



Attempt questions first; check the separate key afterward. Show all working. Draw accurate figures where required.

A. Very short answers - 1 mark each

1. Name the three main subatomic particles.
2. State their relative charges.
3. Who discovered the electron?
4. Describe the key feature of Thomson's atomic model.
5. Which experiment led to the nuclear model?
6. Explain what most undeflected alpha particles imply.
7. Where is almost all atomic mass concentrated?
8. Explain what rare large-angle deflections imply.

B. Short answers / practice - 2 marks each

9. What is atomic number?
10. What is mass number?
11. An atom has 11 protons and 12 neutrons. Find atomic and mass numbers.
12. Find electrons in the neutral atom.
13. An atom has $Z=17$, $A=35$. Find neutrons.
14. Write its shell distribution and usual valency.
15. Write the electronic arrangement of magnesium, $Z=12$.
16. Write its usual ion and electron count.
17. Define isotopes.
18. Give a pair of hydrogen isotopes with proton and neutron counts.
19. Define isobars.
20. Are ^{40}Ar and ^{40}Ca isotopes?

C. Application / reasoning - 3 marks each

21. What is the maximum electron capacity of the K shell?
22. Use $2n^2$ to find maximum capacity of the L shell.
23. Does a neutral atom contain equal protons and electrons?

24. Explain how ions form without changing the nucleus.

25. An element has 75% isotope mass 35 u and 25% isotope mass 37 u. Find mean atomic mass.

26. Explain why atomic masses need not be integers.

27. An atom has atomic number 13 and mass number 27. Find proton, electron and neutron counts.

28. Write the electron arrangement of oxygen, $Z=8$, and state usual valency.

29. A chloride ion has 18 electrons. Find its proton count.

30. Do isotopes of an element usually have similar chemical properties? Explain.

31. An element has equal proportions of isotopes of masses 10 u and 11 u. Find mean atomic mass.

D. Extended practice - 5 marks per pair

32. State one limitation of Rutherford's classical model.
33. Explain Bohr's idea of allowed energy levels.
34. An ion X^{2+} has 18 electrons and 20 neutrons. Find atomic number and mass number.
35. Compare Thomson, Rutherford and Bohr models with their supporting evidence and limitations.

ANSWER KEY - Numerical / closed questions

- 1) Electron, proton, neutron. 2) $-1, +1, 0$. 3) J.J. Thomson. 4) Rutherford's alpha-particle scattering. 5) Nucleus. 6) Number of protons. 7) Protons+neutrons. 8) 11; 23. 9) 11. 10) 18. 11) 2, 8, 7; 1. 12) 2, 8, 2. 13) Mg^{2+} ; 10 electrons. 14) Same atomic number, different mass numbers. 15) Example: ^1H 1p 0n; ^2H 1p 1n. 16) Same mass number, different atomic numbers. 17) 2. 18) 8. 19) Yes. 20) 35.5 u. 21) 13, 13, 14. 22) 2, 6; valency 2. 23) 17. 24) Yes; similar electron arrangements. 25) 10.5 u. 26) $Z=20$; $A=40$.