English for Electrical and Electronic Engineering

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Unit 2

Conductors, Insulations and Semiconductors

2.1 Reading and comprehension

If we connect a battery across a body, there is a movement of free electrons towards the positive end. This movement of electrons is an electric current. All materials can classified into three groups according to how readily they permit an electric current to flow. These are: conductors, insulators and semiconductors.

In the first catagory are substances which provide an easy path for an electric current. All metals are conductors, however some metals do not conduct well. Manganin, for example, is a poor conductor. Copper is a good conductor, therefore it is widely used for cables. A non-metal which conducts well is carbon. Salt water is an example of a liquid conductor.

A material which does not easily release electrons is called an insulator. Rubber, nylon, porcelain and air are all insulator. There are no perfect insulators. All insulators will allow some flows electrons, however this can usually be ignored because the flow they permit is so small (see Fig. 2.1)

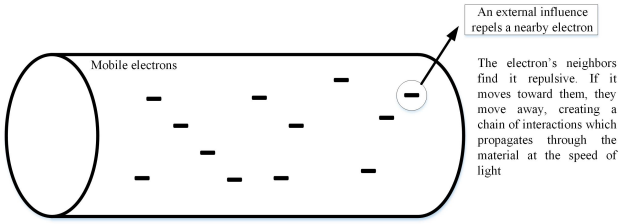


Figure 2.1: Cross section of copper wire

Semiconductors are mid-way between conductors and insulators. Under certain conditions they

allow a current to flow easily but under others they behave as insulators. Germanium and silicon are semisonductors. These are known as thermistors. The resistance of thermistors falls rapidly as their temperature rises. They are therefore used in temperature sensing devices.

2.1.1 Exercises

Exercise1: *Rephrasing*

Rewrite the following sentences, replacing the words in *italics* with expressions from the passage which have similar meanings:

1- The *flow* of free electrons is called an electric conductors.

2- Materials in the first *group* are called conductors.

3- *Materials* which provide a path for an electric current are conductors.

4- All insulators *permit* some flow of electrons.

5- Grmanium sometimes *acts* as an insulator and sometimes as a conductor.

Exercise 2: *Contextual reference*

Which do the pronouns in italics in these sentences refer to?

1- All material can be classified into three groups according to how readily *they* permit an electric current to flow. (line 3)

   a) Three groups

   b) All materials

   c) Free electrons

2- Under certain conditions, *they* allow a current to flow easily but under others *they* behave as insulators. (line 16)

   a) Conductors

   b) Semiconductors

   c) Insulators

3- *These* are known as thermistors. (line 18)

a) Metallic oxides

b) Semiconductors

c) Mixture of certian metallic oxides

4- *They* are therefore used in temperature-sensing devices. (line 20)

a) Thermistors

b) Semiconductors

c) Metallic oxides

Exercise 3: ***Checking facts and ideas***

Describe if these statements are true or false. Quote from the passage to support your decision.

1- Electrons flow from positive to negetive.

2- Copper provides an easy path for an electric circuit.

3- All metals are good conductors.

4- All good conductors are metals.

5- Air is not a perfect good insulator.

6- Rubber readily releases electrons.

7- The resistance of a thermistor is higher at low temperature than at high temperatures.

Exercise 4: ***Describing shapes***

Study these nouns and adjective for describing the shapes of objects.

When something has a regular geometric shape, we can use one of the adjectives from the table to describe it.

Example:  A square wave

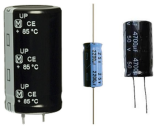
Now describe the shape of the following objects as completely as possible:

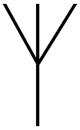
1- Ceramic capacitor 

.....

Shape	Noun	Adjective	Shape	Noun	Adjective
2D			3D		
	circle	Circular		Sphere	Spherical
	Semi-circle	Semi-Circular		Cylinder (Tube)	Cylinderical (Tubular)
	Square	Square		Cube	Cube-shaped
	Rectangle	Rectangular		Rectangular prism	Rectangular prism-shaped
Line		Straight	Edges		Rounded
					
		Curve			Pointed

2- Transformer laminations  .....

3- Electrolytic capacitor  .....

4- Antenna  .....

5- Magnet  .....

6- Resistor  .....

2.2 Use of English:

2.2.1 *Relative clauses 1*

Study these sentences:

1- Starter motor brushes are made of carbon.

2- The carbon contains copper.

Both these sentences refer to carbon. We can link them by making sentence 2 a relative clause.

1+2: Starter motor brushes are made of carbon ***which contains copper***.

The *relative clause* is "***which contains copper***". Note that ***the carbon*** in sentence 2 becomes ***which***.

Study these other pairs of sentences and note how they are linked.

1- 33kV lines are fed to intermidiate substations.

2- In the intermidate substations the voltage is stepped down to 11kV.

3+4: 33kV lines are fed to intermidiate substations ***where the voltage is stepped down to 11kV***.

Now link these sentences. Make the second sentence in each pair a relative clause.

a) 1- The coil is connected in a series with a resistor.

2- The resistor has a value of 249 Ohms.

b) 1- The supply is fed to the distribution substation.

2- The supply is reduced to 415 V in the distribution substation.

c) 1- Workers require a high degree of illmumination.

2- The workers assemble very small precision instrument.

d) 1- Manganin is a metal.

2- This metal has a relatively high resistance.

e) 1- The signal passes to the detector.

2- The signal is rectified by the detector.

f) 1- A milliammeter is an instrument.

2- The isntrument is used for measuring small current.

g) 1- Armoured cables are used in places.

2- There is a risk of mechanical damage in these places.

2.2.2 *Reason and result connectives 1*

Study these sentences:

1- Copper is used for cables.

2- Copper is a good conductor.

Sentence 1 tells us what copper is used for. Sentence 2 tells us why it is used, sentence 2 provides a reason for sentence 1. We can link a statement and a reason using *because*.

1+2: Copper is used for cables ***because*** it is a good conductor.

When the reason is a noun, a noun phrase, we can use *because of*.

Note that a comma is used before *therefore*.

Now link these ideas using ***therefore*** and ***because*** to make shorten two sentences.

a) 1- Soft iron is used in electromagnets.

2- Soft iron can be magnetized easily.

b) 1- The voltage is 250 V and the current is 5 A.

2- The resistance is 50 Ohms.

c) 1- PVC is used to cover cables.

2- PVC is a good insulator.

d) 1- Transistors can be damaged by the heat.

2- Care must be taken when soldering transistors.

e) 1- Capacitance is usually measured in microfarads or pico-farads.

2- The farad is too large as a unit.

f) 1- Output transistors are mounted on a heat sink.

2- Output transistors generate heat.

g) 1- It is easy to control the speed of DC motor.

2- DC motors are used when variable speeds are required.

h) 1- A cathode ray tube screen glows when an electron beam strike it.

2- The screen is coated with a phosphor.

2.2.2.1 *Mathematical symbols used in electrical engineering and electronics*

Study table 2.1 of mathematical symbols used in electrical engineering and electronics. Then write out the following expressions in full:

Example: $I = \frac{E}{R}$ Read: I is equal E over R.

1- $P = I^2 \times R$

2- $\frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

3- $B \propto H$

4- $X_L = \sqrt{Z^2 - R^2}$

5- Frequency ability $\approx 0.04\%/^o\text{C}$

6- $Z = \dfrac{100 \times 10^4}{200 \times 10^{-5}}$

Table 2.1: Mathematical symbols

Symbol	Read as	Example
$=$	equals, is equal to	$x = 2 : x$ is equal to two.
$\equiv$	is defined as	$x \equiv y : x$ is defined as y.
$\approx$	is approximately equal to	$x \approx y : x$ and y are almost equal.
$\neq$	does not equal, is not equal to	$x \neq y : x$ is not equal to y.
$<$	is less than	$x < y : x$ is less than y.
$>$	is greater than	$x > y : x$ is greater than y.
$\ll$	is much less than	$x \ll y : x$ is much less than y.
$\gg$	is much greater than	$x \gg y : x$ is much greater than y.
$\leqslant$	is less than or equal to	$x \leqslant y : x$ is less than or equal to y.
$\geqslant$	is greater than or equal to	$x \geqslant y : x$ is greater than or equal to y.
$\propto$	is proportional to	$x \propto y : x$ is proportional to y.
$+$	plus, add to	$x + y : x$ plus y (is the sum of x and y).
$-$	minus, subtract	$x - y : x$ minus y (is the subtraction of y from x).
$\times, \cdot$	times, multiplied by	$x \times y$ is the multiplication of x by y.
$\div, /$	divided by	x/y is the division of x by y.
$\pm$	plus or minus	$x \pm y : x$ plus or minus y.
$\sqrt{\ }$	square root	$\sqrt{x}$: square root of x.
$\sum$	sum over ... from ... to ... of, (sigma)	$\sum_{n=1}^{4}$: sum over n from 1 to 4.
$\hat{}$	power	$x^y : x$ power y.
%	percent	$x\% : x$ percent
.	point	2.1 : 2 point 1