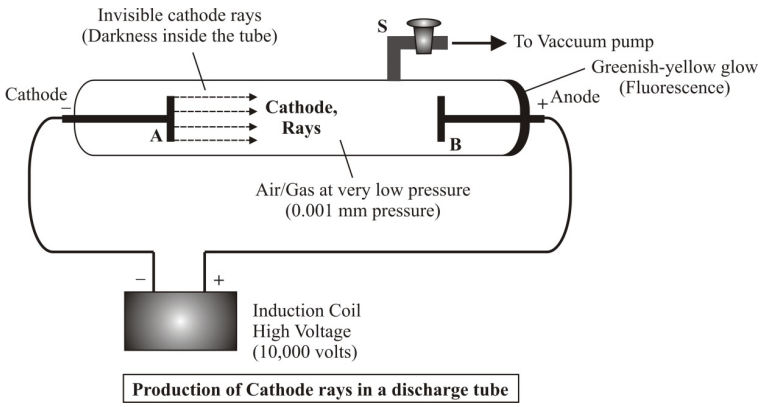
This set of questions contains all the possible concepts which could be asked in the examination

Q.1 How hydrogen atom is different from atoms of all other elements?

All the atoms are made up of three subatomic particles: electrons, protons and neutrons. Hydrogen atom is made up of only one electron and one proton. It does not contain any neutron. So, it is different from atoms of all other elements.

Q.2 What is discharge tube?

A discharge tube is a long glass tube closed at both the ends. Two metal plates A and B are sealed at the ends and these plates are called as electrodes. A vacuum pump is attached to suck out the air or gas present inside the tube to reduce the pressure. Both the plates are connected with electrical power with high voltage. The plate with negative terminal is called cathode and with positive terminal is called anode.



Production of Cathode rays in a discharge tube

Q.3 Name the subatomic particles present in an atom.

Atom is made up of smaller particles called subatomic particles. The sub-atomic particles are electrons, protons and neutrons.

Q.4 What is an electron? What is its relative mass and charge?

An electron is that subatomic particle which is negatively charge and has a mass about 1/1840 u of that of an atom of hydrogen.

Q.5 What is relative mass and charge of an electron?

The mass of electron is about $\frac{1}{1840}$ of the mass of hydrogen .The absolute mass of an electron is 9×10^{-28} gram. The absolute charge on an electron is coulomb of negative charge which is smallest, carried by any particle. Thus, it is taken as unit of negative charge.

Q.6 Find out the number of electrons present in last shell of an atom having atomic number 15?

Electronic configuration of element with atomic number 15 will be 2, 8, 5. Hence, the number of valence electron present in an atom is 5.

Q.7 What is the basic differences between proton and neutron?

The basic difference between proton and neutron is the electric charge. Proton has a positive charge (1.6×10^{-19} coulomb) where as neutron has no charge i.e. electrically neutral.

Q.8 What is meant by atomic number of an element? Does the atomic number of an element change when its atoms form ions? Give one example each of diatomic and triatomic molecules.

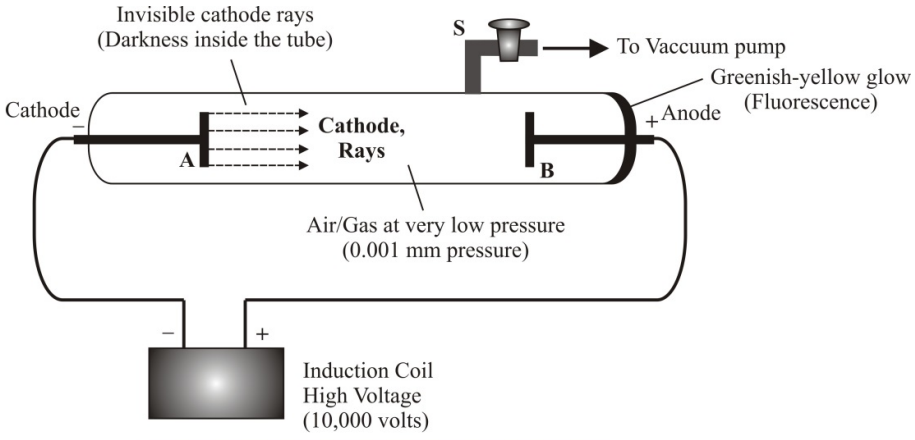
The atomic number of any element is the number of protons present in the nucleus of an atom of that element. The protons are present in the nucleus and they do not take part in the reactions. Therefore, the atomic number of an element which is nothing but the number of protons present in the nucleus of an atom of that element also remains same.
Diatomic molecule is molecule made up of two atoms. For eg – oxygen (O_2).
Triatomic molecule is molecule made up of three atoms.for eg – water (H_2O), O_3 (ozone) etc.

Q.9 Define the term ground state of an atom?

Ground state is the state of an atom, where all the electrons are in their lowest energy levels. After receiving energy, electrons can jump in higher energy levels which are known as excited state.

Q.10 How cathode rays are produced?

Cathode rays are produced in the discharge tube. The gas filled in the discharge tube, contains electrons. When high voltage is applied between electrodes, the electrical energy pushes out some of the electron from the atoms of the gas. These fast moving electrons form “Cathode rays”.

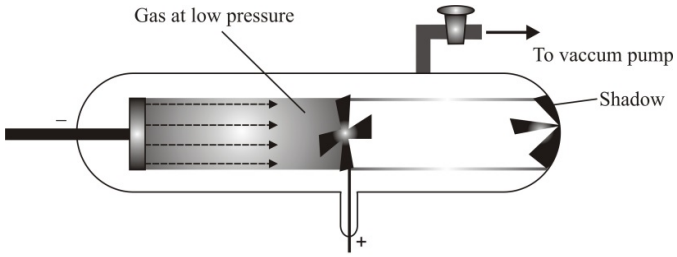


Production of Cathode rays in a discharge tube

Q.11 What are the properties of cathode rays?

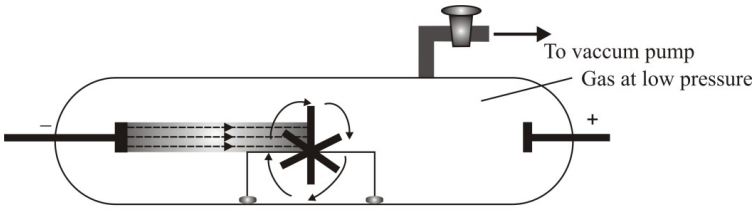
Some important properties of cathode rays are:

1. When an object such as a metal cross is placed in the path of the cathode rays, they generate a shadow of the object at the back of glass tube. So, cathode rays travel in straight lines.



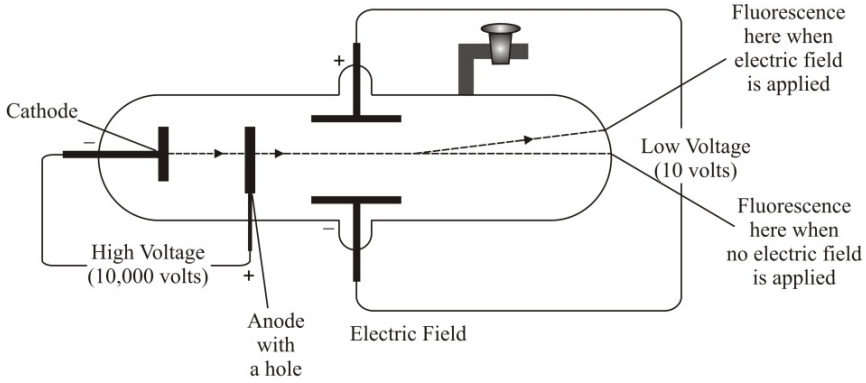
Production of shadow of the object placed in the path of Cathode rays

2. When a light paddle wheel is placed in the path of the cathode rays such that cathode rays strike the blades of upper half, it starts to rotate. Hence, cathode rays are consists of particles.



Rotation of light paddle wheel by cathode rays

3. When an electric field is applied on the cathode rays, they are deflected towards the positive plate of the electric field thus cathode rays carry negative charge.



Deflection of cathode rays towards positive plate of the electric field

4. They produce green fluorescence on the glass walls of the discharge tube. When cathode rays strike the atoms in the glass, they knock their valence electrons into a higher energy level and when the electrons fall back to their original energy level, they emit light. This process is called as fluorescence, causing the glass to glow, usually yellow-green.

5. Cathode rays produce heating effect. Thus, when cathode rays strike a metal foil, it becomes hot.

6. When electrons hit against the surface of hard metals like tungsten, molybdenum etc, some of the

electrons strike on nucleus of metal atoms and get deflected because of positive charge of nucleus. This deflection results the energy of electron to decrease and then results in formation of X-rays. So, cathode rays produce X-rays.

Q.12 Who discovered the fundamental particles neutron, electron and proton?

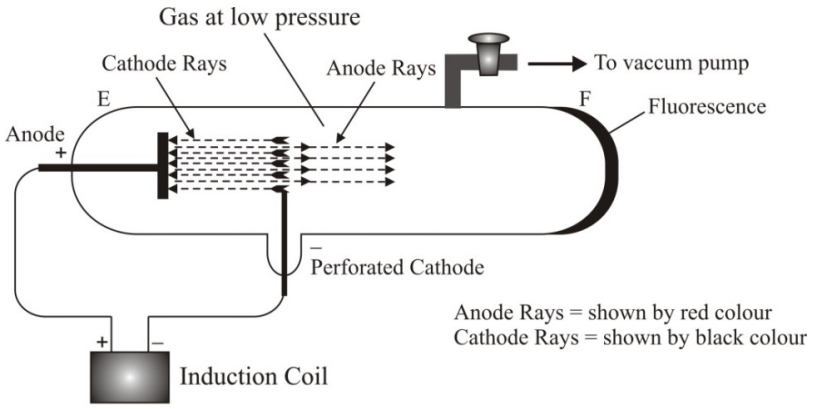
(i) Neutron - Chadwick

(ii) Electrons - Thomson

(iii) Proton - Goldstein

Q.13 How are anode rays produced?

The presence of positively charged particles in an atom was shown by Goldstein in 1886. He took a discharge tube filled with H_2 gas and applied high voltage between the anode and the cathode. He observed that some rays were coming from the side of anode and passed through the holes in the cathode and then strikes on the glass wall and they are called “anode rays”. They carry positive charge and hence called “positive rays”.



Production of anode rays or positive rays or canal rays

Q.14 What are the properties of Anode rays?

The different properties of anode rays are as follows: -

1. They travel in straight lines. If an object is placed in their path, they cast a shadow at the back of glass tube.

2. They are made up of material particles. If a light paddle wheel is placed on an axle in their path, it begins to rotate.

3. Anode rays carry positive charge. They get deflected towards the negative plate of the electric field.

4. Mass of the positively charged particles constituting the anode rays depends upon the nature of the gas. The mass is found to be nearly equal to the mass of the atom of the gas.

Q.15 What is a proton?

A proton is a positively charged particle which carries one unit positive charge and found in the nucleus of atoms of all the elements.

Charge on proton = +1; mass = 1 u

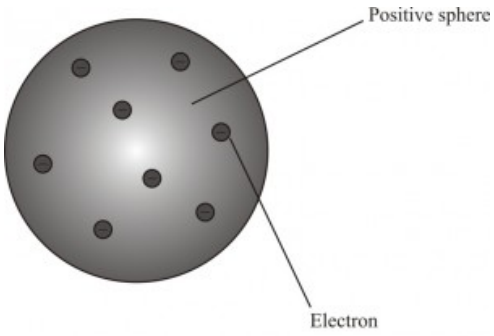
Hence it is represented by the symbol ${}_1P^1$

Q.16 Write detail account on Thomson's model?

J.J. Thomson proposed his model of atom in 1903. According to Thomson's model of the atom:

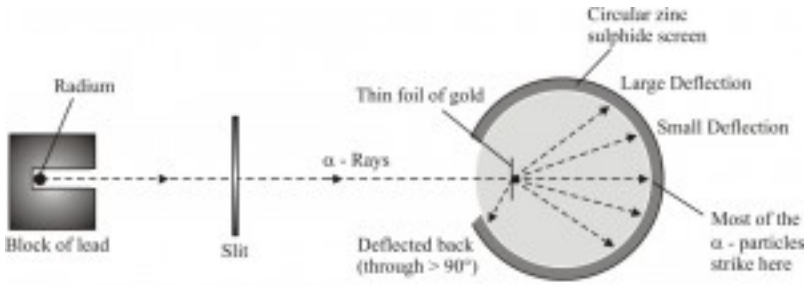
1. An atom consists of a sphere of positive charge with negative charged electrons embedded in it.

2. The positive and negative charges in an atom are equal in magnitude, due to which atom is electrically neutral. These equal and opposite charges balance each other.



Thomson's model of atom

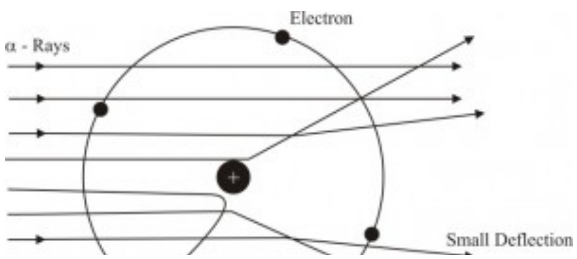
Q.17 Give a detail account on discovery of nucleus.

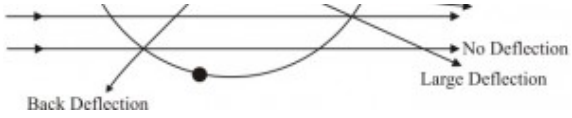


Rutherford's scattering experiments

Rutherford made the following observations:

- Most of the α -particles (99.9%) passed straight through the gold foil without undergoing any deflection.
- Some α -particles were deflected by small angles and a few were deflected through large angles.
- Very few were deflected back, i.e. through an angle greater than 90°.





From these observations, Rutherford drew the following conclusions :

- Most of the α-particles passed through the foil without any deflection, thus there must be sufficient empty space within the atom.
- Since some α-particles were deflected through small angle or large angle and α-particles are positively charged particles, these could be deflected only by some positively charged body present within the atom. The α -particles deflected through large angles were those which passed very close to the positive body.
- Since some α -particles are deflected back and α -particles are heavy particles, these could be deflected back only when they hit heavier body inside the atom.
- Since very few α -particles deflected back, this shows that the heavy body present in the atom must be occupying a very small volume.

Q.18 Define the term scintillations?

Scintillations are bright flashes produced through the α -particles in Rutherford model of an atom. When these particles passed through a slit and strikes against the gold foil, they get scattered and produce bright flashes known as scintillations.

Q.19 What is Rutherford's Nuclear Model of atom?

The main points of this model are as follows:

- An atom is made up of two parts, nucleus and extra nuclear part. Nucleus is the center of the atom with positive charge. Extra nuclear part means the space around the nucleus in which the electrons are distributed.
- The whole mass of the atom is located in the nucleus. Since the electrons have negligible mass, the mass of the atom is mainly due to protons.
- The electrons revolve around the nucleus in well defined orbits.
- An atom is electrically neutral because number of protons and electrons is equal.
- Most of the atom is empty space.

Q.20 What are planetary electrons?

Rutherford compared his model of an atom with our solar system where the nucleus is like the sun and the electrons are like the planets. Thus, these electrons are also called planetary electrons.

Q.21 What was the reason behind the selection of gold foil by Rutherford in α -particle scattering ?

Gold is a highly malleable metal which can be hammered and converted into very thin sheets or foil. Thus, it is easier for the α -particle to pass through the gold foil rarely deviated by nucleus. As the thickness of the foil decrease, the possibility of correctness of experiment increases.

Q.22 Cathode rays originate from the cathode whereas anode rays do not. Explain?

Cathode rays consist of electrons with same mass and charge. These electrons are produced due to their knock out from the atoms of the gas inside. This shows that the cathode rays must be first originating from the cathodes which are hitting the atoms of the gas to knock out electrons from them.

Anode rays consist of positively charged particles with mass nearly equal to the mass of the atoms of the gas. These are also produced due to knock out of electrons from the atoms of the gas by cathode rays converting the atoms into positive ions. Thus, these positive ions are produced in the space between cathode and anode and do not originate from the anode.

Q.23 What are the major drawbacks of Rutherford's model of atom?

A major drawback of Rutherford's model of the atom is that it does not explain the stability of the atom. According to electromagnetic theory of physics, if charged particle undergoes accelerated motion, then it must radiate energy or lose energy continuously. It means the electrons revolving around the nucleus with accelerated motion, will also lose their energy and their speed will also go on decreasing and finally the electrons should fall into the nucleus and atom should collapse. But this does not happen and atom is quite stable.

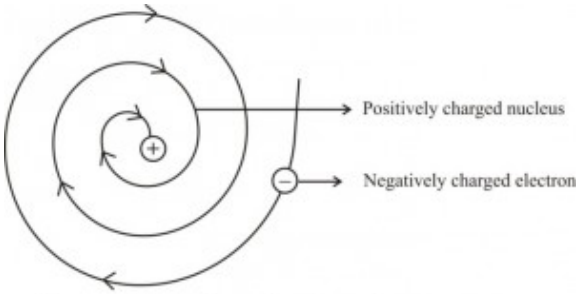


Diagram to show continuous loss of energy by revolving electron

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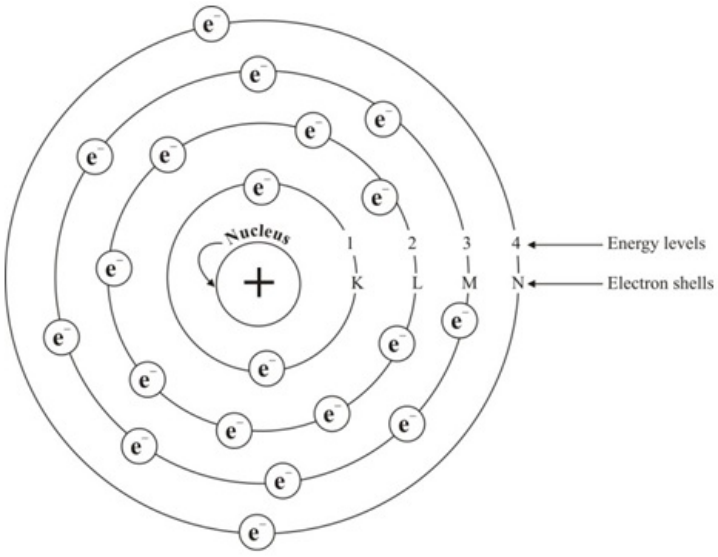
Q.24 During a chemical reaction, number of electrons changes but number of proton remains constant .Why?

In a chemical reaction, exchange of electrons occurs. During a chemical reaction, electrons are lost, gained or shared between different atoms of different elements. Proton which is present in nucleus does not participate and its number which also represents atomic number of element remains constant.

Q.25 What is Bohr's mode of atom?



Bohr's model of the atom : Nucleus is at the centre
Electrons revolve round the nucleus in 'fixed' energy levels or electron shells
(only first four energy levels are shown in the above diagram)

The Bohr's model of atom can be described as follows: -

1) An atom consists of electrons, protons and neutrons. Due to the presence of equal number of negative electrons and positive protons, the atom on the whole is electrically neutral.

2) The protons and neutrons are located in the center of an atom.

3) The electrons revolve in shells or orbits or shells .Orbits are represented either by the numbers 1, 2, 3, 4.....or by the letters K, L, M, N.....

4) The maximum number of electrons accommodated in any shell is fixed. For eg, the first orbit or K shell can hold a maximum of 2 electrons; second orbit or L shell can hold a maximum of 8 electrons; third orbit or M shell can hold a maximum of 18 electrons and fourth orbit or N shell can hold a maximum of 32 electrons.

5) Each orbit or shell is associated with a fixed amount of energy, the shell nearest to the nucleus having minimum energy and the shell farthest from the nucleus having the maximum energy.

6) There is no change in the energy of electrons when it revolves in the same orbit and atom remains stable.

The change in the energy of an electron occurs when it jumps to a higher orbit or when it comes down to a lower energy level. When an electron gains energy, it jumps from a lower shell to a higher shell, and when an electron comes down from a higher shell to a lower shell, it loses energy.

Q.26 Why are Bohr's orbits called stationary states?

According to Bohr's theory, electrons revolves around the nucleus and they have fixed amount of energy. Thus, they are called as stationary states.

Q.27 What is a neutron?

Neutron is a fundamental particle which carries no charge, i.e. it is a neutral particle and has a mass equal to proton (i.e. amu).

Charge on neutron = 0; mass =1 u

It can be represented as ${}_0^1n$

Q.28 What are nucleons?

Total number of protons and neutrons present in nucleus of an atom is known as nucleon.

Q.29 How neutron has been discovered?

The presence of neutrons in the nucleus was confirmed by Chadwick in 1932. He did an experiment

He bombarded the nuclei of some light element with fast moving α - particles. He found some particles were ejected from the nucleus. These particles carry no charge and have a mass equal to proton. These particles were named as neutron.

Q.30 Tabulate the characteristics of electron, proton and neutron.

Particle	Charge on the particle	Mass of the particle	Symbol	Location in the atom
1. Electron	– 1 unit (-1.602×10^{-19} coulomb)	9.11×10^{-31} kg $\left(\frac{1}{1840}u\right)$	${}^{0}_{-1}e$	Outside the nucleus (Extranuclear part)
2. Proton	+1 unit ($+1.602 \times 10^{-19}$ coulomb)	1.673×10^{-27} kg (1 u)	${}_{+1}p^{1}$	In the nucleus
3. Neutron	No charge	1.675×10^{-27} kg (1 u)	${}^{1}_{0}n$	In the nucleus

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Q.31 What is atomic number?

Atomic number of an element is number of protons present in the nucleus of the atom of that element for e.g.

- Nucleus of Hydrogen atom contains one proton; hence its atomic no. is 1.

- Nucleus of C atom contain 6 protons; hence its atomic number is = 6.

All the atoms of same element have same number of protons in their nuclei .Atomic number distinguishes the atoms of different elements. In a neutral atom, the number of protons is equal to the number of electrons.

Thus, atomic number of an element = Number of electrons in one neutral atom

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Q.32 What is mass number?

Mass number of an element is the sum of number of protons and neutrons present in the atom of the element.

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

For e.g. : Hydrogen atom has 1 proton but 0 neutron thus the mass number of H is 1.

The mass number of an element is denoted by the letter A. Protons and neutrons present in a nucleus, together known as nucleons.

Hence, Mass number = Number of nucleons.

Q.33 What is relation between atomic number and mass number?

Mass number = no. of protons + no. of neutrons

As, the number of protons is equal to atomic number of the element.

Hence, Mass number = Atomic number + no. of neutrons.

Q.34 What is the difference between mass number and atomic mass?

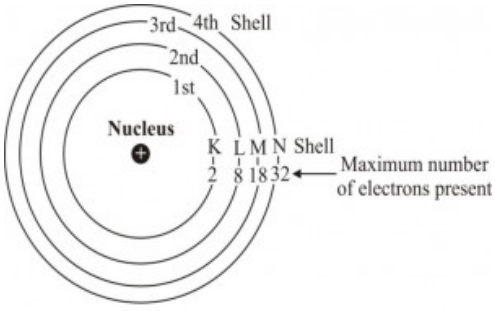
The difference between mass number and atomic number is that mass number is always a whole number (because it is number of protons and neutrons) where as atomic mass is mass of protons and neutrons compared to C-12 atom taken as 12 for e.g. mass number of hydrogen is 1 but its atomic weight is 1.008 u.

Q.35 What is Bohr's – Bury Scheme for distribution of electrons in different shell?

The main points of Bohr-Bury Scheme are as follows:

(i) The maximum number of electrons that can be present in the nth shell is equal to $2n^2$.

Shell	Maximum number of electrons present
1st shell or K-shell (n = 1)	$2 \times 1^2 = 2$
2nd shell or L-shell (n = 2)	$2 \times 2^2 = 8$
3rd shell or M-shell (n = 3)	$2 \times 3^2 = 18$
4th shell or N-shell (n = 4)	$2 \times 4^2 = 32$



Maximum Number of electrons present in different shells

(ii) The outermost shell cannot have more than 8 electrons.

(iii) Electrons do not enter into a new shell unless the inner shells are completely filled. In other words, the shells are filled in a step-wise manner.

(iv) The penultimate shell (i.e. second last shell) cannot accommodate more than 18 electrons.

(v) The anti penultimate shell (i.e.third last shell) can have a maximum of 32 electrons.

Q.36 What do you mean by valence electrons?

The outermost shell of any atom is known as valence shell and the electrons present in this shell are known as valence electrons.

For e.g. Carbon (atomic number Z= 6) => electronic configuration = > K - 2 , L - 4

Thus, L shell is the valence shell and the 4 electrons present in this shell are valence electrons.

Q.37 Define the term valency.

The number of electrons gained, lost or shared by the atom of an element to complete its valence shell with 8 electrons is called the valency of that element.

For e.g.

Sodium (11) = > electronic configuration = > 2, 8, 1

By losing 1 electron its octet will be complete so its valency is 1.

Q.38 What is variable valency?

The term variable valency is used for those elements which show more than one valency.

Valency = Number of electrons in the valence shell

Or

= (8 — Number of valence electrons)

For e.g., Phosphorus (Z = 15) has electronic configuration 2, 8, 5.

So, valency of Phosphorus is 5 as well as 8 – 5 = 3.

Q.39 What is electrovalency? Give examples.

The number of electrons lost or gained by one atom of an element to acquire nearest noble gas configuration, in the process of formation of any ionic / electrovalent compound is known as electrovalency. The element which lose electrons convert into positive ions, so they have positive electrovalency where as the elements which gain electrons convert into negative ions, known as negative electrovalency.

e.g. 1, *Valency of Magnesium* : -

Atomic number of Magnesium is 12 and its electronic configuration is 2, 8, 2. It has 2 valence electrons .Magnesium atom lose these 2 valence electrons and forms a magnesium ion, Mg^{+2} to achieve the noble gas configuration. Thus, the valency of magnesium is (+2).

e.g.2, *Valency of oxygen* :

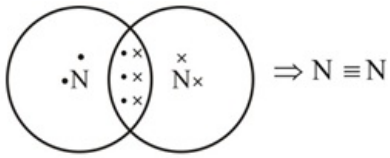
Atomic number of oxygen is 8 and its electronic configuration is 2, 6. It has 6 valence electrons so it needs 2 more electrons and forms oxygen ion, 0^{-2} to achieve the noble gas configuration. Thus, the valency of oxygen is (-2).

Q.40 What is covalency? Give examples.

The number of electrons contributed by one atom for sharing to acquire the nearest noble gas electron configuration is known as covalency.

For e.g., Covalency of Nitrogen : -

Atomic number of N is 7 so its electronic configuration is 2, 5. It has 5 valence electrons. Since one nitrogen atom shares 3 electrons to achieve the nearest noble gas configuration. Thus the covalency of N is 3.In the formation of Nitrogen molecule, N_2; each N atom shares its 3 electrons with other atom.

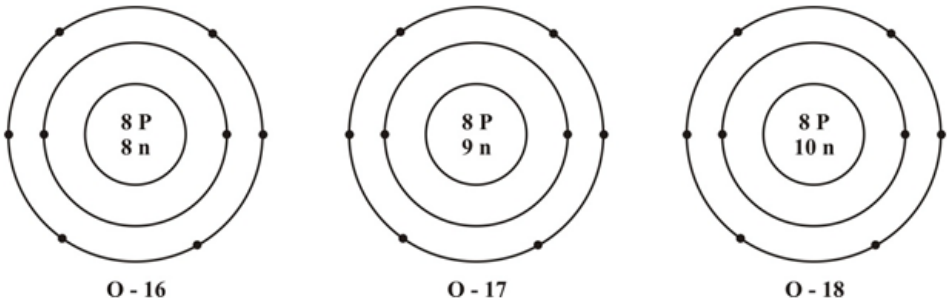


K L
Electron configuration N = 2 5

Q.41 What are the different isotopes of oxygen?

There are three isotopes of oxygen. They are-

Isotope	Atomic number	Mass number	No. of protons	No. of neutrons	No. of electrons
$_8O^{16}$	8	16	8	16 – 8 = 8	8
$_8O^{17}$	8	17	8	17 – 8 = 9	8
$_8O^{18}$	8	18	8	18 – 8 = 10	8



O - 16 O - 17 O - 18

Q.42 What are the general features of isotope?

The general features of isotopes are as follows:

1. The isotopes of an element have same atomic number (i.e. same number of protons in the nucleus and same number of electrons in the extra nuclear part)

2. The isotopes of an element have different mass numbers (i.e. different in the number of neutrons present in the nucleus)

3. Isotopes have same electronic configuration hence share similar chemical properties.

4. Isotopes of an element have different masses, so they have different physical properties like melting point, boiling point, density etc.

5. Due to difference in the nuclear structure (i.e., number of neutrons), they have different nuclear properties, e.g., C-14 isotope is radioactive whereas C-12 isotope is non-radioactive.

Q.43 What are radioisotopes?

The radioactive isotopes are called as radioisotopes. For e.g. C-14

Q.44 Define the term “Half-life”.

Half –Life is a feature of unstable radioactive elements which disintegrate with time and emits alpha and beta particles or Half-life ($t_{1/2}$) is the amount of time required for a quantity to degenerate to half of its value as compared to the starting of the time period. The rate of decay is depends on the amount of substances. For eg the half-life of Cobalt ${}_{27}C^{60}$ is 5 years. If we start with 100 gm of cobalt, then after 5 years only 50 gram would be left.

Q.45 What are the different applications of isotopes?

The isotope having larger number of neutrons is generally unstable. It emits α, β, and γ-radiations spontaneously. Such isotopes are called radioisotopes. These radioisotopes possess some special properties which make them very useful in a number of fields. Some applications of the isotopes are given below:

1. As nuclear fuel -In the nuclear reactor, an isotope of uranium (U-235) is used as a nuclear fuel.

2. In medical field- Some radioisotopes are widely used for treatment as well as diagnosis of fatal diseases like cancer, tumour etc.

A few examples are given below:

(i) Cobalt-60 is used in the treatment of cancer. The high energy -rays emitted by Co-60 kills the malignant cells of the cancer.

(ii) Phosphorus – 32 is used in the treatment of leukemia i.e. blood cancer.

(iii) Iodine-131 is used in the diagnosis and treatment of thyroid disorders (i.e. disease called goiter).

(iv) Some radioisotopes are used as isotope, called tracer, is injected into the body. Radioactive imaging is then used to detect accumulation of the isotope and therefore detect tumours and blood clots before they become dangerous. For e.g., sodium-24 is used to detect the blood clot and arsenic-74 is used to detect the tumour.

3. In carbon dating- Carbon dating is a technique of finding the age of fossils (i.e. old samples dead animals) at archeological sites. Plants fixatmospheric carbon during photosynthesis, so the level of ^{14}C in plants and animals when they die approximately equals the level of ^{14}C in the atmosphere at that time. Although, it decreases thereafter because of radioactive decay, allowing the date of death or fixation to be determined.

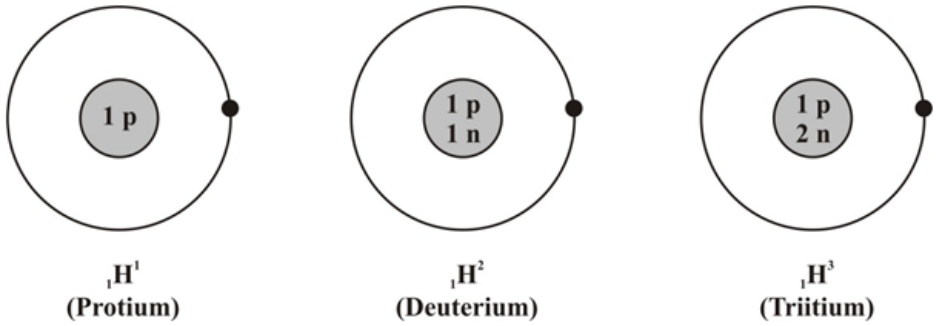
4. In industry- Radioisotopes are used to detect the leakage in the underground oil pipes, gas pipes or water pipes. In such a case, radioisotope is allowed to flow through the pipe. At the point of leakage, a large amount of radiation will be emitted and this can be detected with an instrument called Geiger-Muller counter.

Q.46 What are isotopes? Give example.

Isotopes are the atoms of the same element with same atomic number but different mass numbers.

For e.g., The isotopes of Hydrogen are -

Isotopes	No. of Proton	Mass Number	No. of Neutron	No. of Electron
Protium / Ordinary hydrogen	1	1	0	1
Deuterium / heavy hydrogen	1	2	1	1
Tritium / radioactive isotope	1	3	2	1



$_1H^1$ (Protium) $_1H^2$ (Deuterium) $_1H^3$ (Triitium)

Q.47 Which isotope is used as nuclear fuel?

Uranium-235 is used as nuclear fuel.

Q.48 What is the reason behind fractional atomic mass?

The reason behind the fractional atomic masses of elements are the different isotopes of an element present in nature. Most of the elements have more than one natural isotope having different masses. Since the atomic mass of an element is the average relative mass of all the natural isotopes of that element.

For e.g., Chlorine in found to exist as two isotopes i.e. Chlorine 35 and chlorine 37 in ratio of 75% and 25% respectively.

This means that isotope of mass 35 u will contribute 75% whereas isotope of mass 37 u will contribute 25% to average atomic mass of Chlorine.

$$\text{Average atomic mass of Chlorine} = 35 \times \frac{75}{100} + 37 \times \frac{25}{100}$$

$$= \frac{2625}{100} + \frac{925}{100}$$

$$= 26.25 + 9.25$$

$$= 35.5\,u.$$

Thus, average atomic mass of Chlorine is 35.5 u i.e. in fraction.

Q.49 What are isobars? Give examples.

Isobars are the atoms of different elements having different atomic number but same mass number. Isobars have different number of protons but the total number of nucleons (protons + neutrons) is same.

For e.g., Argon (Ar) and Calcium (Ca).

Isobars	Number of Protons	Number of Neutrons	Mass number
$_{18}Ar^{40}$	18	22	18+22=40
$_{20}Ca^{40}$	20	20	20+20=40

Q.50 Tabulate the properties of Cathode rays and Anode rays.

	Property	Cathode Rays	Anode Rays
(i)	Motion	They travel in straight lines.	They also travel in straight lines.
(ii)	Type of charge	They are deflected towards positive plate so they carry negative charge.	They are deflected towards the negative plate so they carry positive charge.
(iii)	Particles	Particles present in cathode rays are electrons.	Particles present in anode rays are positively charged particles.
(iv)	Quantity of charge and mass	Electrons present in the cathode rays always have the same charge and mass.	The charge on the particles depends upon the number of electrons lost by atoms. Mass of the particles is nearly same as that of the atom of the gas taken in the discharge tube.
(v)	Origin	They originate from the cathode.	They are produced in the space between anode and cathode.

Q.51 What are α - particles?

α-particles are doubly charged helium ions (He^{+2}) each having two protons and two neutrons bound together into a particle identical to helium nucleus.

α - Particles = > He^{+2}.

Q.52 What are isotones?

Some atoms of different element have different atomic number and different mass numbers but they have same number of neutrons. These atoms are known as isotones.

For e.g., $^{12}_{6}C$ and $^{16}_{8}O$.

Both C and O have same number of neutrons i.e. 8.

Q.53 What are isoelectronics ?

The species (atoms or ions) having same number of electrons are called isoelectronics.

For e.g., Na^{+} and Mg^{+2}.

Both Na and Mg contains 10 electrons.

Q.54 What are nucleons?

Total number of protons and neutrons present in nucleus of an atom is known as nucleon.

Q.55 Why Bohr's orbits are called stationary states?

According to Bohr's theory, electrons revolve around the nucleus and they have fixed amount of energy. Thus they are called as stationary states.

Q.56 What is an orbit?

Orbit is the path of the electron around the nucleus.

Q.57 What is mean by electronic configuration of elements?

The systematic arrangement of electrons in different orbits or shells of an atom of element is known as electronic configuration of elements.

Q.58 Why some atoms shows radioactivity?

When the number of neutrons exceeds the number of protons in the nucleus of atom, it becomes unstable and shows radioactivity. For eg , ${}_{6}C^{12}$ has 6 protons and 6 neutrons so it stable while ${}_{6}C^{14}$ has 6 protons and 8 neutrons is unstable and shows radioactivity.

Value Based Questions : -

Q.1 During diwali most of the children burst crackers. This generates a lot of air and noise pollution. Asthma patients suffer lot during this festival. So many people get hurt because of mishandling of the crackers. Some poisonous gases like sulphur dioxide, phosphorus also formed and get mixed into environment.

(a) Why should we restrict children to burst crackers?

(b) Name the elements which are present in gun powder that is used in crackers?

(c) Why we should avoid wear synthetic clothes during bursting crackers?

(a) Bursting crackers produces pollution so we should restrict children from bursting crackers.

(b) Gun powder contains sulphur and carbon.

(c) Synthetic clothes catches fire very easily causes severe burns as well.

Q.2 Some students went to a theme park. First ride could accommodate only 2 students. Teacher decided alphabetically first two children. Second ride could accommodate 8 children. This time teacher decided 8 children height wise. Third ride could have remaining 4 children. All the children were very happy.

(a) Compare the above case with structure of an element. Which element fits into this situation?

(b) Write atomic number of this element.

(c) Is this element metal or non-metal or metalloid?

(d) What kind of children are there in above class? What values are possessed by them?

(e) What is the valency of this element?

(a) This case resembles like silicon because its atomic number is 14(2, 8, 4). Thus, first ride has 2 children, second has 8 and third has 4 children, according to the electronic configuration.

(b) Atomic number of element is 14.

(c) Silicon is a metalloid or semi metal.

(d) They are obedient children as they follow their teacher.

(e) Silicon has 4 electrons in its valence shell so valency of silicon is 4.

Numericals : -

Q.1 The average atomic mass of a sample (X) of an element X is 16.2 u. What are the percentages of isotopes $_8X^{16}$ and $_8X^{18}$ in sample ?

Lets assume the percentage of sample $^{16}_{8}X = x$

Then, the percentage of sample $^{18}_{8}X = (100 - x)$ ..... (i)

Average atomic mass of element X =

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

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

$16x + 1800 - 18x = 1620$

$-2x = -1800 + 1620$

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

Putting the value of x in equation (i)

Percentage of sample $^{18}_{8}X = 100 - 90 = 10\%$

Isotope $^{16}_{8}X = 90\%$; Isotope $^{18}_{8}X = 10\%$

Q.2 Find out the average atomic mass of bromine, If bromine atom is found in environment in the form two isotopes i.e. $_{35}Br^{79}$ (49.7%) and $_{35}Br^{81}$ (50.3%)

Average atomic mass of an element

$= \left[\left(Atomic\ mass\ of\ first\ isotope \times \frac{\%age\ of\ first\ isotope}{100}\right)\right.$

$$\left(Atomic\ mass\ of\ second\ isotope \times \frac{\%age\ of\ second\ isotope}{100}\right)\Big]$$

Average atomic mass of bromine

$$= \left[\left(79 \times \frac{49.7}{100}\right) + \left(81 \times \frac{50.3}{100}\right)\right] = 39.263 + 40.743 = 80.006$$

Q.3 Find the n/p ratio of $_{92}V^{235}$?

Number of neutrons (n) = mass number - number of protons = 235 - 92 = 143

Number of protons, p = 92

Hence $\frac{n}{p} ratio\ of\ V = \frac{143}{92} = 1.55$

Q.4 A student weighs 30 kg. Suppose his entire body is made up of electrons. How many electrons are there in his body ? Compare the total number of electrons in his body with the population of India.

Mass of one electron = 9.1×10^{-31} kg

No. of electrons in 1 kg = $\frac{1}{9.1} \times 10^{31}$

Therefore, number of electrons in 30 kg = $\frac{30}{9.1} \times 10^{31} = 3.3 \times 10^{31}$

Number of electron in 30 kg mass is much larger than the population of India (10^9).

Q.5 The half-life of Actinium is 15 seconds. Starting with 0.1 g of Actinium, how much Actinium would be left over after one minute?

Amount of Actinium left after 15 seconds = $\frac{1}{2} \times 0.1 = 0.05g$

Amount of Actinium left after another 15 seconds (i.e. 30 seconds) = $\frac{1}{2} \times 0.05 = 0.025g$

Amount of Actinium left after another 15 seconds (i.e. 45 seconds) = $\frac{1}{2} \times 0.025 = 0.0125g$

Amount of Actinium left after another 15 seconds (i.e. 60 seconds = 1 min.)

= $\frac{1}{2} \times 0.0125 = 0.00625g = 6.25\ mg.$

Q.6 An ion X^{2-} has 10 electrons and 8 neutrons. Find out the atomic number and atomic mass of element X ? Find out the name of element.

X^{2-} has 10 electrons as it has gained 2 electrons,

so number of electrons in the neutral atom X =10-2= 8

Further, for a neutral atom

Atomic number = No. of protons = No. of electrons

Hence atomic number of the element X = 8

Atomic mass of the element = No. of protons + No. of neutrons = 8 + 8 = 16

The element with atomic number 8 is oxygen.

Q.7 Calculate the total number of electrons which will together weigh 1 g.

Mass of one electron = 9.11×10^{-31} kg.

Thus, mass of 9.11×10^{-31} = 1 electron.

Mass of 1 g i.e., 10^{-3} kg will have electrons = $\frac{1}{9.11 \times 10^{-31}} \times 10^{-3} = 1.098 \times 10^{27}$.

Q.8 Calculate the total number of electrons present in one molecule of methane (CH_4).

Atomic number of C = 6.

Thus, it has 6 electrons.

Atomic number of H = 1

Thus, each H-atom has 1 electron.

Therefore, no. of electrons present in one molecule of CH_4 = 6 + 4 = 10

1 Mark Questions

Q.1 In the notation of nitrogen $_7N^{14}$, what do the numbers 14 and 7 denote?

[CBSE (CCE), 2010]

In the notation subscript 7 represents atomic number and superscript 14 represents atomic mass of nitrogen.

Q.2 If Mg has 12 protons & 12 neutrons, what is its atomic number & mass number ?

[CBSE (CCE), 2010]

Atomic number of any element is equal to protons present in atom.

Hence atomic number = number of protons= 12

Atomic mass is sum of protons and neutrons present in atom.

Therefore mass number = number of protons (p) + number of neutrons(n)

= 12 + 12 = 24

Q.3 What is the difference between Na and Na^+ in terms of number of electrons?

[MSE 2009, CBSE (CCE), 2010]

Na is an atom having 11 electrons and Na^+ is an ion formed when Na lose 1 electron.

Hence number of electrons in:

Na → 11 Electrons

Na^+ → 10 Electrons

Q.4 State two main postulates of Thomson's model of an atom.

[CBSE, 2011]

Main postulates of Thomson's model of an atom are :

(1) Electrons are embedded in positively charged sphere.

(2) The negative and positive charges balance each other which make atom electrically neutral.

Q.5 How are the canal rays different from electrons in terms of charge and mass ?

[CBSE, 2012]

Canal rays is a stream of positively charged particles whereas electrons are negatively charged. In terms of mass canal ray's particles are almost 2000 times as compare to electron.

Q.6 What is the charge and mass of a neutron ?

[CBSE (CCE), 2010]

Neutron is an electrically neutral particle, so it does not carry any charge. Its mass is 1.675×10^{27} kg or 1.675×10^{-24} *gm.*

Q.7 Identify the pair of isotopes from the following :

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

[CBSE, 2010]

Isotopes are the variants of an element which have same atomic number but different atomic mass. Here ${}^{16}_{8}X$ and ${}^{17}_{8}X$ are isotopes as they posses same atomic numbers (i.e. 8) , but different atomic mass(16 and 17).

Q.8 What happens to an element 'Z' if its atom gains 3 electrons ?

[CBSE, 2010]

When any atom accept electrons it converts into negative ion/an anion. So, it will change into Z^{3-} after gaining 3 electrons.

2 Marks Questions

Q.9 (a) Why is Thomson's model of an atom compared with watermelon ?

(b) Why do isotopes have different mass numbers ?

[CBSE (CCE), 2010]

(a) Thomson's model an atom can be considered as a watermelon in which red fleshy part represents positive charge where as electrons (negative charge) are embedded in it similar to seeds.

(b) Isotopes of any element have the same number of protons but different in neutron number, therefore, they have different mass numbers.

Q.10 Give reason for the following :

(a) Nucleus of an atom is heavy and positively charged.

(b) An atom is electrically neutral.

[CBSE (CCE), 2010]

(a) Nucleus consists of proton and neutron. Proton has positive charge where as neutron has no charge hence net charge on nucleus is positive. Nucleus is heavy because of the presence of proton and neutron.

(b) An atom is electrically neutral because it possess same number of proton (positive charge) and electron (negative charge).

Q.11 State three characteristics of Canal rays.

[Board, 2012]

(i) Canal rays travel in straight line.

(ii) Canal rays get deflection by electric and magnetic field in the direction opposite to cathode rays.

(iii) These rays are consists of positively charged particles called as protons.

Q.12 State the characteristics of nucleus of an atom.

[CBSE (CCE), 2010]

(a) Nucleus is made up of proton and neutron.

(b) All the mass of an atom is concentrated in nucleus.

(c) Nucleus is positively charge.

(d) Size of nucleus is $\frac{1}{100,000}$ of the size of atom.

Q.13 What are the maximum number of electrons that can be accommodated in outermost shell of an atom ?

[DAV, 2009, CBSE (CCE), 2010]

Elements has tendency to react in such a manner that each atom has 8 electrons in its outermost shell, acquiring the similar electronic configuration as a inert gas. So maximum number of electrons that can be accommodated in outermost shell is 8.

Q.14 There are 15 protons and 16 neutrons in the nucleus of an element. Calculate its atomic number and mass number.

[CBSE (CCE), 2010]

Atomic number of any element is the number of proton present in that atom

Here no. of proton = 15 therefore atomic number is also 15.

Mass number or atomic mass is the sum of proton and neutron.

Therefore mass number = 15 + 16 = 31

Q.15 For the symbols H, D and T, tabulate the two sub-atomic particles present in the nucleus of each of them.

[CBSE (CCE), 2010]

Subatomic particles	Hydrogen ${}_1^1H(H)$	Deuterium ${}_1^2H(D)$	Tritium ${}_1^3H(T)$
Number of Neutron(n)	0	1	2
Number of Proton(p)	1	1	1

Q.16 Water molecules have hydrogen and oxygen in the ratio of 1 : 8 by mass. Find the ratio of number of atoms of elements in water molecules.

[CBSE (CCE), 2010]

Ratio of number of moles $\frac{1}{1} : \frac{8}{16}$

Number of moles = $\frac{Mass}{Atomic\ mass}$

Number of moles of hydrogen = $\frac{1}{1} = 1$

Number of moles of oxygen = $\frac{8}{16} = \frac{1}{2}$

Since ratio of number of moles 2 : 1

Therefore ratio of number of molecules will also be 2 : 1.

Q.17 If K and L shells of an atom are full then what would be the total number of electrons in the atom ? What is the valency of this element ? Name the element.

[CBSE, 2011, 2012]

Number of electrons in nth shell= $2n^2$

Here n is the number of shell.

As K and L shell is completely filled hence,there would be (2+8)= 10 electrons in atom.

The element with atomic number 10 is inert gas neon (Ne) so the valency will be zero.

Q.18 Why is atomic mass of chlorine taken as 35.5 u and not a whole number like 35 u or 36 u ? Explain.

[CBSE, 2012]

Chlorine in natural state found in the mixture of two isotopes with atomic masses 35 u and 37 u in the ratio 3 : 1. Hence, the atomic mass of chlorine is taken as the average of atomic masses of these two isotopes.

Therefore average atomic mass of Cl = $35 \times \frac{3}{4} + 37 \times \frac{1}{4} = 35.5u$

3 Marks Questions

Q.19 (a) What do you mean by valence electrons ?

(b) Write the electronic configurations of element K(19) ad N(7).

(c) Write the number of valence electrons in each of these elements.

[CBSE, 2013]

(a) The number of electrons present in the outermost shell of an atom is known as valence electrons. For e.g., the electronic configuration of Na (11) is

K	L	M
2	8	1

Thus, the number of valence electrons present in Na is 1.

. K L M N

(b) Electronic configuration of K (19) = 2 8 8 1

Electronic configuration of N (7) = 2 5

(c) No. of valence electrons in K (19) = 1 (as 1 electron is present in last shell)

No. of valence electrons in N (7) = 5 (as 5 electrons is present in last shell)

Q.20 Write the drawbacks of Rutherford's model of an atom.

[CBSE, 2010]

The drawbacks of Rutherford's model are

(i) When any charged particle gets accelerated, it is expected to emit radiation. To remain in a circular orbit, electron also need to undergo acceleration and lose energy in the form of radiation and finally fall into the nucleus.but this does not happens and atom is quite stable.

(ii) Rutherford's model was unable to explain arrangement of electrons in the extra nuclear portion of the atom.

Q.21 If the symbolic representation of an atom is $_3X^6$, find its valency, name and also give the reason for the valency ?

[CBSE (CCE), 2011]

$^{6}_{3}X$ => Here subscript 3 represents its atomic number and superscript 6 denotes its mass number.

Atomic number of element X = 3

Electronic configuration 2, 1.

Element X has single electron in outermost shell so its valency would be 1.

Element X is lithium.

Q.22 State three features of the nuclear model of an atom put forward by Rutherford.

[Board, 2012]

(i) Center of the atom is positively charged and highly densed which is known as nucleus which made the whole mass of the atom.

(ii) The electrons rotate around the nucleus in well-defined orbits.

(iii) The size of the nucleus (10^{-15}) is very small as compared to size of atom(10^{-10}).

Q.23 Two elements X and Y combine in a ratio of 3 : 8 by mass and the compound 'Z' is formed. Z is one of the essential components of photosynthesis to take place. If Z is also one of the green house gases :

(a) Identify X, Y and Z

(b) Write the electronic configuration of X and Y.

(c) Write the atomicity of the molecule Z.

[CBSE (CCE) 2012]

(a) 'X' and 'Y' are C (carbon) and O (oxygen). These combine in ratio of

12 : 32 i.e., 3 : 8. 'Z' is CO_2(carbon dioxide)

(b) 'X' is carbon (atomic number 6) so its electronic configuration is 2, 4.

'Y' is oxygen (atomic number 8)so its electronic configuration is 2, 6.

(c) 'Z' is CO_2 so it is made up of one carbon atom and two oxygen atoms so it atomicity is 3 (i.e. triatomic molecule).

5 Marks Questions

Q.24 Sulphur dioxide (SO_2) is a colourless pungent smelling gas and is a major air pollutant.

(i) Write the electronic configuration of its constituent 'sulphur and oxygen'. (Given $_{16}S^{32}$, $_{8}O^{16}$)

(ii) Write the valencies of sulphur and oxygen.

(iii) Are sulphur and oxygen isotopes of same element ? Explain your answer.

[CBSE, 2012]

K L M

(i) Electronic configuration of sulphur (S) : 2 , 8 , 6

Electronic configuration of Oxygen (O) : 2, 6

(ii) Sulphur and oxygen, both needs 2 electron to complete its octet. Thus valency of both Sulphur and Oxygen is 2.

(iii) Isotopes are variants of same element with same atomic number but differentatomic mass. Hence they are not isotopes.

Q.25 (a) What is an octet ? How do elements reach an octet ?

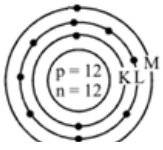
(b) Make a schematic atomic structure of magnesium and phosphorus.

[Given number of protons of magnesium = 12 and that of phosphorus = 15]

[CBSE, 2010]

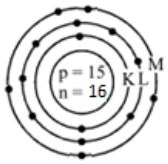
(a) Octet is an arrangement of 8 electrons in outermost shell to achieve nearest noble gas electronic configuration. Elements complete their octet by sharing, gaining or donating electrons to become stable.

(b) Atomic structure of Mg



Electronic configuration of Mg $_{12}Mg = 2\ 8\ 2$ (K L M)

Atomic structure of P



Electronic configuration of P $_{15}P = 2\ 8\ 5$ (K L M)

Q.26 On the basis of the number of protons, neutrons and electrons in the samples given below identify

(i) the cation

(ii) the pair of isobars, and

(iii) the pair of isotopes

Sample	Protons	Neutrons	Electrons
A	17	18	16
B	18	19	18
C	17	20	17
D	17	17	17

[CBSE, 2012, 2011]

(i) Sample A has more protons compare to electrons. If a neutral atom loses electrons, it gets net positive charge and is known as a cation.

(ii) Isobars are the atoms of different Sample B and C have same mass number(protons + neutrons) but different atomic numbers. Hence, they are a pair of isobars.

(iii) Samples C and D have same atomic number but different mass numbers. Hence, they are a pair of isotopes.

Q.27 (a) Write two differences between isobars and isotopes.

(b) Write uses of Co-60 and U-235.

[CBSE, 2010]

(a) Difference between isobars and isotopes are as following:

Isotopes	Isobars
Isotopes are the atoms of the same element with similar atomic number but different atomic mass.	Isobars are the atoms of different elements with same mass number but different atomic numbers.
They shares same chemical	They have different chemical

properties and different physical properties.	properties and different physical properties because these are the atoms of different elements.

(b) (i) Isotope of cobalt (Co-60) is used in the treatment of cancer. It is used in cancer therapy and as a radioactive tracer in biology.

(ii) Isotope of uranium (U-235) is used as a fuel in nuclear reactor.

Q.28 (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 atom this particle is located ?

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

(c) Define isobars, write its one example.

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

[CBSE (CCE) 2011]

(a) Chadwick discovered neutron. Neutron is a neutral particle so it does not have any charge. It is located in nucleus of any atom.

(b) (i)Most of the α -particles passed through the gold foil without any deflection.

(ii) Some of the α -particles were deflected through small angles and a few deflected through large angles.

(iii)Very few were deflected back, i.e. through an angle greater than 90°.

(c) Atoms of different elements having same mass number but different atomic number are known as isobars. For e.g. ${}^{40}_{20}Ca$ and ${}^{40}_{18}Ar$.

(d) Rutherford concluded that size of nucleus is very small as compared to size of an atom.