Exercise walk-through

Types of Radioactive Decay ▪ 15.8

eXercise

You must be able to

- describe **alpha** 阿尔法, **beta** 贝塔, and **gamma** 伽马 decay and what each emits
- write balanced nuclear equations that conserve nucleon number and charge
- compare the penetrating power of the three types

Method — The three decays

- **Alpha** — emits a helium nucleus ($^4_2\mathrm{He}$).
- **Beta** — emits a fast electron.
- **Gamma** — emits a high-energy photon (electromagnetic wave).

Method — Balanced nuclear equations

Both the **nucleon number** (top) and the **charge** (bottom) must balance on each side.

Method — Penetrating power

Alpha is the **least** penetrating (stopped by paper); beta is stopped by aluminium; **gamma is the most** penetrating (needs thick lead).

Practice 2.1 ▪ 2 marks

State what is emitted in alpha, beta, and gamma decay.

Solution 2.1

Worked steps

alpha: a helium nucleus; beta: a fast electron; gamma: a high-energy photon B1 B1 *for any two; for all three.*

Practice 2.2 ▪ 1 mark

State which type of radiation is the most penetrating.

Solution 2.2

Method: Penetrating power

Worked steps

gamma B1.

Practice 2.3 ▪ 2 marks

In alpha decay, state how the mass number and the atomic number change.

Solution 2.3

Worked steps

the mass number decreases by 4 and the atomic number decreases by 2 B1 B1.

Exam-style 3.1 ▪ 1 mark

An alpha particle is a

A helium nucleus

B fast-moving electron

C high-energy photon

D single proton

Solution 3.1

A helium nucleus ✓

B fast-moving electron

C high-energy photon

D single proton

Worked steps

A.

Exam-style 3.2 ▪ 1 mark

The most penetrating type of radiation is

A alpha

B beta

C gamma

D all equally penetrating

Solution 3.2

Method: Penetrating power

A alpha

B beta

C gamma ✓

D all equally penetrating

Worked steps

C.

Exam-style 3.3 ▪ 1 mark

A nucleus $^{238}_{92}\mathrm{U}$ emits an alpha particle.
(a) State the mass number of the new nucleus.
(b) State its atomic number.
(c) Name the two quantities that must be conserved in the equation.

Solution 3.3

Method: The three decays

Worked steps

(a) $238 - 4 = 234$ B1. (b) $92 - 2 = 90$ B1. (c) nucleon number and charge B1.