CBSE Class 9 Science
Important Questions
Chapter 4
Structure of the Atoms

1 Marks Questions

1. What are canal rays?

Ans. E. Goldstein discovered positively charged rays, those rays are called canal rays.

2. If an atom contains one electron and one proton, will it carry any charge or not?

Ans. That atom will not contain any charge because one negative charge of single electron and one positive charge of single proton are neutralized by each other.

3. Name the three sub-atomic particles of an atom.

Ans. Proton, Neutron and Electron.

4. Rutherford's alpha-particle scattering experiment was responsible for the discovery of

(a) Atomic Nucleus

(b) Electron

(c) Proton

(d) Neutron

Ans. (c) Proton

5. Isotopes of an element have

(a) the same physical properties

(b) different chemical properties

(c) different number of neutrons

(d) different atomic numbers.

Ans. (a) the same physical properties

6. Number of valence electrons in Cl– ion are:

(a) 16

(b) 8

(c) 17

(d) 18

Ans. (b) 8

7. 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. (a) 2,8

8. Atomic Number of an element is equal to:

(a) Number of Protons

(b) Number of electrons

(c) Number of neutrons

(d) Both a) and b)

Ans. (a) Number of Protons

9. The charge of proton (p^+) is:

(a) $+1.6 \times 10^{-19} C$

(b) $-1.6 \times 10^{-19} C$

(c) $+1.6 \times 10^{19} C$

(d) $-1.6 \times 10^{19} C$

Ans. (a) $+1.6 \times 10^{-19} C$

10. $^{20}_{10}Ne$ and $^{22}_{10}Ne$ are

(a) Isotopes

(b) Isobars

(c) Isotones

(d) Both a) and b)

Ans. Isotopes

11. Helium $\left(^{4}_{2}He\right)$ **has:**

(a) $2\,P^+$ and $2\,n^\circ$

(b) $2P^+$ and $4n^\circ$

(c) $4\,P^+$ and $2\,n^\circ$

(d) $2P + and\ 4n^{\circ}$

Ans. (a) $2\,P + and\ 2\,n^{\circ}$

12. In which form is oxygen stable?

(a) O^{2-}

(b) O^{2+}

(c) O

(d) Both a) and c)

Ans. (a) O^{2-}

13. How many electrons does Na^{+} has in its Outermost shell?

(a) 10

(b) 11

(c) 18

(d) 8

Ans. (d) 8

14. Atomic number of an element during a Chemical reaction.

(a) Increases

(b) Remain Constant

(c) Decreases

(d) May be a) or c)

Ans. (b) Remain Constant

15. The molecular formula for Aluminum chloride us

(a) Al_3Cl

(b) $AlCl_3$

(c) $AlCl_3$

(d) Both b and c

Ans. (c) $AlCl_3$

16. Atomicity of fluorine is:

(a) 1

(b) 2

(c) 3

(d) 4

Ans. (b) 2

17.Molecular formula for calcium fluoride is –

(a) CaF_2

(b) Ca F

(c) Ca_2F

(d) 2 Ca F

Ans. (a) CaF_2

18.Electronic configuration of calcium is

(a) 2, 8, 8, 2

(b) 2, 8, 6, 4

(c) 2, 8, 7, 1

(d) 2, 8, 1, 7.

Ans. (a) 2, 8, 8, 2

19. Nitrogen is:

(a) Monatomic

(b) Diatomic

(c) Triatomic

(d) Tetratomic

Ans. (b) Diatomic

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2 Marks Questions

1. On the basis of Thomson's model of an atom, explain how the atomic neutral as a whole.

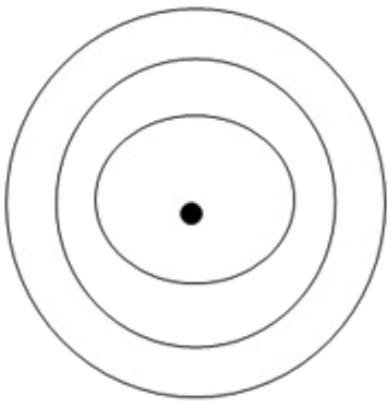
Ans. As per Thomson's model of an atom, the number of electrons (negatively charged) are equal to the number of protons (positively charged) in an atom. Hence the + and – charges are neutralized by each other that makes atom neutral as a whole.

2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

Ans. The sub atomic particle proton is present in the nucleus of an atom according to Rutherford's model of an atom.

3. Draw a sketch of Bohr's model of an atom with three shells.

Ans.



4. What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?

Ans. Yes the observations would have been different if the α-particle scattering experiment is carried out using a foil of a metal other than gold.

5. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

Ans. The number of neutrons present in a helium atom

= atomic mass – no. of protons

= 4-2 = 2

6. Write the distribution of electrons in carbon and sodium atoms.

Ans. Distribution of electrons in carbon atom:

atomic number of carbon = 6 = 2,4

Distribution of electrons in sodium atom:

atomic number of sodium = 11 = 2,8,1

7. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

Ans. If K and L shells of an atom are full, then the total number of electron in the atom will be 10 because K shell can accommodate total 2 and L shell can accommodate maximum 8 electrons that makes a total of 10.

8. If number of electrons in an atomic 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?

Ans. (i) atomic number = number of protons = number of electrons = 8

(ii) atom will be neutral (no charge) because number of protons (+) is equal to the number of

electrons (-)

9. With the help of Table 4.1, find out the mass number of oxygen and sulphur atom.

Ans. mass number of oxygen = number of neutrons + number of protons

= 8+8 =16

mass number of sulphur = number of neutrons + number of protons

= 16 + 16 = 32

10. What are the limitations of J.J. Thomson's model of the atom?

Ans. Main limitation to the J.J. Thomson's atomic model was that it didn't explain the arrangement of electrons in an atom

11. Na^+ has completely filled K and L shells. Explain.

Ans. Na has atomic number 11, so its electronic configuration is = 2,8,1

When it gives away its outermost shell single electron it changes to Na^+ =10= 2,8

The above configuration indicates completely filled K, L shells.

12. If Z = 3, what would be the valency of the element? Also, name the element.

Ans. When Z = 3, so that element has 3 electrons in its shells distributed as = 2,1.

Its valency is 1 because it can easily give away its outermost single electron and the element is Lithium(Li).

13. 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?

Ans. The mass number of X = 6+6 = 12

The mass number of Y = 6+8 = 14

since their number of protons are same but atomic mass are different so they are isotopes.

14. 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 12000 times that of proton.

(d) An isotope of iodine is used for making tincture iodine, which is used as a medicine.

Put tick (ü) against correct choice and cross (×) against wrong choice in questions 15, 16 and 17

Ans. (a) false

(b) true

(c) true

(d) false

15. The nucleus of an atom of Bi – 210 (atomic number = 83) emits a β-particle and becomes a polonium nuclide. Write as equation for the nuclear change described.

Ans. Whenever a β– particle is emitted, atomic number increase by 1 unit and mass number remains same. So. Equality is

$$^{210}_{83}Bi \rightarrow {}^{210}_{84}Po + {}^{0}_{-1}e$$

16. How can one conclude that electrons are fundamental particles?

Ans. Electrons were concluded to be the fundamental particles because the $\frac{e}{m}$ ratio of electron remains same irrespective of the nature of gas and electrodes inside the discharge tube.

17. What happens to the nucleus of an atom when it emits a r-ray?

Ans. When a nucleus emits a γ – ray than there is no change in the mass or charge of nuclide but energy of nuclide decreases by an amount equal to energy of photon emitted.

18. Write the electronic configuration of following ions:

(a) Cl^-

(b) Mg

(c) Al^{3+}

(d) O

Ans. a) $Cl^- \Rightarrow$ electronic configuration = 2, 8, 8

b) Mg $\Rightarrow$ electronic configuration = 2, 8, 2

c) $Al^{3+} \Rightarrow$ electronic configuration = 2, 8

d) O = electronic configuration = 2, 6.

19. State Mendeleev's Periodic law?

Ans. According to Mendeleev's Periodic law, the physical and chemical properties of elements and periodic function of their atomic weight (mass).

According to Mendeleev's Periodic law, the physical and chemical properties of elements and periodic function of their atomic weight (mass).

20. Define ionization energy and electron affinity?

Ans. Ionization energy of an element is the amount of energy that must be supplied to one mole of the element in the gaseous state to obtain one mole of caters in the gaseous state.

Electron affinity → point is the energy change that accompanies the formation of one mole of anions in the gaseous state from one mole of the atoms of the element in the gaseous state.

21. Why is atomic number is more important than atomic weight in predicting the chemical properties of elements?

Ans. Atomic number is the number of protons in an atom and during a chemical reaction the number of protons remains unchanged. Atomic number also gives number of electrons. Electrons are present in shell which participate in chemical reactions and decides chemical properties. Whereas atomic weight is the sum of number of protons and number of neutrons so atomic number is more important in predicting the chemical properties of elements.

22. What are the advantages of the Periodic Table?

Ans. Atomic radius increases down a group because as we move along a group the atomic number increases and the number of shells also increases and the distance of the nucleus from the outermost election increases as it gets far away from the nucleus.

Atomic radius decreases along a period because as we move from left to right along a period, the atomic number of the atom increases, and the positive charge nucleus and electrons are added to the same orbit and increased nuclear charge will increase the force of attraction of the electrons.

23. Which of the following electronic configuration are wrong and why?

(a) 2, 8, 2

(b) 2, 8, 8, 2

(c) 2, 8, 9, 1.

Ans. 2, 8, 9, 1 is wrong because after filling 8 electrons in third shell next two electrons in the fourth shell to maintain stability of an atom.

24. What are ions? What are its two types?

Ans. When one or more electrons are removed from a neural atom, a positively charged particle is formed and this is called an ion. It is of two types

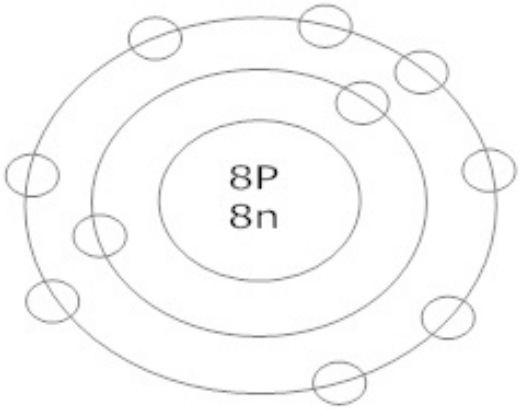
1) Cation

2) Anion.

25. Show diagrammatically the formation O^{2-} ion?

Ans. The atomic number of oxygen [0] = 8

Electronic configuration of 0=2, 6 i.e so, it needs only 2 electrons to complete its outermost orbit and hence on gaining $2e^-$ it becomes O^{2-} ion and electronic configuration is 2, 8.



26. Define Isotopes and Isobars?

Ans. Isotopes are atoms which have same atomic number but different mass number for eg: ${}^{12}_{6}C$ ${}^{14}_{6}C$.

Isobars are atoms which have the same mass number but different atomic number eg: ${}^{40}_{18}Ar$ ${}^{40}_{19}K$.

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3 Marks Questions

1. For the symbol H, D and Tabulate three sub-atomic particles found in each of them.

Ans.

Symbol	Number of electrons	Number of protons	Number of neutrons
H (hydrogen)	1	1	0
D (deuterium)	1	1	1
T(tritium)	1	1	2

2. Write the electronic configuration of any one pair of isotopes and isobars.

Ans. Isotopes of carbon:

${}_{6}C^{12} and {}_{6}C^{14}$ both have same number of electrons and protons.

Isobars:

${}_{20}Ca^{40} and {}_{18}Ar^{40}$

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

Ans.

Proton	Neutron	Electron
i)It is positively charged. ii) Its mass is equivalent to a hydrogen atom i.e. 1 a.m.u. iii) It is present inside the nucleus of the atom.	i) It is neutral ii) It is equal in mass to a proton. iii) It is also found inside the atomic nucleus.	i) it is negatively charged. ii) Its mass is 1/1838 of the mass of a proton. iii) It is found outside the nucleus of the atom.

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

Ans. Rutherford's model of atom didn't explain the stability of atom because as per his model revolving charged electrons while moving through orbit should emit energy and this energy loss will shrink the orbit and ultimately the electron would hit the nucleus and thus atom is unstable but it is not true.

5. Define valency by taking examples of silicon and oxygen.

Ans. That number of electrons (present in outermost shell) /valence electrons which an atom gives or takes or shares to complete its octet, or acquire stable configuration. Therefore, valency of sulphur = 16= 2,8,6= 2 electrons can be gained easily hence valency is 2.

valency of oxygen = 8 = 2,6 = 2 electrons can be gained easily hence valency is 2.

6. If bromine atom is available in the form of, say, two isotopes $^{79}_{35}Br(49.7\%)$ & $^{81}_{35}Br(50.3\%)$, Calculate the average atomic mass of bromine atom.

Ans. The average atomic mass of bromine $= (79\times 49.7)+(81\times 50.3)/100$

= 3926.3 + 4074.3/100

= 8000.6/100

= 80 u

7. The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes $^{16}_{8}X$ and $^{18}_{8}X$ in the sample?

Ans. Since average atomic mass = $16X+18\times(100-X)/100$

16.2= 16X + 1800 – 18X/100

1620 = -2X + 1800

2X = 1800 – 1620

X = 180/2 = 90

When 90% is the X-16 sample so for X-18 sample % = 100-90=10%

8. In a gold – foil experiment:

a) Why did many α – particles pass through the gold foil undeflected?
b) Why did few α – particles deflect through small angles.
c) Why did few α – parties, after striking the gold foil, retrace their path.

Ans. a) Many α – particle passed through the gold foil undeflected shows that most of the space inside the atom was empty.
b) Few α – particles deflected through small angles shows that there is positive charge at the centre of the gold foil.
c) Few α – particle after striking the gold foil retrace their path shows that the positively charged centre was concentrated in a very small volume of space and was called nucleus.

9. Compare the three major particles in atoms with respect to their mass and charge?

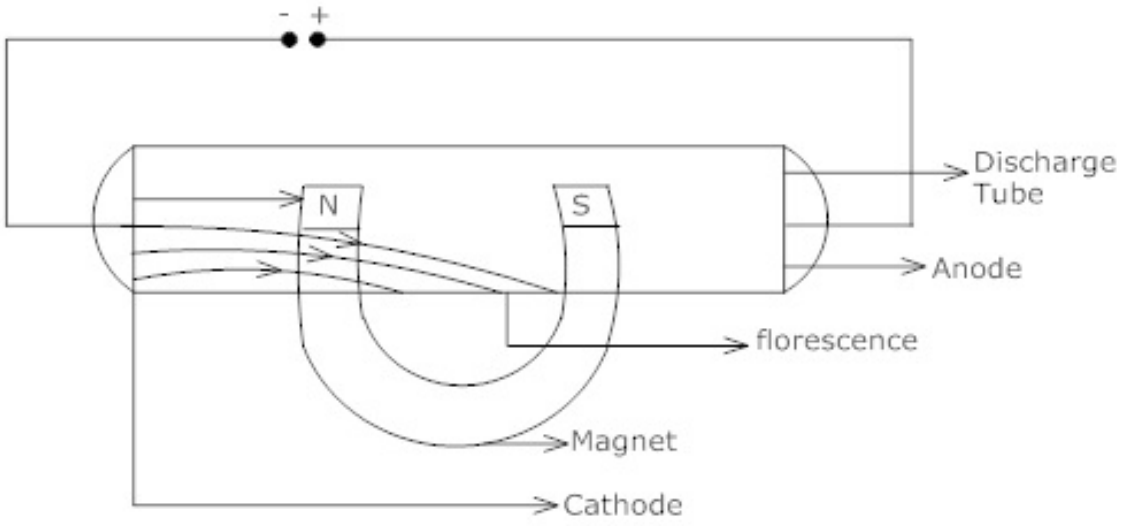
Ans.

	Particles	Symbol	Mass	Charge
1.	Proton	P^+	$1836\left(9.1\times10^{-31}\right)Kg$	$+1.6\times10^{-19}C$
2.	Neutron	N^o	$1836\left(9.1\times10^{-31}\right)Kg$	O
3.	Electron	e^-	$9.1\times10^{-31}Kg$	$-1.6\times10^{-19}C$

Inside an atom, proton and neutron are concentrated at the centre in a nucleus and electrons revolve around the nucleus in definite circular orbits.

10. Write an experiment to show cathode rays are deflected by magnetic fields?

Ans. Experiment to show that cathode rays were deflected by magnetic fields:
1) Take a discharge tube with fluorescent material on its inside.
2) Place a horse – shoe magnet in the centre of the discharge tube.
3) When cathodic rays are produced and travel through discharge tube, then cathode rays get deflected by the magnets in the direction of anode showing that they are deflected by magnetic field and also that they are negatively charged.



12. Write the postulates of Bohr theory?

Ans. The postulates of Bohr's theory are:

1) Electron move around the nucleus in definite circular path called orbits.

2) Each orbit is associated with a fixed amount of energy.

3) The larger the radius of the orbit, the greater is the energy of the electrons in them.

4) Electrons can move from one orbit to another by gaining or losing a fixed amount of energy.

13. Explain the variation of atomic radius along a period and down a group.

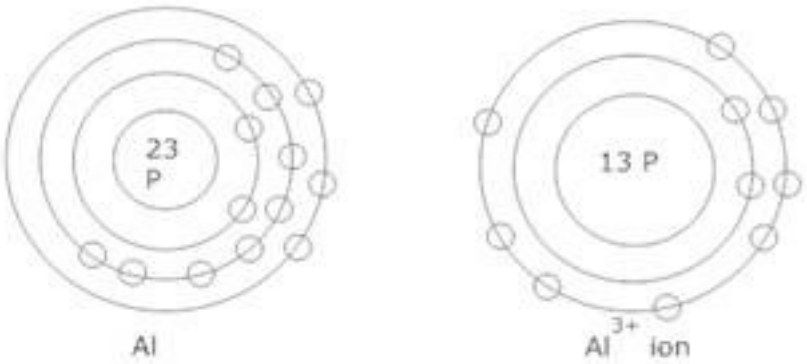
Ans. Metals are electropositive in nature because all metals loose electrons from their outermost shell in order to become stable and hence become positively charged. Non-metals are electronegative in nature because all non-metals gain electrons in order to become stable and hence become negatively charged.

14. Why metals are electropositive and non-metals are electronegative in nature?

Ans. Metals are electropositive in nature because all metals loose electrons from their outermost shell in order to become stable and hence become positively charged. Non-metals are electronegative in nature because all non-metals gain electrons in order to become stable and hence become negatively charged.

15. Explain the formation of Al^{3+} ion and why is it formed?

Ans. Because Al has atomic number of 13, its electronic configuration is 2, 8, 3 so in order that it becomes stable, it should have 8 electrons in its lose $3e^-$ from its outermost shell and as result it has 8 e^- in the outermost shell and forms Al^{3+} ion.



16. Find the percentage composition of sucrose $(C_{12}H_{22}O_{11})$.

Ans. The molecular mass of Sucrose $(C_{12}H_{22}O_{11})$ is

$$12\times(12)+22(1)+11(16)$$

= 144 + 22 + 176

= 342 g /mol.

	C	H	O
342g of sucrose contains :	144g	22g	176g
100g of sucrose contains :	$\frac{100 \text{ X } 144}{342}$	$\frac{22 \text{ X } 100}{342}$	$\frac{176 \text{ X } 100}{342}$
	42.11g	6.43g	51.46g

The composition of sucrose by Mass is

C = 42.11%

H = 6.43%

O = 51.46%

17. Complete the following Table:

Ion Number of electrons Atomic Number of Neutrons Atomic Mass

a) ${}^{86}Rb^{+}{}_{37}$

B) ${}^{24}Mg^{2+}{}_{12}$

c) ${}^{80}Br^{-}{}_{35}$

Ans. An element is represented as ${}^{A}_{Z}X$

X – Symbol of element; Z=Atomic number A=Mass Number.

Z = Atomic Number = No. of protons

Number of protons = Number of electrons

A = Mass Number = No. of protons + No of neutrons.

	Ion	Number of electrons	Z	N	A
a)	${}^{86}Rb^{+}{}_{37}$	36	37	49	86
B)	${}^{24}Mg^{2+}{}_{12}$	10	12	12	24
c)	${}^{80}Br^{-}{}_{35}$	36	35	45	80

18. Calculate

a) The number of gram – atoms of oxygen

b) The number of atom of oxygen

c) The number of molecules of ozone in 32 g of ozone $[O_3]$

Ans. 1 Mole of O = Gram Atomic Mass = Number of atoms

a) In oxygen, 2 gram – atoms are present

b) Gram Atomic mass of oxygen = 6.023×10^{23} atoms

= 1 Mole of oxygen

16 g of oxygen (O) = 6.023×10^{23}

$$32\text{g of oxygen } (O_2) = \frac{6.023 \times 10^{23} \times 32}{16}$$

1.205×10^{24}

c) $48g \text{ of } O_3 = 6.023\times10^{23} \text{ molecules}$

$$1g \text{ of } O_3 = \frac{6.023\times10^{23}}{48}$$

$$32g \text{ of } O_3 = \frac{6.23\times10^{23}}{48}\times32$$

$$= 4.015\times10^{23}$$

19. What mass of water will contain the same number of molecules as 8.0 g of ferrous oxide [FeO]?

Ans. Gram Atomic Mass = 6.023×10^{23} atoms

So, 18 g of H_2O = 6.023×10^{23} atoms.

In FeO = 56+16= 72 g

So, 72 g of FeO = 6.023×10^{23}

$$1g \text{ of } FeO = \frac{6.023\times10^{23}}{72}$$

$$8g \text{ of } FeO = \frac{6.023\times10^{23}\times8}{72}$$

$$8g \text{ of } FeO = 0.669\times10^{23}$$

$$18 \text{ g of } H_2O = 6.023\times10^{23} \text{ atoms}$$

$$\frac{18}{6.023\times10^{23}} \text{gms} = 1 \text{ atoms}$$

$$\frac{18\times0.669\times10^{23}}{6.023\times10^{23}} \text{ gm} = 0.669\times10^{23} \text{ atoms}$$

$$2g \text{ of water contains} = 0.669\times10^{23}$$

So, 2g of water will contain the same number of Molecules as 8 g of Feo.

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5 Marks Questions

1. How will you find the valency of chlorine, sulphur and magnesium?

Ans. The electrons present in the outermost shell of an atom are known as the valence electrons. Those electrons determine the valency of that atom.

The atomic number of chlorine is 17 = 2,8,7

so the number of valence electrons for chlorine is 7 and it needs 1 more electron to complete its octet (8). Therefore, its valency is one.

Similarly, sulphur = 16 = 2,8,6

so the number of valence electrons for sulphur is 6 and it needs 2 more electrons to complete its octet (8). Therefore its valency is two.

Similarly, for magnesium = 12 = 2,8,2

It becomes easier for magnesium to give away its two valence than to acquire 6 more therefore its valency is two.

2. Describe Bohr's model of the atom.

Ans. To remove the drawbacks of Rutherford's atomic model and to explain structure of atom in detail Neils Bohr in 1912 proposed a model of atom. The special features of Bohr's model are given below:

i) An electron revolves in the orbit of atom with well-defined energy.

ii) Energy of orbits increases from inner shell to the outer shells i.e. energy for orbit nearest the nucleus is lowest.

iii) If energy is supplied then electron moves from lower orbit ot the higher orbit and if an electron jumps from higher orbit (energy level) to the lower orbit (energy level) then energy is radiated as electromagnetic waves.

iv) Each orbit or shell represents an energy level. Such orbits are represented as K,L,M,N,O..... and named from centre to outwards.

v) The shell or orbits are associated with certain amount of energy and energy of orbits/shells increases from inward to outwards.eg K<L<M<N<O.....

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

Ans. There are total three atomic models each of which tried to explain the atomic structure in a better way. Following table compares the specific characteristics of the models:

Thomson's model	Rutherford's model	Bohr's model
He said that electrons remain embedded in a positive sphere.	He said that electrons revolve around a very tiny nucleus.	This model got more success than the other two. As per this model electron are distributed in different shells with specific energy around nucleus. With complete atomic shells, atom becomes more stable.

4. Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.

Ans. The following rules are followed for writing the number of electrons in different energy levels or shells:

(i) The maximum number of electrons present in a shell is given by the formula $2n^2$, where 'n' is the orbit number or energy level index, 1,2,3,...Hence the maximum number of electrons in different shells are as follows:

first orbit or K-shell will be $= 2 \times 1^2 = 2,$

second orbit or L-shell will be $= 2 \times 2^2 = 8,$

third orbit or M-shell will be $= 2 \times 3^2 = 18$,

fourth orbit or N-shell will be $= 2 \times 4^2 = 32$, and so on.

(ii) The maximum number of electrons that can be accommodated in the outermost or bit is 8.

(iii) Electrons are not accommodated in a given shell, unless the inner shells are filled. That is, the shells are filled in as tep-wise manner.

5. Explain with examples

(i) Atomic number,

(ii) Mass number,

(iii) Isotopes and

(iv) Isobars.

Give any two uses of isotopes.

Ans. i) Atomic number = It is the number of protons present inside nucleus of the atom.

It is represented as Z. Forge: for hydrogen Z= 1, because in hydrogen atom the number of protons is 1.

ii) Mass number = It is the total number of protons and neutrons present inside the nucleus of an atom and is represented by A = P + Nmass of carbon is 12 u because it has 6 protons and6 neutrons, 6 u + 6 u = 12 u.

iii) Isotopes = They are atoms of the same element and have same atomic number but different mass number/atomic mass. for example: carbon,12 C and 14 6 C

iv) Isobars = They are atoms of different elements having same mass number but different atomic number. for example, calcium, atomic number 20, and argon, atomic number 18. The number of electrons in these atoms is different, but the mass number of both these elements is 40. That is, the total number of neutrons is the same in the atoms of this pair of elements.

Two uses of isotopes are as follows:

(i) An isotope of uranium is used as a fuel in nuclear reactors.

(ii) An isotope of cobalt is used in the treatment of cancer.

6. 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.

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 ion