

5.1 The nuclear model of the atom

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS neutron • proton • electron • nucleus • isotope

Objective

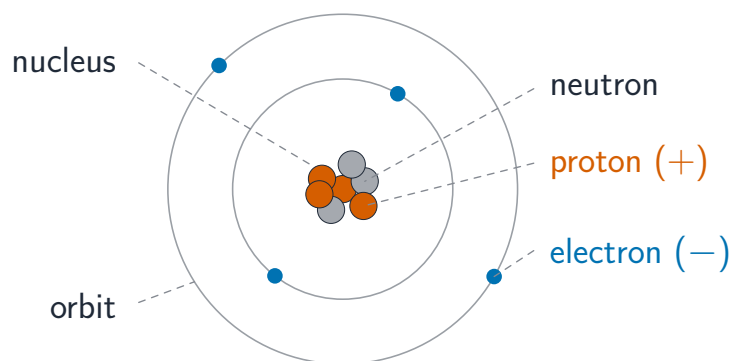
Build the skills to answer exam questions on the **nuclear model of the atom** — atomic structure, the **alpha-scattering** α evidence, **nuclide notation** , and **isotopes** .

You must be able to:

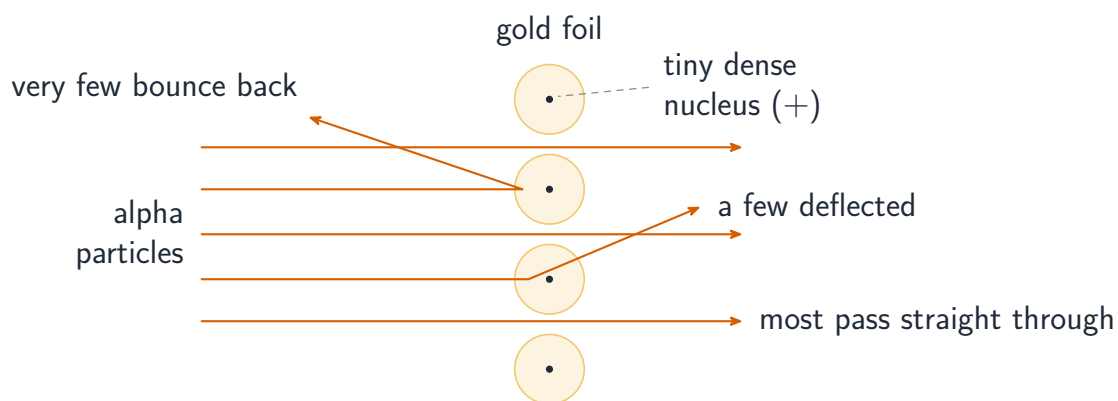
- describe the nuclear atom (tiny dense nucleus, electrons in orbits)
- interpret the alpha-scattering results
- use ${}_Z^AX$ to find protons, neutrons and electrons; define isotopes

1 Key knowledge and 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)

$^{197}_{79}\text{Au}$: 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 $^{23}_{11}\text{Na}$, 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 ${}^{40}_{19}\text{K}$ is given.

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

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

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

Solutions

Each answer shows the steps, then the **result**.

2.1

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

2.2

- protons = 11
- neutrons = $23 - 11 = \mathbf{12}$

3.1 B

- most passing straight through shows the atom is mostly empty space

3.2

(a) protons = 19

- neutrons = $40 - 19 = \mathbf{21}$
- 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