Structure of Atom

OBJECTIVE TYPE QUESTIONS

➲ Multiple Choice Questions (MCQs)

1. The table given below shows the numbers of protons, neutrons and electrons in four ions. For which ion is the data correct?

Ion	Number of		
	Protons	**Neutrons**	**Electrons**
$^{40}_{20}Ca^{2+}$	20	20	20
$^{19}_{9}F^{-}$	9	10	8
$^{16}_{8}O^{2-}$	8	8	10
$^{23}_{11}Na^{+}$	11	12	11

(a) $^{40}_{20}Ca^{2+}$ (b) $^{19}_{9}F^{-}$

(c) $^{16}_{8}O^{2-}$ (d) $^{23}_{11}Na^{+}$

2. 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?

(a) One of the oxygen atoms has gained electrons.

(b) One of the oxygen atoms has gained two neutrons.

(c) The two oxygen atoms are isotopes.

(d) The two oxygen atoms are isobars.

3. Which pair of molecules has the same number of electrons?

(a) N_2 and F_2 (b) Cl_2 and CO_2

(c) H_2O and H_2S (d) O_2 and C_2H_4

4. Atomic models have 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

(a) (i), (ii) and (iii)   (b) (ii), (iii) and (i)

(c) (ii), (i) and (iii)   (d) (iii), (ii) and (i)

5. An atom with 3 protons and 4 neutrons will have a valency of

(a) 3   (b) 7

(c) 1   (d) 4

6. The schematic atomic structures of three elements X, Y and Z are given as:
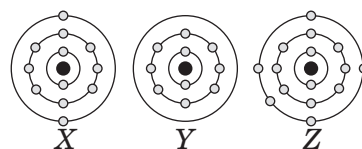
Which of the following statements are incorrect?

I. Z can form ZCl_3 and ZCl_5.

II. Y exists in monatomic form.

III. X and Z combine to form X_3Z type compound.

IV. X and Y combine to form XY_2 type compound.

V. X will gain two electrons to form a stable compound.

(a) I and II   (b) I, II and IV

(c) II, IV and V   (d) III, IV and V

7. The electron distribution in an aluminium atom is

(a) 2, 8, 3   (b) 2, 8, 2

(c) 8, 2, 3   (d) 2, 3, 8

8. Select the correct statements.

(i) An atom is divisible and consists of charged particles.

(ii) It was known by 1900 that the atom was not a simple, indivisible particle but contained at least one sub-atomic particle – the electron.

(iii) E. Goldstein in 1886 discovered the presence of new radiations called canal rays which led to the discovery of another sub-atomic particle – the proton.

(iv) Proton had a charge, equal in magnitude but opposite in sign to that of the electron and its mass was approximately 2000 times as that of the electron.

(v) The mass of an electron is considered to be negligible and its charge is minus one.

(a) (i), (ii) and (iii)

(b) (iii), (iv) and (v)

(c) (ii), (iii) and (iv)

(d) All the statements are correct.

9. The electronic configuration of elements A, B, C and D are (2, 8, 1), (2, 8, 2), (2, 8, 6) and (2, 8, 7) respectively. Which of them can make an ion with two negative charges?

(a) A (b) B

(c) C (d) D

10. The nucleon number of the bromine atom is 79 and its proton number is 35. Which of the following is true about the bromine atom?

(a) It has 79 neutrons.

(b) It has 44 electrons.

(c) Its electronic configuration contains three shells which has 7 electrons in outermost shell.

(d) It has similar chemical properties as chlorine.

11. 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?

(a) 13   (b) 10

(c) 14   (d) 16

12. Which of the following do not represent Bohr's model of an atom correctly?

(i)   (ii)   (iii)   (iv)
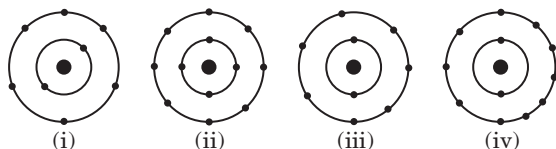
(a) (i) and (ii)   (b) (ii) and (iii)

(c) (ii) and (iv)   (d) (i) and (iv)

13. Match the column I with column II and select the correct answer by choosing an appropriate option.

Column I	Column II
P. Mass of proton	1. 9.1×10^{-28} g
Q. Charge of electron	2. 1.6×10^{-19} C
R. Mass of electron	3. -1.6×10^{-19} C
S. Charge on proton	4. 1.67×10^{-27} kg

(a) P-4, Q-3, R-1, S-2 (b) P-2, Q-1, R-4, S-3

(c) P-2, Q-3, R-4, S-1 (d) P-4, Q-2, R-1, S-3

14. Which of the following has the same number of electrons as an oxide ion (O^{2-})?

(a) K^+ (b) Mg^{2+} (c) Cl^- (d) S^{2-}

15. The given table shows the number of protons, neutrons and electrons in atoms or ions. Which atom/ion in the table is an isotope of the atom with the composition of $11p$, $11e$ and $14n$?

| Atoms/ Ions	Number of protons (p)	Number of electrons (e)	Number of neutrons (n)
P	11	11	12
Q	18	18	22
R	15	18	16
S	11	10	14

(a) P (b) Q (c) R (d) S

16. Dalton's atomic theory successfully explained

(i) law of conservation of mass

(ii) law of constant composition

(iii) law of radioactivity

(iv) law of multiple proportion.

(a) (i), (ii) and (iii)   (b) (i), (iii) and (iv)

(c) (ii), (iii) and (iv)   (d) (i), (ii) and (iv)

17. Which of the following is an accurate illustration of a nitrogen atom?
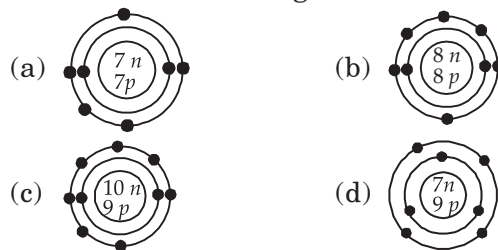
18. Observe the given figure and answer the question that follows :
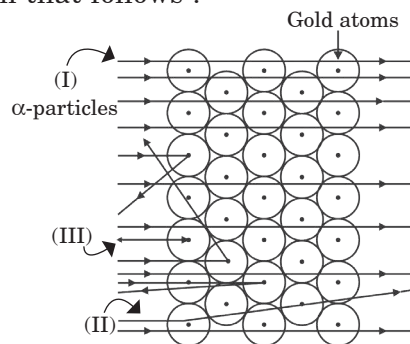
(I) Most of the fast moving α-particles passed straight through the gold foil.

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

(III) Surprisingly one out of every 12000 particles appeared to rebound.

Identify the correct observations.

(a) (I) and (II) (b) (II) and (III)
(c) (I) and (III) (d) All are correct.

19. A monovalent anion has 10 electrons and 10 neutrons. The atomic number and mass number of the element are respectively _____ and _____.

(a) 10, 20 (b) 9, 18
(c) 11, 20 (d) 9, 19

20. In the 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.

(a) (i), (ii) and (iii) (b) (i) and (iii)
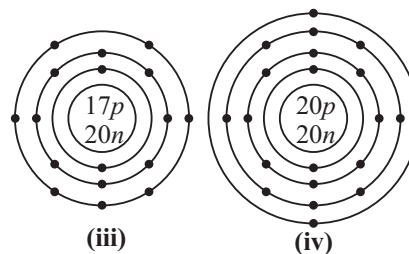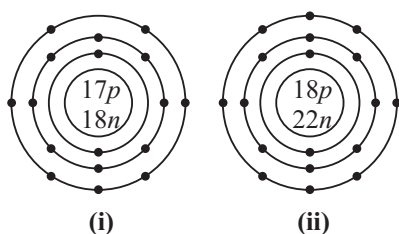(c) (i) and (iv) (d) (i), (iii) and (iv)

21. Mass spectrum of lead is given as
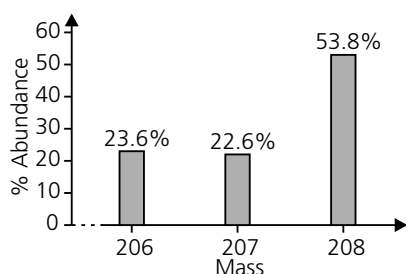
The average atomic mass of lead is

(a) 208 (b) 207.567
(c) 207.302 (d) 209

22. Vivek was given few models of atoms representing their structures. He was asked to choose one pair of isotopes and one pair of isobars.

Which of the following options contains the correct pairs?

	Isotopes	Isobars
(a)	(i) and (ii)	(iii) and (iv)
(b)	(i) and (iv)	(ii) and (iii)
(c)	(i) and (iii)	(ii) and (iv)
(d)	(ii) and (iv)	(i) and (iii)

23. Information about two atoms, X and Y are shown below :

Atom	Nucleon number	Proton number
X	14	7
Y	15	7

Which of the following is correct about these two atoms?

		Atom X	Atom Y
(a)	Electronic configuration :	2, 8, 4	2, 8, 5
(b)	Number of neutrons :	7	7
(c)	Number of valence electrons :	5	5
(d)	Number of electron shells :	2	3

24. Match the column I with column II and select the correct answer by choosing an appropriate option.

Column I	Column II
P. Neutron	1. Rutherford's atomic model
Q. Plum pudding model	2. Bohr's atomic model
R. Mass of the atom is concentrated at the centre of atom	3. Thomson's atomic model
S. Stationary orbit	4. Chadwick

(a) P-1, 4; Q-1, 2, 3; R-2; S-1, 2, 3
(b) P-1; Q-1, 2, 3; R-2; S-1, 2
(c) P-1; Q-3; R-2; S-1
(d) P-4; Q-3; R-1; S-2

25. The main drawback of Rutherford's model of the atom is that

(a) it does not explain the stability of atom

(b) it does not show the location of protons

(c) it does not explain neutral nature of an atom

(d) it does not explain existence of a nucleus in an atom.

26. Rutherford concluded from the α-particle scattering experiment that

(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) very few particles were deflected from their path, indicating that the negative charge of the atom occupies very little space.

(iii) a very large fraction of α-particles were deflected by $180°$, indicating that all the negative charge and mass of the gold atom were not concentrated in a very small volume within the atom.

Identify the incorrect statements.

(a) (i) and (ii)   (b) (ii) and (iii)

(c) (i) and (iii)   (d) (i), (ii) and (iii)

27. Select the correct statements.

(i) The radius of the nucleus is about 10^7 times less than the radius of the atom.

(ii) There is a positively charged centre in an atom called the nucleus. Nearly all the mass of an atom resides in the nucleus.

(iii) The electrons revolve around the nucleus in circular paths.

(iv) The size of the nucleus is very large as compared to the size of the atom.

(a) (i) and (iv)

(b) (ii) and (iii)

(c) (i), (ii) and (iii)

(d) All the statements are correct.

28. Schematic atomic structures of three elements are given below :
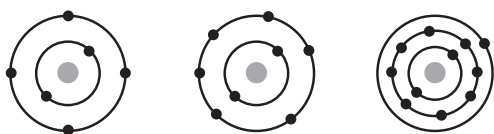
Which of the following is the correct formula of the compound formed by the given three elements?

(a) Na_3PO_4 (b) Na_2CO_3

(c) Na_2SO_4 (d) Na_2SO_3

29. Which pair of atoms contains the same number of neutrons?

(a) $^{114}_{48}Cd$ and $^{119}_{50}Sn$ (b) $^{59}_{27}Co$ and $^{59}_{28}Ni$

(c) $^{133}_{55}Cs$ and $^{132}_{54}Xe$ (d) $^{63}_{29}Cu$ and $^{65}_{29}Cu$

30. Study the table carefully and select the correct statement.

Element	Number of protons	Number of neutrons	Number of electrons
U	11	12	10
V	20	20	20
W	16	18	18
X	20	19	18
Y	14	15	18
Z	10	10	10

(a) W is a noble gas.

(b) X and Y are cations.

(c) U and V are anions.

(d) Z is the lightest element while V is the heaviest.

31. Two particles X and Y have the composition as shown in the table.

Particle	Number of electrons	Number of neutrons	Number of protons
X	10	8	8
Y	18	18	17

The particles X and Y are

(a) metal atoms   (b) non-metal atoms

(c) negative ions   (d) positive ions.

32. A has 9 protons, 9 electrons and 10 neutrons, B has 12 protons, 12 electrons and 12 neutrons. Formula of the compound between A and B is

(a) BA_2 (b) AB_2 (c) B_2A_3 (d) AB_4

33. Match the following:-

List-I	List-II
(P) Proton	1. Thomson
(Q) Electron	2. Goldstein
(R) Neutron	3. Rutherford
(S) Nucleus	4. Chadwick

(a) P-4, Q-3, R-2, S-1   (b) P-1, Q-2, R-3, S-4

(c) P-2, Q-1, R-4, S-3   (d) P-2, Q-1, R-3, S-4

34. An element L has 9 protons and its valency is 1. Another element M has valency 3 and 5. What is the difference in the number of electrons in L and M?

(a) 6 (b) 5 (c) 4 (d) 3

35. Match the following:-

List-I	List-II
(P) Electrons	1. Number of positively charged particles in nucleus
(Q) Carbon dating	2. Negatively charged particles
(R) Valence electrons	3. Technique to know age of fossils
(S) Atomic number	4. Number of electrons in outermost shell

(a) P-1, Q-2, R-3, S-4   (b) P-4, Q-3, R-2, S-1
(c) P-2, Q-4, R-3, S-1   (d) P-2, Q-3, R-4, S-1

36. The relative atomic mass of naturally occurring chlorine is not a whole number. What is the reason for this?

(a) Chlorine atoms can have different numbers of neutrons.

(b) Naturally occurring chlorine cannot be obtained pure.

(c) Chlorine is unstable.

(d) The mass of the electrons has been included.

37. Which one of the following is not isoelectronic with neon atom?

(a) $_8O^{2-}$ (b) $_{11}Na^+$
(c) $_9F^-$ (d) $_{12}Mg^+$

➲ Case Based MCQs

Case I : Read the passage given below and answer the following questions from 38 to 40.

The maximum number of the electrons which are permitted to be assigned to an energy shell of an atom is called the electron capacity of that shell. The distribution of electrons in different orbits or shell is governed by a scheme known as Bohr-Bury scheme. According to this scheme :
(i) The maximum number of the electrons that can be present in any shell is given by the formula $2n^2$ where, n is the number of energy level.
(ii) The maximum number of electrons that can be accommodated in the outermost shell is 8.
Electrons are filled in the shells in a stepwise manner in increasing order of energy of the energy shell.

38. What is the maximum electrons capacity of N shell?

(a) 24 (b) 8 (c) 18 (d) 32

39. Identify the element with the configuration K-2, L-8, M-3.

(a) Aluminium (b) Magnesium
(c) Sodium (d) Beryllium

40. Which of the following configuration represent sodium?

(a) 2, 8, 4 (b) 2, 8, 5
(c) 2, 3 (d) 2, 8, 1

Case II : Read the passage given below and answer the following questions from 41 to 44.

The table shows the number of sub-atomic particles in arbitrary elements, A to H.

Atom	Number of protons	Number of electrons	Number of neutrons
A	1	1	0
B	3	3	4
C	4	4	6
D	5	5	5
E	6	6	6
F	6	6	7
G	9	9	10
H	9	9	11

41. The pair of isotopes from the table is/are

(i) C and D (ii) E and F
(iii) B and C (iv) G and H

(a) (ii) only (b) (iv) only
(c) (ii) and (iv) only (d) (i), (ii), (iii) and (iv)

42. Which of the given elements attains noble gas configuration by gaining an electron?

(i) A (ii) E
(iii) C (iv) H

(a) (iii) only (b) (iv) only
(c) (i) and (iv) only (d) (i) only
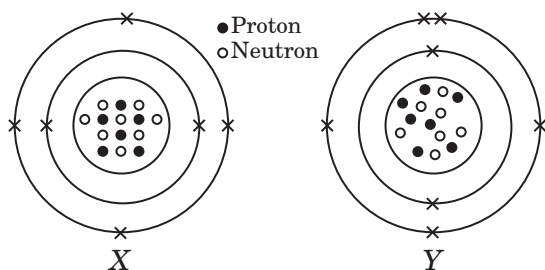
43. Identify pair of isobars from the table.
(a) *C* and *D* (b) *B* and *E*
(c) *G* and *H* (d) *E* and *F*

44. The atom _____ has nucleon number 13 and atom _____ has valency 3.
(a) *G* and *F* (b) *F* and *D*
(c) *C* and *E* (d) *F* and *B*

Case III : Look at the diagram given below and answer the following questions from 45 to 47.

The given diagrams show the atomic structures of elements *X* and *Y*.

45. Element *X* and *Y* could be _____ and _____ respectively.
(a) Be and B (b) C and O
(c) F and N (d) C and N

46. Valency of elements *X* and *Y* are respectively,
(a) 4 and 3 (b) 2 and 5
(c) 1 and 4 (d) 3 and 4

47. Elements *X* and *Y* are
(a) isotopes (b) isoelectronic
(c) isobars (d) isomers.

Case IV : Read the passage given below and answer the following questions from 48 to 50.

The mass of an atom is due to the masses of protons and neutrons in the nucleus. The relative masses of protons and neutrons are almost equal to one. Therefore, the atomic mass of an element should be nearly a whole number. But in many cases the atomic masses are fractional. The main reason for these fractional atomic masses is that these elements occur in nature as a mixture of several isotopes. The atomic mass of an element is the average of the atomic masses of these isotopes in the ratio of their proportion of occurrence.

48. Chlorine occurs in nature in the form of two isotopes with atomic masses 35 u and 37 u in the ratio of 3 : 1 respectively. Atomic mass of chlorine is
(a) 35.5 u (b) 34.5 u (c) 35 u (d) 36 u

49. An element occurs in two isotopic forms with atomic masses 10 and 11. What is the percentage abundance of two isotopes in the sample having atomic mass 10.80?
(a) 20, 80 (b) 50, 50 (c) 25, 70 (d) 60, 40

50. The fractional atomic masses of elements are due to the existence of
(a) isotopes having different masses
(b) diagonal relationship
(c) equal number of electrons and protons
(d) none of these.

➲ Assertion & Reasoning Based MCQs

For question numbers 51-60, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Both assertion and reason are true, and reason is correct explanation of the assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of the assertion.
(c) Assertion is true, but reason is false.
(d) Assertion is false, but reason is true.

51. Assertion : Cathode rays get deflected towards the positive plate of electric field.

Reason : Cathode rays consist of negatively charged particles known as electrons.

52. Assertion : Anions are larger in size than the parent atom.

Reason : In an anion, the number of protons in the nucleus is less than the number of electrons moving around it.

53. Assertion : Thomson's atomic model is known as 'raisin pudding' model.

Reason : The atom is visualized as a pudding of positive charge with electrons (raisins) embedded in it.

54. Assertion : The number of electrons gained, lost or shared by the atom of an element so as to complete its octet is called the valency of the element.

Reason : Elements having the same number of valence electrons in their atoms possess different chemical properties.

55. Assertion : For noble gases, valency is zero.
Reason : Noble gases have 8 valence electrons.

56. Assertion : The size of the nucleus is very small as compared to the size of the atom.
Reason : The electrons revolve around the nucleus of the atom.

57. Assertion : Electrons moving in the same orbit will not lose or gain energy.
Reason : On jumping from higher to lower energy level, the electron will gain energy.

58. Assertion : Bohr's orbits are called stationary orbits.
Reason : Electrons remain stationary in these orbits for sometime.

59. Assertion : The distribution of electrons in different orbits or shells is governed by a scheme known as Bohr-Bury scheme.
Reason : Electrons are filled in the shells in a stepwise manner in increasing order of energy of the energy shell.

**60. Assertion :** In Rutherford's gold foil experiment, very few α-particles are deflected back.
Reason : The size of the nucleus is very small as compared to the size of the atom

SUBJECTIVE TYPE QUESTIONS

➲ Very Short Answer Type Question (VSA)

1. Atomic number is defined in terms of protons and not in terms of electrons. Why?

2. Given below is a diagram of the nucleus of an atom.

$8p$
$8n$
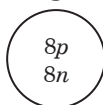
(a) Complete the diagram to show the electronic arrangement of this atom.
(b) Write the electronic configuration of the element.

3. What will be the charge on an atom with mass number one and atomic number one?

4. In Rutherford's model of an atom, fast moving alpha (α)-particles were made to fall on a thin gold foil. State two properties of α-particles.

5. What characteristic feature is seen in the configurations of chemically inactive elements?

6. What would you conclude from the observation that cathode rays rotate a light paddle wheel placed in their path?

7. An oxide of an element Z has a formula Z_2O_3.
(a) How many electrons are there in the outermost shell of an atom of element Z?
(b) Write down the formula for the chloride of Z.

8. Neutrons can be found in all atomic nuclei except in one case. Which is this atomic nucleus and what does it consist of?

9. Find valencies of the elements having atomic numbers 10 and 15.

10. Why are anode rays also called canal rays?

➲ Short Answer Type Question (SA I)

11. (a) If the number of electrons in an ion is 10 and the number of protons is 9, then
(i) what would be the atomic number of the ion?
(ii) what is the charge on the ion?
(b) An ion M^{2+} contains 10 electrons and 12 neutrons. What is the atomic number and mass number of the element M? Name the element.

12. Draw Bohr's model of an atom with three shells. How many electrons L-shell can accommodate?

13. The atom of an element has 9 protons, 9 electrons and 10 neutrons.
(a) What is the atomic number of the element?
(b) What is the mass number of the element?

(c) Name the element and give its electronic configuration.

(d) Predict the valency of the element.

14. Element X has a proton number of 7. It also has seven neutrons.

(a) Deduce the number of electrons and the nucleon number of X.

(b) Represent X by writing the chemical symbol, including the proton and nucleon numbers.

15. Justify the statement 'atomic number of an element is equal to the number of electrons in a neutral atom only and not in anion'.

16. Draw the electronic structures of sodium (proton number = 11) and lithium (proton number = 3). Compare the structures and state one similarity and one difference between them.

17. Give two points of differences between isotopes and isobars.

18. An element has two electrons in N-shell. Identify the element.

19. Justify the given statements :

(a) Most of the space in an atom is empty.

(b) The elements are identified by their atomic numbers and not by their mass numbers.

20. Given that the percentage abundance of the isotope $^{20}_{10}$Ne is 90% and that of the isotope $^{22}_{10}$Ne is 10%, calculate average mass of neon.

➲ Short Answer Type Question (SA II)

21. (a) Electronic configuration of a neutral atom 'X' is 2, 8, 6. What is the electronic configuration of X^{2-}?

(b) What is a valence shell? How many electrons can be present in valence shell?

22. Atoms of elements R, S and T have 8, 9 and 11 protons respectively. Neon has 10 protons.

(a) What is the chemical formula of the compound formed between?

(i) R and T (ii) S and T

(b) What is the formula of a molecule of R?

23. (a) Which fact is proved by the following observation in Rutherford's scattering experiment 'very few alpha particles are deflected back'?

(b) How will you find the valency of nitrogen, oxygen and fluorine?

24. (a) Explain, why $^{3}_{2}$He and $^{3}_{1}$H are not considered isotopes.

(b) What are octet and duplet rules? How do elements attain octet?

25. Elements from A to F have in them the distribution of electrons, neutrons and protons as follows :

Atoms/ Ions	Number of electrons	Number of neutrons	Number of protons
A	4	10	3
B	10	12	11
C	17	18	17
D	17	20	17
E	18	22	18
F	19	21	19

Making use of these data, find

(a) a pair of ions

(b) an atom of a noble gas

(c) a pair of isobars

(d) a pair of isotopes.

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

(b) What are canal rays?

27. 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 $\dfrac{1}{2000}$ times that of proton.

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

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

(b) Write the distribution of electrons in carbon and sodium atoms.

29. Summarise the rules for writing the distribution of electrons in various shells for the first eighteen elements.

30. (a) What is the number of valence electrons in the atom of an element A having atomic number 20? Name the valence shell of this atom.
(b) The atom of an element has 9 protons, 9 electrons and 10 neutrons.
(i) What is the atomic number of the element?
(ii) What is the mass number of the element?
(iii) Name the element and give its electronic configuration.
(iv) Predict the valency of the element.

31. Use the information to answer the following questions :

Element	P	Q	R	S	T	U	V
Proton number	7	8	10	12	15	18	19

(a) Which of these elements have only four filled electron shells?
(b) Which of these elements have a complete outermost shell?
(c) Which of these elements have 5 valence electrons?
(d) Which of these elements have 6 valence electrons?
(e) Which of these elements have 2 valence electrons?
(f) Write the valencies of each of the elements.

32. (a) Explain the formation of a cation. Give its main characteristics.
(b) What is electronic configuration of Al^{3+}?

33. The average atomic mass of 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?
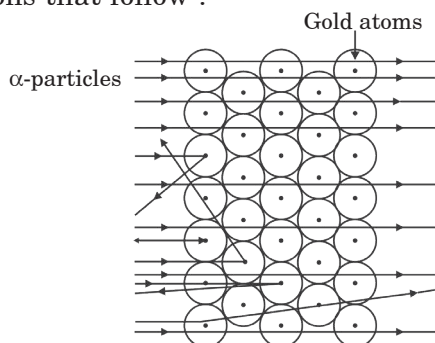
34. (a) Who discovered electron, proton and neutron?
(b) Compare the properties of electrons, protons and neutrons. Write five properties.

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

→ Long Answer Type Question (LA)

36. Observe the given figure and answer the questions that follow :

(a) Which experiment is represented by the given figure?
(b) List three observations of this experiment.
(c) State conclusions drawn from each observation of this experiment.
(d) Write the features of the nuclear model of an atom.
(e) What were the drawbacks of this model of an atom?

37. Answer the following :
(a) Are there elements with the same number of electrons, protons and neutrons? Give few examples.
(b) An ion M^{3+} contains 10 electrons and 14 neutrons. What is the atomic number and mass number of the element M? Name the element.

38. Give reasons for the following :
(a) Isotopes of an element are chemically similar.
(b) An atom is electrically neutral.
(c) Noble gases show least reactivity.
(d) Nucleus of an atom is heavy and positively charged.
(e) Ions are more stable than atoms.

39. (a) An element X has an atomic number 12 and a mass number 26. Draw a diagram showing the distribution of electrons in the orbits and the nuclear composition of the neutral atom of the element. What is the valency of the element and why?
(b) If this element X combines with another element Y whose electronic configuration is 2, 8, 7. What will be the formula of the compound formed?

40. The table shows the numbers of electrons, neutrons and protons in some atoms and ions of elements.
(The letters used in the table are not the chemical symbols of the elements.)

Atom/Ion	Electrons	Neutrons	Protons
S	10	10	10
T	17	20	17
U	10	12	11
V	10	8	8
W	17	18	17

Using only the letters from the table, identify
(a) a negative ion.
(b) a positive ion.
(c) two atoms of the same element.
(d) a noble gas.
(e) an atom with a nucleon number of 20.

ANSWERS

OBJECTIVE TYPE QUESTIONS

1. (c) :

Ion	Number of		
	Protons	Neutrons	Electrons
$^{40}_{20}Ca^{2+}$	20	20	18
$^{19}_{9}F^{-}$	9	10	10
$^{16}_{8}O^{2-}$	8	8	10
$^{23}_{11}Na^{+}$	11	12	10

2. (c) : Two isotopes have same number of electrons and protons but different number of neutrons.

3. (d) : Number of electrons in $O_2 = 2 \times 8 = 16$
Number of electrons in $C_2H_4 = (2 \times 6) + (4 \times 1) = 16$
Number of electrons in $N_2 = 2 \times 7 = 14$
Number of electrons in $F_2 = 2 \times 9 = 18$
Number of electrons in $Cl_2 = 2 \times 17 = 34$
Number of electrons in $CO_2 = 6 + (2 \times 8) = 22$
Number of electrons in $H_2O = (2 \times 1) + 8 = 10$
Number of electrons in $H_2S = (2 \times 1) + 16 = 18$

4. (c) : Thomson's atomic model, followed by Rutherford's model which is followed by Bohr's model.

5. (c) : For the atom $n = 4$, $p = 3$, hence $e = 3$
Distribution of electrons = 2, 1

6. (d) : Number of electrons in $X = 12$
Number of electrons in $Y = 10$
Number of electrons in $Z = 15$
I. Z has five valence electrons, thus, it can form ZCl_3 and ZCl_5 as it shows valency of +3 and +5.
II. Y is neon and exists in monatomic form.
III.
    Valency $X \overset{}{\underset{2}{\searrow}} \quad \overset{}{\underset{3}{\swarrow}} Z$

    Compound X_3Z_2
IV. Y has a complete octet. Thus, it does not combine with any element.

V. X will lose two electrons to form a stable compound. It shows the valency of +2.

7. (a) : Aluminium has 13 electrons. Its electron distribution is 2, 8, 3.

8. (d)

9. (c) : The two negative charges can be shown by that element, which needs two electrons for its stability.
Therefore, it should contain 6 electrons in its valence shell.

10. (d) : The nucleon number of bromine atom is 79 and its proton number is 35.
It has 35 electrons.
It has (79 − 35) 44 neutrons.
Its electronic configuration contains four shells which has 7 electrons in outermost shell.
It has similar chemical properties as chlorine as it has same valency 1 as chlorine.

11. (b) : Mass number of the atom = 27
Number of neutrons = 14
Number of protons = 27 − 14 = 13
Number of electrons in the atom = 13
Number of electrons in ion with 3 positive charges
$$= 13 - 3 = 10$$

12. (c) : First shell can accommodate maximum of two electrons and second shell can accommodate maximum of eight electrons.

13. (a)

14. (b) : O^{2-} has 10 electrons.
K^+ has 18 electrons.
Mg^{2+} has 10 electrons.
Cl^- has 18 electrons.
S^{2-} has 18 electrons.

15. (a) : Isotopes are the atoms of the same element with different mass numbers *i.e.*, they have same number of protons but different number of neutrons.
Mass number = No. of protons + No. of neutrons

Mass number of the given atom = 11 + 14 = 25

Atoms/Ions	p	e	n	Mass number
P	11	11	12	11 + 12 = 23
Q	18	18	22	18 + 22 = 40
R	15	18	16	15 + 16 = 31
S	11	10	14	11 + 14 = 25

16. (d) : Dalton's atomic theory successfully explained law of conservation of mass, law of constant composition and law of multiple proportion.

17. (a) : $^{14}_{7}N$

No. of protons = 7, No. of electrons = 7

No. of neutrons = 7

Electronic configuration of N = 2, 5

18. (d)

19. (d) : As the monovalent anion has 10 electrons hence the element has (10 − 1) = 9 protons.

Hence, atomic number of the element = 9

Mass number of the element = 9 + 10 = 19

20. (a) : Thomson's model could be compared with a raisin pudding model according to which the mass of atom is uniformly distributed over the atom in the form of positive charge and electrons are uniformly distributed over the atom. Electrons do not attract each other.

21. (c) : The average atomic mass of lead

$$=\left(206\times\frac{23.6}{100}+207\times\frac{22.6}{100}+208\times\frac{53.8}{100}\right)$$
$$= (48.616 + 46.782 + 111.904) = 207.302 \text{ u}$$

22. (c) : Atomic no. = No. of protons

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

(i) ⟹ atomic no. = 17 and mass no. = 17 + 18 = 35

(ii) ⟹ atomic no. = 18 and mass no. = 18 + 22 = 40

(iii) ⟹ atomic no. = 17 and mass no. = 17 + 20 = 37

(iv) ⟹ atomic no. = 20 and mass no. = 20 + 20 = 40

Out of these four atoms, (i) and (iii) have same atomic no. *i.e.*, 17 but different mass numbers. Hence, they are isotopes. Atoms (ii) and (iv) have same mass no. *i.e.*, 40 but different atomic numbers. Hence, they are isobars.

23. (c) : The electronic configuration for both atoms X and Y is 2, 5. Hence, the number of valence electrons = 5

The electronic configuration of an atom is based on its proton number and not on its nucleon number.

Number of neutrons in atom X = 14 − 7 = 7

Number of neutrons in atom Y = 15 − 7 = 8

Number of electron shells for both X and Y = 2

24. (d)

25. (a) : The revolution of the electron in a circular orbit is not expected to be stable. The revolving electron would lose energy and finally fall into the nucleus.

26. (b) : Very few particles were deflected from their path, indicating that the positive charge of the atom occupies very little space. A very small fraction of α-particles were deflected by 180°, indicating that all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom.

27. (b) : The radius of the nucleus is about 10^5 times less than the radius of the atom. The size of the nucleus is very small as compared to the size of the atom.

28. (b) : Three elements have the electronic configuration (2,4), (2,6) and (2,8,1) respectively. Hence, the elements are carbon (C), oxygen (O) and sodium (Na). The charge on Na is +1 and on carbonate (CO_3) is −2.

So, symbol   Na CO_3

charge   +1   ⤫   −2

Thus, the formula of the compound formed by these elements is Na_2CO_3.

29. (c) : Number of neutrons =

Mass number − Atomic number

$^{114}_{48}Cd$: 66 $^{119}_{50}Sn$: 69 $^{59}_{27}Co$: 32 $^{59}_{28}Ni$: 31

$^{133}_{55}Cs$: 78 $^{132}_{54}Xe$: 78 $^{63}_{29}Cu$: 34 $^{65}_{29}Cu$: 36

30. (d) : W is not a noble gas, it is an anion ; W^{2-}

(∵ no. of protons = 16 and no. of electrons = 18)

X is dipositive cation ; X^{2+}

(∵ no. of protons = 20 and no. of electrons = 18)

Y is not a cation, it is an anion ; Y^{4-}

(∵ no. of protons = 14, no. of electrons = 18)

U is monopositive cation ; U^+

(∵ no. of protons = 11, no. of electrons = 10)

V is a neutral element,

(∵ no. of protons = no. of electrons).

Mass no. of U is 23 (11 + 12).

Mass no. of V is 40 (20 + 20).

Mass no. of W is 34 (16 + 18).

Mass no. of X is 39 (20 + 19).

Mass no. of Y is 29 (14 + 15).

Mass no. of Z is 20 (10 + 10).

Therefore, Z is lightest element and V is the heaviest.

31. (c) : Particle X is O^{2-} and particle Y is Cl^-. They both are negative ions.

32. (a) : Symbol $\quad {}^{24}_{12}B \qquad {}^{19}_{9}A$

2, 8, 2 $\qquad$ 2, 7

Valency $\qquad$ 2 $\qquad$ 1

Formula is BA_2.

33. (c)

34. (a) :

Element	At. no.= No. of protons (= No. of electrons)	Distribution of electrons				Valency
		K	L	M	N	
L	9	2	7	–	–	1
M	15	2	8	5	–	3, 5

Hence, the element L is fluorine (F) and M is phosphorus (P). The difference between the number of electrons of P and F is $(15 - 9) = 6$.

35. (d)

36. (a) : Chlorine has two isotopes : ${}^{35}_{17}Cl$ and ${}^{37}_{17}Cl$. They both have different number of neutrons.

37. (d) : Isoelectronic species have same number of electrons.

No. of electrons in Ne = 10

No. of electrons in O^{2-} = 8 + 2 = 10

No. of electrons in Na^+ = 11 − 1 = 10

No. of electrons in F^- = 9 + 1 = 10

No. of electrons in Mg^+ = 12 − 1 = 11

38. (d) : Maximum number of electrons present in a shell is given by $2n^2$.

$\therefore$ Number of electrons in N (4) $= 2 \times 4^2 = 32$

39. (a) : 2, 8, 3 electronic configuration means atomic number of the element is 13. Element with atomic number 13 is aluminium.

40. (d) : 2, 8, 1 is configuration of ${}^{23}_{11}Na$.

41. (c) : E and F has same atomic number ($Z = 6$) and different mass numbers 12 and 13 respectively so, these are isotopes. Similarly, G and H has same atomic number ($Z = 9$) and different mass number 19 and 20 respectively so these are isotopes.

42. (c) : Elements A and H will attain noble gas configuration after gaining one electron.

43. (a) : Elements C and D have different atomic numbers 4 and 5 respectively but same mass number (10) so, these are isobars .

44. (b) : The atom F has nucleon number (6 + 7) 13 and element D will attain noble gas configuration after gaining 3 electrons so, its valency is 3.

45. (d) : Element X has proton number 6 ($Z = 6$) so, it is carbon (C) and element Y has proton number 7 ($Z = 7$) so it is nitrogen (N).

46. (a) : Valency of element X is 4 as it has electronic configuration $\begin{pmatrix} K\,L \\ 2\,4 \end{pmatrix}$ and element Y is 3 as it has electronic configuration $\begin{pmatrix} K\,L \\ 2\,5 \end{pmatrix}$.

47. (c) : Elements X and Y are isobars as they have different atomic numbers 6 and 7 but same mass number 14.

48. (a) : Atomic mass $= \dfrac{35 \times 3 + 37 \times 1}{3 + 1} = 35.5$ u

49. (a) : Let the percentage of isotope with atomic mass 10 $= x$

$\therefore$ Percentage of isotope with atomic mass 11 $= 100 - x$

Average atomic mass = 10.80

$10.80 = \dfrac{x \times 10 + (100 - x) \times 11}{100}$

$10.80 \times 100 = 10x + 1100 - 11x$

$x = 1100 - 1080 = 20$

Abundance of isotope − 10 = 20%

Abundance of isotope −11 = 100 − 20 = 80%

50. (a) : The fractional atomic masses of elements are due to the existence of isotopes having different masses, the atomic mass of the element is the average value which comes out to be fractional.

51. (a) : In electric field, negatively charged particles always move towards positive plate and vice - versa.

52. (a) $\qquad\qquad\qquad\qquad$ **53. (a)**

54. (c) : Elements having the same number of valence electrons in their atoms possess similar chemical properties.

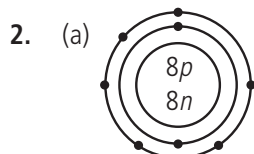**55. (a)** $\qquad\qquad\qquad\qquad$ **56. (b)**

57. (c) : Electrons moving in the same orbit will not lose or gain energy. On jumping from higher to lower energy level, the electron will lose energy.

58. (c) : Electrons in different orbits have fixed energies.

59. (b) $\qquad\qquad\qquad\qquad$ **60. (b)**

1. An atom may lose or gain electrons, but the number of protons remains constant till the same atom exist.

2. (a)

8p
8n

(b) Electronic configuration = 2, 6

3. The atom will not carry any charge because the atom contains one unit negative charge in the form of electron and one unit positive charge in the form of a proton.

4. (a) Alpha particles are positively charged particles.

(b) They are doubly charged helium ions having a mass number of 4 (consists of 2 protons and 2 neutrons).

5. Chemically inactive elements have 8 electrons in their valence shell except helium which has 2 electrons in its valence shell which is the maximum capacity of K shell.

6. When a light paddle wheel is placed in the path of cathode rays, the blades of the paddle wheel begin to rotate. It shows that cathode rays consist of material particles having mass and velocity.

7. (a) An ion of element Z has the formula Z^{3+}. Hence, it has 3 valence electrons.

(b) ZCl_3

8. In case of hydrogen atom, there is no neutron. It consists of only one proton.

9.

Atomic number = 10	Atomic number = 15
Electronic configuration = 2, 8	Electronic configuration = 2, 8, 5
Valency = 0	Valency = 3

10. Canal rays are positively charged anode rays. The canal rays are called so because they pass through the holes or the canals in the cathode.

11. (a) (i) Atomic number (Z) = No. of protons = 9

(ii) Charge on the ion = −1

Here, one electron is more than proton. So this one extra electron attains −1 charge on the ion.
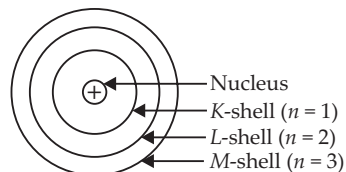
(b) No. of electrons in M^{2+} ion = 10

Atomic number of atom M = 10 + 2 = 12

No. of protons in atom M = 12

Mass number of atom M = No. of protons + No. of neutrons
= 12 + 12 = 24

The element M with atomic number 12 is magnesium (Mg).

12.

Nucleus
K-shell ($n = 1$)
L-shell ($n = 2$)
M-shell ($n = 3$)

Number of electrons in L-shell = $2n^2 = 2 \times 2^2 = 8$.

13. (a) The atomic no. of element = No. of protons = 9

(b) The mass no. of element = No. of protons + No. of neutrons
= 9 + 10 = 19

(c) The element with Z = 9 is fluorine (F). Its electronic configuration : 2, 7.

(d) The valency of fluorine is 1 and is calculated as 8 − 7 = 1.

14. $p = 7$, $n = 7$

(a) Number of electrons = Number of protons = 7

Number of nucleons = number of p + number of n
= 7 + 7 = 14

(b) $^{14}_{7}X$

15. In neutral atom, No. of protons = No. of electrons
= Atomic number

An anion is formed by gain of one or more electrons by an atom. Therefore, anion contains more electrons than neutral atom or in other words number of electrons in anion is greater than atomic number (the number of protons).

16. Sodium (proton number = 11), Electronic configuration
= 2, 8, 1

Lithium (proton number = 3), Electronic configuration = 2, 1

Sodium   Lithium
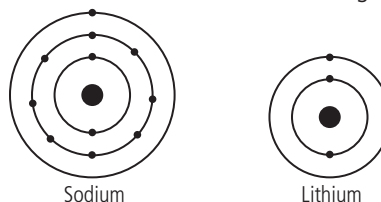
Similarity : Both have same valency, which is equal to one.

Difference : They have different number of shells.

17. Differences between isotopes and isobars:

	Isotopes		Isobars
(i)	These are the atoms of the same element.	(i)	These are the atoms of different elements.
(ii)	These have same atomic number.	(ii)	These have different atomic numbers.
(iii)	These have different mass numbers.	(iii)	These have same mass numbers.
(iv)	The chemical properties of isotopes are similar but their physical properties are different.	(iv)	These have different chemical and physical properties.

18. An element can be identified with its atomic number (Z) which is equal to the number of electrons in its neutral atom. If there are 2 electrons in N shell, it means K, L and M shells are completely filled. Two electrons can be accommodated in K shell, eight in L shell and 8 in M shell since outermost orbit cannot have more than 8 electrons, 2 electrons go to N orbit.

Hence total number of electrons = 20

K L M N

2   8   8   2

The element is calcium.

19. (a) This can be justified by Rutherford's α-scattering experiment. Since most of the alpha particles could pass through the sheet, made up of atoms of gold, undeflected, this means that they did not come across any obstruction. Thus, most of the space in an atom is empty or hollow.

(b) In the study of the atomic structure, we have seen that the isotopes of an element have different mass numbers. In isobars, the atoms of different elements have same mass numbers. However, the atomic numbers of no two elements can be the same. Therefore, the elements are identified by their atomic numbers and not by their mass numbers.

20. Abundance of isotope $^{20}_{10}$Ne = 90% and of Isotope $^{22}_{10}$Ne = 10%

Average atomic mass of neon $= \dfrac{20 \times 90 + 22 \times 10}{100} = 20.2$ u.

21. (a) X = 2, 8, 6

No. of electrons in neutral atom = 2 + 8 + 6 = 16

$X + 2e^- \rightarrow X^{2-}$

No. of electrons in X^{2-} = 16 + 2 = 18

Electronic configuration of X^{2-} = 2, 8, 8

(b) The outermost shell of an atom is called valence shell. The number of electrons that can be present in valence shell is 1 - 8.

22. $R(p = 8)$, Electronic configuration = 2, 6

$S(p = 9)$, Electronic configuration = 2, 7

$T(p = 11)$, Electronic configuration = 2, 8, 1

(a) (i) RT_2 (ii) ST

(b) R_2

23. (a) This shows that in the centre of atom a very small positively charged body called nucleus is present.

(b) (i) Nitrogen has 5 electrons in valence shell, hence its valency is 8 – 5 = 3.

(ii) Oxygen has 6 electrons in valence shell, hence its valency is 8 – 6 = 2.

(iii) Fluorine has 7 electrons in valence shell, hence its valency is 8 – 7 = 1.

24. (a) $^3_2$He and $^3_1$H are not considered as isotopes because they have different atomic numbers and are different elements.

(b) Octet rule was proposed by G.N.Lewis. According to this rule "The atom of an element combines with another atom to have eight electrons in its outermost shell". An atom having 8 electrons in its outermost shell is least reactive or most stable. If there is only one shell, then stability is attained by having 2 electrons in the shell and this is called duplet rule.

Element attains octet in the following ways :

(i) by losing or gaining electrons.

(ii) by sharing electrons with other atoms.

25. (a) A pair of ions is A and B.

Because A has 4 – 3 = 1 negative charge and B has 11 – 10 = 1 positive charge.

(b) An atom of noble gas is E.

Electronic configuration of E is 2, 8, 8.

(c) A pair of isobars is E and F.

Mass number of E = 22 + 18 = 40

Mass number of F = 21 + 19 = 40

(d) A pair of isotopes is C and D.

Atomic number of C = 17

Atomic number of D = 17

Mass numbers of C and D are 35 and 37 respectively.

26. (a) According to Thomson's model of an atom :

(i) An atom consists of a positively charged sphere and the electrons are embedded like the seeds in a watermelon.

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

(b) The beam of rays which travel in a direction away from anode towards cathode when a gas taken in a discharge tube is subjected to the action of high voltage under low pressure are known as canal rays. It is also called anode rays. It was discovered by E. Goldstein in 1886.

27. (a) F : Because it was not proposed by J.J. Thomson.

(b) F : Because neutron is an independent sub-atomic particle.

(c) T : Because it is a fact known from experiments.

(d) F : Because tincture iodine is a solution of ordinary iodine in alcohol.

28. (a) Mass number of helium = 4

Number of protons = 2

Number of neutrons (n)

$\quad$ = Mass number (A) – No. of protons (p)

$\quad$ = 4 – 2 = 2

Thus, no. of neutrons = 2

(b) Atomic number of carbon = 6

Hence first shell (K-shell) have 2 electrons and the remaining 4 electrons will be present in the second shell, *i.e. L*-shell. Thus the distribution will be

K	L
2	4

Atomic number of sodium = 11. Hence, first shell (K-shell) will have 2 electrons and second shell (L-shell) will have 8 electrons and third shell (M-shell) will have 1 electron. Thus, the distribution will be

K	L	M
2	8	1

29. The distribution of elements in different orbits is governed by a scheme called Bohr-Bury scheme. There are following rules :

(i) The maximum number of electrons present in any shell is given by the formula $2n^2$. Where n = no. of orbit.

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

(iii) Electrons in an atom do not occupy a new shell unless all the inner shells are completely filled.

30. (a) The electronic configuration of element A is

K	L	M	N
2	8	8	2

Therefore, the N shell is the outermost shell or the valence shell. Number of valence electrons

= number of electrons in the outermost shell

= 2.

(b) (i) The atomic no. of element = No. of protons = 9

(ii) The mass no. of element

$\quad$ = No. of protons + No. of neutrons

$\quad$ = 9 + 10 = 19

(iii) The element with Z = 9 is fluorine (F).

Its electronic configuration : 2, 7.

(iv) The valency of fluorine is 1 and is calculated as 8 – 7 = 1.

31. (a) V(2, 8, 8, 1) $\qquad$ (b) R(2, 8) and U(2, 8, 8)

(c) P(2, 5) and T(2, 8, 5) $\qquad$ (d) Q(2, 6)

(e) S(2, 8, 2)

(f) P(3), Q(2), R(0), S(2), T(3), U(0), V(1)

32. (a)A cation is formed when an atom loses one or more than one electrons from valence shell.

$M \rightarrow M^+ + e^-$

For example,

$Na \rightarrow Na^+ + 1e^-$

$Mg \rightarrow Mg^{2+} + 2e^-$

Characteristics of cations :

(i) Cations are positively charged.

(ii) Cations are formed when an atom loses electrons from its valence shell to attain octet.

(iii) Cations are smaller in size than parent atom.

(iv) The charge acquired by a cation is equal to the number of electrons lost by the valence shell.

(b)Atomic number of aluminium is 13 and its electronic configuration is 2, 8, 3. Al^{3+} is formed by removing 3 electrons from aluminium atom.

$\quad Al - 3e^- \rightarrow Al^{3+}$
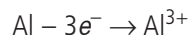
Hence, electronic configuration of Al^{3+} is 2, 8.

33. Let the % of isotope $^{16}_8X = x$ and % of isotope $^{18}_8X = 100 - x$

Average atomic mass of an element (X) = 16.2

Average atomic mass

$$= \frac{\text{Mass of } ^{16}_8X \times \text{percentange of } ^{16}_8X + \text{Mass of } ^{18}_8X \times \text{ percentage of } ^{18}_8X}{100}$$

or $\quad 16.2 = \dfrac{x \times 16 + (100 - x) \times 18}{100}$

or $\quad 16.2 = \dfrac{16x + 1800 - 18x}{100}$

or $\quad 1620 = 16x + 1800 - 18x$

or $\quad 1620 = -2x + 1800$ or $2x = 1800 - 1620$

or $\quad 2x = 180$

$\therefore \quad x = \dfrac{180}{2} = 90$

Thus % of isotope $^{16}_8X$ = 90%

% of isotope $^{18}_8X$ = (100 – 90) = 10%

34. (a) J.J. Thomson discovered electron. E. Goldstein discovered proton. Chadwick discovered neutron.

(b)

	Property	Electron	Proton	Neutron
1.	Nature	Negatively charged	Positively charged	Neutral
2.	Charge	-1 unit or -1.6×10^{-19}C	$+1$ unit or $+1.6 \times 10^{-19}$C	Zero
3.	Mass	9.1×10^{-31} kg	1.67×10^{-27} kg	1.675×10^{-27} kg
4.	Location	Present around the nucleus	Present in nucleus	Present in nucleus
5.	Relative mass	$\dfrac{1}{1838}$ u	1 u	1u

35. Valency of an atom is the number of electrons gained, lost or shared so as to complete the octet of electrons in the valence shell.

Valency of chlorine: It has electronic configuration = 2, 8, 7

Thus, one electron is gained to complete its octet and so its valency is 1.

Valency of sulphur: It has electronic configuration = 2, 8, 6

Thus, two electrons are gained to complete its octet and hence its valency = 2

Valency of magnesium : It has electronic configuration = 2, 8, 2

Thus, it can lose two electrons to attain octet and hence its valency = 2

36. (a) Rutherford's α-particle scattering experiment

(b) **Rutherford observed that :**

(i) Most of the α-particles (nearly 99%) passed through the gold foil undeflected.

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

(iii) A very few α-particles (1 in 12,000) were either deflected by very large angles or were actually reflected back along their path.

(c) **Rutherford explained his observation as follows :**

(i) Since most of the α-particles passed through the foil undeflected, it indicates that the most of the space in an atom is empty.

(ii) α-Particles being positively charged and having considerable mass, could be deflected only by some heavy, positively charged centre. The small angle of deflection of α-particles indicated the presence of a heavy positive centre in the atom. Rutherford named this positive centre as nucleus.

(iii) α-Particles which make head-on collision with heavy positive centre are deflected through large angles. Since

the number of such α-particles is very small, thus the space occupied by the heavy positive centre must be very small.

(d) **The nuclear model of atom had following features :**

(i) There is a positively charged centre in an atom called the nucleus. Nearly whole the mass of an atom resides in the nucleus.

(ii) The electrons revolve around the nucleus in circular paths.

(iii) The size of the nucleus is very small as compared to the size of the atom.

(e) **Drawbacks of Rutherford's atomic model :**

(i) It has been found that, if an electrically charged particle revolves around the circular path, then it always radiates out energy. Thus, if an electron moves around the nucleus, it must continuously radiate out energy and hence, gradually move towards nucleus in a spiral path, till it collides with nucleus. However, we know that atom is very stable. Rutherford's model cannot explain this stability.

(ii) Rutherford's model of atom does not say anything about the arrangement of electrons in an atom.

37. (a) Yes, there are elements with the same number of electrons, protons and neutrons. For example

Element	No. of electrons	No. of protons	No. of neutrons
$^{4}_{2}$He	2	2	2
$^{12}_{6}$C	6	6	6
$^{14}_{7}$N	7	7	7
$^{16}_{8}$O	8	8	8
$^{20}_{10}$Ne	10	10	10
$^{24}_{12}$Mg	12	12	12
$^{28}_{14}$Si	14	14	14
$^{32}_{16}$S	16	16	16
$^{40}_{20}$Ca	20	20	20

(b) Number of electrons in M^{3+} ion = 10

Number of electrons in the neutral atom = 13

$(M - 3e^{-} \rightarrow M^{3+})$

For a neutral atom, number of electrons = number of protons = atomic number

$\therefore$ Atomic number = 13

Mass number = Number of protons + number of neutrons = 13 + 14 = 27

The element with atomic number 13 is aluminium.

38. (a) Isotopes of an element have same atomic number as well as electronic configuration. Since the chemical properties of elements are related to their electronic configuration, *i.e.*, the elements with similar configuration will have similar properties. Thus, the isotopes of an element are chemically similar.

(b) In an atom, the number of protons in the nucleus is equal to the number of electrons in the extra-nuclear portion. Since each proton and each electron has the same charge but with opposite magnitude, the atom is electrically neutral.

(c) The atoms of noble gas elements have complete outermost shells. Hence, they are least reactive.

(d) Nucleus of an atom is made up of protons which are positively charged and neutrons that are neutral. Hence net charge on nucleus is positive. The total mass of neutron and proton makes it heavy.

(e) When an atom changes into an ion (cation or anion) the valence shell of the ion has a complete octet or duplet which makes ions more stable than atoms.
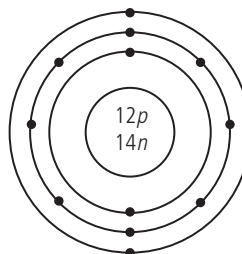
39. (a) Atomic number of $X = 12$

Thus, number of protons = number of electrons = 12

Mass number of $X = 26$

Thus, number of neutrons $= 26 - 12 = 14$

Its electronic configuration = 2, 8, 2

Thus, number of electrons present in the outermost shell is 2, so its valency is 2.

(b) Electronic configuration of $Y = 2, 8, 7$

So, valency of $Y = 8 - 7 = 1$

Thus, formula of compound formed by X and $Y = XY_2$

One atom of X combines with two atoms of Y to achieve stable noble gas configuration.

40. (a) V

(b) U

(c) T and W

(d) S

(e) S

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