CLASS 9 SCIENCE

CHAPTER 8

JOURNEY INSIDE THE ATOM

NCERT QUESTIONS & ANSWERS

Chapter coverage: Development of atomic theory • Thomson, Rutherford and Bohr models • proton and neutron • symbols of elements • atomic number and mass number • electronic configuration • valency • isotopes and isobars • average atomic mass.

Source basis: Prepared from the supplied NCERT Grade 9 *Exploration* Chapter 8, “Journey Inside the Atom”, and its “Revise, Reflect, Refine” exercise. The chapter-end exercise contains 15 questions. ■filecite■turn171file0■L96-L131■ ■filecite■turn171file0■L133-L220■

CHAPTER-END QUESTIONS & ANSWERS

Revise • Reflect • Refine — Chapter 8

1. Choose the correct options in the context of Rutherford's gold foil experiment: (i) The experiment clearly showed neutrons in the nucleus. (ii) The results disproved the plum pudding model and led to the idea of a nucleus. (iii) Large deflection of a few alpha particles indicated that most mass and positive charge are packed into a tiny centre. (iv) Deflection showed electrons move around the nucleus.

Answer: (ii) and (iii) are correct.
(i) Incorrect — the gold foil experiment led to the nuclear model; neutrons were discovered later by Chadwick.
(ii) Correct — the observations could not be explained by Thomson's model and indicated a central nucleus.
(iii) Correct — large deflections showed that positive charge and most mass are concentrated in a very small region.
(iv) Incorrect — the experiment established the nucleus and empty space; the electron arrangement was developed through later atomic models.

2. According to Bohr's atomic model, state whether each statement is correct or incorrect: (i) Electrons lose energy in fixed orbits and fall into the nucleus. (ii) Electrons can exist anywhere around the nucleus with no fixed energy. (iii) Electrons revolve in fixed-energy orbits without losing energy. (iv) Electrons can be found between energy levels.

Answer:
(i) **Incorrect** — electrons in stationary states do not lose energy.
(ii) **Incorrect** — Bohr proposed definite energy levels/shells.
(iii) **Correct** — electrons in allowed stationary states have definite energy and do not lose energy while in that shell.
(iv) **Incorrect** — electrons occupy allowed energy levels, not the region between them in Bohr's model.

3. Atomic species X, Y and Z contain: X = 18 protons, 19 neutrons; Y = 17 protons, 18 neutrons; Z = 17 protons, 20 neutrons. Explain the relation between (i) Y and Z and (ii) Z and X.

Answer:
(i) Y and Z have the same atomic number (17) but different mass numbers: Y = 35 and Z = 37. Therefore, they are **isotopes** of the same element.
(ii) Z has mass number 37, while X has mass number 37 (18 + 19). Their atomic numbers are different (17 and 18). Therefore, they are **isobars**.

4. What conclusion did Rutherford draw about the position and characteristics of the atom's positively charged part from the few alpha particles that bounced back or were strongly deflected?

Answer: Rutherford concluded that the atom's positive charge is concentrated in an **extremely small, dense central region called the nucleus**. The nucleus contains all the positive charge and most of the atom's mass. The strong deflection of a few alpha particles occurred because they came very close to, or encountered, this concentrated positive region.

5. Arrange and explain the development of atomic models: (i) Bohr's fixed-energy orbits, (ii) Thomson's plum-pudding model, (iii) Rutherford's dense central nucleus, (iv) Dalton's indivisible atom.

Answer — chronological order: (iv) Dalton → (ii) Thomson → (iii) Rutherford → (i) Bohr.
Dalton: atom as an indivisible particle. **Thomson:** positive sphere with electrons embedded in it. **Rutherford:** dense, positively charged nucleus with most of the atom being empty space. **Bohr:** electrons occupy fixed energy levels/shells and do not lose energy while in a stationary state.

Exam Tip: Keep these relationships ready: Z = number of protons; for a neutral atom, electrons = protons; A = protons + neutrons; neutrons = A – Z. Isotopes have same Z but different A; isobars have same A but different Z.

6. Electrons move around the nucleus in orbits. Why do they not fly away from the atom? What keeps them attracted to the nucleus?

Answer: The negatively charged electrons are attracted towards the positively charged nucleus by the **electrostatic force of attraction**. This attraction keeps electrons bound to the atom. In Bohr's model, electrons occupy allowed stationary energy levels around the nucleus.

7. Assertion (A): Discovery of subatomic particles helped in understanding atomic structure. Reason (R): Number of electrons is equal to number of protons in an atom. Choose the correct option.

Answer: (ii) — Both A and R are true, but R is **not** the correct explanation of A. The discovery of electrons, protons and neutrons revealed that atoms have internal structure. Equality of electrons and protons explains electrical neutrality of an atom, not the full development of atomic structure.

8. Magnesium has mass number 24 and atomic number 12. Find (i) protons, (ii) neutrons, (iii) electrons, and illustrate its electron arrangement.

Answer:
(i) Atomic number = number of protons = **12**.
(ii) Neutrons = mass number – protons = 24 – 12 = **12**.
(iii) For a neutral atom, electrons = protons = **12**.
Electronic configuration: 2, 8, 2 (K = 2, L = 8, M = 2).

9. For the elements shown in Fig. 8.17, find: (i) name, (ii) symbol, (iii) total electrons, (iv) valence electrons, (v) valency, (vi) protons, (vii) atomic number.

Answer: The supplied textbook answer key identifies the four figures as follows:
(a) Lithium (Li): electrons 3; valence electrons 1; valency 1; protons 3; atomic number 3.
(b) Nitrogen (N): electrons 7; valence electrons 5; valency 3; protons 7; atomic number 7.
(c) Aluminium (Al): electrons 13; valence electrons 3; valency 3; protons 13; atomic number 13.
(d) Fluorine (F): electrons 9; valence electrons 7; valency 1; protons 9; atomic number 9. The supplied answer key confirms these values.
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10. Both Rutherford's and Bohr's models have electrons orbiting the nucleus. Why did Rutherford's model fail to explain atomic stability, while Bohr's model succeeded?

Answer: Rutherford's model could not explain stability because an electron moving in a circular path is accelerating; according to classical ideas, an accelerating charged particle should lose energy, spiral inward and eventually fall into the nucleus. Bohr solved this problem by proposing **stationary energy levels** in which electrons can move without losing energy. Electrons can change levels only by absorbing or releasing a fixed amount of energy.

Exam Tip: Keep these relationships ready: Z = number of protons; for a neutral atom, electrons = protons; A = protons + neutrons; neutrons = A – Z. Isotopes have same Z but different A; isobars have same A but different Z.

11. An atom has mass number 70 and 31 electrons. How many neutrons are present?

Answer: For a neutral atom, electrons = protons = 31. Neutrons = mass number – protons = 70 – 31 = **39 neutrons**.

12. An atom has 79 protons and mass number 197. Calculate (i) neutrons and (ii) electrons.

Answer:
(i) Neutrons = 197 – 79 = **118**.
(ii) For a neutral atom, electrons = protons = **79**.

13. Complete Table 8.5: (a) atomic number 5, mass number 6; (b) mass number 14, electrons 7, element Nitrogen; (c) mass number 24, protons 12; (d) atomic number 15, neutrons 16; (e) mass number 1, neutrons 0.

Answer:
(a) Atomic number 5; mass number 6; neutrons 1; protons 5; electrons 5; **Boron**.
(b) Atomic number 7; mass number 14; neutrons 7; protons 7; electrons 7; **Nitrogen**.
(c) Atomic number 12; mass number 24; neutrons 12; protons 12; electrons 12; **Magnesium**.
(d) Atomic number 15; mass number 31; neutrons 16; protons 15; electrons 15; **Phosphorus**.
(e) Atomic number 1; mass number 1; neutrons 0; protons 1; electrons 1; **Hydrogen**.

14. Element X has mass number 35 and 18 neutrons. Find: (i) electrons and protons, (ii) atomic number, (iii) element, (iv) electronic configuration, (v) valence electrons, (vi) mass number after adding two neutrons, (vii) relation between X and the new atom.

Answer:
Protons = 35 – 18 = **17**. Since X is neutral, electrons = **17**.
(i) Electrons = 17; protons = 17.
(ii) Atomic number = **17**.
(iii) Element = **Chlorine (Cl)**.
(iv) Electronic configuration = **2, 8, 7**.
(v) Valence electrons = **7**.
(vi) New mass number = 35 + 2 = **37**.
(vii) The new atom is an **isotope** of X because the atomic number remains 17 while the mass number changes from 35 to 37.

15. An atom contains 12 protons and 12 neutrons. Imagine replacing all electrons with hypothetical particles having the same charge as electrons but 500 times greater mass. What happens to (i) atomic number, (ii) atomic mass, (iii) mass number, (iv) overall charge?

Answer:
(i) **Atomic number remains 12** because it depends only on the number of protons.
(ii) **Atomic mass increases** because the replacement particles are much heavier than electrons. The chapter normally treats electron mass as negligible, but under this hypothetical condition it would no longer be negligible.
(iii) **Mass number remains 24** because mass number counts protons + neutrons only.
(iv) **Overall charge remains zero** because each replacement particle has the same charge as an electron, so the total negative charge still balances the 12 positive proton charges.

Exam Tip: Keep these relationships ready: Z = number of protons; for a neutral atom, electrons = protons; A = protons + neutrons; neutrons = A – Z. Isotopes have same Z but different A; isobars have same A but different Z.

QUICK REVISION — CHAPTER 8

High-priority concepts, definitions and relationships

Atomic models: Dalton → indivisible atom; Thomson → positive sphere with electrons; Rutherford → tiny dense positive nucleus and mostly empty space; Bohr → fixed energy levels/shells; modern model → quantum mechanical description.

Subatomic particles: Electron (–1), proton (+1), neutron (0). Protons and neutrons are in the nucleus; electrons occupy energy levels around it. Most atomic mass is concentrated in the nucleus.

Atomic number (Z): number of protons. **Mass number (A):** protons + neutrons. Therefore **neutrons = A** – **Z**. For a neutral atom, electrons = protons.

Electronic configuration: Maximum electrons in shell $n = 2n^2$. Electrons fill shells from the one closest to the nucleus outward. For the first 18 elements, common configurations include Na = 2,8,1; Mg = 2,8,2; Cl = 2,8,7; Ar = 2,8,8.

Valency: combining capacity determined by electrons gained, lost or shared to achieve a stable configuration. **Isotopes:** same atomic number, different mass number. **Isobars:** different atomic numbers, same mass number.

Key answers: Q1 (ii),(iii) • Q2 only (iii) correct • Q3 isotopes; isobars • Q7 (ii) • Q8 12 p, 12 n, 12 e, configuration 2,8,2 • Q11 39 neutrons • Q12 118 n, 79 e • Q14 chlorine, 2,8,7, isotope relation • Q15 atomic number unchanged, atomic mass increases, mass number unchanged, charge unchanged. These align with the supplied NCERT answer key. ■filecite■turn169file9■L561-L581■