AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.4

Uses and applications of electromagnetic waves

Past-paper questions

Tier	**Foundation**
Question groups	**163**
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.

4.6.2.4 Uses and applications of electromagnetic waves

Question 01

June 2003 | 3451F | Original Q3 | Legacy

3 (a) In the box are the names of five waves.

infra red	**microwaves**	**ultrasonic**	**ultraviolet**	**X-rays**

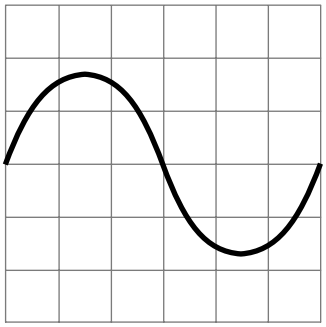
Which wave is used to:

(i) send information to a satellite, ...
(1 mark)

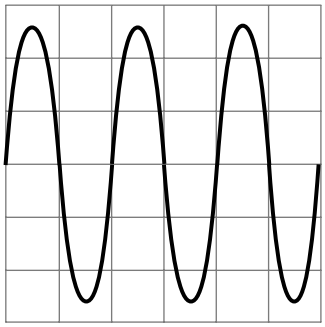
(ii) toast bread, ...
(1 mark)

(iii) clean a valuable ring? .....
(1 mark)

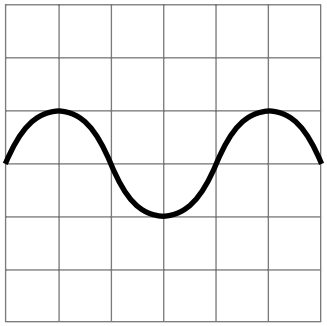
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



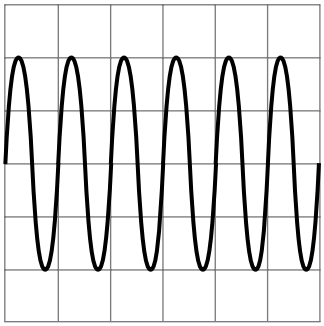
A



B



C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...
(1 mark)

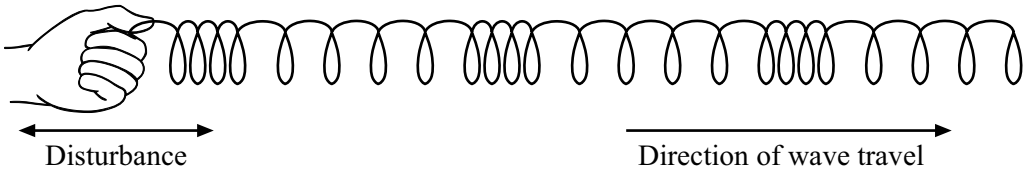
(ii) the lowest frequency? .....
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 01 · continued

MARGIN BLANK

(c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

(2 marks)

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave **sound wave** **water wave**

(1 mark)

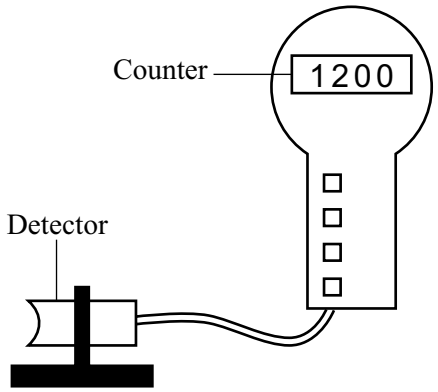
8

4.6.2.4 Uses and applications of electromagnetic waves

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)

4.6.2.4 Uses and applications of electromagnetic waves

Question 02 · continued

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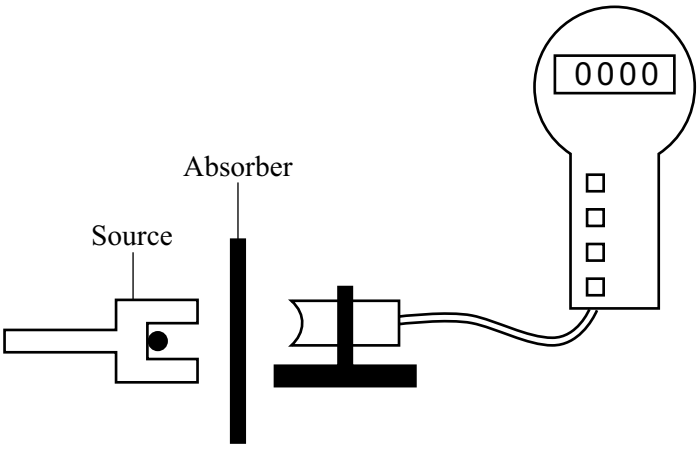
(b) The detector and counter are used in an experiment to show that a radioactive source gives out alpha and beta radiation only.



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

4.6.2.4 Uses and applications of electromagnetic waves

Question 03

June 2003 | 3462F3 | Original Q3 | Legacy

3 (a) In the box are the names of five waves.

infra red	**microwaves**	**ultrasonic**	**ultraviolet**	**X-rays**

Which wave is used to:

(i) send information to a satellite, ...

(1 mark)

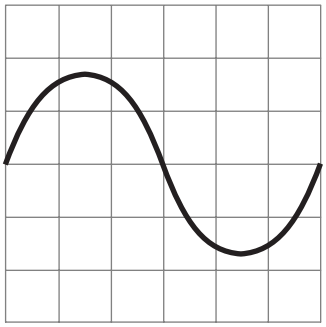
(ii) toast bread, ...

(1 mark)

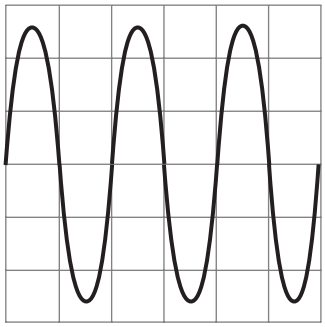
(iii) clean a valuable ring? .....

(1 mark)

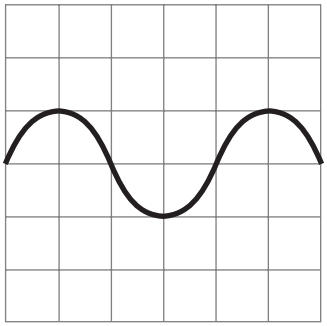
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



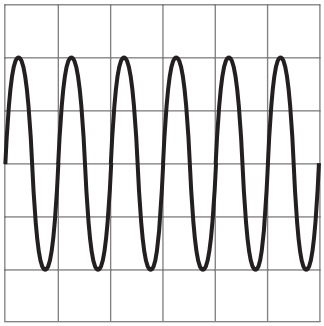
A



B



C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...

(1 mark)

(ii) the lowest frequency? .....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 03 · continued

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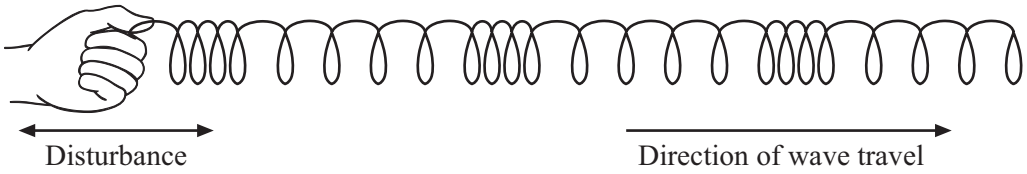
(c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

(2 marks)

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave **sound wave** **water wave**

(1 mark)

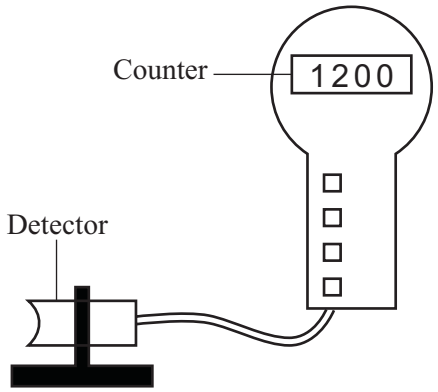
8

4.6.2.4 Uses and applications of electromagnetic waves

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)

4.6.2.4 Uses and applications of electromagnetic waves

Question 04 · continued

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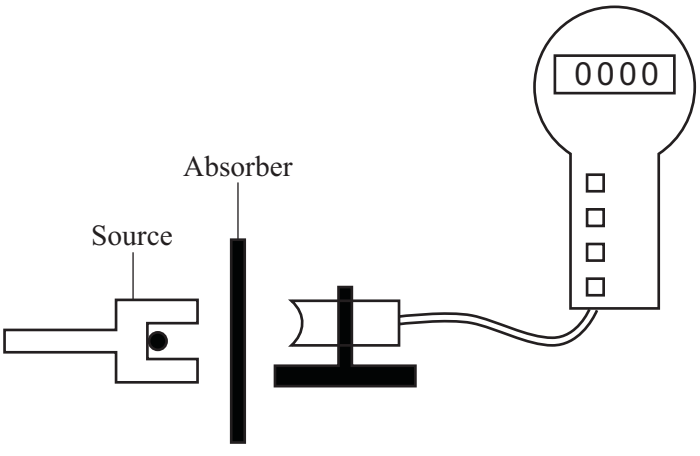
(b) The detector and counter are used in an experiment to show that a radioactive source gives out alpha and beta radiation only.



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

4.6.2.4 Uses and applications of electromagnetic waves

Question 05

June 2004 | 3451F | Original Q2 | Legacy

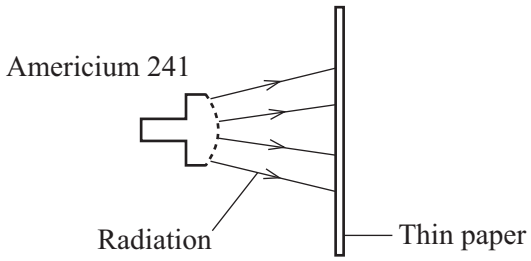
2 A smoke detector fitted inside a house contains a radioactive source, americium 241.

(a) Complete the following table of information for an atom of americium 241.

Number of neutrons	146
Number of protons	95
Number of electrons	

(1 mark)

(b) The diagram shows that the radiation given out by americium 241 does not go through paper.



Which type of radiation, alpha (α), beta (β), or gamma (γ) is given out by americium 241?

.....

(1 mark)

(c) Explain why the radiation given out by the americium 241 is unlikely to do any harm to people living in the house.

.....

.....

.....

.....

(2 marks)

(d) Complete the sentence by choosing an answer from the box.

less than	**more than**	**the same as**

After many years the radiation emitted by americium 241 will be ..... when the smoke detector was new.

(1 mark)

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 06

June 2004 | 3451F | Original Q11 | Legacy

11 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

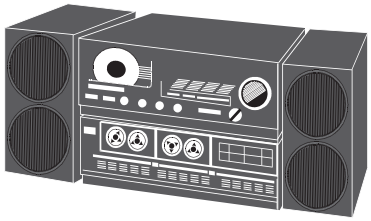
(1 mark)

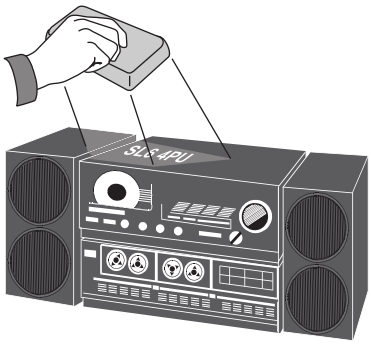
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

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.....

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.....

(2 marks)

4.6.2.4 Uses and applications of electromagnetic waves

Question 06 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

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.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred = ... kWh

(2 marks)

9

4.6.2.4 Uses and applications of electromagnetic waves

Question 07

June 2004 | 3462F3 | Original Q2 | Legacy

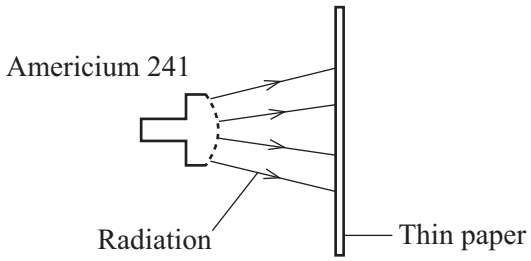
2 A smoke detector fitted inside a house contains a radioactive source, americium 241.

(a) Complete the following table of information for an atom of americium 241.

Number of neutrons	146
Number of protons	95
Number of electrons	

(1 mark)

(b) The diagram shows that the radiation given out by americium 241 does not go through paper.



Which type of radiation, alpha (α), beta (β), or gamma (γ) is given out by americium 241?

.....

(1 mark)

(c) Explain why the radiation given out by the americium 241 is unlikely to do any harm to people living in the house.

.....

.....

.....

.....

(2 marks)

(d) Complete the sentence by choosing an answer from the box.

less than	**more than**	**the same as**

After many years the radiation emitted by americium 241 will be ..... when the smoke detector was new.

(1 mark)

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 08

June 2004 | 3462F3 | Original Q9 | Legacy

9 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

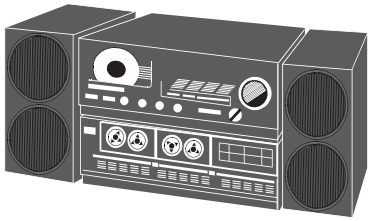
(1 mark)

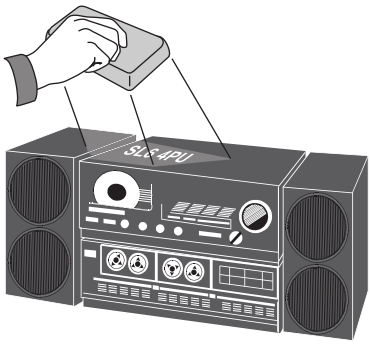
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.6.2.4 Uses and applications of electromagnetic waves

Question 08 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred = ... kWh

(2 marks)

9

4.6.2.4 Uses and applications of electromagnetic waves

Question 09

June 2005 | 3451 | Original Q3 | Legacy

3 The diagram shows the types of wave that make up the electromagnetic spectrum.

gamma rays	**X-rays**	**ultraviolet**	**light**	**infra red**	**microwaves**	**radio**

(a) Which type of wave:

(i) has the longest wavelength and lowest frequency;

.....

(1 mark)

(ii) can be used to kill harmful bacteria in food;

.....

(1 mark)

(iii) is used in sunbeds to give a sun-tan;

.....

(1 mark)

(iv) is used to send information between mobile phones?

.....

(1 mark)

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

The speed of light rays through space is

faster than
the same as
slower than

the speed of radio waves through space.

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 09 · continued

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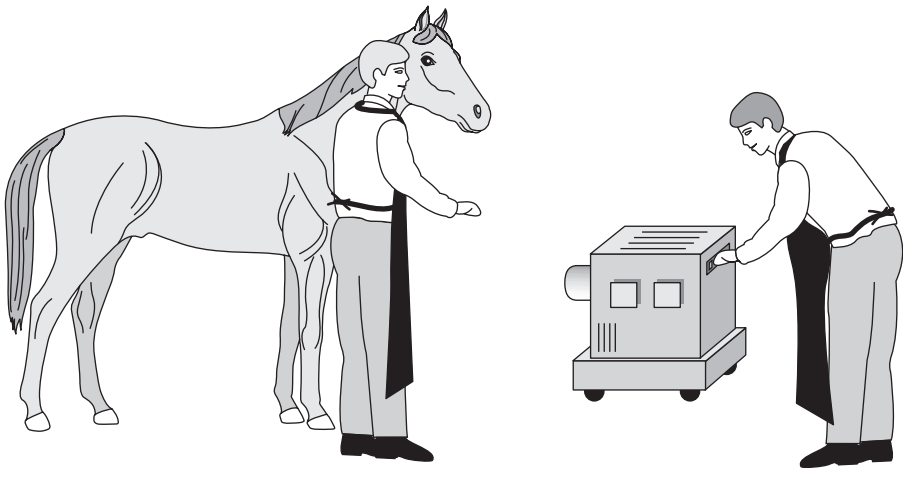
(c) The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

4.6.2.4 Uses and applications of electromagnetic waves

Question 10

June 2005 | 3462 | Original Q3 | Legacy

3 The diagram shows the types of wave that make up the electromagnetic spectrum.

gamma rays	**X-rays**	**ultraviolet**	**light**	**infra red**	**microwaves**	**radio**

(a) Which type of wave:

(i) has the longest wavelength and lowest frequency;

.....

(1 mark)

(ii) can be used to kill harmful bacteria in food;

.....

(1 mark)

(iii) is used in sunbeds to give a sun-tan;

.....

(1 mark)

(iv) is used to send information between mobile phones?

.....

(1 mark)

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

The speed of light rays through space is

faster than
the same as
slower than

the speed of radio waves through space.

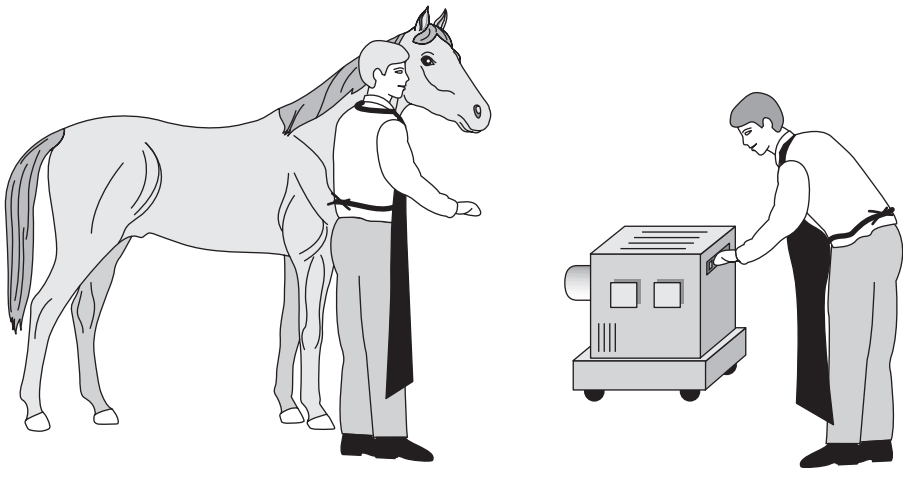
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 10 · continued

MARGIN BLANK

(c) The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

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.....

(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

4.6.2.4 Uses and applications of electromagnetic waves

Question 11

June 2006 | 3451 | Original Q4 | Legacy

4 (a) The diagrams, **A**, **B** and **C**, represent three different nuclei.

Diagram A



2 protons ⊕
4 neutrons ○

Diagram B



3 protons ⊕
3 neutrons ○

Diagram C



2 protons ⊕
2 neutrons ○

(i) Which **two** nuclei are isotopes of the same element?

..... and .....

(1 mark)

(ii) Which **two** nuclei have the same mass number?

..... and .....

(1 mark)

(iii) Give a reason for your choice of answer to part (a)(ii).

.....

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 11 · continued

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(b) The tables below give examples of some stable nuclei and some unstable nuclei.

Stable nuclei
boron-11
carbon-12
oxygen-16
lead-207

Unstable nuclei
boron-12
carbon-14
oxygen-15
lead-209

(i) Write down, from the tables, the names of **two** radioactive nuclei.

..... and .....

(1 mark)

(ii) Write down, from the tables, the names of **two** non-radioactive nuclei.

..... and .....

(1 mark)

(c) Complete the following sentence by crossing out the **two** words in the box that are wrong.

The lungs of a person who has breathed in a radioactive gas will be most damaged if the gas gives out

alpha beta gamma

radiation.

(1 mark)

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 12

June 2006 | 3451 | Original Q9 | Legacy

9 **Diagram 1** shows how beta (β) and gamma (γ) radiation pass through aluminium.

Diagram 1

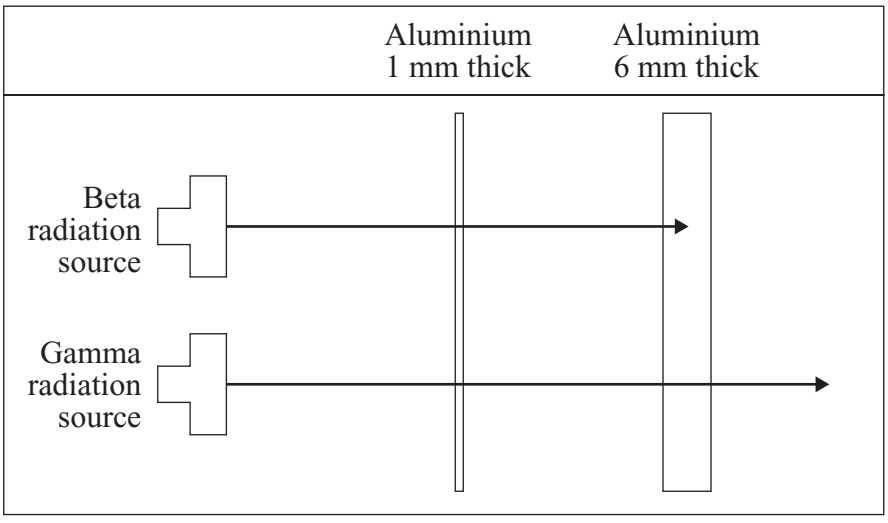
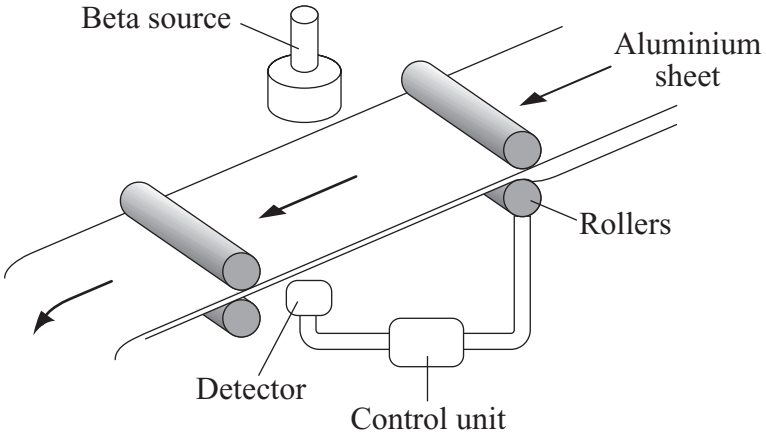


Diagram 2 shows how a beta radiation source is used to monitor and control the thickness of an aluminium sheet as it is made.

Diagram 2



4.6.2.4 Uses and applications of electromagnetic waves

Question 12 · continued

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(a) Explain why a gamma radiation source cannot be used to monitor the thickness of the aluminium sheet.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

(b) The following sentences describe what happens if the aluminium sheet is being made too thin.

The sentences are in the wrong order.

S The aluminium sheet absorbs less beta radiation so more reaches the detector.

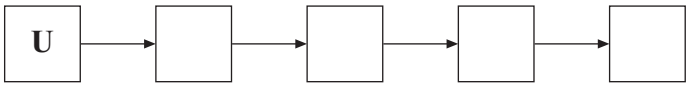
T The gap between the rollers is increased.

U The gap between the rollers is too small, making the aluminium sheet too thin.

V The aluminium sheet is now rolled a little thicker.

W A signal goes from the detector to the control unit.

Arrange the sentences in the right order. Start with sentence **U**.



(3 marks)

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 13

June 2006 | 3462 | Original Q4 | Legacy

4 (a) The diagrams, **A**, **B** and **C**, represent three different nuclei.

Diagram A



2 protons ⊕
4 neutrons ○

Diagram B



3 protons ⊕
3 neutrons ○

Diagram C



2 protons ⊕
2 neutrons ○

(i) Which **two** nuclei are isotopes of the same element?

..... and .....

(1 mark)

(ii) Which **two** nuclei have the same mass number?

..... and .....

(1 mark)

(iii) Give a reason for your choice of answer to part (a)(ii).

.....

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 13 · continued

BLANK

(b) The tables below give examples of some stable nuclei and some unstable nuclei.

Stable nuclei
boron-11
carbon-12
oxygen-16
lead-207

Unstable nuclei
boron-12
carbon-14
oxygen-15
lead-209

(i) Write down, from the tables, the names of **two** radioactive nuclei.

..... and .....

(1 mark)

(ii) Write down, from the tables, the names of **two** non-radioactive nuclei.

..... and .....

(1 mark)

(c) Complete the following sentence by crossing out the **two** words in the box that are wrong.

The lungs of a person who has breathed in a radioactive gas will be most damaged if the gas gives out

alpha
beta
gamma

radiation.

(1 mark)

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 14

June 2006 | 3462 | Original Q9 | Legacy

9 **Diagram 1** shows how beta (β) and gamma (γ) radiation pass through aluminium.

Diagram 1

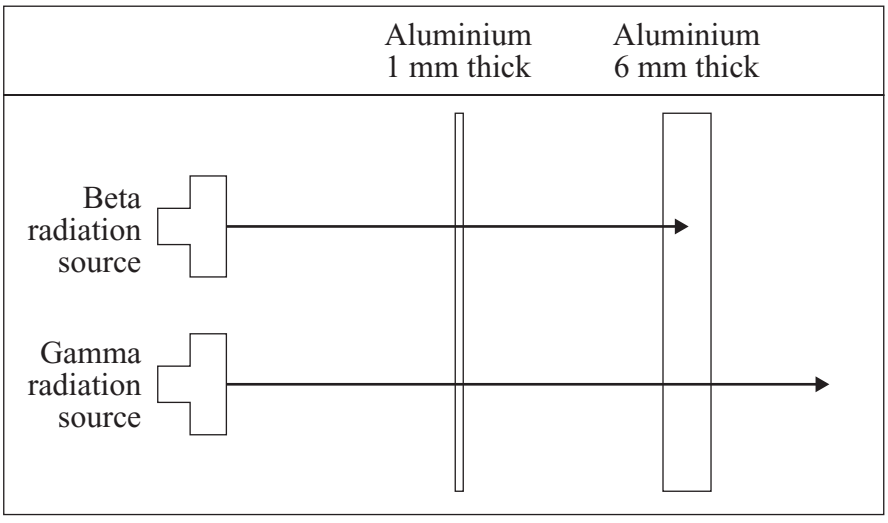
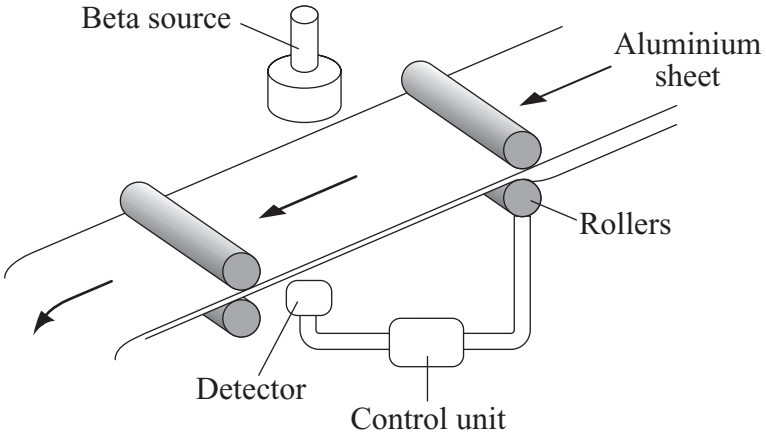


Diagram 2 shows how a beta radiation source is used to monitor and control the thickness of an aluminium sheet as it is made.

Diagram 2



4.6.2.4 Uses and applications of electromagnetic waves

Question 14 · continued

BLANK

(a) Explain why a gamma radiation source cannot be used to monitor the thickness of the aluminium sheet.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

(b) The following sentences describe what happens if the aluminium sheet is being made too thin.

The sentences are in the wrong order.

S The aluminium sheet absorbs less beta radiation so more reaches the detector.

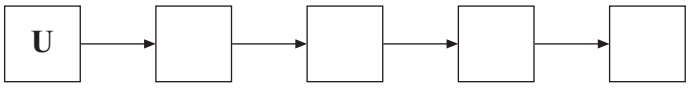
T The gap between the rollers is increased.

U The gap between the rollers is too small, making the aluminium sheet too thin.

V The aluminium sheet is now rolled a little thicker.

W A signal goes from the detector to the control unit.

Arrange the sentences in the right order. Start with sentence **U**.



(3 marks)

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 15

November 2006 | PHY1B | Original Q1 | Legacy

QUESTION ONE

Electromagnetic radiation has many uses.

Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the drawings labelled **1–4**.

A infra red rays

B ultraviolet waves

C visible light

D X-rays

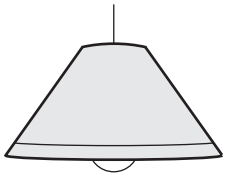
1

Toaster



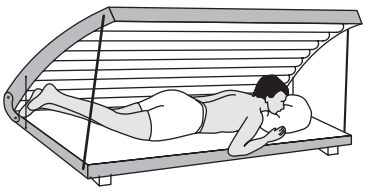
2

Room lamp



3

Sunbed



4

Hospital scanner



4.6.2.4 Uses and applications of electromagnetic waves

Question 16

November 2006 | PHY1B | Original Q2 | Legacy

QUESTION TWO

Electromagnetic radiation can be grouped into types, each with a different range of wavelengths.

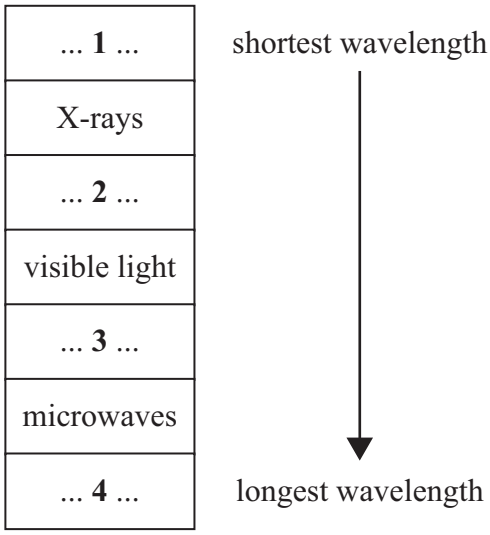
Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the list.

A gamma rays

B infra red rays

C radio waves

D ultraviolet waves



4.6.2.4 Uses and applications of electromagnetic waves

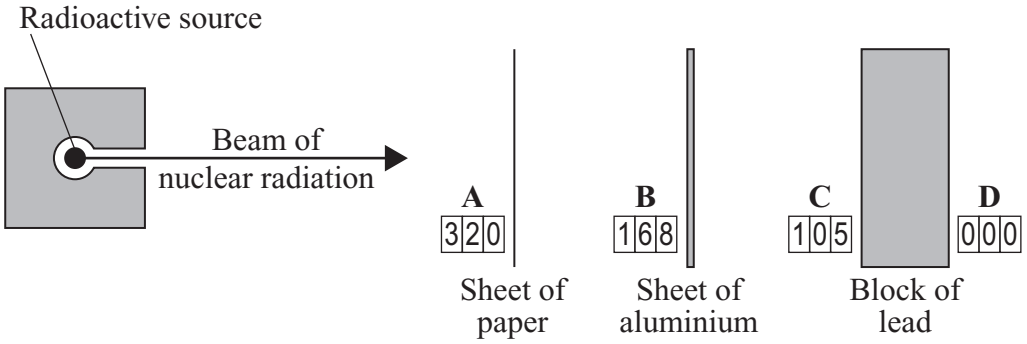
Question 17

November 2006 | PHY1B | Original Q4 | Legacy

QUESTION FOUR

A radioactive source gives out a beam of nuclear radiation.

The diagram shows three different absorbers in the path of the beam. The diagram also shows the readings, in counts per second, on radiation detectors placed at positions **A**, **B**, **C** and **D**.



Match the positions, **A**, **B**, **C** and **D**, with the types of radiation **1–4** in the table.

	Type of radiation
1	gamma only
2	gamma and beta only
3	gamma, beta and alpha
4	no radiation

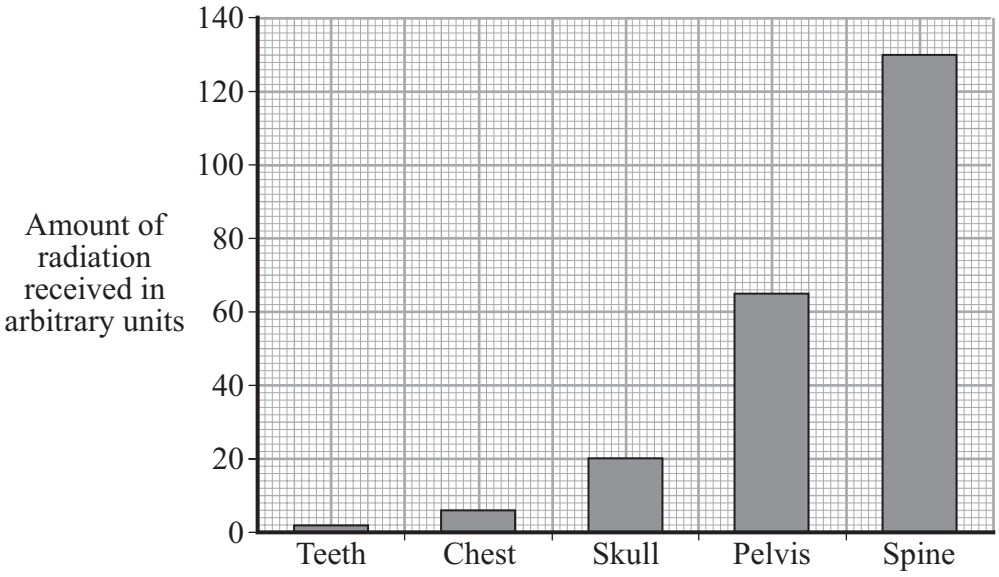
4.6.2.4 Uses and applications of electromagnetic waves

Question 18

November 2006 | PHY1B | Original Q6 | Legacy

QUESTION SIX

The graph shows the amount of radiation received by the body when different parts of the body are X-rayed.



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

A bar

B categoric

C dependent

D reliable

The part of the body X-rayed is described as a . . . **1** . . . variable.

The amount of radiation received is the . . . **2** . . . variable.

The data is displayed as a . . . **3** . . . chart.

Increasing the number of patients surveyed would make the data more . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 19

November 2006 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

Hospital patients are sometimes injected with radioactive tracers.



7A The purpose of a radioactive tracer is . . .

1 to identify the patient's blood group.

2 to sedate the patient before an operation.

3 to track the movement of substances in the patient's body.

4 to track the patient's movements in the hospital.

7B Which of the following is the most suitable radioactive substance to use as a tracer?

1 a gamma emitter with a long half-life

2 a gamma emitter with a short half-life

3 an alpha emitter with a long half-life

4 an alpha emitter with a short half-life

4.6.2.4 Uses and applications of electromagnetic waves

Question 19 · continued

7C Which of the following statements is correct for gamma radiation?

1 It is a stream of electrons.

2 It is a stream of protons.

3 It is deflected by an electric field.

4 It is **not** deflected by a magnetic field.

7D Which description is correct for the nucleus of a medium-sized atom?

It is a group of . . .

1 electrons and neutrons.

2 electrons, neutrons and protons.

3 electrons and protons.

4 neutrons and protons.

4.6.2.4 Uses and applications of electromagnetic waves

Question 20

2 (a) The names of three types of radiation are given in **List A**. Various properties of these three types of radiation are given in **List B**.

Draw a line to link each type of radiation in **List A** to its correct property in **List B**. Draw only **three** lines.

List A **Type of radiation**	**List B** **Property of radiation**
	not dangerous
alpha (α)	
	stopped by paper
beta (β)	
	travels at 300 000 000 m/s
gamma (γ)	
	travels up to 1 metre in air

(3 marks)

(b) This sign warns people that a radioactive source is being used in a laboratory.



Why is it important to warn people that a radioactive source is being used?

.....

.....

(1 mark)

BLANK

(c) To study the blood flow in a patient's lungs, a doctor injects some technetium-99 compound into the patient. The gamma radiation given out by the technetium-99 atoms is detected using a gamma camera outside the patient's body.

Which statement gives the reason why gamma radiation is used? Put a tick (✓) in the box next to your choice.

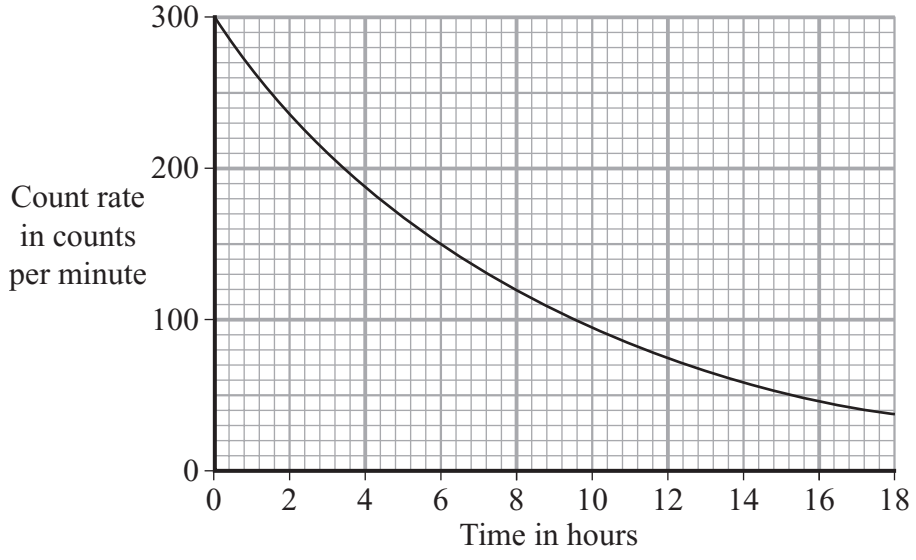
It can travel through a vacuum. ☐

It is not affected by a magnet. ☐

It can pass through the human body. ☐

(1 mark)

(d) The graph shows how the count rate from a sample of technetium-99 changes with time.



(i) How many hours does it take for the count rate to fall from 300 counts per minute to 150 counts per minute?

Time = ... hours
(1 mark)

(ii) What is the half-life of technetium-99?

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

7

4.6.2.4 Uses and applications of electromagnetic waves

Question 21

January 2007 | PHY1F | Original Q3 | Legacy

3 (a) Mobile phones send *digital* signals using electromagnetic waves.

(i) Draw a simple diagram to show a *digital* signal.

(1 mark)

(ii) Which **one** of the following types of electromagnetic wave is used to carry information between masts in a mobile phone network?

Draw a ring around your answer.

light	**microwave**	**radio**

(1 mark)

(b) Some people worry that using a mobile phone may be bad for their health.

Look at this information taken from a recent newspaper article.

- Scientists in Sweden found that the regular use of a mobile phone increases the risk of a cancerous growth between the ear and the brain.
- Some people who use mobile phones for a long time complain of headaches and tiredness. The same effect has not been noticed in laboratory tests.
- There is no reliable evidence to link using mobile phones with ill health.
- The waves from a mobile phone are not strong enough to cause long-term heat damage to cells in the body.

(i) Complete the following sentence by drawing a ring around the word in the box that is correct.

The evidence from different scientists doing the same investigation is reliable if all the scientists get

different
identical
random

results.

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 21 · continued

BLANK

(ii) What information in the article supports the idea that mobile phones are bad for your health?

.....

.....

.....

.....

(2 marks)

(iii) Some scientists say that using a mobile phone is totally safe.

What information in the article supports this view?

.....

.....

.....

.....

(2 marks)

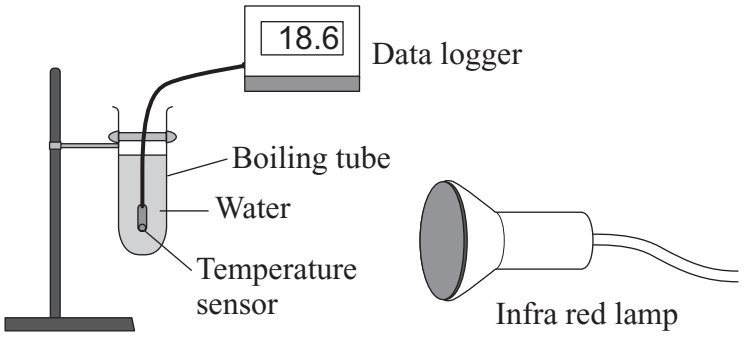
7

4.6.2.4 Uses and applications of electromagnetic waves

Question 22

6 A student had read about a glacier that had been covered in insulating material. The idea was to slow down the rate at which the glacier melts in the summer.

She investigated this idea using the apparatus shown in the diagram.



(a) These are the steps taken by the student.

- Measure 30 cm^3 of cold water into a boiling tube.
- Place the boiling tube 25 cm from an infra red lamp.
- Record the temperature of the water.
- Switch on the infra red lamp.
- Record the temperature of the water every minute for 5 minutes.
- Repeat with boiling tubes covered in different insulating materials.

(i) Why did she use an infra red lamp?

.....

(1 mark)

(ii) Name **one** control variable in this investigation.

.....

(1 mark)

(iii) Give **one** advantage of using a temperature sensor and data logger instead of a glass thermometer to measure temperature.

.....

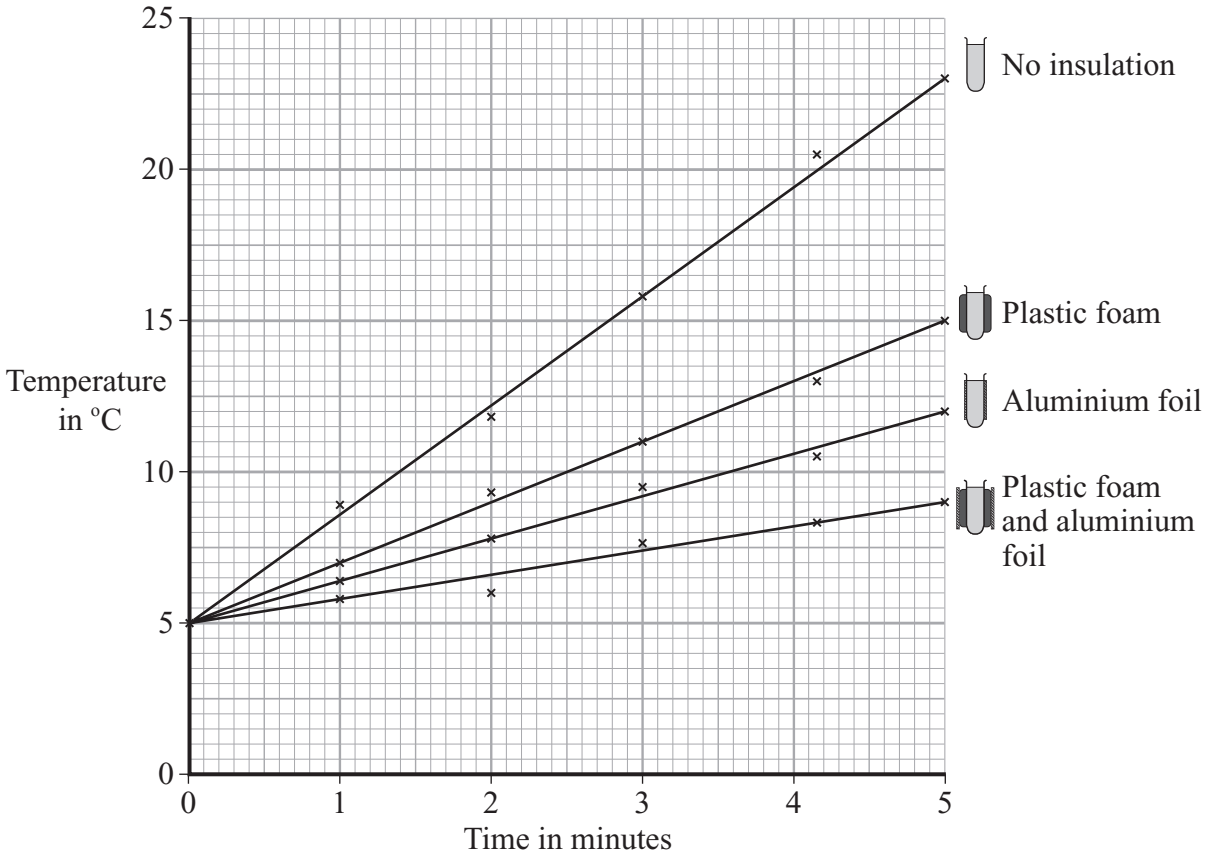
.....

(1 mark)

Question 22 · continued

BLANK

(b) The results of the investigation are shown in the graph.



(i) Why did the student use a boiling tube with no insulation?

.....

.....

(1 mark)

(ii) From her results, what should she recommend is used to insulate the glacier?

.....

(1 mark)

Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 22 · continued

BLANK

(iii) Explain why the insulation recommended by the student will reduce the heat transfer from the Sun to the glacier.

.....

.....

.....

.....

.....

(2 marks)

(c) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

.....

.....

.....

.....

(2 marks)

9

4.6.2.4 Uses and applications of electromagnetic waves

Question 23

March 2007 | PHY1A | Original Q1 | Legacy

QUESTION ONE

Energy is supplied to a microwave oven by mains electricity.

The oven transforms this energy in various ways.

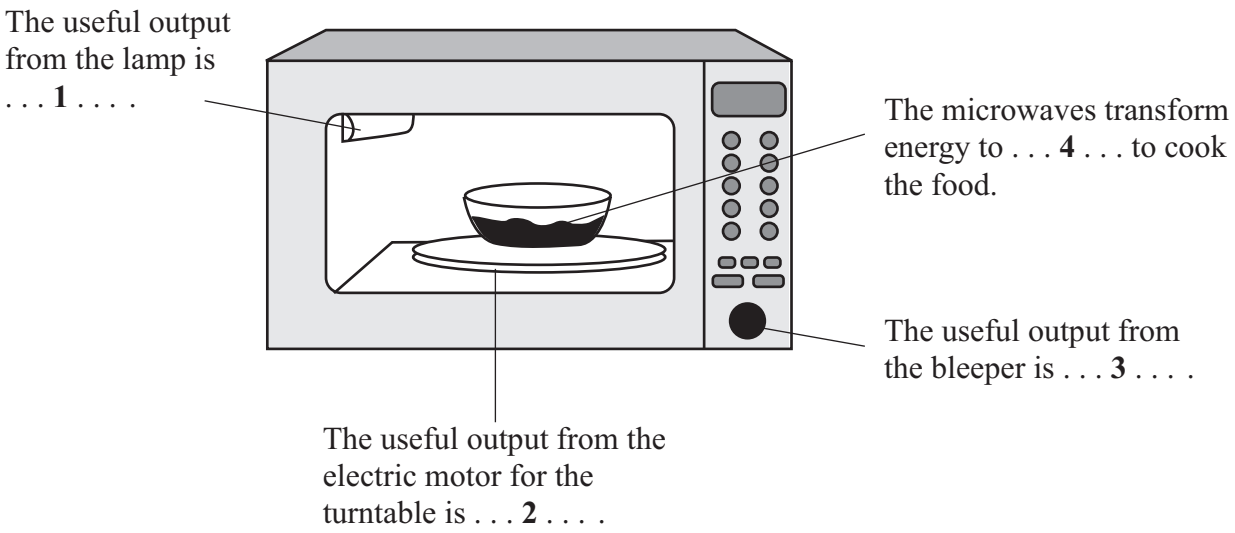
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A heat

B light

C movement

D sound



4.6.2.4 Uses and applications of electromagnetic waves

Question 24

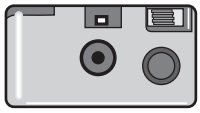
March 2007 | PHY1B | Original Q1 | Legacy

QUESTION ONE

Each of these devices uses electromagnetic radiation.

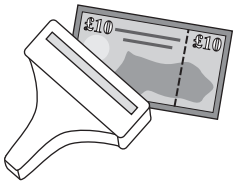
1

Camera



2

Forgery detector



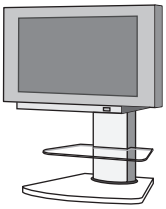
3

Toaster



4

Television



Match the parts of the electromagnetic spectrum, **A**, **B**, **C** and **D**, with the drawings labelled **1–4**.

A infra red

B radio waves

C ultraviolet

D visible light

4.6.2.4 Uses and applications of electromagnetic waves

Question 25

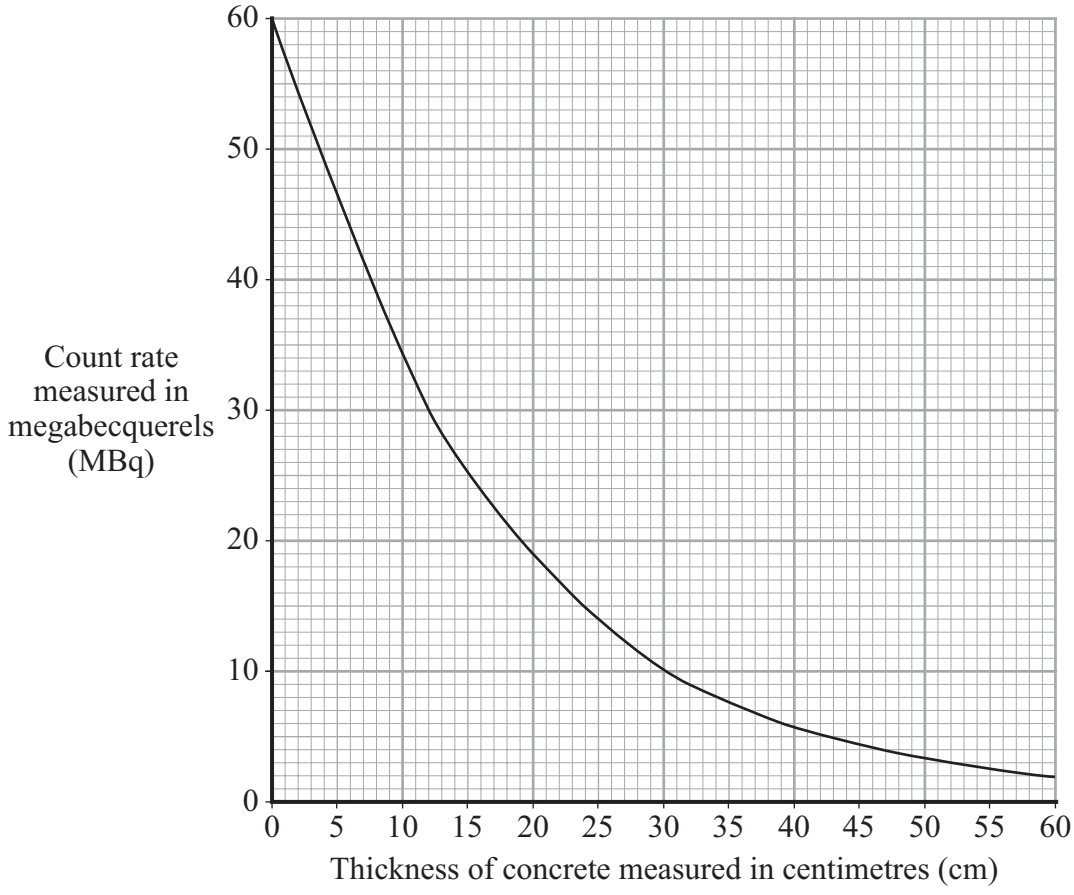
March 2007 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

Gamma radiation is the most penetrating type of ionising radiation.

Concrete is sometimes used to protect people from the harmful effects of gamma radiation.

The graph shows the count rate from a source of gamma radiation after it has passed through various thicknesses of concrete.



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

A 6

B 8

C 12

D 19

Count rate when the thickness is 20 cm = . . . **1** . . . MBq.

Thickness when count rate is 39 MBq = . . . **2** . . . cm.

Reduction in count rate when thickness is increased from 12 cm to 16 cm = . . . **3** . . . MBq.

Thickness needed to reduce the original count rate by half = . . . **4** . . . cm.

4.6.2.4 Uses and applications of electromagnetic waves

Question 26

March 2007 | PHY1B | Original Q6 | Legacy

QUESTION SIX

Read this extract from a magazine article.

X-rays and health

Students studied the health records of hospital patients who had been X-rayed in the previous three years. The patients were compared to a similar group who had not been X-rayed in the same period of time.

The students found that there was no significant difference in the health of the two groups.

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

A conclusion

B confidentiality

C control

D evidence

The group who had not been X-rayed is the . . . **1** . . . .

The data in the health records is the . . . **2** . . . .

What the students found out helps them to reach their . . . **3** . . . .

The ethical issue in such a study is the issue of . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 27

March 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

Electromagnetic radiation fills the Universe

Electromagnetic radiations belong to a spectrum of radiations which have many features in common.

7A In the box, the electromagnetic radiations are meant to be in order of increasing wavelength from left to right. Which one is in the wrong position?

X-rays	Infra red rays	Radio waves	Gamma rays
1	**2**	**3**	**4**

1 X-rays

2 infra red rays

3 radio waves

4 gamma rays

7B Which statement is correct?

1 All electromagnetic radiation can travel through a vacuum.

2 All electromagnetic radiation is visible to the human eye.

3 No electromagnetic radiation can travel through a vacuum.

4 No electromagnetic radiation is visible to the human eye.

4.6.2.4 Uses and applications of electromagnetic waves

Question 27 · continued

7C Which statement about the wavelength of microwaves is correct?

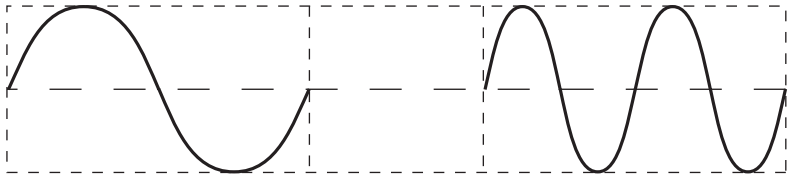
1 longer than both infra red rays and ultraviolet rays

2 longer than infra red rays but shorter than ultraviolet rays

3 shorter than both infra red rays and ultraviolet rays

4 shorter than infra red rays but longer than ultraviolet rays

7D Two electromagnetic waves are shown in the diagrams, which are drawn to the same scale.



Which sentence is correct?

1 The frequency of wave **X** is double that of wave **Y**.

2 The frequency of wave **Y** is double that of wave **X**.

3 The wavelength of wave **Y** is double that of wave **X**.

4 The wavelength of wave **Y** is four times that of wave **X**.

4.6.2.4 Uses and applications of electromagnetic waves

Question 28

March 2007 | PHY1B | Original Q9 | Legacy

QUESTION NINE

A student has been learning about the electromagnetic spectrum.

9A Which part(s) of the electromagnetic spectrum can be used for communication?

1 radio waves only

2 radio waves and microwaves only

3 radio waves, microwaves and infra red rays only

4 radio waves, microwaves, infra red rays and visible light

9B Waves of the electromagnetic spectrum travel through space.

When they do, which property is the same for all of them?

1 energy

2 penetration

3 power

4 speed

9C The frequency of a radio signal is increased.

Which is correct?

1 Its speed decreases.

2 Its speed increases.

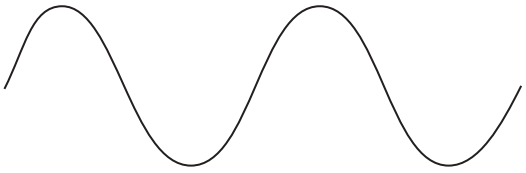
3 Its wavelength decreases.

4 Its wavelength increases.

Question 28 · continued

9D Communication signals are often digital. The diagrams show four signals.

E



F



G



H

Which two could be digital?

1 **E** and **F**

2 **F** and **G**

3 **G** and **H**

4 **H** and **E**

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 29

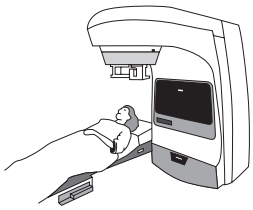
June 2007 | PHY1B | Original Q1 | Legacy

QUESTION ONE

Each of these applications uses electromagnetic radiation.

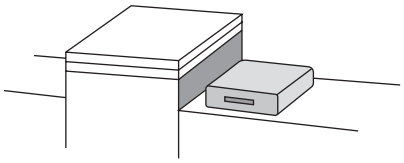
1

Killing cancer cells



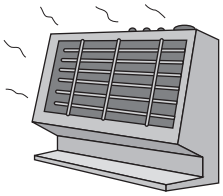
2

Checking bags at an airport



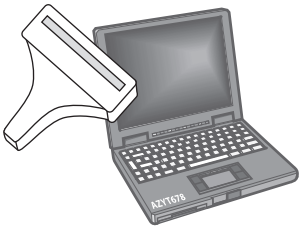
3

In radiant heaters



4

Seeing security markings



Match the parts of the electromagnetic spectrum, **A**, **B**, **C** and **D**, with the drawings labelled **1–4**.

A gamma rays

B infra red rays

C ultraviolet rays

D X-rays

4.6.2.4 Uses and applications of electromagnetic waves

Question 30

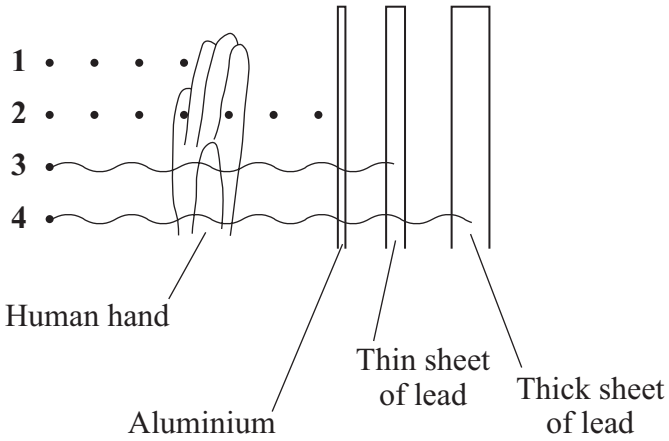
June 2007 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

Technicians in hospitals may be exposed to various types of electromagnetic or nuclear radiation.

The penetrating power of four types of radiation is shown in the diagram.

Technicians in the X-ray department wear aprons containing a thin sheet of lead for protection.



Match the types of nuclear and electromagnetic radiation, **A**, **B**, **C**, and **D**, with the labels **1–4** on the diagram.

A gamma radiation

B X-ray radiation

C alpha radiation

D beta radiation

4.6.2.4 Uses and applications of electromagnetic waves

Question 31

June 2007 | PHY1B | Original Q8 | Legacy

QUESTION EIGHT

Pills are often kept in bottles made from brown plastic. The brown plastic absorbs ultraviolet (UV) radiation which may cause chemical changes to take place in the pills.

A scientist carried out an investigation to compare the amount of UV radiation absorbed by four different pill bottles. Each bottle was made from a different type of plastic.

Instead of pills, she used UV-sensitive beads. The beads were white when kept in the dark. They changed to a red colour when exposed to UV radiation.

- She put twenty beads into each of the bottles.
- She then placed the bottles at equal distances from a UV lamp.
- She then measured the time it took for all of the beads in each bottle to change from white to red.

The table shows her results.

Bottle	Time taken, in minutes, for beads to turn red
W	19
X	37
Y	56
Z	24

8A What kind of variable was the type of pill bottle?

1 categoric

2 continuous

3 discrete

4 ordered

4.6.2.4 Uses and applications of electromagnetic waves

8B Which of these was **not** a control variable in this investigation?

1 the number of beads

2 the distance of the bottle from the UV radiation

3 the intensity of the UV lamp

4 the type of plastic used for the bottle

8C Which bottle would be best for storing pills?

1 **W**

2 **X**

3 **Y**

4 **Z**

8D The best way of displaying the data from this investigation would be in the form of a . . .

1 bar chart.

2 line graph.

3 pie chart.

4 scattergram.

4.6.2.4 Uses and applications of electromagnetic waves

Question 32

June 2007 | PHY1F | Original Q4 | Legacy

4 (a) Ultraviolet and visible light are both electromagnetic waves.

(i) Name **one** other type of electromagnetic wave.

.....

(1 mark)

(ii) Which **one** of the following statements is true for electromagnetic waves travelling through a vacuum?

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

All the waves have the same frequency. ☐

All the waves have the same wavelength. ☐

All the waves travel at the same speed. ☐

(1mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 32 · continued

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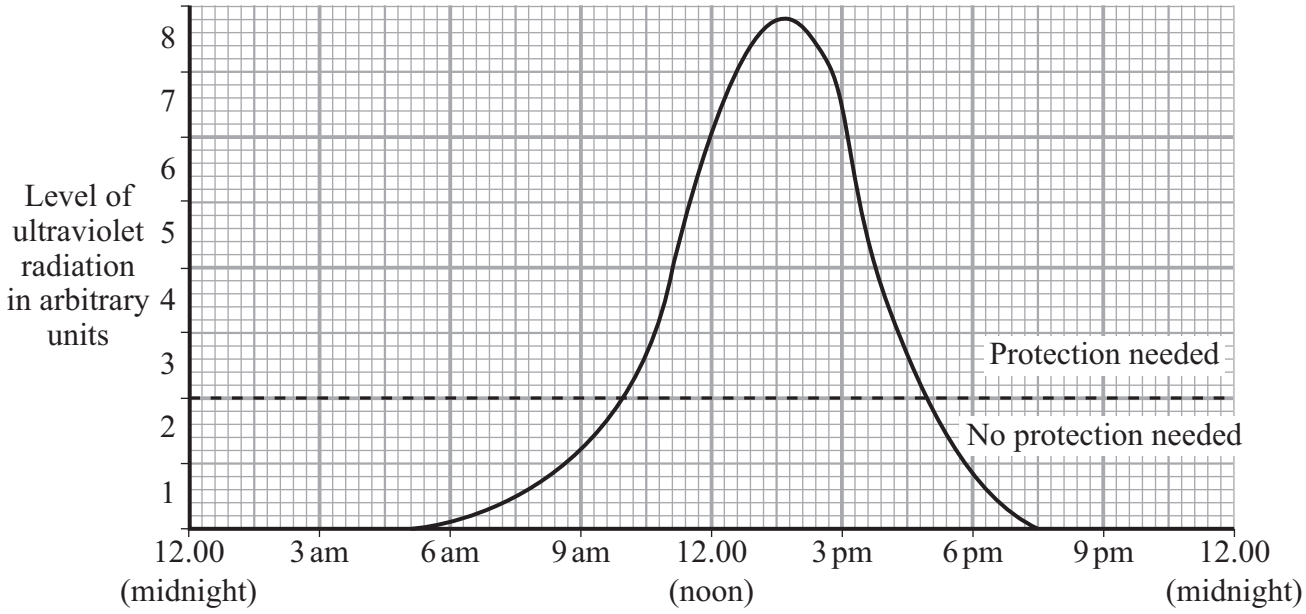
(b) The graph shows how the level of ultraviolet radiation changed during a summer day in England.



(i) What serious health problem can be caused by exposure to the ultraviolet radiation from the Sun?

.....

(1 mark)

(ii) Explain why it would be sensible to stay out of the Sun between 10 am and 4 pm in the summer.

.....

.....

.....

.....

(2 marks)

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 33

June 2007 | PHY1F | Original Q6 | Legacy

6 Some types of food are treated with *gamma* radiation. Low doses of radiation slow down the ripening of fresh fruit and vegetables while higher doses of radiation kill the bacteria that make the food go off.

(a) (i) What is *gamma* radiation?

.....

(1 mark)

(ii) Food packed in crates or boxes can be treated using this method.

Why must a source that emits *gamma* radiation be used?

.....

.....

(1 mark)

(iii) A suitable source of gamma radiation is the isotope caesium 137.

Complete the following sentence by choosing the correct word from the box.

electrons	**neutrons**	**protons**

An atom of caesium 137 has two more ..... than an atom of caesium 135.

(1 mark)

Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 33 · continued

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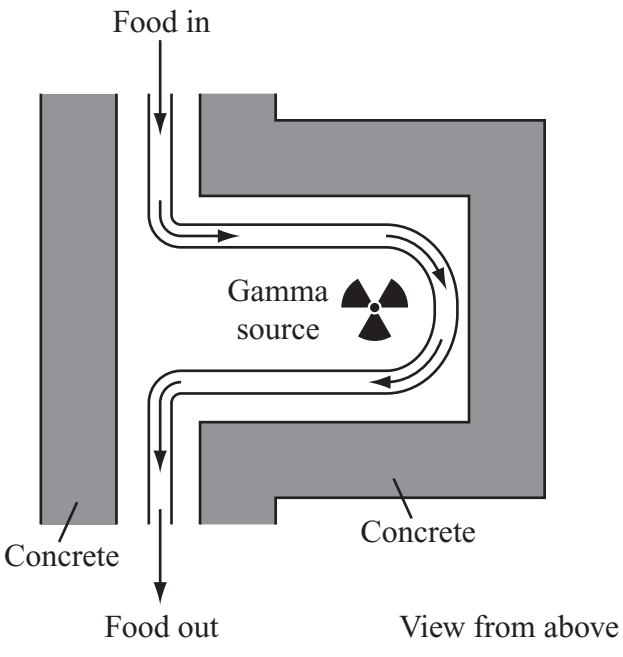
(b) The diagram shows how a conveyor belt can be used to move food past the radioactive source.



(i) How do the concrete walls reduce the radiation hazard to workers outside the food treatment area?

.....

.....

(1 mark)

(ii) Suggest **one** way that the dose of radiation received by the food could be increased other than by changing the radioactive source.

.....

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 33 · continued

BLANK

(c) Some people may not like the idea of eating food treated with radiation.

(i) What evidence could a food scientist produce to show that food treated with radiation is safe to eat?

.....

.....

.....

.....

(2 marks)

(ii) The diagram shows the sign displayed on food treated with radiation.



Why is it important for people to know which foods have been treated with radiation?

.....

.....

(1 mark)

8

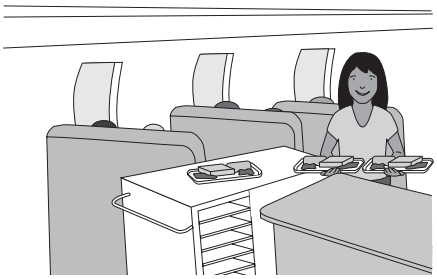
4.6.2.4 Uses and applications of electromagnetic waves

Question 34

November 2007 | PHY1B | Original Q1 | Legacy

QUESTION ONE

The drawing shows meals being served on an aircraft.



Match types of electromagnetic waves, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A gamma rays

B infra red rays

C radio waves

D visible light

The food was heated in ovens by . . . **1** . . . .

The fruit in the meal pack does not go mouldy because it has been treated with . . . **2** . . . .

The lamps in the cabin are designed to give off . . . **3** . . . .

The pilot keeps in touch with air traffic control by using . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 35

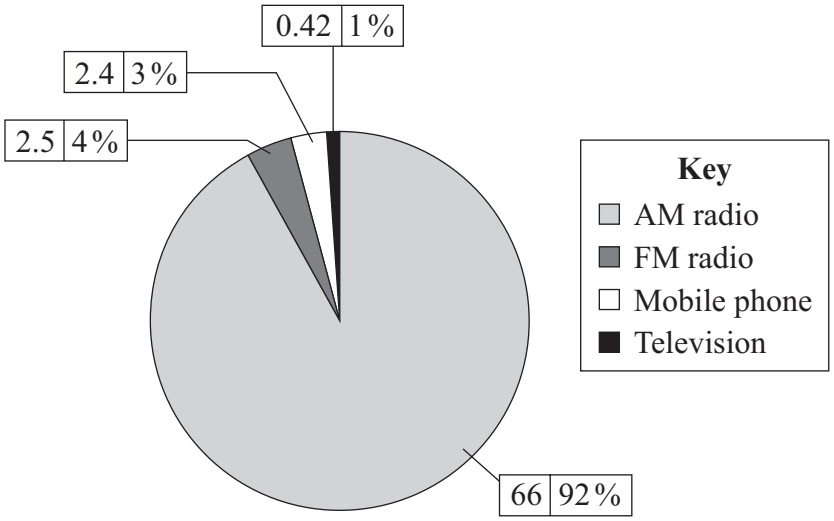
November 2007 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

The pie chart shows the power of four types of electromagnetic radiation received by people living in a small town near both a radio/TV mast and a mobile phone mast. It also shows the percentage of the total power from each source.

The units for the power are microwatts per m^2 of skin surface.

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



A 0.42

B 3

C 27.5

D 68.5

1	the power of the radiation received from TV in microwatts per m^2
2	the percentage of the radiation received from mobile phones
3	the total power received from AM and FM radio waves in microwatts per m^2
4	the number of times greater the power received from AM radio is than that received from mobile phones

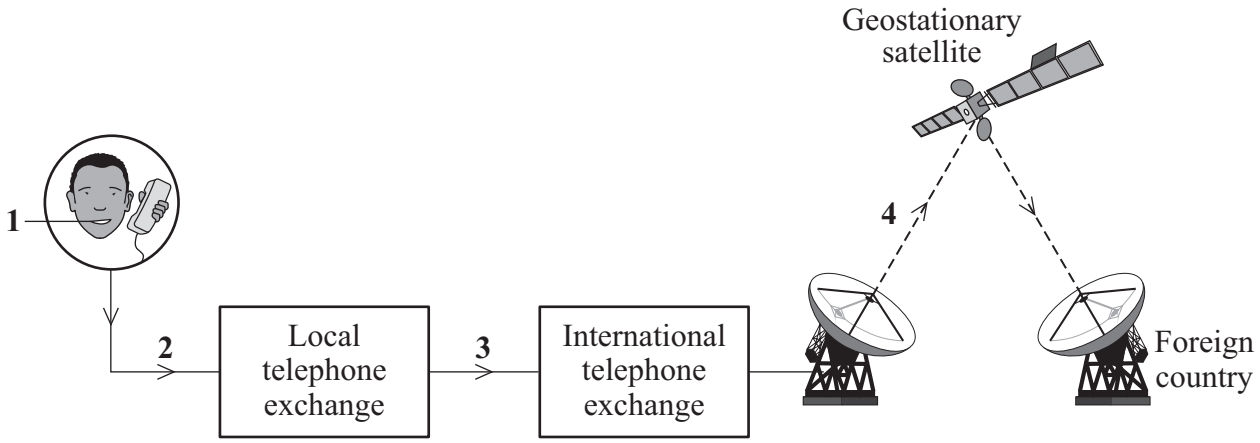
4.6.2.4 Uses and applications of electromagnetic waves

Question 36

November 2007 | PHY1B | Original Q6 | Legacy

QUESTION SIX

The diagram shows how a telephone call can be made to a foreign country.



Match waves and signals, **A**, **B**, **C** and **D**, with the numbers **1–4** on the diagram.

A analogue electrical signal

B digital light signal

C microwaves

D sound waves

4.6.2.4 Uses and applications of electromagnetic waves

Question 37

November 2007 | PHY1B | Original Q9 | Legacy

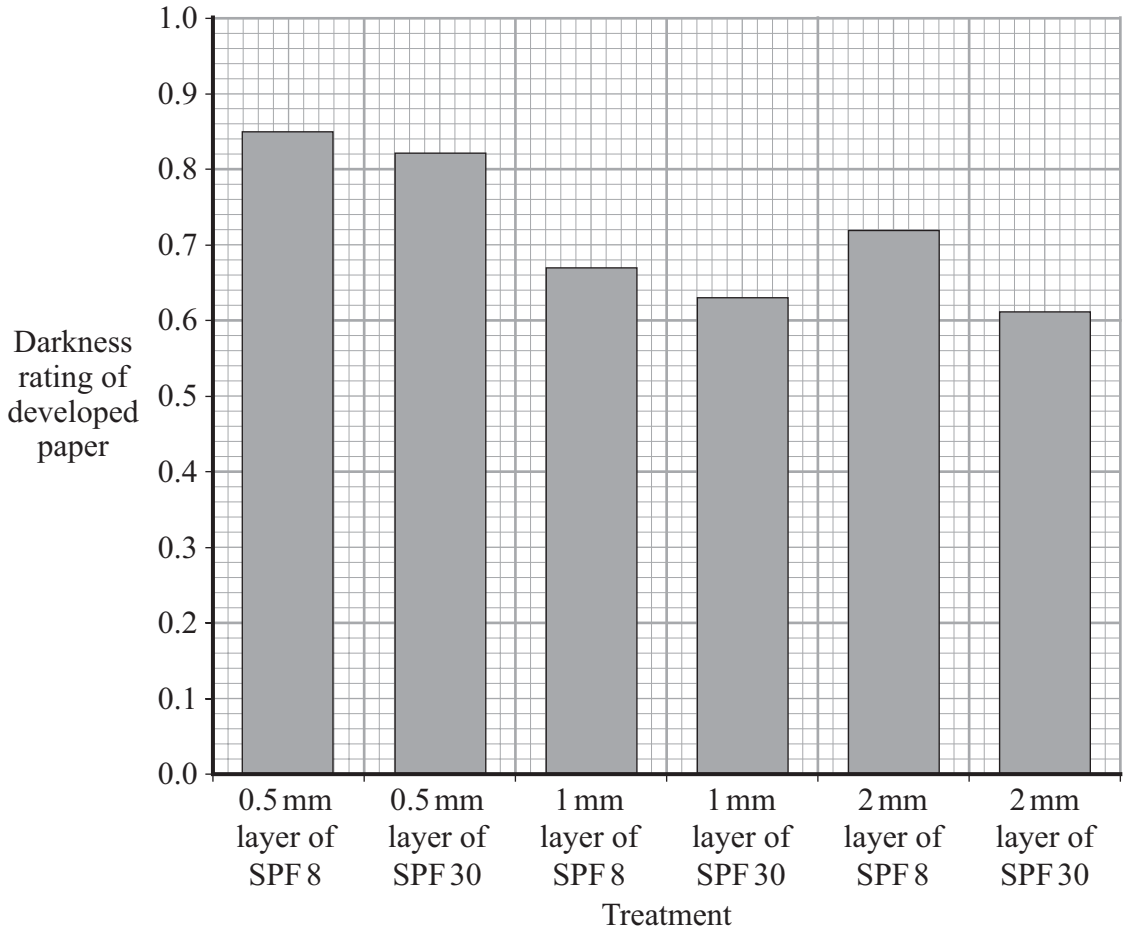
QUESTION NINE

Doctors recommend that a 2 mm layer of sun cream with a sun protection factor (SPF) of 30 should be placed on the skin when you sunbathe.

A student investigated the effectiveness of sun creams in absorbing ultraviolet (UV) rays. She carried out her investigation in a dark room.

- She used sheets of a photographic paper sensitive to UV rays, wrapped in clear polythene.
- She applied two different sun creams, SPF 8 and SPF 30, to the polythene covering the photographic paper.
- She applied the creams in three different thicknesses, 0.5 mm, 1 mm and 2 mm.
- In a dark room, she exposed each piece of photographic paper to UV rays for 1 second.
- She then developed the photographic paper and measured the darkness of each piece of paper.
- A darkness rating of 1 means that all the UV rays penetrated the layer of sun cream; a darkness rating of 0 means that none of the UV rays penetrated the sun cream.

The graph shows her results.



Question 37 · continued

9A What was the dependent variable in this investigation?

1 SPF value of sun cream

2 thickness of sun cream

3 time of exposure to UV rays

4 darkness rating of developed paper

9B Which treatment absorbed most UV rays?

1 0.5 mm layer of SPF 8 sun cream

2 0.5 mm layer of SPF 30 sun cream

3 1 mm layer of SPF 30 sun cream

4 2 mm layer of SPF 30 sun cream

9C Which treatment seemed to produce an anomalous result?

1 0.5 mm layer of SPF 8 sun cream

2 0.5 mm layer of SPF 30 sun cream

3 2 mm layer of SPF 8 sun cream

4 1 mm layer of SPF 30 sun cream

9D The data from this investigation . . .

1 proves that the doctors' recommendations are correct.

2 does **not** support the doctors' recommendations.

3 supports the doctors' recommendations.

4 turns a hypothesis into a theory.

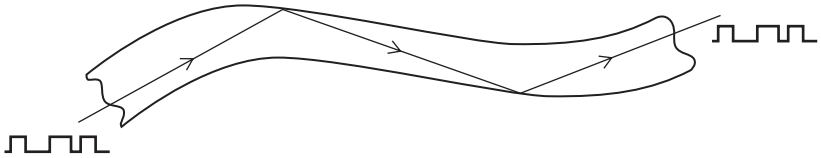
END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 38

January 2008 | PHY1F | Original Q2 | Legacy

2 (a) The diagram shows a signal and the path taken by the signal as it travels along an optical fibre.



(i) What name is given to the type of signal shown in the diagram?

.....

(1 mark)

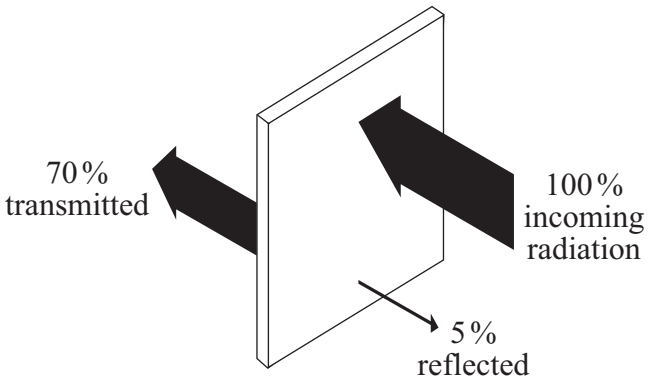
(ii) Name the **two** types of electromagnetic radiation that can be used to send signals along an optical fibre.

1 .....

2 .....

(2 marks)

(b) Infra red radiation can be reflected, absorbed and transmitted by glass.



(i) What percentage of infra red is absorbed by the glass?

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 38 · continued

BLANK

(ii) Complete the following sentence by drawing a ring around the correct word or phrase.

The absorbed infra red | increases / does not change / decreases | the temperature of the glass.

(1 mark)

(c) **Two** of the following statements are true. **One** of the statements is false.

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

All objects absorb infra red radiation.	
Black surfaces are poor emitters of infra red radiation.	
A hot object emits more infra red than a cooler object.	

(1 mark)

(d) The following statement is false.

Black surfaces are good reflectors of infra red radiation.

Change **one** word in this statement to make it true.

Write down your **new** statement.

.....

.....

(1 mark)

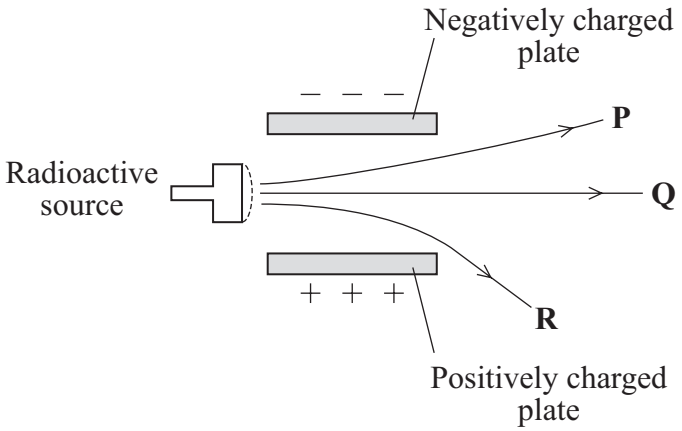
7

4.6.2.4 Uses and applications of electromagnetic waves

Question 39

3 A radioactive source emits alpha (α), beta (β) and gamma (γ) radiation. The diagram shows what happens to the radiation as it passes between two charged metal plates.

Diagram 1



(a) Which line **P**, **Q** or **R** shows the path taken by:

(i) alpha radiation .....

(1 mark)

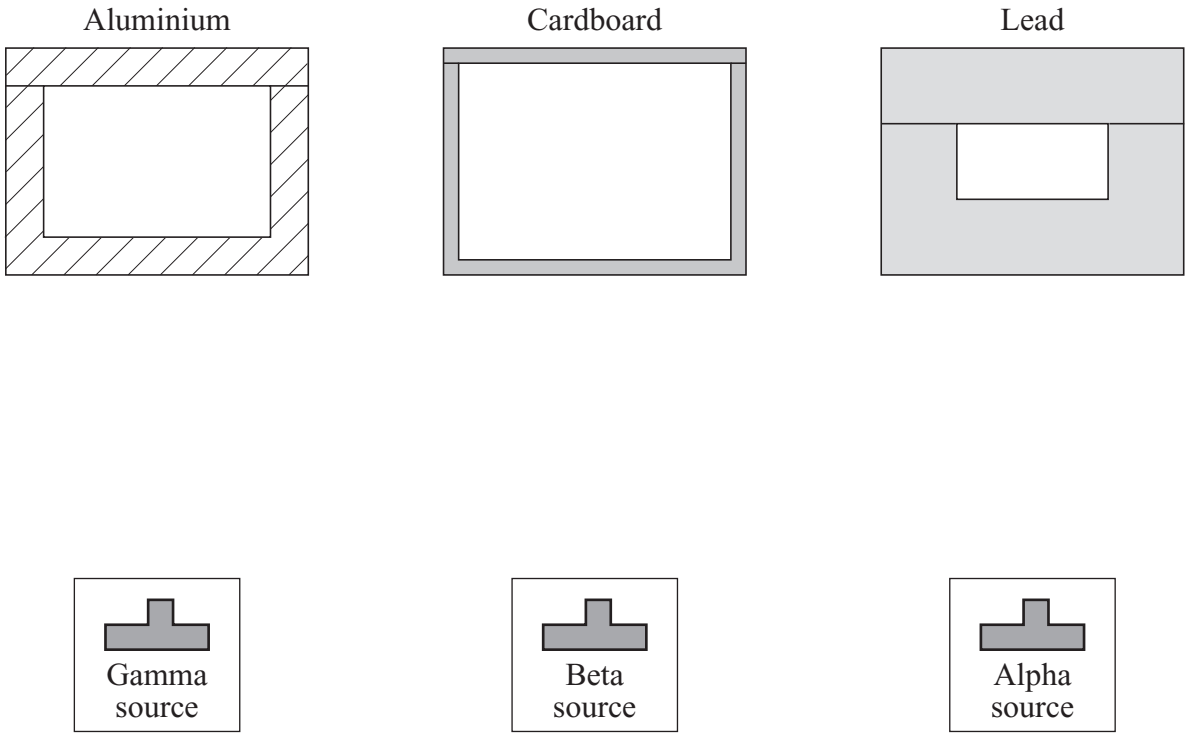
(ii) gamma radiation? .....

(1 mark)

Question 39 · continued

BLANK

(b) The diagram shows three different boxes and three radioactive sources. Each source emits only one type of radiation and is stored in a different box. The box reduces the amount of radiation getting into the air.



Draw **three** lines to show which source should be stored in which box so that the minimum amount of radiation gets into the air.

(2 marks)

Question 3 continues on the next page

Question 39 · continued

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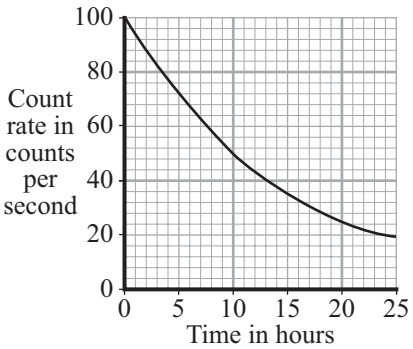
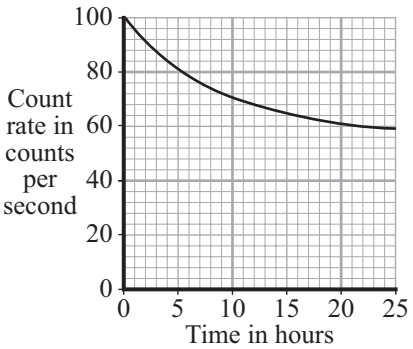
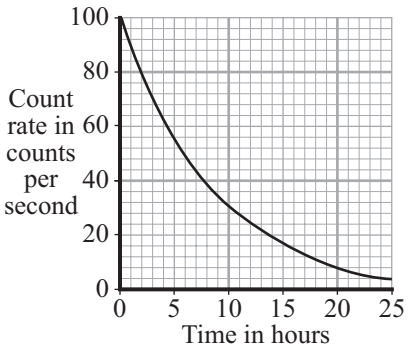
(c) The graphs show how the count rates from three different radioactive sources, **J**, **K**, and **L**, change with time.



J



K



L

(i) Which source, **J**, **K**, or **L**, has the highest count rate after 24 hours? .....

(1 mark)

(ii) For source **L**, what is the count rate after 5 hours?

..... counts per second

(1 mark)

(iii) Which source, **J**, **K**, or **L**, has the longest half-life? .....

(1 mark)

(iv) A radioactive source has a half-life of 6 hours.

What might this source be used for?

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

To monitor the thickness of paper as it is made in a factory ☐

To inject into a person as a medical tracer ☐

To make a smoke alarm work ☐

(1 mark)

8

4.6.2.4 Uses and applications of electromagnetic waves

Question 40

January 2008 | PHY1F | Original Q4 | Legacy

4 Using an optical telescope to look at stars is not always easy because:

- too many street lights often make it too light to see faint stars
- clouds reduce the light getting to the telescope
- atmospheric pollution often distorts the images.

(a) Large optical telescopes are often positioned high up a mountain.

Describe the advantages of positioning a telescope high up a mountain.

.....

.....

.....

.....

.....

.....

(3 marks)

(b) A new telescope is going to be built in Chile. It will detect electromagnetic waves with a frequency between infra red and radio waves.

What type of waves will this telescope detect?

.....

(1 mark)

(c) Telescopes that detect X-rays are always on satellites in space.

Which statement gives the reason for the telescope to be in space?

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

The atmosphere absorbs X-rays. ☐

X-rays can harm people. ☐

X-rays have a shorter wavelength than light. ☐

(1 mark)

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 41

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

4.6.2.4 Uses and applications of electromagnetic waves

Question 41 · continued

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(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

4.6.2.4 Uses and applications of electromagnetic waves

Question 42

March 2008 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

We use electromagnetic radiation in many different ways.

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

A infra red radiation

B gamma radiation

C visible light

D ultraviolet radiation

1	is used to send messages using a torch
2	is used in sunbeds
3	is used in heaters
4	is used to treat cancer

4.6.2.4 Uses and applications of electromagnetic waves

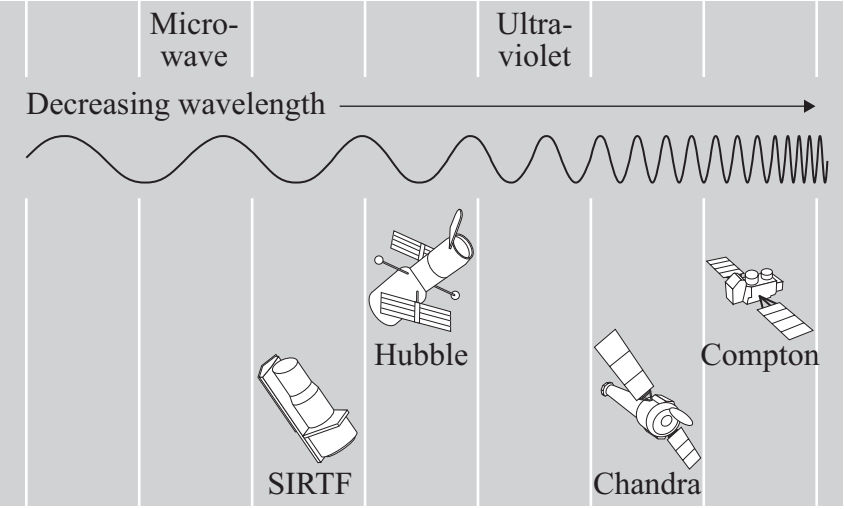
Question 43

March 2008 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

Space telescopes are designed to detect different types of electromagnetic radiation.

The diagram shows part of the electromagnetic spectrum and four different telescopes.



Match telescopes, **A**, **B**, **C** and **D**, with the types of electromagnetic radiation **1–4** in the table that each is designed to detect.

A SIRTF

B Hubble

C Chandra

D Compton

	Type of electromagnetic radiation
1	gamma radiation
2	infra red radiation
3	X-rays
4	visible light

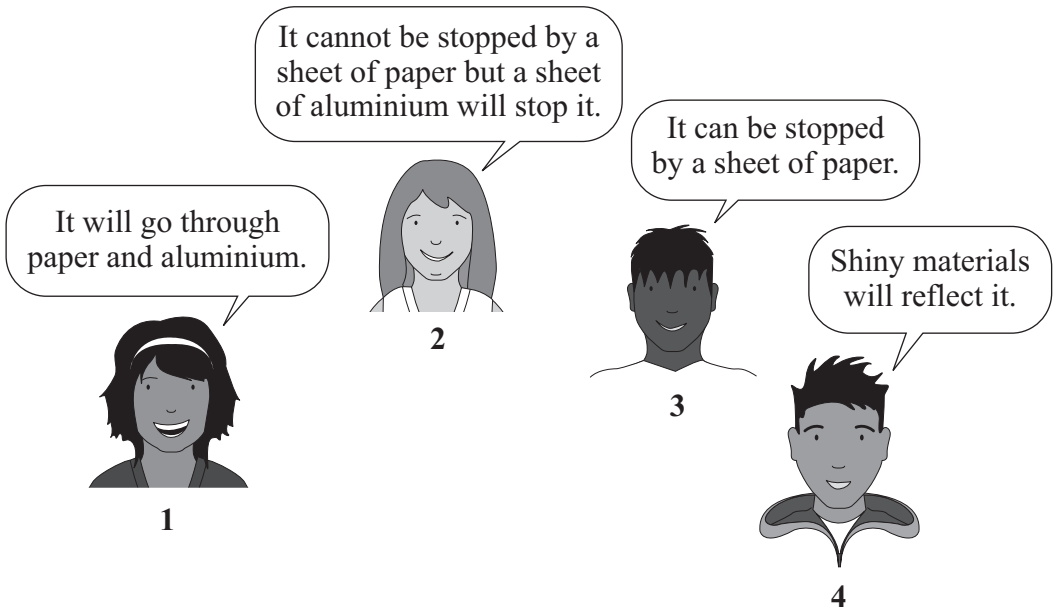
4.6.2.4 Uses and applications of electromagnetic waves

Question 44

March 2008 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

Some students are talking about radiation.



Match words, **A**, **B**, **C** and **D**, with the students' statements **1–4**.

A alpha

B beta

C gamma

D visible light

4.6.2.4 Uses and applications of electromagnetic waves

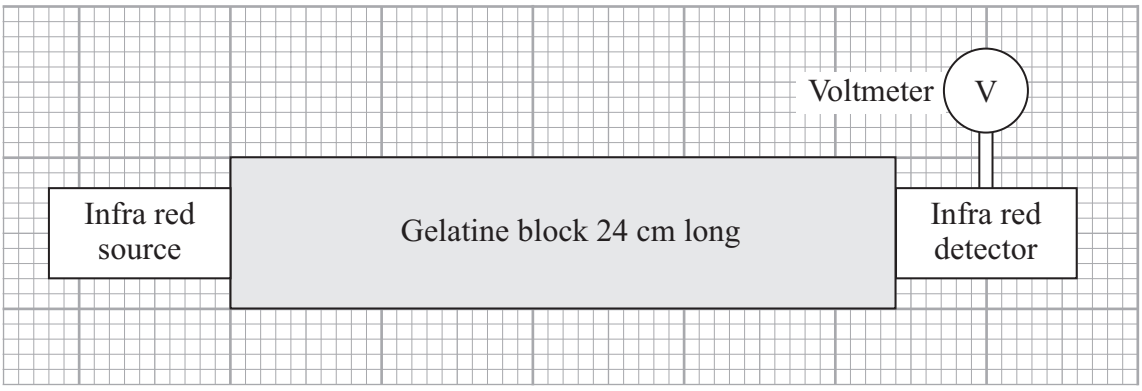
Question 45

March 2008 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

A student investigated the absorption of infra red radiation by a block of gelatine.

She placed a block of gelatine on a piece of graph paper and cut the block to a length of 24 cm. She then placed an infra red source touching one end of the block and an infra red detector touching the other end as shown in the diagram.

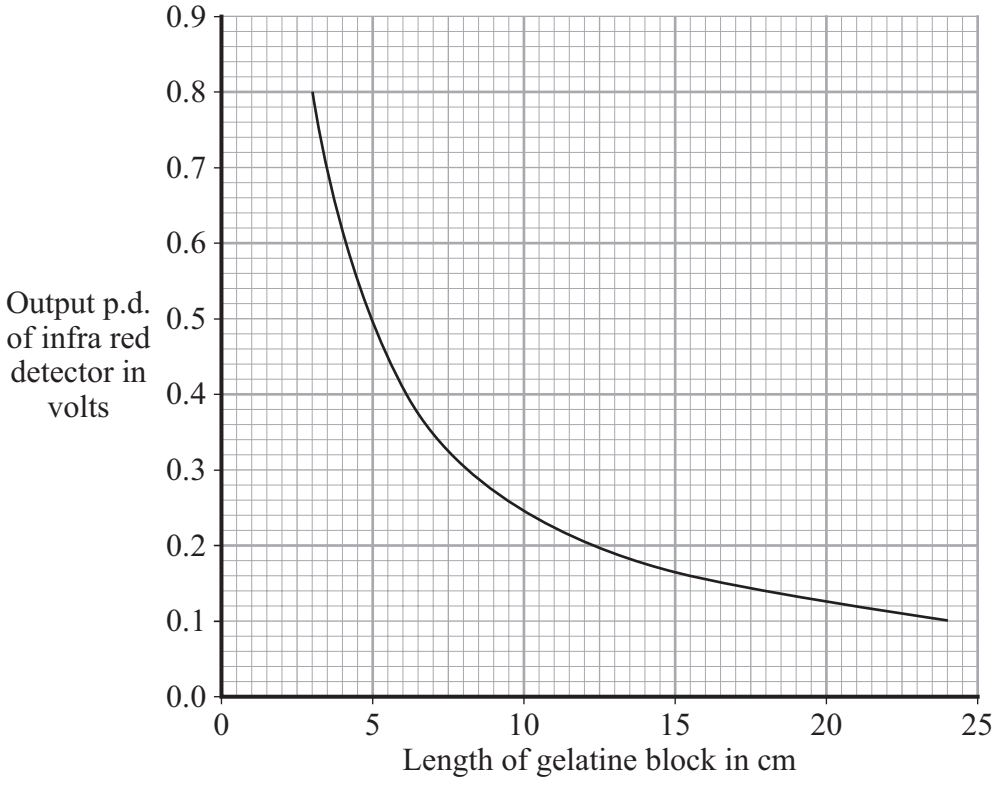


She recorded the output potential difference (p.d.) from the infra red detector.

She then repeated the experiment several times. Each time, she cut 2 cm off the gelatine block and set up the apparatus as shown in the diagram.

The graph shows her results.

The higher the intensity of infra red radiation received by the detector, the greater the output p.d.



Question 45 · continued

8A What was the dependent variable in this experiment?

1 the position of the infra red source

2 the length of the gelatine block

3 the position of the infra red detector

4 the output p.d. from the infra red detector

8B Which is the best description of the pattern shown by the graph?

1 As the length of the gelatine block increases, the intensity of infra red radiation received by the detector decreases.

2 As the length of the gelatine block increases, the intensity of infra red radiation received by the detector decreases by a similar amount.

3 The longer the gelatine block, the larger the effect of cutting off 2 cm on the increase in the intensity of infra red radiation received by the detector.

4 There is no relationship between the length of the gelatine block and the intensity of infra red radiation received by the detector.

8C The table shows the student's results.

Length of gelatine block in cm	Output p.d. in V
24.0	0.1
12.0	0.2
6.0	0.4
3.0	0.8

Based on the data that the student recorded, what was the sensitivity of the voltmeter?

1 0.1 V

2 0.2 V

3 0.4 V

4 1.0 V

Question 8 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 45 · continued March 2008 | PHY1BP | Original Q8 | Legacy

8D Scientists carried out a similar investigation using glass optical fibres in place of the gelatine block. They found that there was no significant reduction in the output p.d. of the infra red detector until the fibre was several kilometres long.

This shows that . . .

1 gelatine absorbs infra red radiation much more strongly than glass.

2 glass is more transparent than water.

3 infra red radiation passes through solids faster than through liquids.

4 infra red radiation can pass through bent optical fibres.

4.6.2.4 Uses and applications of electromagnetic waves

Question 46

March 2008 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Microwaves have many uses.

9A Microwaves can be used to cook food because they . . .

1 are at a high temperature when they leave the source in the oven.

2 travel straight through the food.

3 encourage the food to combine with oxygen.

4 transfer kinetic energy to the water molecules in the food.

9B Microwaves are used to transmit television broadcasts via a satellite because . . .

1 they can penetrate the atmosphere without significant loss of energy.

2 they do not interfere with aircraft navigation systems.

3 they have a longer wavelength than radio waves.

4 they have a lower frequency than radio waves.

9C More and more television and telephone transmissions use digital signals because digital signals . . .

1 are cheaper to use than analogue signals.

2 cause less risk to health.

3 are less prone to interference.

4 travel faster than analogue signals.

9D Some scientists think that mobile phones may be a health risk.

Their main concern is that the microwaves emitted by mobile phones . . .

1 may cause blistering of the ears.

2 may cause blindness.

3 may cause deafness.

4 may cause damage to genetic material in cells.

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 47

June 2008 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about electromagnetic radiation.

Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A infra red

B ultraviolet

C visible light

D gamma

can be used to send messages using a torch	**1**
can cause a suntan	**2**
can be used in a television remote control	**3**
can travel through a person's body	**4**

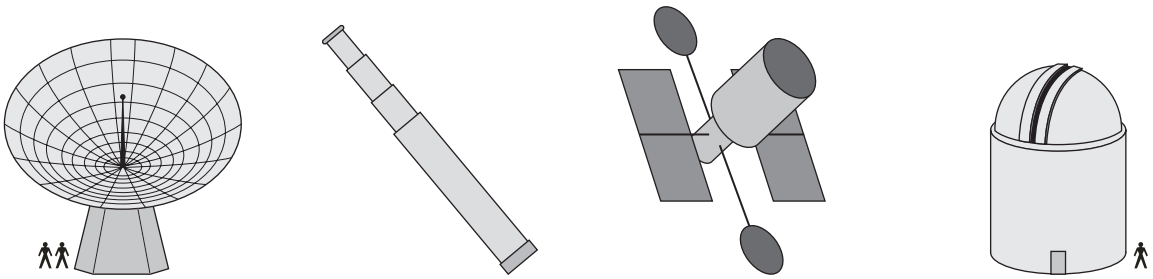
4.6.2.4 Uses and applications of electromagnetic waves

Question 48

June 2008 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The diagrams show different types of telescope. They are not drawn to scale.



1 **2** **3** **4**

Not to scale

Match statements, **A**, **B**, **C** and **D**, with the diagrams **1–4**.

A This telescope is used in space and detects light.

B This telescope is used on Earth and detects radio waves.

C This telescope is used on Earth and can be held in the hand.

D This telescope is used on Earth to view distant stars.

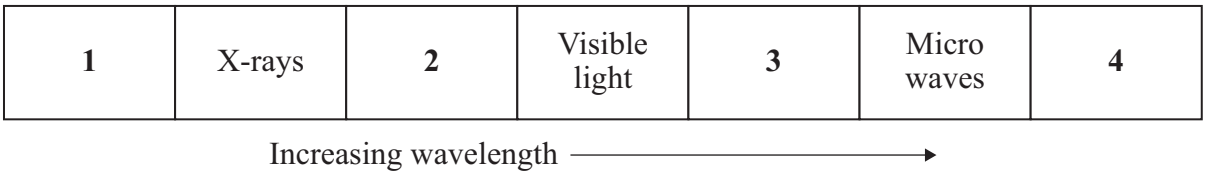
4.6.2.4 Uses and applications of electromagnetic waves

Question 49

June 2008 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows the electromagnetic spectrum.



Match the types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the electromagnetic spectrum.

A gamma

B infra red

C radio waves

D ultraviolet

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 50

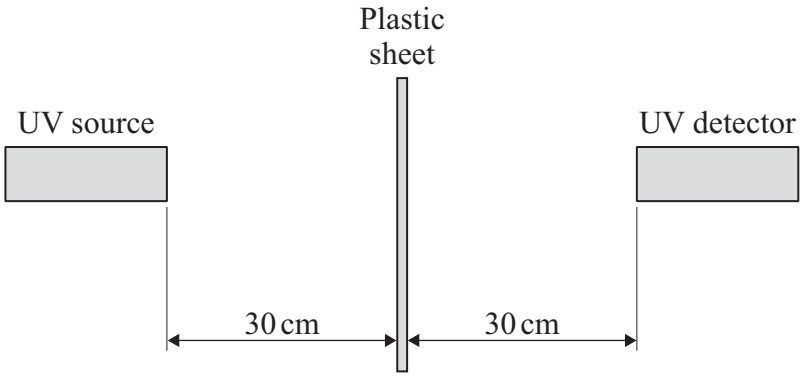
June 2008 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

A scientist investigated the different plastics used to make sunglasses. She wanted to find out which plastic was best at absorbing ultraviolet (UV) radiation.

She used sheets of four different types of plastic, **W**, **X**, **Y** and **Z**. Each plastic sheet was the same thickness. The plastic sheet, a UV source and a UV detector were set up as shown in the diagram.

The scientist recorded the intensity of the UV radiation reaching the detector through each type of plastic.



8A What kind of variable was the type of plastic used in this investigation?

1 categoric

2 continuous

3 discrete

4 ordered

8B What was the dependent variable in this investigation?

1 the type of plastic

2 the distance from the UV source to the plastic sheet

3 the intensity of the UV radiation leaving the source

4 the intensity of the UV radiation reaching the detector

4.6.2.4 Uses and applications of electromagnetic waves

Question 50 · continued June 2008 | PHY1BP | Original Q8 | Legacy

8C The table shows the intensity of UV radiation reaching the detector for each of the four types of plastic.

Type of plastic	Intensity of UV radiation reaching the detector in arbitrary units
W	15
X	13
Y	18
Z	16

Which plastic would give most protection to the eyes when used to make sunglasses?

1 **W**

2 **X**

3 **Y**

4 **Z**

8D The results of the investigation would have been more reliable if the scientist had . . .

1 used a range of thicknesses for each plastic.

2 used different intensities of UV radiation for each plastic.

3 varied the distance between the UV source and the plastic.

4 measured the intensity of UV radiation reaching the detector several times for each plastic.

4.6.2.4 Uses and applications of electromagnetic waves

Question 51

June 2008 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The table gives some information about four radioactive isotopes, **P**, **Q**, **R** and **S**.

Radioactive isotope		Type of radiation emitted	Half-life
P	americium-237	alpha	78 minutes
Q	americium-241	alpha	432 years
R	technetium-99	gamma	6 hours
S	krypton-78	beta	10.7 years

9A Which isotope emits an electron from the nucleus?

1 **P**

2 **Q**

3 **R**

4 **S**

9B Which isotope emits radiation with the longest range in air?

1 **P**

2 **Q**

3 **R**

4 **S**

9C Which isotope would be the most suitable for use in a system for controlling paper thickness in a paper factory?

1 **P**

2 **Q**

3 **R**

4 **S**

4.6.2.4 Uses and applications of electromagnetic waves

Question 51 · continued June 2008 | PHY1BP | Original Q9 | Legacy

9D Which isotope would be most suitable for monitoring the flow of blood through the heart?

1 **P**

2 **Q**

3 **R**

4 **S**

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 52

June 2008 | PHY1F | Original Q3 | Legacy

3 (a) The names of three types of nuclear radiation are given in **List A**. Some properties of these three types of radiation are given in **List B**.

Draw a straight line to link each type of radiation in **List A** to its correct property in **List B**. Draw only **three** lines.

List A Type of nuclear radiation	**List B** Property of radiation
alpha	not deflected by an electric field
beta	stopped by thin metal but not paper
gamma	the most strongly ionising
	will not harm living cells

(3 marks)

Question 52 · continued

for mark

3 (b) Nuclear radiation is given out from the centre of some types of atom.

What name is given to the centre of an atom? .....

(1 mark)

3 (c) One of the substances in the table is used as a radioactive tracer. A hospital patient breathes in air containing the tracer. The radiation given out is measured by a doctor using a detector outside the patient's body.

Substance	Radiation given out	Solid, liquid or gas
X	alpha	gas
Y	gamma	gas
Z	gamma	solid

Which **one** of the substances, **X**, **Y** or **Z**, should be used as the tracer? .....

Give **two** reasons for your answer.

1 .....

.....

2 .....

.....

(3 marks)

3 (d) Radiation can also be used to kill the bacteria on fresh food.

Give **one** reason why farmers, shop owners or consumers may want food to be treated with radiation.

.....

.....

(1 mark)

8

4.6.2.4 Uses and applications of electromagnetic waves

Question 53

4 The table gives data about two space telescopes. The Hubble telescope is already in space, but the James Webb telescope is still being built.

Name of telescope	Mirror diameter in metres	Launch Year	Orbit distance from the Earth in kilometres
Hubble	2.4	1990	575
James Webb	6.5	2013	1 500 000

4 (a) Give **one** reason why the image from an optical telescope on the Earth may not be as clear as the image produced by a space telescope.

.....

.....

(1 mark)

4 (b) Explain why it is easier for astronauts to service the Hubble telescope than it will be for astronauts to service the James Webb telescope.

.....

.....

.....

.....

(2 marks)

4 (c) The large mirror for the James Webb telescope will be folded, launched into space and then opened out. This will be a complicated process so a working scale model of the mirror system has been built.

Which statement gives a reason for building the scale model?

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

To see what the mirror system will look like ☐

To test the design to make sure it will work ☐

To measure the power needed by the telescope ☐

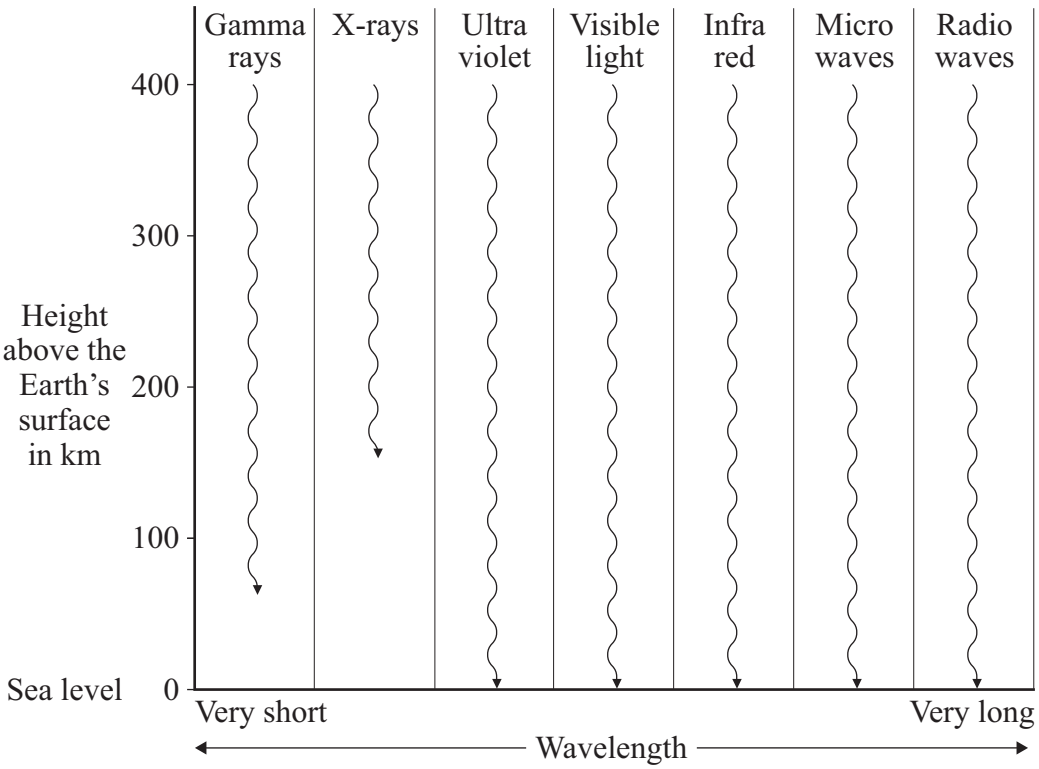
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 53 · continued

for mark

4 (d) The diagram shows how far different types of electromagnetic wave can travel through the Earth's atmosphere before being absorbed.



Name **two** types of electromagnetic wave that can be detected by a space telescope but cannot be detected by a telescope positioned on Earth.

1 .....

2 .....

(2 marks)

4 (e) Observations of distant galaxies have given evidence to support the theory that the universe began from a very small point.

What name is given to this theory?

.....

(1 mark)

7

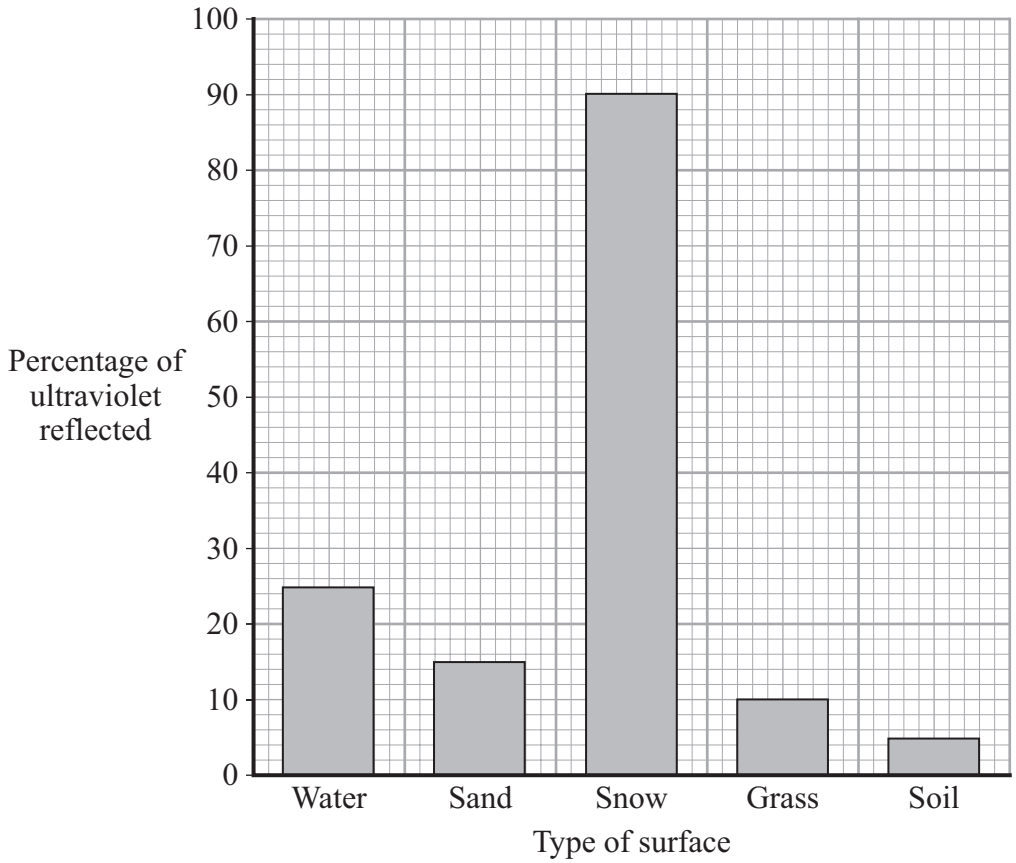
4.6.2.4 Uses and applications of electromagnetic waves

Question 54

June 2008 | PHY1F | Original Q6 | Legacy

6 (a) Ultraviolet (UV) radiation can be reflected or absorbed by a surface.

The percentage of ultraviolet radiation reflected by various surfaces is shown in the bar chart.



6 (a) (i) Which of these surfaces is the best **absorber** of ultraviolet radiation?

.....

(1 mark)

6 (a) (ii) Why has the data been shown as a bar chart rather than a line graph?

.....

.....

(1 mark)

6 (a) (iii) Who is likely to be exposed to more ultraviolet radiation, a skier or a golfer?

Draw a ring around your answer. **skier** **golfer**

Give a reason for your answer.

.....

.....

(1 mark)

Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 54 · continued

for mark

6 (a) (iv) State **one** harmful effect that ultraviolet radiation has on skin.

.....

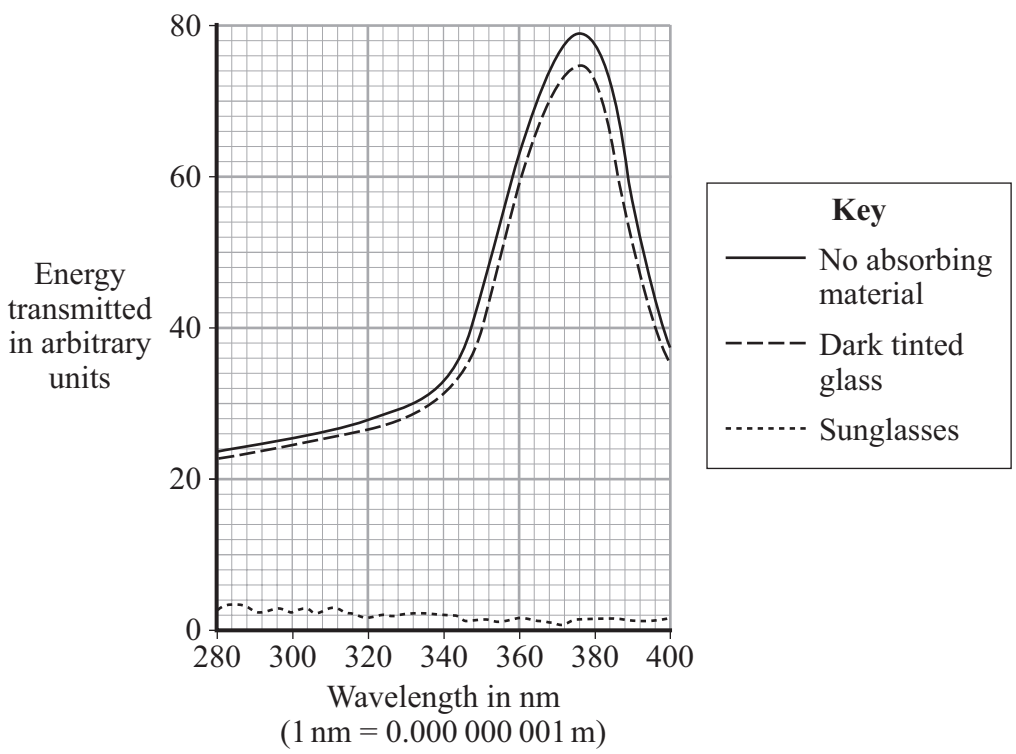
(1 mark)

6 (b) This is a label from a pair of sunglasses.

Sportswear Budget £5

- plastic lenses
- blocks 95% of ultraviolet rays
- UV absorbing up to wavelengths of 400 nm

A student tested the sunglasses by measuring the energy transmitted by the lenses for ultraviolet waves with a range of different wavelengths.
For comparison, the student also measured the transmission of ultraviolet waves through a piece of dark tinted glass.
The results of the tests are shown in the graph.



4.6.2.4 Uses and applications of electromagnetic waves

Question 54 · continued

for mark

6 (b) (i) Explain how the student's results support the claims made on the label.

.....

.....

.....

.....

(2 marks)

6 (b) (ii) Ultraviolet radiation can cause permanent eye damage.

Why should the lenses for sunglasses **not** be made from the dark tinted glass used in the student's tests?

.....

.....

(1 mark)

6 (c) An eye care charity predicts that within 10 years, everyone, when outside, will wear UV protection sunglasses most of the time. This is because the potential damage from ultraviolet radiation is so serious.

6 (c) (i) Which **one** of the following statements is the most likely reason for the prediction made by the eye care charity?

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

Publicity and education will make people aware of the dangers. ☐

The price of UV blocking sunglasses will fall dramatically. ☐

The level of UV in the atmosphere will increase. ☐

(1 mark)

6 (c) (ii) Several manufacturers of sunglasses have said that the research they have carried out supports the view of the eye care charity.

Suggest why the research conducted by the manufacturers could be biased.

.....

.....

(1 mark)

9

4.6.2.4 Uses and applications of electromagnetic waves

Question 55

November 2008 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Electromagnetic waves have many uses.

Match the types of waves, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A infra red rays

B visible light

C ultraviolet rays

D X-rays

Luggage at airports is examined using . . . **1** . . . .

Mobile phone screens give off . . . **2** . . . .

Sunbeds use . . . **3** . . . .

When cooking bacon, a grill uses . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 56

November 2008 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The diagram shows parts of the electromagnetic spectrum.

1	X-rays	**2**	**3**	Infra red rays	Microwaves	**4**

Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the diagram.

A gamma rays

B radio waves

C ultraviolet rays

D visible light

4.6.2.4 Uses and applications of electromagnetic waves

Question 57

November 2008 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

The Earth's atmosphere absorbs all electromagnetic waves except those with wavelengths longer than ultraviolet radiation.

Match the electromagnetic radiations, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A microwaves

B radio waves

C visible light

D X-rays

Three hundred years ago, many objects in the night sky were discovered by looking through hand-held telescopes. These telescopes detect . . . **1** . . . .

In the last century, distant galaxies were discovered by using large dishes and aerials on Earth which detect . . . **2** . . . .

In recent years, many discoveries have been made using telescopes mounted on satellites in space. Unlike telescopes on Earth, these telescopes can detect . . . **3** . . . .

The satellites send images back to Earth using . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 58

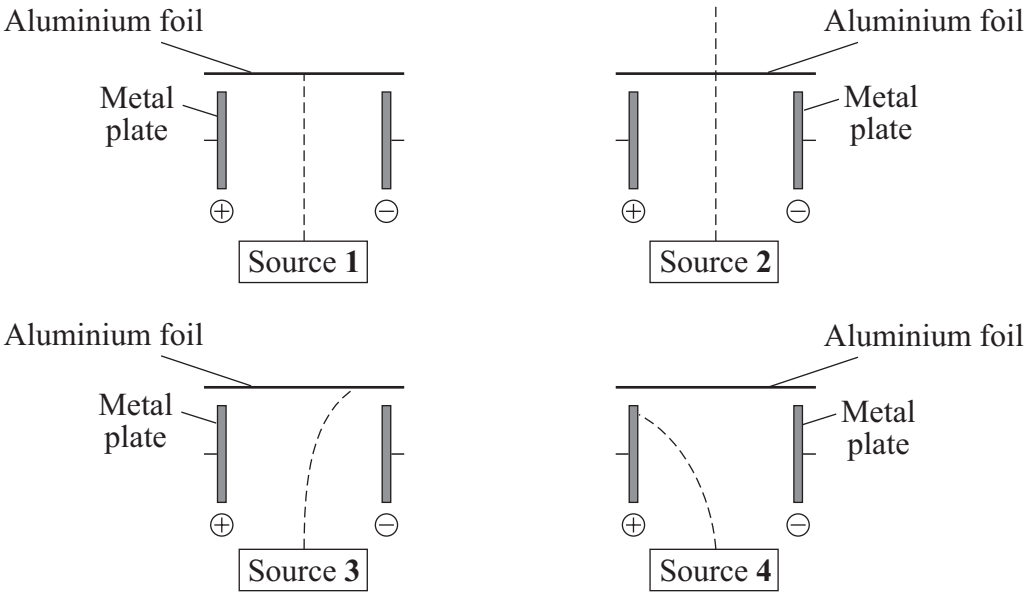
November 2008 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

Radiation from four sources, **1**, **2**, **3** and **4**, is directed into an electric field between two metal plates.

There is a sheet of aluminium foil after the gap between the metal plates.

Light waves are not deflected in electric fields.



In each diagram, the dashed line (----------) shows the path of the radiation.

Match the types of radiation, **A**, **B**, **C** and **D**, with the sources **1–4**.

A alpha radiation

B beta radiation

C gamma radiation

D visible light

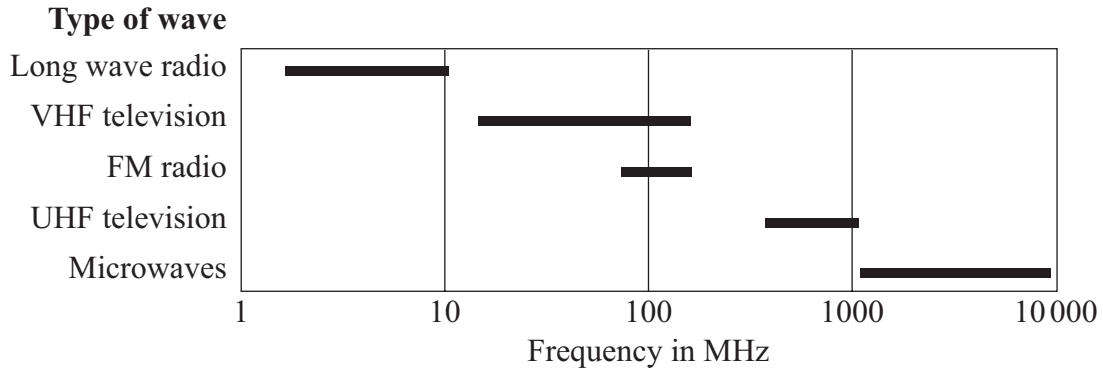
4.6.2.4 Uses and applications of electromagnetic waves

Question 59

November 2008 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

The diagram shows five types of wave. The bars show the range of frequencies of these waves.



6A What kinds of waves are shown in the diagram?

1 electromagnetic waves

2 mechanical waves

3 seismic waves

4 sound waves

6B Which one of the following types of wave has the longest wavelength?

1 VHF television

2 FM radio

3 UHF television

4 microwaves

4.6.2.4 Uses and applications of electromagnetic waves

Question 59 · continued

6C Which of the following can have waves of the same frequency?

1 long wave radio and VHF television

2 UHF television and FM radio

3 VHF television and FM radio

4 microwaves and long wave radio

6D What could microwaves be used for?

1 examining broken bones

2 mobile phone networks

3 skin tanning

4 treating cancer

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 60

January 2009 | PHY1F | Original Q1 | Legacy

1 The table shows the electromagnetic spectrum.
Three types of wave have been missed out.

Gamma rays		Ultraviolet rays	Visible light		Micro-waves	

Shortest wavelength ⟷ Longest wavelength

1 (a) (i) Use words from the box to complete the table.

infra red rays	**radio waves**	**X-rays**

(2 marks)

1 (a) (ii) Which **one** of the following gives a use of gamma rays?

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

to communicate with satellites ☐

to see objects ☐

to kill cancer cells ☐

(1 mark)

1 (a) (iii) Complete the following sentence by drawing a ring around the correct word in the box.

All electromagnetic waves move [energy / gases / particles] from one place to another.

(1 mark)

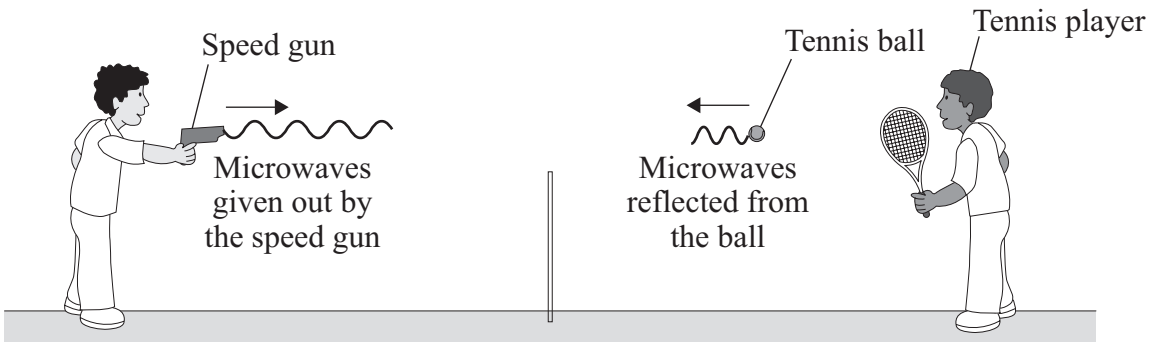
4

4.6.2.4 Uses and applications of electromagnetic waves

Question 61

January 2009 | PHY1F | Original Q2 | Legacy

2 (a) The picture shows a speed gun being used to measure how fast a tennis player hits the ball.



Some of the microwaves from the speed gun are absorbed by the ball and some are reflected by the ball.

2 (a) (i) Complete the following sentence by choosing **one** of the phrases from the box.

longer than	**the same as**	**shorter than**

The wavelength of the microwaves reflected from the ball are

..... the wavelength of the microwaves from the speed gun.

(1 mark)

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

When the ball absorbs microwaves, its temperature will

decrease slightly
not change
increase slightly

.

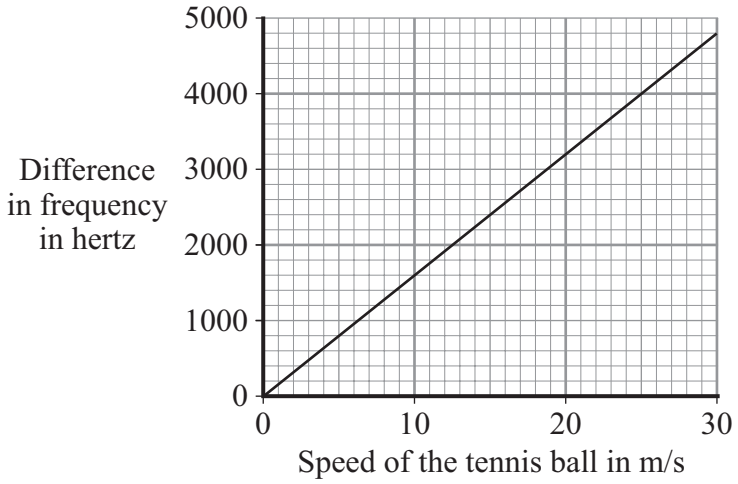
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 61 · continued

for mark

2 (b) The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.
The graph shows how the difference between the two frequencies depends on the speed of the ball.



2 (b) (i) Describe the pattern that links the difference between the two frequencies and the speed of the ball.

.....

.....

(1 mark)

2 (b) (ii) The speed gun measures the difference between the two frequencies as 3200 Hz.

Use the graph to find the speed of the tennis ball.
Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = ... m/s

(2 marks)

2 (b) (iii) Which **one** of the following gives the reason why the data has been shown as a line graph and **not** as a bar chart?

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

Frequency and speed are both categoric variables. ☐

Frequency and speed are both continuous variables. ☐

Speed is a continuous variable and frequency is a categoric variable. ☐

(1 mark)

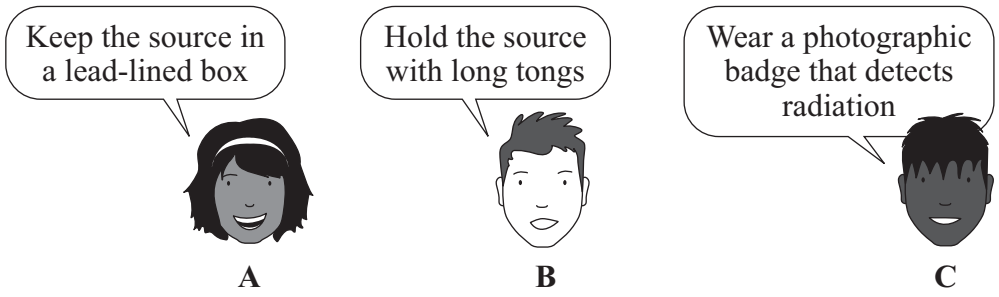
6

4.6.2.4 Uses and applications of electromagnetic waves

Question 62

January 2009 | PHY1F | Original Q4 | Legacy

4 Before using a radioactive source, a teacher asked her students to suggest safety procedures that would reduce her exposure to the radiation. The students made the following suggestions.



A **B** **C**

4 (a) Which suggestion, **A**, **B** or **C**, would **not** reduce the exposure of the teacher to radiation?

.....

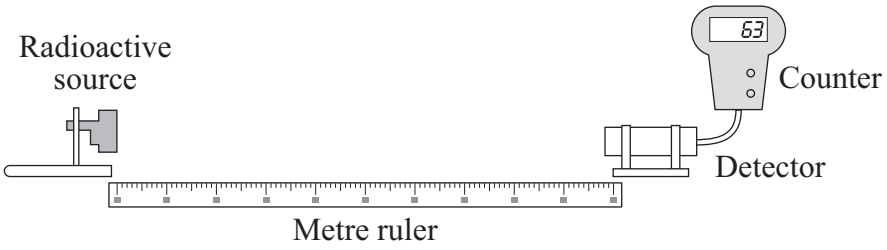
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 62 · continued

for mark

4 (b) The diagram shows how the teacher measured the distance that the radiation travelled from the source. The count-rate at different distances from the source was measured and recorded in the table.



Distance from source to detector in cm	Count-rate in counts per minute
20	85
40	81
60	58
80	53
100	23

What type of radiation was the source emitting, alpha, beta or gamma?

.....

Explain the reasons for your choice.

.....

.....

.....

.....

(3 marks)

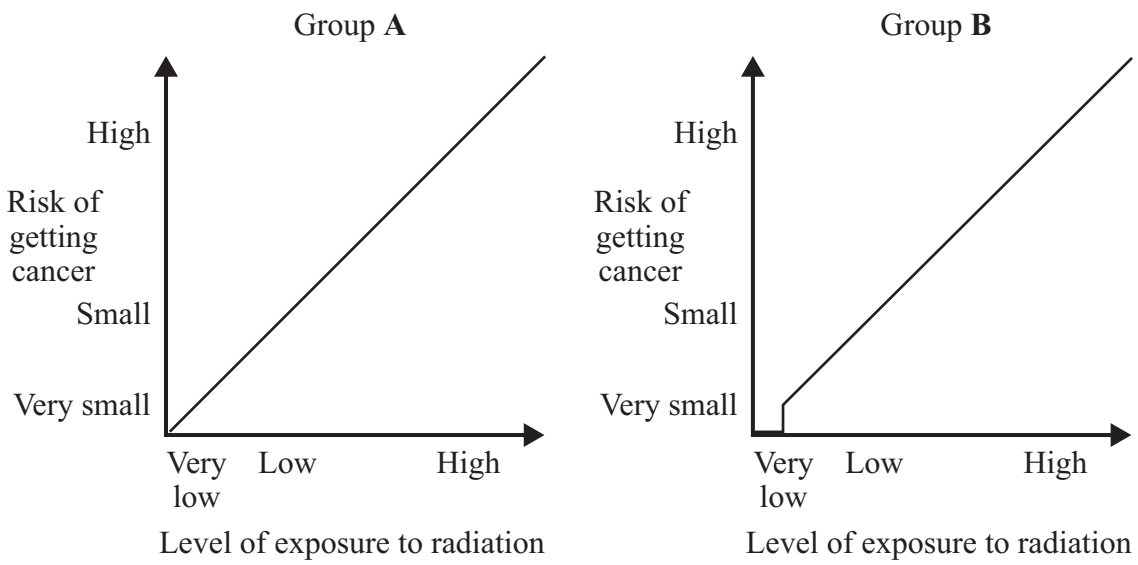
Question 4 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 62 · continued

for mark

4 (c) The graphs show how two groups of scientists, **A** and **B**, link exposure to radiation and the risk of getting cancer.



4 (c) (i) Complete the following sentence using a word or phrase from the box.

decreases	**has no effect on**	**increases**

Both groups of scientists agree that a high level of exposure to radiation

..... the risk of getting cancer.

(1 mark)

4 (c) (ii) Use the graphs to describe carefully how the two groups of scientists disagree when the level of exposure to radiation is very low.

.....

.....

.....

.....

(2 marks)

7

4.6.2.4 Uses and applications of electromagnetic waves

Question 63

1 Four different processes are described in **List A**. The names of these processes are given in **List B**.

Draw a line to link each description in **List A** to its correct name in **List B**.
Draw only **four** lines.

List A	List B
the nuclei of two atoms joining together	gamma emission
the nucleus of an atom splitting into several pieces	electric current
an atom losing an electron	ionisation
an electric charge moving through a metal	nuclear fission
	nuclear fusion

(4 marks)

4

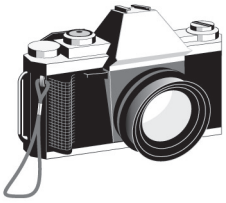
4.6.2.4 Uses and applications of electromagnetic waves

Question 64

March 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

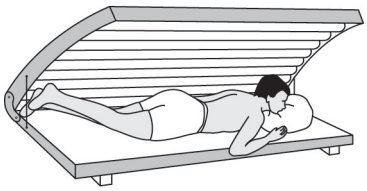
Different devices use different types of electromagnetic waves.



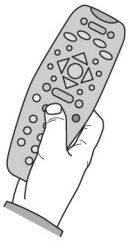
1
Camera



2
Hospital scanner



3
Sunbed



4
TV remote control

Match types of electromagnetic waves, **A**, **B**, **C** and **D**, with the diagrams **1–4**.

A infra red

B visible light

C ultraviolet

D X-rays

4.6.2.4 Uses and applications of electromagnetic waves

Question 65

March 2009 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

A radioactive material gives out radiation all the time.

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

A alpha

B beta

C electron

D gamma

The radiation that is most penetrating is . . . **1** . . . .

The radiation that is stopped by a sheet of paper is . . . **2** . . . .

The radiation that passes through a sheet of paper but is stopped by aluminium foil is . . . **3** . . . .

A beta particle is an . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 66

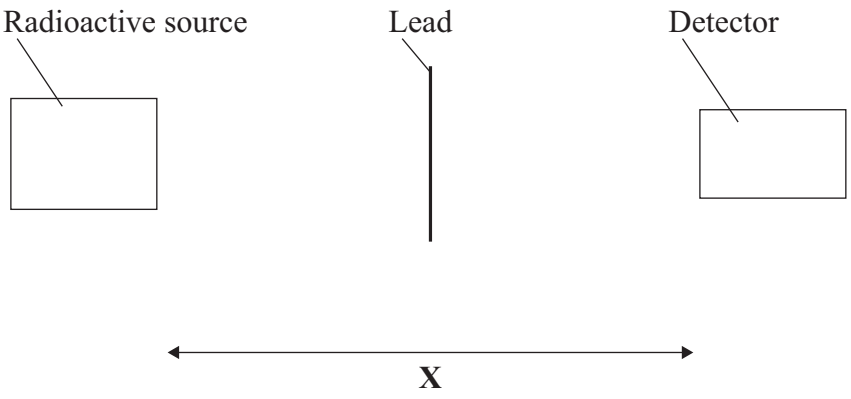
March 2009 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

A student investigated how much gamma radiation was absorbed by lead.

She used different thicknesses of lead.

She plotted a graph of her results.



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

A conclusion

B control variable

C prediction

D independent variable

1	She thought that the amount of radiation absorbed would decrease with thickness.
2	She kept the distance **X** the same.
3	She changed the thickness of the lead.
4	From her graph, she decided that the amount of radiation absorbed increased with thickness.

4.6.2.4 Uses and applications of electromagnetic waves

Question 67

March 2009 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

The table shows part of the electromagnetic spectrum.

gamma rays	X-rays	ultraviolet	visible light	infra red	microwaves

6A Which one of the following parts of the electromagnetic spectrum has the longest wavelength?

1 gamma rays

2 microwaves

3 ultraviolet

4 visible light

6B Which one of the following parts of the electromagnetic spectrum has the highest frequency?

1 gamma rays

2 microwaves

3 ultraviolet

4 visible light

6C Which part of the electromagnetic spectrum is used to show up invisible security marking on valuable equipment?

1 microwaves

2 ultraviolet

3 visible light

4 X-rays

4.6.2.4 Uses and applications of electromagnetic waves

Question 67 · continued

6D Which part of the electromagnetic spectrum is emitted by mobile phone transmitters?

1 microwaves

2 ultraviolet

3 visible light

4 X-rays

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

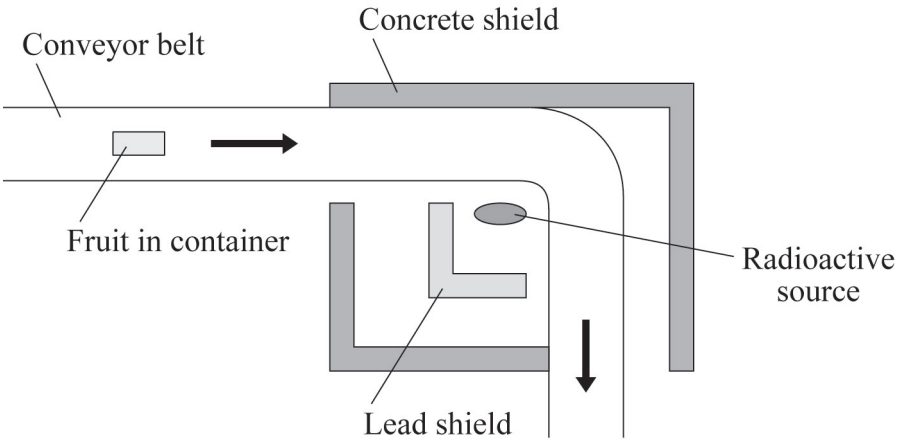
Question 68

March 2009 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

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.



8A 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.

8B 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.

4.6.2.4 Uses and applications of electromagnetic waves

Question 68 · continued

8C 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.

8D 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

4.6.2.4 Uses and applications of electromagnetic waves

Question 69

March 2009 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

This question is about electromagnetic waves.

9A Changes may occur in substances when they absorb the energy carried by electromagnetic waves.

Which row in the table is correct?

	An alternating current is created in the substance	The substance becomes hotter
1	always	never
2	sometimes	always
3	sometimes	sometimes
4	never	sometimes

9B Radio waves travel in straight lines. However, some types of radio waves can be received on the opposite side of the Earth from the transmitter.

This happens because the radio waves are . . .

1 absorbed by the atmosphere.

2 interfered with by the atmosphere.

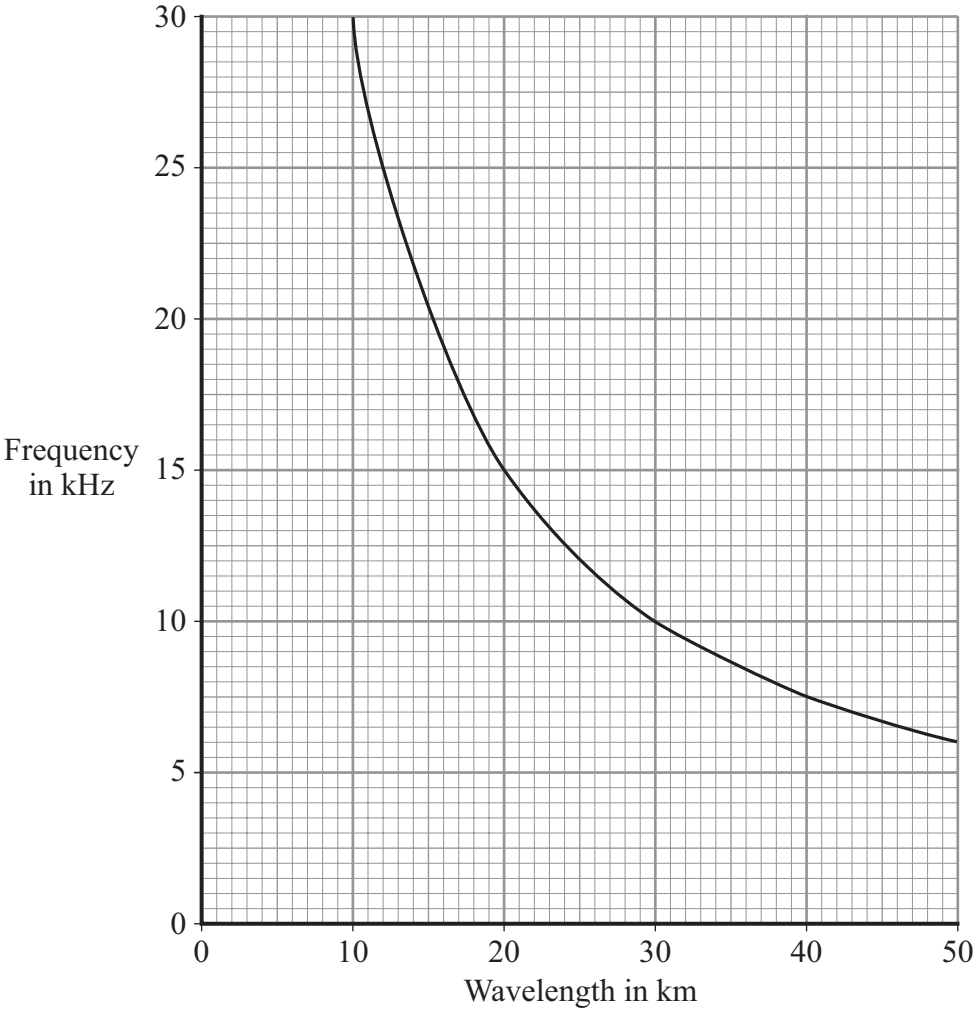
3 reflected by the atmosphere.

4 stopped by the atmosphere.

4.6.2.4 Uses and applications of electromagnetic waves

Question 69 · continued

The graph indicates how the frequency of electromagnetic waves changes with wavelength.



9C The graph shows that when the wavelength doubles, the frequency . . .

1 doubles.

2 halves.

3 quadruples.

4 stays the same.

9D What is the frequency of electromagnetic waves of wavelength 25 000 metres?

1 1.2 kHz

2 1.4 kHz

3 12 kHz

4 14 kHz

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

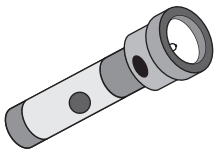
Question 70

June 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

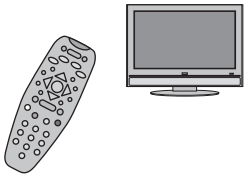
Many everyday devices use electromagnetic waves.

Torch



1

Remote control



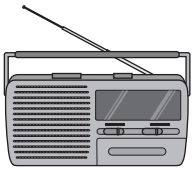
2

Mobile phone



3

Radio



4

Match types of electromagnetic waves, **A**, **B**, **C** and **D**, with the devices **1**–**4**.

A infra red

B microwaves

C radio waves

D visible light

4.6.2.4 Uses and applications of electromagnetic waves

Question 71

June 2009 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

Electromagnetic waves can be dangerous.

There are different ways of protecting ourselves from the radiation.

Match methods of protection, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A wearing thick, insulating gloves

B leaving the room

C looking through blackened glass

D using sun cream

When a dentist takes an X-ray of a patient's mouth, he protects himself by . . . **1** . . . .

A windsurfer protects herself from harmful ultraviolet rays by . . . **2** . . . .

Someone watching an eclipse of the Sun protects her eyes by . . . **3** . . . .

A man taking a metal bar out of a furnace protects himself by . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

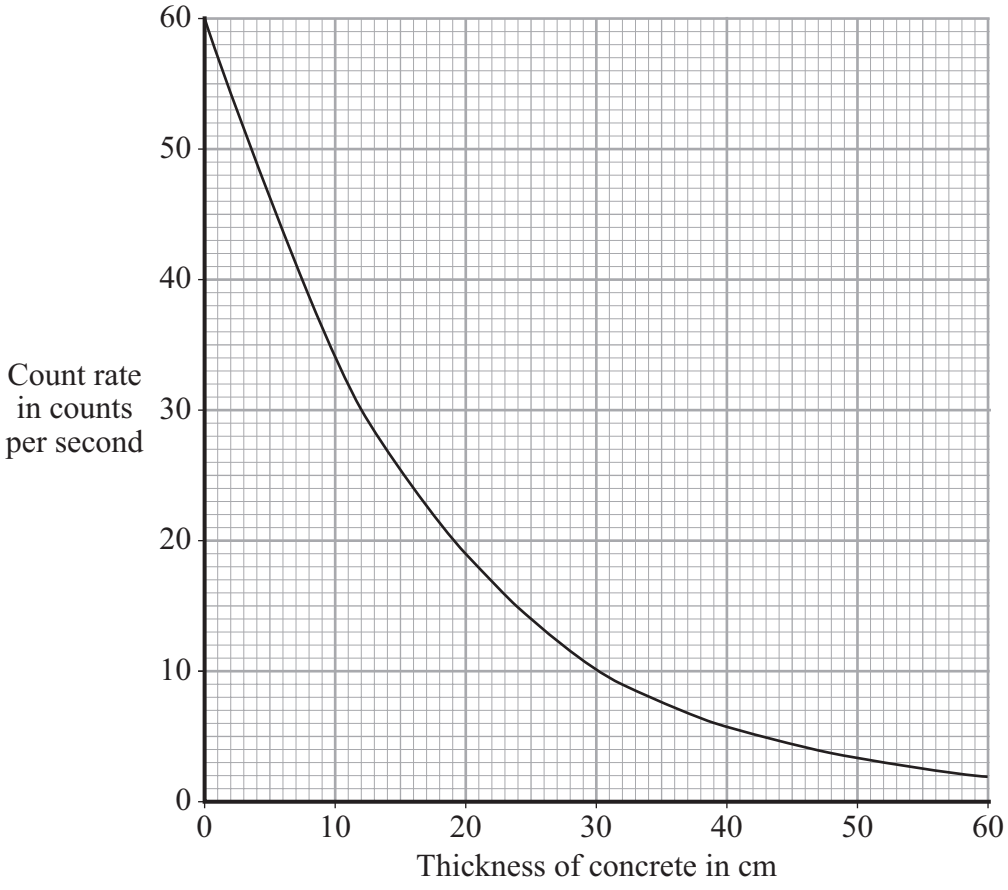
Question 72

June 2009 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

Concrete is sometimes used to protect people from the harmful effects of gamma radiation.

The graph shows the count rate from a source of gamma radiation after it has passed through different thicknesses of concrete.



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

A 8

B 12

C 30

D 60

The count rate when there is no concrete = . . . **1** . . . counts per second.

The thickness of the concrete when the count rate is 10 counts per second = . . . **2** . . . cm.

The thickness of concrete needed to reduce the count rate by half = . . . **3** . . . cm.

The reduction in count rate when the thickness of concrete is increased from 30 cm to 60 cm = . . . **4** . . . counts per second.

4.6.2.4 Uses and applications of electromagnetic waves

Question 73

June 2009 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

Electromagnetic radiation can be grouped into types. Each type has a different range of wavelengths.

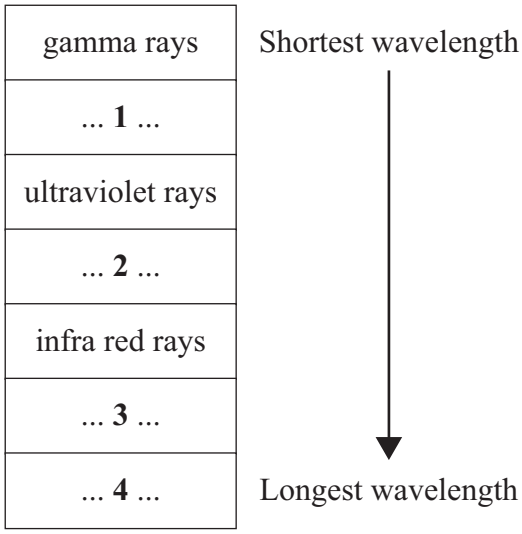
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A microwaves

B X-rays

C visible light

D radio waves



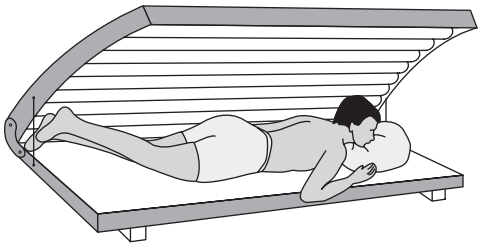
4.6.2.4 Uses and applications of electromagnetic waves

Question 74

June 2009 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Some people use sunbeds to get a suntan. Sunbeds emit ultraviolet radiation which causes the skin to tan. Exposure to too much ultraviolet radiation can lead to the development of skin cancer.



Scientists investigated the risk of cancer developing in people who regularly used sunbeds.

The table gives their results.

	Regular users of sunbeds	Non-users of sunbeds
Number of people	1000	1000
Number of people with skin cancer in 1985	4	4
Number of people with skin cancer in 2005	13	5

9A The group that did not use sunbeds . . .

1 acted as the control group.

2 ensured that the results were reliable.

3 acted as the independent variable.

4 ensured that the results were accurate.

9B Repeating the investigation with another group of people would make the results more . . .

1 reliable.

2 precise.

3 biased.

4 random.

9C These results show that . . .

1 regular use of sunbeds always leads to the development of skin cancers.

2 regular use of sunbeds can reduce the development of skin cancers.

3 regular use of sunbeds increases the risk of developing skin cancers.

4 non-users of sunbeds have a greater risk of developing skin cancers than regular users of sunbeds.

9D The government is concerned about the health of regular users of sunbeds because . . .

1 the sunbed industry is not regulated properly.

2 sunbeds contain cancer-producing chemicals.

3 there are no health benefits from using sunbeds.

4 treatment for skin cancers is an expensive burden on the Health Service.

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 75

June 2009 | PHY1F | Original Q6 | Legacy

6 (a) The table lists the names of seven telescopes. Each one of the telescopes is designed to detect a different one of the seven types of electromagnetic wave.
The table is incomplete.

Name of telescope	Type of wave detected
HESS	Gamma
XMM Newton	X-ray
FUSE	Ultraviolet
William Herschel	Visible light
Spitzer	
SPT	Microwave
Lovell	Radio

6 (a) (i) Which **one** of the telescopes is designed to detect the type of wave with the shortest wavelength?

.....

(1 mark)

6 (a) (ii) What type of wave is the Spitzer telescope designed to detect?

.....

(1 mark)

6 (b) The William Herschel telescope is on the Earth's surface. Another telescope, the Hubble telescope, which also detects visible light, orbits the Earth.

How is the image produced by the Hubble telescope better than the image produced by the William Herschel telescope?

.....

Give a reason for your answer.

.....

.....

(2 marks)

4.6.2.4 Uses and applications of electromagnetic waves

Question 75 · continued

for mark

6 (c) Some types of electromagnetic wave are absorbed by water.
The SPT telescope is located in the Antarctic, which is a dry environment.

Explain why it is better to have this type of telescope in a dry environment rather than in a wet, humid environment.

.....

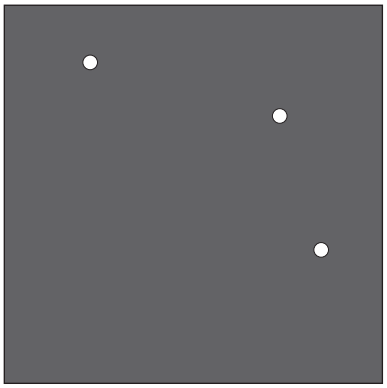
.....

.....

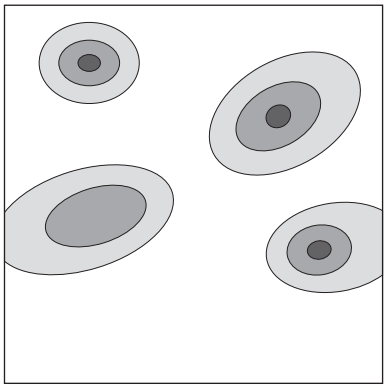
.....

(2 marks)

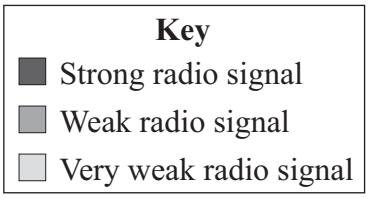
6 (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



Visible light image



Radio telescope image



Suggest what extra information can be gained from the radio telescope image compared with the visible light image.

.....

.....

(1 mark)

7

4.6.2.4 Uses and applications of electromagnetic waves

Question 76

7 (a) Mobile phone networks send digital signals using microwaves.

7 (a) (i) Give **one** advantage of sending information as a digital signal rather than as an analogue signal.

.....

.....

(1 mark)

7 (a) (ii) Give **one** other use of microwaves.

.....

.....

(1 mark)

7 (b) Some scientists think that there is a link between using a mobile phone and some types of illness. Other scientists disagree. They say that the evidence is limited and unreliable.

7 (b) (i) Suggest what scientists could do to show a link between using a mobile phone and illness.

.....

.....

(1 mark)

7 (b) (ii) How could scientists improve the reliability of the evidence?

.....

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 76 · continued

for mark

7 (b) (iii) Complete the following passage by drawing a ring around the word in the box that is correct.

There has been little or no experimental research into the health of children who use mobile phones.

This is partly because of the

economic
environmental
ethical

issues involved in using children in scientific research.

(1 mark)

7 (c) Before being sold, new mobile phones must be tested and given a SAR value.
The SAR value is a measure of the energy absorbed by the head while a mobile phone is being used.

The table gives the SAR value for three mobile phones made by different companies.
To be sold in the UK, a mobile phone must have a SAR value lower than 2.0 W/kg.

Mobile phone	SAR value in W/kg
J	0.18
K	0.86
L	1.40

7 (c) (i) All companies use the same test to measure a SAR value.

Why is using the same test important?

.....

.....

(1 mark)

Question 7 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 76 · continued

for mark

7 (c) (ii) Would the companies that make the mobile phones, **J**, **K** and **L**, be correct to claim that these three phones are totally safe to use?

Answer yes or no. .....

Give a reason for your answer.

.....

.....

(1 mark)

7 (d) Devices designed to protect a mobile phone user from microwave radiation are now available.

Why is it important that these devices are tested by scientists who are **not** working for the company that makes the devices?

.....

.....

(1 mark)

8

4.6.2.4 Uses and applications of electromagnetic waves

Question 77

November 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about the uses of some types of electromagnetic radiation.

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

A infra red

B microwaves

C ultraviolet

D X-rays

	Use
1	sending signals in mobile phone networks
2	sending signals along optical fibres
3	photographing people's bones in hospital
4	reading 'invisible' security markings on property

4.6.2.4 Uses and applications of electromagnetic waves

Question 78

November 2009 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

This question is about four types of electromagnetic radiation.

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

A gamma

B infra red

C radio

D visible light

The type of electromagnetic radiation with the longest wavelength is . . . **1** . . . .

The type of electromagnetic radiation with the highest frequency is . . . **2** . . . .

The type of electromagnetic radiation that is used to cook food is . . . **3** . . . .

The type of electromagnetic radiation that allows us to see is . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 79

November 2009 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Diagram 1 shows a transmitter used to send information to a satellite. The transmitter has a microwave source in front of the dish.

Diagram 2 gives more detail of the dish and the microwave source. The dish is made of metal coated with plastic. The plastic coating prevents corrosion of the metal.

Diagram 1

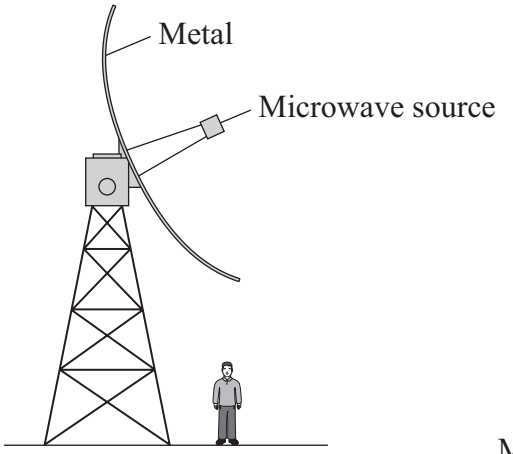
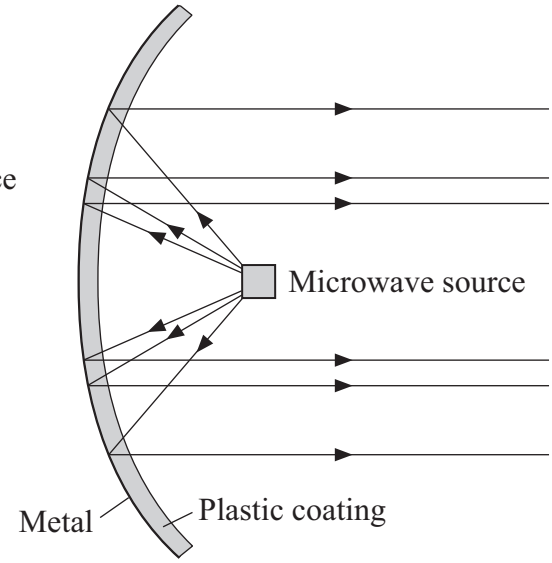


Diagram 2



6A The coating is made of plastic because microwaves are . . .

1 absorbed by plastic.

2 changed to an alternating current by plastic.

3 reflected by plastic.

4 able to pass through plastic.

4.6.2.4 Uses and applications of electromagnetic waves

Question 79 · continued

6B The dish is made of metal because microwaves . . .

1 are absorbed by metals.

2 are reflected by metal.

3 give an alternating current with a different frequency.

4 interfere with the digital signals produced.

6C The microwave source is turned off when maintenance work is done in the dish.

This is to prevent the maintenance workers from . . .

1 becoming deaf from the analogue signals used.

2 causing interference to the digital signals used.

3 having their bodies heated by the microwaves.

4 receiving an electric shock from the alternating current, which is more dangerous than direct current.

6D Which of the following statements is correct about all microwaves?

1 As the frequency decreases, the wavelength decreases.

2 As the frequency decreases, the wavelength increases.

3 As the frequency increases, the wavelength does not change.

4 As the frequency increases, the wavelength increases.

4.6.2.4 Uses and applications of electromagnetic waves

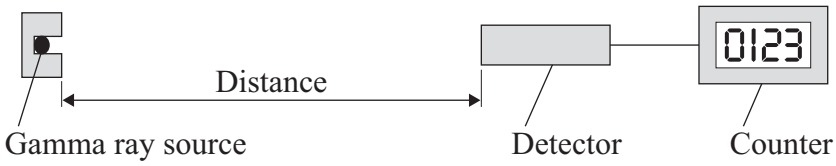
Question 80

November 2009 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

Harmful Gamma Radiation? .... Keep safe, keep away!

A sixth form student decided to test the truth of the newspaper headline. She used a gamma ray source and a detector to measure the amount of radiation reaching the detector per second. She repeated the experiment and calculated the mean count rates. She then moved the detector further away from the source and repeated the procedure.



Her results are shown in the table.

Distance from source in metres	Count rate in counts per second		
	Test 1	Test 2	Mean
0.2	480	484	482
0.4	121	127	124
0.6	55	55	55
0.8	30	32	31
1.0	20	18	19

8A The results with the greatest range of count rate occur at a distance from the source of . . .

1 0.2 m

2 0.4 m

3 0.8 m

4 1.0 m

4.6.2.4 Uses and applications of electromagnetic waves

Question 80 · continued

8B She repeated the experiment and calculated the mean to make her results more . . .

1 accurate.

2 controlled.

3 varied.

4 reliable.

8C A valid conclusion based on her results would be that . . .

1 1.0 m is a safe distance to be from the source.

2 the count rate decreases as the distance from the source increases.

3 the count rate will be almost zero at a distance of 1.2 m from the source.

4 there is no such thing as a safe distance from a gamma source.

8D Another way in which the count rate could be reduced would be to . . .

1 reduce the air temperature between the source and detector.

2 place a thick sheet of lead between the source and detector.

3 produce a strong electric field between the source and detector.

4 produce a strong magnetic field between the source and detector.

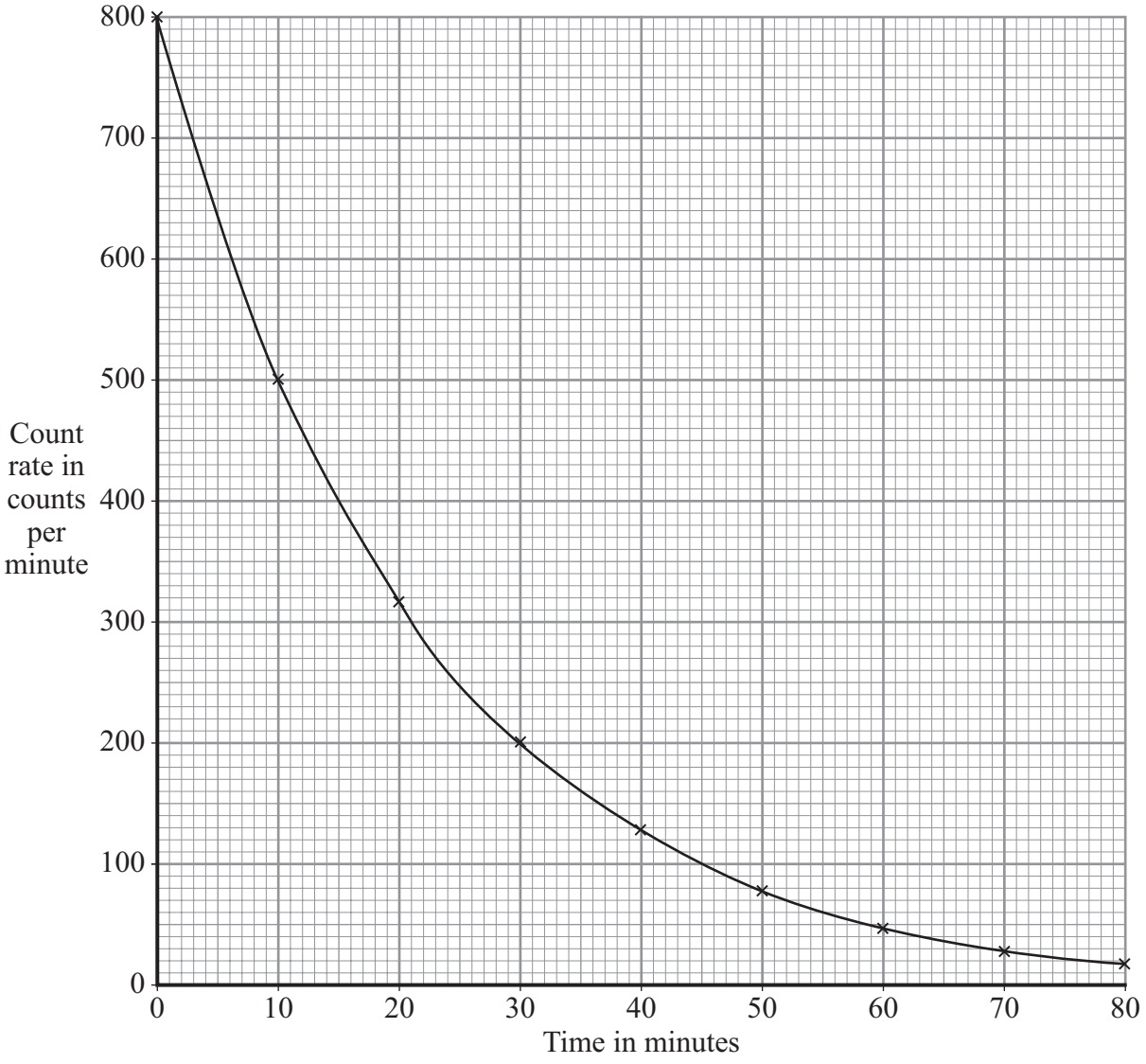
4.6.2.4 Uses and applications of electromagnetic waves

Question 81

November 2009 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The graph shows how the count rate of a radioactive isotope varies with time.



9A What is the half-life of the isotope?

1 10 minutes

2 15 minutes

3 20 minutes

4 80 minutes

Question 81 · continued

9B The person who plotted the graph has drawn a line graph rather than a bar chart.

What is the reason for this?

1 Both the count rate and time are continuous variables.

2 Time is a discrete variable and count rate is a continuous variable.

3 Time is a continuous variable and count rate is a categoric variable.

4 Both the count rate and time are discrete variables.

9C The government recommends that all homes are fitted with smoke alarms. Americium-241 is used in these alarms. Americium-241 emits alpha particles and has a half-life of 460 years.

The americium-241 is safe to use in homes because . . .

1 it has a long half-life.

2 alpha particles travel only a few centimetres in air.

3 smoke alarm batteries are replaced regularly.

4 its nucleus has 146 neutrons.

9D This information is about the isotope technetium-99.

- It emits gamma radiation.
- Its half-life is 6 hours.
- It decays to a stable isotope of rubidium.
- It is used for diagnostic medical studies.
- It is put into the body.

A doctor wants to convince a patient that technetium-99 is safe to use to diagnose a medical problem.

Which of the following should he use to reassure the patient?

1 Rubidium is a rare metallic element.

2 Gamma radiation is part of the electromagnetic spectrum.

3 The half-life of the technetium-99 isotope is relatively short.

4 There is no risk in using radioactive materials.

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 82

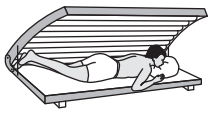
January 2010 | PHY1F | Original Q1 | Legacy

1 (a) The diagram shows the electromagnetic spectrum.
The pictures show four devices that use electromagnetic waves. Each device uses a different type of electromagnetic wave.

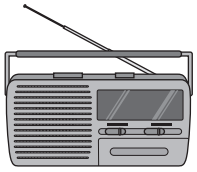
Draw a line from each device to the type of electromagnetic wave that it uses.
One has been done for you.

Gamma rays	X-rays	Ultraviolet rays	Visible light	Infra red rays	Microwaves	Radio waves

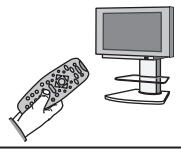
Sunbed



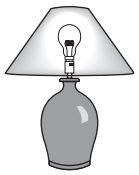
Radio



TV remote control



Filament lamp



(3 marks)

1 (b) A headline from a recent newspaper article is shown below.



1 (b) (i) What serious health problem may be caused by using a sunbed too much?

.....

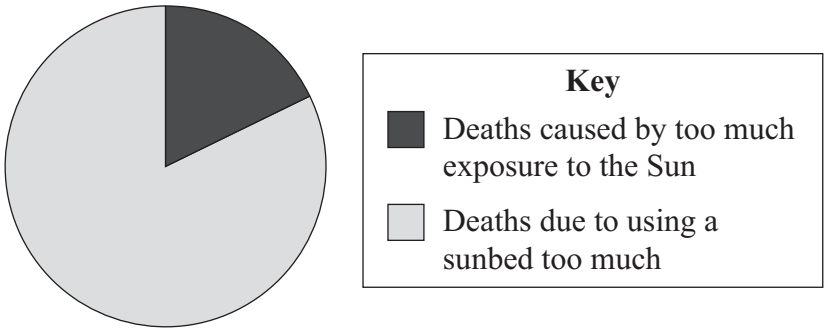
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 82 · continued

for mark

1 (b) (ii) The pie chart compares the number of deaths in Britain each year, which may have been caused by using sunbeds too much, with those which may have been caused by too much exposure to the Sun.



It is difficult for a doctor to be certain that a person has died because of using a sunbed too much.

Suggest why.

.....

.....

(1 mark)

1 (b) (iii) A spokesperson for a leading cancer charity said:

> 'We want people, especially young people, to know the possible dangers of using a sunbed.'

Why is it important that you know the possible dangers of using a sunbed?

.....

.....

(1 mark)

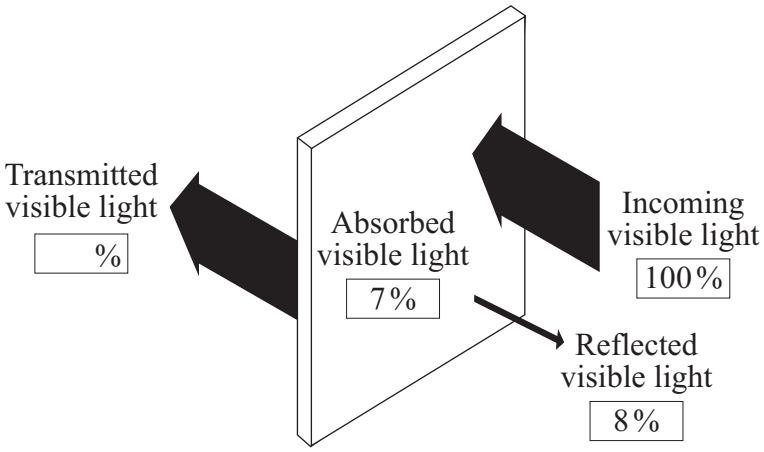
6

4.6.2.4 Uses and applications of electromagnetic waves

Question 83

3 Glass reflects, absorbs and transmits both infra red radiation and visible light.

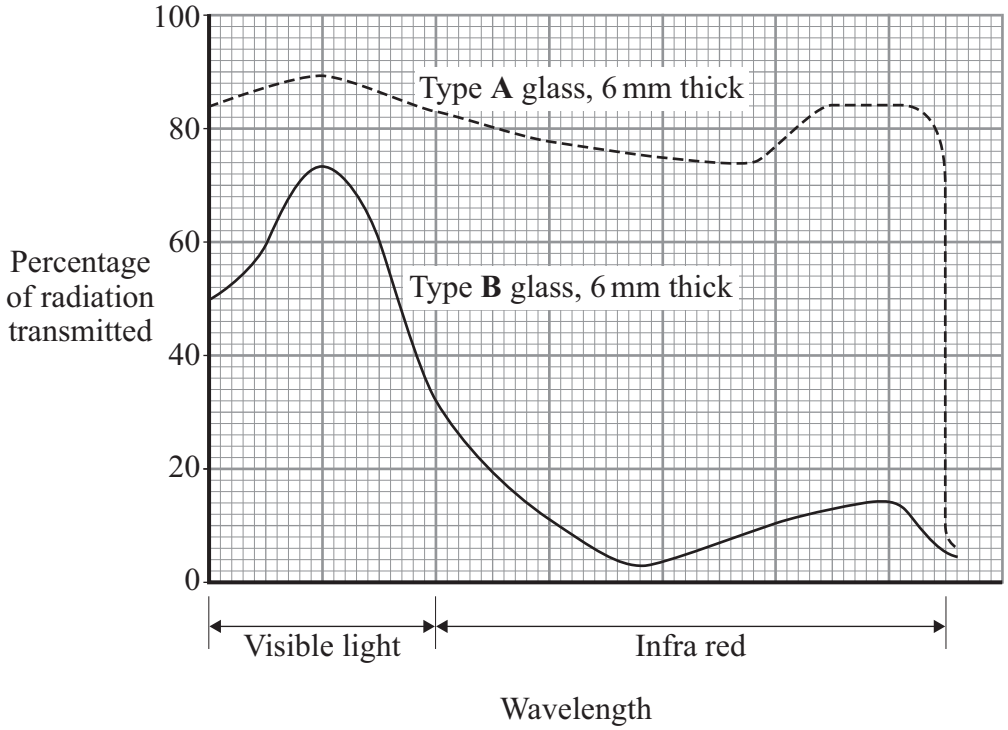
3 (a) The diagram shows the percentages of visible light that are reflected and absorbed by one type of glass.



What percentage of visible light is transmitted by this type of glass?

..... %
(1 mark)

3 (b) The amounts of infra red radiation and visible light transmitted by glass depend on the type and thickness of glass. The data obtained from tests on two different types of glass is displayed in the graph below.



4.6.2.4 Uses and applications of electromagnetic waves

Question 83 · continued

for mark

3 (b) (i) To be able to compare the two types of glass, it was important to control one variable.

What variable was controlled in the tests?

.....

(1 mark)

3 (b) (ii) A homeowner has a glass conservatory built on the back of the house. The homeowner tells the builder that the inside of the conservatory should stay as cool as possible throughout the summer.

Explain why the builder uses 'type **B**' glass for the conservatory.

.....

.....

.....

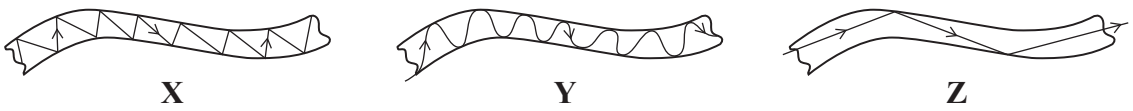
.....

(2 marks)

3 (c) Infra red and visible light can be used to send signals along an optical fibre.

Which **one** of the following diagrams, **X**, **Y** or **Z**, shows the path taken by a signal as it travels along an optical fibre?

Draw a ring around the correct diagram.



X **Y** **Z**

(1 mark)

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 84

5 (a) An optical telescope, used to observe stars, is to be built either at the bottom or at the top of a high mountain.

5 (a) (i) What type of electromagnetic radiation is detected by an optical telescope?

.....

(1 mark)

5 (a) (ii) Give **one** advantage of having the telescope at the top of the high mountain rather than at the bottom.

.....

.....

(1 mark)

5 (b) Gamma radiation from the Sun is absorbed by the atmosphere.

Where should a telescope designed to detect gamma radiation be positioned?

.....

.....

(1 mark)

5 (c) By observing distant galaxies, scientists have found evidence to support the 'Big Bang' theory.

Which statement about the 'Big Bang' theory is correct?

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

Scientists have proved beyond doubt that it happened. ☐

It is the only way of explaining the origin of the Universe. ☐

The Universe began from a very small point. ☐

(1 mark)

4

4.6.2.4 Uses and applications of electromagnetic waves

Question 85

March 2010 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Different types of electromagnetic radiation have different hazards.

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

A microwaves

B ultraviolet rays

C visible light

D X-rays

	Possible hazard
1	could cause skin cancer during sunbathing
2	could cause blindness if you look directly at the Sun
3	could kill cells deep inside your body
4	could damage your brain while using a mobile phone

4.6.2.4 Uses and applications of electromagnetic waves

Question 86

March 2010 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The table shows part of the electromagnetic spectrum.

Gamma		Ultraviolet		Infra red		Radio

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

A gamma

B infra red

C radio

D ultraviolet

The part of the electromagnetic spectrum with the longest wavelengths is . . . **1** . . . .

Between X-rays and visible light in the electromagnetic spectrum is . . . **2** . . . radiation.

Some radioactive isotopes emit . . . **3** . . . radiation.

Signals can be sent from remote controls to a television by . . . **4** . . . radiation.

4.6.2.4 Uses and applications of electromagnetic waves

Question 87

March 2010 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

This question is about types of radiation.

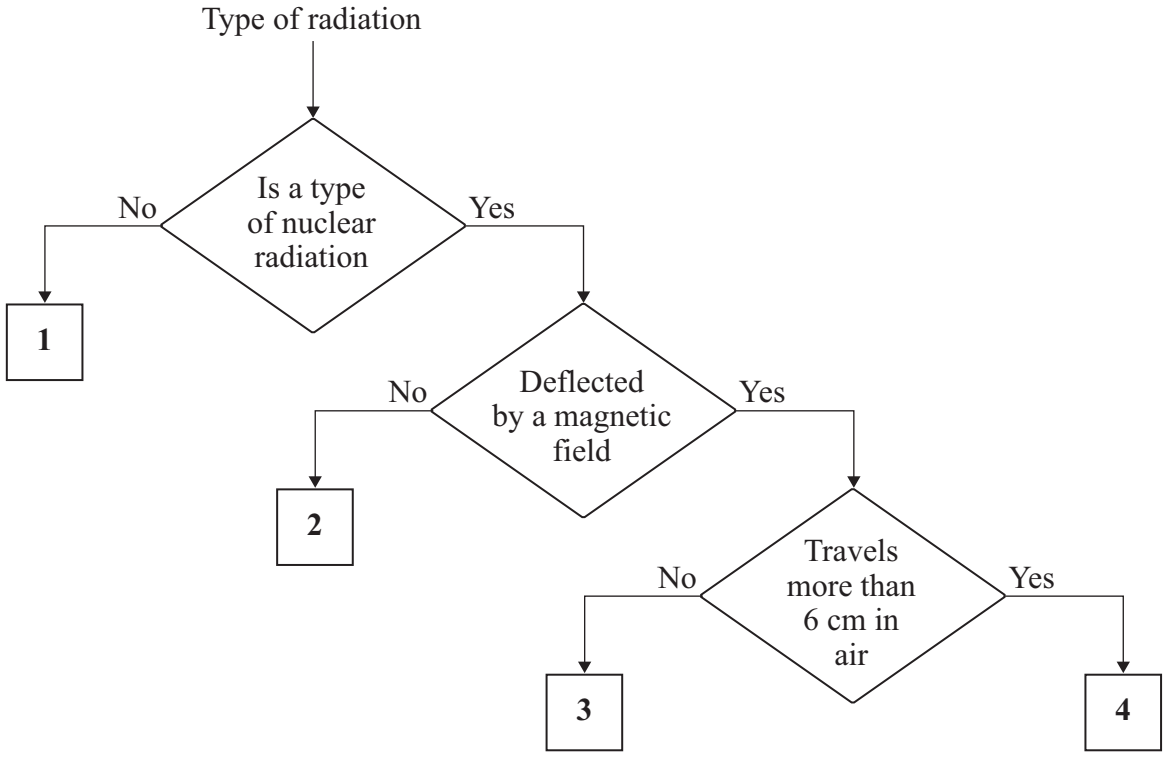
Match radiations, **A**, **B**, **C** and **D**, with the boxes **1–4** on the flow diagram.

A alpha

B beta

C gamma

D X-rays



4.6.2.4 Uses and applications of electromagnetic waves

Question 88

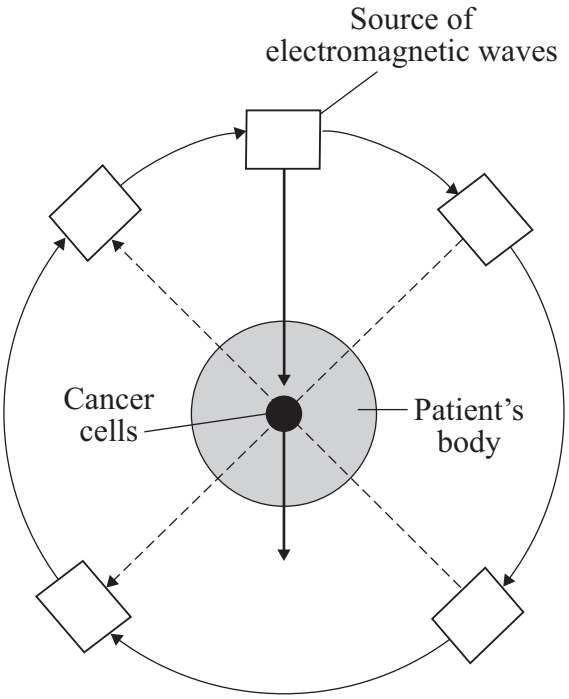
March 2010 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Cancer cells can be killed using some types of electromagnetic waves.

One treatment concentrates a beam of electromagnetic waves onto the cancer cells.

The source of the waves rotates around the patient's body.



6A The electromagnetic waves deliver energy to kill cancer cells.

What type of electromagnetic waves can be used to kill cancer cells?

1 gamma

2 microwave

3 radio

4 ultraviolet

4.6.2.4 Uses and applications of electromagnetic waves

Question 88 · continued March 2010 | PHY1BP | Original Q6 | Legacy

6B This treatment is effective because . . .

1 the energy is spread evenly over the whole body.

2 the energy is concentrated on the cancer cells.

3 the waves all have the same wavelength.

4 the waves all travel at the same speed.

6C The electromagnetic waves used do not cause as much damage to the surrounding cells as they do to the cancer cells.

This is because . . .

1 electromagnetic waves do not affect normal cells.

2 only the cancer cells receive the maximum amount of energy.

3 the normal cells are first treated to protect them.

4 the waves pass through gaps between the normal cells.

6D This type of treatment is not always available to cancer patients. One of the reasons for this is the high cost of the equipment.

What type of issue is this?

1 economic

2 environmental

3 scientific

4 social

4.6.2.4 Uses and applications of electromagnetic waves

Question 89

March 2010 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

There are two types of communication signal: analogue and digital.

9A Which pair of diagrams correctly shows the patterns for digital and analogue signals?

	Digital signal pattern	Analogue signal pattern
1		
2		
3		
4		

9B One reason for using digital signals rather than analogue signals for communication is that . . .

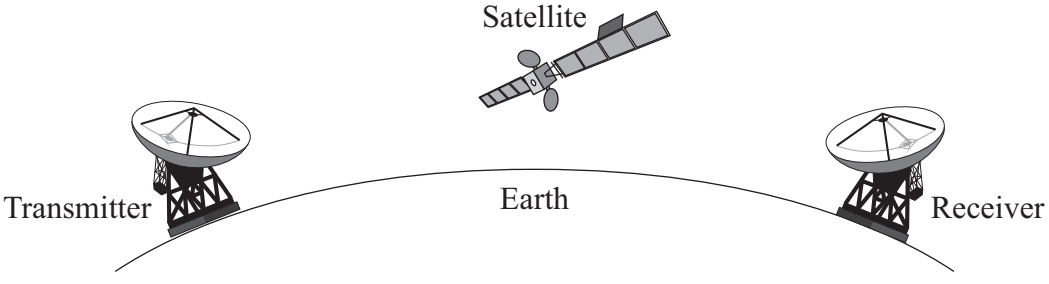
1 analogue signals are less prone to interference.

2 analogue signals can have only two values.

3 digital signals are continuously variable.

4 digital signals can be easily processed by computers.

9C Satellites in orbit around the Earth receive and transmit microwave signals for international telephone communication.



Microwaves are used because . . .

1 they are the only type of electromagnetic wave that can travel through a vacuum.

2 they are not absorbed by the Earth's atmosphere.

3 they follow the curvature of the Earth.

4 they travel faster than radio waves.

4.6.2.4 Uses and applications of electromagnetic waves

Question 89 · continued

9D Properties of waves are often demonstrated in schools using waves on water.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

A wave generator with a frequency of 50 Hz produces water waves with a wavelength of 2 cm.

At what speed do the waves travel?

1 1 m/s

2 25 m/s

3 100 m/s

4 2500 m/s

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 90

June 2010 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Electromagnetic radiation can be grouped into types. Each type has a different range of wavelengths.

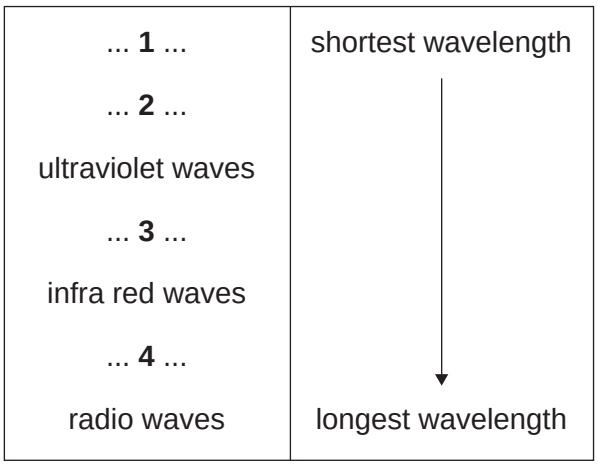
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the diagram.

A gamma rays

B microwaves

C visible light

D X-rays



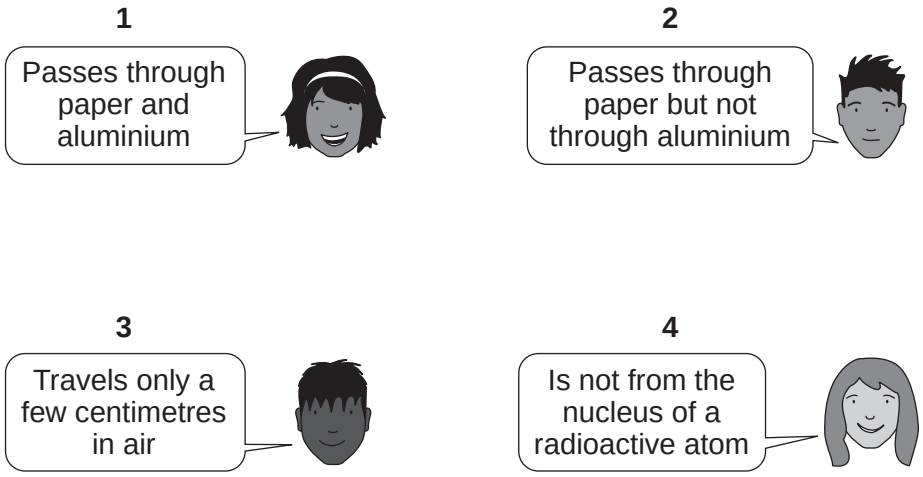
4.6.2.4 Uses and applications of electromagnetic waves

Question 91

June 2010 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

Four students are describing the properties of different types of radiation.



Match types of radiation, **A**, **B**, **C** and **D**, with the descriptions **1–4**.

A alpha

B beta

C gamma

D X-rays

4.6.2.4 Uses and applications of electromagnetic waves

Question 92

June 2010 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

The table gives uses for four types of radiation.

Match types of radiation, **A**, **B**, **C** and **D**, with the uses **1–4** in the table.

A alpha

B beta

C gamma

D X-rays

	Use
1	in medical tracers
2	in smoke detectors
3	to control the thickness of paper during manufacture
4	usually used to take shadow photographs of bones

4.6.2.4 Uses and applications of electromagnetic waves

Question 93

June 2010 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

In 1896, Henri Becquerel was doing an experiment with uranium.

6A Becquerel thought that uranium absorbed energy from the Sun, and then re-emitted the energy as X-rays.

This was . . .

1 a conclusion.

2 an estimate.

3 an observation.

4 a theory.

6B Becquerel found that the uranium emitted radiation even when the sample was sealed in black paper.

He had discovered radioactivity.

Becquerel had to change his ideas because . . .

1 the Sun does not provide energy on a cloudy day.

2 sunlight could not pass through the black paper.

3 X-rays could not pass through the black paper.

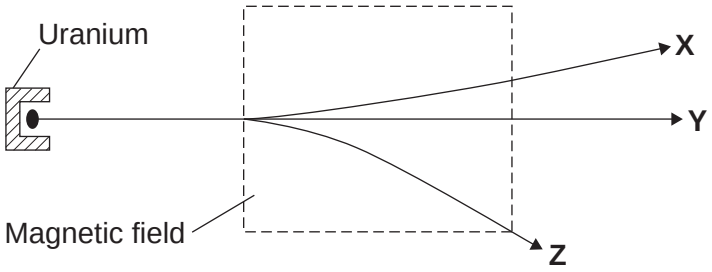
4 radiation could not pass through the black paper.

4.6.2.4 Uses and applications of electromagnetic waves

Question 93 · continued

6C When Becquerel passed the radiation emitted by uranium through a magnetic field, he found that there were three different types of radiation.

The diagram shows the paths of the three types of radiation, **X**, **Y** and **Z**, in the magnetic field.



Which of the following is the path of gamma radiation?

1 **X**

2 **Y**

3 **Z**

4 **X** and **Z**

6D Two types of radiation were deflected in the magnetic field.

These two types of radiation were deflected because they are . . .

1 electrically charged.

2 electrically neutral.

3 have a smaller mass than the third type of radiation.

4 have a bigger mass than the third type of radiation.

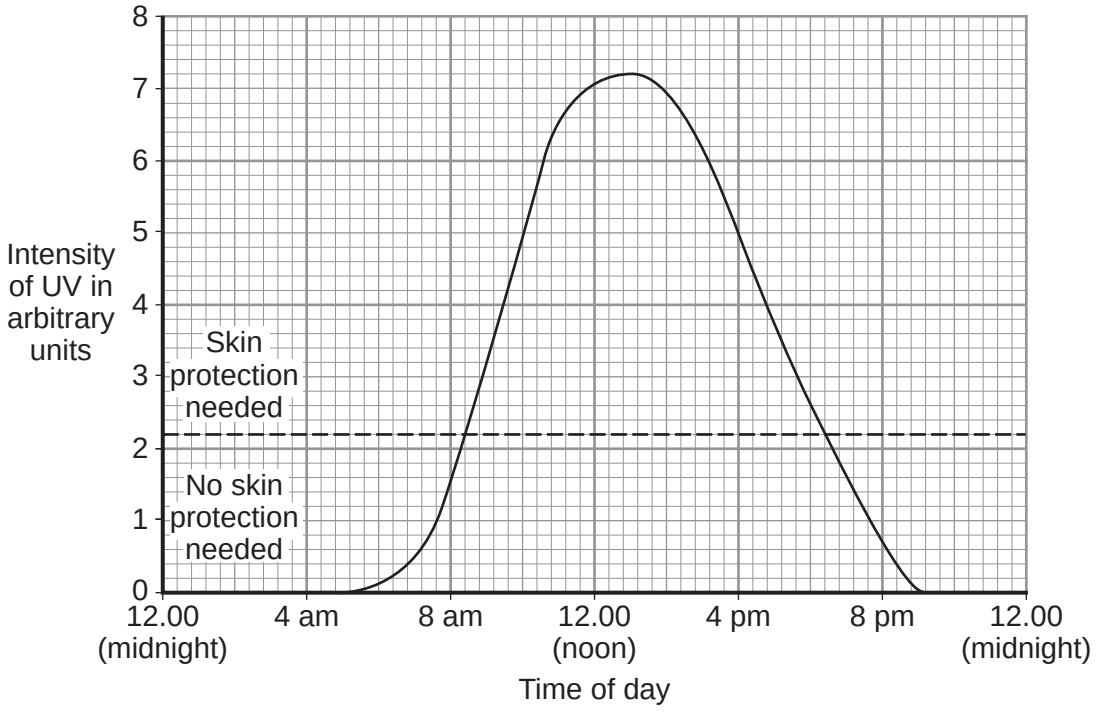
4.6.2.4 Uses and applications of electromagnetic waves

Question 94

June 2010 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.



8A The intensity of UV radiation reaches a maximum at . . .

1 9.30 am

2 12.00 noon

3 1.00 pm

4 5.00 pm

8B The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

1 0 hours

2 7 hours

3 10 hours

4 16 hours

4.6.2.4 Uses and applications of electromagnetic waves

Question 94 · continued

8C For a typical day in December in the UK, how would you expect the graph to be different?

	Peak	Area under the graph
1	higher	the same
2	lower	the same
3	higher	bigger
4	lower	smaller

8D UV radiation travels as an electromagnetic wave.

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

	Speed of UV compared with visible light	Frequency of UV compared with visible light
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

4.6.2.4 Uses and applications of electromagnetic waves

Question 95

June 2010 | PHY1F | Original Q2 | Legacy

2 The diagram shows the seven types of wave that make up the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet rays	Visible light	Infra red rays	Micro-waves	Radio waves

2 (a) (i) Microwaves and visible light can be used for communications.

Name **one** more type of electromagnetic wave that can be used for communications.

.....

(1 mark)

2 (a) (ii) Name **one** type of electromagnetic wave that has a longer wavelength than microwaves.

.....

(1 mark)

2 (b) Wi-Fi is a system that joins a laptop computer to the internet without using wires. A 2400 megahertz microwave signal is used to link a computer to a device called a router.

What quantity is measured in hertz?

Draw a ring around your answer.

frequency **wavelength** **wave speed**

(1 mark)

2 (c) A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

2 (c) (i) Suggest **one** reason why more scientific research into the safety of Wi-Fi systems is needed.

.....

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 95 · continued

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

What the politician said was

a fact.
an opinion.
a prediction.

(1 mark)

5

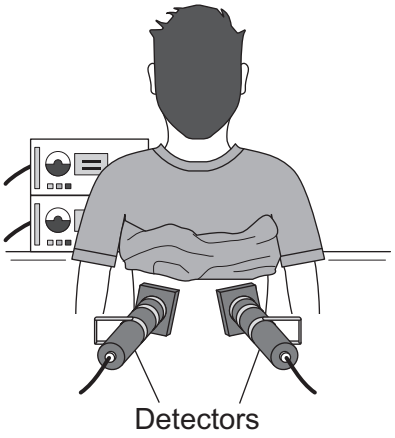
Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 96

June 2010 | PHY1F | Original Q7 | Legacy

7 (a) A doctor uses the radioactive isotope technetium-99 to find out if a patient's kidneys are working correctly.



The doctor injects a small amount of technetium-99 into the patient's bloodstream.

Technetium-99 emits *gamma radiation*.

Give **two** reasons why an isotope that emits gamma radiation is injected into the patient rather than an isotope that emits alpha radiation.

1 .....

.....

2 .....

.....

(2 marks)

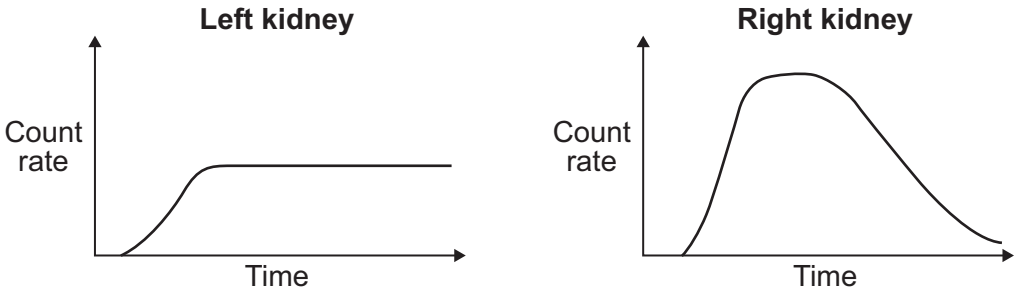
4.6.2.4 Uses and applications of electromagnetic waves

Question 96 · continued

7 (b) If the patient's kidneys are working correctly, the technetium-99 will pass from the bloodstream into the kidneys and then into the patient's urine.

Detectors are used to measure the radiation emitted from the kidneys.

The level of radiation emitted from each kidney is recorded on a graph.



7 (b) (i) How do the graphs show that technetium-99 is passing from the bloodstream into each kidney?

.....

.....

(1 mark)

7 (b) (ii) By looking at the graphs, the doctor is able to tell if there is a problem with the patient's kidneys.

Which **one** of the following statements is correct?

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

Only the right kidney is working correctly. ☐

Only the left kidney is working correctly. ☐

Both kidneys are working correctly. ☐

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

Question 7 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 96 · continued

7 (c) The patient was worried about having a radioactive isotope injected into their body. The doctor explained that the risk to the patient's health was very small as technetium-99 has a short *half-life*.

7 (c) (i) What does the term *half-life* mean?

.....

.....

(1 mark)

7 (c) (ii) Explain why it is important that the doctor uses an isotope with a short half-life rather than an isotope with a long half-life.

.....

.....

.....

.....

(2 marks)

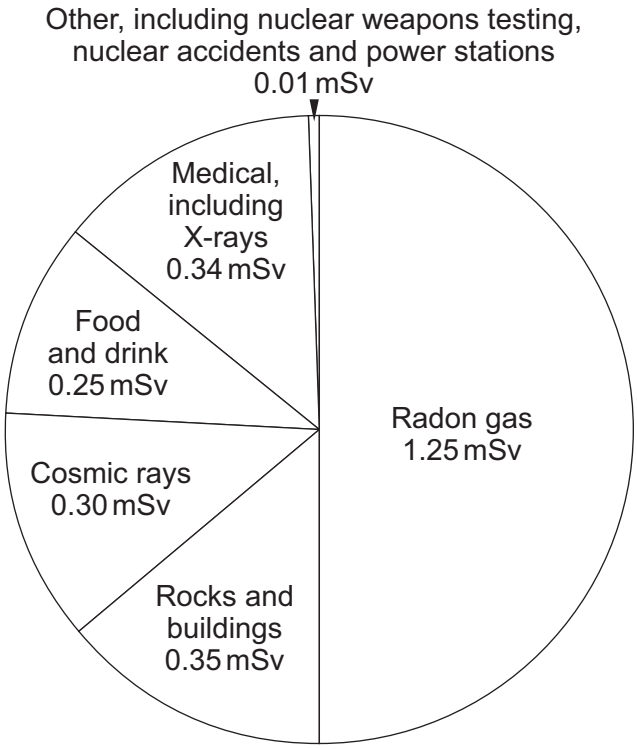
9

4.6.2.4 Uses and applications of electromagnetic waves

Question 97

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)

4.6.2.4 Uses and applications of electromagnetic waves

Question 97 · 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

4.6.2.4 Uses and applications of electromagnetic waves

Question 97 · 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

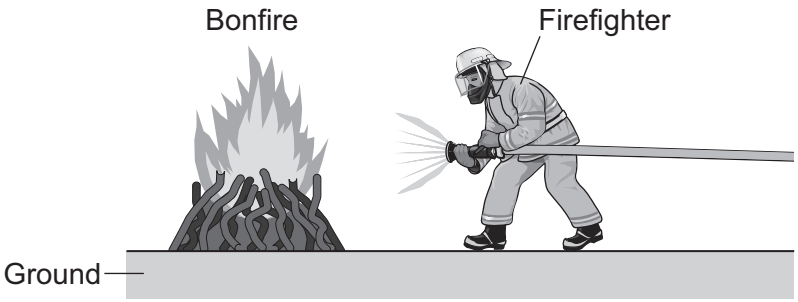
4.6.2.4 Uses and applications of electromagnetic waves

Question 98

November 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The drawing shows a firefighter putting out a bonfire. The firefighter wears thick, woollen clothing. The clothing has a light-coloured, shiny surface.



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

A conduction

B insulation

C radiation

D reflection

Heat is transferred from the fire to the firefighter's clothing by . . . **1** . . . .

The ground underneath the fire will get hot when heat is transferred to it by . . . **2** . . . .

The thick, woollen clothing provides good heat . . . **3** . . . .

The light-coloured, shiny surface of the clothing provides good . . . **4** . . . of infra red.

4.6.2.4 Uses and applications of electromagnetic waves

Question 99

November 2010 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Different types of electromagnetic radiation affect living tissue and cells in different ways.

Match types of radiation, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

A infra red

B ultraviolet

C visible light

D X-rays

	The radiation . . .
1	can be felt by the skin as heat.
2	can pass through fleshy tissue but is absorbed by bone.
3	can be detected by special cells in the eye.
4	can be absorbed by the skin and cause a suntan.

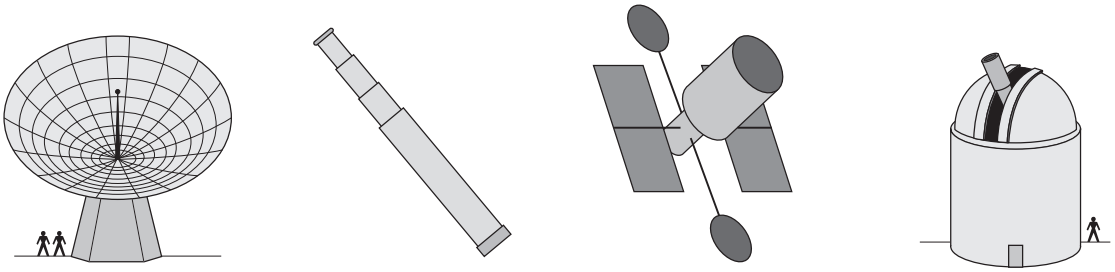
4.6.2.4 Uses and applications of electromagnetic waves

Question 100

November 2010 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The drawings show different types of telescope. They are not drawn to scale.



1 2 3 4

Not to scale

Match descriptions, **A**, **B**, **C** and **D**, with the telescopes **1**–**4**.

A can be used by anyone to view the surface of the Moon

B in orbit around the Earth

C built on the top of a mountain and can be used to view planets

D used by scientists to detect radio waves from space

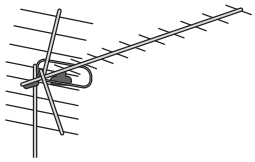
4.6.2.4 Uses and applications of electromagnetic waves

Question 101

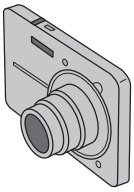
November 2010 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

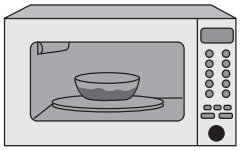
The drawings show devices that use electromagnetic waves.



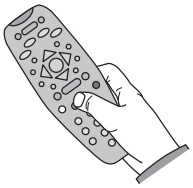
1



2



3



4

Match types of electromagnetic wave, **A**, **B**, **C** and **D**, with the devices **1**–**4**.

A infra red

B microwaves

C radio waves

D visible light

4.6.2.4 Uses and applications of electromagnetic waves

Question 102

November 2010 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows part of the electromagnetic spectrum.

1	X-rays	**2**	Visible light	**3**	Microwaves	**4**

Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1**–**4** on the diagram.

A gamma

B infra red

C radio

D ultraviolet

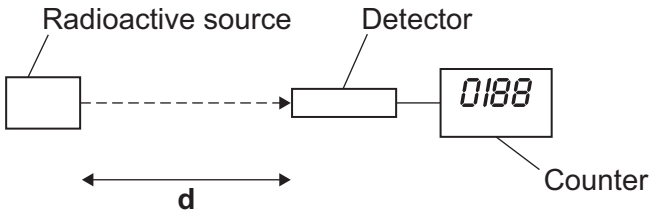
4.6.2.4 Uses and applications of electromagnetic waves

Question 103

November 2010 | PHY1BP | Original Q6 | Legacy

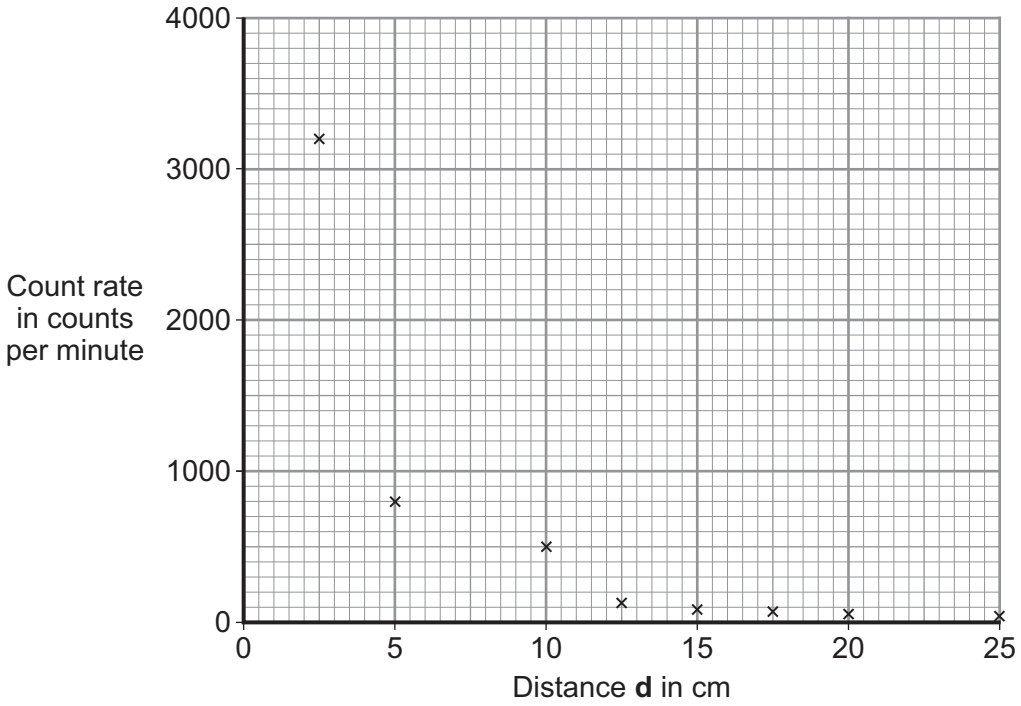
QUESTION SIX

A radioactive source gives out gamma radiation. A student wanted to know how the count rate from the source changes as the distance from the source increases. The following apparatus was set up.



The count rate was measured for a number of different distances, **d**.

The student plotted the results on graph paper.



4.6.2.4 Uses and applications of electromagnetic waves

6A A line graph should be drawn because . . .

1 both variables are categoric.

2 both variables are continuous.

3 both variables are ordered.

4 one variable is categoric and the other variable is continuous.

6B The range of distance measurements is . . .

1 2.5 – 5.0 cm

2 2.5 – 10.0 cm

3 2.5 – 20.0 cm

4 2.5 – 25.0 cm

6C Each reading was repeated twice and the mean calculated.

This made the data more . . .

1 accurate.

2 discrete.

3 reliable.

4 sensitive.

6D The result shown at 10 cm is anomalous and . . .

1 the graph line should be drawn to pass through this result.

2 was caused by a systematic error in the ruler.

3 was caused by a systematic error in the counter.

4 should be ignored when drawing the graph line.

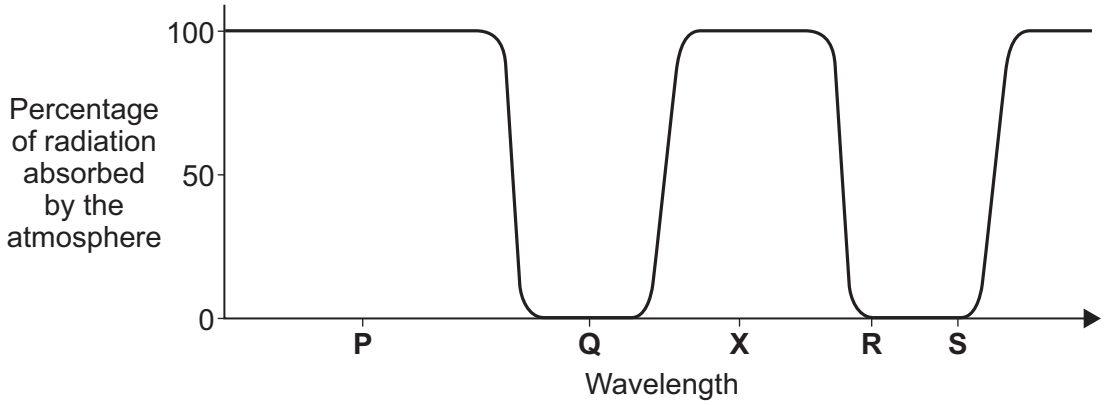
4.6.2.4 Uses and applications of electromagnetic waves

Question 104

November 2010 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

The graph shows how the Earth's atmosphere absorbs different wavelengths of electromagnetic waves.



7A Which wavelength, **P**, **Q**, **R** or **S**, does not reach the Earth's surface?

1 **P**

2 **Q**

3 **R**

4 **S**

7B The wavelength labelled **X** is in the infra red region.

Some objects in space emit infra red radiation.

Where would you put a telescope to collect infra red radiation from objects in space?

1 above the Earth's atmosphere

2 on a high mountain

3 at ground level in a hot desert

4 at ground level in the Antarctic

4.6.2.4 Uses and applications of electromagnetic waves

- The Hubble Space Telescope (HST) is in orbit around the Earth.
- Astronauts from a space shuttle can repair the HST if it breaks down.
- In 2003, a space shuttle returning to Earth exploded.
- After this explosion it was decided to stop sending astronauts to repair the HST.

7C This decision was later changed and in 2009 it was decided to send another space mission to repair the HST.

What is the most likely reason for this?

1 Space missions are now completely safe.

2 Astronomers want to keep using the HST.

3 The HST has never sent data back to Earth.

4 To give jobs to engineers.

7D The HST sends data back to Earth.

Electromagnetic waves labelled **R** on the graph are used to send the data.

The waves labelled **R** are used because the . . .

1 waves have a shorter wavelength than infra red.

2 atmosphere absorbs the waves.

3 atmosphere does not absorb the waves.

4 waves are in the visible light region.

4.6.2.4 Uses and applications of electromagnetic waves

Question 105

January 2011 | PHY1F | Original Q3 | Legacy

3 (a) The names of the three types of nuclear radiation are given in **List A**.
Some properties of these types of radiation are given in **List B**.

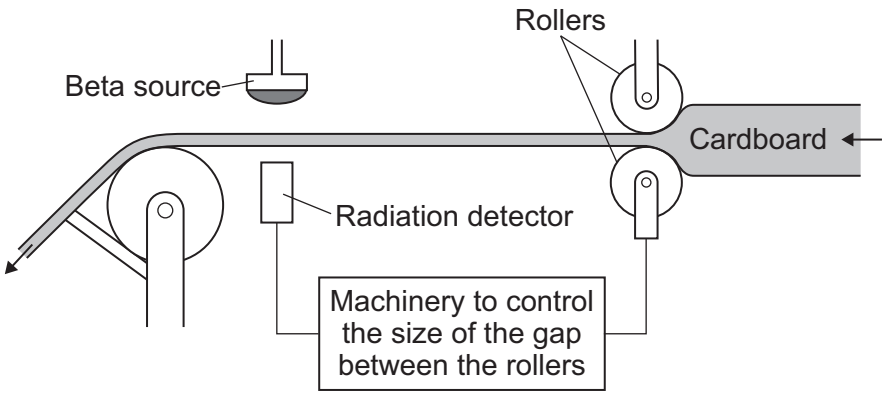
Draw a straight line to link each type of radiation in **List A** to its correct property in **List B**.

Draw only **three** lines.

List A **Type of nuclear radiation**	**List B** **Property of radiation**
Alpha	Has the same mass as an electron
Beta	Very strongly ionising
Gamma	Passes through 10 cm of aluminium
	Deflected by a magnetic field but not deflected by an electric field

(3 marks)

3 (b) The diagram shows a system used to control the thickness of cardboard as it is made.



4.6.2.4 Uses and applications of electromagnetic waves

Question 105 · continued

The cardboard passes through a narrow gap between a beta radiation source and a radiation detector.

The table gives the detector readings over 1 hour.

Time	Detector reading
08:00	150
08:15	148
08:30	151
08:45	101
09:00	149

3 (b) (i) Between 08:00 and 08:30, the cardboard is produced at the usual, correct thickness.

Explain how you can tell from the detector readings that the cardboard produced at 08:45 is thicker than usual.

.....

.....

.....

.....

(2 marks)

3 (b) (ii) Which would be the most suitable half-life for the beta source?

Draw a ring around your answer.

six days **six months** **six years**

(1 mark)

3 (b) (iii) This control system would **not** work if the beta radiation source was replaced by an alpha radiation source.

Why not?

.....

.....

(1 mark)

7

4.6.2.4 Uses and applications of electromagnetic waves

Question 106

January 2011 | PHY1F | Original Q6 | Legacy

6 Small sailing boats can be fitted with a passive radar device. The device increases the chance that the small boat will be seen on the radar screen of a large ship.
The radar transmitter on the large ship emits microwaves.

6 (a) Microwaves and radio waves are both part of the electromagnetic spectrum.

How are microwaves different from radio waves?

.....

.....

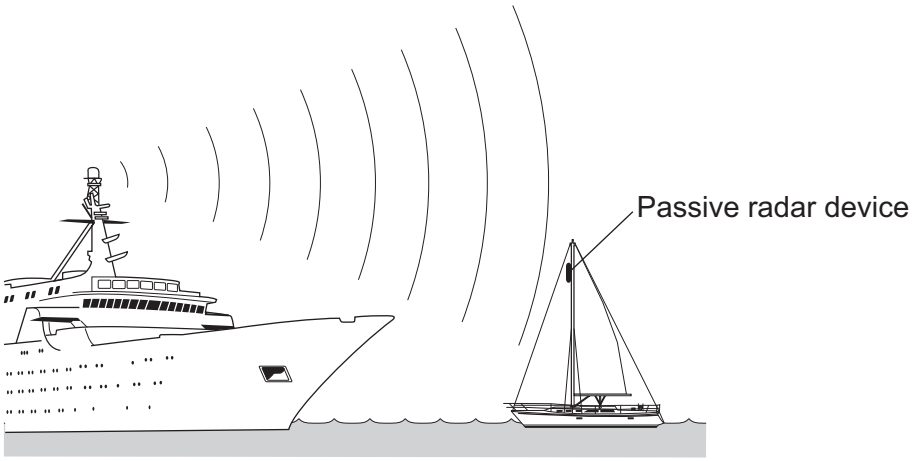
(1 mark)

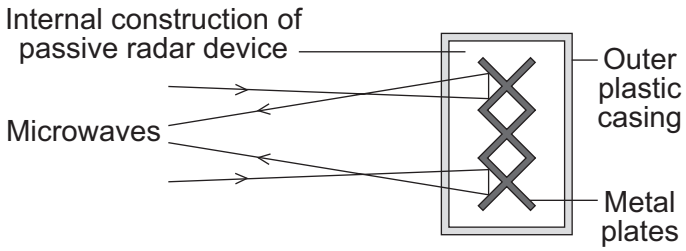
6 (b) How fast do microwaves travel through the air or a vacuum compared to radio waves?

.....

(1 mark)

6 (c) The diagrams show the position of a passive radar device on a small boat and the internal construction of one type of passive radar device.





4.6.2.4 Uses and applications of electromagnetic waves

Question 106 · continued

Microwaves can be absorbed, reflected or transmitted by different materials and types of surface.

Explain what happens to the microwaves from the ship's transmitter when they reach the passive radar device.

.....

.....

.....

.....

(2 marks)

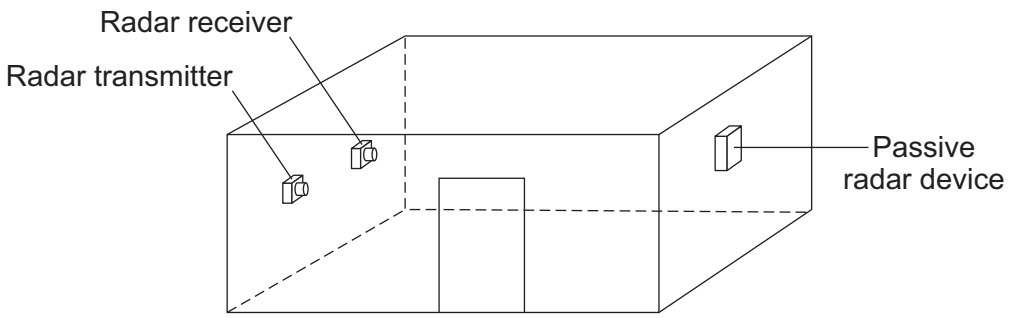
Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 106 · continued

6 (d) Each type of passive radar device has an RCS value. The larger the RCS value, the easier it is for a small boat fitted with the device to be detected.

An independent group of scientists measured the RCS values of 4 different types of device. The RCS value for each device was measured in the same room using the same equipment.



6 (d) (i) Why are the walls of the room covered in a material that absorbs the waves emitted by the radar transmitter?

.....

.....

(1 mark)

6 (d) (ii) Why is it important to use the same room and the same equipment?

.....

.....

(1 mark)

6 (d) (iii) Why is it important that the measurements are made by an independent group of scientists?

.....

.....

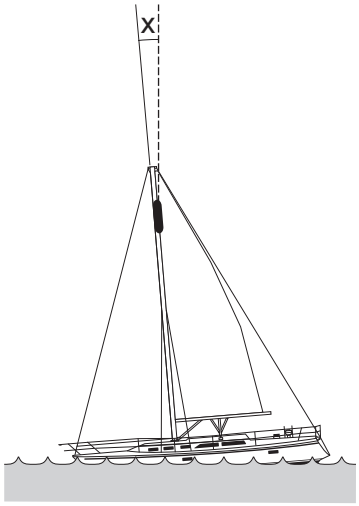
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 106 · continued

6 (e) The movement of a small boat causes the mast and device to lean over, therefore the RCS values were measured at different angles.

The table gives the RCS values obtained by the scientists.



Device	Angle X			
	0°	5°	10°	15°
A	1.4	1.6	1.7	1.8
B	4.7	2.6	2.3	1.9
C	9.3	3.3	1.9	1.1
D	4.5	4.8	5.0	4.6

6 (e) (i) Describe how the RCS values for **device A** are different to the RCS values for **device B**.

.....

.....

.....

.....

(2 marks)

6 (e) (ii) The scientists recommended that a passive radar device fitted to a small boat should have:

- the largest possible RCS value
- an RCS value consistently above 2.0

Which **one** of the devices, **A**, **B**, **C** or **D**, would you recommend that someone fits to their boat?

.....

Give a reason for your answer.

.....

.....

(1 mark)

10

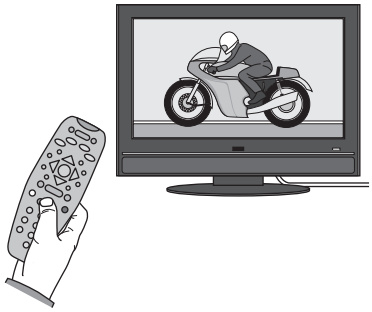
4.6.2.4 Uses and applications of electromagnetic waves

Question 107

March 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about electromagnetic radiation and television.



Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A infra red

B microwaves

C radio waves

D visible light

Television signals from a transmitter on Earth are carried by . . . **1** . . . .

Television signals from a satellite are carried by . . . **2** . . . .

A television remote control uses . . . **3** . . . .

A television screen is designed to produce . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 108

March 2011 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

Electromagnetic radiation can be absorbed, reflected and transmitted.

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

A infra red

B microwaves

C visible light

D X-rays

A mirror is designed to reflect . . . **1** . . . .

Mobile phone masts are designed to transmit . . . **2** . . . .

The metal surface inside an oven is designed to reflect . . . **3** . . . .

Lead-lined aprons used in hospitals are designed to absorb . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 109

March 2011 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

This question is about gamma radiation.

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

A bacteria

B cells

C isotopes

D particles

Gamma radiation is emitted by the nuclei of radioactive . . . **1** . . . .

Gamma radiation can be used by doctors to kill cancer . . . **2** . . . .

Gamma radiation can be used to kill . . . **3** . . . that cause food to rot.

Unlike alpha and beta radiation, gamma radiation does not consist of . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 110

March 2011 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

The waves in the electromagnetic spectrum can be grouped in order of wavelength.

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

A gamma rays

B infra red rays

C radio waves

D ultraviolet rays

. . . **1** . . .
X-rays
. . . **2** . . .
visible light
. . . **3** . . .
microwaves
. . . **4** . . .

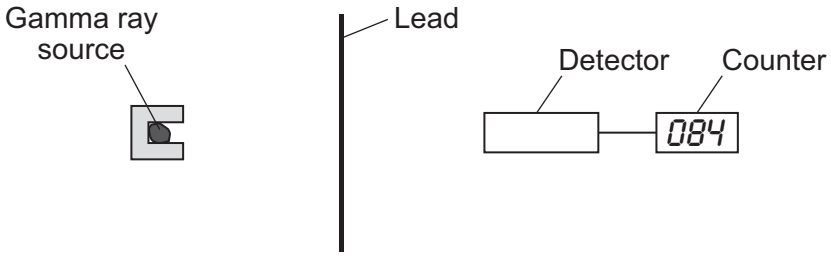
4.6.2.4 Uses and applications of electromagnetic waves

Question 111

March 2011 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

A student investigated the absorption of gamma rays. He used lead of different thicknesses.



He increased the thickness of the lead by 1 mm each time and measured the count rate.

His results are shown in the table.

Thickness of lead in mm	Count rate in counts per second
0	100
1	84
2	70
3	60
4	50
5	44
6	35
7	30
8	25

7A What was the interval used in the thickness of the lead sheets?

1 1 mm

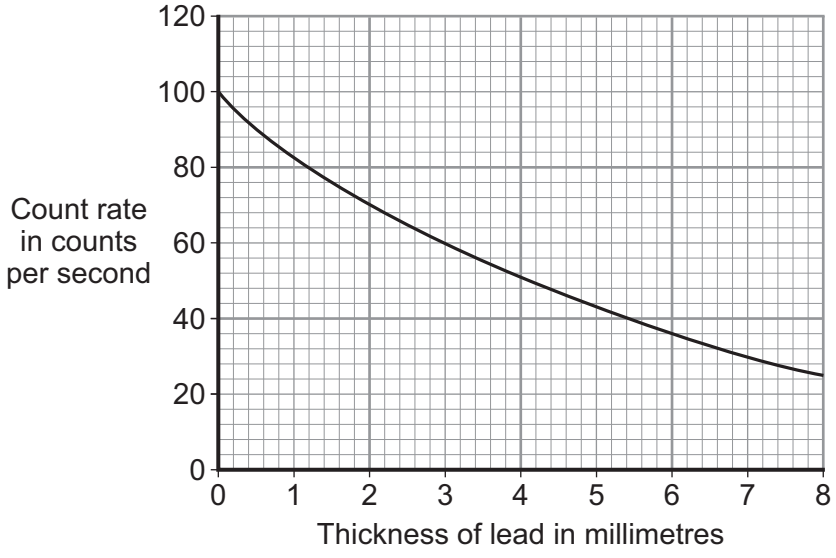
2 2 mm

3 5 mm

4 10 mm

Question 111 · continued March 2011 | PHY1BP | Original Q7 | Legacy

The graph shows the results.



7B The graph shows that . . .

1 doubling the thickness of lead doubles the count rate.

2 there is no relationship between thickness and count rate.

3 doubling the thickness of lead makes the count rate three times bigger.

4 the thicker the lead, the lower the count rate.

7C A thickness of 2 mm of lead will reduce the count rate by . . .

1 30 counts per second.

2 40 counts per second.

3 50 counts per second.

4 70 counts per second.

7D What thickness of lead reduced the count rate to half of its original value?

1 1 mm

2 4 mm

3 9 mm

4 10 mm

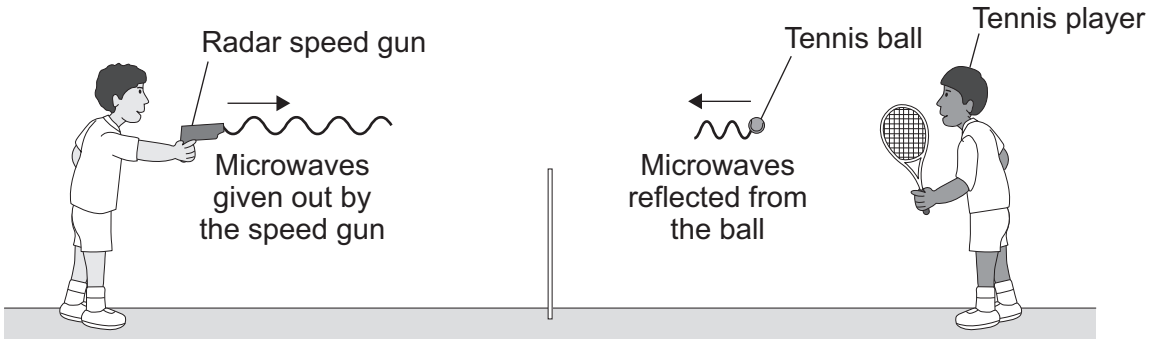
4.6.2.4 Uses and applications of electromagnetic waves

Question 112

March 2011 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

The picture shows a radar speed gun being used to measure how fast a tennis player hits the ball.



Some of the microwaves from the radar speed gun are absorbed by the ball and some are reflected by the ball.

8A What effect will the absorbed microwaves have on the ball?

1 The temperature of the ball will increase slightly.

2 The ball will go faster.

3 The temperature of the ball will decrease slightly.

4 The ball will go slower.

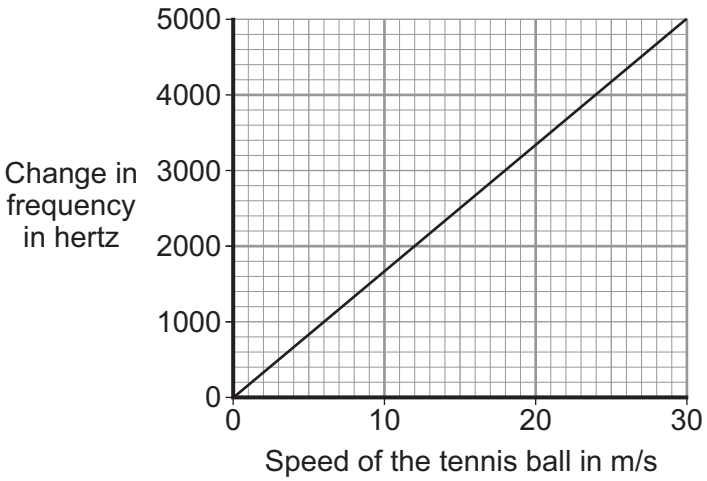
8B Which row in the table describes how the frequency and wavelength of the reflected microwaves are different from the microwaves given out by the speed gun?

	Frequency of reflected waves	Wavelength of reflected waves
1	higher	longer
2	lower	shorter
3	higher	shorter
4	lower	longer

4.6.2.4 Uses and applications of electromagnetic waves

Question 112 · continued

The graph shows how the change in frequency of the microwaves depends on the speed of the ball.



8C The data has been drawn as a line graph because . . .

1 frequency and speed are both categoric variables.

2 frequency and speed are both continuous variables.

3 frequency is a categoric variable and speed is a continuous variable.

4 frequency is a continuous variable and speed is a categoric variable.

8D The speed gun measures the change in frequency as 3000 Hz.

What is the speed of the ball?

1 18 m/s

2 20 m/s

3 21 m/s

4 22 m/s

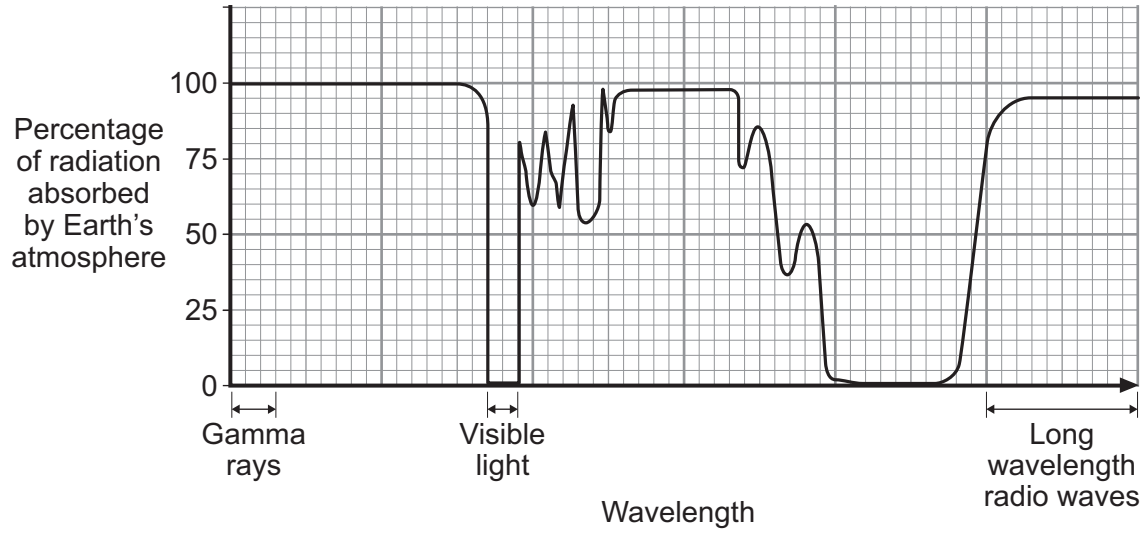
4.6.2.4 Uses and applications of electromagnetic waves

Question 113

March 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The diagram shows the absorption of electromagnetic radiation by the Earth's atmosphere.



9A The diagram shows that . . .

1 all wavelengths of gamma radiation reach the Earth's surface.

2 all wavelengths of radio waves reach the Earth's surface.

3 all wavelengths of ultraviolet radiation reach the Earth's surface.

4 all wavelengths of visible light reach the Earth's surface.

9B Some objects in space emit X-rays.

Where would you put a telescope to detect these X-rays?

1 above the Earth's atmosphere

2 at the top of a hill

3 at ground level in a hot desert

4 at ground level in the Antarctic

4.6.2.4 Uses and applications of electromagnetic waves

Question 113 · continued March 2011 | PHY1BP | Original Q9 | Legacy

The table gives information about some space telescopes.

Name	Hubble	Compton	Chandra	Spitzer
Launched in	1990	1991	1999	2003
Detects	infra red rays ultraviolet rays visible light	gamma rays	X-rays	infra red rays

9C Which statement about these space telescopes can be deduced from the information in the table?

1 They all collect data using mirrors.

2 They all detect electromagnetic radiation.

3 They are all in space at present.

4 They were all used to study the Earth.

9D From the information in the table, which one of the following emissions could be detected by one of these space telescopes?

1 alpha particles

2 nuclear radiation

3 radio waves

4 sound waves

END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 114

June 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Electromagnetic radiation has many uses.

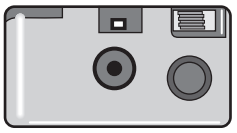
1

Toaster



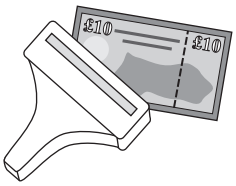
2

Camera



3

Forgery detector



4

Hospital scanner



Match useful types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the drawings labelled **1**–**4**.

A infra red

B ultraviolet

C visible light

D X-rays

4.6.2.4 Uses and applications of electromagnetic waves

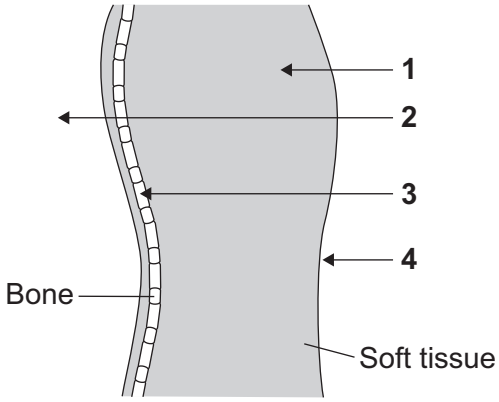
Question 115

June 2011 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The human body can be exposed to different types of radiation.

The arrows on the diagram show how far four types of radiation would penetrate.



Match types of radiation, **A**, **B**, **C** and **D**, with the arrows **1**–**4** on the diagram.

A alpha

B beta

C gamma

D X-rays

4.6.2.4 Uses and applications of electromagnetic waves

Question 116

June 2011 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

Electromagnetic waves can be dangerous.

People using electromagnetic waves have to protect themselves.

Match methods of protection, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A leaving the room to switch on the equipment

B looking through blackened glass

C wearing thick, insulating gloves

D using remotely controlled equipment

An astronomer watching an eclipse of the Sun protects his eyes by . . . **1** . . . .

A radiographer taking X-rays of patients protects herself by . . . **2** . . . .

A steelworker opening the door of a furnace protects himself by . . . **3** . . . .

A scientist working with radioactive materials protects himself by . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

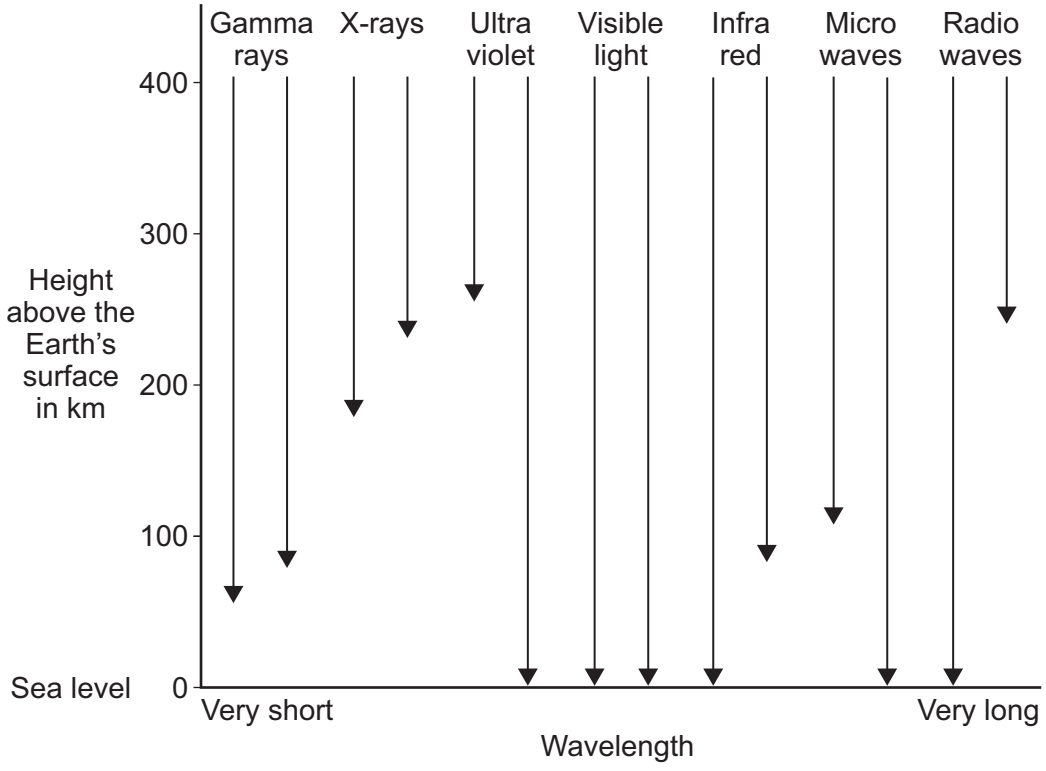
Question 117

June 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Telescopes can be based on the Earth's surface or put into orbit in space.

The diagram shows how far electromagnetic waves penetrate the Earth's atmosphere. For some types of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Telescopes on Earth detect **all** wavelengths of . . .

1 radio waves only.

2 visible light only.

3 radio waves and visible light.

4 visible light and X-rays.

9B Which of the following statements about the use of telescopes in space is true?

1 The atmosphere distorts the image produced by the telescope.

2 The telescopes are affected by light pollution from the Earth.

3 The telescopes can detect electromagnetic waves that cannot reach the Earth's surface.

4 The telescopes are easy to repair and maintain.

4.6.2.4 Uses and applications of electromagnetic waves

Question 117 · continued

The table gives information about some space telescopes. Each telescope detects a different type of electromagnetic radiation.

Telescope	Wavelength detected in nanometres
INTEGRAL	less than 0.01
Chandra	0.01 – 20
FUSE	20 – 400
Hubble	400 – 700
Spitzer	1000 – 1 000 000

9C The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

9D Which telescope detects X-rays?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

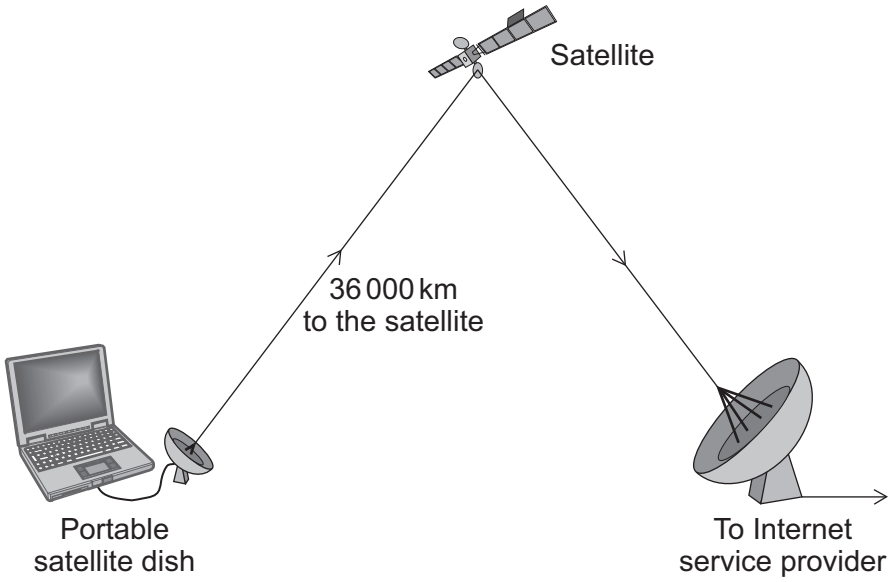
END OF TEST

4.6.2.4 Uses and applications of electromagnetic waves

Question 118

June 2011 | PHY1F | Original Q2 | Legacy

2 (a) The diagram shows a computer connected to the Internet using a satellite link.



2 (a) (i) Which **one** of the following types of electromagnetic wave is used to send information to the satellite?

Draw a ring around your answer.

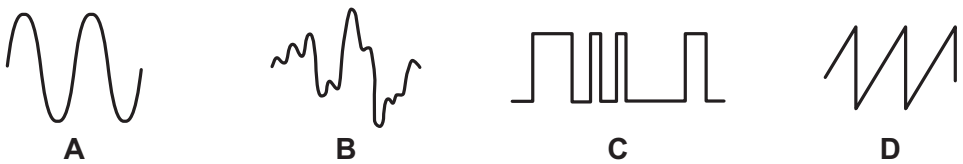
microwave **radio** **visible light**

(1 mark)

2 (a) (ii) The information is sent to the satellite using a digital signal.

Which **one** of the signals, **A**, **B**, **C** or **D**, is a digital signal?

Write your answer, **A**, **B**, **C** or **D**, in the box.



Signal ☐

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 118 · continued

2 (a) (iii) It is better to send information as a digital signal rather than as an analogue signal.

Which **one** of the following statements explains why?

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

Digital signals travel faster. ☐

Digital signals can be switched on and off. ☐

Digital signals are less affected by interference. ☐

(1 mark)

2 (b) Since 2009, people in some parts of Kenya have been able to connect to the Internet using signals sent through an optical fibre cable rather than via a satellite link.

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

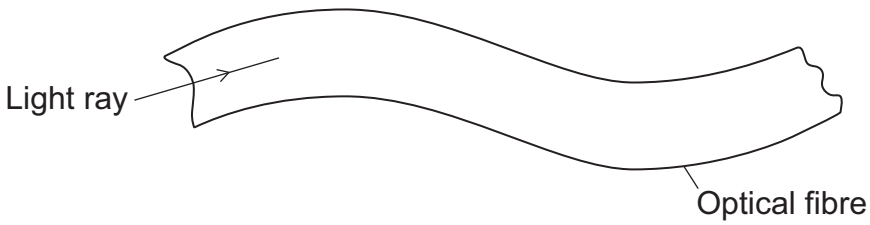
Visible light and

infra red
radio
ultraviolet

can be used to send signals along an optical fibre.

(1 mark)

2 (b) (ii) The diagram shows part of an optical fibre.



Complete the diagram to show how the light ray travels through the optical fibre.

(2 marks)

6

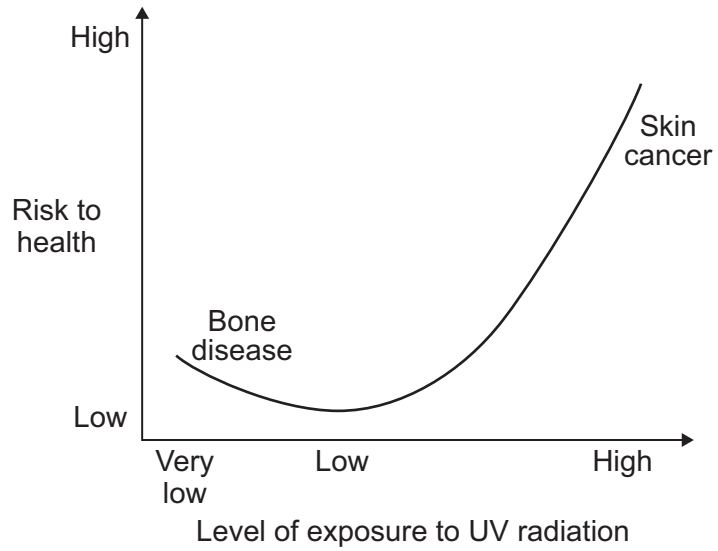
4.6.2.4 Uses and applications of electromagnetic waves

Question 119

June 2011 | PHY1F | Original Q3 | Legacy

3 Exposure to ultraviolet (UV) radiation can harm a person's health.

The graph shows how the risk to health depends on the level of exposure to UV.



3 (a) What level of exposure to UV radiation gives the highest health risk?

Draw a ring around your answer.

very low **low** **high**

(1 mark)

3 (b) The body needs vitamin D to prevent bone disease. The ultraviolet radiation in sunlight enables the body to produce vitamin D. Some people hardly ever go outside into direct sunlight.

3 (b) (i) Complete the following sentence by drawing a ring around the line in the box that is correct.

Staying inside will

reduce
not affect
increase

the risk of developing skin cancer.

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 119 · continued

3 (b) (ii) How will staying inside affect the risk of developing bone disease?

.....

Give a reason for your answer.

.....

.....

(2 marks)

4

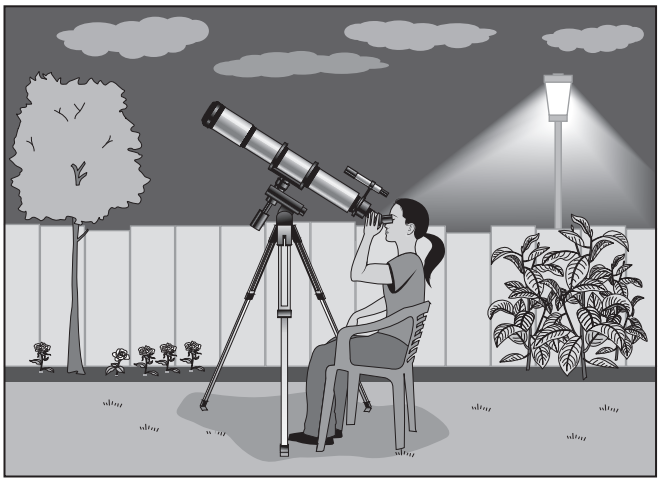
Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 120

June 2011 | PHY1F | Original Q4 | Legacy

4 (a) The picture shows a person using an optical telescope to look at stars.



Give **two** reasons why it can be difficult to see distant stars using this type of telescope.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) As well as optical telescopes, other types of telescope are on satellites in orbit above the Earth.

Give **one disadvantage** of having a telescope in orbit above the Earth.

.....

.....

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 120 · continued

4 (c) In 2008, a new gamma ray telescope, called Fermi, was launched into space. The telescope orbits 560 km above the Earth.

4 (c) (i) Which statement gives a reason why gamma ray telescopes are usually in orbit above the Earth?

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

The telescopes need to be closer to the stars. ☐

The atmosphere absorbs gamma rays. ☐

The telescopes can be used to look at the Earth. ☐

(1 mark)

4 (c) (ii) Some theories predict that particles called WIMPs exist. The theories predict that WIMPs produce a background of gamma rays in very distant galaxies.

Complete the following sentence by drawing a ring around the line in the box that is correct.

If a background of gamma rays in very distant galaxies is detected using the Fermi telescope, this will

- prove that WIMPs exist.
- support the theories that predict that WIMPs exist.
- make scientists change the existing theories.

(1 mark)

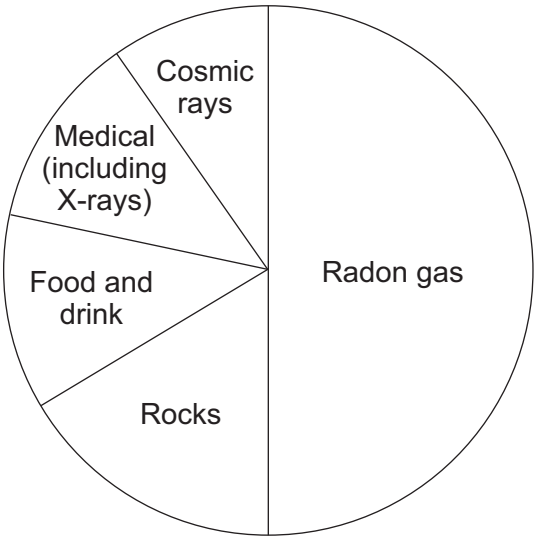
5

4.6.2.4 Uses and applications of electromagnetic waves

Question 121

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

4.6.2.4 Uses and applications of electromagnetic waves

Question 122

November 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Different types of electromagnetic waves are used in hospitals.

Match types of electromagnetic wave, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A gamma rays

B infra red rays

C radio waves

D visible light

Surgical instruments are sterilised using . . . **1** . . . .

Laser eye surgery uses . . . **2** . . . .

Damaged muscles are given heat treatment using . . . **3** . . . .

A doctor can be contacted by a bleeper that uses . . . **4** . . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 123

November 2011 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

This question is about nuclear and electromagnetic radiation.

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

A alpha particle

B beta particle

C gamma ray

D X-rays

1	an electromagnetic wave emitted from the nucleus of an atom
2	an electron from the nucleus of an atom
3	absorbed by bone but not absorbed by soft tissue
4	very good at ionising the atoms of a gas

4.6.2.4 Uses and applications of electromagnetic waves

Question 124

November 2011 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

The frequencies of the waves in the electromagnetic spectrum can be grouped into types.

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

A gamma rays

B infra red rays

C radio waves

D ultraviolet rays

1	They have a higher frequency than X-rays.
2	They have a lower frequency than microwaves.
3	They have a lower frequency than visible light but a higher frequency than microwaves.
4	They have a lower frequency than X-rays but a higher frequency than visible light.

4.6.2.4 Uses and applications of electromagnetic waves

Question 125

November 2011 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

This question is about visible light and infra red rays.

6A Which statement is true for both visible light and infra red rays?

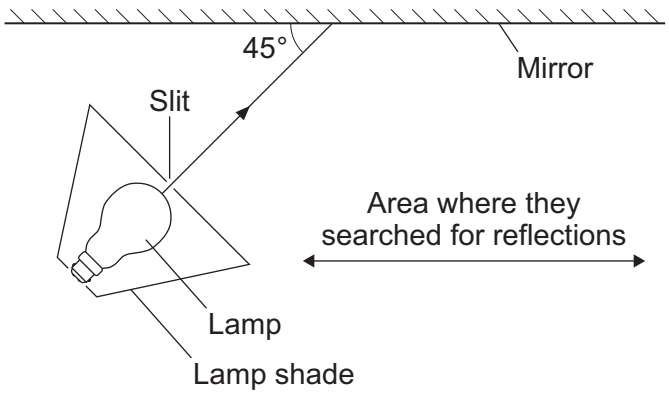
1 They have the same wavelength.

2 They have the same speed in a vacuum.

3 Only visible light can travel along an optical fibre.

4 Only infra red rays can be absorbed.

Some students wanted to see if visible light and infra red rays reflect at the same angle from a mirror. They set up a lamp pointing at 45° to a mirror. They then searched for reflections in the area shown in the diagram. Their investigation was carried out in a dark room.



6B The students carried out their investigation in a dark room because . . .

1 visible light travels faster in the dark.

2 it cuts out any other sources of visible light.

3 it allows them to do their investigation safely.

4 you can only see visible light in a dark room.

4.6.2.4 Uses and applications of electromagnetic waves

Question 125 · continued

6C To minimise random errors, the students should have . . .

1 used a curved mirror.

2 plotted a graph of the angles they measured.

3 repeated the measurements several times and calculated the average.

4 carried out the investigation in a room with the lights on.

6D When a household lamp was used, the students saw a reflection of the light at 45° to the mirror.

When an infra red source was used, they could not see the rays. Using an infra red detector, they did find a reflection at 45°.

This is because . . .

1 infra red rays are not reflected by a mirror.

2 infra red rays are absorbed by the mirror.

3 human eyes are not sensitive to infra red rays.

4 visible light and infra red rays reflect in different ways.

4.6.2.4 Uses and applications of electromagnetic waves

Question 126

November 2011 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

X-rays are useful for obtaining images of internal parts of the body. However, there are dangers from exposure to X-rays.

8A Why is exposure to X-rays dangerous?

1 X-rays are poisonous.

2 X-rays can damage cells.

3 Your body can store up X-rays.

4 Your body becomes immune to X-rays.

8B There is a maximum dose of radiation from X-rays that you should not exceed each year.

The table shows the percentage of this maximum that you receive from X-ray scans of different parts of the body.

Part of the body being X-rayed	Percentage of maximum yearly allowed dose
Chest	5
Teeth	1
Pelvis	24
Spine	40

What is the best way to display the data in the table?

1 a bar chart, because one of the variables is categoric

2 a bar chart, because both of the variables are continuous

3 a line graph, because one of the variables is categoric

4 a line graph, because both of the variables are continuous

8C A patient has two chest X-rays and one spine X-ray taken in one year.

How much of the maximum yearly allowed dose has he received?

1 45 %

2 50 %

3 70 %

4 85 %

4.6.2.4 Uses and applications of electromagnetic waves

Question 126 · continued

8D A dentist taking an X-ray of a patient's teeth needs to protect himself from the radiation.

He does this by . . .

1 taking no more than 1000 X-rays in a year.

2 operating the X-ray machine from outside the room.

3 making sure that the patient wears a lead apron.

4 wearing special gloves.

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 127

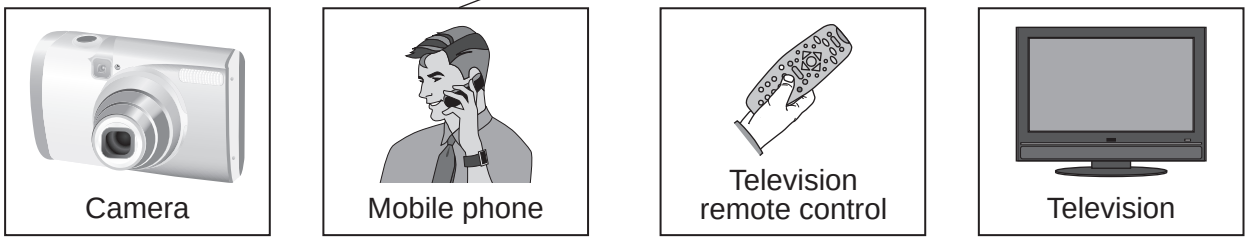
June 2012 | PH1FP | Original Q2 | Legacy

2 (a) The diagram shows the electromagnetic spectrum.

The pictures show four devices. Each device uses a different type of electromagnetic wave.

Draw **one** line from each device to the type of electromagnetic wave the device uses. One line has been drawn for you.

Gamma rays	X-rays	Ultraviolet waves	Visible light waves	Infrared waves	Microwaves	Radio waves



(3 marks)

2 (b) Visible light waves travel through space at a speed of 300 000 km/s.

How fast do infrared waves travel through space?

.....

(1 mark)

2 (c) Draw a ring around the correct answer in the box to complete the sentence.

Infrared waves have

a longer wavelength than
the same wavelength as
a shorter wavelength than

visible light waves.

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 127 · continued

2 (d) The two diagrams, **A** and **B**, show a light ray travelling into a glass block.

Diagram A

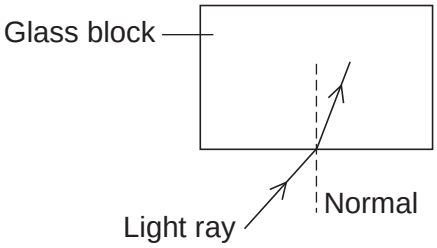
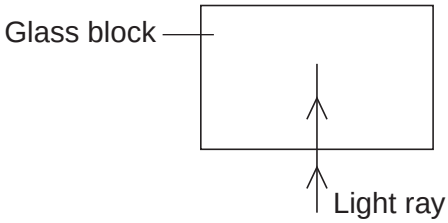


Diagram B



2 (d) (i) Look at **Diagram A**.

What name is given to the process that happens as the light enters the glass block?

.....

(1 mark)

2 (d) (ii) Look at **Diagram B**.

The light enters the glass block without changing direction.

Why?

.....

.....

(1 mark)

7

4.6.2.4 Uses and applications of electromagnetic waves

Question 128

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.

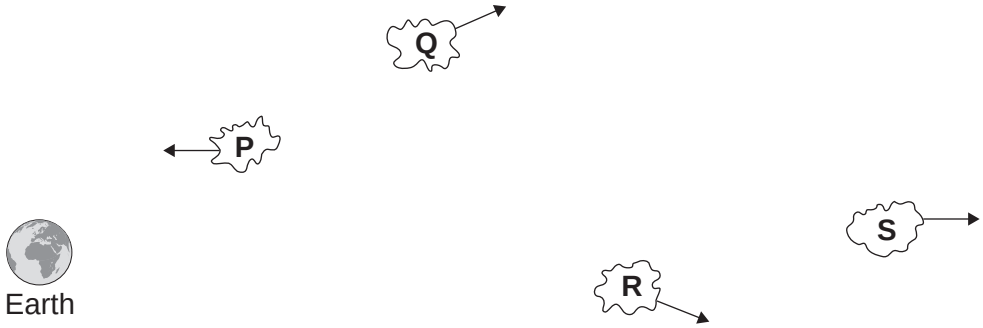
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 128 · continued June 2012 | PH1FP | Original Q3 | Legacy

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

4.6.2.4 Uses and applications of electromagnetic waves

Question 128 · 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

4.6.2.4 Uses and applications of electromagnetic waves

Question 129

June 2012 | PH1FP | Original Q7 | Legacy

7 A wood burning stove is used to heat a room.



The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

7 (a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

.....

.....

.....

.....

(2 marks)

4.6.2.4 Uses and applications of electromagnetic waves

Question 129 · continued

7 (b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Efficiency = ...

(2 marks)

7 (c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

.....

(1 mark)

7 (d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1 .....

.....

2 .....

.....

(2 marks)

Question 7 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 129 · continued

7 (e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

Energy required = ...

(3 marks)

10

4.6.2.4 Uses and applications of electromagnetic waves

Question 130

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)

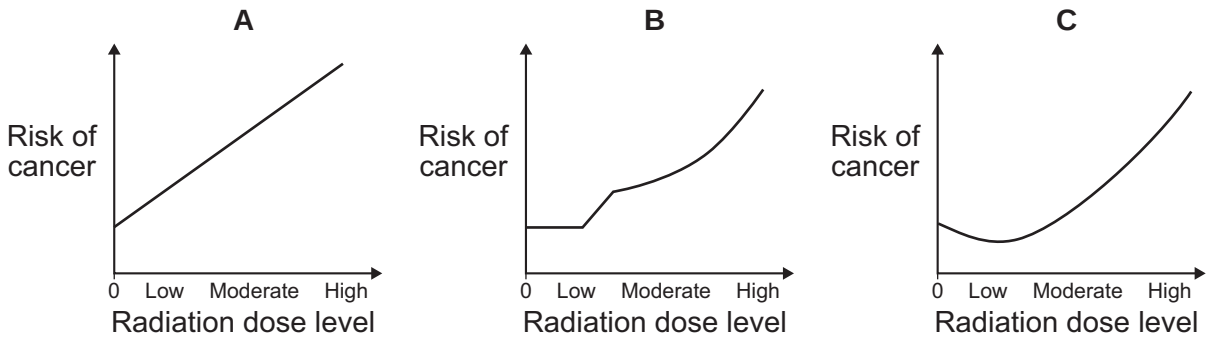
Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 130 · 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)

4.6.2.4 Uses and applications of electromagnetic waves

Question 130 · 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)

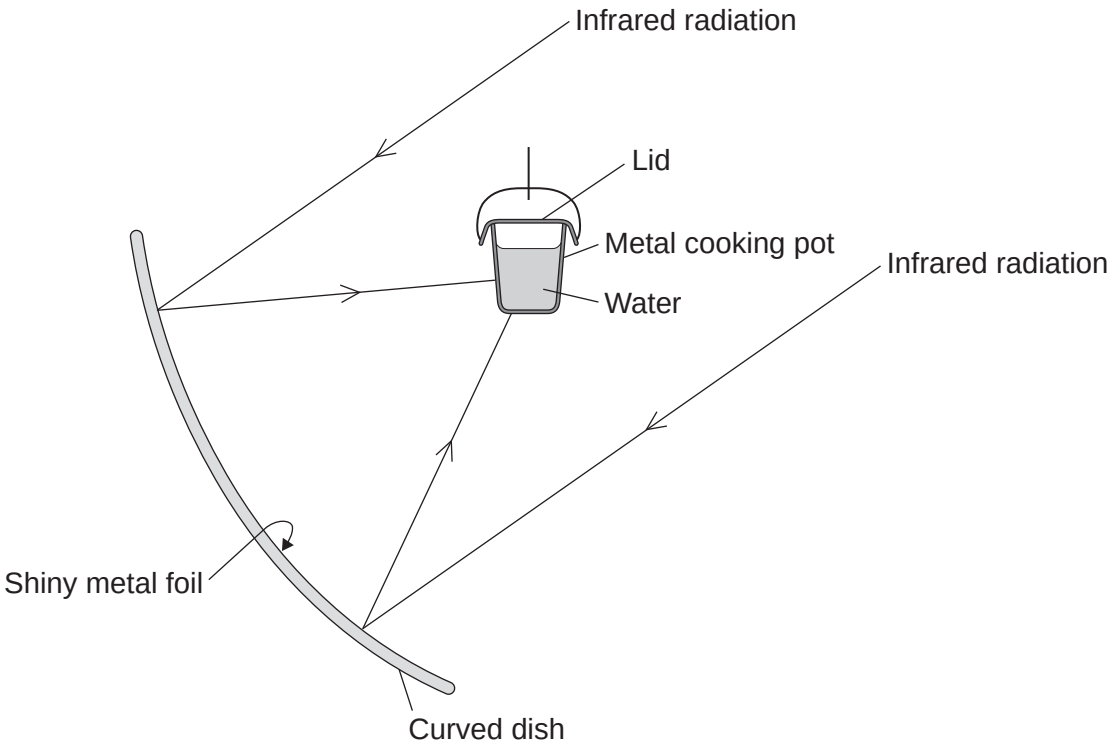
10

4.6.2.4 Uses and applications of electromagnetic waves

Question 131

January 2013 | PH1FP | Original Q5 | Legacy

5 The diagram shows the design of a solar cooker. The cooker heats water using infrared radiation from the Sun.



5 (a) Why is the inside of the large curved dish covered with shiny metal foil?

.....

.....

(1 mark)

5 (b) Which would be the best colour to paint the outside of the metal cooking pot?

Draw a ring around the correct answer.

black **silver** **white**

Give a reason for your answer.

.....

.....

.....

(2 marks)

4.6.2.4 Uses and applications of electromagnetic waves

Question 131 · continued

5 (c) Why does the cooking pot have a lid?

.....

.....

(1 mark)

5 (d) Calculate how much energy is needed to increase the temperature of 2 kg of water by 80 °C.

The specific heat capacity of water = 4200 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy = ... J

(2 marks)

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 132

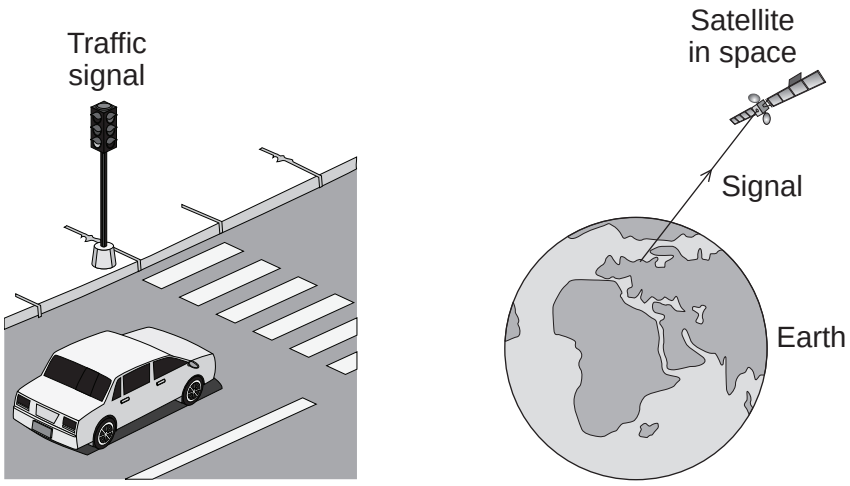
June 2013 | PH1FP | Original Q2 | Legacy

2 **Diagram 1** shows four of the seven types of wave in the electromagnetic spectrum.

Diagram 1

J	**K**	**L**	Visible light	Infrared	Microwaves	Radio waves

2 (a) The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.



2 (a) (i) Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

.....

(1 mark)

2 (a) (ii) Which type of electromagnetic wave is used to communicate with a satellite in space?

.....

(1 mark)

2 (b) Gamma rays are part of the electromagnetic spectrum.

Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?

Draw a ring around the correct answer.

J **K** **L**

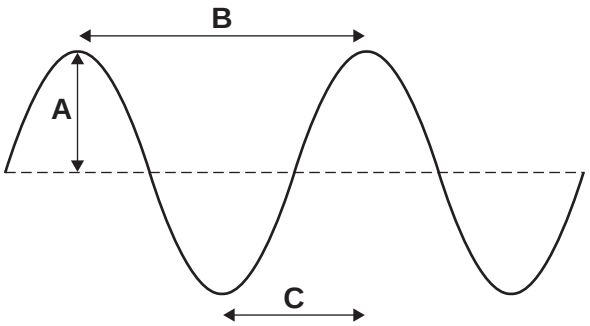
(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 132 · continued

2 (c) **Diagram 2** shows an infrared wave.

Diagram 2



2 (c) (i) Which **one** of the arrows, labelled **A**, **B** or **C**, shows the wavelength of the wave?

Write the correct answer, **A**, **B** or **C**, in the box. ☐

(1 mark)

2 (c) (ii) Draw a ring around the correct answer to complete the sentence.

The wavelength of infrared waves is [shorter than / the same as / longer than] the wavelength of radio waves.

(1 mark)

Question 2 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 132 · continued

2 (d) Mobile phone networks send signals using microwaves. Some people think the energy a person's head absorbs when using a mobile phone may be harmful to health.

2 (d) (i) Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones.

Which **one** of the following statements gives a reason why scientists have done this?

Tick (✓) **one** box.

To find out if using a mobile phone is harmful to health. ☐

To find out if mobile phones give out radiation. ☐

To find out why some people are healthy. ☐

(1 mark)

2 (d) (ii) The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person's head absorbs when a mobile phone is used.

Mobile Phone	SAR value in W/kg
X	0.28
Y	1.35

A parent buys mobile phone **X** for her daughter.

Using the information in the table, suggest why buying mobile phone **X** was the best choice.

.....

.....

.....

.....

(2 marks)

8

4.6.2.4 Uses and applications of electromagnetic waves

Question 133

June 2013 | PH2FP | Original Q1 | Legacy

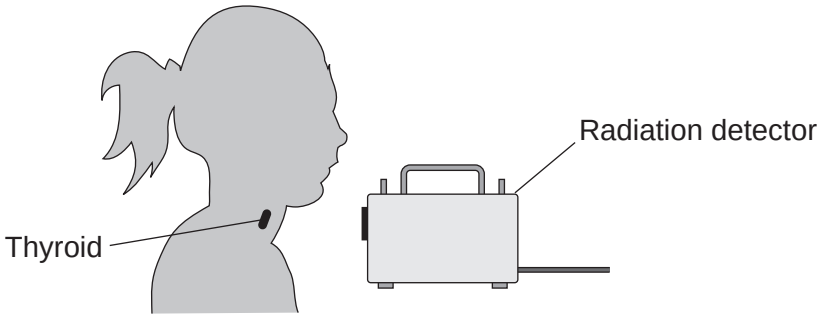
1 (a) The names of three types of radiation are given in **List A**. Some properties of these three types of radiation are given in **List B.**

Draw **one** line from each type of radiation in **List A** to its correct property in **List B**.

List A Type of radiation	List B Property of radiation
	will pass through paper but is stopped by thin metal
alpha	
	has the shortest range in air
beta	
	will not harm human cells
gamma	
	is very weakly ionising

(3 marks)

1 (b) The radioactive isotope iodine-123 can be used by a doctor to examine the thyroid gland of a patient. The iodine, taken as a tablet, is absorbed by the thyroid gland. The gamma radiation emitted as the iodine atoms decay is detected outside the body.



The doctor uses an isotope emitting gamma radiation to examine the thyroid gland rather than an isotope emitting alpha or beta radiation.

Which **one** of the following gives a reason why gamma radiation is used?

Tick (✓) **one** box.

Gamma radiation will pass through the body. ☐

Gamma radiation is not deflected by a magnet. ☐

Gamma radiation has a long range in air. ☐

(1 mark)

4.6.2.4 Uses and applications of electromagnetic waves

Question 133 · continued

1 (c) Iodine-123 has a half-life of 13 hours.

Use a word from the box to complete the sentence.

all	half	most

After 13 hours ..... of the iodine-123 atoms the thyroid absorbed have decayed.

(1 mark)

1 (d) Iodine-123 and iodine-131 are two of the isotopes of iodine.

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

The nucleus of an iodine-123 atom has the same number of | electrons | neutrons | protons | as the

nucleus of an iodine-131 atom.

(1 mark)

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 134

June 2013 | PH3FP | Original Q8 | Legacy

8 Ultrasound and X-rays are waves used in hospitals to create images of the inside of the human body. To produce the images below, the waves must enter the human body.

Ultrasound scan of an unborn child



X-ray of a broken bone



8 (a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe the features of ultrasound and X-rays, and what happens to each type of wave after it has entered the human body.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

4.6.2.4 Uses and applications of electromagnetic waves

Question 134 · continued

8 (b) It would **not** be safe to use X-rays to produce an image of an unborn child.

Explain why.

.....

.....

.....

.....

(2 marks)

8 (c) Ultrasound can be used for medical treatments as well as for imaging.

Give **one** use of ultrasound for medical treatment.

.....

.....

(1 mark)

9

4.6.2.4 Uses and applications of electromagnetic waves

Question 135

June 2014 | PH3FP | Original Q1 | Legacy

1 **Figure 1** shows an X-ray image of a human skull.

Figure 1



1 (a) Use the correct answers from the box to complete the sentence.

[2 marks]

absorbs	**ionises**	**reflects**	**transmits**

When X-rays enter the human body, soft tissue ..... X-rays and bone ..... X-rays.

1 (b) Complete the following sentence.

[1 mark]

The X-rays affect photographic film in the same way that ..... does.

4.6.2.4 Uses and applications of electromagnetic waves

Question 135 · continued

1 (c) **Table 1** shows the total dose of X-rays received by the human body when different parts are X-rayed.

Table 1

Part of body X-rayed	Dose of X-rays received by human body in arbitrary units
Head	3
Chest	4
Pelvis	60

Calculate the number of head X-rays that are equal in dose to one pelvis X-ray.

[2 marks]

.....

.....

.....

Number of head X-rays = ...

1 (d) Which **one** of the following is another use of X-rays?

Tick (✓) **one** box.

[1 mark]

Cleaning stained teeth ☐

Killing cancer cells ☐

Scanning of unborn babies ☐

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 136

June 2014 | PH3FP | Original Q7 | Legacy

7 (a) What is ultrasound?

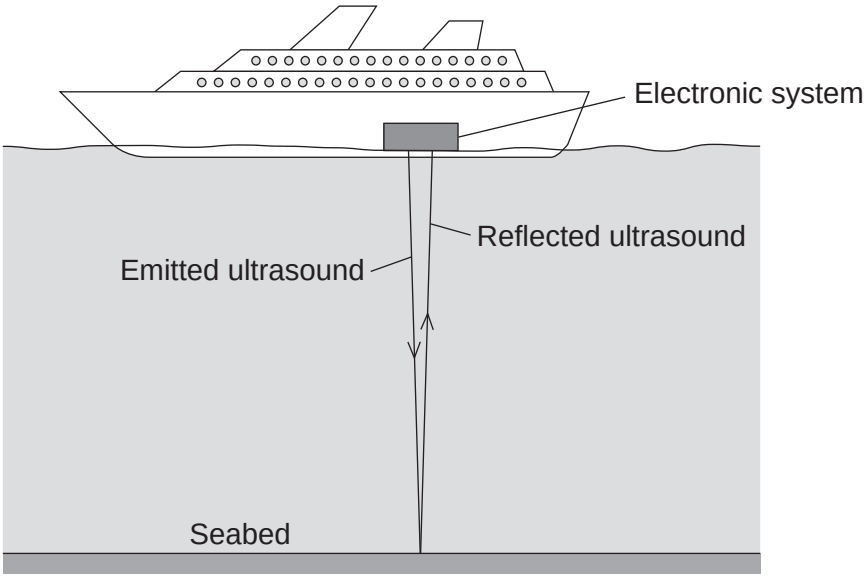
[1 mark]

.....

.....

7 (b) **Figure 12** shows how ultrasound is used to measure the depth of water below a ship.

Figure 12



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water.

Speed of ultrasound in water = 1600 m/s

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

Depth of water = ... metres

4.6.2.4 Uses and applications of electromagnetic waves

Question 136 · continued

7 (c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

[1 mark]

.....

7 (d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 13** uses X-rays to produce these images.

Figure 13



State **one** advantage and **one** disadvantage of using a CT scanner, compared with ultrasound scanning, for forming images of the inside of the human body.

[2 marks]

Advantage of CT scanning .....

.....

.....

Disadvantage of CT scanning .....

.....

.....

7

4.6.2.4 Uses and applications of electromagnetic waves

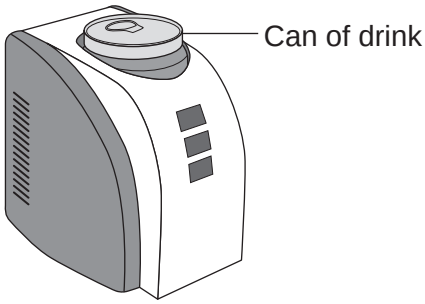
Question 137

June 2015 | PH1FP | Original Q4 | Legacy

4 A 'can-chiller' is used to make a can of drink colder.

Figure 6 shows a can-chiller.

Figure 6



4 (a) The can-chiller decreases the temperature of the liquid in the can by 15 °C.
The mass of liquid is 0.33 kg.
The specific heat capacity of the liquid is 4200 J/kg °C.

Calculate the energy transferred from the liquid as it cools.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Energy = ... J

4 (b) Complete the following sentence.

[1 mark]

The specific heat capacity of a substance is the amount of energy required to change the ..... of one kilogram of the substance by one degree Celsius.

4.6.2.4 Uses and applications of electromagnetic waves

Question 137 · continued

4 (c) To calculate the specific heat capacity of a material, the mass of the material needs to be measured.

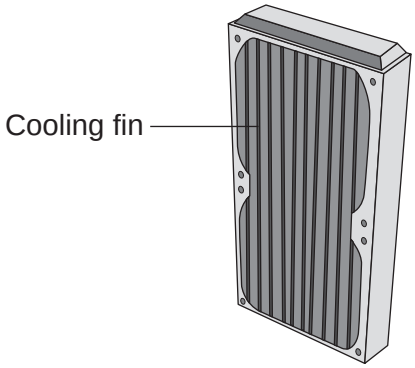
State the name of a measuring instrument used to measure mass.

[1 mark]

.....

4 (d) The back of the can-chiller has cooling fins, as shown in **Figure 7**.

Figure 7



The cooling fins increase the rate of energy transfer from the can-chiller to the surroundings.

Complete the following sentences.

[2 marks]

The cooling fins are a ..... colour because that makes them good emitters of infrared radiation.

The large surface area of the cooling fins allows the air around the can-chiller to gain energy quickly and rise, transferring energy by ..... .

Question 4 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 137 · continued

4 (e) (i) The energy input to the can-chiller is the same as the energy output. This shows that energy is conserved.

Complete the following sentence.

[1 mark]

Energy can be transferred usefully, stored or dissipated, but cannot be

..... or destroyed.

4 (e) (ii) The temperature of the can of drink decreases while it is in the can-chiller.

What happens to the temperature of the air around the cooling fins?

[1 mark]

.....

8

4.6.2.4 Uses and applications of electromagnetic waves

Question 138

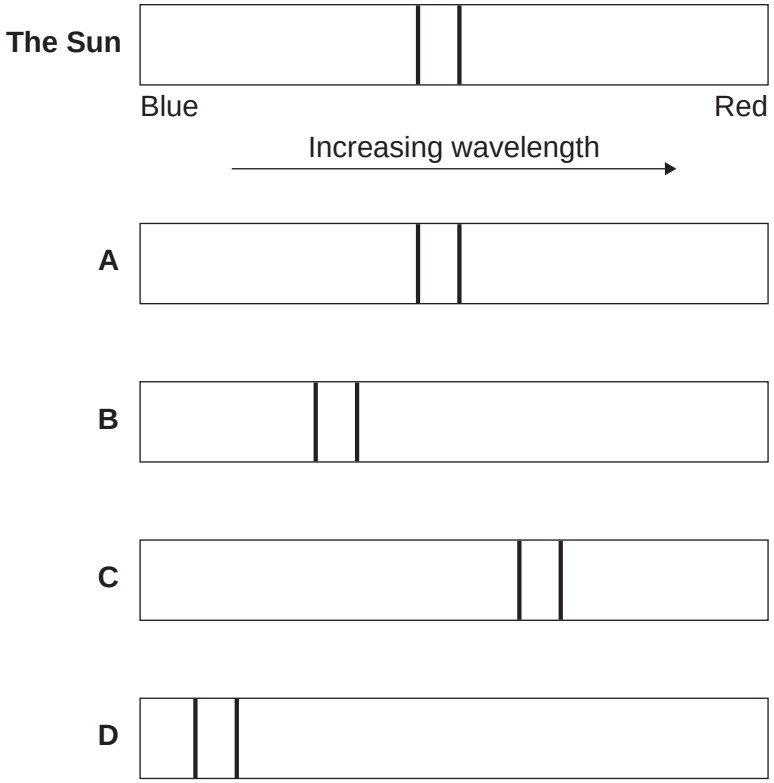
June 2015 | PH1FP | Original Q6 | Legacy

6 Scientists can use the visible light spectrum from distant stars to determine whether the stars are moving.

The visible light spectrum from stars includes dark lines at specific wavelengths.

6 (a) **Figure 9** shows the visible light spectrum from the Sun and from four other stars, **A**, **B**, **C** and **D**.

Figure 9



6 (a) (i) Which star, **A**, **B**, **C** or **D**, is moving away from the Earth?

[1 mark]

4.6.2.4 Uses and applications of electromagnetic waves

Question 138 · continued

6 (a) (ii) How does the speed of star **B** compare with the speed of star **D**?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
The speed of star **B** is greater than the speed of star **D**.	
The speed of star **B** is less than the speed of star **D**.	
The speed of star **B** is the same as the speed of star **D**.	

6 (b) A radio wave is emitted by a star.
The radio wave has a wavelength of 1500 m and a frequency of 200 000 Hz.

Calculate the speed of this radio wave.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Choose the correct unit from the list below.

m **m/s** **m/s^2**

.....

.....

.....

Speed = ... unit .....

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 139

June 2015 | PH2FP | Original Q6 | Legacy

6 (a) Radioactive sources that emit alpha, beta or gamma radiation can be dangerous.

What is a possible risk to health caused by using a radioactive source?

[1 mark]

.....

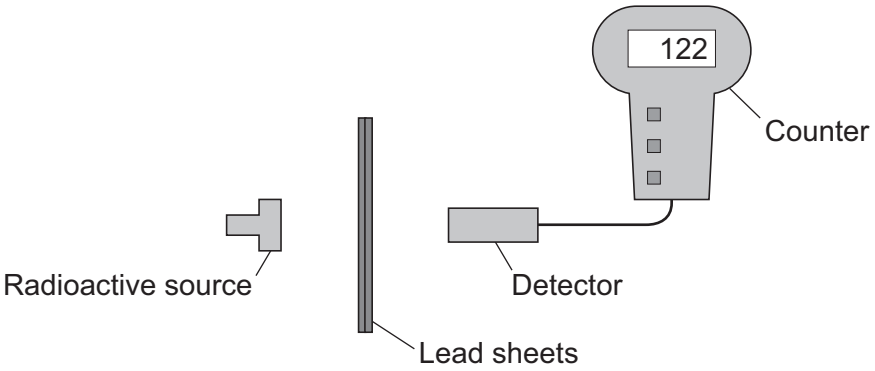
.....

6 (b) In an experiment, a teacher put a 2 mm thick lead sheet in front of a radioactive source. She used a detector and counter to measure the radiation passing through the lead sheet in one minute.

She then put different numbers of lead sheets, each 2 mm thick, in front of the radioactive source and measured the radiation passing through in one minute.

The apparatus the teacher used is shown in **Figure 7**.

Figure 7



6 (b) (i) When using a radioactive source in an experiment, how could the teacher reduce the risk to her health?

Suggest **one** way.

[1 mark]

.....

.....

Question 6 continues on the next page

Question 139 · continued

6 (b) (ii) The number recorded on the counter is actually higher than the amount of radiation detected from the source.

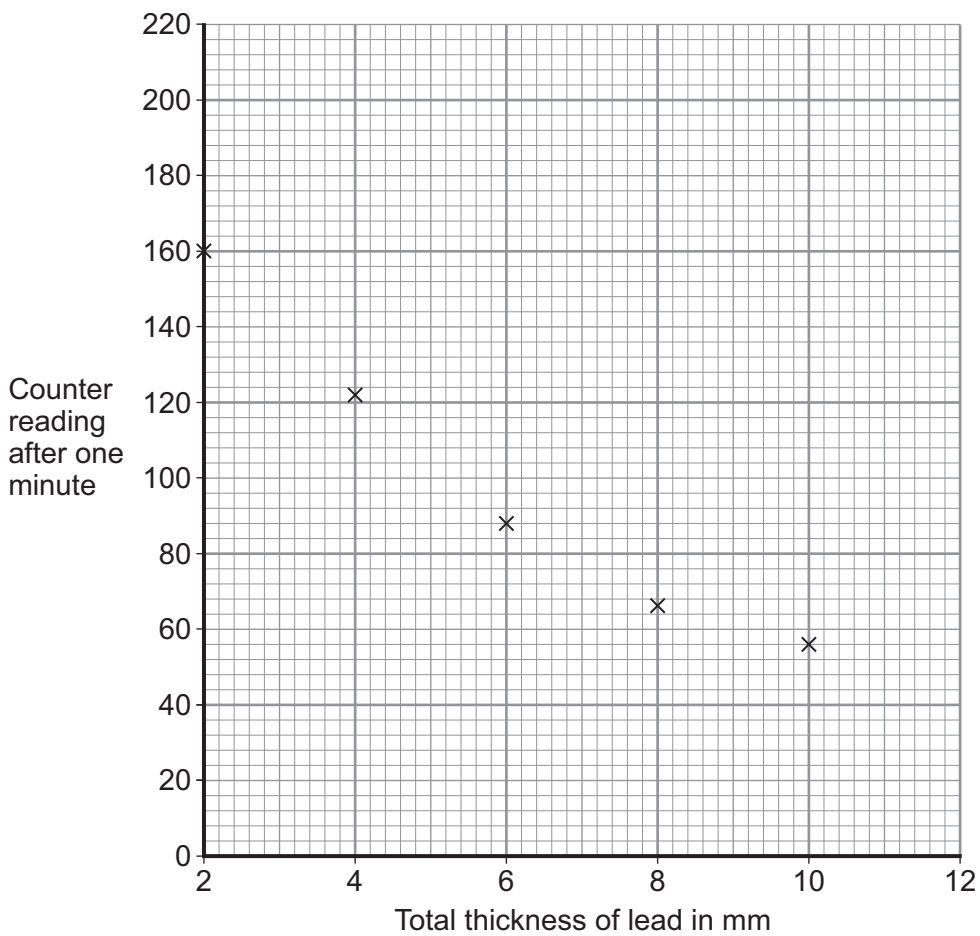
Complete the following word equation.

[1 mark]

The number recorded on the counter	=	The amount of radiation detected from the source	+	..... radiation

6 (c) The readings taken by the teacher are plotted in **Figure 8**.

Figure 8



6 (c) (i) Draw a line of best fit to complete **Figure 8**.

[1 mark]

4.6.2.4 Uses and applications of electromagnetic waves

Question 139 · continued

6 (c) (ii) How does the amount of radiation **absorbed** by the lead change as the total thickness of the lead is increased?

[1 mark]

.....

.....

6 (c) (iii) Use **Figure 8** to estimate the reading on the counter when the total thickness of the lead is increased to 12 mm.

[1 mark]

Estimated counter reading = ...

6 (d) What type of radiation was emitted from the radioactive source?

[2 marks]

Draw a ring around the correct answer.

alpha **beta** **gamma**

Give a reason for your answer.

.....

.....

8

4.6.2.4 Uses and applications of electromagnetic waves

Question 140

June 2015 | PH3FP | Original Q9 | Legacy

9 (a) Complete the following sentences.

[2 marks]

Ultrasound waves have a minimum frequency

of ..... hertz.

The wavelength of an X-ray is about the same as

the diameter of ..... .

9 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 17 shows one medical use of ultrasound and one medical use of X-rays.

Figure 17





Compare the medical uses of ultrasound and X-rays.

Your answer should include the risks, if any, and precautions, if any, associated with the use of ultrasound and X-rays.

[6 marks]

.....

.....

.....

.....

.....

.....

.....

.....

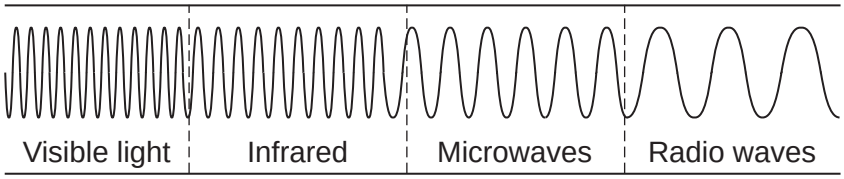
4.6.2.4 Uses and applications of electromagnetic waves

Question 141

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.

4.6.2.4 Uses and applications of electromagnetic waves

Question 141 · continued June 2016 | PH1FP | Original Q3 | Legacy

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

4.6.2.4 Uses and applications of electromagnetic waves

Question 142

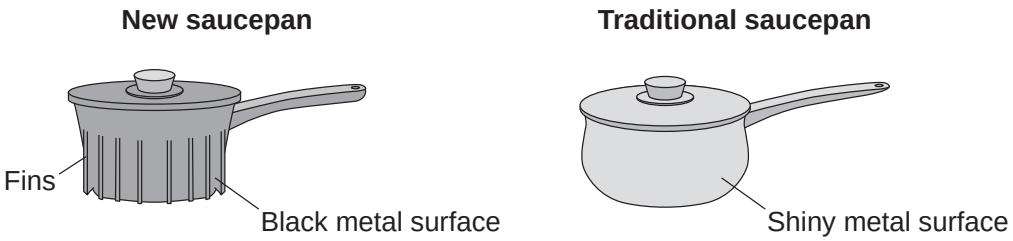
June 2016 | PH1FP | Original Q8 | Legacy

8 (a) Heating food in a saucepan over a gas flame is inefficient.
Suggest why.

[2 marks]

8 (b) A new saucepan has been designed that heats up food much faster than a traditional saucepan. **Figure 13** shows the two saucepans.

Figure 13



Describe how the features of the new saucepan cause the food to heat up faster than when the food is heated in the traditional saucepan.

[2 marks]

Fins

Black metal surface

8 (c) State the relationship between the temperature of the saucepan and the rate at which the saucepan emits infrared radiation.

[1 mark]

5

4.6.2.4 Uses and applications of electromagnetic waves

Question 143

June 2016 | PH2FP | Original Q9 | Legacy

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

9 (a) Describe the structure of an alpha particle.

[1 mark]

_____

_____

9 (b) Nuclear radiation can change atoms into ions by the process of ionisation.

9 (b) (i) Which type of nuclear radiation is the least ionising?

[1 mark]

Tick (✓) **one** box.

alpha particles ☐ beta particles ☐ gamma rays ☐

9 (b) (ii) What happens to the structure of an atom when the atom is ionised?

[1 mark]

_____

_____

9 (c) People working with sources of nuclear radiation risk damaging their health.

State **one** precaution these people should take to reduce the risk to their health.

[1 mark]

_____

_____

4.6.2.4 Uses and applications of electromagnetic waves

Question 143 · continued

9 (d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The type of radiation emitted from a radioactive source can be identified by comparing the properties of the radiation to the properties of alpha, beta and gamma radiation.

Describe the properties of alpha, beta and gamma radiation in terms of their:

- penetration through materials
- range in air
- deflection in a magnetic field.

[6 marks]

Extra space

10

4.6.2.4 Uses and applications of electromagnetic waves

Question 144

June 2016 | PH3FP | Original Q2 | Legacy

2 **Figure 2** shows an X-ray of an arm with a broken bone.

Figure 2



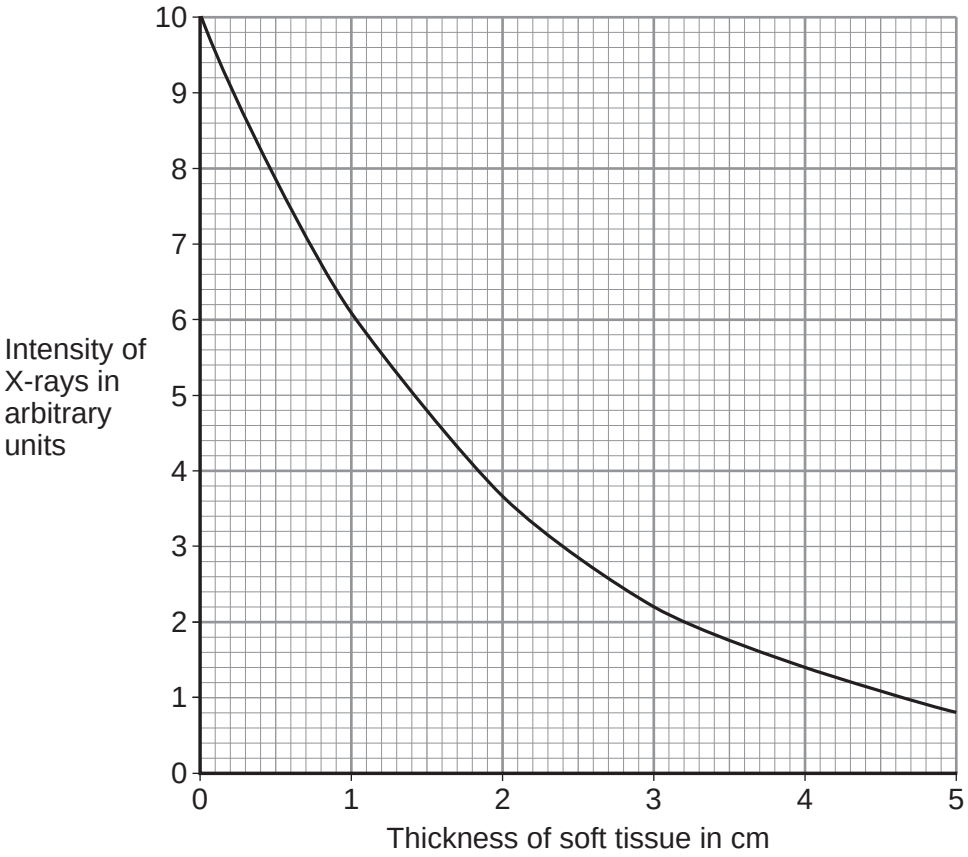
2 (a) Complete the following sentence.

[1 mark]

X-rays are part of the _____ spectrum.

2 (b) **Figure 3** shows how the intensity of the X-rays changes as they pass through soft tissue and reach a detector.

Figure 3



4.6.2.4 Uses and applications of electromagnetic waves

Question 144 · continued

2 (b) (i) Use **Figure 3** to determine the intensity of X-rays reaching the detector for a 3 cm thickness of soft tissue.

[1 mark]

Intensity of X-rays = _____ arbitrary units

2 (b) (ii) Describe how the thickness of soft tissue affects the intensity of the X-rays.

[2 marks]

_____

_____

_____

_____

2 (b) (iii) The data in **Figure 3** are shown as a line graph and not as a bar chart.

Choose the reason why.

[1 mark]

Tick (✓) **one** box.

Both variables are categoric ☐

Both variables are continuous ☐

One variable is continuous and one is categoric ☐

2 (c) What happens to X-rays when they enter a bone?

[1 mark]

_____

_____

Question 2 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 144 · continued

2 (d) How are images formed electronically in a modern X-ray machine?

[1 mark]

Tick (✓) **one** box.

With a charge-coupled device (CCD) ☐

With an oscilloscope ☐

With photographic film ☐

2 (e) Radiographers who take X-ray photographs may be exposed to X-rays.

2 (e) (i) X-rays can increase the risk of the radiographer getting cancer.

Why can X-rays increase the risk of getting cancer?

[1 mark]

Tick (✓) **one** box.

X-rays travel at the speed of light ☐

X-rays can travel through a vacuum ☐

X-rays are ionising ☐

2 (e) (ii) What should the radiographer do to reduce the risk from X-rays?

[1 mark]

_____

_____

9

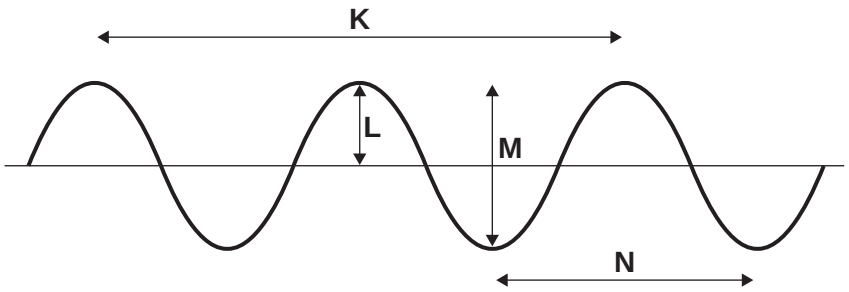
4.6.2.4 Uses and applications of electromagnetic waves

Question 145

June 2017 | PH1FP | Original Q3 | Legacy

3 (a) **Figure 4** shows an electromagnetic wave.

Figure 4



3 (a) (i) Which arrow, **K**, **L**, **M** or **N**, shows the wavelength of the wave?

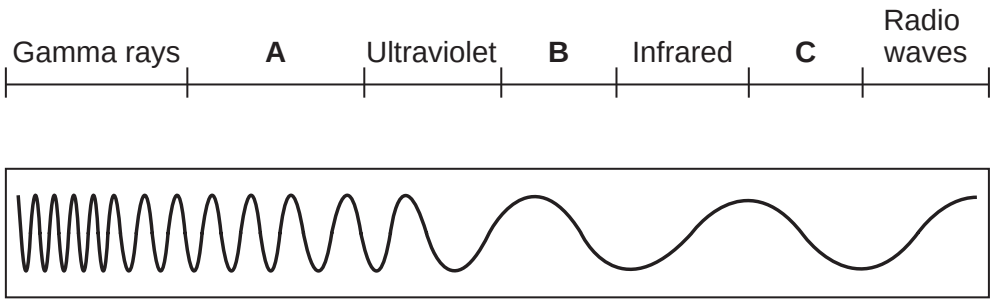
[1 mark]

3 (a) (ii) Which arrow, **K**, **L**, **M** or **N**, shows the amplitude of the wave?

[1 mark]

3 (b) **Figure 5** shows the electromagnetic spectrum.

Figure 5



A laser emits visible light.

Which letter, **A**, **B** or **C**, on **Figure 5** shows the position of visible light?

[1 mark]

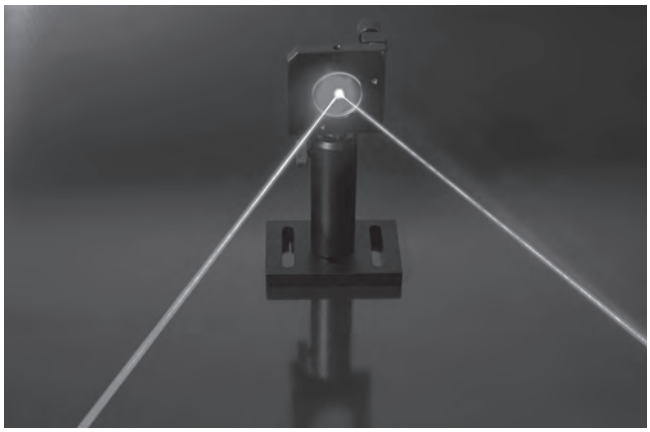
4.6.2.4 Uses and applications of electromagnetic waves

Question 145 · continued

3 (c) Laser light is used in some burglar alarms.

Figure 6 shows laser light being reflected by a mirror. The light then reaches a detector.

Figure 6



3 (c) (i) How does the size of the angle of incidence compare with the size of the angle of reflection?

[1 mark]

_____

_____

3 (c) (ii) When a burglar gets in the way of the laser light, the light no longer reaches the detector.

Suggest **one** reason why.

[1 mark]

_____

_____

5

4.6.2.4 Uses and applications of electromagnetic waves

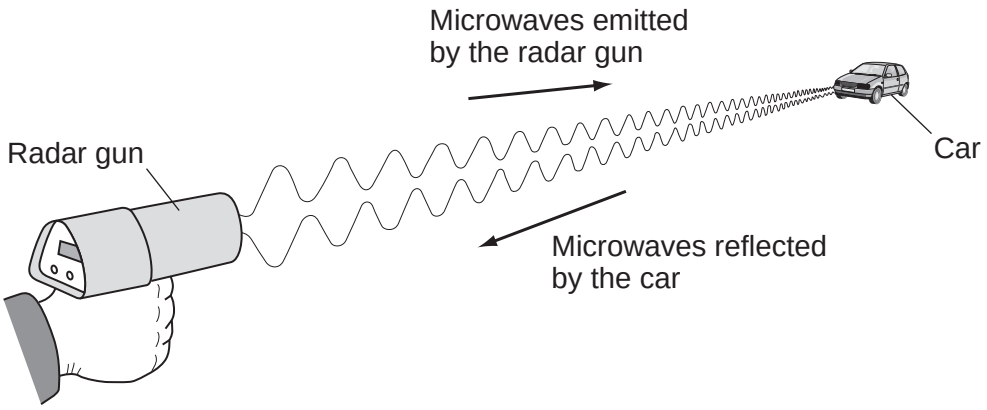
Question 146

June 2017 | PH1FP | Original Q8 | Legacy

8 A radar gun can be used to measure the speed of a car.

Microwaves are emitted by the radar gun and reflected by the car, as shown in **Figure 13**.

Figure 13



8 (a) The microwaves reflected by the moving car have a different frequency from the microwaves emitted by the radar gun.

What is the name of the effect causing this change in frequency?

[1 mark]

_____

8 (b) The data in **Table 3** are measurements taken from three different cars on the same piece of road.

Table 3

Car	Frequency of emitted microwaves in kHz	Frequency of reflected microwaves in kHz
A	27 000 000	27 000 002
B	27 000 000	27 000 000
C	27 000 000	26 999 997

4.6.2.4 Uses and applications of electromagnetic waves

Question 146 · continued

8 (b) (i) State which car in **Table 3** is moving towards the radar gun. Give a reason for your answer.

[2 marks]

Car _____

Reason _____

_____

8 (b) (ii) State which car in **Table 3** is moving the fastest. Give a reason for your answer.

[2 marks]

Car _____

Reason _____

_____

5

Turn over for the next question

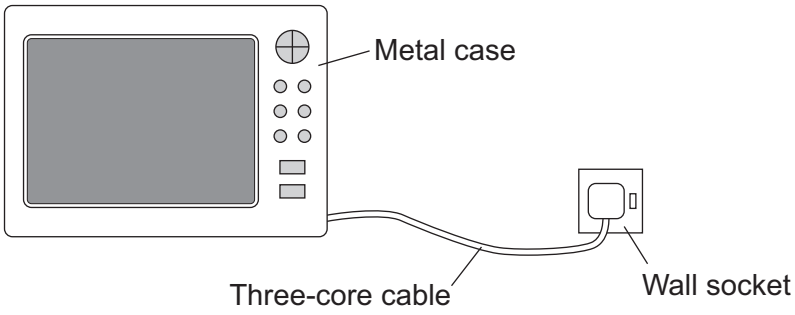
4.6.2.4 Uses and applications of electromagnetic waves

Question 147

June 2017 | PH2FP | Original Q5 | Legacy

5 **Figure 10** shows a microwave oven.

Figure 10



5 (a) The microwave oven is connected to the mains electricity supply using a three-core cable and plug.

Explain why a three-core cable must be used and not a two-core cable.

[2 marks]

5 (b) (i) The microwave oven draws a current of 3.3 amps from the mains electricity supply.

Which one of the following fuses should be used inside the plug?

[2 marks]

Tick (✓) **one** box.

1 A ☐ **3 A** ☐ **13 A** ☐

Give the reason for your answer.

Question 5 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 147 · continued

5 (b) (ii) The microwave oven is used to cook a meal.
The microwave oven is switched on for 300 seconds.

During this time 225 000 joules of energy are transferred from the mains electricity supply to the oven.

Calculate the power of the microwave oven.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Power = _____ W

6

4.6.2.4 Uses and applications of electromagnetic waves

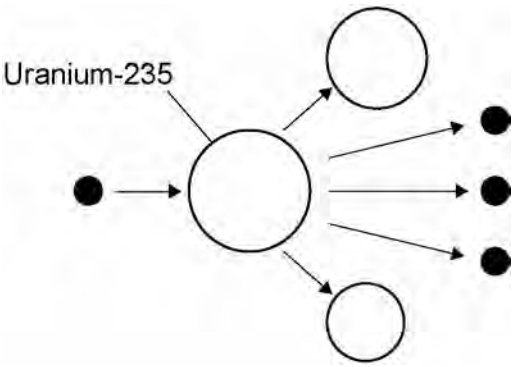
Question 148

June 2018 | 8463/1F | Original Q6

0 6 Nuclear power can be used to generate electricity through nuclear fission.

Figure 6 shows the process of nuclear fission.

Figure 6



0 6 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

gamma rays	**light rays**	**proton**	**neutron**	**nucleus**	**X-rays**

During the process of nuclear fission a uranium _____

absorbs a _____ .

Electromagnetic radiation is released in the form of _____ .

0 6 . 2 The UK needs at least 25 000 000 kW of electrical power at any time.

A nuclear power station has an electrical power output of 2 400 000 kW

Calculate how many nuclear power stations are needed to provide 25 000 000 kW of electrical power.

[2 marks]

_____

_____

_____

_____

Number of nuclear power stations = _____

4.6.2.4 Uses and applications of electromagnetic waves

Question 148 · continued

0 6 . 3 State **two** environmental issues caused by generating electricity using nuclear power stations.

[2 marks]

1 _____

_____

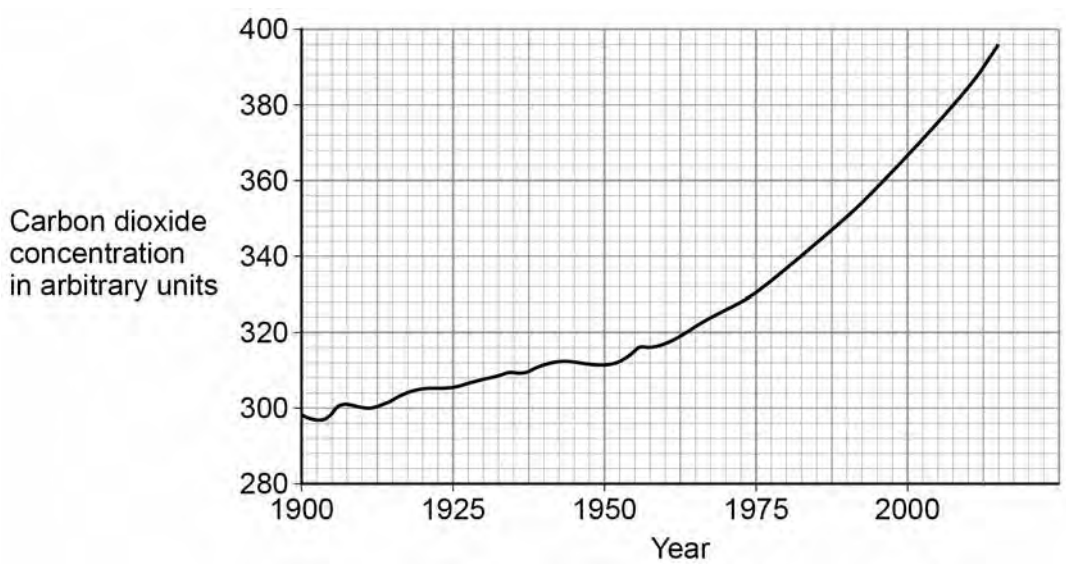
2 _____

_____

0 6 . 4 The UK currently generates a lot of electricity by burning natural gas. This process releases carbon dioxide into the atmosphere.

Figure 7 shows how the concentration of carbon dioxide in the atmosphere has changed over the past 115 years.

Figure 7

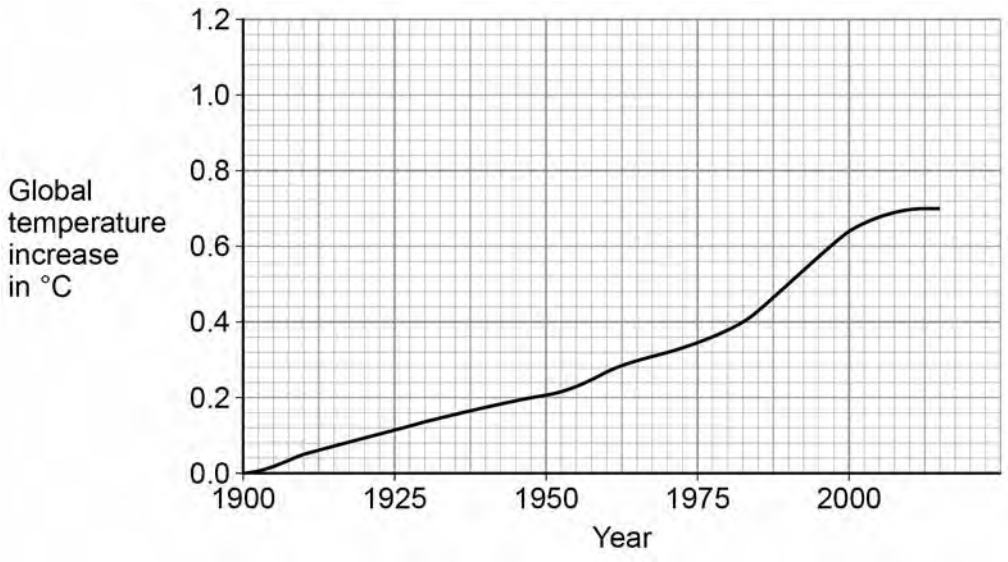


4.6.2.4 Uses and applications of electromagnetic waves

Question 148 · continued

Figure 8 shows how the global temperature has changed over the past 115 years.

Figure 8



Give **one** similarity and **one** difference between the data in **Figure 7** and **Figure 8**.

[2 marks]

Similarity _____

_____

_____

Difference _____

_____

_____

9

4.6.2.4 Uses and applications of electromagnetic waves

Question 149

June 2018 | 8463/2F | Original Q5

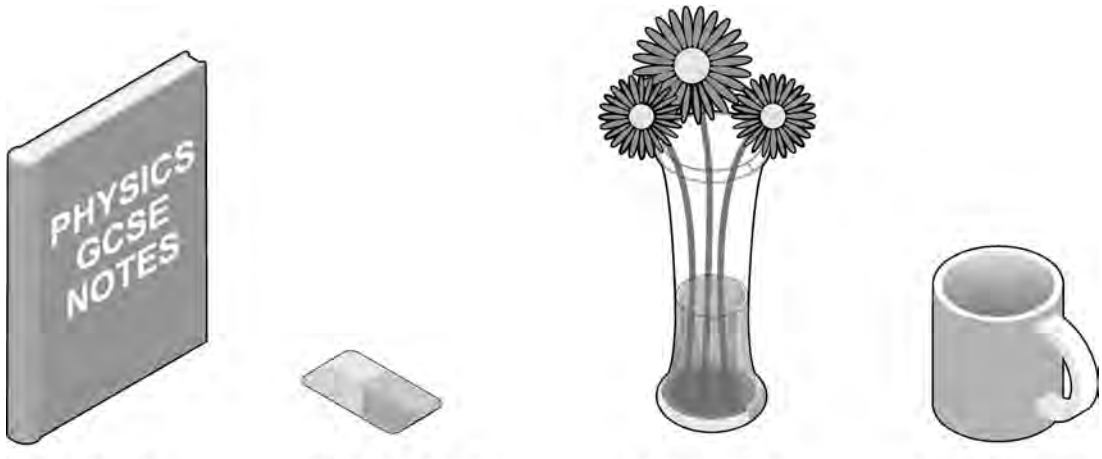
0 5 Some objects are transparent and some objects are opaque.

0 5 . 1 Which **one** of the objects in **Figure 5** is transparent?

Tick **one** box.

[1 mark]

Figure 5



Book ☐ Pencil rubber ☐ Glass vase ☐ Ceramic mug ☐

0 5 . 2 Complete the sentence.

Choose an answer from the box.

[1 mark]

absorb	**reflect**	**transmit**

An opaque object does not _____ light.

4.6.2.4 Uses and applications of electromagnetic waves

Question 149 · continued

A student wears a white T-shirt and a red baseball cap to a party.

0 5 . 3 Why does the T-shirt look white in white light?

[1 mark]

0 5 . 4 Explain how the colour of the baseball cap appears to change when the room lights at the party change from white to blue.

[2 marks]

Question 5 continues on the next page

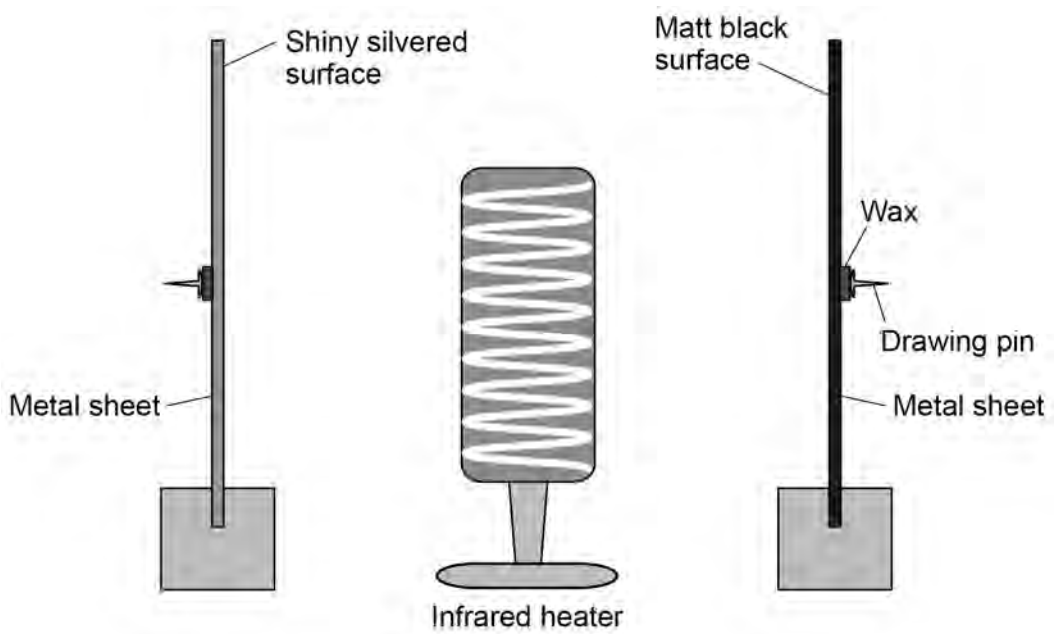
4.6.2.4 Uses and applications of electromagnetic waves

Question 149 · continued

A student investigated how the type of surface affects the amount of infrared radiation the surface absorbs.

Figure 6 shows the equipment that the student used.

Figure 6



The metal sheets absorb infrared radiation. The wax melts and the drawing pins fall off the surfaces.

0 5 . 5 In the investigation there are several variables.

Draw **one** line from each variable to the correct description of that variable.

[2 marks]

Variable	Description
Control	Distance from the metal sheets to the infrared heater.
Dependent	The surface colour of the metal sheets.
Independent	Time taken for the drawing pins to fall off.

4.6.2.4 Uses and applications of electromagnetic waves

Question 149 · continued

0 5 . 6 What is the main hazard in this investigation?

[1 mark]

0 5 . 7 The drawing pin attached to the matt black metal sheet fell off first.

What can be concluded from this result?

[1 mark]

9

Turn over for the next question

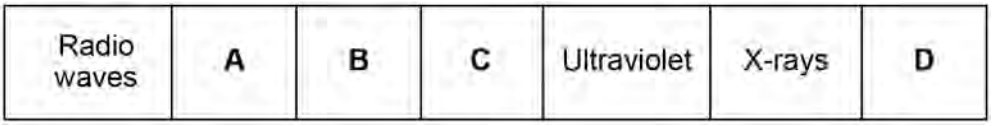
4.6.2.4 Uses and applications of electromagnetic waves

Question 150

June 2018 | 8463/2F | Original Q8

0 8 **Figure 10** shows the position of three types of wave in the electromagnetic spectrum.

Figure 10



0 8 . 1 Which position shows where visible light is in the spectrum?

Tick **one** box.

[1 mark]

A ☐ **B** ☐ **C** ☐ **D** ☐

0 8 . 2 Which **one** of the statements about electromagnetic waves is correct?

Tick **one** box.

[1 mark]

Radio waves have a higher frequency than X-rays. ☐

Radio waves have a longer wavelength than ultraviolet. ☐

X-rays have a longer wavelength than radio waves. ☐

X-rays travel faster through the air than ultraviolet. ☐

0 8 . 3 Give **one** possible danger of exposing your skin to ultraviolet radiation.

[1 mark]

4.6.2.4 Uses and applications of electromagnetic waves

Question 150 · continued

0 8 . 4 Having an X-ray taken exposes a person to ionising radiation.

Table 3 gives the average radiation dose for an X-ray of the chest and an X-ray of the upper digestive system.

Table 3

Part of the body	Radiation dose in millisieverts (mSv)
Upper digestive system	5.0
Chest	0.1

The risk of an X-ray causing cancer is about 1 in 20 000 for each mSv of radiation received.

Compare the risk of developing cancer from having an X-ray of the upper digestive system with the risk from having an X-ray of the chest.

Use the data in **Table 3**.

[2 marks]

5

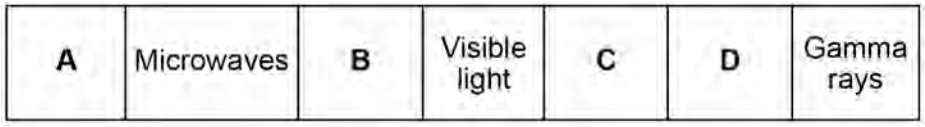
4.6.2.4 Uses and applications of electromagnetic waves

Question 151

June 2019 | 8463/2F | Original Q4

0 4 . 1 **Figure 11** shows the position of three types of wave in the electromagnetic spectrum.

Figure 11



Which letter represents infrared in the electromagnetic spectrum?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 4 . 2 What is infrared used for?

[1 mark]

Tick (✓) **one** box.

Electrical heating ☐

Energy efficient lamps ☐

Satellite communications ☐

Sun tanning ☐

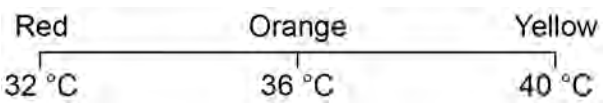
Question 4 continues on the next page

Question 151 · continued

An infrared camera produces a colour image. Different colours show different temperatures.

People emit infrared radiation. **Figure 12** shows how the colour of the image of a person on an infrared camera depends on the person's body temperature.

Figure 12



0 4 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

orange	**red**	**yellow**

The image produced by an infrared camera of a person with a body temperature of 37 °C is mainly _____ .

0 4 . 4 Rescue workers use infrared cameras to search for people trapped under rubble after an earthquake.

How does the image of a trapped person change if the person's body temperature drops from 37 °C to 33 °C?

[1 mark]

_____

_____

_____

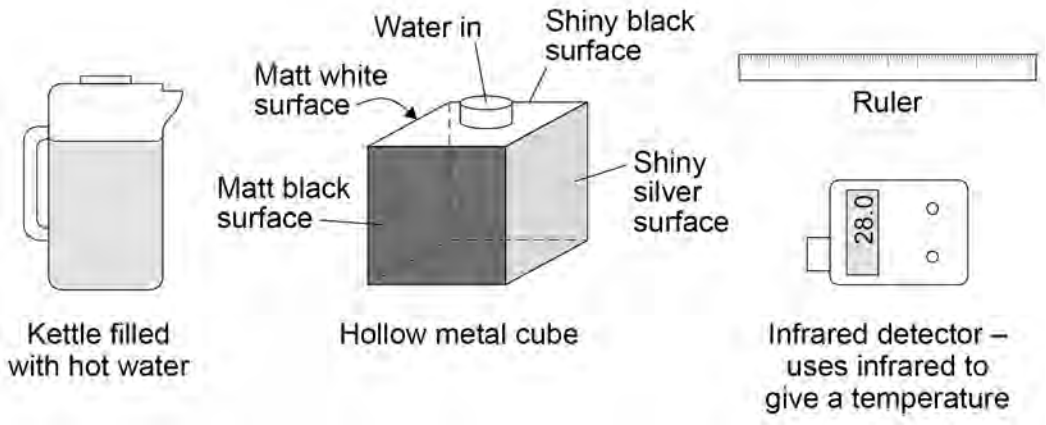
4.6.2.4 Uses and applications of electromagnetic waves

Question 151 · continued

A student investigated how the type of surface affects the amount of infrared the surface radiates.

Figure 13 shows the equipment used.

Figure 13



0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

a control	**the dependent**	**the independent**

In this investigation the type of surface is _____ variable.

0 4 . 6 Describe how the equipment shown in **Figure 13** would be used to compare the infrared radiation emitted from the vertical surfaces of the cube.

[3 marks]

4.6.2.4 Uses and applications of electromagnetic waves

Question 151 · continued

Table 1 shows the results.

Table 1

Type of surface	Temperature in °C
Matt black	68.0
Matt white	65.5
Shiny black	66.3
Shiny silver	28.0

0 4 . 7 What is the resolution of the infrared detector?

[1 mark]

Tick (✓) **one** box.

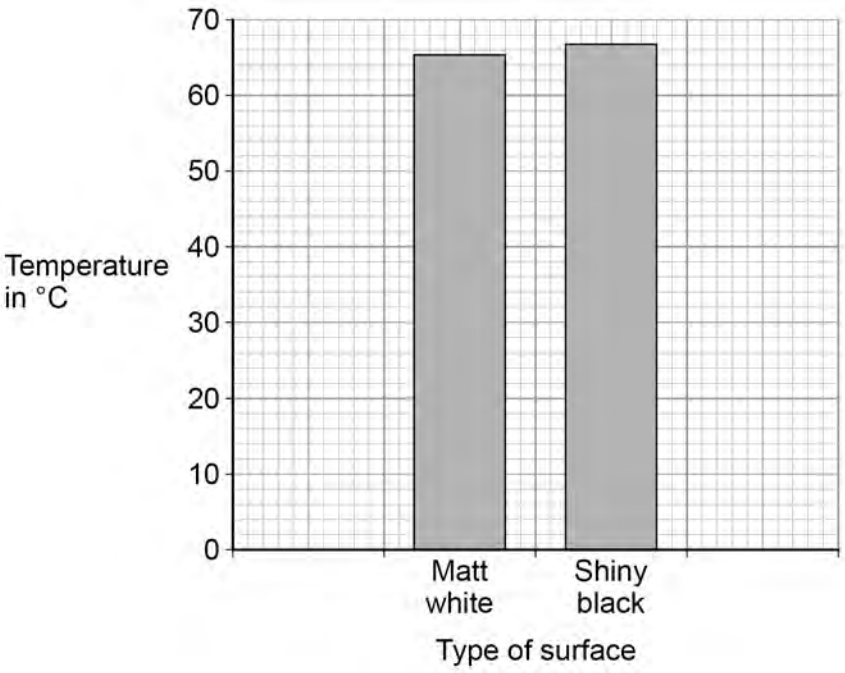
- 0.1 °C ☐
- 1.0 °C ☐
- 1.7 °C ☐
- 68.0 °C ☐

4.6.2.4 Uses and applications of electromagnetic waves

Question 151 · continued

The bar chart in **Figure 14** shows two of the results.

Figure 14



0 4 . 8 Complete the bar chart to show all of the results.

[3 marks]

0 4 . 9 Give **one** conclusion that can be made from the results.

[1 mark]

13

4.6.2.4 Uses and applications of electromagnetic waves

Question 152

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 _____ .

4.6.2.4 Uses and applications of electromagnetic waves

Question 152 · 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. ☐

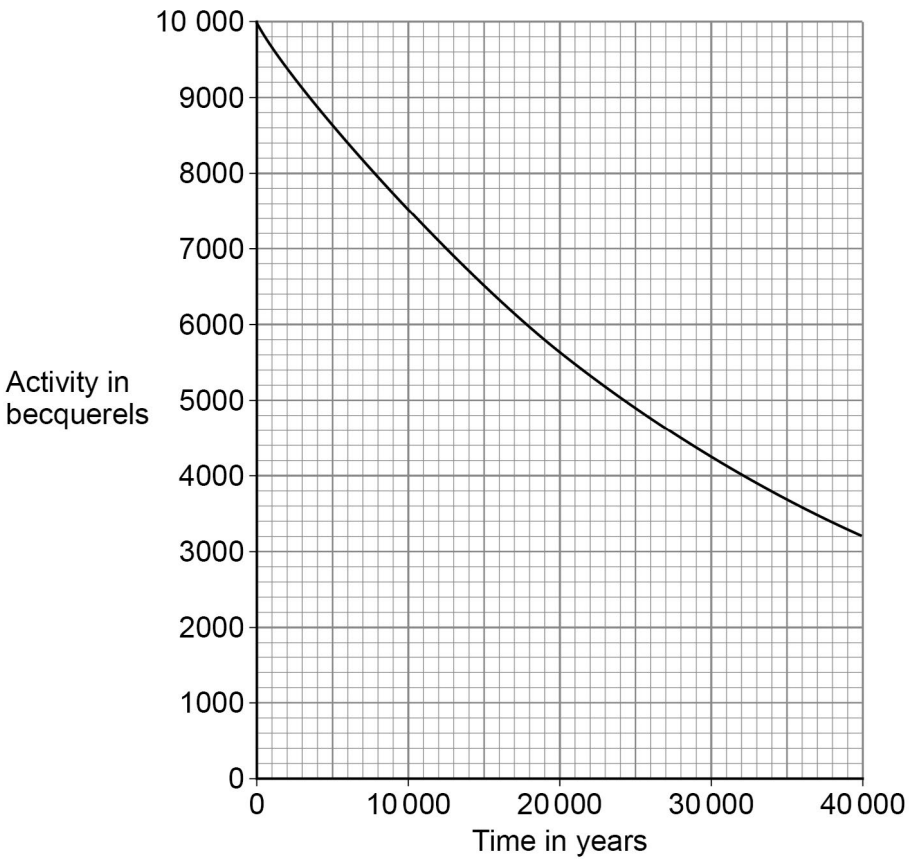
Question 5 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 152 · 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

4.6.2.4 Uses and applications of electromagnetic waves

Question 152 · 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

4.6.2.4 Uses and applications of electromagnetic waves

Question 153

November 2020 | 8463/2F | Original Q4

0 4 . 1 Visible light is used for communications.

Which other parts of the electromagnetic spectrum are used for communications?

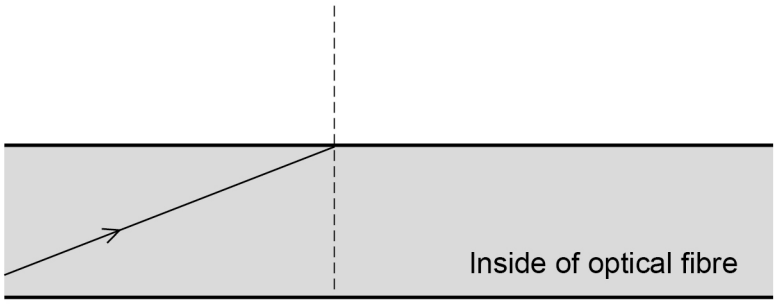
[2 marks]

Tick (✓) **two** boxes.

- Gamma rays ☐
- Microwaves ☐
- Radio waves ☐
- Ultraviolet ☐
- X-rays ☐

Figure 5 shows a ray of light in an optical fibre.

Figure 5



0 4 . 2 What is the name given to the dotted line on **Figure 5**?

[1 mark]

0 4 . 3 Where the ray of light touches the edge of the optical fibre it is reflected.

Draw the reflected ray on **Figure 5**.

[2 marks]

Question 4 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 153 · continued

0 4 . 4 Optical fibres need to be able to bend around corners without breaking.

Suggest the property that optical fibres must have to allow them to bend around corners.

[1 mark]

_____

_____

0 4 . 5 The appearance of visible light can change when it interacts with different objects.

Complete the sentences.

Choose the answers from the box.

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

[3 marks]

absorbed	**reflected**	**refracted**	**transmitted**

When white light is incident on a green filter, only green light passes through the filter.

This is because green light is _____ by the filter.

All other colours of light are _____ by the filter.

When red light shines on a blue object the red light is _____.

9

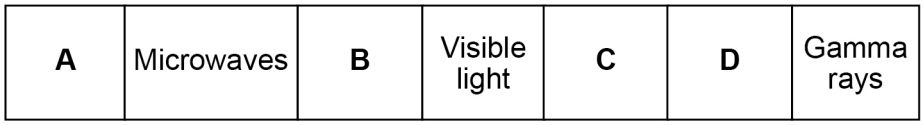
4.6.2.4 Uses and applications of electromagnetic waves

Question 154

November 2020 | 8463/2F | Original Q6

0 6 . 1 **Figure 10** shows the position of three types of wave in the electromagnetic spectrum.

Figure 10



Which letter represents the position of X-rays in the electromagnetic spectrum?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 154 · continued

A doctor needs to obtain an image of a bone in a patient's injured arm.

The doctor takes an X-ray of the arm.

0 6 . 2 Give **one** possible harmful consequence of receiving a dose of X-ray radiation.

[1 mark]

Table 3 gives information about two methods of bone imaging.

Table 3

Method	Radiation dose in millisieverts
X-ray of arm	0.1
CT scan of arm	6.0

0 6 . 3 Compare the risk of harm to the patient of having an X-ray rather than a CT scan.

[2 marks]

4.6.2.4 Uses and applications of electromagnetic waves

Question 154 · continued

November 2020 | 8463/2F | Original Q6

0 6 . 4 Which of the following is the same as 6.0 millisieverts?

[1 mark]

Tick (✓) **one** box.

0.60 sieverts ☐

0.060 sieverts ☐

0.0060 sieverts ☐

0.00060 sieverts ☐

0 6 . 5 The patient received a total radiation dose of 2.5 millisieverts during one year.

Calculate the percentage of this dose that came from one X-ray of the arm.

Use the data in **Table 3**.

[2 marks]

Percentage = _____ %

7

4.6.2.4 Uses and applications of electromagnetic waves

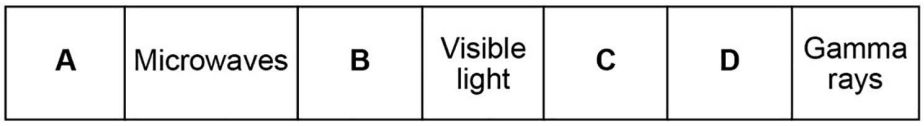
Question 155

November 2021 | 8463/2F | Original Q3

0 3 There are different groups of waves in the electromagnetic spectrum.

0 3 . 1 **Figure 8** shows the position of three groups of the waves.

Figure 8



Which letter shows the position of infrared?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 3 continues on the next page

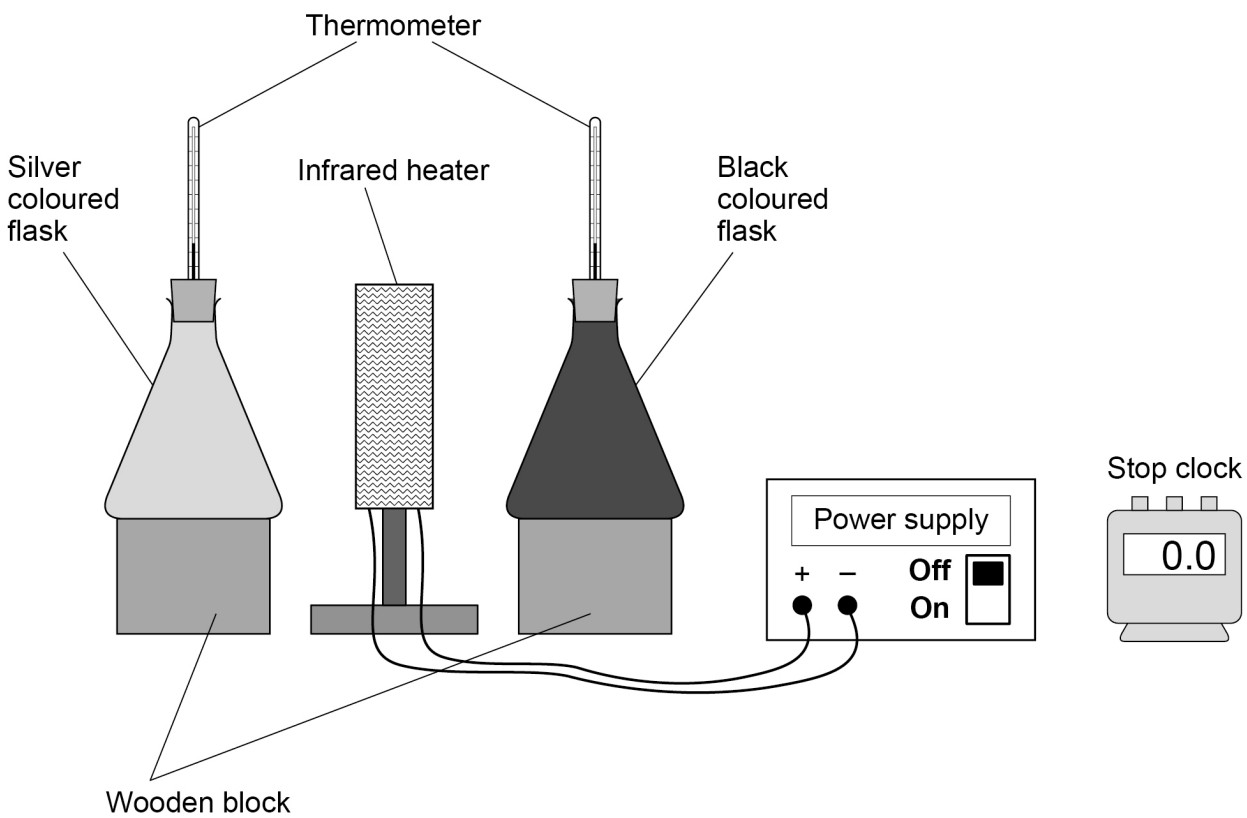
4.6.2.4 Uses and applications of electromagnetic waves

Question 155 · continued

A student investigated how the colour of a surface affects the amount of infrared the surface absorbs.

Figure 9 shows the equipment used.

Figure 9



4.6.2.4 Uses and applications of electromagnetic waves

Question 155 · continued

0 3 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a control	**the dependent**	**the independent**

In this investigation the distance between each flask and the infrared heater

is _____ variable.

0 3 . 3 The student wrote the hypothesis:

'Surface colour of the flask affects the amount of infrared absorbed when the heater is switched on for five minutes.'

Describe how the equipment in **Figure 9** could be used to test this hypothesis.

[4 marks]

Question 3 continues on the next page

Question 155 · continued

Table 1 shows the results.

Table 1

Colour of flask	Temperature increase in °C		
	Test 1	Test 2	Test 3
Black	19	17	27
Silver	10	12	11

0 3 . 4 Which **one** of the results for the black flask is anomalous?

[1 mark]

0 3 . 5 The anomalous result was caused by reading the thermometer incorrectly.

What should the student do with the anomalous result?

[1 mark]

0 3 . 6 Calculate the mean temperature increase for the silver flask.

[1 mark]

Mean temperature increase = _____ °C

4.6.2.4 Uses and applications of electromagnetic waves

Question 155 · continued

0 3 . 7 What conclusion can be made from **Table 1?**

[1 mark]

Tick (✓) **one** box.

Both flasks absorbed the same amount of infrared during the five minutes. ☐

The black flask absorbed the most infrared during the five minutes. ☐

The silver flask absorbed the most infrared during the five minutes. ☐

10

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 156

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.

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

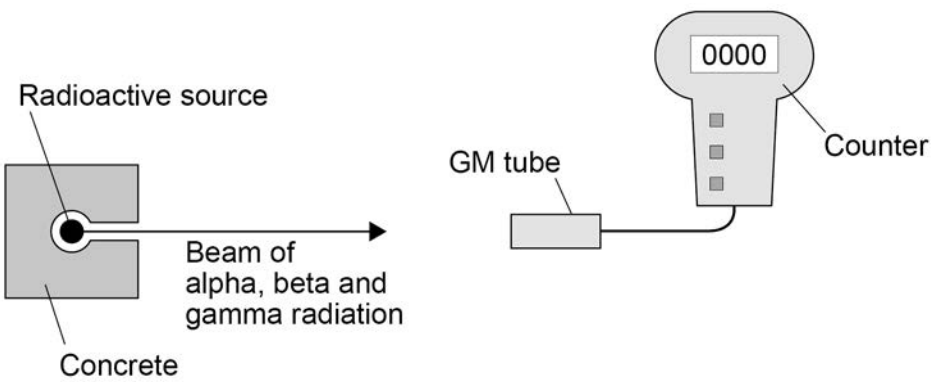
4.6.2.4 Uses and applications of electromagnetic waves

Question 156 · 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	

4.6.2.4 Uses and applications of electromagnetic waves

Question 156 · 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

4.6.2.4 Uses and applications of electromagnetic waves

Question 157

June 2022 | 8463/2F | Original Q5

0 5 Ultraviolet and visible light are both parts of the electromagnetic spectrum.

0 5 . 1 How does the speed of ultraviolet in a vacuum compare to the speed of visible light in a vacuum?

[1 mark]

Tick (✓) **one** box.

Ultraviolet travels at a faster speed than visible light. ☐

Ultraviolet travels at a slower speed than visible light. ☐

Ultraviolet travels at the same speed as visible light. ☐

0 5 . 2 **Figure 9** shows parts of the electromagnetic spectrum.

Figure 9

Radio waves	A	B	C	D	X-rays	Gamma rays

Which letters represent the positions of ultraviolet and visible light in the electromagnetic spectrum?

[2 marks]

Ultraviolet _____

Visible light _____

4.6.2.4 Uses and applications of electromagnetic waves

Question 157 · continued

0 5 . 3 **Table 3** shows the range of wavelengths for different types of ultraviolet.

Table 3

Type	Range of wavelength in nanometres
Ultraviolet **A** (UVA)	315–400
Ultraviolet **B** (UVB)	280–315
Ultraviolet **C** (UVC)	100–280

Determine which type of ultraviolet shown in **Table 3** has the largest range of wavelengths.

To gain full marks you must calculate the range of wavelengths for each type of ultraviolet.

[3 marks]

Type of ultraviolet with the largest range of wavelengths _____

Question 5 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 157 · continued

Figure 10 shows how different types of ultraviolet are absorbed by the ozone layer in the Earth's atmosphere.

Table 4 shows the relative ionising power from each type of ultraviolet.

Figure 10

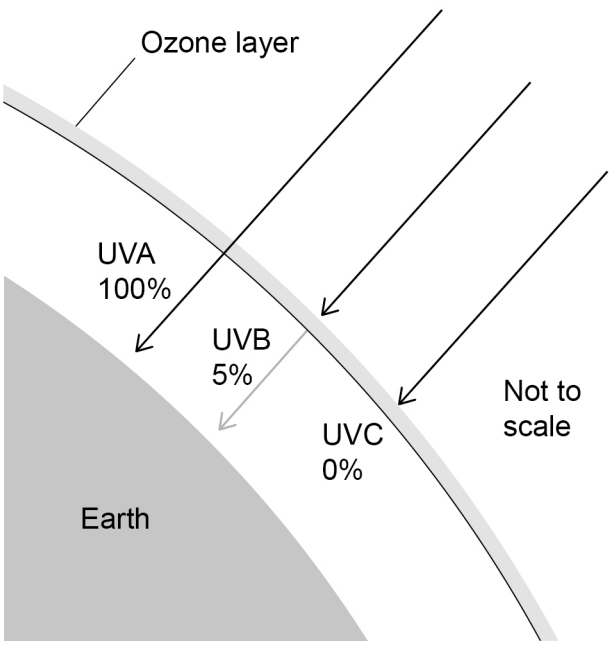


Table 4

Type	Relative ionising power
UVA	Low
UVB	Medium
UVC	High

0 5 . 4 Explain the importance of the ozone layer in reducing the risk to people from all types of ultraviolet.

Use **Figure 10** and **Table 4**.

[4 marks]

4.6.2.4 Uses and applications of electromagnetic waves

Question 157 · continued

0 5 . 5 The Sun emits visible light.

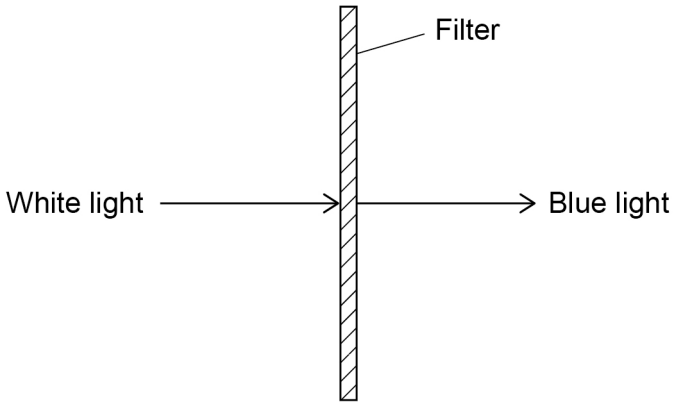
A student concludes that visible light is **not** absorbed by the ozone layer.

Give **one** piece of evidence that shows the student's conclusion is correct.

[1 mark]

0 5 . 6 **Figure 11** shows white light incident on a colour filter.

Figure 11



Complete the sentence.

Choose the answers from the box.

[2 marks]

absorbed	**radiated**	**reflected**	**refracted**	**transmitted**

When white light is incident on the filter, only blue light is _____

and all other colours of light are _____ .

13

4.6.2.4 Uses and applications of electromagnetic waves

Question 158

June 2023 | 8463/1F | Original Q3

0 3 Some isotopes emit nuclear radiation.

0 3 . 1 Carbon-12 and carbon-14 are both isotopes of carbon.

Complete the sentences.

Choose answers from the box.

[2 marks]

alpha particles	**electrons**	**neutrons**	**protons**

The nucleus of a carbon-12 atom and the nucleus of a carbon-14 atom have the **same** number of _____ .

The nucleus of a carbon-12 atom and the nucleus of a carbon-14 atom have a **different** number of _____ .

0 3 . 2 Different radioactive isotopes have different half-lives.

What does 'half-life' mean?

[1 mark]

Tick (✓) **one** box.

- Half the time taken for all of the nuclei in a sample to decay. ☐
- The time taken for half the nuclei in a sample to decay. ☐
- The time taken for one nucleus to split in half. ☐

Question 3 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 158 · continued

0 3 . 3 **Table 2** shows the half-life of some different isotopes of carbon.

Table 2

Isotope	Half-life in seconds
Carbon-15	2.45
Carbon-16	0.75
Carbon-17	0.19
Carbon-18	0.09

Which isotope is the least stable?

[1 mark]

Tick (✓) **one** box.

Carbon-15 ☐

Carbon-16 ☐

Carbon-17 ☐

Carbon-18 ☐

4.6.2.4 Uses and applications of electromagnetic waves

Question 158 · continued

0 3 . 4 Workers in nuclear power stations must be aware of nuclear irradiation and radioactive contamination.

Draw **one** line from each term to an example of the term.

[2 marks]

Term	Example
Radioactive contamination	Exposure to a beam of gamma rays
Nuclear irradiation	Exposure to ultraviolet radiation from the Sun
	Accidental transfer of plutonium onto a human body
	Using a mobile phone

Question 3 continues on the next page

Question 158 · continued

0 3 . 5 Why are workers required to walk across a sticky floor before leaving the nuclear power station?

[1 mark]

Tick (✓) **one** box.

To remove alpha particles from their shoes. ☐

To remove gamma radiation from their shoes. ☐

To remove radioactive dust from their shoes. ☐

0 3 . 6 The places where people work and live contribute to the nuclear radiation they are exposed to.

Table 3 shows the mean daily dose of radiation caused by two different jobs.

Table 3

Job	Mean daily dose in mSv
Aeroplane pilot	0.072
Nuclear power station worker	0.00050

Calculate the number of days a nuclear power station worker must work before receiving the same dose that an aeroplane pilot receives in one day.

[2 marks]

Number of days = _____

4.6.2.4 Uses and applications of electromagnetic waves

Question 158 · continued

June 2023 | 8463/1F | Original Q3

0 3 . 7 The process of nuclear fission takes place in nuclear power stations.

The process of nuclear fusion takes place in the Sun.

Draw **one** line from each process to its fuel.

[2 marks]

Process	Fuel
	Hydrogen
Nuclear fission	Iron
Nuclear fusion	Lead
	Uranium

11

4.6.2.4 Uses and applications of electromagnetic waves

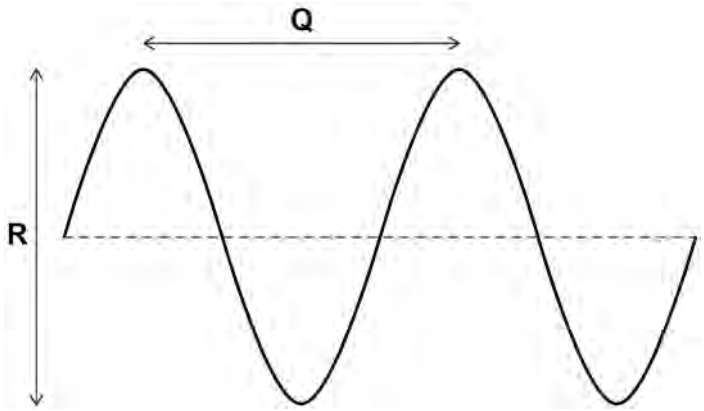
Question 159

June 2023 | 8463/2F | Original Q5

0 5 Electromagnetic waves are transverse.

Figure 13 represents a transverse wave.

Figure 13



0 5 . 1 Which of the following gives the wavelength of the transverse wave?

[1 mark]

Tick (✓) **one** box.

wavelength = $\frac{Q}{2}$ ☐

wavelength = Q ☐

wavelength = 2 Q ☐

0 5 . 2 Which of the following gives the amplitude of the transverse wave?

[1 mark]

Tick (✓) **one** box.

amplitude = $\frac{R}{2}$ ☐

amplitude = R ☐

amplitude = 2 R ☐

4.6.2.4 Uses and applications of electromagnetic waves

Question 159 · continued

0 5 . 3 Microwaves are electromagnetic waves used for mobile phone communications.

Which other type of electromagnetic wave is also used for communications?

[1 mark]

Tick (✓) **one** box.

Radio waves ☐

Ultraviolet ☐

X-rays ☐

0 5 . 4 Microwaves from a mobile phone take 0.000 009 s to reach a mobile phone mast.

speed of microwaves = 300 000 000 m/s

Calculate the distance between the mobile phone and the mobile phone mast.

Use the equation:

distance = speed × time

[2 marks]

Distance = _____ m

0 5 . 5 Mobile phone communications is only one of the uses for microwaves.

Give **one** other use of microwaves.

[1 mark]

6

4.6.2.4 Uses and applications of electromagnetic waves

Question 160

0 9 Infrared waves are transverse waves.

0 9 . 1 Complete the sentence.

[1 mark]

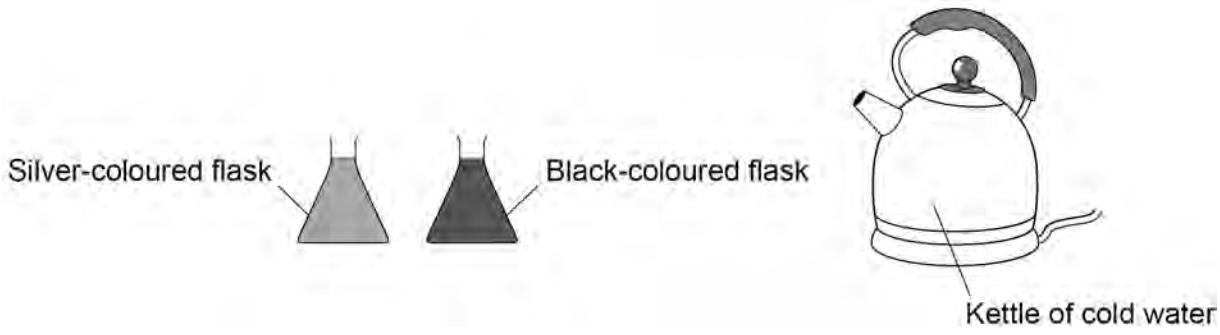
In a transverse wave, the direction of oscillation is _____

to the direction of energy transfer by the wave.

A student investigated how the colour of a surface affects the rate at which the surface emits infrared radiation.

Figure 23 shows some of the equipment used.

Figure 23



4.6.2.4 Uses and applications of electromagnetic waves

Question 160 · continued

0 9 . 2 The student wrote the following hypothesis:

‘The black-coloured flask will emit more infrared radiation than the silver-coloured flask during 10 minutes of cooling.’

Describe a method to test this hypothesis.

[6 marks]

Question 9 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 160 · continued

0 9 . 3 When will the flasks emit infrared radiation at the greatest rate?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

During the 1st minute ☐

During the 5th minute ☐

During the 9th minute ☐

Reason _____

_____

4.6.2.4 Uses and applications of electromagnetic waves

Question 160 · continued

Another student investigated the absorption of infrared radiation by different surface colours.

The student filled four hollow metal cubes with cold water.

Each cube was the same size but had a different surface colour.

The cubes were then placed the same distance from an infrared heater.

After 10 minutes, the student measured the temperature increase of the water inside each cube.

0 9 . 4 What was the dependent variable in this investigation?

[1 mark]

0 9 . 5 **Table 2** shows the results.

Table 2

Surface colour of the cube	Temperature increase after 10 minutes in °C
Matt white	3.0
Shiny white	2.0
Matt black	6.5
Shiny black	4.0

Give **two** conclusions that can be made from the results in **Table 2**.

[2 marks]

1

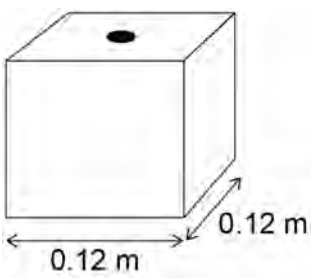
2

Question 160 · continued

Figure 24 shows one of the cubes. The cube is filled with water.

The weight of the water exerts a pressure on the bottom of the cube.

Figure 24



Use the Physics Equations Sheet to answer questions **09.6** and **09.7**.

0 9 . 6 Which equation correctly links area, force and pressure?

[1 mark]

Tick (✓) **one** box.

pressure = force × area^2 ☐

pressure = force × area ☐

pressure = $\frac{\text{force}}{\text{area}}$ ☐

pressure = $\frac{\text{area}}{\text{force}}$ ☐

4.6.2.4 Uses and applications of electromagnetic waves

Question 160 · continued

0 9 . 7 The water pressure at the bottom of the cube is 1500 Pa.

Calculate the force of the water on the bottom of the cube.

[4 marks]

Force = _____ N

17

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

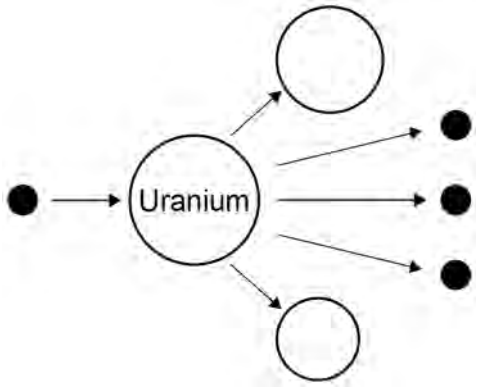
Question 161

June 2024 | 8463/1F | Original Q10

1 0 The process of nuclear fission is used in nuclear power stations.

Figure 17 shows the process of nuclear fission.

Figure 17



1 0 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

electrons	**gamma rays**	**neutrons**	**nuclei**	**protons**

In nuclear power stations, energy is released from

uranium _____.

The uranium in **Figure 17** splits into two parts and

releases three _____.

The process of nuclear fission releases electromagnetic radiation in the

form of _____.

4.6.2.4 Uses and applications of electromagnetic waves

Question 161 · continued

Use the Physics Equations Sheet to answer questions **10.2** and **10.3**.

10.2 Write down the equation which links energy (*E*), power (*P*) and time (*t*).

[1 mark]

10.3 A nuclear power station has a power output of 500 MW.

Calculate the energy output in 3600 s.

Give your answer in J.

[3 marks]

Energy output = _____ J

10.4 Radioactive waste produced by nuclear power stations has a long half-life.

Suggest **one** precaution taken to reduce the hazard caused by radioactive waste from power stations.

[1 mark]

4.6.2.4 Uses and applications of electromagnetic waves

Question 161 · continued

1 0 . 5 Nuclear power stations do **not** generate electricity every day of the year.

One nuclear power station generated electricity for 92% of a year.

one year = 365 days

Calculate the number of days during the year that the nuclear power station generated electricity.

[2 marks]

Number of days = _____

10

Turn over for the next question

4.6.2.4 Uses and applications of electromagnetic waves

Question 162

June 2024 | 8463/2F | Original Q1

0 1 A group of stars is called a galaxy.

0 1 . 1 What is the name of our galaxy?

[1 mark]

Tick (✓) **one** box.

- Black Eye ☐
- Hockey Stick ☐
- Milky Way ☐
- Sculptor Dwarf ☐

0 1 . 2 The Sun is one of the stars in our galaxy.

What was the Sun originally formed from?

[1 mark]

Tick (✓) **one** box.

- Dust and gas ☐
- Heavy elements ☐
- Oxygen ☐

Question 162 · continued

0 1 . 3 Which of the following forces was involved in the formation of the Sun?

[1 mark]

Tick (✓) **one** box.

- Electrostatic force ☐
- Gravitational force ☐
- Magnetic force ☐

0 1 . 4 Stars produce light because they release energy.

Complete the sentence.

Choose the answer from the box.

[1 mark]

combustion	**conduction**	**fusion**

The process which releases energy inside stars is _____.

0 1 . 5 Visible light and infrared radiation travel from the Sun to the Earth.

Which statement describes the time taken for visible light and infrared radiation to travel from the Sun to the Earth?

[1 mark]

Tick (✓) **one** box.

- Visible light takes less time than infrared radiation ☐
- Visible light takes the same time as infrared radiation ☐
- Visible light takes more time than infrared radiation ☐

4.6.2.4 Uses and applications of electromagnetic waves

Question 162 · continued

0 1 . 6 Infrared radiation has a longer wavelength than visible light.

Complete the sentence.

Choose the answer from the box.

[1 mark]

smaller	**the same**	**greater**

Compared with the frequency of infrared radiation, the frequency of

visible light is _____.

0 1 . 7 The Sun and the Earth both emit infrared radiation.

How does the rate of infrared radiation emitted by the Sun compare with the rate of infrared radiation emitted by the Earth?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Lower rate than the Earth ☐

Same rate as the Earth ☐

Greater rate than the Earth ☐

8

Reason _____

_____

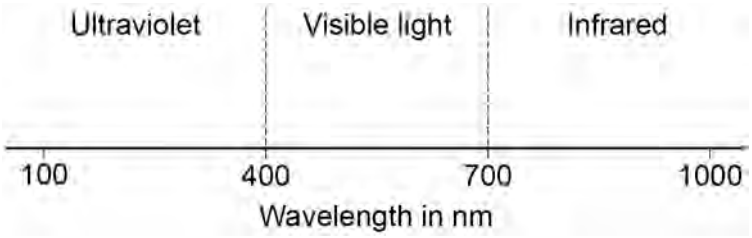
4.6.2.4 Uses and applications of electromagnetic waves

Question 163

June 2024 | 8463/2F | Original Q6

0 6 **Figure 10** shows the wavelengths of some types of electromagnetic radiation.

Figure 10



0 6 . 1 Suggest **one** piece of equipment that can be used to detect infrared radiation.

[1 mark]

0 6 . 2 Which of the following values is a wavelength of red light?

[1 mark]

Tick (✓) **one** box.

320 nm ☐

410 nm ☐

690 nm ☐

750 nm ☐

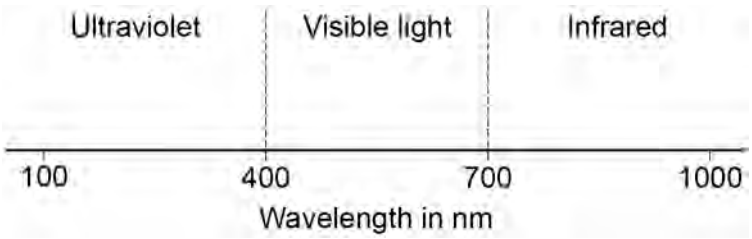
Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 163 · continued

Figure 10 is repeated below.

Figure 10



0 6 . 3 The eyes of a bee can detect electromagnetic radiation with wavelengths between 300 nm and 600 nm.

Give **two** ways the radiation detected by the eyes of a bee is different from the radiation detected by human eyes.

[2 marks]

1 _____

_____

2 _____

_____

0 6 . 4 Complete the sentences.

Choose the answers from the box.

[2 marks]

absorbed	**emitted**	**reflected**	**refracted**

When sunlight shines on a red flower, the red light

is _____.

All other colours of light shining on the red flower

are _____.

4.6.2.4 Uses and applications of electromagnetic waves

Question 163 · continued

June 2024 | 8463/2F | Original Q6

0 6 . 5 A gardener looks at a red flower through a green filter.

How does the flower appear to the gardener?

[1 mark]

Tick (✓) **one** box.

Black ☐

Green ☐

Red ☐

White ☐

0 6 . 6 The leaves of the plant reflect light.

The leaves have a rough surface.

What type of reflection happens at the leaf surface?

[1 mark]

_____

8