UNIT 16

BASIC ELECTRONICS

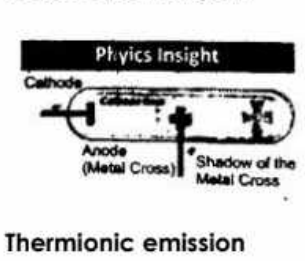
After studying this unit, the students will be able to:

a. Explain the process of thermionic emission emitted from a filament.
b. Describe the simple construction and use of an electron gun as a source of electron beam.
c. Describe the effect of electric field on an electron beam.
d. Describe the effect of magnetic field on an electron beam.
e. Describe the basic principle of CRO and make a list of its uses.
f. Differentiate between analogue and digital electronics. .
g. State the basic operations of digital electronics.
h. Identify and draw the symbols for the logic. Gates (NOT, OR, AND, NOR and NAND)
i. State the action of the logic gates in truth table form
j. Describe the simple uses of logic gates.

Q.1 What is electron gun? Describe the process of thermionic emission?

Answer: Electron gun

The part of a discharge tube, from which the negative charges (electrons) are produced from a hot cathode and are accelerated towards the screen is called electron gun.



Thermionic emission

"The process of' emission of electrons from the hot metal surfaces is called thermionic emission." Metals contain a large number of free electrons. At room temperature electrons cannot escape metal surface due to attractive forces of

atomic nucleus. If the metal is heated to a high cross is formed at the end temperature, some of the free electrons may gain sufficient energy to escape the metal surface. Thermionic emission can also be produced by electrically heating a fine tungsten filament.

When an opaque object like a metal cross is placed in the path the of cathode rays in a cathode-ray the tube, 3 shadow of the metal cross is formed at the end opposite to the cathode This is an evidence that rays of some kind are Passing straight through the tube.

Q.2 Describe, 'using one simple diagram in each case, what happened when a narrow been of electrons is passed through (a) a uniform magnetic field (b) a uniform electric field. What do these results indicate about the charge on an electron?

Answer

Electrons gun is used to investigate the properties of electron beam as shown in the figure 16.1

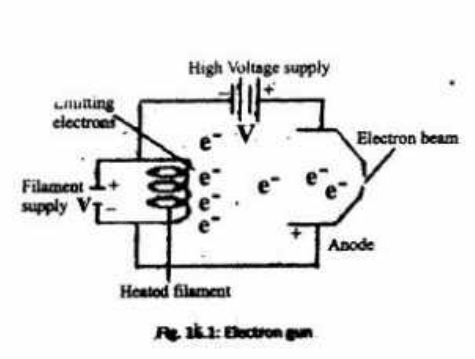


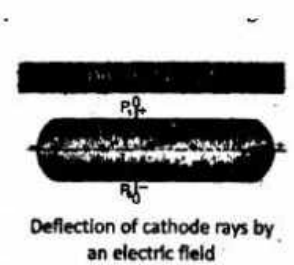
Fig. 16.1: Electron gun

The electrons are produced by thermionic emission from a tungsten filament heated by 6v supply. A high positive potential (several thousands) is applied to a cylindrical anode (+ve).

The electrons are accelerated to a high speed and pass through the hole of the anode in the form of a fine beam of electrons. The whole set up is fitted in an evacuated glass tube.

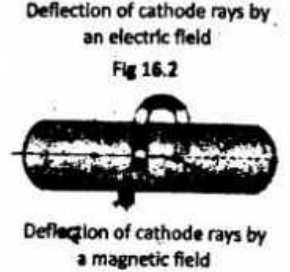
Deflection of electrons by electric field

An electric field can be set up by applying a potential difference across two parallel metal plates placed horizontally separated with some distance. When an electron beam passes between the plates, it can be seen that the electrons are deflected towards the positive plate as shown in the fig. 16.2. The reason for this is that electrons are attracted by the positive charges 'and repealed' by the negative charges due to force, F = qE, where q is the electron charge and 'E' is the electric field due to plates.



Deflection of cathode rays by an electric field
Fig 16.2

The degree of deflection of electrons from their original direction is proportional to the strength of the electric field applied.



Deflection of cathode rays by a magnetic field
Fig.16.3

Deflection of electrons by magnetic field

Now a magnetic field is applied at right angle to the beam of electrons by using a horse—shoe magnet as shown in the fig. 16.3.

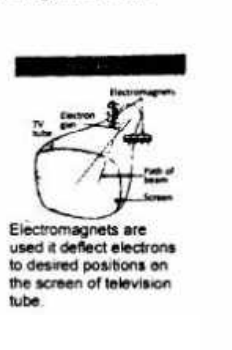
It is noticed that the spot of the electrons beam on screen is getting deflected from its original direction. Now change the direction of the horse shoe magnet. It is observed that, the spot on the fluorescent screen is getting deflected m the opposite direction.

Q3 What is a cathode ray oscilloscope? Explain the working of different parts of oscilloscope?

Answer.

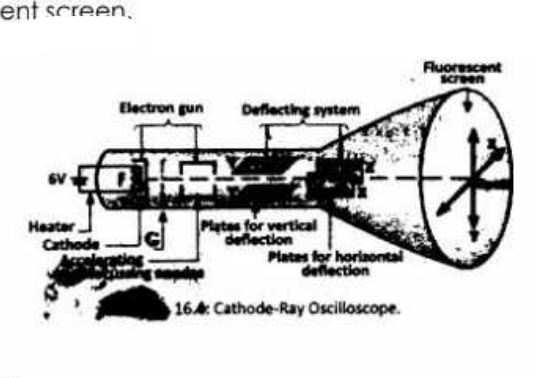
Cathode ray oscilloscope

The cathode ray oscilloscope is an instrument which is used to display the magnitude of changing electric currents or potentials as shown in the figure16.4. The information is displayed on the screen of cathode-ray tube. This screen appears as a circular or rectangular window usually with a centimeter graph superimposed on it. For example, the picture tube in over TV set and the display terminal of most computers are cathode ray tube. The cathode-ray oscilloscope consists of the following components.



Electromagnets are used it deflect electrons to desired positions on the screen of television tube.

- The electron gun.
- The deflecting plates
- The fluorescent screen.



16.4: Cathode-Ray Oscilloscope.

1. The electron gun

The cathode-ray oscilloscope consists of an "electron gun" for producing a beam of fast moving electrons called cathode rays.

Point to ponder!
When a magnet is brought near to the screen of a television tube picture on the screen is distorted. Do you know why?

The electron gun consists of the electron source which is an electrically heated cathode that effects electrons. Electron gun also has an electrode called grid 'G' for controlling the flow of electrons 1n the beam.

The grid is connected to a negative potential the more negative this potential, the more electrons will be repelled from the grid and hence fewer electrons will reach the anode and the screen. The number of electrons reaching the screen determines the brightness on the screen light. Hence the Negative potential of the gird can be used as brightness control. The anode is connected to positive potential and hence is used to accelerate the electrons. The electrons are focused in to a fine beam on the bass through the anode.

Do you know?
The beam of electrons was called a cathode ray because the electron had not yet been discovered. The old terminology scurvies in electronic engineering. Where a cathode-ray tube is any tube constructed along Thomson's lines whether in a computer monitor, a television, or an oscilloscope.

2) The deflating plates

After leaving the electron gun, the electron beam passes between a pair of horizontal plates. A potential difference applied between these plates' deflects the beam in a vertical plane. This pair of plates provides the y—axis or vertical movements of the spot on the screen. A pair of vertical plates provides the x-axis or horizontal movement of the spot on the screen.

3) The florescent screen

The screen of a cathode ray tube consists of a thin layer of phosphor, which is a material that gives light as a result of bombardment by fast moving electrons.

Do you know?

The glow in the tube is due to circular motion of electron in the magnetic field. The glow comes from the light emitted from the excitations of the gas atoms in the tube

USES of C.R.O

The CRO is used in many fields of 'Science, displaying the Wave-forms, measuring voltages, range finding (as in order), echo-sounding (to find the depth of sea beds). The CRO is also used to display heart beats.

Q.4 What do you understand by digital and analogue quantities?

Answer

1) Analogue quantities

The quantities whose values vary continuously or remain constant are known as analogue quantities. For example, the temperature of air varies in a 'continuous fashion during 24 hours of a day.

If we plot a graph between "me and temperature recorded at different times, we get a graph like shown in the figure 16.5 (a)

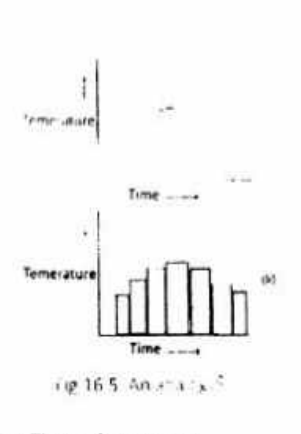


Fig 16.5 [illegible]

This graph shows that temperature varies continuously with time. Therefore, we say that temperature is an analogue quantity.

Similarly, time, pressure, distance etc. are analogue mg quantities.

2) Digital quantities

The quantities whose values vary in non-continuous manner are called digital quantities. Digital version of analogue signal is shown in the figure 16.5 (b).

Digital quantities are expressed in the form of digits or numbers.

Q.5 Differentiate between-analogue electronics and digital electronics?

Answer:

1) Analogue electronics

"The branch of electronics consisting of circuits 'which process analogue quantities is called analogue electronics."

For instance, the public address system is an analogue system in which the microphone converts sound into continuously varying electric 'potential. This potential is-an analogue signal which is fed into an amplifier. An amplifier is an analogue circuit which amplifies the signal without changing its shape to such as extent that is can operate a loud speaker. In this way, loud sound is produced out of the speaker. Radios, televisions and telephones are a few common devices that transfer analogue signals.

2) Digital electronics

"The branch of electronics which deals with digital quantities is called digital electronics. The computer operates by counting the digits. The word digit has been adopted from this mode of computer's operation. For this purpose, digital electronic uses only two digits (0) zero and 1(one) and the whole data becomes easy.

Q.6 Discuss analogue and digital signals graphically? What are analogue and digital converters?

Answer:

Analogue and digital signals

Fig. 16.6 shows an analogue and digital signal. A continuously varying signal is called an analogue Signal.

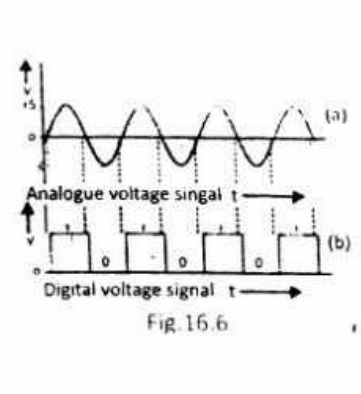


Fig. 16.6

For example; an alternating voltage varying between the maximum value of +5v and minimum value of —5V is an analogue signal as shown in fig. l6.6 (a).

A signal that can have only two discrete values is called a digital signal as shown in the fig. 16.6 (b).

The signal has only two values i.e. +5v and 0V. The high voltage is +5v and the low voltage is 0V. It can be seen that' digital signal provides the data by -a maximum and a minimum voltage level. The changes occurring in the digital signal are not continuous.

For quite a long period the use of digital electronics was limited to computers only, but now-a-days its application is very wide spread. Modern telephone system, radars system, naval and other system of military importance, devices to control the operation of industrial machines. Medical equipment and many household appliances are using digital technology.

For your information
Digital technology has entered every part of our lives. Digital TV gives excellent view and allows you to be interactive. Digital cameras are fast replacing traditional film equipment. You can download an image into a PC and crop enhance, airbrush and edit the picture. Smart ID cards are being developed. A single card can be a passport, national insurance card and driving license all in one. The card could also hold biometric data like an eye retina scan and voice scan for unique identification and security. All of this data would be held digitally in the tiny chip.

Analogue and digital converters

In our daily life, the quantities that we perceive by our senses are usually analogue quantities which cannot be processed by digital circuits. To overcome this problem, a speed circuit has been designed which converts the analogue signal into a digital one in the form of digits. This circuit is known as analogue to digital converter (ADC).

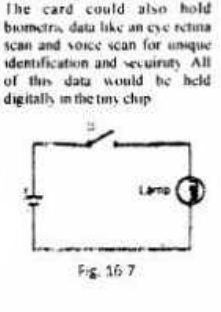


Fig. 16.7

When we get an analogue signal in the form of digits, we can process it with digital circuit, the output which is also in digital form. This digital output is converted into analogue by a circuit known as digital to analogue converter (DAC).

Q.7 Write a note on the basic operations of digital electronics-logic gates?

Answer

A switch has only two possible states. It could be either open or closed. Similarly, a given statement. Would be either true or it would be false. Such things which can have only two possible states are known as binary variables. The states of binary variables are ' usually represented by the digits 0 and 1. Suppose we form a circuit by connecting a lamp to a battery using a switch's'. We call state of switch as input and state of current or lamp as output. When the switch is open, no current passes through the circuit and lamp is off. In other words, when input is zero, output is also zero. When the switch is closed current passes through the circuit and lamp is on. Thus the output current is also a binary variable. In case the current is passing, we can say the value of the output is I and it is zero when no current is passing.

Introduction to Boolean algebra
The algebra used to describe logic operations by symbols is called Boolean Algebra. Like ordinary algebra, English alphabets (A, B, C etc.) are used to represent the Boolean variables. However, Boolean variable can have only two values; 0 and 1. Digital circuits perform the binary arithmetic operations with binary digits 1 and 0. These operations are called logic function or logical operations.

These states are also called logic states or logic variables. 'If the values of input variables of a circuit are known, the value of 7 output can be determined by using Boolean algebra also called as algebra of logics.

Instead of variables that represent numerical quantities as in Conventional algebra, Boolean algebra handles variables that represent two types of logic propositions; 'true' and 'false'.

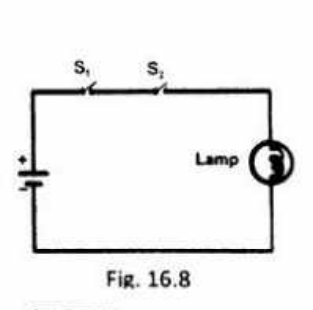


Fig. 16.8

Boolean algebra's simple interpretation of logic operators AND, OR and NOT has allowed the systematic development of complex digital system.

Since a logic gate is a switching circuit (i.e. digital circuit); It's outputs have only one of the two possible states. Either a high voltage '1'or a low voltage '0'— it is either ON or OFF.

Table 16.2

S_1	S_2	Lamp
Open	Open	OFF
Open	Closed	OFF
Closed	Open	OFF
Closed	Closed	ON

A	B	X = A.B
0	0	0
0	1	·0
1	0	0
1	1	1

Q.8 What is AND gate? Give its symbol and truth table?

Answer

AND Gate

The fig. 16.8 shows the logic AND operations, in which a lamp is connected to a battery using two switches 51 and 52 connected in series considered as two inputs. There are four possible states of these two switches which are given below:

1. When S. and S; are both open, the lamp 'is off.
2. When Sl is open and S: closed, the lamp is off.
3. When S. is closed and S; open, the lamp is off.
4. When both S. and S: are closed, the lamp is ON.

The four possible combination of switches S_1 and S_2 are shown in the table l6.2. It is clear that when either of the switches (S_1 or S_2) or both are open, the lamp is OFF. When both switches are closed the lamp is ON.

Symbol

Symbol for AND operation is dot (.). Its Boolean expression is x= AB and is read as "X equals A and B."

Truth table

1) Set of inputs and outputs in binary form is called truth table. In binary language:

A when either of the inputs or both the input are low (0). The output is low (0).

When both the inputs are high" (1), the output is high (1). The. Truth table AND operation is shown in table 16.3, where x represents the output. Therefore, AND operation may be represented by switches connected in series. With each switch representing an input.

2) When two switches are closed i.e., the inputs of the AND operation are at logic '1', the output of the AND operation will be at logic '1'. But when two switches are open W. the inputs of AND operation will be at logic '0'. For any other state of two switches (i.e. the input of AND operation) the output will be zero.

AND Gate:

The circuit which implements the AND operation is known as AND gate. Its symbol is shown in fig. 16.9.

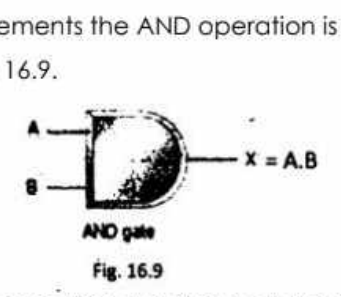


Fig. 16.9

AND gate has two or more than two inputs and only one output. The value of output of

AND gate is always in accordance with the truth table of AND operation. it means output of AND gate will be '1' only when both of its inputs are at logic '1' and for all other situations output of AND gate will be '0'.

Q.9 What is an OR gate? Give its symbol and truth table?

Answer

OR operation

In order to understand the logic OR operation. fig. 16.10 is shown. A-Lamp is connected to a battery using two switches S' and S is connected in parallel considered as two inputs.

There are four possible states of these two switches which are given below:

1. When S' and S; are open, the lamp is OFF.
2. When S is open and S' close, the lamp is ON.
3. When S' is closed and S; open, the lamp is ON.
4. When both S' and S; are closed, the lamp is ON.

As evident from the circuit in fig. 16.10", the lamp will be on if and only if at least one of the switches is closed. In the language of Boolean algebra. We say the lamp will glow if at least one of the values of S_1 and S_2 is at logic '1'.

Table 16.4 describes all possible states of the switches for 'OR' Operation.

Symbol

OR operation is represented by the symbol of plus (+).Boolean expression for 'OR' operation is: x = A '+ and is read as "x equal A or B."

Table 16.4

S_1	S_2	Lamp
Open	Open	OFF
Open	Closed	ON
Closed	Open	ON
Closed	Closed	ON

Truth table

Truth table of OR operation is shown in table 16.5 An OR operation may be represented by switches connected in Parallel, since only one of these parallel switches need to turn on in order to flow current in the circuit.

Table 16.5

A	B	X = A+B
0	0	0
0	1	1
1	0	1
1	1	1

OR gate

The electronic circuit which implements the OR operation is known as OR gate. Symbolically, OR gate is shown in the fig. 16.11.

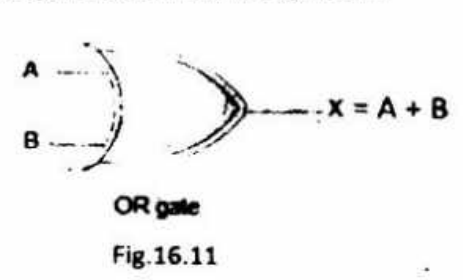


Fig.16.11

It has two or more than two inputs and has only one output. The values of output of 'OR' gate are always in accordance with the truth table of 'OR' operation.

It means, the value of output of 'OR' gate will be '1' when one of' its inputs is at '1'. The output will be '0', when both inputs are at '0'.

Q.10 What is a NOT gate? Give its symbol and truth table?

Answer

NOT operation

The circuit of NOT operation is shown in the fig. 16.12. A lamp is connected to a battery with a switch S.

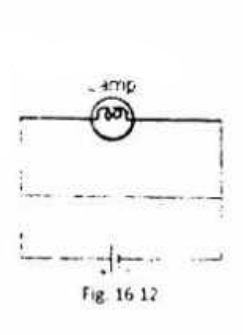


Fig. 16.12

When the switch is open, current will pass through the lamp and it will glow.

When switch is closed, no current will pass through the lamp due to large resistance of its filament and it will not glow. States of the switch and the lamp are shown in table 16.6.

NOT operation is represented by a line or bar over the symbol i.e. and is read as 'x equals A NOT." it means NOT operation changes the state of a Boolean variable.

For example, if the value ofa Boolean variable is 1, then after NOT operation its value would change to '0'. Similarly. if its value before NOT operation is '0'. then after NOT operation it would change to '1'. Thus NOT operation invents the state

Table 16.6

S	Lamp
Open	ON
Closed	OFF

Table 16.7

A	
0	1
1	0

of Boolean variable. Truth table of NOT operation is shown in table 16.7.

NOT gate

The electronic circuit which implements NOT operation is known as NOT gate. Symbol of NOT gate is shown in fig. 16.13.

It has only one input and one output terminal. NOT gate work in such a way that if its input is '0', its output would be '. '1'. Similarly if its input is 1, then output would be zero.

NOT gate performs the basic logical function called inversion or complementation NOT gate is also called invertor. The purpose of this gate is to convert one logic level into the opposite logic level.

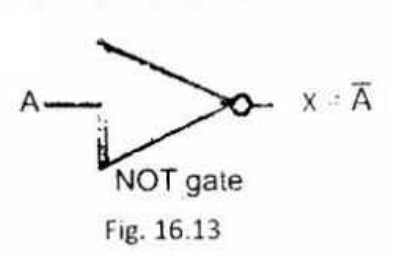


Fig. 16.13

When a HIGH level is applied to an inverter, a LOW level appears on its output and vice versa.

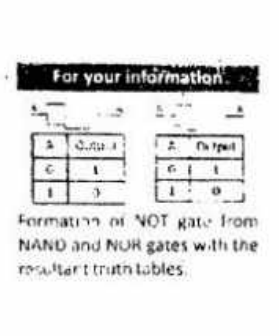
Q.11 What are NAND and NOR gates? Give their symbols and truth tables?

Answer

NAND gate

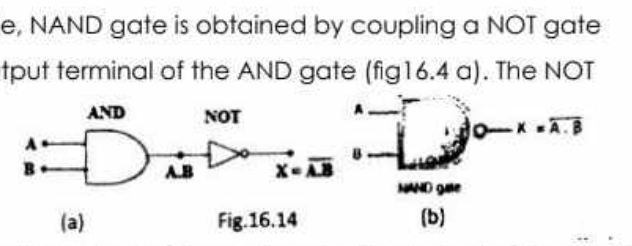
NAND operation is simply an AND operation followed by a NOT operation.

For your information



Formation of NOT gate from NAND and NOR gates with the resultant truth tables.

For example, NAND gate is obtained by coupling a NOT gate with the output terminal of the AND gate (fig16.4 a). The NOT



(a) Fig.16.14 (b)

gate Inverts the output of the AND gate. The output of the NAND equals AB and is written as x = A.B. It is read as X equals A AND NOT. Symbol of NAND gate is shown in fig. l6.14 (b).

As shown in the figure. The NOT gate has been replaced with a small Circle. In the

Symbol of NAND gate shows NOT operation. Truth table of NAND gate 15 shown

Table 16.8

A	B	$X = \overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

For your information

$X = \overline{\overline{A}} = A$

$X = \overline{\overline{A+B}} = A+B$

$X = \overline{\overline{A.B}} = A.B$

Here double line indicates double NOT operation

Table 16.9

A	B	$X = \overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

in table 16.8.

NOR gate

The NOR operation is simply an OR operation followed by a NOT operation. The NOR gate is obtained by coupling the output of the OR gate with the NOT gate as shown in the figure 16. 15 (a).

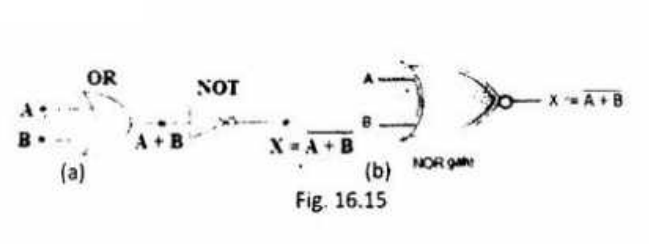


Fig. 16.15

Thus for the same combination of inputs, the output of a NOR gate will be opposite to that of an OR gate. Its Boolean expression is X = A + B. It is read as X equals A or B NOT. Symbol of NOR gate is shown in the figure 16.15 (b). Table 16.9 is the truth table of NOR gate.

Q.12 Write the use of logic gates with the help of an example?

Answer

Use of logic gales in electronic circuits to do useful tasks. These circuits usually use light depending resistors (LDRs) to keep inputs LOW. An LDR can act as a switch that is closed when illuminated by light and open in the dark.

For your information
Most of today's technologies fall under classification of digital electronics.
Digital electronics devices store and process ***bits*** electronically.
A bit represents data using 1's and 0's.
Eight bits is ***byte*** – the standard grouping in digital electronics.
Digitization is the process of transforming information into 1's and 0's

House safety alarm

We can use single NAND gate to make burglar alarm. This can be done by using NAND gate, an LDR, a push-button switch 3 and alarm as shown in fall under the

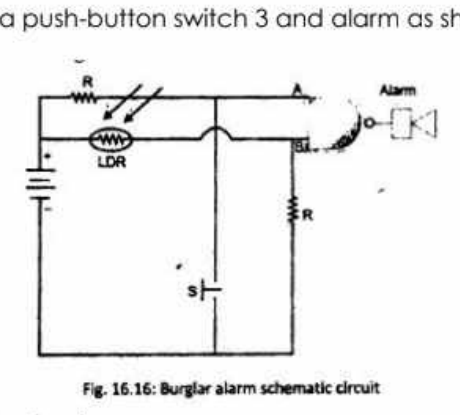


Fig. 16.16: Burglar alarm schematic circuit

figure 16,16, digital electronics.

Connect LDR between NAND gate input B and the positive terminal of the battery.

The LDR will cause a HIGH level input (1) at B when in light because of its low resistance.

The LDR will cause a low level input (0) at B when light is interrupted and causes high resistance in LDR. A low level signal is also caused at A when burglar steps on switch

S: So this burglar alarm sounds when either burglar interrupts light falling on LDR or steps on switch 'S'

Multiple Choice Questions

Choose the correct answer from the following choices:

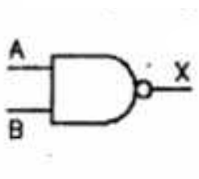
i) The process by which electrons are emitted by a hot metal surface is known as:

a) boiling b) evaporation c) conduction d) thermionic emission

ii) The particles emitted from a hot cathode surface are:

a) positive ions b) negative ions c) protons d) electrons

iii) The logical operation performed by this gate is:



a) AND b) NOR c) NAND d) OR

iv) AND gate can be formed by using two:

a) NOT gates b) OR gates c) NOR gates d) NAND gates

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v) The output of a two—input NOR gate is 1 when:

a) A is 1 and B is 0 c) both A and B are 0
b) A is 0 and B is 1 d) Both A and B are 1

vi) "X = AB, then X is I when:

a) A and B are 1 c) A is 0 and B is 1
b) A or B is 0 d) A is 1 and B is 0

vii) The output of a NAND gate is 0 when:

a) both of its inputs are 0 c) any of its inputs is 0
b) both of its inputs are I d) any of its inputs is I

Correct Answers

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

REVIEW QUESTIONS

16.1 Describe, using one simple diagram in each case, what happens when a narrow beam of electrons is passed through (a) a uniform electric field (b) a

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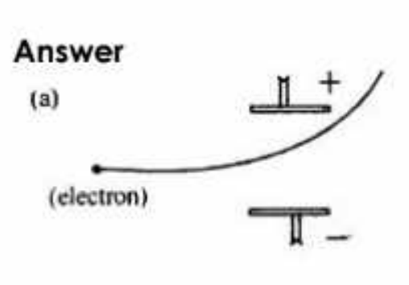
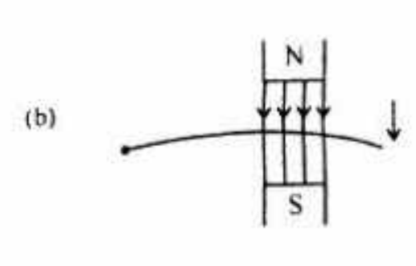
uniform magnetic field. What do these results indicate about the charge on electron?

Answer



(Uniform electric field).

[Electron is attracted by the positive plate]



(uniform magnetic field).

[electron is deflected perpendicular to the direction

Of magnetic field by right hand rule.

16.2 Explain the working off different parts of oscilloscope.

Answer

Please see the topic

16.3 Name some uses of oscilloscope.

Answer

Uses of oscilloscope

I) it is used to study the waves form of the wave displayed on the screen.

2) CRO is used to measure the voltage and frequency of the wave.

3) The time period can also be determined with the help of CRO.

16.4 Considering an oscilloscope explain.

i) How the filament is heated?

ii) Why the filament is heated?

iii) Why the anode potential is positive with respect to the cathode potential?

iv) Why a large potential is applied between anode and cathode?

v) Why the tube is evacuated?

Answer

i) Filament in CRO is heated due to the resistance in tungsten wire, when the current is passed through it.

ii) The high resistance of filament wire (tungsten) cause to produce heat. That is why it starts glowing when current passes through it.

iii) Anode potential is kept positive to accelerate the electrons in the form of a beam with high speed.

iv) The purpose of large potential difference of anode is to accelerate the electrons towards the screen with a high speed. '

v) The tube is evacuated so that no ionization due to electrons could take place and the electrons could move freely towards the screen.

16.5 What is electron gun? Describe the process of thermionic emission.

Answer

Please see the topic.

16.6 What do you understand by digital and analogue quantities?

Answer

Please see the topic.

16.7 Differentiate between analogue electronics and digital electronics. Write down names of five analogue and five digital devices that are commonly used in everyday life.

Answer

a) Please see analogue and digital electronic in the topic.

b) **Analogue devices**

Thermometer, barometer, manual watches, loud speaker, amplifier etc..

Digital devices

Radar, telephone, naval system, computer, digital watches, digital filling station unit.

16.8 State and explain for each case whether the information given by the following devices is in analogue or a digital form.

a) a moving-coil voltmeter measuring the e.m.1' of a cell.

b) a microphone generating an electric current.

c) a central heating thermostat controlling the water pump.

d) automatic traffic lights controlling the flow of traffic.

Answer

a) A moving coil galvanometer measuring the e. m. f. ofa cell Is an analogue form because it measure the potential difference when it changes gradually. .

b) Microphone also gives the result when the intensity of sound Is gradually changed so it Is also an analogue form.

---

c) A central heating thermostat gives us only two states either high or low. At one of the states, thermostat works and at the other state it stops working so it is a digital from.

d) Automatic traffic lights give us two states only. It means that either the lights will be ON or OFF. So it is also a digital form.

16.9 Write down some benefits of using digital electronics over analogue electronics.

Answer

Quick output result small sized circuits, Auto system, visual study of waves etc. are the benefits of digital electronics.

16.10 What are the three universal Logic Gates? Give their symbols and truth tables.

Answe.

Please see the topic.

Conceptual Questions

16.1 Name two factors which can enhance thermionic emission.

Answer

---

1) Passing more current through the filament wire.

2) Using such material in the filament wire which has more resistance.

16.2 Give three reasons to support the evidence that cathode rays are. negatively charged electrons.

Answer

a) By setting up an electric field perpendicular to the flow of calpode rays the deflection of electron towards the positive plate will indicate that cathode rays are negatively charged.

b) By setting up a magnetic field perpendicular to cathode rays. By right hand rule, the deflection of cathode rays will indicate that these have negative charge.

c) By placing a cathode cylinder in front of filament. The repulsion of cathode rays from the negatively charged cathode cylinder will show the negativ charge on the cathode rays.

16.3 When electrons pass through two parallel plates having opposite charges, they are deflected towards the positively charged plate. What important characteristic of the electron can be inferred from this?

Answer

It infer that electrons are negatively charged particles.

16.4 When a moving electron enters the magnetic field, it is deflected from its straight path. Name two factors which can enhance electron deflection.

Answer

More strength of magnetic field and more speed of electrons may enhance deflection of electrons from the straight path.

16.5 In what ways is an oscilloscope a voltmeter?

Answer

We can measure the voltage from the wave displayed on the screen of CRO. A graph is calibrated on the screen. By measuring the amplitude of the wave graphically, we can calculate the voltage- '

16.6 How can you compare the logic operation X=A.B with usual operation of multiplication.

Answer

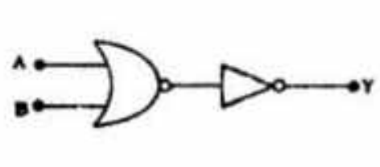
In the expression X = A.B, dot (.) stand for AND, means A and B while in usual form (.) means multiplication of two digits or factors.

16.7 NAND gate is the reciprocal of AND gate. Discuss

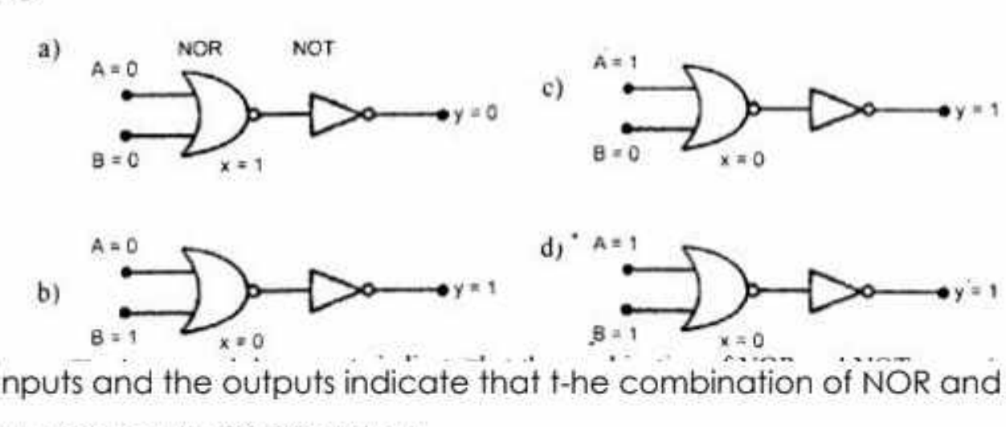
Answer

It is clear from the truth tables of NAND gate and AND gate that in AND gate output will be '1' when both inputs are also 'I' while in NAND gate when both inputs are '1' then the output is '0'. It shows that AND gate and NAND gate are reciprocal to each other.

16.8 Show that the circuit given as below acts as OR gate.

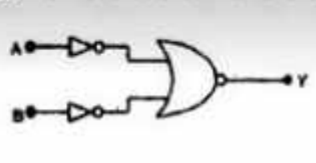


Answer

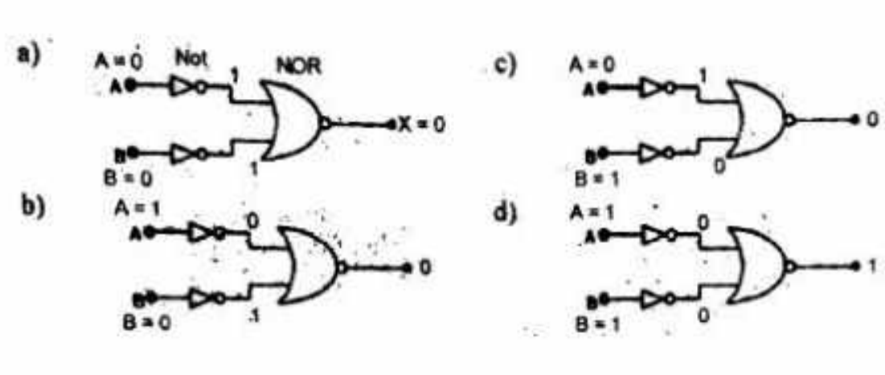


The inputs and the outputs indicate that t-he combination of NOR and NOT gate gives us the results Of OR gate. '

16.9 Show that the circuit given as below acts as AND gate.



Answer



The inputs and the outputs indicate that the combination of NOT gate with NOR gate as shown above gives us the results of AND gate.

OBJECTIVE TYPE QUESTIONS

Q2. Give short Answers.

1. Define electronics.

Answer

Electronics is that branch of Physics in which different types of work can be done performed by controlling the flow of electrons.

2. Name two main branches of electronics.

Answer

Two main branches of electronics are:

- Analogue electronics
- Digital electronics

3. What is amplifier?

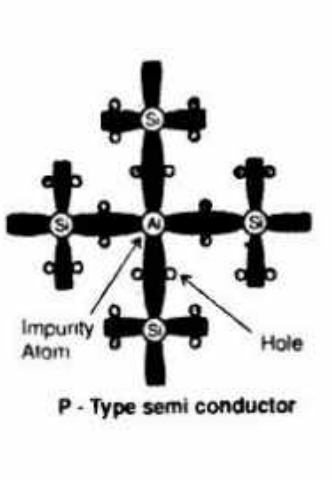
Answer

Amplifier is an analogue circuit. Which amplifies the signal without changing Its shape to such an extent that it can operate a loudspeaker.

4. What is p-type substance?

Answer

A single crystal of Ge or Si formed after the addition of an Impurity atom of a trivalent substance is called p-type substance

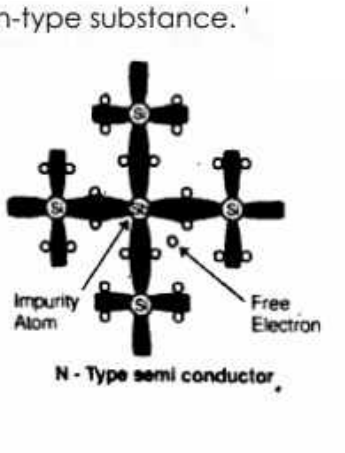


P - Type semi conductor

5. What is n—type substance?

Answer

A single crystal of Ge or Si formed after the addition of an impurity atom of a pentavalent substance is called n-type substance. '

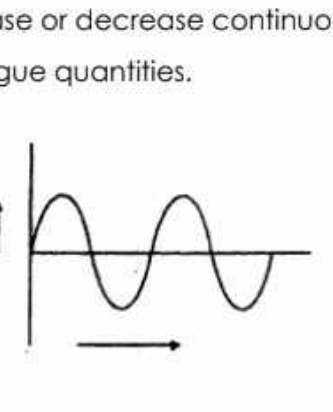


N - Type semi conductor.

6. Define analogue quantities.

Answer

Those quantities, which increase or decrease continuously with time or remain constant are known as analogue quantities.



7. Give some examples of analogue quantities.

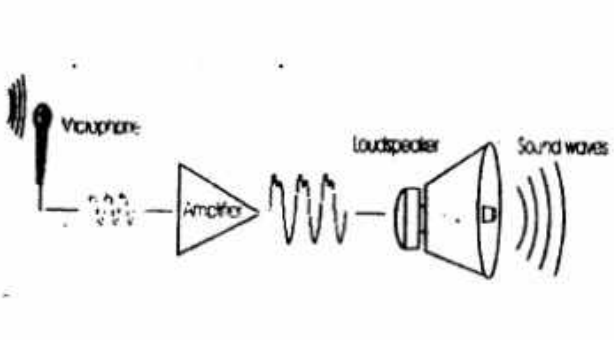
Answer

Temperature, time, pressure, distance etc.

8. What is public address system?

Answer

The public address system is an analogue system in which the microphone converts sound into a continuously varying electric potential. This potential is an analogue signal. Which is fed to an amplifier, which is analogue circuit. It amplifies the signal and a loud sound is produced out of the speaker.



9. What is analogue electronics?

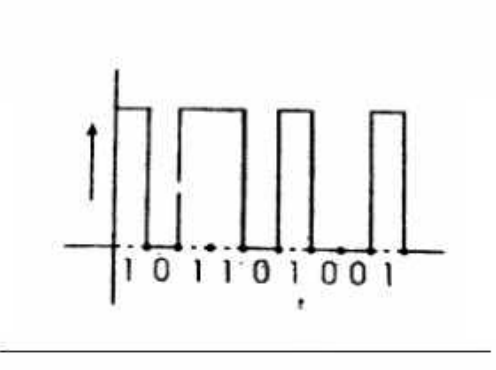
Answer

The part of electronics consisting of such circuits which process analogue quantities Is called analogue electronics.

10. What is digital electronics?

Answer

The branch of electronics, which processes the data being provided in the form of digits, is known as digital electronics.



11. Differentiate between ADC and DAC.

Answer

The circuit, which converts the analogue signal into digital signal one in the form of digits, is called analogue to digital converter (ADC).

The digital output is converted into analogue form by a circuit known as digital to analogue converted (DAC).

12. Name the areas where digital technology is applied.

Answer

Modern telephone system, radar system, naval and other systems of military importance, devices to control the operation of industrial machines, medical equipment and many household appliances are all using digital technology.

13. What are conductors?

Answer

The substances through which electric current flow easily are called conductors. Examples: gold. silver. copper.

14. Why conductors conduct electricity?

Answer

In conductors' free electrons are present in very large numbers due to which electric current can easily flow through them.

15. What are insulators?

Answer

These are the substances through which electric current does not flow.

Examples: mica, plastic. rubber, glass etc..

16. Why electric current does not flow through insulators?

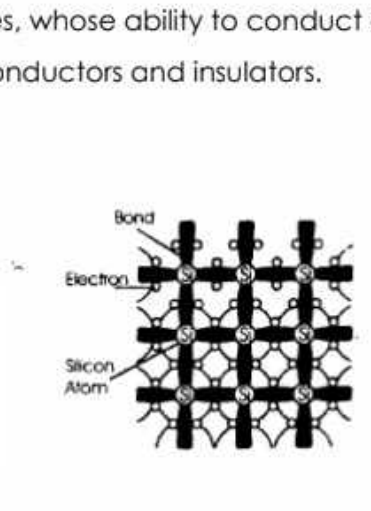
Answer

In insulators, all the electrons are bound with their respective atoms and cannot move freely. It is because of this reason that the electric current does not flow through them.

17. What are semi-conductors?

Answer

These are the substances, whose ability to conduct current at room temperature lies midway between conductors and insulators.

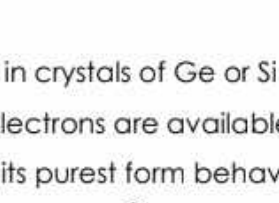


Examples: Ge and Si

18. How the crystal of Ge and Si behave as an insulator?

Answer

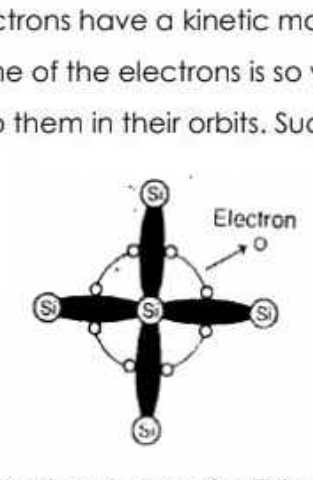
All the valence electrons present in crystals of Ge or Si are bound in their orbits by covalent bonds and no free electrons are available for the flow of electric current. 50 a crystal of Ge or Si in its purest form behaves as an insulator.



19. How the crystal Ge and Si behave as a conductor?

Answer

At ordinary temperature, the electrons have a kinetic motion due to thermal kinetic energy. The motion of some of the electrons is so vigorous that the covalent bonds Is unable to keep them in their orbits. Such electrons break their

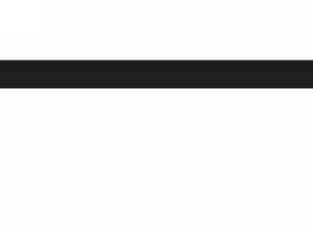


covalent bonds and create the electron-hole pairs. This motion becomes a mean of flow of current.

20. What is p-n junction?

Answer

When p-type and n-type substances are joined together the new arrangement is called p-n Junction. it is also called a semi-conductor diode.



P-N Junction

21. How p—n junction is formed?

Answer

If a crystal of Si or Ge is doped in such a way that its one part becomes n-type and the other p-type and then p-n junction would be formed in between.

22. What are the majority charge carriers in p-n junction?

Answer

- In p-type region. There are free electrons as majority charge carriers;

- In II-type region. There are holes as majority charge carriers.

23. What is the net charge on the p-type and n-type substance?

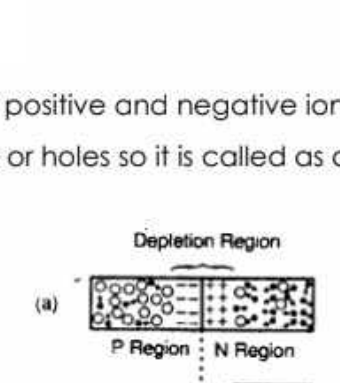
Answer

The net charge on p—type or n-type substance is zero.

24. What is depletion region?

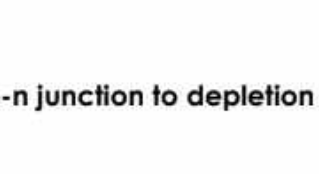
Answer

The region of the layers of positive and negative ions across the junction does not contain free electrons or holes so it is called as depletion region.



25. Draw the circuit diagram of p-n junction to depletion region.

Answer



26. What is potential barrier?

Answer

A potential difference at the common boundary of a p-n junction due to movement of electrons from n-type substance and the holes from the p-type substance Is called potential barrier.

27. What is meant by doping?

Answer

The process by which impurity is added to pure semi-conductor is called doping.

28. Name the types of impurity added to crystals.

Answer

The impurities added to crystals are of two types:

I) n-type semi-conductor

2) p-type semi-conductor

29. What is the effect on the conductivity of a semi-conductor?

Answer

A semi-conductor in its purest form is not a good conductor. Doping increases the conductivity of a semi-conductor.

30. Name some trivalent impurities.

Answer

- The trivalent impurities are Aluminium. Boron, and Gallium etc..
- The trivalent impurity increases the number of holes in pure crystal.

31. Name some pentavalent impurities.

Answer

- The pentavalent impurities are Arsenic, Bismuth and Antimony etc..
- The pentavalent impurity increases the number of free electrons in pure crystal.

32. What is meant by biasing?

Answer

The application of some electric potential across the diode is known as biasing.

33. What is potential barrier of Ge and SI?

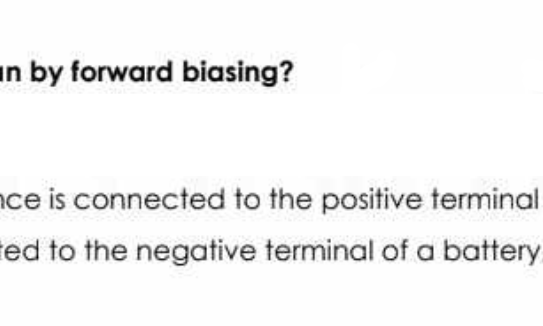
Answer

- The value of potential barrier for Ge is 0.3 V.
- The value of potential barrier for Si is 0.7 V.

34. What do you mean by forward biasing?

Answer

When p-type-substance is connected to the positive terminal and 'n-type substance is connected to the negative terminal of a battery, then p-n junction



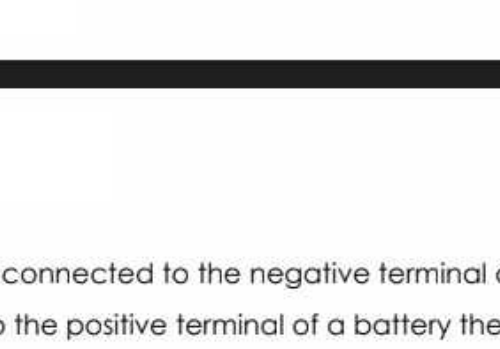
Forward biased diode

is said to be forward biased.

35. What do you mean by reverse biasing?

Answer

When p-type substance is connected to the negative terminal and II-type substance is connected to the positive terminal of a battery then p-n junction is



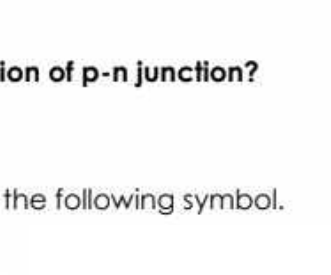
Reverse biased diode

said to be reverse biased.

36. Draw the symbolic representation of p-n junction?

Answer

The p-n junction is represented by the following symbol.



37. What are holes?

Answer

The vacant space for an electron in the orbit is known as hole.

38. Why current does not pass through a reverse biased diode?

Answer

Since the width of depletion region in reverse biased diode is increased due to which the potential barrier becomes so high that the charge carriers are unable to overcome it.

Hence no current passes through this junction.

39. What is rectification?

Answer

The process of convening an alternating current to direct current is called rectification.

Semi-conductor diodes are used for this purpose.

40. Name the types of rectification.

Answer

There are two types of rectification:

- Half-wave rectification.
- Full-wave rectification.

41. How many diodes are used in half—wave rectification?

Answer

'A single diode can be used for half—wave rectification of A.C.

42. The Si junction diode is preferred to Ge for rectification. Why?

Answer

As rectifiers, Si junction diodes are preferred to Ge type because:

- Si diodes have much lower reverse current.
- Si also has a higher breakdown voltage:

43. What is transistor?

Answer.

A transistor is a three terminal electronic device. it consists of two p-n junctions.

44. How transistor is formed?

Answer

The transistor is formed by combined effect of n-type and p-type substances. in such a way that the central substance is sandwiched by an opposite substance at the either ends.

45. Name the types of a transistor.

Answer

There are two types of transistors:

I) p-n-p transistor

2) n-p-n transistor

46. What is a p—n-p transistor?

Answer

The central region is n-type, which is sandwiched between two p—type regions, then this type of transistor is called p-n-p transistor.

47. What is a n-p—n transistor?

Answer

The central region is p-type which is sandwiched between two n-type regions, then this type of transistor is called n-p-n transistor.

48. What are the main components of a transistor?

Answer

There are three main components of a transistor:

- Base
- Emitter
- Collector

49. What is the main function of a base of a transistor?

Answer

The central region is known as base.

The base is very thin.

The base has less concentration of impurity as compared to emitter and collector.

50. What the main function of emitter?

Answer -

- The region on one side of base is called emitter.
- The emitter has greater concentration of impurity as compared to collector.
- The collector is comparatively smaller than the emitter.

MULTIPLE CHOICE QUESTIONS

1) **Atomic number of silver is 47. the number of its valence electrons would be**
a. 2
b. 32
c. 8
d. Is

2) **In a n-type crystal, the majority carriers are:**
a. holes
b. free electrons
c. Protons
d. Positron

3) **The output of an OR gate would be 0-when:**
a. Both of its inputs are 0
b. One of its two inputs is zero
c. Both of its inputs are I
d. Any one of its two inputs is I.

4) **The output of an AND gate is only 1 when:**
a. Both of its inputs are 0
b. Any one of the two inputs is 0
c. Both of its inputs are I
d. Anyone of the two

5) **The two inputs of a NAND gate are A and B. Its output would be 0 when:**
a. A=I.B=I
b. A=0.B=0
c. A=I.B=0
d.A=I.B=0

6) **A and B are the two inputs of a NAND gate. Its output would be 1 when:**
a. A=I.B=I
b. A=0,B=I
c. A=I,B=0
d. A=0,B=0

7) **The branch of applied physics in which we control the flow of electrons using diodes, transistors and other semiconductor devices in order to meet our various requirements is**
a. Metaphysics
b. Mechanics
c. Electricity
d. Electronics

8) **Those quantities whose values vary continuously or remains constant are called:**
a. Light quantities
b. Vector quantities
c. Analogue quantities
d. Scalar quantities

9) **Which is the semiconductor:**
a. Iron
b. Germanium
c. Gold
d. Silver

10) **Which statements not true:**
a. Microphone converts sound into electric potential
b. Temperature is an analogue quantity
c. Amplifier is an analogue circuit
d. Amplifier is not an analogue circuit

11) **Which of the following is an insulator?**
a. Aluminum
b. Plastic
c. Silicon
d. Copper

12) **Which is not a true statement?**
a. Germanium is the member of 6^{th} group of periodic table
b. Germanium has four electrons in its valence shell
c. Germanium forms covalent bond by sharing four electrons
d. Germanium crystal acts as insulator in its purest form

13) **Which statement is not true about semi-conductor:**
a. They are not good conductors in their purest form.
b. They are not of such practical use in this state.
c. The number of electron can be added according to our requirement
d. Hexavalent impurity is usually added in them

14) **When germanium or silicon is doped with Boron or Gallium, then the number of holes is increased and we get______ doped conductor.**
a. n-type
b. p-type
c. p-ntype
d. d-type

15) **Which is not true:**
a. The width of its depletion region increase
b. The width of its depletion region decrease
c. the quantity ofpositive and negative ions become less
d. In this condition, the resistance ofthejunction is only a few ohms.

16) **The instrument used to convert A.C voltage into D.C. is called:**
a. Transformer
b. Step down transformer
c. Rectifier
d. Magnetic needles

17) **Which is not the part of a transistor:**
a. Base
b. Emitter
c. Collector
d. Microphone

18) **If the value of Boolean variable, after NOT operation become x, then it is symbolically written as:**
a. x = A
b. A=x
c. x = I+I
d. x=π.B

19) **The electronic devices in the artificial satellites are controlled from earth stations with the help of:**
a. current '
c. computers
b. electrical power
d. electromagnetic waves

20) **The artificial satellites orbiting earth are used in:**
a. telecommunication
b. weather forecast
c. scan Earth's natural resources
d. all of them

21) **A microchip equal to size of thumbnail has electronic devices about:**
a. 1000
b. 500
c. 100
d. 10

22) **The quantities whose values changes continuously or remains constant are called:**
a. electronics
b, analogue quantities V
c. digital quantities
d. both(b)& (c)

23) **Which is not an analogue quantity:**
a. pressure
b. microchip
c. temperature
d. time

24) **The output is an analogue of:**
a. ADC
b. ACD
c. DAC
d. CDA

25) **The analogue signal is converted into digital by:**
a. DAC
b. computer
c. transistor
d. ADC

26) **The resistance of an idea conductor is:**
a. infinity
b. low
c. zero
d. high

27) **Which is the best conductor:**
a. gold
b. Silver
c. copper
d. aluminum

28) **The substances which have infinite resistance are called:**
a. conductor
b. insulator

c. semi-conductor
d. none of these

29) **Which one of following in not a insulator:**
a. wood
b. rubber
c. copper
d. glass

30) **Germanium and silicon belongs with periodic table:**
a. 2
b. 1
c. 3
d. 4

31) **At zerb Kelvin temperature semi-conductors becomes: .**
a. conductor
b. insulator
c. ionize
d. none of these

32) **The germanium of silicon becomes good conductor at:**
a. ordinary temperature
b. 100° C
c. 0°C
d. zero Kelvin

33) **In semi-conductors holes are:**
a. Neutral particles
b. negative charge
c. positive charge carrier
d. none of these

34) **Electric current In semi-conductors flow due to flow of :**
a. holes
b. electrons
c. both hole and electrons
d. neutral paretic

35) **The process which increase the current conducting properties of an element called:**
a. covalent bonding
b. doping
c. decreasing temp.
d. increasing temp.

36) **A semi-conductor in its purest form is not such a good:**
a. conductor
b. insulator
c. element
d. metal

37) **The ratio of impurity added in semi-conductor in the ratio:**
a. 10^2:10^10
b. 10^5:10^20
c. 1:10^^{x}
d. 1:10^5

38) **Which type of impurity is used in making n-type semi-conductor:**
a. monovalent
b. trivalent
c. divalent
d. pentavalent

39) **Which of the following is not pentavalent:**
a. phosphorous
b, gallium
c. bismuth
d. arsenic

40) **Which of the following is not trivalent?**
a. antimony
b. aluminum
c. indium
d. boron

41) **When a trivalent impurity is added, which type of semi-conductor is formed?**
a. n-type
b. p-type
c. both (a) and (b)
d. none of these

42) **In p-type semi-conductors current flow due to flow of:**
a. electrons
b. protons
c. holes
d. beta particles

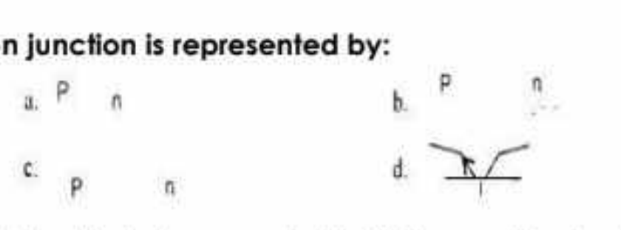
43) **In semi-conductors whenever a covalent bond breaks, it forms a:**
a. electron
b. hole
c. proton
d. electron-hole pair

44) **A neutral region between p-n junction is called:**
a. potential barrier
b. p-region
c. depletion region
d. n-region

45) **The potential barrier in case of silicon is of the order of:**
a. I volt
b. 0.3 volt
c. 0.5 volt
d. 0.7 volt

46) **The potential barrier in case of Germanium is of the order of:**
a. 0.3 volt
b. 0.5 volt
c. 0.7 volt
d. 1 volt

47) **The symbol of p-n junction is represented by:**



48) **When The p part of a diode is connected with the positive terminal of battery, then the diode is said to be:**
a. Forward biased
b. reversed biased
c. Neutral
d. none of these

49) **In reversed biasing the p part of the diode is connected by the battery at:**
a. positive terminal
b. negative terminal
c. cathode
d. earthed

50) **The width of depletion region increases when diode is:**
a. earthed
b. forward biased
c. reversed biased
d. neutral

51) **In forward biasing the current passing through diode is:**
a. Zero.
b. minimum
c. maximum
d. none of these

52) **The process in which alternating current is converted into direct current is called:**
a. forward biasing
b. reverse biasing
c. doping
d. rectification

53) **The central region of a transistor is known as:**
a. emitter
b. collector
c depletion region
d. base

54) **In n-p—n transistor the emitter is made of:**
a. p-type
b. II—type
c. neutral
d. wood

55) **In transistors which of the following junction is forward biased:**
a. emitter-base
b. emitter-collector
c. base-collector
d. none oi these

56) **The equation of transistor is:**
a. $I_c=I_B+I_E$
b. $I_B=I_E+I_C$
c. $I_C=I_E+I_B$
d. $I_E=I_B+I_C$

57) **The Boolean formula for AND gate is:**
a. x=A+B
b. x=A.B
c. x=KB
d. x=A.B

58) **The output of which gate is at '0' when both 01' its inputs are at '0':**
a. OR gate
b. AND gate
c. NOT gate
d. both a and b

59) **Which gate is called 'INVERTOR'? "**

a. OR
b. AND
c. NOT
d. NAND

60) **x = A + B is the Boolean formula for the gate:**
a. OR
b. AND
c. NOT
d. NAND

ANSWERS

No	Answer	No	Answer	No	Answer	No	Answer
1	C	2	B	3	A	4	C
5	C	6	D	7	D	8	C
9	B	10	D	11	B	12	A
13	D	14	B	15	A	16	C
17	D	18	A	19	D	20	D
21	A	22	B	23	B	24	C
25	D	26	C	27	A	28	B
29	C	30	D	31	B	32	A
33	C	34	C	35	B	36	A