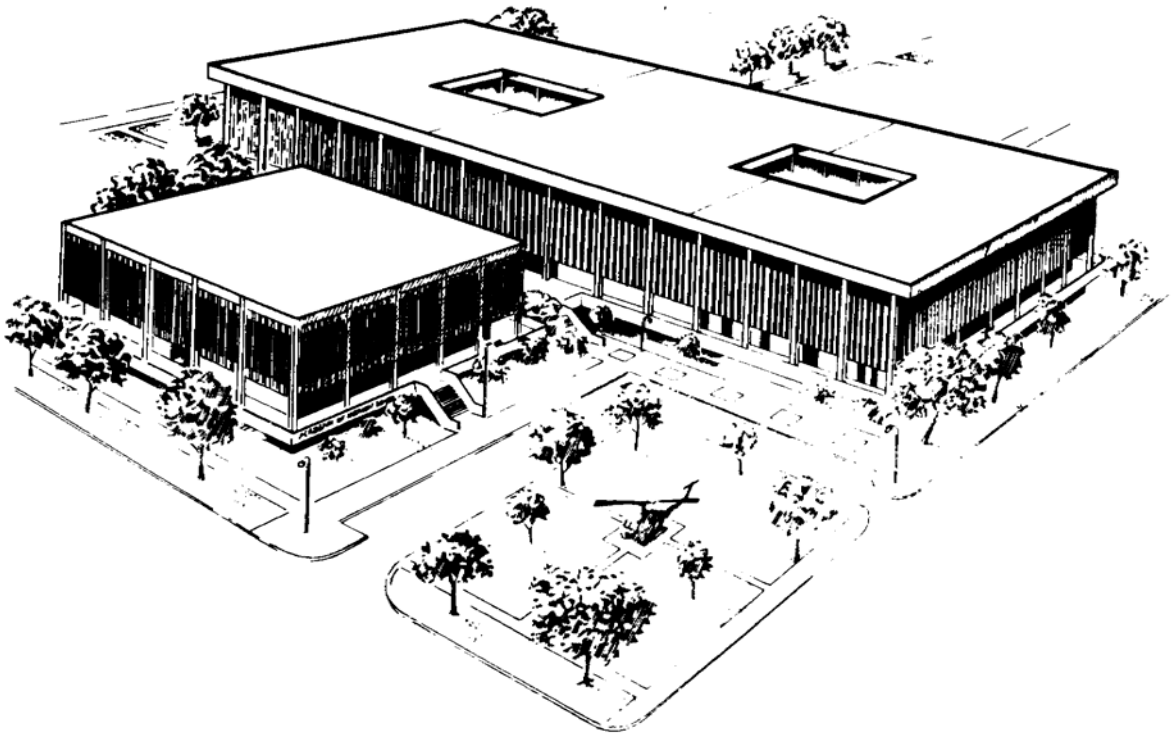
U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
FORT SAM HOUSTON, TEXAS 78234-6100



BASIC ELECTRICITY

SUBCOURSE MD0902 **EDITION 200**

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

For comments or questions regarding enrollment, student records, or shipments, contact the Nonresident Instruction Section at DSN 471-5877, commercial (210) 221-5877, toll-free 1-800-344-2380; fax: 210-221-4012 or DSN 471-4012, e-mail accp@amedd.army.mil, or write to:

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Approved students whose enrollments remain in good standing may apply to the Nonresident Instruction Section for subsequent courses by telephone, letter, or e-mail.

Be sure your social security number is on all correspondence sent to the Academy of Health Sciences.

CLARIFICATION OF TRAINING LITERATURE TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.
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TABLE OF CONTENTS

CORRESPONDENCE COURSE OF
THE US ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MDO902

BASIC ELECTRICITY

INTRODUCTION

This subcourse is designed to give you a basic knowledge of simple circuits that carry electricity from a power source to some kind of electrical equipment. With a knowledge of these fundamentals, you will be able to make better use of electrical equipment and to better understand future textual materials that mention electrical factors in the function of equipment.

Subcourse Components:

This subcourse consists of programmed text.

Lesson 1. Basic Electrical Circuits

Study Suggestions:

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson.

Credit Awarded:

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Section at Fort Sam Houston, Texas. Upon successful completion of the examination for this subcourse, you will be awarded 3 credit hours.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

SUBCOURSE MD0902

LESSON 1	Basic Electricity
LESSON ASSIGNMENT	Frames 1 through 135.
LESSON OBJECTIVES	After completing this lesson, you should be able to choose the correct answers to questions about matter, current, electrical charges, conduction, potential difference, voltage, resistance, amperes, and OHM's law.
INSTRUCTIONS	This text is set up differently from most subcourses It is a workbook that utilizes programmed instruction. The numbered "frames" present information and/or a question about presented information. You should work through the frames in the order presented. Answer each question that is presented. To check your answers, go to the shaded box of the NEXT frame. For example. the solution to the question presented in Frame 2 is found in the shaded box of Frame 3.
DISCLAIMER	The language used in this subcourse was chosen to make the lesson easier to understand and may not be as precise as definitions and terminology you will learn in the future.

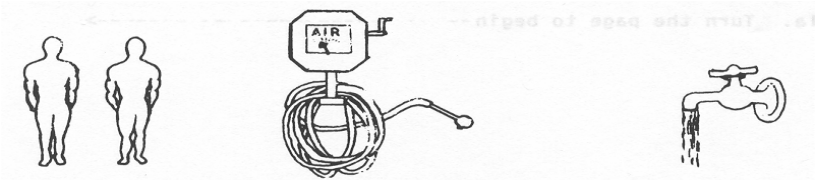
FRAME 1

Purpose.

In order to understand electricity, you must know certain things about the atom and atomic physics. You will learn these fundamentals from this subcourse. (See the directions on the preceding page.)

GO TO FRAME 2.

FRAME 2

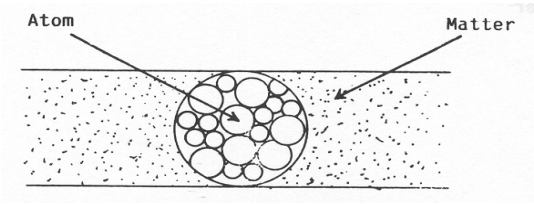


Everything you can think of is made out of matter. People, air, and water are made out of _____

Solution to Frame 1

No question was given in Frame 1. Read and work Frame 2.

FRAME 3



If we could look "inside" a piece of matter with a very powerful microscope, we would see that matter is made up of tiny particles called _____.

Solution to Frame 2

matter

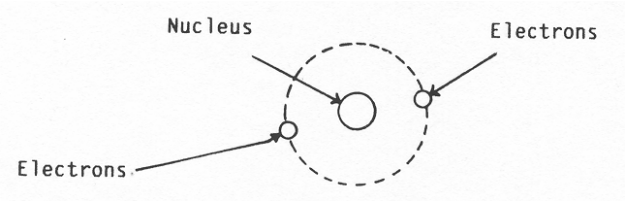
FRAME 4

All matter is made up of tiny particles called atoms. Tiny particles called _____ make up all matter.

Solution to Frame 3

atoms

FRAME 5



This drawing represents a single atom. It has two parts to it. In the center is a _____. Around the nucleus are _____.

Solution to Frame 4

atoms

FRAME 6

Some kinds of atoms have more electrons than others, but they all have two main parts. In the center is a _____. Around the nucleus are _____.

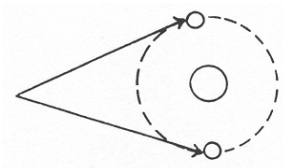
Solution to Frame 5

nucleus

electrons

FRAME 7

All electrons are said to be negatively charged.



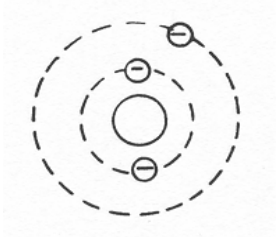
The electrons (indicated by arrows) are _____ charged.

Solution to Frame 6

nucleus

electrons

FRAME 8



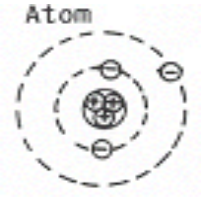
The electrons above have minus signs inside them because they are negatively charged. All electrons are said to be _____.

Solution to Frame 7

negatively

FRAME 9

Electrons



Nucleus

Protons

Inside the nucleus of atoms are positively charged particles called _____.

Solution to Frame 8

negatively charged

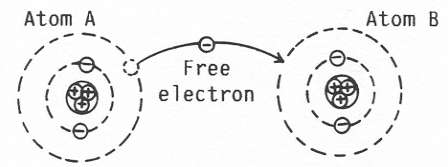
FRAME 10

The negatively charged particles are called _____
The positively charged particles are called _____.

Solution to Frame 9

protons

FRAME 11



Some types of atoms (mostly in metals) have electrons that are free to move from one atom to another. These electrons are called “free electrons”. The electrons moving from atom A to atom B is a _____.

Solution to Frame 10

electrons [negative]

protons [positive]

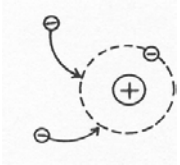
FRAME 12

Free electrons (<u>can/cannot</u>) leave their atom.

Solution to Frame 11

free electron

FRAME 13



An atom that gains electrons is said to be negatively charged. The atom above is gaining electrons. It will be _____ charged.

Solution to Frame 12

can

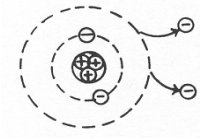
FRAME 14

A negatively charged atom always has more _____ than protons.

Solution to Frame 13

negatively

FRAME 15



An atom that loses electrons is said to be positively charged. The atom above will be _____ charged.

Solution to Frame 14

electrons

FRAME 16

A positively charged atom always has more _____ than electrons.

Solution to Frame 15

positively

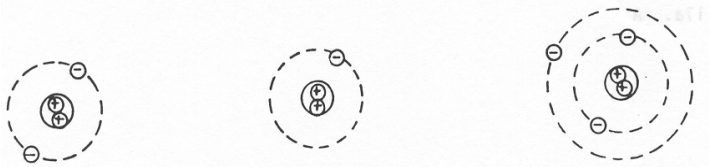
FRAME 17

An atom with an equal number of electrons and protons has no charge. Which atom above has no charge, A or B? ___.

Solution to Frame 16

protons

FRAME 18



_____ _____ _____

(Label here) (Label here) (Label here)

Under each atom, write whether it has no charge, is positively charged or is negatively charged.

Solution to Frame 17

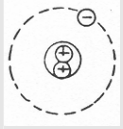
A

FRAME 19

If the atoms that make up mater are negatively charged, then the matter is also _____.

Solution to Frame 18

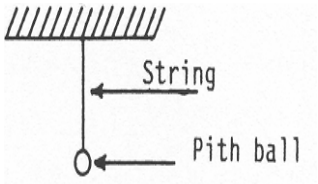
No charge



Positively charged

Negatively charged

FRAME 20

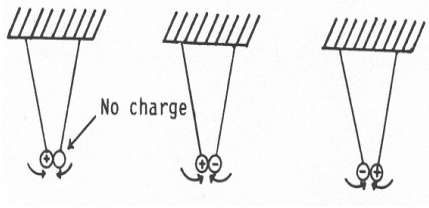


To show how matter with like and unlike charges react to each other, we will use drawings of small, lightweight balls called pith balls. The drawing above shows a _____ Hanging from a string.

Solution to Frame 19

negatively charged

FRAME 21

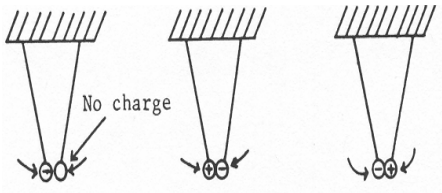


If pit balls with unlike (positive and negative) charges are placed near each other, they (attract/repel) each other.

Solution to Frame 20

pith ball

FRAME 22



You have heard the expression that “opposites attract.” It may or may not be true with people, but it is true with electricity. As you can see, pith balls with (unlike/like) charges attract each other.

Solution to Frame 21

attract

FRAME 23

Unlike charges attract because the excess of electrons from the negatively charged object want to get to the positively charged object. They will also try to go to an object with no charge. Electrons from the negative pith ball want to go to the _____.

Solution to Frame 22

unlike

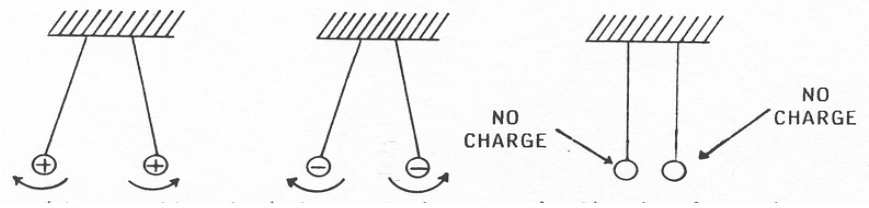
FRAME 24

The positively charge pith ball attracts the negatively charged pith ball because it lacks electrons and wants to (gain/lose) electrons.

Solution to Frame 23

positive pith ball (and also, to the pith ball with no charge)

FRAME 25

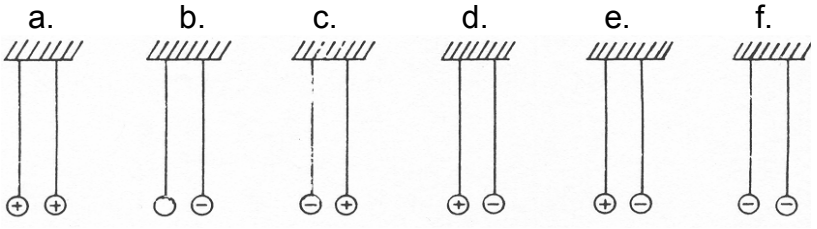


Unlike charges attract, but, as can be seen in the drawings above, like charges (repel/attract). Note that the two pith balls with no charge neither repel nor attract each other.

Solution to Frame 24

gain

FRAME 26



_____ _____ _____ _____ _____ _____

Indicate whether the pith balls shown will attract, repel, or neither attract nor repel. their direction of movement.

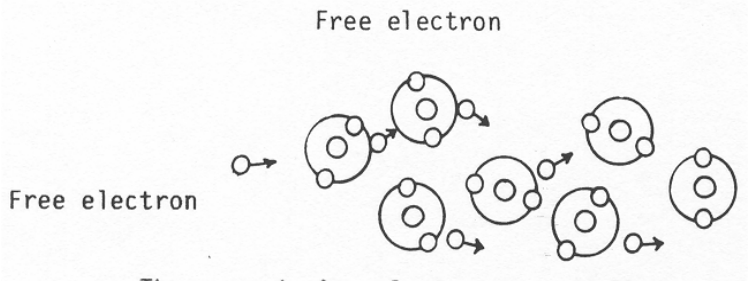
Solution to Frame 25

repel

FRAME 27 Five review questions follow Frames 28 through 32). IMPORTANT! ANSWER THESE REVIEW QUESTIONS CAREFULLY. CHECK YOUR ANSWERS.	Solutions to Frame 26 a. repel b. attract c. attract d. attract e. attract f. repel
FRAME 28 If an atom GAINS electrons so that it has more electrons than protons, it is then (negative/positively) charged.	Solution to Frame 27 No question. Go on to the next step
FRAME 29 If an atom loses electrons so that it has more protons than electrons, it is then (negatively/positively) charged.	Solution to Frame 28 negatively
FRAME 30 Unlike charges (attract/repel) each other.	Solution to Frame 29 positively
FRAME 31 Like charges (attract/repel) each other.	Solution to Frame 30 attract
FRAME 32 If an uncharged atom loses electrons, it becomes (negatively/positively) charged.	Solution to Frame 31 repel
FRAME 33 Now that you know something about the fundamentals of the atom, you are ready to learn about conductors, voltage, current, and resistance. By the end of this part of the lesson, you will be able to analyze an electric circuit.	Solutions to Frame 32 positively

FRAME 34

If you could greatly magnify a piece of material that has many free electrons, you might "see" these free electrons moving freely about.



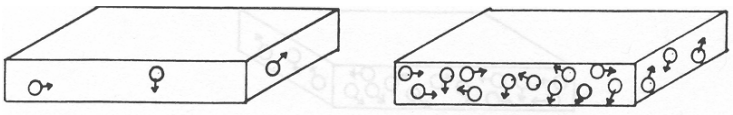
These wandering electrons are called _____

Solution to Frame 33

No question. Go to Frame 34.

FRAME 35

A material that has many free electrons is called a conductor. Decide which material below is a conductor; and then write the word “conductor” under it.

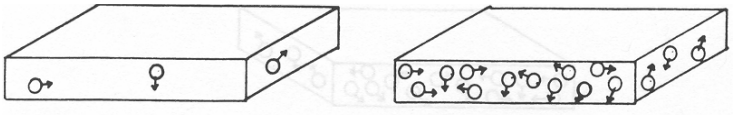


Solutions to Frame 34

free electrons

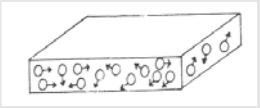
FRAME 36

A material that has extremely few, if any, free electrons is called an insulator. Label each of the materials below as either a “conductor” or “insulator.”



_____ _____

Solution to Frame 35

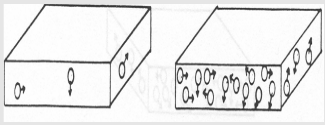


Conductor
(It has many free electrons)

FRAME 37

A material that has many free electrons s a _____.
A material that has few, if any, free electrons is an _____.

Solutions to Frame 36



Insulator Conductor

FRAME 38

Silver, copper, and aluminum have many free electrons; therefore, they are all _____.

Solution to Frame 37

Conductor

Insulator

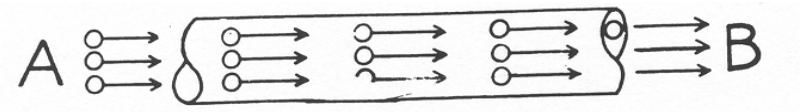
FRAME 39

Plastics, glass, and rubber have extremely few, if any, free electrons. They are all _____.

Solution to Frame 38

conductors

FRAME 40



Free electrons can be made to move from atom to atom through a conductor. For example, electrons are entering the conductor above at ____, moving from atom to atom. and coming out at _____.

Solution to Frame 39

insulators

FRAME 41

The movement of electrons from one atom to another through a conductor can be compared to forcing marbles through a tube. As soon as you force a marble in one end, another marble at the other end comes _____.

Solution to Frame 40

A

B

FRAME 42

The electrons being forced into the conductor (<u>are/are not</u>) the same as the electrons immediately coming out.

Solution to Frame 41

out

FRAME 43

This movement of different electrons from atom to atom through a conductor is called “current.” Instead of saying that electrons are moving from atom to atom through a conductor, we can say there is a _____ in the conductor.

Solution to Frame 42

are not

FRAME 44

Which statement best defines current?

a. Movement of electrons from atom to atom through a nonconductor.

b. Movement of atoms from electron to electron through a conductor.

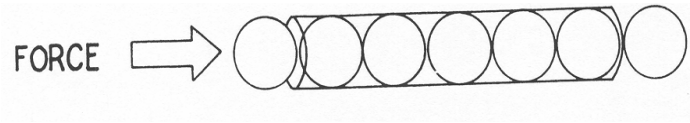
c. Movement of electrons from atom to atom through a conductor.

Solution to Frame 43

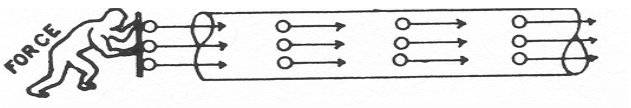
current

FRAME 45

Marbles in a Tube



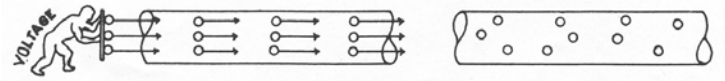
In order to make the marbles move through the tube above, a force has to be applied.



To make a current flow through a conductor, we must also apply a _____.

Solution to Frame 44

c. Movement of electrons from atom to atom through a conductor.

FRAME 46 "Voltage" is the electronic term for this "force" that makes current flow in a conductor. Current will flow unless we apply a force, or _____.	Solution to Frame 45 Force
FRAME 47 Conductor A Conductor B  Current will flow in conductor A because we have applied _____ (use the electronic term). Current will not flow in conductor B because we did not apply _____.	Solution to Frame 46 Voltage
FRAME 48 The force that makes electrons move from atom to atom through a conductor is called _____.	Solution to Frame 47 voltage voltage
FRAME 49 Another term for voltage is "electromotive force." This is a very descriptive term for voltage because, read backward, it reads "force-motive-electro," which means the force that moves the _____.	Solution to Frame 48 voltage
FRAME 50 "Electromotive force" and "voltage" both refer to the force which moves electrons through a conductor. In referring to this force, you can use either the term _____ or _____.	Solution to Frame 49 electrons

FRAME 51

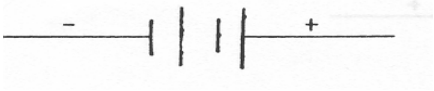
Defining voltage or electromotive force as a force that makes electrons flow through a conductor is correct; but to really know what makes current flow, we must use a more technical definition. This will require several steps.

Solution to Frame 50

electromotive force}
}either order
voltage }

FRAME 52

Let us start on a more technical definition of voltage or electromotive force by talking about a battery. One of the symbols for a battery is shown below.



Draw one for practice here:

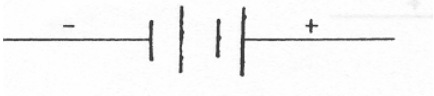
You have just drawn the symbol for a _____.

Solution to Frame 51

go on to the next step.

FRAME 53

(negative) (positive)

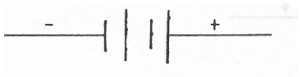


One side of a battery is always negative. This means that it has more electrons than it has _____.

Solution to Frame 52

battery

FRAME 54

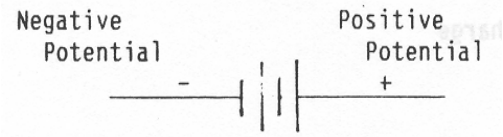


The negative side of the battery has a negative charge. The positive side has a _____.

Solution to Frame 53

protons

FRAME 55



As you can see from above, the negative charge can be referred to a negative _____
The positive charge is referred to as a _____.

Solution to Frame 54

positive charge

FRAME 56

The more the electrons outnumber the protons, the (greater/smaller) the negative potential.

Solution to Frame 55

potential

positive potential

FRAME 57

The more the protons outnumber the electrons, the (greater/smaller) the positive potential.

Solution to Frame 56

greater

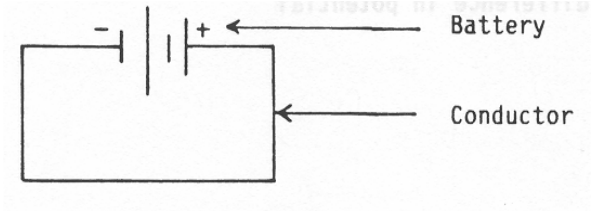
FRAME 58

When there is a difference in charge between two points, it is called a difference in potential. For example, the two sides of a battery have a _____.

Solutions to Frame 57

greater

FRAME 59

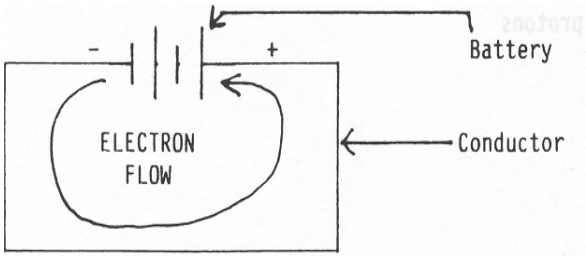


If we connect a conductor between the negative and positive potentials, electrons of the negative potential are greatly attracted to the _____ of the positive potential.

Solution to Frame 58

difference in potential

FRAME 60

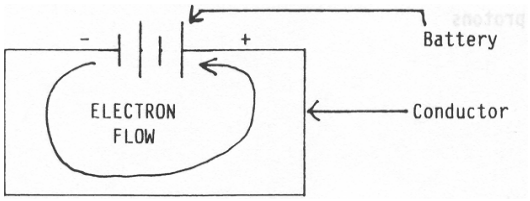


Because of this attraction between negative and positive potentials, electrons (current) will flow from the (negative/posivite) potential to the (negative/positive).

Solution to Frame 59

protons

FRAME 61



The difference in charge between the negative and positive potentials of the battery is referred to as a difference in potential. As you can see the conductor is connected across the _____ in _____.

Solution to Frame 60

[from] negative (-)

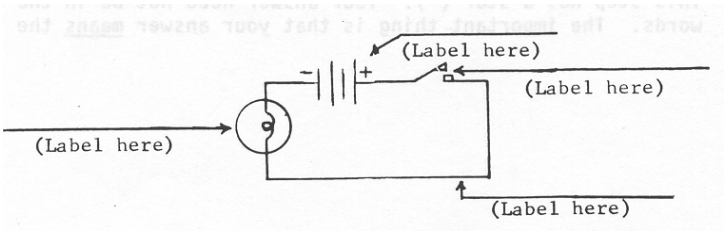
[to] positive (+)

FRAME 62

For current to flow, a conductor must be connected across a _____.
Since excess electrons of the negative potential want to get to the positive potential, electrons always flow from _____ to _____.

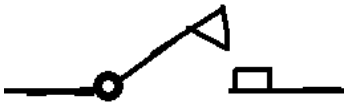
Solution to Frame 61

difference
[in]
potential

FRAME 63 Voltage or electromotive force can be correctly thought of as “force” that makes electrons flow through a conductor; however, a more technical definition is that voltage or electromotive force is a _____ in potential.	Solution to Frame 62 difference in potential negative (-) positive (+)
FRAME 64 In summary then: A technical definition of voltage (or electromotive force) is that it is a _____. A less technical (but correct) definition of voltage is that it is the _____ _____.	Solution to Frame 63 difference
FRAME 65 You must know enough about electricity to understand how a simple circuit works. For example, below is the circuit for the dashboard of an automobile. Label what you think is the battery, the lamp, the switch and the conductor.  	Solution to Frame 64 difference in potential force that makes electrons flow through a conductor (NOTE: Your answer need not be in the exact words. The important thing is that your answer means the same thing.)

FRAME 66

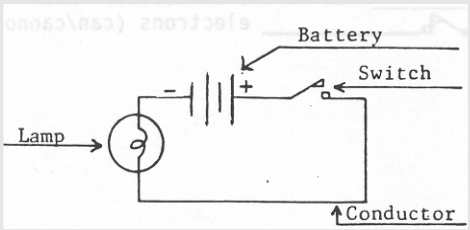
Open switch



Closed switch

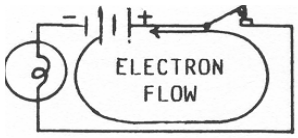
When the switch is open, electrons (<u>can/cannot</u>) flow in the conductor. When it is closed, electrons (<u>can/cannot</u>) flow in the conductor.

Solution to Frame 65



FRAME 67

Note that the switch below is closed. Electrons can now flow through the conductor from the negative side of the battery through the _____, then through the _____ and to the _____ side of the battery.



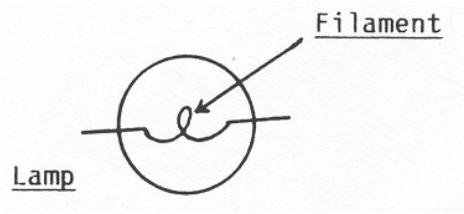
Remember. This all happens at the same time since an electron enters the battery at the positive (+) terminal as soon as one leaves the battery at the negative (-) terminal.

Solution to Frame 66

cannot

can

FRAME 68



Inside the lamp is a wire filament that heats up and "glows" when electrons pass through it, thereby producing the _____ by which we see the dashboard instruments.

Solution to Frame 67

lamp

switch

positive

FRAME 69

You may have noticed that if a car battery gets weak (loses voltage), the dashboard light gets _____.

Solution to Frame 68

light (glow)

FRAME 70

If you have this weak battery recharged (restoring the voltage), the dim light then gets _____.

Solution to Frame 69

weak (dim, less bright, etc.)

FRAME 71

What happens is that when the voltage in the battery decreases, the number of electrons passing through the filament _____.

Solutions to Frame 70

brighter (stronger, etc.)

FRAME 72

When the voltage increases after recharging the battery, the number of electrons passing through the filament _____.

Solutions to Frame 71

decreases

FRAME 73

The relationship between voltage and current is when voltage increases, current _____.

Solution to Frame 72

increases

FRAME 74

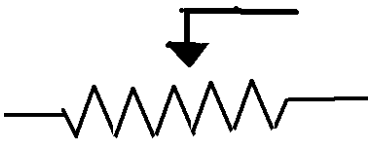
When voltage decreases, then current _____ .

Solution to Frame 73

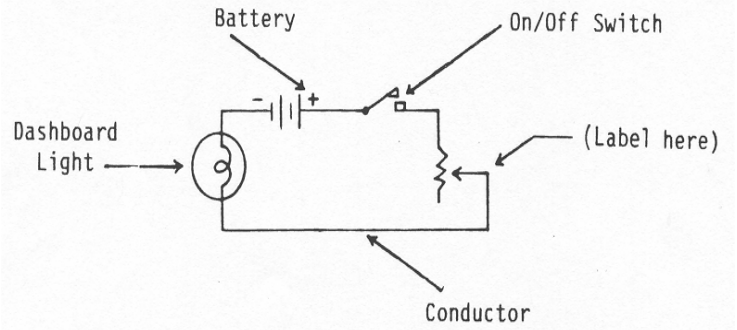
increases

FRAME 75

In most cars, you can make the dashboard light dimmer or brighter by turning a knob back and forth. What you are really turning is a variable resistor: The symbol for a variable resistor is shown below.



Label the variable resistor in the circuit below.



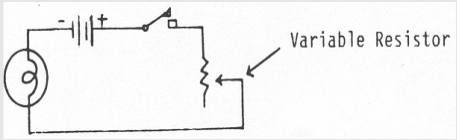
Solution to Frame 74

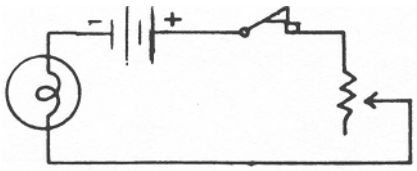
decreases

FRAME 76

A variable resistor is a device that opposes the flow of current. As its name implies, the amount of resistance that a variable resistor offers to current can be _____.

Solution to Frame 75



FRAME 77 As we increase the resistance in the circuit below, what will happen to the amount of electrons or current that can flow through the filament? _____ 	Solution to Frame 76 varied (changed, etc.)
FRAME 78 If we decrease the resistance in the circuit below, what will happen to the amount of electrons or current that can flow through the filament? _____.	Solution to Frame 77 It will decrease (fewer electrons will pass, etc.)
FRAME 79 When you turn the variable resistor so as to decrease resistance, the dashboard light becomes _____.	Solution for Frame 78 It will increase, etc,
FRAME 80 When you turn the variable resistor so as to increase resistance, the dashboard light becomes _____.	Solution to Frame 79 brighter
FRAME 81 See what you can conclude about the relationship between resistance and current. When resistance increases, then current _____. When resistance decreases, then current _____.	Solution to Frame 80 dimmer

FRAME 82

Actually there are two kinds of resistors—variable and fixed. In a fixed resistor, the amount of resistance is _____.

Solution to Frame 81

decreases

increases

FRAME 83

Label each resistor below:

_____ resistor _____ resistor

Solution to Frame 82

fixed (unchanging)

FRAME 84

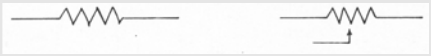
Let us review some of the things we have covered:

a. A material with many free electrons is called a _____.

b. A material with few if any free electrons is a _____.

c. The flow of electrons from atom to atom through a conductor is called _____.

Solution to Frame 83



fixed resistor variable resistor

FRAME 85

Review (continued)

d. The force or push that makes electrons flow through a conductor is called _____.

e. Voltage or electromotive force is technically defined as a _____.

f. A device that opposes the flow of current is called a _____.

Solution to Frame 84

a. conductor

b. nonconductor

c. current

FRAME 86 Review (continued) g. As voltage is increased, the current _____. h. As voltage is decreased, the current _____. i. As resistance increases, then current _____. j. As resistance decreases, then current _____.	Solution to Frame 85 d. voltage (or electromotive force} e. difference in potential f. resistor
FRAME 87 You know how we use a unit of measurement, such as miles or feet, to measure distances. We also use a unit of measurement for current. It is the ampere. For example, a house fuse will be rated for 10 amperes, 15 amperes or perhaps, 20 _____.	Solution to Frame 86 g. increases h. decreases i. decreases j. increases
FRAME 88 The unit of measurement for current, as you have just seen, is the _____.	Solution to Frame 87 amperes
FRAME 89 Amperes are the unit of measurement for _____.	Solution to Frame 88 ampere
FRAME 90 Amperes can be abbreviated with the letters "amp." For example, house fuse of 20 amperes might be labeled 20 _____.	Solution to Frame 89 current

FRAME 91 The word “current” can also be abbreviated. The abbreviation for current is the capital “I.” Instead of writing “the current = 10 amperes,” you could write that _____ = 10 _____.	Solution to Frame 90 amp
FRAME 92 Rewrite this statement using abbreviations instead of words: The current is 30 amperes _____ (Rewrite the statement here	Solution to Frame 91 I amp
FRAME 93 The unit of measurement for voltage is the volt. For example, most houses are wired to have 110 _____.	Solution to Frame 92 I = 30 amp
FRAME 94 Instead of writing out the word “volts,” it can be abbreviated with the “v.” For example, 12 volts can also be written as _____.	Solution to Frame 93 volts
FRAME 95 Voltage, like volts, can also be abbreviated. The abbreviation for voltage is the capital “E.” Instead of writing that “the voltage = 10 volts,” we can also write _____ = 10 v.	Solution to Frame 94 12 v

FRAME 96 Rewrite this statement using abbreviations instead of words: The voltage = 500 volts _____ (Rewrite the statement here)	Solution to Frame 95 E
FRAME 97 Instead of writing out “electromotive force,” we sometimes use the letters EMF. The letters EMF stand for _____.	Solution to Frame 96 E = 500 v
FRAME 98 Resistance is measured in ohms. For example, a resistor may be 1,000 ohms, or perhaps 50,000 _____.	Solution to Frame 97 electromotive force
FRAME 99 Resistance is abbreviated with the letter R, and ohms is represented with this symbol **Ω** . Rewrite this statement using the abbreviated representations. The resistance = 500 ohms _____	Solution to Frame 98 ohms

FRAME 100

We have gone through these symbols and units of measurement rather quickly, so why don't you practice them by completing the table a few times in the next few steps.

	Abbreviation	Unit of Measure-ment	Abbreviation or Symbol
Current			
Voltage			
Resistance			

Solution to Frame 99

R = 500 Ω

FRAME 101

If you are really positive you know this, you can skip this frame. If not, practice again. DO NOT FOOL YOURSELF. YOU MUST LEARN THIS, SO WHY NOT DO IT NOW?

	Abbreviation	Unit of Measure-ment	Abbreviation or Symbol
Current			
Voltage			
Resistance			

Solution to Frame 100

Current	I	ampere	amp
Voltage	E	volt	v
Resistance	R	ohm	Ω

FRAME 102

Unlike charges (<u>attract/repel</u>) each other.

Solution to Frame 101

Current	I	ampere	amp
Voltage	E	volt	v
Resistance	R	ohm	Ω

FRAME 103

The movement of electrons from atom to atom through a conductor is called _____.

Solution to Frame 102

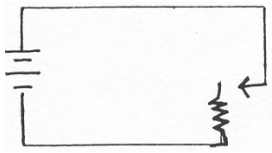
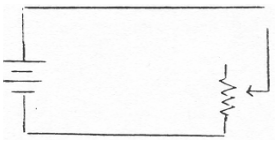
attract

FRAME 104

Matter that has many free electrons is called a _____.

Solution to Frame 103

current

FRAME 105 Matter with few or no free electrons is called an _____.	Solution to Frame 104 conductor
FRAME 106 The “force” or difference in potential, which makes electrons flow through a conductor, is referred as either _____ or _____.	Solution to Frame 105 insulator
FRAME 107 A device, which is designated to oppose the flow of current, is called a _____.	Solution to Frame 106 voltage (E) electromotive force (EMF)}
FRAME 108  As resistance is decreased in the above circuit, what will happen to the current? _____	Solution to Frame 107 resistor
FRAME 109  As resistance is increased in the above circuit, what will happen to the current? _____	Solution to Frame 108 It will increase

FRAME 110

This drawing represents a voltmeter. Voltage is measured by a _____.

Solution to Frame 109

It will increase.

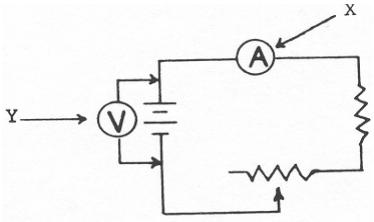
FRAME 111

This drawing represents an ammeter. Current (in amperes) is measured by an _____.

Solution to Frame 110

voltmeter

FRAME 112



In this drawing of a circuit, part "X" represents a(n) _____ and part "Y" represents a(n) _____ .

Solution to Frame 111

ammeter

FRAME 113

You have already learned the relationship between voltage and current in a circuit; that is, if voltage increases, current will also _____.

Solution to Frame 112

ammeter

voltmeter

FRAME 114

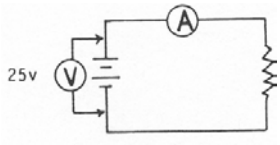
Suppose you have worn down your car battery. Your headlights become dim. You get the battery recharged. Your headlights become _____.

Why? _____
_____.

Solution to Frame 113

increase

FRAME 115



Suppose we replace the battery in this circuit with a 15-volt battery, the current will (increase/decrease).

Solution to Frame 114

brighter

Because you have increased the voltage which causes the current in the headlights to increase also.

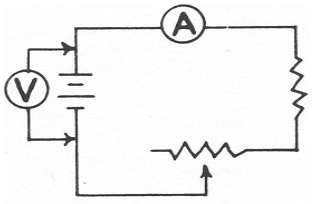
FRAME 116

Remember that resistance opposes the flow of electrons (current). Therefore, if we increase the resistance in a circuit, the current will _____.

Solution to Frame 115

decrease (went from 25v to 15v)

FRAME 117



Suppose we turn the variable resistor so that it gives less resistance. The current will _____.

Solution to Frame 116

decrease

FRAME 118

Let us review the relationship between current, resistance, and voltage.

a. If voltage is increased, the current _____

b. If voltage is decreased, the current _____

c. If resistance is increased, the current _____

d. If resistance is decreased, the current _____

Solution to Frame 117

increase

FRAME 119

The relationships among current, voltage and resistance were first expressed by George Ohm. “Ohm’s Law" states that the current is directly proportional to applied voltage and inversely proportional to resistance. Since this relationship was first recognized by Ohm, this principle is named after him. We call it _____ law.

Solution to Frame 118

a. increases

b. decreases

c. decreases

d. increases

FRAME 120

Ohm’s Law states that:

a. If voltage is increased, the current _____ .

b. If voltage is decreased, the current _____ .

c. If resistance is increased, the current _____ .

d. If resistance is decreased, the current _____ .

Solution to Frame 119

Ohm’s

FRAME 121

Ohm’s law can be expressed as a formula. The basic formula is I = E/R (current = voltage divided by resistance). There are other ways of writing Ohm’s law, but the basic way is I = _____.

Solution to Frame 120

a. increases

b. decreases

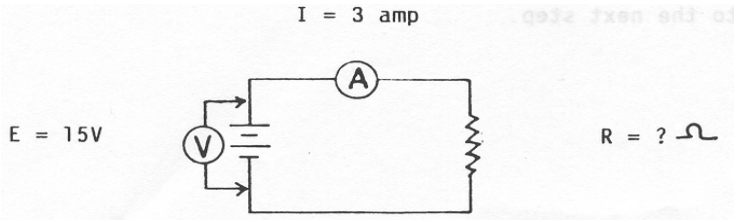
c. decreases

d. increases

FRAME 122 The basic formula for Ohm's law is _____. In this formula: I stands for _____ E stands for _____ R stands for _____	Solution to Frame 121 $\frac{E}{R}$
FRAME 123 When Ohm's Law is written $I = \frac{E}{R}$, it solves for current (I). When Ohm's Law is written $R = \frac{E}{I}$, it solves for resistance (R). Complete the following Ohm's Law formula so that it solves for voltage (E). E = _____	Solution to Frame 122 $I = \frac{E}{R}$ current voltage resistance
FRAME 124 Write the formula for Ohm's Law as you would use it to find resistance. _____	Solution to Frame 123 E = IR
FRAME 125 Write the formula for Ohm's Law as you would use it to find voltage _____	Solution to Frame 124 $R = \frac{E}{I}$
FRAME 126 The basic formula for Ohm's Law is _____.	Solution to Frame 125 E = IR

FRAME 127 Solve this problem: $R = \frac{E}{I}$: E = 15 volts, I = 3 amp R = _____	Solution to Frame 126 $I = \frac{E}{R}$
FRAME 128 Solve this problem: E = IR: I = 3 amp, R = 3 ohms E = _____	Solution to Frame 127 $R = \frac{E}{I} = \frac{15}{3}$ R = 5 ohms
FRAME 129 The basic formula for Ohm's law ($I = \frac{E}{R}$) expresses the basic relationship between current and voltage. That is, if the voltage is increased, the current will _____. If the voltage is decreased, the current will _____.	Solution to Frame 128 E = IR E = 3 x 3 E = 9 volts
FRAME 130 Now let us work with some actual circuit drawings.	Solution to Frame 129 increase decrease

FRAME 131

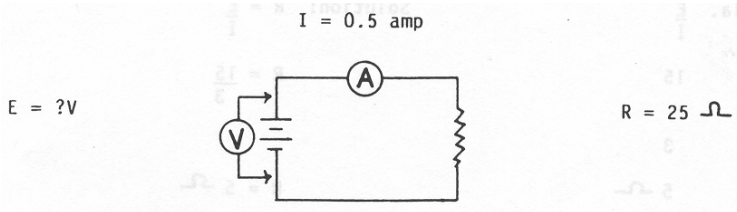


They value of the resistor in the above circuit can be found by using the formula R = _____. Since the value of E is _____ volts, and the value of I is _____ amps, R = _____.

Solution to Frame 130

go on to the next step

FRAME 132



In the circuit above, the voltmeter would read _____.

Solution to Frame 131

$\frac{E}{I}$

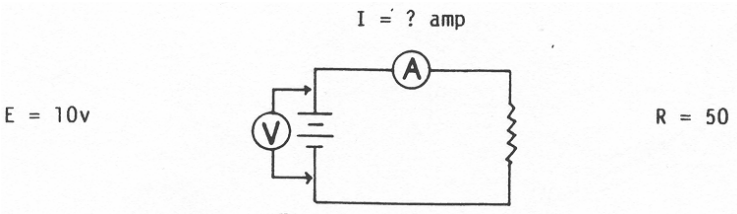
15

3

5

Solution:
R = E/I =15/3 = 5 Ω

FRAME 133



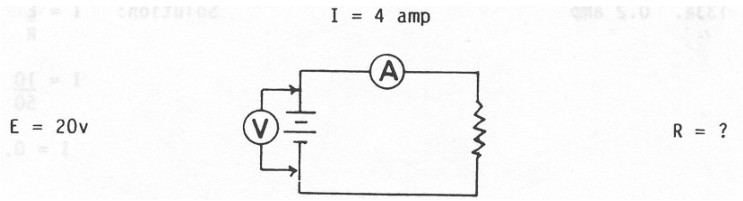
In the circuit above, the ammeter would read _____.

Solution to Frame 132

12.5 v

Solution:
E = I R = 0.5 x 25 = 12.5

FRAME 134



The value of the resistor in the above circuit is _____.

Solution to Frame 133

0.2 amp

Solution:

$I = \frac{E}{R} = \frac{10}{50} = 0.2$

FRAME 135

You have completed this text, “Basic Electricity.”

If you are taking the course for credit, you should review the frames before starting the examination.

Solution to Frame 134

5 Ω

Solution:

$R = \frac{E}{I} = \frac{20}{4} = 5$

End of Lesson 1