PRACTICE PAPER 10 (2024-25)

CHAPTER 04 STRUCTURE OF THE ATOM (ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : IX **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

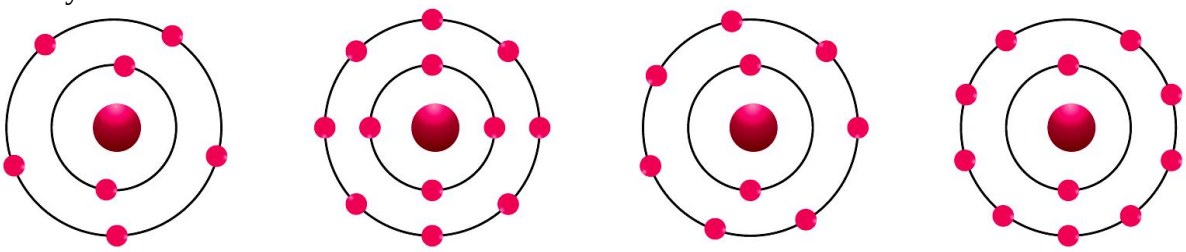
(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. Which of the following in figures given below 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)

Ans. (c) (ii) and (iv)

In figure (ii), K shell has more than 2 electrons.

In figure (iv), L shell has more than 8 electrons.

2. Arrange the following atomic model's experiments in the order of their chronology.

(I) Rutherford's atomic model

(II) Thomson's atomic model

(III) Bohr's atomic model

Options:

(a) (I), (II) and (III) (b) (II), (III) and (I) (c) (II), (I) and (III) (d) (III), (II) and (I)

Ans. (c) (II), (I) and (III)

The correct order of the atomic models is (II) Thomson's atomic model, (I) Rutherford's atomic model, and (III) Bohr's atomic model.

3. Characteristics of an Isotope represent:

(I) Isotopes have different numbers of neutrons.

(II) Isotopes have same number of electrons and protons.

(III) Isotopes have different chemical properties.

(IV) Isotopes have different physical properties.

Which of the following represent the properties of an Isotope?

(a) (I) and (II) (b) (II) and (III) (c) (III) and (IV) (d) (I), (II) and (IV)

Ans. (d) (I), (II) and (IV)

Isotope is defined as two or more forms of the same element that have equal numbers of protons but different numbers of neutrons in their nucleus, due to which atomic mass is different but possesses same chemical properties.

4. Elements with valency 1 are:
(a) always metals
(b) always metalloids
(c) either metals or non-metals
(d) always non-metals
Ans. (c) either metals or non-metals
Metals and non-metals both can have valency 1.
Metals that have 1 valence electron and non-metals which have 7 electrons have valency 1. It is because metals lose 1e– and non-metals gain 1e– to complete their octet.

5. The ion of an element has three 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
Ans. (b) 10
Atomic Mass (A) of the atom = 27
Number of the neutrons in the atom = 14
Number of Protons = Mass number–Number of neutrons = 27–14
Number of electrons = Number of protons = 13
Since ions of the element have 3 positive harges, the number of the electron in the ion is 13–3 which is equal to 10.

6. Which of the following statement is always correct?
(a) An atom has an equal number of electrons and protons.
(b) An atom has an equal number of electrons and neutrons.
(c) An atom has an equal number of protons and neutrons.
(d) An atom has an equal number of electrons, protons and neutrons.
Ans. (a) An atom has an equal number of electrons and protons.
Atoms are neutral and the neutral nature of atoms is possible when an atom has equal number of electrons and protons.

7. The picture shows the symbol for sodium.

$$^{23}_{11}\mathrm{Na}$$

What can be concluded about sodium from the symbol?
(a) It contains 11 neutrons.
(b) It contains 12 protons.
(c) It contains 12 neutrons.
(d) It contains 34 electrons.
Ans. (b) It contains 12 protons.
The atomic weight of sodium is 23.
The number of neutrons in sodium = Atomic weight of sodium – number of protons in sodium = 23 – 11 = 12.
Therefore, there are 12 neutrons in a sodium atom.

8. Which of the following is NOT true about Bohr & Bury's rule for electronic configuration, where n is the shell no.?
(a) The maximum number of electrons present in a shell is given by the formula 2n2.
(b) The maximum number of electrons present in a shell is given by the formula 2n.
(c) The maximum number of electrons that can be accommodated in the outermost orbit is 8.
(d) Electrons are not accommodated in a given shell, unless the inner shells are filled.
Ans. (b) The maximum number of electrons present in a shell is given by the formula 2n.

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. Assertion (A): The size of the nucleus is very small as compared to the size of the atom.
Reason (R): The electrons revolve around the nucleus of the atom.
Ans. (b) Both A and R are true and R is not the correct explanation of A.
The nucleus of an atom is about 10^{-15} m in size; this means it is about 10^{-5} (or 1/100,000) of the size of the whole atom. The electrons revolve around the nucleus.

10. Assertion (A): For noble gases, valency is zero.
Reason (R): Noble gases have 8 valence electrons.
Ans. (a) Both A and R are true and R is the correct explanation of A.
Noble gas has 8 electrons in the outermost shell and they are the least reactive. Noble gases are already stable in their elemental form and thus, don't need to gain or lose electrons. So, its valency is zero.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. What are the limitations of J.J. Thomson's model of the atom?
Ans. The limitations of the J.J. Thomson's model are as follows:
(i) Thomson's model explained that atoms are electrically neutral, the results of experiments carried out by the other scientists could not be explained by this model.
(ii) This model failed to explain the location of electrons in the atom.

OR

Why did Rutherford select a gold foil in his alpha-ray scattering experiment?
Ans. As a light metal cannot be used because on being hit by a fast moving particle, the atom of light metal will be simply pushed forward and no scattering will occur.
Whereas, gold is a heavy metal with a high mass number and has a high malleable property. So, a very thin foil (=1000 atoms thick) can be made from gold to get clear observations.

12. If Z = 3, what would be the valency of the element? Also, name the element.
Ans. Atomic number of the element = 3
Number of electrons present in the atom = 3
Electronic configuration of the atom : K = 2, L = 1
The valency of the element = 1
The name of the element = Lithium (Li)

13. Define valency by taking example of silicon.
Ans. The valency of an atom is the number of electrons lost or gained or shared to complete octet. For example, Silicon (atomic number 14) has the following electronic distribution:
K = 2, L = 8, M = 4.
In the outermost shell, there are 4 electrons hence one atom of silicon will share its 4 electrons to complete its octet. So, the valency of silicon is 4.

14. On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.
Ans. According to Thomson's model, an atom consists of a sphere of positive charge and the electrons are embedded into it in such a way to give most stable electrostatic arrangement. This model explains the neutrality of the atom because equal number of electrons and positively charged particles are embedded together.

OR

Write the distribution of electrons in carbon and sodium atoms.
Ans. (i) Electronic distribution in carbon atom

Atomic number of carbon = 6
Number of electrons = 6
Distribution of electrons : K = 2, L= 4
(ii) Distribution of electrons in sodium atom
Atomic number of sodium atom = 11
Number of electrons in sodium atom = 11
Distribution of electrons in sodium atom: K = 2, L = 8, M = 1

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Mention the observations made by Bohr to overcome the limitations of Rutherford's atomic model.
Ans. Bohr postulated the following in his observations:
(i) Negatively charged electrons revolve around the positively charged nucleus in a definite circular path known as discrete orbits or shells.
(ii) While revolving in discrete orbits the electrons do not radiate energy. So, they don't lose energy and neither falls into the nucleus.
(iii) These circular orbits have fixed energy called energy shells.

16. Write the electronic configuration, number of neutrons, and valency of the following:
(a) Phosphorus
(b) Calcium
(c) Neon
Ans. (a) Atomic number of Phosphorus, Z = 15
Atomic mass of Phosphorus, A = 31
Electronic Configuration = 2,8,5
Number of neutrons = Z – A = 31–15 = 16
Valency = 3
(b) Atomic number of Calcium, Z = 20
Atomic mass of Calcium, A = 40
Electronic Configuration = 2,8,8,2
Number of neutrons = Z – A = 40 – 20 = 20
Valency = 2
(c) Atomic number of Neon, Z = 10
Atomic mass of Neon, A = 20
Electronic Configuration = 2,8
Number of neutrons = Z – A = 20 – 10 = 10
Valency = 0

17. (a) In Chemistry class, teacher asked Nina that the electronic configuration of Fluoride ion and Neon is the same. Then what is the difference between them?
(b) Why do inert gases have zero valencies?
(c) Name three isotopes of Hydrogen.
Ans. (a) Atomic number of Neon atom is 10 which is electrically neutral having 10 protons and 10 electrons whereas Fluoride ions are negatively charged having 9 protons and 10 electrons.
(b) Inert gases like Helium have only a K shell and it is completely filled with 2 electrons. Argon and Neon have 8 electrons in their outermost shell which is the maximum number of electrons that can be accommodated in the outermost shell, hence inert gases have zero valency.
(c) There are three isotopes of the element hydrogen: hydrogen ${}_{1}^{1}H$, deuterium ${}_{1}^{2}H$, and tritium ${}_{1}^{3}H$.

OR

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

Ans. Rutherford proposed a model in which electrons revolve around the nucleus in well-defined orbits. There is a positively charged centre in an atom called the nucleus. He also proposed that the size of the nucleus is very small as compared to the size of the atom and nearly all the mass of an atom is centred in the nucleus. Whereas, Thomson proposed the model of an atom to be similar to a christmas pudding. The electrons are studded like currants in a positively charged sphere like christmas pudding and the mass of the atom was supposed to be uniformly distributed.

SECTION – D

Questions 18 carry 5 marks each.

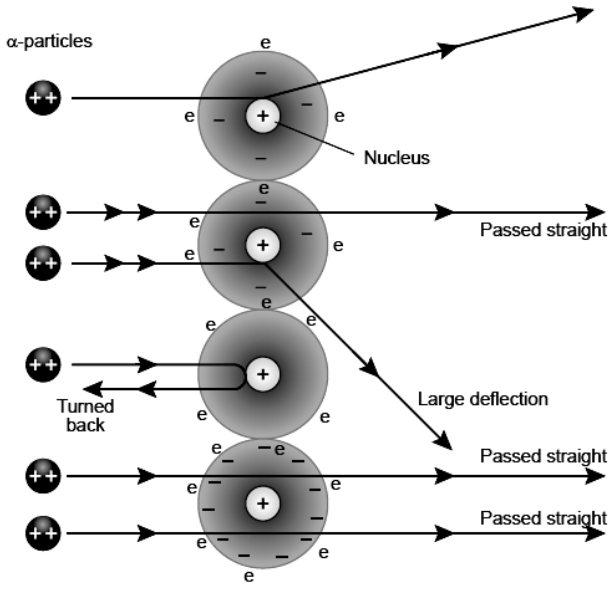
18. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.

(a) Oxygen has three isotopes of atomic masses 16, 17, and 18 respectively.
Explain the following:
(i) They have the same chemical properties.
(ii) They are all electrically neutral.
(b) Name the isotopes of hydrogen.
(c) Give one point of similarity and one point of difference between isotopes ${}^{14}_{6}C$ and ${}^{12}_{6}C$.

Ans. (a) (i) Mass numbers of isotopes of oxygen are different, i.e., 16, 17, and 18 but they have the same atomic number 8. Thus, the number of electrons is the same. Therefore, they have the same electronic configurations i.e., 2, 6, and the same number of valence electrons. So, their chemical properties are the same.
(ii) They are electrically neutral because the number of negatively charged electrons is the same as the number of positively charged protons.
(b) There are three isotopes of hydrogen- (1) Protium (${}^{1}_{1}H$) (2) Deuterium (${}^{2}_{1}H$) (3) Tritium (${}^{3}_{1}H$).
(c) (i) One point of similarity between isotopes ${}^{14}_{6}C$ and ${}^{12}_{6}C$: They have the same number of protons.
(ii) One point of difference between isotopes ${}^{14}_{6}C$ and ${}^{12}_{6}C$: They have different numbers of neutrons.

OR

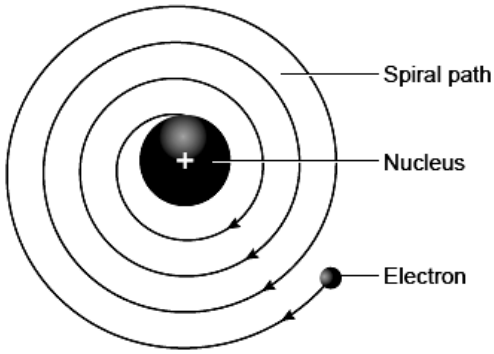
What is the gold foil experiment? Name the scientist who performed this experiment. Write the conclusions and shortcomings of Rutherford's model of atom.
Ans. In 1911, Rutherford performed the gold foil experiment. He bombarded a stream of a-particles on a gold foil, a thin sheet which was 0.00006 cm thick in an evacuated chamber. An a-particle is a positively charged helium ion (He2+). A simplified picture of this experiment is shown in the figure. In this famous experiment, the following observations were made.
(i) Most of the a-particles passed straight through the foil without any deflection. This concluded that most of the space inside of an atom is empty.
(ii) A few a-particles were deflected through small angle and few through larger angles. This happened due to repulsion between positive charge on a-particles and core (nucleus) of the atom. The heavy positively charged 'core' was named as nucleus.
(iii) The number of a-particles which bounced back was very small. This concluded that the volume of the nucleus is very small in comparison to the total volume of the atom. On the basis of gold foil experiment, Rutherford concluded that an atom consists of nucleus which has positive charge and it is surrounded with electrons which are moving around the nucleus. The number of electrons and protons are equal and the entire mass of the atom is concentrated at its nucleus.



Drawbacks in the Rutherford's model

(i) According to classical electro-magnetic theory, a moving charged particle, such as an electron under the influence of attractive force loses energy continuously in the form of radiations. As a result of this, electron should lose energy and therefore, should move in even smaller orbits ultimately falling into the nucleus. But the collapse does not occur. There is no explanation for this behaviour.

(ii) Rutherford did not specify the number of orbits and the number of electrons in each orbit.

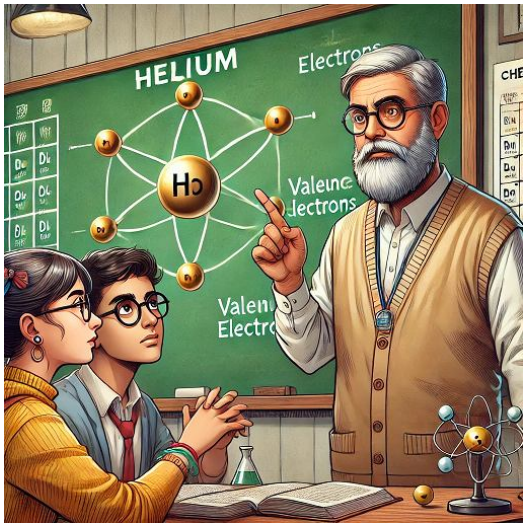


SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Read the following information and answer the questions based on information and related studied concepts.

Salima and Sheenu have a few doubts about the number of atoms in Helium. Salima says Helium atom has 2 electrons in its valence shell but its valency is not 2. According to Sheenu, Helium has 2 electrons and also its valency is 2. You are required to work as an arbitrator to solve the doubts of Salima and Sheenu. Similarly, they both have doubts regarding the valency and valence electrons of elements and are not able to recognise the difference between valence electrons and valency. Let's try to clear their doubts.



(a) What is the valency of He?
(b) How many valence electrons does each noble gas have?
(c) Why is the valency of inert gases zero?
Ans. (a) Helium has only one shell (K shell) and the maximum number of electrons within the K shell can be 2. Hence, the valency is zero.
(b) The number of valence electrons present in noble gases are either 2 or 8. Noble gas has a group 18, the configuration of electrons of every element is such that the outermost shell of the atom is full which implies that it does not have any electrons to donate or accept.
(c) The atoms of noble gases already have complete outermost shells, so they do not lose, gain, or share electrons. This is why noble gases are inert and do not take part in chemical reactions. Inert gases have very high ionisation enthalpy because they have a stable electronic configuration. Therefore, they do not tend to lose electrons. Thus, the valency of inert gases is zero.

20. Read the given passage and answer the questions that follow based on the passage and related studied concepts.

A large amount of research and many studies have been conducted to ensure success in new treatment plants using chlorine as a disinfectant. A leading advantage of chlorination is that it has proven effective against bacteria and viruses; however, it cannot inactivate all microbes. Some protozoan cysts are resistant to the effects of chlorine. Chlorine inactivates a microorganism by damaging its cell membrane. Once the cell membrane is weakened, chlorine can enter the cell and disrupt cellular respiration and DNA activity (two processes that are necessary for cell survival).

(a) What is the symbol for chlorine?
(b) What is the atomic number and atomic mass of chlorine?
(c) Find the number of protons, electrons and neutrons.
Ans. (a) The symbol of chlorine is Cl.
(b) The atomic number of chlorine is 17 and its atomic mass is 35. It is represented as $^{35}_{17}Cl$.
(c) Number of protons = Atomic number = 17
Number of electrons = Number of protons = 17
Number of neutrons = Atomic mass –
Atomic number = 35 – 17 = 18