T.C.
MİLLÎ EĞİTİM BAKANLIĞI

AIRCRAFT MAINTENANCE

TEKNİK YABANCI DİL (İNGİLİZCE) 1

Ankara, 2011

CONTENTS

AÇIKLAMALAR

KOD	**222YDK099**
ALAN	**Uçak Bakım**
DAL/MESLEK	**Uçak Gövde Motor Teknisyenliği** **Uçak Elektronik Teknisyenliği**
MODÜLÜN ADI	**Teknik Yabancı Dil (İngilizce) 1**
MODÜLÜN TANIMI	Teknik alet, cihaz, ölçüm, birim gibi terimleri içeren İngilizce teknik yayınları tekniğine uygun olarak okuyup anlayabilmeyi sağlayan öğretim materyalidir.
SÜRE	40 / 32
ÖN KOŞUL	10. ve 11. sınıf İngilizce derslerini başarmış olmak (Temel seviyede İngilizce yeterliğine sahip olmak)
YETERLİK	Elektrik – elektronik içerikli İngilizce mesleki ve teknik yayınları incelemek, okumak ve anlamak
MODÜLÜN AMACI	**Genel Amaç** Elektrik – elektronik içerikli İngilizce mesleki ve teknik yayınları inceleyerek okuyup anlayabileceksiniz. **Amaçlar** **1.** Tekniğine uygun olarak teknik birimleri İngilizce okuyabileceksiniz. **2.** Tekniğine uygun olarak teknik çizim terimlerini İngilizce okuyabileceksiniz. **3.** Tekniğine uygun olarak basit el aletlerini ve çalışmasını İngilizce okuyabileceksiniz. **4.** Tekniğine uygun olarak malzemeleri İngilizce okuyabileceksiniz. **5.** Tekniğine uygun olarak elektrik ve elektronik terimleri İngilizce okuyabileceksiniz. **6.** Tekniğine uygun olarak elektrik – elektronik ölçü aletlerini ve ölçüm işlemlerini İngilizce okuyabileceksiniz.
EĞİTİM ÖĞRETİM ORTAMLARI VE DONANIMLARI	**Ortam:** Laboratuvar, atölye, işletme, kütüphane vb. gibi araştırmaya yönelik etkinlikler yapılabilecek tüm ortamlar ve sınıf. **Donanım:** TV, VCD, Video, Internet
ÖLÇME VE DEĞERLENDİRME	Modül içinde yer alan her öğrenme faaliyetinden sonra verilen ölçme araçları ile kendinizi değerlendireceksiniz. Öğretmen modül sonunda ölçme aracı (çoktan seçmeli test, doğru-yanlış testi, boşluk doldurma vb.) kullanarak modül uygulamaları ile kazandığınız bilgi ve becerileri ölçerek sizi değerlendirecektir.

INTRODUCTION

Dear student;

If you want to be a qualified technician, Technical English is a very important subject because; English is the common language of the entire world. In our country, aviation is one of the fastest growing sectors.

The first step in the entry to this sector is the English language, because all the maintenance manuals, catalogs and documents are in this language. In addition, all international correspondence, and studies have been using this language. If we want to get safe and high quality results we must use a common language for communication.

At the end of this module, you will learn measuring systems, basic hand tools, materials, electrics and electronics ext.

LEARNING ACTIVITY-1

AIM

According to information in this module and in suitable conditions, you can learn the units of measurement used in the aviation sector. You will learn the methods of the units how can be changed. You can read these topics with English language.

SEARCH

- Write the units of measurement what you learned before and discuss with your friends.

1. TECHNICAL MEASUREMENTS (METRIC UNITS)

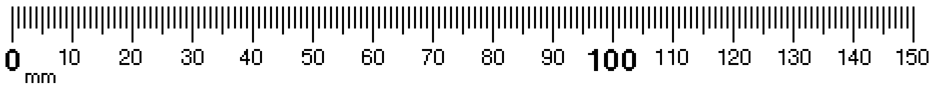


Figure 1.1: 15 centimeter ruler

Measuring is one of the activities that you have taken a part in since you were very small.

Numbers and units are used to make these measurements. You measure how tall you are, how far you walk, how much water you drink, and how much you weigh.

You may measure how far you by how many steps you take.

If all people measured how far they walked by how many steps they took there would be problems in comparing the distance because everyone has a different length step.

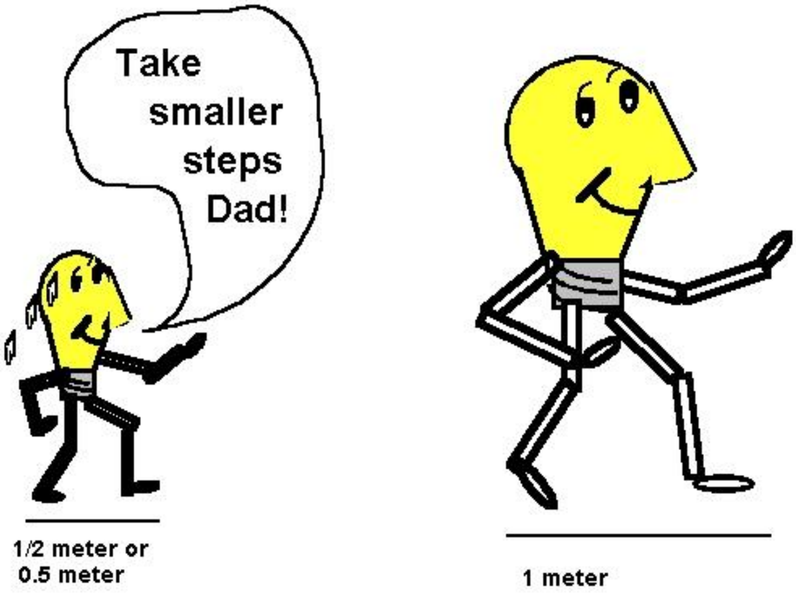


Figure 1.2: There would be problems if all people measure how far they walk by how many steps they take.

The standard unit of length in the metric system is the **meter**.

The basic unit of volume is the **liter**.

One unit of mass is the **gram**.

One other commonly measured physical property is temperature. The Celsius or centigrade scale is used in the metric system. On this scale water freezes at 0 ^{o}C and it boils at 100 ^{0}C.

The basic unit of the Celsius scale is the **degree**.

Physical Quantity	**Unit**	**Symbol**
length	meter	m
mass	gram	g
volume	liter	l
temperature	Degrees Celsius	^{o}C

Table 1.1: Some physical quantities, their units and symbols.

The metric system is so easy because it is set up in units of 10s.

Thus, to convert from one unit of length to another in metric; all you have to do is multiply or divide by 10, 100, 1000, and so on.

Here is a table to help you remember.

Multiple of Sub multiple	Prefix	Value	Power of Ten
one million	Mega	1,000,000	10^6
one thousand	Kilo	1,000	10^3
one hundred	Hector	100	10^2
ten	Deca	10	10
base unit		**1**	$\mathbf{10^0}$
one tenth	Deci	0.1	10^{-1}
one hundredth	Centi	0.01	10^{-2}
one thousandth	Milli	0.001	10^{-3}
one millionth	Micro	0.000001	10^{-6}
one billionth	Nano	0.000000001	10^{-9}

Table 1.2: It is important to remember the order in size and the relationship of the units.

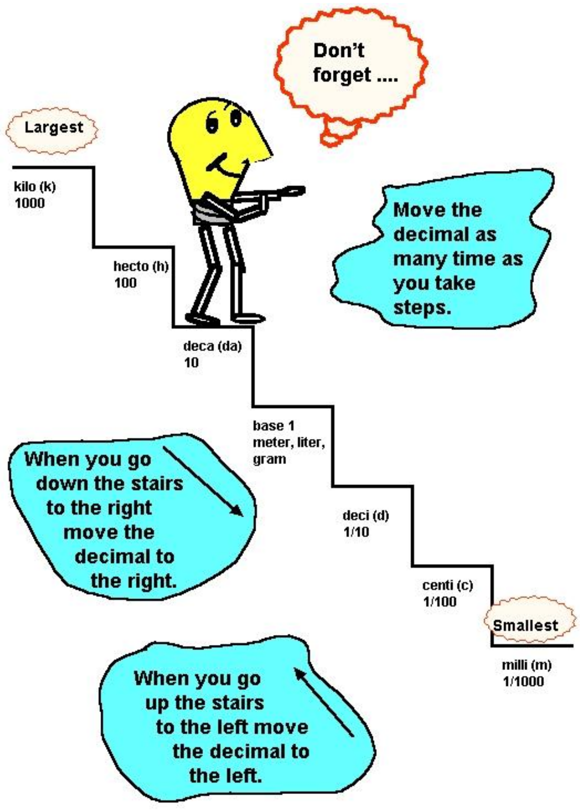


Figure 1.3: Learning main units using the metric staircase

1.1. Length

The basic unit of length is the meter which is represented by the abbreviation m.

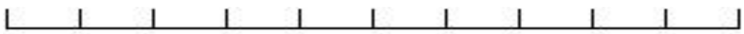


Figure 1.4: A line divided into ten sections

Did you see how the line was divided? Each section is a centimeter. If a centimeter was divided into 10 sections, each of that small section would be a millimeter.

The meter which is about the length of a man's arm and can be divided into 10 segments each of which is called a "deci-meter".

Deci means one tenth.

Each of the decimeters is divided into 10 segments called "centi-meters".

There are 100 centimeters in a meter and centi just happens to mean one hundredth.

Next the centimeter is divided into 10 segments which are called "milli-meters".

Since there are 1000 millimeters in one meter, what do you think milli means? It does mean one thousandth.

Since that was so easy let us go the other way.

When we have 10 meters side by side we have a "decameter". Deca means 10.

Now we lay 10 decameters or 100 meters side by side we have a "hecto-meter". Hecto means 100.

If you lay 10 hectometers or 1000 meters side by side you would have a "kilo-meter". What does kilo mean? It does mean 1000.

Remember we said the metric system is easy because it is in units of 10's.

1.1.1. Here Is Another Way Of Looking At Order And Size Of The Units:

1 meter = 10 decimeters = 100 centimeters = 1000 millimeters

1 kilometer = 10 hectometers = 100 decameters = 1000 meters

Example – 1 How many centimeters are there in 80 millimeters?

Solution: You know that, there are 0.1 centimeters in 1 millimeter or that there are 10 millimeters per one centimeter. If we have 80 millimeters we have 8 centimeters.

All we did was dividing 80 by 10 to get 8 centimeters.

$$\textbf{80 millimeters} \times \frac{\textbf{1 centimeter}}{\textbf{10 millimeters}} = \textbf{8 centimeters}$$

When over you divide by 10 it is the same as moving the decimal over one place to the left.

$$\mathbf{80.} \longrightarrow \mathbf{8.0}$$

b. This problem can also be solved using the metric staircase. When you move from millimeters to centimeters you take one step up. Since you are going up to the left, you move the decimal to the left.

See the solution below

$$\mathbf{80.} \longrightarrow \mathbf{8.0} \text{ centimeters}$$

You already know that a decimeter is equal to 10 centimeters.

Some items which are about the length of a decimeter are the length of a bar of soap or the width of a wallet.

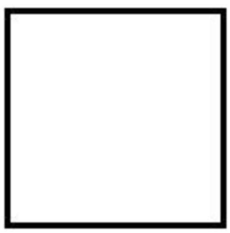
The kilometer is the most commonly used unit. Using kilometer unit can be much more useful than using meter unit.

As you remember the kilometer is 1000 meters. This about the length of 11 football fields placed end to end.

Did you remember that the maximum speed limit on many highways is 90 kilometers per hour?

Use a metric ruler to answer the questions below.

Example – 2 What is the side length of the square below?



Example – 3 What is the length of the drawing of the pencil?

There Are Abbreviations For The Units Of Lengths. These are listed in the table below.

UNIT	**ABBREVIATION**	**NUMBER OF METERS**
kilometer	km	1000
hectometer	hm	100
decameter	dam	10
meter	**m**	**1**
decimeter	dm	0.1
centimeter	cm	0.01
millimeter	mm	0.001

Table 1.3: Abbreviations of the units of lengths

Remember these abbreviations because they will be used frequently in place of the words.

Example – 4 How far is it from Istanbul to Ankara?

It is about 450 km from Istanbul to Ankara.

Exercise 1.1

1. How many meters are there in 5.8 kilometers?
A) 5800 B) 580 C) 58 D) 58000

2. How many centimeters are there in 4.8 meters?
A) 4800 B) 480 C) 48 D) 48000

3. What is the abbreviation for decameter?
A) dm B) dem C) hm D) dam

4. What is the width of the rectangle below? About …… cm.
A) 3 B) 30 C) 300 D) 3000

5. How many centimeters are there in 0.133 decameters?
A) 13300 B) 1330 C) 133 D) 13

6. How many decimeters are there in 640 millimeters?
A) 64 B) 6,4 C) 640 D) 0,64

1.2. Mass

The basic unit of mass is the **gram** which is represented by the abbreviation **g**.

Kilogram (kg) is another basic unit for mass.

Remember, kilo is the prefix for1000 times as much.

So, one thousand grams (1000 g) is simply written 1 kg (1 kilogram).

1 kilogram = 1000 gram

Remember, milli is the prefix meaning one thousandth (0.001). So, one thousandth of the unit of measure gram being 1 milligram, is simply written 1 mg

1000 kilograms (1000 kg) is called 1 **tonne**, and it is represented by the abbreviation **t**.

Let us repeat the main units of mass:

1 kg is equal to 1000 g

1 g is equal to 1000 mg

1 tonne equals 1000 kg

Example – 1 How many kilograms are there in 5 grams?

Solution:

You know grams and you are looking for kilograms. How many steps is it from grams to kilograms? You are right if you said there are three. You move the decimal to the left because you are going up the stairs.

_ _ <u>5</u>.

What do we do now? You need to fill in each empty trough with a zero.

.<u>0</u> <u>0</u> <u>5</u> ⟶ .005 kilograms = .005 kg

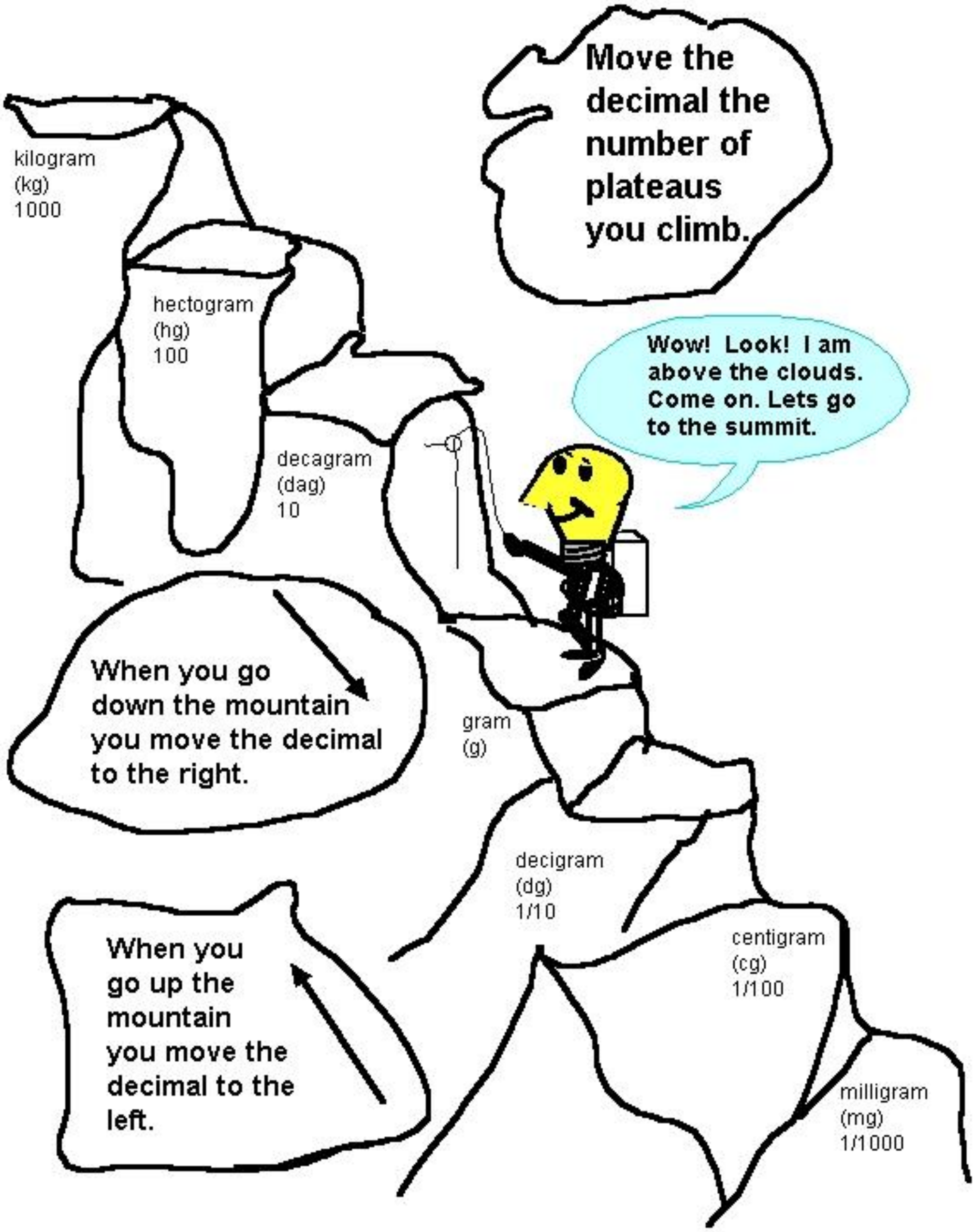


Figure 1.5: Scaling the metric mountain

Here are a couple sample climbs to show you how to convert from one prefix to another.

Example – 2 How many grams are there in 3 kilograms?

Solution:

How many plateaus do you climb when going from grams to kilograms?

If you said 3 you are right. You move the decimal three places to the left since you are climbing up the mountain.

Remember that, if the decimal is not shown it is after the number.

$\_\ \_\ \underline{3}.$

Now you need to fill in the empty troughs with zeros.

$\underline{0}\underline{0}\underline{3}$ .003 kilograms →

We found that 3 thousandths of a kilogram is the same as 3 grams

Example – 3 How many milligrams are there in 3 grams?

Solution:

How many plateaus do you descend or go down? If you said 3 you are right. If you go down three plateaus then you move the decimal three places to the right.

$3.\_\ \_\ \_$

Now fill in the troughs.

$3\underline{0}\underline{0}\underline{0}$ → 3000. milligrams

Exercise 1.2

1. How many grams are there in 15 milligrams?
   A) 0,0015 B) 1,5 C) 0,015 D) 0,15

2. How many grams are there in 3 kilograms?
   A) 300 B) 3000 C) 30 D) 30000

3. Finish the chart below by converting the units.

milligram (mg)	**gram (g)**	**kilogram (kg)**
10		
	25	
1.4		
		16
96		
	213	
		10
25		

1.3. Area

The area of a shape is a measure of how many square units it contains.

The units employed would be typically;

square meters - m^2

square centimeters - cm^2

square millimeters - mm^2

For larger areas, the hectare is used - an area equivalent to the area of a square with sides of 100 meters.

$(100\ m)^2 = 10\ 000\ m^2$

This means that a square kilometer contains 100 hectares

Example - 1: An area of 679 hectares = 6.79 km^2

Note that, in the case of area, conversion to different units is more complicated than with 'straightforward' length.

For example, a square kilometer is 1 000 000 times as large as a square meter (NOT 1000 times as large).

Consider squares for simplicity.

Each side of a square kilometer will be 1 000 times as long as a square meter, and by multiplying 1 000 by 1 000 you can see that a square kilometer is indeed 1 000 000 (1 million) times as large as a square meter.

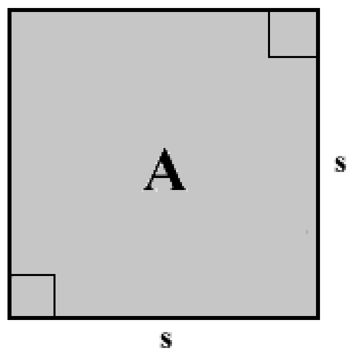
Units of Area	
100 square millimeters (mm^2)	= 1 square centimeter (cm^2)
100 square centimeters	= 1 square decimeter (dm^2)
100 square decimeters	= 1 square meter (m^2)
100 square meters	= 1 square decameter (dam^2) = 1 are
100 square decameters	= 1 square hectometer (hm^2) = 1 hectare (ha)
100 square hectometers	= 1 square kilometer (km^2)

Table 1.4: Units of area

1.3.1. The Area Of A Square

The area A of any square is equal to the square of the length s of a side.

Formula: $A = s^2$



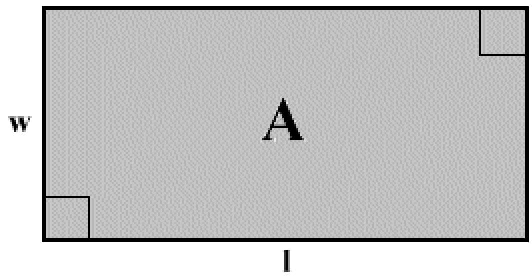
Example - 2: What is the area of a square having side-length 3.4 cm.?

Solution: The area is the square of the side-length, which is $3.4 \times 3.4 = 11.56$ cm^2.

1.3.2. The Area Of A Rectangle

The area A of any rectangle is equal to the product of the length l and the width w.

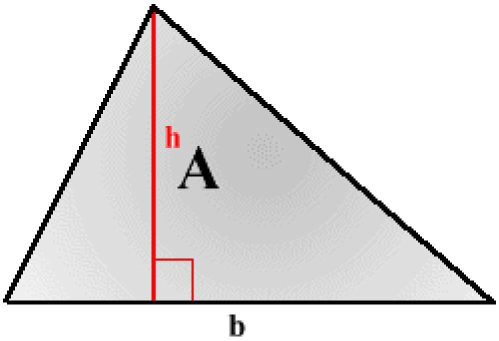
Formula: $A = l\,w$



1.3.3. The Area Of A Triangle

The area A of any triangle is equal to one-half the product of any base b and corresponding height h.

Formula: A = 0.5 b h



1.4. Force

What is force?

One type of **force** that everyone is familiar with is, weight. This is the amount of force that the Earth exerts on you.

There are two interesting things about this force:

- It pulls you down, or, more exactly, toward the center of the Earth.
- It is proportional to your mass. If you have more mass, the Earth exerts a greater force on you.

Force causes **acceleration**.

If you apply a force to a toy car (for example, by pushing on it with your hand), it starts to move. This may sound simple, but it is a very important fact. The movement of the car is governed by **Isaac Newton's Second Law**, which forms the foundation for classical mechanics.

a = F/m, or F = ma

In the formula that is written above, a represents acceleration, F represents force and m represents mass.

To honor Newton's achievement, the standard unit of force in the SI system was named the **newton**.

Acceleration is directly proportional to force

One newton (N) of force is enough to accelerate 1 kilogram (kg) of mass at a rate of 1 meter per second squared (m/s^2).

In fact, this is really how force and mass are defined. A **kilogram** is the amount of weight at which 1 N of force will accelerate at a rate of 1 m/s^2.

1.5. Volume

Metric volume is so easy to understand as metric length. The basic unit of volume is the **liter**.

A liter is a cube which has a length, width, and height of 10 centimeters.

A cube is what you might call a square box.

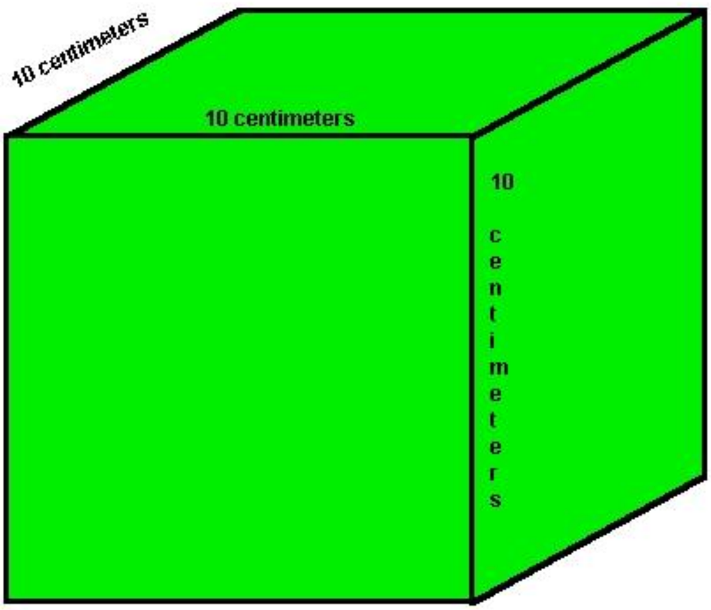


Figure 1.6: A simple cube

Did you see the size of the diagram of the cube? Let us calculate the volume of the cube.

Two liters would fit into a small shoe box.

The mathematical expression for the volume of a box is length times width times height.

VOLUME = LENGTH X WIDTH X HEIGHT

The length, width, and height of a cube which has a volume of one liter are all 10 centimeters. The volume if the liter is calculated below.

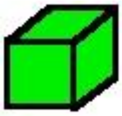
$$\text{VOLUME} = 10\ \text{cm} \times 10\ \text{cm} \times 10\ \text{cm}$$

$$\text{VOLUME} = 100\ \text{cm}^2 \times 10\ \text{cm}$$

$$\text{VOLUME} = 1000\ \text{cm}^3$$

The symbol cm^3 is read as centimeter cubed or cubic centimeter. A cubic centimeter is a cube with the length, width, and height all 1 centimeter in length.

Look at the diagram of the cubic centimeter below. The cubic centimeter is about the size of a sugar cube.



1000 of these little cubes can fit into a cube which is a liter big.

Since 1000 cubic centimeters can fit into a liter, it is given the special name of a millimeter.

Remember that the prefix milli means 1/1000 or one thousandth.

So, a millimeter is one thousandth of a liter.

Units of Liquid Volume	
10 milliliters (mL)	= 1 centiliter (cL)
10 centiliters	= 1 deciliter (dL) = 100 milliliters
10 deciliters	= 1 liter = 1000 milliliters
10 liters	= 1 dekaliter (daL)
10 dekaliters	= 1 hectoliter (hL) = 100 liters
10 hectoliters	= 1 kiloliter (kL) = 1000 liters

Table 1.5: Units of Liquid Volume

Units of Volume	
1000 cubic millimeters (mm^3)	= 1 cubic centimeter (cm^3)
1000 cubic centimeters	= 1 cubic decimeter (dm^3) = 1 000 000 cubic millimeters
1000 cubic decimeters	= 1 cubic meter (m^3) = 1 000 000 cubic centimeters = 1 000 000 000 cubic millimeters

Table 1.6: Units of Volume

A simple way to convert between the prefixes of metric volume is through the use of the **metric staircase**.

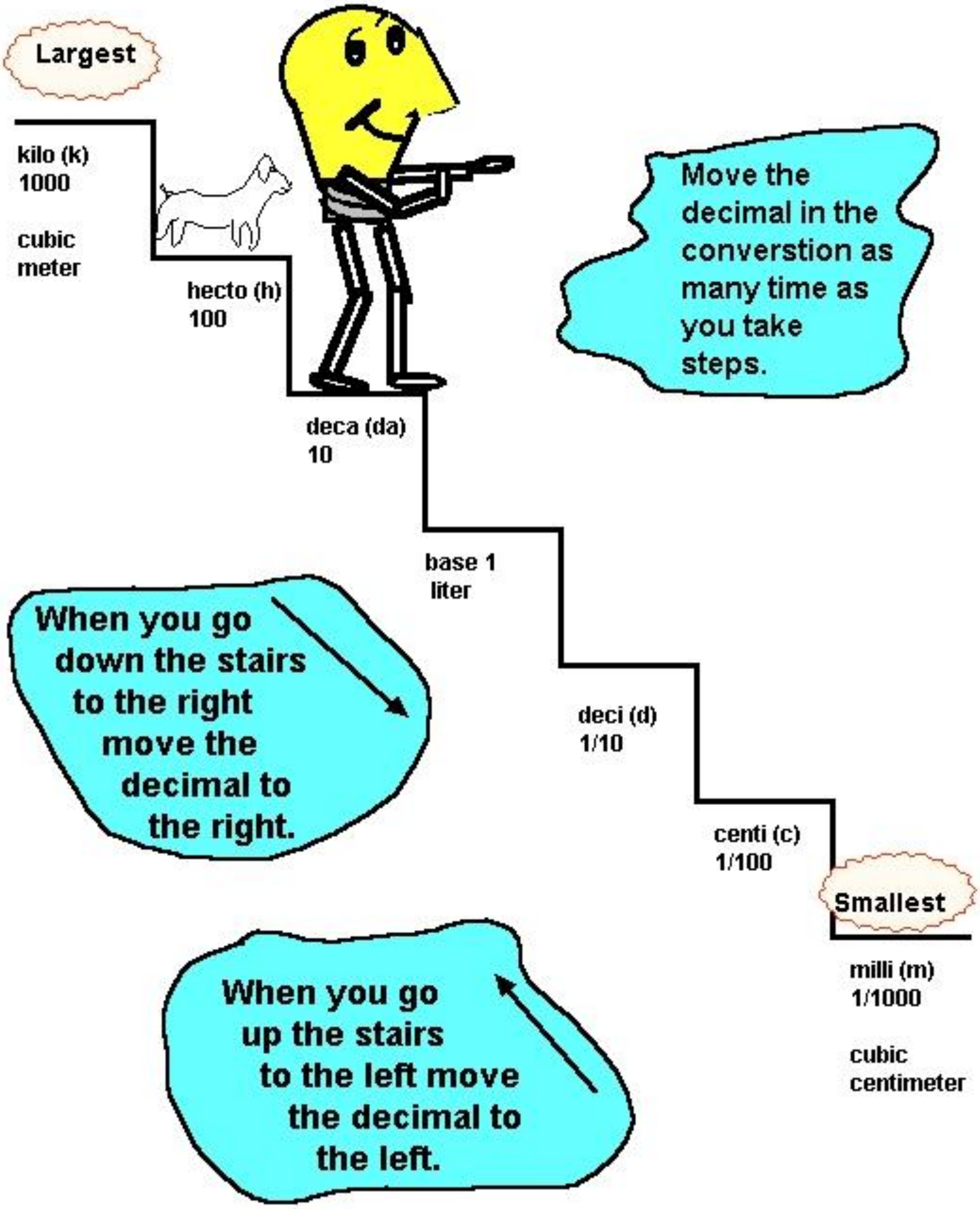


Figure 1.7: The metric staircase for volume

Here is a sample problem to help you understand the use of the metric staircase.

Example – 1: How many millimeters are there in 5 liters?
Solution:

How many steps is it from the liter to the millimeter?

You are right if you said 3. You move the decimal point three places to the right since you are moving down the staircase.

5.__ __ __

Now let's fill the troughs with zeros.

5000 **5000 milliliters**

We found out that there are 5000 milliliters in 5 liters.

To give you an idea of what a cubic meter is, let' s demonstrate.

A cubic meter of $1m^3$ is about the same size as the refrigerator part of your refrigerator/freezer At home.

The cubic meter is used to measurevery large objects, such as the water in a pool or the room inside of a railway box car.

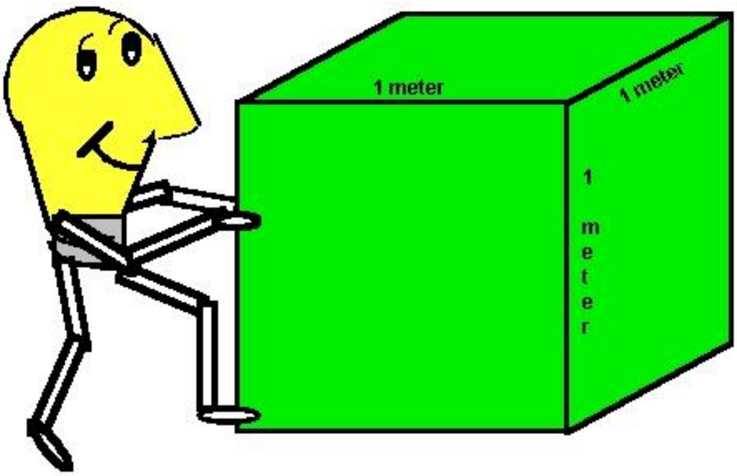


Figure 1.8: A representation of a cubic meter

Metric mass can be expressed in terms of metric volume. The gram is the mass of 1 milliliter of water that is at 4 centigrade.

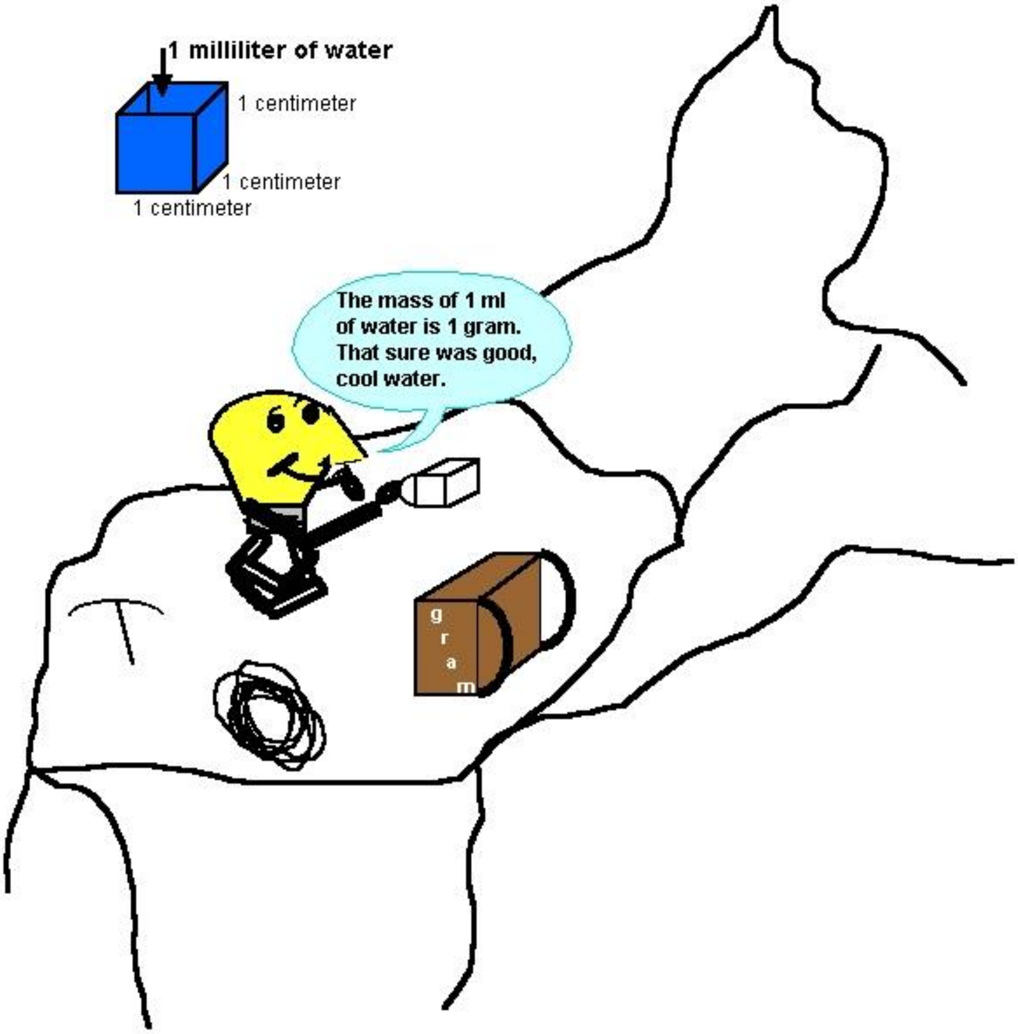


Figure 1.9: Meaning of 1 milliliter of water

If one milliliter of water has a mass of one gram, then one liter of water should have a mass of 1000 grams or one kilogram.

One liter of water weighs one kilogram.

Exercise 1.3

1. What is the volume of a cube which has a length, width, and height equal to 10 cm?
A) 10000 cm^3 B) 100 cm^3 C) 1000 cm^3 D) 100000 cm^3

2. What is equation used to determine the volume of a rectangular box?
A) Volume = length x width - height
B) Volume = length x width / height
C) Volume = length x width + height
D) Volume = length x width x height

3. How many centiliters are there in 500 milliliters?

A) 5 B) 50 C) 0,5 D) 0,05

4. What unit of measurement would you use to measure the volume of a swimming pool?

A) 1 m^3 B) 1 m^2 C) 1 m D) 1 cm^3

5. What is the volume of a box with a height and length equal to 10 cm and a width of 20 cm?

A) 2000 cm^3 or two liters
B) 4000 cm^3 or four liters
C) 6000 cm^3 or six liters
D) 8000 cm^3 or eight liters

6. Fill in the following chart by converting

	milliliter (ml)	**liter (l)**	**kiloliters or cubic meter (kl)**
1.	1000		
2.		6.5	
3.			0.5
4.		2	
5.	1.5		

Fill in the following chart:

	prefix and root	symbol	size
6.		kl	1000
7.	hectoliter		
8.		dal	10
9.	deciliter		
10.		cl	
11.	milliliter		1/1000

1.6. Pressure

Pressure is defined as force per unit area.

It is usually more convenient to use pressure rather than force to describe the influences upon fluid behavior.

The standard unit for pressure is the **Pascal**, which is **a Newton per square meter**.

For an object sitting on a surface, the force pressing on the surface is the weight of the object, but in different orientations it might have a different area in contact with the surface and therefore exert a different pressure.

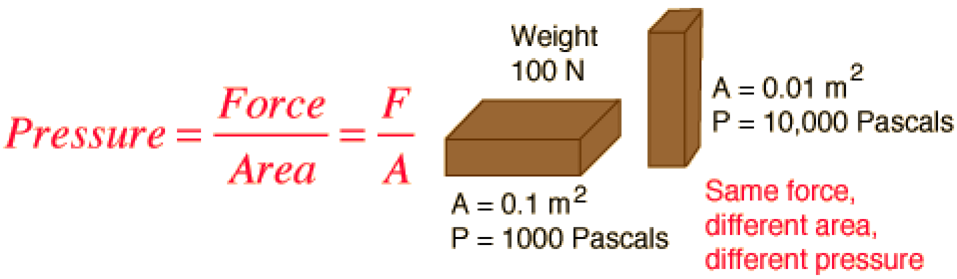


Figure 1.10: Pressure formula

1.6.1. Air Pressure

Air pressure is the force exerted on you by the weight of tiny particles of air (air molecules).

Although air molecules are invisible, they still have weight and take up space. Since there's a lot of "empty" space between air molecules, air can be compressed to fit in a smaller volume.

When it's compressed, air is said to be "under high pressure".

Weather forecasters measure air pressure with a **barometer**.

Barometers are used to measure the current air pressure at a particular location in "inches of mercury" or in "millibars" (mb).

A measurement of 29.92 inches of mercury is equivalent to 1013.25 millibars.

1.7. Time

1.7.1. Understanding Time

Astronomer **Carl Sagan** had it right when he said that time is "resistant to simple definition." Lots of us think we know what time is, but it is hard to define. You can not literally see or touch time, but you can see its effects.

The **day** is an obvious starting point for time.

A day consists of a period of sunlight followed by night. Our bodies are tuned in to this cycle through sleep, so each morning we wake up to a new day. No matter how primitive the culture, the concept of a day arises as an obvious and natural increment.

We use **clocks** to divide the day into smaller increments.

We use calendars to group days together into larger increments.

1.7.2. Measuring Time

The measurement of time covers an incredible range. Here are some common time spans, from the shortest to the longest.

- **1 picosecond** (one-trillionth of a second) - This is about the shortest period of time scientists can currently measure accurately.
- **1 nanosecond** (one-billionth of a second) - 2 to 4 nanoseconds is the length of time that a typical home computer spends executing one software instruction.
- **1 microsecond** (one-millionth of a second)
- **1 millisecond** (one-thousandth of a second) - This is the typical fastest time for the exposure of film in a normal camera. A picture taken in 1/1000th of a second will usually stop all human motion.
- **1 centisecond** (one-hundredth of a second) - The length of time it takes for a stroke of lightning to strike.
- **1 decisecond** (one-tenth of a second) - A blink of an eye
- **1 second -** An average person's heart beats once each second.

- **60 seconds -** One minute; a long commercial.
- **60 minutes** - An hour
- **24 hours** - One day; the amount of time it takes for the planet Earth to rotate one time on its axis.
- **7 days** - One week
- **365.24 days -** One year; the amount of time it takes for the planet Earth to complete one orbit around the sun.
- **10 years -** One decade

1.7.3. Clocks

How long is a day?

It's the amount of time it takes for the Earth to rotate one time on its axis. But how long does it take the Earth to rotate? That is where things become completely arbitrary.

The world has decided to standardize on the following increments:

- A **day** consists of two 12-hour periods, for a total of 24 hours.
- An **hour** consists of 60 minutes.
- A **minute** consists of 60 seconds.
- **Second**s are subdivided on a decimal system into things like "hundredths of a second" or "millionths of a second."

Example – 1 How many hours does a week consist of?

Solution: A week is 7 days and each day is 24 hours. So we should multiply 24 hours by 7.

The result is, 7 X 24 = 168 hours

1.8. Speed

What exactly is speed?

I am sure you have a rough idea.

Speed is how fast something moves. But more exactly the speed of an object is the distance traveled over time.

Speed is how far you travel in a certain amount of time. For example, when driving a car you would not exceed the speed limit of 55 miles per hour.

Miles refers to the distance traveled and hour refers to the amount of time.

If you were to travel a steady 55 miles per hour on the expressway for every hour you travel you would cover a distance of 55 miles. This brings us to the formula for speed.

The formula for speed is distance divided by time. Let's place the letters in the triangle below:

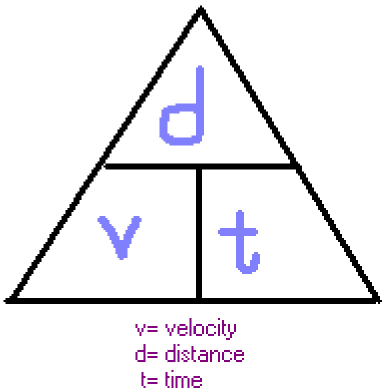


Figure 1.11: Generating speed formula

When you look at the formula for speed you may wonder why the "s" was left out.

"V" is used to represent **velocity**.

Velocity is speed with a direction (ex. 55 miles per hour due East).

The units used for speed will vary based on what you are measuring.

For example: time can be measured in seconds, minutes or hours. Distance can be measured in meters or Kilometers (distance can be measured as a meter using any prefix such as Kilo-, centi-, mili- etc…).

For speed we can combine the two units of measure:

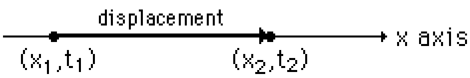
meters per second or kilometers per hour (Any combination will do, as long as it makes sense with the question).

1.8.1. Velocity

The average speed of an object is defined as the distance traveled divided by the time elapsed.

Velocity is a vector quantity, and average velocity can be defined as the displacement divided by the time.

For the special case of straight line motion in the x direction, the average velocity takes the form:



$$V_{average} = v = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

Figure 1.12: Average velocity

The units for velocity can be implied from the definition to be **meters/second** or in general any distance unit over any time unit.

1.9. Temperature

What is Temperature?

In a qualitative manner, we can describe the temperature of an object as that which determines the sensation of warmth or coldness felt from contact with it.

On the Celsius scale the boiling point of water at standard atmospheric pressure is 99.975 C in contrast to the 100 degrees defined by the Centigrade scale.

To convert from Celsius to Fahrenheit: multiply by 1.8 and add 32.

$$°F = 1.8\ °C + 32$$
$$°K = °C + 273$$

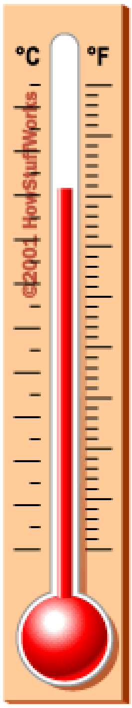


Figure 1.13: A celcius and fahrenheit scaled thermometer

1.9.1. Fahrenheit Scale

Daniel Fahrenheit arbitrarily decided that the freezing and boiling points of water would be separated by 180 degrees, and he pegged freezing water at 32 degrees.

So he made a thermometer, stuck it in freezing water and marked the level of the mercury on the glass as 32 degrees.

Then he stuck the same thermometer in boiling water and marked the level of the mercury as 212 degrees.

He then put 180 evenly spaced marks between those two points.

1.9.2. Celsius Scale

Anders Celsius arbitrarily decided that the freezing and boiling points of water would be separated by 100 degrees, and he pegged the freezing point of water at 100 degrees. (His scale was later inverted, so the boiling point of water became 100 degrees and the freezing point became 0 degrees.)

Water freezes at 0 degrees, so we commonly encounter negative numbers in connection with temperature.

Water will boil at 100 degrees

Body temperature is about 36.9 degrees

1.10. Sound

An object produces sound when it vibrates in matter. This could be a solid, such as earth; a liquid, such as water; or a gas, such as air.

Most of the time, we hear sounds traveling through the air in our atmosphere.

When something vibrates in the atmosphere, it moves the air particles around it. Those air particles in turn move the air particles around them, carrying the pulse of the vibration through the air.

A vibrating object sends a wave of pressure fluctuation through the atmosphere. We hear different sounds from different vibrating objects because of variations in the sound wave **frequency**.

A higher wave frequency simply means that the air pressure fluctuation switches back and forth more quickly. We hear this as a higher **pitch**.

When there are fewer fluctuations in a period of time, the pitch is lower.

The level of air pressure in each fluctuation, the wave's **amplitude**, determines how loud the sound is.

The speed of sound is 770 miles per hour in air.

Example – 1: If sound travels 770 miles per hour in air, how far does it travel in one minute?

Solution: Sound travels at 770 miles per hour, which is the same as 129 miles in 10 minutes. If we put 129 miles into groups of 10, then each minute gets almost 13 miles.

Then: Sound travels at about 13 miles per minute.

The most common approach to sound intensity measurement is to use the **decibel** scale.

A useful general reference is that, the just noticeable difference in sound intensity for the human ear is about **1 decibel**.

The sound intensity may be expressed in **decibel**s above the standard threshold of hearing.

In fact, the use of the factor of 10 in the definition of the decibel is to create a unit which is about the least detectable change in sound intensity.

Frequency is the measurement of the number of times that a repeated event occurs per unit time.

Complex sounds are made up of many pure tones of different frequencies.

Hertz is The SI unit of frequency, in particular the number of times something occurs in one second. It is abbreviated by **Hz**.

1 Hertz = 1 vibration / 1 second

the human ear is capable of detecting sound waves with a wide range of frequencies, ranging between approximately 20 Hz to 20 000 Hz.

Any sound with a frequency below the audible range of hearing (i.e., less than 20 Hz) is known as an **infrasound** and any sound with a frequency above the audible range of hearing (i.e., more than 20 000 Hz) is known as an **ultrasound**.

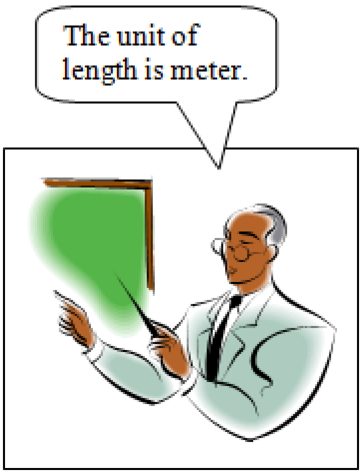
Conversion of frequency units:

1000 Hz = 1 KHz (Kilohertz) = 1 Kilocycle / second

1000 KHz = 1 MHz (Megahertz) = 1 Megacycle / second

1000 MHz = 1 GHz (Gigahertz) = 1 Gigacycle / second

APPLICATION ACTIVITY

Steps of process	Suggestions
➢ Make conversations with each other in classroom, laboratory, workshop or wherever you are using terms you have learned by this learning activity.   	➢ You can look at examples below.

➢ Complete the following table.	➢ Take advantage from activity 1.

prefix	Symbol
kilo	
hecto	
	da
deci	
	C
milli	

➢ Fill in the chart below by converting.	➢ Take advantage from activity 1.

milligrams	grams	kilograms
1000		
		5
	10	
		15
25		

CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation criteria	Yes	No
1. Did you learn units of metric?		
2. Did you learn basic units of mass?		
3. Did you learn the units of areas'?		
4. Did you learn that what had been of the power ?		
5. Did you learn that how occurred of sound ?		

EVALUATION

Please review your “No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "Yes" to all questions, pass to the "Measuring and Evaluation".

MEASURING AND EVALUATION

Please read the following questions carefully and tick the correct option.

1. What does the prefix deci represent?

A) 1/10 **B)** 10 **C)** 1/100 **D)** 100

2. What is the prefix for 1/1000?

A) deci **B)** milli **C)** kilo **D)** nano

3. How many milliliters are there in 4 liters?

A) 40 ml **B)** 400 ml **C)** 40 000 ml **D)** 4000 ml

4. How many hectares does a square kilometer contain?

A) 10 hectares **B)** 100 hectares **C)** 1000 hectares **D)** 10 000 Hectares

5. What is the standard unit of force in the SI system?
A) pascal **B)** joule **C)** newton **D)** Kelvin

6. What is the standard unit of pressure?

A) Pascal **B)** hertz **C)** joule **D)** kelvin

7. How many minutes is one hour?

A) 24 **B)** 60 **C)** 7 **D)** 365

8. Which one is correct for speed unit?

A) hour per Km **B)** centigrade **C)** Newton **D)** Km per hour

EVALUATION

Please check your answers from the answer key table which is at the end of this module. If you have more than 1 mistakes you need to review the learning activity – 1.

If you give right answers to all questions, pass to learning activity-2.

LEARNING ACTIVITY-2

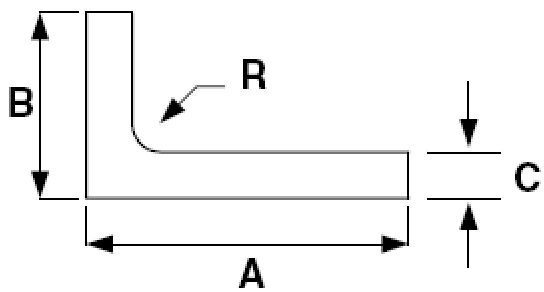
AIM

End of this module, you can apply the technical drawing rules.

SEARCH

- Try to remember that you learn before about technical drawing (line, shape ext) Refresh the information on this subject. For this, you can take advantage from the technical drawing lesson.

2. TECHNICAL DRAWING



Technical drawing, also known as drafting or draughting, is the technique of creating engineering drawings.

A skilled practitioner of the art of technical drawing is known as a draftsman or draftsperson.

2.1. Lines

A straight thick line	
A straight thin line	
A thin waved line	
Dotted and broken thin line	
broken line	
Dotted and broken thick line	

Table 2.1: Some main lines used in technical drawing

Look at these:

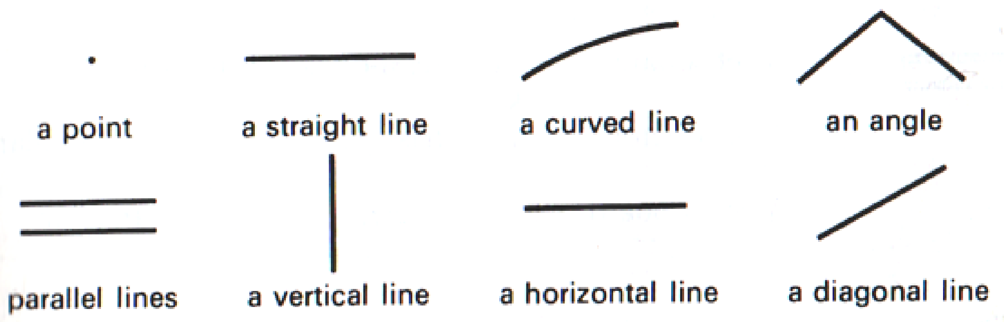


Figure 2.1: Point and the other lines

Now, read this statement and then answer the exercise questions:

The letter “E” has one vertical line and three horizontal lines. It also has four angles.

Exercise 2.1

Which of these letters are described below?

D, M, C, H, F, L, Z, B

1. A letter with 2 horizontal lines and 1 vertical line.
2. A letter with 1 curved line and no straight lines.
3. A letter with 2 curved lines and 1 vertical line.

4. A letter with parallel vertical lines, 1 horizontal line and four angles.

5. A letter with 2 vertical lines and 2 diagonal lines.

2.1.1. The Signs

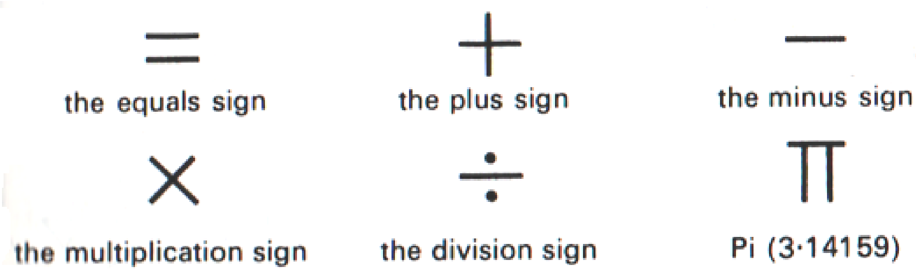


Figure 2.2: The arithmetic signs

2.2. Shapes

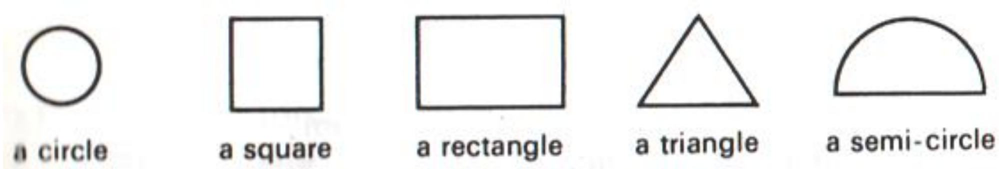
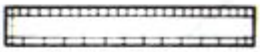
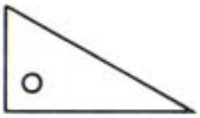


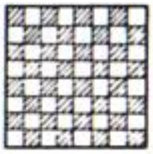
Figure 2.3: Main shapes

- The circle is curved.
- The square and the rectangle have parallel sides.
- The square always has equal sides.
- The triangle may have equal sides.
- The square has four angles.
- The semi-circle has a curved side and a straight side

Exercise 2.2







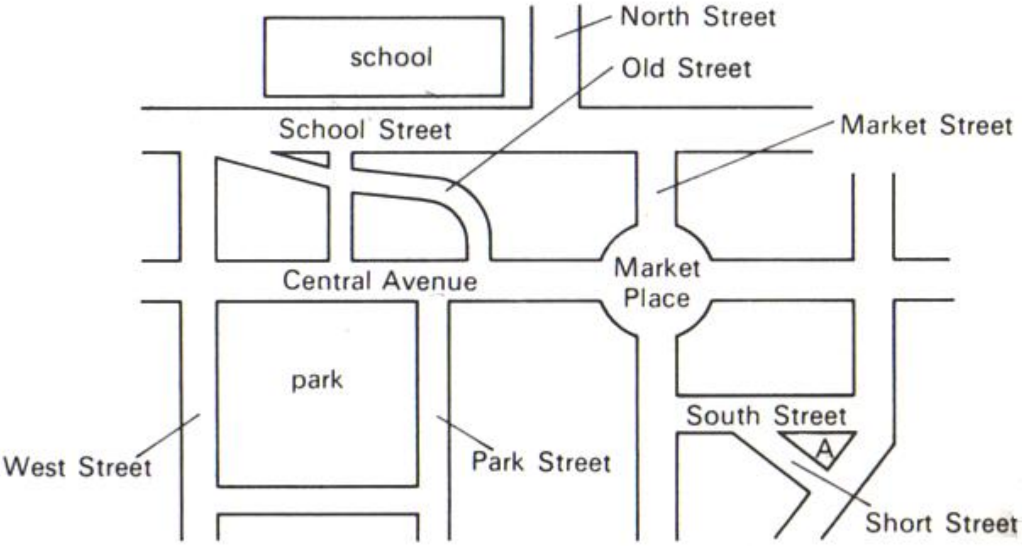
A coin		square.		rectangular	
A ruler		rectangle.		circular	
A set square	is shaped like a	semi-circle.	It is	square	in shape.
A protractor		triangle.		semi-circular	
A chess-board		circle.		triangular	

Now make sentences from the table:

Example: A coin is shaped like a circle. It is circular in shape.

Exercise 2.3

Look at this plan of a town:



Answer these questions:

1. What shape is the plan of the school?
2. Which street is curved?
3. What shape is area A?
4. Which area is square?
5. Name two streets which are parallel.
6. Are Old Street and School Street parallel?
7. Which part is roughly circular in shape?

2.2.1. Three-Dimensional Shapes

Look at these solids.

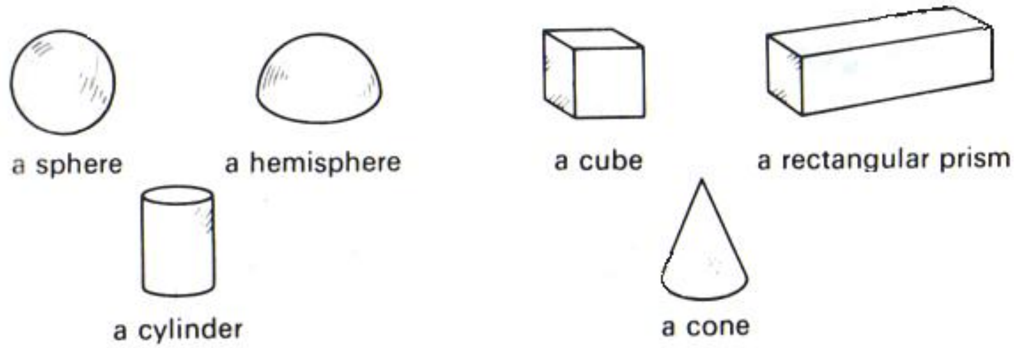


Figure 2.4: Three - dimensional shapes

Now describe them:

Example: A cube has 6 surfaces. They are all flat and square.

2.3. Angles

Two rays that share the same endpoint form an angle.

The point where the rays intersect is called the vertex of the angle.

The two rays are called the sides of the angle.

Here are some examples of angles.

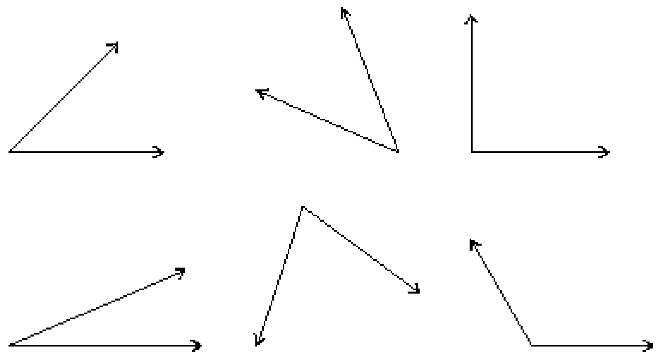
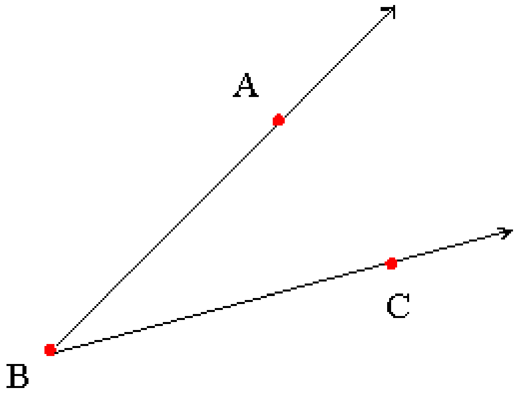


Figure 2.5: some examples of angles

We can specify an angle by using a point on each ray and the vertex.

The angle below may be specified as angle ABC or as angle CBA.

Note how the vertex point is always given in the middle.



We measure the size of an angle using degrees.

Here are some examples of angles and their degree measurements.

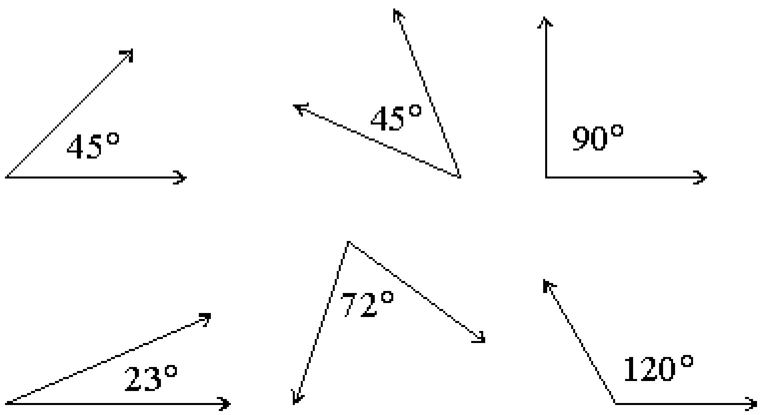


Figure 2.6: Degrees of angles

2.3.1. Acute Angles

An acute angle is an angle measuring between 0 and 90 degrees.

Example: The following angles are all acute angles.

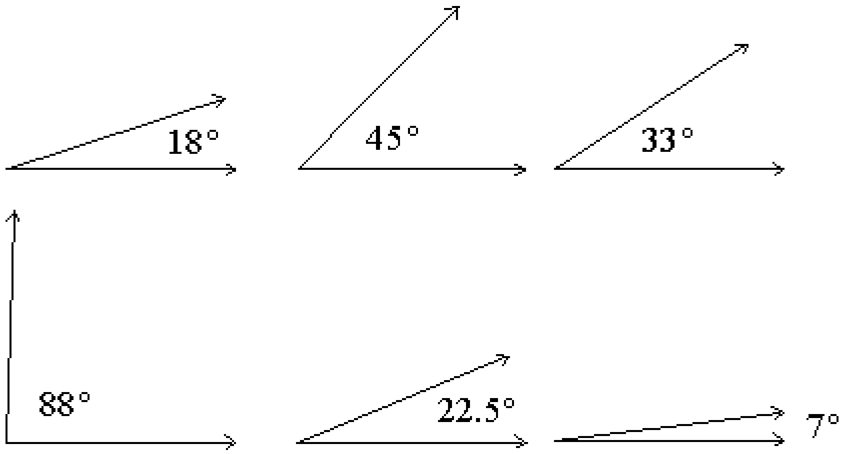


Figure 2.7: Acute angles

2.3.2. Obtuse Angles

An obtuse angle is an angle measuring between 90 and 180 degrees.

Example: The following angles are all obtuse.

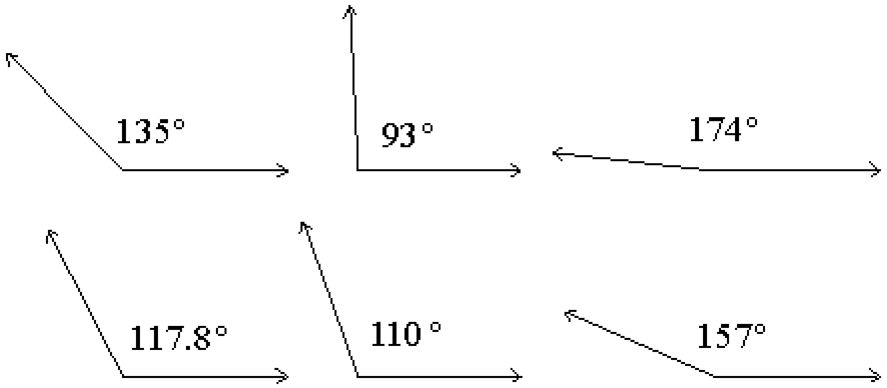


Figure 2.8: Obtuse Angles

2.3.3. Right Angles

A right angle is an angle measuring 90 degrees.

Two lines or line segments that meet at a right angle are said to be perpendicular.

Example: The following angles are both right angles.

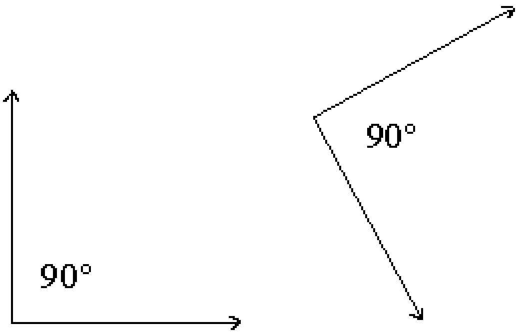
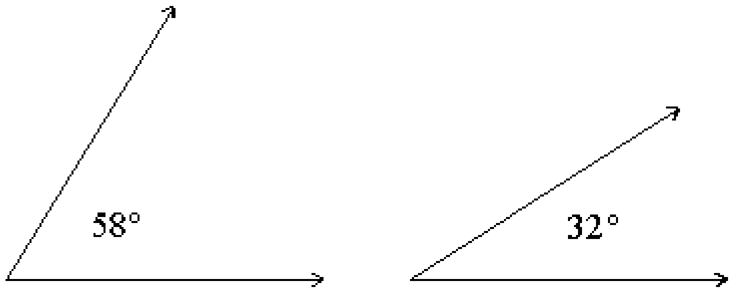


Figure 2.9: Right Angles

2.3.4. Complementary Angles

Two angles are called complementary angles if the sum of their degree measurements equals 90 degrees.

One of the complementary angles is said to be the complement of the other.
Example: These two angles are complementary.



Note that these two angles can be "pasted" together to form a right angle!

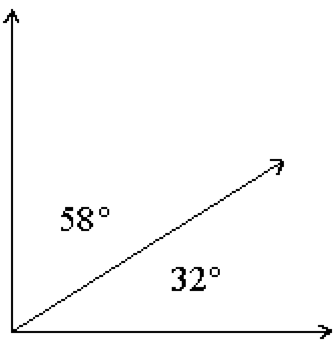


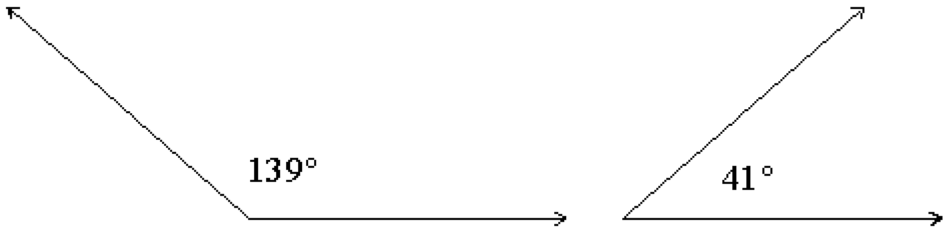
Figure 2.10: Complementary Angles

2.3.5. Supplementary Angles

Two angles are called supplementary angles if the sum of their degree measurements equals 180 degrees.

One of the supplementary angles is said to be the supplement of the other.

Example: These two angles are supplementary.



Note that these two angles can be "pasted" together to form a straight line!

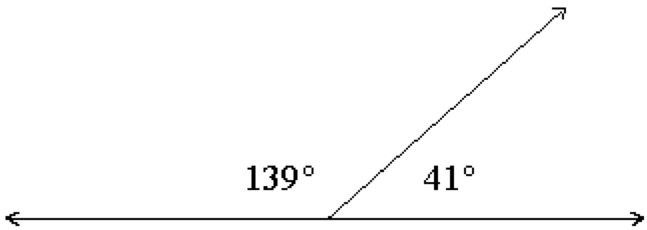


Figure 2.11: supplementary Angles

2.3.6. Vertical Angles

For any two lines that meet, such as in the diagram below, angle AEB and angle DEC are called vertical angles.

Vertical angles have the same degree measurement.

Angle BEC and angle AED are also vertical angles.

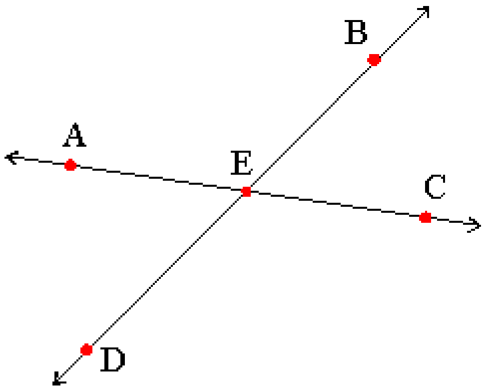


Figure 2.12: Vertical Angles

2.3.7. Alternate Interior Angles

For any pair of parallel lines 1 and 2, that are both intersected by a third line, such as line 3 in the diagram below, angle A and angle D are called alternate interior angles.

Alternate interior angles have the same degree measurement.

Angle B and angle C are also alternate interior angles.

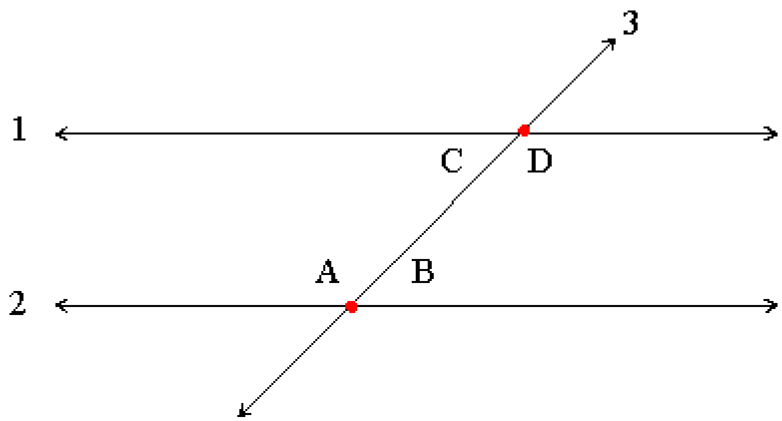


Figure 2.13: Alternate Interior Angles

2.3.8. Alternate Exterior Angles

For any pair of parallel lines 1 and 2, that are both intersected by a third line, such as line 3 in the diagram below, angle A and angle D are called alternate exterior angles.

Alternate exterior angles have the same degree measurement.

Angle B and angle C are also alternate exterior angles.

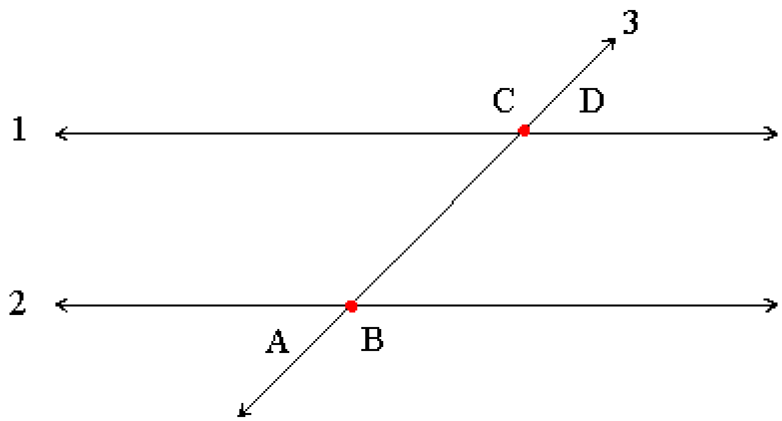


Figure 2.14: Alternate Exterior Angles

2.3.9. Corresponding Angles

For any pair of parallel lines 1 and 2, that are both intersected by a third line, such as line 3 in the diagram below, angle A and angle C are called corresponding angles.

Corresponding angles have the same degree measurement.

Angle B and angle D are also corresponding angles.

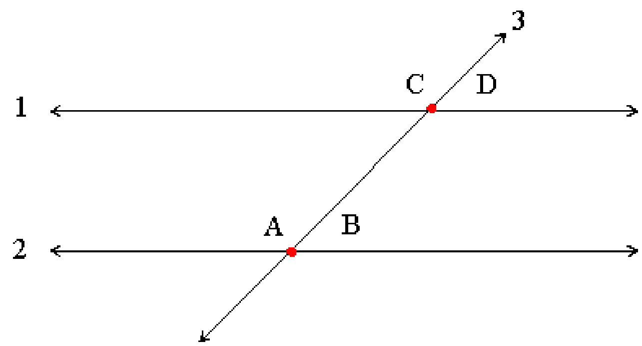
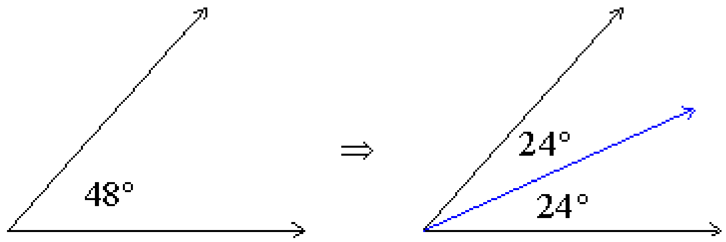


Figure 2.15: Corresponding Angles

2.3.10. Angle Bisector

An angle bisector is a ray that divides an angle into two equal angles.

Example: The blue ray on the right is the angle bisector of the angle on the left.



The red ray on the right is the angle bisector of the angle on the left.

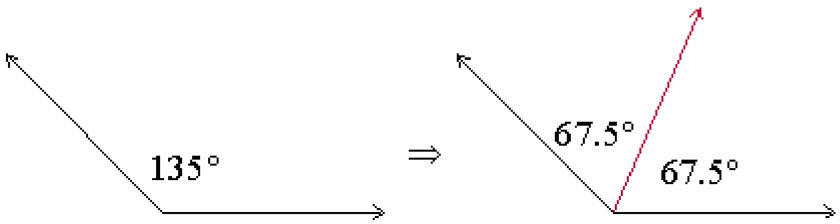
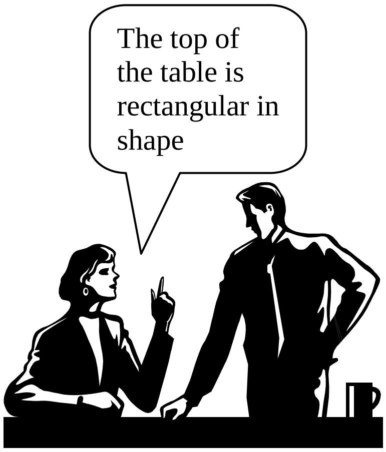


Figure 2.16: Angle Bisector

APPLICATION ACTIVITY

Steps of process	Suggestions
➢ Look at the objects located in your classroom (desk, table, etc.). Now, make conversations with each other describing those objects.	➢ You can look at examples below.

Example:



CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation criteria	Yes	No
1. Did you learn types of angle?		
2. Did you learn types of shape?		
3. Did you learn types of sign?		

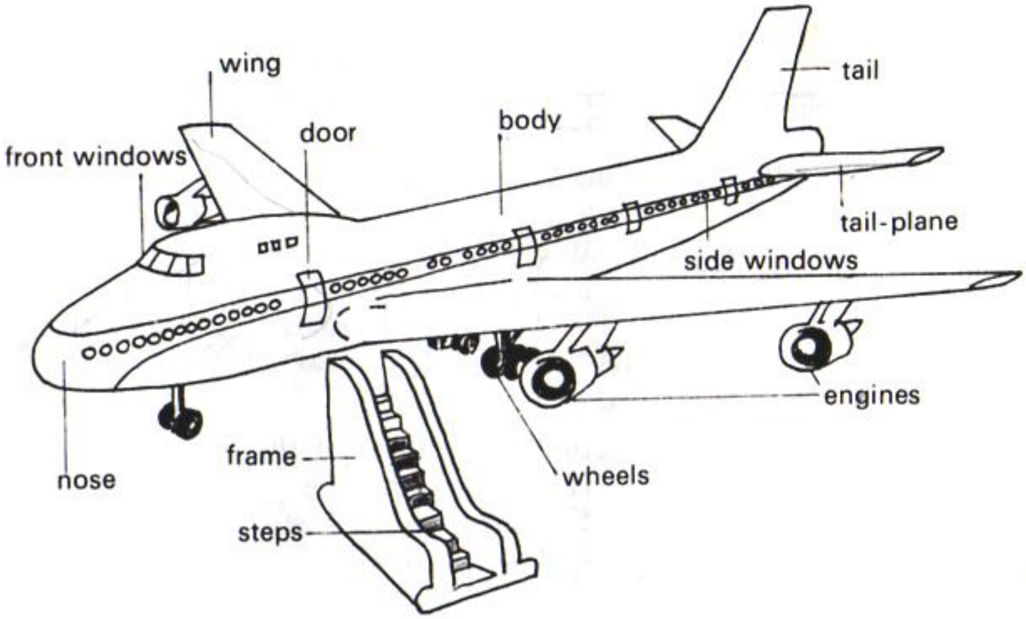
EVALUATION

Please review your “No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "Yes" to all questions, pass to the "Measuring and Evaluation".

MEASURING AND EVALUATION

Evaluate the given knowledge, If the knowledge is TRUE, write “T” , if it is FALSE, write “F” to end of the empty parenthesis.

Look at this picture.



1. ( ) The tail is nearly triangular in shape.

2. ( ) The door is flat.

3. ( ) The steps are parallel to each other.

4. ( ) The sides of the frame are curved.

5. ( ) The tail-plane is wing-shaped.

6. ( ) All the windows are circular.

7. ( ) The engines are nearly cylindrical.

8. ( ) The wheels are cubic in shape.

9. ( ) The front of the plane is cylindrical.

10. ( ) The nose is tapering.

11. ( ) The wings are at right angles to the body.

Fill in the blanks with correct words.

12. An acute angle is an angle measuring between …. and …. degrees.

13. The angle measuring 90 degrees is called ………… angle

14. The angle measuring between 90 and 180 degrees is called …………. angle

EVALUATION

Please check your answers from the answer key table which is at the end of this module. If you have more than 1 mistakes you need to review the learning activity – 1.

If you give right answers to all questions, pass to learning activity-3.

LEARNING ACTIVITY-3

AIM

You can get the necessary skills that to read English the simple hand tools.

SEARCH

- Discuss with your friends that what you know about simple hand tools.

3. BASIC HAND TOOLS

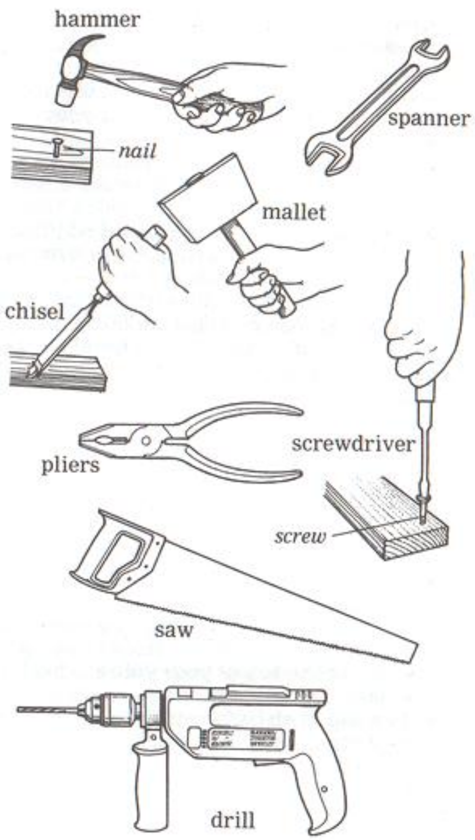


Figure 3.1: Some hand tools

A tool is a piece of equipment that you use to help you do a particular type of job. Tools help us do work and make things.

Hammers, screwdrivers and saws are all carpenters' tools.

Let's mention about basic hand tools one by one:

3.1. Screwdriver

A screwdriver is a device used to insert and tighten, or to loosen and remove screws.

A typical hand screwdriver comprises an approximately cylindrical handle of a size and shape to be held by a human hand, and an axial shaft fixed to the handle, the tip of which is shaped to fit a particular type of screw.

The handle and shaft allow the screwdriver to be postioned and supported and, when rotated manually, to apply torque. Screwdrivers are made in a variety of shapes, and the tip can be rotated manually or by an electric or other motor.

There Are Many Types Of Screw Heads, Of Which The Most Common Are The Slotted, Phillips, Robertson, torx, And Allen (Hex).

3.1.1. Slot (Flat-Bladed) Screwdriver

Figure 3.2: a simple flat-bladed screwdriver

A slot head screw is driven by a flat-bladed screwdriver.

3.1.2. Phillips Screwdriver

Figure 3.3: a basic phillips screwdriver (star tipped)

Cross-head, or Phillips screw has an X-shaped slot and is driven by a cross-head screwdriver

People generally use the term star, as in "star screwdriver" or "star bits."

3.1.3. Robertson Screwdriver

Figure 3.4: Robertson screwdrivers

A Robertson screw head has a square hole and is driven by a special screwdriver.

A Robertson screwdriver is a type of screwdriver with a square-shaped tip with a slight taper.

3.1.4. Torx Screwdriver

A torx screwdriver developed by Textron Fastening Systems, is the trademark for a type of screw head characterized by a 6-point star-shaped pattern.

Figure 3.5: Torx screwdriver

3.1.5. Allen (Hexagonal) Screwdriver

Hexagonal or hex screw head has a hexagonal hole and is driven by a hexagonal and sometimes called an Allen key, or a power tool with a hexagonal bit.

Figure 3.6: Allen (hexagonal) screwdriver

3.1.6. Jeweler's Screwdriver Set

Figure 3.7: Jeweler's screwdriver set

Screwdrivers come in a large variety of sizes to match those of screws, from tiny jeweler's screwdrivers up.

It is important to use a screwdriver that is the right size and type for the screw used, or it is likely that the screw will be damaged in the process of tightening it.

When tightening a screw with force, it is important to press the head hard into the screw, again to avoid damaging the screw.

3.1.7. Other Types Of Screwdriver

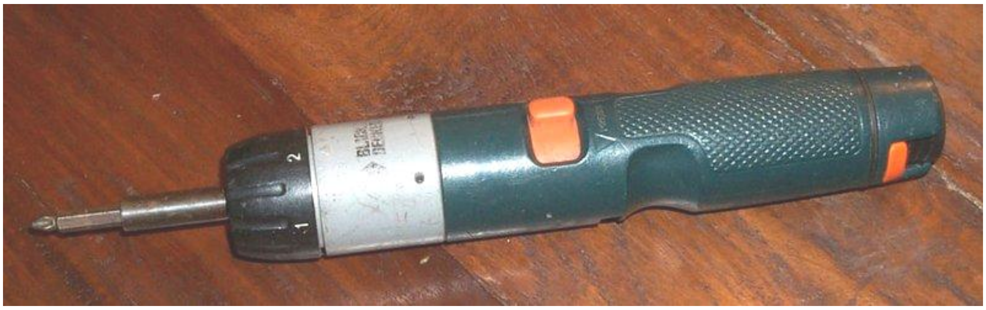


Figure 3.8: A rechargeable battery-powered electric screwdriver.

Figure 3.9: An electric screwgun, used mainly to set drywall screws

3.2. Hammer

Figure 3.10: A hammer

A hammer is a tool with a heavy metal head that is used for hitting nails.

Other common uses for a hammer are fitting parts, and breaking up objects.

Hammers are often designed for a specific purpose, and so their design varies quite a lot. Usual features are a handle and a head, with most of the weight in the head.

The hammer is a basic tool of many professions. It is perhaps the oldest human tool.

3.3. Pliers

Pliers are hand tools primarily for gripping and they may also used for holding things tightly, pulling nails out of wood, cutting wire, etc.

There are numerous different jaw configurations to grip, turn, pull, or crimp a variety of things. Let’s have a look at them and their names:

Figure 3.11: Linesman's pliers

Figure 3.12: Slip joint pliers

Figure 3.13: Needle nose pliers

Figure 3.14: Blacksmith's pincers

Figure 3.15: Electrical wire stripping and terminal crimping pliers

Figure 3.16: Side cutters

Figure 3.17: Lock jaw pliers, also called vise grip or "mole grips".

3.4. Saw

A saw is a tool that is used for cutting wood.

A saw has a long metal blade with sharp teeth on it.

Figure 3.18: A simple saw

3.5. Drill

A drill is a tool with a rotating drill bit used for drilling holes in various materials.

Drills are commonly used in woodworking and metalworking.

The drill bit is gripped by a chuck at one end of the drill, and is pressed against the target material and rotated.

Figure 3.19: A drill

Figure 3.20: A cordless drill with clutch

3.6. Chisel

A chisel is a tool for carving and/or cutting a hard material such as wood, stone, or metal.

A chisel, typically made of hardened or tempered steel, or more rarely, common steel, consists of a sharpened end (called the blade) attached to a straight handle.

In use, a worker forces the chisel into the material to cut the material. The driving force may be manually applied or applied using a mallet or hammer.

Figure 3.21: A chisel

3.7. File

Figure 3.22: File

A file is a hand tool consisting of a steel shaft whose surface is cut with sharp parallel ridges made by a chisel before the file is hardened.

It is used to smooth or cut materials by abrasion. The tool is usually fitted in a handle.

Files are classified according to several attributes. One is the cross-section of the shaft, which may be flat, round, half-round, square or triangular. Another is the size of the ridges, which can range from rough, coarse and bastard to second-cut, smooth and dead smooth.

3.8. Scissors

Scissors are tool used for cutting thin material which requires little force.

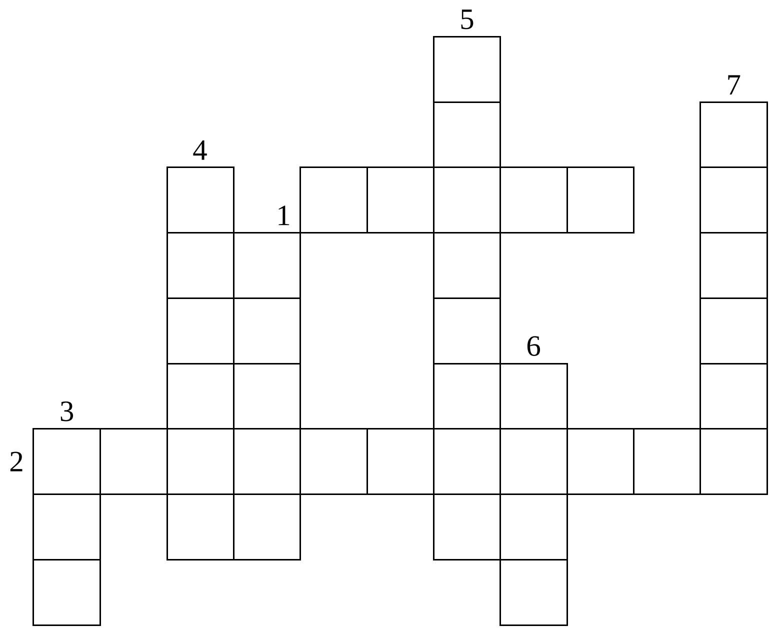
They are used for cutting, for example, paper, cardboard, metal foil, thin plastic, food, cloth, rope and wire. They are also used for cutting hair and nails.

Unlike a knife, scissors have two pivoted (or hinged) blades.

Figure 3.23: Scissors

APPLICATION ACTIVITY

Steps of process	Suggestions
➢ Complete the following puzzle.	➢ Take advantage from activity 3.



HORIZONTAL:

1. It is used for making (boring) holes in hard materials such as metal or wood.
2. It is used for driving screws.

VERTICAL:

1. It is used to turn hexagonal screws.
3. It is used to cut wood or other hard materials.
4. It is used for gripping and pulling things, e.g. for pulling nails out of wood.
5. It is used for cutting thin material which requires little force.
6. It is used to smooth wooden or metal surfaces.
7. It is used for breaking things or hitting nails.

CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation criteria	Yes	No
1. Did you learn types of screwdriver?		
2. Did you learn basic units of mass?		
3. Did you learn the tasks of hammer, pliers, file, drill ext.?		
4. Did you learn that how can we use the general hand tools?		

EVALUATION

Please review your “No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "Yes" to all questions, pass to the "Measuring and Evaluation".

MEASURING AND EVALUATION

Please read the following questions carefully and tick the correct option.

1. It is used to smooth or cut materials by abrasion.
A) Scissors B) Pliers C) File D) Nail

2. It is a tool for carving and/or cutting a hard material such as wood, stone, or metal.
A) Screwdriver B) Chisel C) File D) Nail

3. It is a tool that is used for cutting wood.

A) File B) Pliers C) Knife D) Saw

4. People generally use the term star, as in "star screwdriver" or "star bits" for ……….. screwdriver
A) Phillips B) Robertson C) Allen key D) Torx

5. It is used for breaking things or hitting nails
A) File B) Pliers C) Hammer D) Axe

EVALUATION

Please check your answers from the answer key table which is at the end of this module. If you give right answers to all questions, pass to learning activity-4.

LEARNING ACTIVITY-4

AIM

You can read English materials and material types according to the technique.

SEARCH

- Discuss with your friends that what you know about materials.

4. MATERIALS

Figure 4.1: A picture of ferrous materials

4.1. Ferrous Materials

The word "ferrous" usually refers to materials that have a lot of iron in them.

It's common for these materials to be strongly magnetic, but not all of them are. Different types of iron and steel are more or less magnetic.

The major products of the ferrous industry are cast iron, low and medium alloyed steels and specialty steels such as tool steels and stainless steels.

High-chromium stainless steel is nearly non-magnetic, while pure iron tends to form magnets easily. Iron with impurities usually stays magnetic better than pure iron, however.

4.1.1. Carbon Steel

Carbon steel, also called plain carbon steel, is a malleable, iron-based metal containing carbon, small amounts of manganese, and other elements that are inherently present.

4.1.2. Alloy Steel

Steels that contain specified amounts of alloying elements – other than carbon and the commonly accepted amounts of manganese, copper, silicon, sulfur, and phosphorus – are known as alloy steels.

Alloying elements are added to change mechanical or physical properties.

4.1.3. Stainless Steel

One of the features that characterize stainless steels is a minimum 10.5% chromium content as the principal alloying element.

Four major categories of wrought stainless steel are based on metallurgical structure; they are austenitic, ferritic, martensitic, and precipitation hardening.

4.1.4. Tool Steel

Tool steels are increasingly being used for mechanical parts to reduce size or weight, or to resist wear or high-temperature shock.

Tool steels are metallurgically "clean," high-alloy steels that are melted in relatively small heats in electric furnaces and produced with careful attention to homogeneity.

4.1.5. HSLA Steel

Those steel alloys known as high-strength low-alloy (HSLA) steels provide increased strength-to-weight ratios over conventional low-carbon steels for only a modest price premium.

Because HSLA alloys are stronger, they can be used in thinner sections, making them particularly attractive for transportation-equipment components where weight reduction is important.

HSLA steels are available in all standard wrought forms - sheet, strip, plate, structural shapes, bar-size shapes, and special shapes.

Typically, HSLA steels are low-carbon steels with up to 1.5% manganese, strengthened by small additions of elements, such as columbium, copper, vanadium or titanium and sometimes by special rolling and cooling techniques.

4.2. Non-Ferrous Materials

Non-ferrous metals offer a wide variety of mechanical properties and material characteristics.

Non-ferrous metals are specified for structural applications requiring reduced weight, higher strength, non-magnetic properties, higher melting points, or resistance to chemical and atmospheric corrosion. They are also specified for electrical and electronic applications.

Material selection for a mechanical or structural application requires some important considerations, including how easily the material can be shaped into a finished part and how its properties can be either intentionally or inadvertently altered in the process.

The commonly used non-ferrous materials are the aluminum alloys and bronzes. Zinc diecast alloys are used also. Non-ferrous metals generally offer light weight, corrosion resistance and they are non-magnetic.

4.2.1. Aluminum

Though light in weight, commercially pure aluminum has a tensile strength.

Cold working the metal approximately doubles its strength.

In other attempts to increase strength, aluminum is alloyed with elements such as manganese, silicon, copper, magnesium, or zinc.

The alloys can also be strengthened by cold working.

Some alloys are further strengthened and hardened by heat treatments. At subzero temperatures, aluminum is stronger than at room temperature and is no less ductile.

Aluminum and its alloys, numbering in the hundreds, are available in all common commercial forms.

4.2.2. Beryllium

Among structural metals, beryllium has a unique combination of properties.

It has low density (two-thirds that of aluminum), high modulus per weight (five times that of ultrahigh-strength steels), high specific heat, high strength per density, excellent dimensional stability, and transparency to X-rays.

Beryllium is expensive, however, and its impact strength is low compared to values for most other metals.

Beryllium behaves like other light metals when exposed to air by forming a tenacious protective oxide film that provides corrosion protection.

Beryllium typically appears in military-aircraft and space-shuttle brake systems, in missile reentry body structures, missile guidance systems, mirrors and optical systems, satellite structures, and X-ray windows.

4.2.3. Copper

Copper conducts electricity at a rate 97% that of silver, and is the standard for electrical conductivity.

Copper provides a diverse range of properties: good thermal and electrical conductivity, corrosion resistance, ease of forming, ease of joining, and color. In addition, however, copper and its alloys have relatively low strength-to-weight ratios and low strengths at elevated temperatures.

Some copper alloys are also susceptible to stress-corrosion cracking unless they are stress relieved.

There are approximately 370 commercial copper and copper-alloy compositions. Brass mills make wrought compositions in the form of rod, plate, sheet, strip, tube, pipe, extrusions, foil, forgings, and wire.

4.2.4. Magnesium

Magnesium is widely recognized for its favorable strength-to-weight ratio and excellent castability.

Because of their low modulus of elasticity, magnesium alloys can absorb energy elastically. Because of being combined with moderate strength, this provides excellent dent resistance and high damping capacity.

Magnesium has good fatigue resistance and performs particularly well in applications involving a large number of cycles at relatively low stress. The metal is sensitive to stress concentration, however, so notches, sharp corners, and abrupt section changes should be avoided.

A problem with magnesium is its lack of sufficient corrosion resistance for many applications.

4.2.5. Nickel

Structural applications that require specific corrosion resistance or elevated temperature strength receive the necessary properties from nickel and its alloys.

Some nickel alloys are among the toughest structural materials known.

When compared to steel, other nickel alloys have ultrahigh strength, high proportional limits, and high module of elasticity.

Commercially pure nickel has good electrical, magnetic, and magnetostrictive properties.

4.2.6. Refractory Metals

Refractory metals are characterized by their extremely high melting points, which range well above those of iron, cobalt, and nickel.

They are used in demanding applications requiring high-temperature strength and corrosion resistance. The most extensively used of these metals are tungsten, tantalum, molybdenum, and columbium (niobium).

These four refractory metals and their alloys are available in mill forms as well as products such as screws, bolts, studs, and tubing.

4.2.7. Titanium

Depending on the predominant phase or phases in their microstructure, titanium alloys are categorized as alpha, alpha-beta, and beta.

This natural grouping not only reflects basic titanium production metallurgy, but it also indicates general properties peculiar to each type.

4.2.7.1. Alpha Alloys

The single-phase and near-single-phase alpha alloys of titanium have good weldability. The generally high aluminum content of this group of alloys ensures good strength characteristics and oxidation resistance at elevated temperatures (in the range of 600 to 1,100°F).

4.2.7.2. Alpha-Beta Alloys

The addition of controlled amounts of beta-stabilizing alloying elements causes the beta phase to persist below the beta transus temperature, down to room temperature, resulting in a two-phase system.

4.2.7.3. Beta Alloys

The high percentage of beta-stabilizing elements in these alloys results in a microstructure that is substantially beta.

The beta phase in pure titanium has a body-centered cubic structure, and is stable from approximately 1,620°F to the melting point of about 3,040°F.

4.2.8. Zirconium

Zirconium and its alloys also have excellent resistance in sulfuric acid at temperatures above boiling and concentrations.

Relatively few metals besides zirconium can be used in chemical processes requiring alternate contact with strong acids and alkalis.

However, zirconium has no resistance to hydrofluoric acid and is rapidly attacked, even at very low concentrations.

Zirconium has better weldability than some of the more common construction metals including some alloy steels and aluminum alloys.

Major uses for zirconium and its alloys are as a construction material in the chemical-processing industry.

4.3. Composite Materials

What are Composite Materials?

When two or more materials with very different properties are combined together they form a composite material.

The different materials work together to produce a new material, which combines all of the properties of the previously separate materials.

Within the composite it is still possible to easily tell the different materials apart. They do not tend to blend or dissolve into each other.

Composite Materials can be either man-made but they may also exist in nature.

Generally, composites are solid materials composed of two or more elements possessing different properties. Combining the advantages of each element, results in a material with broader and more attractive properties than its individual components.

Organic matrix composites made from plastic materials.

Thermo set or thermoplastic currently represent the largest group of composites used (about 99 percent).

Extensive research is constantly generating new products and applications

So why use composites?

The greatest advantage of composite materials is strength and stiffness combined with lightness. By choosing an appropriate combination of reinforcement and matrix material, manufacturers can produce properties that exactly fit the requirements for a particular structure for a particular purpose.

Thermosetting plastics are liquid when prepared but harden and become rigid when they are heated. The setting process is irreversible, so that these materials do not become soft under high temperatures. These plastics also resist wear and attack by chemicals making them very durable, even when exposed to extreme environments.

Thermo-softening plastics, as the name implies, are hard at low temperatures but soften when they are heated. Although they are less commonly used than thermosetting plastics they do have some advantages, such as greater fracture toughness, long shelf life of the raw material, capacity for recycling and a cleaner, safer workplace because organic solvents are not needed for the hardening process.

Ceramics, carbon and metals are used as the matrix for some highly specialized purposes. For example, ceramics are used when the material is going to be exposed to high temperatures and carbon is used for products that are exposed to friction and wear.

Here are three main composite types:

4.3.1. Reinforced Thermoset Materials:

These materials are used in all areas of application, from traditional semi-industrial processes to open molding techniques or more industrialized processes such as filament winding and pultrusion.

4.3.2. Reinforced Thermoplastics

Growth of this category is expected to be two to three times that of reinforced thermoset materials, largely due to the automotive industry, which uses thermoplastics in the production of a wide range of automotive, both exterior and interior.

4.3.3. Woven Textiles

This category is constantly growing due to important research and development in the sector.

Many recent advances in sporting achievement have come about via a better understanding of how either traditional materials, such as steel, plastics and glass, as well as improved or novel materials, such as polymer and carbon fibers and composite materials, may be used in sports equipment and clothing.

4.4. Non-Metal Materials

In general, the physical properties of the nonmetals are the opposite of those attributed to metals. Nonmetals tend to gain electrons to form negative ions rather than to lose electrons to form positive ions.

Non-metals are the elements in groups 14-16 of the periodic table. As opposed to metals, non-metallic elements are very brittle, and cannot be rolled into wires or pounded into sheets.

Nonmetals are often gases at room temperature. The nonmetals that are solids are not lustrous, are not malleable or ductile, and are poor conductors of heat and electricity. That is, Non-metals are not able to conduct electricity or heat very well.

Hydrogen, carbon, nitrogen, oxygen, phosphorus, sulfur and selenium are the mostly used nonmetal materials.

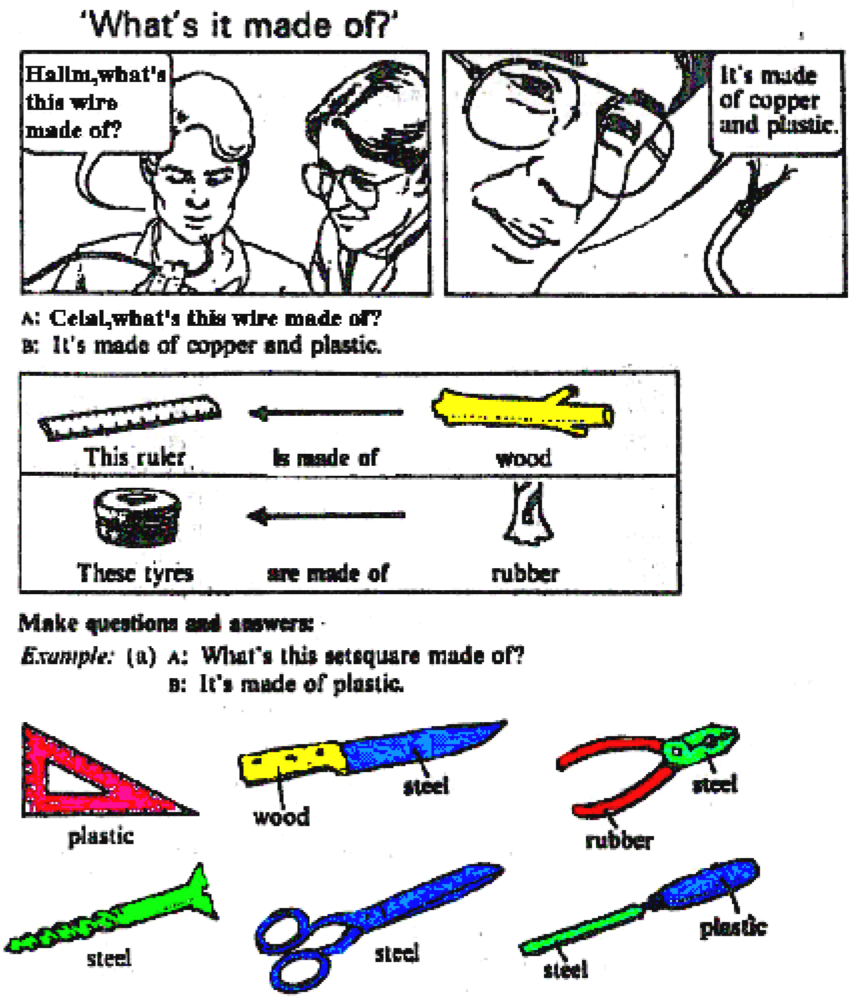
The non-metals exist in two of the three states of matter at room temperature: gases (such as oxygen) and solids (such as carbon). The non-metals have no metallic luster, and do not reflect light.

Argon, chlorine, fluorine, helium, hydrogen, krypton, neon, nitrogen, oxygen, and xenon are normally gases.

Boron, carbon, iodine, phosphorus, silicon, and sulfur are solids.

APPLICATION ACTIVITY

Steps of process	Suggestions
➢ Make conversations with each other in classroom, laboratory, workshop or wherever you are using terms you have learned by this learning activity:	➢ You can look at examples below.



CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation criteria	Yes	No
1. Did you learn types of ferrous material?		
2. Did you learn types of nonferrous material?		
3. Did you learn types of composite?		
4. Did you learn that where can we use the materials ?		

EVALUATION

Please review your “No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "Yes" to all questions, pass to the "Measuring and Evaluation".

MEASURING AND EVALUATION

Evaluate the given knowledge, If the knowledge is TRUE, write “T” , if it is FALSE, write “F” to end of the empty parenthesis.

1. ( ) Tool steels are kind of nonferrous materials.

2. ( ) Aluminum alloys are nonferrous materials.

3. ( ) Beryllium is a heavy metal.

4. ( ) Copper conduct electricity well.

5. ( ) Magnesium is a kind of composite.

6. ( ) Nickel alloys are ferrous materials.

7. ( ) Tungsten is a kind of refractory nonferrous metal.

8. ( ) Zirconium is a kind of nonmetal.

9. ( ) A composite material forms from two or more materials with very different properties.

10. ( ) Organic matrix composites made from plastic materials.

11. ( ) Selenium can conduct electricity or heat very well.

12. ( ) Phosphorus is a nonmetal material.

EVALUATION

Please compare the answers with the answer key. If you have wrong answers, you need to review the Learning Activity. If you give right answers to all questions, pass to the next learning activity.

LEARNING ACTIVITY-5

AIM

You can read the simple electric, electronic terms and tools.

SEARCH

- Discuss with your friends that what you know about electric electronic units and components.

5. ELECTRIC AND ELECTRONICS

ELECTRICITY

Many devices are powered by electricity, including lights, TVs, radios and computers. Electricity starts with **electrons**.

Most **metals** have electrons that can detach from their atoms and move around. These are called **free electrons**. Gold, silver, copper, aluminum, iron, etc., all have free electrons. The loose electrons make it easy for electricity to flow through these materials, so they are known as **electrical conductors**. They conduct electricity. The moving electrons transmit electrical energy from one point to another.

Electricity needs a conductor in order to move.

5.1. Circuit Elements

Current moves from a point of high potential energy to one of low potential. It can only do so if there is a path for it to follow. This path is called an electric circuit. All circuits contain four elements: a source, a load, a transmission system and a control.

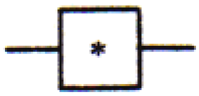
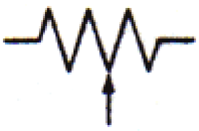
The source provides the electromotive force. This establishes the difference in potential which makes current flow possible. The source can be any device which supplies electrical energy. For example, it may be a generator.

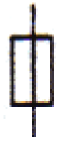
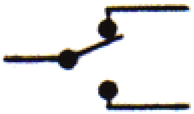
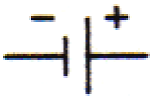
The load converts the electrical energy from the source into some other form of energy. For instance, a lamp changes electrical energy into light and heat. The load can be any electrical device.

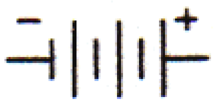
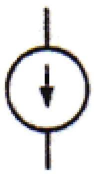
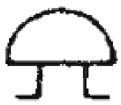
The transmission system conducts the current round the circuit. Any conductor can be part of a transmission system. Most systems consist of wires.

The control regulates the current flow in the circuit. It may control the current by limiting it, as does a rheostat, or by interrupting it, as does a switch.

Common schematic symbols and names of components, devices and conductors are shown in the table below:

	*The letter in the center identifies the type: V voltmeter A ammeter mA milliammeter Q ohmmeter W wattmeter G galvanometer
	Resistor or resistance (fixed value)
	Variable resistor
	Capacitor or capacitance
	Inductor (coil) or inductance
	Transformer

	Relay contacts
	Single-pole, single-throw (SPST) switch
	Single-pole, double-throw (SPDT) switch
	Double-pole, single-throw (DPST) switch
 **or** 	Fuse
	Two conductors crossing—no connections
	Two conductors connected
	Cell

	Battery
	Ground connection
	Power supply (usually identified by voltage and type) polarity would indicate dc power supply—voltage source
	Ac power supply—voltage source
	Constant current source
	Bell
	Bulb lamp
	Motor

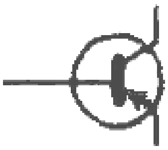
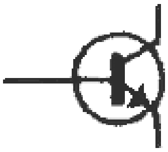
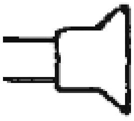
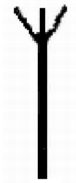
	Diode
	Zener diode
	PNP transistor
	NPN transistor
	Loudspeaker
	Microphone
	Antenna

Table 5.1: Common schematic symbols and names of components, devices and conductors

The symbols used in schematic diagrams represent the components and conductors of the circuit, but the symbols do not try to show the physical shape or size of the actual component.

5.2. Definitions and Units of Some Main Parts

5.2.1. Resistor

Figure 5.1: A resistor

Resistor is - a two- terminal electronic component that resists electrical current and turns the extra current into heat.

Resistors are rated in ohms, and can be used to regulate the voltage and current in a circuit. Basically, a resistor resists the flow of electricity. Resistors are used to lower voltages and currents so that components that require smaller voltage/current can function properly. If a power supply puts out 12 volts and you have a chip that runs on three, you need a resistor to cut down the voltage.

As we mentioned that, the **ohm** is the unit of resistance, and it is represented by the symbol Ω (Greek letter omega).

Resistance values are indicated by a standard color code that manufacturers have adopted. This code uses color bands on the body of the resistor. The colors and their numerical values are given in the resistor color chart, Table 5.2

Color	Significant Figure* (First and Second Bands)	No. of Zeros (Multiplier) (Third Band)	% Tolerance (Fourth Band)	% Reliability* (Fifth Band)
Black	0	0	—	—
Brown	I	1 (10^1)	—	1
Red	2	2 (10^2)	—	0.1
Orange	3	3 (10^3)	—	0.01
Yellow	4	4 (10^4)	—	0.001
Green	5	5 (10^5)	—	—
Blue	6	6 (10^6)	—	—
Violet	7	7 (10^7)	—	—
Gray	8	8 (10^8)	—	—
White	9	9 (10^9)	—	—
Gold	—	(0.1 or 10^{-1})	5	—
Silver	—	(0.01 or 10^{-2})	10	—
No color	—	—	20	—

* MILSTD five - band code

Table 5.2: Resistor Color Codes

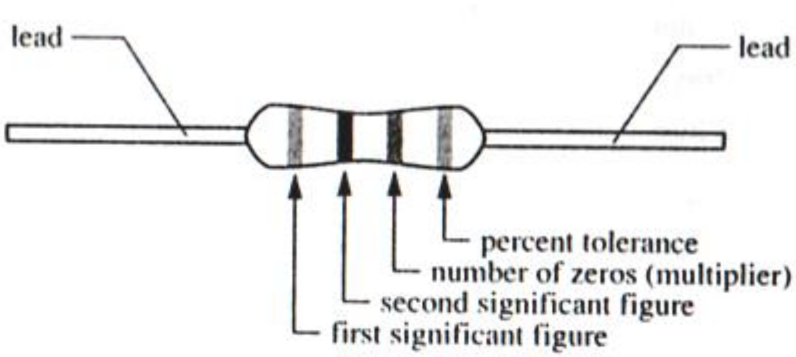


Figure 5.2: Resistor color coding

The basic resistor is shown in Figure 5.2. The standard color-code marking consists of four bands around the body of the resistor. The color of the first band indicates the first significant figure of the resistance value. The second band indicates the second significant figure. The color of the third band indicates the number of zeros that follow the first two significant figures. If the third band is gold or silver, the resistance value is less than 10Ω. For resistors less than 10Ω, the third band indicates a fractional value of the first two significant figures:

- A gold band means the resistance is 1/10 the value of the first two significant figures.

- A silver band means the resistance is 1/100 the value of the first two significant figures.

The fourth band indicates the percent tolerance of the resistance. Percent tolerance is the amount the resistance may vary from the value indicated by the color code. Tolerances are usually given as plus or minus the nominal, or color-code, value.

High-precision resistors have five bands. The first three bands indicate the first three significant figures of the resistance; the fourth band indicates the number of zeros; the fifth band is the percent tolerance. Percent tolerances for these resistors range from 0.1 percent to 2 percent.

Resistors manufactured to military specification (MILSTD) also contain a fifth band. The fifth band in this case is used to indicate reliability.

Examples of color-coded resistors are given in Table 5.3

To avoid having to write all the zeros for high-value resistors the metric abbreviations of k (for 1000) and M (for 1,000,000) are used. For example,

- 33,000 Ω can be written as 33 kΩ (pronounced 33 kay, or 33 kilohms).

- 1,200,000 Ω can be written as 1.2 MΩ (pronounced 1.2 meg, or 1.2 megohms)

In addition to fixed-value resistors, variable resistors are used extensively in electronics. The two types of variable resistors are the **rheostat** and the **potentiometer**.

A rheostat is essentially a two-terminal device however; potentiometer is a three-terminal device.

A potentiometer may be used as a rheostat if the center terminal and one of the end terminals are connected into the circuit and other end terminal is left disconnected.

First Band	**Second Band**	**Third Band**	**Fourth Band**	**Resistor Value**		**Resistance Range, Ω**
				Ω	**% Tolerance**	
Orange	Orange	Brown	No color	330	20	264 - 396
Gray	Red	Gold	Silver	8.2	10	7.4 - 9.0
Yellow	Violet	Green	Gold	4.7 M	5	4.465 M - 4.935 M
Orange	White	Orange	Gold	39 k	5	37.1k - 41k
Green	Blue	Brown	No color	560	20	448 - 672
Red	Red	Yellow	Silver	220 k	10	198 k - 242 k
Brown	Green	Gold	Gold	1.5	5	1.43 - 1.58
Blue	Gray	Green	No color	6.8 M	20	5.44 M - 8.16 M
Green	Black	Silver	Gold	0.5	5	0.475 - 0.525

Table 5.3: Examples of color-coded resistors

5.2.2. Cell

Figure 5.3: A dry cell

Electric cells are a source of direct current. They produce electric energy through chemical reactions. Two dissimilar materials separated by a chemical that allows the materials to exchange electrons produce a potential difference.

The two dissimilar materials are the electrodes, or poles, of the cell; the material permitting the exchange of electrons is called an electrolyte.

Different combinations of materials produce different potential differences, or voltages. The most common voltages in general use range from about 1.25 V to 1.5 V for the familiar C, D, AA, and AAA size cells. These cells are often called "dry" cells.

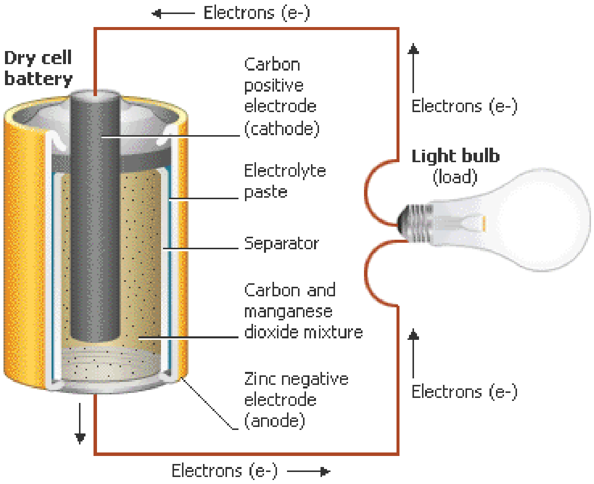


Figure 5.4: Dry cell chemical structure

5.2.2.1. Cells and Batteries

In popular usage the terms cell and battery are used interchangeably. From a technical standpoint, cells and batteries differ.

A cell is a single unit producing voltage from the chemical reaction of the electrode materials and an electrolyte.

A battery is a combination of cells that are series, parallel, or series-parallel connected.

For example, a common automobile battery has a nominal voltage of 12 V. However, the cell that makes up the auto battery produces 2.1 V. The 12 V is obtained by connecting six cells in series (6 X 2.1 = 12.6 V). The 12.6 V across the terminals of the auto battery reduces to 12 V nominally as current is drawn by the car's electrical system. Auto batteries, however, are called upon to deliver extraordinary currents (in the hundreds of amperes) when starting. This capability is designed into the auto battery by connecting many pairs of electrodes in parallel, in effect, connecting many cells in parallel.

5.2.3. Light Bulb

Figure 5.5: A light bulb

Light bulbs have a very simple structure. At the base, they have two metal contacts, which connect to the ends of an electrical circuit. The metal contacts are attached to two stiff wires, which are attached to a thin metal filament. The filament sits in the middle of the bulb, held up by a glass mount. The wires and the filament are housed in a glass bulb, which is filled with an inert gas, such as argon.

When the bulb is hooked up to a power supply, an electric current flows from one contact to the other, through the wires and the filament. Electric current in a solid conductor is the mass movement of free electrons (electrons that are not tightly bound to an atom) from a negatively charged area to a positively charged area.

As the electrons zip along through the filament, they are constantly bumping into the atoms that make up the filament. The energy of each impact vibrates an atom, in other words, the current heats the atoms up. A thinner conductor heats up more easily than a thicker conductor because it is more resistant to the movement of electrons.

Bound electrons in the vibrating atoms may be boosted temporarily to a higher energy level. When they fall back to their normal levels, the electrons release the extra energy in the form of photons. Metal atoms release mostly infrared light photons, which are invisible to the human eye. But if they are heated to a high enough level – around 4,000 degrees Fahrenheit (2,200 degrees C) in the case of a light bulb – they will emit a good deal of visible light.

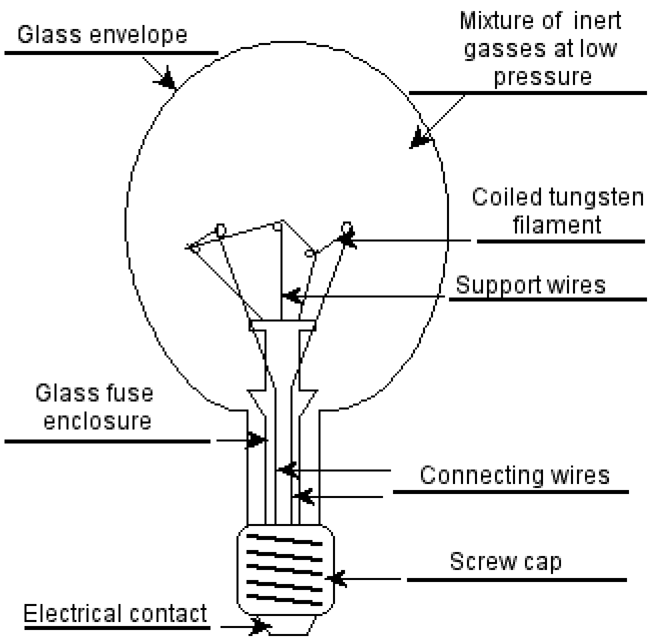


Figure 5.6: A light bulb's structure

Coiled tungsten filament - the metal wires that glow brightly when electricity flows through them.

Connecting wires - The wires that carry electricity from the bulb's electrical contact to the filament.

Electrical contacts - the metallic base of the bulb which connects to the electrical contacts of the lamp when the bulb is in the lamp.

Glass envelope - the thin layer of glass that surrounds the light bulb mechanism and the inert gases.

Glass fuse enclosure - glass that insulates the bulb's fuses **-** located in the stem of the bulb.

Mixture of inert gases at low pressures - the bulb is filled with inert (non-reactive) gases.

Screw cap - the threaded base of the bulb that secures it to a lamp.

Support wires - wires that physically hold up the filament.

5.2.4. Capacitance And Capacitors

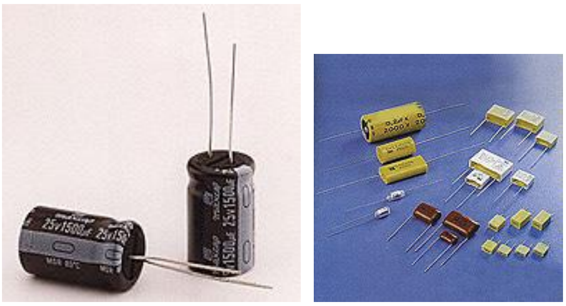


Figure 5.7: Simple capacitors

Capacitance is created when two conductors are separated by a nonconductor, or dielectric. This description would appear to be applicable to many electrical conditions, and, in fact, it is.

For example, two wires separated only by air (a dielectric) exhibit capacitance that under certain situations can create problems in a circuit.

The symbol for capacitance is C. The unit of capacitance is the **farad**, named after the English scientist Michael Faraday. The abbreviation for farad is **F**. Since the farad is such a large unit of measurement a device with 1 F of capacitance would be very big, so farads are usually expressed in smaller units using metric prefixes. Typical capacitance values used in electronic circuits are given in millionths of a farad (a microfarad, or μ). Other typical units are picofarads (pF) and nanofarads (nF).

In electric circuits capacitors are used for many purposes. For example, they are used to store energy, to pass alternating current while blocking direct current, and to shift the phase relationship between current and voltage. They are also used as components in filter and resonant circuits. Three major types of capacitors are ceramic, electrolytic, and tantalum.

5.2.4.1. Ceramic Capacitors

Ceramic capacitors are small in size and value, ranging from a few Pico Farads to 1 μF. Not polarized, so either end can go to ground.

Figure 5.8: ceramic capacitors

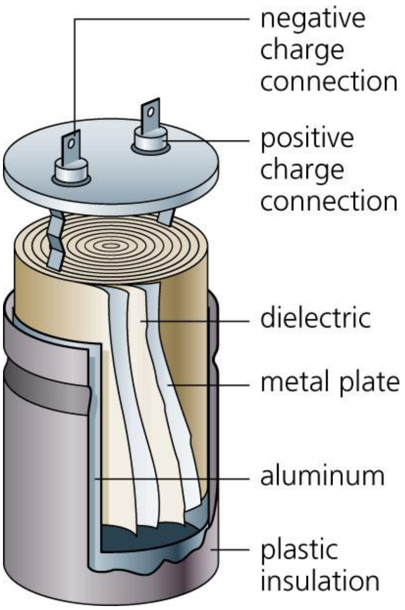


Figure 5.9: Structure of an electrolytic capacitor.

5.2.4.2. Electrolytic capacitors:

Electrolytic capacitors look like small cylinders and range in value from 1 μF to several Farads. Very inaccurate and change in value as the electrolytic ages. Polarized, cathode must go to ground. Cathode is marked with a minus sign on case. Value is usually written on case.

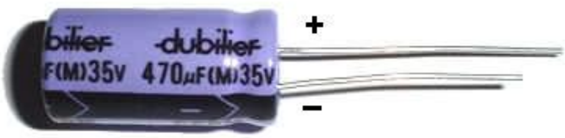


Figure 5.10: an electrolytic capacitor.

5.2.4.3. Tantalum Capacitors

Tantalum capacitors are similar in size to ceramic but can hold more charge, up to several hundred μF. They are accurate and stable, but relatively expensive. Usually polarized, anode is marked with a plus sign.

Figure 5.11: A tantalum capacitor

5.2.5. The Charge On A Capacitor

The quantity of electric charge is measured in coulombs.

The size of a capacitor, given in farads (more commonly in microfarads or picofarads), is known as its capacitance.

The relationship between the charge Q on a capacitor and the capacitance of the capacitor C is given by the formula

$$\mathbf{Q} = \mathbf{C} \times \mathbf{V}$$

where

Q is the charge in coulombs,

C is the capacitance in farads.
V is the voltage across the capacitor in volts.

5.2.6. Frequency

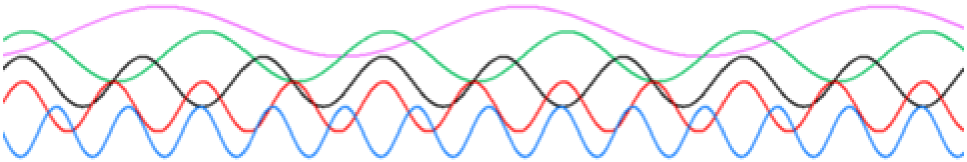


Figure 5.12: Some signals with different frequencies

A commonly used unit for frequency is the **Hertz** (abbreviated Hz), where

1 Hertz = 1 vibration/second

To calculate the frequency of an event, the number of occurrences of the event within a fixed time interval are counted, and then divided by the length of the time interval.

In SI units, the result is measured in hertz (Hz), named after the German physicist Heinrich Rudolf Hertz. 1 Hz means that an event repeats once per second, 2 Hz is twice per second, and so on. This unit was originally called a cycle per second (cps), which is still used sometimes. Other units that are used to measure frequency include revolutions per minute (rpm) and radians per second (rad/s).

An alternative method to calculate frequency is to measure the time between two consecutive occurrences of the event (the period) and then compute the frequency as the reciprocal of this time:

$$f = \frac{1}{T}$$

5.2.7. Electric Current

Current is defined as the movement of electric charges. Electric current cannot exist by itself, but to have movement there must be voltage and a path along which the charges can move. A voltage source by itself cannot produce current. The electric circuit provides the complete path. Current is restricted to this closed path.

The amount of current in a circuit is dependent on the amount of voltage applied by the voltage source and on the nature of the conductive path. If the path offers little opposition, the current is greater than it would be in a circuit where there is more opposition to current. Opposition to direct current is called resistance (measured in ohms). Current, then, can be controlled by the amount of resistance in a circuit.

The unit of electric current is **ampere.** A current of one coulomb per second equals one ampere. That means ampere is a measure of the flow of electrons through a metal conductor or wire.

In circuits, the current flowing is directly proportional to the voltage applied and inversely proportional to resistance.

I (Amperes) = E (Volts) / R (Ohms)

5.2.8. Inductans And Coil

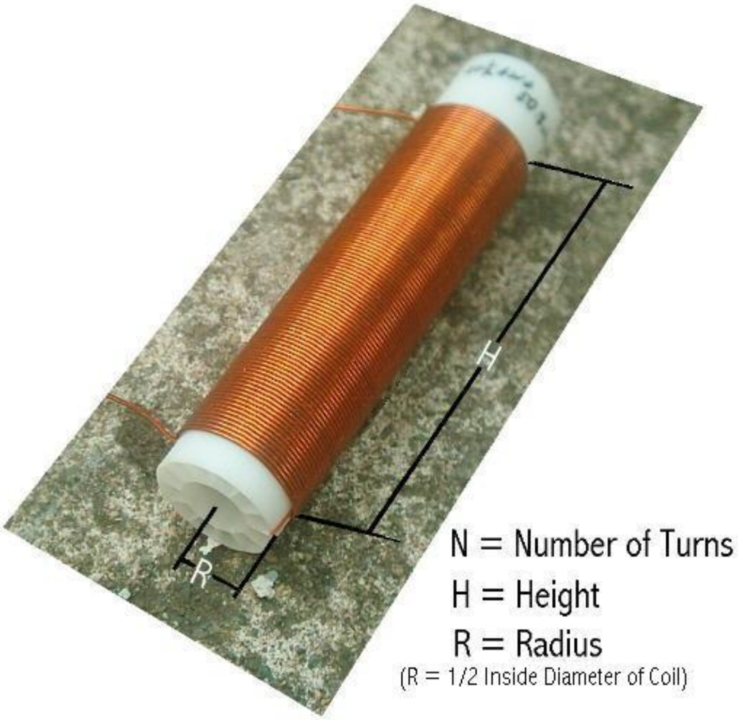


Figure 5.13: A simple coil

Inductance is a measure of the amount of **magnetic flux** produced for a given electric current.

$$L = \frac{\Phi}{i}$$

where

L is the inductance in **Henries**,
i is the current in **amperes**,
Φ is the magnetic flux in **webers**

The unit of inductance is the Henry (abbreviated H), named in honor of the American physicist Joseph Henry. The number of henrys in an inductor can be measured by means of an instrument called an inductance bridge.

The symbol used to denote inductance is L.

The amount of opposition offered by an inductor is called inductive reactance and is denoted by the symbol X_L. Inductive reactance is measured in ohms.

The inductive reactance of a coil is not constant but is a variable quantity. It depends on the inductance L and the frequency f of the voltage source. Inductive reactance may be calculated from the formula

$$X_L = 2\pi f L$$

where

π is the constant 3.14,
f is the frequency in hertz.
L is the inductance in henrys.

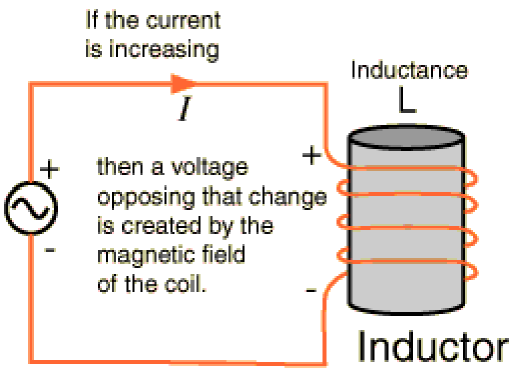


Figure 5.14: Inductance (L)

Inductance is typified by the behavior of a coil of wire, which is resisting any change of electric current through the coil. (Figure 5.14)

5.2.9. Diode

Figure 5.15: A diode

A diode is a component that restricts the direction of movement of charge carriers. It allows an electric current to flow in one direction, but essentially blocks it in the opposite direction.

If two crystal of a semiconductor material, one of p-type and one of n-type are joined together, a PN junction is formed. This junction can be used as a rectifier and is known as a PN junction diode.

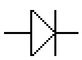
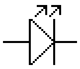
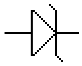
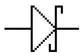
			
Diode	Light-Emitting Diode	Zener Diode	Schottky Diode

Figure 5.16: Symbols of some diode types

Figure 5.17: Light emitting diode (LED)

In a PN diode, conventional current can flow from the p-type side (the **anode**) to the n-type side (the **cathode**), but not in the opposite direction.

5.2.10. Transistor

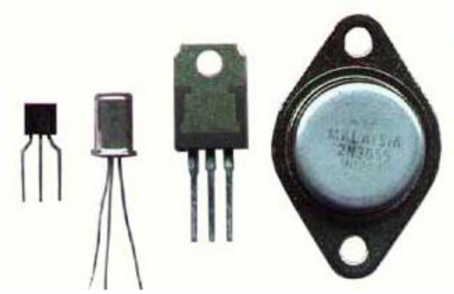


Figure 5.18: Different types of transistors

The transistor is a solid state semiconductor device which can be used for amplification, switching, voltage stabilization, signal modulation and many other functions. It acts as a variable valve which, based on its input voltage, controls the current it draws from a connected voltage source.

Transistors are divided into two main categories: bipolar junction transistors (BJTs) and field effect transistors (FETs). Transistors have three terminals where, in simplified terms, the application of voltage to the input terminal increases the conductivity between the other two terminals and hence controls current flow through those terminals.

A BJT consists of three semiconductor differently doped regions, the **emitter** region, the **base** region and the **collector** region, these regions are, respectively, p type, n type and p type in a PNP transistor, and n type, p type and n type in an NPN transistor. Each semiconductor region is connected to a terminal, appropriately labeled: emitter (E), base (B) and collector (C).

The junction field-effect transistor (JFET), like other transistors, can be used as an electronically-controlled switch. It is also used as voltage-controlled resistances. An electric current flows from one connection, called the **source**, to a second connection, called the **drain**. A third connection, the **gate**, determines how this current flows. By applying an increasing negative bias voltage to the gate, the current flow from source to drain can be impeded by pinching off the channel, in effect switching off the transistor.

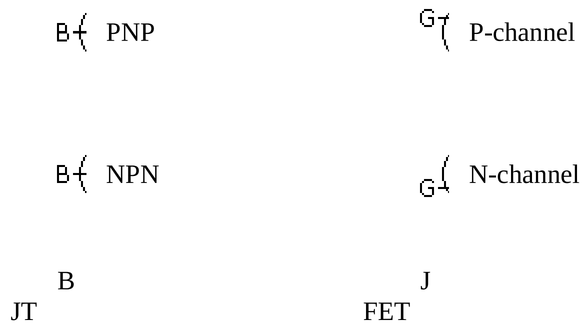


Figure 5.19: Symbols and terminals of two transistor types

5.2.11. Power

Power is the energy dissipated in an electrical or electronic circuit or device per unit of time. The electrical energy supplied by a current to an appliance enables it to do work or provide some other form of energy such as light or heat. Electric power is usually measured in **Watts**, kilowatts (1,000 watts), and megawatts (1,000,000 watts).

The amount of electrical energy used by an appliance is found by multiplying its consumed power by the length of time of operation. The units of electrical energy are usually watt-seconds (joules), watt-hours, or kilowatt-hours. For commercial purposes the kilowatt-hour is the unit of choice.

Watt is a unit of power equal to 1 joule per second; the power dissipated by a current of 1 ampere flowing across a resistance of 1 ohm.

Electrical power is calculated by voltage across a load multiplied by the current through that load:

$P = EI$ or

1 W = 1 Volt X 1 Ampere

Watts are typically rated as AMPS x VOLTS or VOLT-AMP (V-A). However, this rating is only equivalent to watts when it applies to devices that absorb all the energy, such as electric heating coils or incandescent light bulbs.

5.2.12. Transformer

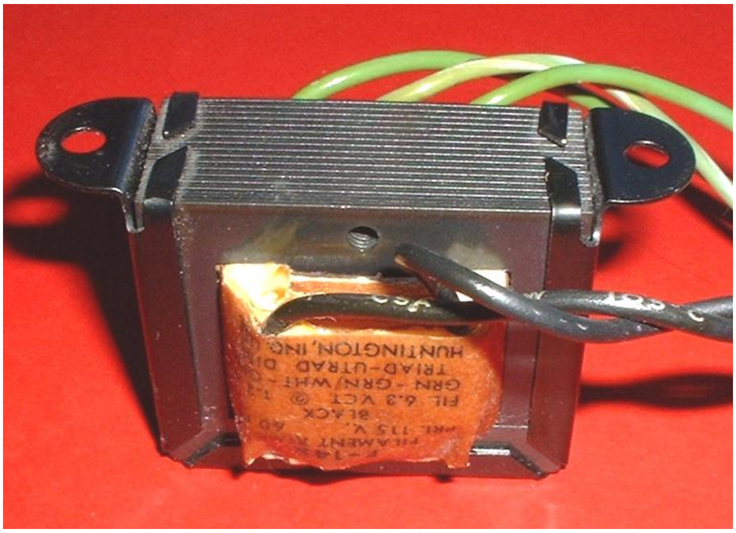


Figure 5.20: A simple transformer

A transformer is an electrical device that transfers energy from one electrical circuit to another by magnetic coupling. It is often used to convert between high and low voltages, for impedance transformation, and to provide electrical isolation between circuits.

The transformer is one of the simplest of electrical devices. Its basic design, materials, and principles have changed little over the last one hundred years, yet transformer designs and materials continue to be improved.

Transformers are essential in high voltage power transmission providing an economical means of transmitting power over large distances. The simplicity, reliability, and economy of conversion of voltages by transformers were the principal factors in the selection of alternating current power transmission.

Figure 5.21: Sizes of some transformers

A transformer consists of two coils, a **primary** and **secondary**. The primary coil creates a magnetic field when an AC current passes through.

A transformer is able to create a potential difference between the primary coil and secondary coil. The resulting effect from this magnetic potential is an electrical current is created in the second coil. The overall effect of this can be controlled by the power of the magnetic field, which is proportional to the surface area of the coils.

A transformer is composed of two different coils of wire around opposite sides of an iron core.

As you know, passing an alternating current through a coil of wire that surrounds a metal core induces a varying magnetic field in the core. This field will cause a responding current flow in a secondary coil wound around the opposite side.

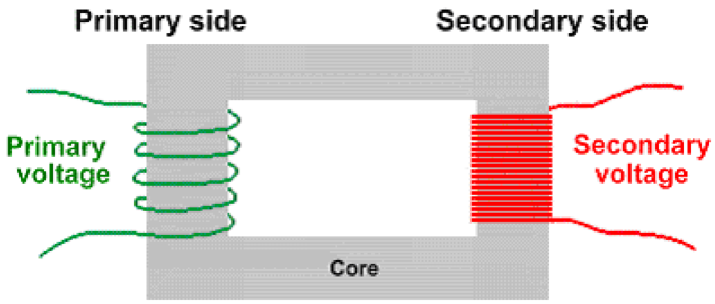


Figure 5.22: Transformer coils

The primary voltage (on the left) induces a magnetic field in the core, which creates the secondary voltage (on the right).

What makes transformers so useful is that if you **change the number of turns** from one side to the other, you **change the voltage** in the wire on the right! Transformers can change a high voltage to a lower one, or a low voltage to a higher one.

5.2.13. Describing Component Values

Study this table:

Prefix	Symbol	Multiple	Example	
giga	G	10^9	GHz	gigahertz
mega	M	10^6	MΩ	megohms
kilo	k	10^3	kv	kilovolts
deci	d	10^{-1}	dB	decibels
milli	m	10^{-3}	mW	milliwatts
micro	μ	10^{-6}	μA	microamps
nano	n	10^{-9}	nF	nanofarads
pico	p	10^{-12}	pF	picofarads

Table 5.4: Units of electronics components

Examples:

R = 3.9 Ω — A three point nine ohm resistor.

C = 1000 μF — A thousand microfarad electrolytic capacitor.

Puzzle (Exercise 5.1)

There are 16 terms such as device, unit, quantity, etc. written in squares below horizontally, vertically, straight or inversely. Find and sketch them. There will be some words remaining. Stabilize those words and write them.

R	E	L	T	N	E	R	R	U	C	C
O	E	H	E	R	T	Z	C	T	R	O
T	C	A	P	A	C	I	T	O	R	I
S	C	O	H	M	R	E	W	O	P	L
I	E	L	I	G	H	T	B	U	L	B
S	L	E	I	C	F	A	R	A	D	A
N	L	D	A	M	P	E	R	E	N	D
A	E	O	L	E	W	A	T	T	C	T
R	R	I	J	F	E	T	L	E	D	O
T	N	D	I	C	Y	R	N	E	H	S

Remaining words:

5.3. Logic Gates

Logic gates are electronic switching devices. Figure 5.23 represents in simple terms the function of one type of logic gate, the OR gate.

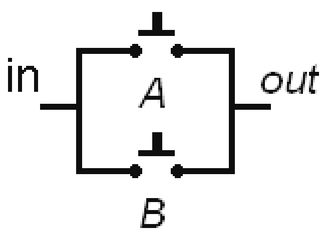


Figure 5.23: OR gate representation

If switch A is closed, the output will equal the input. Similarly if B is closed, or if both A and B are closed, the output and input will be equal. Any of these three conditions will permit an output to flow.

Logic gates contain semiconductors, not mechanical switches, which can be opened and closed. But they have only two levels of input and output: a high level and a low level. These correspond to the closed and open states of the switches in Figure 5.23. The high level is represented by 1 and the low level by 0. All information in digital systems is transmitted in terms of these two levels.

We can make a table to represent the output value of an OR gate for all possible combinations of inputs. Such a table is called a truth table. A truth table can be made for any logic gate.

INPUT		**OUTPUT**
A	B	A OR B
0	0	0
1	0	1
0	1	1
1	1	1

Table 5.3.1: Truth table for OR gate

We can summarize this table by the formula, $Q = A + B$ where the symbol + stands for OR.

Other common digital devices are AND, NOR and NAND gates, and inverters. AND gates will have an output of 1 only if 1 is present on all inputs. An inverter is a device which inverts its input. Thus an input of 0 will have an output of 1 and vice-versa. Complex circuits are made by combining these basic devices. Their circuit symbols are as follows:

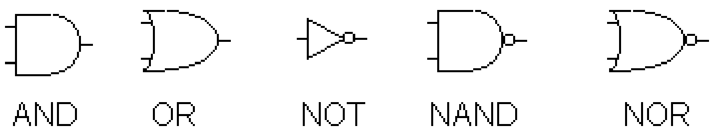


Figure 5.24: Logic gates

Let us now consider an example of the use of logic gates to control an industrial process. Suppose a motor controlling the flow of aluminum blanks to a hydraulic press is to be switched on only under the following conditions:

1. the switch is on
2. the supply voltage is correct
3. there is a supply of aluminum blanks in the feed-hopper
4. the pressure in the hydraulic system of the press is correct.

Information on these four conditions will be fed into an AND gate as all four must be satisfied for the motor to run. The output from the AND gale will be a logic level which is fed into the store input of the memory unit to provide a continuous signal to operate the motor.

The motor must stop if any one of the following conditions arises:

1. the switch is off
2. the supply voltage rises too high
3. the hopper is empty
4. the pressure in the hydraulic system drops.

Information of these conditions will be fed into an OR gate as the presence of any one must result in the motor being stopped.

An input of 1 from the OR gate to the memory reset input will remove the continuous output and hence stop the motor. The complete system will look like this:

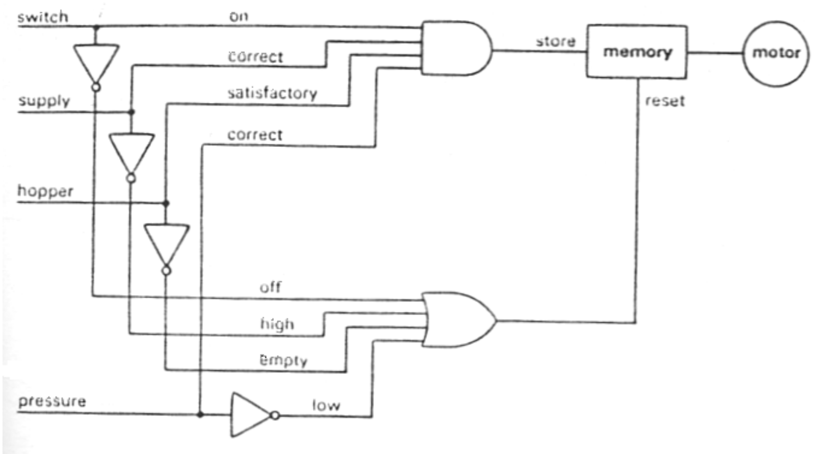


Figure 5.25: The sheme

Exercise 5.2

Making definitions

Use information from the passage to make definitions of the items below:

Example:

A logic gate

A logic gate is an electronic switching device which responds to two levels of input: a high level represented by 1 and a low level represented by 0.

1. **A truth table**
2. **An inverter**
3. **An OR gate**
4. **An AND gate**

Answers:

1. A truth table represents the output value of a gate for all possible combinations of inputs.

2. An inverter is a device which inverts its input.

3. An OR gate has an output of 1 if anyone of its inputs is 1.

4. An AND gate has an output of 1 only if 1 is present on all inputs.

5.4. Circuits

Circuit is a string of electronic devices such as transistors, resistors, capacitors, and diodes connected by wires so that current can run through it in a complete loop.

Circuits can be simple or complex. The wiring connecting a switch to a light to the power source and back to the switch is a simple circuit; opening the switch breaks the circuit and stops the current flow.

5.4.1. Simple Circuit

A simple circuit (Figure 5.26) consists of a power source (in this case a battery) and a device (in this case a bulb). Note that "circuit" sounds like "circle" - this is a good way for you to check when your circuits don't seem to work properly.

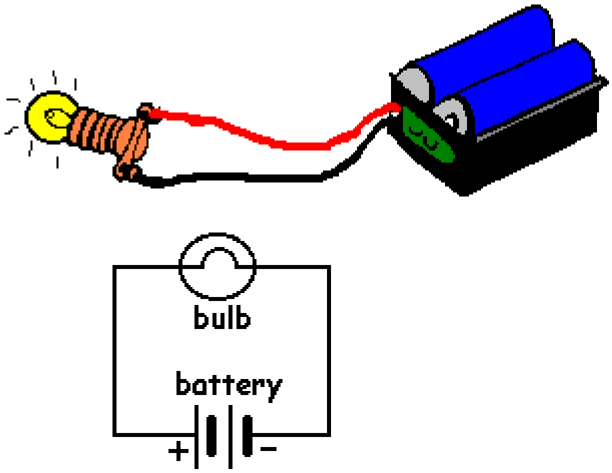


Figure 5.26 Simple circuit

5.4.2. Open Circuit

An open circuit is a circuit with a break in it. The flow of electricity is stopped by a break and therefore the bulb will not light. This may be because of a disconnected wire (as shown in figure 5.27) or it may have been done on purpose as in the Switched Circuit, below.

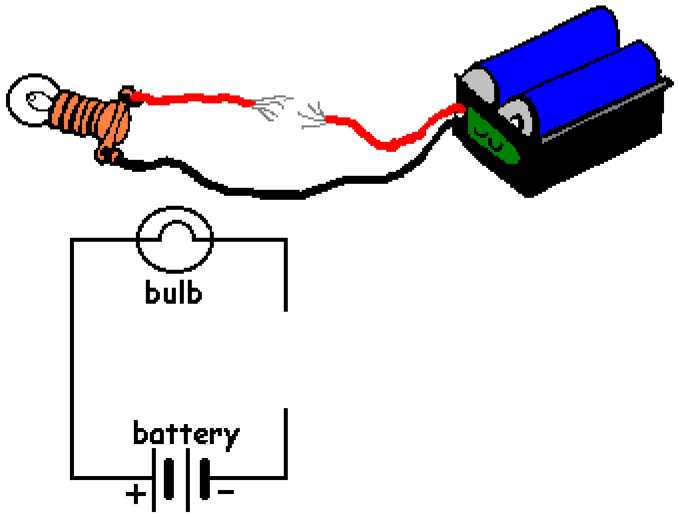


Figure 5.27: Open circuit

5.4.3. Short Circuit

A short circuit (sometimes known as simply a short) is a fault whereby electricity moves through a circuit in an unintended path, usually due to a connection forming where none was expected. This unintended path often has a very low resistance which means that a much larger current than normal flows, potentially causing overheating, fire or explosion.

If electricity has a choice between travelling through a device (high resistance) or a wire (low resistance) it will always choose the wire! And because it can travel much faster with low resistance, electricity creates more heat in a short circuit. If you feel your batteries getting hot, you've got a short circuit! Disconnect a wire to the battery, because the batteries will quickly be ruined.

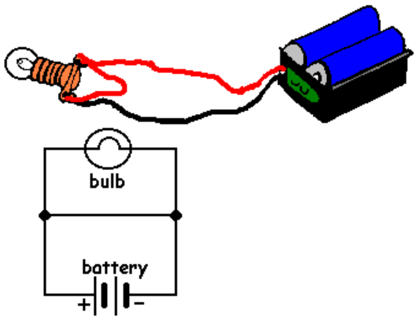


Figure 5.28: Short circuit

5.4.4. Switched Circuit

A switch is a device that allows us to easily convert an open circuit to a closed circuit.

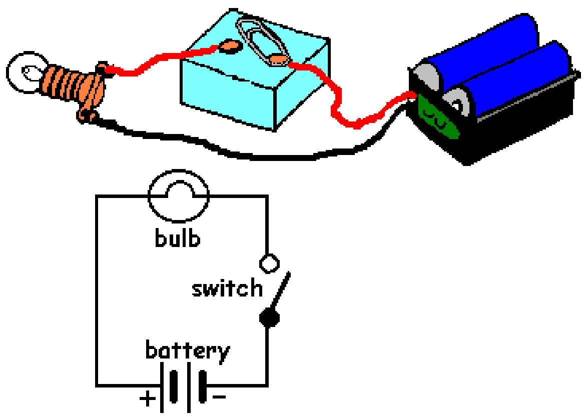


Figure 5.29: Switched circuit

5.4.5. Series Circuit

A series circuit looks like a loop. The same electric current flows through all of the parts of the circuit, sort of like a toy train running around a single, closed track.

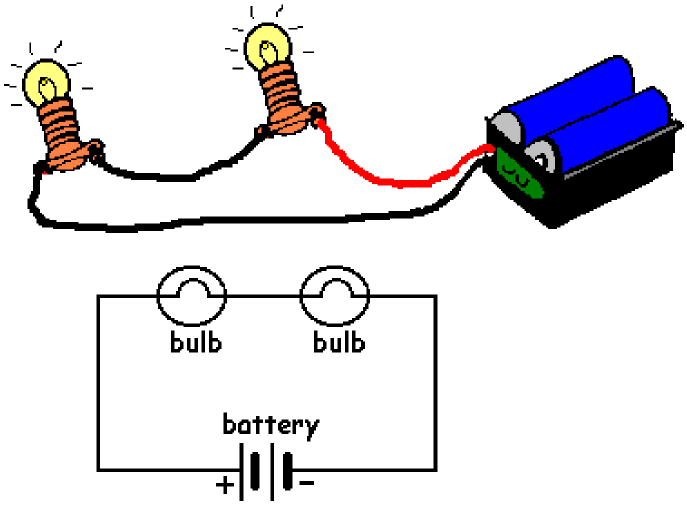


Figure 5.30: Series circuit

5.4.6. Parallel Circuit

A parallel circuit is one in which the current has more than one path to follow. Because of this, the current in each path can be controlled individually.

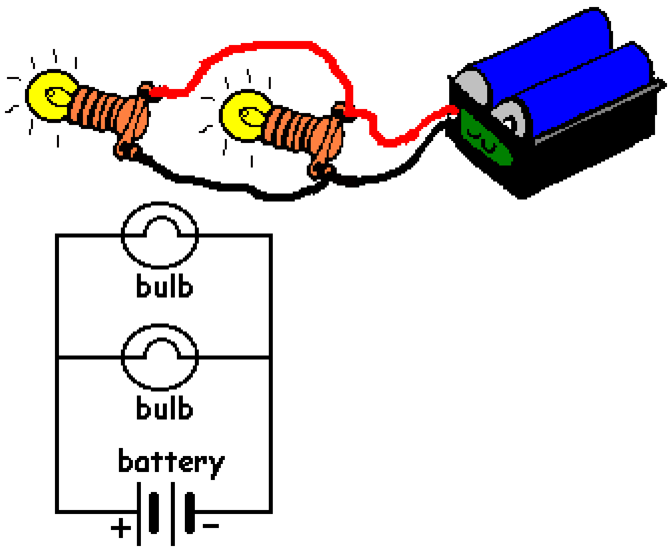
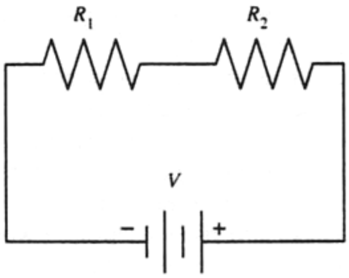
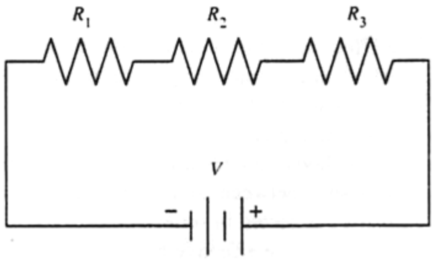


Figure 5.31 Parallel circuit

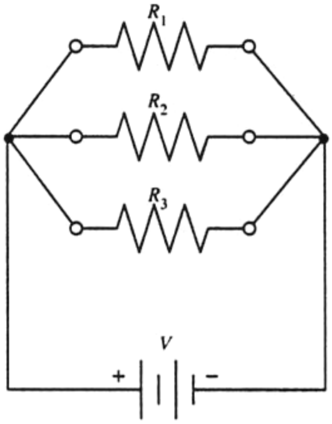
STUDY



- Voltage V applied across a series circuit.
- Two resistors, R_1, and R_2, are connected in series.



- Voltage V applied across a series circuit.
- Three resistors, R_1, R_2 and R_3, are connected in series.



- **Voltage V applied across three resistors, R_1, R_2 and R_3.**
- **R_1, R_2 and R_3 are connected in parallel.**

5.4.7. Series – Parallel Circuits

This circuit (Figure 5.32) is neither simple series nor simple parallel. Rather, it contains elements of both. The current exits the bottom of the battery, splits up to travel through R_3 and R_4, rejoins, then splits up again to travel through R_1 and R_2, then rejoins again to return to the top of the battery.

There exists more than one path for current to travel (not series), yet there are more than two sets of electrically common points in the circuit (not parallel).

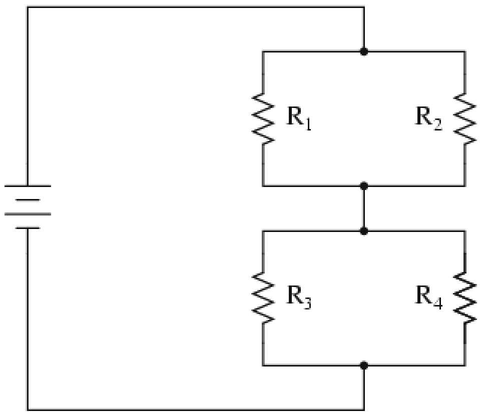
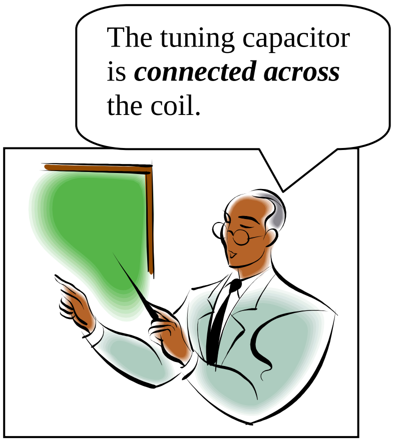


Figure 5.32: Series-parallel circuit

APPLICATION ACTIVITY

Look at the Exercise-1. After you answer all questions make conversations with each other in classroom using those answers.

Example:



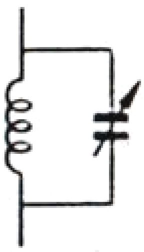
Exercise-1

Describing position and connection

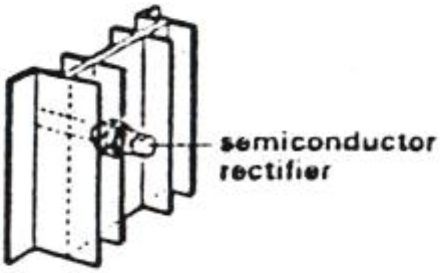
When describing the position of a component or how it is connected in a circuit, phrases of this pattern are used:

be + past participle + preposition

Examples



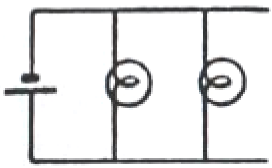
1. The tuning capacitor is ***connected across*** the coil.



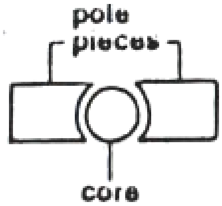
2. The semiconductor rectifier is ***mounted on*** the heat sink.

Now complete each sentence using an appropriate phrase from this list:

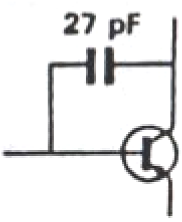
wound round	connected across
mounted on	wired to
located within	applied to
connected to	connected between



1. The bulbs are......the battery.

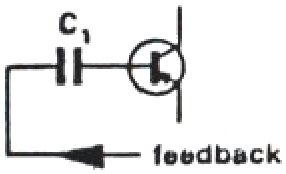


2. The core is......the pole pieces.

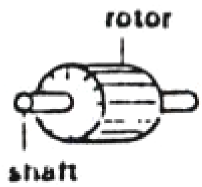


3. The 27pF capacitor is……the collector and the base.

4. The antenna is........the coil.

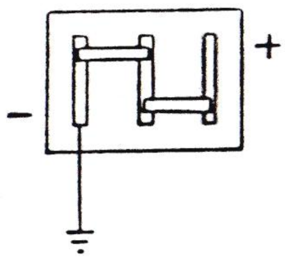


5. Feedback voltage is......the base of the transistor through c_1.



6. The rotor is…….. the shaft.

7. The coil is…….an iron core.



8. The negative pole of the battery ……….earth.

CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation criteria	Yes	No
1. Did you learn the features of electricity?		
2. Did you learn common schematic symbols?		
3. Did you learn the features of cell and battery?		
4. Did you learn the features of coil?		
5. Did you learn the features of capacitor?		
6. Did you learn types of circuit?		
7. Did you learn types of logic gate?		
8. Did you learn the features of transformer?		

EVALUATION

Please review your “No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "Yes" to all questions, pass to the "Measuring and Evaluation".

MEASURING AND EVALUATION

Evaluate the given knowledge, If the knowledge is TRUE, write “T” , if it is FALSE, write “F” to end of the empty parenthesis.

1. ( ) Bridge circuits contain two diodes; one conduct in the positive half and one conduct in the negative half of each cycle.

2. ( ) A transformer is able to create a potential difference between the primary coil and secondary coil.

3. ( ) One method of full-wave rectification uses a centre-tapped secondary and two diodes.

4. ( ) Logic gates are electronic switching devices.

5. ( ) The unit of electric current is **volt.**

6. ( ) Half-wave circuits use the four diodes to pass the positive half of each cycle but block the negative half.

EVALUATION

Please compare the answers with the answer key. If you have wrong answers, you need to review the Learning Activity. If you give right answers to all questions, pass to the next learning activity

LEARNING ACTIVITY-6

AIM

You can read the basic measuring instruments used by electronics technicians.

SEARCH

- Discuss with your friends about electric electronic measuring instruments that what you learned before.

6. MEASURING INSTRUMENTS

Figure 6.1: A measuring instrument used by electronics technicians

6.1. Ammeter

An ammeter is a measuring instrument used to measure the flow of electric current in a circuit. Electric current is measured in ampere, hence the name. The word "ammeter" is commonly misspelled or mispronounced as "ammeter" by some.

An ideal ammeter has zero resistance and is placed in series with the circuit.

Figure 6.2: Miliammeter

6.2. Ohmmeter

An Ohmmeter is an electrical measuring instrument that measures electrical resistance, the opposition to the flow of an electric current.

6.3. Voltmeter

A voltmeter is a measuring instrument for measuring the voltage between two points in an electric circuit. An ideal voltmeter has infinite resistance and should be placed in parallel in the circuit.

Figure 6.3: A voltmeter

6.4. Multimeter

A multimeter is an electronic measuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter. A multimeter which includes these three items is also called “AVO meter”.

Modern multimeters are exclusively digital, and identified by the term DMM or digital multimeter. In such an instrument, the signal under test is converted to a digital voltage and an amplifier with an electronically controlled gain preconditions the signal. Since the digital display directly indicates a quantity as a number, there is no risk of parallax causing an error when viewing a reading.

Figure 6.4: A multimeter

6.5. Galvanometer

A galvanometer is an electromechanical transducer. It produces a rotary deflection, through a limited arc, in response to electric current flowing through its coil. The name galvanometer has been applied to devices used in measuring, recording, and positioning equipment.

Extremely sensitive measuring equipment once used mirror galvanometers that substituted a mirror for the pointer. A beam of light reflected form the mirror acted as a long, massless pointer.

Figure 6.5: A galvanometer

6.6. Oscilloscope

An oscilloscope (commonly abbreviated CRO or scope) is a piece of electronic test equipment that allows voltage levels and signals to be viewed by creating a visible two-dimensional graph of one or more electrical potential differences. The horizontal axis of the display normally represents time, making the instrument useful for displaying periodic signals. The vertical axis usually shows voltage.

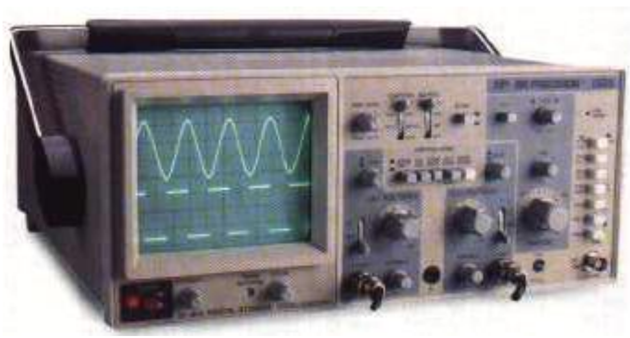


Figure 6.6: An oscilloscope

6.7. Wattmeter

Figure 6.7: A wattmeter

The wattmeter is an electrodynamic instrument for measuring the electric power or the supply rate of electrical energy of any given circuit. The device consists of a pair of fixed coils known as current coils, and a movable coil known as the potential coil.

The current coils are connected in series with the circuit, while the potential coil is connected across the line. Also, on analog wattmeters, the potential coil carries a needle that moves over a scale to indicate the measurement. A current flowing through the current coil generates an electromagnetic field around the coil. The strength of this field is proportional to the line current and in phase with it. The potential coil has, as a general rule, a high-value resistor connected in series with it to reduce the current that flows through it.

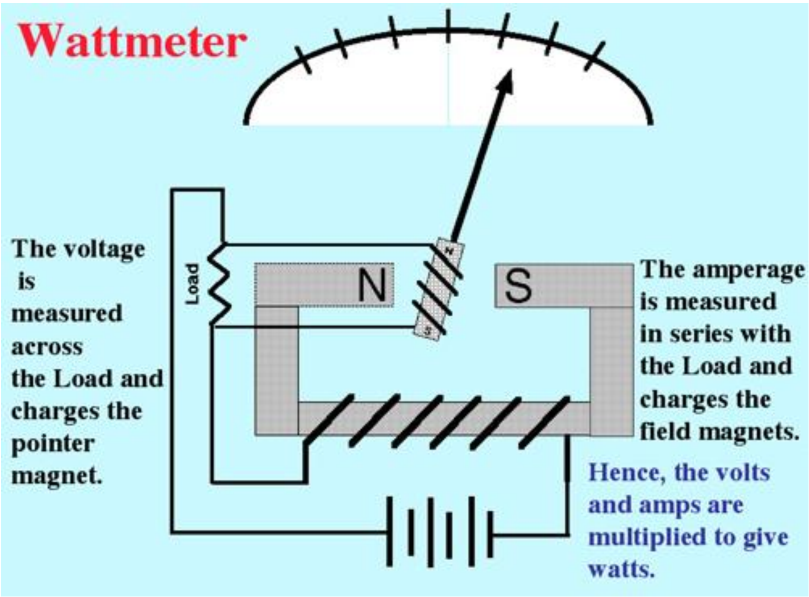


Figure 6.8: Working principle of a wattmeter

APPLICATION ACTIVITY

Look at the pictures. Write its name below the box.

CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation criteria	Yes	No
1. Did you learn that how can we use the ammeters?		
2. Did you learn that how can use the voltmeters?		
3. Did you learn that how can use the multimeters?		
4. Did you learn that how can use an oscilloscope?		
5. Did you learn that how can use the wattmeters?		

EVALUATION

Please review your “No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "Yes" to all questions, pass to the "Measuring and Evaluation".

MEASURING AND EVALUATION

Write the name of instruments explained by filling in the blanks below and tick the correct option.

1. …………. is used to measure the flow of electric current in a circuit.
A) An oscilloscope B) An ammeter C) A voltmeter D) A wattmeter

2. ………….. is a piece of electronic test equipment that allows voltage levels and signals to be viewed by creating a visible two-dimensional graph.

A) A galvanometer B) An oscilloscope C) A voltmeter D) A wattmeter

3. …………. is an electronic measuring instrument that combines several functions in one unit.
A) An oscilloscope B) An ammeter C) A voltmeter D) A multimeter

4. ………….. is an analog measuring instrument which is an electromechanical transducer.
A) galvanometer B) An ammeter C) A voltmeter D) A wattmeter

5. …………. is used for measuring the voltage between two points in an electric circuit.

A) An oscilloscope B) An ammeter C) A voltmeter D) A wattmeter

6. …………... is an electrodynamic instrument for measuring the electric power or the supply rate of electrical energy of any given circuit.
A) An oscilloscope B) An ammeter C) A voltmeter D) A wattmeter

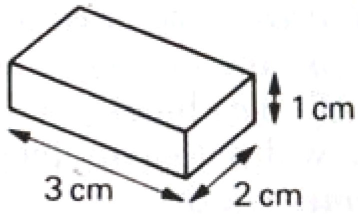
7. …………. measures electrical resistance, the opposition to the flow of an electric current.
A) An ammeter B) An ohmmeter C) A voltmeter D) A wattmeter

EVALUATION

Please check your answers from the answer key table which is at the end of this module. If you give right answers to all questions, pass to the evaluation of the module.

MODULE EVALUATION

Fill in the blanks below with correct words and tick the correct option.

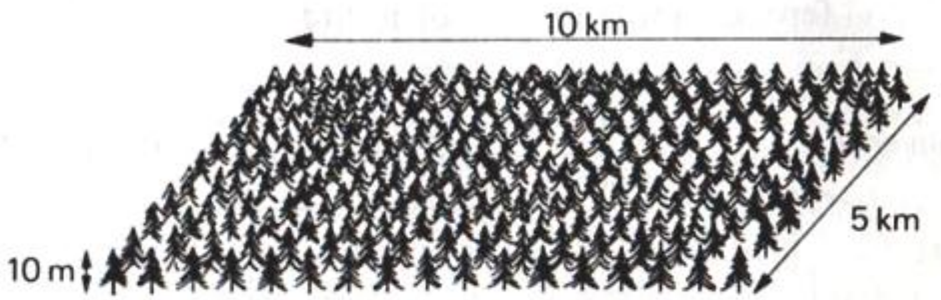


1. This brick has a/an ……….. of 3 cm.

A) length B) width C) height D) depth

2. It has a/an ………… of 6 cm^3.

A) height B) area C) weight D) volume



3. This forest has a/an ……….. of 50 km^2

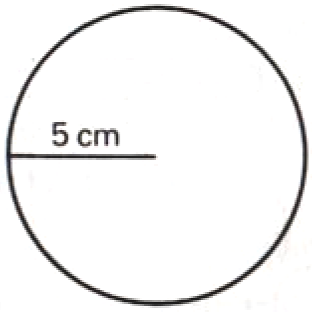
A) height B) area C) weight D) volume

4. Each tree has ……….. centimeter height.

A) 100 B) 1000 C) 10000 D) 100000

5. the …………… for decameter is “dam”

A) measuring B) writing C) abbreviation D) position



6. This circle has a/an ………… of 5 cm.
A) area B) diameter C) volume D) radius

7. It has a/an …………… of 10 cm.
A) area B) diameter C) volume D) radius

8. .... are mixtures of metals in different proportions.
A) semiconductors B) nonmetals C) conductors D) alloys

9. A/an ………. is a device used to insert and tighten, or to loosen and remove screws.
A) screwdriver B) nail C) hammer D) drill

10. ………. are source of direct current. They produce electric energy through chemical reactions.
A) capacitors B) cells C) transformers D) bulbs

11. ………… is created when two conductors are separated by a nonconductor, or dielectric.
A) resistance B) capacitance C) quantity D) inductance

12. A/an ………….. is one circuit in which the current has more than one path to follow.

A) serial circuit B) parallel circuit C) short circuit D) switched circuit

Evaluate the given knowledge, If the knowledge is TRUE, write "T" , if it is FALSE, write "F" to end of the empty parenthesis.

13. ( ) There are 100 centimeters in a meter and centi just happens to mean one hundredth.

14. ( ) The second is a unit of temperature.

15. ( ) The basic unit of mass is the gram which is represented by the abbreviationg.

16. ( ) Pressure is defined as force per unit area.

17. ( ) Duration is measured in degrees centigrade.

18. ( ) The area of a shape is a measure of how many square units it contains.

19. ( ) Speed is measured in kilograms per hour.

20. ( ) Pliers are hand tools primarily for gripping and they may also used for holding things tightly, pulling nails out of wood, cutting wire, etc.

21. ( ) Copper doesn’t conduct electricity well.

22. ( ) A short circuit is a fault whereby electricity moves through a circuit in an unintended path.

EVALUATION

Please compare the answers with the answer key. If you have wrong answers, you need to review the Learning Activity. If you give right answers to all questions, pass to the next learning activity.

ANSWERS KEYS

ANSWER KEY OF LEARNING ACTIVITY-1

1	C
2	D
3	B
4	B
5	C
6	A
7	B
8	D

ANSWER KEY OF LEARNING ACTIVITY-2

1	True
2	False
3	True
4	False
5	True
6	False
7	True
8	False
9	False
10	True
11	False
12	90
13	RIGHT
14	OBTUSE

ANSWER KEY OF LEARNING ACTIVITY-3

1	C
2	B
3	D
4	A
5	C

ANSWER KEY OF LEARNING ACTIVITY-4

1	**False**
2	**True**
3	**False**
4	**True**
5	**False**
6	**False**
7	**True**
8	**False**
9	**True**
10	**True**
11	**False**
12	**True**

ANSWER KEY OF LEARNING ACTIVITY-5

1	**False**
2	**True**
3	**True**
4	**True**
5	**False**
6	**False**

ANSWER KEY OF LEARNING ACTIVITY-6

1	**B**
2	**B**
3	**D**
4	**A**
5	**C**
6	**D**
7	**B**

ANSWER KEY OF MODULE EVALUATION

1	**A**
2	**D**
3	**B**
4	**B**
5	**C**
6	**D**
7	**B**
8	**D**
9	**A**
10	**B**
11	**B**
12	**B**
13	**True**
14	**False**
15	**True**
16	**True**
17	**False**
18	**True**
19	**False**
20	**True**
21	**False**
22	**True**

PRISCRIBED SOURCES

- BATES Martin, Tony DUDLEY, **Nucleus – English for Science and Technology**, Longman, Hong Kong, 1993.
- COMFORT Jeremy, Allan SAVAGE, Steve HICK, **Basic Technical English,** Oxford University Press, Hong Kong, 1990.
- GLENDINNING Eric H, **English in Electrical Engineering and Electronics**, Oxford, 1991.
- ÖZBALKAN Nuri, **İngilizce - Türkçe Teknik Terimler Sözlüğü**, Özbalkan Yayınları, İstanbul, 1998.
- WEBBER Martin, **Elementary Technical English,** Nelson, Hong Kong, 1993

SOURCES

- BATES Martin, Tony DUDLEY, **Nucleus – English for Science and Technology**, Longman, Hong Kong, 1993.
- BROWN Bogart, **Electronics Devices and Circuits, Merill Publishing**, London, 1999.
- GLENDINNING Eric H, **English in Electrical Engineering and Electronics**, Oxford, 1991.
- GÖLBOL Mehmet, **Puzzles For Improving Technical English In Electric & Electronics Department,** Hatay, 2005.
- WEHMEIER Sally, **Oxford Word Power Dictionary**, Oxford, 1994.
- ZBAR Paul B, Gordon Rockmaker, **Basic Electricity**, California, 1999.