AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.4.2.2

Nuclear equations

Past-paper questions

Tier	**Foundation**
Question groups	**3**
Available paper years	**2020–2023**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

6.4.2.2 Nuclear equations

Question 01

November 2020 | 8464/P/1F | Original Q6

0 6 Different radioactive isotopes emit different types of nuclear radiation.

A polonium-210 (Po) nucleus emits an alpha particle (α) and turns into a lead (Pb) nucleus.

This can be represented by the equation:

$$^{210}_{84}Po \longrightarrow {}^{A}_{Z}Pb + \alpha$$

0 6 . 1 What is the value of A in the equation?

[1 mark]

Tick (✓) **one** box.

A = 206 ☐ A = 208 ☐ A = 210 ☐ A = 211 ☐

0 6 . 2 What is the value of Z in the equation?

[1 mark]

Tick (✓) **one** box.

Z = 80 ☐ Z = 82 ☐ Z = 85 ☐ Z = 86 ☐

Question 6 continues on the next page

6.4.2.2 Nuclear equations

Question 01 · continued

0 6 . 3 A strontium-89 nucleus (Sr) emits a beta particle (β) and turns into an yttrium nucleus (Y).

This can be represented by the equation:

$$^{89}_{38}\mathrm{Sr} \longrightarrow {}^{A}_{Z}\mathrm{Y} + \beta$$

What are the values of A and Z in the equation?

[2 marks]

A = _____

Z = _____

0 6 . 4 Gamma radiation is another type of nuclear radiation.

What does gamma radiation consist of?

[1 mark]

Tick (✓) **one** box.

- High energy neutrons ☐
- Electromagnetic waves ☐
- Particles with no charge ☐
- Positively charged ions ☐

6.4.2.2 Nuclear equations

Question 01 · continued

November 2020 | 8464/P/1F | Original Q6

0 6 . 5 Explain the differences between the properties of alpha, beta and gamma radiations.

[6 marks]

11

6.4.2.2 Nuclear equations

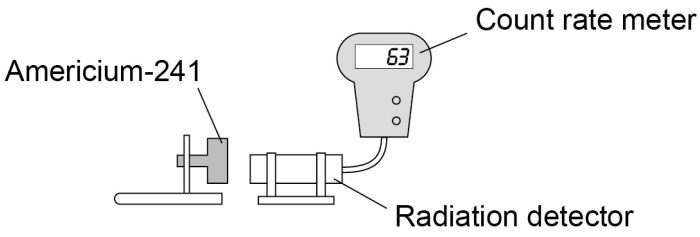
Question 02

June 2022 | 8464/P/1F | Original Q3

0 3 A teacher demonstrated that the radioactive isotope americium-241 emits alpha particles.

Figure 4 shows the equipment used.

Figure 4



0 3 . 1 An americium-241 nucleus (Am) emits an alpha particle and turns into a neptunium nucleus (Np).

Which is the correct nuclear equation for this decay?

Tick (✓) **one** box.

[1 mark]

$^{241}_{95}Am \longrightarrow {}^{237}_{93}Np + {}^{4}_{2}He$ ☐

$^{241}_{95}Am \longrightarrow {}^{245}_{93}Np + {}^{4}_{2}He$ ☐

$^{241}_{95}Am \longrightarrow {}^{237}_{97}Np + {}^{4}_{2}He$ ☐

0 3 . 2 What is the furthest distance that alpha radiation can travel in air?

Tick (✓) **one** box.

[1 mark]

A few millimetres ☐

A few centimetres ☐

A few metres ☐

6.4.2.2 Nuclear equations

Question 02 · continued

0 3 . 3 The teacher placed a piece of paper between the americium-241 and the radiation detector.

The reading on the count rate meter decreased by a large amount.

Why does the decreased reading show that americium-241 emits alpha radiation?

Tick (✓) **one** box.

[1 mark]

Paper stops alpha radiation. ☐

Paper stops all types of radiation. ☐

Paper stops beta and gamma radiation. ☐

The teacher replaced the americium-241 with a source of beta radiation.

0 3 . 4 Which symbol represents a beta particle?

[1 mark]

Tick (✓) **one** box.

$^{0}_{-1}e$ ☐

$^{0}_{0}e$ ☐

$^{-1}_{-1}e$ ☐

$^{-1}_{0}e$ ☐

Question 3 continues on the next page

6.4.2.2 Nuclear equations

Question 02 · continued

0 3 . 5 The count rate from the source was 119 ± 7 counts per second.

Calculate the smallest count rate this could have been.

[1 mark]

Smallest count rate = _____ counts per second

A teacher investigated how the distance between a different radioactive source and the detector affects the count rate.

0 3 . 6 Draw **one** line from each type of variable to the description.

[3 marks]

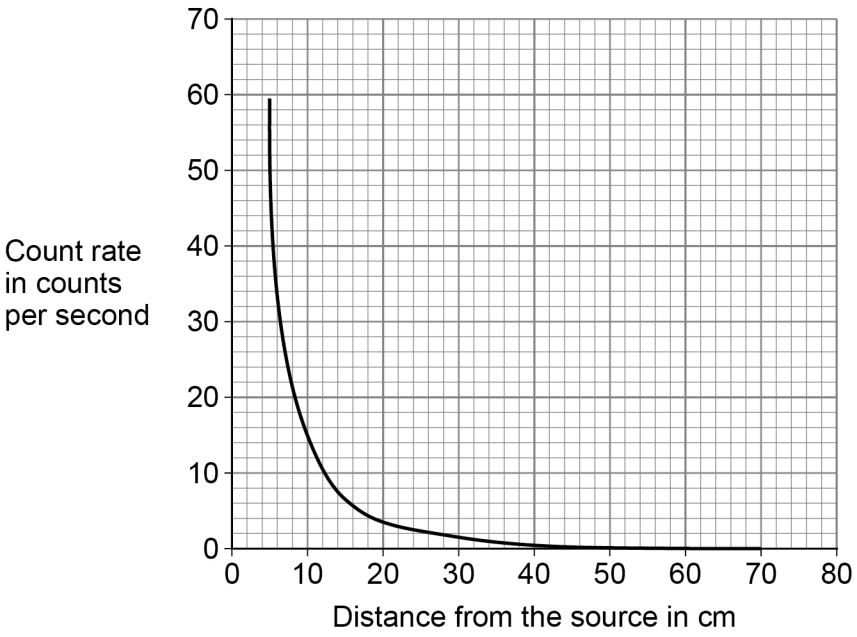
Type of variable	Description
	Count rate
Control variable	
	Distance between the source and detector
Dependent variable	
	Radioactive source
Independent variable	
	Time

6.4.2.2 Nuclear equations

Question 02 · continued

0 3 . 7 **Figure 5** shows how the count rate from the different radioactive source changed with the distance from the source.

Figure 5



Describe the relationship between the distance from the source and the count rate.

[2 marks]

10

6.4.2.2 Nuclear equations

Question 03

June 2023 | 8464/P/1F | Original Q1

0 1 A scientist investigated the radiation emitted by different radioactive isotopes.

The scientist had a sample of polonium-210.

The radiation emitted by polonium-210 can be represented by the symbol $^{4}_{2}\text{He}$.

0 1 . 1 Which type of radiation can be represented by the symbol $^{4}_{2}\text{He}$?

[1 mark]

Tick (✓) **one** box.

Alpha ☐

Beta ☐

Gamma ☐

0 1 . 2 How many protons are there in a particle of radiation represented by $^{4}_{2}\text{He}$?

[1 mark]

Tick (✓) **one** box.

2 ☐ 4 ☐ 6 ☐ 8 ☐

0 1 . 3 A polonium-210 (Po) nucleus changes into a lead (Pb) nucleus by emitting a $^{4}_{2}\text{He}$ particle. This is shown by the following nuclear equation.

$$^{210}_{84}\text{Po} \rightarrow {}^{206}_{\mathbf{X}}\text{Pb} + {}^{4}_{2}\text{He}$$

What is the value of **X**?

[1 mark]

Tick (✓) **one** box.

80 ☐ 82 ☐ 84 ☐ 86 ☐

6.4.2.2 Nuclear equations

Question 03 · continued

0 1 . 4 The sample of polonium-210 had an activity of 100 Bq.

Complete the sentence.

Choose the answer from the box.

[1 mark]

25	**50**	**100**	**200**

After one half-life, the activity of polonium-210 in the sample

was _____ Bq.

Question 1 continues on the next page

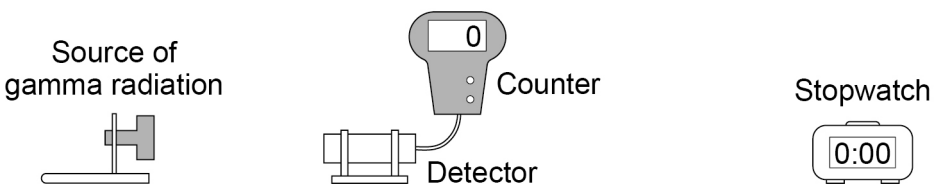
6.4.2.2 Nuclear equations

Question 03 · continued

The scientist investigated another radioactive isotope that is a source of gamma radiation.

Figure 1 shows the equipment used.

Figure 1



0 1 . 5 The count-rate is the number of counts detected each second.

In 30 seconds the number of counts detected was 1500.

Calculate the count-rate.

[2 marks]

Count-rate = _____ counts per second

6.4.2.2 Nuclear equations

Question 03 · continued

The scientist placed a thick sheet of lead between the source of gamma radiation and the detector.

0 1 . 6 What was the effect of the sheet of lead on the count-rate?

Give a reason for your answer.

[2 marks]

Effect _____

_____

Reason _____

_____

0 1 . 7 The lead was irradiated by the gamma radiation.

What happened to the lead when it was irradiated by the gamma radiation?

[1 mark]

Tick (✓) **one** box.

The lead atoms became radioactive. ☐

The lead gained atoms from the radioactive source. ☐

The lead was exposed to gamma radiation. ☐

Question 1 continues on the next page

6.4.2.2 Nuclear equations

Question 03 · continued

0 1 . 8 Gamma radiation is emitted from the nucleus of an atom.

Complete the sentence.

Choose the answer from the box.

[1 mark]

electromagnetic waves	**high speed electrons**
neutrons	**positively charged ions**

Gamma radiation consists of _____.

0 1 . 9 **Figure 2** shows the scientist holding the radioactive source using tongs.

Figure 2



Suggest **one** reason why using long tongs rather than short tongs was safer for the scientist.

[1 mark]

_____

_____

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