NCERT QUESTIONS WITH SOLUTION

1. What are canal rays?

Ans. Canal rays (or anode rays) are beams of positive ions that are created by certain types of gas discharge tubes. They were first observed in Crookes tubes during experiments by the German scientist Eugen Goldstein, in 1886. These rays were called canal rays because they passed through the canals or holes of the cathode.

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

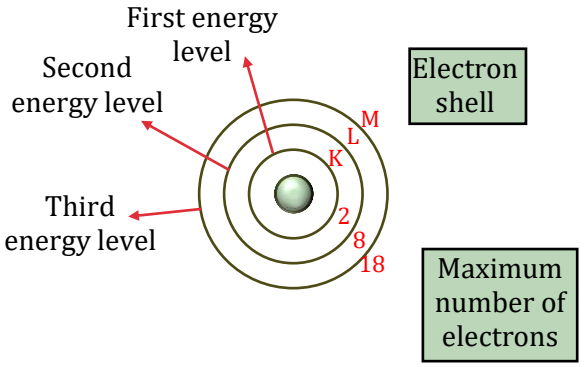
Ans. An electron is a negatively charged particle, where as a proton is a positively charged particle. The magnitude of their charges is equal. Therefore, it will be a neutral atom.

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

Ans. J. J Thomson, the discoverer of the electron believed that the atom is a uniform sphere of positive charge with electrons (raisins) embedded in it. The positive charge due to protons and negative charge due to electrons balance each other and so an atom as a whole is electrically neutral.

4. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

Ans. Protons which are positively-charged particles are present in the nucleus of an atom.



Different energy levels

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

Ans. If α-particle scattering experiment is carried out using a foil of any metal as thin as gold foil used by Rutherford, there would be no change in observations. But since other metals are not so malleable so, such a thin foil is difficult to obtain. If we use a thick foil, then more α-particles would bounce back and no idea about the location of positive mass in the atom would be available with such a certainty.

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

Ans. The three sub-atomic particles of an atom are:
Protons, Electrons and Neutrons.

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

Ans. The mass of an atom is given by the sum of the masses of protons and neutrons present in the nucleus. Since helium atom has an atomic mass of 4u and it has two protons, the protons contribute 2u to atomic mass. Hence, it must contain 2 neutrons as each neutron contributes 1u to the nucleus.

9. Write the distribution of electrons in carbon and sodium atoms?

Ans. The total number of electrons in a carbon atom is 6. The distribution of electrons in carbon atom is given by:
First orbit or K-shell = 2 electrons
Second orbit or L-shell = 4 electrons
or, we can write the distribution of electrons in a carbon atom as 2, 4.
The total number of electrons in a sodium atom is 11. The distribution of electrons in sodium atom is given by:
First orbit or K-shell = 2 electrons
Second orbit or L-shell = 8 electrons
Third orbit or M-shell = 1 electron
Or, we can write distribution of electrons in a sodium atom as 2, 8, 1.

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

Ans. The maximum number of electrons that can occupy K and L-shells of an atom are 2 and 8 respectively. Therefore, if K and L-shells of an atom are full, then the total number of electrons in the atom would be (2 + 8) = 10 electrons.

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

Ans. (i) Atomic number of chlorine = 17
∴ Distribution of electrons
= K L M
2 8 7
Thus, outermost shell has 7 electrons. It can easily complete its octet by gaining one electron. Hence, its valency = 1.
(ii) Atomic number of sulphur = 16
∴ Distribution of electrons
= K L M
2 8 6
Thus, outermost shell has 6 electrons.
Hence, valency = 8 – 6 = 2
(iii) Atomic number of magnesium = 12
∴ Distribution of electrons
= K L M
2 8 2
Thus, outermost shell has 2 electrons. It can easily complete its octet by loosing two electrons. Hence, its valency = 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?

Ans. (i) Atomic number = number of protons.= 8.
(ii) Number of electrons (-ve)
= number of protons (+ve),
therefore, the charge on the atom is 0.

13. Oxygen atom has 8 electrons, 8 protons and 8 neutrons whereas sulphur atom has 16 electrons, 16 protons and 16 neutrons. Find out the mass number of oxygen and sulphur atoms.

Ans. Mass number of oxygen = Number of protons + Number of neutrons
= 8 + 8 =16
Mass number of sulphur = Number of protons + Number of neutrons
= 16 +16 = 32

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

Ans.

Symbol	Proton	Neutron	Electron
H	1	0	1
D	1	1	1
T	1	2	1

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

Ans. $^{12}_{6}C$ and $^{14}_{6}C$ are isotopes, have the same electronic configuration as (2, 4).
$^{40}_{20}Ca$ and $^{40}_{18}Ar$ are isobars. They have different electronic configuration as given below:
$^{40}_{20}Ca$ – 2, 8, 8, 2
$^{40}_{18}Ar$ – 2, 8, 8

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

Ans. **Electron**

(i) Electrons are present outside the nucleus of an atom.
(ii) Electrons are negatively charged.
(iii) The mass of an electron is considered to be negligible.

Proton

(i) Protons are present in the nucleus of an atom.
(ii) Protons are positively charged.
(iii) The mass of a proton is approximately 2000 times as the mass of an electron

Neutron

(i) Neutrons are present in the nucleus of an atom.
(ii) Neutrons are neutral.
(iii) The mass of neutron is nearly equal to the mass of a proton.

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

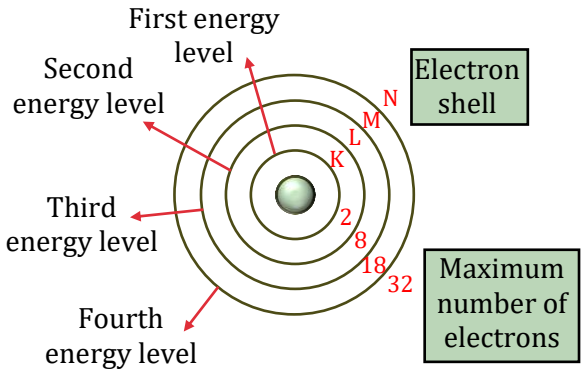
Ans. According to J.J. Thomson's model of an atom, an atom consists of a positively charged sphere with electrons embedded in it. However, it was later found that the positively charged particles reside at the centre of the atom called the nucleus, and the electrons revolve around the nucleus.

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

Ans. According to Rutherford's model of an atom, electrons revolve around the nucleus in fixed orbits. But, an electron revolving in circular orbits will not be stable because during revolution, it will experience acceleration. Due to acceleration, the electrons will lose energy in the form of radiation and fall into the nucleus. In such a case, the atom would be highly unstable and collapse.

19. Describe Bohr's model of the atom.

Ans. Bohr's model of the atom



Different energy levels

Neils Bohr proposed the following postulates regarding the model of the atom.

(i) Only certain orbits known as discrete orbits of electrons are allowed inside the atom.

(ii) While revolving in these discrete orbits, the electrons do not radiate energy.

These discrete orbits or shells are shown in the following diagram.

The first orbit (i.e., for n = 1) is represented by letter K. Similarly, for n = 2, it is L shell, for n = 3, it is M shell and for n = 4, it is N shell. These orbits or shells are also called energy levels.

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

Thomson's model, Rutherford's model, Bohr's model

Ans.

Thomson's model	Rutherford's model	Bohr's model
An atom consists of a positively charged sphere with electrons embedded in it.	An atom consists of a positively charged particles concentrated at the centre known as the nucleus. The size of the nucleus is very small as compared to the size of the atom. The electrons revolve around the nucleus in well-defined orbits.	There are only certain orbits known as discrete orbits inside the atom in which electrons revolve around the nucleus. Electrons do not radiate energy while revolving.

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

Ans. The rules for writing of the distribution of electrons in various shells for the first eighteen elements are given below.

(i) The maximum number of electrons that a shell can accommodate is given by the formula '$2n^2$', where 'n' is the orbit number or energy level index (n = 1, 2, 3...).

The maximum number of electrons present in an orbit of n = 1 is given by $2n^2 = 2 \times 1^2 = 2$

Similarly, for second orbit, it is $2n^2 = 2 \times 2^2 = 8$

For third orbit, it is $2n^2 = 2 \times 3^2 = 18$

And so on.....

(ii) The outermost orbit can be accommodated by a maximum number of 8 electrons.

(iii) Shells are filled with electrons in a stepwise manner i.e., the outer shell is not occupied with electrons unless the inner shells are completely filled with electrons.

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

Ans. The valency of an element is the combining capacity of that element. The valency of an element is determined by the number of valence electrons present in the atom of that element.

If the number of valence electrons of the atom of an element is less than or equal to four, then the valency of that element is equal to the number of valence electrons. For example, the atom of silicon has four valence electrons. Thus, the valency of silicon is four.

On the other hand, if the number of valence electrons of the atom of an element is greater than four, then the valency of that element is obtained by subtracting the number of valence electrons from eight. For example, the atom of oxygen has six valence electrons. Thus, the valency of oxygen is (8 – 6) i.e., two.

23. Explain with examples

(i) Atomic number,

(ii) Mass number,

(iii) Isotopes and

(iv) Isobars. Give any two uses of isotopes.

Ans. (i) Atomic number

The atomic number of an element is the total number of protons present in the atom of that element. For example, nitrogen has 7 protons in its atom. Thus, the atomic number of nitrogen is 7.

(ii) Mass number

The mass number of an element is the sum of the number of protons and neutrons present in the atom of that element. For example, the atom of boron has 5 protons and 6 neutrons. So, the mass number of boron is 5 + 6 = 11.

(iii) Isotopes

Isotopes are atoms of the same element having the same atomic number, but different mass numbers. For example, hydrogen has three isotopes. They are protium, deuterium, and tritium.

(iv) Isobars

Isobars are atoms having the same mass number, but different atomic numbers i.e., isobars are atoms of different elements having the same mass number. For example $^{40}_{20}Ca$ and $^{40}_{18}Ar$ are isobars.

Two uses of isotopes are:

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

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

24. Na^+ has completely filled K and L shells. Explain.

Ans. An atom of Na has total 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-shell, thereby completely filling K and L shells.

25. If bromine atom is available in the form of Br^{79}, Br^{81}, say, two isotopes (49.7%) and (50.3%), calculate the average atomic mass of bromine atom.

Ans. It is given that two isotopes of bromine are (49.7%) and (50.3%). Then, the average atomic mass of bromine atom is given by:

$\therefore$ Average atomic mass of Br

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

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

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

Ans. Suppose percentage of isotope $^{16}_{8}X = x$

Then percentage of isotope $^{18}_{8}X = (100 - x)$

$\therefore$ Average atomic mass

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

$$= \frac{1800 - 2x}{100} = 18 - 0.02\,x$$

$\therefore$ $18 - 0.02\,x = 16.2$ (Given)

or $0.02\,x = 1.8$ or $x = \frac{1.8}{0.02} = 90$

Hence, percentage of $^{16}_{8}X = 90\%$

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

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

Ans. By Z = 3, we mean that the atomic number of the element is 3. Its electronic configuration is 2, 1. Hence, the valency of the element is 1 (since the outermost shell has only one electron).

Therefore, the element with Z = 3 is lithium.

28. 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 numbers of X and Y. What is the relation between the two species?

Ans. Mass number of X = Number of protons + Number of neutrons = 6 + 6 = 12

Mass number of Y = Number of protons + Number of neutrons = 6 + 8 = 14

These two atomic species X and Y have the same atomic number, but different mass numbers. Hence, they are isotopes.

29. 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 iodine, which is used as a medicine.

Ans. (a) (F) (b) (F)
(c) (T) (d) (F)

30. Choose the correct answer:
Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) Atomic nucleus (b) Electron
(c) Proton (d) Neutron

Ans. (a)

31. Choose the correct answer:
Isotopes of an element have
(a) the same physical properties
(b) different chemical properties
(c) different number of neutrons
(d) different atomic numbers

Ans. (c)

32. Choose the correct answer:
Number of valence electrons in Cl^- ion are
(a) 16 (b) 8
(c) 17 (d) 18

Ans. (b)

33. 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

Ans. (d)

34. Complete the following table.

Atomic no.	Mass number	No. of Neutrons	No of protons	No. of electrons	Name of the Element
9		10			
16	32				Sulphur
	24		12		
	2		1		
	1	0	1	1	

Ans.

Atomic no.	Mass number	No. of Neutrons	No. of protons	No. of electrons	Name of the Atomic
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	1	Protium

EXERCISE-01

Multiple choice questions

1. The charge/mass ratio of electrons
(1) depends upon the nature of gas
(2) remains constant
(3) nucleons
(4) both (1) and (3)

2. When a gas at reduced pressure is subjected to an electric discharge, the rays originating from the negative electrode are
(1) anode rays
(2) cathode rays
(3) X-rays
(4) radiation ray

3. $^{40}_{18}Ar$ and $^{40}_{20}Ca$ have the same number of
(1) electron
(2) proton
(3) nucleons
(4) both (1) and (3)

4. Plum-Pudding model is also known as
(1) Rutherford Model
(2) Thomson's model
(3) Bohr Model
(4) All of these

5. The first model of an atom was given by
(1) N. Bohr (2) E. Goldstein
(3) Rutherford (4) J.J. Thomson

6. With respect to Thomson's model of atom, which of the following statements are correct?
(i) The mass of the atom is assumed to be uniformly distributed over the atom.
(ii) The positive charge is assumed to be uniformly distributed over the atom.
(iii) The electrons are uniformly distributed in the positively charged sphere.
(iv) The electrons attract each other to stabilise the atom.
(1) (i), (ii) and (iii) (2) (i) and (iii)
(3) (i) and (iv) (4) (i), (iii) and (iv)

7. Rutherford's α–particle scattering experiment showed that
(i) electrons have negative charge.
(ii) the mass and positive charge of the atom is concentrated in the nucleus.
(iii) neutron exists in the nucleus.
(iv) most of the space in atom is empty.
Which of the above statements are correct?
(1) (i) and (iii) (2) (ii) and (iv)
(3) (i) and (iv) (4) (iii) and (iv)

8. Which of the following statements about Rutherford's model of atom are correct?
(i) He considered the nucleus as positively charged.
(ii) He established that the α–particles are four times as heavy as a hydrogen atom.
(iii) It can be compared to solar system.
(iv) It was in agreement with Thomson's model.
(1) (i) and (iii)
(2) (ii) and (iii)
(3) (i) and (iv)
(4) (i) only

9. Rutherford's alpha (α) particles scattering experiment' resulted in to discovery of
(1) Electron
(2) Proton
(3) Nucleus in the atom
(4) Atomic mass

10. Which of the following is not correct observation/conclusion from Rutherford scattering experiment?
(1) Nucleus is small but heavy.
(2) Nucleus always carries positive charge.
(3) Atom is nearly 10^5 times greater than the size of the nucleus.
(4) The number of α-particle hitting the nucleus is very large.

11. Atomic model has been improved over the years. Arrange the following atomic models in the order of their chronological order.
(i) Rutherford's atomic model
(ii) Thomson's atomic model
(iii) Bohr's atomic model
(1) (i), (ii) and (iii)
(2) (ii), (iii) and (i)
(3) (ii), (i) and (iii)
(4) (iii), (ii) and (i)

12. Nucleus consist of
(1) proton and electron
(2) proton and neutron
(3) neutron and electron
(4) only neutron

13. Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(1) proton (2) electron
(3) neutron (4) atomic nucleus

14. Deflection back of a few particles on hitting thin foil of gold shows that
(1) nucleus is heavy
(2) nucleus is small
(3) both (1) and (2)
(4) electron create hindrance in the movement ofα-particles.

15. Neutron is a fundamental particle which has
(1) +1 unit charge and 1 unit mass.
(2) no charge and 1 unit mass.
(3) have no charge and mass.
(4) have –1 unit charge and 1 unit mass.

16. Mass number of element is
(1) number of protons in its nucleus
(2) number of electrons and protons in the atom
(3) number of neutrons and protons in the nucleus
(4) number of neutrons in the nucleus

17. Which species does not contain neutron?
(1) H (2) Li^{+2} (3) C (4) O

18. Atomic number of any element is -
(1) atomic weight divided by two
(2) number of neutron in nucleus
(3) nucleus weight
(4) nuclear charge

19. Lightest particle is
(1) neutron (2) electron
(3) proton (4) none of these

20. Fundamental particle of atomic nucleus is
(1) p^+, e^- (2) p^+, n^0, e^-
(3) p^+, n^0 (4) n^0, e^-

21. The atomic size is nearly
(1) 10^{-10}cm (2) 10^{-6}m
(3) 10^{-7}m (4) 10^{-10}m

22. An atom which has a mass number of 14 and 8 neutrons is
(1) isotope of oxygen
(2) isotope of nitrogen
(3) isotope of carbon
(4) isobar of carbon

23. The total number of neutrons in zinc (Z = 30) with mass number 70 is
(1) 40 (2) 20 (3) 36 (4) 38

24. Which of the following statement is always correct?
(1) An atom has equal number of electrons and protons.
(2) An atom has equal number of electrons and neutrons.
(3) An atom has equal number of protons and neutrons.
(4) An atom has equal number of electrons, protons and neutrons.

25. An atom with 3 protons and 4 neutrons will have a valency of
(1) 3 (2) 7 (3) 1 (4) 4

26. Elements with valency 1 are
(1) always metals
(2) always metalloids
(3) either metals or non-metals
(4) always non-metals

27. In a sample of ethyl ethanoate ($CH_3COOC_2H_5$) the two oxygen atoms have the same number of electrons but different number of neutrons. Which of the following is the correct reason for it?
(1) One of the oxygen atoms has gained electrons.
(2) One of the oxygen atoms has gained two neutrons.
(3) The two oxygen atoms are isotopes.
(4) The two oxygen atoms are isobars.

28. The ion of an element has 3 positive charges. Mass number of the atom is 27 and the number of neutrons is 14. What is the number of electrons in the ion?
(1) 13 (2) 10 (3) 14 (4) 16

29. Which of the following are true for an element?
(i) Atomic number = number of protons + number of electrons
(ii) Mass number = number of protons + number of neutrons
(iii) Atomic mass = number of protons = number of neutrons
(iv) Atomic number = number of protons = number of electrons
(1) (i) and (ii) (2) (i) and (iii)
(3) (ii) and (iii) (4) (ii) and (iv)

30. The number of electrons in an element X is 15 and the number of neutrons is 16. Which of the following is the correct representation of the element?
(1) $^{31}_{15}X$ (2) $^{31}_{16}X$
(3) $^{16}_{15}X$ (4) $^{15}_{16}X$

31. Neutron is present in all atom except
(1) protium (2) deuterium
(3) tritium (4) helium

32. A monovalent anions has 10 electrons and 10 neutrons. The atomic number and mass number of the element are respectively
(1) 10, 20 (2) 9, 18
(3) 20, 10 (4) 9, 19

33. A trivalent cation of an element contains 10 electrons. The atomic number of the element is
(1) 10 (2) 7
(3) 13 (4) none of these

34. The charge and mass of the nucleus of helium atom are respectively
(1) +2, 4u (2) +1, 1u
(3) +2, 1u (4) +2, 2u

35. The number of electrons in the M-shell of the element with atomic number 16 is
(1) 6 (2) 8 (3) 2 (4) 4

36. The number of valence electron in Na is
(1) 1 (2) 2 (3) 3 (4) 4

37. The sum of number of neutron and protons in one of the isotopes of hydrogen is
(1) 4 (2) 2 (3) 5 (4) 6

38. The maximum number of electrons that can be accommodated in the n^{th} level is
(1) n^2 (2) $2n^2$ (3) $4n^2$ (4) n

39. Number of valence electron in Ar are
(1) 8 (2) 18 (3) 19 (4) 20

40. Which one of the following is a correct electronic configuration of calcium?
(1) 2, 8, 8, 1 (2) 2, 6, 8, 2
(3) 2, 8, 8, 2 (4) 2, 8, 2, 8

41. The electron distribution in an aluminium atom is
(1) 2, 8, 3 (2) 2, 8, 2
(3) 8, 2, 3 (4) 2, 3, 8

42. Which of the following correctly represent the electronic distribution in the Mg atom?
(1) 3, 8, 1 (2) 2, 8, 2
(3) 1, 8, 3 (4) 8, 2, 2

43. Which isotope is used in treatment of blood cancer?
(1) Co-60 (2) U-235
(3) P-32 (4) Iodine

44. Which isotope is generally used as a nuclear fuel?
(1) U-235 (2) Co-60
(3) P-32 (4) Iodine

45. Which of the following isotope is used in the treatment of cancer?
(1) P-32
(2) I-131
(3) Co-60
(4) Any one of these

46. $_{18}Ar^{40}$, $_{19}K^{40}$, $_{20}Ca^{40}$ are
(1) isotopes (2) isobars
(3) both (1) and (2) (4) none of these

47. According to the Dalton's atomic theory,
(1) electrons, proton and neutron are found in atom.
(2) atom is indivisible.
(3) atom of various element have same properties.
(4) atoms are destroyed in the chemical reaction.

48. $^{35}_{17}Cl$ and $^{37}_{17}Cl$ differ from each other in number of
(1) electron
(2) proton
(3) neutron
(4) both (1) and (3)

49. Which of the following shows the electronic configuration of Ca^{2+}?
(1) He (2) Ne (3) Ar (4) Xe

50. Isotopes of an element are the atom which have
(1) the same number of neutrons in their nuclei.
(2) the same mass number.
(3) different number of electrons in their orbit.
(4) the same number of proton in their nuclei.

True or False

1. The mass of an electron is $\frac{1}{1837}$ about times that of proton.
2. J.J. Thomson proposed that the nucleus of an atom contain only nucleons.
3. Hydrogen does not have neutron.
4. Helium does not have neutron.
5. The valency of potassium is 2.
6. Neutron were discovered by Henry Becquerel.
7. In Na^+ number of e^- are more than the number of protons.
8. Neutron is sum of proton plus electron and therefore, it is neutral.
9. The number of protons in Na^+ is 10 (Z = 11).
10. Isobars of differ in the number of neutron.

Fill in the blanks

1. The fundamental particles of an atom are _____, _____ and_____.
2. Electron are _____ charged particle.
3. Alpha-particle scattering experiment was responsible for the discovery of_____.
4. Rutherford's α-particle scattering experiment led to the discovery of the _____.
5. Protons were discovered by _____and electron _____ and neutrons by _____.
6. The electronic configuration of silicon is _____ and that of sulphur is _____.
7. Neon and chlorine have atomic numbers 10 and 17 respectively. Their valencies will be _____ and _____ respectively.
8. The sum of number of protons and neutrons in the nucleus of an atom is called its _____.
9. The maximum number of electrons that can be present in the outermost shell of an atom is _____.
10. Neutron are not present in _____.
11. The charge on the atom containing 17 protons, 18 neutrons and 18 electrons is _____.
12. An element has mass number 23, its atomic number is 11, the number of neutrons will be equal to ____.
13. The atomic number is equal to the number of ____.
14. $_6C^{12}$ contain ____ protons and ____ neutrons.
15. Neutron have mass equal to ____ but have ____ electric charge.
16. The scientist who discovered the nucleus is ____.
17. $_{17}Cl^{35}$ and $_{17}Cl^{37}$ are ____.
18. Isotopes have same ____.
19. Isobars have same number of ____.
20. Isotopes have same ____ but different ____.

Match the column

1. Match the description in column B with the term/statement in column A.

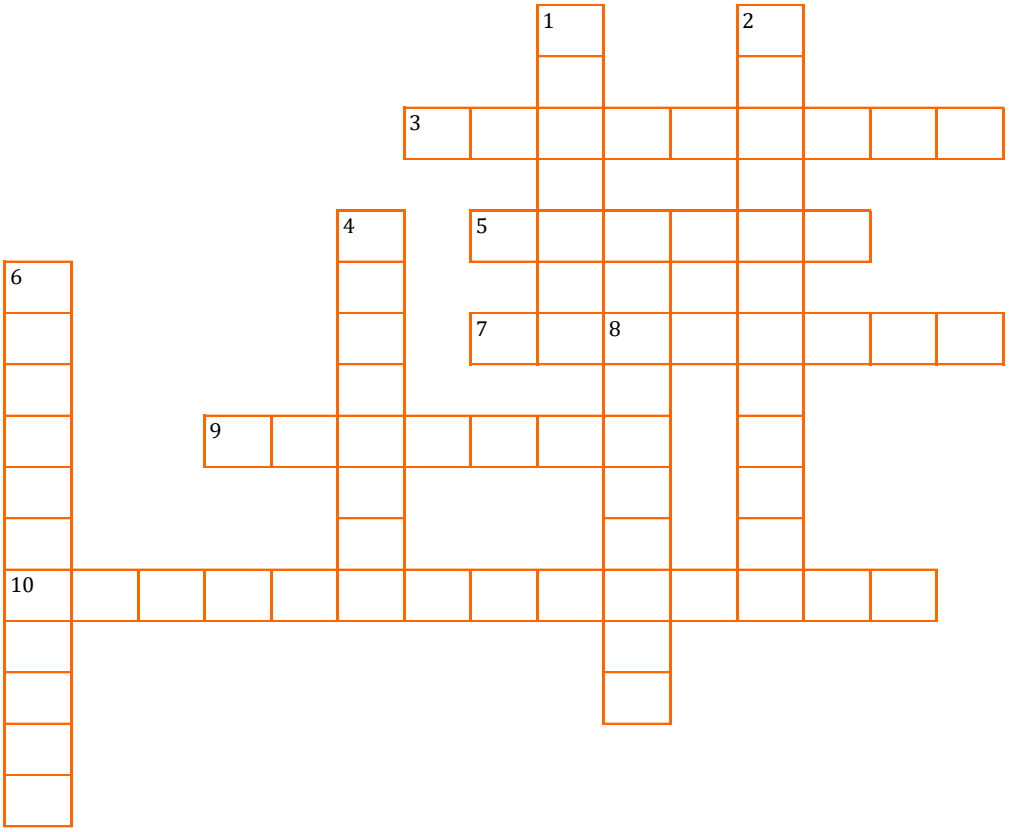
Column-I	Column-II
(A) Isobars	(i) Shells in an atom
(B) Isotopes	(ii) Number of +ve charge on the nucleus.
(C) Valence electrons	(iii) Electron present in outer most shell.
(D) Electron	(iv) Negative charged particle having in elements.
(D) K, L, M, N	(v) Atoms having same atomic number but different mass number.
(E) Mass number	(vi) Same mass number but different atomic number
(F) Atomic number	(vii) The number of protons and neutrons in the nucleus.

2. Match the names of the Scientists given in column-I with their contributions towards the understanding of the atomic structure as given in column-II

Column-I	Column-II
(A) Ernest Rutherford	(i) Indivisibility of atoms
(B) J.J.Thomson	(ii) Stationary orbits
(C) Dalton	(iii) Concept of nucleus
(D) Neils Bohr	(iv) Discovery of electrons
(E) James Chadwick	(v) Neutron
(F) E. Goldstein	(vi) Canal rays

Crossword puzzle

Complete the puzzle using the clues about chemical reactions shown below.



Down

1. Particle with no charge.

2. The most common isotope of carbon.

4. The lightest element.

6. Elements having an unstable nucleus are

8. Negatively charged particle.

Across

3. Isotope of hydrogen with one neutron.

5. Positively charged particle in the nucleus.

7. Helium, neon, argon, or krypton.

9. An atom of an element with a different number of neutrons in the nucleus.

10. The isotope of carbon that is used for dating things in archaeology.

Fill in the blank spaces in the table below

Name	Symbol	Atomic Number	Number of Protons	Number of Electrons	Electron Arrangement
Hydrogen					
Helium					
Lithium					
Beryllium					
Boron					
Carbon					
Nitrogen					
Oxygen					
Fluorine					
Neon					
Sodium					
Magnesium					
Aluminium					
Silicon					
Phosphorus					
Sulfur					
Chlorine					
Argon					
Potassium					
Calcium					

ANSWER KEY

Multiple choice questions

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	**2**	**2**	**3**	**2**	**4**	**1**	**2**	**1**	**3**	**4**	**3**	**2**	**4**	**3**	**2**
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	**3**	**1**	**4**	**2**	**3**	**4**	**3**	**1**	**1**	**3**	**3**	**3**	**2**	**4**	**1**
Question	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Answer	**1**	**4**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**3**	**1**	**2**	**3**	**1**	**3**
Question	46	47	48	49	50										
Answer	**2**	**2**	**3**	**3**	**4**										

True or False

1. True **2.** False **3.** True **4.** False **5.** False

6. False **7.** False **8.** False **9.** False **10.** True

Fill in the blanks

1. e^-, p^+ and n^0 **2.** negative **3.** nucleus **4.** nucleus

5. Goldstein, J.J. Thomson, Chadwick

6. 2,8,4 ; 2,8,6 **7.** zero, one **8.** mass number **9.** 8

10. hydrogen **11.** negative **12.** 12 **13.** proton

14. 6, 6 **15.** proton, no **16.** Rutherford **17.** isotopes

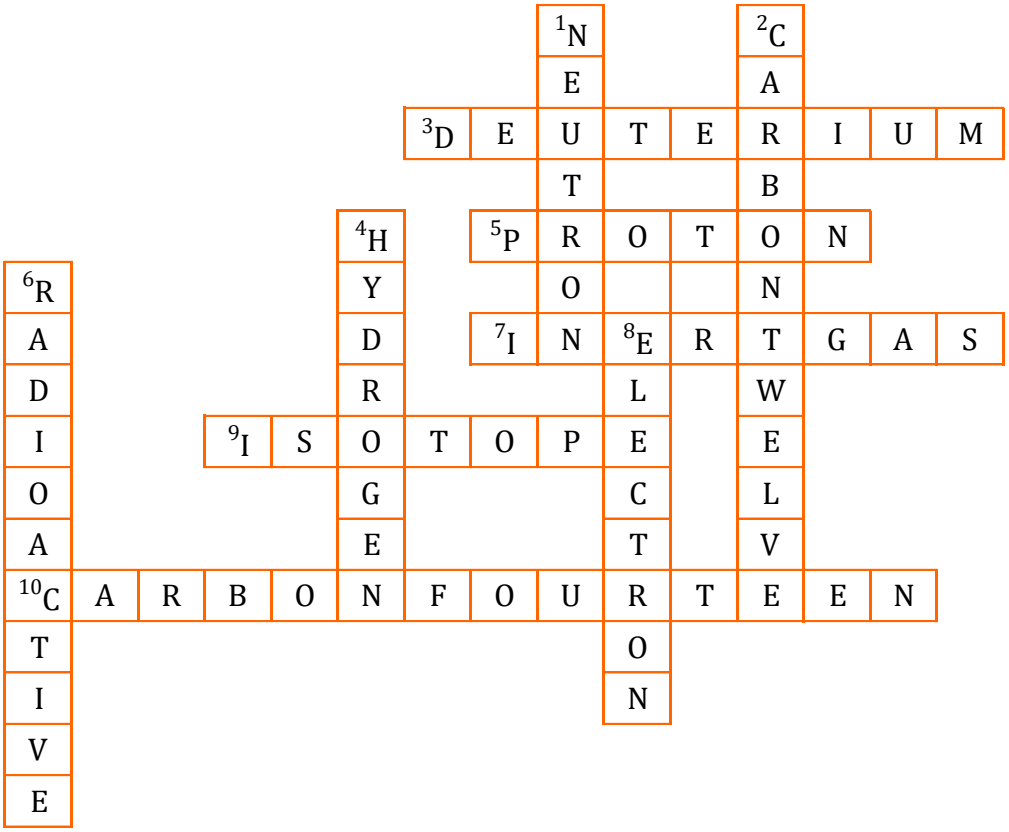
18. atomic number **19.** mass number **20.** atomic number, mass number

Match the column

1. (A) → (vi), (B) → (v), (C) → (iii), (D) → (iv), (E) → (i), (F) → (vii), (G) → (ii)

2. (A) → (iii), (B) → (iv), (C) → (i), (D) → (ii), (D) → (v), (F) → (vi)

Crossword puzzle



Fill in the blank space in the table below

TRY YOUR SELF.

EXERCISE-02

Very short answer type questions

1. Write any two observations which support the fact that atoms are divisible.
2. How many times a proton is heavier than an electron?
3. Compare the properties of electron, proton and neutron.
4. What is an orbit?
5. What is a proton? How does it differ from a neutron?
6. Is it possible for the atom of an element to have one electron, one proton and no neutron. If so, name the element.
7. Who was the first to discover neutrons?
8. Why are anode rays called canal rays?
9. Define valency and valence shell.
10. Find the atomic number of an element whose atom has the electronic configuration 2, 8, 4.
11. The mass number and atomic number of an element is 23 and 11 respectively. What is the number of nucleons present in it?
12. What determines the number of positive charges on the nucleus?
13. An element may be represented as $^{40}_{18}X$. Find the number of electrons, protons and neutrons in this atom. Give its electronic configuration.
14. Calculate the number of neutrons present in the nucleus of an element X which is represented as $^{31}_{15}X$.
15. An element X has a mass number 4 and atomic number 2. Write the valency of this element?
16. Out of O^{16} and O^{18} isotopes, which has more number of neutrons?
17. Give one example of isobars.
18. How many electrons at the maximum can be present in the first shell?
19. What is the electronic configuration of Neon?
20. An element has atomic number 19 and mass number 39. How many electron and protons are present in the unipositive ion of this element?

Short answer type questions

1. What are the differences in the discharge tubes used to study cathode rays and positive rays?
2. Give four properties of cathode rays.
3. What would you conclude from the observation that cathode rays rotate a light paddle wheel placed in their path?
4. What are the characteristic features of Thomson's model of atom?
5. What are the main postulates of Bohr's atomic theory?

6. Give evidence to support that the nucleus of an atom is dense and positively charged.

7. Write the Bohr Bury scheme to fill the electrons in various energy levels of an atom? Using these rules, write the electron arrangement of the elements having atomic numbers 6, 11, 15 and 18.

8. Why did Rutherford select a gold foil in his α–ray scattering experiment?

9. Are relative atomic masses of elements whole numbers?

10. What do you understand by atomic number and mass number?

11. What is mass number of an element? How is the mass number related to the protons and neutrons present in the nucleus of an atom?

12. The atomic number of calcium and argon are 20 and 18 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements?

13. Write down the electron distribution of chlorine atom. How many electrons are there in the L shell? (Atomic number of chlorine is 17).

14. In the atom of an element X, 6 electrons are present in the outermost shell. If it acquires noble gas configuration by accepting requisite number of electrons, then what would be the charge on the ion so formed?

15. In response to a question, a student stated that in an atom, the number of protons is greater than the number of neutrons, which in turn is greater than the number of electrons. Do you agree with the statement? Justify your answer.

16. Helium atom has 2 electrons in its valence shell but its valency is not 2. Explain.

17. Why do Helium, Neon and Argon have a zero valency?

18. Complete the table on the basis of information available in the symbols given below

(a) $^{37}_{17}Cl$ (b) $^{12}_{6}C$ (c) $^{81}_{35}Br$

Element	No. of Protons	No. of Neutrons

19. One electron is present in the outer most shell of the atom of an element X. What would be the nature and value of charge on the ion formed if this electron is removed from the outer most shell?

20. Will ^{35}Cl and ^{37}Cl have different valencies? Justify your answer.

21. Consider an atom of manganese, represented as $^{55}_{25}Mn$. Give the number of:

(i) electron

(ii) protons

(iii) nucleons present in the atom.

22. Oxygen has three isotopes having mass number 16, 17 and 18. How do atoms of these isotopes differ?

23. Write electronic configuration for the following elements: $^{16}_{8}O$, $^{28}_{14}Si$, $^{35.5}_{17}Cl$, $^{40}_{18}Ar$

24. What are isotopes? Write three isotopes of hydrogen.

25. What are the maximum number of electrons that can be present in the K, L and M shells?

Long answer type questions

1. Who discovered the presence of electrons in an atom? Discuss detailed experiment connected with it. How is its mass and charge determined?

2. Describe Rutherford's experiment to establish the position of electrons and protons in an atom.

3. Enlist the conclusions drawn by Rutherford from his α-ray scattering experiment.

4. What were the drawbacks of Rutherford's model of an atom?

5. In what way is the Rutherford's atomic model different from that of Thomson's atomic model?

6. What are the postulates of Bohr's model of an atom?

7. Discuss in brief the Bohr's model of atom.

8. Show diagrammatically the electron distributions in a sodium atom and a sodium ion and also give their atomic number.

9. Define isotopes. What are the essential characteristics of isotopes? Give important application of isotopes.

10. Write brief notes on:

(i) Isotopes

(ii) Isobars

Exercise-01 Solutions

Multiple choice questions

1. Option (2)

The charge/mass ratio of electrons remains constant.

2. Option (2)

Cathode rays are carrying negatively charged particles. These rays are originated from the negative electrode.

3. Option (3)

Nucleons i.e. p + n are same i.e. 40.

4. Option (2)

Thomson's Model of atom also called as plum pudding Model.

5. Option (4)

First model of an atom was given by J.J. Thomson.

6. Option (1)

(i), (ii) and (iii)

Electrons are negatively charged particles, repel each other.

7. Option (2)

(ii) and (iv)

The mass and positive charge of the atom is concentrated in the nucleus. Most of the space in atom is empty.

8. Option (1)

(i) and (iii)

He considered the nucleus as positively charged. It can be compared to solar system.

9. Option (3)

Rutherford's alpha (α) particles scattering experiment' resulted in to discovery of Nucleus in the atom.

10. Option (4)

The number of α - particles hitting the nucleus is very small because nucleus is very small.

11. Option (3)

(ii), (i) and (iii)

12. Option (2)

Nucleus is composed of Protons and neutrons.

13. Option (4)

Atomic nucleus

14. Option (3)

Deflection back of a few particles on hitting thin foil of gold shows that nucleus is small and heavy.

15. Option (2)

No Charge and 1 unit mass, so it is neutral.

16. Option (3)

Mass number of element is the number of neutrons and protons in nucleus.

17. Option (1)

Number of neutrons = mass of an atom – number of protons

For hydrogen mass = 1, number of protons = 1.

So, number of neutrons = 1 – 1 = 0

18. Option (4)

Atomic number of any element is equal to its Nuclear charge.

19. Option (2)

Electron carrying 9.31×10^{-31} kg of mass.

20. Option (3)

Fundamental particle of atomic nucleus is P^{+}; n^{0}

21. Option (4)

The atomic size is nearly 10^{-10}m

22. Option (3)

Isotope of carbon is $^{14}_{6}C$

Atomic No. = mass No. – No. of neutrons = 14 – 8 = 6 i.e., $^{14}_{6}C$

23. Option (1)

40

No. of neutrons = Mass No. – No. of protons = 70 – 30 = 40

24. Option (1)

An atom has equal no. of electrons and protons.

25. Option (3)

1

No. of electrons = 3

Electronic configuration

K, L

2, 1 $\rightarrow$ Valence electron

26. Option (3)

Either metals or non - metals.

Alkali metals = +1; halogens = – 1

27. Option (3)

The two oxygen atoms are isotopes.

28. Option (2)

10

Number of protons = atomic number = atomic mass – number of neutrons

P = 27 – 14 = 13.

No. of electron = No. of protons – 3 = (27 – 14) – 3 = 10

29. Option (4)

(ii) and (iv)

Mass number = number of protons + number of neutrons,

Atomic number = number of protons = number of electrons

30. Option (1)

$^{31}_{15}X$ $^{A}_{Z}X$

No. of electron = No. of protons

Z = 15; A = 15 + 16 = 31

31. Option (1)

Protium is $^{1}_{1}H$ so it has no neutron.

32. Option (4)

9, 19

No. of electrons in monovalent anion = 10

$\therefore$ No. of electrons in element = (10 – 1) = 9

So, No. of protons = 9

Mass no. = 10 + 9 = 19

33. Option (3)

13

Z = No. of electrons + 3 = 10 + 3 = 13

34. Option (1)

+2, 4u. $^{4}_{2}He$

35. Option (1)

6

K, L, M $\Rightarrow$ 2, 8, 6

36. Option (1)

1

Na : 2, 8, 1 (electronic configuration)

37. Option (2)

2

$^{2}_{1}H$ $\quad p^+ + n = 1 + 1 = 2$

38. Option (2)

$2n^2$

39. Option (1)

8

$_{18}Ar$ – K, L, M $\Rightarrow$ 2, 8, 8

40. Option (3)

2, 8, 8, 2

41. Option (1)

2, 8, 3 $_{13}Al$

42. Option (2)

2, 8, 2 $_{12}Mg$

43. Option (3)

P – 32 isotope is used in treatment of blood cancer.

44. Option (1)

U – 235 isotope is generally used as a nuclear fuel.

45. Option (3)

Co – 60 isotope is used in the treatment of cancer.

46. Option (2)

Isobars carry same mass number but different atomic number and are of different elements.

47. Option (2)

According to the Dalton's atomic theory atom is indivisible.

48. Option (3)

Neutron

$^{35}_{17}Cl$ = 18 neutrons, $^{37}_{17}Cl$ = 20 neutrons

49. Option (3)

E.C. of Ca = 2, 8, 8, 2

Ca^{2+} = 2, 8, 8

Ar = 2, 8, 8

50. Option (4)

Same number of protons in their nuclei.

True or False

1. True

Mas of an electron is $\frac{1}{1837}$ times that of proton.

2. False

Concept of nucleus was proposed by Rutherford.

3. True

$^{1}_{1}H$ Number of neutrons = 1 - 1 = 0

4. False

$^{4}_{2}He$ Number of neutrons = 4 - 2 = 2

5. False

K = 2, 8, 8, 1 Valency = 1

6. False

Neutron were discovered by Chadwick.

7. False

Na^{+}

No. of electrons = 10

No. of proton = 11

8. False

No. of electrons = No. of protons

9. False

No. of proton = 11

10. True

Isobars of differ in the number of neutron.

Exercise-02 Solutions

Very short answer type questions

1. (i) Electrolysis
(ii) Radioactivity

2. Mass of protons = 1840 × mass of electron

3.

	Electron	Proton	Neutron
Charge	-1.6×10^{-19}C	$+1.6 \times 10^{-19}$C	0
Mass	9.10939×10^{-31}kg	1.67262×10^{-27}kg	1.67493×10^{-27}kg

4. Electrons revolve around the nucleus in well-defined circular paths. These circular paths are known as orbits or shells.

5. Positively charged particles inside the nucleus of an atom are known as protons. Neutrons are neutral particle in the nucleus of the atom having same mass as that of proton.

6. Yes, it is possible e.g. $^{1}_{1}H$.

7. Chadwick (1932) discovered neutrons.

8. Because anode rays passed through canal/holes of the cathode.

9. The combining capacity of an element with atoms of other elements in order to acquire 8 electrons (2 in some exceptional cases) is called valency of an element. outermost shell of an atom, is known as valence shell.

10. Atomic No. = No. of protons = No. of electrons = 2 + 8 + 4 = 14
$_{14}Si$.

11. No. of neutrons = A – Z = 23 – 11 = 12
No. of nucleons = 23

12. No. of protons determines, number of positive charges on the nucleus.

13. Ar
No. of electrons = 18
No. of protons = 18
No. of neutrons = 40 – 18 = 22
electronic configuration 2,8,8

14. No. of neutrons = A – Z = 31 – 15 = 16

15. $^{4}_{2}He$ Valency = 0

16. No. of neutrons A – Z
$^{16}_{8}O$ $^{18}_{8}O$ } $^{18}_{8}O$ posses
16 - 8 18 - 8 } more neutrons

17. e.g $^{14}_{6}C$ $^{14}_{7}N$

18. No. of electrons = $2n^2 = 2 \times 1^2 = 2$

19. $^{20}_{10}Ne \Rightarrow 2, 8$

20. No. of proton = Z = 19
No. of electron in ion = 19 – 1 = 18

Short answer type questions

1. In case of positive rays, a perforated cathode was used and placed in the middle of discharge tube.

2. Properties of cathode rays.
(i) It travels in a straight path.
(ii) It causes heating effect.
(iii) These are particulate in nature.
(iv) They are deflected towards anode on applying electric field.

3. Cathode rays are particulate in nature, as they are made of matter particles.

4. Thomson proposed that an atom consist of a uniform sphere of positive charge (Proton) in which the negative charge (Electrons) are distributed uniformly more or less, both the charges balance each other, so atom remains electrically neutral.

5. Bohr Theory

(i) Electrons revolve around the nucleus in well defined orbitals or shells. Each shell have a definite amount of energy associated with the electron in it. Therefore, these shells are also called energy levels.

(ii) The energy associated with the electron in an orbit increase as the radius of the orbit increases. These shells are known as K, L, M, N ..... Starting from the closest to the nucleus.

6. Rutherford's experiment proved it -

(a) Very small nucleus : Only few particles obstructed by it.

(b) Each α - particle has 4u mass and is quite heavy. It could easily pass through a light obstruction by pushing it aside.

(c) Positively charged : α - particles have position charge. Since they were repelled and deflected back, the obstruction must carry same charge i.e.; positive charge.

7. Bohr - Burry scheme

(i) The maximum number of electrons which can be present in a particular energy shell of an atom is given by $2n^2$. Here n is the number of energy shell or energy level.

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

(iii) Electrons do not enter into a new shell unless the inner shells are completely filled.

$_{6}C = 2, 4$; $_{11}Na = 2,8,1$; $_{15}P = 2,8,5$; $_{18}Ar = 2, 8,8$

8. Rutherford selected a thin foil of a heavy gold metal because it was only 1000 atoms thick, so thin layer of gold can be taken.

9. Yes, relative atomic mass of elements are whole number.

10. Atomic number : It is the number of protons present in nucleus.

Mass number : sum of the total number of protons and neutrons present in the nucleus of an atom.

11. Mass Number : Sum of the total number of protons and neutrons present in the nucleus of an atom.

12. This pair denotes Isobaric species.

$^{40}_{20}Ca$ $^{40}_{18}Ar$

13. $_{17}Cl$

K	L	M
2	8	7

14. To attain noble gas configuration, element X require $2e^-$

$\therefore$ Charge = 8 – 6 = 2

Charge on ion = –2

15. Disagree

An atom is always neutral which is only possible when number of proton (+ve) is equal to number of electron (–ve). So it is not possible.

16. In $_{2}^{4}He$, outmost shell remain fully filled,

Hence, it is regarded as fully filled noble gas configuration.

He has 1 shell only. And as per Bohr's $2n^2$ law = $2 \times 1^2 = 2$ means if 1^{st} shell is outermost then it can have maximum 2 electrons.

17. These noble gases posses fully filled outermost orbital.

He $\rightarrow$ K $\rightarrow$ 2

Ne $\rightarrow$ K, L $\rightarrow$ 2, 8

Ar $\rightarrow$ K, L, M $\rightarrow$ 2, 8, 8

18.

Element	Number of Protons	No. of Neutrons
$_{17}^{35}Cl$	17	18
$_{6}^{12}C$	6	6
$_{35}^{81}Br$	35	46

19. This element will be metallic in nature and forms monovalent cation i.e., x^+.

For e.g. Na $\rightarrow$ 2, 8, 1

$Na^{+1} \rightarrow$ 2, 8

20. These are isotopes and contain same number of protons and show similar valencies due to similar electronic configuration.

21. Electron : 25; Proton = 25; Nucleons = 55

22. ^{16}O, ^{17}O and ^{18}O contains 8, 9 and 10 neutrons, respectively.

23. $_{8}^{16}O$: 2, 6 $\quad$ $_{17}^{35.5}Cl$: 2, 8, 7

$_{14}^{28}Si$: 2, 8, 4 $\quad$ $_{18}^{40}Ar$: 2, 8, 8

24. Isotopes : Atoms of same element having same atomic number but different mass number.

e.g.;

$_{1}^{1}H$ $\quad$ $_{1}^{2}H$ $\quad$ $_{1}^{3}H$

Protium $\quad$ Deuterium $\quad$ Tritium

25. According to Bohr - Burry Scheme

K = 2; L = 8; M = 18

Long answer type questions

1. (i) The electrons were noticed and identified for the first time by J.J Thomson in 1897 in an experiment which was performed in discharge tube.

(ii) The discharge tube was filled with air (or any other gas) under study and the following observations were recorded on the basis of experiments performed.

(a) A current of high voltage (10,000 volts) was passed through the discharge tube under normal pressure of 1 atmosphere. No electricity could flow through it as air is the very poor conductor of electricity.

(b) The pressure inside the discharge tube was reduced to 1mm of Hg and on passing electric discharge again, electricity started flowing through the tube and light was emitted inside the tube.

(c) Pressure further reduced to about 0.01 mm Hg. The walls of the discharge tube opposite to the cathode started glowing with a greenish light called fluoroscence.

(iii) On further investigations, it was found that the fluorescence is due to the bombardment of the walls of the tube by the rays emitted from cathode. These were known as cathode rays.

2. (i) In 1911, scientist "Ernest Rutherford" gave a new picture for the structure of atom by his α - particle Scattering experiment and proposed the structure of atom.

(ii) Rutherford performed the famous α - particle scattering experiment in order to know the relative. Positions of electrons and protons in an atom.

(iii) α - particle are charged particle having 2 units of positive charge and 4 units of mass i.e. α particles ($_2He^4$) are doubly charged helium atom (He^{+2}). He selected a thin foil of a heavy gold metal because it was only 1000 atom thick. He bombarded the same with high speed (α) particles.

Observation :

(i) Most of the fast moving α - particles passed straight through the gold foil, without any deflection from their original path.

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

(iii) A very few α-particles got completely rebound on hitting the gold foil and turned back on their path.

3. (i) Most of the space inside the atom is empty because most of the α - particles passed through the gold foil without getting deflected.

(ii) As a few α - particles suffered minor deflections and a very few major deflections, this means that these must have met with some obstruction in their path.

(iii) This obstruction must be :

(a) Very small : Only a few particles obstructed by it.

(b) Each α - particle has 4u mass and is quite heavy. It could easily pass through a light obstruction by pushing it aside.

(c) Positively charged : α - particle have positive charge. Since, they were repelled or difflected back, the obstruction must also carry some charge i.e., positive charge.

Rutherford regarded this very small dense and positively charged obtruction in an atom as nucleus. Therefore, Rutherford predicted that all the protons present in an atom are present in this small space i.e., nucleus. The electrons with negligible mass and negative charge were supposed to be present in this portion around the nucleus known as extra nuclear portion.

4. According to Maxwell's Radiation theory, any charged particle moving in circular orbits with fast speed emit energy in the form of radiations.

Since, electrons are also fast moving charged particles, they must release energy continously in the form of radiations. With reduced energy, they must be drawn closer to the nucleus.

Since, the loss of energy is a continous process, the electrons must come closer and closer to the nucleus of the atom.

Ultimately, they must fall into the nucleus or becomes its part. In other words the atom should collapse. However this actually does not happen and the atom is quite stable.

5. Thomson proposed that an atom consist of a uniform sphere of positive (protons) in which the negatively charged (electrons) are distributed more or less uniformly. Rutherford predicted that all the protons present in an atom are present in this small space i.e., nucleus The electrons with negligible mass and negative charge were supposed to be present in this portion around the nucleus known as extra nuclear protons.

6. **According to Bohr's theory**

(i) Electrons revolve around the nucleus in well defined orbits or shell. Each shell have a definite amount of energy associated with the electron in it. Therefore, these shells are also called energy levels.

(ii) The energy associated with the electrons in an orbit increase as the radius of the orbit increase. These shells are also known as K,L,M,N ..... starting from the one closest to the nucleus.

(iii) An electron in a shell can move to a higher or lower energy shell by absorbing or releasing a fixed amount of energy. The order of energy in shell is

$K < L < M < N < O <$ .....

(iv) While revolving in an orbit, the electron is not in a position to either lose or gain energy. In other words, the energy remains stationary. Therefore, these energy states for the electrons are also known as stationary states.

7. Bohr model of an atom.

(i) Electrons revolve around the nucleus in well defined orbits or shell. Each shell have a definite amount of energy associated with the electron in it. Therefore, these shells are also called energy levels.

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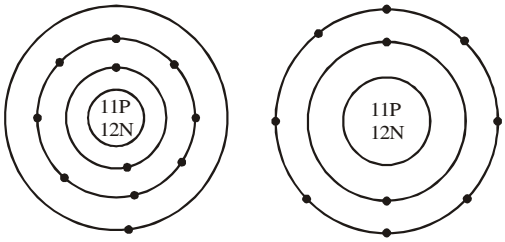
8.



Na = atom $\quad$ Na^+ Ion

Z = 11 (2, 8, 1) $\quad$ Z = 11 (2, 8)

9. Isotopes are atoms of the same element, having the same atomic number but different mass number.

Applications :-

(i) Uranium $\left({}^{235}_{92}\mathrm{H}\right)$ is used as a fuel in nuclear reactor.

(ii) Cobalt $\left({}^{60}_{27}\mathrm{H}\right)$ is used in the treatment of cancer.

(iii) Iodine $\left({}^{131}_{53}\mathrm{I}\right)$ is used in the treatment of goiter.

(iv) Sodium $\left({}^{23}_{11}\mathrm{Na}\right)$ is used for differentiating cancerous tissues from the normal tissue.

(v) Carbon $\left({}^{14}_{6}\mathrm{C}\right)$ is used in dating of fossil samples known as carbon dating.

(vi) Phosphorus $\left({}^{31}_{15}\mathrm{P}\right)$ is used in the treatment of blood cancer.

10. (i) Isotopes : Isotopes are atoms of the same element, having the same atomic number but different mass number.

Applications :-

(a) Uranium $\left({}^{235}_{92}\mathrm{H}\right)$ is used as a fuel in nuclear reactor.

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(c) Iodine $\left({}^{131}_{53}\mathrm{I}\right)$ is used in the treatment of goiter.

(ii) Isobars : Atoms of different elements with different atomic number which have same mass number, are known as isobars.