# CBSE Test Paper 04 Chapter 04 Structure of the Atoms

- 1. The triad which is isoelectronic **(1)** 
  - a.  $Mg_2^+, F^-, O$
  - b. Na<sup>+</sup>, O<sub>2</sub><sup>-</sup>, Ne
  - c. Na<sup>+</sup>, Al, N<sub>3</sub><sup>-</sup>
  - d. Cl<sup>-</sup>, Ar, Ca
- 2. What is name given to the number of protons in the nucleus of the atom? (1)
  - a. Isotope
  - b. Isobar
  - c. Mass number
  - d. Atomic number
- 3. Match the following with the correct response: (1)

(1) Carbon	(A) 2
(2) Sodium	(B) 2,8,1
(3) Argon	(C) 2,4
(4) Helium	(D) 2,8,8

- a. 1-D, 2-A, 3-C, 4-B
- b. 1-B, 2-D, 3-A, 4-C
- c. 1-C, 2-B, 3-D, 4-A
- d. 1-A, 2-C, 3-B, 4-D
- 4. The conclusion of Rutherford's scattering experiment does not include (1)
  - a. The radius of nucleus is less than 10-14 m.
  - b. The positively charged particles of atom move with very high velocity
  - c. Scattering follows coulomb's law, i.e., same charges repel each other

- d.  $\, lpha$  -particles can come within the distance of order of 10-14 m of the nucleus
- 5. Which of the following statements is false? (1)
  - a. Nucleus of atom contains only nucleons (neutrons and protons) was proposed by Rutherford.
  - b. Matter is electrically neutral in nature.
  - c. Neutron is sum of electrons and protons, therefore it is neutral.
  - d. Mass of electron is  $\frac{1}{1840}$  times that of proton.
- 6. What is the number of electrons in the valence shell of chlorine (Z = 17)? (1)
- 7. The electronic configuration of an element is : 2(K), 8(L), 5(M). Predict its valency. (1)
- 8. How hydrogen atom is different from atoms of all other elements? (1)
- 9. Which radioisotope is used for the treatment of cancer? (1)
- 10. If the K and L shells of an atom are full, then what would be the number of electrons in the atom? (1)
- 11. Under what conditions are the protons and electrons same in an atom? (3)
- 12. Na<sup>+</sup> ion has completely filled K and L shells. Explain. **(3)**
- 13. Draw a sketch of Bohr's model of an atom with three shells. (3)
- 14. The ratio of the radii of the hydrogen atom and its nucleus is  $\sim 10^5$ . Assuming the atom and the nucleus to be spherical, **(5)** 
  - i. What will be the ratio of their sizes?
  - ii. If an atom is represented by planet Earth 'R\_e'= 6.4  $\,\times\,$  10  $^{6}$  m. Estimate the size of the nucleus.
- 15. Give an experiment to show that cathode rays are deflected by magnetic fields. (5)

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#### Answers

## 1. b. $Na^+, O^{2^-}, Ne$

**Explanation:** An Isoelectronic Series is a group of atoms/ions that have the same number of electrons.

Examples:  $N^{3^-}$ ,  $O^{2^-}F^{-}$ , Ne, N<sub>a</sub>+, Mg<sup>2</sup>+, Al<sup>3</sup>+

This series each have 10 electrons.

 $P^{3}, S^{2}, Cl^{-}, Ar, K^{+}, Ca^{2+}, Sc^{3+}$ 

This series each have 18 electrons.

2. d. Atomic number

**Explanation**: The number of protons in the nucleus of an atom is equal to its atomic number (Z). The sum of the number of protons and neutrons present in a nucleus is called the mass number (A).

### 3. c. 1-C, 2-B, 3-D, 4-A

**Explanation**: Electronic configuration is the distribution of electrons of an atom in various orbitals of differing energy levels. The electronic configuration of Carbon is 2,4. The electronic configuration of Sodium is 2,8,1. The electronic configuration of Argon is 2,8,8. The electronic configuration of Helium is 2.

## 4. b. The positively charged particles of atom move with very high velocity

### **Explanation:**

Conclusion of Rutherford's scattering experiment:

- i. Most of the space inside the atom is empty because most of the  $\alpha$ -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  $\alpha$ -particles were deflected by very large angles, indicating that all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom.
- iv. Since very less number of alpha particles deflected, hence the volume of

nucleus is very less compare to whole atom. The size of nucleus is less than  $2 \times 10^{-14}$  m while the size of an atom is around  $10^{-10}$  m. So, The positively charged particles of atom move with very high velocity

does not include conclusion of Rutherford's scattering experiment.

c. Neutron is sum of electrons and protons, therefore it is neutral.
 Explanation: The number of protons in the nucleus of the atom is equal to the atomic number (Z).

The number of electrons in a neutral atom is equal to the number of protons. The mass number of the atom (M) is equal to the sum of the number of protons and neutrons in the nucleus.

The number of neutrons is equal to the difference between the mass number of the atom (M) and the atomic number (Z).

- 6. The outer shell of any atom is called the valence shell.The electronic distribution of the element is: K(2), L(8), M(7).This means that the valence shell of chlorine has 7 electrons.
- 7. The valency of an element is the combining capacity of that element. It is determined by the number of electrons present in the outermost shell (valence shell) of an atom of that element, if the number of valence electrons of an atom of an element is less than or equal to 4, then the valency of that element is equal to the number of valence electrons.

On the other hand, if the number of valence electrons of the atom of an element is greater than 4, then the valency of that element is obtained by subtracting the number of valence electrons from 8.

Valancy of element = 8 - 5 = 3

The valency of the element is 3.

- 8. All the atoms are made up of three subatomic particles: electrons, protons and neutrons. Hydrogen atom is made up to only one electron and one proton. It does not contain any neutron. So, it is different from atoms of all other elements.
- 9. Cobalt therapy or cobalt-60 therapy is the medical use of gamma rays from the radioisotope cobalt-60 to treat conditions such as cancer.

- Maximum no. of electrons in K-shell = 2
  Maximum no. of electrons in L-shell = 8
  Therefore, if K and L shells of an atom are full, then the total number of electrons in the atom would be (2 + 8) = 10 electrons.
- 11. The electrons and protons are same in an atom provided it has no charge. This means that it is a neutral atom and is neither a cation (positively charged) nor an anion (negatively charged).

Actually the proton and electron count of an atom are equal only when the atom is neutral in charge.

The protons and neutrons are found in the nucleus of the of the atom and make up the major it of the mass of the atom. The electrons are found in orbitals surrounding the nucleus.

In order for the atom to remain electrically neutral the protons and electrons must balance each other.

- 12. Na<sup>+</sup> is a positively charged sodium ion. Normally an atom of sodium has 11 electrons, so according to formula it has 2 electrons in K shell, 8 electrons in L shell and 1 electron in M shell. However Na<sup>+</sup> has 10 electrons only, therefore it has 2 electrons in K shell and 8 in L shell. 2 and 8 are the full capacity of the K and L shell respectively. Hence it is said ' Na<sup>+</sup> has completely filled K and L shells. '
- 13. Bohr's model of an atom with three shells:

The three stationary orbits are designated as K-shell (nearest to the nucleus), M-shell and N-shell.

The atom with three shells can accommodate a maximum of 2, 8 and 18 electrons respectively.



- 14. i. As atom and nucleus is considered to be spherical. Volume of the sphere =  $\frac{4}{3}\pi r^3$ Let R be the radius of the atom and r be that of the nucleus.
  - $\Rightarrow R = 10^{5} r$ Volume of the atom of radius 'R' =  $R_{3}^{43} \pi$ Volume of atom =  $\frac{4}{3} \pi (10^{5}r)^{3}$  (.' R =  $10^{5}r$ )
    Or, Volume of the atom =  $\frac{4}{3} \pi r^{3} \times 10^{15}$ Now, Volume of the nucleus =  $\frac{4}{3} \pi r^{3}$ Therefore, Ratio of the size of atom to that of nucleus =  $\frac{\frac{4}{3} \times 10^{15} \times \pi r^{3}}{\frac{4}{3} \pi r^{3}} = 10^{15}$
  - ii. If the atom is represented by the planet Earth ( $R_e = 6.4 \times 10^6$ m), then the radius of the nucleus would be

$$r_n = \frac{R_e}{10^{15}} = \frac{6.4 \times 10^6 m}{10^5} = 6.4 \times 10m = 64 m.$$

Here,  $\frac{R}{r} = 10^{\circ}$  (Given)

- 15. An experiment to show that cathode rays are deflected by magnetic fields is as follows:
  - i. Take a discharge t<mark>ube with a fluo</mark>rescent material coated on its inside.
  - ii. Place a horseshoe magnet at the centre of the discharge tube.
  - iii. When cathode rays are produced, they travel through the discharge tube in a straight line and get deflected by the magnet towards the anode.

This shows that cathode rays are deflected by a magnetic field. This also shows that cathode rays are negatively charged.

