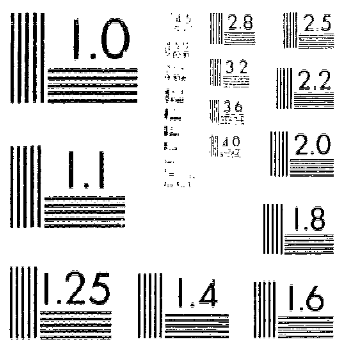
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ABSTRACT

This is a copy of the script for the electrical relationships unit in an auto-tutorial physical science course for non-science majors, offered at the University of Maine at Orono. The unit includes 15 simple experiments designed to allow the student to discover various fundamental electrical relationships. The student has the option of reading the script or listening to the tape prior to completing the experiment. (Author/SL)

Static and Current Electricity

by

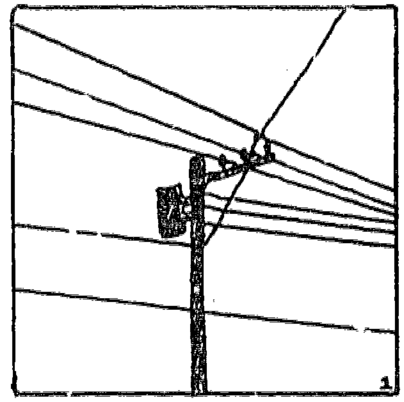
Richard M. Schlenker and Kathy T. Murtha

Abstract

This is the script portion of unit #9 of a physical science course. The physical science course is currently being offered through the College of Education of the University of Maine at Orono for non-science majors. The course is auto-tutorial. This portion of the unit contains the same information as the slide tape portion. The student then has the option of using the script or listening to the slide tape presentation prior to accomplishing the experiments which the course requires. The student uses the inquiry approach to discover various electrical relationships.

UNIT 9

STATIC AND CURRENT ELECTRICITY



Advance your slide tray to slide 1.

In this unit you will study static and current electricity, but first, let's look at slide 2 and see what the unit objectives are.

OBJECTIVES FOR UNIT 9

1. The student will be able to define the following terms;
   a. static electricity
   b. current electricity
   c. alternating current
   d. direct current
   e. positive
   f. negative
   g. voltage
   h. current flow
   i. resistance
   j. capacitance
   k. conductor
   l. non-conductor
2. The student will be able to produce static electricity.
3. The student will be able to use different measuring devices.
4. The student will be able to predict the behavior of charged materials.
5. The student will be able to distinguish between conductors and non-conductors.
6. The student will be able to construct simple circuits.
7. The student will be able to identify positive and negative charges.
8. Using Ohm's Law, the student will be able to compute voltage, resistance and current flow.

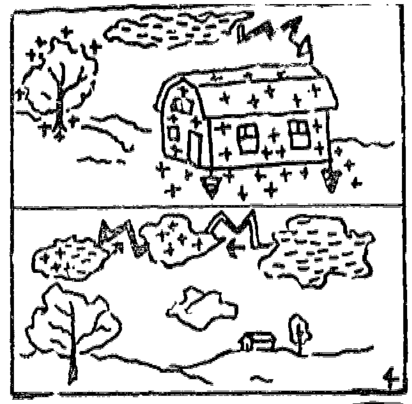
On slide 3 you will find a list of experiments which you will conduct while studying this unit.

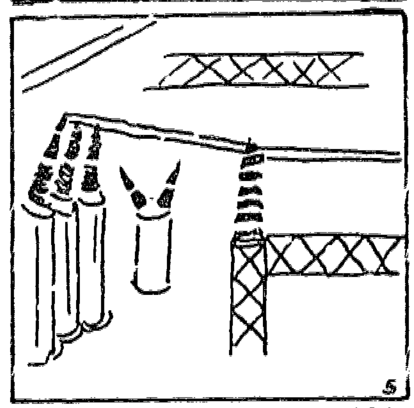
EXPERIMENTS FOR UNIT 9

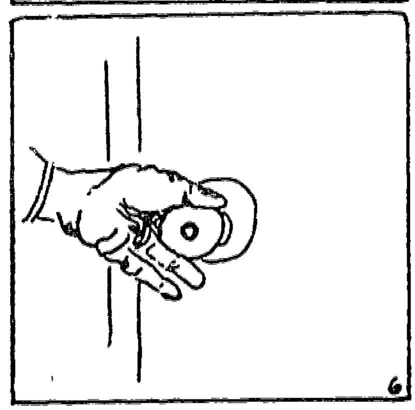
1. Exploring charges
2. Transfer of charges
3. Types of charges
4. Conductors and insulators
5. Charge generator
6. Atoms and electrons
7. Charge density
8. Storage of charges
9. Forces of charges
10. Coulombs Law
11. Direct current batteries and simple currents
12. Schematic diagrams
13. Ohms Law
14. Measuring circuit parameters
15. Building simple circuits

At the end of the unit you will find that we have inserted slides of an historical nature. Historical material, while not vital to the understanding of electrical concepts, better allows us to appreciate the subject with which we are dealing.

Before it is possible to study static or current electricity, we must first define electricity. The word "electric" is derived from the Greek word amber. Now look at slides 4, 5 and 6.







What do you suppose happened when the hand first touched the doorknob? You have probably experienced this phenomenon yourself, especially when the humidity was of the correct value. Would you expect the humidity to be high or low when this happens? Why? Based on the previous slides and discussion, can you define electricity? Record your definition in your notebook. Now study slides 7 and 8, comparing and contrasting what you see here with your definition.

SEE PAGE 2A

7

SEE PAGE 2A

8

The word "electric" is actually a Greek derived word meaning AMBER. Amber is a translucent (semitransparent) yellowish mineral, which, in the natural form, is composed of fossilized resin. The ancient Greeks used the works "electric force" in referring to the mysterious forces of attraction and repulsion exhibited by amber when it was rubbed with a cloth. They did not understand the fundamental nature of this force. They could not answer the seemingly simple question, "What is electricity?" This question is still unanswered. Though you might define electricity as "that force which moves electrons," this would be the same as defining an engine as "that force which moves an automobile." You would have described the effect, not the force.

We presently know little more than the ancient Greeks knew about the fundamental nature of electricity, but tremendous strides have been made in harnessing and using it. Elaborate theories concerning the nature and behavior of electricity have been advanced, and have gained wide acceptance because of their apparent truth and demonstrated workability.

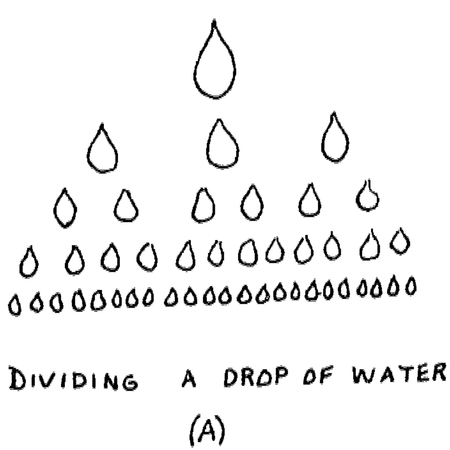
From time to time various scientists have found that electricity seems to behave in a constant and predictable manner in given situations, or when subjected to given conditions. These scientists, such as Faraday, Ohm, Lenz and Kirchoff, to name only a few, observed and described the predictable characteristics of electricity and electric current in the form of certain rules. These rules are often referred to as "laws". Thus, though electricity itself has never been clearly defined, its predictable nature and easily used form of energy has made it one of the most widely used power sources in modern time. By learning the rules, or laws, applying to the behavior of electricity, and by learning the methods of producing, controlling and using it, you will have "learned" electricity without ever having determined its fundamental identity.

The Molecule

One of the oldest, and probably the most generally accepted, theories concerning electric current flow is that it is comprised of moving electrons. This is the ELECTRON THEORY. Electrons are extremely tiny parts, or particles of matter. To study the electron you must therefore study the structural nature of matter itself. (Anything having mass and inertia, and which occupies any amount of space, is composed of matter.) To study the fundamental structure or composition of any type of matter, it must be reduced to its fundamental fractions. Assume the drop of water in figure 1-1A was halved again and again. By continuing the process long enough, you would eventually obtain the smallest particle of water possible-the molecule. All molecules are composed of atoms.

A molecule of water (H_2O) is composed of one atom of oxygen and two atoms of hydrogen, as represented in figure 1-1B. If the molecule of water were further subdivided, there would remain only unrelated atoms of oxygen and hydrogen, and the water would no longer exist as such. This example illustrates the following fact-the molecule is the smallest particle to which a substance can be reduced and still be called by the same name. This applies to all substances-liquids, solids, and gases.

When whole molecules are combined or separated from one another, the change is generally referred to as a PHYSICAL change. In a CHEMICAL change the molecules of the substance are altered such that new molecules result. Most chemical changes involve positive and negative ions and thus are electrical in nature.



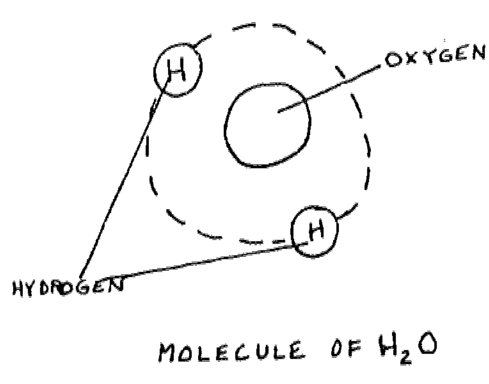
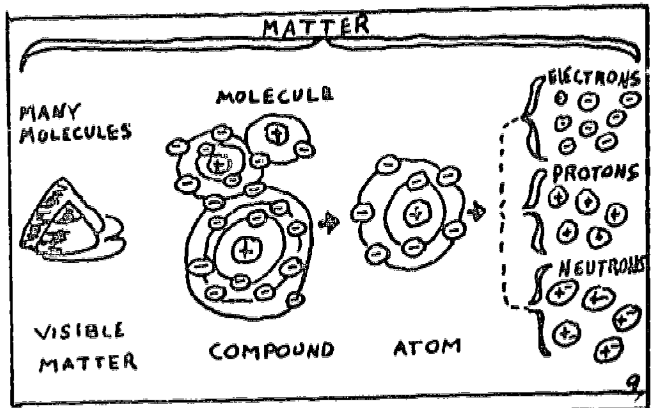
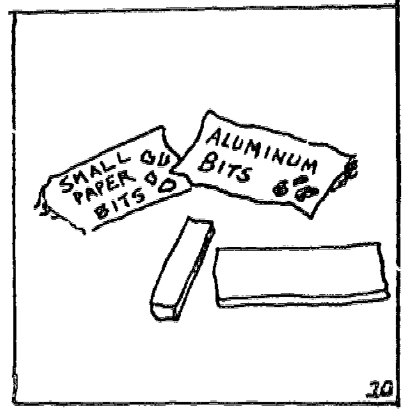


figure 1-1 : MATTER IS MADE UP OF MOLECULES

Advance to slide 9.

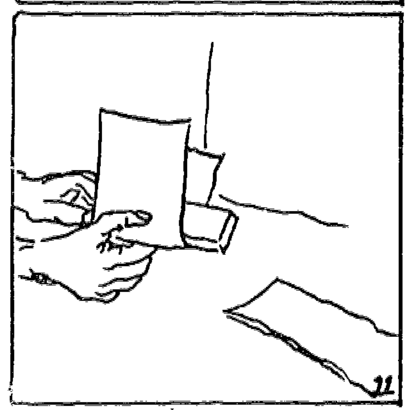


You should remember that slide 9 shows a model which fits mans' observations; however, no one has ever actually seen a proton, neutron, or electron. In theory, which subatomic particle moves? If you do not know the answer to this question or are not sure, research the question in one of the physics texts found on the bookshelf and record your answer in your notebook.

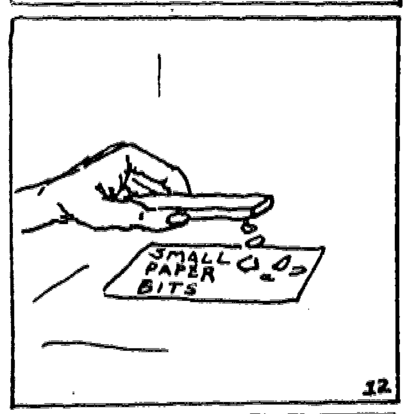


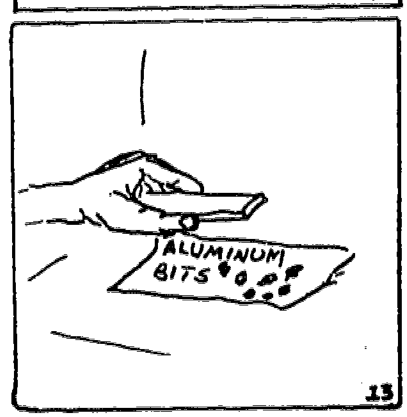
EXPERIMENT # 1

One type of charge is a static charge. At this point we will define static as not moving. From the unit 9 equipment cabinet, obtain the items shown in slide 10 and proceed as in slide 11.

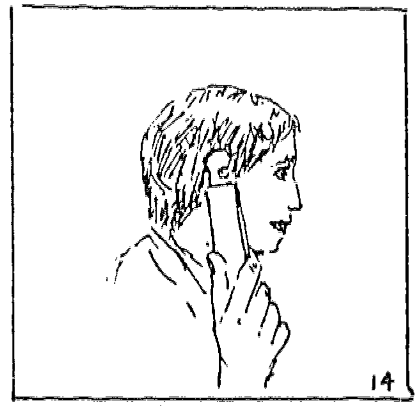


Advance to slide 12 and hold the charged rod over the bits of paper as shown. Now record your results and repeat this procedure, this time holding the charged rod over the bits of aluminum foil as shown in slide 13.

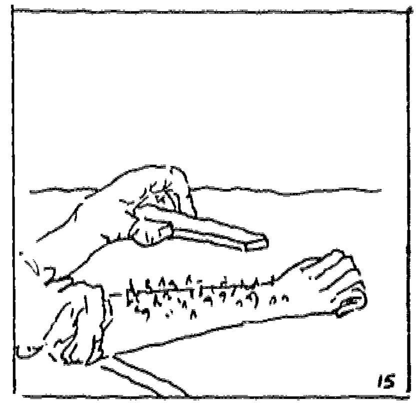




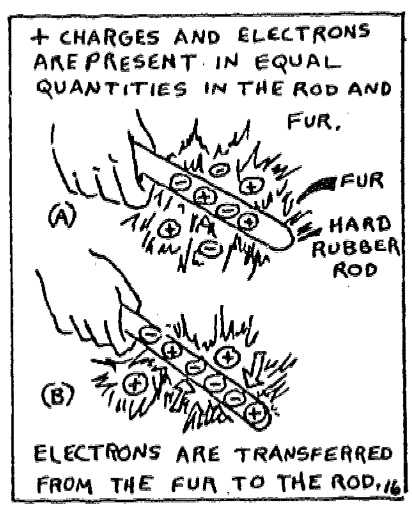
What happened? Now repeat the above operations with a piece of wool cloth and the rubber rod. Record your results. Were they the same as those obtained using the plastic strip and paper towel? Why? Rub the plastic strip as you did before and perform the operation shown in the next slide 14.



Did anything happen and if so, what? Rub the plastic strip with the paper towel again, advance to slide 15 and perform the operation shown. Record your results.



You should now write a summary of what you have learned about charges. In your summary you should decide if there is more than one type of charge. If you feel that this is the case, how would you name these charges and what led you to believe there was more than one type of charge? Now that you have completed your summary, advance to slide 16.



When you rubbed the various rods, you created situations similar to those seen in this slide. When using some types of materials, electrons are transferred in one direction. While the use of other materials results in electrons being transferred in the opposite direction. The direction in which electrons move is important. Do you know why?

EXPERIMENT # 2

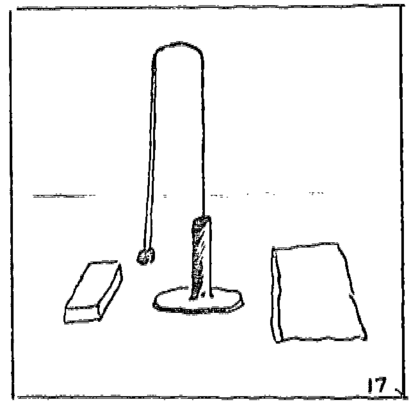
Obtain the materials shown in slide 17.

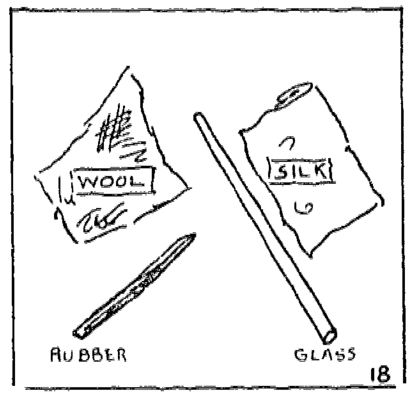
Charge the plastic scrip as you have done before and hold it close to the ball. What happened? Record your results and advance to slide 18.

Rub the rubber rod with a piece of wool, and hold the rcd close to the pith ball. Repeat this operation using the glass rod and the piece of silk and then record your results. Were your observations the same using the three rods?

If you noticed a difference in reactions, describe it and then explain why you think there was a difference.

What can you conclude from your observations?





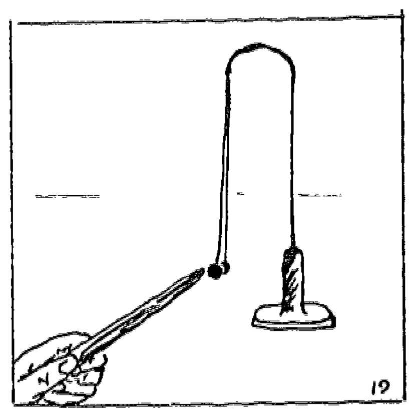
EXPERIMENT # 3

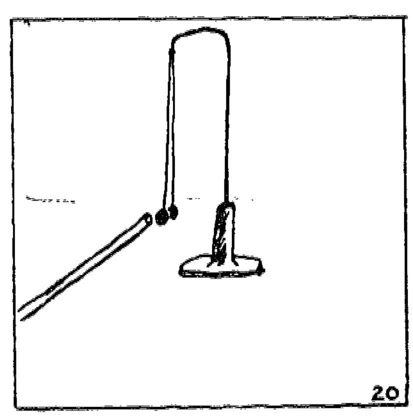
Using the equipment shown in slide 18, rub the rubber rod with the piece of wool and touch the pith ball as shown in slide 19.

Now rub the glass rod with the piece of silk and hold it close to the pith ball as shown in slide 20.

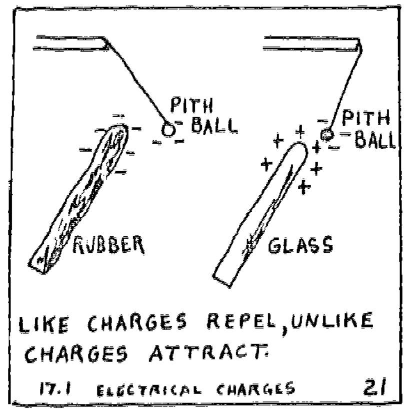
This time, first rub the glass rod with silk and touch the pith ball. Then rub the rubber rod with the piece of wool and hold the rod near the ball. Describe your results in both the operations which you have just performed.

Why do you think these events happened?

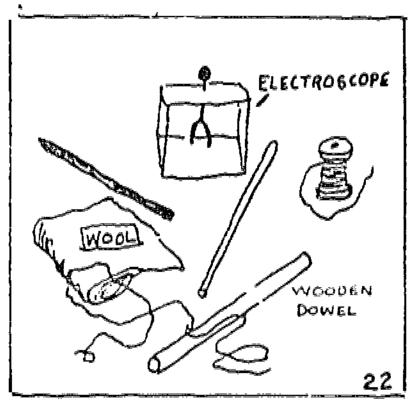




Advance to slide 21.

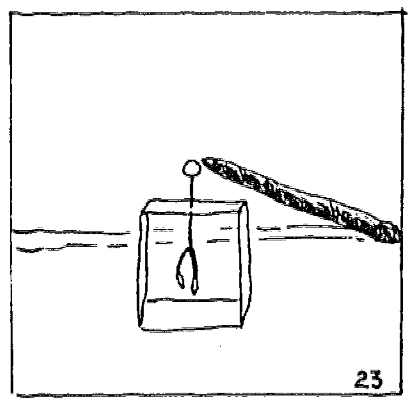


You have probably discovered that there are two types of charges. These charges are known as positive and negative, or plus and minus charges. Obtain one or more texts from the book shelves and contrast your results in Experiment # 2 and 3 with the text information and then write a short summary of this comparison in your notebook. Before going further, obtain Quiz #1 from your instructor. As soon as you have completed the Quiz, ask your instructor to evaluate it. This will give us a chance to see how you are doing and to identify problems which you might be having before you are too far into the unit.



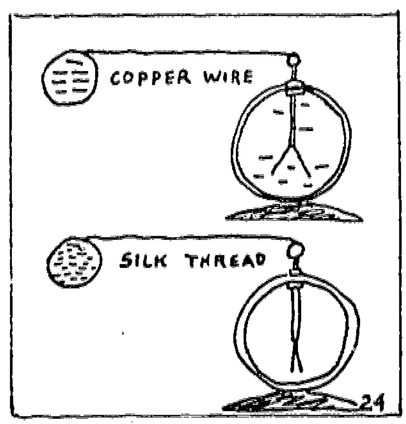
EXPERIMENT #

Obtain the items seen in slide 22.



Charge the rubber rod and proceed as in slide 23, recording your results when you have completed this task. Based on what you have learned in the previous experiments, EXPLAIN YOUR RESULTS.

Now advance to slide 24. This time touch the ball with one end of the copper wire, charge the rod and touch the other end of the copper wire. This operation may require two people, one of whom will holdthe copper wire. When holding the copper wire, you should insure that it touches only the ball on the electroscope and the rod and that it is insulated



from your hands. Repeat this operation, touching the ball of the electroscope with one end of the silk thread while touching the other end with the glass rod.

Repeat this again, this time replacing the thread with a block of wood. In each case, record your results. What are the reasons for your observations?

Advance to slide 25.

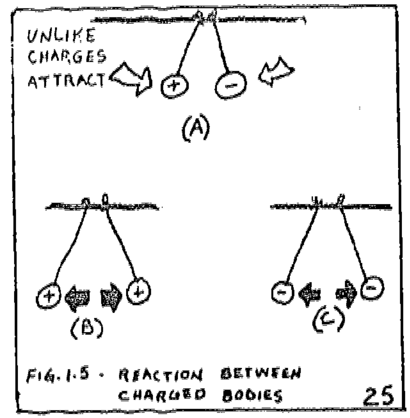


FIG. 1.5 · REACTION BETWEEN CHARGED BODIES 25

You have just investigated conductors and non-conductors, non-conductors are often called insulators. Why did the leaves of the electroscope spread when the copper wire was used?

Based upon what you have learned, classify those items listed in the next slide as either insulators or conductors.

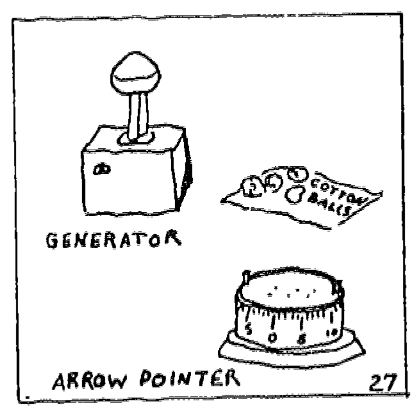
Advance to slide 26.

SILVER	RUBBER
DRY AIR	ALUMINUM
GLASS	ZINC
MICA	BRASS
COPPER	ASBESTOS
IRON	BAKELITE

26

EXPERIMENT # 5

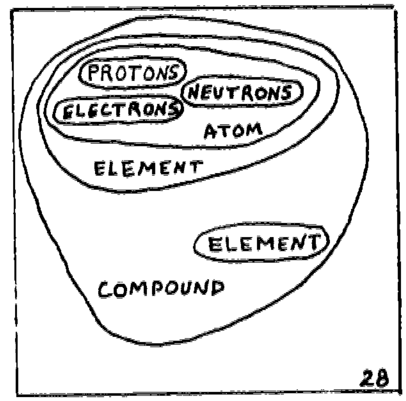
Obtain the equipment shown in slide 27.



Turn the machine on. What do you observe happening to the paper strips on top of the generator? Now set a cotton ball on top of the machine. What happens when the cotton ball touches the ball on top of the machine?

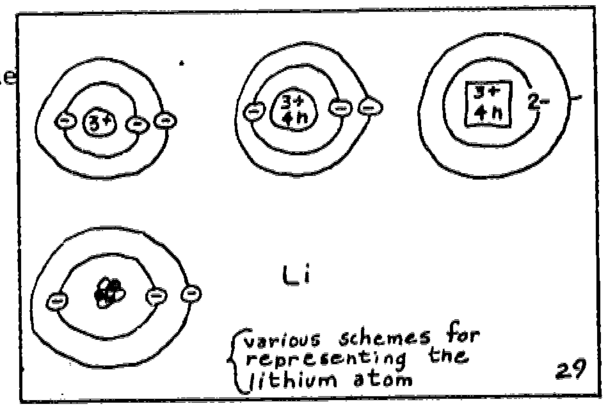
Record your results and then move the pointer close to the generator. What do you observe happening?

Design and conduct an experiment which will allow you to determine whether the generator produces positive or negative charges. Then outline your experiment and discuss your results.



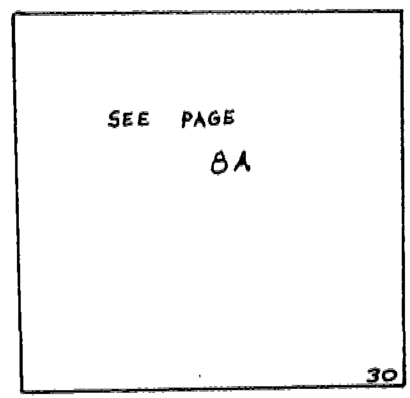
EXPERIMENT # 6

Advance your carrousel to slide 28 and describe the relationships which you think exist between the items shown. Compare this slide with slide 29. What, if any, similarities do you find to exist between the two slides?



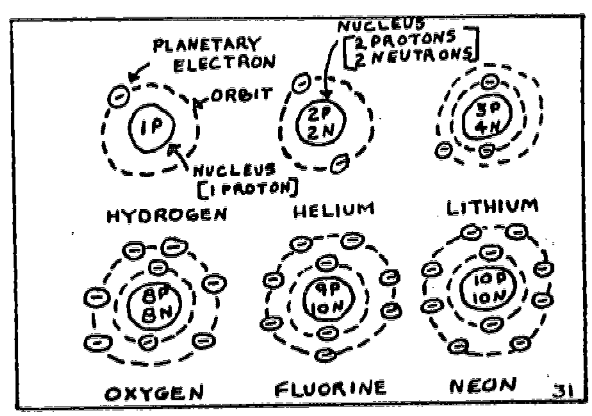
Advance to slide 30.

Describe what you see. What relationship do you find in evidence? Why do you think this table is named the periodic table?



If two atoms were situated on this table such that there was a third atom between them being discussed, what might you predict about the electrons, protons, and neutrons of the guy in the middle?

Compare your answers with the information presented in the next slide (31).



Now, what similarity exists between all of the elements shown except hydrogen?

Where are the protons and neutrons located?

The answers to all of these questions are included in slides 28, 29, 30, 31. At this point, if you are unsure of the answers to thses questions, you should consult a chemistry text. Please cousult your instructor if further questions exist.

Periodic Chart of the Elements

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	NOBLE GASES
1 H 1.0079																1 H 1.0079	2 He 4.00260
3 Li 6.941	4 Be 9.01218											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.99840	10 Ne 20.179
11 Na 22.98877	12 Mg 24.305											13 Al 26.98154	14 Si 28.086	15 P 30.97376	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.096	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.90	23 V 50.9414	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4878	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.84	43 Tc 98.9062	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.4	47 Ag 107.868	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.30
55 Cs 132.9054	56 Ba 137.34	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.9665	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.9804	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 Ac (227)	104 § (260)	105 § (260)													

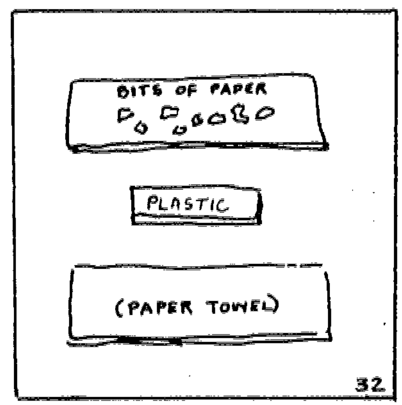
58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (147)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.97

90 Th 232.0381	91 Pa 231.0359	92 U 238.029	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (255)	103 Lr (256)

Next, draw a diagram of an atom having a) 4 protons, b) 5 electrons, c) 6 electrons, d) 7 electrons. If a given atom had 18 electrons, how many orbital rings would you hypothesize it to have? If you are not sure about how to answer this question, obtain either a chemistry or physics text from the book shelf and research the answer. You might also obtain your answer from slide 30. Based upon what you have seen of subatomic particles, if one were to move, for example, be attracted away by some external force, which one would you expect it to be and why?

EXPERIMENT # 7

Obtain the equipment shown in slide 32. Rub the plastic strip once with the paper towel and hold it about 2 cm above the paper bits. Do you note anything happening? Rub the strip twice and repeat the operation. Repeat rubbing three times, then four and five. What results were observed? Now repeat these operations but this time hold the plastic strip 3 cm above the paper bits, then repeat again at 4 cm above the paper bits. Record your results. What effect did the number of times you rubbed the strip have on the bits? What do these operations suggest to you about the quantity of charge? Based upon what you have learned in previous units and the observations



you have just made, define charge density.

Is there a relationship between the number of times you rubbed the rod and the density of the charge?

If you are still confused about charge density, obtain a physics text and seek out the answer.

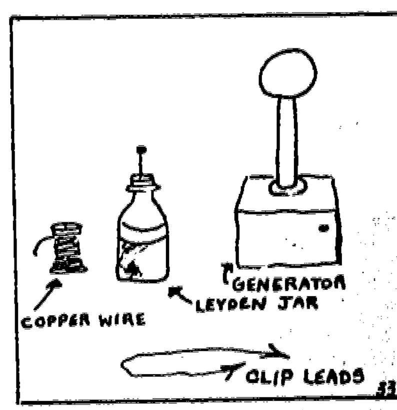
Now design an experiment which relates number of times the rod is rubbed and its ability to attract bits. Collect some data, graph your results, pick the best fitting line, determine the slope, compute the y-intercept and write an equation for the line. Using the experiment you have just run, see if you can add the distance from the rod to the bits dimension and then proceed as you did before, graphing your results, etc.

Obtain Quiz # 2 from your instructor, complete it, and have it evaluated before going on to Experiment 8.

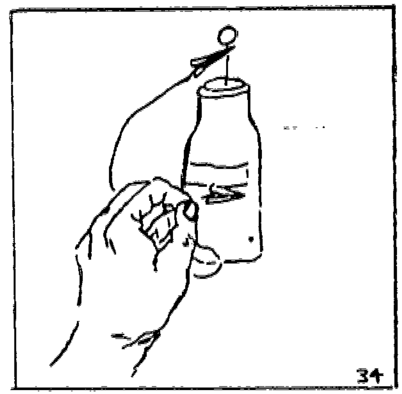
EXPERIMENT # 8

Can charges be stored? Procure the equipment shown in slide 33 and set it up as shown in the slide. If you are in doubt as to how to correctly set up the equipment, see your instructor.

Turn on the generator and let it run for a moment, being careful not to touch any of the equipment.

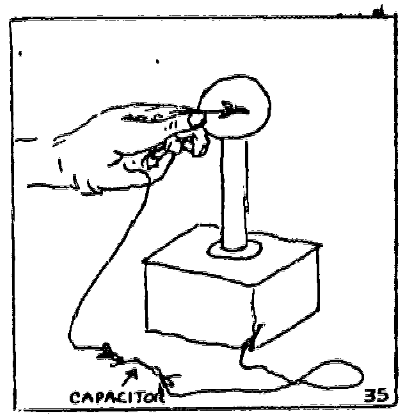


Turn the generator off and carefully disconnect it from the leyden jar. Now touch the clip lead to the top post of the jar while touching the side with the other end of the same lead as shown in slide 34. Record your observations.



Did you see an arc? If you did see an arc, why do you suppose it occured?

Repeat this experiment using the setup shown in slide 35. When you shorted the capacitor, what did you observe to happen? From your observations, what can you say about the storage of charges?

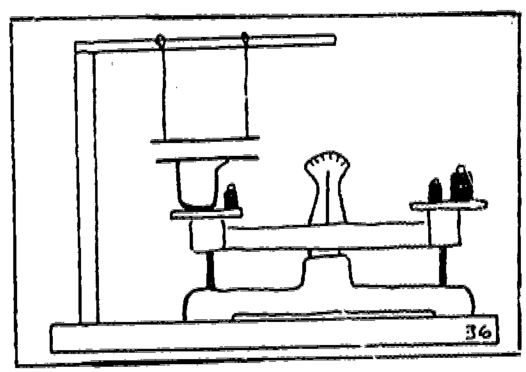


What is one function of a capacitor?

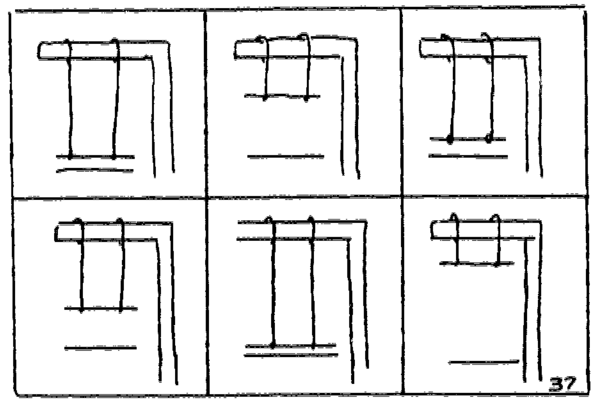
What are some of the uses which electrical and electronic engineers find for capacitors?

EXPERIMENT # 9

Set up the equipment as shown in slide 36.

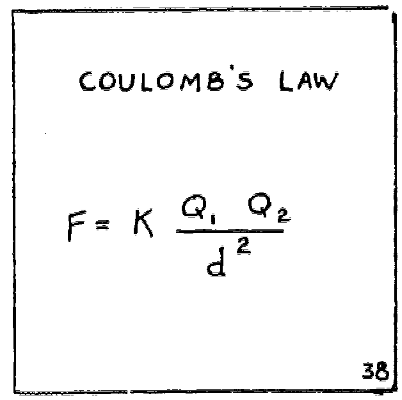


The two rods, one hanging over the balance and the other sitting on the balance, should be of the same substance. It matters not whether they are glass or rubber as long as they are the same. The rods should be charged as they were in Experiment 2. When a charged rod is set on the balance it should also be insulated from the balance. Find a suitable material and place it on the scale when you are obtaining a balance. Charge both rods at the same time, this may require two people. Change the height of the top rod several times such that the distance between the rods varies as shown in slide 37.



You charge each rod each time you change the height. This is a difficult experiment. If you are to obtain results, remember, patience is a virtue.

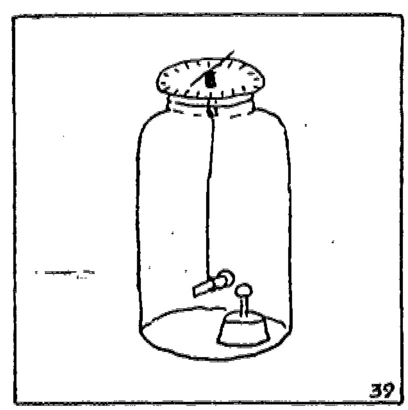
What happens to the balance? Graph your results. Is there a relationship between the distance between the rods and the amount of change of the balance? If there is a relationship, can you decide what it is? Does a force exist between the two rods? Advance to slide 38.



Where Q and Q_2 are the charges on two objects, K is a constant and d is the distance between the objects, F = the force between the objects.

What can you say about the relationship between the force and the distance between the rods?

<u>EXPERIMENT # 10</u>



Set up the equipment as shown in slide 39.

Charge both balls by touching them with a charged rubber rod. Set the toothpick indicator at 15° and record your observations. Repeat this operation , moving the pointer an additional 15°; what happened this time?

Is there a relationship between what you have just accomplished and the formula you were given in slide 38?

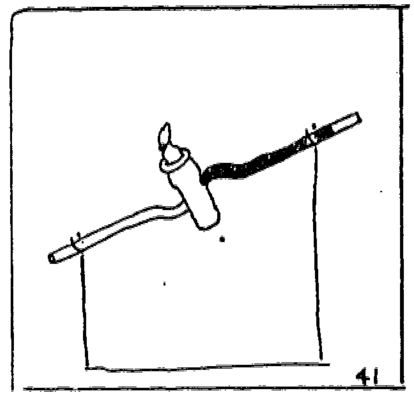
If you think that there is a relationship, what is it? In this experiment you have been investigating Coulombs Law.

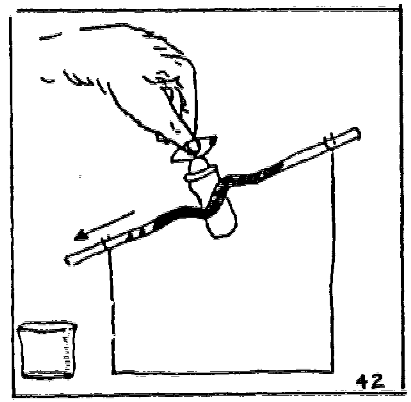
Now advance to slide 40. [see page 13 A]

You should now have some idea of how static electricity acts under different circumstances. Before going on, review the results of Experiment 4. In this experiment you may have concluded that charges move along conductors. We might define current electricity as electricity which moves.

Advance to slide 41.

After examining slide 41, advance to slide 42.

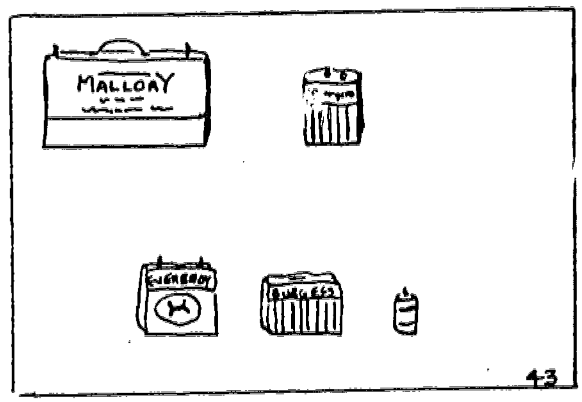


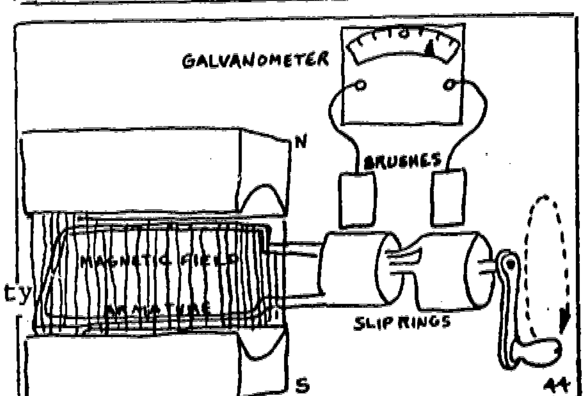


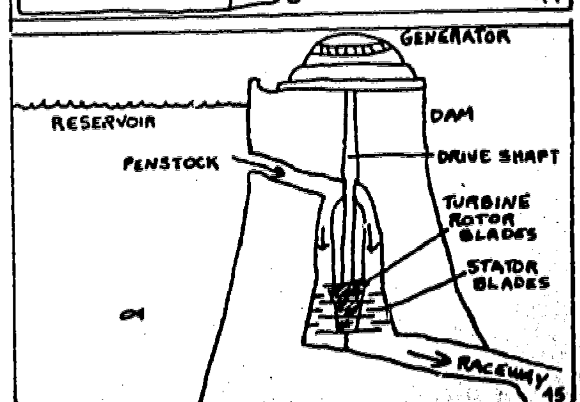
What force causes the liquid to flow?

In electricity, if electrons are to move as in current electricity (this movement if commonly called current flow), there must be some force which causes this movement.

In slides 43, 44, 45, we see several sources of a force. This force is often referred to as an electromotive force or a difference in potential.







Can you think of another name which might be given to this force? If not, consult the electricity section of a physics or physical science text.

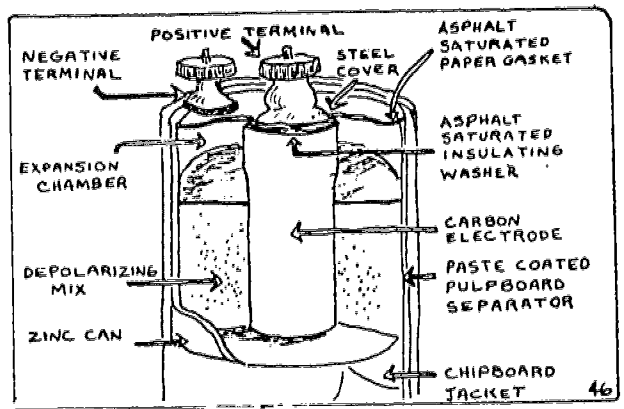
You might think of this force which moves electrons as being analogus to the force of gravity which moved the liquid shown in slide 42. You should remember, however, that no one has ever seen an

COUL 'B'S LAW OF CHARGES

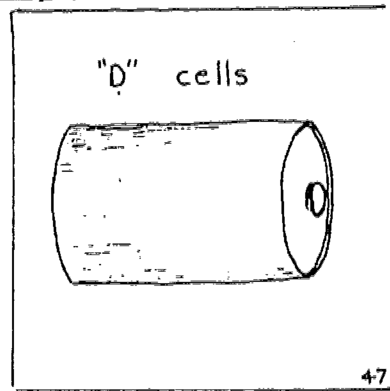
The amount of attracting or repelling force which acts between two electrically charged bodies in free space depends on two things: (1) their charges, and (2) the distance between them. The relationship of charge and distance to electrostatic force was first discovered and written by a French scientist named Charles A. Coulomb.

Coulomb's Law states that CHARGED BODIES ATTRACT OR REPEL EACH OTHER WITH A FORCE THAT IS DIRECTLY PROPORTIONAL TO THE PRODUCT OF THEIR CHARGES, AND IS INVERSELY PROPORTIONAL TO THE SQUARE OF THE DISTANCE BETWEEN THEM.

(SLIDE 40)

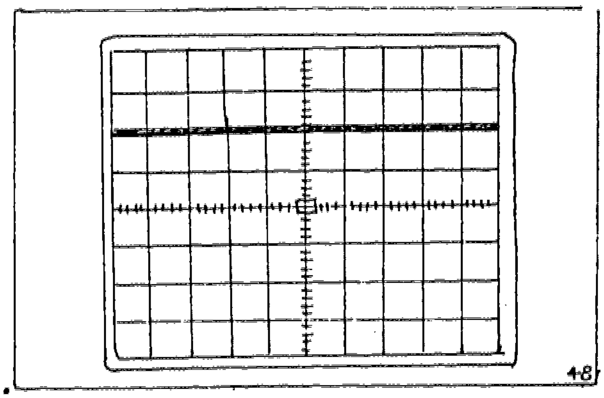


electron. Research evidence does suggest that electrons move or are pushed when a force is applied, depending upon your point of reference, as the liquid did when gravitational force was allowed to operate.

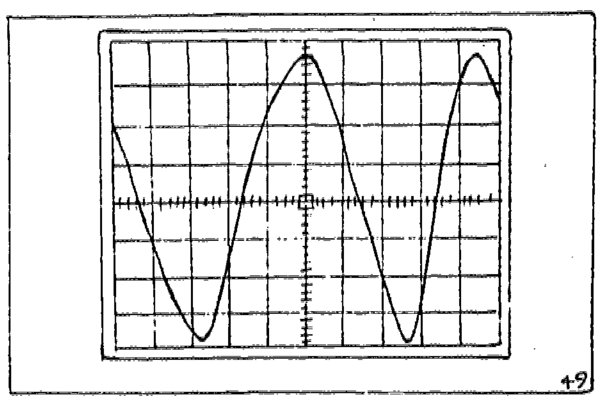


EXPERIMENT # 11

Examine the batteries shown in slide 46 and 47. What do you find these two batteries to have in common? You should have concluded that they both have a positive and a negative pole. They have positive and negative poles because they produce a type of current flow known as direct current. Direct current moves in one direction only and is commonly abbreviated DC. Alternating current, abbreviated AC, moves in two directions. You may compare these two types of current flow by viewing slides 48 and 49.

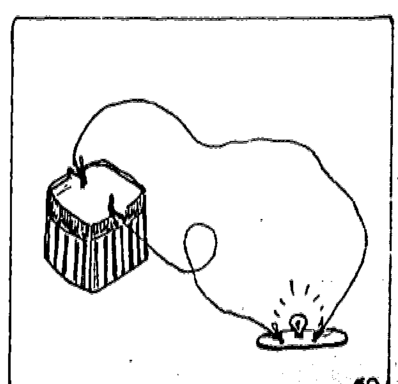


Describe the differences you find between the two types of current. You should remember that what you see in the slides is only a graphic representation of a phenomenon.



We are able to view these phenomenon only because of technological developments in the field of electricity which results in the construction of equipment such as the oscillascope.

Using a 1 1/2 volt battery, build the circuit shown in slide 50.



Does the light light?

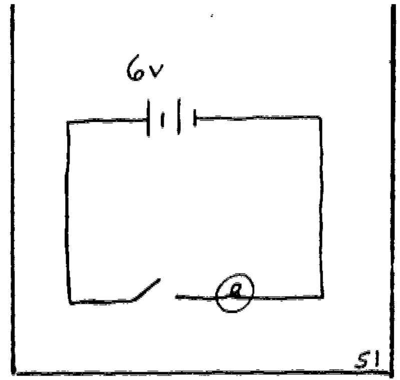
Describe the path of current flow.

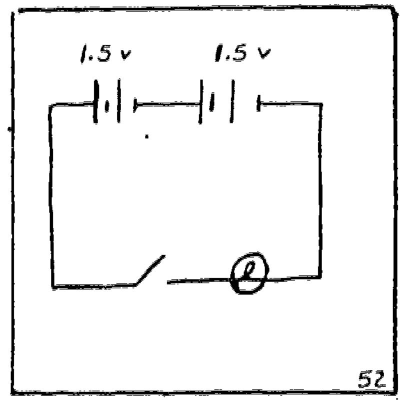
Now build the circuits shown in slides 51-55.

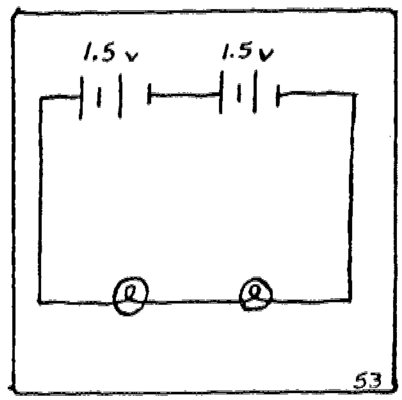
If you have difficulty understanding these diagrams, refer to slide 56 before going on.

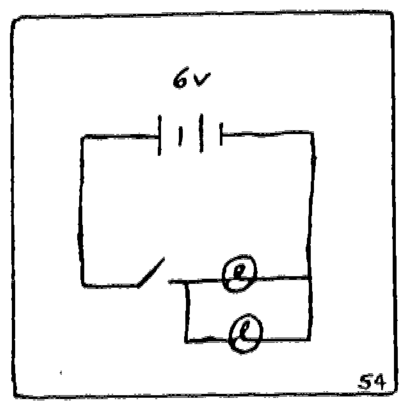
Compare and contrast your observations of these circuits in operation. Is there a difference between the amount of voltage impressed across the circuit in slide 54 and that impressed across the circuit in slide 55?

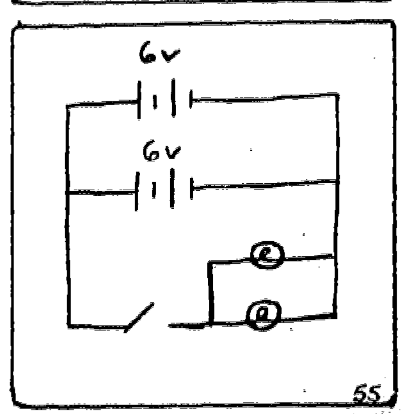
Is there a difference in the amount of current flow in these two circuits? If there are differences, what causes the differences?







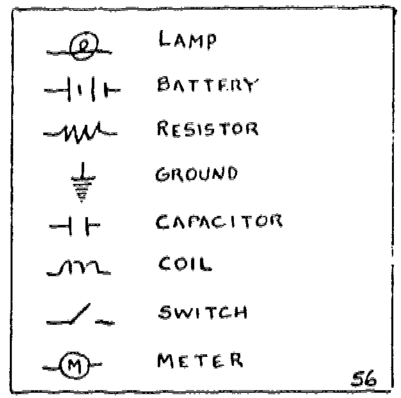




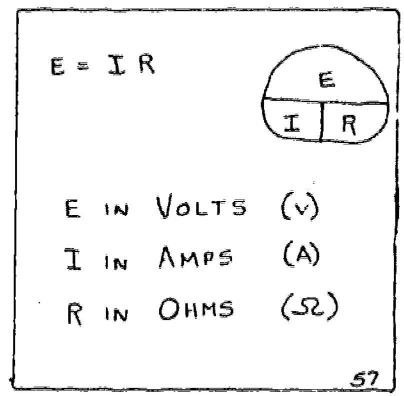
EXPERIMENT # 12

Electric circuits are often written in diagram form called schematic diagrams. These diagrams use a common set of symbols which allow all readers to understand their meaning. These symbols are called circuit symbols and in larger schematics they are numbered usually sequentially. Using the symbols shown in slide 56, draw schematic diagrams of those circuits shown in slides 51-55, using the resistor symbol instead of the lamp symbol.

If there is more than one of a given component in a circuit, assign each component a number.



Now redraw each schematic drawing, substituting the resistor symbol for the lamp symbol. Can you hypothesize what similarity there might be between the lamp and the resistor?



EXPERIMENT # 13

Advance to slide 57.

The letter E represents electromotive force or voltage; the letter R, resistance; and the letter I, current. These three quantities are related in a law known as Ohms' Law. Ohms' Law is used to describe circuits quantitatively as shown in slide 57. Using the information given in slide 57, complete the chart shown in slide 58, giving the units of each unknown.

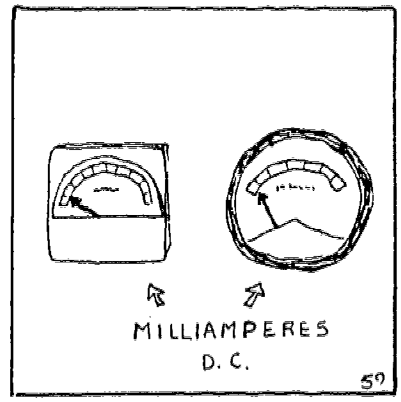
E	I	R
	2	4
2	4	
3		6
10	10	
	7	1
7		7
3		8
	0.25	500
110	11	
	10	10500

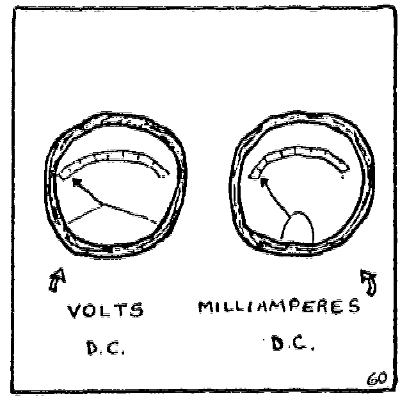
58

EXPERIMENT # 14

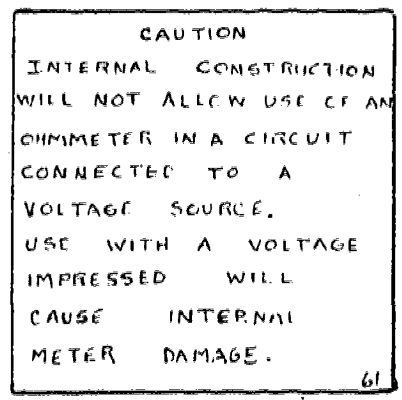
From time to time it is necessary to use meters of various types to measure circuit parameters. There are many types of meters, three of which are the voltmeter, the ammeter and the ohmmeter. In what units do you think these meters read?

In slides 59 and 60, you will see several styles of meters used to measure the quantities we have discussed.

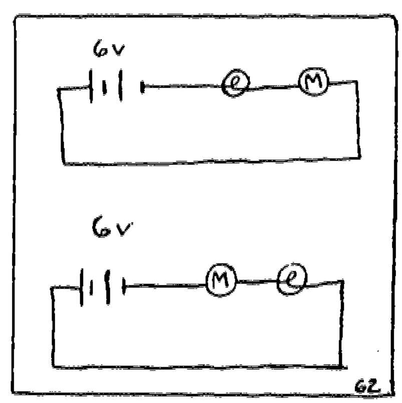




Now advance to slide 61.



Ammeters are placed in series with the circuit and, in the case of DC or direct current, are polarity sensitive. See slide 62.



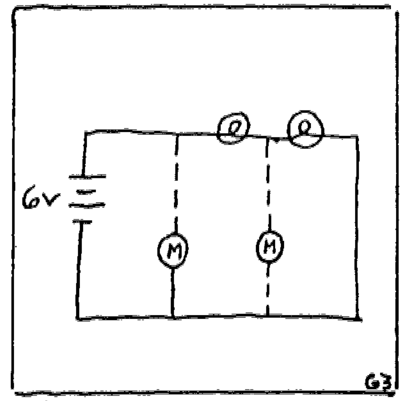
What is meant by the term "polarity"?

Build the circuit shown in this slide using a 0 to 50 milliammeter. If you do not recall the meaning of "milli", review that portion of Unit 1 of EDC 140 in which this prefix is discussed.

Connect your meter with care; if the pointer begins to move in a negative direction, quickly remove and reverse the connections, remember the meter is polarity sensitive.

One more word of caution, if your meter should peg in a positive direction, quickly remove the meter and use one which will measure larger values. Why would a meter peg?

In the circuits shown, if the current were 50 milliamps, is it possible to determine the resistance of the meter? The meter and the lamp together? Record the results obtained when the meter was placed in each of the two positions. From your metering, what can you determine about current flow in a series circuit?



Advance to slide 63.

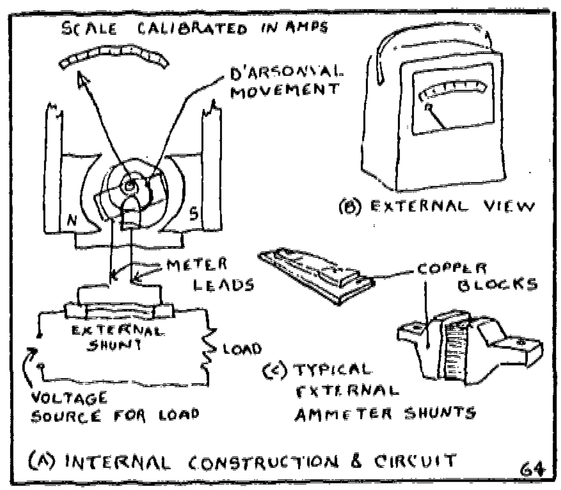
Connect a voltmeter, whose full scale value is not excessive, as shown in two different positions and record your results.

Was there a difference in these readings?

Can you guess why?

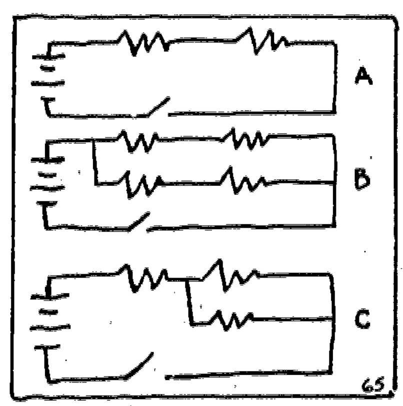
To fully understand these circuits, it is necessary to understand what causes meters to work and how they work. Write a report explaining this operation and the theory behind it as if you were the instructor and your students were at the same point in their study as you now are.

Advance and study slide 64, it may help you get started on this project.



EXPERIMENT # 15

Build the three circuits shown in slide 65. Using the letter S to stand for switch and R to stand for resistance, assign circuit symbol numbers to your components and list them in your notebook. Can you think of how these



circuits might be named? Circuit A is a series circuit; B, a parallel circuit; and C, a series parallel circuit. Why are they so named? What can you predict about current flow and voltage in these circuits?

EXPERIMENT # 16

Slides 66-72 are, in some way, historically related to the unit you have just completed. Discuss how each slide is related, indicating to which experiments the individual slides are related.

Now that you have some ideas about statics and current, we would appreciate your discussing the concepts you have learned from your experiences.

You are now ready to take the unit pretest and final test.

Good Luck.

Quiz I

1. The experiments conducted thusfar have dealt with exploring the various charges, and have introduced you to the phenomenom of static electricity. You are now asked to define this force and explain more explicitly WHY this phenomenon occurs. Please include an explanation of how, when an object (such as the rubber rod)has been staticly charged, does it effect other objects in which it has contact.

Quiz II

1. In experiment 7 you were asked to design an experiment which related the number of times a rod was rubbed to its' ability to attract bits of paper. Interpret the results of this experiment (not just your graphed data). What law is exhibited through your experimentation? Would the results have been the same if the charge on the rod had been positive? Negative?

Quiz III

1. Electric current is the flow of electrons through a conductor. Why do only the negatively charged particles "flow"? What force or forces cause electrons to move? Describe what happens to the movement of free electrons if resistance is added to the circuit.

Pretest

1. In a electric circuit, what are the three quantities present? Explain how they are related in Ohm's Law.

2. Complete the following table, using the three quantities you discussed in the first question:

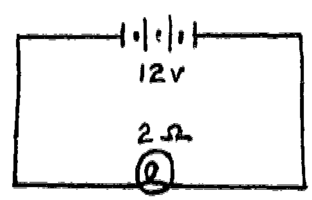
quantity	unit	symbol	"Ohm's Law symbol"
		V	
	amperes		
			R

3. Given the equation: E = I R .
   what does R = ?
   what does I = ?

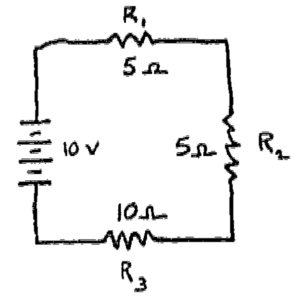
4. When a difference in potential exists between two charged bodies which are connected by a conductor, in which direction will the electrons flow, and for how long a duration of time?

5. What are some of the ways resistance can be changed within a closed circuit? In what unit is resistance measured?

6. In the simple series circuit shown, the effective resistance of the lamp is 2 ohms, what is the current flow (amperes). If the resistance is 12 ohms?



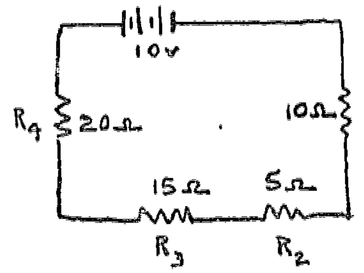
Pretest, cont.



7. a) What is the total resistance (R_t) of this circuit?
   b) What is the current flow (I) at any point in this circuit?
   c) What is the voltage at each point of resistance?

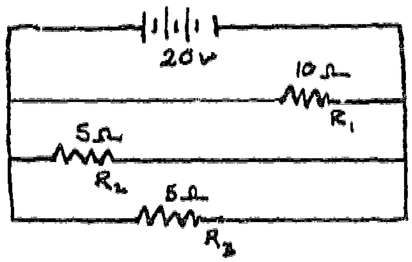
8. Fill in the following table, using the information given in the diagram:

E_1	I_1	R_1
E_2	I_2 .2a	R_2
E_3 3.0v	I_3	R_3
E_4	I_4	R_4
E_T	I_T	R_t 50Ω



9. In a series circuit, when additional resistances are added, the total resistance increases. What happens if additional resistance is added to a parallel circuit?

10. Compute the total current (I_t) of this parallel circuit:



Given the formula, can you compute the total resistance (R_t)?

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

What is the voltage at R_1, R_2, R_3 ?

For final test, be able to construct circuits. Example: Build a parallel and a series circuit which have the same resistance.