IGCSE PHYSICS • EXERCISE SHEET

5.1 The nuclear model of the atom

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS neutron 中子 • proton 质子 • electron 电子 • nucleus 原子核 • isotope 同位素

Objective

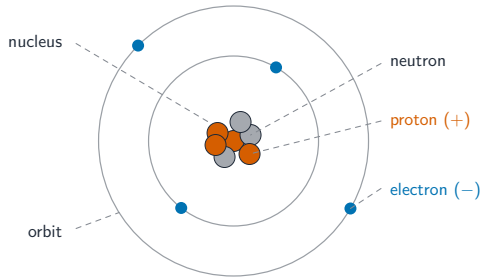
Build the skills to answer exam questions on the **nuclear model of the atom** 原子核模型 — atomic structure, the **alpha-scattering** α 散射 evidence, **nuclide notation** 核素符号, and **isotopes** 同位素.

You must be able to:

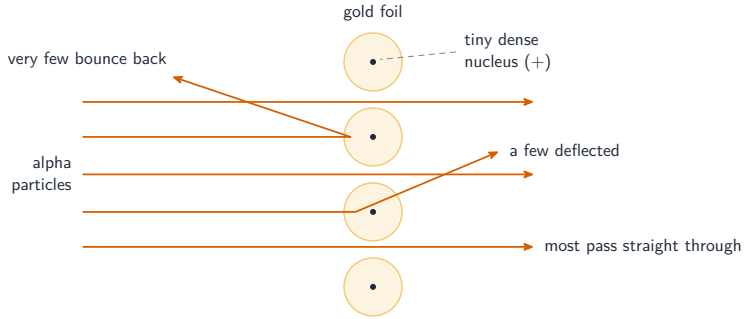
- describe the nuclear atom (tiny dense nucleus, electrons in orbits)
- interpret the alpha-scattering results
- use ${}^{A}_{Z}\mathrm{X}$ to find protons, neutrons and electrons; define isotopes

1 Worked examples

■ Nuclide notation & scattering



Almost all the mass is in the tiny nucleus; the atom is mostly empty space



Most pass straight through (empty space); a few bounce back (small, heavy, positive nucleus)

${}^{197}_{79}$Au: 79 protons, $197 - 79 = 118$ neutrons, 79 electrons (neutral atom).

2 Practice

2.1 State what is meant by an isotope. [1]

2.2 For ${}^{23}_{11}$Na, write down the number of protons and the number of neutrons. [2]

3 Exam-style questions

3.1 In the alpha-scattering experiment, most alpha particles pass straight through the foil. This shows the atom is: [1]

- **A** solid throughout
- **B** mostly empty space
- **C** negatively charged
- **D** very large

3.2 The nuclide $^{40}_{19}\mathrm{K}$ is given.

(a) State the number of protons, neutrons and electrons in a neutral atom. [3]

(b) An isotope of potassium is $^{39}_{19}\mathrm{K}$. State how its nucleus differs from $^{40}_{19}\mathrm{K}$. [1]

3.3 Explain why a very few alpha particles bounce almost straight back off the gold foil. [2]

Solutions

2.1 atoms of the same element (same proton number) with different numbers of neutrons.

2.2 protons = 11; neutrons = $23 - 11 = 12$.

3.1 B. Most passing straight through shows the atom is mostly empty space.

3.2 (a) protons = 19; neutrons = $40 - 19 = 21$; electrons = 19.
(b) it has one fewer neutron (20 instead of 21).

3.3 the nucleus is very small, very dense and positively charged; a head-on approach is strongly repelled, so the positive alpha particle bounces back.