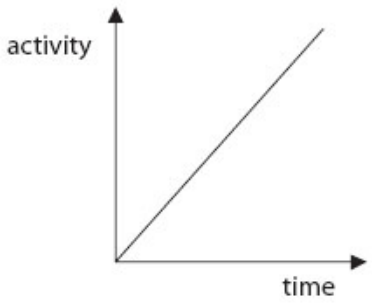
Questions

Q1.

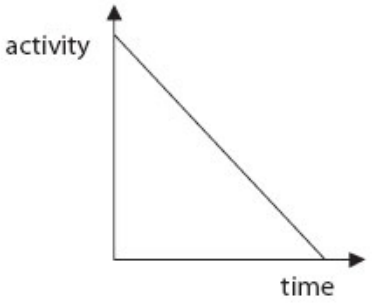
Which graph best shows how the activity of a radioactive isotope changes with time?

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

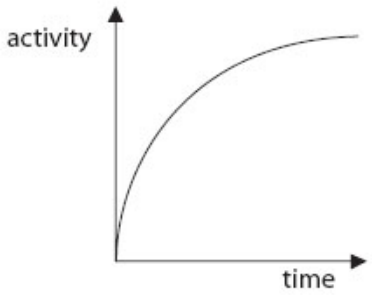
(1)



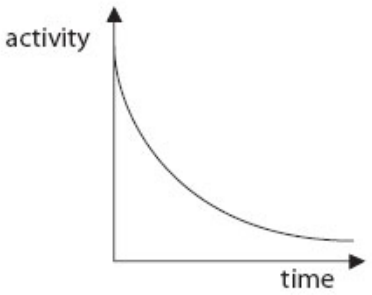
☐ **A**



☐ **B**



☐ **C**



☐ **D**

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.

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

Q4.

Carbon-14 is a radioactive isotope that occurs naturally.

Scientists use carbon-14 to help find the age of old pieces of wood.

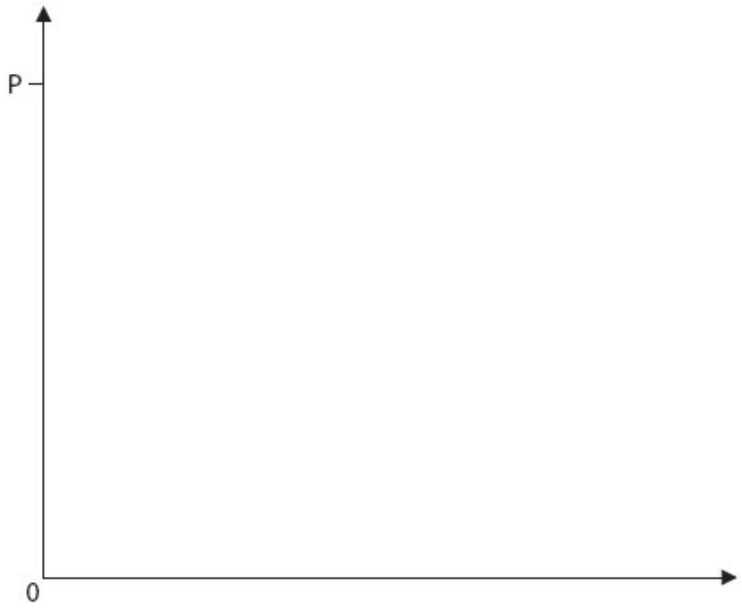
This technique is called carbon dating.

It uses the idea of half-life.

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)



Q5.

Carbon-14 is radioactive and has a half-life of 5 700 years.

The number of radioactive carbon-14 atoms in a very old piece of wood is found to have decreased from 1 000 000 to 125 000.

Determine the age of the piece of wood.

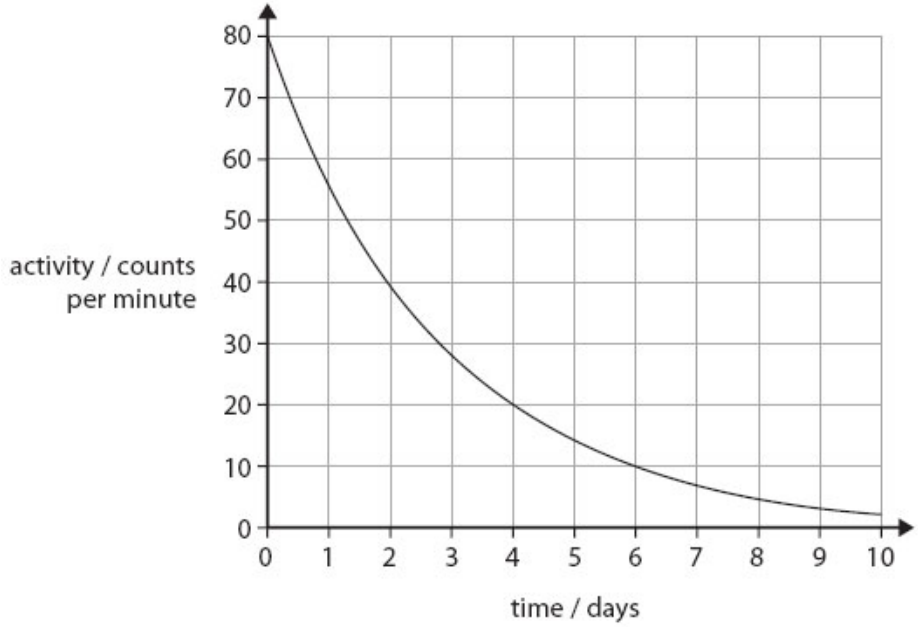
(2)

age of wood = ... years

(Total for question = 2 marks)

Q6.

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)

half life = ...days

(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)

Q7.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.

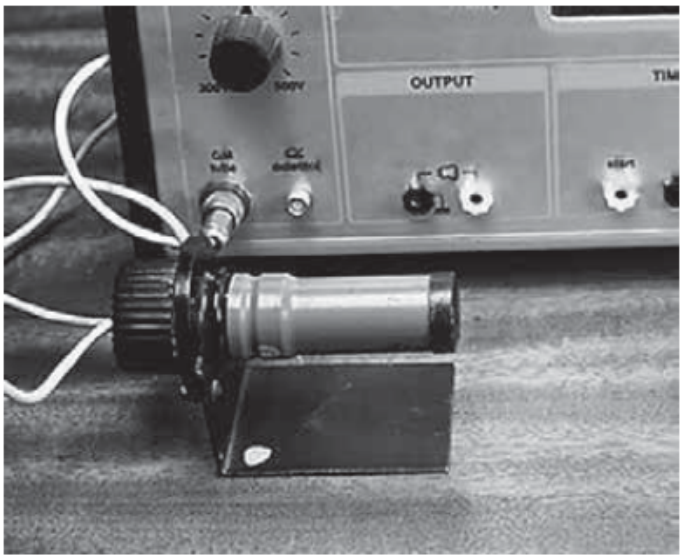


Figure 4

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.

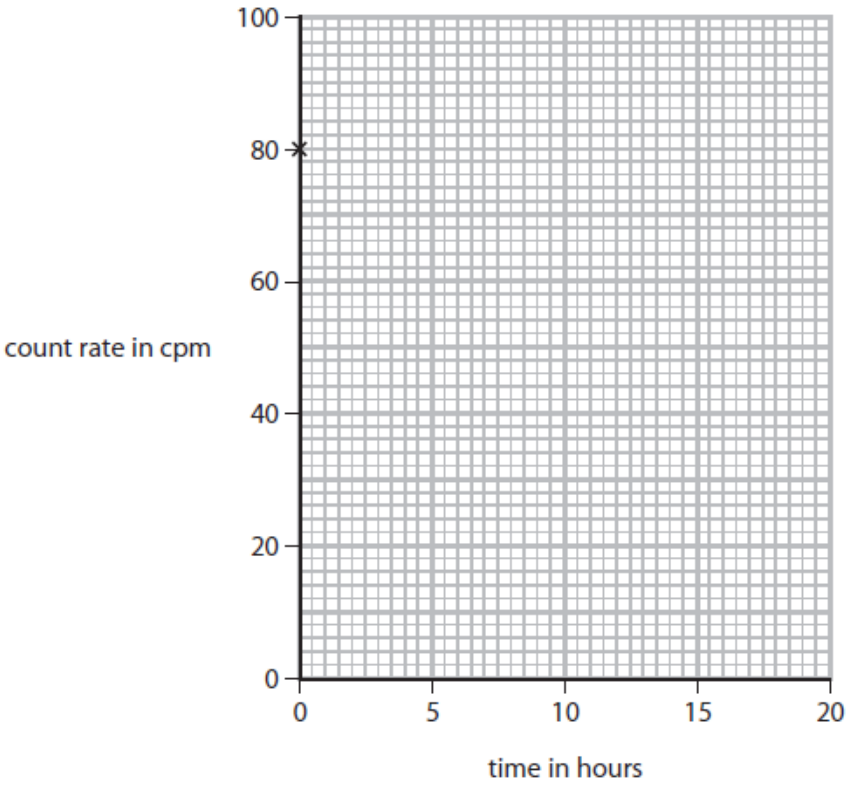


Figure 5

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)

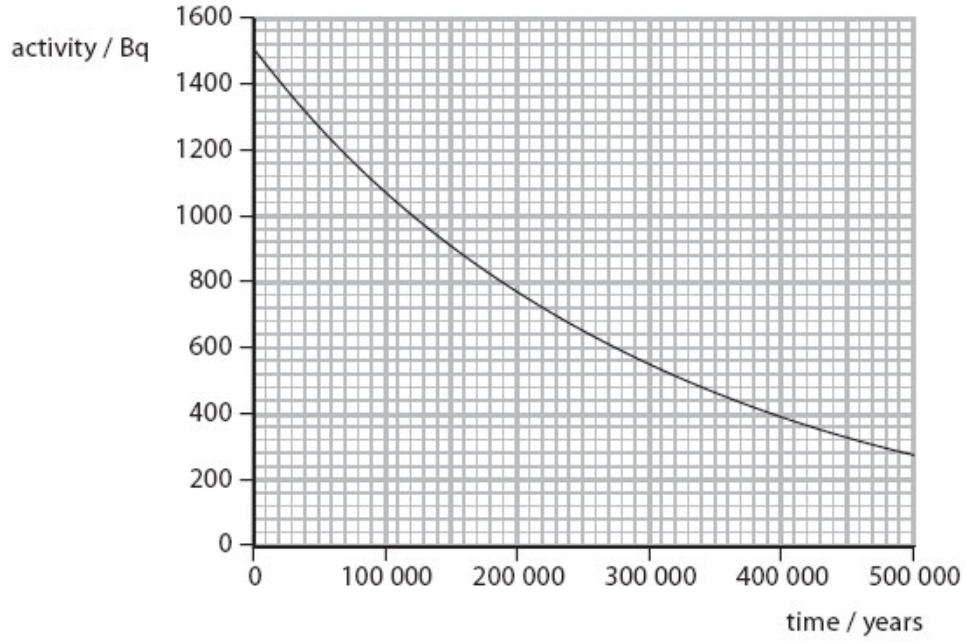
(Total for question = 3 marks)

Q8.

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)

(ii) Technetium-99 emits beta particles.

Give **one** reason that beta particles can cause harm to people.

(1)

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.....

Q9.

Hospitals use ionising radiation for many purposes.

(a) State **one** use of ionising radiation in a hospital.

(1)

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(b) An isotope of technicium, technicium-99, has a half-life of 6 hours.

A hospital has a sample which contains 40 mg of technicium-99.

Calculate how much technicium-99 will be in this sample after 12 hours.

(2)

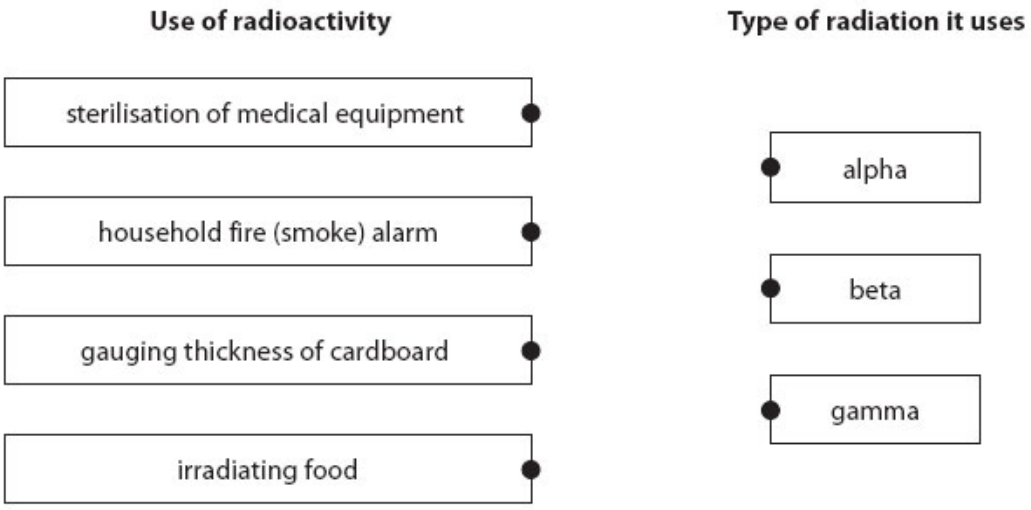
amount remaining = ... mg

Q10.

(a) Here are four uses of radioactivity.
Draw a line from each one of them to the type of radiation it uses.

Each type of radiation may be chosen once, more than once or not at all.

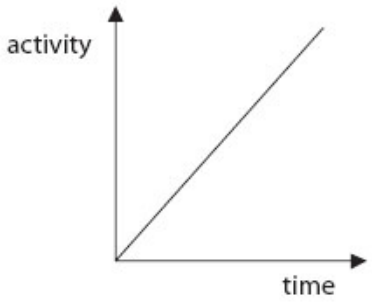
(4)



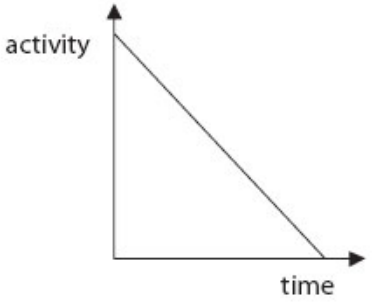
(b) Which graph best shows how the activity of a radioactive isotope changes with time?

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

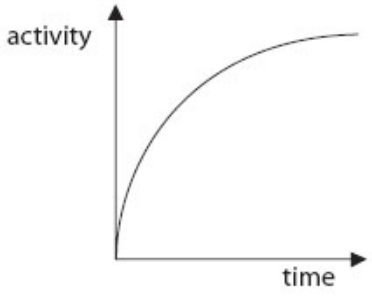
(1)



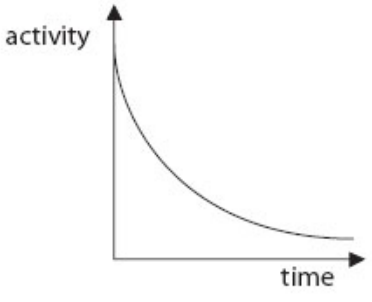
☐ **A**



☐ **B**



☐ **C**



☐ **D**

(c) 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

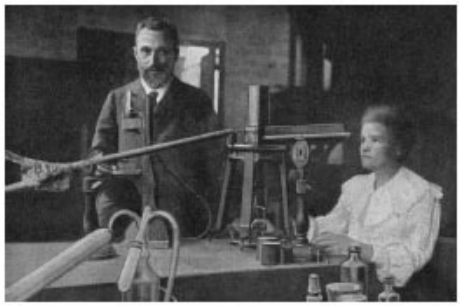
☐ **B** becquerel

☐ **C** einstein

☐ **D** radium

(d)

Marie Curie investigated radioactivity over 100 years ago.



She often carried radioactive materials in her pocket.
She stored them in her desk drawer.
She liked the coloured light they gave off.
Marie probably died from exposure to their radiation.

Describe **two** precautions that scientists now take when they use radioactive materials.

(2)

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(Total for Question = 8 marks)

Q11.

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 scientist investigates an old wooden comb.

The activity of the carbon-14 in it is 0.55 Bq.

The estimated age of the comb is 11 400 years.

The half-life of carbon-14 is 5700 years.

(i) Calculate the activity of the carbon-14 in the comb when it was new.

(3)

activity = ...Bq

(ii) The scientist takes several readings of background radiation.

Explain why this is necessary to improve the accuracy of the investigation.

(2)

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(iii) Old objects like the comb emit a very small amount of radiation.

The activity from the comb is about the same as comes from background radiation.

Scientists have stopped measuring the activity of carbon-14 for carbon dating.

Instead, they can measure the mass of undecayed carbon-14 left in the sample.

Suggest a reason for this change.

(1)

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Q12.

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

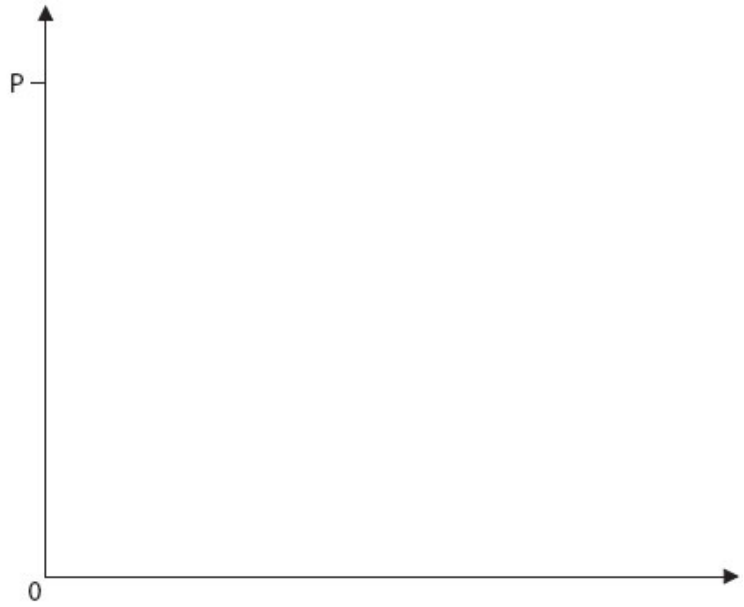
☒ **C** half the time it takes for all of the undecayed nuclei to decay

☒ **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)



(c) A scientist investigates an old wooden comb.

The activity of the carbon-14 in it is 0.55 Bq.

The estimated age of the comb is 11 400 years.

The half-life of carbon-14 is 5700 years.

(i) Calculate the activity of the carbon-14 in the comb when it was new.

(3)

activity = ...Bq

(ii) The scientist takes several readings of background radiation.

Explain why this is necessary to improve the accuracy of the investigation.

(2)

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(iii) Old objects like the comb emit a very small amount of radiation.

The activity from the comb is about the same as comes from background radiation.

Scientists have stopped measuring the activity of carbon-14 for carbon dating.

Instead, they can measure the mass of undecayed carbon-14 left in the sample.

Suggest a reason for this change.

(1)

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(Total for Question is 10 marks)

Q13.

(a) An underground oil pipe starts to leak oil.
To find the leak, a technician adds a gamma source to the oil flowing in the pipe.

Describe how the technician can find the position of the leak.

(2)

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(b) Which of these is correct for half-life?

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

(1)

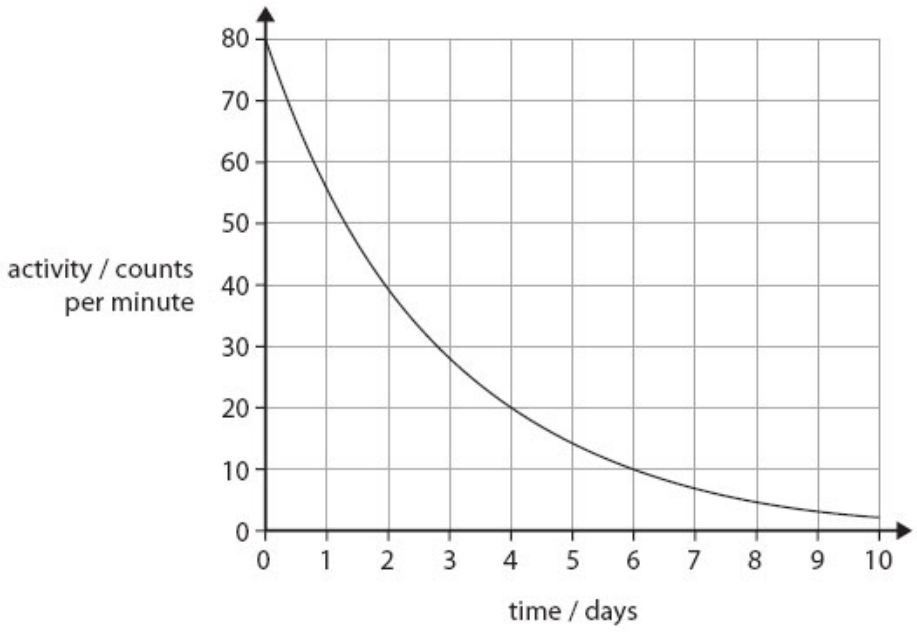
☒ **A** It is half the time for all the atoms to decay

☒ **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

(c) 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)

half life = ...days

(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)

*(d) Some scientists carry out an experiment to measure the radioactivity from a source to be used in a factory.

They measure the background radiation before and after their experiment.
They take the background count at the same place as they do their experiment.

Explain how this procedure helps to make sure that the results of the experiment are valid.

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(Total for Question = 12 marks)

Q14.

(a) In some countries food is sold with this label.

This food has been deliberately exposed to gamma radiation.

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

The gamma radiation is used to

(1)

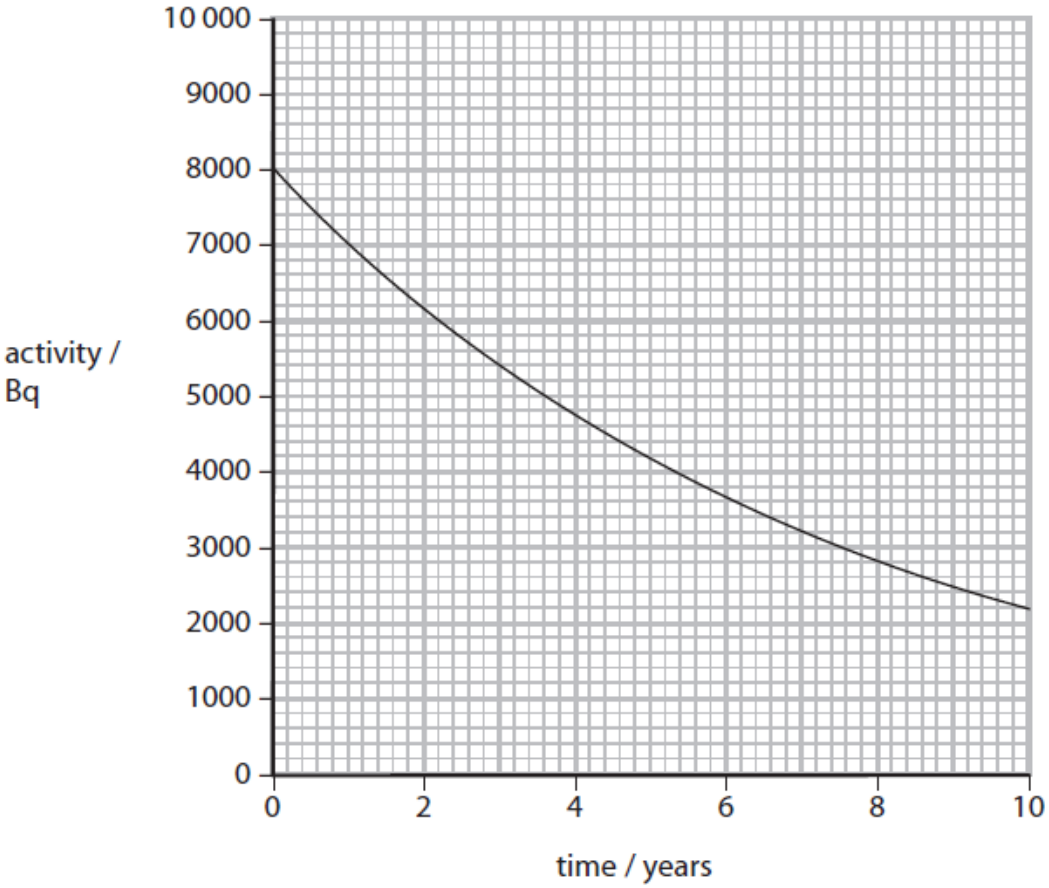
☒ **A** produce cancer cells in the food

☒ **B** kill cancer cells in the food

☒ **C** kill microbes in the food

☒ **D** make the food radioactive.

(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

(c) The cobalt-60 sources used to irradiate the food are small metal rods about the size of a pencil. They are made from stable cobalt-59 which is put inside a nuclear reactor. Some of the cobalt-59 is turned into cobalt-60 by the radiation in the reactor.

(i) The nuclei of the two isotopes can be represented as

$^{60}_{27}Co$ $^{59}_{27}Co$

Compare these two isotopes of cobalt.

(2)

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*(ii) When it is time to replace the cobalt-60 rods there are two options.

- The rods can be disposed of.
- The rods can be transported to a nuclear reactor to turn more of the cobalt-59 into cobalt-60 so that they can be used again.

Discuss the hazards in these two options.

(6)

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(Total for Question = 12 marks)

Q15.

Everyone is exposed to background radiation. Some of this radiation comes from natural sources.

(a) (i) One example of a source of background radiation that does not occur naturally is radiotherapy.

State **one** other source of background radiation that does not occur naturally.

(1)

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(ii) Radon gas is a natural source of background radiation.

In some parts of the country, a lot of the background radiation comes from radon gas.

Explain why there is no radon gas in some other parts of the country.

(2)

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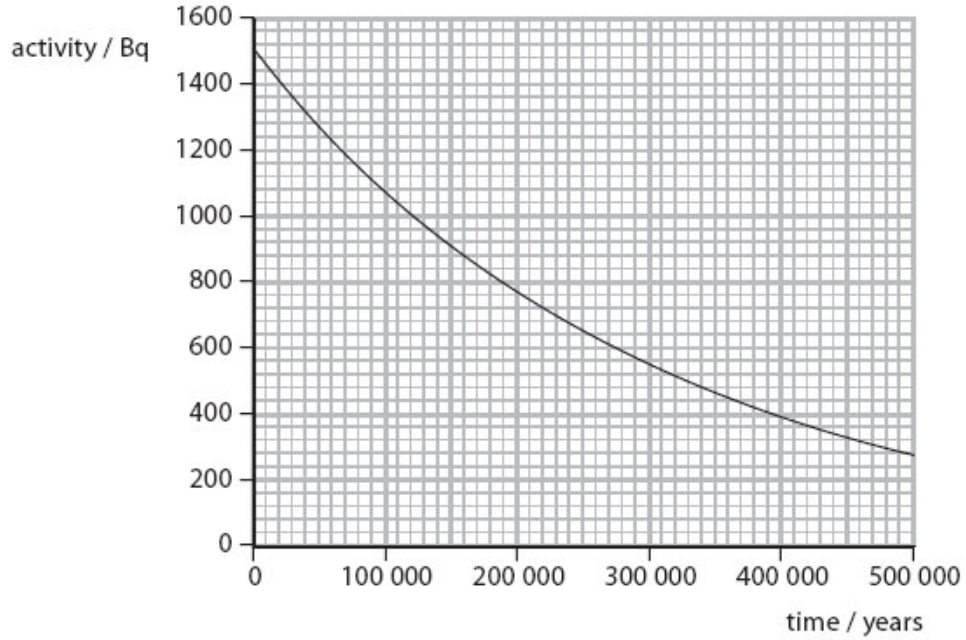
(b) Technetium-99 is one of the radioactive isotopes in nuclear waste.

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)

(ii) Technetium-99 emits beta particles.

Give **one** reason that beta particles can cause harm to people.

(1)

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*(c) There are many radioactive isotopes in nuclear waste.

Technetium-99 is just one of these isotopes.

People are worried about how we should deal with nuclear waste.

Explain why it is difficult to deal with nuclear waste safely.

(6)

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(Total for Question is 12 marks)