c) Where would you insert a switch on the parallel circuit so that only one lamp can be turned on at a time? Show four possible answers.

d) Where would you insert a switch on the parallel circuit so that only both lamps can be turned off at the same time? Show two possible answers.

Exercises

1. a) Identify the circuit as either series or parallel.

   b) Which lamps will be on if one does not press down on the switch.

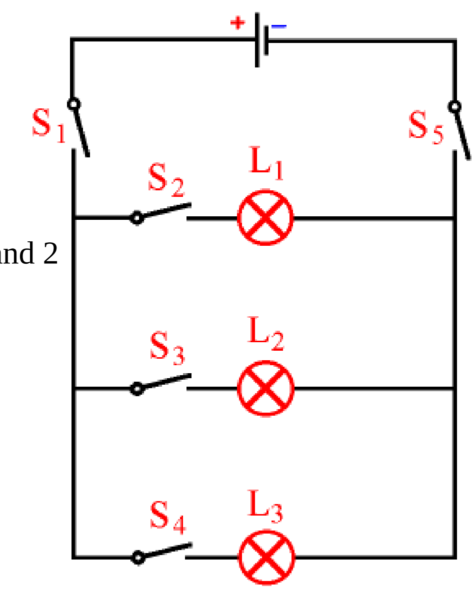


2. a) Identify the circuit as either series or parallel.

   b) If we press down on switches 1,4 and 5 (S_1, S_4, and S_5), which light bulb , if any, will turn on?

   c) On which switches do you have to press to get lights 1 and 2 to go on?

   d) What do you have to press to turn on all three lights?



3. In your house, do you believe most electrical components are connected in parallel? Why?

4. Draw four resistors in parallel. Include a battery and an ammeter positioned to measure total current from the battery.

5. Draw four resistors in series. Include a battery and a voltmeter positioned so that it measure the voltage of the battery.

17. Power

What is power?

Power is the amount of energy used or delivered in a given unit of time. It is measured in watts(W).

$$1 \text{ W} = 1 \text{ J/s}$$

If an appliance consumes 1000 J in 10s, its power rating becomes 1000/10 = 100 W.

A small microwave oven has a low power rating because it cannot convert electrical energy into heat as fast as a bigger microwave oven.

A digital watch consumes very little energy per second. Its battery lasts a long time. Its power rating is very low: only 1.2×10^{-5} W. It would be unrealistic to cook an egg with the heat released by a digital watch. *If you could conserve the heat* released by a watch, it would still take 323 days just to get a cup of 20 C water to boil.

Example1

A typical clothes dryer on the other hand releases 6480 J of heat every second to dry your LaurenHill uniform in time for you to get to school in the morning. So it is 540 million times more powerful than your digital watch and consumes that many time more energy.

What is the power rating of a typical clothes dryer?

Example 2

An instrument uses 400 kJ of energy in 3 minutes. What is its power rating in watts?

H- Power, Voltage, Current and Resistance.

Recall that 1V = 1 J/C; in other words if a resistor's voltage drop is 1 V, then 1 J of energy has been lost for every coulomb of charge that goes through that resistor.

1 A = 1 C/s; in other words if a 1 A current goes through a light bulb, then it means that 1 C of charge is going by every second.

Now let's multiply the units of V by those of I.

(J/C) (C/s) = J/s. Wow! Those are the units for power! So that means:

$$P = VI$$

or substituting Ohm's Law $P = I^2R$

Examples

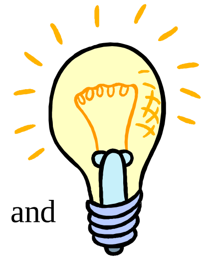
a. What is the power rating of a 10 Ω resistor that operates at 120 V.

b. If an appliance draws a maximum of 2.0 A of current and its resistance is 100 Ω, what is its power rating?

c. The power rating of a certain computer is 200 W. It is designed to operate at 120 V. What maximum current can flow through the computer?

c. The power rating of a certain gadget is 200 W. Its resistance is 50 Ω. What maximum current can it draw?

I. Relating Energy to Power



Since by definition $E = P*t$, where if P is power in watts(J/S = W) and time is measured in seconds, then E will be in joules (J).

Substituting P = VI in to the above formula:

$$E = V\,I\,t$$

<u>Example 1</u> A heating coil has a resistance of 10 Ω. It is designed to operate at 120 V.

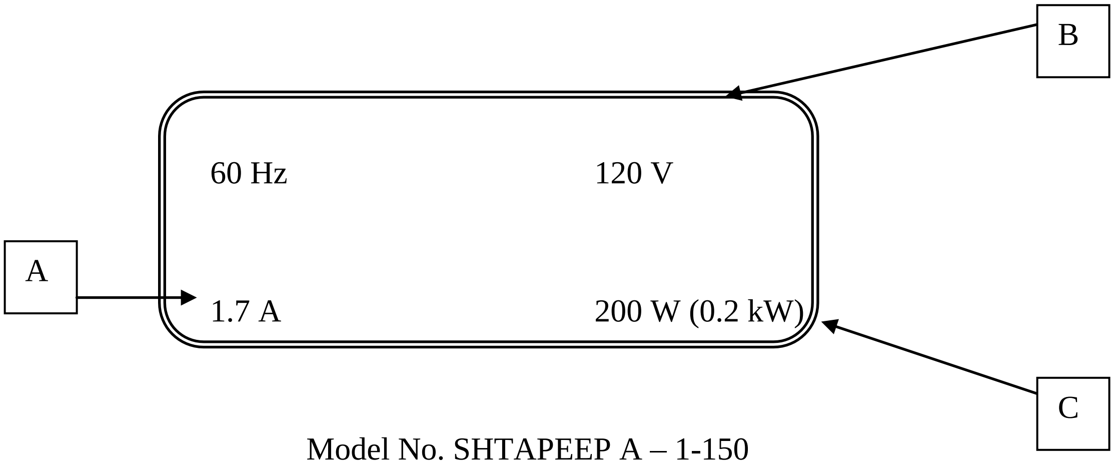
a. What current flows through the coil?

b. What energy, in joules, is supplied by the heater if it's on for 10 seconds?

c. What if the 1440 W heater was on for 200 hours, how much energy in joules was consumed?

Exercises

1. Explain the meaning behind each of the labeled bits of information on a rating plate.



Model No. SHTAPEEP A – 1-150

2. Remember 1kJ = 1000 J.

Convert the following:

a. 3 kJ = ____________J

b. 1 J = _____________kJ

c. 1299 J = __________kJ

d. 0.345 kJ = __________J

<u>Remember 1 J = small unit of energy.</u>

Eating a 100 g banana provides the body with 385 000 J of energy.

3. Power = amount of energy used in a given unit of time

= J/s = W = watt.

Convert to W.

a. 100 J / 10 s

b. 20000 J / 25 s

c. 60000 J / 1 minute

4. Convert. . Remember 1kW = 1000 W.

a. 100 W = ___kW

b. .400 kW = ______W

c. 10 000 J / 10 s = _____kW

5. Find the power of a 15 Ω heater operated at 120 V.

6. What maximum current flows through a 300 W gadget with a resistance of 10 Ω ?

7. Three 20 Ω resistors are connected in series. If a 250 mA current flows through them, what it their total power rating?

8. Remember E = P* t where P= power in W and t= time in seconds

Find the electrical energy, in J and in kJ consumed by the following appliances:

a. Water heater: 4500 W turned on for 3 hours.

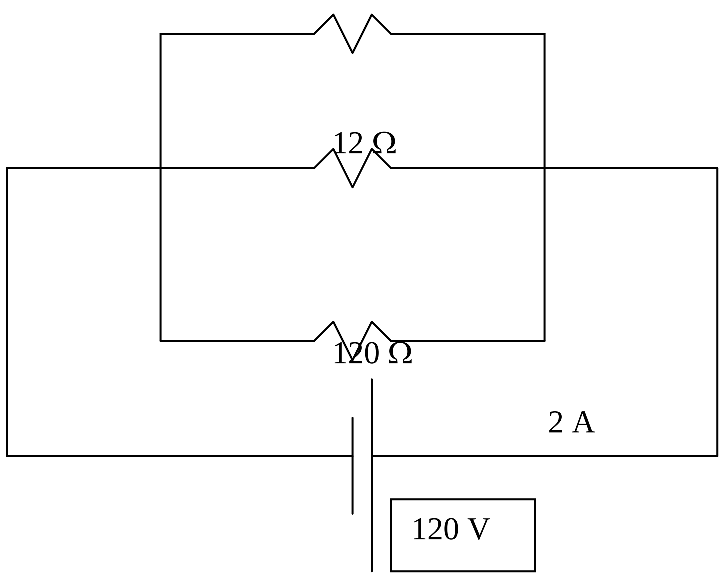
b. computer: 200 W turned on for 5.2 hours

c. school vcr: 27 W turned on for 30 minutes

d. laser disc player: 37 W, on for 300 minutes

9. How much energy in J is consumed by 30 W appliance turned on for 6.0 hours?

10. Find the *energy* delivered by the battery in 2 hours.



11. The following information is found on the back of a television:

Model SFMCL
Serial # : 181920
120 V
60 Hz
1.5 A

This television is used an average of 8 hours a day for a week.

How much electrical energy in kJ does this television use during these 7 days?

12. A toaster is connected to a source that has a potential difference (voltage) of 110 V. The appliance uses 990 kJ when operating for 20 minutes.

What current intensity (I) is flowing through this appliance when it is operating?

13. The resistance of a heating element is 10 Ω and the potential difference (voltage) across its terminals is 240 V. This element is used for 3 hours.

How much electric energy in kJ was used during this period?

14. The internal resistance of an electric circuit is 20 Ω. The potential difference (voltage) across the terminals of this circuit is 10 V. This circuit was used for 30 min.

How much energy in J did this circuit use in 30 minutes?

15. A coffee maker is connected to a 120 V outlet. The resistance, *R*, of the heating element of the coffee maker is 20 Ω. This coffee maker stays on for 2 hours.

How much energy is used by the heating element of the coffee maker during this period?

18. Magnetism

A. What's a Magnet?

A magnet is a substance with two opposite poles: North and South. Like opposite charges, opposite poles attract, so the north pole of one magnet will stick to the south pole of another magnet. Similar poles, like similar charges, repel. In addition, magnets attract certain materials known as ferromagnetic materials.

B. Nonmagnetic, Ferromagnetic and Permanent Magnets

Example: Complete the following table

Classification of Materials		
Types of Materials	**Examples**	**Characteristics**
Nonmagnetic		• Will not attract a magnet or a ferromagnetic substance • domains do not form; although electron spins create magnetic fields, they cancel out.
Ferromagnetic		• can only attract a ferromagnetic substance if stuck to a permanent magnet; otherwise only attracts another magnet • domains form as electron spin are aligned, but the domains themselves are scrambled until

		they're placed in a magnetic field.
Permanent Magnets		• can attract another magnet(if properly aligned)and a ferromagnetic substance • domains are locked into place by impurities

Nonmagnetic materials do not stick to a magnet. Examples are given in the table above. Those materials that are attracted to magnets are known as *ferromagnetic* materials. Note that not all metals are ferromagnetic. Copper, zinc and aluminum will not stick to a magnet, but Fe, Co, Ni , Nd, and Sm will.

What is a temporary magnet?

C. Domains: Why Magnetism Exists

There are four basic forces in nature:

(1) ***gravity***, which attracts matter to itself and acts over large distances

(2) the ***strong*** force, which is much more powerful than gravity but which acts only over miniscule distances. It is what keeps quarks (the basic particles of neutrons and protons) bonded together.

(3) the ***electroweak*** force which controls a radioactive process in which a neutron breaks down into a proton and a fast moving electron (beta particle)

(4) the ***electromagnetic*** force which is what makes ferromagnetic material stick to a permanent magnet and what also keeps positive ions attracted to negative ions.

Now notice we mention the electric force and magnetic force in the same breath. That's because electricity and magnetism go hand in hand. If the current in a wire is strong enough it can deflect the magnetic needle of a compass. A generator of electricity consists of rotating magnets.

Electrons not only go around the nucleus, but each spins on its own axis. In doing so, every spinning electron creates a tiny magnetic field. (a magnetic field is a 3D area where the magnetic force acts) But if a neighboring electron from within the atom or from another atom spins in the opposite direction, the magnetic fields cancel out. This happens in most materials, which explains why most materials are not magnetic. But in *ferromagnetic atoms*, two things are going on:

(1) there are unpaired electrons whose magnetic fields point in the same direction and

(2) these electrons are "shielded" from other unpaired electrons in neighboring atoms. No canceling occurs.

The above two conditions lead to the formation of **domains**. A domain is a small group of about 10 000 atoms whose magnetic fields strengthen each other because they act in the same direction. Each arrow in the diagram below represents 1 domain.

<u>Example:</u> Draw the domains for each of the following:

Domains in a ferromagnetic material	Domains in a temporary magnet	Domains in a permanent magnet

If you place a piece of iron near a magnet, the domains of the iron align themselves with the external magnetic field. The "north pole" of each domain will attract the south pole of the external magnet. The alignment is so perfect, that while a paper clip is stuck to a magnet, it can act as a temporary magnet and attract another clip. But unless there are impurities in the temporary magnet to lock the domains into place, it will lose its "power" once taken away from the permanent magnet.

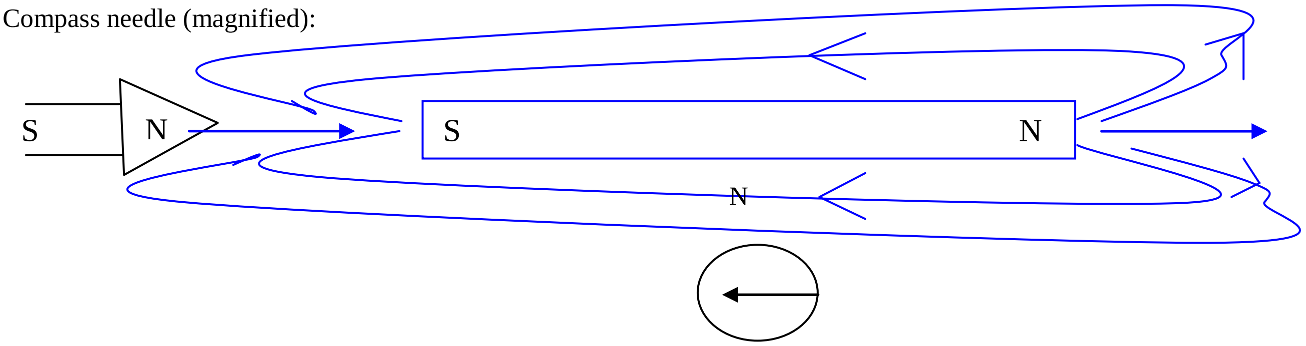
Permanent magnets then have impurities like Al in Alnico magnets to lock the domains into place.

Example: How can a permanent magnet lose its magnetism?

D. **Magnetic Field Lines**

These are obtained by placing a compass in the vicinity of a magnet and moving it around while taking note of the compass *direction*. According to the direction of the compass we place the arrows on the magnetic lines accordingly. (Keep in mind that the compass needle itself is a magnetic needle with the pointy part being the North. North repels north which accounts for the direction they are pointing in.) If we do that around a bar magnet we obtain the following:

Compass needle (magnified):



The more lines there are, then the stronger the magnet.

<u>Example</u> Draw the magnetic field lines around the following magnet. Assume it is stronger than the one drawn above.

Exercises

1. State whether there is repulsion, attraction or neither.

A. N and S ends of two magnets
B. S and S ends of a magnet
C. S end of magnet and ferromagnetic material
D. N end of a magnet and Cu
E. Two ferromagnetic materials; neither is a permanent or temporary magnet

2. Draw the domains, if any, for each of the following:

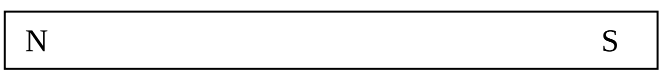
a. Cu	b. Fe not near a magnet	c. pure Fe near a magnet	d. Fe with impurities. It sticks to another iron nail.

3. a. In #2, which one was non-magnetic?

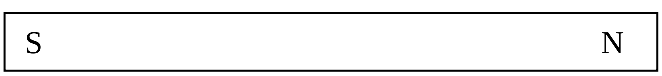
   b. a permanent magnet?

   c. A temporary magnet

4. Draw the magnetic field lines around the following bar magnet.

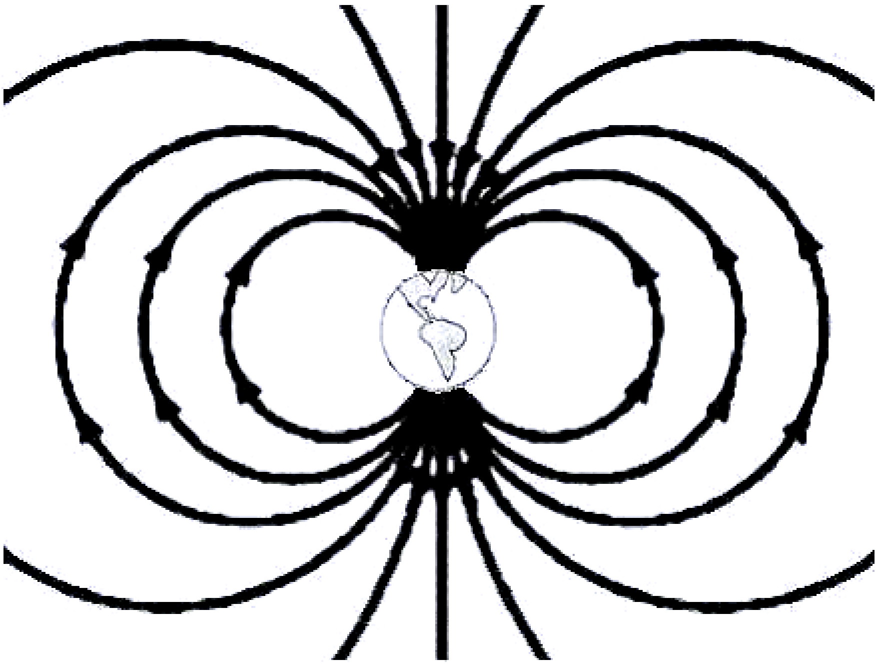


6. Now here is a stronger bar magnet. Draw the field lines again.



6. Explain how we obtain magnetic field lines. How do we know they really exist? What experiment can be performed to reveal their existence?

7. Locate the ***magnetic*** south pole in the following.



8. How can a permanent magnet be ruined? List two ways and explain what happens.

9. Neodymium magnets are actually made up of Nd, B and Fe, while many cheaper magnets consist of Al, Ni and Co.

a. Pick out the non magnetic material from each trio.

b. Explain why it is included.

10. TRUE? Or FALSE?

a. When an electron spins around the nucleus, it creates a magnetic field._____

b. An electron spinning in a direction opposite to that of another electron will create a magnetic field pointing in the opposite direction, canceling the first field._____

c. A group of atoms with magnetic field lines that strengthen each other is known as a *domain*.______

d. Aluminum, lithium and gallium form domains_____

e. Ferromagnetic elements include iron, cobalt, nickel and neodymium.____

f. In a strong magnetic field, the domains of a ferromagnetic element get scrambled in all directions.________

g. If impurities lock domains into an aligned state, we have a permanent magnet_______

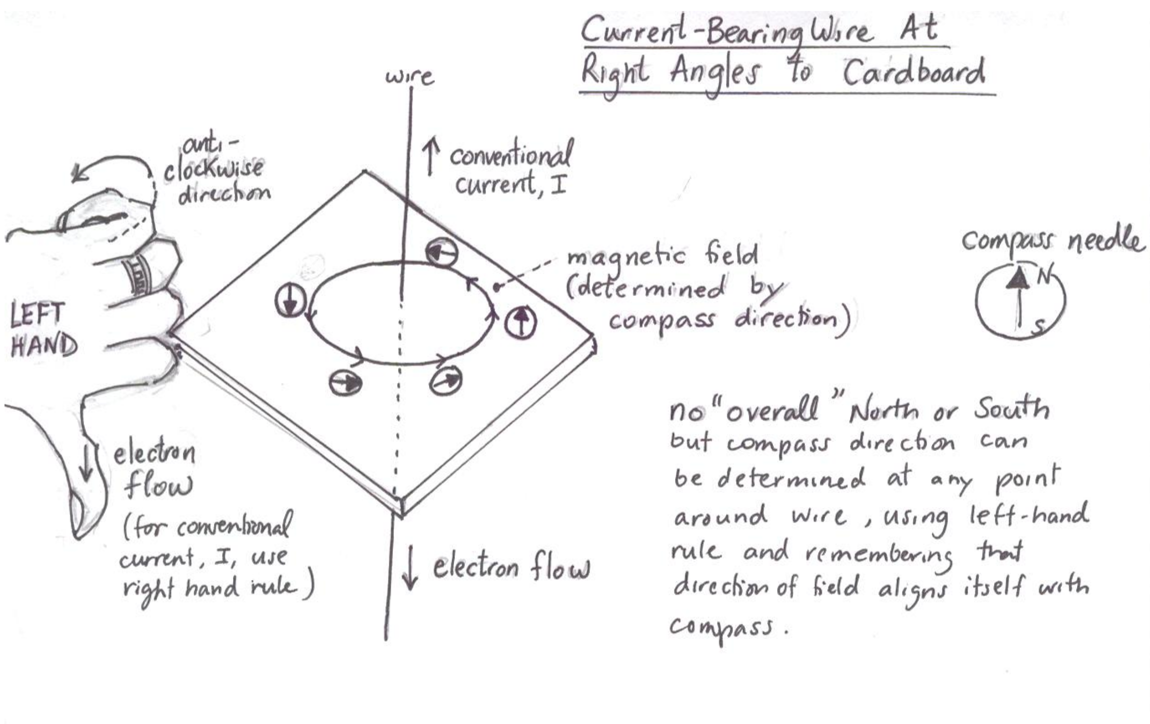
h. Lodestone, compasses and horseshoe magnets are examples of temporary magnets.

19. Magnetic Field Induced By a Current

Left Hand Rule

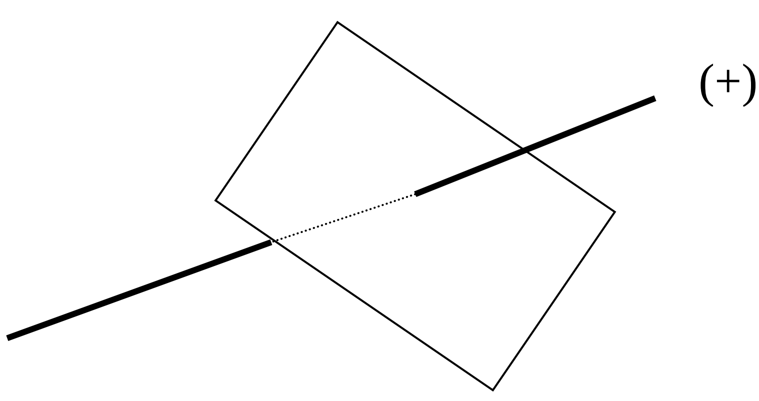
If a strong enough current moves through a straight wire it will create a magnetic field perpendicular to the direction of the current. The **first left hand rule** reveals whether the compass direction along the circle would be clockwise or counter clockwise.

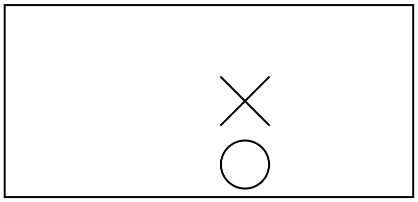
Notice that the thumb points in the direction of the electron flow.



Example 1 Draw the magnetic field in each case.

a.

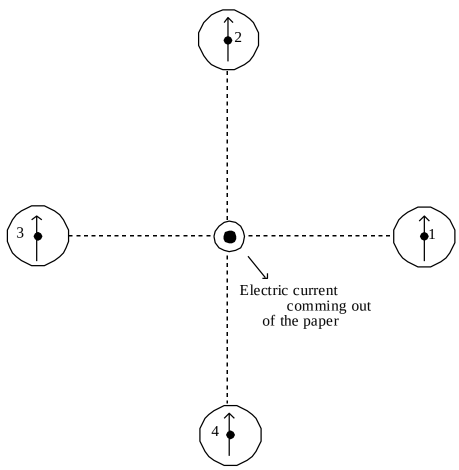


b. 

The X represents electrons moving into the paper.

Exercises

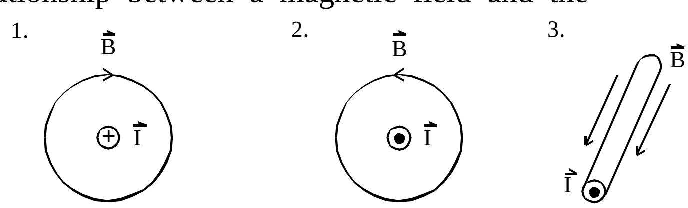
1. An electric current in a straight wire comes up through a sheet of paper. Four compasses are placed on the paper at different points around the wire.



Which arrow on the diagram correctly shows the direction of the needle of the compass at the location where it is placed?

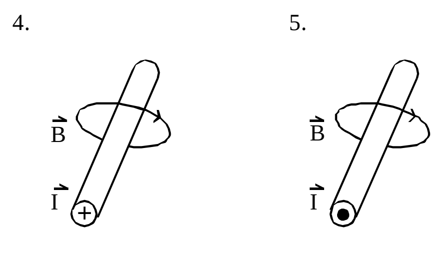
2. Study the five diagrams below.

Which diagram(s) correctly show the relationship between a magnetic field and the electric current producing it?



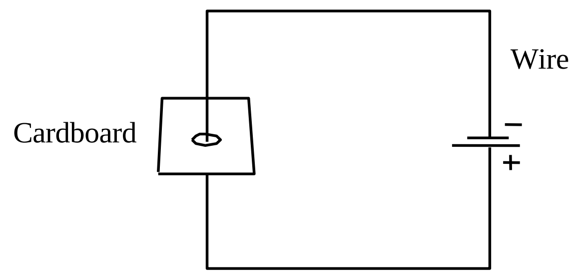
Legend :

⦿electron flow "out of the paper"



⊕ electron flow "into the paper"

3. A copper wire with a current flowing through it passes through a piece of cardboard as shown in the diagram to the right.



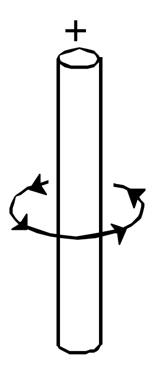
A magnetic compass is placed on the piece of cardboard near the wire. Draw where the compass would be pointing if it was placed at the

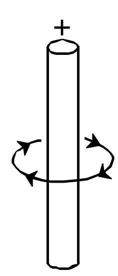
a. 12 o clock position on top of the cardboard

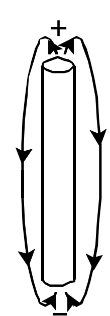
b. 3 o clock position on top of the cardboard

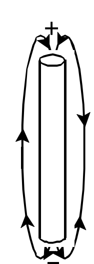
4. An electric current flows through a *straight wire* and produces a magnetic field.

Which of the following diagrams correctly represents this magnetic field?

A) 

B) 

C) 

D) 

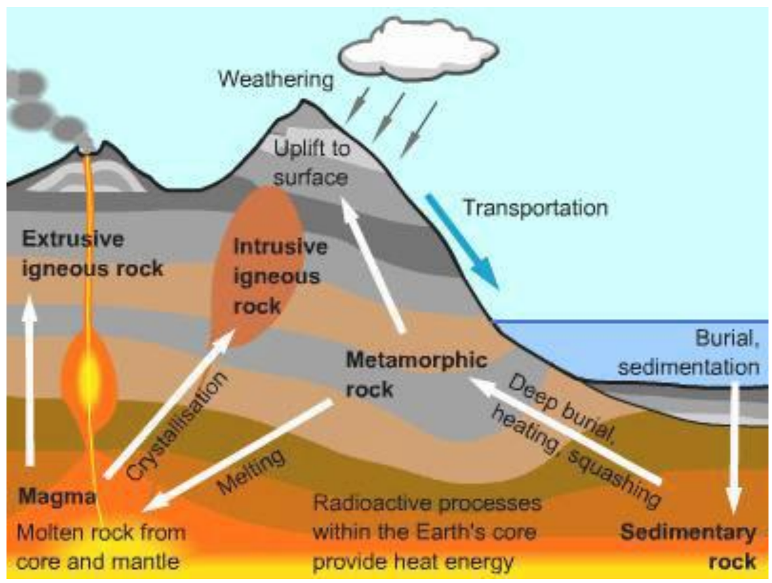
20. Rocks and Minerals

1. What is a mineral? What part of the planet contains all of the minerals?____
____

Example 1: Halite is NaCl and quartz is mostly SiO_2. Are they minerals? What is the shape of NaCl?

2. What is a rock?____
____

A) Types of Rocks



1. Igneous____
____
2. Sedimentary
____
____
3. Metamorphic____
____
____

B) Uses of Rocks

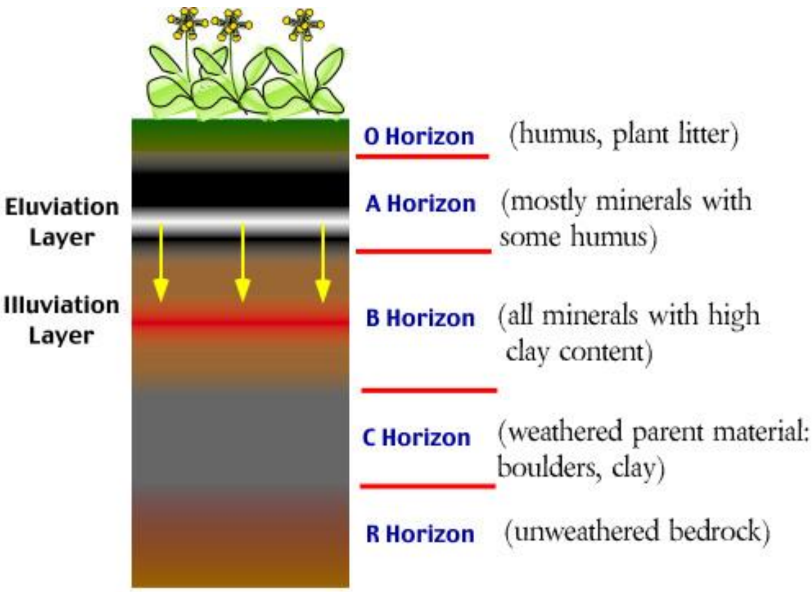
Type of Rock	Specific Example	Use
Igneous		
Sedimentary		
Metamorphic		

Exercises   textbook p214: #2,3,7,8 and……

……Also do the following. You come across an incredibly large rock. It cannot be moved. How do you estimate its mass using the concept of density?

21. Soil Profiles

Most **soils** have a distinct **profile** or sequence of horizontal layers. Generally, these horizons result from the processes of (1)chemical weathering, (2)**eluviation**(The lateral or downward movement of dissolved or suspended material within soil when rainfall exceeds evaporation.), (3)**illuviation**(The deposition of colloids, soluble salts, and suspended mineral particles in a lower soil horizon through the process of eluviation (downward movement) from an upper soil horizon.) and (4)**organic** decomposition.) Up to five layers can be present in a typical soil: **O**, **A**, **B**, **C**, and **R horizons**



The **O horizon** = **ORGANIC** MATTER is the topmost layer of most soils. It is composed mainly of plant **litter** at various levels of decomposition and **humus**.(organic matter)

A horizon is found below the O layer. This layer of **TOPSOIL** is composed primarily of **mineral** particles. which has two characteristics: it is the layer in which humus and other organic materials are mixed with mineral particles, and it is a zone of translocation from which eluviation has removed finer particles and soluble substances. Thus the A horizon is dark in color and usually light in texture and porous. The A horizon is commonly differentiated into a darker upper horizon or organic accumulation, and a lower horizon showing loss of material by eluviation.

The **B horizon(SUBSOIL)** is a mineral soil layer which is strongly influenced by **illuviation(leaching from layer above)**. Consequently, this layer receives material from the A horizon. The B horizon also has a higher bulk density than the A horizon due to its enrichment of clay particles. The B horizon may be colored by oxides of iron and aluminum or by calcium carbonate illuviated from the A horizon.

The **C horizon** is composed of **weathered PARENT ROCK** material. The texture of this material can be quite variable with particles ranging in size from clay to boulders. The C horizon has also not been significantly influenced by the **soil-forming** processes, translocation, and/or organic modification.

The final layer in a typical soil profile is called the **R horizon**. This soil layer simply consists of unweathered bedrock. But on inhabited islands, it is what serves as the basis of all other layers that eventually form.

Examples

1. Into which soil layers would the roots spread?

2. Where would pH, moisture and amount of mineral ions be an important factor in plant growth?

3. What ions colour the B-layer(subsoil)?

4. Why is the R-layer unweathered?

Exercises

1. Give examples of mineral ions that are needed for plant growth.
2. In what soil layer would these be found?
3. Why is soil a product of both earth and life?
4. Match the following characteristics with the correct soil layer:

Characteristic	**Soil layer or horizon**
a) Solid part of lithosphere; eventual base of all other soil layers_____	Organic Matter(O)
b) Large pieces of rock____	Top Soil (A)
c) has humus(natural compost)	Subsoil(B)
d) consists of small mineral particles;receives particles from layer A	Weathered Parent rock (C)
e) a mixture of organic material and minerals	Unweathered Parent rock (R)