AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.3.3

Uses of nuclear radiation

Past-paper questions

Tier	**Higher**
Question groups	**16**
Available paper years	**2007–2023**

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.

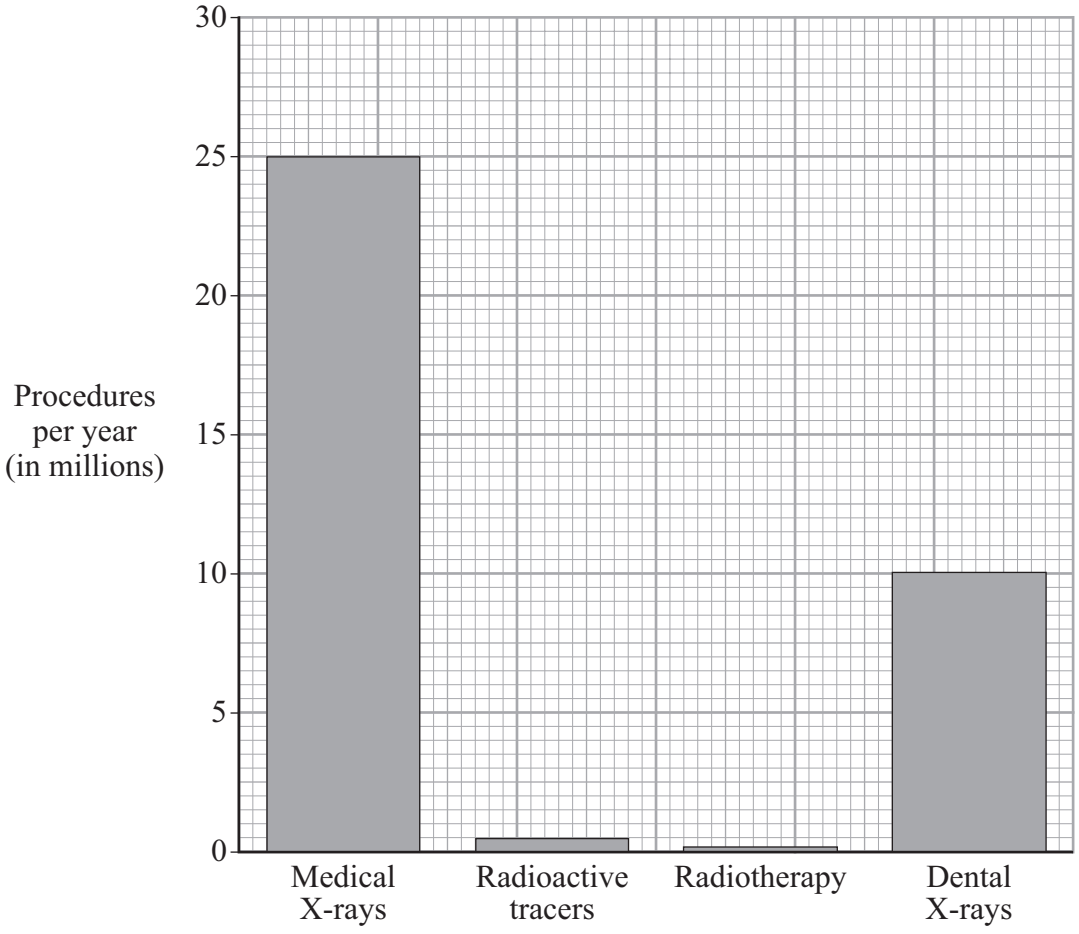
4.4.3.3 Uses of nuclear radiation

Question 01

June 2007 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

The bar chart shows the number of medical procedures per year in the UK that involve exposure to electromagnetic and nuclear radiation.



5A In how many procedures were radioactive tracers used?

1 100 000

2 500 000

3 1 000 000

4 2 000 000

5B Which type of procedure is used to treat patients?

1 dental X-rays

2 medical X-rays

3 radioactive tracers

4 radiotherapy

4.4.3.3 Uses of nuclear radiation

5C What is the approximate total number of X-rays taken in the UK each year?

1 10 000

2 25 000

3 35 000

4 35 000 000

5D Medical X-rays are dangerous because . . .

1 they can pass through the body.

2 they cause burns to the skin.

3 they cause water inside cells to heat up.

4 they cause ionisation inside cells.

Turn over for the next question

4.4.3.3 Uses of nuclear radiation

Question 02

June 2008 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

This question is about a smoke detector which contains a radioactive source.

Americium-241 is used because it emits alpha particles and has a half-life of 432 years.

6A Why is an alpha source the safest one to use in a domestic smoke detector?

1 Alpha particles are absorbed by a few centimetres of air.

2 Alpha particles do not cause any ionisation.

3 Alpha particles are completely harmless to humans.

4 Alpha particles are not deflected by a magnet.

6B What is an alpha particle?

1 a helium nucleus

2 a hydrogen nucleus

3 a proton

4 an electron

6C Why is the half-life of americium-241 considered to be suitable for use in a smoke detector?

1 It has a long half-life, and so will not need replacing.

2 An isotope with a very short half-life would not provide enough energy.

3 An isotope with a much longer half-life would give off too much energy.

4 An isotope with a much shorter half-life would give off beta particles.

6D The half-life of americium-241 is 432 years.

A source contains 1 gram of americium-241.

How long will it be before only 0.25 g of americium-241 remains?

1 108 years

2 216 years

3 648 years

4 864 years

4.4.3.3 Uses of nuclear radiation

Question 03

June 2008 | PHY1H | Original Q6 | Legacy

6 In 1986, a nuclear reactor exploded in a power station at Chernobyl in the Ukraine.

6 (a) The table gives information about some of the radioactive substances released into the air by the explosion.

Radioactive substance	Half-life	Type of radiation emitted
Iodine-131	8 days	beta and gamma
Caesium-134	2 years	beta
Caesium-137	30 years	beta

6 (a) (i) How is the structure of a caesium-134 atom different from the structure of a caesium-137 atom?

.....

(1 mark)

6 (a) (ii) What is a beta particle and from which part of an atom is a beta particle emitted?

.....

.....

(1 mark)

6 (a) (iii) Once a radioactive substance is dissolved in rainwater, it can enter the food chain.

Following the Chernobyl explosion, some milk supplies were found to be radioactive.

If one litre of milk contaminated with iodine-131 gives a count rate of 400 counts/second, how long will it take for the count rate to fall to 25 counts/second?

Show clearly how you work out your answer.

.....

.....

.....

Time taken = ... days

(2 marks)

4.4.3.3 Uses of nuclear radiation

Question 03 · continued

for mark

6 (a) (iv) After 20 years, the caesium-137 emitted into the atmosphere is a more serious problem than the iodine-131.

Explain why.

.....

.....

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.....

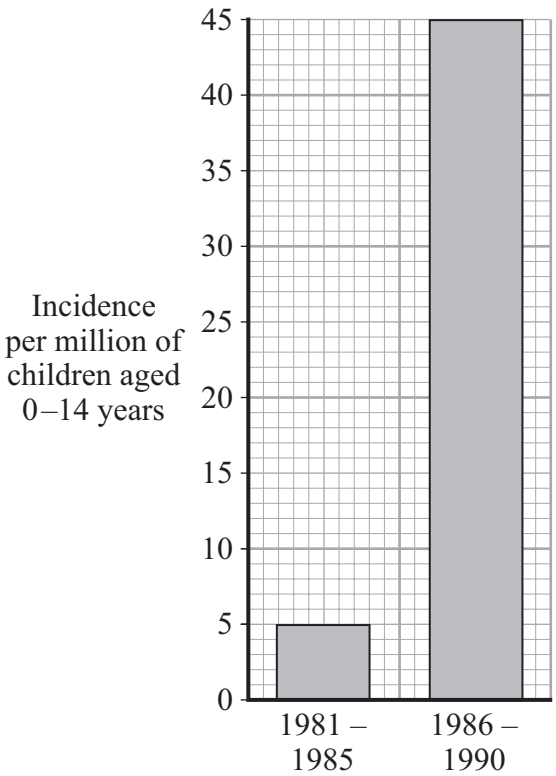
(2 marks)

Question 6 continues on the next page

Question 03 · continued

for mark

6 (b) The bar chart compares the incidence of thyroid cancer in Ukrainian children, aged 0–14 years, before and after the Chernobyl explosion.



Of the children that developed thyroid cancer, 64% lived in the areas most contaminated by the radiation.

Considering this data, can you be certain that a child who developed thyroid cancer between 1986 and 1990 did so because of the Chernobyl explosion?

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

4.4.3.3 Uses of nuclear radiation

Question 03 · continued

for mark

6 (c) In 1991, some scientists compared the health of two groups of people: a *control* group and a group that had been exposed to the radiation from Chernobyl.

What people would have been in the *control* group?

.....

(1 mark)

6 (d) Although there are some risks associated with nuclear power stations, it is likely that new ones will be built.

Give **two** reasons to justify the use of nuclear power.

1 .....

.....

2 .....

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(2 marks)

11

4.4.3.3 Uses of nuclear radiation

Question 04

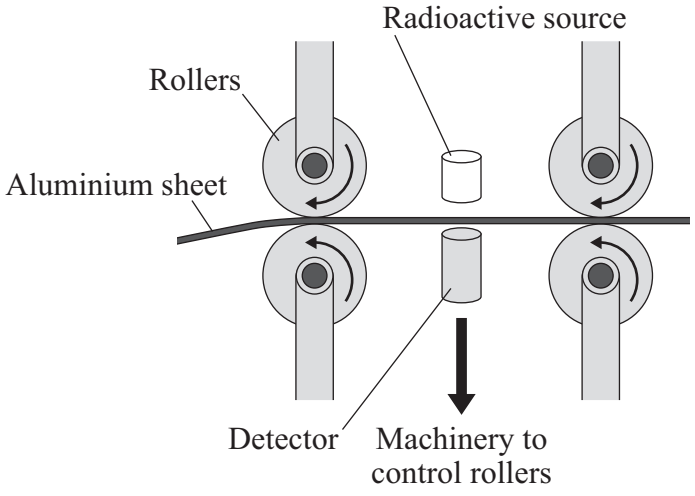
November 2008 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

The table shows the type of radiation emitted by, and the half-life of four radioactive isotopes, **P**, **Q**, **R** and **S**.

Radioactive isotope	Radiation emitted	Half-life
P	beta	6000 years
Q	alpha	400 years
R	gamma	6 hours
S	beta	30 seconds

7A The diagram shows how a radioactive isotope is used to monitor the thickness of aluminium in the continuous manufacture of aluminium sheet.



Which of the isotopes should be used?

1 **P**

2 **Q**

3 **R**

4 **S**

4.4.3.3 Uses of nuclear radiation

7B A smoke alarm uses a small mass of a radioactive isotope. So that the alarm can be used safely in a house, isotope **Q** is used.

This is because isotope **Q** is an alpha emitter . . .

1 with a short half-life; alpha particles have a short range in air.

2 with a short half-life; alpha particles have a long range in air.

3 with a long half-life; alpha particles have a short range in air.

4 with a long half-life; alpha particles have a long range in air.

7C Radioactive isotopes can be injected into the human body to act as tracers in medical diagnosis.

The isotope used is . . .

1 **P** because it has a very long half-life and beta particles can reach the detector.

2 **Q** because it has a long half-life and alpha particles are relatively safe outside the body.

3 **R** because it has a short half-life and gamma rays can reach the detector.

4 **S** because it has a short half-life and beta particles can reach the detector.

7D Trees contain the radioactive isotope carbon-14. After a tree has been chopped down, the count rate from the carbon-14 it contains gradually decreases. By measuring the count rate and knowing the half-life of the isotope, the age of the dead wood can be estimated.

Which isotope could be used to estimate the age of a wooden box thought to be about 18 000 years old?

1 **P** because its half-life is about 6000 years so the box has existed for 3 half-lives.

2 **Q** because its half-life is about 400 years which means that the box has existed for 45 half-lives.

3 **R** because its half-life is about 30 seconds which means that it is safe to do the estimation.

4 **S** because its half-life is about 6 hours which is enough time to do the estimation.

4.4.3.3 Uses of nuclear radiation

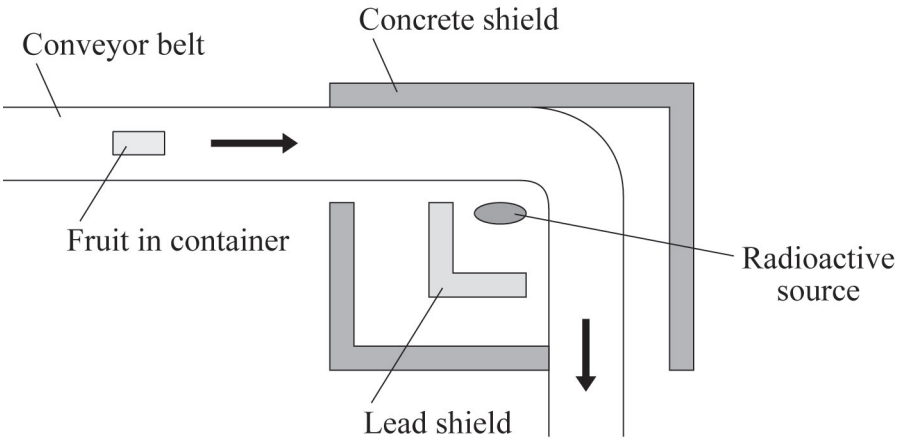
Question 05

March 2009 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

In some countries, fruit is passed in front of a radioactive source. The gamma radiation from the source kills bacteria. This keeps the fruit fresh for longer.

The main process is shown in the diagram.



3A Gamma radiation is used because it is . . .

1 able to penetrate the container and fruit.

2 stopped by the lead shield.

3 not harmful to people.

4 the only radiation that can kill bacteria.

3B The amount of radiation absorbed by the fruit can be increased by . . .

1 moving the source further from the fruit.

2 packing the fruit in thicker containers.

3 slowing down the conveyor belt.

4 speeding up the conveyor belt.

4.4.3.3 Uses of nuclear radiation

Question 05 · continued

3C Some fruit growers use X-ray machines instead of gamma ray sources.

The X-rays are safer to work with because . . .

1 gamma ray sources are used in hospitals.

2 X-ray machines can be switched on and off.

3 gamma rays have a lower frequency than X-rays.

4 X-rays have a shorter wavelength than gamma rays.

3D Some scientists investigated the effect of radiation on the vitamin C content of fruit.

They measured the amount of radiation absorbed by some fruit.

They also measured the amount of vitamin C in the fruit before and after the radiation treatment.

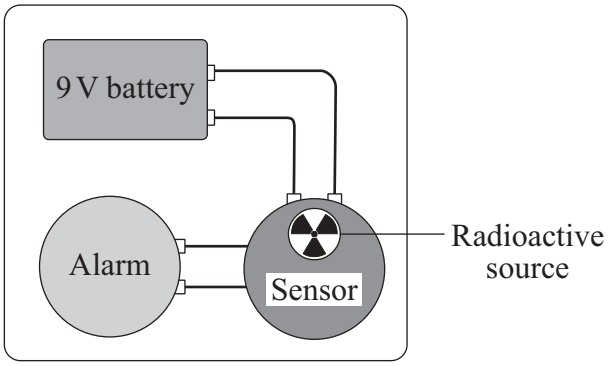
Which row of the table describes the variables for a fair test?

	Amount of radiation absorbed	Amount of vitamin C lost during irradiation	Size and type of fruit
1	independent	dependent	control
2	independent	control	dependent
3	dependent	independent	control
4	control	independent	dependent

4.4.3.3 Uses of nuclear radiation

Question 06

6 (a) The diagram shows the parts of a smoke detector. The radioactive source emits alpha particles.



The alpha particles ionise the air inside the sensor which causes a small electric current. Any smoke getting into the sensor changes the current. The change in current sets the alarm off.

6 (a) (i) The smoke detector would **not** work if a radioactive source that emitted only gamma rays was used.

Why not?

.....

.....

(1 mark)

6 (a) (ii) Curium-242 is a radioactive isotope with a half-life of 160 days. It emits alpha particles.

Why is curium-242 **not** suitable for use inside smoke detectors?

.....

.....

(1 mark)

6 (a) (iii) Curium-242 and curium-244 are two of the isotopes of the element curium.

How is an atom of curium-242 different from an atom of curium-244?

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.....

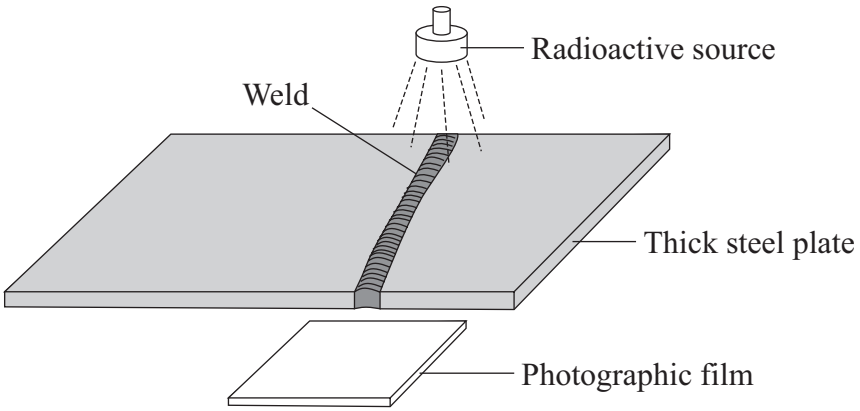
(1 mark)

4.4.3.3 Uses of nuclear radiation

Question 06 · continued

for mark

6 (b) Sections of steel are often joined by welding them together. The diagram shows how a radioactive source can be used to check for tiny cracks in the weld.



Cracks in the weld will be shown up on the photographic film below the thick steel plate.

6 (b) (i) Which type of source, alpha, beta or gamma, should be used to check the weld?

.....

(1 mark)

6 (b) (ii) Give a reason why the other two types of source **cannot** be used.

.....

.....

(1 mark)

Question 6 continues on the next page

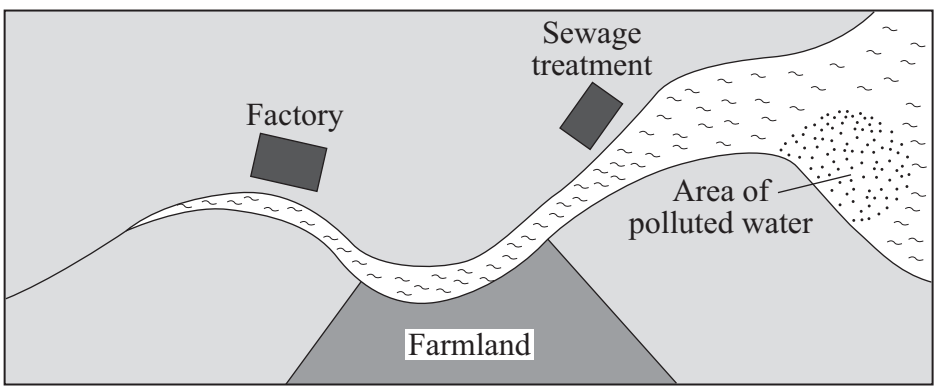
4.4.3.3 Uses of nuclear radiation

Question 06 · continued

for mark

6 (c) The diagram shows a map of a river and its estuary.

Environmental scientists have found that the water flowing into one part of the river estuary is polluted. To find where the pollution is coming from, the scientists use a radioactive isotope, gold-198.



6 (c) (i) Explain how the gold-198 is used to find where the pollution is coming from.

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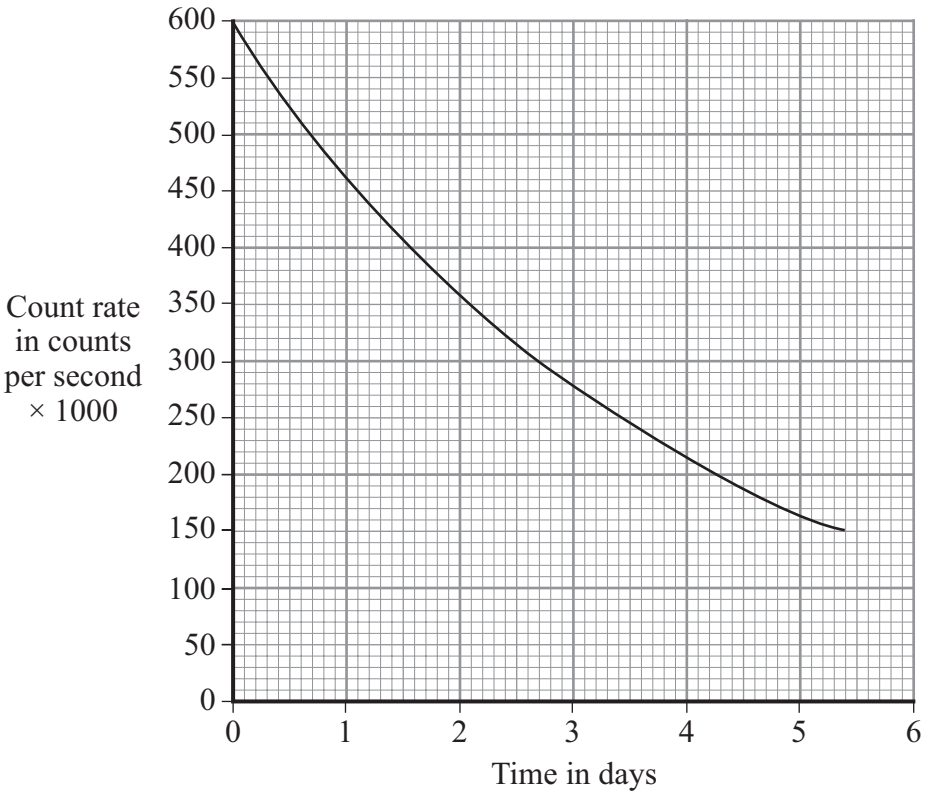
(2 marks)

4.4.3.3 Uses of nuclear radiation

Question 06 · continued

for mark

6 (c) (ii) The graph shows how the count rate from a sample of gold-198 changes with time.



Use the graph to calculate the half-life of gold-198.

Show clearly on the graph how you obtain your answer.

.....

.....

Half-life = ... days
(2 marks)

9

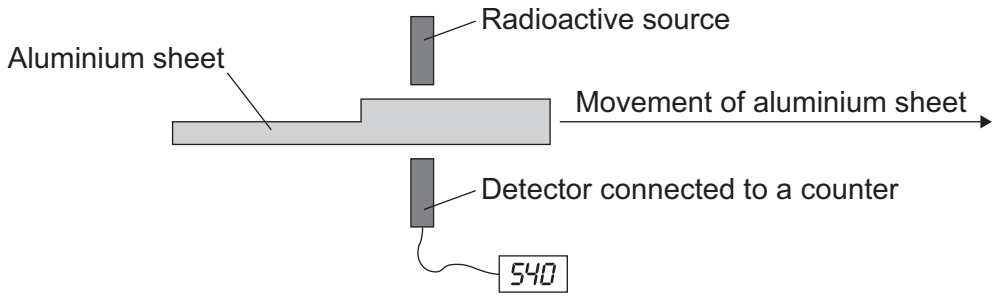
4.4.3.3 Uses of nuclear radiation

Question 07

June 2011 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

A teacher demonstrates how radiation can be used in industry to monitor the thickness of aluminium sheets.



7A Which type of radioactive source should she choose?

1 an alpha emitter

2 a beta emitter

3 a gamma emitter

4 it does not matter

7B The teacher chose the isotope strontium-90 as the radioactive source. The most common isotope of strontium, strontium-88, contains 38 protons and 50 neutrons in its nucleus.

What particles are in the strontium-90 nucleus?

1 38 protons and 50 neutrons

2 38 protons and 52 neutrons

3 40 protons and 50 neutrons

4 42 protons and 48 neutrons

7C What happens to the count rate shown by the counter when a thinner part of the aluminium sheet passes the detector?

1 It increases.

2 It decreases.

3 It stays the same.

4 It falls to zero.

4.4.3.3 Uses of nuclear radiation

7D Strontium-90 has a half-life of 28 years. The source contains 100 mg of strontium-90.

How long will it be before 75 mg of strontium-90 has decayed?

1 7 years

2 14 years

3 56 years

4 84 years

Turn over for the next question

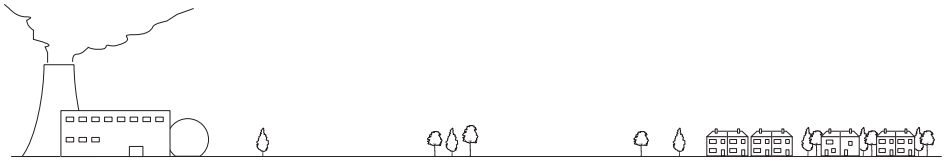
4.4.3.3 Uses of nuclear radiation

Question 08

November 2011 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

A nuclear power station is built a few miles away from a village.



The nuclear power station uses radioactive uranium as its fuel. After a few years, there are more cases of cancer than usual occurring in the village. The villagers think that this is because of radiation from the power station.

4A Any radiation reaching the village directly from the power station will be . . .

1 alpha radiation only.

2 beta radiation only.

3 gamma radiation only.

4 alpha, beta and gamma radiation.

4B The increased number of cancer cases near the power station . . .

1 proves that the power station is the only cause of these cancers.

2 proves that the power station is one possible cause of these cancers.

3 suggests that the power station is the only cause of these cancers.

4 suggests that the power station is one possible cause of these cancers.

4C Checks are to be made for any link between the power station and the increased number of cancer cases in the village.

This is most likely to be done by . . .

1 shutting down the power station to see if the number of cases decreases.

2 re-housing the villagers away from the power station to see if the number of cancer cases decreases.

3 re-housing the villagers closer to the power station to see if the number of cancer cases increases.

4 comparing the villagers' health records with those of people who do not live near nuclear power stations.

4.4.3.3 Uses of nuclear radiation

4D Exposure to radiation from radioactive sources used in schools must be kept to a minimum.

The best way to do this is to store the source in a box lined with . . .

1 aluminium.

2 glass.

3 lead.

4 wood.

Turn over for the next question

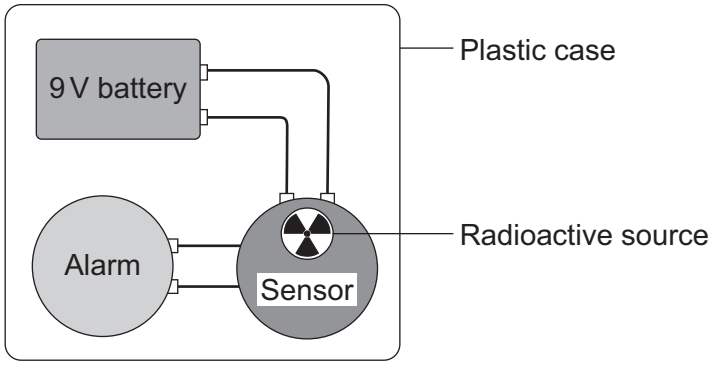
4.4.3.3 Uses of nuclear radiation

Question 09

November 2011 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows the parts of a smoke detector. The radioactive source emits alpha particles.



The alpha particles ionise the air inside the sensor, which causes a small electric current. Any smoke getting into the sensor will absorb alpha particles. This reduces the current. The change in current sets off the alarm.

7A A source that emits alpha particles will not harm people in the same room as the detector.

This is because alpha particles . . .

1 do not damage human cells.

2 are highly ionising.

3 will not pass through the plastic case.

4 are deflected by the Earth's magnetic field.

7B The smoke detector would **not** work if a radioactive source that emitted only gamma rays was used.

This is because gamma rays . . .

1 would pass through the plastic case.

2 would not ionise the air inside the sensor sufficiently.

3 travel through the air at the same speed as light.

4 would be affected by the battery.

4.4.3.3 Uses of nuclear radiation

Question 09 · continued November 2011 | PHY1BP | Original Q7 | Legacy

7C An alpha particle consists of . . .

1 2 electrons and 2 neutrons.

2 2 electrons and 2 protons.

3 2 neutrons and 2 protons.

4 2 neutrons only.

7D The radioactive source has a half-life of about 400 years.

What fraction of the nuclei in the source will have decayed in 1200 years?

1 $\frac{1}{8}$

2 $\frac{1}{3}$

3 $\frac{2}{3}$

4 $\frac{7}{8}$

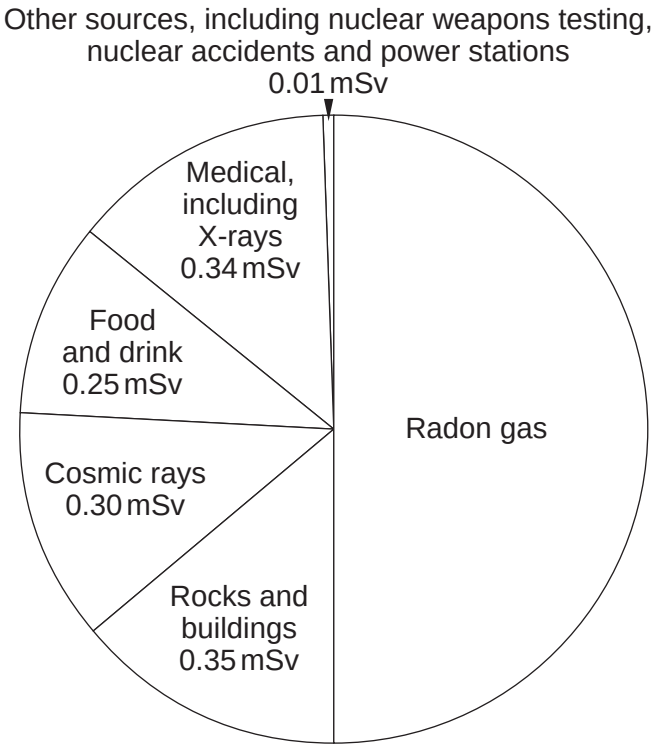
4.4.3.3 Uses of nuclear radiation

Question 10

June 2012 | PH2HP | Original Q2 | Legacy

2 The pie chart shows the sources of the background radiation and the radiation doses that the average person in the UK is exposed to in one year.

Radiation dose is measured in millisieverts (mSv).



2 (a) (i) What is the radiation dose that the average person in the UK receives from radon gas?

.....

.....

Radiation dose from radon gas = ... mSv

(1 mark)

2 (a) (ii) A person may receive a higher than average dose of radiation from background sources.

Suggest **two** reasons why.

1 .....

.....

2 .....

.....

(2 marks)

4.4.3.3 Uses of nuclear radiation

Question 10 · continued

2 (b) Exposure to radon gas can cause lung cancer.
A recent study has compared the risk of getting lung cancer, by the age of 75 years, for cigarette smokers and non-smokers.
The people in the study had been exposed throughout their lives to different levels of radon gas.
A summary of the data produced from the study is given in the table.

Exposure to radon gas	Risk of lung cancer by age of 75	
	Non-smoker	Smoker
No exposure	0.4%	10%
Moderate exposure	1.0%	14%
Very high exposure	1.5%	32%

2 (b) (i) Why were people that have had **no exposure** to radon gas included in the study?

.....

.....

(1 mark)

2 (b) (ii) Using information from the table, what conclusions can be made about exposure to radon gas and the risk of getting lung cancer?

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(2 marks)

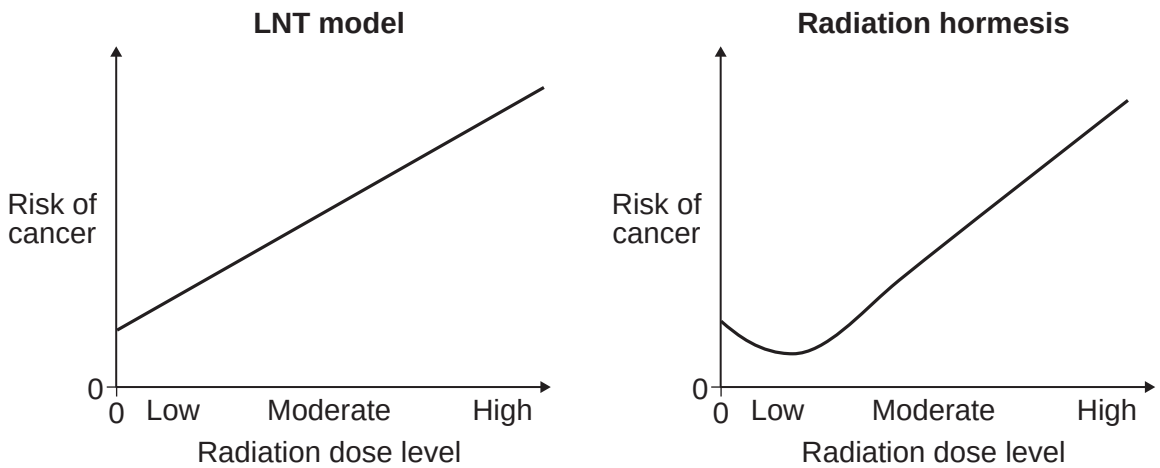
Question 2 continues on the next page

4.4.3.3 Uses of nuclear radiation

Question 10 · continued

2 (c) At the moment, the regulations designed to protect people from over-exposure to radiation are based on a model called the 'linear no-threshold' (LNT) model.
Some scientists believe that the LNT model is too simple. These scientists believe that at low radiation levels a process called 'radiation hormesis' happens.

The graphs show that each model suggests a link between the risk of developing a cancer and exposure to low levels of radiation.



The link between the risk of developing cancer and exposure to low levels of radiation suggested by each of the models is different.

Describe how.

.....

.....

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.....

.....

(2 marks)

4.4.3.3 Uses of nuclear radiation

Question 10 · continued

2 (d) Scientists have conducted experiments in which mice have been exposed to different levels of radiation. The number of mice developing a cancer has then been measured.

Discuss whether it is ethical to use animals in scientific experiments.

.....

.....

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.....

(2 marks)

10

Turn over for the next question

4.4.3.3 Uses of nuclear radiation

Question 11

June 2014 | PH2HP | Original Q6 | Legacy

6 (a) There are many isotopes of the element molybdenum (Mo).

What do the nuclei of different molybdenum isotopes have in common?

[1 mark]

.....

6 (b) The isotope molybdenum-99 is produced inside some nuclear power stations from the nuclear fission of uranium-235.

6 (b) (i) What happens during the process of nuclear fission?

[1 mark]

.....

.....

6 (b) (ii) Inside which part of a nuclear power station would molybdenum be produced?

[1 mark]

.....

6 (c) When the nucleus of a molybdenum-99 atom decays, it emits radiation and changes into a nucleus of technetium-99.

$$^{99}_{42}\text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + \text{Radiation}$$

What type of radiation is emitted by molybdenum-99?

[2 marks]

.....

Give a reason for your answer.

.....

.....

Question 6 continues on the next page

4.4.3.3 Uses of nuclear radiation

Question 11 · continued

6 (d) Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term ‘half-life’?

[1 mark]

.....

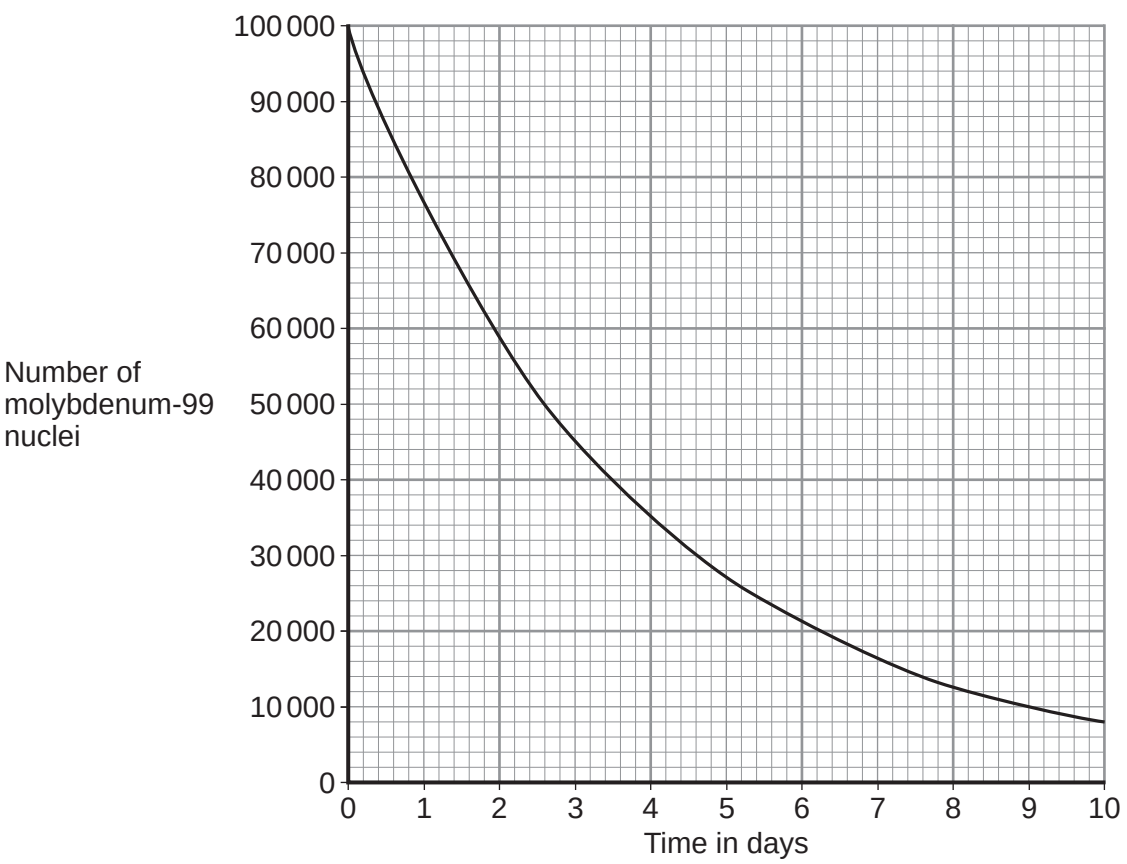
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6 (e) Technetium-99 is used by doctors as a medical tracer. In hospitals it is produced inside a technetium generator by the decay of molybdenum-99 nuclei.

6 (e) (i) **Figure 7** shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.

Figure 7



4.4.3.3 Uses of nuclear radiation

Question 11 · continued

A technetium generator will continue to produce sufficient technetium-99 until 80% of the original molybdenum nuclei have decayed.

After how many days will a source of molybdenum-99 inside a technetium-99 generator need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

[2 marks]

.....

.....

.....

Number of days = ...

6 (e) (ii) Medical tracers are injected into a patient's body; this involves some risk to the patient's health.

Explain the risk to the patient of using a radioactive substance as a medical tracer.

[2 marks]

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6 (e) (iii) Even though there may be a risk, doctors frequently use radioactive substances for medical diagnosis and treatments.

Suggest why.

[1 mark]

.....

.....

11

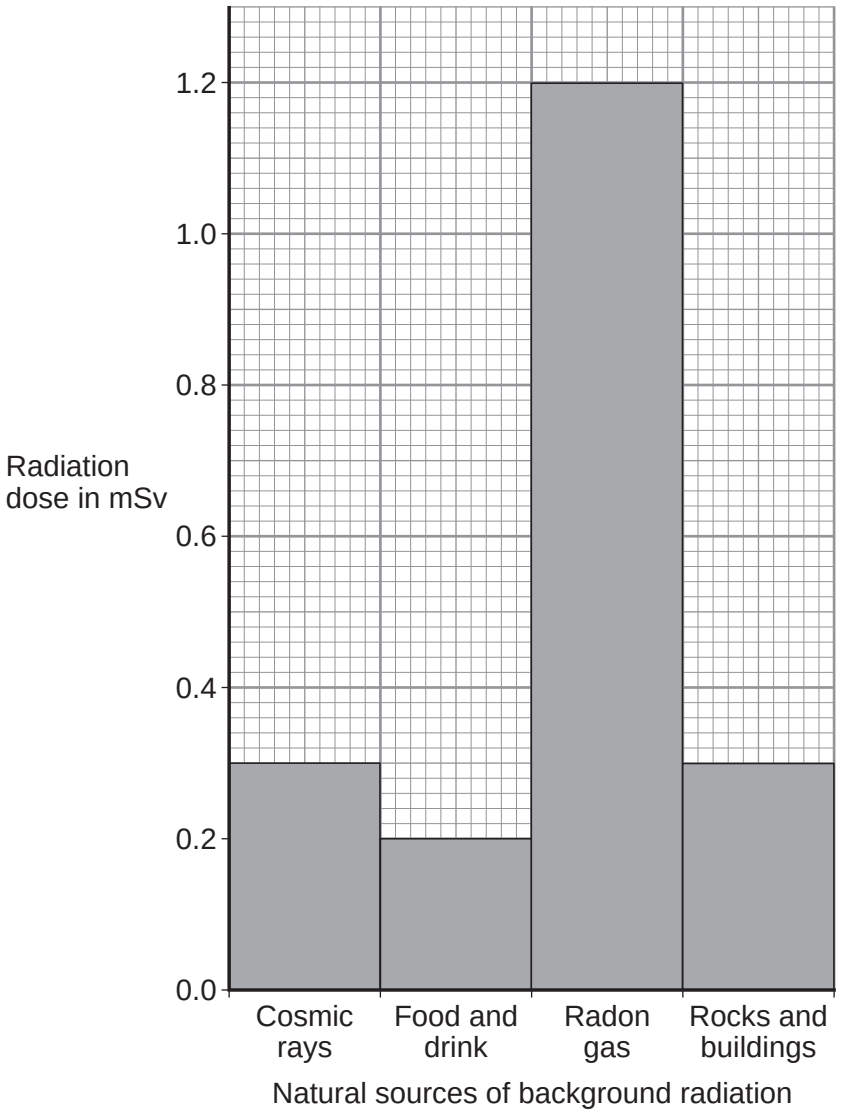
4.4.3.3 Uses of nuclear radiation

Question 12

June 2017 | PH2HP | Original Q2 | Legacy

2 **Figure 1** shows the total radiation dose that the average person in the UK gets from natural background radiation sources in one year.

Figure 1



2 (a) (i) Calculate the percentage of the total radiation dose the average person in the UK receives from cosmic rays.

[2 marks]

Percentage radiation dose from cosmic rays = _____ %

4.4.3.3 Uses of nuclear radiation

Question 12 · continued

2 (a) (ii) Over one year, a person may get a higher than average dose of radiation from cosmic rays.

Suggest **one** reason why.

[1 mark]

_____

_____

2 (a) (iii) Some sources of background radiation are man-made.

Name **one** man-made source of background radiation.

[1 mark]

_____

_____

2 (b) Before using a radioactive source a teacher measured the background radiation in her laboratory. She did this three times. The measurements were taken correctly but the three measurements were different.

Why were the three background measurements different?

[1 mark]

_____

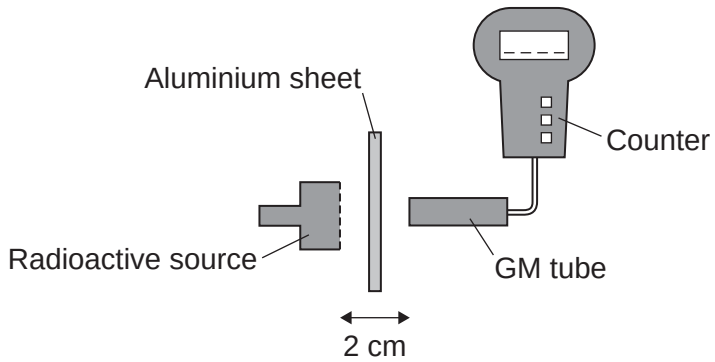
_____

Question 2 continues on the next page

Question 12 · continued

2 (c) **Figure 2** shows the apparatus the teacher used to investigate the radiation emitted by a source.

Figure 2



The teacher changed the thickness of the aluminium between the source and the Geiger-Müller (GM) tube.

The number of counts recorded for each thickness is given in **Table 1**.
The mean background measurement was 20 counts in one minute.

Table 1

Thickness of aluminium in millimetres	Counts in one minute
2	350
4	68
6	20

2 (c) (i) A student concluded that the radioactive source emits beta radiation.

Explain how the information in **Table 1** supports this conclusion.

[2 marks]

4.4.3.3 Uses of nuclear radiation

Question 12 · continued

2 (c) (ii) The teacher said that the source also emits alpha radiation.

Describe how the investigation could be changed in order to show that the source emits alpha radiation.

[2 marks]

_____

_____

_____

_____

_____

_____

9

Turn over for the next question

4.4.3.3 Uses of nuclear radiation

Question 13

June 2018 | 8463/1H | Original Q2

0 2 A teacher used a Geiger-Muller tube and counter to measure the number of counts in 60 seconds for a radioactive rock.

0 2 . 1 The counter recorded 819 counts in 60 seconds. The background radiation count rate was 0.30 counts per second.

Calculate the count rate for the rock.

[3 marks]

Count rate = _____ per second

0 2 . 2 A householder is worried about the radiation emitted by the granite worktop in his kitchen.

1 kg of granite has an activity of 1250 Bq. The kitchen worktop has a mass of 180 kg.

Calculate the activity of the kitchen worktop in Bq.

[2 marks]

Activity = _____ Bq

Question 2 continues on the next page

Question 13 · continued

0 2 . 3 The average total radiation dose per year in the UK is 2.0 millisieverts.

Table 1 shows the effects of radiation dose on the human body.

Table 1

Radiation dose in millisieverts	Effects
10 000	Immediate illness; death within a few weeks
1000	Radiation sickness; unlikely to cause death
100	Lowest dose with evidence of causing cancer

The average radiation dose from the granite worktop is 0.003 millisieverts per day.

Explain why the householder should **not** be concerned about his yearly radiation dose from the granite worktop.

One year is 365 days.

[2 marks]

0 2 . 4 Bananas are a source of background radiation. Some people think that the unit of radiation dose should be changed from sieverts to Banana Equivalent Dose.

Suggest **one** reason why the Banana Equivalent Dose may help the public be more aware of radiation risks.

[1 mark]

8

4.4.3.3 Uses of nuclear radiation

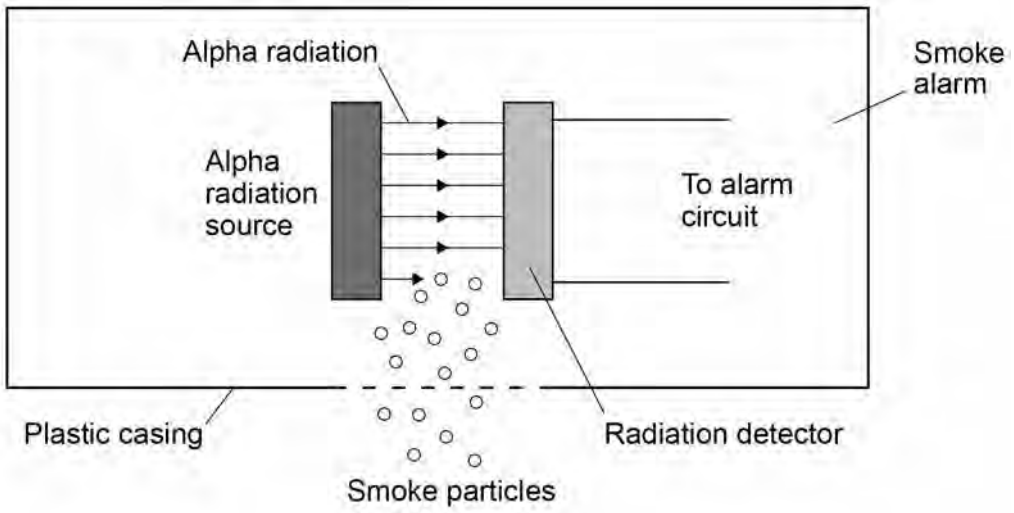
Question 14

June 2018 | 8463/1H | Original Q6

0 6 Smoke alarms contain an alpha radiation source and a radiation detector.

Figure 9 shows part of the inside of a smoke alarm.

Figure 9



0 6 . 1 The smoke alarm stays off while alpha radiation reaches the detector.

Why does the alarm switch on when smoke particles enter the plastic casing?

[1 mark]

0 6 . 2 Why is it safe to use a source of alpha radiation in a house?

[1 mark]

4.4.3.3 Uses of nuclear radiation

Question 14 · continued

0 6 . 3 The smoke alarm would not work with a radiation source that emits beta or gamma radiation.

Explain why.

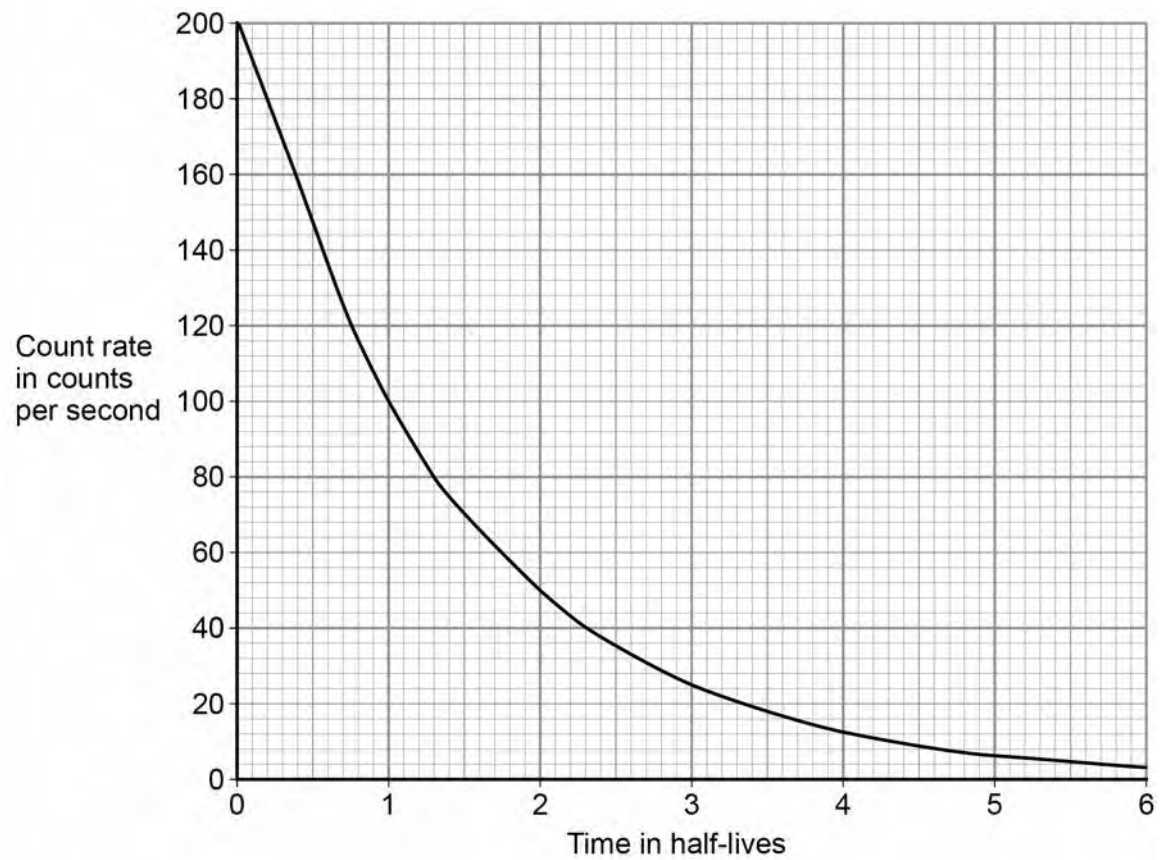
[2 marks]

Question 6 continues on the next page

Question 14 · continued

0 6 . 4 **Figure 10** shows how the count rate detected from the radiation source in the smoke alarm changes with time.

Figure 10



The smoke alarm switches on when the count rate falls to 80 counts per second.

Explain why the radiation source inside the smoke alarm should have a long half-life.

[2 marks]

4.4.3.3 Uses of nuclear radiation

Question 14 · continued

0 6 . 5 **Figure 11** shows a patient who has been injected with a radioactive source for medical diagnosis.

Figure 11



Explain the ideal properties of a radioactive source for use in medical diagnosis.

[4 marks]

10

4.4.3.3 Uses of nuclear radiation

Question 15

June 2022 | 8463/1H | Original Q7

0 7 Alpha particles, beta particles and gamma rays are types of nuclear radiation.

0 7 . 1 What does an alpha particle consist of?

[1 mark]

0 7 . 2 A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

Complete the nuclear equation for this decay by writing the missing number in each box.

[2 marks]

$$\square_{36}\mathrm{Kr} \longrightarrow \square^{85}\mathrm{Rb} + {}^{0}_{-1}\mathrm{e}$$

0 7 . 3 Internal contamination of the human body means radioactive material is inside the human body.

Explain how the risk from internal contamination is different to the risk from external irradiation by a source of alpha radiation.

[5 marks]

8

4.4.3.3 Uses of nuclear radiation

Question 16

June 2023 | 8463/1H | Original Q5

0 5 Some isotopes emit nuclear radiation.

0 5 . 1 Carbon-14 and carbon-12 are isotopes of carbon.

Compare the structure of an atom of carbon-14 with the structure of an atom of carbon-12.

[3 marks]

0 5 . 2 Carbon-14 is a radioactive isotope.

Carbon-14 has a half-life of 5700 years.

What does 'a half-life of 5700 years' mean?

[1 mark]

Question 5 continues on the next page

Question 16 · continued

Table 1 gives the half-life of some other radioactive isotopes.

Table 1

Isotope	Half-life in seconds
Nitrogen-18	0.62
Nitrogen-17	4.17
Fluorine-17	64.37
Fluorine-18	6584.34

0 5 . 3 A sample of fluorine-17 has an activity that is one quarter of its original activity.

Calculate the age of the sample of fluorine-17.

[2 marks]

Age = _____ s

0 5 . 4 All of the isotopes in **Table 1** emit beta radiation.

Explain which isotope would cause the biggest risk to a person's health based only on the half-life of each isotope.

[3 marks]

4.4.3.3 Uses of nuclear radiation

Question 16 · continued

0 5 . 5 People who work in the nuclear power industry need to be aware of irradiation and contamination.

Describe the difference between irradiation and contamination.

[2 marks]

0 5 . 6 Give **one** health risk to a person working close to a source of nuclear radiation.

[1 mark]

0 5 . 7 Workers in nuclear power stations are monitored to check the radiation they emit.

A worker stands 1 cm away from a radiation detector.

The amount of radiation the worker emits is recorded.

Explain why the worker needs to stand close to the radiation detector.

[2 marks]

4.4.3.3 Uses of nuclear radiation

Question 16 · continued

0 5 . 8 Workers in the nuclear power industry are exposed to nuclear radiation.

Pilots on aircraft are exposed to cosmic radiation from space.

daily dose caused by working in a nuclear power station = 0.00050 mSv

hourly dose from cosmic rays to a pilot while flying = 0.0030 mSv

Calculate the number of days it takes for a nuclear power station worker to receive the same dose as a pilot flying for 24 hours.

[3 marks]

Number of days = _____

17