# CBSE – IX – SCIENCE Q.A.

## CH. 4 b.STRUCTURE OF THE ATOM

Q. 36. State the model of an atom proposed by J. J. Thomson.
Ans.:-

fig.

J. J. Thomson proposed that :
(i) An atom contains positively charged sphere embedded in it like seeds embedded in watermelon.
(ii) The negative and positive charges are equal in magnitude so that the atom as a whole is electrically neutral.

Q. 37. Give an evidence in support of the existence of nucleus in an atom.
Ans.:-


fig.

Rutherford bombarded thin sheet of gold foil with α-particles ($He^{2+}$) and found that :
(i) most of the α-particles passed through the foil without any deflection. Only one particle out of 12000 bounced back. He concluded that most of the space inside the atom is empty.
(ii) Some of the α-particles were deflected through various angles. This concluded that
(a) There is a heavy positively charged centre inside the atom known as nucleus.
(b) As only small number of α-particles were deflected through large angles, the nucleus occupies very small volume of the atom.
(c) α-particles has an appreciable mass and is deflected by the nucleus, the entire mass of atom lies inside the nucleus.

Q. 38. Who discovered neutrons and how ?
Ans.:- Neutron was discovered by Chandwick. Hydrogen atom contains 1 (one) proton and helium atom contains 2 (two) protons. Therefore relative atomic mass of helium atom should be 2 (two). But it is 4 (four). When nuclei of atoms were examined, it was discovered that nuclei of atoms contain another particles of the same mass as protons but of neutral charge. These were called neutrons.
Q. 39. What is nucleus ?
Ans.:- Positively charged small central part of an atom is called nucleus. All the protons and neutrons are present in this region. It is $10^6$ times smaller than the size of the atom.
Q. 40.How we determine the number of positive charges on the nucleus ?
Ans.:- Number of proton in an atom determine the number of positive charges.
Q. 41. "In Rutherford's experiment, some of the α-particles were bombarded on a gold foil, were repelled". Give reason.
Ans.:- α-particles are positively charged helium ions ($He^{2+}$). When α-particles are bombarded in Rutherford's experiment, only those were repelled which bombarded the central part. We know that like charges repell each other, therefore, it was concluded that the nucleus of an atom is positively charged.
Q, 42. Charged particles are present in the atom, then why is it neutral ?
Ans.:- The number of electrons are equal to the number of protons. Electron is negatively charged and proton is positively charged.
Q. 43. Give evidence to show that an atom has a lot of empty space within it.
Ans.:- When α-particles are bombarded on a very thin gold foil, it is found that most of these particles pass directly through the foil without any deflection. On calculation it is found that one for $10^5$ are deflected by 180º. This shows that larger part ( $10^5$ : 1 ) of the atomic space is empty.
Q. 44. How was it established that atomic nuclei are positively charged ?
Ans.:- When Rutherford bombarded α-particles on a very thin gold foil, it was observed that only a small fraction of α-particles are deflected through large angles and the rest pass through the foil without any deflection. This shows that positive charge of the atom is concentrated at the centre of the nucleus.
Q. 45. Why Rutherford believed that central part of the atom is positively charged ?
Ans.:- When Rutherford bombarded α-particles on a very thin foil of gold, he found that only a small fraction of α-particles was deflected through large angle. This made him believe that central part of the atom is positively charged.
Q. 46. What is the magnitude of the size of an atom in comparison to its nuclear size ?
Ans.:- Radius of an atom = $10^{-8}$ cm
Radius of nucleus = $10^{-13}$ cm
Radius of an atom : Radius of nucleus = $10^{-8}$ cm : $10^{-13}$ cm = $10^5$ = 100,000.
Q. 47. State the characteristic features of the Thomson model of atom.
Ans.:- The characteristic feature of the Thomson model of atom are :
(i) Electrons are uniformly distributed in the entire volume of the atom.

(ii) The mass of the atom is also uniformly distributed.
(iii) The size of the atom is $10^{-10}$ m.
Q. 48. Describe the essential properties of nucleus of an atom. Compare these properties with the properties of an electron.
Ans.:- Nucleus is a positively charged space located in the centre of the atom and occupies a very small volume. Its radius is $10^{-15}$ m. An electron is a very small negatively charged particle. It has well established charge to mass ratio. The charge on electron is the smallest unit of charge in an atom.
Q. 49. State the basis on which Rutherford rejected the model of atom as proposed by J. J. Thomson.
Ans.:- Firstly the similarity between seeds embedded in watermelon is not tenable with the charged particles.

Secondly he did not expected such large deflection of heavy α-particles by lighter protons.
Q. 50. State the model of atom proposed by Rutherford.
Ans.:- The main features of Rutherford's model of an atom :
(i) The centre of the atom called nucleus is positively charged.
(ii) Most of masses is concentrated in the nucleus.
(iii) Volume of the nucleus is very small as compared to the volume of atom.
(iv) The nucleus is surrounded by the negatively charged particles called electrons revolving round the nucleus with a great speed.
Q. 51. State the main objection to Rutherford's model of atom.
Ans.:- Electrons being charged particles are expected to radiate energy when accelerated. Electrons would need acceleration to remain in the circular motion round the nucleus. Due to loss in energy, the orbit would shrink and electrons would hit the nucleus. This would not give stabilization.
Q. 52. Describe the nuclear ( Bohr's ) model of an atom.
Ans.:-

fig.

According to Bohr's theory :
(i) The atom consists of a small positively charged centre called nucleus.
(ii) The whole mass of the atom is concentrated at the centre (nucleus).

(iii) Volume of nucleus to the volume of atom is $1 : 10^5$.
(iv) All the protons and neutrons are present in the nucleus.
(v) The electrons revolve round the nucleus in a definite circular path known as orbits or shells.
(vi) Each orbit is associated with a fixed amount of energy.
(vii) The energy of the atom changes when an electron jumps from one energy level to another energy level.
(viii) As long as an electron remains in a particular orbit, it does not lose or gain energy.

Q. 53. Can we use foil of any other metal instead of gold in Rutherford experiment of scattering of alpha particles ?

Ans.:- Any other metal's foil can be used, but the metal should be highly malleable because for this experiment we need a very thin foil. Gold is highly malleable and the thickness of gold foil used was about 1000 atoms.

Q. 54. Why does the energy of the atom increases when an electron jumps from energy level K to energy level L ?

Ans.:- Each shell has a fixed energy. The energy of the atom changes when an electron jumps from one energy level to another energy level. The energy level of L shell is higher than K shell. When an electron jumps from K to L, it acquires energy of level L. This leads to the overall increase in the energy of the atom.

Q. 55. Why are the orbits or shells in which the electrons revolve around the nucleus of an atom called energy levels ?

Ans.:- An electron revolving in a shell is associated with a definite energy. Its energy changes when it jumps from one energy level to other. Thus, a shell also gives the energy to an electron besides its location and are, therefore, called energy level.

Q. 56. How does Bohr's model of atom explain characteristic spectra of different atoms and ionization of gases in the discharge tube experiment ?

Ans.:- In Bohr's model, electrons occupy different energy levels. When an electron falls from higher energy level to lower energy level the difference in energy is radiated in the form of electromagnetic radiation of a fixed wavelength. As each atom has its specific energy level, it can emit radiations of specific wavelength.

When the electron is excited with external energy so that it is able to overcome force between it and the nucleus, it comes out of the atom.

Q. 57. What is an orbit ?

Ans.:- Orbit is the path of an electron in which it revolves round the nucleus in an atom.

Q. 58. State the essential features of the model of atom proposed by E. Rutherford. How is it different from that proposed by J. J. Thomson ?

Ans.:- According to E. Rutherford, each atom consists of a positive nucleus around which electrons having negative charge revolves round the nucleus just like the planets move round the sun in fixed orbits in our solar system. Most of the mass is concentrated in a small central part of the atom. J. J. Thomson thought that mass was uniformly distributed in the atom.

Q. 59. State the fundamental contributions of E. Rutherford in understanding the structure of atom.
Ans.:- Fundamental contributions of E. Rutherford in understanding the structure of atom :
(i) Each atom consists of a positively charged centre called nucleus.
(ii) Most of the mass in each atom is concentrated at the nucleus.
(iii) The size of the nucleus in each atom is about 105 times smaller than the atom.
Q. 60. State the concept incorporated by Neils Bohr in the model of atom proposed by him.
Ans.:- According to Neils Bohr's particles of atomic level would behave differently from the macroscopic objects. He suggested that electrons could revolve in stable orbit without continuously radiating energy. An electron revolves in an orbit with well defined energy.
Q. 61. What is neutron ? State its Characteristics.
Ans.:- (i) Neutron is an elementary particle.
(ii) The mass of neutron is approximately equal to the mass of a proton i.e. $1.672\times10^{-27}$ Kg or 1 u.
(iii) It carries no charge.
Q. 62.Compare an electron, a proton and a neutron in respect of their symbol, mass and charge.
Ans.:-

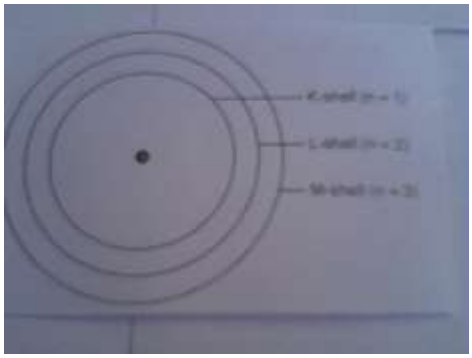
| Particles | Symbol | Mass | Charge |
|---|---|---|---|
| Electron | $_0e^{-1}$ | $9\times10^{-31}$ Kg | $-1.6\times10^{-19}$ C |
| Proton | $_1p^{+1}$ | $1.67\times10^{-27}$ Kg or 1 u | $+1.6\times10^{-19}$ C |
| Neutron | $_1n^0$ | 1 u | No charge |

Q. 63. What are the fundamental particles present in an atom of any element ?
Ans.:- The following are the fundamental particles in an atom of any element :
(i) Electron ( $_0e^{-1}$ ) (ii) Proton ( $_1p^{+1}$ ) (iii) Neutron ( $_1n^0$ ).
Q. 64. What are similarities and dissimilarities between protons and neutrons ?
Ans.:- Similarities :- (i) Both protons and neutrons are present in the nucleus of an atom.
(ii) The mass of a neutron is nearly same to the mass of a proton.
Dissimilarities :- The charge of proton is unit positive charge but neutrons has no charge.
Q. 65. What is effect of addition of a neutron to the nucleus of an atom ?
Ans.:- The atomic mass of the atom will increase.
Q. 66. What constituent properties of the atom determine the following :
(i) Mass of the atom (ii) Size of the atom (iii) Charge on the nucleus.
Ans.:- (i) Protons and neutrons (ii) Electrons (iii) Protons.
Q. 67. Why scattering experiment cannot be used to prove the existence of neutrons ?
Ans.:- Neutrons are neutral particles and so there will be no repulsion between positively charged α-particles and neutrons.

Q. 68. "Nucleus does not contain any electron. Even then the β-particles emission has been described as the ejection of an electron from the nucleus." Comment.
Ans.:- Electrons are produced as a result of decay of neutrons as given below :

Neutron → proton + electron + neutrino.

The electron produced escapes as a β-particle leaving the proton behind.

Q. 69. What is the effect of emission of γ-rays on the nucleus ?
Ans.:- γ-rays are emitted as a result of rearrangement of neutrons and protons in a nucleus. The nucleus is not affected in terms of number of protons and neutrons due to emission of γ-rays.
Q. 70. Why is extra nuclear part neglected when calculating the mass of the atom ?
Ans.:- The extra nuclear part of the atoms contains electrons which has negligible mass. Heavier particles like protons and neutrons are contained in the nucleus. Hence only nucleus is taken into account at the time of calculating atomic mass.
Q. 71. State the importance of extra nuclear part of the atom when its mass is negligible.
Ans.:- Extra nuclear part is very important as it has different arrangement of electrons in different atoms. The distribution of electrons in this part determine the chemical properties of elements.
Q. 72. On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole ?
Ans.:- The positive and negative charges are equal in number and magnitude. Hence the atom as a whole is chemically neutral.
Q. 73. On the basis of Rutherford's model of an atom, which sub-atomic particle is present in the nucleus of an atom ?
Ans.:- On the basis of Rutherford's model of an atom, proton resides in the nucleus of an atom.
Q. 74. Draw a sketch of Bohr's model of an atom with three shells.
Ans.:-  fig.
Q. 75. What do you think would be the observation if the a-particle scattering experiment is carried out using a foil of metal other than gold ?
Ans.:- Any other's metal can be used, but the metal should be highly malleable , because for this experiment, we need a very thin foil. Gold is highly malleable and the thickness of gold foil used was about 1000 atoms.

Q. 76. Name the three sub-atomic particles of an atom.
Ans.:- The following are the sub-atomic particles of an atom :
(i) Electron ($_0e^{-1}$) (ii) Proton ($_1p^{+1}$) (iii) Neutron ($_1n^0$).
Q. 77. Helium atom has an atomic number of 4u and has two protons in the nucleus. How many neutrons does it have ?
Ans.:- The mass of an atom is sum of the masses of protons and neutrons present in the nucleus. As helium has an atomic mass of 4u and it has two protons, which contribute 2u to atomic mass. Therefore, it must have 2 neutrons, as each neutron contribute 1u to the nucleus.

**BEST OF LUCK.**