

Q1. (2018)

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.

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

a)

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]

b)

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]

Q2. (2019)

0 6

Lanthanum-140 is a radioactive isotope.

The teacher investigated how the thickness of lead affected the amount of gamma radiation that could pass through it.

Figure 6 shows the apparatus.

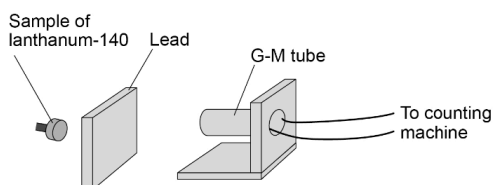
Figure 6

Table 1 shows the results.

Table 1

Thickness of lead in cm	Count rate in counts per second
0.5	110
1.0	60
1.5	33
2.0	18
2.5	10

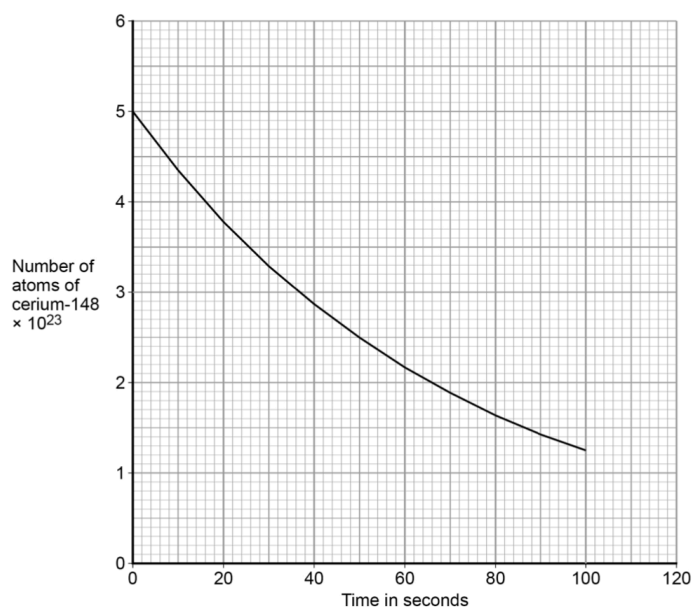
There are other isotopes of cerium which are radioactive.

Different isotopes of cerium have different half-lives.

The half-life of an isotope can be found by studying how the number of atoms changes over time.

Figure 7 shows how the number of atoms of cerium-148 in a 120 g sample changes over time.

Figure 7



a)

- 0 6 . 7** Determine the ratio of the number of cerium atoms in the sample when it was 100 seconds old compared with when the sample was 350 seconds old.

Use data from **Figure 7**.

[4 marks]

b)

- 0 6 . 8** Determine the activity of the sample of cerium when the sample was 20 seconds old.

Use **Figure 7**.

[3 marks]

Q3. (2020)

- 0 6** A student modelled radioactive decay by rolling some dice in a tray.

Dice that landed on the number six were removed from the tray.

The removed dice represent nuclei that have decayed.

a)

- 0 6 . 1** Why is rolling dice a suitable model for radioactive decay?

[1 mark]

b)

- 0 6 . 2** The student rolled 144 dice and removed all those that landed on the number six.

The student rolled the remaining dice and again removed all those that landed on the number six.

When the student had rolled the dice 20 times there were 9 dice left.

Calculate the most likely number of times that the student had rolled the dice before the number of dice had halved.

You should show how you work out your answer.

[3 marks]

c)

0 6 . 3 The number of times the dice have to be rolled to halve the original number of dice in the tray represents the half-life.

Figure 7 shows an eight-sided dice and a six-sided dice.

Figure 7



The student now used eight-sided dice to model radioactive decay. Dice that landed on the number six were again removed from the tray.

The half-life represented by rolling eight-sided dice is likely to be different from the half-life represented by rolling six-sided dice.

Explain how.

[2 marks]

d)

0 6 . 4 A teacher has two radioactive sources, **A** and **B**.

Source **A** has a longer half-life than source **B**.

What can be deduced about the nuclei in source **A** compared with the nuclei in source **B**?

Do **not** refer to isotopes in your answer.

[1 mark]

Q4. (2021)

0 2 . 3 A spark detector is a device that can be used to detect alpha radiation.

A spark detector works by alpha particles ionising atoms in the air near a wire mesh.

A large potential difference creates a spark when the air near the wire mesh is ionised.

Suggest why a spark detector **cannot** detect beta radiation.

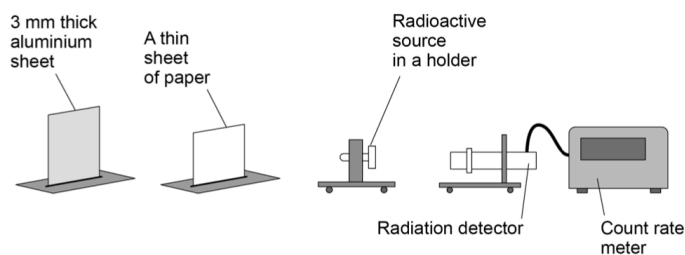
[1 mark]

Q5. (2021)

- 0 2 . 4 A teacher wants to demonstrate that the radioactive source emits alpha, beta and gamma radiation.

Figure 3 shows the equipment the teacher has.

Figure 3



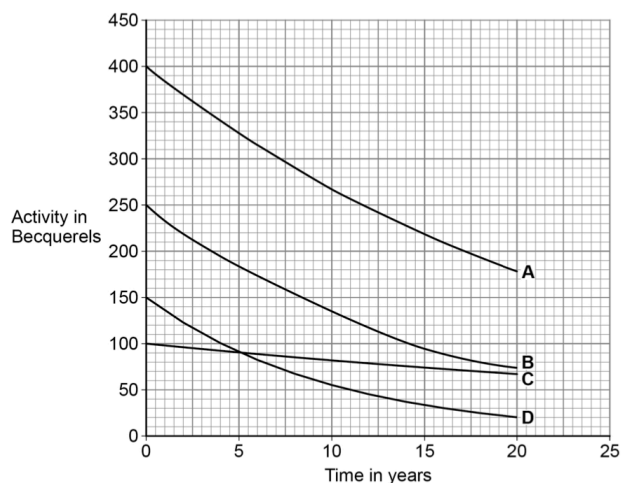
Describe a method the teacher could use.

[6 marks]

Q6. (2022)

- 0 6 . 4 Figure 11 shows how the activity of four different radioactive isotopes, A, B, C and D, changes over time.

Figure 11



Write the isotopes A, B, C and D in order of increasing stability of their nuclei.

Explain your answer.

[3 marks]

Least stable

Most stable

Explanation _____

Q7. (2023)

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

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]

Q8. (2024)

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

The water contained radon-222 and vanadium-52.

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]