Q1.

Carbon-14 is a radioactive isotope that occurs naturally.
Scientists use carbon-14 to help find the age of old pieces of wood.
This technique is called carbon dating.
It uses the idea of half-life.
   Which of these describes half-life?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A**   the time it takes for half of the undecayed nuclei to decay

☒ **B**   the time it takes for all of the undecayed nuclei to decay

☒ **C**   half the time it takes for all of the undecayed nuclei to decay

☒ **D**   half the time it takes for half of the undecayed nuclei to decay

Q2.

   Which of these is correct for half-life?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A**   It is half the time for all the atoms to decay

☒ **B**   It is the time it takes for an atom to half decay

☒ **C**   It is the time it takes for half an atom to decay

☒ **D**   It is the time it takes for half the atoms to decay

Q3.

State what is meant by the term 'half-life'.
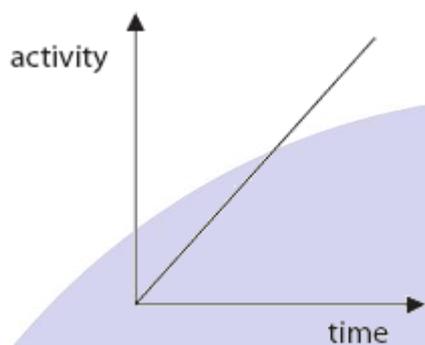
(1)

....

....
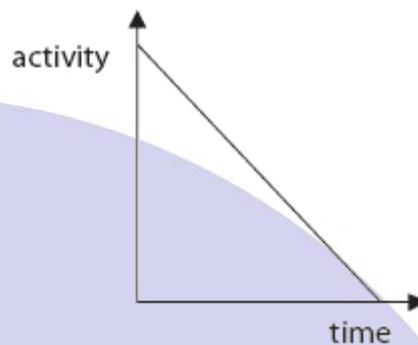
(Total for question = 1 mark)

Q4.

Which graph best shows how the activity of a radioactive isotope changes with time?

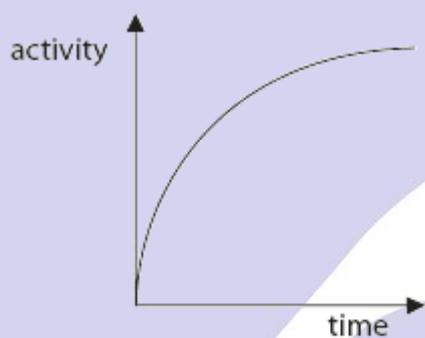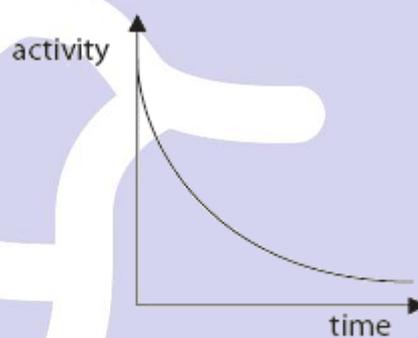Put a cross (⊠) in the box next to your answer.

(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**

Q5.

Complete the sentence by putting a cross (⊠) in the box next to your answer.

The unit of activity of a radioactive isotope is the

(1)

⊠ **A** americium

⊠ **B** becquerel

⊠ **C** einstein

⊠ **D** radium

Q6.

Carbon-14 is a radioactive isotope that occurs naturally.
Scientists use carbon-14 to help find the age of old pieces of wood.
This technique is called carbon dating.
It uses the idea of half-life.
(a) Which of these describes half-life?

Put a cross (☒) in the box next to your answer.

(1)

☒   **A**   the time it takes for half of the undecayed nuclei to decay

☒   **B**   the time it takes for all of the undecayed nuclei to decay

☒   **C**   half the time it takes for all of the undecayed nuclei to decay

☒   **D**   half the time it takes for half of the undecayed nuclei to decay

(b) Sketch a graph to show how the activity of a radioactive isotope changes with time.
Use the axes below. Start your line from point P.

(3)

(Total for Question is 4 marks)

Q7.

An atom has a central nucleus containing neutrons and protons.

Electrons orbit the nucleus.

One isotope of carbon is carbon-14.

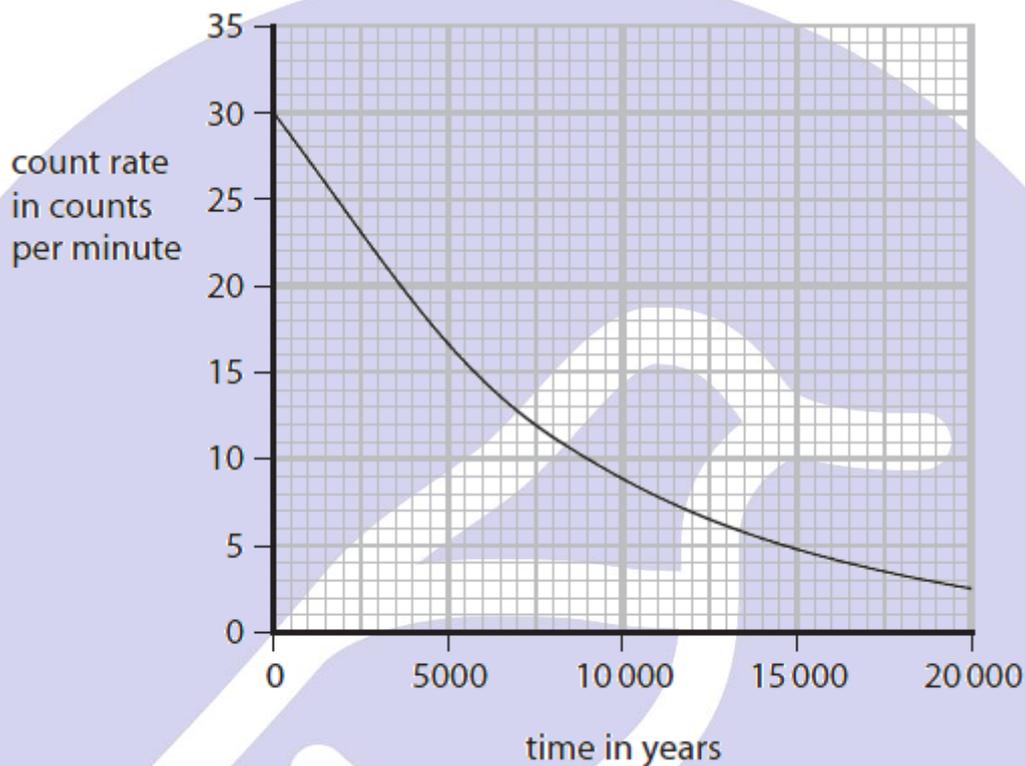(iii) Figure 4 shows a graph for the decay of the radioactive isotope carbon-14.

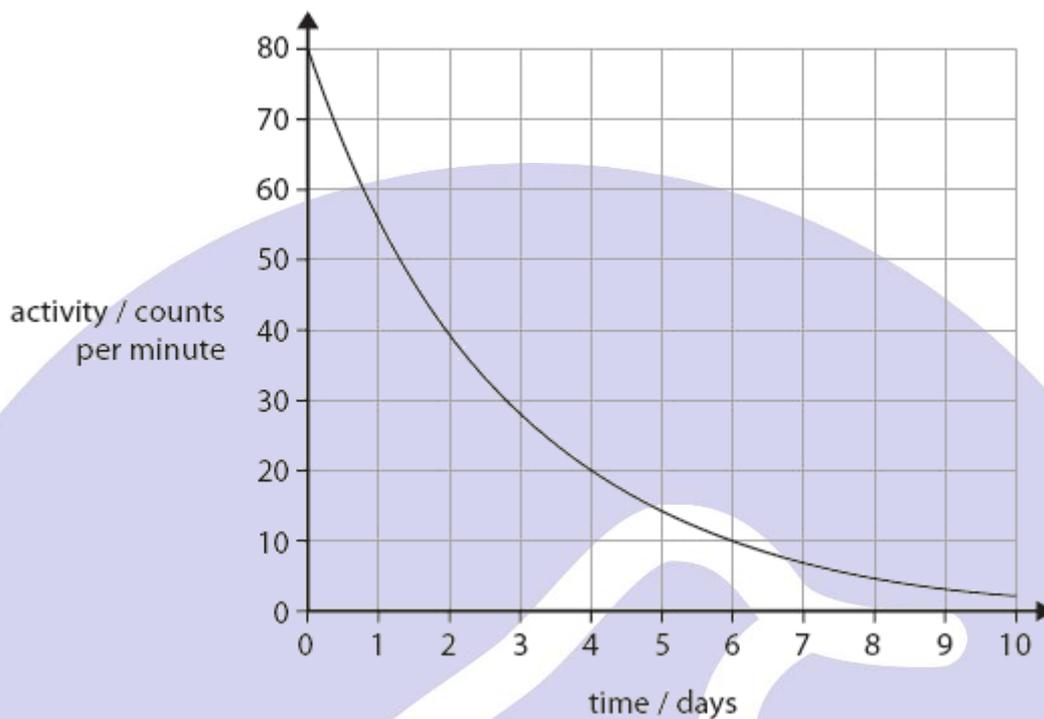**Figure 4**

Use the graph to estimate the half-life of carbon‑14.

(2)

Half-life = ... years

(Total for question = 2 marks)

Q8.

The graph shows how the activity of a sample of a radioactive material changes with time.
The sample has an initial activity of 80 counts per minute.

(i) Use the graph to find the half-life of the material.

(1)

....

(ii) Another sample of the material has an initial count rate of 40 counts per minute.

Sketch, on the same axes, the activity of this sample for the first 4 days.

(2)

(Total for question = 3 marks)

Q9.

The activity of a radioactive source is measured as 128 Bq.

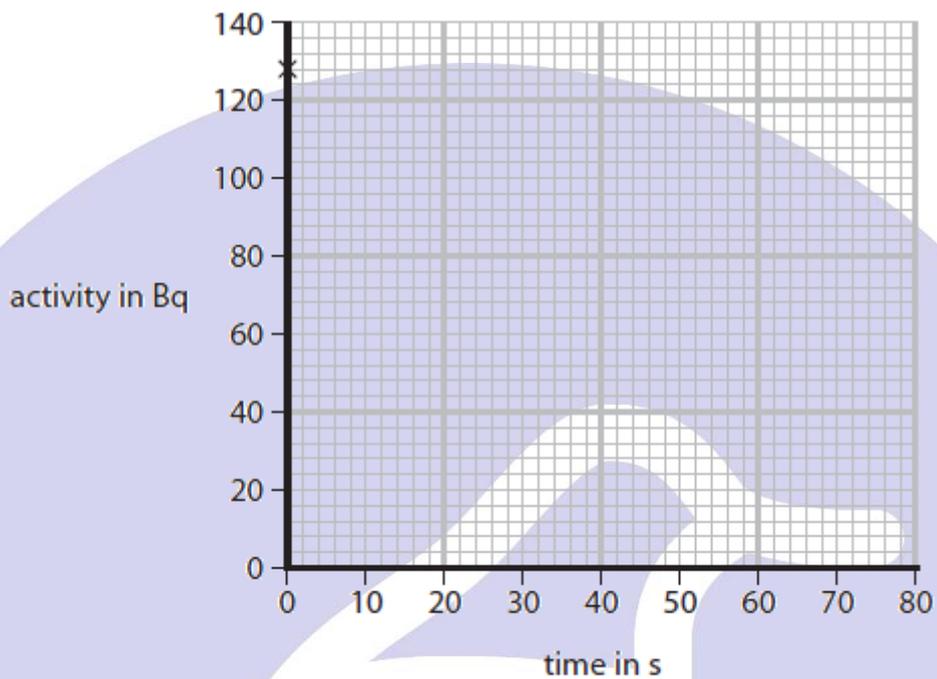This is shown as a point on the graph in Figure 13.

(3)

Figure 13

The half-life of this radioactive source is 17 s.

Use this information to plot three more points on the graph grid in Figure 13 to show how the activity of the source changes with time.
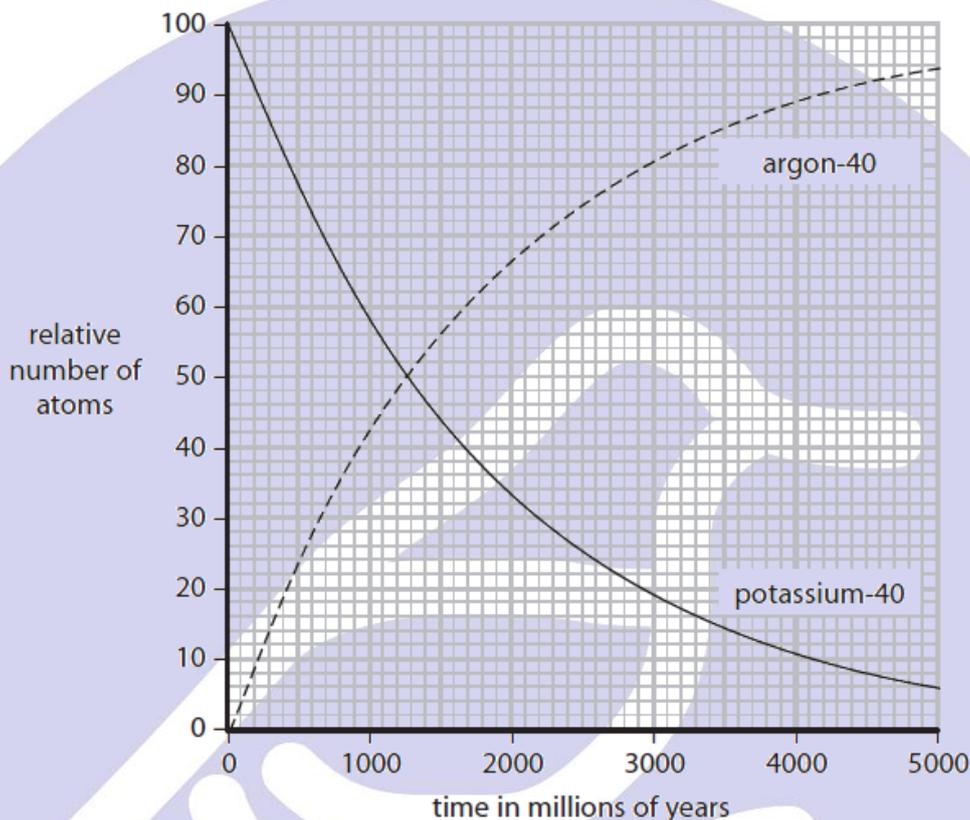
(Total for question = 3 marks)

Q10.

Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.

(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.
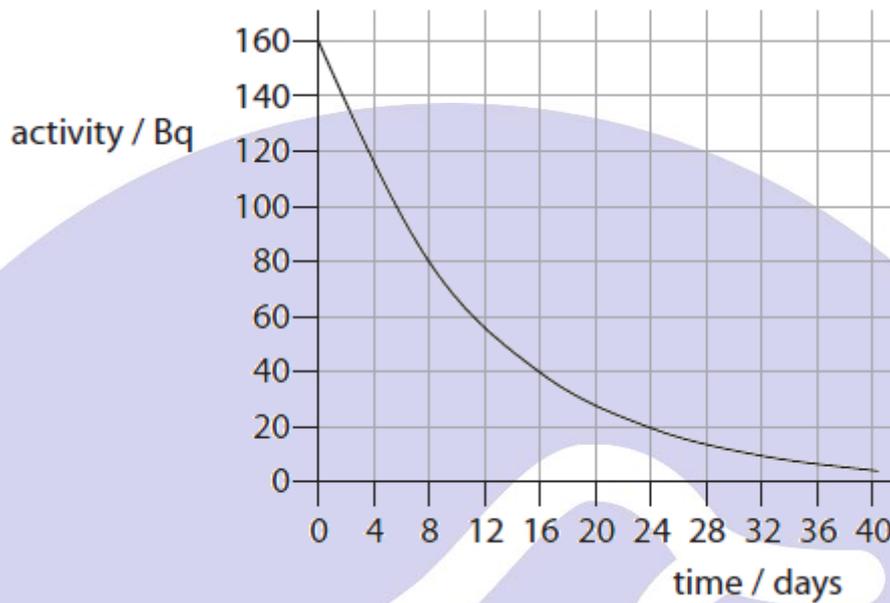Use the graph to find the age of the rock.

(2)

age of rock = ... million years

(Total for question = 3 marks)

Q11.

(b)   Iodine-131 is a radioactive isotope of iodine.

The graph shows how the activity of a sample of iodine-131 decreases with time.

activity / Bq

(graph showing activity in Bq on y-axis from 0 to 160, and time / days on x-axis from 0 to 40, with a decreasing curve)

time / days

(i) Use the graph to calculate the half-life of iodine-131.

(2)

half-life = ... days

(ii) Another sample of iodine-131 has an activity of 800 Bq.
Calculate how long it will take before its activity decreases to 200 Bq.

(2)

time = ... days

(Total for Question = 4 marks)

Q12.

A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.
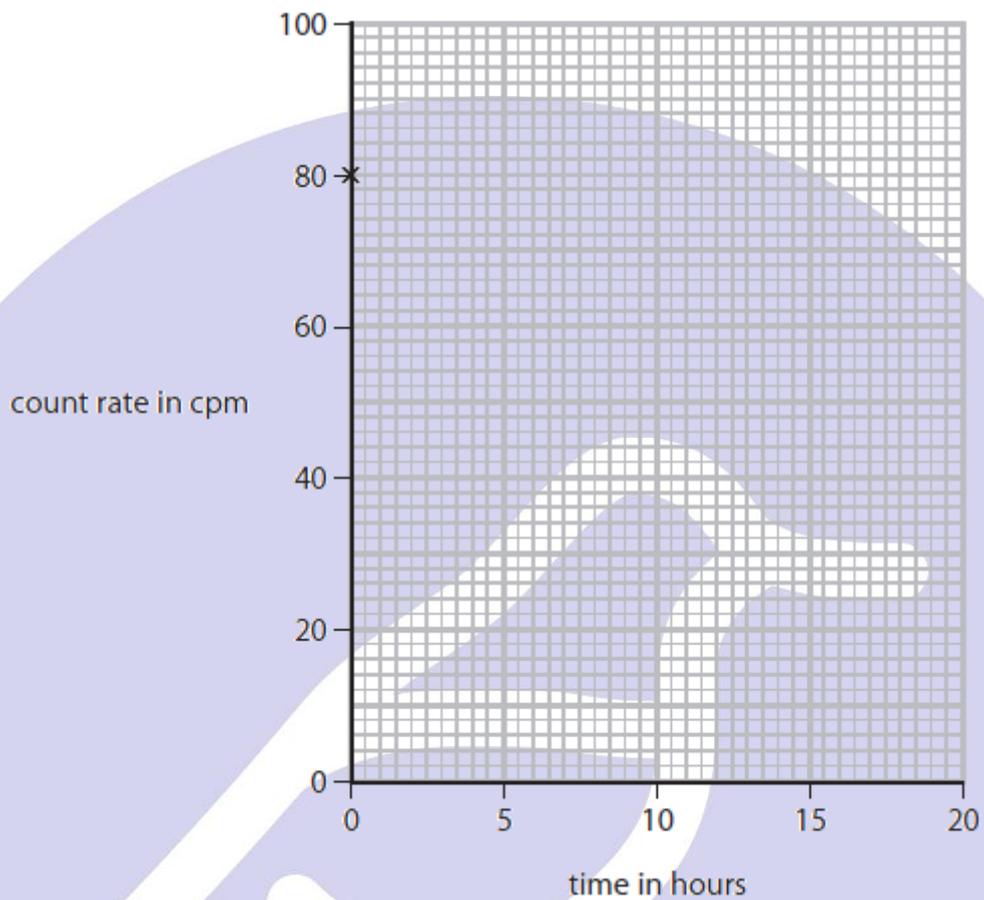

Figure 5

Complete the graph on Figure 5, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.
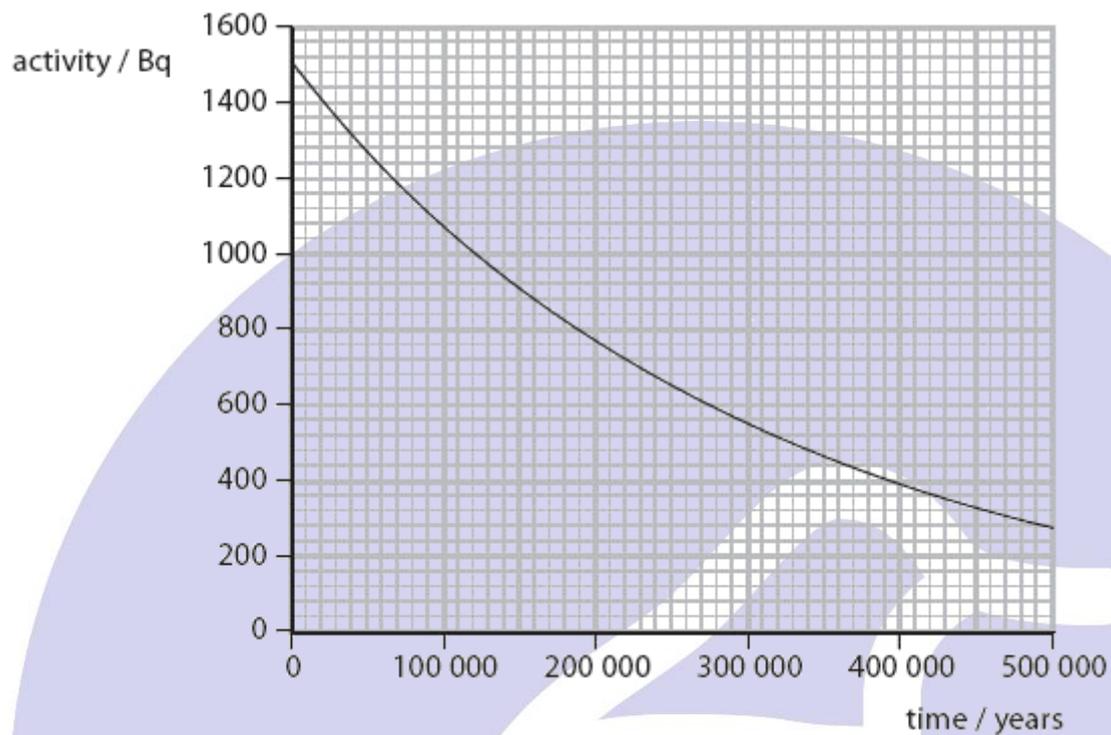
The first point is already drawn in Figure 5.

(3)

(Total for question = 3 marks)

Q13.

Everyone is exposed to background radiation. Some of this radiation comes from natural sources.
Technetium-99 is one of the radioactive isotopes in nuclear waste.
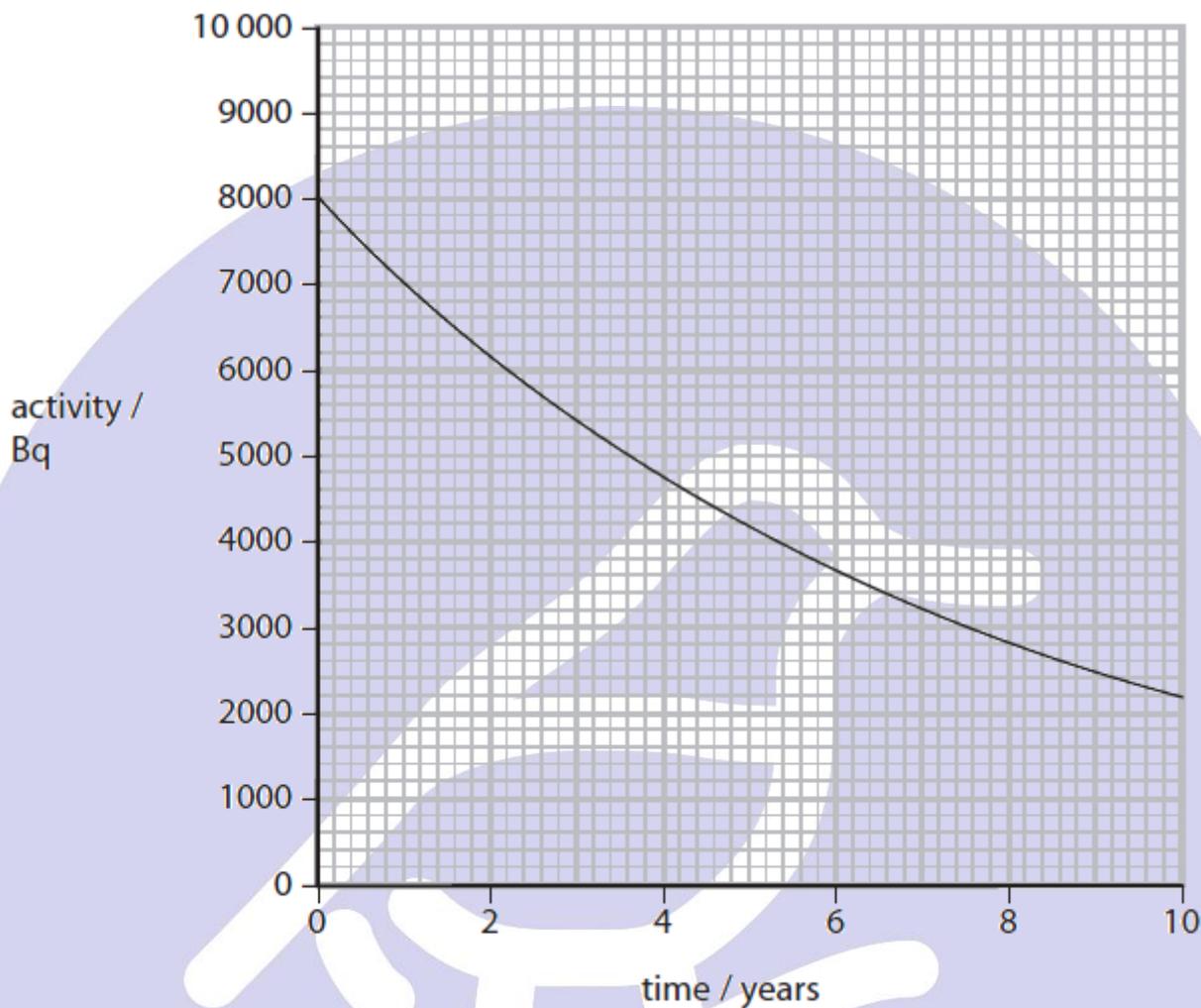The graph shows the decay curve for technetium-99.

(i) Use the graph to show that the half-life of technetium-99 is about 200 000 years.

(2)

(Total for question = 2 marks)

Q14.

(b) Cobalt-60 is one source of gamma radiation used for food irradiation. This graph shows how the activity of a sample of cobalt-60 changes over 10 years.

(i) Use the graph to find the half-life of cobalt-60.

(2)

half-life = ... years

(ii) The cobalt-60 has to be replaced when its activity has fallen below 1000 Bq.
   Estimate how long it takes for the activity to fall from 8000 Bq to 1000 Bq.

(1)

half-life = ... years

(Total for Question = 3 marks)