Exercise walk-through

The nuclear model of the atom ▪ 5.1

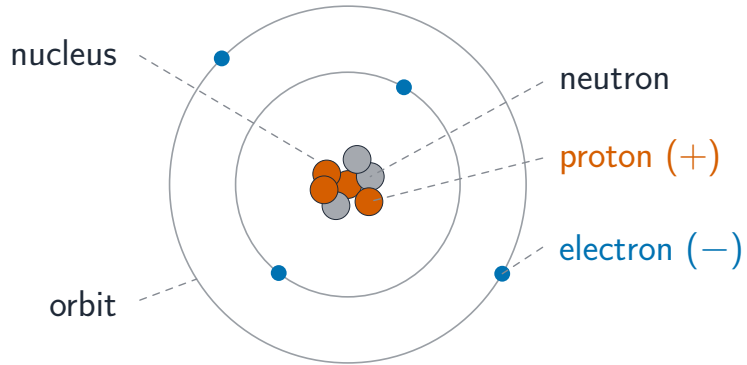
eXercise

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

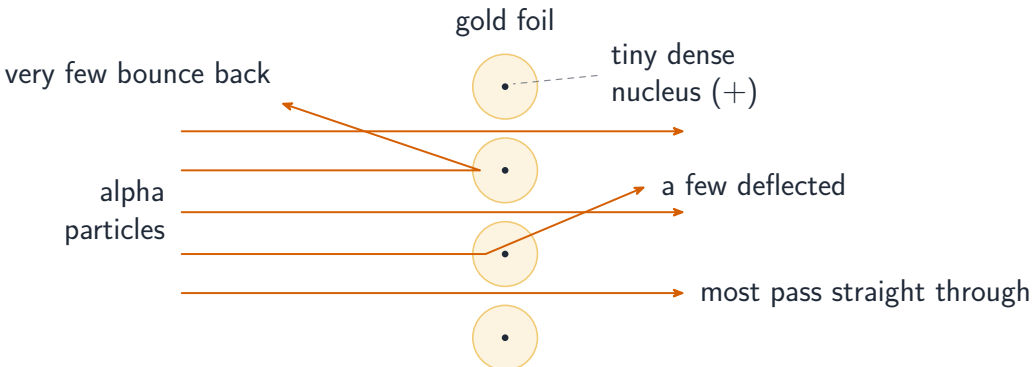
Method — Nuclide notation & scattering

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



A nucleus of protons and neutrons with electrons in orbits

Method — Nuclide notation & scattering



Practice 2.1 ▪ 1 mark

State what is meant by an isotope.

Solution 2.1

Worked steps

atoms of the same element (same proton number) with different numbers of neutrons B1.

Practice 2.2 ▪ 2 marks

For $^{23}_{11}\text{Na}$, write down the number of protons and the number of neutrons.

Solution 2.2

Method: Nuclide notation & scattering

Worked steps

protons $= 11$; neutrons $= 23 - 11 = 12$ B1 B1.

Exam-style 3.1 ▪ 1 mark

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

A solid throughout

B mostly empty space

C negatively charged

D very large

Solution 3.1

Method: Nuclide notation & scattering

A solid throughout

B mostly empty space ✓

C negatively charged

D very large

Worked steps

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

Exam-style 3.2 ▪ 3 marks

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

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

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

Solution 3.2

Method: Nuclide notation & scattering

Worked steps

(a) protons $= 19$; neutrons $= 40 - 19 = 21$; electrons $= 19$ **B1** **B1** **B1**.
(b) it has one fewer neutron (20 instead of 21) **B1**.

Exam-style 3.3 ▪ 2 marks

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

Solution 3.3

Method: Nuclide notation & scattering

Worked steps

the nucleus is very small, very dense and positively charged M1; a head-on approach is strongly repelled, so the positive alpha particle bounces back A1.