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Class - 9th Chapter - 4 K.V.S.

STRUCTURE OF THE ATOM

☆ **Electron :–** Negatively charged particles is called electron.

* Electron discovered by J.J. Thomson in 1897.
* the relative mass of an electron is $\frac{1}{1840}$ u.
* The relative charge of an electron is -1 (minus one)

Proton :– Positively charged particles is called proton.

* Proton discovered by E. Goldstein.
* The relative mass of a proton is 1u.
* The relative charge of a proton is +1 (plus one)

Neutron :– Neutral charged particle is called neutron.

* Neutron discovered by James chadwick in 1932
* The relative mass of a neutron is 1u.
* The ~~is~~ Neutron is No charge.

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Thomson's Model of An atom

i) An Atom Consist of a positively charged sphere and the electrons are embedded in it.

ii) The negative and positive charges are equal in magnitude. So, the atom as a whole is electrically neutral.

Rutherford's Model of An atom

i) Most of the fast moving a-particles Passed Straight through the gold foil.

ii) Some of the a-particles were deflected by the foil by small angles.

iii) Surprisingly one out of every 12000 Particles appeared to rebound.

Rutherford's experiment of a-particle.

i) Most of the a-particles pass straight through the gold-foil without any deflection from their original path.

ii) A few alpha particles are deflected through small angles and a few are deflected through large angles.

iii) A very few alpha particles Completely rebound on hitting the gold foil and turn back on their path.

Nucleus:— The nucleus is a small positively charged part at the centre of an atom.

Bohr's model of Atom:—

i) only certain special orbits known as discrete orbits of electrons, are allowed inside the atom.

ii) while revolving in discrete orbits the electrons do not radiate energy.

energy levels:— orbits or shells are called energy levels.

Electronic Configurations of elements:—

1- The maximum number of electrons present in a shell is given by the formula $2n^2$.

K shell, $n=1 = 2(n)^2$
$= 2\times(1)^2 = 2\times 1 = 2$ shell

L shell, $n=2 = 2(n)^2$
$= 2(2)^2 = 2\times 4 = 8$ shell

M shell $n=3 = 2(n)^2$
$= 2(3)^2 = 2\times 9 = 18$ shell

N shell, $n=4 = 2(n)^2$
$= 2(4)^2 = 2\times 16 = 32$ shell.

ii) The maximum number of electrons that can be accommodated in the outermost orbit is 8.

Valency:- The capacity of an atom of an element to form chemical bonds is known as Valency.

Valence electrons:- electrons present in the outermost shell of an atom are known as Valence electrons.

Types of valency :-
i) Electrovalency
ii) Covalency

Home-work

Q:1 What are Canal rays?

Ans Canal rays are positively charged rediations that can pass through Perforated Cathode Plate. Canal rays is called Proton.

Q.2 if an atom contains one electron and one proton, will it carry any charge or not?

Ans No, the atom will not carry any electric charge. This is because the electron has

1 unit negative charge whereas a proton has an equal and opposite 1 unit positive charge due to which the net charge on the atom is zero.

Q.3 on the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.

Ans As per thomson's model of the atom, an atom consists both negative and positive charges which are equal in number and magnitude. So, they balance each other as a result of which atom as a whole is electrically neutral.

Q.4 on the basis of Rutherford's model of an atom, which sub-atomic particle is present in the nucleus of an atom?

Ans Rutherford's model says that an atom has positively charged nucleus. So, the sub-atomic particle present in the nucleus of an atom is proton.

Q.5 what do you think would be the observation if the a-particle scattering experiment is carried out using a foil of a metal other than gold?

Ans i) if the foil of a heavy metal like platinum is used, then the observations in the a-particle

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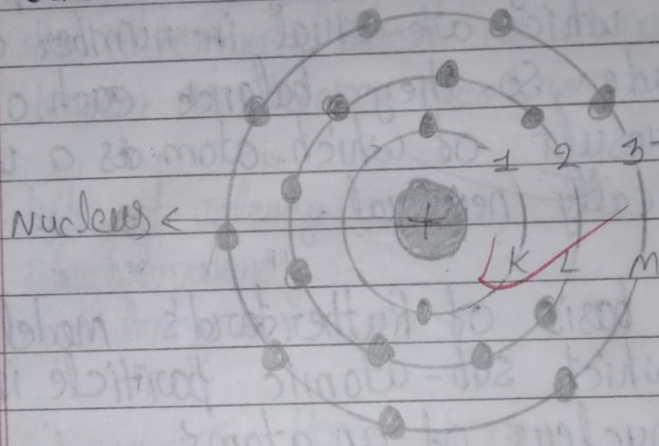
Scattering experiment would be the same as that in the gold foil experiment.

ii) if, however, the foil of a light metal like lithium is used, then the fast moving heavy α-particles may even push the light nucleus aside and may not be deflected back.

Q.6 Draw a sketch of Bohr's model of an atom with three shells.

Ans-



Q.7 Name the three sub-atomic particles of an atom.

Ans Electron, proton, Neutron

Q.8 Helium atom has an atomic mass of 4u and two protons in its nucleus. How many neutron does it have?

Ans Mass number = No. of protons + No. of neutrons

$4 = 2 + \text{No. of neutrons}$

$\text{No. of neutrons} = 4 - 2$

$\text{No. of neutrons} = 2$ Ans

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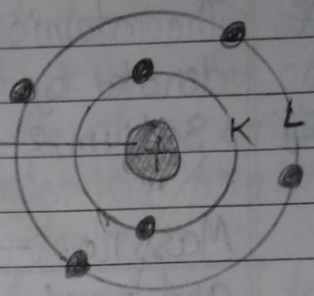
Q.9 Write the distribution of electrons in Carbon and Sodium atoms.

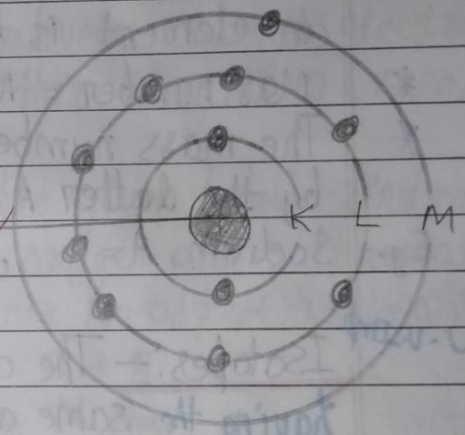
Ans Carbon ⇒ atomic no. = 6

K, L
2, 4



Sodium ⇒ atomic no = 11

K, L, M
2, 8, 1



Q.10 If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

Ans K shell becomes full with 2 electrons and L shell becomes full with 8 electrons. So, if the K and L shells of an atom are full, then it will have a total of 2+8 = 10 electron.

Q.11 ~~if the~~

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Atomic number:— The number of proton in one atom of an element is known as atomic number.

* The atomic number of an element is denoted by the letter Z.

Eg:- Sodium, Z = 11, Chlorine; Z = 17.

Mass no.:— The total number of protons and neutrons present in one atom of an element is known as its mass number.

* Mass number = no. of protons + No. of neutrons.
* The mass number of an element is denoted by the letter A.

Eg. Sodium, A = 11, Chlorine, A = 17.

J.V.Imp **Isotopes:—** The atoms of the same element having the same atomic number but different Mass number is called Isotopes.

* Hydrogen element has three isotopes: Protium, deuterium and tritium having the same atomic no. of 1 but different mass no. of 1, 2, and 3.

Eg:- $^{35}_{17}Cl$ and $^{37}_{17}Cl$, $^{1}_{1}H$, $^{2}_{1}H$, $^{3}_{1}H$

Isobars:— The atoms of the different element having the different atomic number but same mass number is called Isobars.

Eg:- $^{40}_{18}Ar$ and $^{40}_{20}Ca$; $^{24}_{11}Na$ and $^{24}_{12}Mg$

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Home-work

Q.1 If the number of electrons in an atom is 8 and the number of proton is also 8, then (i) what is the atomic number of the atom? and (ii) what is the charge on the atom?

Ans i) Atomic is equal to the number of proton in one atom. So, the atomic number is 8.

ii) This atom contains an equal number of positively charged proton and negatively charged electron That is, the charge on this atom is 0 (zero).

Q.2 With the help of table given below, find out the mass numbers of oxygen and sulphur atoms.

Ans Mass number of oxygen = No. of protons + No of Neutr
= 8 + 8
= 16 Ans

Mass no. of sulphur = No. of protons + No. of neutron
= 16 + 16
= 32 Ans

Q.3 Write the electronic configuration of any one pair of isotopes and isobars.

Ans a) A pair of isotopes of chlorine is $^{35}_{17}Cl$ and $^{37}_{17}Cl$. The atomic no. of both the isotopes is the same, 17. So, the electronic Configuration of is 2,8,7.

"You have to take the calculated risk, to earn something." – Dhirubhai Ambani

b) A pair of isobars is $^{40}_{18}Ar$ and $^{40}_{20}Ca$. The atomic no. of Ar is 18. so, its electronic Configuration will be 2, 8, 8. The atomic number of Calcium is 20, so, its electronic Configuration is 2, 8, 8, 2.

Q. 4 For the symbol H, D and T, Tabulate three Sub-atomic particles found in each of them.

Ans

Isotope	Symbol	Mass no.	No. of Electron	No. of Proton	No. of Neutron
Hydrogen	H	1	1	1	0
Deuterium	D	2	1	1	1
Tritium	T	3	1	1	2

Exercise

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

Ans

Subatomic Particle	Relative mass	Relative charge	Location in the atom
i) Proton	1u	+1	in the nucleus
ii) Neutron	1u	0	in the nucleus
iii) Electron	$\frac{1}{1840}$ u	-1	out side nucleus.

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

Ans The limitations of J.J. Thomson's model of an atom:
i) it could not explain the result of scattering experiment performed by rutherford.
ii) it did not have any experiment support.

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

Ans The limitations of Rutherford's model of the atom are:—
i) it failed to explain the stability of an atom.
ii) it doesn't explain the spectrum of hydrogen and other atoms.

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Q.7 Describe Bohr's Model of the atom.

Ans i) The atom consist of a small positively charged nucleus at its center.

ii) All the protons and neutrons of the atom are contained in the nucleus.

iii) only certain orbits known as discrete orbits of electrons are allowed inside the atom.

iv) The maximum number of electrons that can be accommoted in the outermost orbit is 8.

Q.8 Give to uses of isotopes.

Ans i) one isotopes of uranium is used as a fuel in nuclear reactors.

ii) one isotope of cobalt is used in the treatment of cancer.

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

Ans A sodium ion has 10 electrons. Now, the Capacity of k shell is 2 and L shell is 8 electron. The capacity of K and L shell is 2+8=10 electron. Na^+ has completely fill K and L shells because 10 electrons Completly fill K and L shells.

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Q.10 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 i) The bromine isotope $^{79}_{35}Br$ has mass of 79u and its abundance in nature is 49.7%.

ii) The bromine isotope $^{81}_{35}Br$ has mass of 79u and its abundance in nature is 50.3%.

Average atomic mass of bromine

$$= 79 \times \frac{49.7}{100} + 81 \times \frac{50.3}{100}$$

$$= \frac{3926.3}{100} + \frac{4074.3}{100}$$

$$= 39.263 + 40.743$$

$$= 80.006 \text{ u}$$ Ans

Q.11 The average atomic mass of a sample of an element X is 16.2 u. what are the Precentage of isotopes $^{16}_{8}X$ and $^{18}_{8}X$ in the sample?

Ans i) The mass of $^{16}_{8}X$ isotope is 16u. Suppose its % in the sample is x%.

ii) The mass of $^{18}_{8}X$ isotope is 18u. its % in the sample is (100-x)%.

Average atomic mass of X

$$= 16 \times \frac{x}{100} + 18 \times \frac{(100-x)}{100}$$

average atomic mass of X is given 16.2u.

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$$16.2 = 16 \times \frac{x}{100} + 18 \times \frac{(100-x)}{100}$$

$$16.2 = \frac{16x + 1800 - 18x}{100}$$

$$16.2 \times 100 = 1800 - 2x$$

$$1620 = 1800 - 2x$$

$$2x = 1800 - 1620$$

$$2x = 180$$

$$x = \frac{180}{2} \; 90$$

$$\boxed{x = 90}$$

The % of ${}^{16}_{8}X$ is 90%. Ans

and % of ${}^{18}_{8}X$ is (100-90)%.

= 10%. Ans

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

Ans The atomic number for Z element is 3. its electronic conifiguration is 2, 1. Hence, the valency of the element is 1. The element with Z=3 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 no. of X and Y. what is the

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relation between the two species?

Ans Mass no. = No. of protons + No. of neutrons

Mass no of X = 6 + 6
= 12

Mass no. of Y = 6 + 8
= 14

The mass no. of X is 12 and Y is 14.
X and Y have the same atomic no. but different mass no. - This is isotopes. Atomic no. 6 is Carbon elemen. So X and Y are presented Carbon 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. (False)

b) A neutron is formed by an electron and a proton combining together. Therefore, it is neutral. (False)

c) The mass of an electron is about $\frac{1}{2000}$ times that of proton. (True)

d) An isotope of iodine is used for making tincture iodine, whic is used as a medicine (false)

Q. 15 Rutherford's a-particles sattering experiment was responsible for the discovery of

a) Atomic nucleus ✓ b) Electron

c) Proton d) neutron.

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Q.16 Isotopes of an element have :-
a) The same physical properties
b) different chemical properties
c) different number of neutrons. ✓
d) different atomic numbers.

Q.17 Number of valence electrons in Cl^- ion are :-
a) 16 b) 8 ✓
c) 17 d) 18

Q.18 Which one of the following is a correct electronic configurations of sodium :-
a) 2, 8 b) 8, 2, 1
c) 2, 1, 8 d) 2, 8, 1 ✓

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Revision

Q.1 Find the electron distribution for the element that has atomic number 20 and write its valency.

Q.2 if number of electrons in an atom is 8 and number of proton is also 8, then.

i) what is the atomic number of atom?

ii) what is the charge on the atom?

Q.3

	A	B	C	D	E
Electron	4	18	17	11	17
Proton	6	18	17	9	17
Neutron	6	22	20	10	18

a) which of them is cation?

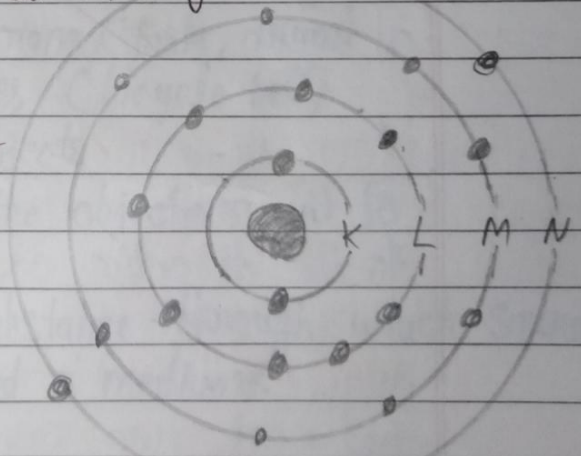
b) which of them is anion?

c) which is an atom of inert gas.

Ans-1 atomic no. = 20

K, L, M, N

2, 8, 8, 2



Valency = 2 because last shell present in 2 electron.

Ans-2 i) Atomic is equal to the number of proton in one atom. So, the atomic no. is 8.

ii) The atom contains in equal number of positively charged proton and negatively charged electron. So, the charge on this atom is 0 (zero).

Ans-3 a) Proton

b) Electron

c) Neutron