

Structure of Atom — CBSE Pattern Test 1

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

Test 1 — 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 atomic number of an element is the number of
 - protons
 - neutrons
 - nucleons
 - electrons plus neutrons
- Isotopes of an element have the same
 - atomic number but different mass numbers
 - mass number but different atomic numbers
 - number of neutrons
 - number of nucleons
- Rutherford's alpha-particle scattering experiment led to the discovery of the
 - nucleus
 - electron
 - neutron
 - orbital
- According to Bohr, the angular momentum of an electron in an allowed orbit is
 - an integral multiple of $h/2\pi$
 - continuous
 - zero
 - an integral multiple of h
- The azimuthal quantum number decides the
 - shape of the orbital
 - size of the orbital
 - orientation of the orbital
 - spin of the electron
- The number of orbitals in a d subshell is
 - 5
 - 3
 - 1
 - 7
- The Aufbau principle states that electrons are filled in
 - increasing order of orbital energy

- (B) decreasing order of orbital energy
 (C) random order
 (D) the order of atomic number
8. The de Broglie wavelength of a particle is given by
 (A) h/mv
 (B) mv/h
 (C) hmv
 (D) $h/(m+v)$
9. State Pauli's exclusion principle.
10. Write the expression for the energy of the electron in the n th Bohr orbit.

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

11. Give the number of protons and neutrons in ^{37}Cl .
12. The radius of the first Bohr orbit is $0.53 \text{ \AA}$. Find the radius of the second orbit.
13. Write the electronic configuration of chlorine ($Z = 17$).
14. How many electrons in an atom can have $n = 3$ and $l = 2$?

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

15. Describe Rutherford's alpha-particle scattering experiment and state the conclusions drawn from it.
16. State the postulates of Bohr's model and derive the expression for the energy of the electron in the n th orbit.
17. State the Aufbau principle, Pauli's exclusion principle and Hund's rule and use them to write the electronic configuration of chromium ($Z = 24$).
18. State the de Broglie hypothesis and Heisenberg's uncertainty principle and explain how they support the concept of an orbital.

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

19. State Bohr's postulates. Derive the expressions for the radius and the energy of the electron in the n th orbit of the hydrogen atom and hence calculate the wavelength of the radiation emitted in the transition from $n = 3$ to $n = 2$.
20. Explain the four quantum numbers, state the information each gives, and use them to describe the shape and number of orbitals in the s , p and d subshells.

Answer Key (Marking Scheme)

- Q1 — (A) protons. Q2 — (A) atomic number but different mass numbers. Q3 — (A) nucleus. Q4 — (A) an integral multiple of $h/2\pi$.
- Q5 — (A) shape of the orbital. Q6 — (A) 5. Q7 — (A) increasing order of orbital energy. Q8 — (A) h/mv .
- Q9 — No two electrons in an atom can have the same set of all four quantum numbers.
- Q10 — $E_n = -13.6/n^2 \text{ eV}$.
- Q11 — 17 protons, 20 neutrons.
- Q12 — $r_2 = 0.53 \times 4 = 2.12 \text{ \AA}$.
- Q13 — $1s^2 2s^2 2p^6 3s^2 3p^5$.
- Q14 — $l = 2$ is d (5 orbitals), so 10 electrons.

Q15 — Alpha particles scattered by a gold foil; most pass straight, a few deflect strongly, implying a small dense nucleus.

Q16 — Postulates as in notes; $E_n = -13.6/n^2$ eV.

Q17 — [Ar] $3d^5 4s^1$; the half-filled d subshell gives extra stability.

Q18 — $\lambda = h/mv$ and $\Delta x \cdot \Delta p \geq h/4\pi$; together they replace fixed orbits with probability-based orbitals.

Q19 — $r_n = 0.53 n^2 \text{ \AA}$, $E_n = -13.6/n^2$ eV; transition $3 \rightarrow 2$ gives $\lambda \approx 656 \text{ nm}$.

Q20 — n, l, m_l, m_s ; s has 1 orbital, p has 3, d has 5.