

Structure of Atom — CBSE Pattern Test 2

Class 11 Chemistry · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 2 — CBSE Pattern (90 minutes, 40 marks)

Class 11 Chemistry · Structure of Atom · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

- The mass number of an atom is the number of
 - protons plus neutrons
 - protons only
 - electrons only
 - neutrons only
- Isobars are atoms with the same
 - mass number but different atomic numbers
 - atomic number
 - number of neutrons
 - number of electrons
- The main drawback of Rutherford's model is that it could not explain
 - the stability of the atom
 - the charge of the electron
 - the mass of the proton
 - the existence of isotopes
- The energy of an electron in the n th Bohr orbit of hydrogen is proportional to
 - $-1/n^2$
 - $-n^2$
 - $1/n$
 - n
- The principal quantum number decides the
 - size and energy of the orbital
 - shape of the orbital
 - orientation of the orbital
 - spin of the electron
- Hund's rule states that electrons occupy degenerate orbitals
 - singly, with parallel spins, first
 - in pairs first
 - with opposite spins
 - randomly
- Heisenberg's uncertainty principle states that the product of the uncertainties in position and momentum is
 - greater than or equal to $h/4\pi$

- (B) equal to zero
 (C) less than h
 (D) exactly h
8. The magnetic quantum number gives the
 (A) orientation of the orbital in space
 (B) size of the orbital
 (C) shape of the orbital
 (D) spin of the electron
9. State the Aufbau principle.
10. What are isotopes?

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. Calculate the de Broglie wavelength of an electron moving with a speed of 10^6 m/s.
12. Write the possible values of the magnetic quantum number for a d orbital.
13. State the composition of ^{23}Na in terms of protons, neutrons and electrons.
14. State Hund's rule with one example.

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. Describe Thomson's model of the atom and state its limitations, and explain how Rutherford's experiment improved upon it.
16. State Bohr's postulates and derive the expression for the radius of the n th orbit of the hydrogen atom.
17. Explain the four quantum numbers and state the information given by each.
18. State the de Broglie hypothesis and Heisenberg's uncertainty principle and explain their significance.

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. Explain the Aufbau principle, Pauli's exclusion principle and Hund's rule. Use them to write and justify the electronic configurations of nitrogen ($Z = 7$) and chromium ($Z = 24$).
20. Calculate the wavelength of the radiation emitted when an electron in a hydrogen atom falls from $n = 3$ to $n = 2$. State which spectral series this belongs to and derive the relevant formula.

Answer Key (Marking Scheme)

- Q1 — (A) protons plus neutrons. Q2 — (A) mass number but different atomic numbers. Q3 — (A) the stability of the atom. Q4 — (A) $-1/n^2$.
- Q5 — (A) size and energy of the orbital. Q6 — (A) singly, with parallel spins, first. Q7 — (A) greater than or equal to $h/4\pi$. Q8 — (A) orientation of the orbital in space.
- Q9 — Electrons fill orbitals in order of increasing energy.
- Q10 — Atoms of the same element with the same atomic number but different mass numbers.
- Q11 — $\lambda = h/mv \approx 7.3 \times 10^{-10}$ m.
- Q12 — $m_l = -2, -1, 0, +1, +2$.
- Q13 — 11 protons, 12 neutrons, 11 electrons.
- Q14 — Electrons fill degenerate orbitals singly with parallel spins before pairing, e.g. nitrogen $2p^3$.

Q15 — Thomson: positive sphere with embedded electrons; Rutherford's scattering revealed the nucleus.

Q16 — Postulates as in notes; $r_n = n^2 h^2 \epsilon_0 / \pi m e^2$.

Q17 — n, l, m_l, m_s with meanings as in notes.

Q18 — $\lambda = h/mv$; $\Delta x \Delta p \geq h/4\pi$; both are significant only for microscopic particles.

Q19 — N: $1s^2 2s^2 2p^3$; Cr: $[\text{Ar}] 3d^5 4s^1$ (half-filled stability).

Q20 — $1/\lambda = R(1/2^2 - 1/3^2)$; Balmer series; $\lambda \approx 656 \text{ nm}$.