BASIC ELECTRONICS

Basic electronics

Basic electronics is the branch of science and technology that makes use of **controlled motions of electron** through different **media** or **vacuum**.

Most of the electronic components are made up of semiconductors.

Examples include **diode, transistors , capacitors, light emitting diodes (LED) and resistors.**

BASIC ELECTRONICS

Basic electronics

Electronics is the branch of science and technology that deals with the behaviour and movement of electrons in a semi-conductor, vacuum or gas. Electronics involves components such as **vacuum tubes** ,**transistors**, **diodes**, **inductors**, **capacitors** and **resistors**.

BASIC ELECTRONICS

COMPONENTS IN AN ELECTRONIC CIRCUIT

A **circuit** is a complete path through which electric current flows.

The discrete components of an electronic circuit are

1. **battery**,
2. **switch**
3. **resistor**,
4. **light emitting diode** (LED),
5. **P- N junction diode**,
6. **a capacitor**
7. **inductor**

Differences between cell and battery

A battery is a combination of two or more cells but A cell is a unit containing two or more electrodes (such as strips of metal) immersed in an electrolyte (a solution of an acid, base or salt in

Differences between cell and battery

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The **battery** is the source of electrical energy in an elec c c







The polarity of a battery is shown, being marked with conventional **positive** (+) and **negative** (-) signs.

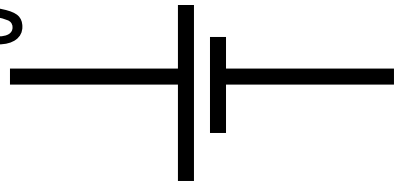
BASIC ELECTRONICS

The polarity of a battery is shown, being marked with conventional **positive** (+) and **negative** (-) signs.

The circuit symbol for a battery is



The circuit symbol for a cell is



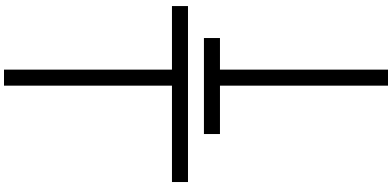
BASIC ELECTRONICS

The polarity of a battery is shown, being marked with conventional **positive** (+) and **negative** (−) signs

The circuit symbol for a battery is



The circuit symbol for a cell is



The long bar is the positive terminal and the short bar is the negative terminal

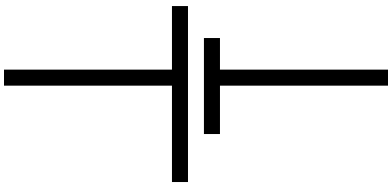
BASIC ELECTRONICS

The polarity of a battery is shown, being marked with conventional **positive** (+) and **negative** (−) signs

The circuit symbol for a battery is



The circuit symbol for a cell is



The long bar is the positive terminal and the short bar is the negative terminal

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Switch

A switch is an **device that is used to open or close a circuit.**

A switch is a device that is used to **turr OFF**.



The circuit symbol for **switch** is



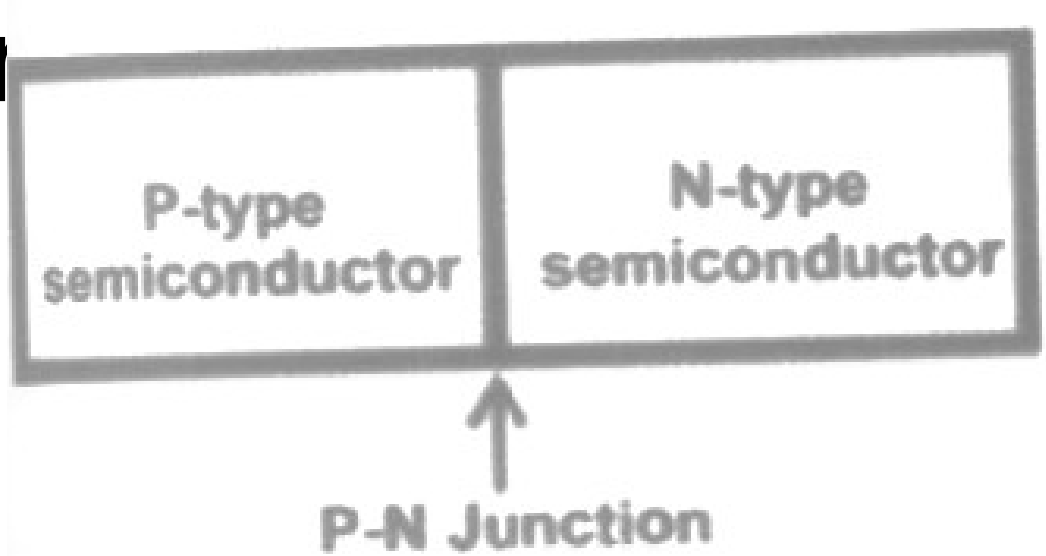
P-N Junction Diode

The P-N Junction diode is an electronic device that which **allows current to flow in only one direction.**

P-N Junction diode is made from semiconductor materials such as **silicon**, **germanium** and **arsenic.**

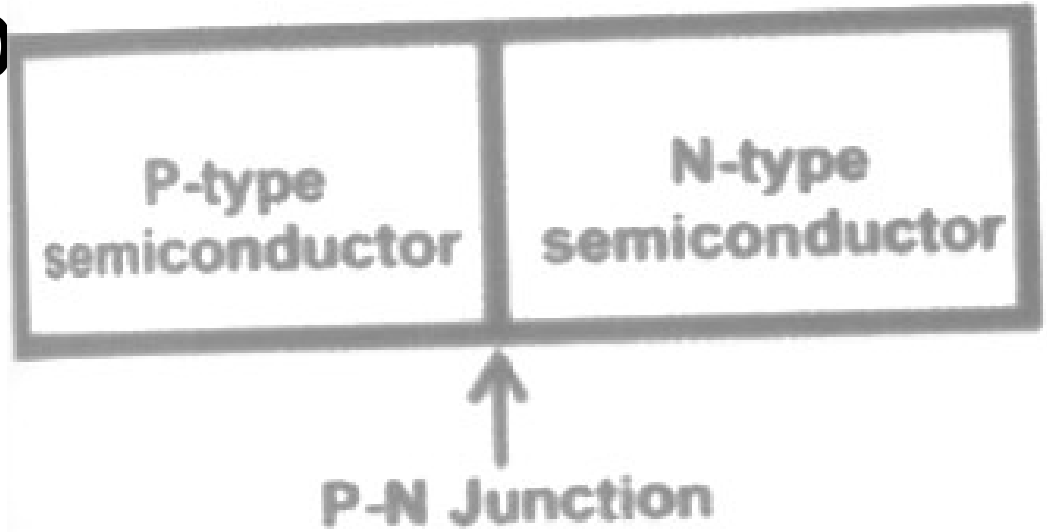
Composition of P-N Junction Diode

The component of P-N junction diode is a P-type semiconductor joined together with an N-type semiconductor as shown in figure.

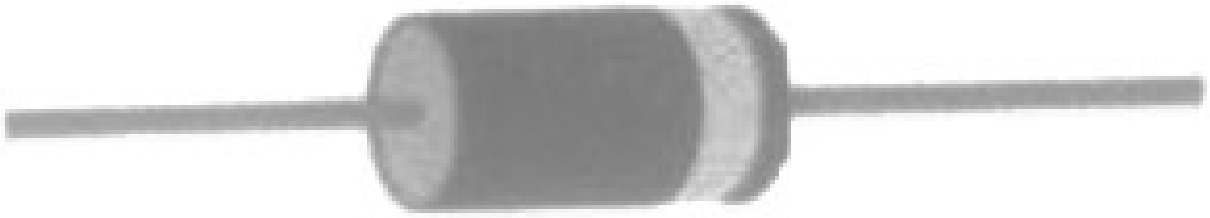


What is P-N Junction ?

P-N junction of a diode is the **region between** the P-type and the N-type semiconductors o



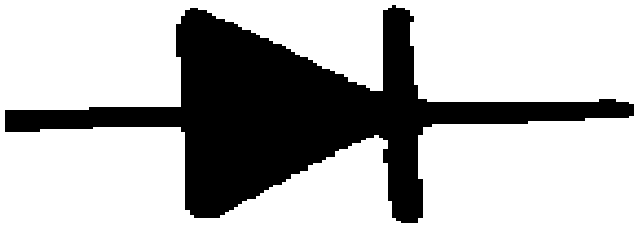
Picture of P-N Junction Dic



P-N Junction Diode

From the diagram above **dark portion** is the P-region and the **white** is the N-region.

Symbol of P-N Junction Diode



From the diagram above **the triangular shape** is the P-region and the **vertical bar** is the N-region.

Differences between P-type and N-type semiconductors

The types of semiconductors are

1. N-type semiconductor.
2. P-type semiconductor

N-type semiconductor is a specially prepared

Biasing a P-N Junction Diode

What is biasing?

Biasing refers to the **application of electric voltage** to a P-N junction diode.

Types of biasing

1. Forward biasing

When is a diode said to be forward biased?

Forward bias is when the **positive terminal** of a battery is connected to the **p-type** of the diode and the **negative terminal** of the battery is connected to the **n-type** of the diode.

When is a diode said to be Reverse-bias?

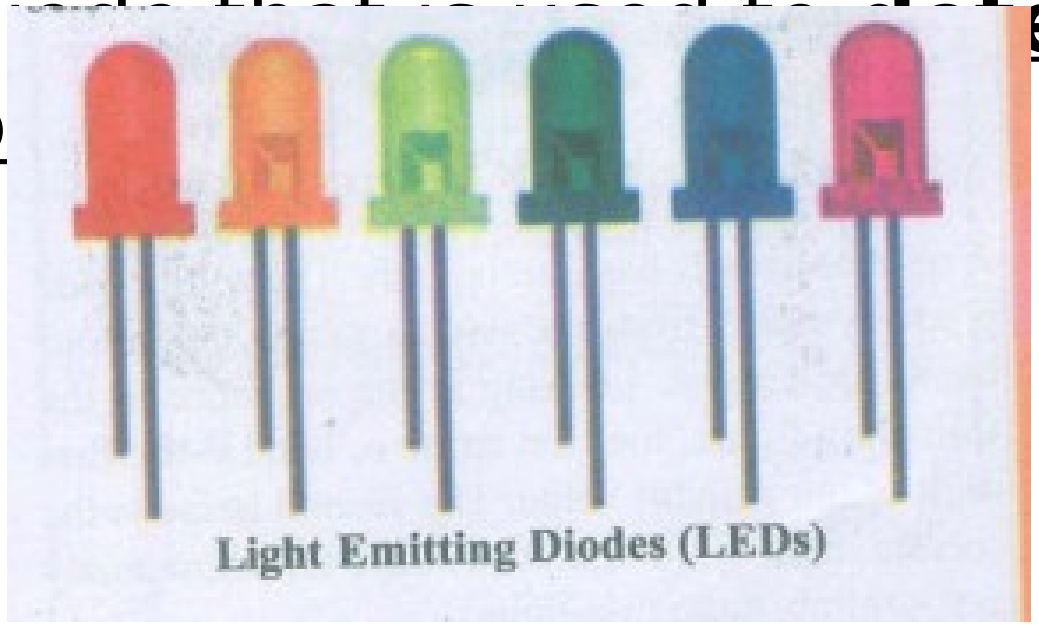
Reverse bias means connecting the **P-type** region to the **negative terminal** of the battery and the **N-type** region to the **positive terminal**, produces the reverse-bias effect.

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Light Emitting Diode (LED)

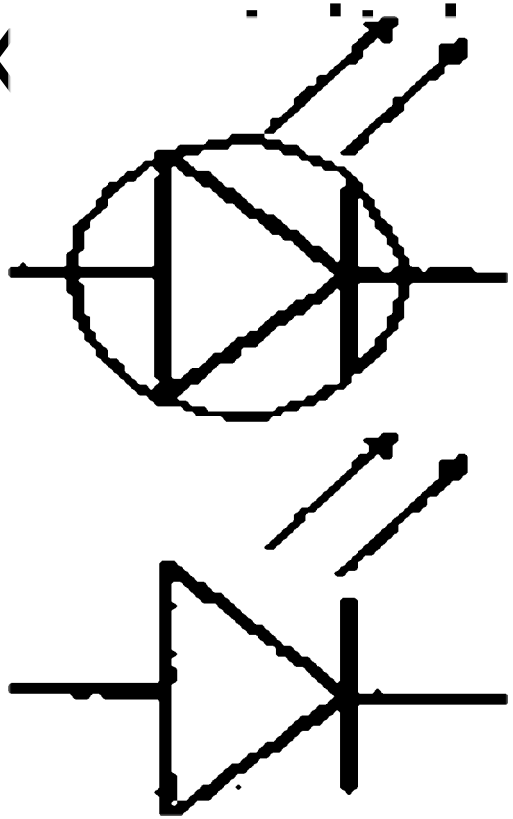
A light emitting diode (LED) is an electronic device which **changes electrical energy to light energy**.

It is a special type of P-N junction semiconductor di[illegible] **ect the presence o current.**



Symbol for Light Emitting Diode (LED)

The symbol for LED is just like a diode ex[illegible] as **arrows**



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How to connect a LED

An LED has two leads. The long lead is the positive terminal and the short lead is the negative terminal.

When an LED is connected in an electronic dc circuit, the positive terminal should be connected to the connecting wire from the positive terminal of the battery, and the short lead to the negative terminal path of

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Resistors

A resistor is an electronic component used to **control the flow of electric current in a circuit**.

What is resistance?

Resistance refers to **the ability to resist the flow of current by a resistor.**

The resistance is measured in ohms (**Ω**).

Carbon resistors have colour codes.

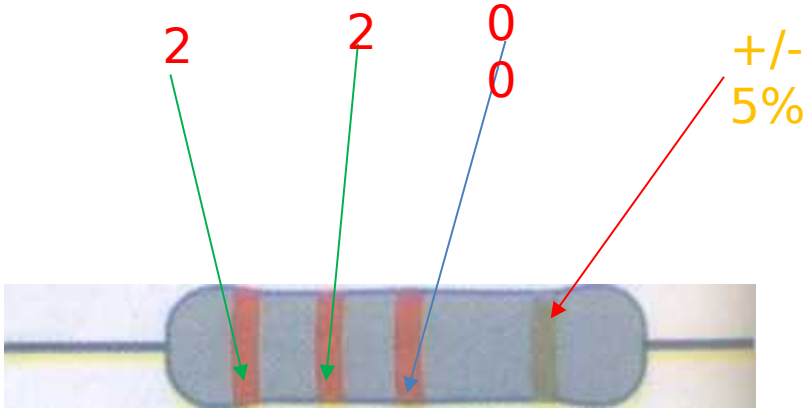
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Reading The Resistance Of Carbon Resistors

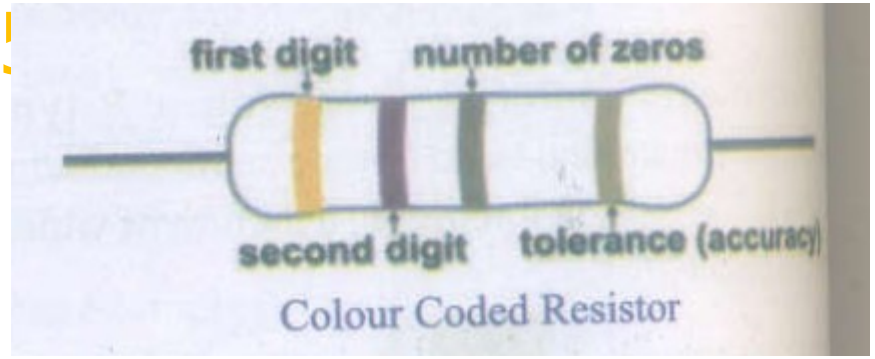




	COLOUR	NUMERS OR ZEROS
Bad	BLACK	0
Boys	BROWN	1
Rap	RED	2
Our	ORANGE	3
Young	YELLOW	4
Girls	GREEN	5
But	BLUE	6
Virgins	VOILET	7
Go	GREY	8
Without	WHITE	9
Silver and	Silver	+/- 10



Reading : 2200Ω +/-



NUMBER-NUMBER- NUMBER OF ZEROS-

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Picture of resistors



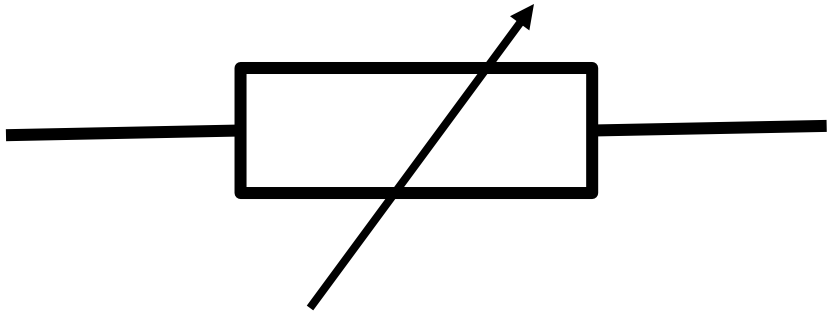


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Circuit symbol for resistors



resistor



heostat(variable resistor)



resistor

A **rheostat(variable resistor)** is used in an electric circuit in order to **increase and decrease electric current**.

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Capacitor

Capacitor is an electronic component used for **storing electrical charges**. They are used in cameras to produce flash light.

Picture and circuit symbol of capacitor



Capacitor

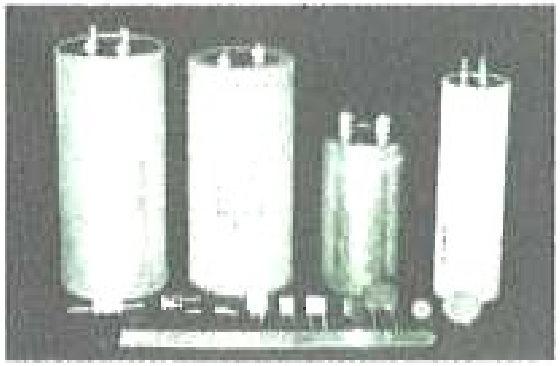

Symbol for Capacitor

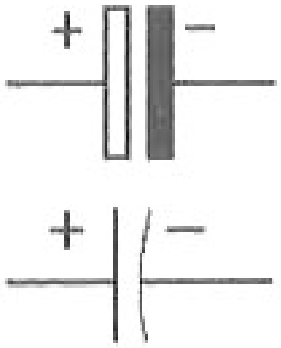
BASIC ELECTRONICS

Capacitor

Capacitor is an electronic component used for **storing electrical charges**. They are used in cameras to produce flash light.

Picture and circuit symbol of capacitor





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Composition of a capacitor

It is basically made up of two **metal plates** separated by an **insulating material** and then rolled into a cylindrical form. The insulating material is called **dielectric**. Examples of dielectric are **paper**, **air**, **milk** and **electrolyte**.

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What is charging of a capacitor?

Charging is the process of **storing electric charges on the plates of a capacitor**.

When a capacitor is connected in a dc circuit, charges accumulate on either plates. One plate becomes positively charged and the other plate negatively charged.

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When does charging stop?

When the **voltage across the capacitor** is **equal to the applied voltage**, the capacitor is said to be charged and current flow ceases.

Connecting a capacitor in a circuit

A capacitor has two leads, the **positive** lead which is **long** and

BASIC ELECTRONICS

What is capacitance?

Capacitance is the **ability for a capacitor to store electrical charges.**

It is measured in **Farads(F).**

Sub unit is **microfarad (µF).**

Inductor

An **inductor** is an electronic device which **opposes a sudden change in the electric current** flow.

Composition of an inductor

An inductor is simply a **coil of wire of several turns**.



Air-core Inductor



Iron-core Inductor

of iron

(air

The symbol for inductor is 

Inductor

An **inductor** is an electronic device which **opposes a sudden change in the electric current** flow.

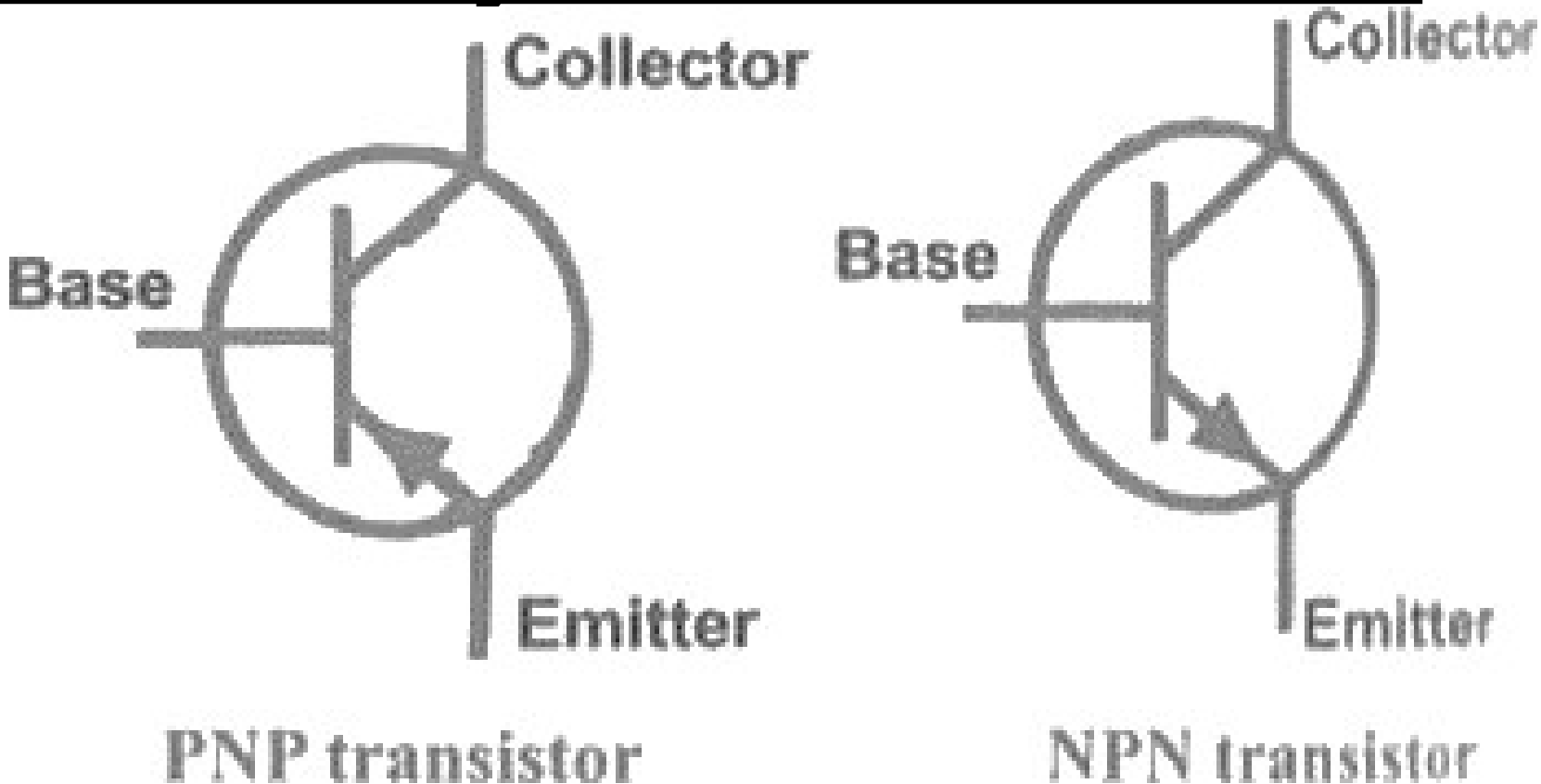
Composition of an inductor

An inductor is simply a coil of wire of several turns. The wire may be wound on a piece of

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Transistors

Transistor is an electronic device commonly used as **amplifier** or **electronically controlled switch**

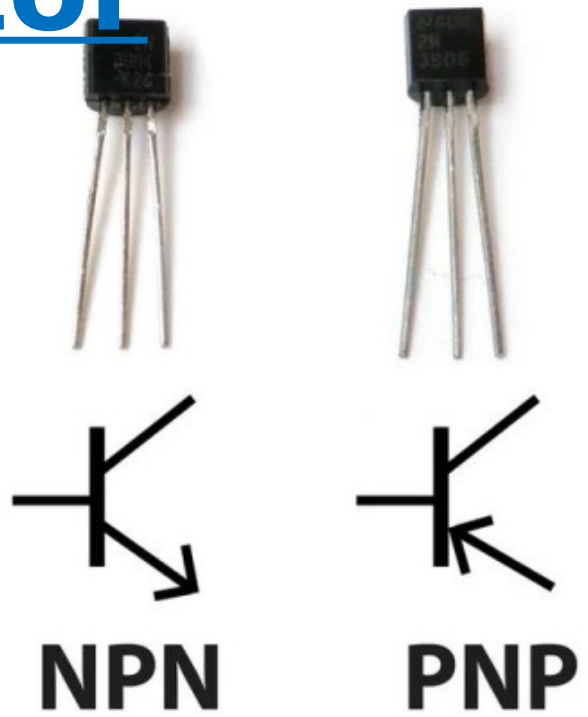


BASIC ELECTRONICS

Transistors

Types of Transistors

1. PNP transistor
2. NPN transistor



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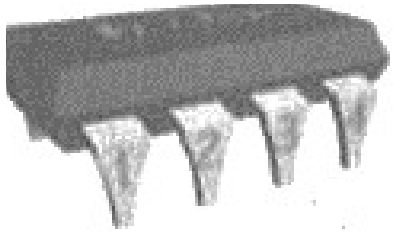
Integrated circuit (IC)

An integrated circuit is a tiny complex electronic component containing a semi-conductor material used to perform a special electronic function.

Composition of IC inc

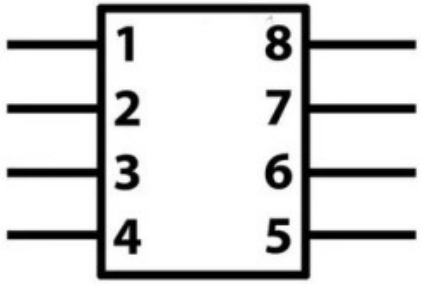
resistor and **capaci**

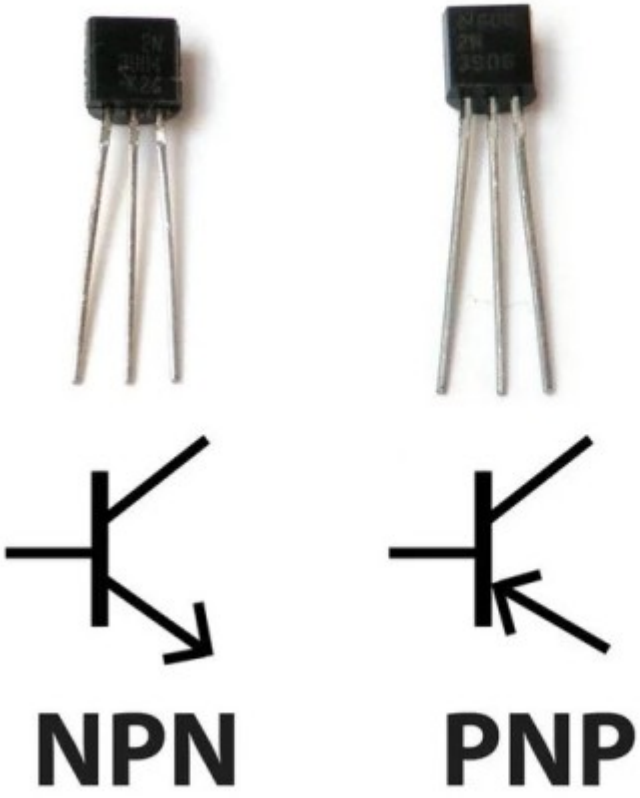






An integrated circuit and its symbol




NPN
PNP

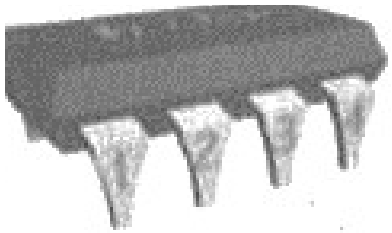
BASIC ELECTRONICS



Capacitor



Symbol for Capacitor





An integrated circuit and its symbol

Semiconductor

A **semiconductor** is a **material** that is able to conduct electricity at room temperature more readily than an insulator (e.g. rubber, wood, glass) but less easily than a metal.

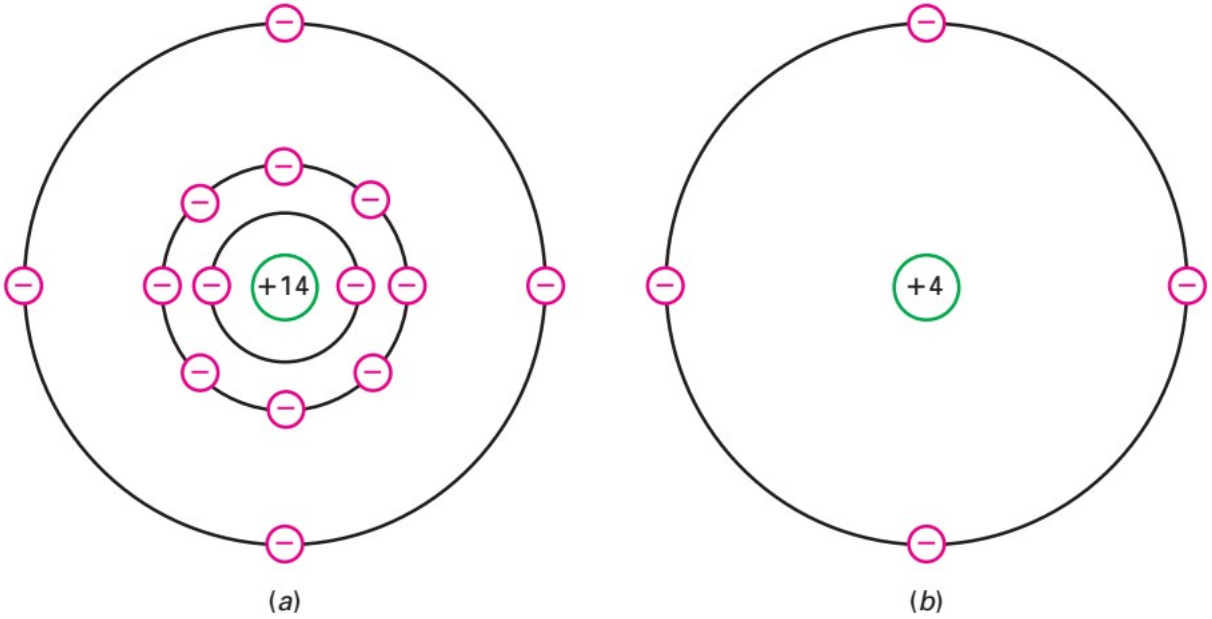
Examples of semiconductors are **silicon**, **arsenic**, **germanium.**

They usually have 4 valence electrons.

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Silicon

Next to oxygen, silicon is the most abundant element on the earth. Without it, modern electronics, communications, and computers would be impossible. It exist as silicon oxide in soil(**Si**



Making semiconductors become good conductors?

At low temperatures, pure semiconductors cannot conduct electricity well , however, semiconductors can be made to conduct electricity in two ways. These are:

(i) under **higher temperatures** and

(ii) with the **addition of impurities** (doping)

Doping

Doping **simply means the** addition of small amount of foreign elements to a pure semiconductor to make it conduct electricity.

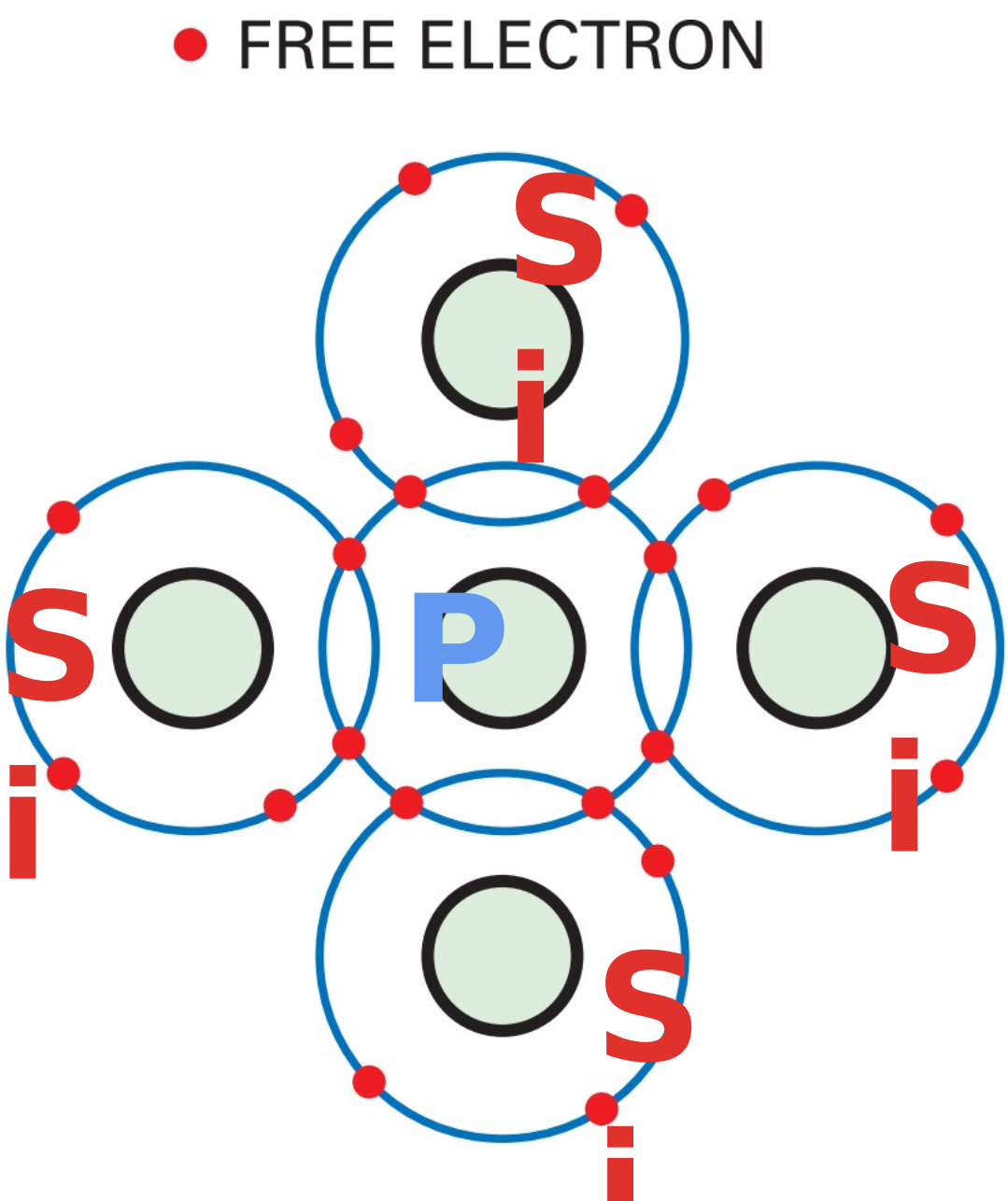
Two Types of Extrinsic Semiconductors

A semiconductor can be doped to have an **excess of free electrons** or **an excess of holes.**

Increasing the Free Electrons (N-Ttype semiconductor)

Pentavalent atoms include **phosphorus** and **antimony**. These materials(**5 electrons)** will **donate an extra electron to the silicon(4)** crystal.
A pentavalent atom is in the center, surrounded by four silicon atoms. Since only eight electrons can fit into the valence orbit, the ***extra electron***

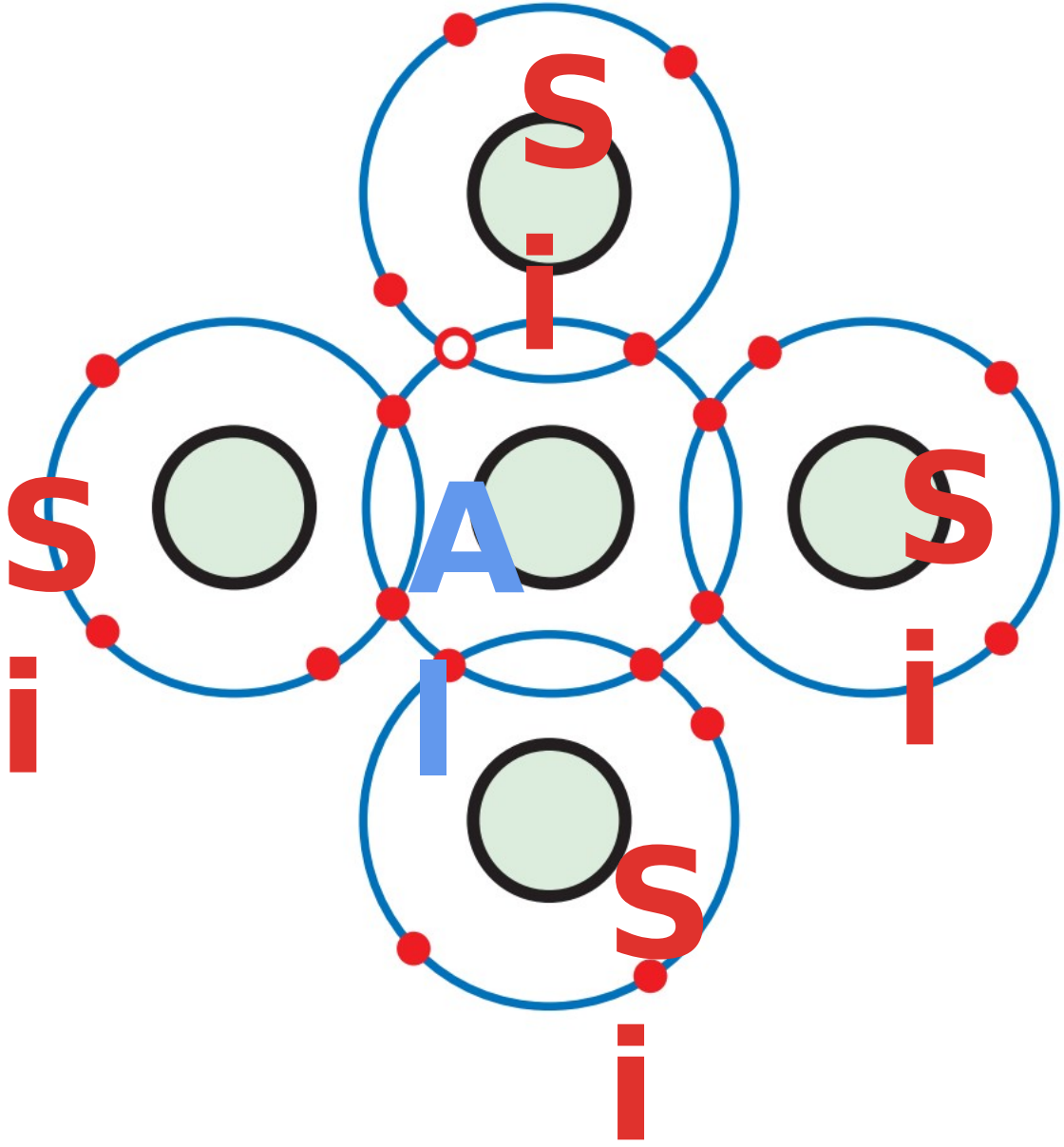
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Increasing the Number of Holes (making P-Ntype semiconductors)

Trivalent impurity, one whose atoms have only three valence electrons. Examples include aluminum, boron, and gallium.

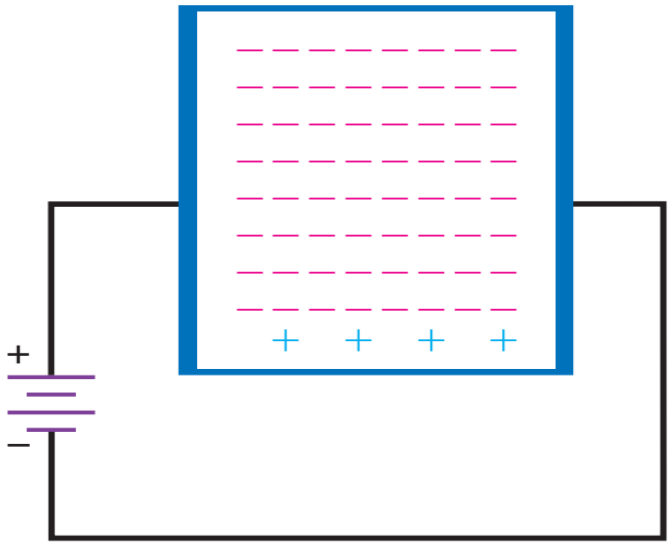
Trivalent atom in the center. It is surrounded by four silicon atoms, each sharing one of its valence electrons. Since the trivalent atom originally had only three valence electrons and each neighbor shares one electron, only seven electrons are in the valence orbit. This means that a ***hole exists in the valence orbit of each trivalent atom***. A trivalent atom is also called an acceptor atom because each hole it contributes can accept a


Si
Si
Al
Si
Si
Si

N-Type Semiconductor

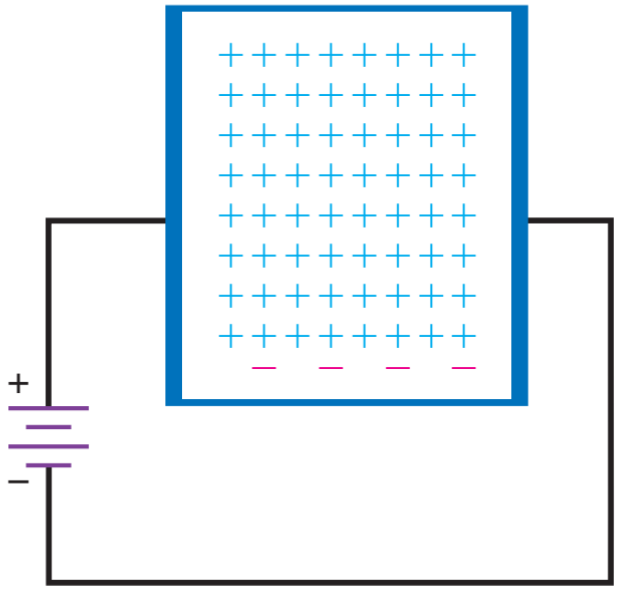
Silicon that has been doped with a pentavalent impurity is called an n-type semiconductor, where the n stands for negative. Since the free electrons are more than the holes in an n-type semiconductor, the ***free electrons are called the majority c*** ***are called the minority c***

n-type semiconductor has many free electrons.



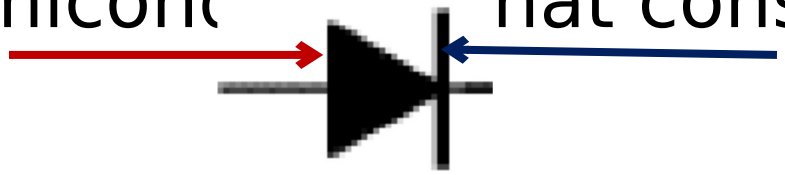
P-Type Semiconductor

Silicon that has been doped with a trivalent impurity is called a p-type semiconductor, Since holes are more than free electrons in a ***p-type semiconductor, the holes are referred to as the majority carriers*** and ***the free electrons are known as the***

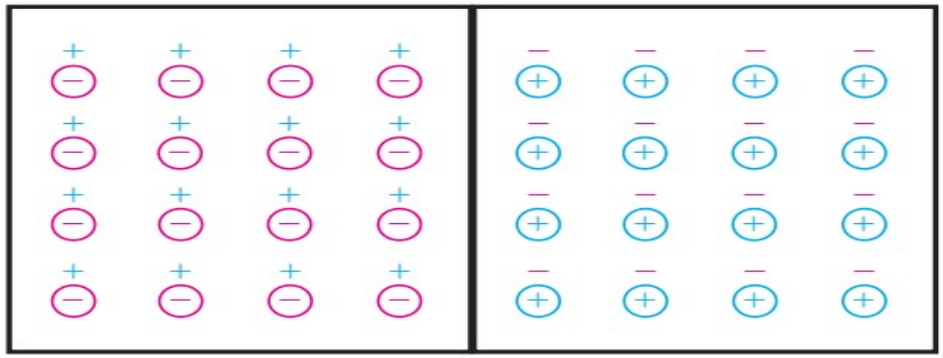


Joining N-type semiconductor to P-Type Semiconductor

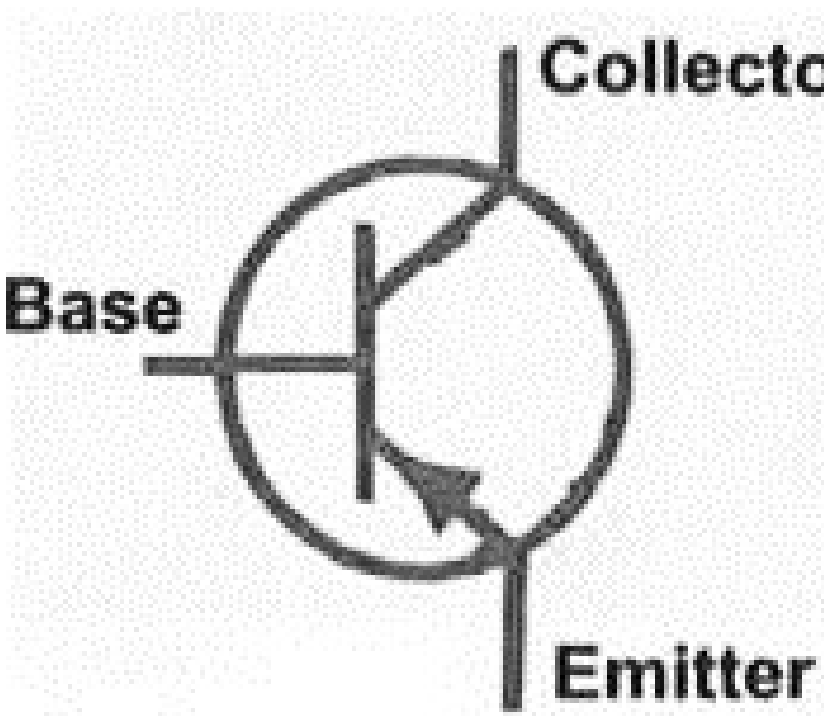
Diode is a semicond hat consists of a p-n junction.



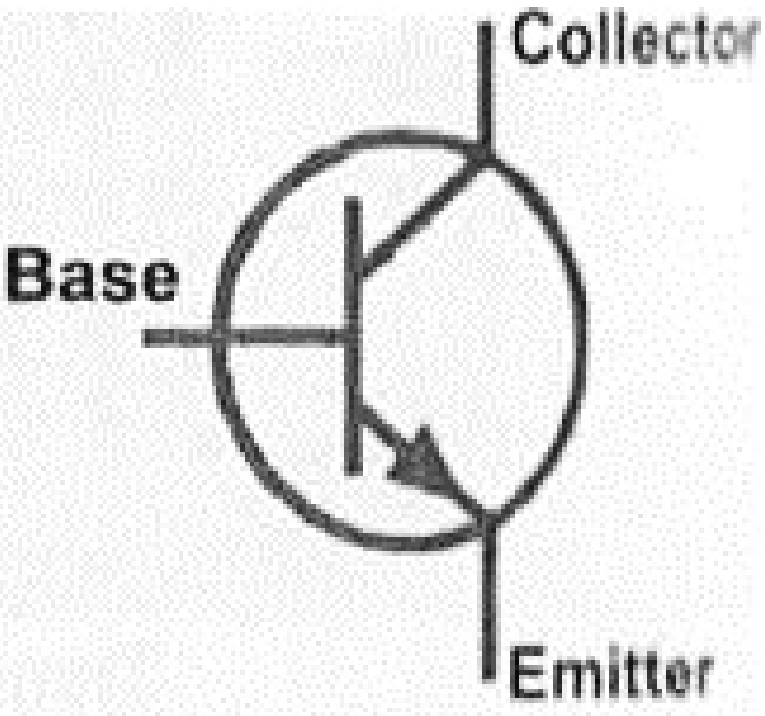
The *pn* junction.



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PNP transistor



NPN transistor

Using Doped semiconductors

Series of pn junction are used to make **transistors, diodes,** and **integrated circuits** (which are a collection of transistors, diodes, resistors, and capacitors on a tiny chip of silicon)

What is a transistor?

A transistor is a **small low-powered solid state** electronic device consisting of a semiconductor and at least three electrodes called the emitter (E), base (B) and the collector C).

A transistor can generally be classified as

1. Bipolar Junction Transistor (**BJT**)
   or
2. Field Effect Transistor (**FET**).

Bipolar Junction Transistor (BJT)

The Bipolar Junction Transistor is a three terminal semiconductor device.

Bipolar refers to the charge carriers responsible for current flow are two: **holes** and **electrons.**

Composition of transistors

A transistor has three doped regions. These are

1. emitter which is the bottom region
2. base which is the middle region
3. collector which is the top region

What is a transistor?

A transistor is a three terminal semi-conductor device commonly use as an amplifier or an electrical control

What is a transistor?

The transistor is the **fundamental building block** of the circuitry that governs the operation of **computers, cellular**

What is a transistor?

A transistor is a three-semiconductors, two junction device used to control the flow of electrons.

Where transistors are used

The transistor is the **fundamental building block** of the circuitry that governs the operation of **computers**, **cellular** or **mobile phones**, **television**

Components of a transistor

A transistor has three main parts.

1. Emitter (negative lead)
2. Base
3. Collector (positive lead)

Components of a transistor

Base lead is to activate the transistor.

Emitter lead is to inject electrons into a transistor.

Junctions of a transistor

Two P-N junctions are joined back to back to form a transistor. The two junctions of the transistors are :

Types of Transistors

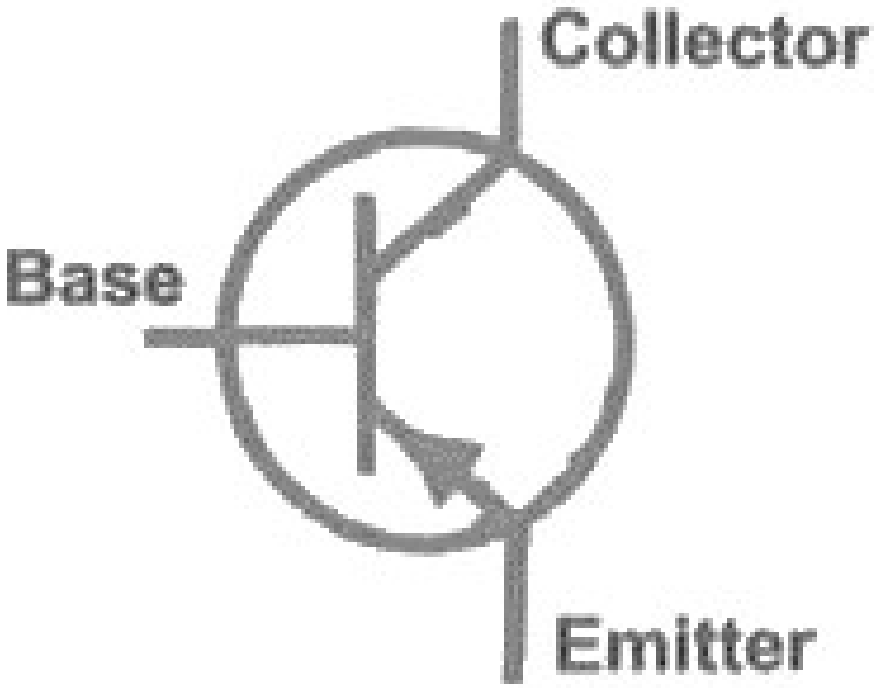
They are

1. N PN transistors and

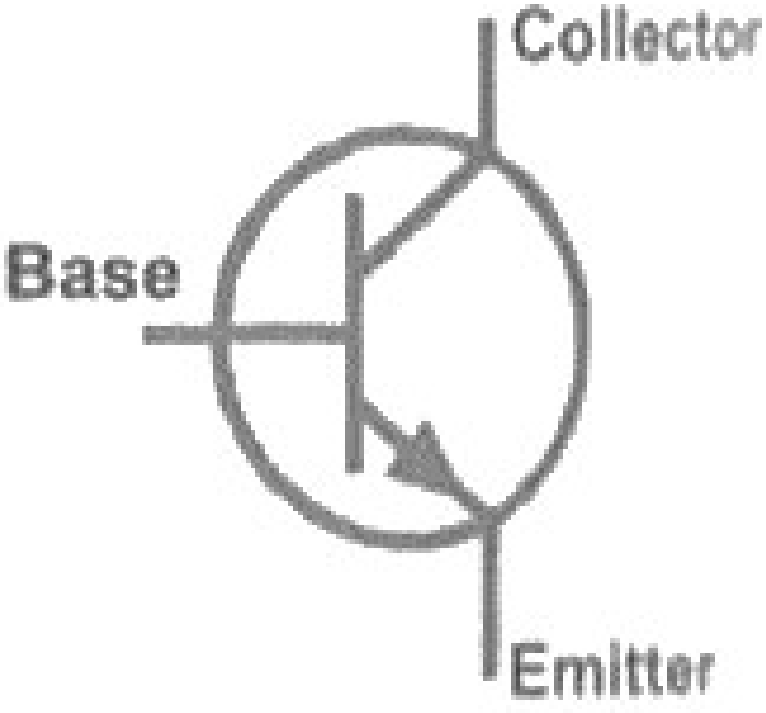
2. PNP transistors.

In both types of transistors, the middle region which is smaller than the two others is called the base (b). The outer regions are called emitter (e)

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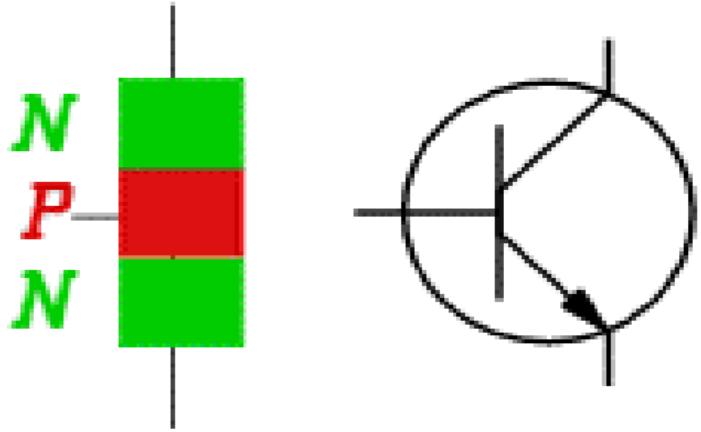
PNP transistor



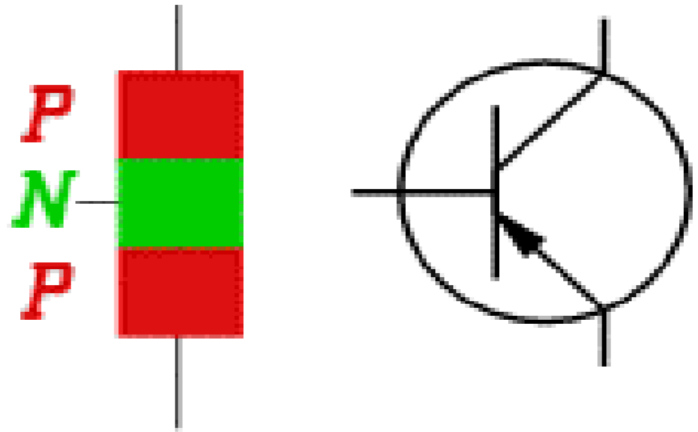
NPN transistor

BASIC ELECTRONICS

npn transistor



pnp transistor



N PN Transistors

This is a two-junction semiconductor transistor with an **N-type collector and emitter** and **a P-type base**. An **N P N transistor** is formed by introducing a thin piece of **P-type** semiconductor material **between two N-**

PNP Transistors

This is a two-junction semiconductor transistor with a **P-type collector and emitter** and an **N-type base.** A **P N P transistor** is formed by introducing a thin piece of **N-type** semiconductor material **between two P-**

Note: As the arrow is always on the emitter lead, it also points in the direction of conventional current flow (i.e. from positive to negative).

- A transistor is similar to two diodes .
- It consists of three leads which are emitter, base and

Uses of a transistor

1. Used as an amplifier.
2. Used as a switch.
3. For voltage or current regulation.
4. For rectification.
5. For tuning in radios.

Uses of a transistor

Electronic components that are used to produce oscillator circuits include the following:

- Transistor
- Inductor
- Capacitor

An **oscillator circuit** is a circuit that is used to generate

Regions of Operation of a Transistor

Active Region

When the base-emitter junction is forward biased and the collector-base junction is reverse biased the transistor operates in the active region i.e. current flows.

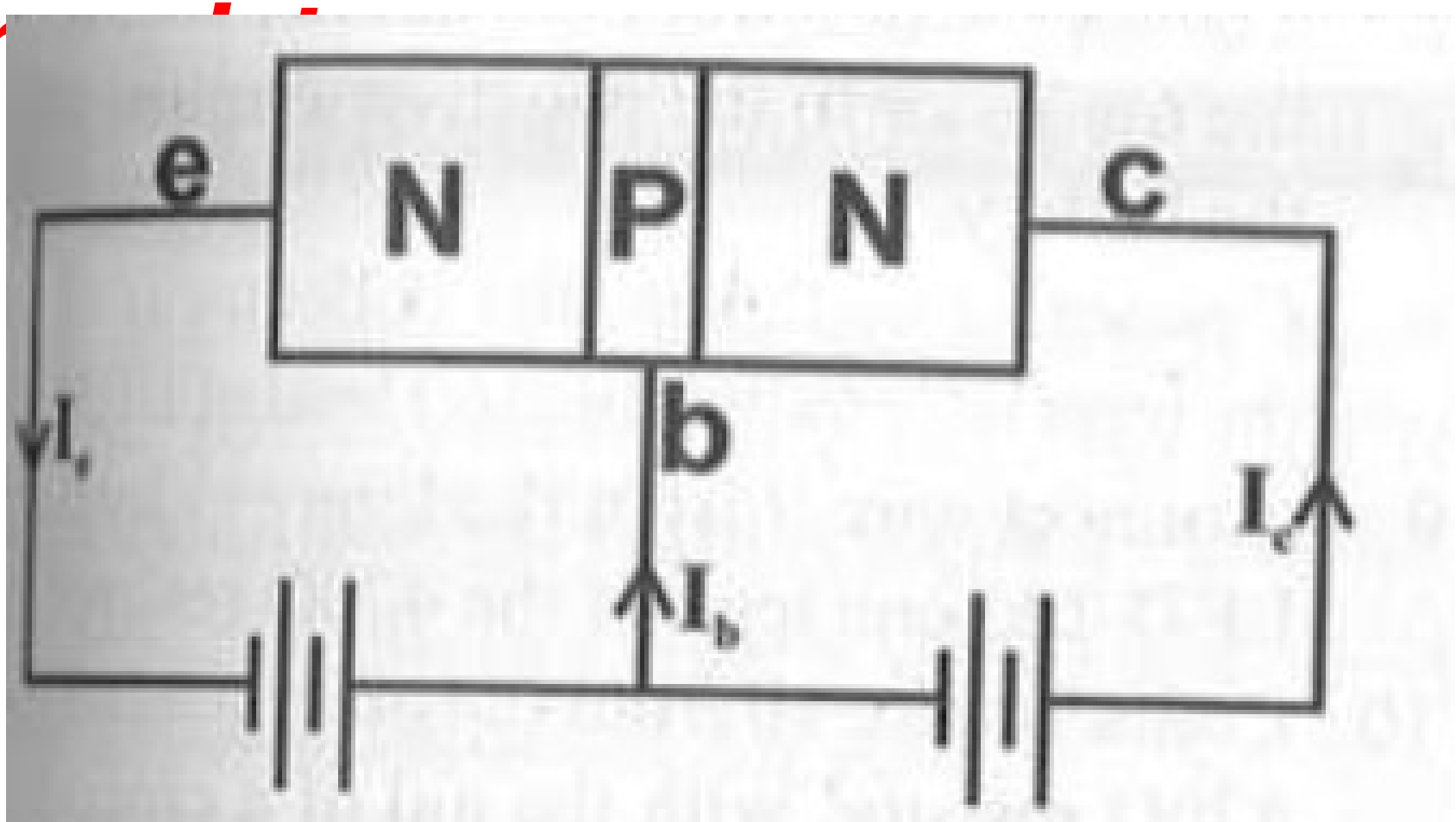
Saturation Region

When both the base-emitter and collector-base junctions are forward biased the transistor operates in saturation i.e. large current flows.

Cut off Region

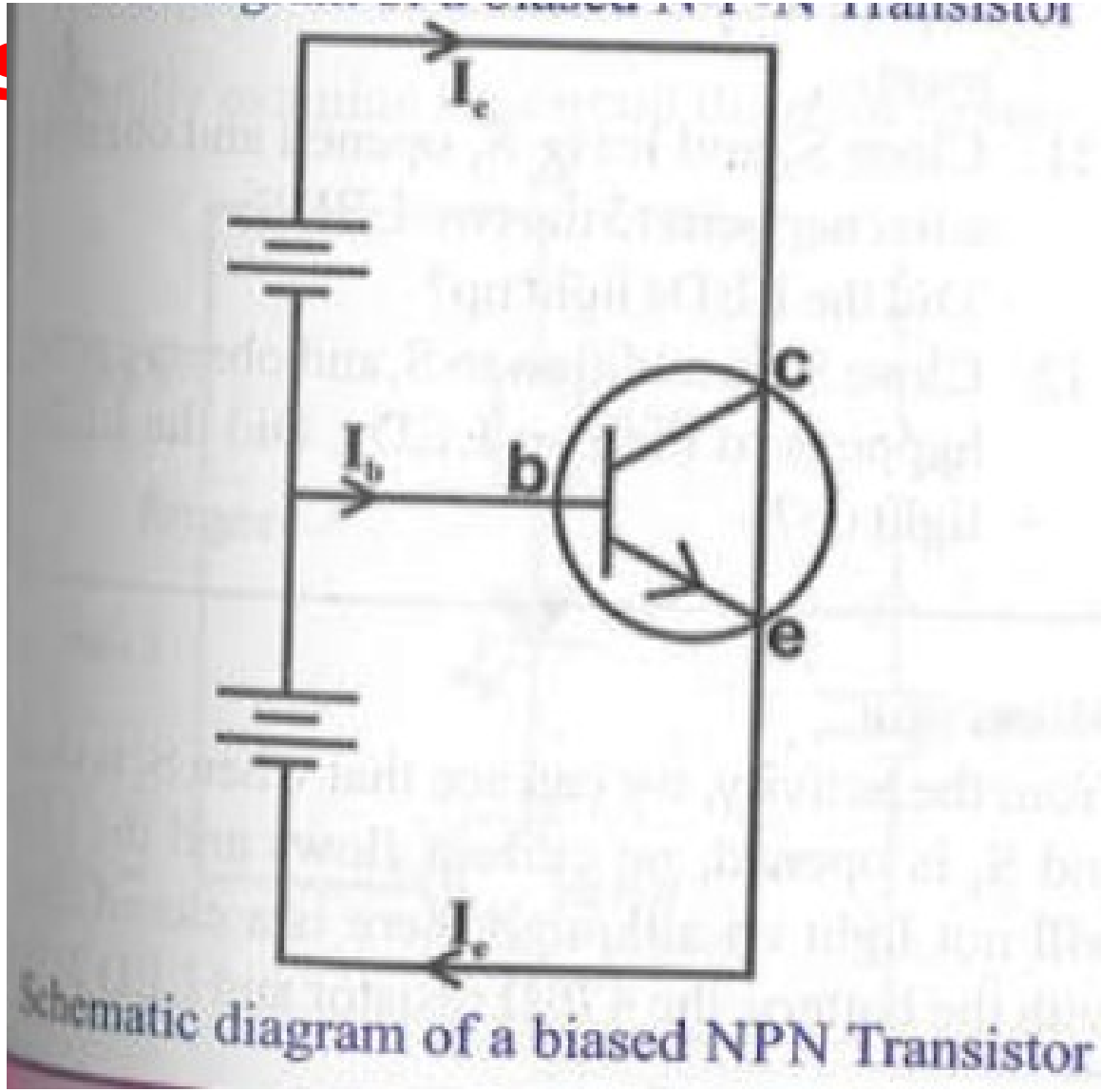
When the base-emitter junction is reversed biased the transistor is in cut off region and no

Regions of Operation of a Tr



Block diagram of a biased N-P-N Transistor

Regions of Operation of a Trans



Schematic diagram of a biased NPN Transistor

The use of a transistor as a current amplifier

An amplifier is any electronic device which is capable of increasing the power level of a signal (voltage or current) without distorting it.

The process **of increasing the strength of a signal using a**

Mode of operation for amplification

When the transistor is operated in the active region then it can be made to function as an amplifier.

That is, a small signal (e.g. a small ac voltage) applied at the input produces a large signal at the output

For example, in amplifiers of a sound system, transistors are used to amplify the weak electrical signals into a

How the NPN transistor works

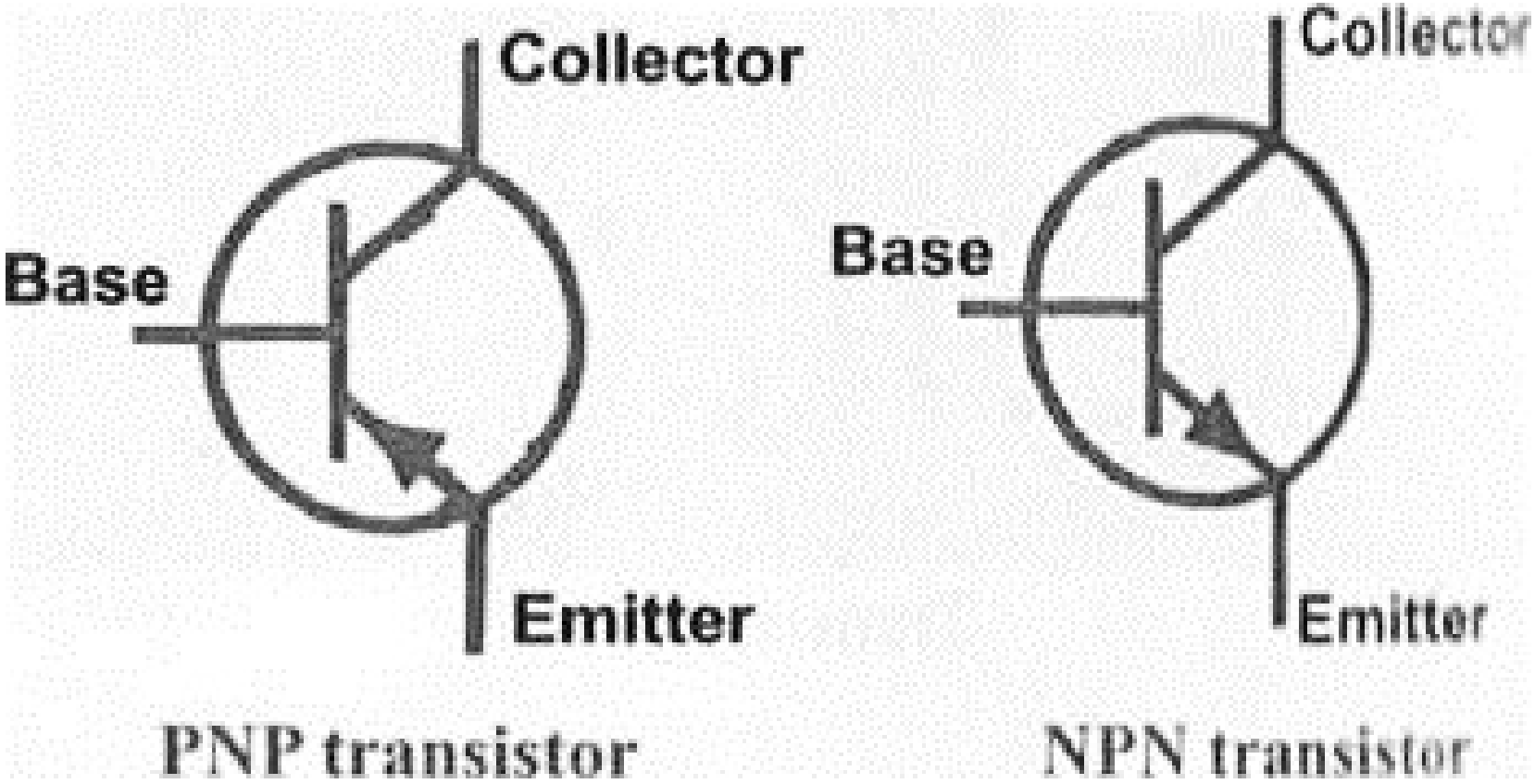
The layers of an N P N transistor must have the proper voltage connected across them. The voltage of the base must be more positive than that of the emitter. The voltage of the collector in turn, must be more positive than that of the base. The voltages are supplied by a battery or source of emf.

The emitter supplies negative charges called electrons. The base pulls the electrons from the emitter because the base has a more positive voltage than the emitter. This movement of electrons creates the flow of electric current or electricity through the transistor. The current

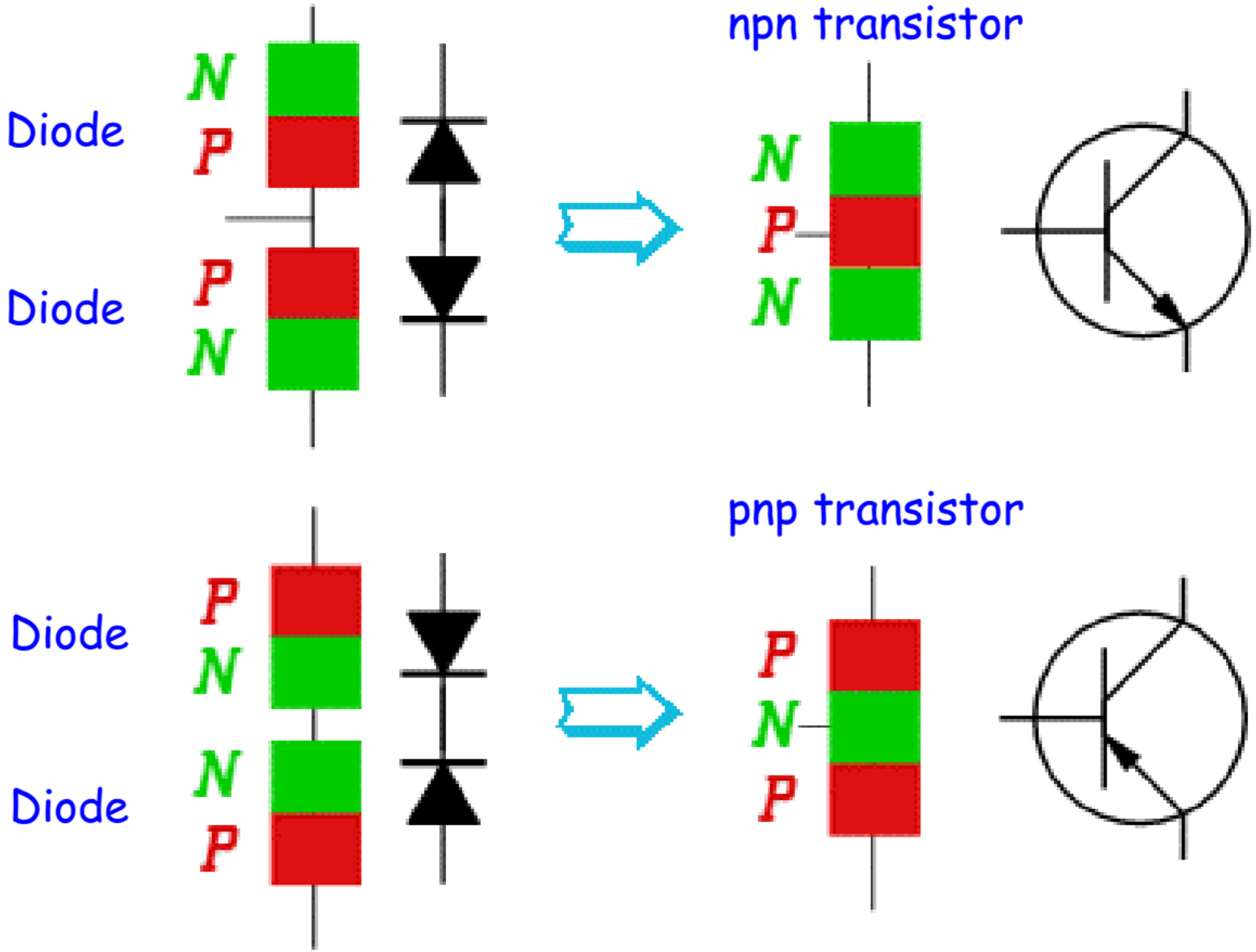
How the PNP transistor works

In the P N P transistor the voltage of the base must be more negative than that of the emitter. The voltage of the collector in turn, must be more negative than that of the base. The voltages are supplied by a battery. The emitter supplies positive charges called holes. The base pulls the holes from the emitter because the base has a more negative voltage than the emitter. This movement of holes creates the flow of electric current or electricity through the transistor. The current passes

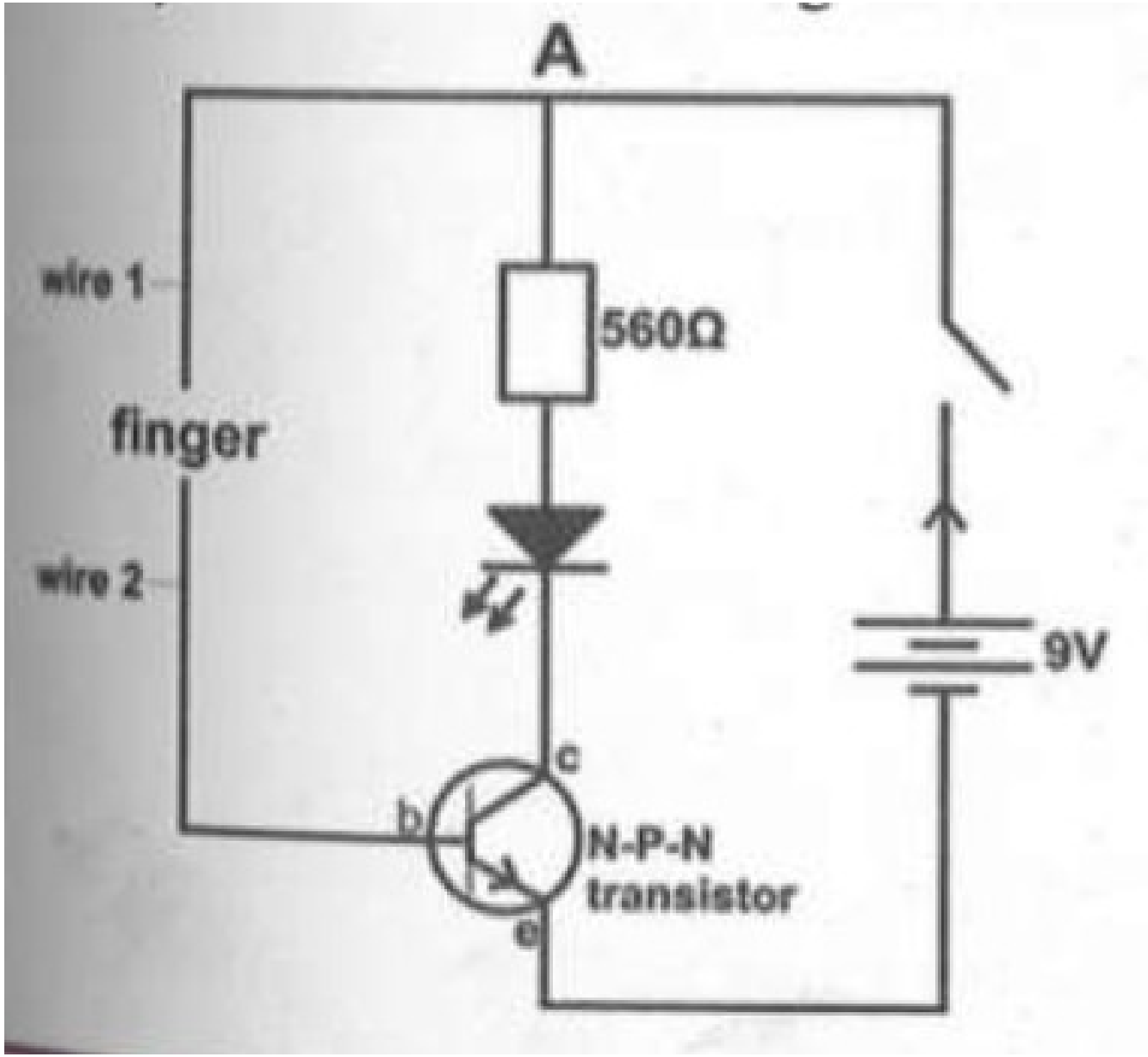
Circuit Diagram for PNP and NPN transistors



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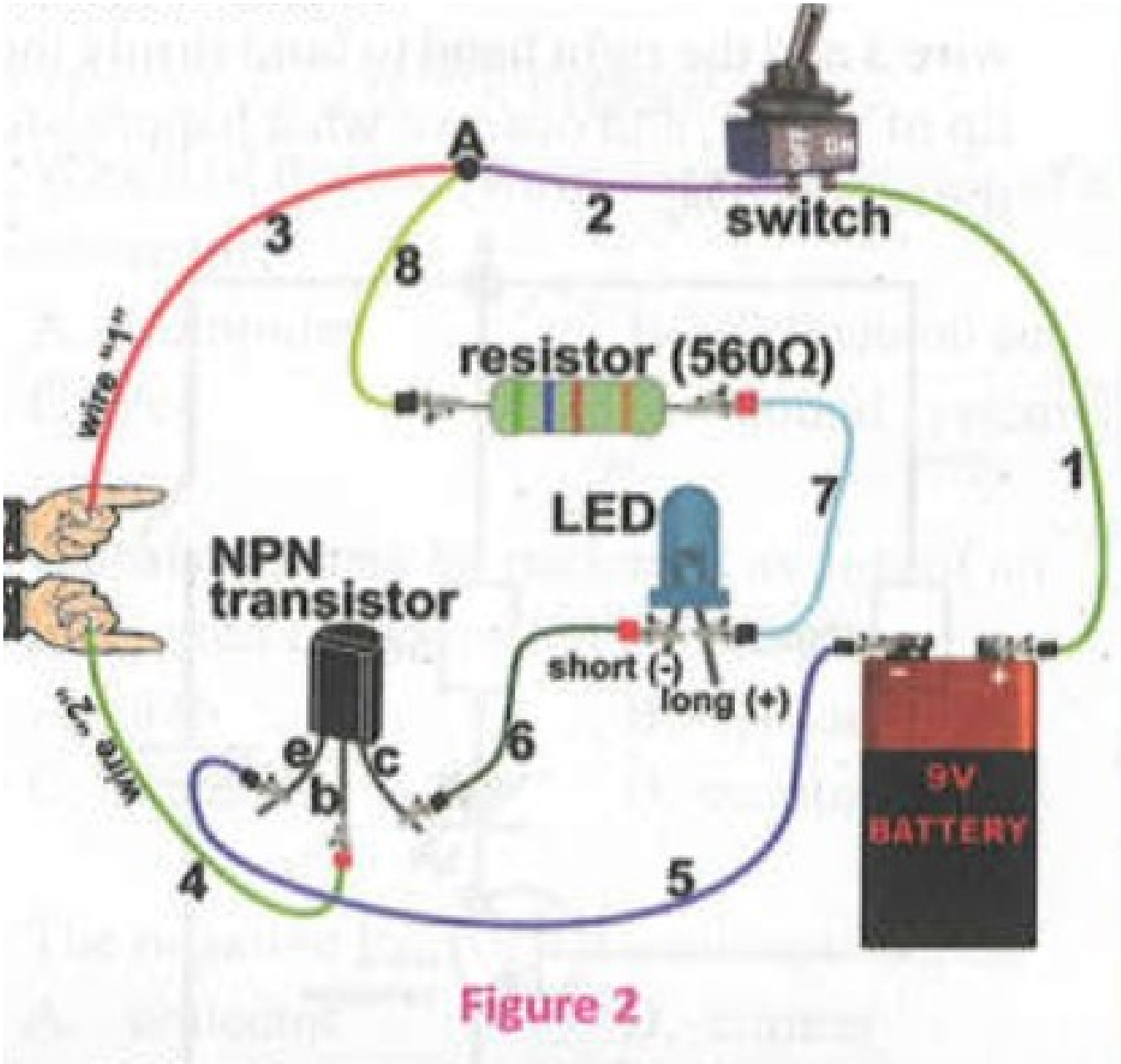


Figure 2

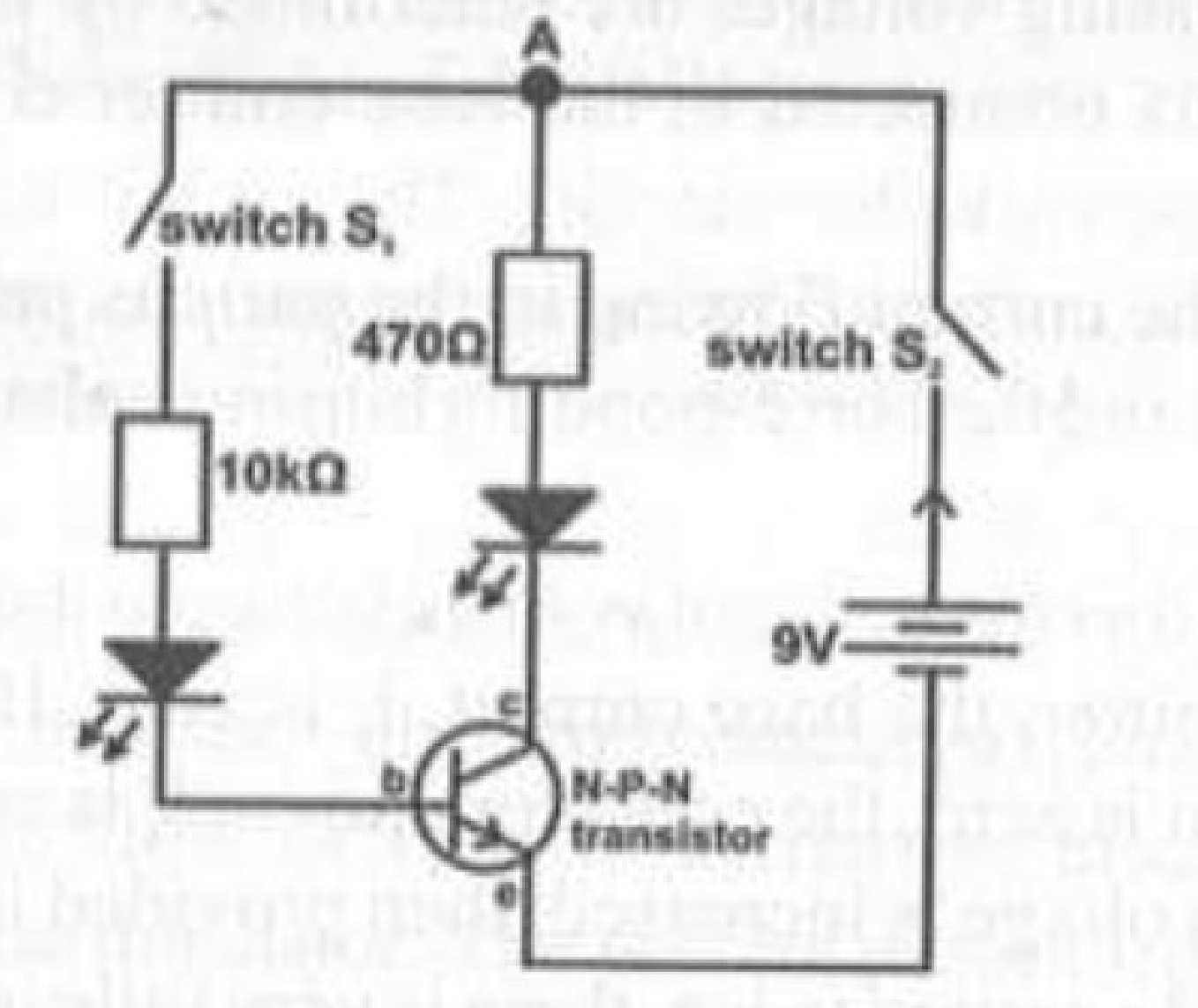
The use of a transistor as a switch

A switch is any device that makes or breaks a circuit.

When a switch is open, no current flows and when the switch is closed current flows.

With the transistor the switch is electronic. Thus when we talk about using the transistor as a switch we are referring to an **electronically controlled switch** and not a manual

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transistor.

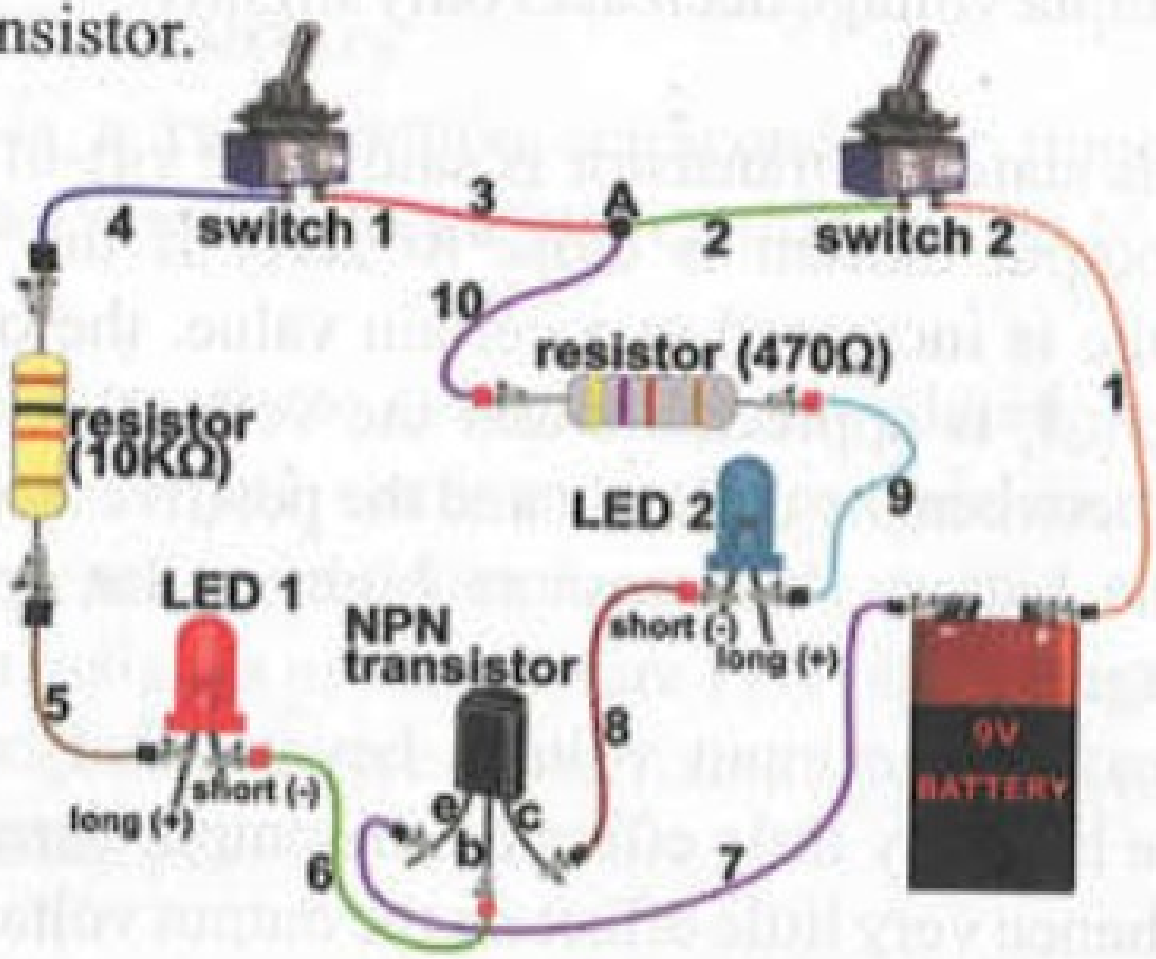


Figure 1

The use of a transistor as a switch

To operate the transistor as a switch it is operated between **saturation** and **cut off**.

When the base-emitter junction is reversed biased, (when the voltage applied to the base emitter junction is less than or equal to 0.7 V) the **transistor operates in cut off** and no current flows through the collector and hence the transistor is off.

When both **the base-emitter junction and the collector-base junction are forward biased** the **transistor operates in saturation and a large amount of current flows through the collector and hence the transistor is on**.

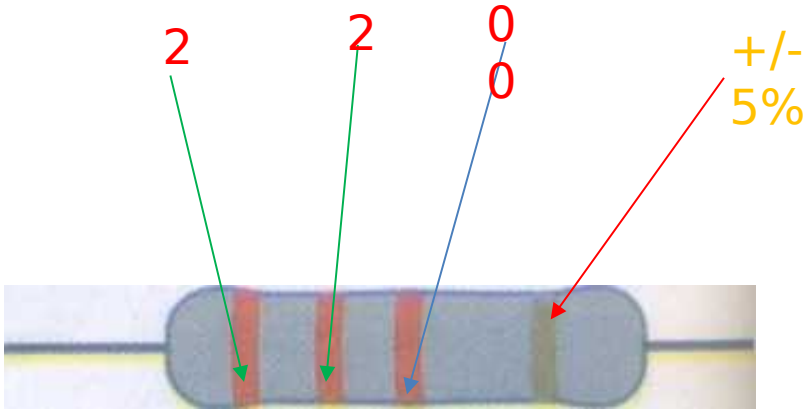
An LED can be placed in the output section to

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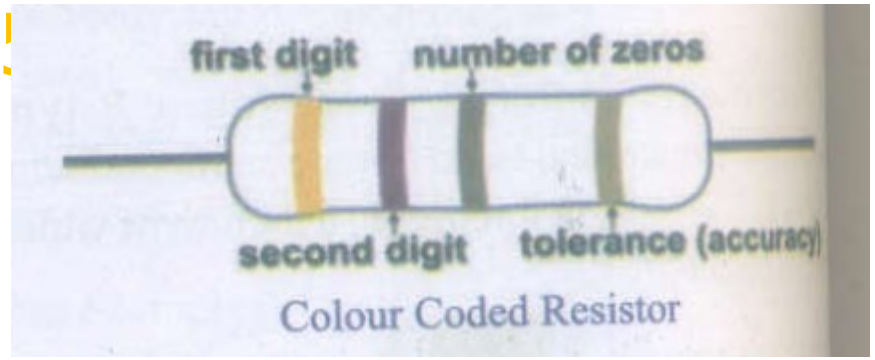
READING THE RESISTANCE OF CODED RESITORS



COLOUR	NUMERS OR ZEROS
BLACK	0
BROWN	1
RED	2
ORANGE	3
YELLOW	4
GREEN	5
BLUE	6
VOILET	7
GREY	8
WHITE	9
Silver	+/- 10
Gold	+/- 5



Reading : 2200Ω +/-



NUMBER-NUMBER- NUMBER OF ZEROS-

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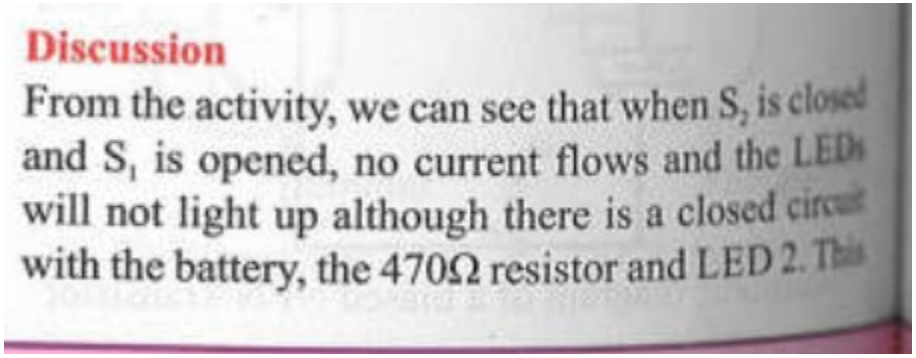
Transistor As A Switch

By varying the input voltage, the transistor can be made to switch between two states; the cut-off and saturation states. As a switch, the transistor operates between the cut-off and saturation states.

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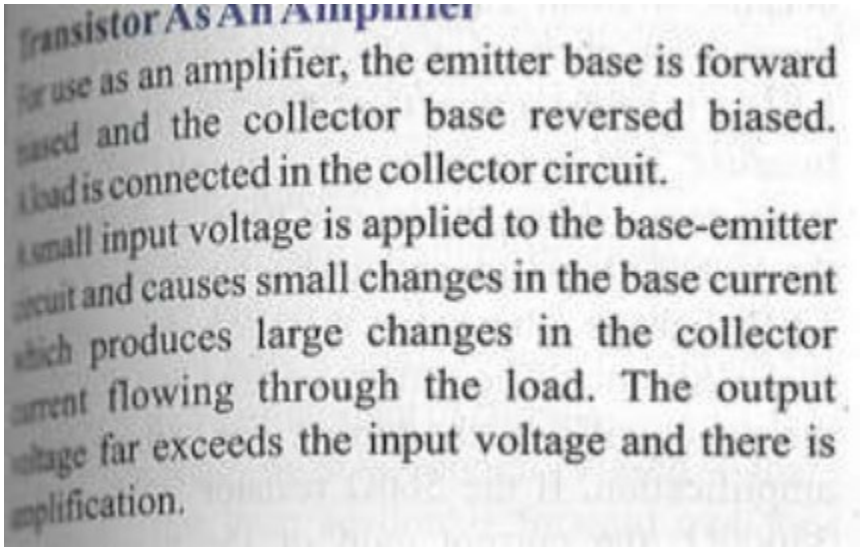
because no current flows through the base. When
is closed as well as S_2, base current flows and both
LEDs light up. The transistor is being used as a
witch. A small current must flow through the base
turn on the transistor. In practice, S_1 is
ectronically operated with the use of sensors.

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Discussion

From the activity, we can see that when S_2 is closed and S_1 is opened, no current flows and the LEDs will not light up although there is a closed circuit with the battery, the 470Ω resistor and LED 2. This



Transistor As An Amplifier

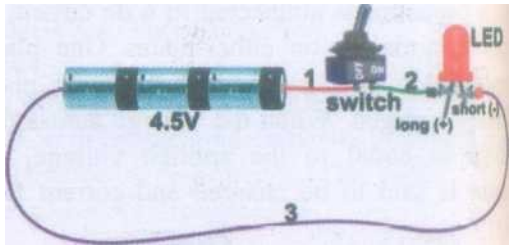
For use as an amplifier, the emitter base is forward biased and the collector base reversed biased. A load is connected in the collector circuit.

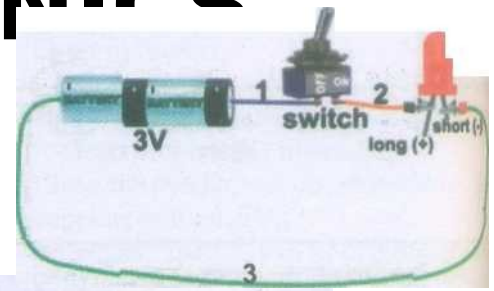
A small input voltage is applied to the base-emitter circuit and causes small changes in the base current which produces large changes in the collector current flowing through the load. The output voltage far exceeds the input voltage and there is amplification.

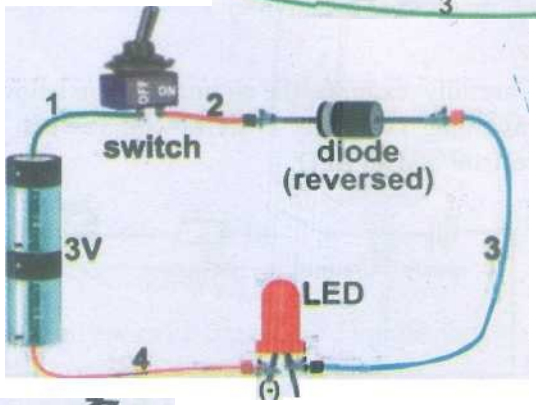
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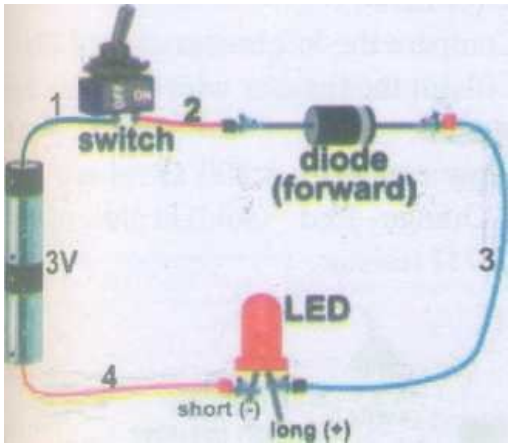
Electronics deals with the precise control of the flow of electrons at lower voltage and current levels.
Electronics is the branch of science that deals with the behaviour and movement of electrons in a **semi-conductor**, vacuum or gas.
Some discrete components of an electronic circuit are the **battery**, **switch**, **LED**, **P-N junction diode**, **resistor**, **capacitor** and **inductor**.
The LED changes electricity to light.
A **P-N junction diode** allows current to flow in only one direction.
The current flows in a diode when it is forward-biased.
A **diode** is said to be forward-biased when the P-region of the diode is connected to the positive terminal of the battery, and the N-junction region to the negative (-) terminal of the battery.
A **resistor** opposes the flow of electric current.

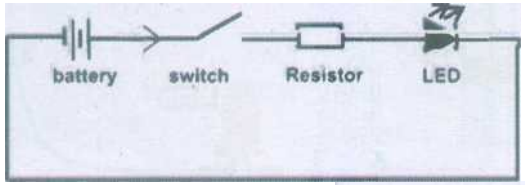
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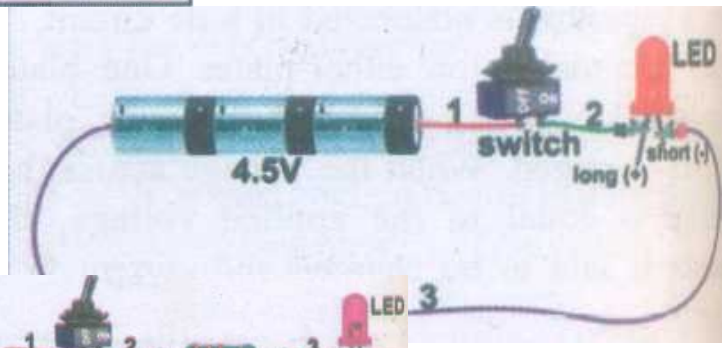








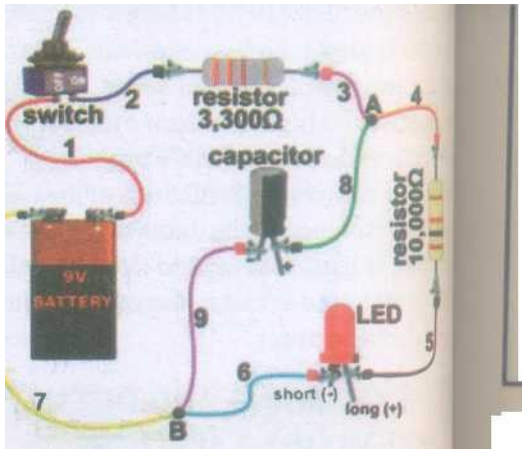






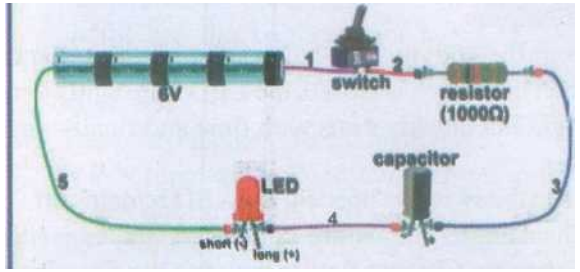


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SEC. 2-4 INTRINSIC SEMICONDUCTORS

An intrinsic semiconductor is a pure semiconductor. When an external voltage is applied to the intrinsic semiconductor, the free electrons flow toward the positive battery terminal and the holes flow toward the negative battery terminal.

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SEC. 2-6 DOPING A SEMICONDUCTOR

Doping increases the conductivity of a semiconductor. A doped semiconductor is called an *extrinsic semiconductor.* When an intrinsic semiconductor is doped with pentavalent (donor) atoms, it has more free electrons than holes. When an intrinsic semiconductor is doped with trivalent (acceptor) atoms, it has more holes than free electrons.

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SEC. 2-5 TWO TYPES OF FLOW

Two types of carrier flow exist in an intrinsic semiconductor. First, there is the flow of free electrons through larger orbits (conduction band). Second, there is the flow of holes through smaller orbits (valence band).

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SEC. 2-6 DOPING A SEMICONDUCTOR

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SEC. 2-14 REVERSE-BIASED DIODE

There are three components of reverse current in a diode. First, there is the transient current that occurs when the reverse voltage changes. Second, there is the minority-carrier current, also called the *saturation current* because it is independent of the reverse voltage. Third, there is the surface-leakage current. It increases when the reverse voltage increases.

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