CLASS-9 SCIENCE (PHYSICS & CHEMISTRY)

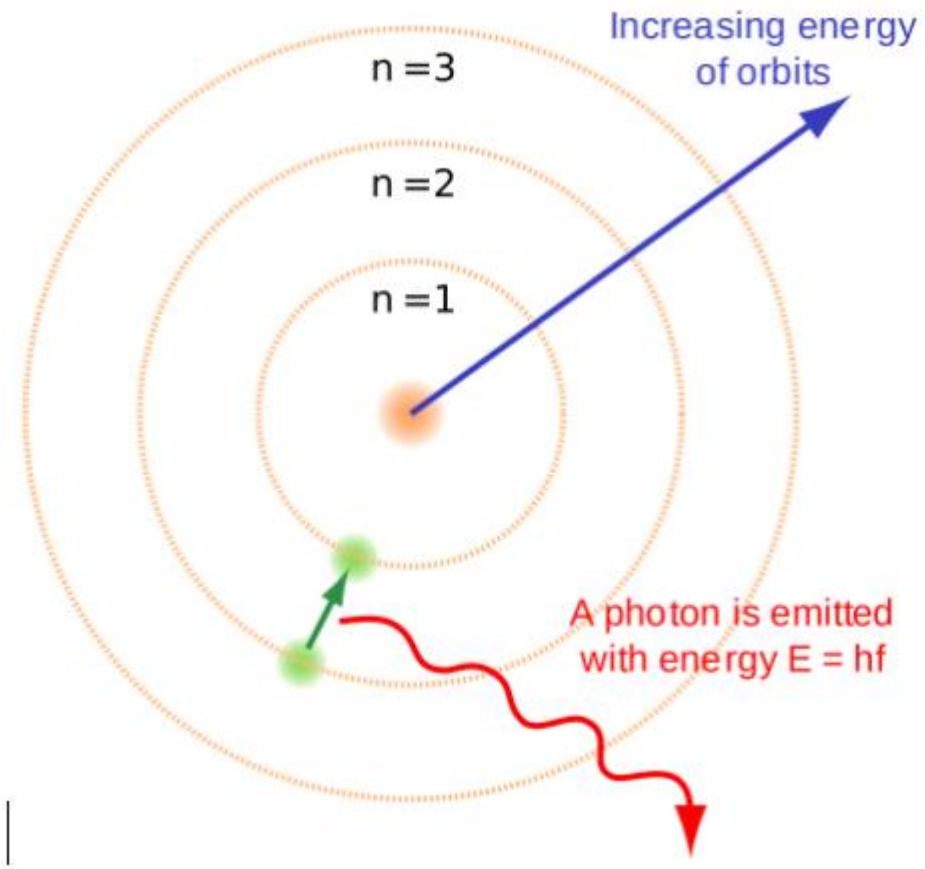
THIRD TERM
CHAPTER-4 (STRUCTURE OF THE ATOM)
In-text questions Page- 50

1. What are the canal rays?
Ans: The radiations that are positively charged are canal rays. This discovery was crucial in the discovery of another subatomic particle that was positively charged – proton.
2. If an atom contains one electron and one proton, will it carry any charge or not?
Ans: Since a proton is a positively charged particle and an electron is a negatively charged particle, the net charge becomes neutral as both the particles neutralizes each other.
In-text questions Page - 52

1. On the basis of Thompson's model of an atom, explain how the atom is neutral as a whole.
Ans: As per Thompson's model of an atom,
(i) An atom contains a positively charged sphere in which the negatively charged electrons are implanted.
(ii) Electrons and protons are equal in magnitude, hence an atom on the whole is electrically neutral.

2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?
Ans: As per Rutherford's model of an atom, the positively charged protons are the ones that are present in the atom.
3. Draw a sketch of Bohr's model of an atom with three shells.

Solution:



4. What do you think would be the observation if the ∝– particle scattering experiment is carried out using a foil of a metal other than gold?
Ans: In the ∝ – particle scattering experiment, when any other metal foil is used instead of gold, the observation would remain the same. This is because the structure of an atom when considered individually remains the same.
In-text questions Page -53
1. Name the three subatomic particles of an atom.
Ans: An atom consists of three subatomic particles:
Protons – positively charged
Electrons – negatively charged
Neutrons – neutral in nature (no charge)
2. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?
Solution: Given: Atomic mass of helium atom = 4u, 2 protons in helium nucleus
Atomic mass = number of protons + number of neutrons
4 = 2 + number of neutrons
Number of neutrons = 4 – 2 = 2
Hence, Helium has 2 neutrons.
In-text questions Page- 53
1. Write the distribution of electrons in Carbon and Sodium atoms.
Ans: Distribution of electrons in Carbon atoms:
The atomic number of Carbon is 6
Number of electrons is equal to the number of protons in carbon atom i.e., 6
The distribution of electrons in carbon atom is K – 2, L – 4
Distribution of electrons in sodium atoms:
The atomic number of Sodium is 11
Number of electrons is equal to the number of protons in sodium atom i.e., 11
The distribution of electrons in sodium atom is K – 2, L – 8, M – 1
2. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?
Ans: K shell can hold 2 electrons
L shell can hold 8 electrons
Hence, when both the shells are full, the total number of electrons present in the atom = 2+8 = 10 electrons.
In-text questions Page -55
1. How will you find the valency of chlorine, sulphur and magnesium?
Ans: The definite combining capacity of the atoms of each element, wherein electrons are lost, gained or shared to make the octet of electrons present in the outermost shell is defined as valency. To measure valency, we can figure out the number of electrons that are required to complete the shell in which it is contained or losing excess electrons if present, once the filling is complete.
To find the valency of chlorine:
The atomic number of chlorine is 17
Number of electrons is equal to the number of protons in chlorine i.e., 17
The distribution of electrons in chlorine atom is K – 2, L – 8, M – 7
Hence, from the distribution of chlorine it is clearly evident that to fill the M shell only one electron is required. Therefore, its valency is -1. i.e, one electron less
To find the valency of sulphur:
The atomic number of sulphur is 16
Number of electrons is equal to the number of protons in sulphur i.e., 16
The distribution of electrons in sulphur atom is K – 2, L – 8, M – 6
Hence, from the distribution of sulphur it is clearly evident that to fill the M shell two more electrons are required. Therefore, its valency is -2, i.e., two electrons lesser.
To find the valency of magnesium:
The atomic number of magnesium is 12
Number of electrons is equal to the number of protons in magnesium i.e., 12
The distribution of electrons in magnesium atom is K – 2, L – 8, M – 2

Hence, from the distribution of magnesium it is clearly evident that to fill the M shell six more electrons are required. But M shell has two electrons only. It possesses lesser electrons than needed to fill the shell.
Thus, we say that the magnesium atom is not stable as the M shell has 2 electrons. Its valency is +2, meaning it has 2 electrons in excess.
In-text questions Page- 55
1. If the number of electrons in an atom is 8 and number of protons is also 8, then
(i) What is the atomic number of the atom? And
(ii) What is the charge on the atom?
Solution: Given: Number of electrons = 8
Number of protons = 8
(a) The atomic number of an atom is the same as the number of protons in that atom, hence its atomic number is 8.
(b) In an atom, the number of protons is equal to the number of electrons. Hence both the charges – positive and negative neutralize each other. Therefore, the atom does not possess any charge.
2. With the help of given Table, find out the mass number of oxygen and sulphur atom.

Table: Composition of Atoms of the First Eighteen Elements with Electron Distribution in Various Shells.

Name of Element	Symbol	Atomic number	Number of Protons	Number of Neutrons	Number of electrons	Distribution of electrons				Valency
						K	L	M	N	
Hydrogen	H	1	1	–	1	1	–	–	–	1
Helium	He	2	2	2	2	2	–	–	–	0
Lithium	Li	3	3	4	3	2	1	–	–	1
Beryllium	Be	4	4	5	4	2	2	–	–	2
Boron	B	5	5	6	5	2	3	–	–	3
Carbon	C	6	6	6	6	2	4	–	–	4
Nitrogen	N	7	7	7	7	2	5	–	–	3
Oxygen	O	8	8	8	8	2	6	–	–	2
Fluorine	F	9	9	10	9	2	7	–	–	1
Neon	Ne	10	10	10	10	2	8	–	—	0
Sodium	Na	11	11	12	11	2	8	1	–	1
Magnesium	Mg	12	12	12	12	2	8	2	–	2
Aluminium	Al	13	13	14	13	2	8	3		3
Silicon	Si	14	14	14	14	2	8	4	–	4
Phosphorus	P	15	15	16	15	2	8	5	–	3,5
Sulphur	S	16	16	16	16	2	8	6	–	2
Chlorine	Cl	17	17	18	17	2	8	7	–	1
Argon	Ar	18	18	22	18	2	8	8		0

Solution:

(a) To find the mass number of Oxygen:
Number of protons = 8

Number of neutrons = 8
Atomic number = 8

Atomic mass number = Number of protons + number of neutrons = 8 + 8 = 16
Therefore, mass number of oxygen = 16

(b) To find the mass number of Sulphur:
Number of protons = 16
Number of neutrons = 16
Atomic number = 16
Atomic mass number = Number of protons + number of neutrons = 16 + 16 = 32
In-text questions Page – 56
1. For the symbol H, D and T, tabulate three subatomic particles found in each of them.

Ans:

The following table depicts the subatomic particles in Hydrogen (H), Deuterium (D), and Tritium(T).

Isotope	Symbol	Mass no.	Atomic no.	No. of electrons	No. of protons	No. of neutrons
Hydrogen	H	1	1	1	1	0
Deuterium	D	2	1	1	1	1
Tritium	T	3	1	1	1	2

2. Write the electronic configuration of any one pair of isotopes and isobar.
Ans:
(a) Isotopes: Isotopes are atoms which have the same number of protons but the number of neutrons differs. This leads to the variation in mass number too. Example: Carbon molecule exists as ${}_{6}C^{12}$ and ${}_{6}C^{14}$ but when their electronic configuration is noticed, both have K-2; L-4
(b) Isobars: Isobars are atoms which have the same mass number but differ in the atomic number. Electronic configuration of an isobar pair is as follows,
Example: Electronic configuration of ${}_{20}Ca^{40}$ – K-2; L-8; M-8; N- 2
Electronic configuration of ${}_{18}Ar^{40}$ – K-2; L-8; M-8

Exercise questions (Page- 57 to 60)

1. Compare the properties of electrons, protons and neutrons.

Ans:

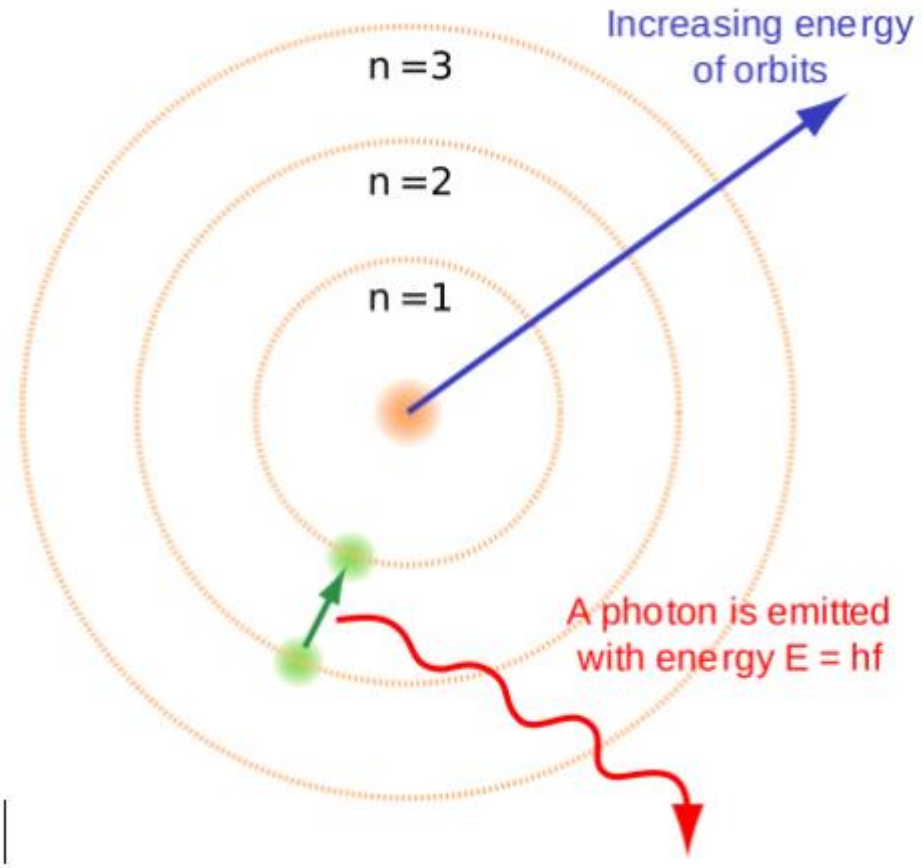
Property	Electrons	Protons	Neutrons
Charge	Negatively charged	Positively charged	No charge.
Location	Located outside the nucleus	Located within the nucleus	Located inside the nucleus of an atom
Weight	Mass is negligible	1 a.m.u	1 a.m.u
Affinity	Attracted towards positively charged	Attracted towards negatively charged	Do not get attracted to any charged particle

2. What are the limitations of J.J. Thomson’s model of the atom?
Ans: The limitations of the J.J. Thomson’s model of an atom are:

(i) It could not explain the stability of an atom.
(ii) It could not explain hydrogen spectrum.

3. What are the limitations of Rutherford's model of the atom?

Ans: Limitations of Rutherford's model of the atom are:
(i)Rutherford model could not explain the stability of atom.
(ii)Rutherford model could not explain the spectrum of hydrogen and other atoms.
4. Describe Bohr's model of the atom.
Ans: (i) An atom holds the nucleus at the centre.
(ii) Negatively charged electrons revolve around the nucleus.
(iii)The atoms in it contains distinct orbits of electrons.
(iv)Electrons do not radiate energy when they are in their orbits.
(v)The distinct orbits are named as K, L, M, N orbits. Numbers used to denote them are n=1, 2, 3, 4



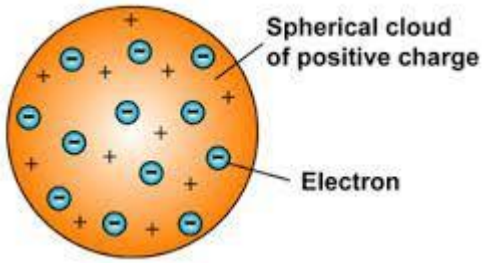
5. Compare all the proposed models of an atom given in this chapter.

Ans:

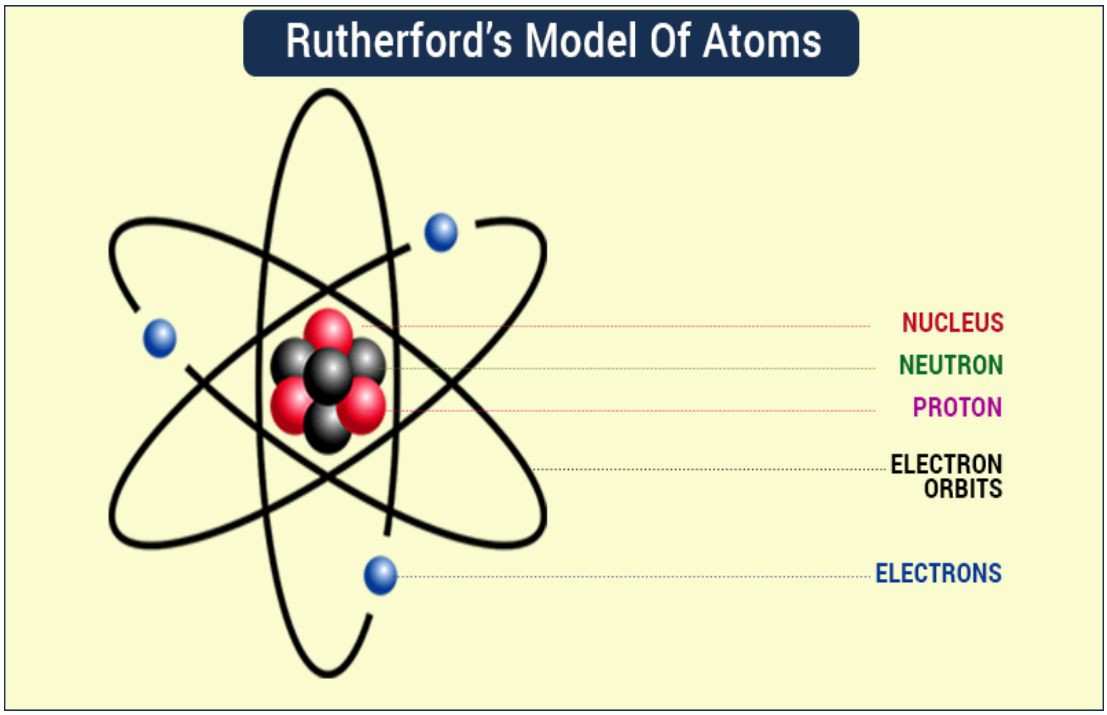
Thomson	Rutherford	Bohr
● Sphere is positively charged ●Electrons are negatively charged and scattered all through the inside of the sphere. ● Positively charged = negatively charged	● The nucleus is at the centre and is positively charged holding the entire mass. ● Electrons are negatively charged revolving in a well-defined path ●In comparison with the nucleus,	●Nucleus is present at the centre and is positively charged ● Electrons are negatively charged, revolving around but do not radiate energy. ● The distinct orbits are labelled as K, L, M, N

● The net charge in the atom is zero. the size of the atom is very large.

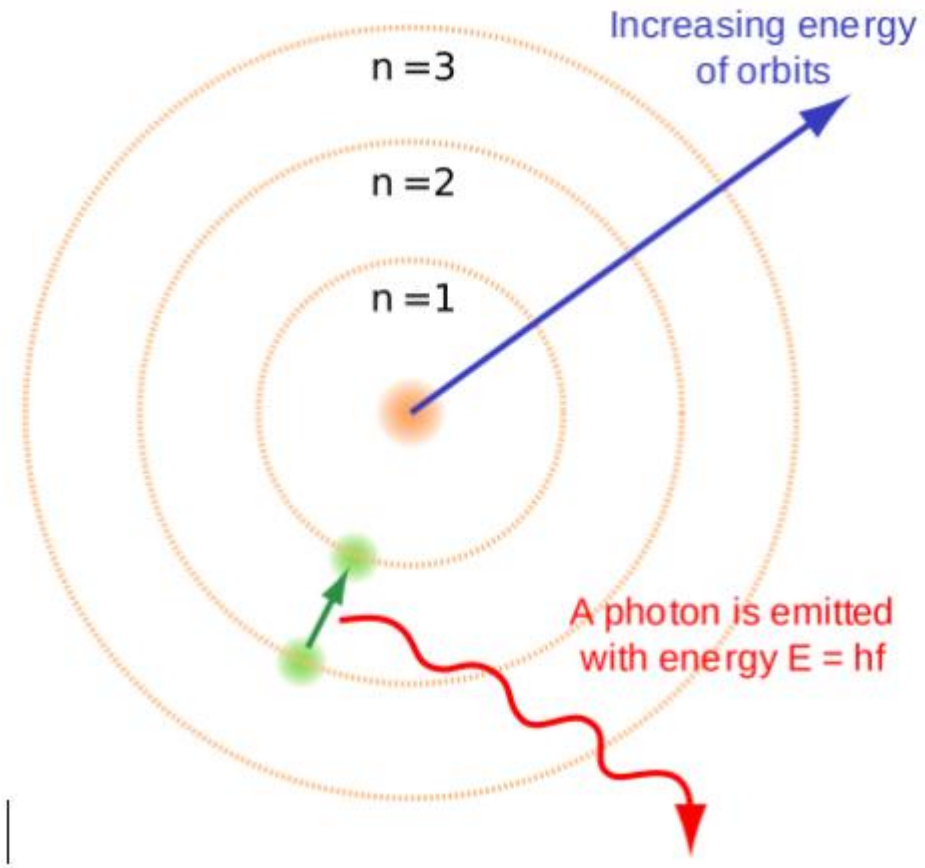
Thomson's Model of Atom :



Rutherford's Model of Atoms:



Bohr's model of the atom:



6.Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.
Ans: (i) Maximum number of electrons that can be accommodated in a shell is given by the formula: 2n2 , where n= 1, 2, 3…
(ii)Maximum number of electrons in different shells are:

K shell – n=1 ; 2n2 = 2(1)2 = 2

L shell – n=2 ; 2n2 = 2(2)2 = 8

M shell – n=3 ; 2n2 = 2(3)2 = 18

N shell- n=4 ; 2n2 = 2(4)2 = 32

- The outermost orbit can be accommodated with 8 electrons at the maximum.
- The electrons are not taken in unless the inner shells are filled which are filled step-wise, hence the highest element has K-2; L-8; M-8 distribution of electrons.
  7. Define valency by taking examples of silicon and oxygen.
  Ans: Valency is the combining tendency of an atom and is equal to number of electrons lost, gained or shared by it.
  Example: To find the valency of silicon:
  The atomic number of silicon is 14
  Number of electrons is equal to the number of protons in silicon i.e., 14
  The distribution of electrons in silicon atom is K – 2, L – 8, M – 4
  Hence, from the distribution of silicon it is clearly evident that to fill the M shell 4 electrons are required. Therefore, its valency is 8-4=4.
  To find the valency of oxygen:
  The atomic number of oxygen is 8

Number of electrons is equal to the number of protons in oxygen i.e., 8
The distribution of electrons in oxygen atom is K – 2, L – 6
Hence, from the distribution of oxygen it is clearly evident that to fill the M shell 6 more electrons are required. Therefore, its valency is 8-6=2.
8. Explain with examples: (i) Atomic number (ii) Mass number (iii) Isotopes and (iv) Isobars. Give any two uses of isotopes.
Ans:(i) The number of positively charged protons present in the nucleus of an atom is defined as the atomic number and is denoted by Z. E.g. Hydrogen has one proton in its nucleus, hence its atomic number is one.
(ii) The total number of protons and neutrons present in the nucleus of an atom is known as the mass number. It is denoted by A. $_{20}Ca^{40}$. Mass number is 40. Atomic number is 20.
(iii) The atoms which have the same number of protons but different number of neutrons are referred to as isotopes. Hence the mass number varies.
E.g. The most simple example is the Carbon molecule which exists as $_{6}C^{12}$ and $_{6}C^{14}$
(iv) Isobars: Isobars are atoms which have the same mass number but differ in the atomic number.

E.g. $_{20}Ca^{40}$and $_{18}Ar^{40}$
Uses of isotopes: (i) The isotope of Iodine atom is used to treat goitre and iodine deficient disease.
(ii) In the treatment of cancer, an isotope of cobalt is used.
(iii) Fuel for nuclear reactors is derived from the isotopes of the Uranium atom.
9. Na+ has completely filled K and L shells. Explain.
Ans: The atomic number of sodium is 11. It has 11 electrons in its orbitals wherein the number of protons is equal to the number of electrons. Hence, its electronic configuration is K-2; L-8 ; M-1 ; The one electron in the M shell is lost and it obtains a positive charge since it has one more proton than electrons, and obtains a positive charge, Na+ . The new electronic configuration is K-1; L-8 which is the filled state. Hence it is very difficult to eliminate the electron from a filled state as it is very stable.
10. If bromine atom is available in the form of, say, two isotopes $_{35}Br^{79}$ (49.7%) and $_{35}Br^{81}$ (50.3%), calculate the average atomic mass of Bromine atom.
Solution: The atomic masses of two isotopic atoms are 79 (49.7%) and 81 (50.3%).
Thus, total mass = (79 * 49.7 / 100) + (81 * 50.3 / 100) = 39.263 + 40.743 = 80.006 u
11. The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes $_{8}X^{16}$ and $_{8}X^{18}$ in the sample?
Solution: Let the percentage of $_{8}X^{16}$ be ‘a’ and that of $_{8}X^{18}$ be ‘100-a’.
As per given data,16.2u = 16 a / 100 + 18 (100-a) /100
1620 = 16a + 1800 – 18a
1620 = 1800 – 2a
a = 90%
Hence, the percentage of isotope in the sample $_{8}X^{16}$ is 90% and that of
$_{8}X^{18}$ = 100-a = 100- 90=10%
12. If Z=3, what would be the valency of the element? Also, name the element.
Solution: Given: Atomic number, Z = 3
The electronic configuration of the element = K-2; L-1, hence its valency = 1
The element with atomic number 3 is Lithium.
13. Why atom is called an electrically neutral particle of matter?
Ans: Atoms are electrically neutral because they have equal numbers of protons (positively charged) and (negatively charged).
14. Why atomic number is considered very important to know about the chemical behaviour of an element?
Ans: Chemical behaviour of an element depends upon the number of valence electrons present in it. The atomic number gives the number of valence electrons in atom. Atomic number also helps to distinguish atoms of one element from atoms of other elements.
15. Which problem of atomic structure was solved by the discovery of neutron?
Ans: The problem was that the sum of mass of electrons and protons is not equal to mass of an atom. So there should be another sub-atomic particle which have only mass and no change. This problem was solved by the discovery of neutron by J. Chadwick.

16. Which of the two would be chemically more reactive:
(a) An element X with atomic number 10
(b) An element Y with atomic number 17 Give reason also.
Ans: The electronic configuration of the element X is 2, 8 and that of element Y is 2, 8, 7. The element X has stable atomic structure while element Y has a shortage one electron to reach the stable structure. So, it is clear that the element Y will be more reactive than the element X.
17. What will be the number of valence electrons in:
(a) Na^+ ion (b) Mg^{2+} ion
(c) Cl^- ion (d) N^{3-} ion

Ans: (a) Number of valence electrons Na^+ ion is 1

(b) Number of valence electrons Mg^{2+} ion is 2

(c) Number of valence electrons Cl^- ion is 1

(d) Number of valence electrons N^{3-} ion is 3
18. Give reasons for the following:
(i) In potassium and calcium, the filling of electrons in the N-shell starts after M-shell has acquired 8 electrons although M shell can accommodate upto 18 electrons.
(ii) Atoms combine with other atoms
(iii) The atomic masses of elements are in fractions.
Ans: (i) It is because the maximum of electrons that can be accommodated in the outermost orbit is 8.
(ii) Atoms combine together to complete their octect and become stable in the outermost shell.
(iii) The atomic mass of most elements are in fraction because they exist as a mixture of isotopes of different masses.
19. An ion Y^{3-} contains 18 electrons and 16 neutrons. Calculate the atomic number and mass number of the element Y. Name the element Y.
Soution: Atomic number of the element Y = 18 – 13 = 15
Mass number = 15 + 16 = 31
The element Y is phosphorus.
20. Composition of the nuclei of two atomic species X and Y are given as under

	X	Y
Protons =	6	6
Neutrons =	6	8

Give the mass numbers of X and Y. What is the relation between the two species?
Solution: Mass number of X = Protons + neutrons = 6+6 = 12
Mass number of Y= Protons + neutrons = 6+8 = 14
These are isotopes because they have same atomic number but different mass numbers.
21. For the following statements, write T for true and F for false.
(a) J.J. Thomson proposed that the nucleus of an atom contains only nucleons.
(b) A neutron is formed by an electron and a proton combining together. Therefore, it is neutral.
(c) The mass of an electron is about 1/2000 times that of proton.
(d) An isotope of iodine is used for making tincture iodine, which is used as a medicine.
Ans:(a) False (b) False (c) True (d) False
22. Rutherford's alpha – particle scattering experiment was responsible for the discovery of
(a) Atomic nucleus (b) Electron
(c) Proton (d) Neutron
Ans: (a) Atomic nucleus
23.Isotopes of an element have
(a) The same physical properties (b) Different chemical properties

(c) Different number of neutrons (d) Different atomic numbers.

Ans:(c) Different number of neutrons

24. Number of valence electrons in Cl– ion are:
(a) 16 (b) 8
(c) 17 (d) 18
Ans: (b) 8

*(Note-Electronic distribution of Cl is K-2, L-8, M-7. Valence electrons are 7, hence chlorine gains one electron for the formation of Cl^-. Therefore, its valency is 8.)

25. Which one of the following is a correct electronic configuration of Sodium?
(a) 2, 8 (b) 8, 2, 1 (c) 2, 1, 8 (d) 2, 8, 1
Ans: (d) 2, 8, 1

26.Complete the following table.

Atomic number	Mass number	Number of neutrons	Number of Protons	Number of electrons	Name of the atomic species
9	–	10	–	–	–
16	32	–	–	–	Sulphur
–	24	–	12	–	–
–	2	–	1	–	–
–	1	0	1	0	–

Ans: The following table depicts the missing data:
Atomic number(Z) =Number of protons
Mass number = Number of neutrons + atomic number
(or)
Mass number(A) = Number of neutrons + number of neutrons

Atomic number	Mass number	Number of neutrons	Number of Protons	Number of electrons	Name of the atomic species
9	19	10	9	9	Fluorine
16	32	16	16	16	Sulphur
12	24	12	12	12	Magnesium
1	2	1	1	1	Deuterium
1	1	0	1	0	Hydrogen

TICK THE CORRECT OPTION:

1. Ans : (iv)
2. Ans: (i)
3.Ans: (i)
4.Ans: (iv)
5.Ans: (ii)

CHAPTER-12 (SOUND)

In-text questions Page-174

1. How does the sound produced by a vibrating object in a medium reach your ear?

Ans: When an object vibrates, it necessitates the surrounding particles of the medium to vibrate. The particles that are adjacent to vibrating particles are forced to vibrate. Hence the sound produced by a vibrating object in a medium is transferred from particle to particle till it reaches your ear.

In-text questions Page-175

1. Explain how sound is produced by your school bell.

Ans: When the school bell is hit with a hammer, it moves forward and backwards producing compression and rarefaction due to vibrations. This is how sound is produced by the school bell.

2. Why are sound waves called mechanical waves?

Ans: Sound waves require a medium to propagate to interact with the particles present in it. Therefore, sound waves are called mechanical waves.

3. Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Ans: No. This is because sound needs material medium to travel and there is no atmosphere on the moon

In –text Page -178

1. Which wave property determines (a) loudness, (b) pitch?

Ans:(a). The amplitude of wave determines the loudness of wave.

(b). The pitch of wave is determined by the frequency of vibration of the vibrating object which produces sound.

2. Guess which sound has a higher pitch: guitar or car horn?

Ans: The guitar has a higher pitch than a car horn.

3. What are wavelength, frequency, time period and amplitude of a sound wave?

Ans: (a) Wavelength – Wavelength can be defined as the distance between two consecutive rarefactions or two consecutive compressions. The SI unit of wavelength is meter (m).

(b) Frequency – Frequency is defined as the number of oscillations per second. The SI unit of frequency is hertz (Hz).

(c) Amplitude – Amplitude can be defined as the maximum height reached by the trough or crest of a sound wave.

(d) Time period – The time period is defined as the time required to produce one complete cycle of a sound wave.

4. How are the wavelength and frequency of a sound wave related to its speed?

Ans: Speed = Wavelength x Frequency

5. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Solution: Given, Frequency of sound wave = 220 Hz.

Speed of sound wave = 440 m/s.

wavelength =?

We know, Speed = Wavelength × Frequency

$v = \lambda \nu$

440 = Wavelength × 220

Wavelength = 440/220

Wavelength = 2

Therefore, the wavelength of the sound wave = 2 m

6. A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?

Solution: Given, v=500Hz

we know v= 1/T

T= 1/v = 1/500

T = 0.002 s.

7. Distinguish between loudness and intensity of sound.

Ans: The amount of sound energy passing through an area every second is called intensity of a sound wave. Loudness is defined by its amplitude.

In-text questions Page-179

1. In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Ans: Sound travels fastest in a solid medium. Therefore, the answer is iron.

In-text questions Page- 180

1. An echo is heard in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 ms^{-1}?

Solution: Speed of sound (v) = 342 ms^{-1}

Echo returns in time (t) = 3 s

Distance travelled by sound = v × t = 342 × 3 = 1026 m

In the given interval of time, sound must travel a distance which is twice the distance of reflecting surface and source.

Therefore, the distance of reflecting surface from the source =1026/2 = 513 m.

In text question Page-181

1. Why are the ceilings of concert halls curved?

Ans: Ceilings of concert halls are curved to uniformly spread sound in all directions after reflecting from the walls.

In-text questions Page-182

1. What is the audible range of the average human ear?

Ans: 20 Hz to 20,000 Hz.

2. What is the range of frequencies associated with (a) Infrasound? (b) Ultrasound?

Ans: (a). For infrasound< 20 Hz (b). For ultrasound > 20,000 Hz.

In-text question Page-184

1. A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is 1531 m/s, how far away is the cliff?

Solution: Time (t) taken by the sonar pulse to return = 1.02 s

Speed (v) of sound in salt water = 1531 m s^{-1}

Distance travelled by sonar pulse = Speed of sound × Time taken

= 1531 x 1.02 = 1561.62 m

Distance of the cliff from the submarine = (Total distance travelled by sonar pulse) / 2

= 1561.62 / 2

= 780.81 m.

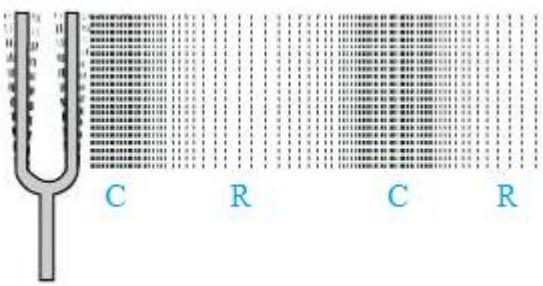
EXERCISE QUESTIONS (PAGE-186 to188)

1. What is sound and how is it produced?

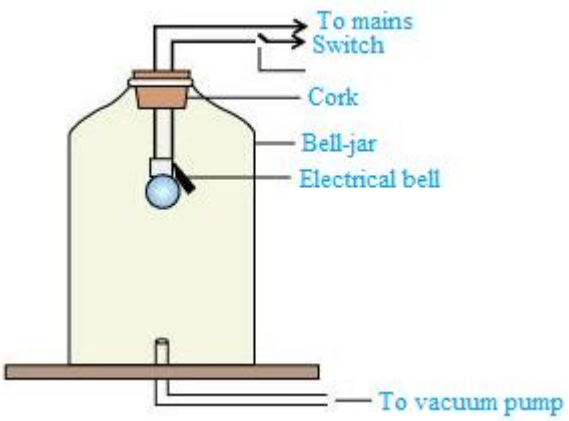
Ans: Sound is a form of energy which is produced by vibrating bodies.

2. Describe with the help of a diagram, how compressions and rarefactions are produced in the air near a source of sound.

Ans: When the school bell is hit with a hammer, it moves forward and backwards producing compression and rarefaction due to vibrations. When it moves forward, it creates high pressure in its surrounding area. This high-pressure region is known as compression. When it moves backwards, it creates a low-pressure region in its surrounding. This region is called rarefaction.



3. Cite an experiment to show that sound needs a material medium for its propagation.
Ans: Take an electric bell and hang it inside an empty bell-jar which is fitted with a vacuum pump (as shown in the figure below).



Initially, one can hear the sound of the ringing bell. Now, pump out some air from the bell-jar using the vacuum pump. You will realize that the sound of the ringing bell decreases. If you keep on pumping the air out of the bell-jar, then glass-jar will be devoid of any air after some time. Now try to ring the bell. No sound is heard but you can see bell prong is still vibrating. When there is no air present in the bell jar, a vacuum is produced. Sound cannot travel through vacuum. Therefore, this experiment shows that sound needs a material medium for its propagation.
4. Why sound wave is called a longitudinal wave?
Ans: Sound wave is called a longitudinal wave because the vibration of the particle of medium is along the direction of propagation of sound wave.
5. Which characteristics of the sound help you to identify your friend by his voice while sitting with others in a dark room?
Ans: Quality of sound is a characteristic that helps us identify the voice of a particular person. Two people may have the same pitch and loudness, but their qualities will be different.
6. Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?
Ans: Velocity of light is much higher than the velocity of sound.
7. A person has a hearing range from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as 344 m s^{-1}.
Solution: For sound waves, Speed = Wavelength × frequency
$v = \lambda \times v$
Speed of sound wave in air = 344 m/s
(a) For v = 20 Hz

$\lambda_1 = v/v_1 = 344/20 = 17.2$ m
(b) For $v_2 = 20{,}000$ Hz
$\lambda_2 = v/v_2 = 344/20{,}000 = 0.0172$ m
Therefore, for human beings the hearing wavelength is in the range of 0.0172 m to 17.2 m.
8. Two children are at opposite ends of an aluminium rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in the air and in aluminium to reach the second child.
Solution: Consider the length of aluminium rod = d
Speed of sound wave at 25° C, V Al = 6420 ms-1
Time taken to reach other end
T Al = d/ (V Al) = d/6420
Speed of sound in air, V air = 346 ms-1
Time taken by sound to each other end,
T air = d/ (V air) = d/346
Therefore, the ratio of time taken by sound in aluminium and air,
T air / t Al = 6420 / 346 = 18.55

9. The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?
Solution: Given, Frequency of sound = 100 Hz
Total time = 1 min (1 min = 60 s)
Number of oscillations or vibrations = 100 × 60 = 6000
10. Does sound follow the same laws of reflection as light does? Explain.
Ans: Yes. Sound follows the same laws of reflection as light. The reflected sound wave and the incident sound wave make an equal angle with the normal to the surface at the point of incidence. Also, the reflected sound waves, the normal to the point of incidence, and the incident sound wave all lie in the same plane.
11. When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remains the same. Do you hear echo sound on a hotter day?
Ans: On a really hot day, sound travels faster. Therefore, it may reach your ear before 1/10 th of a second. In that case, echo will not be heard.
12. Give two practical applications of reflection of sound waves.
Ans:(i) Reflection of sound is used to measure the speed and distance of underwater objects. This method is called SONAR.
(ii) Working of a stethoscope – the sound of patient's heartbeat reaches the doctor's ear through multiple reflections of sound.
13. A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower. When is the splash heard at the top? Given, g = 10 m s^{-2} and speed of sound = 340 m s^{-1}.
Solution: Height (s) of tower = 500 m
Velocity (v) of sound = 340 m s^{-1}
Acceleration (g) due to gravity = 10 m s^{-1}
Initial velocity (u) of the stone = 0
Time (t_1) taken by the stone to fall to tower base
As per second equation of motion:
$s= ut_1 + (½)\ g\ (t_1)^2$
$500 = 0 \times t_1 + (½)\ 10\ (t_1)^2$
$(t_1)^2 = 100$
$t_1 = 10$ s
Time (t_2) taken by sound to reach top from tower base = 500/340 = 1.47 s.
$t = t_1 + t_2$

$t = 10 + 1.47$
$t = 11.47$ s.
14. A sound wave travels at a speed of 339 m s^{-1}. If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?
Solution: Speed (v) of sound = 339 m s^{-1}
Wavelength (λ) of sound = 1.5 cm = 0.015 m
Speed of sound = Wavelength × Frequency
Frequency = speed / λ
= 339 / 0.015 = 22600 Hz.
It will not be audible.
15. Explain how a transverse wave can be generated in a slinky.
Ans: Slinky produces transverse waves when an end is fixed and the other end is stretched and given a jerk at right angle to its length. On jerking, there is formation of crests and troughs, along the slinky from free end towards its fixed end.
16. Give two points of distinction between transverse and longitudinal waves.
Ans:

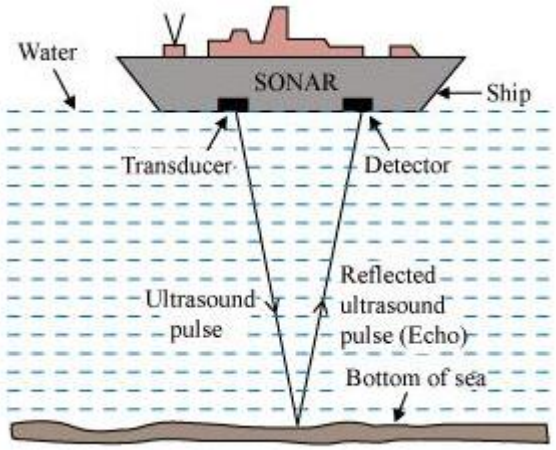
Transverse wave	Longitudinal wave
(i) Crests and troughs are formed.	(i) Compressions and rarefactions are formed.
(ii) They are formed in solids and surfaces of	(ii) They propagate in solids, liquids and gases.

liquids.	

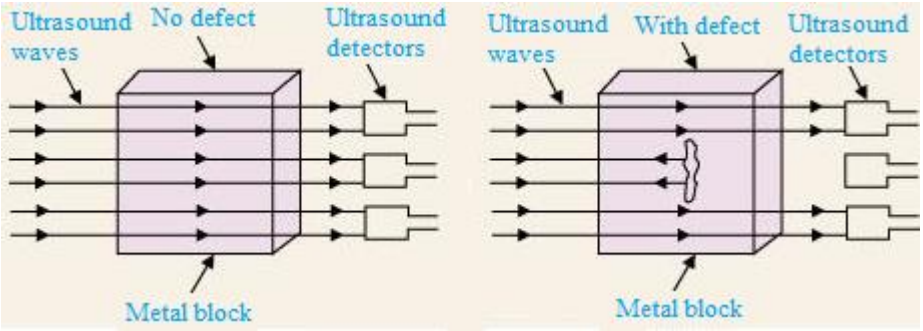
17. What is a speaking tube? What is its use?
Ans: A speaking tube is a device based on two cones connected by an air pipe through which speech can be transmitted over an extended distance.
Speaking tubes are used in intra-ship communications, affluent homes and offices, expensive automobiles, military aircrafts and even locomotives.
18. Name a few applications of ultrasound in medicine.
Ans: Few applications of ultrasound in medicine are:
(i) It is used for diagnosing the different parts of a human body and detects the diseases in human body.
(ii)It is used for getting images of internal organs of the human body and thereby to abnormalities.
(iii)It is employed to break small stones formed in the kidneys into fine grains.
19. What is an echo? Explain the following uses of multiple reflection of sound (i) Sound boards (ii) Ear trumpet (iii) Speaking tube.
Ans: The repetition of sound caused by multiple reflection of sound wave is called echo.
(i) Sound boards: It prevents the spreading out of sound waves in different directions and send the sound towards audience in big hall or auditorium.
(ii)Ear trumpet: The sound waves received by the wide end of the trumpet are reflected into a much narrow area, leading it to the ear. This increases amplitude of the vibrating air inside the ear and helps in improving hearing.
(iii)Speaking tube: They are designed to send sound in a particular direction without spreading it in all directions. Its conical opening reflects sound successively to guide most of the sound waves from the source in the forward direction towards the audience.
20. A vibrating body produces a wave of wavelength 2.5 m in a medium where the wave travels with a velocity of 1250 m s-1. Find the period of vibration of the wave.
Solution: Given,
Wave length, $\lambda = 2.5$ m
Speed, v = 1250 m/s
Time period, T = ?
we know, $T = \lambda / v = \frac{2.5}{1250} = 0.002$ s
21. Longitudinal waves travel at the speed of 10 m s-1 in a coiled spring. If the distance between two successive rarefactions is 1.0 cm, find the frequency of the wave.
Solution: Given,
Speed, v = 10 m/s = 10 x 100 m/s
Wave length, $\lambda = 1$ cm
Frequency, v =?
We know, $v = v/\lambda = \frac{10 \times 100}{1} = 1000$ Hz
22. An observer measures the time interval between the sighting of lightning and hearing the thunder. He finds it to be 5.0 s. If the speed of sound in air is 340 m s-1, how far is the cloud from the observer?
Solution: Given,
Speed of sound = 340m/s
Time = 5 s
Distance =?
We know,
Distance = speed x time
= 340 x 5m
= 1700m
i.e., Distance of the cloud, from the observer = 1700m

23. What is reverberation? How can it be reduced?
Ans: The continuous multiple reflections of sound in a big enclosed space is reverberation. It can be

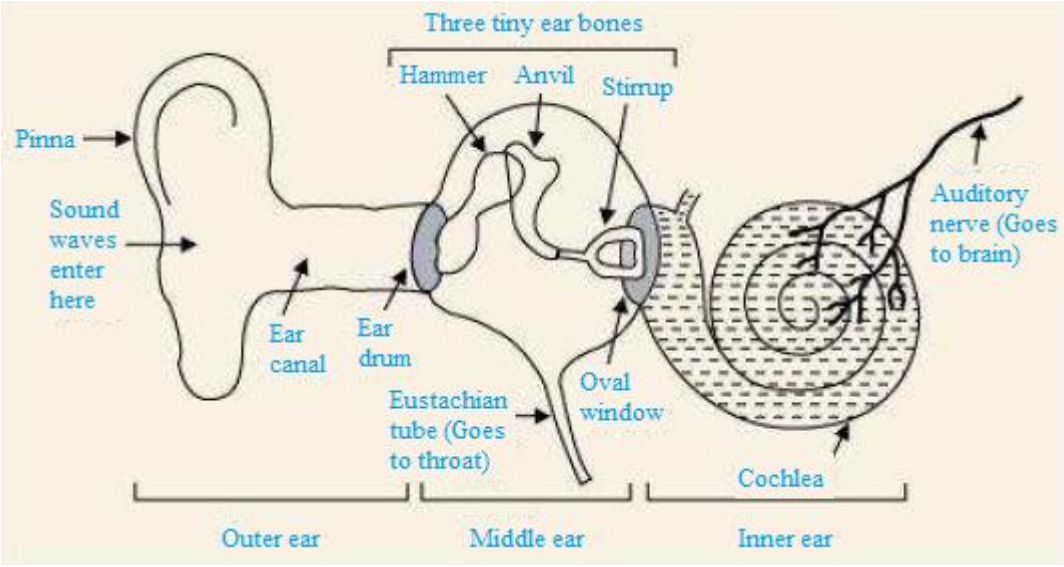
reduced by covering walls and ceiling of enclosed space with the help of sound absorbing materials such as loose woollens, fibre boards.
24. What is loudness of sound? What factors does it depend on?
Ans: Loud sounds have high energy. Loudness directly depends on the amplitude of vibrations. It is proportional to the square of the amplitude of vibrations of sound.
25. Explain how bats use ultrasound to catch prey.
Ans: Bats have the ability to produce high-pitched ultrasonic squeaks. These squeaks get reflected by objects like preys and return to their ears. This helps a bat to know how far his prey is.
26. How is ultrasound used for cleaning?
Ans: Objects that need to be cleansed are put in a cleaning solution and ultrasonic sound waves are passed through the solution. The high frequency of ultrasound waves helps in detaching the dirt from the objects. In this way ultrasound is used for cleaning purposes.
27. Explain the working and application of a sonar.
Ans: SONAR is an abbreviation of Sound Navigation and Ranging. It is an acoustic device used in measuring the direction, speed, and depth of under-water objects viz. ship wrecks and submarines using ultrasound.
Also, it is used to determine the depth of oceans and seas.
A beam of ultrasonic sound is produced and travels through the sea water which is transmitted by the transducer. When it reflects an echo is produced which is detected and recorded by the detector. It is then converted into electrical signals. The distance is represented by 'd' of the under-water object is calculated from the time (represented as 't') taken by the echo to return with speed (represented as '*v*') is expressed as,
$2d = v \times t$.
This method of measuring distance is also referred to as echo-ranging.



28. A sonar device on a submarine sends out a signal and receives an echo 5 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3625 m.
Solution: Time (t) taken to hear the echo = 5 s
Distance (d) of object from submarine = 3625 m
Total distance travelled by SONAR during reception and transmission in water = 2d
Velocity (v) of sound in water = 2d/t = (2 × 3625) / 5
= 1450 ms^{-1}
29. Explain how defects in a metal block can be detected using ultrasound.
Ans: Defective metal blocks will not allow ultrasound to pass through it and reflect it back. This technique is used in detecting defects in metal blocks. Make a set up as shown in the figure with ultrasound being passed through one end and detectors placed on the other end of a metal block. Since the defective part of the metal block does not allow ultrasound to pass through it.it will not be detected by the detector. In this way, defects in metal blocks can be detected with the help of ultrasound.



30. Explain how the human ear works.
Ans: Each part has a specific task to perform. The outer ear, collects and amplifies the sound and guides it to the middle ear. In the middle ear sound energy is converted into mechanical energy in the form of internal vibrations of the bone structure and the sound is further amplified. These vibrations are then transferred into the inner ear which converts the vibrations into nerve impulses.



TICK THE CORRECT OPTION:

1. Ans: (i)

2.Ans : (iv)

3. Ans: (ii)

4. Ans: (iv)

5.Ans : (ii)