Class 9 Science Ch 4 Structure of Atom

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

Ans:

Property	Electron	Proton	Neutron
Charge	Negative (-1)	Positive (+1)	Neutral (0)
Mass	Very small, approximately **1/1836** of a proton or neutron	Approximately **1 amu** (1.67×10^{-27} kg)	Approximately **1 amu** (1.67×10^{-27} kg)
Location in Atom	Orbiting around the nucleus in electron shells	Found in the nucleus	Found in the nucleus
Symbol	e^-	p^+	**n**
Role in Atom	Determines the chemical behavior and bonding	Determines the atomic number and identity of the element	Contributes to the mass and stability of the nucleus
Relative Mass	Negligible compared to protons and neutrons	1 amu	1 amu

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

Ans: According to J.J. Thomson's model of an atom, the electrons are embedded all over in the positively charged spheres. But experiments done by other scientists showed that protons are present only in the centre of the atom and electrons are distributed around it.

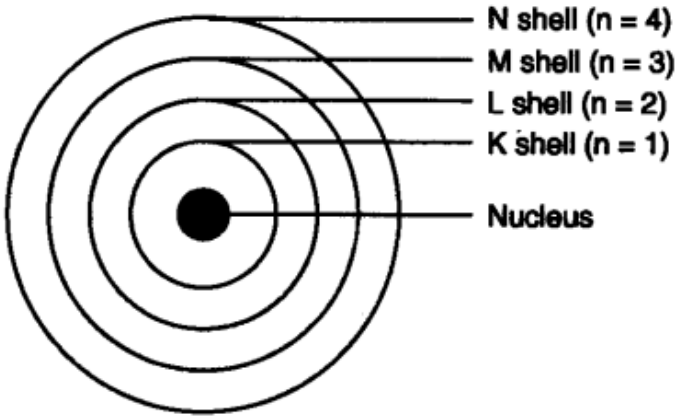
Q.3 What are the limitations of Rutherford's model of the atom?

Ans: According to Rutherford's model of an atom the electrons are revolving in a circular orbit around the nucleus. Any such particle that revolves would undergo acceleration and radiate energy. The revolving electron would lose its energy and finally fall into the nucleus, the atom would be highly unstable. But we know that atoms are quite stable.

Q.4 Describe Bohr's model of the atom.

Ans: Bohr's model of the atom

1) Atom has nucleus in the centre.
2) Electrons revolve around the nucleus.
3) Certain special orbits known as discrete orbits of electrons are allowed inside the atom.
4) While revolving in discrete orbits the electrons do not radiate energy.
5) These orbits or shells are called energy levels.
6) These orbits or shells are represented by the letters K, L, M, N or the numbers n = 1, 2, 3, 4



Bohr's model

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

Ans**:**

Aspect	Bohr's Model (1913)	Bohr-Rutherford Model (1911)	Bohr-Sommerfeld Model (1916)
Electrons' Movement	Electrons revolve in stable orbits around the nucleus without emitting radiation.	Electrons revolve in circular orbits around the nucleus.	Electrons can move in elliptical orbits (not just circular).
Energy Levels	Electrons occupy quantized orbits or energy levels with specific radii.	Did not clearly define energy levels as in Bohr's later model.	Electrons occupy quantized orbits and can also have elliptical paths.
Stability of Electron Orbits	Electrons are stable in specific orbits and do not lose energy as radiation.	Orbiting electrons would lose energy and spiral inward, causing atom collapse.	Electrons are stable in both circular and elliptical orbits.
Radiation Emission	Electrons emit or absorb energy when they jump between fixed orbits.	Not clearly explained how energy changes occur.	Electrons emit or absorb radiation during transitions between energy levels.

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

Ans: The rules for writing of distribution of electrons in various shells for the first eighteen elements are:

i) The maximum number of electrons present in a shell is given by the formula-2 n^2

∵ n = orbit number i.e., 1, 2, 3

∵ Maximum number of electrons in different shells are:

K shell n = 1 $2n^2$ => $2(1)^2 = 2$

L shell n = 2 $2n^2$ => $2(2)^2 = 8$

M shell n = 3 $2n^2$ => $2(3)^2 = 18$

N shell n = 4 $2n^2$ => $2(4)^2 = 32$

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. (Shells are filled step-wise).

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

Ans: Valency is the combining capacity of an atom.

Atomic number of oxygen = 8 Atomic number of silicon = 14 K L M

Electronic configuration of oxygen = 2 6

Electronic configuration of silicon =2 8 4

In the atoms of oxygen the valence electrons are 6 (i.e., electrons in the outermost shell). To fill the orbit, 2 electrons are required. In the atom of silicon, the valence electrons are 4. To fill this orbit 4 electrons are required.

Hence, the combining capacity of oxygen is 2 and of silicon is 4.

i.e., Valency of oxygen = 2

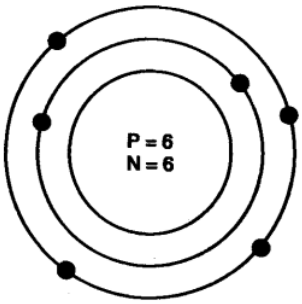
Valency of silicon = 4

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 atomic number of an element is equal to the number of protons in the nucleus of its atom. e.g., Oxygen has 6 protons hence atomic no. = 6.

(ii) Mass number: The mass number of an atom is equal to the number of protons and neutrons in its nucleus.

Nucleons = number of protons + number of neutrons Example: Protons + Neutrons = Nucleus = Mass number 6 + 6 = 12



iii) Isotopes: Isotopes are atoms of the same element which have different mass number but same atomic number. *E.g.,* $^{1}_{1}H$, $^{2}_{1}H$, $^{3}_{1}H$

iv) Isobars: Isobars are atoms having the same mass number but different atomic numbers. *E.g.,* $^{40}_{20}Ca$ $^{40}_{18}Ar$
Both calcium and argon have same mass number but different atomic number.

Two uses of isotopes are:

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

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

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

Ans: Sodium atom (Na), has atomic number =11
Number of protons =11
Number of electrons = 11
Electronic configuration of Na = K L M – 2 8 1
Sodium atom (Na) looses 1 electron to become stable and form Na^+ ion. Hence it has completely filled K and L shells.

Q10 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: Average Atomic Mass = (79 u×0.497) + (81 u×0.503)
Average Atomic Mass = 39.263 u+40.743 u
Average Atomic Mass = 80.006 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?

Ans: Let the percentage of $^{16}_{8}X$ be x and the percentage of $^{16}_{8}X$ be 100 – x.
To find the percentages of the two isotopes, you can use the formula for average atomic mass. Let the fractional abundance of the isotope 16X be represented by **x**. Then the fractional abundance of the isotope 18X will be **(1 – x)**.
The average atomic mass is calculated as:
Average Atomic Mass = (Mass of Isotope 1× Abundance of Isotope 1) + (Mass of Isotope 2×Abundance of Isotope 2)
16.2= (16×x) + (18 × (1−x)) = x = 0.9
Since **x** is the fractional abundance of the 16X isotope, its percentage is 0.9×100%=90%.
The percentage of the 18X isotope is (1−x) × 100% = (1−0.9) × 100% = 0.1 × 100% = 10%.

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

Ans**:** Z = 3, (i.e, atomic number —> z)
∴ Electronic configuration = 2, 1
Valency = 1
Name of the element is lithium.

Q.13 Composition of the nuclei of two atomic species X and Y are given as under X – Y Protons =6 6
Neutrons = 6 8
Give the mass number of X and Y. What is the relation between the two species?

Ans: Mass number of X = Protons + Neutrons = 6 + 6 = 12
Mass number of Y = Protons + Neutrons = 6 + 8 = 14
As the atomic number is same i.e., = 6.
[atomic number = number of protons].
Both X and Y are isotopes of same element.

Q.14 For the following statements, write T for True and F for False.
a) J.J. Thomson proposed that the nucleus of an atom contains only nucleons.
b) A neutron is formed by an electron and a proton combining together. Therefore, it is neutral.
c) The mass of an electron is about 1/2000 times that of proton.
d) An isotope of iodine is used for making tincture iodine, which is used as a medicine**.**

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

Q.15 Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) Atomic nucleus (b) Proton (c)Electron (d)neutron

Ans: (a) Atomic nucleus

Q.16 Isotopes of an element have
(a) the same physical properties (c) different number of neutrons
(b)different number of neutrons (d) different atomic numbers.

Ans: (c) different number of neutrons