United Arab Emirates
Ministry of Education

الإمـارات العـربيـة المتحدة
وزارة التـربيـــة والتعليـــم

CDI Revision Notes

Term 1 (2017 – 2018)

Grade 10 General

Unit 3 – Fundamentals of Electronics

STUDENT INSTRUCTIONS –

- Student must attempt **all** questions.
- For this examination, you must have:
  - (a) An ink pen – blue.
  - (b) A pencil.
  - (c) A ruler.
  - (d) A calculator (if required).
- Electronic devices are not allowed.

Examination Specifications		
Domain	Marks	Time
Section 1 - 5 Multiple Choice Questions	5 Marks	3 - 4 minutes
Section 2 - 5 True or False Statements	5 Marks	3 - 4 minutes
Section 3 - 2 Short answer Questions 2 Diagram Questions 1 Matching Task	10 Marks (2 x 5) 20 Marks (2 x 10) 10 Marks	8 - 10 minutes 10 – 12 minutes 3 – 5 minutes
	Total – 50 Marks	Total – 35 minutes (5 minutes reading)

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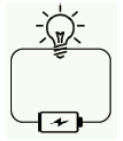
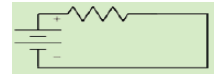
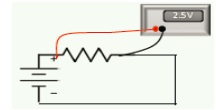
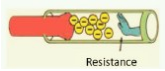
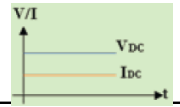
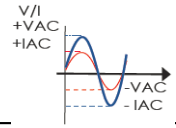
SECTION 1 – ELECTRICAL CIRCUITS

Word	Meaning	Image
Electrical Circuit	A closed path for electrons to move through electrical components, connected by a conductive wire.	
Schematic Diagram	A visual & graphical representation of an electrical circuit that uses symbols.	
Voltage	The charge difference between two points.	
Current	The rate at which electric charge flows through a certain point.	
Resistance	A materials tendency to resist (oppose) the flow of charge (current).	
DC	An electric current that flows in one direction and has a constant voltage level; used in devices that use batteries or USB cables for power.	
AC	An electric current that periodically changes its direction. The voltage level also reverses with the current. It is used to deliver power to houses, office buildings, etc.	
Battery	An electrical DC power source.	

INTRODUCTION

We use electricity in our daily lives to power our electric devices.

For example –

1. Cars get electric power from batteries.
2. Computers, televisions, air conditioners, cell phone chargers, electric gates & electric wall sockets.

Electric current is the flow of electric charge carried by **electrons**. **Electrons** are very small particles within atoms. They carry electric energy and flow through defined paths known as **electric circuits**.

Electronics is described as the science of dealing with electricity.

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SIGNAL

For receiving and sending information

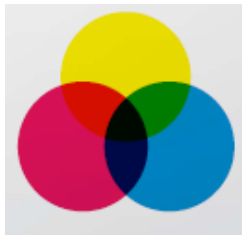
- Analog Signals

These signals have an infinite number of values.

Stored in continuous form between minimum and maximum value.

Examples

- Brightness of sun
- Room temperature
- Speaker
- Mixing colors
- Old radio
- Old photograph



- Digital Signals

These signals have a finite set of possible values. (0V or 5V)

Stored in coded form (0,1) (min., max.)

Examples

- Light switches in a class room
- Power button of phone
- Game controller buttons
- Calculator screen
- Digital camera
- Digital music player

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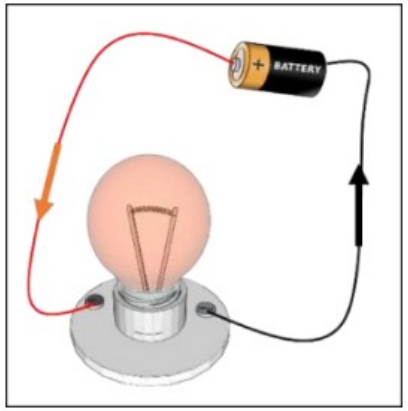


Electric Circuit : Group of electrical components connected by conductors for current flow.

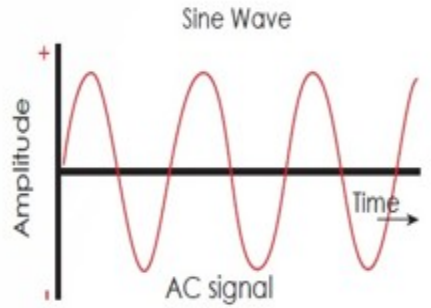
Voltage Source → **Conductive Path** → **Load**

It causes the current to flow through a circuit.

Through which current flows.

Consumes electric power.

Types of Voltage Source



Alternating Current : Wall Socket

Direct Current : Battery

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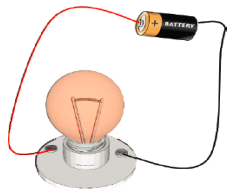
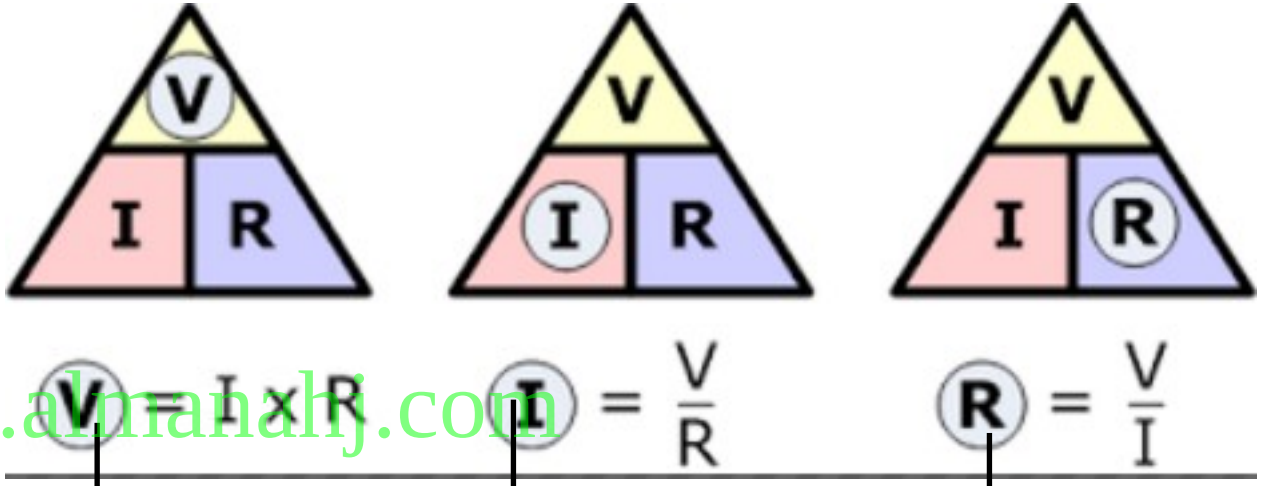
ELECTRICAL SCHEMATIC

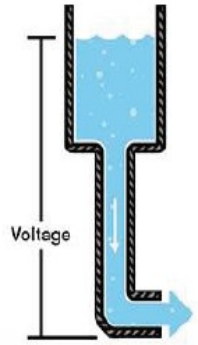
An electrical wire	
A connected wire	Connected
A disconnected wire	Not connected
A battery	+ - or + -
A light lamp or load	
Motor	M

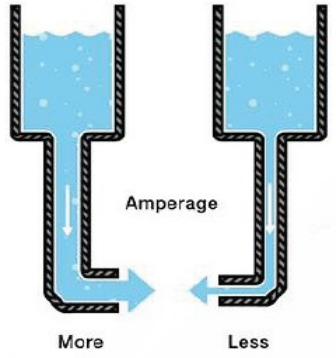


Ohm's Law

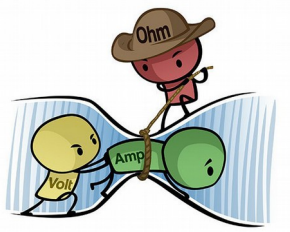


- **Voltage** is the difference in charge between two points.
- Measured in Volts (V).





- **Current** is the rate at which charge is flowing.
- Measured in Amperes (A).



- **Resistance** is a material's tendency to resist the flow of charge (current).
- Measured in Ohms (Ω).

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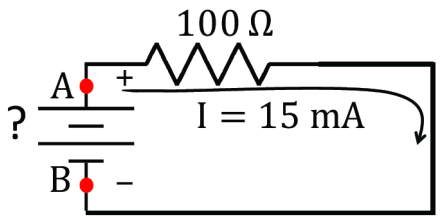
Problem 1:

Using Ohm's Law, what is the **voltage difference** between point A and B if the **current** flowing through the resistor is **15 mA,** and the **resistance** is **100 Ω**?



Solution:

V = I × R = 0.015 A × 100 Ω =1.5 V

Problem 2:

If the resistor in the previous example is replaced with another resistor, that has double the resistance, how much current would be flowing in the circuit using the same 1.5V battery as a voltage supply?

Solution:

V = 1.5 V,
R = 2 × 100Ω = 200 Ω
V = I × R ⟶ I = V / R = 1.5 V / 200 Ω = 0.0075 A = 7.5 mA

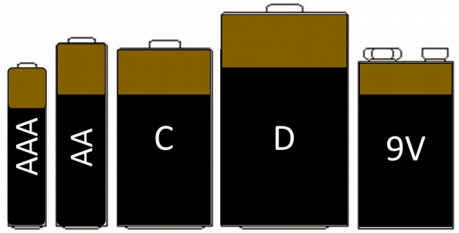
Problem 3:

Compare the value of the new current with the value of the initial current. Justify your answer.

Solution:

The new current is half the initial current (7.5 is half of 15). When the resistance was doubled, the current flowing became less (half the original current). This is because current is INVERSELY proportional to the resistance.

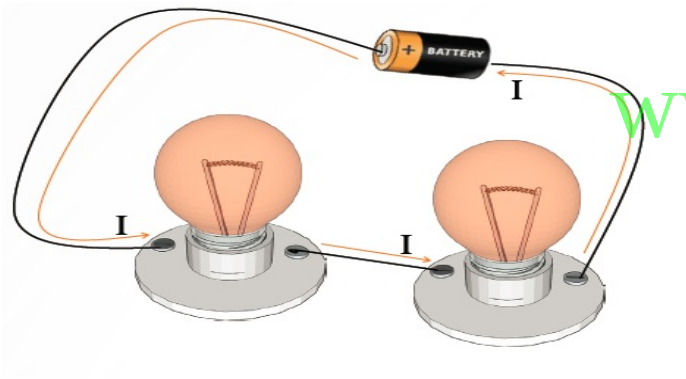
BATTERIES

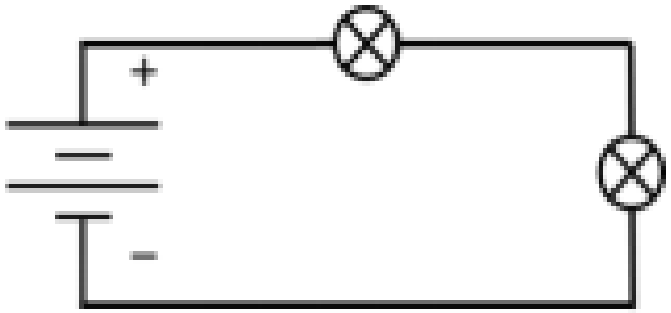


- A battery is a common DC power supply.
- A battery is made up of two plates. One plate is positively charged (+), the other plate is negatively charged (-).
- The plates are surrounded by a chemical solution called electrolyte.
- The electrical energy of a battery is made by converting the chemical energy of the battery. This happens when a chemical reaction between the plates and the electrolyte produces a voltage difference between the two plates.
- This makes the electrons flow and generates an electric current.
- The figure below shows some commonly used batteries that are available at the market. Each type has a different voltage.

SERIES CIRCUITS

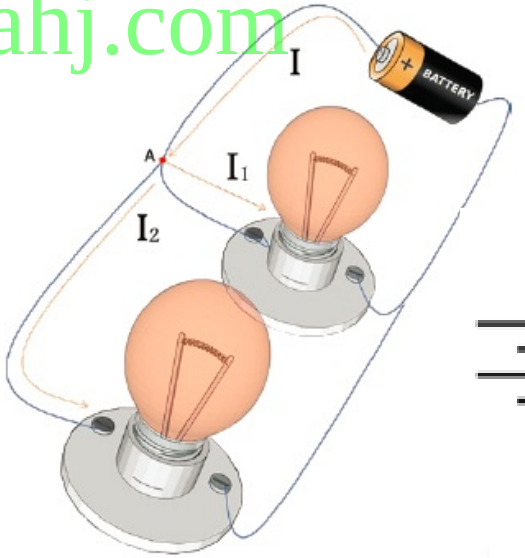
- Electric current flows in **ONE** defined path in series circuits.
- The current must flow through the wires, all the way through both light bulbs and back to the battery.

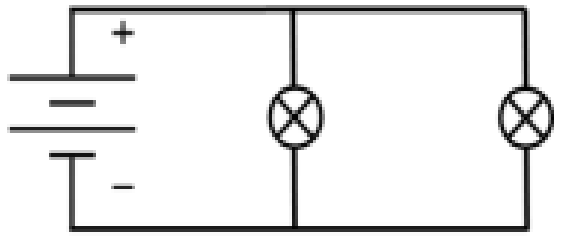




PARALLEL CIRCUITS

- In parallel circuits, electric current has more than one path.
- The components are connected to the same common points, this allows the current to be distributed over the paths.





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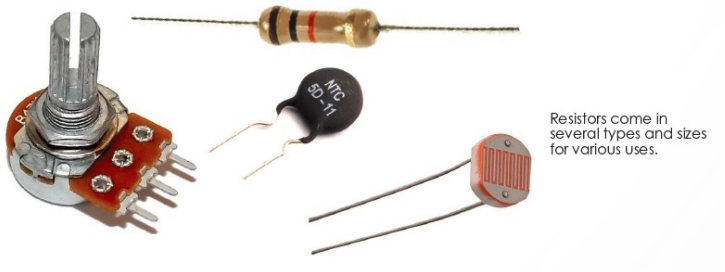
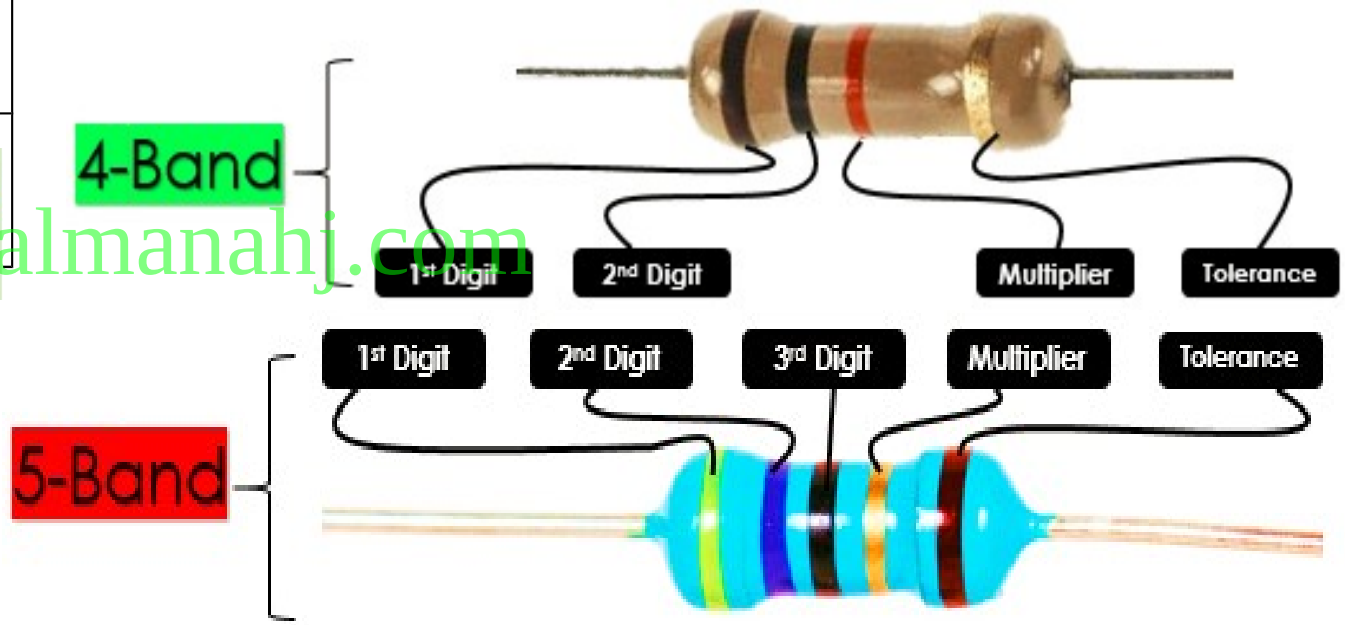
SECTION 2 – RESISTORS

Word	Meaning	Image
Resistor	An electronic component that resists the flow of current in an electric circuit.	
Colour Code Table	A table used to find out the resistance value of the colour coded resistor.	



- Resistors are also used to divide voltages.
- The schematic symbol is shown below –

Types of Resistors



Tolerance is the maximum electrical or mechanical variations plus or minus in the specifications tolerated without affecting the operations of the device.

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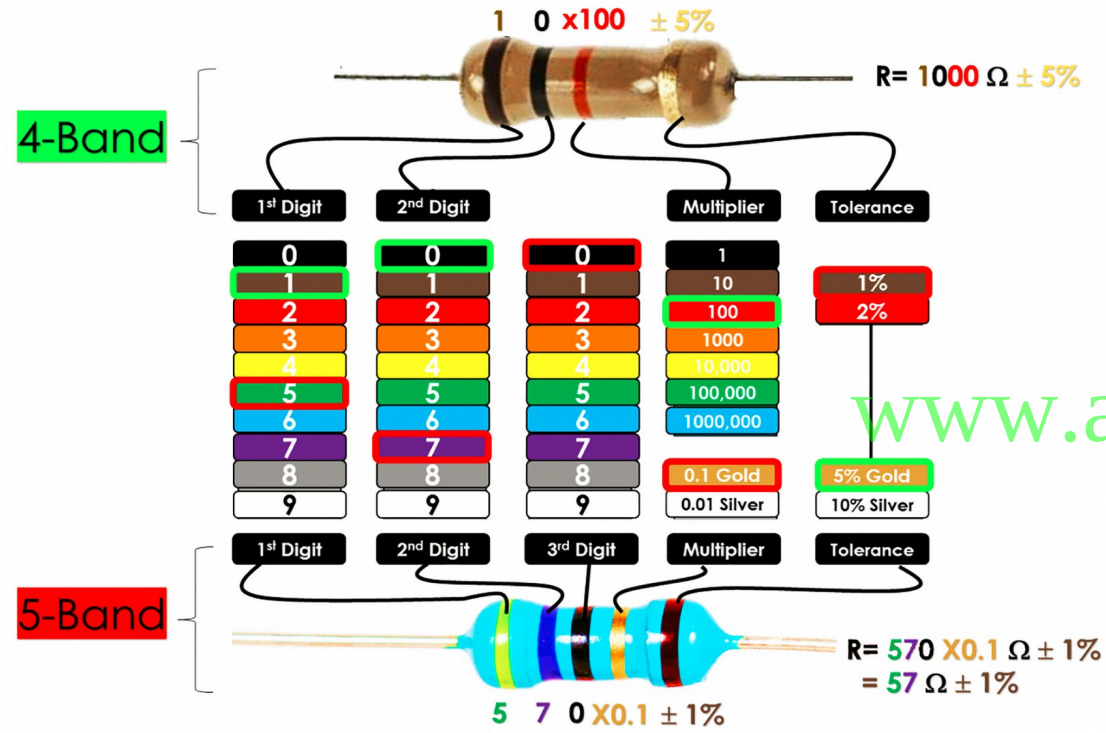
The resistance of a resistor



	Colour 1	Colour 2	Colour 3	Colour 4	Colour 5
4-Band	1st Digit	2nd Digit	Multiplier	Tolerance	
	1	0	100	5%	
	R= Digit1 Digit 2 x Multiplier ± Tolerance R = 10 x 100 ± 5% = 1000 Ω ± 5% = 1kΩ ± 5%				
5-Band	1st Digit	2nd Digit	3rd Digit	Multiplier	Tolerance
	5	7	0	0.1	1%
	R= Digit1 Digit 2 Digit 3 x Multiplier ± Tolerance R = 570 x 0.1 ± 1% = 57 Ω ± 1%				

For the 4-band resistor, the tolerance is ±5%. This means that the real resistance of this resistor will not be exactly 1000 Ω. It might be +5% more or -5% less than 1000 Ω. So how much is 5% of 1000 Ω?

Tolerance = ±5 % of 1000 Ω

5% of 1000 Ω = $\frac{5}{100} \times 1000\ \Omega = 50\ \Omega$

∴ Tolerance = ± (5 % of 1000) = ±50 Ω

∴ R = 1000 Ω ± 50 Ω

∴ R is between (1000-50) Ω and (1000+50) Ω

∴ R is between (950) Ω and (1050) Ω

We call this a 'range'. So, the range of the resistance is {950 Ω to 1050 Ω}.

For the 5-band resistor, the tolerance is ±1%. This means that the real resistance of this resistor will not be exactly 57 Ω. It might be +1% more or -1% less than 57 Ω. So how much is 1% of 57 Ω?

Tolerance = ±1 % of 57 Ω

1% of 57 Ω = $\frac{1}{100} \times 57\ \Omega = 0.57\ \Omega$

∴ Tolerance = ± (1 % of 57) = ±0.57 Ω

∴ R = 57 Ω ± 0.57 Ω

∴ R is between (57 – 0.57) Ω and (57 + 0.57) Ω

∴ R is between (56.43) Ω and (57.57) Ω

We call this a 'range'. So, the range of the resistance is {56.43 Ω to 56.43 Ω}.

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SECTION 3 – ELECTRONIC CALCULATIONS

Word	Meaning	Image
Breadboard	An electronic base used for building prototypes for electric circuits.	
Multimeter	An electronic device used for measuring different electrical values.	

Breadboard	Multimeter
• There are three main components – (a) Nodes – electronic components are connected to the nodes. (b) Power Rails – It is used to supply the board with power. Internally these nodes are connected vertically. (c) Terminal stripes – These are the horizontally connected nodes. • They are marked with letters (columns) and numbers (rows) to help build the circuit properly.	• It also checks the continuity in a circuit. • The different values measured are - current (Amps – AC & DC) - resistance (Ohms), - voltage (Volts – AC or DC) - diode testing - capacitance (Farads) - transistor testing, etc. • It has two probes.

SECTION 4 – EMBEDDED SYSTEMS

Word	Meaning
Embedded system	A computer system that has a specific function within a larger system.
Microcontroller	A minicomputer that fits on a single chip and controls a system.
Processing	A series of actions / steps that lead to a certain result.
Input	The information or data entered into a system.
Output	The information or data produced by a system based on the input information.

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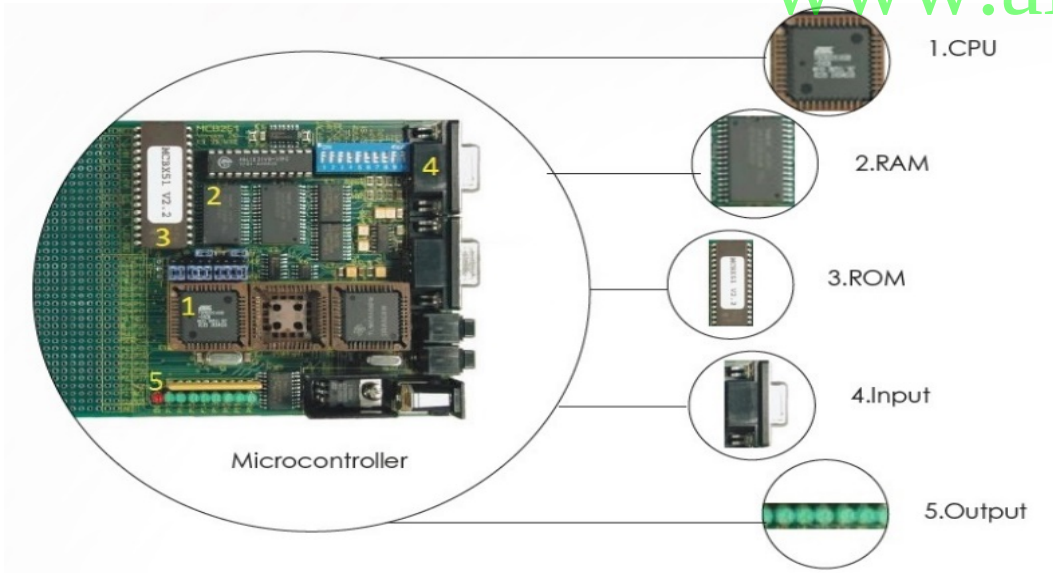
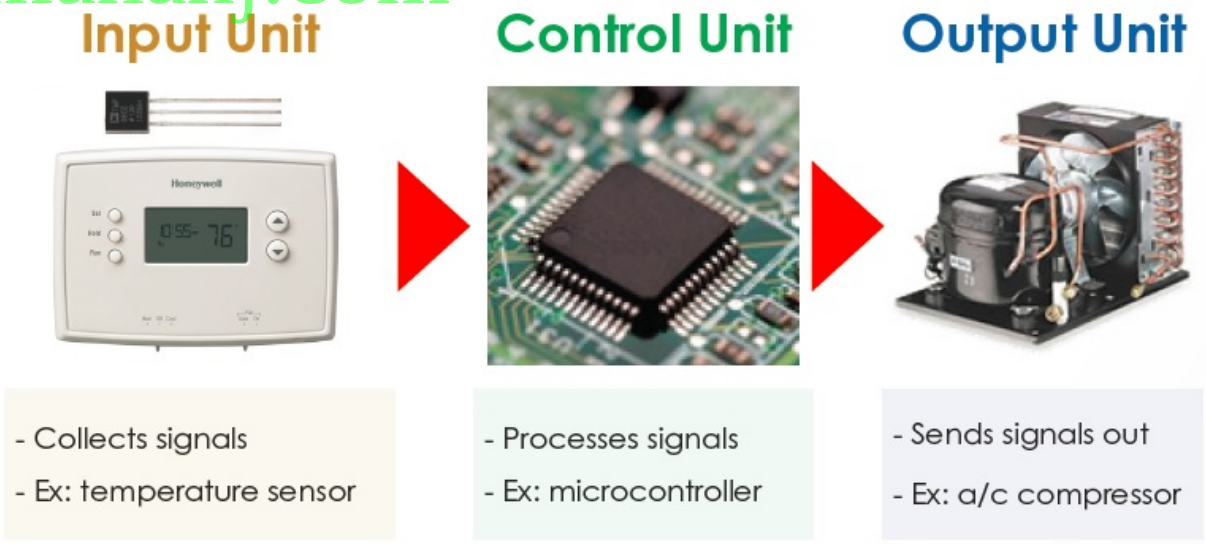
- **Embedded systems** : It is a specialized computer system with a specific function within a larger mechanical or electrical system. Examples include an air conditioner in car; a seatbelt warning in a car, a garden watering system & a motion sensitive security system.
- An “embedded system” is known as an **input.** It is a device that contains a **computer unit or a microcontroller** that reads the changes in an environment. It then controls an **output** system to change the environment.
- **Controller** : It is an electronic chip that works as a computer to manage the operation of electronic devices. It controls certain machines. It can be programmed to read input and controlling output. It has 3 main parts.



A controller has four main parts: central processing unit, random access memory, read only memory and I/O ports. When all these parts are connected on a single chip, you have a microcontroller.



An embedded system has an input unit to collect data, a control unit to process the signal and an output unit to send signals out.