Structure of the atom

Assess Yourself

Q.1. Size of the nucleus of an atom is _____ as compared to the size of the atom.

Answer: Size of the nucleus of an atom is very small as compared to the size of the atom.

According to Rutherford gold foil experiment nucleus is very small in size as compared to the size of the atom as a whole. Nucleus is very hard, dense and positively charged which consists of protons and neutrons.

Q.2. Who discovered the neutron?

Answer: James Chadwick in 1932 discovered the neutrons.

Neutron is a neutral particle found in the nucleus of an atom and is represented by symbol n.

Q.3. What is the number of valence electrons in the chlorine atom?

Answer: The number of valence electrons in the chlorine atom is 7.

The atomic number of chlorine is 17. So, its electronic configuration is 2, 8, 7. So there are 7 valence electrons.

Q.4. Identify the pair of isotopes from the following:

$^{16}_{8}X,\ ^{16}_{7}X,\ ^{17}_{8}X,$

Answer: $^{16}_{8}X,\ ^{17}_{8}X$ are a pair of isotopes as they have a same atomic number but a different mass number.

Here 8 is the atomic number and 16, 17 are a mass number which is different so these are isotopes.

Q.5. There are 15 protons and 16 neutrons in the nucleus of an element. Calculate its atomic number and mass number.

Answer: Atomic number of the element is 15 as the number of protons in one atom of the element represents the atomic number of that element.

Mass number of element = number of protons + number of neutrons

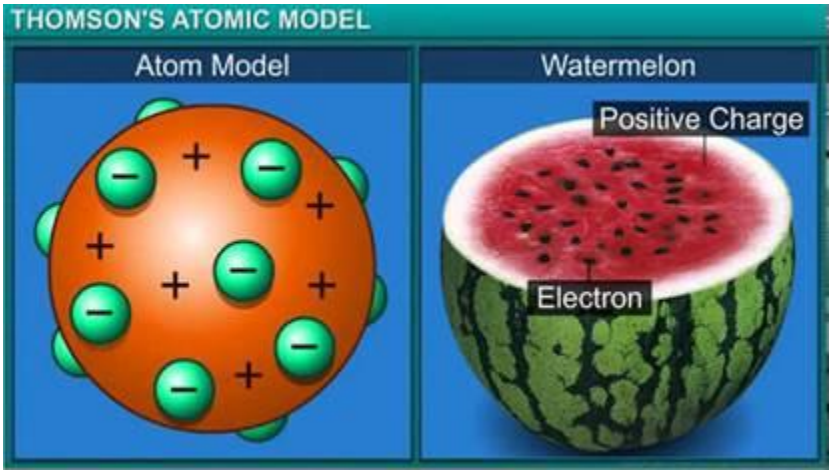
= 15 + 16

= 31

Q.6. (a) Why is Thomson's model of an atom compared with watermelon?

(b) Why do isotopes have different mass numbers?

Answer: a. According to Thomson's model of the atom, the atom is a sphere of positive charge with negatively charged electrons embedded in it. It is compared with a watermelon because the sphere of positive charge represents the red, edible part of watermelon whereas electrons embedded in a positively charged sphere represent the black seeds.



b. Isotopes of an element differ in the number of neutrons in the nuclei so they have a different mass number as the mass number is the sum of a number of protons and neutrons in the nucleus.

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

Answer: The valency of chlorine is 1 because valency of an element is either equal to the number of valence electrons in its atom or equal to the number of electrons required to complete 8 electrons in the valence shell. Since chlorine is a non-metal so valency of nonmetal = 8 – the number of valence electrons in its atom which is 8-7 = 1.

Q.8. Write one pair of isobars. Why the chemical properties of isobars are not similar?

Answer: Isobars are the atoms of different elements having different atomic numbers but a same mass number. One pair of isobars is $^{40}Ar_{18}$ and $^{40}Ca_{20}$.

Isobars do not have the same number of protons or electrons so the chemical properties are not similar.

Q.9. 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
Atomic no.	1	3	7	18	20

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

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

Answer: a. Elements D and E are isobars as they have a same mass number but a different atomic number.

b. The atomic number of element B is 3. So, its electronic configuration is 2, 1. Hence its valency is 1 as it has only 1 valence electron.

Q.10.

(a) List any two postulates of Bohr's model of an atom.

(b) Draw a sketch of Bohr's model of an atom with four shells

(c) name the three sub-atomic particles.

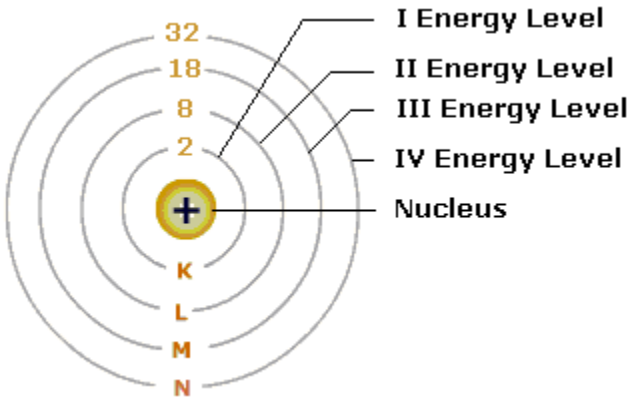
Answer:

a. Two postulates of Bohr's model of an atom are -

1. Electrons revolve rapidly around the nucleus in fixed circular paths called energy levels or shells.

2. Each shell can hold electrons up to some limits and each shell is associated with a fixed amount of energy.

b. Bohr's model



c. The three sub-atomic particles are electrons, protons, and neutrons. Electrons are negatively charged, protons are positively charged, neutrons are neutral.

Q.11.

(a) What are the canal rays? State the nature of the constituents of canal rays.

(b) Who discovered canal rays?

Answer: a. Canal rays are anode rays which are a beam of positive ions given by anode in an experiment conducted by Goldstein when he passed electricity at high voltage through a gas at very low pressure in a discharge tube. They consist of positively charged particles.

b. E. Goldstein discovered these canal rays.

Q.12. Define valence of an element. Find the valency of chlorine and magnesium (At. No. of chlorine = 17, magnesium = 12).

Answer: The capacity of an atom of an element to form chemical bonds is known as valency of an element.

An atomic number of chlorine is 17 so its electronic configuration is 2, 8, 7.

Valency of non-metal chlorine = 8 – the number of valence electrons in its atom

= 8 – 7

= 1

Atomic number of magnesium is 12 so its electronic configuration is 2, 8, 2

Valency of magnesium = number of valence electrons in its atom = 2.

Q.13. Complete the following table:

Elements	Atomic number	Mass number	Protons	Electrons	Neutrons	Electronic configuration	Valency
Chlorine	17	----	----	----	18	----	----
Silicon	----	28	----	14	----	----	----
Fluorine	----	----	9	----	10	----	----

Answer:

Elements	Atomic number	Mass number	Protons	Electrons	Neutrons	Electronic configuration	Valency
Chlorine	17	35	17	17	18	2, 8, 7	1
Silicon	14	28	14	14	14	2, 8, 4	4
Fluorine	9	19	9	9	10	2, 7	1

Chlorine atomic number is 17 so protons = electrons = 17; since number of protons/electrons in an atom determine the atomic number. Mass number will be sum of protons and neutrons = 17 + 18 = 35.

Since the atomic number is 17 for chlorine so electronic configuration is 2, 8, 7. Valency is 1.

Silicon atomic number is 14 = number of electrons/protons. Since the mass number is 28 so the number of neutrons is a mass number – the number of protons = 28-14 = 14.

The electronic configuration will be 2, 8, 4 and valency is 4.

Fluorine atomic number is 9 = number of protons/electrons. Mass number is 9 + 10 = 19. Electronic configuration is 2, 7 and valency 1.

Q.14. The chlorine atom is electrically neutral but chloride ion is charged. Explain.

Answer: Chlorine atomic number is 17 so its number of protons = number of electrons = 17 so chlorine atom is electrically neutral. But when chlorine atom is changed to chloride ion it has gained one electron so the number of electrons is more than a number of protons hence it is negatively charged.

Q.15.

(a) Write the name of the sub – atomic particle discovered by J. Chadwick. What type of charge occurs on this particle? In which part of an atom this particle is located?

(b) List three steps of an experiment performed by Rutherford for his model of an atom.

(c) Define isobar, write its one example.

(d) Which scientist concluded that the size of the nucleus is very small as compared to the size of an atom?

Answer:

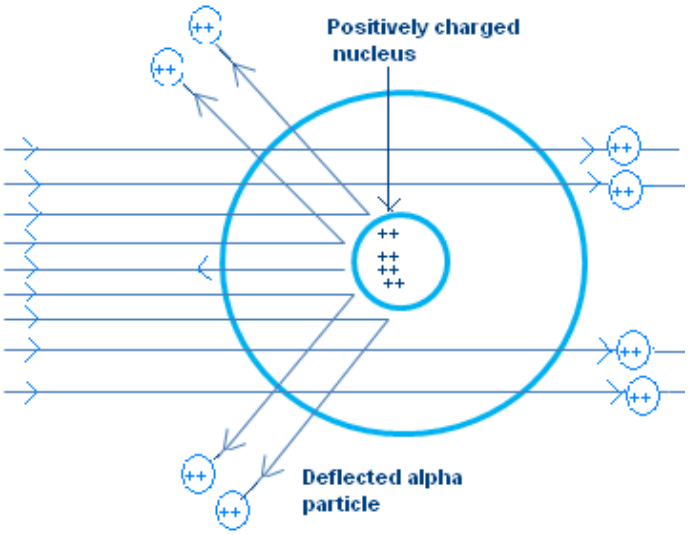
a. James Chadwick discovered neutrons in 1932. Neutrons are neutral particles and they are found in the nucleus of an atom.

b. The three steps of Rutherford's experiment for his model of an atom are -

i. He allowed fast moving alpha particles to strike a very thin gold foil in a vacuum, he found most of the alpha particles pass straight through the gold foil without any deflection from the original path.

ii. Few alpha particles deflected through small angles and few through large angles.

iii. Few alpha particles bounce back on hitting the gold foil.



c. Isobars are the atoms of different elements having a different atomic number but a same mass number. Example- $_{18}Ar^{40}$, $_{20}Ca^{40}$

d. Rutherford through his gold foil experiment concluded that the size of the nucleus is very small as compared to the size of an atom.

Q.16.

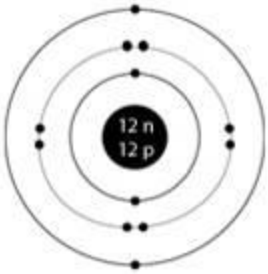
(a) What is an octet? How do elements reach an octet?

(b) Make a schematic atomic structure of Magnesium of Phosphorus.

(Given: number of protons of Magnesium = 12, Phosphorus = 15).

Answer: a. Octet means the presence of 8 electrons in the outermost shell of an atom which means atom is stable and has the electron arrangement of inert gas. Every atom wants to attain stability so they combine with one another and by gaining or losing or mutually sharing electrons they reach the octet state.

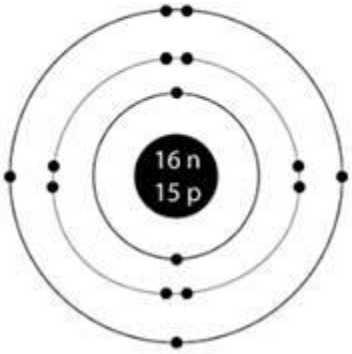
b. Structure of magnesium whose atomic number is 12- 2, 8, 2



Structure of phosphorus whose atomic number is 15- 2, 8, 5

Phosphorus

$^{31}_{15}P$



Q.17.

(a) What are isobars? Give one example.

(b) Write two differences between isobars and isotopes.

(c) Write any two uses of isotopes.

Answer:

a. Isobars are the atoms of different elements having different atomic number but same mass number. **Example- $_{18}Ar^{40}$, $_{20}Ca^{40}$**

b. Differences between isobar and isotopes-

Isotopes	Isobars
They have a same atomic number but a different mass number.	They have a same mass number but a different atomic number.
They have the same number of protons/electrons but neutrons number is different so they have similar chemical properties.	They have different chemical properties as they have different protons/electrons number.
Example: Isotopes of hydrogen: $_1H^1$, $_1H^2$, $_1H^3$	Example: Isobars : $_{18}Ar^{40}$, $_{20}Ca^{40}$

c. Two uses of isotopes are-

i. Radioactive isotopes are used as tracers in medicine to detect the presence of tumours, blood clots in the human body.

ii. They are used in industry to detect leakage in underground oil, gas or water pipelines.