CBSE NCERT Solutions for Class 9 Science Chapter 4

Back of Chapter Questions

1. What are canal rays?

Solution:

Canal rays are positively charged radiations that can pass through perforated cathode. They consist of positively charged particles and travel towards another cathode in a gas discharge tube. E. Goldstein discovered these radiations in 1866.

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

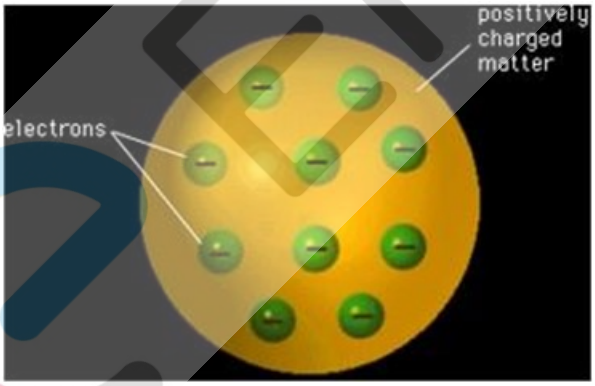
Solution:

An atom having one electron and one proton will not carry any charge as the positive charge on the proton will neutralize the negative charge on the electron. Therefore, there the net charge on the atom is zero.

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

Solution:

Thomson proposed a model of an atom. According to this model, an atom consists of a sphere of positive charge. The positive charge in the atom is spread all over like the red edible part of a watermelon, while the electrons are studded in the positively charged sphere, just like the seeds in the watermelon.



Both charges are equal in magnitude. These opposite charges balance each other thus the atom becomes electrically neutral as a whole.

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

Solution:

Proton is the sub-atomic particle present in the nucleus of an atom. At that time neutron was not discovered.

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

Solution:

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

Solution:

If we will use a foil of a heavy metal like platinum, then the observations in the alpha - particle scattering experiment would be the same as that in the gold foil experiment. If a foil of a light metal like lithium is used, then the observations in the alpha-particle scattering experiment would not be the same as that in the gold foil experiment.

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

Solution:

The three subatomic particles of an atom are -

(i) Electrons

(ii) Protons and

(iii) Neutrons

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

Solution:

Atomic mass of Helium = 4 u

No. of protons = 2

We know that, Atomic mass = no. of protons + no. of neutrons

No. of neutrons = Atomic mass - no. of protons

= 4 - 2 = 2

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

Solution:

Element	Atomic number	Electronic configuration		
		K shell	L shell	M shell
Carbon	6	2	4	
Sodium	11	2	8	1

10. If K and L shell of an atom is full then what would be the total number of electrons in the atom?

Solution:

We know that,

No. of electrons in K-shell = 2

No. of electrons in L-shell = 8

The total no. of electrons in the atom will be = 2 + 8 = 10

11. How will you find the valency of chlorine, sulphur and magnesium?

Solution:

We know that atomic number of Chlorine = 17

Its electronic configuration will be = 2, 8, 7

Valency of Cl = 8 -7 = 1

We know that Atomic number of sulphur = 16

Its electronic configuration will be = 2, 8, 6

Valency of S = 8 - 6 = 2

We know that Atomic number of magnesium = 12

Its electronic configuration = 2, 8, 2

Valency of Mg = 2

12. If number of electrons in an atom is 8 and number of protons is also 8, then

(i) what is the atomic number of the atom? and

(ii) what is the charge on the atom?

Solution:

(i) We know that, Atomic number = Number of Protons = 8

(ii) Given that,

Number of Protons (8) = Number of electrons (8)

So, the charge on the atom will be zero.

13. With the help of below table, find out the mass number of oxygen and sulphur atom.

Name of Element	Symbol	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons	Distribution of Electrons				Vale-ncy
						K	L	M	N	
Oxygen	O	8	8	8	8	2	6	-	-	2
Sulphur	S	16	16	16	16	2	8	6	-	2

Solution:

We know that, Mass number = Number of Protons + Number of neutrons

So, for oxygen,

Number of Protons = 8, Number of neutrons = 8

Mass number of oxygen will be = 8 + 8 = 16

So, for Sulphur,

Number of Protons = 16, Number of neutrons = 16

Mass number of oxygen will be = 16 + 16 = 32

14. For the symbol H, D and T tabulate three subatomic particles found in each of them.

Solution:

H, D and T are isotopes of hydrogen with mass numbers of 1, 2 and 3 respectively.

Element	Symbols	Electrons	Protons	Neutrons
Hydrogen	H	1	1	0
Deuterium	D	1	1	1
Tritium	T	1	1	2

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

Solution:

Isotopes	Protons	Electrons	Neutrons	Electronic configuration
				Shell
				K L M N
$^{35}_{17}Cl$	17	17	18	2 8 7 –
$^{37}_{17}Cl$	17	17	20	2 8 7 –

Isobars	Protons	Electrons	Neutrons	Electronic configuration Shell K L M N
$^{40}_{20}Ca$	20	20	20	2 8 8 2
$^{40}_{18}Ar$	18	28	22	2 8 8 –

Back of the book:

1. Compare the properties of electrons, protons and neutrons.

Solution:

The properties of electrons, protons and neutrons (i.e. nature of their charge, mass and location) are given below in a tabulated form-

Particle	Nature of charge	Mass	Location
Electron	negative (-1) or -1.6×10^{-19} C	9.0×10^{-31} kg	Extra nuclear part
Proton	Positive $(+1)$ or $+1.6 \times 10^{-19}$ C	1.672×10^{-27} kg (1 u)	Nucleus
Neutron	No charge	1.672×10^{-27} kg (1 u)	Nucleus

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

Solution:

J.J. Thomson model says that the mass of an atom is due to electrons and protons which are evenly spread throughout the atom which did not agree with observations of Rutherford according to whom the mass is concentrated in a very small space.

Thomson's model could not explain the results of alpha particle scattering experiment.

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

Solution:

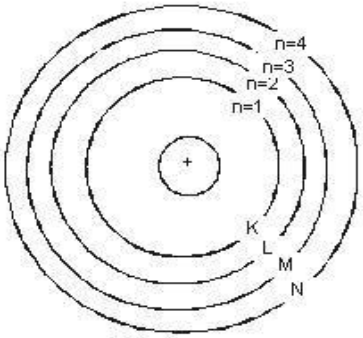
The major limitation of Rutherford's model is that it does not explain the stability of the atom. When charged bodies move in circular motion, they emit radiations. This means that the electrons revolving round the nucleus (as suggested by Rutherford) would lose energy and come closer and closer to nucleus, and a stage will come when they would finally merge into the nucleus. This makes the atom unstable. The electrons do not fall into the nucleus, atoms are very stable and do not collapse on their own.

4. Describe Bohr's model of the atom.

Solution:

In order to overcome the objections raised against Rutherford's model of the atom, Neil's Bohr put forward his model of the atom. According to Bohr's model of the atom,

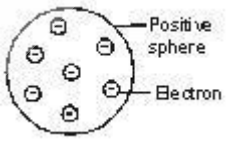
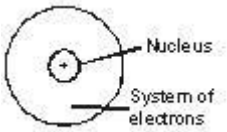
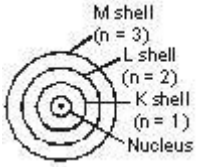
1. An atom consists of a small positively charged nucleus at its center.
2. The whole mass of the atom is concentrated at the nucleus.
3. The volume of the nucleus is smaller than the volume of the atom (by a ratio of about 1: 105).
4. The protons and neutrons of the atom are present in the nucleus.
5. The electrons of the atom, which are negatively charged, revolve around the nucleus indefinite circular paths known as orbits or which are designated as K, L, M, N etc. or numbered as (n) = 1, 2, 3, 4 etc. (outward from the nucleus).
6. As each orbit is associated with a fixed amount of energy, these orbits are also known as energy levels.
7. While revolving in discrete orbits, the electrons do not radiate energy. When an electron jumps from one energy level to another, the energy of the atom changes.



Orbits in an atom

5. Compare all the proposed models of an atom given in this chapter.

Solution:

Feature	Thomson's model of an atom	Rutherford's model of an atom	Bohr's model of an atom
1. Positive Charge (Protons)	As per Thomson's model of an atom, an atom consists of a positively charged sphere.	The positive charge is concentrated at the core of the atom, which is called nucleus.	The positive charge is present in the core of the atom, called nucleus.
2. Negative charge (electrons)	The electrons are embedded in the positively charged sphere of an atom, like the seeds in a watermelon.	The nucleus is surrounded by electrons, and the electrons and the nucleus are held together by electrostatic force of attraction.	The electrons move in discrete orbits, and each orbit is associ-ated with a definite amount of energy.
3. Diagrammatic representation			
4. Limitation:	This model could not explain the results of alpha particle scattering experiment carried out by Rutherford.	This model could not explain the stability of the atom.	Advantage: This model explains the stability of atoms.

6. Summarize the rules for writing of distribution of electrons in various shells for the first eighteen elements.

Solution:

The Bohr and Bury scheme for the distribution of electrons in an atom is based on the following rules:

1. The maximum number of electrons which a shell can have is represented by 2n2, where n is the quantum number of that particular energy shell. Thus, the maximum number of electrons in the shells is:

   1st (K) shell 2 x 12 = 2

   2nd (L) shell 2 x 22 = 8

   3rd (M) shell 2 x 32 = 18

   4th (N) shell 2 x 42 = 32

2. The outermost shell (valence shell) can have a maximum of 8 electrons.
3. The shell next to (or inner to) the outermost shell, which is called the penultimate shell, can accommodate a maximum of 18 electrons, (if permitted by rule 1).
4. Electrons are not accommodated in a given shell unless the inner shells are filled, i.e., the shells are filled in a stepwise manner.

7. Define valency by taking examples of silicon and oxygen.

Solution:

Valency is defined as the combining capacity of an atom of an element. If an atom has four or less than four electrons in its valence shell, then valency is equal to the no. of valence electrons. But if it has more than 4 valence electrons, then valency is equal to 8 minus no. of valence electrons.

Silicon has atomic number 14 and its electronic configuration is:

K	L	M
2	8	4

So, valency of silicon = 8 - 4 = 4

Oxygen has atomic number 8 and its electronic configuration is:

K	L
2	6

So, valency of oxygen = 8 - 6 = 2

8. Explain with examples

(i) Atomic number

(ii) Mass number

(iii) Isotopes and

(iv) Isobars

Give any two uses of isotopes.

Solution:

(i) Atomic number: Atomic number of an atom is the total number of protons present within the nucleus of an atom.

Example: As sodium atom has 11 protons in its nucleus, its atomic number is 11.

(ii) Mass number: Mass number of an atom is the sum total of number of proton and neutrons present in the atom.

Mass Number = No. of Protons + No. of Neutrons

Example: As a sodium atom has 11 protons and 12 neutrons in its nucleus, its mass number = 11 + 12 = 23.

(iii) Isotopes: The atoms which possess same atomic number (the atoms same element) but different mass numbers are called Isotopes.

Example: Hydrogen has three isotopes ^{11}H , ^{12}H , ^{13}H . The atomic number of all the three is 1, but their mass numbers are 1, 2 and 3 respectively.

(iv) Isobars: Isobars are the atoms of different elements having the same mass number but different atomic numbers.

Example:

Mass numbers of calcium and argon atoms are 40, but different atomic numbers 20 and 18 respectively.

Two uses of isotopes are:

(i) Isotope of uranium is used as a fuel in nuclear reactors.

(ii) Isotope of cobalt is used in the treatment of cancer.

9. Na^+ has completely filed K and L shells. Explain.

Solution: An atom of Na has a total of 11 electrons. Its electronic configuration is 2, 8, 1. But, Na+ ion has one electron less than Na atom i.e. it has 10 electrons. Therefore, 2 electrons go to K-shell and 8 electrons go to L-electrons, thereby completely filling K and L shells.

10. If bromine atom is in the form of say two isotopes $^{79}_{35}\text{Br}(49.7\%)$ and $^{81}_{35}\text{Br}\ (50.3\%)$, then calculate the average mass of bromine atom.

Solution:

Given, two isotopes of bromine are $^{79}_{35}\text{Br}(49.7\%)$ and $^{81}_{35}\text{Br}\ (50.3\%)$,

Average atomic mass of bromine atom$= 79 \times \frac{49.7}{100} + 81 \times \frac{50.3}{100}$

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

$= 80.006$ u

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

Solution:

Let the percentage of one of the isotopes in the sample be x, so that the percentage of the other isotope in the sample will be (100-x).

Mass of isotope $^{16}_{8}\text{X}$ is 16 u and let its percentage be x%.

Mass of isotope $^{18}_{8}\text{X}$ is 18 u and its percentage be $(100 - x)\%$

Average atomic mass of $\text{X} = 16 \times \frac{x}{100} + 18 \times \frac{100-x}{100}$

But, the average atomic mass of X is give as 16.2 u

Therefore, $16.2 = 16 \times \frac{x}{100} + 18 \times \frac{100-x}{100}$

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

$16.2 \times 100 = 1800 - 2x$

$2x = 1800 - 1620$

So, $x = 180/2 = 90$

Thus,

Percentage of $^{16}_{8}\text{X}$ in the sample= 90 %

Percentage of $^{18}_{8}\text{X}$ in the sample= 10 %

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

Solution:

Atomic number, Z = 3

Distribution of electrons: K = 2, L = 1 (K can have a maximum of two electrons)

So, Valency = 1, The element is Lithium (From periodic table).

13. Composition of the nuclei of two atom X and Y are given as under:

	X	Y
Protons =	6	6
Neutrons =	6	8

Give the mass numbers of X and What is the relation between the two species?

Solution:

As we know, mass number of an atom = No. of protons + No. of Neutrons

So, Mass number of X = 6 + 6 = 12

Mass number of Y = 6 + 8 = 14

As both X and Y have the same atomic number (6) but different mass numbers (i.e., 12 and 14 respectively), so they are isotopes.

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.

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

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

(d) An isotope of iodine is used for making tincture of iodine which is used as a medicine.

Solution:

(a) F (Rutherford proposed that the nucleus of an atom contains only nucleons.)

(b) F (Neutron is an independent subatomic particle)

(c) T (It is observed from experiments)

(d) F (Tincture iodine is solution of ordinary iodine in alcohol)

15. Rutherford's alpha-particle scattering experiment was responsible for the discovery of

(a) Atomic nucleus

(b) Electron

(c) Proton

(d) Neutron

Solution: (a)

Atomic nucleus

Rutherford's alpha-particle scattering experiment was responsible for the discovery of atomic nucleus.

16. Isotopes of an element have:

(a) the same physical properties

(b) different chemical properties

(c) different number of neutrons

(d) different atomic numbers

Solution: (c)

Isotopes of an element have different numbers of neutrons.

17. Number of valence electrons in Cl^- ion is

(a) 16

(b) 8

(c) 17

(d) 18

Solution: (b)

Electronic configuration of Cl (Atomic number = 17) will be 2,8,7

Cl- will gain one more electron. Hence, number of valence electrons will be = 7+1 = 8.

18. Which one of the following is a correct electronic configuration of sodium?

(a) 2, 8

(b) 8, 2, 1

(c) 2, 1, 8

(d) 2, 8, 1

Solution: (d)

Atomic number of sodium (Na) = 11. Hence, K shell will have 2 electrons, L will have 8 and M shell (valence shell) will have 1 electron.

Electronic configuration will be 2, 8, 1.

19 Complete the following table:

Atomic Number	Mass Number	Number of Neutron	Number of protons	Number of Electrons	Name of the atomic species
9	–	10	–	–	–
16	32	–	–	–	Sulphur
–	24	–	12	–	–
–	2	–	1	–	–
–	1	0	1	0	–

Solution:

We know that,

Atomic number = Number of protons = Number of electrons

First row:

Mass number = number of protons + number of neutrons = 9 + 10 = 19

Second row:

Since atomic no. is 16 so, number of protons = number of electrons = 16

Number of neutrons = Mass number - number of protons = 32 - 16 = 16

Third row:

Number of protons = Atomic number = 12

So, the element is Magnesium.

Number of electrons = number of protons = 12

Number of neutrons = Mass number - number of protons = 24 - 12 = 12

Fourth row:

Number of protons = Atomic number = 1

So, the element is Deuterium.

Number of electrons = number of protons = 1

Number of neutrons = Mass number - number of protons = 2 - 1 = 1

Fifth row:

Number of protons = Atomic number = 1

The element is Protium since the mass number is 1.

Atomic number	Mass number	Number of neutrons	Number of protons	Number of electrons	Name of the atomic species
9	19	10	9	9	Fluorine
16	32	16	16	16	Sulphur
12	24	12	12	12	Magnesium
1	2	1	1	1	Deuterium
1	1	0	1	0	Protium