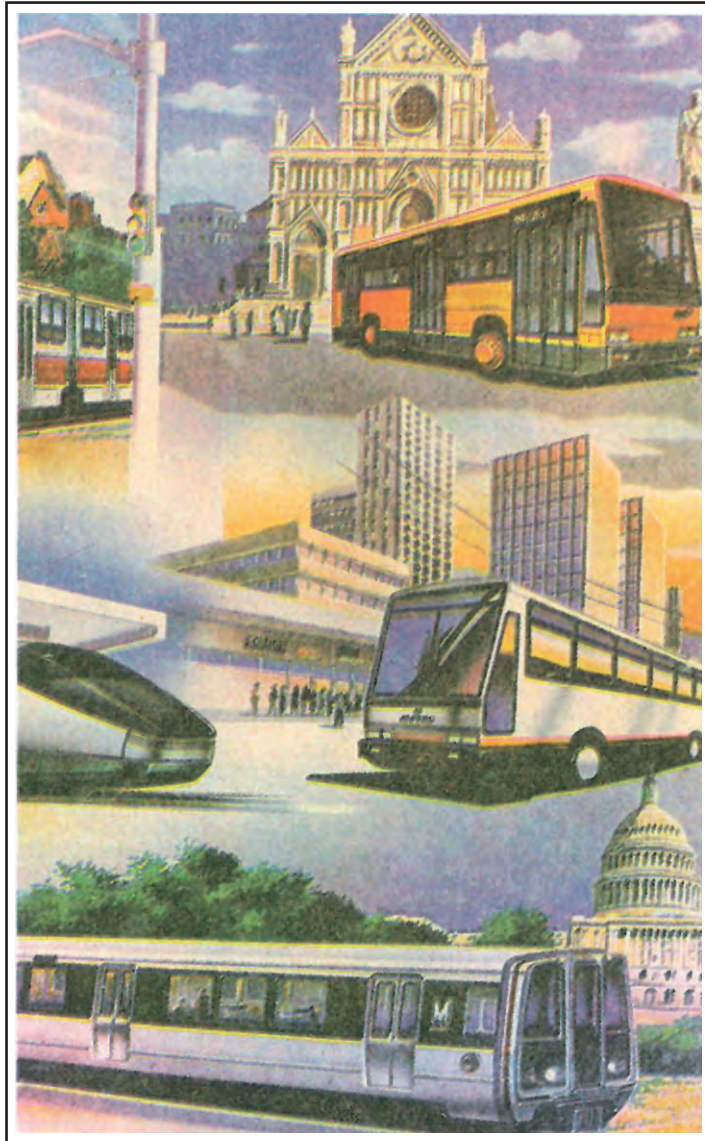


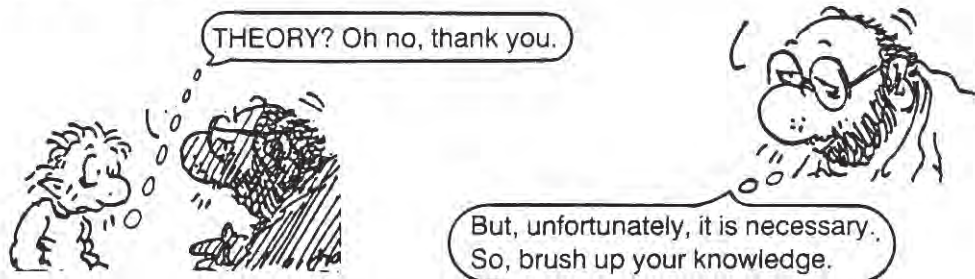
**UNIT 2**

**ELECTRICITY HOLDS THE WORLD TOGETHER**



## FUNDAMENTALS OF ELECTRICITY

In the first unit we discussed the importance of electricity and its effects on society. Well, what is electricity after all? You will find the answer in this unit. Some theory is useful.



**Work with your partner to find out the correct answer to the questions below. All the information you need is included in the boxes. But first, it would be helpful to find the meaning of the following words.**

- |                     |                    |
|---------------------|--------------------|
| 1. matter= _____    | 2. element= _____  |
| 3. molecule= _____  | 4. mixture= _____  |
| 5. substance= _____ | 6. compound= _____ |
|                     | 7. particle= _____ |

### Questions

- Matter can be found in.
  - a liquid or solid state.
  - a solid or gaseous state.
  - all three states: liquid, solid and gaseous.
- Oxygen (O) and Hydrogene (H) are
  - elements.
  - compounds.
  - mixtures.
- A mixture is obtained
  - by chemical means.
  - by physical means.
  - by both physical and chemical means.
- A compound
  - can be separated by physical means only.
  - can be separated by chemical means only.
  - cannot be separated at all.
- An element is a substance which
  - can be reduced to a simpler one.
  - can be separated by chemical means.
  - cannot be separated by any means.

6. The smallest particle of an element is the
- atom.
  - molecule.
  - matter.
7. A molecule has
- all the characteristics of a compound.
  - all the characteristics of a mixture.
  - only some characteristics of a compound.
8. The smallest particle of a chemical combination of elements is
- a mixture.
  - a molecule.
  - a compound.
9. The words "electron" and "electricity" are derived from
- an ancient Egyptian word.
  - an ancient Greek word.
  - an ancient Latin word.
10. The word "electron" means
- copper.
  - current.
  - amber.

### **MATTER**

It is everything that occupies space and has weight, e.g. air, water, our bodies.

### **ELEMENT**

It is a substance which cannot be reduced to a simpler one by either physical or chemical means, e.g. iron, oxygen, gold.

### **MOLECULE**

It is the smallest particle of a compound which has all the characteristics of the compound.

### **COMPOUND**

It is a chemical combination of elements which cannot be separated by physical means, e.g. water, table salt.



**MIXTURE**  
 It is a combination of elements or compounds, not chemically combined, which can be separated by physical means, e.g. air, sea water.

**ATOM**  
 It is the smallest particle of an element which has all the characteristics of the element.

### Listening Activity

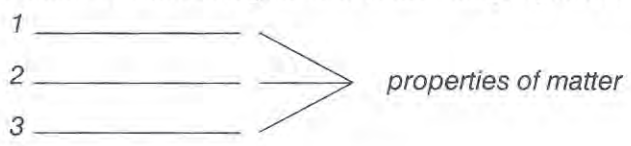
**STEP 1**

*Listen to the text and answer the questions.*

1. Do the atoms of the various elements have the same structure?
2. How many factors determine the properties of matter?

**STEP 2**

*Listen to the text again and name the properties of matter.*



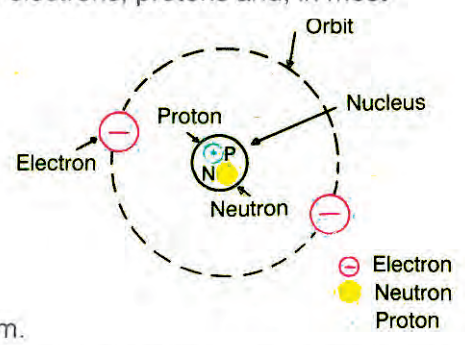
### The atom and charged bodies

The atoms of each element are made up of electrons, protons and, in most atoms, neutrons.

Electrons are negatively charged.  
 Protons have a positive electric charge, equal and opposite to the charge of electrons.  
 Neutrons have no electric charge.

The protons and neutrons form a heavy nucleus with a positive charge, around which the very light electrons revolve in orbit, just like the planets in our solar system.

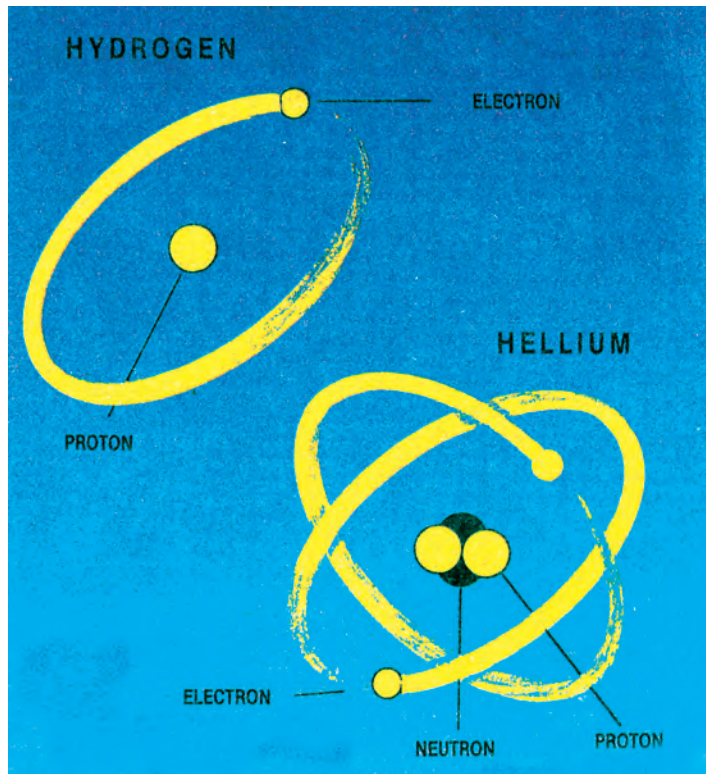
Electrons which move close to the nucleus are tightly bound to the atom. Those



moving in orbit farther from the nucleus are rather loosely bound and when influenced by an outside force, they may be drawn away from the atom. These electrons are sometimes called "free" electrons. They are not exactly free, but tend to move from one atom to another exchanging places continuously with other free electrons. Some materials, such as metals, contain many more of these so called "free" electrons than others, such as rubber and glass.

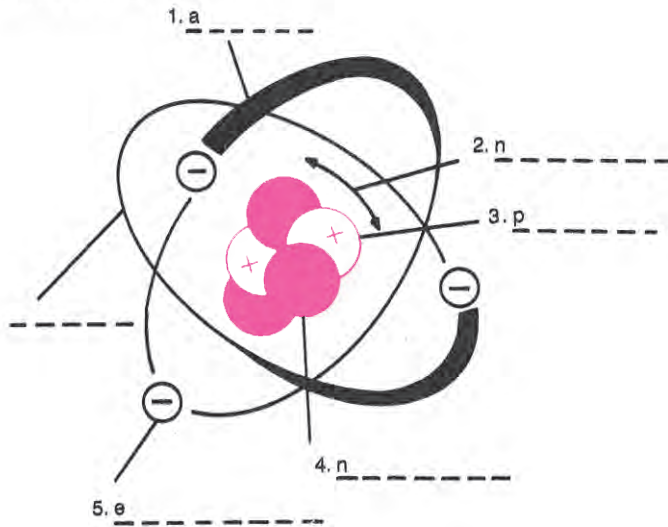
### The potential difference and electric current

If two differently charged bodies come into contact, or are connected with a wire, free electrons will move from the body which has an excess of electrons to the one which has a deficiency of them. The movement of electrons is explained by the theory that an electrical pressure exists between any two bodies when one of them has a charge of greater intensity than the other. The difference in electrical pressure caused by these charges is called "potential difference" and is measured in Volts (V). The greater the potential difference, the greater the movement of electrons along a wire (conductor). This movement of electrons between two differently charged bodies is what we call "electric current". The symbol used to represent electric current is (I), which means intensity of current flow. Current is measured in Amperes (A).



## EXERCISES

### 1. Complete the words:



2. A lot of scientific terms are derived from the Greek language. **Search your text to find 9 English words deriving from Greek**  
e.g. system=σύστημα

3. **The following statements are false. Make any necessary changes to correct them.**

1. *Electrons are positively charged.*  
e.g. Protons are positively charged.
2. *Electrons and neutrons make up the nucleus of the atom.*
3. *Neutrons and electrons have equal but opposite charges.*
4. *Electrons which orbit far from the nucleus are tightly bound to the atom.*
5. *Electrons which move close to the nucleus intend to move from atom to atom and can be made to flow as electric current.*
6. *Electrons move from a positively charged body to a negatively charged one, when these bodies come in contact.*
7. *An electrical pressure exists between any two bodies when they are equally charged.*
8. *The lower the electrical pressure, the greater the movement of electrons across a wire.*
9. *Electric current is measured in Volts and is represented by the letter V.*

4. **Find words in the text which can be replaced by the following:**



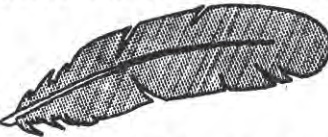
3. move around: \_\_\_\_\_
4. near: \_\_\_\_\_
5. driven: \_\_\_\_\_
6. are inclined: \_\_\_\_\_
7. include: \_\_\_\_\_
8. flow: \_\_\_\_\_
9. stand for: \_\_\_\_\_
10. influence: \_\_\_\_\_
11. more than the normal number: \_\_\_\_\_
12. less than the normal number: \_\_\_\_\_

**5. Match each word with its opposite**

- |                  |   |                |
|------------------|---|----------------|
| e.g. 1. positive | → | a. close       |
| 2. equal         |   | b. free        |
| 3. tightly       | → | c. negative    |
| 4. far           |   | d. connected   |
| 5. similarly     |   | e. unequal     |
| 6. disconnected  |   | f. deficiency  |
| 7. bound         |   | g. loosely     |
| 8. excess        |   | h. charged     |
| 9. uncharged     |   | i. differently |

**6. Find words in your text which characterize the word “charge”**

e.g. equal charge



**Writing Activities**

**1. Write the definitions of the following terms in the boxes below.**

- a) Free electrons
- b) Electric current
- c) Potential difference

a) Free electrons are these electrons which \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

b) Electric current is the movement / flow of \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

c) Potential difference is the difference \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

2. These are the parts, symbols and labels you need to draw a diagram illustrating how electric current is produced.

**Work with your partner a) to draw and label it b) to write a short paragraph to describe the phenomenon it illustrates.**



flow of electrons  
 negatively charged body  
 conductor connecting the two bodies  
 positively charged body

## Listening Activity

### STEP 1

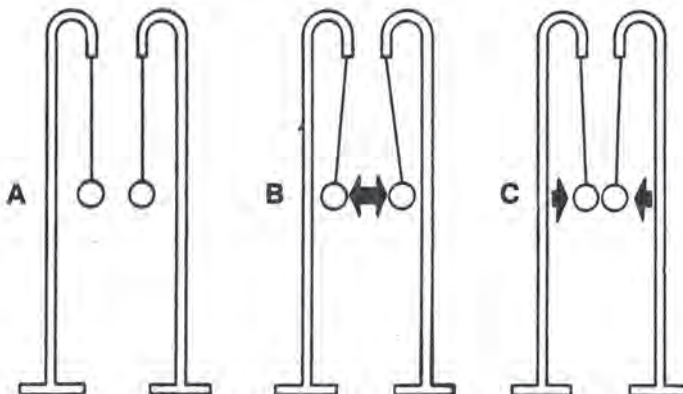
You are going to listen to what a teacher of Physics said during a session. After listening to it, say what the session was about.

### STEP 2

Familiarize yourself with the following tasks. Listen again to what the teacher said and carry them out.

### TASK 1

Write a plus (+=positive) or a minus (=-negative) to show what the electrical charge of each body is and then fill in the blanks in the paragraphs under the pictures.





- A. The two bodies are \_\_\_\_\_, that is they have \_\_\_\_\_ electrical \_\_\_\_\_  
\_\_\_\_\_. As a result, no electric \_\_\_\_\_ is developed.
- B. The two bodies are either \_\_\_\_\_ or \_\_\_\_\_ charged, that is  
they have \_\_\_\_\_ charges. As a result, they \_\_\_\_\_ each other
- C. One of the bodies is \_\_\_\_\_ and the other \_\_\_\_\_ charged,  
that is they have \_\_\_\_\_ charges. As a result they \_\_\_\_\_  
each other.

### TASK 2

**Write (in Greek) how ancient Greeks expressed the phenomenon illustrated in Task 1.**

### TASK 3

**Write the symbol used for the following:**

1. Force of attraction or repulsion: \_\_\_\_\_
2. Charge: \_\_\_\_\_
3. Distance: \_\_\_\_\_

### STEP 3

**Work with your partner to check your answers to the Tasks of Step 2. If necessary, ask your teacher to listen to the session (text) again.**

## ADDITIONAL USEFUL INFORMATION ASSOCIATED WITH ELECTRICITY

**Read the following text and give titles to its paragraphs. Write them in the space provided.**

---

When two differently charged bodies are connected with a wire (conductor), current will flow only until the two bodies become equally charged. In electrical circuits, however, current must flow continuously. As a result, it is necessary to have some source which will maintain the difference of potential between the ends of the conductor. A source of this type is usually referred to as electromotive force (emf). Devices used to produce electromotive force are mechanical generators, chemical cells (batteries), photovoltaic cells or piezoelectric crystals.

The source of electromotive force is the main component of an electrical circuit. Another important component is the conductor, which connects the terminals of the source and offers a path for the electric current to flow through. Conductors are made of materials which contain a lot of free electrons and so permit a large current to flow; that is, they are materials with a great ability to conduct current (conductance). The metals, and especially silver, copper, aluminium, and tungsten belong to this group of materials. Water solutions of acids and bases or salts are conductors, as well.

---

There are other materials, such as glass, rubber, porcelain, mica, plastic, paper, silk, etc. which contain very few electrons and, as a result, permit relatively little current to flow. These materials are called "insulators" and are used to coat or wrap wires, to prevent two or more wires from touching each other, etc.

---

Some other materials, such as germanium, silicon and copper oxide, which cannot be classified either to conductors or to insulators, are called semiconductors.

---

Actually no material is a perfect conductor or a perfect insulator. All materials have some free electrons which will flow as a current and even the best conductors offer some opposition to current flow. This opposition is called resistance ( $R$ ) and is measured in Ohms ( $\Omega$ ). The amount of resistance a conductor offers to current flow depends upon the type and the temperature of the material, as well as the length and the cross section of the conductor.

---

Finally, there is a group of materials, such as germanium-silver and nickel-chromium alloys, which, although they are conductors, have such high resistance that their principal function is to oppose current flow. They are used to add resistance to a certain point of a circuit, and are called resistors. They are especially useful in high temperature devices, such as electric heaters, toasters and other such household devices.

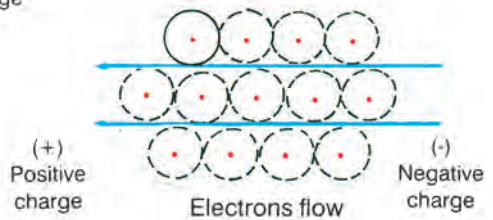
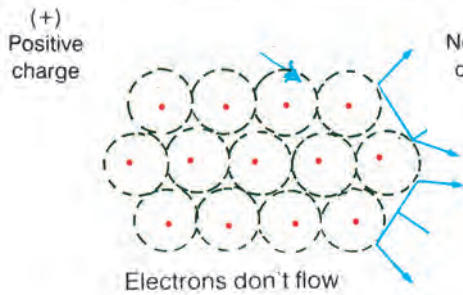
## **EXERCISES**

### **1. Answer the following questions.**

1. *What happens when two differently charged bodies are connected?*
2. *What is the use of an emf source?*
3. *What is the difference between a conductor and an insulator?*
4. *What is a semiconductor?*
5. *Are there any materials which offer no resistance to current flow?*

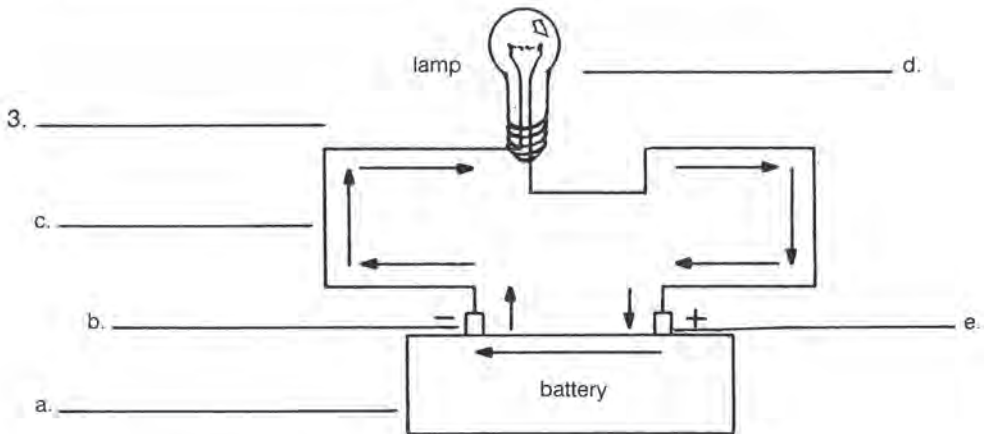
6. Mention the factors which influence the amount of resistance a conductor offers to electric current.  
 7. What are resistors used for?

**2. Identify what is illustrated in the following diagrams and label them.**



1. \_\_\_\_\_

2. \_\_\_\_\_



**3. Match the English words with their Greek equivalents.**

**A**

- |       |         |
|-------|---------|
| alloy | οξειδίο |
| base  | οξύ     |
| salt  | βάση    |
| oxide | κράμα   |
| acid  | άλας    |

**B**

- |         |             |
|---------|-------------|
| zinc    | χάλυβας     |
| steel   | πυρίτιο     |
| rubber  | χαλκός      |
| silicon | καουτσούκ   |
| copper  | ψευδάργυρος |

**C**

- |           |            |
|-----------|------------|
| brass     | σίδηρος    |
| carbon    | γερμάνιο   |
| tungsten  | ορείχαλκος |
| germanium | βολφράμιο  |
| iron      | άνθρακας   |



4. Classify the items or materials in the following categories. Tick appropriately.

Item or Material	Used as				
	Source of EMF	Conductor	Insulator	Semi- conductor	Resistor
<i>water solutions of acids</i>		✓			
<i>chemical cell</i>					
<i>glass</i>					
<i>aluminium</i>					
<i>silicon</i>					
<i>nickel-chromium alloys</i>					
<i>tungsten</i>					
<i>porcelain</i>					
<i>piezoelectric crystals</i>					
<i>iron</i>					
<i>water solutions of salts</i>					
<i>silver</i>					
<i>plastics</i>					
<i>germanium</i>					
<i>mechanical generators</i>					
<i>water solutions of bases</i>					
<i>mica</i>					
<i>german silver</i>					
<i>copper</i>					
<i>rubber</i>					
<i>copper oxide</i>					
<i>zinc</i>					
<i>photovoltaic cells</i>					
<i>brass</i>					
<i>steel</i>					

**5. Use the table to make meaningful sentences.**

Silver Mica Mechanical generators German silver Aluminium Plastics Batteries Carbon Porcelain Copper	is / are used to	<ul style="list-style-type: none"> <li>• maintain the difference of potential between the ends of a conductor.</li> <li>• oppose current flow.</li> <li>• offer a path for the electric current to flow.</li> <li>• add resistance at a certain point of an electrical circuit.</li> <li>• prevent the flow of electric current.</li> <li>• produce electromotive force.</li> <li>• conduct current along a circuit.</li> <li>• coat or wrap wires.</li> </ul>
---	---------------------	--

**e.g.** Silver is used to conduct current along a circuit.

**6. Match the two columns to make combinations of words found in the text.**

<p><b>e.g.</b> household                  chemical                  piezoelectric                  large                  little                  perfect                  high                  mechanical                  photovoltaic                  principal                  nickel-chromium                  certain</p>		temperature alloys current point cell generator crystal device conductor insulator resistance function
--	--	---

**7. Odd - man out**

1. continue ✓ preserve keep maintain	2. principal basic principle main	3. function product work operation
4. classify group categorize divide	5. pass conduct transmit drive	6. oppose resist press face

7. permit prevent let allow	8. element material part component	9. pack wrap cover coat
--------------------------------------	---	----------------------------------

8. Fill in the boxes below with the definitions of the following terms.

**Conductance** is an electrical property of matter. It is \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Conductor** is a material which \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Insulator** is \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Resistance** is called the \_\_\_\_\_  
 \_\_\_\_\_ . It is the opposite of \_\_\_\_\_  
 conductance \_\_\_\_\_

**Electromotive force** \_\_\_\_\_  
 \_\_\_\_\_

## GENERAL EXERCISES

### 1. EXPRESSING PARALLEL INCREASE

A. Write the comparative form of the following adjectives.

long \_\_\_\_\_ many \_\_\_\_\_  
 great \_\_\_\_\_ much \_\_\_\_\_  
 high \_\_\_\_\_ little \_\_\_\_\_  
 large \_\_\_\_\_ few \_\_\_\_\_



## **B. Using the cues below make sentences as in the example.**

**e.g.** (little) the electrical pressure / (little) the amount of electron flow.

*The less the electrical pressure, the less the amount of electron flow.*

1. (little) the difference in the number of electrons / (little) the electrical pressure.
2. (great) the magnitude of charges / (great) the forces of attraction.
3. (great) the distance between two bodies / (little) the force of attraction.
4. (long) the difference of potential is maintained / (long) the electric current will flow.
5. (many) free electrons a material contains / (good) conductor it is.
6. (long) a conductor is / (high) its resistance becomes.
7. (large) the cross section of a conductor / (little) its resistance.

## **2. CAUSE AND EFFECT**

Cause and effect can also be expressed following the structure of the 1<sup>st</sup> Conditional as in the example.

### **Example**

*If / when two positively charged bodies come close, → they (will) repel each other*

### **Use the cues below to form similar conditional sentences.**

1. two or more elements / be combined chemically,  
→ cannot be separated by physical means.
2. two or more elements / be combined physically,  
→ form mixture.
3. a wire connects two differently charged bodies,  
→ electrons flow from negatively to positively charged one.
4. a material contains lots of free electrons,  
→ can be used as a conductor..
5. two differently charged bodies / be connected,  
→ electrons will flow until the two bodies become equally charged.
6. a body contains atoms with same number of protons and electrons,  
→ is not charged.

## **3. EXPANDING YOUR VOCABULARY**

Most words are formed by adding prefixes or suffixes. If you know the most common of them, you can easily understand the meaning of new words and form new ones by adding the appropriate prefixes or suffixes.

**A. Complete the following table.**

<b>Verb</b>	<b>Noun</b>	<b>Adjective</b>
e.g. <i>oppose</i>	<i>opposition</i>	<i>opposite</i>
<i>attract</i>	_____	_____
_____	<i>relation</i>	_____
_____	_____	<i>repulsive</i>
<i>define</i>	_____	_____
_____	_____	<i>measurable</i>
_____	<i>permission</i>	_____
_____	_____	<i>resistive</i>
_____	_____	_____
<i>represent</i>	_____	_____
_____	<i>action</i>	_____
_____	_____	_____
_____	_____	<i>experimental</i>
_____	_____	_____

**B. Write the suffixes used to form nouns and adjectives.**

<b>SUFFIXES</b>	
<b>NOUN</b>	<b>ADJECTIVE</b>
e.g. <i>-tion</i>	

**Choose the appropriate preposition from the list, to fill in the gaps.**

**List:** *along, to, into, up, from, in, between, upon.*

- e.g.** 1. An electric circuit is made **up** of various components.  
 2. Electrons have negative electric charge, equal and opposite \_\_\_\_\_ that of protons.

3. Electrons which move far \_\_\_\_\_ the atom are called free electrons.
4. From an electrical point of view, matter can be classified \_\_\_\_\_ conductors, insulators and semiconductors.
5. Electric current is the flow of electrons \_\_\_\_\_ a conductor.
6. The intensity of current flow is measured \_\_\_\_\_ amperes.
7. Paper, silk, glass, mica and rubber belong \_\_\_\_\_ insulators.
8. Resistors offer high resistance \_\_\_\_\_ current flow.
9. The force with which two charged bodies attract or repel each other depends \_\_\_\_\_ the charges of the bodies and the distance \_\_\_\_\_ them.

## 5. NOUNS AS QUALIFIERS

Nouns are often used as adjectives to qualify other nouns. **Look at the examples.**

current flow = the flow of current

book case = case for books

petrol engine = engine using petrol

**Complete the following table**

- |   |                           |
|---|---------------------------|
| 1. TV screen / receiver / set / control |                           |
| 2. _____                                | washer for dishes         |
| 3. shop keeper                          |                           |
| 4. _____                                | products which are washed |
| 5. ice box                              |                           |
| 6. household devices                    |                           |
| 7. cassette recorder                    |                           |
| 8. _____                                | meter for measuring Volts |
| 9. shop window                          |                           |
| 10. glass insulator                     |                           |

## 6. WORDSQUARE

Your teacher is going to read the definitions of some scientific terms already familiar to you. **Listen to him, identify the terms and write their initials in the squares provided.**

	a	b	c	d
1	EC			
2				
3				

e.g. 1-a: EC = Electric current