

# Chapter 4

## STRUCTURE OF THE ATOM

### Multiple Choice Questions

- Which of the following correctly represent the electronic distribution in the Mg atom?
  - 3, 8, 1
  - 2, 8, 2
  - 1, 8, 3
  - 8, 2, 2
- Rutherford's 'alpha ( $\alpha$ ) particles scattering experiment' resulted in to discovery of
  - Electron
  - Proton
  - Nucleus in the atom
  - Atomic mass
- 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?
  - ${}_{15}^{31}\text{X}$
  - ${}_{16}^{31}\text{X}$
  - ${}_{15}^{16}\text{X}$
  - ${}_{16}^{15}\text{X}$
- Dalton's atomic theory successfully explained
  - Law of conservation of mass
  - Law of constant composition
  - Law of radioactivity
  - Law of multiple proportion
  - (i), (ii) and (iii)
  - (i), (iii) and (iv)
  - (ii), (iii) and (iv)
  - (i), (ii) and (iv)

5. Which of the following statements about Rutherford's model of atom are correct?
- (i) considered the nucleus as positively charged
  - (ii) established that the  $\alpha$ -particles are four times as heavy as a hydrogen atom
  - (iii) can be compared to solar system
  - (iv) was in agreement with Thomson's model
- (a) (i) and (iii)  
(b) (ii) and (iii)  
(c) (i) and (iv)  
(d) only (i)
6. 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
- (a) (i) and (ii)  
(b) (i) and (iii)  
(c) (ii) and (iii)  
(d) (ii) and (iv)
7. 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)
8. Rutherford's  $\alpha$ -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?
- (a) (i) and (iii)  
(b) (ii) and (iv)  
(c) (i) and (iv)  
(d) (iii) and (iv)

9. 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
10. Identify the  $\text{Mg}^{2+}$  ion from the Fig. 4.1 where, n and p represent the number of neutrons and protons respectively

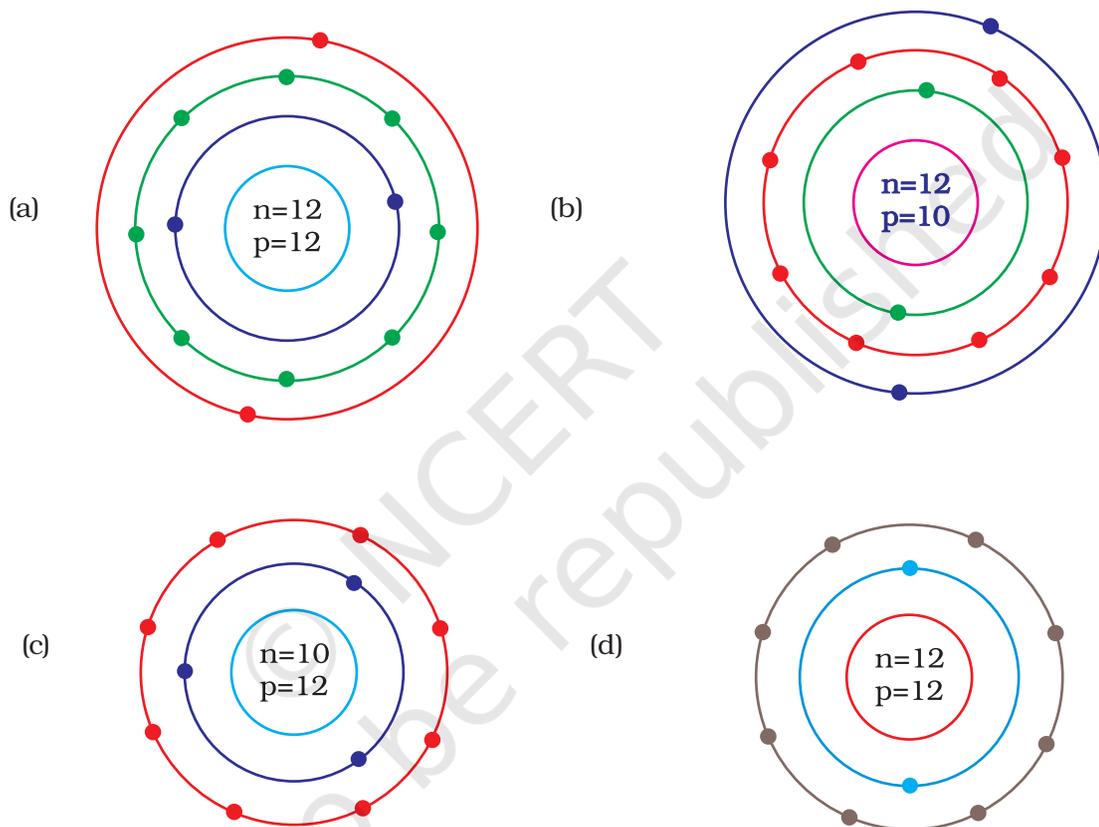
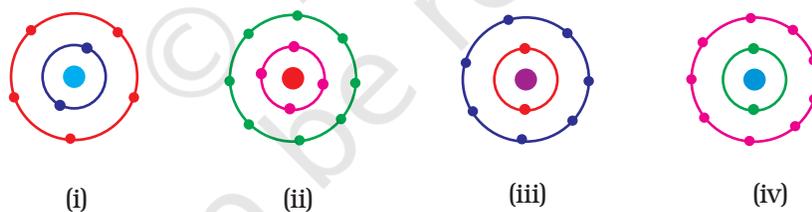


Fig. 4.1

11. In a sample of ethyl ethanoate ( $\text{CH}_3\text{COOC}_2\text{H}_5$ ) 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.

- 12.** Elements with valency 1 are  
 (a) always metals  
 (b) always metalloids  
 (c) either metals or non-metals  
 (d) always non-metals
- 13.** The first model of an atom was given by  
 (a) N. Bohr  
 (b) E. Goldstein  
 (c) Rutherford  
 (d) J.J. Thomson
- 14.** An atom with 3 protons and 4 neutrons will have a valency of  
 (a) 3  
 (b) 7  
 (c) 1  
 (d) 4
- 15.** The electron distribution in an aluminium atom is  
 (a) 2, 8, 3  
 (b) 2, 8, 2  
 (c) 8, 2, 3  
 (d) 2, 3, 8
- 16.** Which of the following in Fig. 4.2 do not represent Bohr's model of an atom correctly?



**Fig. 4.2**

- (a) (i) and (ii)  
 (b) (ii) and (iii)  
 (c) (ii) and (iv)  
 (d) (i) and (iv)
- 17.** Which of the following statement is always correct?  
 (a) An atom has equal number of electrons and protons.  
 (b) An atom has equal number of electrons and neutrons.  
 (c) An atom has equal number of protons and neutrons.  
 (d) An atom has equal number of electrons, protons and neutrons.

18. Atomic models have been improved over the years. Arrange the following atomic models in the order of their chronological order
- Rutherford's atomic model
  - Thomson's atomic model
  - Bohr's atomic model
- (i), (ii) and (iii)
  - (ii), (iii) and (i)
  - (ii), (i) and (iii)
  - (iii), (ii) and (i)

### Short Answer Questions

19. Is it possible for the atom of an element to have one electron, one proton and no neutron. If so, name the element.
20. Write any two observations which support the fact that atoms are divisible.
21. Will  $^{35}\text{Cl}$  and  $^{37}\text{Cl}$  have different valencies? Justify your answer.
22. Why did Rutherford select a gold foil in his  $\alpha$ -ray scattering experiment?
23. Find out the valency of the atoms represented by the Fig. 4.3 (a) and (b).

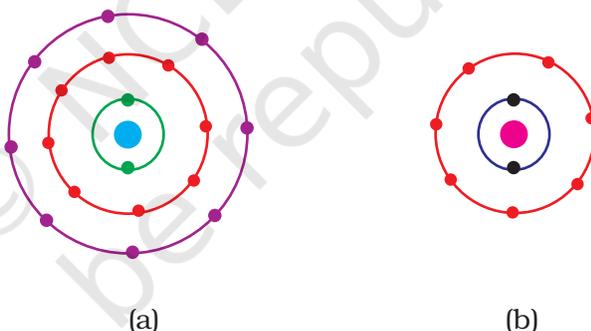


Fig. 4.3

24. 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?
25. Write down the electron distribution of chlorine atom. How many electrons are there in the L shell? (Atomic number of chlorine is 17).
26. 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?



- 33.** Helium atom has 2 electrons in its valence shell but its valency is not 2, Explain.
- 34.** Fill in the blanks in the following statements
- (a) Rutherford's  $\alpha$ -particle scattering experiment led to the discovery of the \_\_\_\_\_
  - (b) Isotopes have same \_\_\_\_\_but different\_\_\_\_\_.
  - (c) Neon and chlorine have atomic numbers 10 and 17 respectively. Their valencies will be\_\_\_\_\_and\_\_\_\_\_respectively.
  - (d) The electronic configuration of silicon is \_\_\_\_\_and that of sulphur is \_\_\_\_\_.
- 35.** An element X has a mass number 4 and atomic number 2. Write the valency of this element?

### Long Answer Questions

- 36.** Why do Helium, Neon and Argon have a zero valency?
- 37.** The ratio of the radii of hydrogen atom and its nucleus is  $\sim 10^5$ . Assuming the atom and the nucleus to be spherical, (i) what will be the ratio of their sizes? (ii) If atom is represented by planet earth ' $R_c$ ' =  $6.4 \times 10^6$  m, estimate the size of the nucleus.
- 38.** Enlist the conclusions drawn by Rutherford from his  $\alpha$ -ray scattering experiment.
- 39.** In what way is the Rutherford's atomic model different from that of Thomson's atomic model?
- 40.** What were the drawbacks of Rutherford's model of an atom?
- 41.** What are the postulates of Bohr's model of an atom?
- 42.** Show diagrammatically the electron distributions in a sodium atom and a sodium ion and also give their atomic number.
- 43.** In the Gold foil experiment of Geiger and Marsden, that paved the way for Rutherford's model of an atom,  $\sim 1.00\%$  of the  $\alpha$ -particles were found to deflect at angles  $> 50^\circ$ . If one mole of  $\alpha$ -particles were bombarded on the gold foil, compute the number of  $\alpha$ -particles that would deflect at angles less than  $50^\circ$ .