

GCSE Combined Science: Trilogy

Worksheet: Nuclear equations

TIME 30 min	TOTAL 30 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Nuclear equations

NAME _____

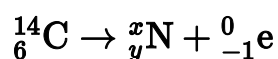
CLASS _____

DATE _____

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A nucleus of carbon-14 decays by emitting a beta particle:



0 1 . 1

Determine the values of x and y in the equation.

.....

.....

.....

.....

[2 marks]

0 2

0 2 . 1

Which symbol represents an alpha particle?

Tick (✓) **one** box.

${}^4_2\text{He}$

${}^0_{-1}\text{e}$

${}^1_0\text{n}$

γ

☐

☐

☐

☐

[1 mark]

0 2 . 2

Which symbol represents a beta particle?

Tick (✓) **one** box.

☐☐☐☐

[1 mark]

0 2 . 3

What happens to the mass number and to the atomic number of a nucleus when it emits an alpha particle?

.....

.....

.....

.....

[2 marks]

0 2 . 4

What happens to the mass number and to the atomic number of a nucleus when it emits a gamma ray?

.....

.....

[1 mark]

0 3

0 3 . 1

In a balanced nuclear equation, what must be true about the mass numbers on each side of the equation?

.....

.....

[1 mark]

0 3 . 2

What must be true about the atomic numbers (proton numbers) on each side?

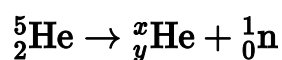
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[1 mark]

0 4

Some very unstable nuclei decay by emitting a neutron. A nucleus of helium-5 decays in this way:



0 4 . 1

Determine the values of x and y, and explain why the atomic number does not change.

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[3 marks]

0 5

Radium-226 decays by emitting an alpha particle to form radon (Rn):



0 5 . 1

Determine the values of x and y.

.....

.....

.....

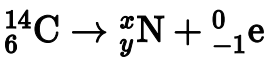
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[2 marks]

0 6

Carbon-14 decays by emitting a beta particle to form nitrogen (N):



0 6 . 1

Determine the values of x and y.

.....

.....

.....

.....

[2 marks]

0 7

Table 1 shows four nuclides in part of a decay series. Each nuclide decays to form the next nuclide in the table.

Table 1

Nuclide	Mass number	Atomic number
lead-214	214	82
bismuth-214	214	83
polonium-214	214	84
lead-210	210	82

0 7 . 1

Identify the type of decay when lead-214 decays to bismuth-214. Explain your answer.

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.....

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[2 marks]

0 7 . 2

Write a balanced nuclear equation for the decay of polonium-214 to lead-210.
The symbol for polonium is Po and the symbol for lead is Pb.

.....

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.....

[3 marks]

0 7 . 3

Which **two** nuclides in Table 1 are isotopes of the same element?

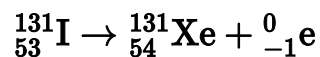
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[1 mark]

0 8

Iodine-131 is radioactive. Its nucleus decays by emitting a beta particle, and a gamma ray is also emitted. The equation for the beta decay is:



0 8 . 1

Describe what happens inside the nucleus when a beta particle is emitted.

.....

.....

.....

.....

[2 marks]

0 8 . 2

Explain how the equation shows that the charge of the nucleus increases.

[2 marks]

0 8 . 3

Explain why emitting the gamma ray does not change the mass number or the atomic number of the nucleus.

[2 marks]

0 9

0 9 . 1

Explain why the mass numbers and the atomic numbers must each balance on both sides of a nuclear equation.

[2 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Nuclear equations · 30 marks

Question 1 (2 marks)

01.1 [2 marks]

Answer: $x = 14$, $y = 7$

- $x = 14$ (unchanged) (1)
 - $y = 6 + 1 = 7$ (1)
-

Question 2 (5 marks)

02.1 [1 mark]

Correct: ${}^4_2\text{He}$

02.2 [1 mark]

Correct: ${}^0_{-1}\text{e}$

02.3 [2 marks]

Answer: Mass number falls by 4; atomic number falls by 2.

- the mass number decreases by 4 (1)
 - the atomic number decreases by 2 (1)
-

02.4 [1 mark]

Answer: Neither changes.

- neither changes / both stay the same (1)
-

Question 3 (2 marks)

03.1 [1 mark]

Answer: The total mass number is the same on both sides.

- they must be equal — the total mass number is the same on both sides (1)
-

03.2 [1 mark]

Answer: The total atomic number is the same on both sides.

- they must be equal — the total atomic number is the same on both sides (1)
-

Question 4 (3 marks)

04.1 [3 marks]

Answer: $x = 4$, $y = 2$

- $x = 5 - 1 = 4$ (1)
 - $y = 2$ (unchanged) (1)
 - a neutron has no charge, so the number of protons in the nucleus does not change (1)
-

Question 5 (2 marks)

05.1 [2 marks]

Answer: $x = 222$, $y = 86$

- $x = 226 - 4 = 222$ (1)
 - $y = 88 - 2 = 86$ (1)
-

Question 6 (2 marks)

06.1 [2 marks]

Answer: $x = 14$, $y = 7$

- $x = 14$ (the mass number is unchanged) (1)
 - $y = 6 + 1 = 7$ (1)
-

Question 7 (6 marks)

07.1 [2 marks]

Answer: Beta decay: the mass number stays at 214 and the atomic number increases by 1.

- beta (decay) (1)
 - the mass number does not change and the atomic number increases by 1 (1)
-

07.2 [3 marks]

Answer: ${}_{84}^{214}\text{Po} \rightarrow {}_{82}^{210}\text{Pb} + {}_2^4\text{He}$

- ${}_{84}^{214}\text{Po}$ on the left-hand side (1)
 - ${}_{82}^{210}\text{Pb}$ on the right-hand side (1)
 - ${}_2^4\text{He}$ on the right-hand side (1)
-

07.3 [1 mark]

Answer: Lead-214 and lead-210

- lead-214 and lead-210 (1)
-

Question 8 (6 marks)

08.1 [2 marks]

Answer: A neutron changes into a proton and a high-speed electron is ejected from the nucleus.

- a neutron changes into a proton (1)
- a high-speed electron (the beta particle) is emitted from the nucleus (1)

08.2 [2 marks]

Answer: The atomic number (number of protons) rises from 53 to 54, so the nucleus has one more positive charge.

- the atomic number increases from 53 to 54 (1)
- the atomic number is the number of protons, so the nucleus has one more (positive) charge (1)

08.3 [2 marks]

Answer: A gamma ray is electromagnetic radiation with no mass or charge, so the numbers of protons and neutrons are unchanged.

- a gamma ray is electromagnetic radiation, with no mass and no charge (1)
- so the numbers of protons and neutrons in the nucleus do not change (1)

Question 9 (2 marks)

09.1 [2 marks]

Answer: Nucleon number is conserved (mass numbers balance) and charge is conserved (atomic numbers balance).

- the total number of nucleons (protons and neutrons) is conserved in the decay, so the mass numbers must balance (1)
 - the total charge is conserved, so the atomic numbers (total proton/charge number) must balance (1)
-