5. INSIDE THE ATOM

Q 1) Answer the following.

a. What is the difference in the atomic models of Thomson and Rutherford?

Ans.

Thomson's atomic model	Rutherford's atomic model
1. It is also known as the Plum pudding model and it was developed in 1867.	1. It is also known as the Planetary model and it was developed in 1911.
2. Atom is homogenous sphere of positive charge	2. The positive charge is in the nucleus of the atom.
3. The negatively charged electrons are embedded in a gel of positive charge.	3. The negatively charged electrons revolve around the nucleus.
4. There is no presence of empty spaces in this atomic model.	4. There are many empty spaces in this atomic model.

b. What is meant by Valency of an element? What is the relationship between the number of valence electron and valency?

Ans. Valency: It is the ability of an atom to lose or gain electrons to complete its valence shell and combine with another element is known as valency. The electrons revolve around the nucleus.

Valence electrons: The electrons in the outermost shell of an atom of an element are called valence electrons.

Helium and neon are gaseous elements, their atoms do not combine with any other atom. Their valency is zero as these elements are chemically inert, i.e.. Helium atom has two electrons, and so its outermost shell has electron duplet. The valence shell of neon is fully filled, i.e. neon has an electron octet. Also argon has eight electrons in the valence shell, i.e. argon has an electron octet. Its valency is zero when electron octet (or duplet) is complete.

Valency of an element depends on the valence. The valency of an elements is same as the number of valence electrons, if this number is four or less than four. Atoms of all the elements excluding inert gases have a non-zero valency they combine with other atoms. The valency of hydrogen is one molecules formed by combination with hydrogen (E.g. H_2 HCI). The electronic configuration of hydrogen shows that there is one electron less

than the complete duplet state. This number 'one' matches with the valency of hydrogen which is also one. It means that there is relationship between the valency of an element and the number of electrons in its valence shell.

c. What is meant by atomic mass number ? Explain how the atomic number and mass number of carbon are 6 and 12 respectively.

Ans. Atomic mass number is the sum of the number of protons and the number of neutrons in the nucleus of the atom. The atomic number is the number of protons or electrons. Carbon's atomic number is 6 that means carbon has 6 protons in the nucleus. Carbon's atomic mass is 12 that means it has 6 protons and 6 neutrons in its nucleus. According to definition of atomic mass, it is the sum of number of protons and neutrons, therefore 6 protons + 6 neutrons = 12, is the atomic mass of carbon atom.

d. What is meant by subatomic particle? Give brief information of three subatomic particles with reference to electrical charge, mass and location.

Ans. The subatomic particles are particles which are smaller than an atom. It is a unit of matter or energy which is the fundamental make up of all matter.

The subatomic particles are of three types in an atom: Proton (p), Neutron (n), and Electrons (e^-)

Nucleus: The charge of atomic nucleus is positive. Entire mass of an atom is concentrated in the nucleus. The nucleus has two types of subatomic particles together that are called nucleons. Further, two types of nucleons are Protons and neutrons.

Proton (p)

Proton has a positive charge which is a subatomic particle in the atomic nucleus, located inside the nucleus.

A proton is represented by the symbol 'p'.

Each proton carries a positive charge of + le

(le = 1.6×10^{-19} Coulomb)

The atomic number of an element is number of protons in the nucleus of atom. It is denoted by the ' Z '.

Mass of one proton is approximately 1u (1 Dalton).

1u = 1.66×10^{-27}g)

Neutron (n)

Neutron is an electrically neutral subatomic particle and is denoted by the symbol 'n'.

Neutron is also located inside the nucleus.

The mass of neutron is approximately 1u, which is almost equal to that of a proton.

Electron (e^-)

Electron is a negatively charged subatomic particle and is denoted by the symbol e^-.

It carries one unit of negative charge (-1e).

Mass of an electron is 1800 times less than that of a hydrogen atom. Therefore, mass of an electron can be treated as negligible.

Electron is the extra nuclear part revolving in the discrete orbits around the nucleus.

Subatomic particles	Charge	Mass	Location
Proton(p)	Positively charged or 1 unit positive	Approximately 1u	In the nucleus
Neutron(n)	No charge	Approximately 1u	In the nucleus
Electron e^-	1 unit negative	1800 times less than Hydrogen atom	Revolve around the nucleus.

Q 2) Give scientific reason.

a. All the mass of an atom is concentrated in the nucleus.

The protons and neutrons are present in the nucleus.

The mass of a neutron is approximately equal to that of a proton. When the electrons revolve around the nucleus they have specified orbits but their mass is negligible as compared to that of a proton or neutron. Hence, the mass of an atom is concentrated in the nucleus.

b. Atom is electrically neutral.

Ans. An atom is made of two parts, viz. the nucleus and the extra nuclear part. Positively charged protons are present in the nucleus of an atom, so nucleus is positively charged. The negatively charged electrons revolve around the nucleus in orbits., extra nuclear part of an atom is made of negatively charged electrons.

The magnitude of the positive charge on the nucleus equals the magnitude of the negative charge on the electrons. The neutrons do not carry any charge. As the opposite charges are balanced, the atom is electrically neutral.

c. Atomic mass number is a whole number.

Ans. Atomic mass number is the sum of protons and neutrons present in the atom (A). As the number of protons and neutrons are always whole numbers, the atomic mass number is also a whole number.

d. Atoms are stable though negatively charged electron are revolving within it.

Ans. Electrostatic forces act on the electrons present in the atoms, the entire mass of the atom is concentrated in the nucleus and the positively charged nucleus at centre of an atom. The negatively charged electrons revolve around the nucleus. The total negative charge on all the electrons is equal to positive charge on the nucleus. Hence, atoms are stable though negatively charged electrons are revolving within it, and the opposite charges are balanced.

Q 3) Define the following terms.

a. Atom

Ans. The smallest particle of an element is an atom, which retains its chemical identity in all the physical and chemical changes.

b. Isotope

Ans. The fundamental property of an element is atomic number and its chemical identity. Some elements in nature have atoms with same atomic number but different mass number. Such elements with same atomic number but different mass number are called Isotopes.

c. Atomic Number

Ans. The number of electrons or protons present in the nucleus is atomic number. It is denoted by letter 'Z'.

d. Atomic mass number

Ans. Atomic mass number is defined as the sum of the number of protons and neutrons in the nucleus. It is denoted by letter 'A'.

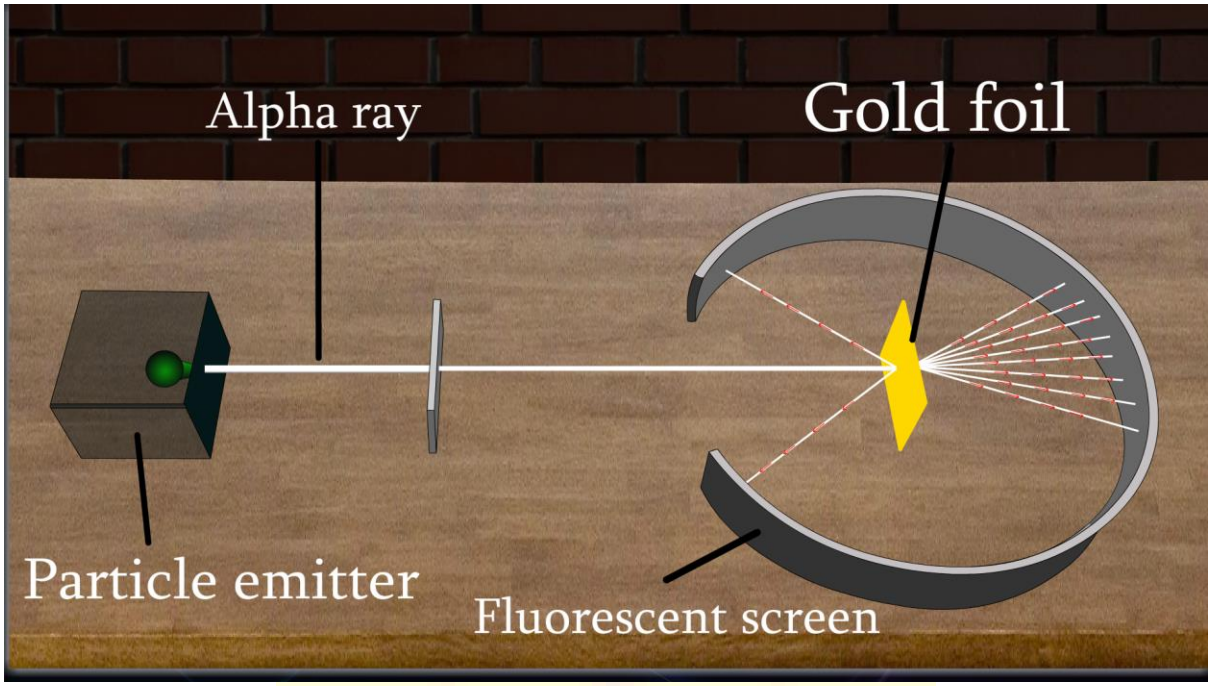
e. Moderator in nuclear reactor.

Ans. In nuclear reactor, a moderator is a medium that reduces the speed of fast neutrons and thereby turning them into thermal neutrons, that iscapable of a nuclear chain reaction.

Q 4) Draw a neat labelled diagram.

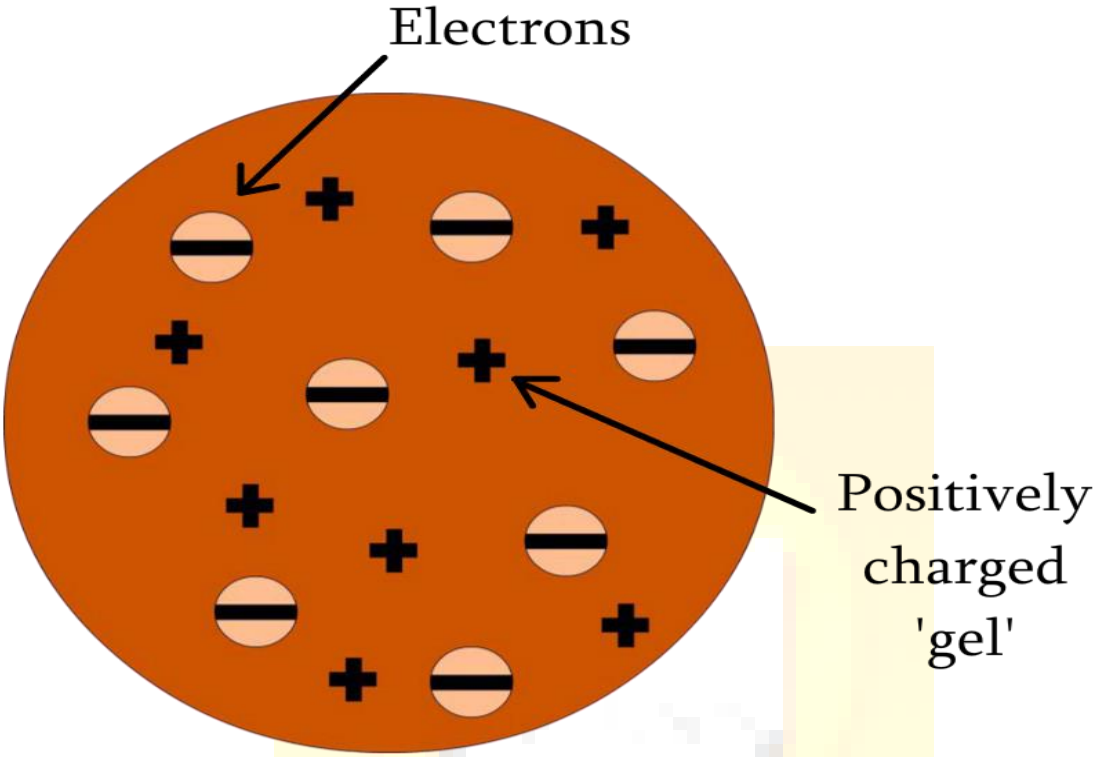
a. Rutherford scattering experiment

Ans.



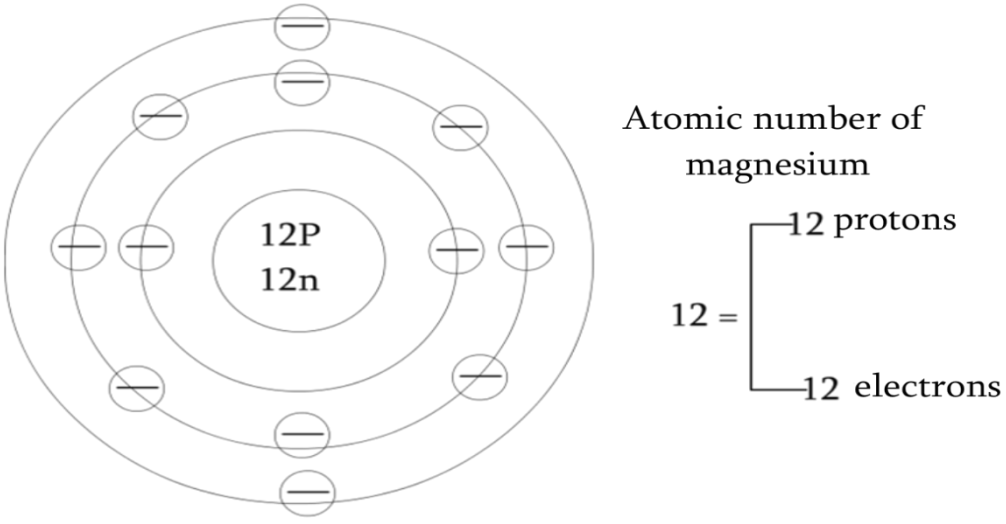
b. Thomson's atomic model.

Ans.



c. Diagrammatic sketch of electronic configuration of Magnesium (Atomic number 12)

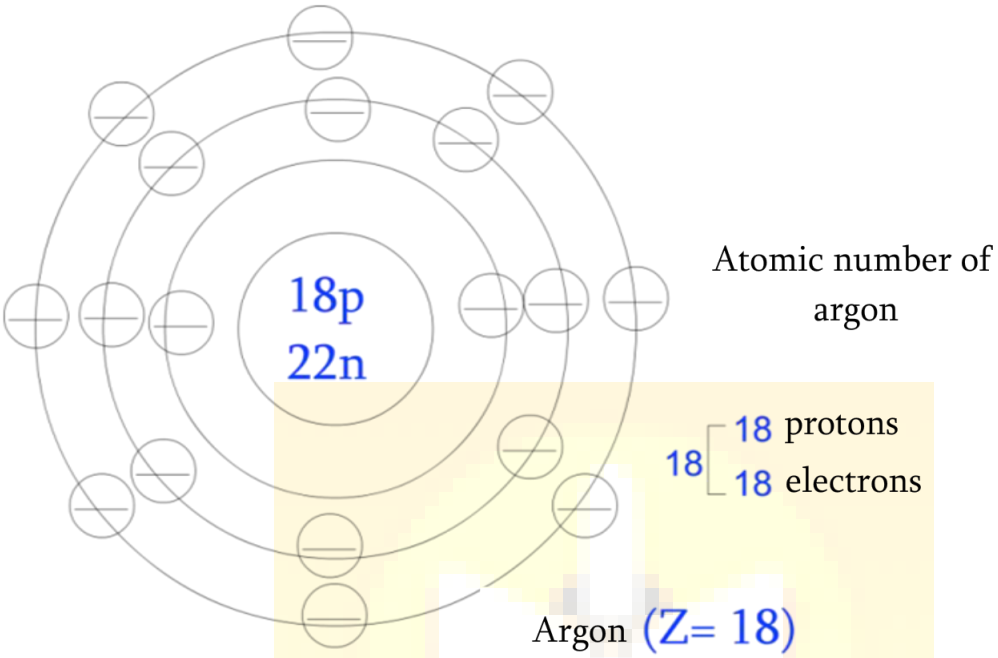
Ans.



Magnesium (Z=12)

d. Diagrammatic sketch of electronic configuration of Argon (Atomic number 18)

Ans.



Q 5) Fill in the blanks.

a. Electron, proton, neutron are the types of ..... in an atom.

Ans. Subatomic particles

b. An electron carries a ..... charge.

Ans. Negative.

c. The electron shell ..... is nearest to the nucleus.

Ans. K

d. The electronic configuration of magnesium is 2, 8, 2. From this it is understood that the valence shell of magnesium is.....

Ans. M

e. The valency of hydrogen is 'one' as per the molecular formula H_2 O. Therefore valency of 'Fe' turns out to be ..... As per the formula Fe_2O_3.

Ans. 3

Q 6) Match the pairs.

Group 'A'	Group 'B'
a. Proton	i. Negatively charged
b. Electron	ii. Neutral
c. Neutron	iii. Positive

Ans.

Group 'A'	Group 'B'
a. Proton	Positively charged
b. Electron	Negatively charged
c. Neutron	Neutral

Q 7) Deduce from the datum provided.

Datum	To deduce
$^{23}_{11}Na$	Neutron number
$^{14}_{6}C$	Mass number
$^{37}_{17}Cl$	Proton number

Ans.

1) There are 12 neutrons in the sodium $^{23}_{11}Na$.

And sodium has 11 protons, to calculate number of neutrons,

(N = A – Z) 23 -11 = 12

(2) Carbon has atomic number 6 that means it has 6 protons. The number of Neutrons must be 14 - 6 = 8 Neutrons.

Atomic mass number is the sum of number of protons and number of neutrons.

∴ Mass number of this carbon atom is 8 + 6 = 14.

Atomic mass number of $^{14}_{6}C$ is 14.

(3) Atomic number of chlorine is 17.

By the definition of atomic number, it is the number of protons or electrons of an atom.

∴ Number of protons = Atomic number

∴ Number of protons is 17. There are 17 protons in chlorine $^{37}_{17}Cl$.

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