AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.3.1

Background radiation

Past-paper questions

Tier	**Foundation**
Question groups	**24**
Available paper years	**2003–2024**

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:** _____

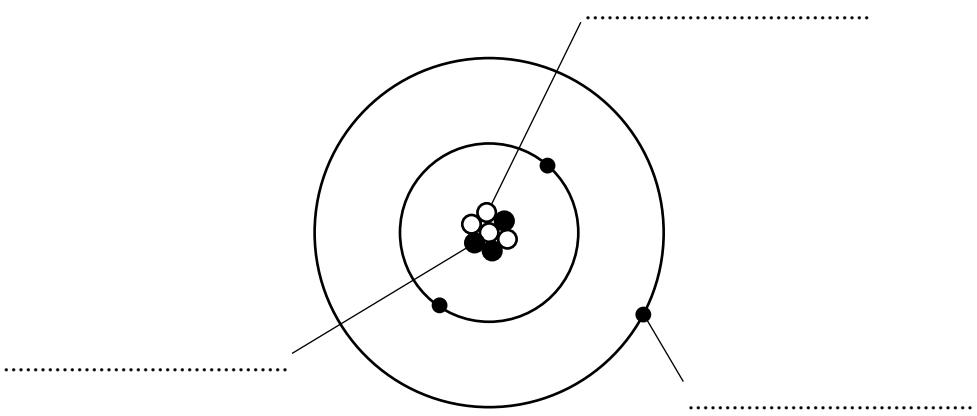
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.4.3.1 Background radiation

Question 01

June 2003 | 3451F | Original Q6 | Legacy

6 (a) The diagram represents an atom of lithium.



(i) Complete the diagram by writing in the spaces the name of each type of particle. Use only words given in the box. Each word may be used once or not at all.

electron	**neutron**	**nucleus**	**proton**

(3 marks)

(ii) Which type of particle found inside the atom is uncharged?

.....

(1 mark)

(iii) What is the mass number of this atom, 3, 4, 7 or 10?

.....

Give a reason for your choice.

.....

.....

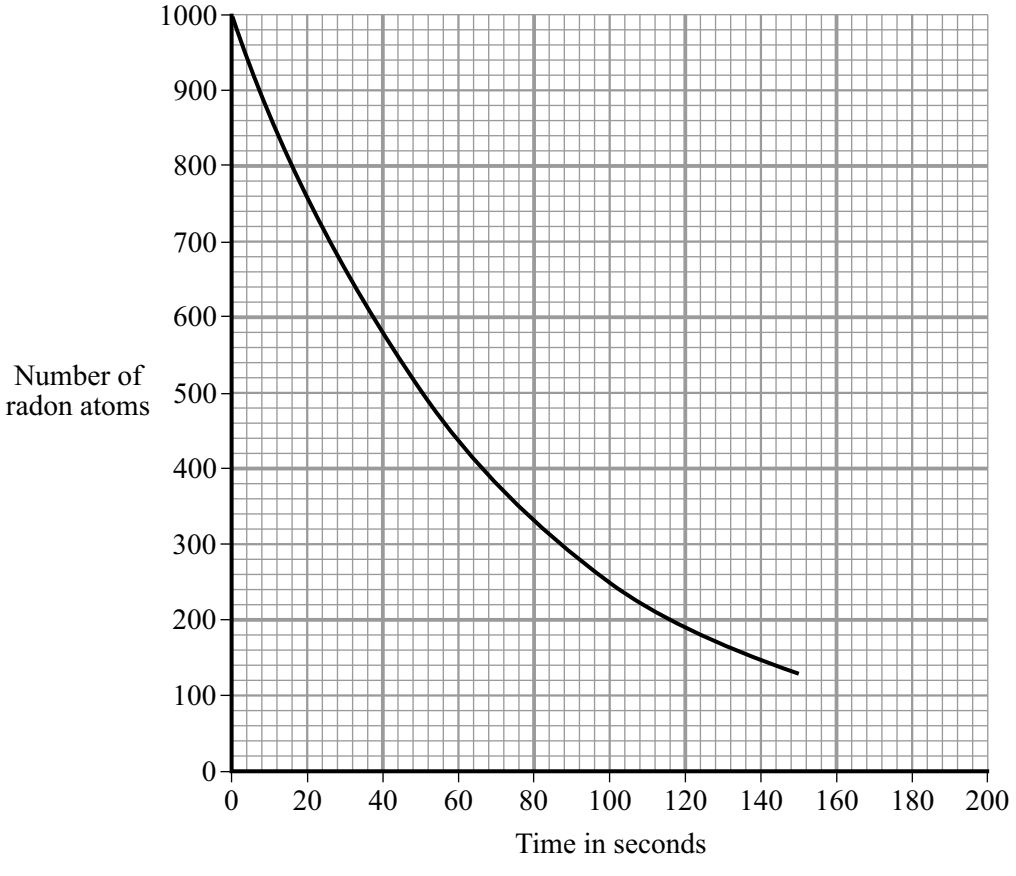
(2 marks)

4.4.3.1 Background radiation

Question 01 · continued

MARGIN
BLANK

(b) Radon is a radioactive element. The graph shows how the number of radon atoms in a sample of air changes with time.



(i) How long did it take the number of radon atoms in the sample of air to fall from 1000 to 500?

Time = ...seconds
(1 mark)

(ii) How long is the half-life of radon?

Half-life = ...seconds
(1 mark)

(iii) Complete this sentence by crossing out the **two** lines in the box that are wrong.

As a radioactive material gets older, it emits

less
a constant level of
more

radiation per second.

(1 mark)

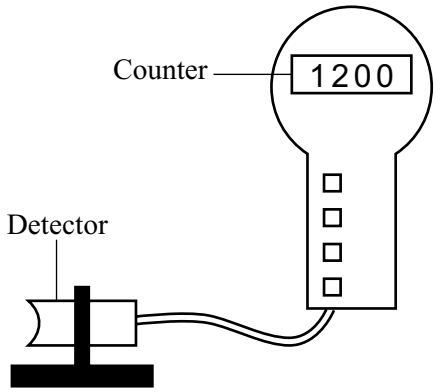
9

4.4.3.1 Background radiation

Question 02

June 2003 | 3451F | Original Q14 | Legacy

14 (a) The diagram shows a radiation detector and counter being used to measure background radiation. The number shows the count ten minutes after the counter was reset to zero.



(i) Name **one** source of background radiation.

.....

(1 mark)

(ii) Calculate the average background radiation level, in counts per second. Show clearly how you work out your answer.

.....

.....

Background radiation level = ...counts per second

(2 marks)

4.4.3.1 Background radiation

Question 02 · continued

MARGIN
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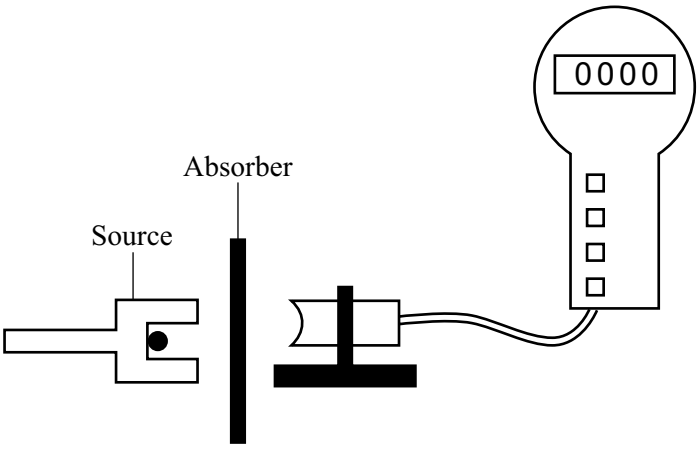
(b) The detector and counter are used in an experiment to show that a radioactive source gives out alpha and beta radiation only.



Two different types of absorber are placed one at a time between the detector and the source. For each absorber, a count is taken over ten minutes and the average number of counts per second worked out. The results are shown in the table.

Absorber used	Average counts per second
No absorber	33
Card 1 mm thick	20
Metal 3 mm thick	2

Explain how these results show that alpha and beta radiation is being given out, but gamma radiation is **not** being given out.

.....

.....

.....

.....

.....

.....

(3 marks)

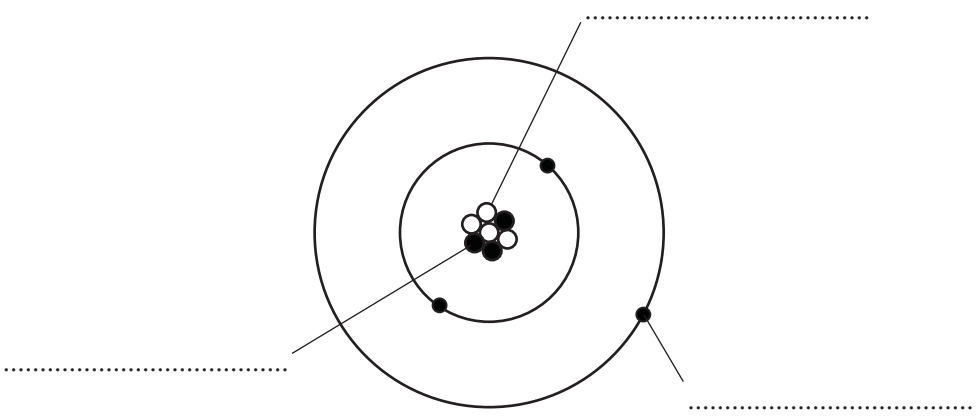
6

4.4.3.1 Background radiation

Question 03

June 2003 | 3462F3 | Original Q6 | Legacy

6 (a) The diagram represents an atom of lithium.



(i) Complete the diagram by writing in the spaces the name of each type of particle. Use only words given in the box. Each word may be used once or not at all.

electron	**neutron**	**nucleus**	**proton**

(3 marks)

(ii) Which type of particle found inside the atom is uncharged?

.....

(1 mark)

(iii) What is the mass number of this atom, 3, 4, 7 or 10?

.....

Give a reason for your choice.

.....

.....

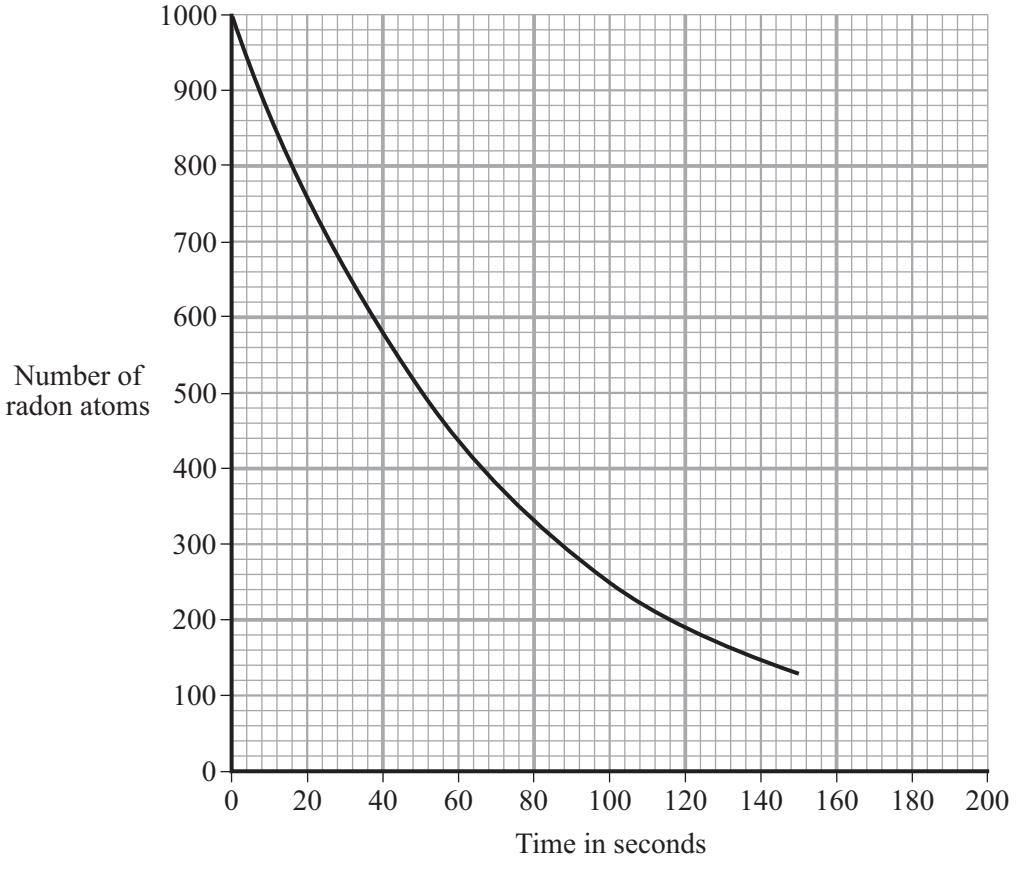
(2 marks)

4.4.3.1 Background radiation

Question 03 · continued

MARGIN BLANK

(b) Radon is a radioactive element. The graph shows how the number of radon atoms in a sample of air changes with time.



(i) How long did it take the number of radon atoms in the sample of air to fall from 1000 to 500?

Time = ...seconds
(1 mark)

(ii) How long is the half-life of radon?

Half-life = ...seconds
(1 mark)

(iii) Complete this sentence by crossing out the **two** lines in the box that are wrong.

As a radioactive material gets older, it emits

less
a constant level of
more

radiation per second.

(1 mark)

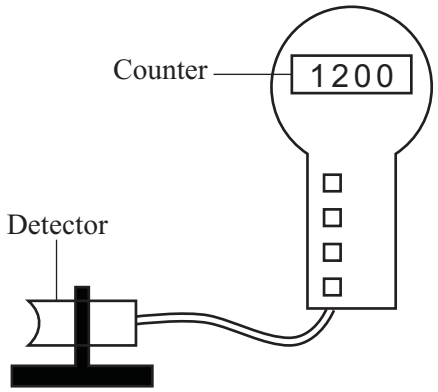
9

4.4.3.1 Background radiation

Question 04

June 2003 | 3462F3 | Original Q12 | Legacy

12 (a) The diagram shows a radiation detector and counter being used to measure background radiation. The number shows the count ten minutes after the counter was reset to zero.



(i) Name **one** source of background radiation.

.....

(1 mark)

(ii) Calculate the average background radiation level, in counts per second. Show clearly how you work out your answer.

.....

.....

Background radiation level = ...counts per second

(2 marks)

4.4.3.1 Background radiation

Question 04 · continued

MARGIN
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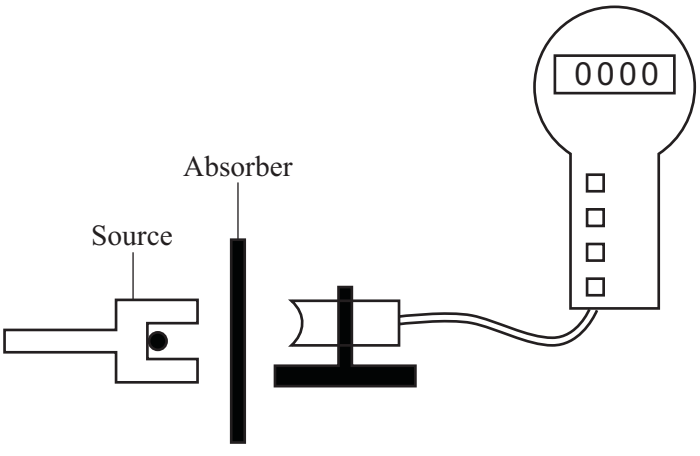
(b) The detector and counter are used in an experiment to show that a radioactive source gives out alpha and beta radiation only.



Two different types of absorber are placed one at a time between the detector and the source. For each absorber, a count is taken over ten minutes and the average number of counts per second worked out. The results are shown in the table.

Absorber used	Average counts per second
No absorber	33
Card 1 mm thick	20
Metal 3 mm thick	2

Explain how these results show that alpha and beta radiation is being given out, but gamma radiation is **not** being given out.

.....

.....

.....

.....

.....

.....

(3 marks)

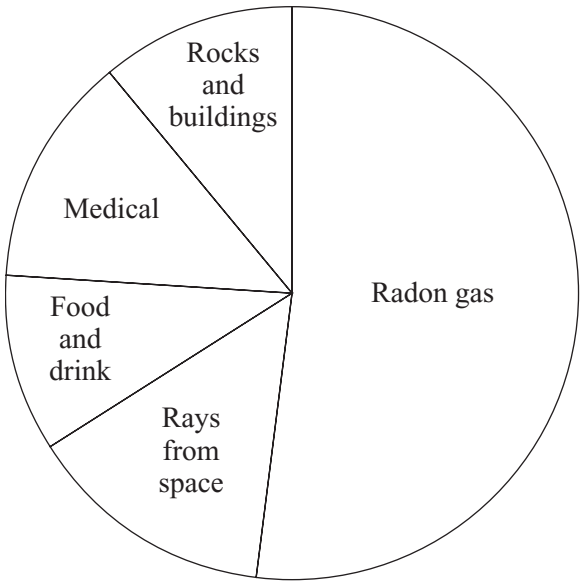
6

4.4.3.1 Background radiation

Question 05

June 2005 | 3451 | Original Q5 | Legacy

5 (a) Radiation is around us all of the time. The pie chart shows the sources of this radiation.



(i) What is the main source of this radiation?

.....

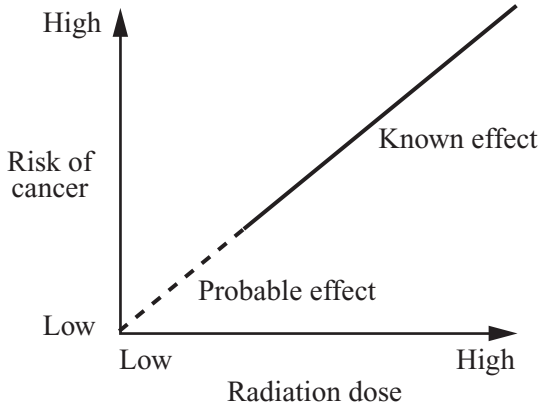
(1 mark)

(ii) What name is given to the radiation that is around us all of the time?

.....

(1 mark)

(b) Radiation can cause cancer. The graph shows that the risk of cancer depends on the radiation dose a person is exposed to.



Complete the following sentence.

The ..... the dose of radiation a person gets, the greater the risk of cancer.

(1 mark)

4.4.3.1 Background radiation

Question 05 · continued

MARGIN BLANK

(c) A worker in a nuclear power station wears a special badge (diagram **1**). Diagram **2** shows what is inside the badge. When the film inside the badge is developed, it will be dark in the places where it has absorbed radiation.

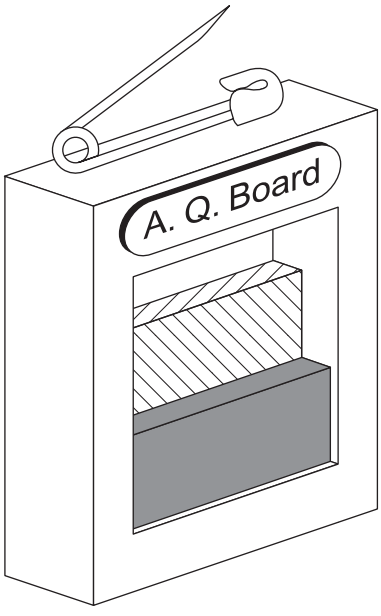


Diagram 1

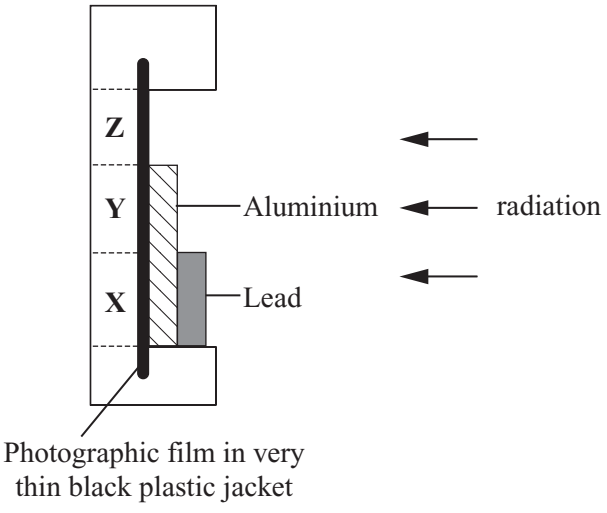


Diagram 2

Which part of the film, **X**, **Y** or **Z**, would darken if the worker had received a dose of alpha radiation?

.....

Give a reason for your answer.

.....

.....

(2 marks)

5

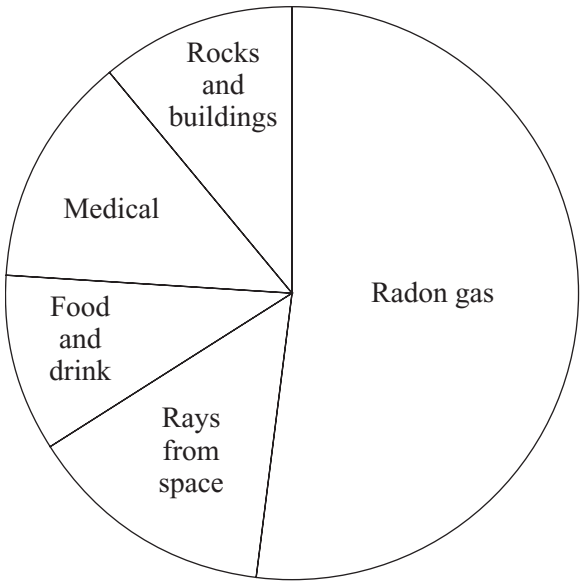
TURN OVER FOR THE NEXT QUESTION

4.4.3.1 Background radiation

Question 06

June 2005 | 3462 | Original Q5 | Legacy

5 (a) Radiation is around us all of the time. The pie chart shows the sources of this radiation.



(i) What is the main source of this radiation?

.....

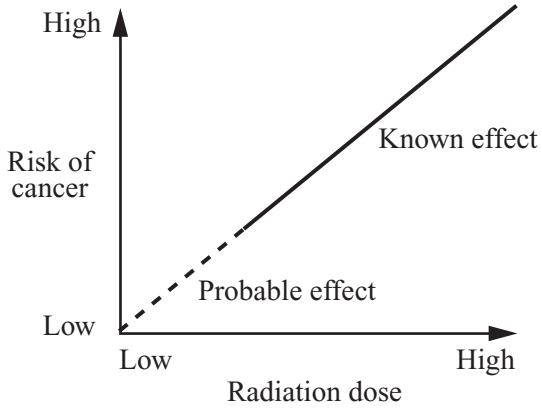
(1 mark)

(ii) What name is given to the radiation that is around us all of the time?

.....

(1 mark)

(b) Radiation can cause cancer. The graph shows that the risk of cancer depends on the radiation dose a person is exposed to.



Complete the following sentence.

The ..... the dose of radiation a person gets, the greater the risk of cancer.

(1 mark)

4.4.3.1 Background radiation

Question 06 · continued

MARGIN BLANK

(c) A worker in a nuclear power station wears a special badge (diagram **1**). Diagram **2** shows what is inside the badge. When the film inside the badge is developed, it will be dark in the places where it has absorbed radiation.

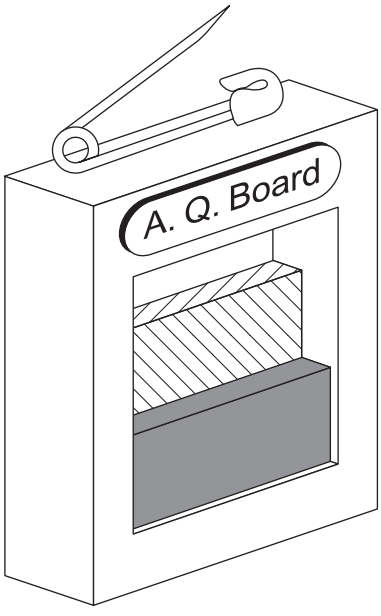


Diagram 1

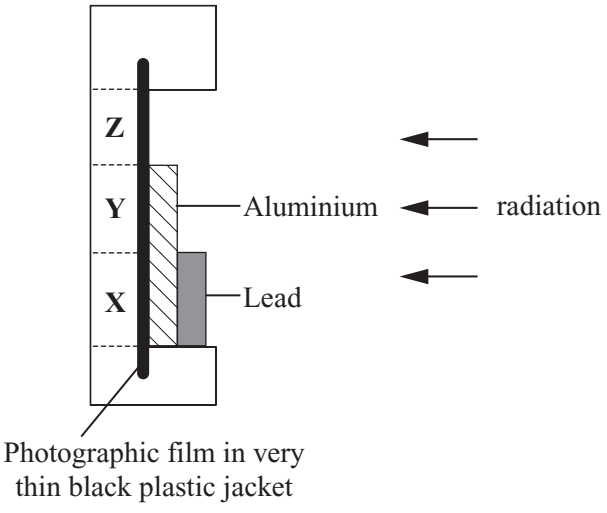


Diagram 2

Which part of the film, **X**, **Y** or **Z**, would darken if the worker had received a dose of alpha radiation?

.....

Give a reason for your answer.

.....

.....

(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

4.4.3.1 Background radiation

Question 07

November 2007 | PHY1B | Original Q8 | Legacy

QUESTION EIGHT

Radon is a radioactive gas which seeps up from the ground into houses in some parts of the country.

The table shows the results of a survey of radioactive emissions due to radon gas in four houses in one local authority.

House	Radioactive emissions in Bq per m^3 of air
1	11
2	33
3	15
4	21

8A What was the average of the radioactive emissions in the four houses?

1 20.0 Bq per m^3

2 26.6 Bq per m^3

3 40.0 Bq per m^3

4 80.0 Bq per m^3

8B The local authority wanted a more reliable average for the houses in their area.

Scientists could obtain more reliable results by . . .

1 increasing the number of houses sampled.

2 measuring radioactive emissions in 1 cm^3 of air in each house.

3 using a different unit for the radioactive emissions.

4 sampling the air outside the houses.

4.4.3.1 Background radiation

8C Radon gas causes cancer.

Which part of the body is most likely to be the site of a cancer caused by radon gas?

1 brain

2 legs

3 stomach

4 lungs

8D What advice would you give to a householder whose house has a high level of radioactive emissions from radon gas?

1 keep the house well ventilated

2 fit double glazing

3 take up all the carpets

4 place draught excluders around all the windows and doors

4.4.3.1 Background radiation

Question 08

January 2008 | PHY2F | Original Q5 | Legacy

5 The table shows the average background radiation dose from various sources that a person living in Britain receives in one year.

Source of background radiation	Average amount each year in dose units
Buildings	50
Food and drink	300
Medical treatments (including X-rays)	300
Radon gas	1250
Rocks	360
Space (cosmic rays)	240
TOTAL	2500

4.4.3.1 Background radiation

Question 08 · continued

BLANK

(a) Only **two** of the following statements are true.

Tick (✓) the boxes next to the true statements.

Half the average background radiation dose comes from radon gas. ☐

Everyone receives the same background radiation dose. ☐

Cosmic rays produce less background radiation than food and drink. ☐

(1 mark)

(b) Most sources of background radiation are natural but some are artificial (man-made).

Which source of background radiation given in the table is artificial?

.....

(1 mark)

(c) Each time a dental X-ray is taken, the patient receives about 20 units of radiation.

How many dental X-rays would give the yearly average dose for medical treatments?

.....

.....

Number of X-rays = ...

(2 marks)

4

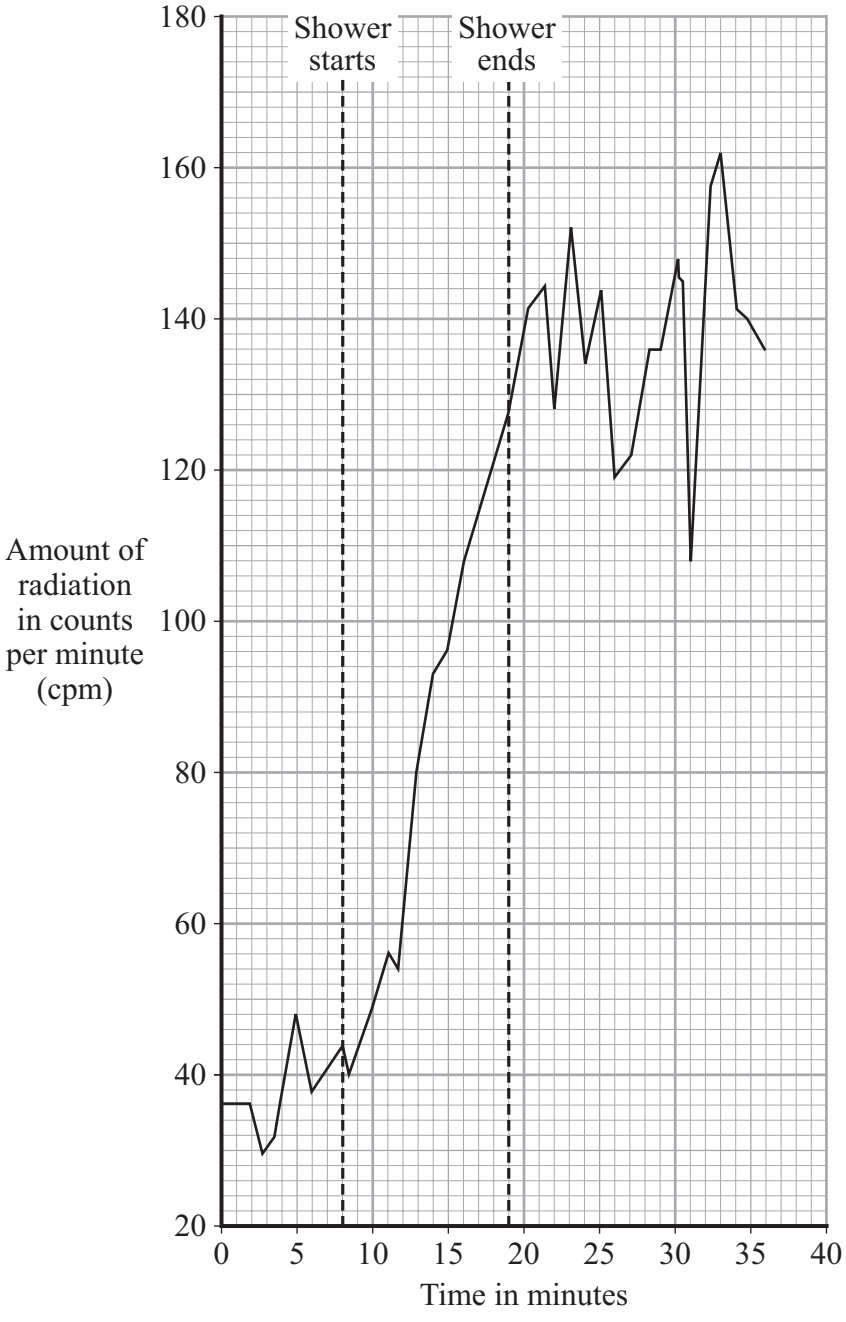
4.4.3.1 Background radiation

Question 09

March 2008 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

The graph shows how the amount of radiation from radon varies in the bathroom of a house.



4.4.3.1 Background radiation

Question 09 · continued

Match figures, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A 11

B 33

C 44

D 84

1	the length of time of the shower in minutes
2	the amount of radiation at the start of the shower in cpm
3	the time at which the radiation in the bathroom reaches a maximum
4	the rise in the amount of radiation during the shower in cpm

Turn over for the next question

4.4.3.1 Background radiation

Question 10

June 2008 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Radon is a radioactive gas. It emits alpha particles and has a half-life of 4 days. It occurs naturally in certain rocks and can become trapped in houses built on these rocks.

7A What is meant by describing radon as a *radioactive* gas?

1 It is a very reactive chemical.

2 It emits radio waves when it decays.

3 It emits radiation when it decays.

4 It reacts chemically only when exposed to radio waves.

7B What is meant by the *half-life* of a radioactive substance?

1 The time taken for its count rate to fall to half its initial value.

2 The time taken for all of the atoms to halve in size.

3 The time taken for half of an atom to decay.

4 The time taken for half of the atoms to become radioactive.

7C Why is it important to remove radon gas that becomes trapped in houses?

1 Alpha radiation can cause illnesses such as cancer.

2 Alpha radiation can weaken the rock structure.

3 Radioactivity will cause television interference.

4 Radon gas is highly flammable.

4.4.3.1 Background radiation

Question 10 · continued

7D A sheet of plastic is often built into the foundations of houses built on these rocks to stop . . .

1 alpha particles rising through the rocks into the houses.

2 radon gas rising into the houses.

3 gamma radiation rising into the houses.

4 all forms of radiation rising into the houses.

Turn over for the next question

4.4.3.1 Background radiation

Question 11

June 2008 | PHY2F | Original Q6 | Legacy

6 (a) The table gives information about the radioactive isotope, radon-222.

mass number	222
atomic number	86
radiation emitted	alpha particle

6 (a) (i) Complete the following sentence.

The mass number is the total number of..... and

..... inside an atom.

(2 marks)

6 (a) (ii) Radon-222 is an isotope of radon.

How many protons are there in an atom of radon-222?

..... *(1 mark)*

6 (a) (iii) When an atom of radon-222 emits an alpha particle, the radon-222 changes into an atom of polonium-218.

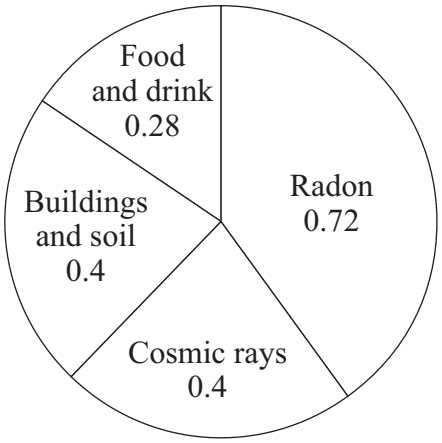
An alpha particle consists of 2 protons and 2 neutrons.

How is the structure of the nucleus of a polonium-218 atom different from the structure of the nucleus of a radon-222 atom?

.....

(1 mark)

6 (b) The pie chart shows the average radiation dose that a person in the UK receives each year from natural background radiation.
The doses are measured in millisieverts (mSv).



4.4.3.1 Background radiation

Question 11 · continued

for mark

6 (b) (i) Calculate the proportion of natural background radiation that comes from radon. Show clearly how you work out your answer.

.....

.....

Proportion of radon = ...

(2 marks)

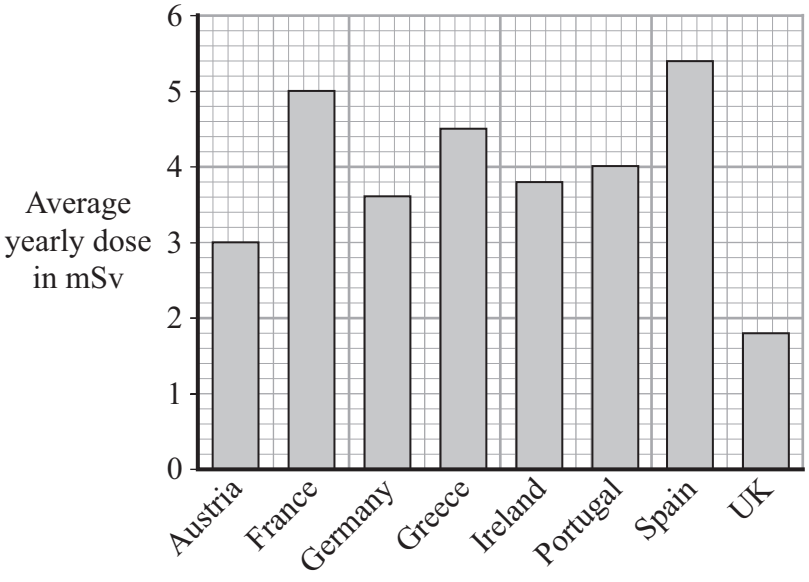
6 (b) (ii) Not all background radiation is from natural sources.

Name **one** source of background radiation that is not natural.

.....

(1 mark)

6 (c) The bar chart shows the average yearly dose from natural background radiation in different European countries.



6 (c) (i) How many times bigger is the average annual background dose in Germany compared to the UK?

.....

(1 mark)

Question 6 continues on the next page

4.4.3.1 Background radiation

Question 11 · continued

for mark

6 (c) (ii) The following table gives the effects of different radiation doses on the human body.

Radiation dose in mSv	Effects
10 000	Immediate illness; death within a few weeks
1 000	Radiation sickness; unlikely to cause death
50	Lowest dose with evidence of causing cancer

A family goes to Germany for a two-week holiday. Should they be concerned about the higher level of background radiation in Germany?

Draw a ring around your answer.

Yes **No**

Explain your answer.

.....

.....

.....

.....

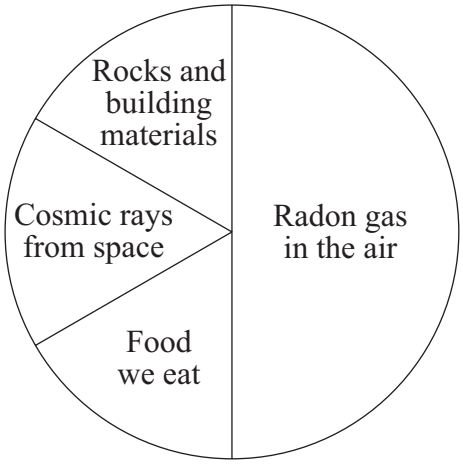
(2 marks)

10

4.4.3.1 Background radiation

Question 12

5 (a) The pie chart shows the average proportions of natural background radiation from various sources in one part of the UK.



5 (a) (i) What proportion of the background radiation comes from radon gas?

.....

(1 mark)

5 (a) (ii) Suggest why our bodies are slightly radioactive.

.....

.....

(1 mark)

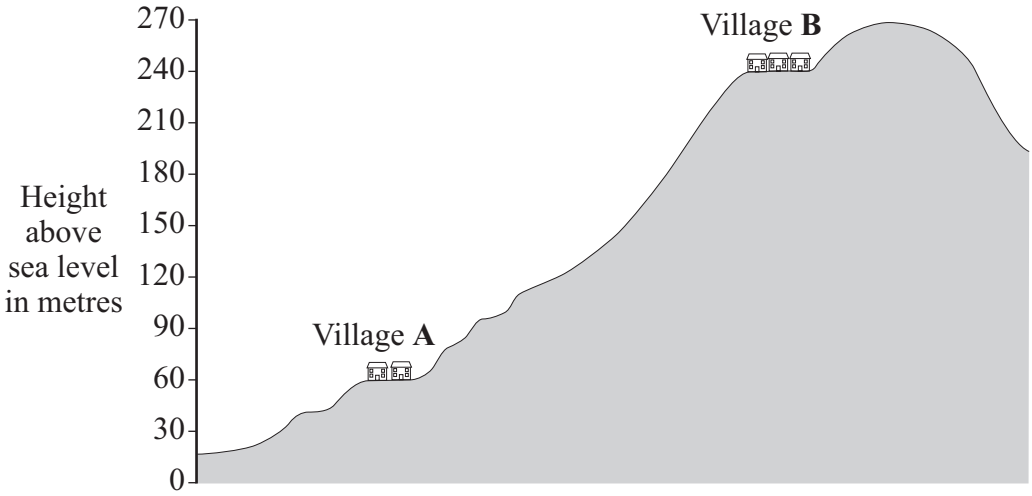
4.4.3.1 Background radiation

Question 12 · continued

for mark

5 (b) The level of background radiation from cosmic rays is not the same everywhere. For every 30 metres above sea level, the amount of background radiation increases by one unit.

The diagram shows the position of two villages, **A** and **B**, built on a hill.



How is the amount of background radiation from cosmic rays different in village **A** compared to village **B**?

To obtain full marks you must include a calculation in your answer.

.....

.....

.....

.....

.....

.....

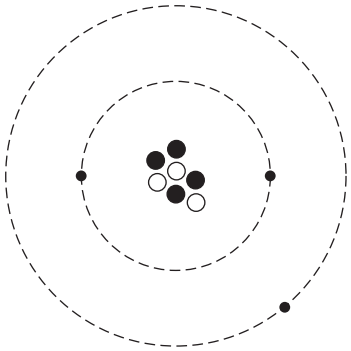
(3 marks)

5

4.4.3.1 Background radiation

Question 13

4 The diagram represents an atom of lithium.



4 (a) (i) Complete the following table of information for an atom of lithium.

Number of protons	
Number of electrons	
Number of neutrons	

(2 marks)

4 (a) (ii) What is the mass number of a lithium atom?

Draw a ring around your answer.

3	**4**	**7**	**10**

Give a reason for your answer.

.....

.....

(2 marks)

4 (b) Complete the following sentence by drawing a ring around the correct line in the box.

An atom that has lost an electron is called

an ion
an isotope
a positive atom

.

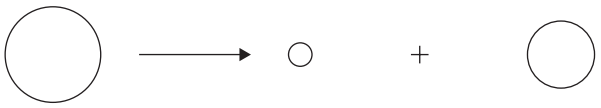
(1 mark)

4.4.3.1 Background radiation

Question 13 · continued

for mark

4 (c) When an alpha particle is emitted from the nucleus of a radon atom, the radon changes into polonium.



Radon — Alpha particle — Polonium

Not to scale

An alpha particle consists of 2 protons and 2 neutrons.

4 (c) (i) Complete the following sentence by drawing a ring around the correct line in the box.

The mass of a polonium atom is

greater than
the same as
smaller than

the mass of a radon atom.

(1 mark)

4 (c) (ii) Give a reason for your answer to part (c)(i).

.....

.....

(1 mark)

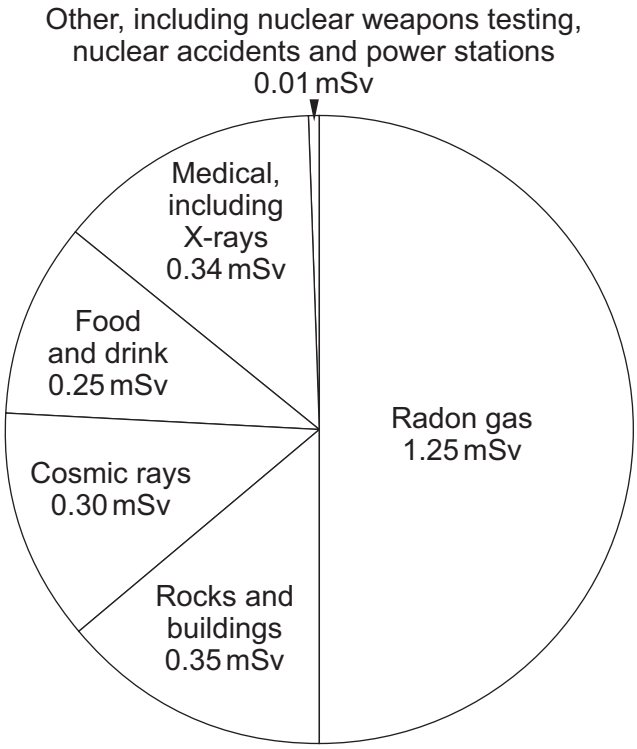
7

4.4.3.1 Background radiation

Question 14

June 2010 | PHY2F | Original Q7 | Legacy

7 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).



7 (a) (i) What is the total radiation dose that the average person in the UK receives?

.....

.....

Total radiation dose = ... mSv
(1 mark)

4.4.3.1 Background radiation

Question 14 · continued

7 (a) (ii) A student looked at the pie chart and then wrote down three statements.

Which **one** of the following statements is a correct conclusion from this data?

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

In the future, more people will be exposed to a greater proportion of radon gas. ☐

People that have never had an X-ray get 50% of their radiation dose from radon gas. ☐

The radiation dose from natural sources is much greater than from artificial sources. ☐

(1 mark)

Question 7 continues on the next page

4.4.3.1 Background radiation

Question 14 · continued

7 (b) The concentration of radon gas inside a home can vary from day to day. In some homes, the level can build up to produce a significant health risk. It is estimated that each year 1000 to 2000 people die because of the effects of radiation from radon gas.

7 (b) (i) It is not possible to give an exact figure for the number of deaths caused by the effects of radiation from radon gas. Why?

.....

.....

(1 mark)

The table gives data for the radiation levels measured in homes in 4 different parts of the UK. The radiation levels were measured using two detectors, one in the living room and one in the bedroom. The measurements were taken over 3 months.

Area of the UK	Number of homes in the area	Number of homes in the sample	Average radiation level in Bq/m^3	Maximum radiation level in Bq/m^3
A	590 000	160	15	81
B	484 000	130	18	92
C	221 000	68 000	162	10 000
D	318 000	35 300	95	6 900

7 (b) (ii) Give **one** reason why the measurements were taken over 3 months using detectors in different rooms.

.....

.....

(1 mark)

7 (b) (iii) Use information from the table to suggest why a much higher proportion of homes were sampled in areas **C** and **D** than in areas **A** and **B**.

.....

.....

.....

(2 marks)

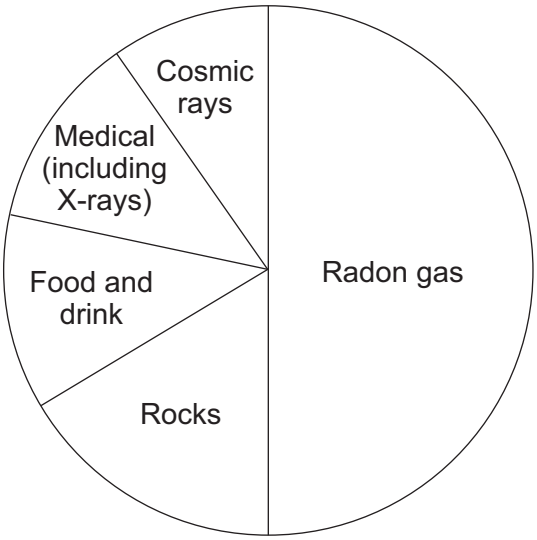
6

4.4.3.1 Background radiation

Question 15

June 2011 | PHY2F | Original Q1 | Legacy

1 The pie chart shows the average proportions of background radiation from various sources in the UK.



Three sources of background radiation are given in **List A**.
Statements about sources of background radiation are given in **List B**.

Draw **one** line to link each source of background radiation in **List A** to the statement about that source given in **List B**.

Draw only **three** lines.

List A	List B
X-rays	Are used to show broken bones.
Cosmic rays	The radiation comes from outer space.
Radon gas	Comes from soil containing a radioactive isotope of potassium.
	Gives about 50% of all background radiation.

(3 marks)

3

4.4.3.1 Background radiation

Question 16

June 2012 | PH1FP | Original Q3 | Legacy

3 A school is near a busy road. A car travels past the school at high speed.



The students notice that the sound of the car engine seems to change as the car travels past the school. A teacher says that this is an example of the Doppler effect. The students decide to study the sound they hear from passing cars.

3 (a) (i) Give **one** risk the students should consider when doing their study.

.....

(1 mark)

3 (a) (ii) As a car travels towards the students, the frequency of the sound the students hear is different to the frequency of the sound they would hear if the car was stationary.

Draw a ring around the correct answer in the box to complete the sentence.

Compared to the sound from the stationary car, the frequency has

decreased.
increased.
become quieter.

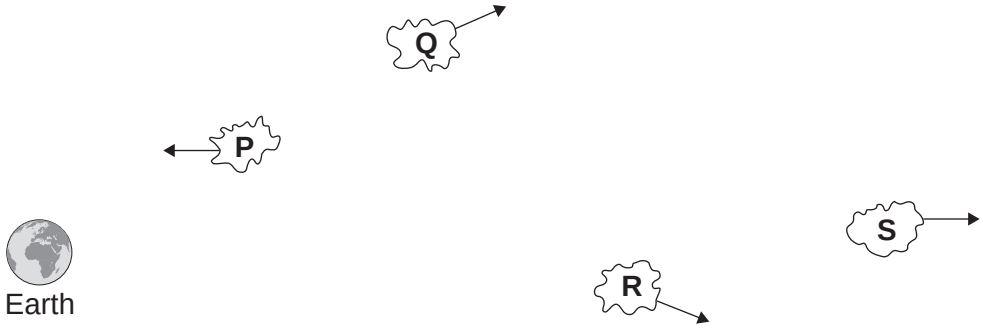
(1 mark)

4.4.3.1 Background radiation

Question 16 · continued

3 (b) In the same way as the sound from the car engine changes, the light from most galaxies also seems to have a change in observed frequency. This is called red-shift.

3 (b) (i) The diagram shows four galaxies, **P**, **Q**, **R** and **S**. The arrows show the direction the galaxies are moving relative to the Earth.



Which **one** of the galaxies is moving the fastest?

Write the correct answer in the box. ☐

Which **one** of the galaxies will produce the biggest red-shift?

Write the correct answer in the box. ☐

(2 marks)

Question 3 continues on the next page

4.4.3.1 Background radiation

Question 16 · continued

3 (b) (ii) Most scientists support a theory that the Universe began from a very small initial point. Red-shift can be used as evidence for this theory.

What name is given to the theory that the Universe began from a very small initial point?

.....

(1 mark)

3 (b) (iii) Cosmic microwave background radiation (CMBR) provides more evidence for this theory. CMBR is detected coming from space.

Where does CMBR come from?

Tick (✓) **one** box.

CMBR only comes from near the Sun. ☐

CMBR comes from all parts of the Universe. ☐

CMBR only comes from the Moon. ☐

(1 mark)

3 (b) (iv) Which statement gives the reason why most scientists support the theory that the Universe began from a very small initial point?

Tick (✓) **one** box.

The evidence proves it happened. ☐

There is no other way of explaining how the Universe began. ☐

At the moment it is the best way of explaining our scientific knowledge. ☐

(1 mark)

7

4.4.3.1 Background radiation

Question 17

June 2012 | PH2FP | Original Q6 | Legacy

6 The table shows the average background radiation dose from various sources that a person living in the UK receives in one year.

Source of background radiation	Average radiation dose received each year in dose units
Cosmic rays (from space)	300
Food and drink	250
Medical treatments (including X-rays)	350
Radon gas	1250
Rocks	350
TOTAL	2500

6 (a) (i) A student looked at the data in the table and then wrote down four statements.

Only **two** of the statements are true.

Put a tick (✓) in the boxes next to the **two** true statements.

More than half of the average radiation dose comes from radon gas. ☐

On average, cosmic rays produce less background radiation than rocks. ☐

Everyone living in the UK receives the same background radiation dose. ☐

Having no X-rays reduces a person's radiation dose. ☐

(2 marks)

6 (a) (ii) Each time a chest X-ray is taken, the patient receives about 100 units of radiation.

How many chest X-rays would just exceed the yearly average dose for medical treatments?

.....

Number of chest X-rays = ...

(2 marks)

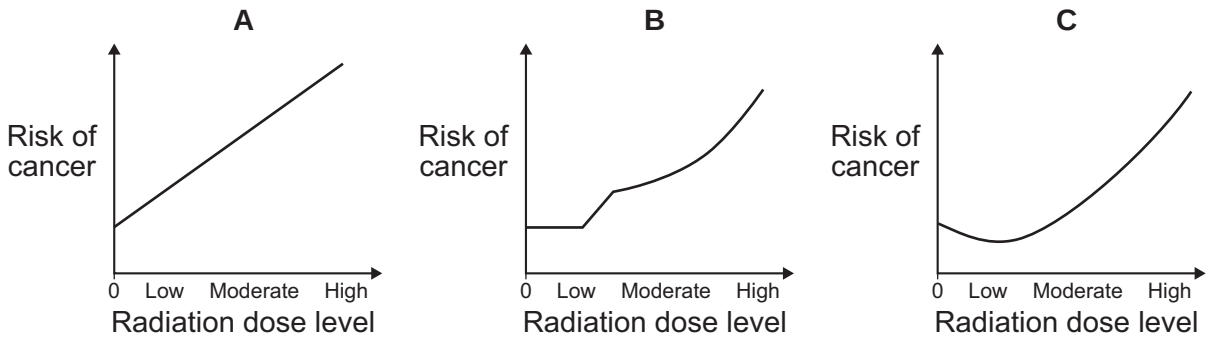
Question 6 continues on the next page

4.4.3.1 Background radiation

Question 17 · continued

6 (b) Exposure to radiation can cause cancer.

The graphs, **A**, **B** and **C**, show three different ways that the exposure to radiation and the risk of getting cancer could be linked.



6 (b) (i) What do all three of these graphs suggest happens to the risk of getting cancer when the radiation dose goes from moderate to high?

.....

.....

(1 mark)

6 (b) (ii) Some scientists believe that exposure to **low** radiation doses reduces the chance that a person will get cancer. This effect is called 'radiation hormesis'.

Which **one** of the graphs, **A**, **B** or **C**, shows 'radiation hormesis'?

Write your answer in the box. ☐

Give a reason for your answer.

.....

.....

.....

(2 marks)

4.4.3.1 Background radiation

Question 17 · continued

6 (c) Scientists did an experiment in which mice were exposed to different doses of radiation.

The results from the experiment are given in the table.

Description of exposure	Percentage of mice getting cancer
Mice exposed to a low dose of radiation and then a high dose of radiation.	16%
Mice exposed to a high dose of radiation only.	46%

6 (c) (i) Do the results from this experiment provide evidence to support 'radiation hormesis'?

Draw a ring around your answer. NO YES

Explain the reason for your answer.

.....

.....

.....

.....

.....

(2 marks)

6 (c) (ii) Complete the following sentence by drawing a ring around the correct word in the box.

Using animals in scientific experiments raises | environmental / ethical / social | issues.

(1 mark)

10

4.4.3.1 Background radiation

Question 18

January 2013 | PH2FP | Original Q2 | Legacy

2 (a) Sources of background radiation are either natural or man-made.

Which **two** of the sources listed in the box are *natural* sources of background radiation?

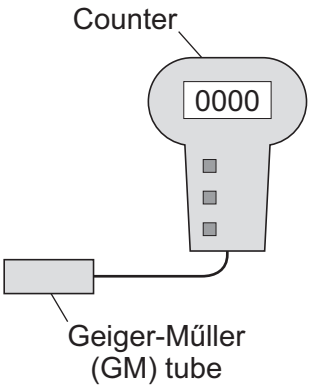
Draw a ring around each of your answers.

cosmic rays	**nuclear accidents**	**X-rays**	**radon gas**

(2 marks)

2 (b) A teacher used a Geiger-Műller (GM) tube and counter to measure the background radiation in her laboratory. The teacher reset the counter to zero, waited one minute and then took the count reading. The teacher repeated this two more times.

The three readings taken by the teacher are given in the table.



Count
17
21
19

2 (b) (i) The three readings are different.

What is the most likely reason for this?

Tick (✓) **one** box.

The teacher did not reset the counter to zero. ☐

Radioactive decay is a random process. ☐

The temperature in the laboratory changed. ☐

(1 mark)

2 (b) (ii) Calculate the mean (average) value of the three readings given in the table.

.....

Mean (average) value = ... counts

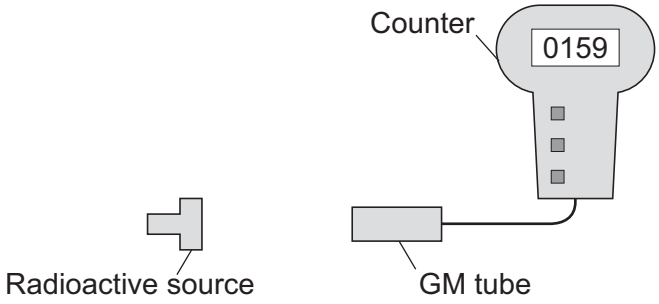
(1 mark)

4.4.3.1 Background radiation

Question 18 · continued

2 (b) (iii) The diagram shows how the teacher used the GM tube and counter to measure the radiation emitted from a radioactive source.

The counter was reset to zero. The count after one minute was 159.



Calculate how many counts were due to the radiation from the radioactive source.

.....

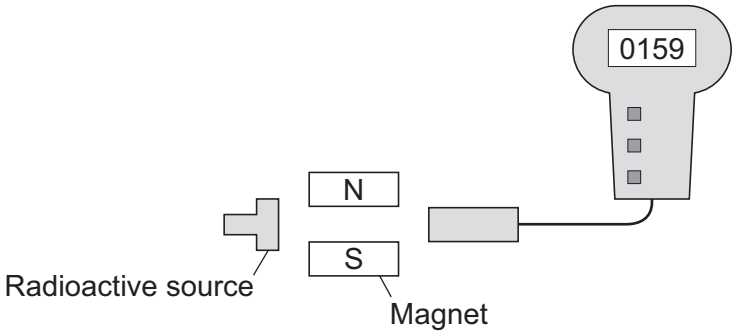
.....

Counts due to the radiation from the radioactive source = ...

(1 mark)

2 (b) (iv) The teacher then put a powerful magnet between the radioactive source and the GM tube.

The counter was reset to zero. The number on the counter shows the count after one minute.



What type of radiation was being emitted from the radioactive source?

Draw a ring around your answer.

alpha **beta** **gamma**

Explain the reason for your answer.

.....

.....

.....

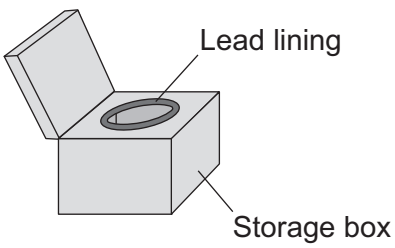
.....

(3 marks)

4.4.3.1 Background radiation

Question 18 · continued

2 (c) At the end of the lesson the teacher put the radioactive source back inside its storage box.



Why is the inside of the box lined with lead?

.....

.....

(1 mark)

2 (d) Which **one** of the following questions **cannot** be answered by scientific study?

Tick (✓) **one** box.

Where does background radiation come from? ☐

What is meant by the half-life of a radioactive source? ☐

Should radioactive waste be dumped in the oceans? ☐

(1 mark)

10

4.4.3.1 Background radiation

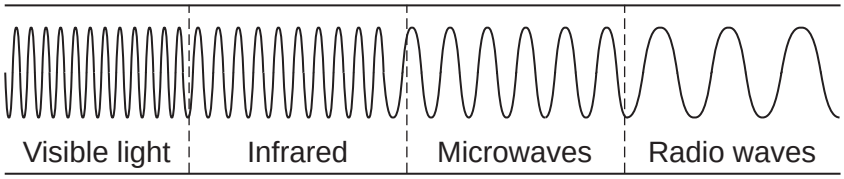
Question 19

June 2016 | PH1FP | Original Q3 | Legacy

3 Infrared and microwaves are two types of electromagnetic radiation.

Figure 4 shows the positions of the two types of radiation within part of the electromagnetic spectrum.

Figure 4



3 (a) (i) Name **one** type of electromagnetic radiation which has more energy than infrared.

[1 mark]

_____

3 (a) (ii) Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

[3 marks]

greater than	**less than**	**the same as**

The wavelength of infrared is _____ the wavelength of microwaves.

The frequency of microwaves is _____ the frequency of infrared.

The speed of microwaves in a vacuum is _____ the speed of infrared in a vacuum.

4.4.3.1 Background radiation

Question 19 · continued

3 (b) Cosmic Microwave Background Radiation (CMBR) is electromagnetic radiation that fills the universe.

Only one theory about the origin of the universe can explain the presence of CMBR.

3 (b) (i) Give the name of this theory.

[1 mark]

_____

3 (b) (ii) Which other piece of evidence supports this theory?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
the diffraction of sound waves	
the electromagnetic spectrum	
the red-shift of light from distant galaxies	

6

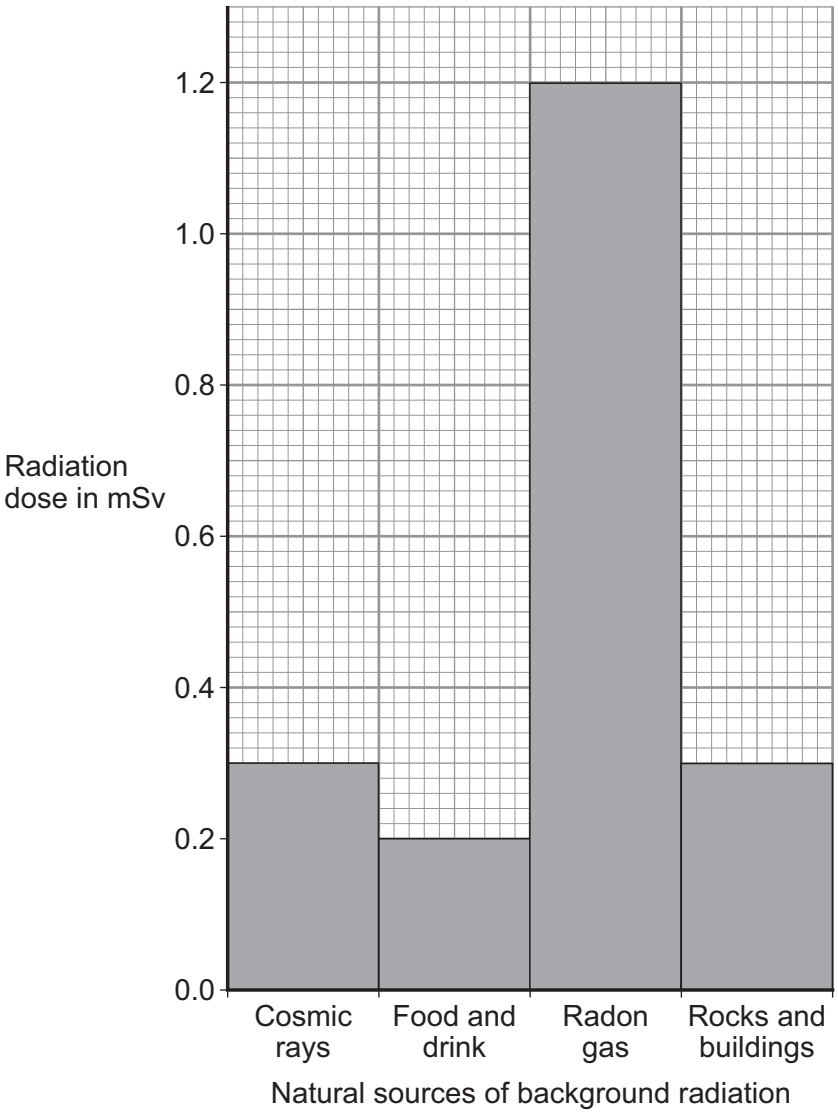
4.4.3.1 Background radiation

Question 20

June 2017 | PH2FP | Original Q7 | Legacy

7 **Figure 13** shows the total radiation dose that the average person in the UK gets from natural background radiation sources in one year.

Figure 13



7 (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 = _____ %

4.4.3.1 Background radiation

Question 20 · continued

7 (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]

_____

_____

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

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

[1 mark]

_____

_____

7 (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]

_____

_____

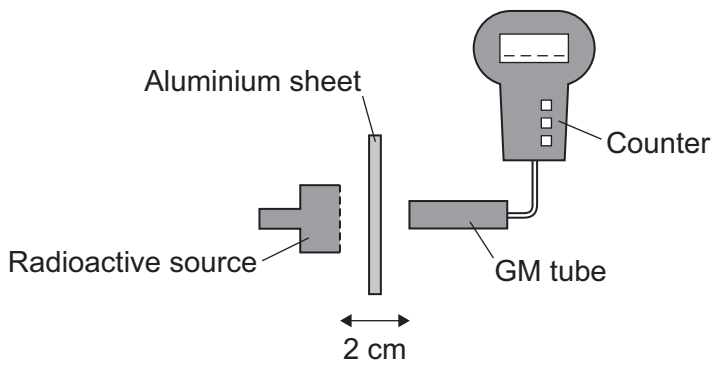
Question 7 continues on the next page

4.4.3.1 Background radiation

Question 20 · continued

7 (c) **Figure 14** shows the apparatus the teacher used to investigate the radiation emitted by a source.

Figure 14



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

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

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

[2 marks]

4.4.3.1 Background radiation

Question 20 · continued

7 (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

4.4.3.1 Background radiation

Question 21

June 2018 | 8463/1F | Original Q11

1 1 A teacher used a Geiger-Muller tube and counter to measure the number of counts in 60 seconds for a radioactive rock.

1 1 . 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

1 1 . 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

4.4.3.1 Background radiation

Question 21 · continued

1 1 . 3 The average total radiation dose per year in the UK is 2.0 millisieverts.

Table 2 shows the effects of radiation dose on the human body.

Table 2

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]

1 1 . 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

4.4.3.1 Background radiation

Question 22

November 2020 | 8463/1F | Original Q5

0 5 Radioactive waste from nuclear power stations is a man-made source of background radiation.

0 5 . 1 Which of the following is also a man-made source of background radiation?

[1 mark]

Tick (✓) **one** box.

- cosmic rays ☐
- radiotherapy ☐
- rocks ☐
- stars ☐

0 5 . 2 Nuclear power stations use the process of nuclear fission.

Complete the sentences to describe the process of nuclear fission.

Choose answers from the box.

[3 marks]

a neutron	**a proton**		**an electron**
cosmic rays	**energy**	**gamma rays**	**x-rays**

An unstable nucleus absorbs _____ and splits into two parts.

Two or three neutrons are released, as well as _____

and _____ .

4.4.3.1 Background radiation

Question 22 · continued

0 5 . 3 Plutonium-239 is one type of radioactive waste from nuclear power stations.

The following nuclear equation represents the decay of plutonium-239 (Pu-239).

$$^{239}_{94}Pu \rightarrow {}^{235}_{92}U + {}^{4}_{2}He$$

How does the nuclear equation show that alpha radiation is emitted when plutonium-239 decays?

[1 mark]

Tick (✓) **one** box.

An alpha particle contains 92 protons. ☐

An alpha particle has a mass number of 235. ☐

An alpha particle is the same as a helium nucleus. ☐

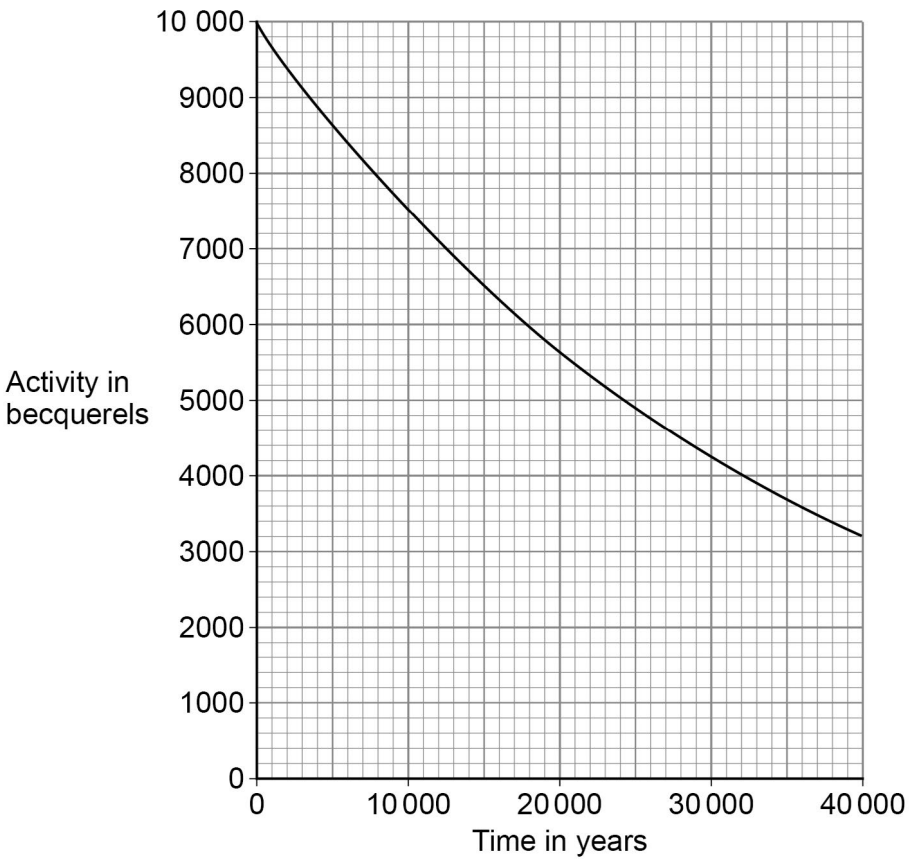
Question 5 continues on the next page

4.4.3.1 Background radiation

Question 22 · continued

Figure 8 shows how the activity of a sample of plutonium-239 varies with time.

Figure 8



0 5 . 4 How much time will it take for the activity of the sample of plutonium-239 to fall to half of its initial activity?

[1 mark]

Time = _____ years

0 5 . 5 What is the half-life of plutonium-239?

[1 mark]

Half-life = _____ years

4.4.3.1 Background radiation

Question 22 · continued

0 5 . 6 The radioactive waste from a nuclear power station is buried underground.

People are warned to stay away from places where radioactive waste is buried.

Suggest **one** risk of going near the place where radioactive waste is buried.

[1 mark]

8

Turn over for the next question

4.4.3.1 Background radiation

Question 23

June 2022 | 8463/1F | Original Q4

0 4 Radioactive isotopes emit different types of nuclear radiation.

0 4 . 1 What does an alpha particle consist of?

[1 mark]

Tick (✓) **one** box.

- 2 protons and 2 electrons ☐
- 2 protons and 2 neutrons ☐
- 4 protons ☐
- 4 neutrons ☐

0 4 . 2 What is a beta particle?

[1 mark]

Tick (✓) **one** box.

- An electron ☐
- A neutron ☐
- Electromagnetic radiation ☐

0 4 . 3 A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

What is the correct equation for this decay?

[1 mark]

Tick (✓) **one** box.

- $^{85}_{36}Kr + {}^{0}_{-1}e \longrightarrow {}^{85}_{37}Rb$ ☐
- $^{85}_{36}Kr \longrightarrow {}^{85}_{37}Rb + {}^{0}_{-1}e$ ☐
- $^{85}_{37}Rb \longrightarrow {}^{85}_{36}Kr + {}^{0}_{-1}e$ ☐

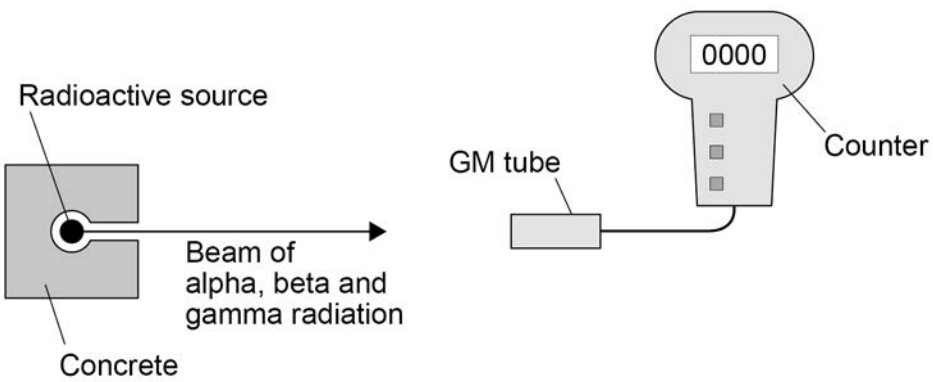
4.4.3.1 Background radiation

Question 23 · continued

0 4 . 4 **Figure 5** shows an experiment to demonstrate how alpha, beta and gamma radiation penetrate different materials.

The experiment takes place in a vacuum.

Figure 5



Three different materials are used:

- a sheet of paper
- a 0.5 cm thick sheet of aluminium
- a 10 cm block of lead.

Each material is placed one at a time between the radioactive source and the GM tube.

The GM tube and counter show whether the material has stopped the radiation.

Complete **Table 1** to show how alpha, beta and gamma radiation penetrate the materials in **Figure 5**.

Use the words **Yes** and **No**.

Part of **Table 1** has been completed for you.

[3 marks]

Table 1

Type of radiation	Most radiation is stopped by:		
	the sheet of paper	the sheet of aluminium	the block of lead
Alpha			Yes
Beta	No		
Gamma		No	

4.4.3.1 Background radiation

Question 23 · continued

0 4 . 5 Alpha, beta and gamma radiation have different ionising powers.

Draw **one** line from each radiation type to the correct ionising power.

[3 marks]

Radiation type	Ionising power
Alpha	Zero
Beta	Low
Gamma	Medium
	High

0 4 . 6 Some sources of background radiation are natural and other sources are man-made.

Which of the following is a man-made source of background radiation?

[1 mark]

Tick (✓) **one** box.

Cosmic rays ☐

Nuclear accidents ☐

Rocks ☐

0 4 . 7 The average background radiation dose per year in the UK is 2.0 millisieverts.

A dental X-ray gives a patient a radiation dose of 0.005 millisieverts.

Calculate how many dental X-rays would be the same as the average background radiation dose per year.

[2 marks]

Number of dental X-rays = _____

12

4.4.3.1 Background radiation

Question 24

June 2024 | 8463/1F | Original Q6

0 6 A teacher measured the background radiation in a laboratory.

0 6 . 1 Which sources of background radiation are natural and which are man-made?

[2 marks]

Tick (✓) **one** box in **each** row.

Source of background radiation	Natural	Man-made
Cosmic rays		
Medical X-rays		
Nuclear accidents		
Radon gas		

Question 6 continues on the next page

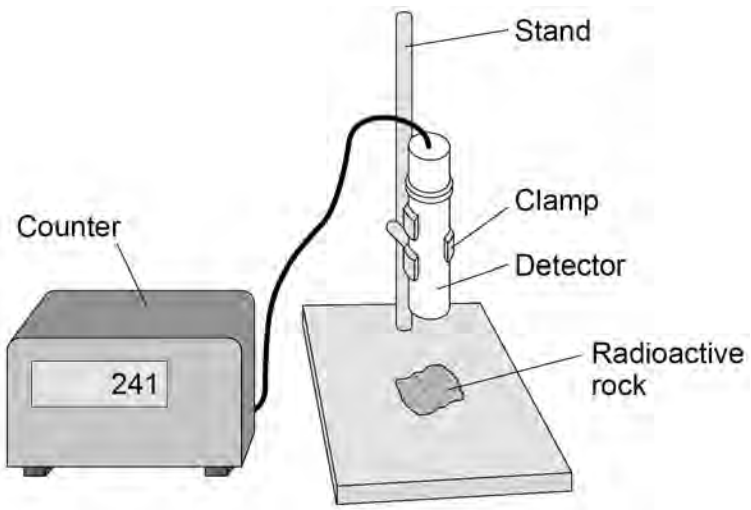
4.4.3.1 Background radiation

Question 24 · continued

The teacher measured the radiation emitted by four different types of radioactive rock.

Figure 12 shows the equipment used.

Figure 12



Each radioactive rock was placed below the detector one at a time.

The radiation was recorded as the number of counts in 1 minute.

The experiment was repeated with different materials between each rock and the detector.

Table 2 shows the results.

Table 2

	Number of counts in 1 minute		
	No material	One sheet of paper	Thick aluminium sheet
No rock	21	20	22
Rock **A**	450	448	18
Rock **B**	385	387	356
Rock **C**	870	21	20
Rock **D**	620	473	214

4.4.3.1 Background radiation

Question 24 · continued

0 6 . 2 Which radioactive rock emitted only alpha radiation?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Rock **A** ☐

Rock **B** ☐

Rock **C** ☐

Rock **D** ☐

Reason _____

_____

0 6 . 3 Which radioactive rock emitted only beta radiation?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Rock **A** ☐

Rock **B** ☐

Rock **C** ☐

Rock **D** ☐

Reason _____

_____

4.4.3.1 Background radiation

Question 24 · continued

0 6 . 4 The teacher took safety precautions during the experiment.

Which precaution would prevent the teacher from becoming contaminated by the radioactive rocks?

[1 mark]

Tick (✓) **one** box.

- Displaying the radiation hazard symbol ☐
- Handling the rocks with clean hands ☐
- Wearing protective gloves ☐

0 6 . 5 What is the activity of each rock after one half-life?

[1 mark]

Tick (✓) **one** box.

- The activity is a quarter of the original activity. ☐
- The activity is half the original activity. ☐
- The activity is double the original activity. ☐
- The activity is zero. ☐

4.4.3.1 Background radiation

Question 24 · continued

0 6 . 6 How does the activity of a radioactive source affect the risk of harm from the source?

[1 mark]

Tick (✓) **one** box.

The smaller the activity, the greater the risk of harm. ☐

The activity does not affect the risk of harm. ☐

The greater the activity, the greater the risk of harm. ☐

9

Turn over for the next question