CBSE Test Paper 02

Chapter 04 Structure of Atom

1. Which of the following was not observed by Rutherford in α-particle scattering experiment? **(1)**

   A. Most of the α-particles rebounded after hitting the gold foil.

   B. Some of the α-particles were deflected from their path.

   C. Some of the α-particles did not pass through the goil foil.

   D. Most of the α-particles passed straight through the gold foil.

   a. B and C
   b. C and D
   c. All of these
   d. A and C

2. Which of the following correctly represent the electronic distribution in the Mg atom? **(1)**

   a. 8, 2, 2
   b. 2, 8, 2
   c. 3, 8, 1
   d. 1, 8, 3

3. In neutral atoms, number of electrons are equal to number of_____**(1)**

   a. Mass number
   b. Protons
   c. Neutrons
   d. Nuclear charge

4. If K, L, M, N, shells of an atom are full. The total number of electrons in that atom are: **(1)**

   a. 26
   b. 36

c. 60

d. 42

5. The $\frac{charge}{mass}$ ratio of electron **(1)**

a. depends upon nature of electrodes

b. depends upon nature of gas

c. remains constant

d. depends upon both nature of gas and nature of electrodes

6. Atomic mass of oxygen is 16u. What does it indicate? **(1)**

7. What are canal rays? **(1)**

8. i. Why chemical properties of all the isotopes of an element are same?

ii. Name the isotopes used in the treatment of goitre and cancer.

iii. An element 'X' has 2 electrons in its M shell. What is its atomic number? **(1)**

9. Name the three sub-atomic particles of an atom. **(1)**

10. What is the maximum number of electrons which can be accommodated in 'N' shell? **(1)**

11. How many electrons, protons and neutrons will be there in an element ${}_9X^{19}$? What will be the valency of the element? **(3)**

12. Nucleus of an atom has positive charge on it. Establish. **(3)**

13. The atomic number of Al and Cl are 13 and 17 respectively. What will be number of electrons in Al^{3+} and Cl^-? **(3)**

14. If Z = 3, what would be the valency of the element? Also, name the element. **(5)**

15. What is the gold foil experiment? Name the scientist who performed this experiment. Write the conclusions and shortcomings of Rutherford's model of atom. **(5)**

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Answers

1. d. A and C

   Explanation: Rutherford had observed in the scattering experiment that most of the α-particles went straight through the gold foil while some of the α-particles were deflected from their path by different angles.

2. b. 2, 8, 2

   Explanation: Atomic number of magnesium = 12

   Therefore number of electrons = 12

   Thus, electronic configuration of magnesium is Magnesium = 2,8,2.

3. b. Protons

   Explanation:

   i. The number of protons in the nucleus of the atom is equal to the atomic number (Z).

   ii. The number of electrons in a neutral atom is equal to the number of protons.

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

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

4. c. 60

   Explanation: Maximum number of electrons in K-shell i.e. 1st shell = 2

   maximum number of electrons in L-shell = 8

   maximum number of electrons in M-shell = 18

   maximum number of electrons in N-shell = 32

   2 + 8 +18 + 32 = 60

5. c. remains constant

   Explanation: The $\frac{charge}{mass}$ on the type of ray one is passing. Since we are talking about electron, the cathode ray particles are nothing but a beam of electrons. Since, the

charge as well as mass is constant for electron no matter any gas we take in during the experiment in the discharge tube. So, their charge/mass ratio remains constant for electron.

6. Mass of atom is called atomic mass.
   The atomic mass of hydrogen atom = 1u.
   The atomic mass of oxygen is 16u, this means one atom of oxygen is 16 times heavier than $\frac{1}{12^{th}}$ of carbon atom.

7. Canal rays also called anode rays, are seen moving from the anode towards the cathode in the specially designed discharge tube. However, they do not originate from the anode. They were discovered by Goldstein in 1886.

8. i. This is because isotopes have same atomic number, so the number of valence electrons present in them are same and it is the valence electrons which take part in chemical reactions. So the isotopes of an element have same chemical properties.
   ii. Goitre - Isotope of iodine
   Cancer - Isotope of cobalt
   iii. Atomic number of X = 12

9. The three sub-atomic particles of an atom are as follows:-

   a. **Proton** (positively-charged particle)
   b. **Neutron** (neutral particle)
   c. **Electron** (negatively-charged particle)

10. The maximum number of electrons present in a shell is given by the formula $\mathbf{2n^2}$, where 'n' is the orbit number or the energy level (1, 2, 3, ...)

    The value of n for N shell is 4. So, the maximum number of electrons = 2 x $(4)^2$ = 2 x 16 = 32

    N shell (n = 4) can accommodate a maximum of **32 electrons**.

11. No. of protons = Atomic number = 9

No. of (protons + neutrons) = Mass number = 19
Number of electrons = 9
Number of protons = 9
Number of neutrons = Mass number - Atomic number = 19 - 9 = 10
Electronic configuration of X = 2, 7
Valency of X = 1 (since it requires one electron to complete its octet)

12. This can be established on the basis of Rutherford experiment. Since some alpha particles were repelled by the nucleus of the atom, it is expected to have the same charge as on alpha particles. Therefore, nucleus of an atom has positive charge.
The nucleus of an atom contains two things: Protons and neutrons. Because neutrons have no charge and protons have positive charge, the overall charge of the nucleus is positive.

13. Number of electrons in Al = Number of protons in Al = Atomic number (Z) of Al = 13
Number of electrons in Al^{3+} = 13 - 3 = **10**
Number of electrons in Cl = Number of protons in Cl = Atomic number (Z) of chlorine = 17
Number of electrons in Cl^- = 17 + 1 = **18**

14. When atomic number Z = 3, the element will have 3 protons in its nucleus.

Since the atom is electrically neutral, the number of electrons in its shells will be equal to the number of protons .

The element will have 3 electrons in its different shells.

The maximum number of electrons that can be accommodated in the first orbit (n = 1) or K-shell will be = $2n^2$ = 2

So, the 3 electrons in the element would be distributed as 2, 1.

The number of valence electrons (i.e. electrons in the outermost shell) is 1.

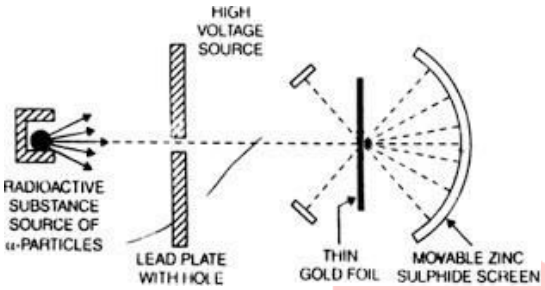
Valency = number of valence electrons (for 4 or lesser valence electrons)

The element can easily give away its outermost single electron for achieving a duplet

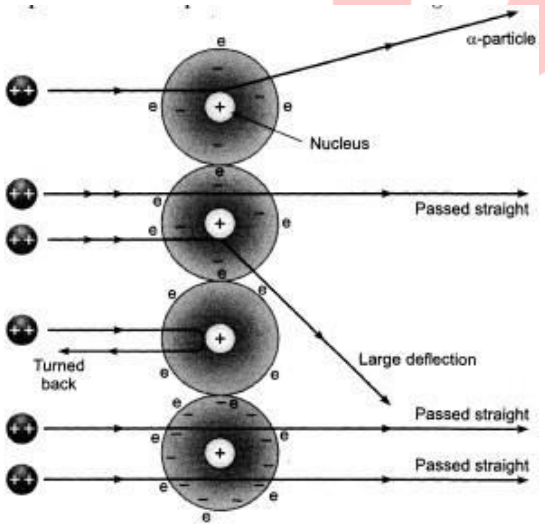
(Helium) configuration.

The valency of the element is 1. The given element is Lithium (Li).

15. **Rutherford's α-particles scattering Experiment:** In 1911, Rutherford performed the gold foil experiment. He bombarded a stream of α-particles on a gold foil, a thin sheet which was 0.00006 cm thick in an evacuated chamber. An α-particle is a positively charged helium ion (He^{2+}). A simplified picture of this experiment is shown in the figure.

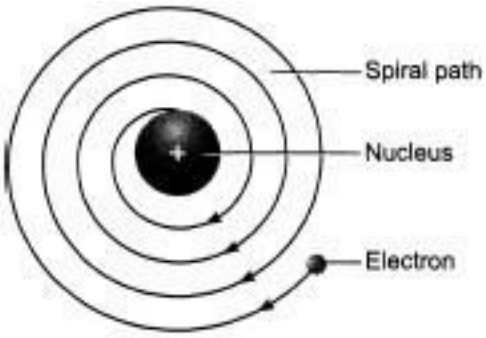


Observation:



Conclusion:

Structure of atom: On the basis of gold foil experiment, Rutherford concluded that an atom consists of nucleus which has positive charge and it is surrounded with electrons which are moving around the nucleus. The number of electrons and protons are equal and the entire mass of the atom is concentrated at its nucleus. He compared the model of an atom with solar system, in which sun as a nucleus is at center and planets as electrons revolve around the sun.



Drawbacks in the Rutherford's model:

i. Most of the α-particles passed straight through the foil without any deflection.
ii. A few α-particles were deflected through a small angle and few through larger angles.
iii. The number of α-particles which bounced back was very small.
iv. The most of the space inside of an atom is empty.
v. The heavy positively charged 'core' is present at the centre of atom named as nucleus.
vi. The volume of the nucleus is very small in comparison to the total volume of the atom.
vii. According to classical electromagnetic theory, a moving charged particle, such as an electron under the influence of attractive force loses energy continuously in the form of radiations. As a result of this, electron should lose energy and therefore, should move in even smaller orbits ultimately falling into the nucleus. But the collapse does not occur.
viii. Rutherford did not specify the number of orbits and the number of electrons in each orbit.