4 | STRUCTURE OF THE ATOM

CONCEPTS

1. Experiments on static electricity have proved that seemingly electrically neutral matter consists of electrically charged particles, such that positive charges in it are equal to the negative charges.

2. The electron was discovered by J.J. Thomson.

3. The proton was discovered by E. Goldstein.

4. Rutherford's experiment regarding the scattering of alpha particles led to the discovery of nucleus inside the atom.

5. J.J. Thomson's atomic model proposed that electrons are embedded in a positive sphere made from the protons.

6. Rutherford's atomic model proposed that a very, very small nucleus is present inside the atom and the electrons revolve around it in fixed orbits or shells, much like the planets revolve around the sun. The stability of the atom could not be explained by this model.

7. Neils Bohr's model best explains the model of atom. According to him, electrons are distributed in different shells/orbits/energy levels around the nucleus and are associated with discrete amounts of energy. When an atomic shell is complete, the atom has least energy and is very stable and least reactive.

8. Chadwick discovered the presence of neutrons within the nucleus.

9. An atom consists of three sub-atomic particles, the protons, the neutrons and the electrons. The protons have a positive charge of 1.6×10^{-19} C and mass equal to 1 amu or 1 u (unified mass). The neutrons have no charge and mass equal to 1 amu. The electrons have a negative charge of 1.6×10^{-19} C and mass $1/1837$ amu. The protons and neutrons constitute the nucleus, whereas the electrons revolve around the nucleus in energy levels designated as K, L, M, N, ...

10. Valency is the combining capacity of an element. Its value is the same as the number of electrons in the valence shell, if the number of electrons are 1, 2 or 3. Its value is (8 – No. of electrons in valence shell), if the number of electrons in the valence shell are 4, 5, 6 or 7. All atoms having only 2 electrons or 8 electrons in their valence shell have zero valency.

11. The mass number of an atom is equal to the number of nucleons (protons + neutrons) in the nucleus of an atom.

12. The atomic number of an atom is equal to the number of protons in its nucleus.

13. Isotopes are atoms of the same element, having same atomic number, but different mass numbers.

14. Isobars are atoms of different elements, having same mass number, but different atomic numbers.

I. SUMMATIVE ASSESSMENT

NCERT QUESTIONS WITH THEIR ANSWERS

SECTION A : IN-TEXT QUESTIONS

Page 47

Q.1. What are canal rays?

Ans. The positively charged radiations which consist of positively charged particles which passed out of the perforated cathode in a gas discharge tube, were named canal rays. These radiations were discovered by E. Goldstein in 1866.

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

Ans. It will not carry any detectable electric charge, as the positive charge on the proton, neutralise the negative charge on the electron.

Page 49(I)

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

Ans. J. J. Thomson believed that an atom is made up of positively charged substance in the form of a sphere. Into this sphere are embedded electrons, much the same way as the apples are embedded in an apple pie.

Furthermore, the total positive charge of the sphere is equal to the total negative charge of the electrons and hence the atom remains electrically neutral.
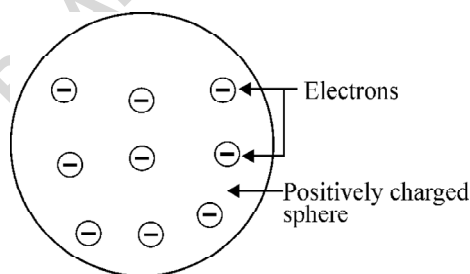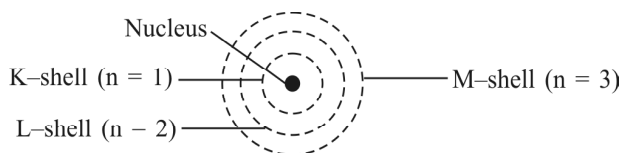

J.J. Thomson's atomic model

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

Ans. Protons which are positively charged are present in the nucleus of an atom.

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

Ans.

Bohr's model of an atom

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

Ans. If some other metal can be beaten into a foil as thin as the gold foil, the scattering of α–particles will take place, because it is produced by the positively charged nucleus.

Page 49(II)

Q.1. Name three subatomic particles of an atom.

Ans. (i) Protons (positively charged particles) present within the nucleus.

(ii) Neutrons (neutral particles) present within the nucleus.

(iii) Electrons (negatively charged particles) revolving around the nucleus.

Q.2. Helium atom has an atomic mass of 4 *u* and two protons in its nucleus. How many neutrons does it have?

Ans. Number of neutrons = Mass number − Number of protons

= (4 − 2) = **2**

Page 50

Q.1. Write the distribution of electrons in carbon and sodium atoms.

Ans. For carbon atom :

Number of electrons = Atomic number = 6

∴ Electron distribution, K–shell = 2 **electrons**

L–shell = (6 − 2) = **4 electrons**.

For sodium atom :

Number of electrons = Atomic number = 11

∴ Electron distribution, K–shell = **2 electrons**

L–shell = **8 electrons**

M–shell = **1 electron**

Q.2. If K and L shells of an atom are full, then what would be total number of electrons in an atom?

[2011 (T-II)]

Ans. Number of electrons in full K–shell = 2

Number of electrons in full L–shell = 8

∴ Total number of electrons in an atom = (2 + 8) = **10 electrons**

Page 52(I)

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

Ans. (i) Valency of chlorine (a non-metal) = 8 − Number of electrons in the valence shell

= 8 − 7 = **1**

(ii) Valency of sulphur (a non-metal) = 8 − Number of electrons in the valence shell

= 8 − 6 = **2**

(iii) Valency of magnesium (a metal) = Number of electrons in the valence shell

= **2**

Page 52 (II)

Q.1. If 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?

Ans. (i) Atomic number of the atom = Number of protons in its nucleus = 8

(ii) The charge on the atom is zero, because total number of positive charges due to the protons is equal to total number of negative charges due to electrons.

Q.2. With the help of the given table, find the mass number of oxygen and sulphur atom.

Element	Symbol	No. of Protons	No. of Neutrons	No. of Electrons
Oxygen	O	8	8	8
Sulphur	S	16	16	16

Ans. For oxygen atom :

$$\text{Number of protons} = 8$$
$$\text{Number of neutrons} = 8$$
$$\therefore \text{ Mass number of oxygen} = \text{Number of protons} + \text{Number of neutrons}$$
$$= 8 + 8 = \mathbf{16\ u}$$

For sulphur atom :

$$\text{Number of protons} = 16$$
$$\text{Number of neutrons} = 16$$
$$\therefore \text{ Mass number of sulphur} = \text{Number of protons} + \text{Number of neutrons}$$
$$= 16 + 16 = \mathbf{32\ u}$$

Page 53

Q.1. For the symbol H, D and T, tabulate three subatomic particles found in each of them.

Ans.

Element	Symbol	Protons	Neutrons	Electrons
Hydrogen	H	1	0	1
Deuterium	D	1	1	1
Tritium	T	1	2	1

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

Ans.

Isotopes	Protons	Neutrons	Electrons	Electron configuration
$^{35}_{17}\text{Cl}$	17	18	17	2(K), 8(L), 7(M)
$^{37}_{17}\text{Cl}$	17	20	17	2(K), 8(L), 7(M)

Isobars	Protons	Neutrons	Electrons	Electron configuration
$^{40}_{20}\text{Ca}$	20	20	20	2(K), 8(L), 8(M), 2(N)
$^{40}_{18}\text{Ar}$	18	22	18	2(K), 8(L), 8(M)

SECTION B : QUESTIONS AT THE END OF CHAPTER

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

Ans.

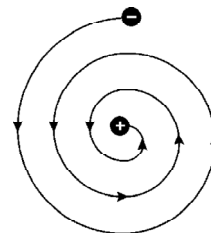| Property	Electron	Proton	Neutron
Mass	Has 1/1837 the unit atomic mass	Has unit atomic mass	Has unit atomic mass
Charge	Has unit negative charge	Has unit positive charge	Has no electric charge

Q.2. What are the limitations of J.J. Thomson's model of an atom?

Ans. The major limitation of J.J. Thomson's model is that it does not explain how positively charged particles are shielded from negatively charged particles, without getting neutralised.

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

Ans. The comparison of electrons to the planets in the solar system is the main drawback of Rutherford's atomic model.

According to classical electrodynamics, if an electrically charged particle revolves around a circular path, then it always radiates out energy. Thus, if an electron moves around a nucleus, it must continuously radiate out energy and hence, gradually move towards the nucleus in a spiral path, till it collides with the nucleus.

However, we know that an atom is very stable. Rutherford's model cannot explain this stability.

Q.4. Describe Bohr's model of an atom. **[2011 (T-II)]**

Ans. **(i)** An atom is made up of three kinds of particles : electrons, protons and neutrons.

(ii) Electrons are negatively charged, protons are positively charged and neutrons are neutral, i.e, they have no electric charge.

(iii) The number of electrons and protons are equal, so that an atom on the whole is electrically neutral.

(iv) Protons and neutrons are present within the nucleus. Due to the presence of protons, the nucleus is positively charged.

(v) The electrons revolve around the nucleus in fixed orbits called energy levels or shells which are represented by numbers 1, 2, 3, 4, 5, and 6 or letters K, L, M, N, O and P. These numbers are counted from the nucleus outwards.

(vi) Each energy level has a fixed amount of energy. The orbit nearest to the nucleus has minimum energy, whereas the orbit farthest from the nucleus has highest energy.

(vii) There is no change in the energy of electrons as long as they revolve in the same orbit and remain stable. But if an electron gains energy, it jumps to a higher energy level and if it loses energy it falls to a lower energy level.

(viii) The mass of the atom is almost entirely due to the nucleus, as electrons have negligible mass.

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

Ans. **Thomson's Model**	**Rutherford's Model**	**Bohr's Model**
Recognised subatomic particles i.e. protons and electrons, but failed to explain how are they arranged within the atom and how are they electrically shielded.	Recognised subatomic particles electrons, protons and undiscovered neutrons. Recognised the presence of nucleus containing protons and neutrons revolving around it. It failed to explain how the electrons continued revolving around the nucleus without loosing energy and how they are actually arranged in different shells.	It overcame all the objections raised for Rutherford's model and accurately fixed the number of electrons in each shell or energy level around the nucleus.

Q.6. Summarise the rules for writing distribution of electrons in various shells for the first eighteen elements.

Ans. (i) The maximum number of electrons revolving around the nucleus of an atom in different shells is given by the formula $2n^2$, where n is the number of the shell as counted from the nucleus of an atom. So,

Maximum number of electrons in shell number 1 $= 2n^2 = 2(1)^2 = 2$
Maximum number of electrons in shell number 2 $= 2n^2 = 2(2)^2 = 8$
Maximum number of electrons in shell number 3 $= 2n^2 = 2(3)^2 = 18$

(ii) The outermost shell will not have more than 8 electrons. For example, if there are 9 electrons after filling the first two shells then in the third shell there will be 8 electrons and one electron goes to the fourth cell.

Q.7. Define valency by taking examples of silicon and oxygen.

Ans. The number of electrons donated or accepted or shared by an atom of an element, so as to have a stable configuration of the nearest noble gas is called its valency.

The valency is equal to the number of electrons in the outermost shell (valence shell) of an atom, provided it has 1 to 3 electrons in it. Such atoms are generally metals.

The valency is equal to 8 − number of electrons in valence shell of an atom, provided it has 4 to 8 electrons in the valence shell.

Silicon has electronic configuration 2(K), 8(L), 4(M). As silicon has four electrons in its valence shell, therefore, its valency is $(8 − 4) = 4$.

Oxygen has electronic configuration 2 (K), 6(L). As oxygen has six electrons in its valence shell, therefore, its valency is $(8 − 6) = 2$.

Q.8. Explain with examples (i) atomic number (ii) mass number (iii) isotopes and (iv) isobars. Give any two uses of isotopes.

Ans. (i) **Atomic number :** The number of protons in the nucleus of an atom is called its atomic number.

Example : Chlorine has 17 protons in its nucleus, therefore, its atomic number is 17.

(ii) **Mass number :** The number of protons and neutrons present in the nucleus of an atom is known as its mass number.

Example : Sodium has 11 protons and 12 neutrons in its nucleus, therefore, its mass number is $(11 + 12) = 23$.

(iii) **Isotopes :** Atoms of the same element having the same atomic number but different mass numbers are called isotopes.

Example : Chlorine has two isotopes $^{35}_{17}Cl$ and $^{37}_{17}Cl$, in which atomic number is 17 for both, but mass numbers are 35 and 37.

(iv) **Isobars :** Atoms of different elements having the same mass number, but different atomic numbers are known as isobars.

Example : Calcium and argon atoms have the same mass number 40, but different atomic numbers 20 and 18 respectively.

Uses of Isotopes

1. Isotope of uranium $^{235}_{92}U$ is used as a nuclear fuel in atomic reactors.

2. Cobalt − 60, an isotope of cobalt is used in the treatment of cancer.

Q.9. Na^+ has completely filled K and L shells. Explain.

Ans. The neutral atom of sodium has electronic configuration 2(K), 8(L), 1(M). Thus, in order to acquire a stable structure like that of the nearest noble gas (neon), it donates one electron from the M shell. In doing so it has one unit more positive charge, and hence, changes into sodium ion (Na^+) with electronic configuration 2(K), 8(L), such that both of its shells are completely filled.

Q.10. If bromine atom is available in the form of, say, two isotopes $^{79}_{35}Br$ (49.7%) and $^{81}_{35}Br$ (50.3%), calculate the average atomic mass of bromine atom.

Ans.   Atomic mass of 49.7% bromine atoms $= 49.7 \times 79 = 3926.3\ u$

     Atomic mass of 50.3% bromine atoms $= 50.3 \times 81 = 4074.3\ u$

 $\therefore$ Atomic mass of 100% bromine atoms $= 3926.3 + 4074.3 = 8000.6\ u$

 $\therefore$ Average atomic mass of bromine atom $= \dfrac{8000.6}{100} = \mathbf{80.006\ \textit{u}}$

Q.11. 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?   **[2011 (T-II)]**

Ans.   Let the number of atoms in the sample $= 100$

     Average atomic mass of element X $= 16.2\ u$

     $\therefore$ Total mass of 100 atoms of X $= 16.2 \times 100 = 1620\ u$ ... (i)

 Let the number of atoms of $^{16}_{8}X$ in 100 atoms $= P$

 $\therefore$ Number of atoms of $^{18}_{8}X$ in 100 atoms $= (100 - P)$

     Total mass of 'P', $^{16}_{8}X$ atoms $= 16\ P$

     Total mass of $(100 - P)$, $^{18}_{8}X$ atoms $= 18(100 - P) = 1800 - 18\ P$

 $\therefore$ Total mass of 100 atoms of X $= 16\ P + 1800 - 18P$

                 $= 1800 - 2P$ ...(ii)

 Comparing (i) and (ii) $1620 = 1800 - 2P$

                 $\Rightarrow 2P = 180$

                 $\Rightarrow P = \dfrac{180}{2} = 90$

 Thus, percentage of $^{16}_{8}X$ atoms $= \mathbf{90\%}$ and, percentage of $^{18}_{8}X$ atoms $= (100 - 90) = \mathbf{10\%}$

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

Ans.   Atomic number $= Z = 3$

                 $\therefore$ Electronic configuration $= 2(K), 1(L)$

As there is 1 electron in the valence shell, therefore, valency of the element is 1. The element is lithium.

Q.13. Composition of the nuclei of two atomic species X and Y are given as under : **[2011 (T-II)]**

	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. Mass number of X = No. of protons + No. of neutrons = 6 + 6 = **12 u**

Mass number of Y = No. of protons + No. of neutrons = 6 + 8 = **14 u**

The species X and Y are **isotopes,** because they have the same atomic number (6), but different mass numbers 12 u and 14 u respectively.

Q.14. For the following statements, write T for true and F for false.

(a) J.J. Thomson proposed that 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 $\dfrac{1}{2000}$ times that of proton.

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

Ans. (a) False   (b) True   (c) True   (d) False

Q.15. Tick (✓) the correct answer :

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 is true.

Q.16. Tick (✓) the correct answer :

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 is true.

Q.17. Number of valence electrons in Cl⁻ ion are :

(a) 16   (b) 8   (c) 17   (d) 18

Ans. (b) 8 is true.

Q.18. Tick (✓) the correct answer

Which one of the following is the 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 is true.

Q.19. 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	

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(D)
1	1	0	1	0	Protium

Ans. appears before the table.

ADDITIONAL QUESTIONS
(As Per CCE Pattern)

A. Very Short Answer Questions   (1 Mark)

Previous Years' Questions

Q.1. Name the fundamental particle not present in the nucleus of hydrogen atom. **[2011 (T-II)]**

Ans. Neutron.

Other Important Questions

Q.1. Why does the nucleus not disintegrate inspite of repulsion among the protons?

Ans. Stability of the nucleus is due to the presence of neutral subatomic particles (neutrons) between the positively charged protons. The neutrons neutralise the repulsion among protons.

**Q.2.** Mention one postulate about Rutherford's atomic model which makes the atom highly unstable.

Ans. According to the classical laws of mechanics and electrodynamics, if an electrically charged particle is in motion, it radiates energy continuously, i.e., loses energy. Therefore, an electron should lose energy and fall into the nucleus. This would make the atom highly unstable.

Q.3. What are discrete orbits of atoms?

Ans. The discrete orbits are those orbits of atoms in which the electrons do not radiate energy.

Q.4. What is the difference between magnesium atom and magnesium ion in terms of number of electrons?

Ans. Magnesium ion contains two less electrons than magnesium atom.

$$Mg - 2e^- \rightarrow Mg^{2+}$$
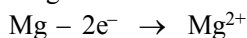
Q.5. Among H^+ and H^-, which one has a single electron in its outermost shell?

Ans. None.

H^+ has no electrons in its outermost shell.

H^- has 2 electrons in its outermost shell.

Q.6. The mass of an atom of any natural element is taken as the average mass of all the naturally occurring atoms of that element. Replace the underlined phrase by a word.

Ans. Isotopes

Q.7. An element X is represented as $_3^7 X$. How many protons and neutrons are present in the element?
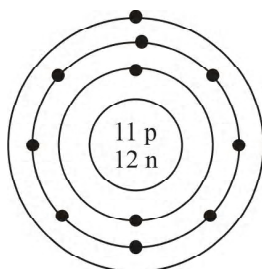
Ans. No. of protons = 3

No. of neutrons = 7 − 3 = 4

Q.8. ^{235}Z and ^{238}Z are two isotopes. How do the two isotopes differ (w.r.t. number of subatomic particles)?

Ans. There are 3 more neutrons in ^{238}Z than in ^{235}Z.

Q.9. Represent the structure of $_{11}^{23} Na$ geometrically.

Ans.

Q.10. Why is an atom electrically neutral?

Ans. The number of positively charged particles in the atom is equal to the number of negatively charged particles, thus making the atom neutral.

Q.11. What will be the charge on an ion formed from an atom which has seven valence electrons?
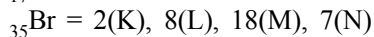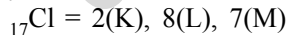
Ans. − 1

Q.12. Why is the atom of an element P (at. no. 16) more reactive than an atom of an element Q (at. no. 18)?

Ans. P (2, 8, 6) can easily gain two electrons to form an octet while Q (2, 8, 8) already has an octet and does not gain or lose electrons. Therefore, P is more reactive than Q.

Q.13. What is the similarity in the electronic configuration of the following set of elements?

$_9 F$, $_{17} Cl$ and $_{35} Br$
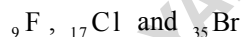
Ans. All the elements have seven valence electrons.

$_9 F = 2(K), 7(L)$

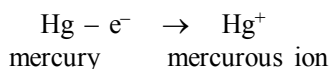$_{17} Cl = 2(K), 8(L), 7(M)$

$_{35} Br = 2(K), 8(L), 18(M), 7(N)$

Q.14. What is the maximum number of electrons present in the N-shell?

Ans. 32

Q.15. What is the difference between mercury atom $\left(_{80}^{200} Hg \right)$ and mercurous ion in terms of the fundamental particles?

Ans. A mercurous ion contains one electron less than a mercury atom.

$Hg - e^- \rightarrow Hg^+$

mercury   mercurous ion

Q.16. What is the atomic number of a species which contains 20 protons, 20 neutrons and 18 electrons?

Ans. Atomic number = no. of protons = 20

Q.17. A uni-negative ion contains 18 electrons. What will be its atomic number?

Ans. An atom gains one electron to form a uninegative ion. Therefore, the neutral atom will contain one electron less. Thus, its atomic number is 17.

Q.18. Which isotope of hydrogen contains one neutron?

Ans. 'Deuterium contains one proton and one neutron in its nucleus.

Q.19. Write the mass number of the isotope of the element $_Z^A X$ which has two excess neutrons.

Ans. A + 2

Q.20. Write the mass number of neon and argon from the data given below :

Element	No. of Protons	No. of Neutrons
Neon	10	10
Argon	18	22

Ans. Mass number of neon = no. of protons + no. of neutrons = 10 + 10 = 20
Mass number of argon = no. of protons + no.of neutrons = 18 + 22 = 40

Q.21. Find the valency of sulphur (atomic number = 16).

Ans. Electronic configuration of sulphur (Z = 16) = 2, 8, 6. Therefore sulphur can gain two electrons to form an octet. So, valency of sulphur is 2.

Q.22. Write the electronic configuration of K (19) and P (15).

Ans. Electronic configuration of K(19) = 2, 8, 8, 1
Electronic configuration of P(15) = 2, 8, 5.

Q.23. Who discovered the neutron?

Ans. J. Chadwick discovered the neutron.

Q.24. Who discovered the electron?

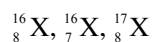**Ans.** J.J. Thomson discovered the electron.

Q.25. What is the charge and mass of a neutron?

Ans. A neutron is neutral and has a mass of 1 *amu* or 1 *u*.

Q.26. What do the species $_1^3 A$ and $_2^3 B$ represent?

Ans. The species A and B are isobars since they have the same atomic mass but different atomic numbers.

Q.27. Identify the pair of isotopes from the following.

$_8^{16} X, _7^{16} X, _8^{17} X$

Ans. $_8^{16} X$, and $_8^{17} X$ are isotopes (since they have the same atomic number but different mass numbers.)

Q.28. What is the atomic number of the element X which has 2 shells, K and L having 2 and 6 electrons respectively?

Ans. Total number of electrons in an atom of X = total number of protons in the atom of X = atomic number = 2 + 6 = 8.

Q.29. The atomic number of neon is 10. Write its electronic configuration.

Ans. Electronic configuration of Ne (Z = 10) = 2 (K), 8(L).

Q.30. How many electrons are present in the outermost orbit of a noble gas other than helium?

Ans. Eight

Q.31. Atomic number of an element is 16. What is its valency?

Ans. Electronic configuration of the element (Z = 16) = 2, 8, 6

Valency of the element = 8 − 6 = 2

Q.32. There are 15 protons and 16 neutrons in the nucleus of an element. Calculate its atomic number and mass number.

Ans. Atomic number = no. of protons = 15

Mass number = no. of protons + no. of neutrons = 15 + 16 = 31.

Q.33. What happens to an element 'Z' if its atom gain three electrons?

Ans. The element forms Z^{3-} ion.

Q.34. Which sub atomic particles of an atom are responsible for atomic mass?

Ans. Protons and neutrons.

Q.35. Mention one application each of cobalt and uranium isotopes.

Ans. Isotope of cobalt is used in the treatment of cancer while isotope of uranium is used as a fuel in nuclear reactors.

Q.36. How is an α-particle different from a helium atom?

Ans. An α-particle contains two units of positive charge and has a mass of 4 units, i.e., it is a doubly charged helium atom.

An atom of helium is neutral with a mass of 4 units.

B. Short Answer Questions – I **(2 Marks)**

Previous Years' Questions

Q.1. The following data represents the distribution of electrons, protons and neutrons in atoms of four elements A, B, C, D. **[2011 (T-II)]**

Element	Protons	Neutrons	Electrons
A	9	10	9
B	16	16	16
C	12	12	12
D	17	22	17

Answer the following questions :

(a) Give the electronic distribution of element B.   (b) The valency of element A.

(c) The atomic number of element B.   (d) The mass number of element D.

Ans. (a) Electronic distribution of element B = 2, 8, 6

(b) The valency of element A = 8 − Number of electrons in valency shell.

Electronic configuration of element A = 2, 7

Valency of element A = 8 − 7 = 1

(c) Atomic number of element B = no. of protons = 16

(d) Mass number of element D = number of protons + number of neutrons

$$= 17 + 22 = 39$$

Q.2. Explain the following terms :

(i) Isotopes (ii) Isobars **[2011 (T-II)]**

Ans. (i) **Isotopes :** Atoms of the same element, having the same atomic number, but different mass number, are called isotopes.

(ii) **Isobars :** Atoms of different elements, having the same mass number but different atomic number, are called isobars.

Q.3. The atomic numbers of atoms of two elements are 18 and 20 respectively and their mass numbers are 40. Mention the term that can be given to relate such pairs of atoms. Will they have the same chemical properties? Justify your answer. **[2011 (T-II)]**

Ans. As these two elements have same mass numbers, so these are called isobars. They show different chemical properties because isobars of different elements have different number of protons in their nuclei.

Q.4. An atom of an element has one electron in the outermost M shell. State its :

(a) Electronic configuration (b) Number of protons

(c) Atomic number (d) Valency of this element **[2011 (T-II)]**

Ans. (a) As the element have 1 electron in M shell. Its electronic configuration = 2, 8, 1

K L M

(b) Number of protons = no. of electrons = 11

(c) Atomic number = no. of protons = 11

(d) Valency of this element = no. of electrons in its outermost shell = 1

Q.5. Which of the Na^+ and He has completely filled K and L shells. Give reason to support your answer. **[2011 (T-II)]**

Ans. Na^+ has electronic configuration = 2, 8

So it has completely filled K and L shells. While He has electronic configuration = 2

So, it has only K shell completely filled.

Q.6. The electronic configuration of an element 'X' is 2, 8, 2 :

(a) Find the number of electrons present in the atom of element X

(b) Write its atomic number.

(c) This element 'X' is a metal or a non metal?

(d) Find out the valency of the element X. **[2011 (T-II)]**

Ans. (a) Number of electrons present in atom of element X = 12

(b) Atomic number = no. of protons = no. of electrons = 12

(c) Metal

(d) Valency of element X is 2 because it has 2 electrons in its valency shell.

Q.7. (a) J. Chadwick discovered a subatomic particle which has no charge and has mass nearly equal to that of a proton. Name the particle and give its location in the atom.

(b) If 'K' and 'L' shells of an atom are completely filled with electrons, then what would be

(i) the total number of electrons in the atom and (ii) its valency? **[2011 (T-II)]**

Ans. (a) J. Chadwick discovered neutron. It is found in the nucleus of an atom.
  (b) Completely filled K and L shell will have 2 and 8 electrons respectively.
   (i) Total number of electrons = 10
   (ii) Its valency is zero because it has complete octet structure.

Q.8. The number of electrons in the outermost 'L' shell of an atoms is 5.
  (a) Write its electronic configuration. (b) What is its valency and why? **[2011 (T-II)]**

Ans. (a) Electronic configuration = 2, 5
  (b) Valency = 8 − Number of electrons in valency shell = 8 − 5 = 3
  Its valency is 3 because to complete its octet structure this element will gain 3 electrons easily.

Q.9. Composition of the nuclei of two atoms "X" and "Y" are given below. **[2011 (T-II)]**

	X	Y
Protons	4	4
Neutron	4	6

  Give the mass number of X and Y. Mention the relationship between the two atoms.

Ans. Mass number of X = no. of protons + no. of neutrons = 4 + 4 = 8
  Mass number of Y = no. of protons + no. of neutrons = 4 + 6 = 10
  These two atoms are isotopes because they have same number of protons (atomic number).

Q.10. The following data represents the distribution of electrons, protons and neutrons in atoms of four elements A, B, C, D.

Element	Protons	Neutrons	Electrons
A	19	21	19
B	17	18	17
C	17	20	17
D	18	22	18

  Answer the following questions :
  (i) Describe the electronic distribution in atom of element B.
  (ii) Is element B a metal or a non-metal? Why?
  (iii) Which two elements form a pair of ISOTOPES?
  (iv) Which two elements form a pair of ISOBARS? **[2011 (T-II)]**

Ans. (i) Electronic distribution of element B = 2, 8, 7
  (ii) Element B is a non-metal because it will accept one electron to complete its nearest noble gas configuration.
  (iii) B and C are isotopes   (iv) A and D are isobars

Q.11. An atom of an element has three electrons in its 3rd orbit which is the outermost shell. Write :
  (i) The electronic configuration   (ii) Atomic number
  (iii) Number of protons   (iv) Valency **[2011 (T-II)]**

Ans. (i) Electronic configuration = 2, 8, 3
  (ii) Atomic number = no. of protons = no. of electrons = 13

(iii) No. of protons = Atomic no. = 13

(iv) Valency = 3

Q.12. Composition of the nuclei of two atomic species 'X' and 'Y' are given below :

	X	Y
Protons	8	8
Neutron	8	10

(i) Give the mass number of 'X' and 'Y'.

(ii) What is the relationship between the two species? **[2011 (T-II)]**

Ans. (i) Mass number of X = no. of protons + number of neutrons = 8 + 8 = 16

Mass number of Y = no. of protons + number of neutrons = 8 + 10 = 18

(ii) The two species are isotopes.

Q.13. The atom of an element has 9 protons, 10 neutrons and 9 electrons. Mention its atomic number, mass number, electronic configuration and valency. **[2011 (T-II)]**

Ans. Atomic number = no. of protons = 9

Mass number = no. of protons + no. of neutrons = 9 + 10 = 19

Electronic configuration = 2, 7. Valency = 8 – no. of electrons in valency shell = 8 – 7 = 1

Q.14. An atom of an element is represented as $_{9}^{19}X$. How many electrons and neutrons are present in this atom? What will be the valency of the element? **[2011 (T-II)]**

Ans. Atomic number of X = 9 = no. of protons present in X = no. of electrons present in X

Atomic mass of X = 19 = no. of protons + no. of neutrons

∴ no. of neutrons = 19 – 9 = 10

Electronic distribution – K shell = 2 electrons

L shell = (9 – 2) = 7 electrons

Valency = 8 – number of electrons in valency shell = 8 – 7 = 1

Q.15. Nucleus of an atom is heavy and positively charged. Justify your answer. **[2011 (T-II)]**

Ans. In an atom, the mass of protons and neutrons are one unit each while the mass of electron is negligible. Since a nucleus consists of protons and neutrons, it is heavy. Also the proton is positively charged while the neutron is neutral, which makes the nucleus positively charged.

Q.16. Give two postulates of Thomson's model of an atom. **[2011 (T-II)]**

Ans. Thomson's postulates are :

(a) An atom consists of a positively charged sphere and the electrons are embedded in it.

(b) The negative and positive charges are equal in magnitude and so an atom as a whole is electrically neutral.

Q.17. Composition of the nuclei of two atomic species X and Y are given as : **[2011 (T-II)]**

	Protons	Neutrons
X	17	18
Y	17	20

What are the mass numbers of X and Y? State the relationship between the two.

Ans. Mass number of X = 17 + 18 = 35

Mass number of Y = 17 + 20 = 37

Since the number of protons (or atomic number) is the same for both X and Y but their mass numbers differ, therefore, they are isotopes.

Other Important Questions

Q.1. What will be the mass of one atom of potassium, if there are 94 atoms of K-39 and 6 atoms of K-41?

Ans. Mass of 1 atom of potassium $= \dfrac{94}{100} \times 39 + \dfrac{6}{100} \times 41 = 36.66 + 2.46 = 39.12$

Q.2. What is the ratio of neutrons/protons in $^{208}_{82}Pb$ and $^{209}_{82}Pb$?

Ans. Ratio of neutrons/protons for $^{208}_{82}Pb = 126 : 82 \approx 1.54 : 1$

Ratio of neutrons/protons for $^{208}_{82}Pb = 127 : 82 \approx 1.55 : 1$

Q.3. (i) Why is an alpha particle called a helium nuclei?

(ii) What is the charge on the above mentioned particle?

Ans. (i) An α-particle carries two units of positive charge and four units of mass just like a helium nuclei which contains two protons and two neutrons.

(ii) The charge on an alpha particle is +2.

Q.4. State one difference and one similarity between the isotopes of an element.

Ans. (i) All isotopes of the same element have different physical properties.

(ii) All isotopes of the same element have similar chemical properties.

Q.5. Select a pair of isotopes from the following list

$^{24}_{11}A$, $^{24}_{12}B$, $^{23}_{11}C$, $^{27}_{13}D$

Give reasons for your choice.

Ans. Isotopes have the same atomic number but different mass numbers.

Therefore $^{24}_{11}A$ and $^{23}_{11}C$ are isotopes.

Q.6. Give reasons :

(i) Isotopes have different mass numbers.   (ii) Isotopes are electrically neutral.

Ans. (i) Isotopes have different number of neutrons which result in different atomic masses.

(ii) The number of protons is equal to the number of electrons in the isotopes of an element. So, they are electrically neutral.

Q.7. $^{16}_{8}O$, $^{17}_{8}O$ and $^{18}_{8}O$ represent different atoms of oxygen.

(i) What do superscripts and subscripts represent?

(ii) Which subatomic particle is responsible for the change in superscript?

Ans. (i) Superscripts represent the mass numbers and the subscripts represent the atomic numbers of different atoms of oxygen.

(ii) Neutrons

Q.8. Amongst the electrons revolving around the nucleus which electrons

(i) determine the chemical properties of an element?

(ii) do not determine the chemical properties of an element?

Give reasons for your answer.

Ans. (i) The electrons present in the valence shell determine the chemical properties of an element. It is because a chemical reaction takes place only, if the valence electrons are transferred or shared by the atoms of other elements.

(ii) The electrons other than the valence electrons do not determine the chemical properties of an element. It is because, these electrons are firmly held by the nucleus and hence cannot be shared or transferred.

Q.9. State two differences between a cation and an atom, by taking sodium ion (Na^+) and sodium atom (Na) as an example.

Ans. (i) Sodium atom is electrically neutral whereas sodium ion has a unit positive charge.

(ii) Sodium atom has the electronic configuration 2(K), 8(L), 1(M) and hence has three electron shells, whereas sodium ion has the electronic configuration 2(K), 8(L) and hence has two electron shells.

Q.10. An atom has mass number 40 and atomic number 20.

(i) How many electrons are revolving around the nucleus?

(ii) How many electron shells are there in the atom?

Ans. (i) 20 electrons are revolving around the nucleus.

(ii) The electronic configuration of the element is 2(K), 8(L), 8(M) and 2(N).

So, there are 4 electron shells in the atom of the element.

Q.11. The number of electrons in the outermost shell of chlorine is 7. What is its valency and why?

Ans. Chlorine can gain one electron in its outermost shell to form an octet. Hence its valency is determined by subtracting seven electrons from octet which gives a valency of one.

Q.12. Number of protons, neutrons and electrons in the four specimen A, B, C and D are respectively 6, 6, 6; 7, 7, 7; 6, 8, 6; and 9, 10, 10. Tell which of them are :

(a) Isotopes   (b) Isobars. Why?

Ans. (a) Isotopes of an element have the same atomic number but different mass numbers, i.e., they have different number of neutrons.

Therefore A and C are isotopes.

(b) Isobars are atoms of different elements having the same mass number but different atomic numbers.

Mass no. of B = no. of protons + no. of neutons = 7 + 7 = 14

Mass no. of C = no. of protons + no. of neutons = 6 + 8 = 14

Q.13. An atom of an element has two electrons in the K shell and four electrons in the L shell. What is the atomic number of the element? Identify the element.

Ans. Electronic configuration of the element = 2   4

                                                                    K   L

Therefore, atomic number of the element = 2 + 4 = 6. The element is oxygen (O).

Q.14. (a) Why is Thomson's model of an atom compared with a watermelon?

(b) Why do isotopes have different mass numbers?

Ans. (a) In the Thomson's model of an atom, the negative charges (or electrons) are spread in a sphere of positive charge just like the seeds are spread inside a watermelon.

(b) The number of neutrons present in isotopes are different. Since mass number of an element is equal to the sum of protons and neutrons, therefore mass numbers of isotopes are different.

Q.15. State the characteristics of the nucleus of an atom.

Ans. The nucleus is positively charged and located in the centre of the atom. It is made up of protons and neutrons. Its size is very very small as compared to the size of the atom.

Q.16. Find the electron distribution in the element which has atomic number 12 and also write its valency.

Ans. Electronic configuration = 2, 8, 2

The element can easily lose two electrons to attain an octet structure. Therefore its valency is 2.

Q.17. Name the constituents of an atom. What is the net charge on the nucleus of an atom?

Ans. An atom consists of positively charged protons, negatively charged electrons and neutral neutrons. The nucleus is positively charged due to the presence of protons.

Q.18. The number of electrons in the outermost shell of an element is 5. What is its valency and why?

Ans. Valency of the element = 8 – 5 = 3

An atom of the element can gain or share 3 electrons to achieve an octet of electrons in the outermost shell and this gives the valency of the element.

If there are four, five, six or seven valence electrons in an atom of an element then the valency is determined by subtracting the number of electrons from the octet.

| **C.** | **Short Answer Questions – II** | **(3 Marks)** |

Previous Years' Questions

Q.1. An element X has a mass number 27 and it contains 13 protons. **[2011 (T-II)]**
   (i) Write the symbolic representation of the element.
  (ii) Find the number of neutrons and electrons in the element.
 (iii) Write the electronic configuration of the element.

Ans. (i) Atomic number = no. of protons = 13

   Symbol — $^{27}_{13}X$

  (ii) No. of neutrons = mass number – no. of protons = 27 – 13 = 14
      No. of electrons = no. of protons (in a neutral atom) = 13

 (iii) Electronic configuration of element = 2, 8, 3

Q.2. On the basis of the number of protons, neutrons and electrons in the samples given below identify (a) the cation (b) the pair of isobars and (c) the pair of isotopes.

Sample	Protons	Neutrons	Electrons
A	17	18	16
B	18	19	18
C	17	20	17
D	17	17	17

[2011 (T-II)]

Ans. (a) A is a cation because it number of protons is not equal to number of electrons. It has donate one electron to form a cation.
   (b) Mass number = number of protons + number of neutrons
      Mass number of A = 17 + 18 = 35
      Mass number of B = 18 + 19 = 37

Mass number of C = 17 + 20 = 37

Mass number of D = 17 + 17 = 34

B and C have same mass numbers. So, these are isobars.

(c) Atomic number = no. of protons

As C and D have same atomic number and different mass numbers. So, these are isotopes.

Q.3. (a) Give one important application of an isotope of cobalt.

(b) Elements from A to E have in them the distribution of e, p and n as follows.

Elements	Electrons	Neutrons	Protons
A	4	4	3
B	8	9	9
C	18	22	18
D	17	20	17
E	17	18	17

Making use of these data find

(i) cation (ii) anion (iii) a pair of isotopes (iv) an atom of noble gas **[2011 (T-II)]**

Ans. (a) An isotope of cobalt $\left({}^{60}_{27}\text{Co} \right)$ is used in treatment of cancer.

(b) (i) B is a cation because it has 9 protons and 8 electrons. By losing electron it gains positive charge hence forms cation.

(ii) A is an anion because it has 3 protons and 4 electrons. By accepting an electron it gains negative charge, hence forms anion.

(iii) D and E have same number of protons hence they have same atomic numbers. D and E are isotopes.

(iv) C has 18 electrons its configuration is 2, 8, 8. Hence it is a noble gas.

Q.4. In the following table the mass number and the atomic number of certain elements are given.

Elements	A	B	C	D	E
Mass No.	1	7	14	40	40
At. No.	1	3	7	18	20

(a) Select a pair of isobars from the above table.

(b) What would be the valency of element C listed in the above table?

(c) Which two subatomic particles are equal in number in a neutral atom? **[2011 (T-II)]**

Ans. (a) D and E have same mass numbers. So these are isobars.

(b) In element C, no. of electrons = numbers of protons = atomic number

∴ Number of electrons = 7

Electronic configuration of element C = 2, 5

Valency = 8 − number of electrons in valency shell = 8 − 5 = **3**

(c) In a neutral atom, number of protons is equal to the number of electrons.

Q.5. Enlist the conclusions drawn by Rutherford from his α-ray scattering experiment.

OR

List three main features of Rutherford's nuclear model of an atom. **[2011 (T-II)]**

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Ans. Rutherford concluded from the α-particle scattering experiment that :

   (i) Most of the space inside the atom is empty because most of the α-particles passed through the gold foil without getting deflected.

  (ii) Very few particles were deflected from their path indicating that the positive charge of the atom occupies very little space.

 (iii) A very small fraction of α-particles were deflected by 180°, indicating that all the positive charges and mass of the gold atom were concentrated in a very small volume within the atom.

Q.6. What is meant by valency? How will you find the valency of chlorine and magnesium?

Ans. Valency is the combining capacity of an element.

Chlorine ($Z = 17$) has the electronic configuration 2, 8, 7. Since the number of electrons in the outermost shell is close to full capacity, therefore it is easier for chlorine to gain one electron rather than lose seven electrons to achieve an octet. Therefore valency is determined by subtracting seven electrons from the octet. This gives a valency of one for chlorine.

Similarly for magnesium ($Z = 12$) with electronic configuration 2, 8, 2 valency is 2.

Other Important Questions

Q.1. What are the important properties of the neutron? Compare these properties with those of the electron and proton.

Ans. (i) A neutron is an electrically neutral particle whereas a proton is positively charged and an electron is negatively charged.

  (ii) Mass of a neutron is almost equal to the mass of a proton whereas the mass of an electron is 1/1837 times the mass of a proton.

 (iii) A neutron resides within the nucleus just like a proton but an electron revolves around the nucleus in fixed orbits.

Q.2. Define atomic number, mass number and valency.

Ans. The number of protons present within the nucleus of an atom is called its atomic number.

The number of protons and neutrons (nucleons) present in the nucleus of an atom is called its mass number.

Valency is the combining capacity of an element. Its value is the same as the number of electrons in the valence shell, if the number of electrons are 1, 2 or 3. If the number of electrons are 4, 5, 6 or 7, the valency is given by subtracting the number of electrons in the valence shell from 8. Atoms having 2 or 8 electrons in the valence shell have zero valency.

Q.3. What were the drawbacks of Rutherford's model of an atom?

Ans. The orbital revolution of the electron as suggested by Rutherford was not expected to be stable. This is because any particle in a circular orbit would undergo acceleration and radiate energy continuously. Thus the revolving electron would lose energy and fall into the nucleus. Therefore, the atom would be highly unstable and matter would not exist in the form that we know.

Q.4. In the Gold foil experiment of Geiger and Marsden, that paved the way for Rutherford's model of an atom, $\sim 1.00\%$ of the α-particles were found to deflect at angles > 50°. If one mole of α-particles were bombarded on the gold foil, compute the number of α-particles that would deflect at angles less than 50°.

Ans. % of α-particles deflected more than $50° = 1\%$ of α-particles

% of α-particles deflected less than $50° = 100 - 1 = 99\%$

Number of α-particles bombarded = 1 mole = 6.022×10^{23} particles

Number of particles that deflected at an angle less than $50°$

$= \dfrac{99}{100} \times 6.022 \times 10^{23} = \dfrac{596.178}{100} \times 10^{23} = 5.96 \times 10^{23}$

Q.5. Show diagramatically the electron distributions in a sodium atom and a sodium ion and also give their atomic number.

Ans. Atomic number of sodium atom is 11. So, it contains 11 protons and 11 electrons.

A sodium ion is formed by the removal of one electron from a sodium atom. Thus, the number of electrons in a sodium ion will be $11 - 1 = 10$, but the number of protons will be the same. Therefore, the atomic number of both (sodium atom and sodium ion) will be 11.
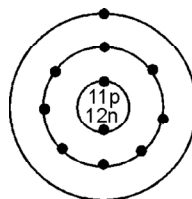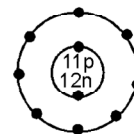
Sodium atom   Sodium ion

Q.6. Write down the symbols of the ions formed from the elements A (at. no. 11), B (at. no. 17) and C (at. no. 16). Also write the electronic configuration of the ions.

Ans. (i) The electronic configuration of A is (2, 8, 1) and hence its ion is A^+. Electronic configuration of A^+ is (2, 8).

(ii) The electronic configuration of B is (2, 8, 7) and hence its ion is B^-. Electronic configuration of B^- is (2, 8, 8).

(iii) The electronic configuration of C is (2, 8, 6) and hence its ion is C^{2-}. Electronic configuration of C^{2-} is (2, 8, 8).

Q.7. Choose the noble gases from the table.

Element	A	B	C	D
Mass number	4	40	27	20
Number of neutrons	2	22	14	10

Ans. (i) Atomic number of A = Mass number – no. of neutrons = $4 - 2 = 2$

Electronic configuration of A = 2(K). Therefore, A is a noble gas.

(ii) Atomic number of B = $40 - 22 = 18$.

Electronic configuration of B = 2(K), 8(L), 8(M). Therefore B is a noble gas.

(iii) Atomic number of C = $27 - 14 = 13$

Electronic configuration of C = 2(K), 8(L), 3(M). Therefore, C is not a noble gas but a metal.

(iv) Atomic number of D = $20 - 10 = 10$

Electronic configuration of D = 2(K), 8(L). Therefore, D is a noble gas.

Q.8. (a) What was Thomson's model of an atom?

(b) Write any two observations of Rutherford's model of atom.

Ans. (a) Thomson proposed the model of an atom which was similar to that of a Christmas pudding. The electrons like currents are spread over in a sphere of positive charge like in a spherical Christmas pudding.

(b) (i) There is a positively charged centre in an atom called the nucleus. Nearly all the mass of the atom resides in the nucleus.

    (ii) The size of the nucleus is very small as compared to the size of the atom.

Q.9. (a) During a radioactive disintegration, an atom gets converted into another atom whose mass number remains the same but atomic number increases by 1. Will the new atom formed be an isobar or isotope of the parent atom?

    (b) Which is heavier : a proton or an electron and how many times?

    (c) How many electrons are present in the outer shell of the atom of a noble gas other than helium?

Ans. (a) The new atom formed will be an isobar since isobars have same mass numbers but different atomic number.

    (b) A proton is heavier than an electron. The mass of a proton is 1837 times that of an electron.

    (c) Eight.

Q.10. Elements from A to F have in them the distribution of electrons, neutrons and protons as follows :

Ans.

Atom/ion	Number of Elecrtrons	Number of Neutrons	Number of Protons
A	4	4	3
B	10	12	11
C	17	18	17
D	17	20	17
E	18	22	18
F	19	21	19

Making use of these data, find

  (i) a pair of ions.   (ii) an atom of a noble gas.

  (iii) a pair of isobars   (vi) a pair of isotopes.

Ans. (i) A and B [since the number of protons is not equal to the number of electrons]

  (ii) E [Electronic configuration of E(Z = 18) is 2, 8, 8]

  (iii) E and F [Mass number is 40 for both but atomic numbers are 18 and 19 respectively]

  (iv) C and D [Atomic number is same for both i.e., 17 but mass numbers are different (i.e., 35 and 37 respectively]

Q.11. State the three rules proposed by Bohr and Bury regarding distribution of electrons in different orbits of atoms.

Ans. The Bohr-Bury rules regarding the distribution of electrons in different orbits of atoms are :

  (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 maximum number of electrons in the first orbit or K-shell will be = $2 \times 1^2 = 2$, second orbit or L-shell will be = $2 \times 2^2 = 8$, and so on.

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

(iii) Electrons are not accommodated in a given shell, unless the inner shells, are filled up.

Q.12. With the help of schematic representation of atomic structures of magnesium and sulphur, explain how electrons are distributed in different orbits?

Ans. Atomic number of magnesium is 12. According to the Bohr-Bury rule of electronic distribution in the different orbits of atom, the maximum number of electrons that can be accommodated in the first orbit (K-shell) of magnesium is $2 \times 1^2 = 2$ electrons. The second shell (L-shell) can accommodate $2 \times 2^2 = 8$ electrons. The third shell (M-shell) can accommodate a maximum of $2 \times 3^2 = 18$ electrons. But after accommodating $2 + 8 = 10$ electrons in the first two shells, magnesium is left with only 2 electrons which can be accommodated in the third orbit or M-shell.

Atomic structure
of magnesium

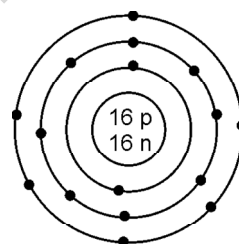Similarly for sulphur (Z = 16),

K-shell can hold $2 \times 1^2 = 2$ electrons

L-shell can hold $2 \times 2^2 = 8$ electrons

M-shell can hold the rest 6 electrons.
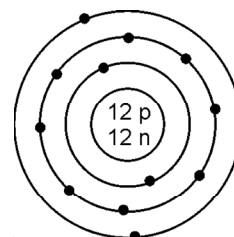
Atomic structure
of sulphur

Q.13. (a) Define valency.

(b) Why helium gas is considered as chemically inert? Explain.

(c) Write valency of potassium in the compound K_2CO_3.

Ans. (a) Valency is the combining capacity of an atom of an element.

(b) Helium has two electrons in the outermost shell which is the maximum number of electrons that can be accommodated in this shell. Thus it cannot gain, lose or share electrons and hence its valency is zero.

(c) Since valencies are exchanged while forming a molecule, we find the valency of potassium to be one in K_2CO_3.

D. Long Answer Questions   **(5 Marks)**

Previous Years' Questions

Q.1. (i) What is the drawback of Rutherford's model of an atom?

(ii) Mention the postulates Neils Bohr put forth to overcome the objections raised against Rutherford's atomic model.

(iii) Chlorine occurs in nature in two isotopic forms, with atomic masses 35 u and 37 u in the ratio of 3 : 1. Calculate the average atomic mass of chlorine atom.   **[2011 (T-II)]**

Ans. (i) The comparison of electrons to the planets in the solar system is the main drawback of Rutherford's atomic model.

According to classical electrodynamics, if an electrically charged particle revolves around a circular path, then it always radiates out energy. Thus, if an electron moves around a nucleus, it must continuously radiate out energy and hence, gradually move towards the nucleus in a spiral path, till it collides with the nucleus.

However, we know that an atom is very stable. Rutherford's model cannot explain stability.

(ii) Bohr's postulates which overcome the drawbacks of Rutherford's model of atom are :
 (a) Only certain special orbits konwn as discrete orbits of electron are allowed inside the atom.
 (b) While revolving in discrete orbits, the electrons do not radiate energy.

(iii) Average atomic mass of chlorine atom = $\dfrac{35 \times 3 + 37 \times 1}{4} = \dfrac{105 + 37}{4} = \dfrac{142}{4}$ = **35.50**

Q.2. (i) State Bohr's postulates about the model of an atom. Draw a sketch of Bohr's model of an atom with three shells
  (ii) Mention one use of each of the following :
  (a) Isotope of cobalt   (b) Isotope of iodine   **[2011 (T-II)]**

Ans. (i) The postulates of Bohr's model of an atom are :
  (a) Only certain special orbits known as discrete orbits of electrons are allowed inside the atom.
  (b) While revolving in discreate orbits the electrons do not radiate energy. These orbits are called energy levels. They are represented by 1, 2, 3, 4, ... or by the letters K, L, M, N, ...
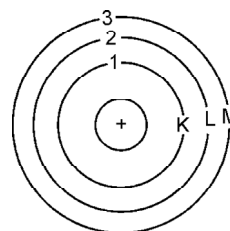
  (ii) (a) Isotope of cobalt is used in the treatment of cancer.
  (b) Isotope of iodine is used in the treatment of goitre.

Q.3. Read the following passage and with your own knowledge answer the following questions :
 In order to overcome the objections raised against Rutherford's model of the atom, Neil Bohr put forward the following postulates about the model of an atom.
 (i) Only certain special orbits known as discrete orbits of electrons are allowed inside the atom.
 (ii) While revolving in discrete orbits the electrons do not radiate energy. Write the following statements in your answer book after completing them :
  (a) Atoms are made up of ...., ... and ....
  (b) .... amended Rutherford's short-comings.
  (c) Electrons do not radiate energy while revolving in .... orbits
  (d) Discrete orbits are also known as ....
  (e) The K shell can accommodate .... electrons whereas L can accommodate........... electrons.
  (f) Atomic mass of an element is the sum of number of .... and .... **[2011 (T-II)]**

Ans. (a) Atoms are made up of protons, electrons and neutrons.
 (b) Neil Bohr amended Rutherford's shortcomings.
 (c) Electrons do not radiate energy while revolving in discrete orbits.
 (d) Discrete orbits are also known as energy levels.
 (e) The K shell can accommodate 2 electrons whereas L can accommodate 8 electrons.
 (f) Atomic mass of an element is the sum of number of protons and neutrons.

Q.4. (a) Write the maximum number of electrons which can be accommodated in K, L, M, N shells and give the rule on basis of which decides it.

(b) Atom A has a mass number 238 and atomic number 92 and atom B has a mass number 235 and atomic number 92.

  (i) How many protons, atoms A and B have?

 (ii) How many neutons, atom A and B have?

(iii) Are atoms A and B isotopes of the same element ? How? **[2011 (T-II)]**

Ans. (a) The maximum number of electron which can be accommodated in K, L, M, N shells are respectively 2, 8, 18, 32. This distribution of electrons is given by Bohr and Bury.

  (b) (i) Number of protons of atom A = Atomic number = 92

       Number of protons of atom B = Atomic number = 92

    (ii) Number of neutrons of atom A = Mass number – Atomic number = 238 – 92 = 146

       Number of neutrons of atom B = Mass number – Atomic number = 235 – 92 = 143

   (iii) Yes, A and B are the isotopes of the same element, because they have same atomic numbers.

Q.5. (a) Describe briefly Thomson's model of an atom.

  (b) Who discovered Neutron?

  (c) What are Canal Rays?

  (d) What is the mass of proton as compared to electron? **[2011 (T-II)]**

Ans. (a) J.J. Thomson believed that an atom is made up of positively charged substance in the form of a sphere. Into this sphere are embedded electrons, much the same way as the apples are embedded in an apple pie. Furthermore, the total positive charge of the sphere is equal to total negative charge of the electrons and hence the atom remained electrically neutral.

  (b) Chadwick

  (c) The positively charged radiations which consists of positively charged particles, originated from the anode and passing through the perforated cathode in a gas discharge tube is known as canal rays.

  (d) Mass of proton is approximately 2000 times more than the mass of an electron.

Q.6. (a) Give Bohr - Bury rules for distribution of electrons in different shells (any 2).

  (b) For chlorine, Z = 17, A = 35. Give the number of protons, electrons and neutrons in (i) Chlorine (ii) Chloride ion. **[2011 (T-II)]**

Ans. (a) (i) The maximum number of electrons which can be present in any shell of an atom is given by the formula **$2n^2$,** where **n** is the number of shell as counted from nucleus. Thus, according to above formula :

      Maximum no. of electrons in first shell (K-shell) = $2n^2 = 2(1)^2 = 2$

      Maximum no. of electrons in second shell (L-shell) = $2n^2 = 2(2)^2 = 8$

      Maximum no. of electrons in third shell (M-shell) = $2n^2 = 2(3)^2 = 18$

      Maximum no. of electrons in fourth shell (N-shell) = $2n^2 = 2(4)^2 = 32$

   (ii) The outermost shell cannot have more than 8 electrons and the last but one shell cannot have more than 18 electrons.

  (b) (i) Atomic number of chlorine = 17

     Atomic number = number of protons = number of electrons = 17

     Number of neutrons = Mass number – Atomic number = 35 – 17 = 18

   (ii) Chlorine has electronic configuration 2, 8, 7. By accepting one electron its form

chloride ions. So the number of electrons will be 18. Number of protons and neutrons remains same as for chlorine.

Q.7. Answer the following in one line or one word
    (a) Who discovered neutron?
    (b) On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.
    (c) What is the maximum number of electrons that can be accommodated in the outermost shell of an atom?
    (d) What term is assigned to the atoms of different elements having same atomic mass but different atomic numbers.
    (e) How many neutrons are present in a hydrogen atom? **[2011 (T-II)]**

Ans. (a) Chadwick
    (b) According to Thomson's model of an atom, an atom is made up of positively charged substance in the form of a sphere. Into this sphere electrons are embedded. The total negative charge of the electrons is equal to the positive charge of sphere, hence atom remains electrically neutral.
    (c) The outermost shell of an atom is N shell, that can accommodated upto 32 electrons.
    (d) Isobars
    (e) No neutrons

Q.8. (i) Name the scientist who proposed this model of atom.
    (ii) Write the three postulates of this model.
    (iii) How many maximum electrons can be accommodated in M orbit ? **[2011 (T-II)]**
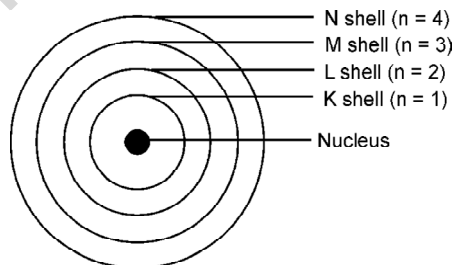
Ans. (i) Neils Bohr
    (ii) 1. An atom is made up of three kinds of particles : electrons, protons and neutrons.
        2. Electrons are negatively charged, protons are positively charged and neutrons are neutral, i.e, they have no electric charge.
        3. The number of electrons and protons are equal, so that an atom on the whole is electrically neutral.
   (iii) 18 electrons

Q.9. (a) Which popular experiment is shown in the figure?
    (b) List three observations of this experiment.
    (c) State conclusions drawn from each observation of this experiment.
    (d) State the model of atom suggested on the basis of the above experiment. **[2011 (T-II)]**

Ans. (a) Scattering of alpha particles by gold foil.
    (b) 1. Most of the alpha particles passed through the foil straight, without suffering any change in their direction.
        2. A small fraction of alpha particles deflected through small angles and a few through large angles.
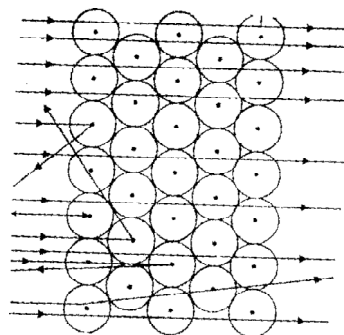
3. One out of 12000 particles rebounded.
(c) 1. The nucleus of an atom is positively charged.
2. The atom on the whole is relatively empty and the positively charged mass in the nucleus, is concentrated over a very, very small space.
3. Nucleus of the atom is very dense and hard.
4. The angle through which alpha particles get scattered, depends upon the angle at which they approach the positively charged nucleus of the concentrated mass.
(d) Rutherford's model of an atom.

Q.10. (a) Write the symbol and name of the element having 14 proton.
(b) Complete the table.

Element	Atomic No	Mass No	Proton	Neutron
Cl	17	-	-	18
Si	-	28	-	-
F	-	-	9	10

(c) Give one drawback of Rutherford model. **[2011 (T-II)]**

Ans. (a) $^{28}_{14}$Si (Silicon)

(b)

Element	Atomic No	Mass No	Proton	Neutron
Cl	17	35	17	18
Si	14	28	14	14
F	9	19	9	10

(c) Rutherford could not explain the stability of atom.

Q.11. State postulates of Neils Bohr to describe model of an atom. Draw diagram indicating the distribution of electrons in the atoms of the elements having atomic numbers 6, 16, 20. Write the name and symbols of the elements. **[2011 (T-II)]**

**Ans. Postulates of Neils Bohr's atomic model**
1. Atom is made up of electrons, protons and neutrons.
2. Electrons are negatively charged, protons are positively charged and neutrons are neutral.
3. The number of electrons and protons are equal so that an atom is electrically neutral.
4. Protons and neutrons are present within the nucleus. Due to the presence of protons, the nucleus is positively charged.
5. The electrons revolve around the nucleus in fixed orbits, called energy levels or shells, which are represented by numbers 1, 2, 3, 4, 5 and 6 or letters K, L, M, N, O and P. These numbers are counted from the nucleus outwards.
6. Each energy level has a fixed amount of energy. The orbit nearest to the nucleus has minimum energy, whereas the orbit farthest from the nucleus has highest energy.
7. There is no change in the energy of electrons as long as they revolve in the same orbit and remain stable. But if an electron gains energy, it jumps to a higher energy level and if it loses energy it falls to a lower energy level.

8. The mass of the atom is almost entirely due to the nucleus, as electrons have negligible mass.

Atomic number — 6

Number of electrons = number of protons = atomic number = 6
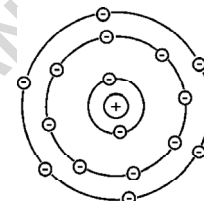
Electronic configuration : 2, 4
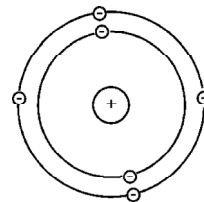
Name and Symbol — Carbon $\left(^{12}_{6}C\right)$

Atomic number — 16

Number of electrons = number of protons = atomic number = 16
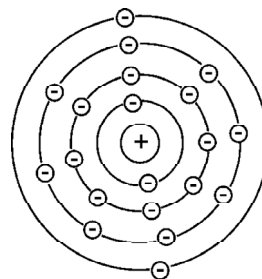
Electronic configuration : 2, 8, 6

Name and Symbol : Sulphur $\left(^{32}_{16}S\right)$

Atomic number — 20

Number of electrons = number of protons = atomic number = 20

Electronic configuration = 2, 8, 8, 2

Name and Symbol — Calcium $\left(^{40}_{20}Ca\right)$

Q.12. (a) What are isobars?

(b) Atomic number of an element Y is 17.

  (i) Write its electronic configuration.

  (ii) What is the number of valence electrons in Y?

  (iii) How many electrons are needed to complete the octet of Y?

  (iv) It is a metal or non metal ?

(c) The valency of Na is 1 and not 7. Give reason.   **[2011 (T-II)]**

Ans. (a) Atoms of different elements, having the same mass number but different atomic numbers, are calle isobars.

(b) (i) Electronic configuration = 2, 8, 7

  (ii) Number of valency electrons = 7

  (iii) One electron is needed to complete the octet of Y.

  (iv) It is a non-metal because it accept electron to complete its octet.

(c) Electronic configuration of Na = 2, 8, 1. It donates 1 electrons and aquire its stable gas configuration. It is easy to donate 1 electron rather than to accept 7 electrons, hence, sodium has a valency of 1 not 7.

Q.13. (a) State the rules followed for writing the number of electrons in different energy shells.

(b) List the important observations made by Rutherford from his α-particle scattering experiment.   **[2011 (T-II)]**

Ans. (a) The distribution of the electrons in different orbits of an atom occurs according to the Bohr-Bury rules.

 (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, ...

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

 (iii) Electrons are not accommodated in a given shell unless the inner shells are filled up.

 (b) The observations made by Rutherford in his α-particle scattering experiment were :

 (i) Most of the fast moving α-particles passed straight through the gold foil.

 (ii) Some of the α-particles were deflected by the foil by small angles.

 (iii) One out of every 12000 particles rebounded.

Q.14. (a) Describe Rutherford's model of the atom with the help of a diagram.　　　**[2011 (T-II)]**
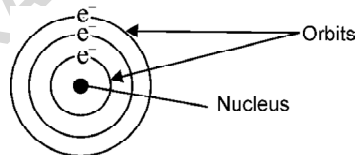
　　　(b) What was the limitation of the above model?

Ans. (a) Rutherford proposed the following model of an atom :

 (i) There is a positively charged centre in an atom called the nucleus. Nearly all the mass of an atom resides in the nucleus.

 (ii) The electrons revolve around the nucleus in well defined orbits.

 (iii) The size of the nucleus is very small as compared to the size of the atom.

 (b) The comparison of electrons to the planets in the solar system is the main drawback of Rutherford's atomic model.

 According to classical electrodynamics, if an electrically charged particle revolves around a circular path, then it always radiates out energy. Thus, if an electron moves around a nucleus, it must continuously radiate out energy and hence, gradually move towards the nucleus in a spiral path, till it collides with the nucleus.

 However, we know that an atom is very stable. Rutherford's model cannot explain this stability.

Other Important Questions

Q.1. Describe the essential features of the model of an atom proposed by Rutherford. How is it different from that proposed by J. J. Thomson?

Ans. (i) The nucleus, containing positively charged particles called protons is located within the atom.

 (ii) The size of the nucleus is extremely small as compared to the size of an atom.

 (iii) The electrons revolve around the nucleus at various distances at a very high speed, such that they counterbalance the electrostatic force of attraction between the positively charged nucleus by the centrifugal force, much the same way as the planets revolve around the sun.

 The volume occupied by an atom consists mostly of large empty space. Rutherford's model is different from J.J. Thomson's model in a sense that it provides an explanation, how the electrons do not fall into protons and neutralise themselves. J.J. Thomson's model does not provide the above explanation.

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Q.2. The ratio of the radii of hydrogen atom and its nucleus is 10^5. Assuming the atom and the nucleus to be spherical,

  (i) What will be the ratio of their sizes?

 (ii) If an atom is represented by the planet earth 'R$_e$' = 6.4×10^6m, estimate the size of the nucleus.

(iii) How many neutrons are present in each of the three isotopes of hydrogen?

Ans. (i) Volume of the sphere = $\frac{4}{3}\pi \times r^3$

Let R be the radius of the atom and r that of the nucleus $\Rightarrow$ R = $10^5 r$

Volume of the atom = $\frac{4}{3}\pi R^3 = \frac{4}{3}\pi\left(10^5 r\right)^3 = \frac{4}{3}\pi \times r^3 \times 10^{15}$

Volume of the nucleus = $\frac{4}{3}\pi \times r^3$

Ratio of the atom to that of the nucleus = $\dfrac{\frac{4}{3}\pi r^3 \times 10^{15}}{\frac{4}{3}\pi r^3} = \dfrac{10^{15}}{1}$ = 10^{15} : 1

(ii) If the atom is represented by the planet earth (R$_e$ = 6.4×10^5m) then the radius of the nucleus would be $r_n = \dfrac{R_e}{10^5}$

$r_n = \dfrac{6.4 \times 10^6 \, m}{10^5}$ = 6.4×10 m = 64 m

(iii) Protium contains no neutron, deuterium contains one neutron while tritium contains two neutrons.

Q.3. (a) Write the three features put forward by Rutherford about his nuclear model of an atom.

  (b) The atom of an element has mass number 20 and atomic number 10. Write its electronic configuration. What will be its valency?

Ans. (a) (i) There is a positively charged centre in an atom called the nucleus, where all the mass of the atom resides in the nucleus.

  (ii) The electrons revolve around the nucleus in well-defined orbits.

(iii) The size of the nucleus is very small as compared to the size of the atom.

 (b) Electronic configuration of the element = 2, 8. Since the atom of the element has a complete octet hence cannot lose or gain or share any electron, therefore it has zero valency.

Q.4. Give reasons for the following :

(a) $^{40}_{18}$Ar and $^{40}_{20}$Ca are called isobars.

(b) 'He' and 'Ne' have zero valency.

(c) An atom is neutral.

(d) Nucleus is positively charged.

(e) Isotopes have similar chemical properties.

Ans. (a) Argon and calcium have the same mass number but different atomic numbers. Atoms of elements having the same mass number but different atomic numbers are called isobars.

(b) Helium has two electrons in its outermost shell (duplet structure) while neon has eight electrons in its outermost shell (octet structure). Both the elements have completely filled outermost shell and cannot lose or gain or share electrons and hence their valencies are zero.

(c) The number of positively charged protons is equal to the number of negatively charged electrons in an atom. Thus an atom is electrically neutral.

(d) The nucleus is made up of positively charged protons and neutral neutrons. Therefore it is positively charged.

(e) Isotopes are atoms of the same element having the same atomic number but different mass numbers. Since the number of electrons or more precisely the number of valence electrons in isotopes are same, therefore they have similar chemical properties.

Q.5. (a) What are isobars? Give one example.

(b) Write two differences between isobars and isotopes.

(c) Write any two uses of isotopes.

Ans. (a) Isobars are atoms of different elements having the same mass number but different atomic numbers.

Chlorine $_{17}^{35}Cl$ and $_{17}^{37}Cl$ are isotopes.

(b) (i) Isobars have the same mass number but different atomic numbers while isotopes have the same atomic number but different mass numbers.

(ii) Isobars have different chemical properties while isotopes have similar chemical properties.

(c) (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.

Q.6. State the three observations made by Rutherford in the α-particle scattering experiment. Write the electronic configuration of an element whose mass number is 31 and atomic number is 15. What is its valency?

Ans. The observations made by Rutherford in his α-particle scattering experiment were :

(a) Most of the fast moving α-particles passed straight through the gold foil.

(b) Some of the α-particles were deflected by the foil by small angles.

(c) One out of every 12000 particles rebounded.

Mass no. of the element = 31

Atomic no. of the element = 15

Electronic configuration = 2, 8, 5

Since there are 5 electrons in the outermost shell, the element can gain three electrons to complete its octet. Therefore, the valency of the element is 3.

Q.7. (a) What are canal rays?

(b) If an atom contains one electrons and one proton, will it carry any charge? Identify the element.

(c) 'X' and 'Y' are isobars. 'X' has mass number 14 and atomic number 6.

'Y' has 7 neutrons. Predict the atomic number and mass numbers of 'Y'.

Ans. (a) The positively charged radiations which consists of positively charged particles, originating from the anode and passing through the perforated cathode in a gas discharge tube are known as canal rays.

(b) No, the atom will be neutral since the opposite charges are balanced.

The element having one proton and one electron has a mass number one and atomic number one. So it is identified as a hydrogen atom.

(c) Isobars of elements have the same mass number.

Therefore mass number of Y = mass no. of X = 14

Atomic number of Y = Mass number − no. of neutrons

$$= 14 - 7 = 7$$

**Q.8.** (a) What is an octet? How do elements reach an octet?

(b) Make a schematic atomic structure of magnesium or phosphorus.

(given : number of proton of magnesium = 12, phosphorus = 15)

(c) If bromine atom is available in the form of two isotopes $_{35}^{79}Br$ and $_{35}^{81}Br$ in 49.7% and 50.3% respectively. Calculate the average atomic mass bromine.

Ans. (a) The outermost shell of an atom which has eight electrons is said to possess an octet.

Atoms of elements by gaining, losing or sharing electrons with other atoms of elements to make an octet of electrons in the outermost shell.

(b)

Atomic structure of magnesium

Atomic structure of phosphorus
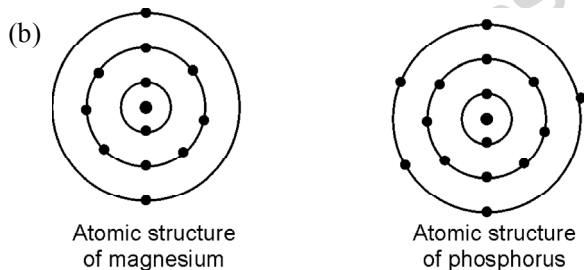
(c) Average atomic mass of bromine $= \dfrac{79 \times 49.7 + 81 \times 50.3}{100} = \dfrac{3926.3 + 4074.3}{100}$

$$= \dfrac{8000.6}{100} = \mathbf{80.006\ u}.$$

Q.9. (a) Why do the inert gases like neon and argon have zero valency?

(b) The atomic number of sodium is 11 and oxygen is 8. Predict their valencies.

(c) Draw the schematic atomic structure of $_{12}^{24}Mg$

(d) State the difference between a proton and an electron on the basis of their location.

(e) Give one use of an isotope of cobalt and one use of an isotope of iodine.

Ans. (a) Neon and argon have completely filled electrons in their outermost shell with eight electrons and cannot lose, gain or share electrons with atoms of other elements. Therefore, the valency of these gases is zero.

(b) Electronic configuration of sodium (Z = 11) = 2, 8, 1

Therefore, its valency is 1

Electronic configuration of oxygen (Z = 8) = 2, 6

Therefore, its valency is (8–6) = 2

(c)

Atomic structure
of magnesium
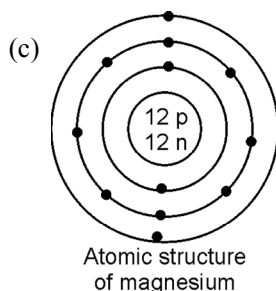
(d) A proton is located within the nucleus of an atom while an electron revolves in the orbits around the nucleus of an atom.

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

An isotope of iodine is used in the treatment of goitre.

II. FORMATIVE ASSESSMENT

A. Science Quiz

I. **Q.1.** An atom has mass number 14 and 8 neutrons in its nucleus. The atom is an isotope of

    (a) carbon   (b) nitrogen   (c) oxygen   (d) silicon

Ans. **(a)** *Reason :* No. of neutrons in the atom = 8

    No. of protons in the atom = mass no. – no. of neutrons = (14 – 8) = 6

    Thus, the atom is identified as a carbon atom.

Q.2. An element has mass number 31 and atomic number 15. The number of electrons, protons and neutrons in it are respectively

    (a) 15, 16, 15   (b) 16, 15, 15   (c) 15, 15, 16   (d) 31, 15, 15

Ans. **(c)** *Reason :* No. of protons = atomic number of the element = 15

    No. of electrons = number of protons = 15

    No. of neutrons = mass number – atomic number = 31 – 15 = 16

Q.3. Rutherford's experiment of scattering of α-particles showed for the first time, an atom has :

    (a) neutrons   (b) protons   (c) electrons   (d) nucleus

Ans. **(d)** *Reason :* The central positive (and rigid) nucleus in an atom was established for the first time by Rutherford's α-particle scattering experiment.

Q.4. Which of the following classes of elements differ in their chemical properties?

    (a) Allotropes   (b) Isotopes   (c) Isobars   (d) Allotropes and isobars

Ans. **(c)** *Reason :* Isobars are atoms of different elements having the same mass numbers. Thus they have different chemical properties.

Q.5. Which of the following has equal number of protons and neutrons?

    (a) Sulphur   (b) Magnesium   (c) Oxygen   (d) All the above

Ans. (d) *Reason :* $^{32}_{16}S$ has 16 protons and 16 neutrons.

$^{24}_{12}Mg$ has 12 protons and 12 neutrons.

$^{16}_{8}O$ has 8 protons and 8 neutrons.

II. Q.1. An isotope of carbon $\left(^{14}_{6}C\right)$ is used in dating of _____ samples.

Ans. fossil

Q.2. An isotope of iodine $\left(^{128}_{53}I\right)$ is used in the treatment of _____.

Ans. goitre

Q.3. All isotopes of an element have _____ valency.

Ans. same

Q.4. Isotope of uranium used in nuclear reactors is _____.

Ans. $^{235}_{92}U$

Q.5. An isotope of cobalt used in the treatment of cancer is _____.

Ans. $^{60}_{27}Co$

Q.6. The isobars of elements can be separated easily by _____ means.

Ans. chemical

Q.7. _____ number is never fractional.

Ans. atomic

Q.8. An element loses/gains electron from/in its valence shell so as to attain a structure of the nearest _____.

Ans. noble gas

III. Q.1. An electron has 6 protons in its nucleus. What is the atomic number of the element?

Ans. Atomic number of an element = no. of protons = 6

Q.2. An element has mass number 37 and atomic number 17. How many neutrons are present in its nucleus?

Ans. No. of neutrons = Mass number – atomic number = 37 – 17 = 20

Q.3. The symbols of an element are $^{1}_{1}E, ^{2}_{1}E$ and $^{3}_{1}E$. What is the scientific name given to them?

Ans. The mass numbers of the elements are different but their atomic number is the same. Thus the elements are isotopes.

Q.4. $^{40}_{20}Ca$ and $^{40}_{18}Ar$ are the atoms of calcium and argon. How are they related to one another?

Ans. The mass number of calcium and argon are the same. So, they are isobars.

Q.5. What is the maximum number of electrons in the K-shell of an element?

Ans. The K shell is the first shell. Hence it can have a maximum of $2 \times 1^2 = 2$ electrons.

Q.6. How many electrons can be present in the valence shell of an atom?

Ans. The valence shell of an atom can have a maximum of 8 electrons.

Q.7. $^{39}_{19}K$ changes to its ions by the loss/gain of electrons. How many electrons will it lose or gain?

Ans. Electronic configuration of $^{39}_{19}K$ is = 2, 8, 8, 1. Therefore, one atom of the element will lose one electron to form a stable octet.

Q.8. $^{39}_{19}K$ changes to an ion of the nearest noble gas. What kind of change occurs when it forms a K ion?

Ans. It is a chemical change as an ion is formed with a different electronic configuration.

Q.9. Name the part of the atom, where most of its mass is concentrated.

Ans. Most of the mass of an atom is concentrated in the nucleus.

Q.10. An element $\left[^{16}_{8}O\right]$ acquires two protons by nuclear bombardment. To which element does it change.

Ans. The element $^{16}_{8}O$ gains two protons by nuclear bombardment. Therefore, the mass number and the atomic number both increase by 2. The element therefore changes to neon $\left(^{18}_{10}Ne\right)$.

B. Projects / Models

Take 10 cm by 10 cm pieces of thermcol. On each of the piece draw the geometric model of :

(i) Sodium	(ii) Phosphorus	(iii) Calcium	(iv) Lithium
(v) Silicon	(vi) Potassium	(vii) Sulphur	(viii) Fluorine