AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.4.2.4

Radioactive contamination

Past-paper questions

Tier	**Higher**
Question groups	**3**
Available paper years	**2018–2024**

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.

6.4.2.4 Radioactive contamination

Question 01

June 2018 | 8464/P/1H | Original Q4

0 4 The Chernobyl disaster was a nuclear accident that happened in 1986

Radioactive isotopes were released into the environment.

The radioactive isotopes emitted alpha, beta and gamma radiation.

0 4 . 1 What is an alpha particle?

[1 mark]

Tick **one** box.

- 2 charged particles and 2 neutral particles. ☐
- 2 charged particles and 4 neutral particles. ☐
- 4 charged particles and 2 neutral particles. ☐
- 4 charged particles and 4 neutral particles. ☐

0 4 . 2 Which statement about beta radiation is true?

[1 mark]

Tick **one** box.

- It is the fastest moving type of radiation. ☐
- It is the type of radiation with a negative charge. ☐
- It is the type of radiation with the greatest mass. ☐
- It is the type of radiation with the greatest range in air. ☐

6.4.2.4 Radioactive contamination

Question 01 · continued

0 4 . 3 Which statement about gamma radiation is true?

[1 mark]

Tick **one** box.

- It is a low frequency electromagnetic wave. ☐
- It causes the charge of the nucleus to change. ☐
- It causes the mass of the nucleus to change. ☐
- It has a very long range in air. ☐

Question 4 continues on the next page

6.4.2.4 Radioactive contamination

Question 01 · continued

Table 3 shows the half-lives of two of the radioactive isotopes that contaminated the environment.

Table 3

Isotope	Half-life
Caesium–137	30 years
Iodine–131	8 days

0 4 . 4 A soil sample was taken from the area around Chernobyl in 1986

The soil sample was contaminated with equal amounts of caesium–137 and iodine–131

Explain how the risk linked to each isotope has changed between 1986 and 2018

Both isotopes emit the same type of radiation.

[4 marks]

0 4 . 5 Determine the year when the activity of the caesium–137 in the soil sample will be 1/32 of its original value.

[3 marks]

Year = _____

10

6.4.2.4 Radioactive contamination

Question 02

June 2023 | 8464/P/1H | Original Q4

0 4 A scientist investigated a sample of a radioactive material to determine if it would be suitable for medical use.

0 4 . 1 The method, results and conclusions of the scientist will need to be checked by other scientists before the results of the investigation are published.

What name is given to this checking process?

[1 mark]

0 4 . 2 There is an increased risk of cancer if the scientist is irradiated by nuclear radiation.

What property of nuclear radiation causes the increased risk of cancer?

[1 mark]

0 4 . 3 The activity of a radioactive source is the rate at which the nuclei of the source decay.

What is the unit for the activity of a radioactive source?

[1 mark]

0 4 . 4 The scientist placed a radiation detector near the sample and measured the count-rate.

Explain why the count-rate is less than the activity of the sample.

[2 marks]

6.4.2.4 Radioactive contamination

Question 02 · continued

0 4 . 5 The scientist recorded the count-rate from the sample with the radiation detector at different distances from the sample.

Table 2 shows the results.

Table 2

Distance between the sample and the detector in centimetres	Count-rate in counts/second
2.0	300
5.0	24
10.0	0

Explain which type of radiation was emitted by the sample.

[2 marks]

Question 4 continues on the next page

0 4 . 6 The scientist moved the detector closer to the sample and started a stopwatch.

The scientist measured the count-rate from the sample at different times.

Table 3 shows some of the results.

Table 3

Time in minutes	Count-rate in counts/second
0	1568
30	**X**
60	98

The scientist realised that 30 minutes is a whole number of half-lives.

Calculate the value of **X** in **Table 3**.

[3 marks]

X = _____ counts/second

6.4.2.4 Radioactive contamination

Question 02 · continued

0 4 . 7 The scientist had a second sample of the radioactive material.

The scientist made appropriate measurements, then calculated the half-life of each sample.

Why was the half-life calculated from the second sample slightly different from the half-life calculated from the first sample?

[1 mark]

Tick (✓) **one** box.

Radioactive decay is a random process. ☐

The count-rate from a radioactive sample is predictable. ☐

The samples were at different temperatures. ☐

The size of each sample was different. ☐

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Turn over for the next question

6.4.2.4 Radioactive contamination

Question 03

June 2024 | 8464/P/1H | Original Q5

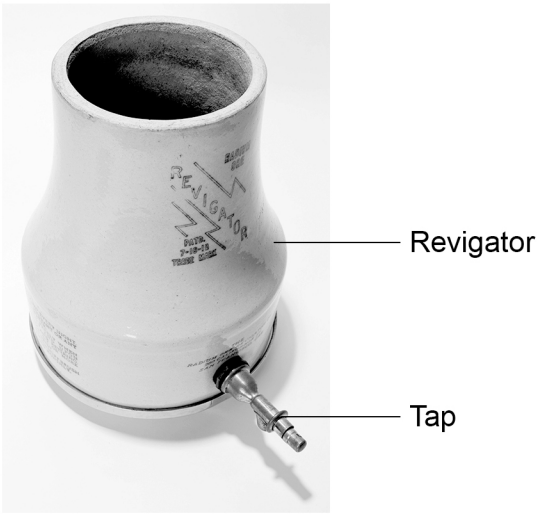
0 5 Some people used to think that radioactive substances had health benefits.

In the 1920s, a water container called a revigator was sold.

The walls of a revigator contain radioactive isotopes.

Figure 6 shows a revigator.

Figure 6



The revigator was filled with water and left overnight.

People then drank the water from the revigator.

6.4.2.4 Radioactive contamination

Question 03 · continued

0 5 . 1 The water was irradiated and contaminated by the radioactive isotopes in the walls of the revigator.

Explain how irradiating and contaminating the water affected the hazard caused by drinking the water.

[4 marks]

Irradiating _____

_____

_____

_____

Contaminating _____

_____

_____

_____

Question 5 continues on the next page

6.4.2.4 Radioactive contamination

Question 03 · continued June 2024 | 8464/P/1H | Original Q5

A scientist tested some water that had been left in a revigator.

The water contained radon-222 and vanadium-52.

0 5 . 2 Vanadium-52 (V) decays by emitting beta particles.

What is the correct nuclear equation for this process?

[1 mark]

Tick (✓) **one** box.

$^{52}_{23}V - {}^{0}_{-1}\beta \rightarrow {}^{52}_{22}Ti$ ☐

$^{52}_{23}V - {}^{0}_{-1}\beta \rightarrow {}^{52}_{24}Cr$ ☐

$^{52}_{23}V \rightarrow {}^{52}_{22}Ti + {}^{0}_{-1}\beta$ ☐

$^{52}_{23}V \rightarrow {}^{52}_{24}Cr + {}^{0}_{-1}\beta$ ☐

Question 03 · continued

0 5 . 3 **Table 2** shows the half-lives of radon-222 and vanadium-52.

Table 2

Isotope	Half-life
Radon-222	3.8 days
Vanadium-52	3.7 minutes

The scientist measured the radiation emitted by a sample of radon-222 and the radiation emitted by a sample of vanadium-52.

The scientist repeated the measurements 7.4 minutes later.

Explain how the activity of the radon-222 and vanadium-52 had changed after 7.4 minutes.

[4 marks]

Radon-222 _____

_____

_____

_____

Vanadium-52 _____

_____

_____

_____

0 5 . 4 Scientists monitored the effects of drinking the water from a revigator.

Their methods and results were checked by other scientists.

What name is given to the process of other scientists checking work before it is published?

[1 mark]

_____

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