AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.1

Types of electromagnetic waves

Past-paper questions

Tier	**Foundation**
Question groups	**92**
Available paper years	**2004–2024**

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.

4.6.2.1 Types of electromagnetic waves

Question 01

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;

.....

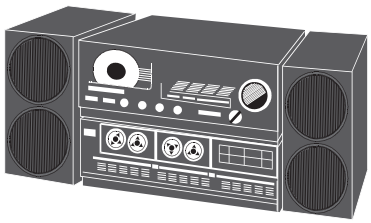
(1 mark)

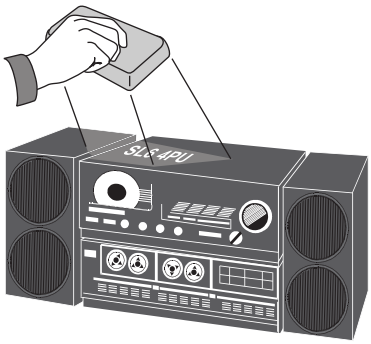
(ii) to send a signal to a TV from a remote control.

.....

(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.

.....

.....

.....

.....

(2 marks)

4.6.2.1 Types of electromagnetic waves

Question 01 · 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

4.6.2.1 Types of electromagnetic waves

Question 02

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;

.....

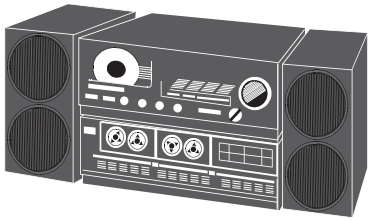
(1 mark)

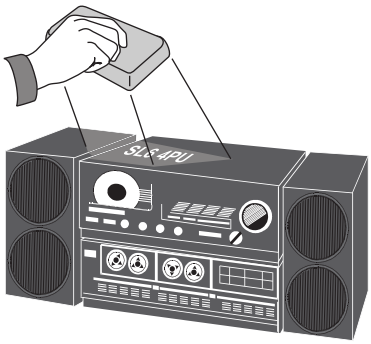
(ii) to send a signal to a TV from a remote control.

.....

(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)

4.6.2.1 Types of electromagnetic waves

Question 02 · 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

4.6.2.1 Types of electromagnetic waves

Question 03

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)

4.6.2.1 Types of electromagnetic waves

Question 03 · continued

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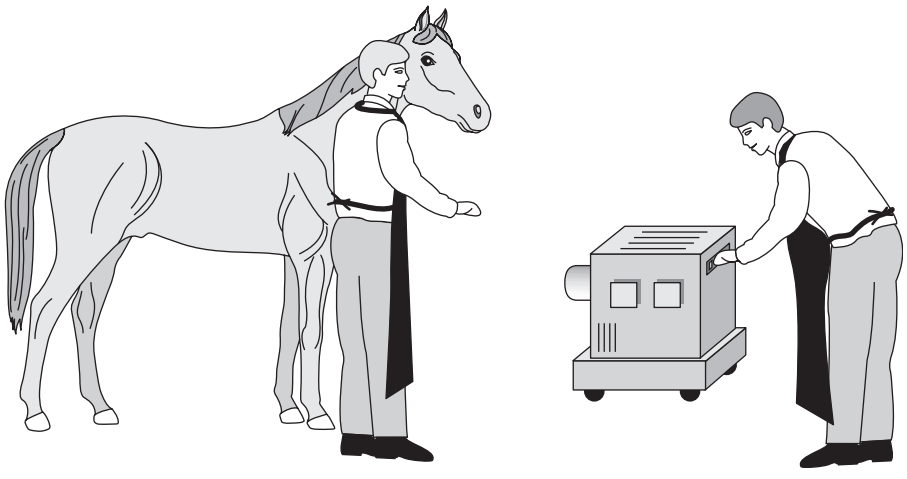
(c) The picture shows a horse being prepared for an X-ray.



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

4.6.2.1 Types of electromagnetic waves

Question 04

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.

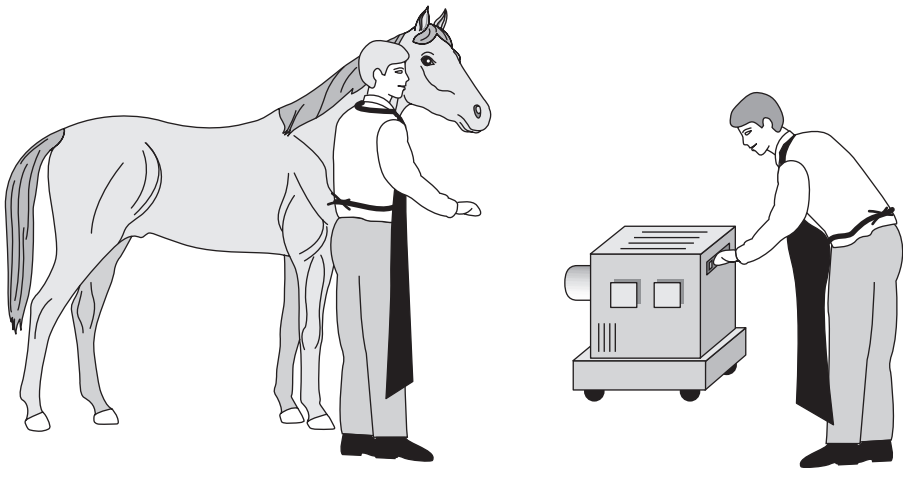
(1 mark)

4.6.2.1 Types of electromagnetic waves

Question 04 · 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.

.....

.....

.....

.....

.....

.....

(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

4.6.2.1 Types of electromagnetic waves

Question 05

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

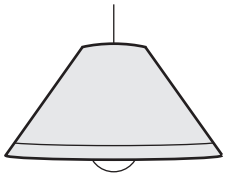
1

Toaster



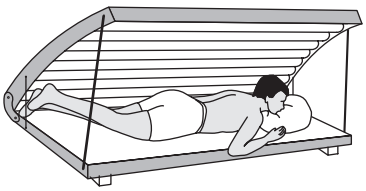
2

Room lamp



3

Sunbed



4

Hospital scanner



4.6.2.1 Types of electromagnetic waves

Question 06

November 2006 | PHY1B | Original Q2 | Legacy

QUESTION TWO

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

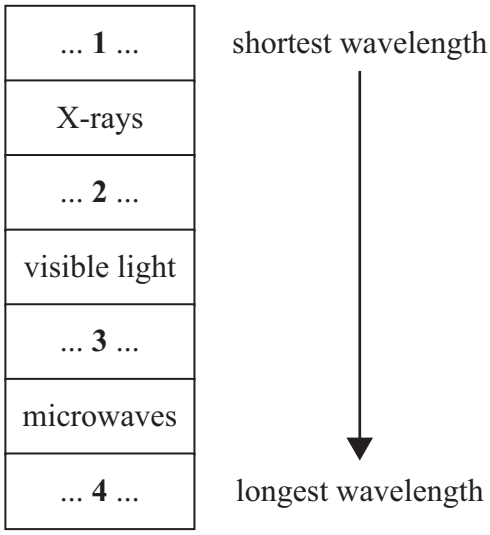
Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the list.

A gamma rays

B infra red rays

C radio waves

D ultraviolet waves



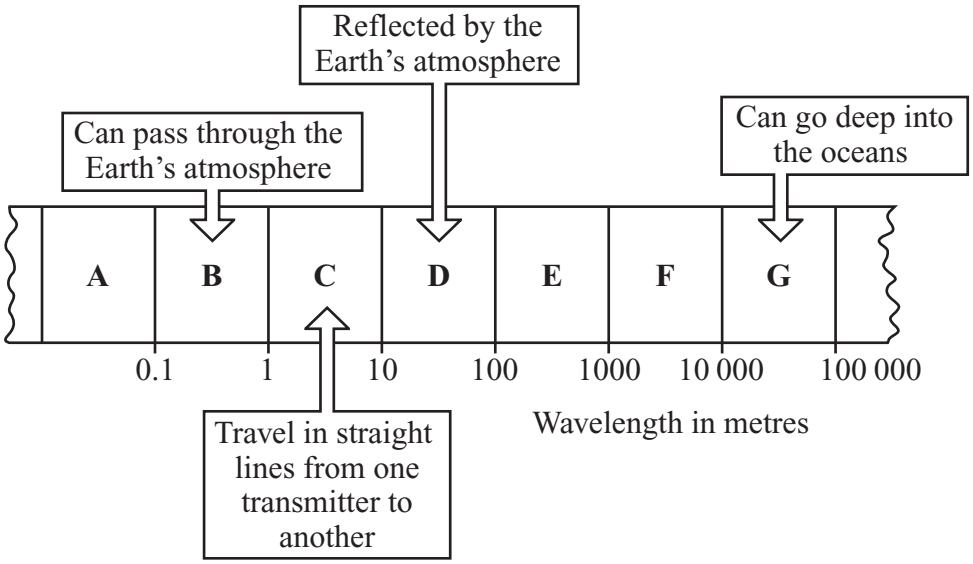
4.6.2.1 Types of electromagnetic waves

Question 07

January 2007 | PHY1F | Original Q1 | Legacy

1 The diagram shows a small part of the electromagnetic spectrum divided into seven sections.

The different properties of the waves in each section make them useful in different ways.



The waves in which section, **A**, **B**, **C**, **D**, **E**, **F** or **G**, are:

(a) used to send a signal to a satellite in space

.....

(1 mark)

(b) used to communicate with a submarine under the water

.....

(1 mark)

(c) used by a radio station to broadcast programmes around the world

.....

(1 mark)

(d) the waves with the shortest wavelength?

.....

(1 mark)

4

4.6.2.1 Types of electromagnetic waves

Question 08

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)

4.6.2.1 Types of electromagnetic waves

Question 08 · 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

4.6.2.1 Types of electromagnetic waves

Question 09

January 2007 | PHY1F | Original Q4 | Legacy

4 Light is given out by the Sun and a distant galaxy.

(a) Compared to the light from the Sun, the light from the distant galaxy has moved towards the red end of the spectrum.

(i) What name is given to this effect?

.....

(1 mark)

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

The fact that light from a distant galaxy seems to move towards the red end of the spectrum gives scientists evidence that

galaxies are shrinking
galaxies are changing colour
the universe is expanding

.

(1 mark)

(b) Scientists have a theory that the universe began from a very small point and then exploded outwards.

(i) What name is given to this theory?

.....

(1 mark)

(ii) Which statement gives a reason why scientists think that the universe began with an explosion?

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

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

It can be proved using equations. ☐

People felt the explosion. ☐

(1 mark)

4.6.2.1 Types of electromagnetic waves

Question 09 · continued

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(c) Scientists use various types of telescope to obtain data from our solar system and beyond.

(i) What type of electromagnetic radiation is detected using an optical telescope?

.....

(1 mark)

(ii) The image from a telescope orbiting in space is usually clearer than the image from a telescope on the Earth.

Which statement gives a reason for this? Put a tick (✓) in the box next to your choice.

A space telescope is bigger. ☐

A space telescope is closer to the stars. ☐

The atmosphere does not block the light to a space telescope. ☐

(1 mark)

(iii) Give **one** disadvantage of having a telescope in space.

.....

.....

(1 mark)

7

4.6.2.1 Types of electromagnetic waves

Question 10

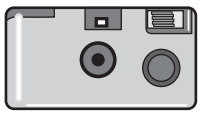
March 2007 | PHY1B | Original Q1 | Legacy

QUESTION ONE

Each of these devices uses electromagnetic radiation.

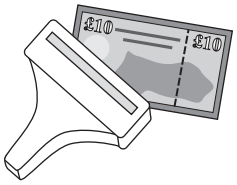
1

Camera



2

Forgery detector



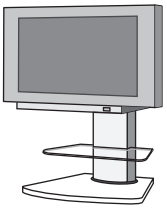
3

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

4.6.2.1 Types of electromagnetic waves

Question 11

March 2007 | PHY1B | Original Q4 | Legacy

QUESTION FOUR

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

A away from

B beyond

C furthest

D towards

The light that reaches us from distant galaxies shows a shift . . . **1** . . . the red end of the electromagnetic spectrum. This is evidence that these galaxies are moving . . . **2** . . . us at a very high speed.

Telescopes orbiting outside the Earth's atmosphere can detect infra red radiation from the . . . **3** . . . galaxies. This is . . . **4** . . . the capability of telescopes on the Earth's surface.

4.6.2.1 Types of electromagnetic waves

Question 12

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.

4.6.2.1 Types of electromagnetic waves

Question 12 · continued

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

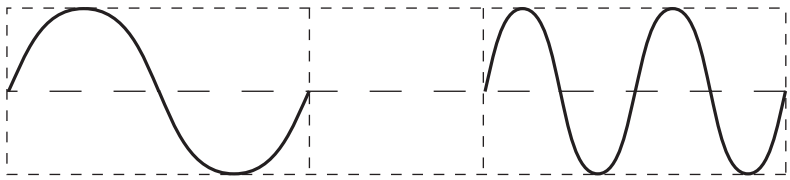
1 longer than both infra red rays and ultraviolet rays

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.



X **Y**

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**.

4.6.2.1 Types of electromagnetic waves

Question 13

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.

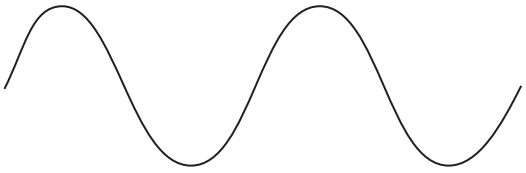
4 Its wavelength increases.

4.6.2.1 Types of electromagnetic waves

Question 13 · 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

4.6.2.1 Types of electromagnetic waves

Question 14

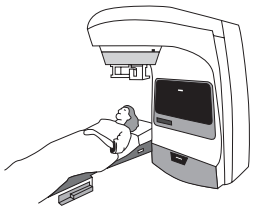
June 2007 | PHY1B | Original Q1 | Legacy

QUESTION ONE

Each of these applications uses electromagnetic radiation.

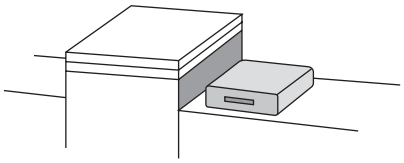
1

Killing cancer cells



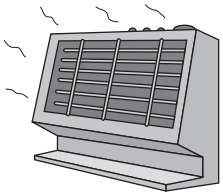
2

Checking bags at an airport



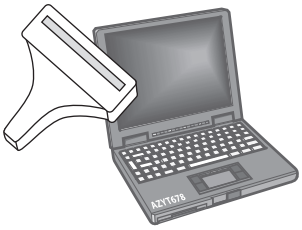
3

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

4.6.2.1 Types of electromagnetic waves

Question 15

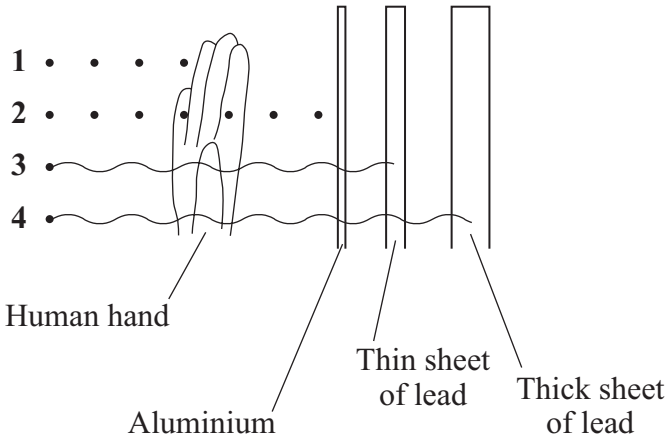
June 2007 | PHY1B | Original Q5 | Legacy

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

4.6.2.1 Types of electromagnetic waves

Question 16

June 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

The solar system is part of the Milky Way galaxy.

7A Astronomers measure the wavelengths of light from distant galaxies.

The unit for wavelength is . . .

1 Hz

2 m/s

3 m

4 °C

7B Visible light from distant galaxies shows an increase in . . .

1 frequency.

2 intensity.

3 speed.

4 wavelength.

7C There is a red-shift in light observed from most distant galaxies.

This has led scientists to the belief that . . .

1 galaxies are moving away from each other.

2 galaxies are moving towards each other.

3 galaxies are moving towards the Milky Way.

4 galaxies are moving towards each other, but some are moving apart.

4.6.2.1 Types of electromagnetic waves

7D Scientists who have studied electromagnetic radiation from distant galaxies support the 'big bang' theory, which states that the Universe began . . .

1 in many places at the same time.

2 from a very small point.

3 as one very big galaxy.

4 as one very big solar system.

Turn over for the next question

4.6.2.1 Types of electromagnetic waves

Question 17

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)

4.6.2.1 Types of electromagnetic waves

Question 17 · continued

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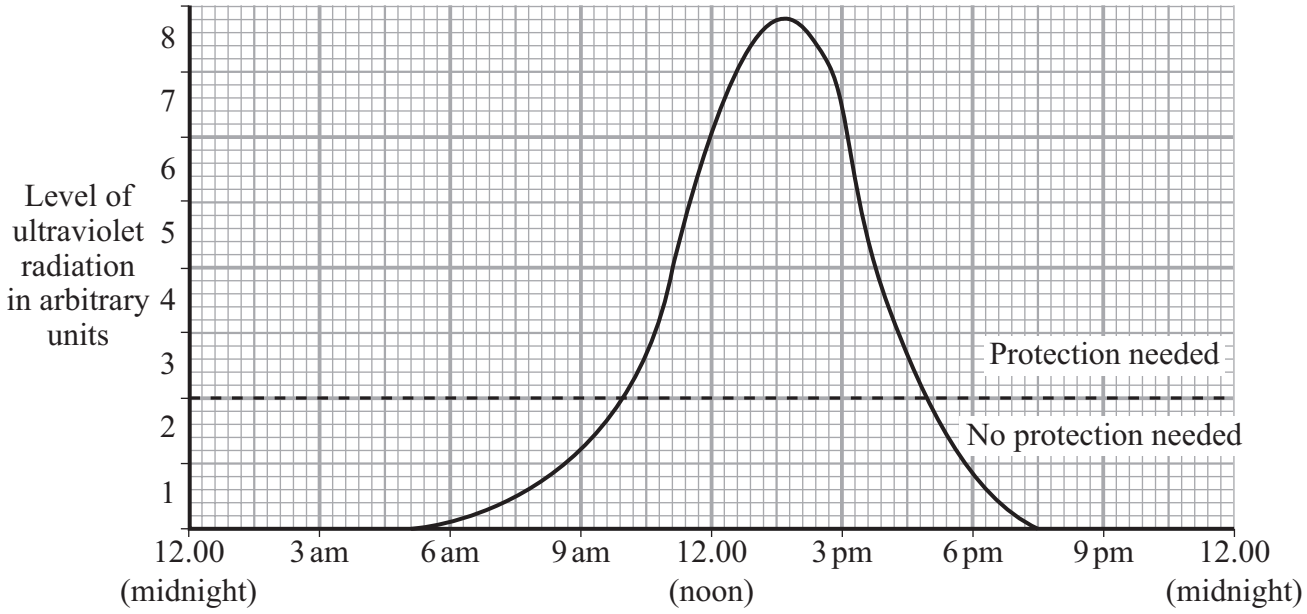
(b) The graph shows how the level of ultraviolet radiation changed during a summer day in England.



(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

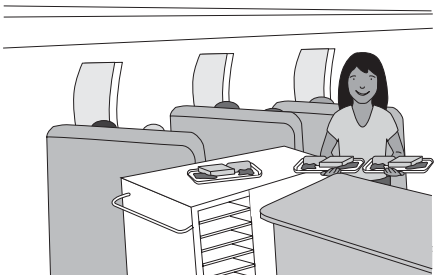
4.6.2.1 Types of electromagnetic waves

Question 18

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** . . . .

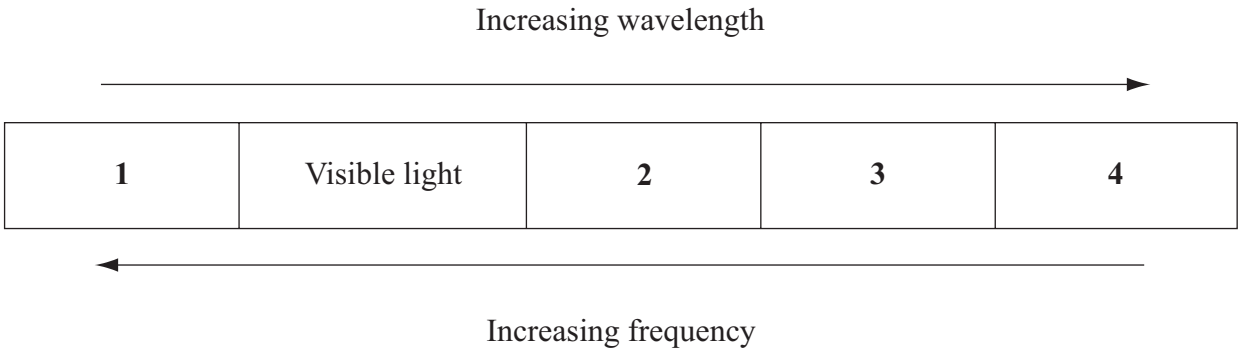
4.6.2.1 Types of electromagnetic waves

Question 19

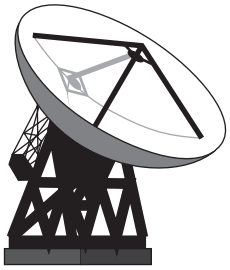
November 2007 | PHY1B | Original Q3 | Legacy

QUESTION THREE

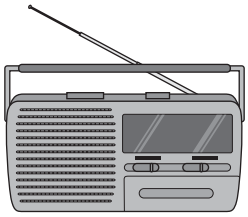
The diagram shows part of the electromagnetic spectrum.



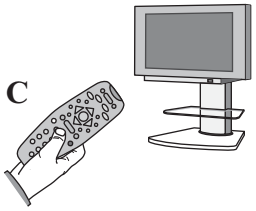
Match devices, **A**, **B**, **C** and **D**, with the types of electromagnetic radiation **1–4** in the spectrum.



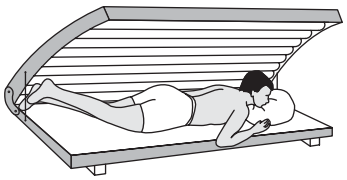
A



B



C



D

4.6.2.1 Types of electromagnetic waves

Question 20

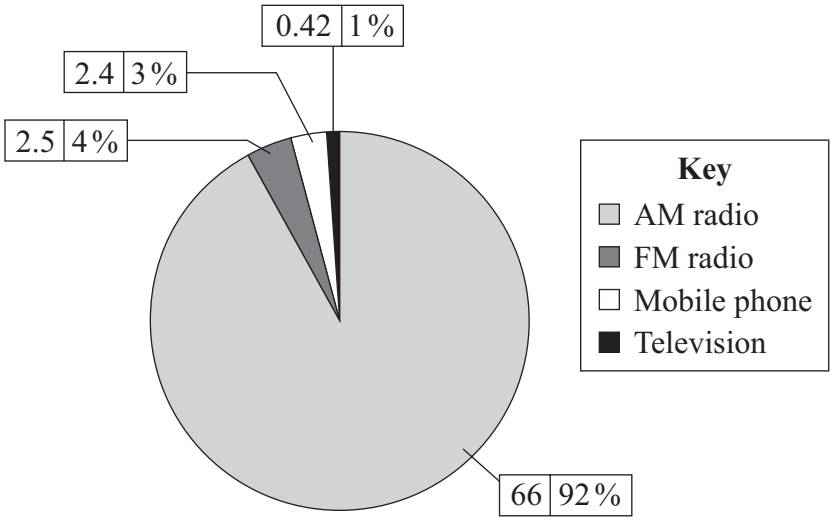
November 2007 | PHY1B | Original Q5 | Legacy

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

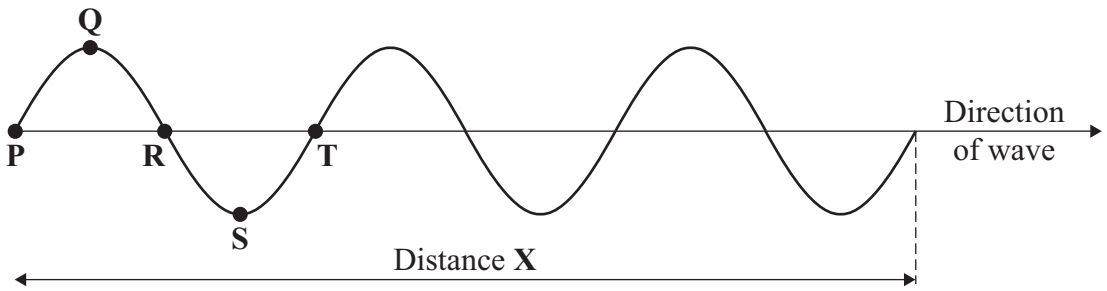
4.6.2.1 Types of electromagnetic waves

Question 21

November 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows part of a wave.



7A The wavelength of this wave is . . .

1 **PR**

2 **PT**

3 **RT**

4 **QS**

7B The wave travels distance **X** in 1 second.

The frequency of the wave is . . .

1 1 Hz

2 2 Hz

3 3 Hz

4 6 Hz

4.6.2.1 Types of electromagnetic waves

Question 21 · continued

7C The spectrum of light from a source of white light moving away at high speed shows . . .

1 a ‘shift’ towards the red end of the spectrum.

2 an increase in the intensity of the ultraviolet radiation.

3 that light travels in straight lines.

4 that red light travels more slowly than blue light in a vacuum.

7D Scientists have analysed light from distant galaxies.

Their conclusion is that . . .

1 our solar system and distant galaxies are moving apart at high speed.

2 galaxies are moving towards each other at high speed.

3 galaxies are stationary.

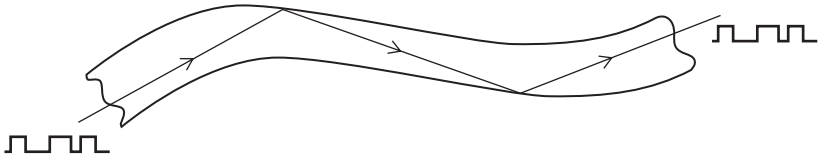
4 the planets in our solar system are moving away from the Sun at high speed.

4.6.2.1 Types of electromagnetic waves

Question 22

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)

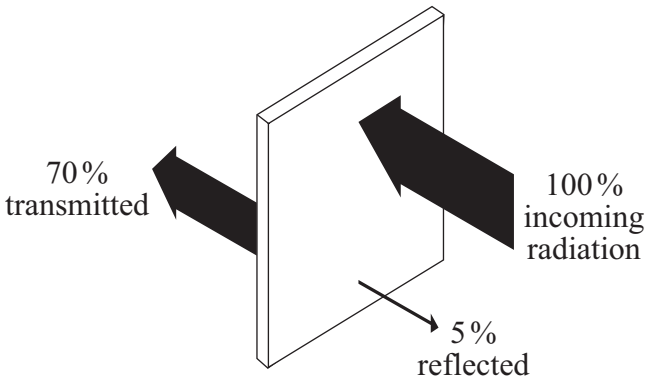
(ii) Name the **two** types of electromagnetic radiation that can be used to send signals along an optical fibre.

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)

4.6.2.1 Types of electromagnetic waves

Question 22 · 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

4.6.2.1 Types of electromagnetic waves

Question 23

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

4.6.2.1 Types of electromagnetic waves

Question 24

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

4.6.2.1 Types of electromagnetic waves

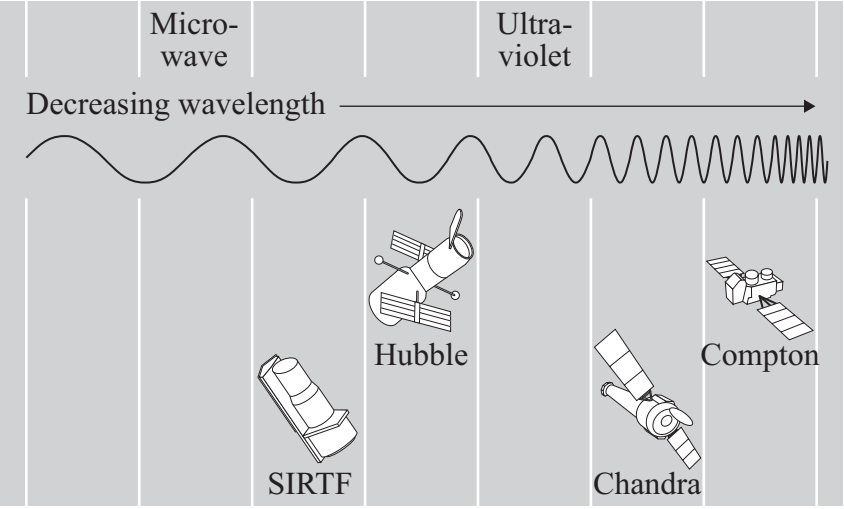
Question 25

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

4.6.2.1 Types of electromagnetic waves

Question 26

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**

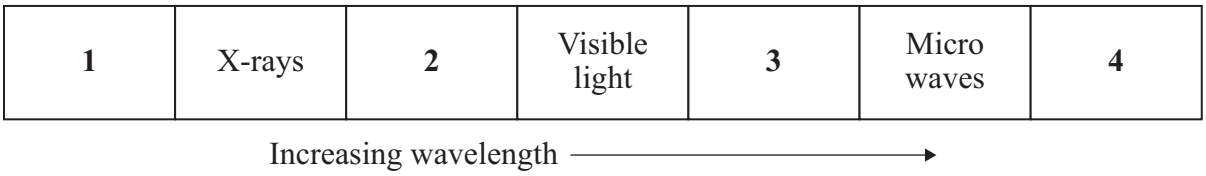
4.6.2.1 Types of electromagnetic waves

Question 27

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

4.6.2.1 Types of electromagnetic waves

Question 28

June 2008 | PHY1F | Original Q4 | Legacy

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 ☐

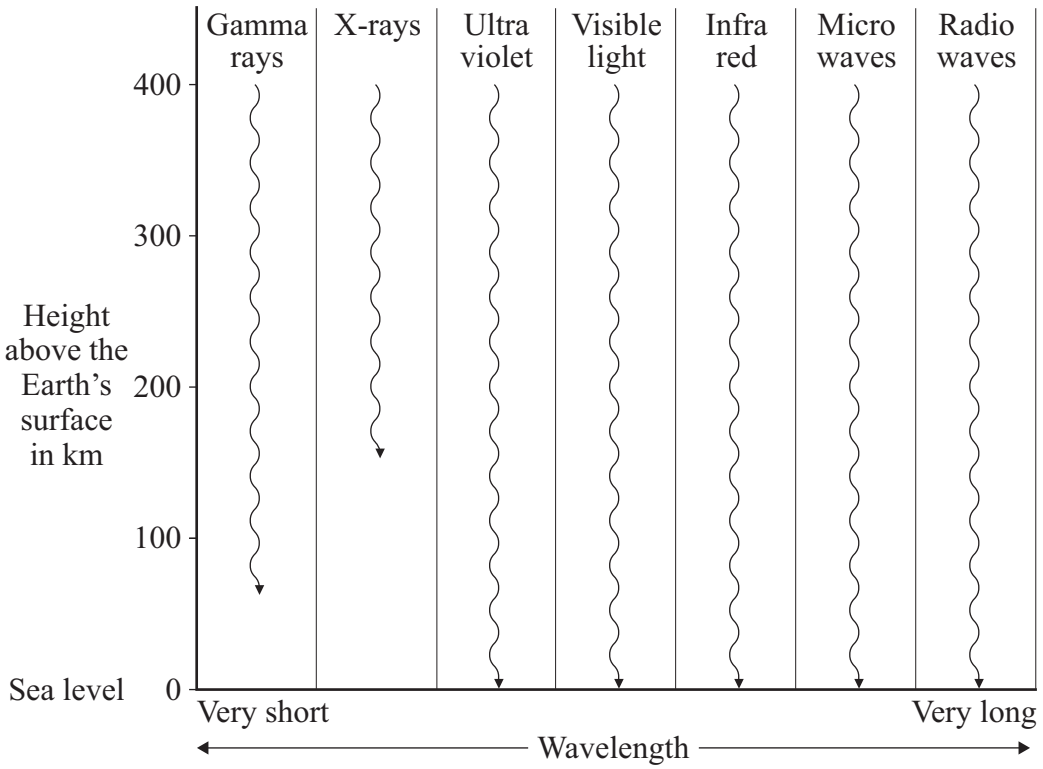
(1 mark)

4.6.2.1 Types of electromagnetic waves

Question 28 · 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

4.6.2.1 Types of electromagnetic waves

Question 29

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** . . . .

4.6.2.1 Types of electromagnetic waves

Question 30

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

4.6.2.1 Types of electromagnetic waves

Question 31

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** . . . .

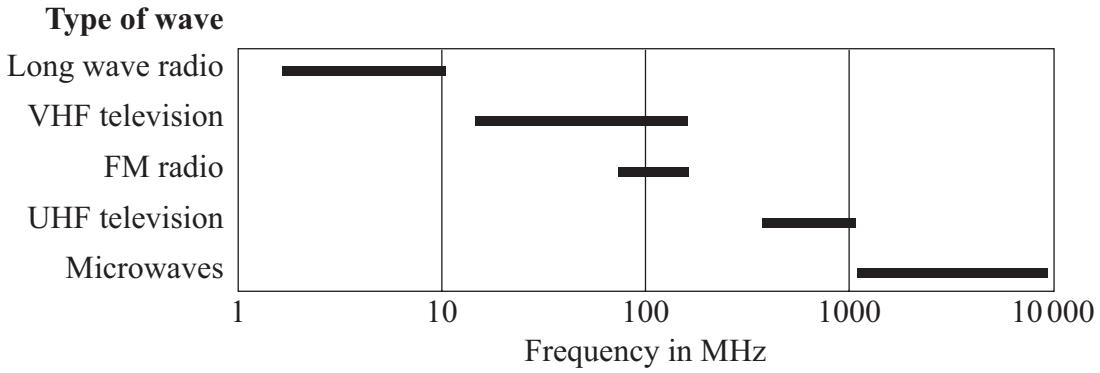
4.6.2.1 Types of electromagnetic waves

Question 32

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

4.6.2.1 Types of electromagnetic waves

Question 32 · 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

4.6.2.1 Types of electromagnetic waves

Question 33

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

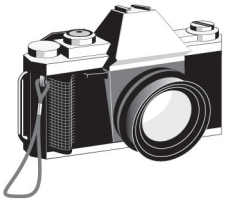
4.6.2.1 Types of electromagnetic waves

Question 34

March 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

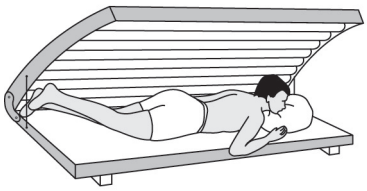
Different devices use different types of electromagnetic waves.



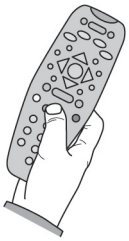
1
Camera



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

4.6.2.1 Types of electromagnetic waves

Question 35

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

4.6.2.1 Types of electromagnetic waves

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

4.6.2.1 Types of electromagnetic waves

Question 36

March 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

The radiation from stars produces spectra. By studying these spectra, scientists can learn a lot about the behaviour and history of stars.

Sometimes, lines in a spectrum appear to be shifted towards the longer wavelength end of the spectrum.

7A What name is given to the shift towards the longer wavelength end of the spectrum?

1 blue-shift

2 green-shift

3 yellow-shift

4 red-shift

7B What information can this shift give scientists about the star that is producing it?

1 the diameter of the star

2 the distance the star is from Earth

3 the mass of the star

4 the temperature of the star

7C What theory about the universe does observation of this shift support?

1 the universe is contracting

2 the universe is expanding

3 the universe is not changing

4 the universe is expanding and contracting

7D A scientist making measurements with a telescope complains that his observations lack precision.

What type of instrument would give more precision?

1 one that has been better calibrated

2 one that has been less well calibrated

3 one with a larger scale division

4 one with a smaller scale division

4.6.2.1 Types of electromagnetic waves

Question 37

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.

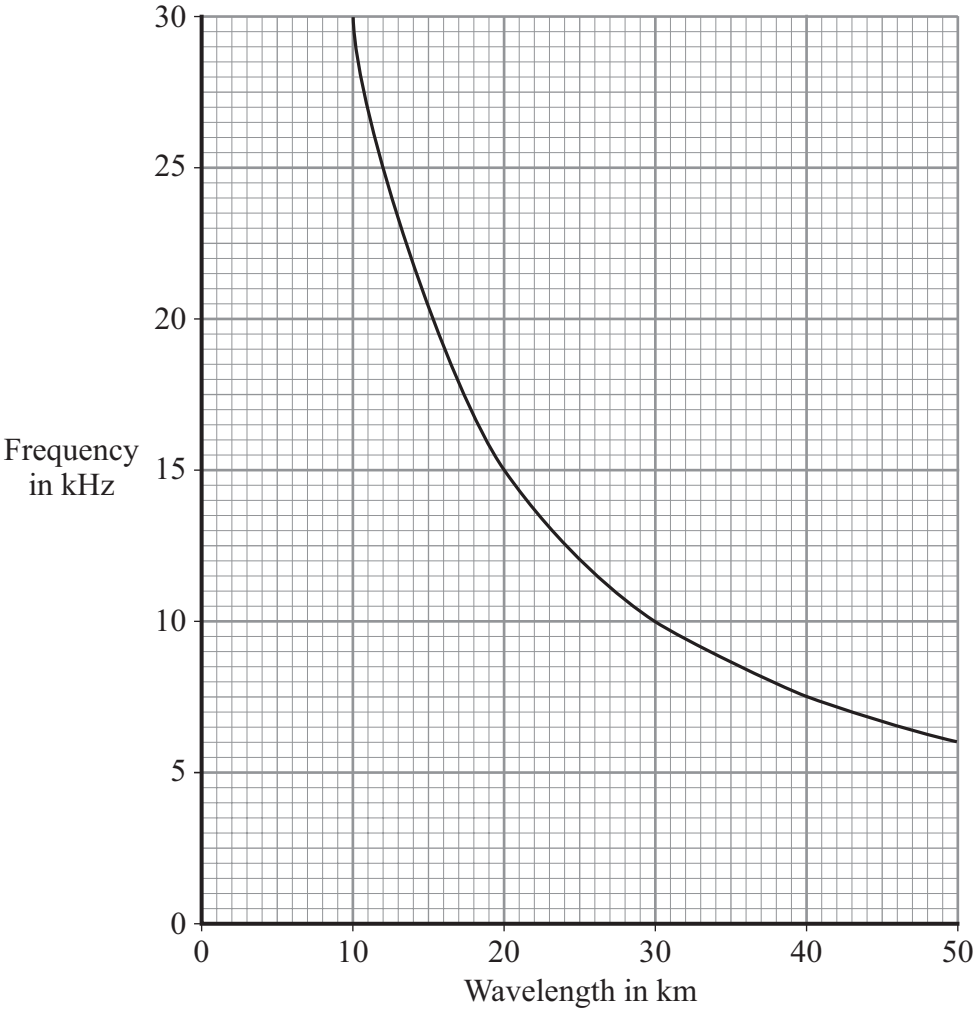
3 reflected by the atmosphere.

4 stopped by the atmosphere.

4.6.2.1 Types of electromagnetic waves

Question 37 · 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

4.6.2.1 Types of electromagnetic waves

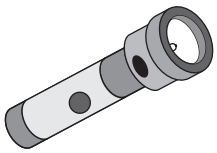
Question 38

June 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

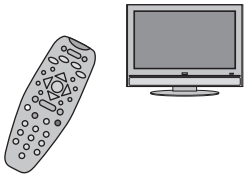
Many everyday devices use electromagnetic waves.

Torch



1

Remote control



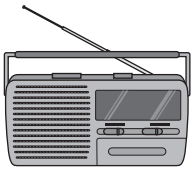
2

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

4.6.2.1 Types of electromagnetic waves

Question 39

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** . . . .

4.6.2.1 Types of electromagnetic waves

Question 40

June 2009 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

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

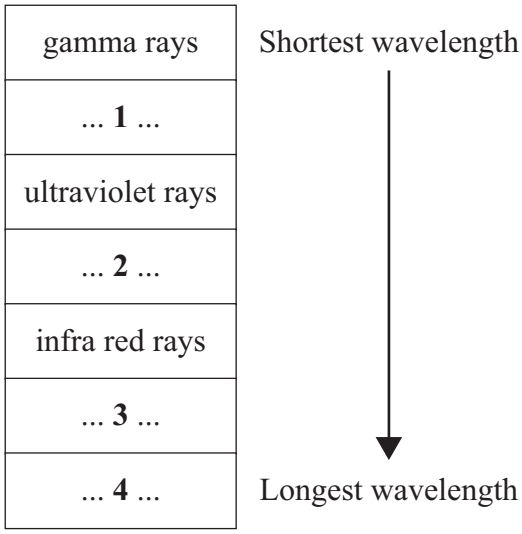
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A microwaves

B X-rays

C visible light

D radio waves



4.6.2.1 Types of electromagnetic waves

Question 41

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)

4.6.2.1 Types of electromagnetic waves

Question 41 · 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.

.....

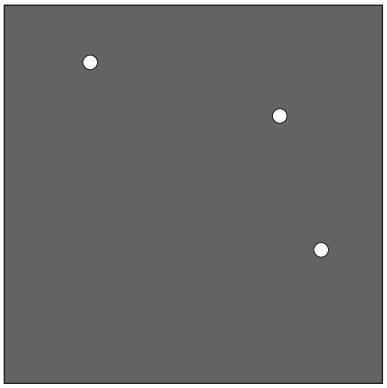
.....

.....

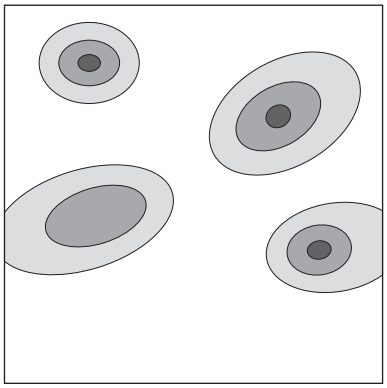
.....

(2 marks)

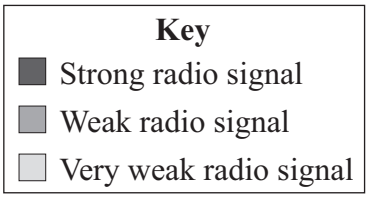
6 (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



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

4.6.2.1 Types of electromagnetic waves

Question 42

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

4.6.2.1 Types of electromagnetic waves

Question 43

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** . . . .

4.6.2.1 Types of electromagnetic waves

Question 44

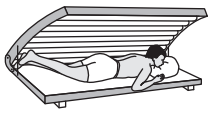
January 2010 | PHY1F | Original Q1 | Legacy

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.

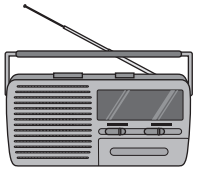
Draw a line from each device to the type of electromagnetic wave that it uses.
One has been done for you.

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

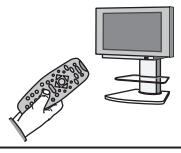
Sunbed



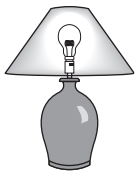
Radio



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?

.....

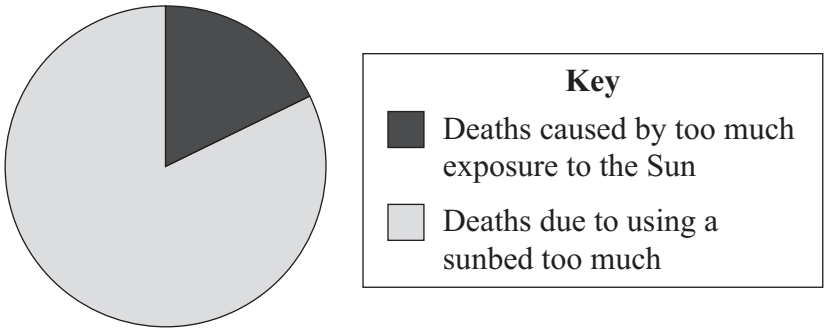
(1 mark)

4.6.2.1 Types of electromagnetic waves

Question 44 · 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

4.6.2.1 Types of electromagnetic waves

Question 45

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

4.6.2.1 Types of electromagnetic waves

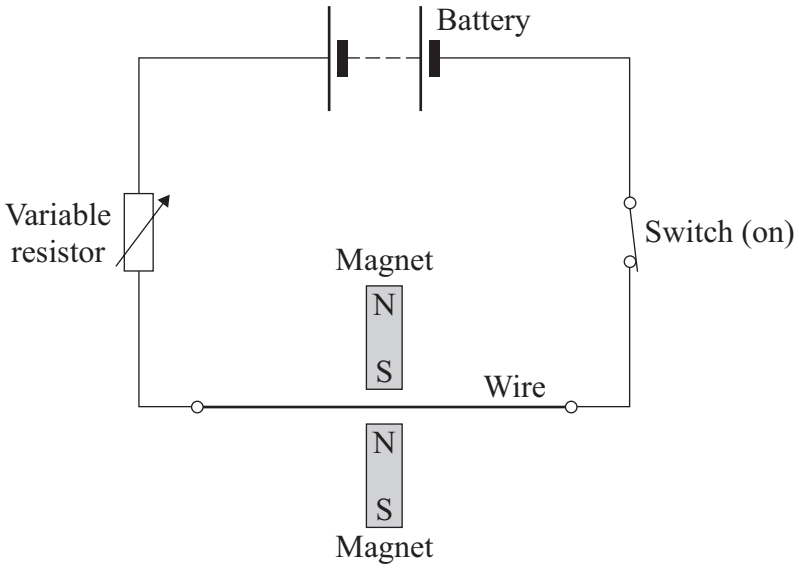
Question 46

January 2010 | PHY3F | Original Q6 | Legacy

6 A student investigates the electromagnetic force acting on a wire which carries an electric current. The wire is in a magnetic field.

The diagram shows the circuit which the student uses.

6 (a) Draw an **X** on the diagram, with the centre of the **X** in the most strongest part of the magnetic field.



(1 mark)

6 (b) Give **one** change that she can make to the magnets to **decrease** the electromagnetic force on the wire.

.....

.....

(1 mark)

6 (c) The student wants to change the electromagnetic force on the wire without changing the magnets or moving their position.

6 (c) (i) Give **one** way in which she can **increase** the electromagnetic force.

.....

.....

(1 mark)

6 (c) (ii) Give **one** way in which she can **reverse** the direction of the electromagnetic force.

.....

.....

(1 mark)

4

4.6.2.1 Types of electromagnetic waves

Question 47

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

4.6.2.1 Types of electromagnetic waves

Question 48

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.

4.6.2.1 Types of electromagnetic waves

Question 49

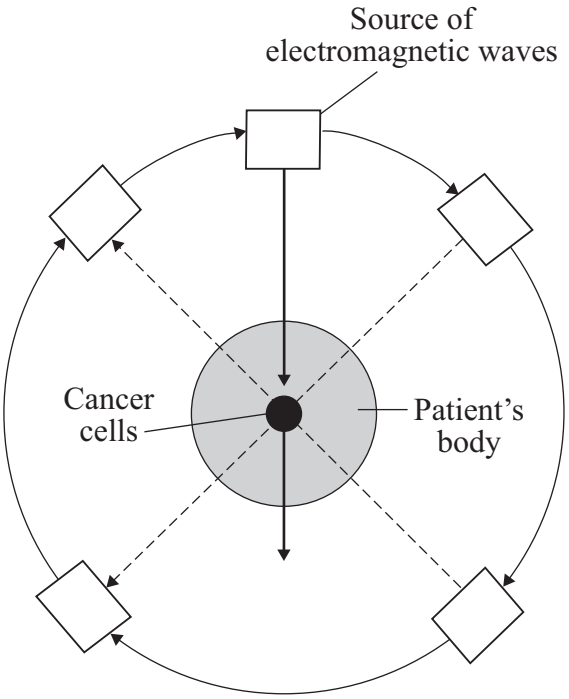
March 2010 | PHY1BP | Original Q6 | Legacy

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

4.6.2.1 Types of electromagnetic waves

Question 49 · 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

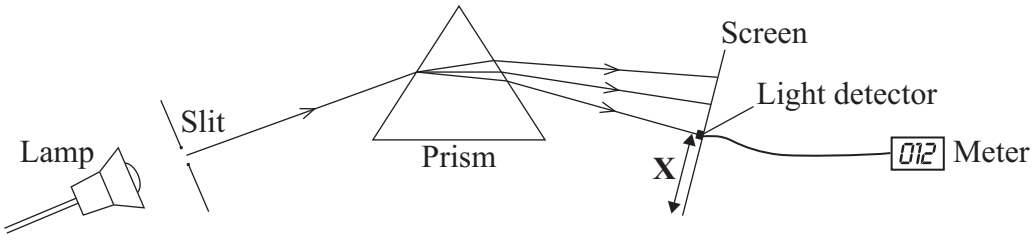
4.6.2.1 Types of electromagnetic waves

Question 50

March 2010 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows apparatus used by some students investigating the light given out by a lamp.



The students used a prism to split the light into the colours of the spectrum.
They used a light detector and meter to measure the amount of light.
They measured the amount of light detected for different colours of the spectrum.

The only light in the room was from the lamp.

7A Which was a control variable in the experiment?

1 amount of light detected

2 the distance from the screen to the meter

3 the distance from the slit to the screen

4 the distance **X** from the end of the screen to the detector

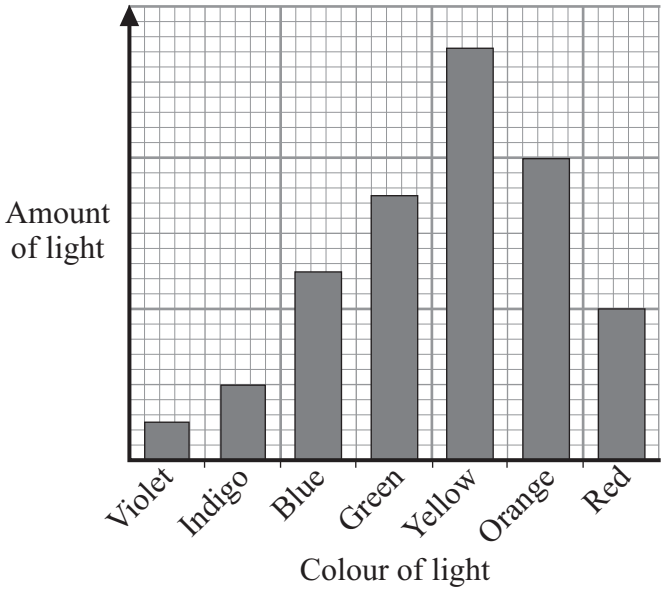
7B Which row in the table gives a correct description of variables?

	Independent variable	**Dependent variable**
1	amount of light	colour of light
2	colour of light	amount of light
3	amount of light	distance from screen to prism
4	colour of light	distance from the slit to the screen

4.6.2.1 Types of electromagnetic waves

Question 50 · continued March 2010 | PHY1BP | Original Q7 | Legacy

The students displayed their results.



7C The students plotted a bar chart because . . .

1 both variables were categoric.

2 the amount of light was a continuous variable and the colour was a categoric variable.

3 the amount of light was a categoric variable and the colour was a continuous variable.

4 both variables were continuous.

7D From the graph we can conclude that the amount of light . . .

1 decreases steadily from violet to red.

2 increases steadily from violet to red.

3 is the same for all colours.

4 is bigger for one colour than for any of the others.

4.6.2.1 Types of electromagnetic waves

Question 51

June 2010 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

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

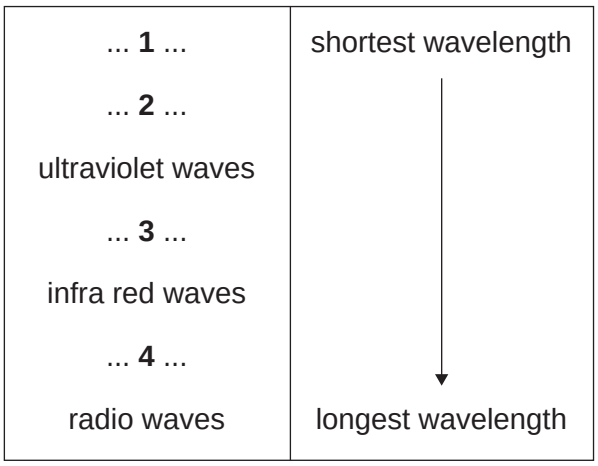
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the diagram.

A gamma rays

B microwaves

C visible light

D X-rays



4.6.2.1 Types of electromagnetic waves

Question 52

June 2010 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Light is given out by the Sun and by galaxies.

7A Compared with the light from the Sun, the light from many galaxies has moved towards the red end of the spectrum.

What name is given to this effect?

1 light-move

2 light-shift

3 red-move

4 red-shift

7B The light from many galaxies is moved towards the red end of the spectrum.

This fact gives scientists evidence that . . .

1 galaxies are shrinking.

2 galaxies are changing colour.

3 the universe is expanding.

4 the universe is shrinking.

7C Scientists have a theory that the universe began from a very small point.

What name is given to this theory?

1 Big Bang

2 Big explosion

3 Expansion of space

4 Steady state

7D Scientists think that the universe began from a very small point because . . .

1 it can be proved using equations.

2 it is the only way of explaining how the universe began.

3 powerful telescopes enable us to see the small point.

4 at the moment it is the best way of explaining our observations.

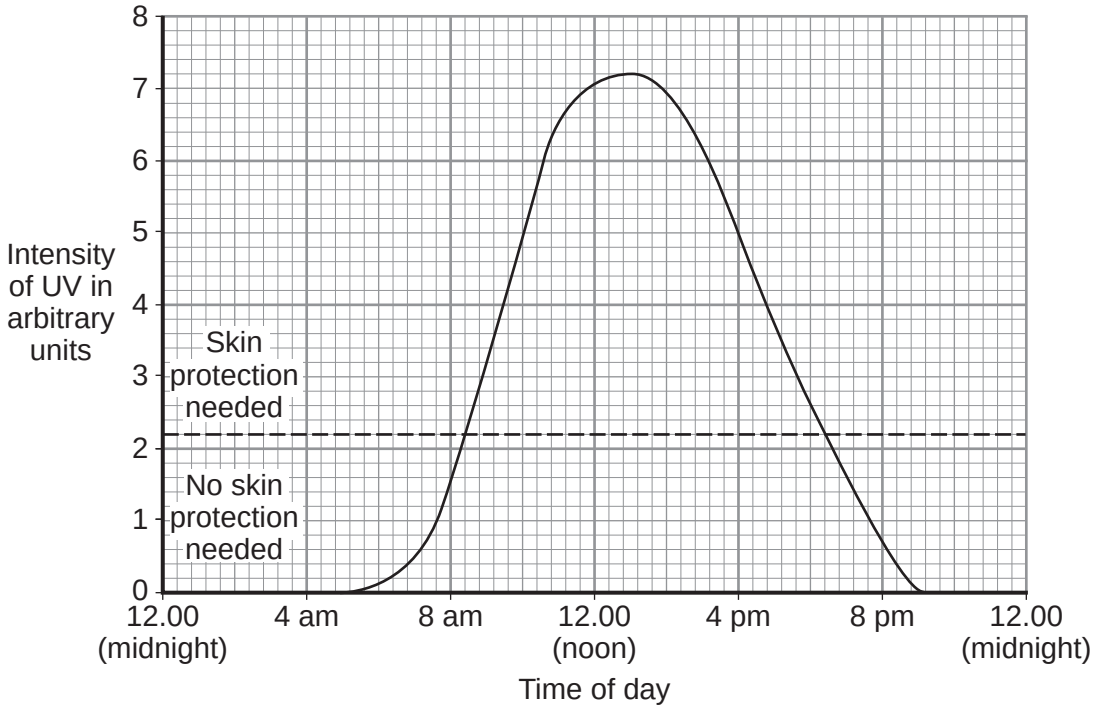
4.6.2.1 Types of electromagnetic waves

Question 53

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

4.6.2.1 Types of electromagnetic waves

Question 53 · 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

4.6.2.1 Types of electromagnetic waves

Question 54

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)

4.6.2.1 Types of electromagnetic waves

Question 54 · 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

4.6.2.1 Types of electromagnetic waves

Question 55

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.

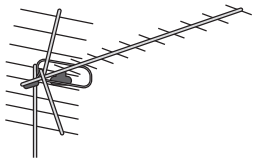
4.6.2.1 Types of electromagnetic waves

Question 56

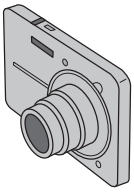
November 2010 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

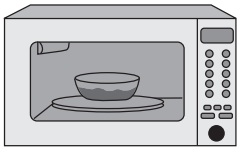
The drawings show devices that use electromagnetic waves.



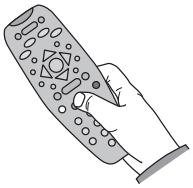
1



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

4.6.2.1 Types of electromagnetic waves

Question 57

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

4.6.2.1 Types of electromagnetic waves

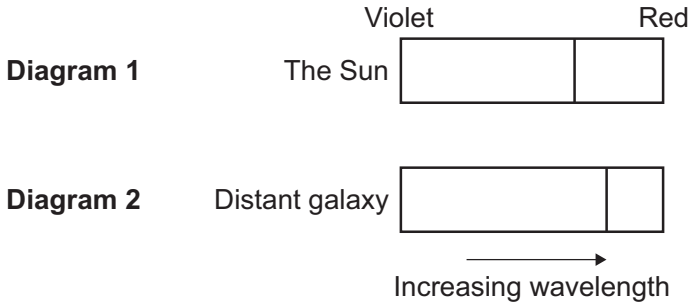
Question 58

November 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

Diagram 1 shows the spectrum of light from the Sun. There is a black line in the spectrum.

Diagram 2 shows the spectrum of light from a distant galaxy. This spectrum has the same black line.



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

A decreased

B increased

C shifted

D not changed

Edwin Hubble compared the spectrum of light from this distant galaxy to the spectrum of light from the Sun.

Hubble found that the position of the black line had . . . **1** . . . .

This was because the wavelength of the observed light had . . . **2** . . . .

The frequency of the observed light had . . . **3** . . . .

The speed of the light had . . . **4** . . . .

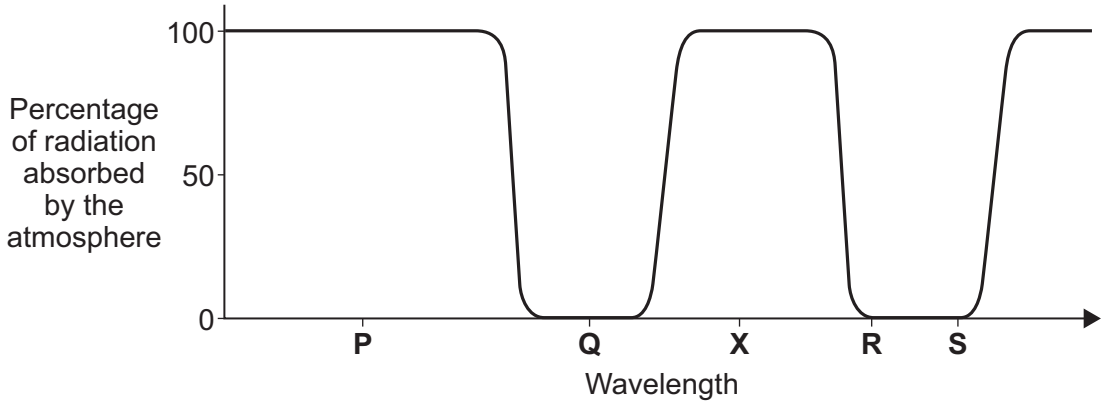
4.6.2.1 Types of electromagnetic waves

Question 59

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

4.6.2.1 Types of electromagnetic waves

Question 59 · continued

- 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.

4.6.2.1 Types of electromagnetic waves

Question 60

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?

.....

.....

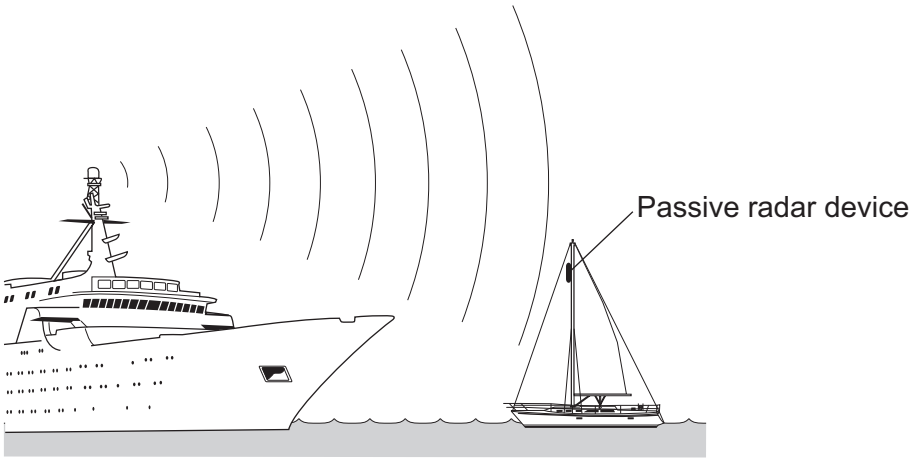
(1 mark)

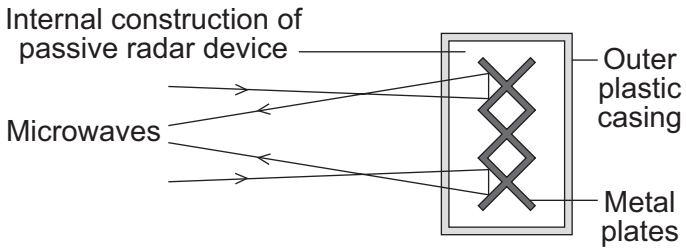
6 (b) How fast do microwaves travel through the air or a vacuum compared to radio waves?

.....

(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.





4.6.2.1 Types of electromagnetic waves

Question 60 · 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)

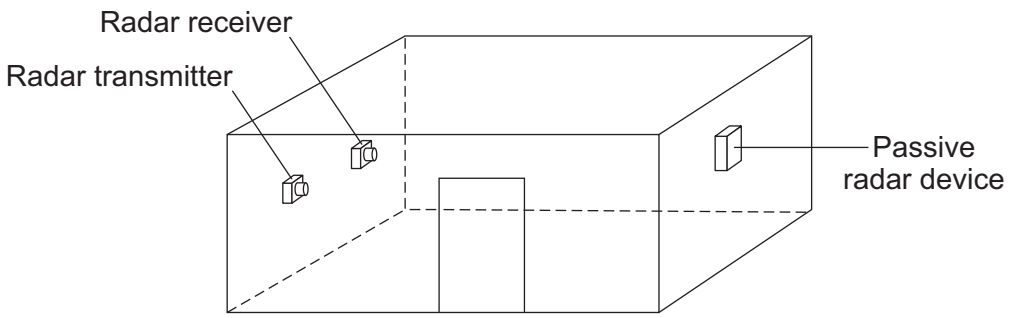
Question 6 continues on the next page

4.6.2.1 Types of electromagnetic waves

Question 60 · 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?

.....

.....

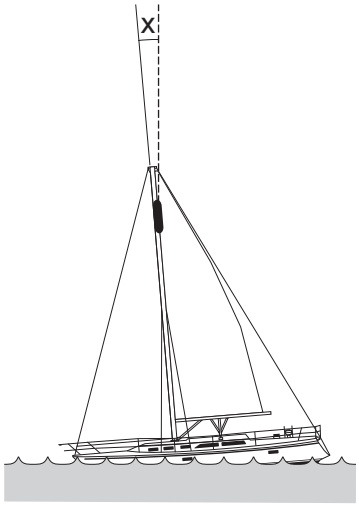
(1 mark)

4.6.2.1 Types of electromagnetic waves

Question 60 · 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

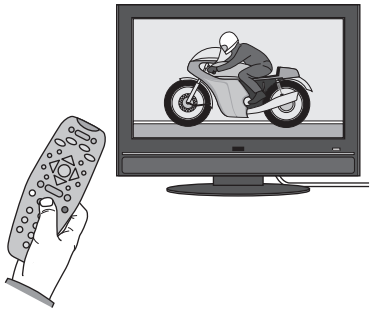
4.6.2.1 Types of electromagnetic waves

Question 61

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** . . . .

4.6.2.1 Types of electromagnetic waves

Question 62

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** . . . .

4.6.2.1 Types of electromagnetic waves

Question 63

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** . . .

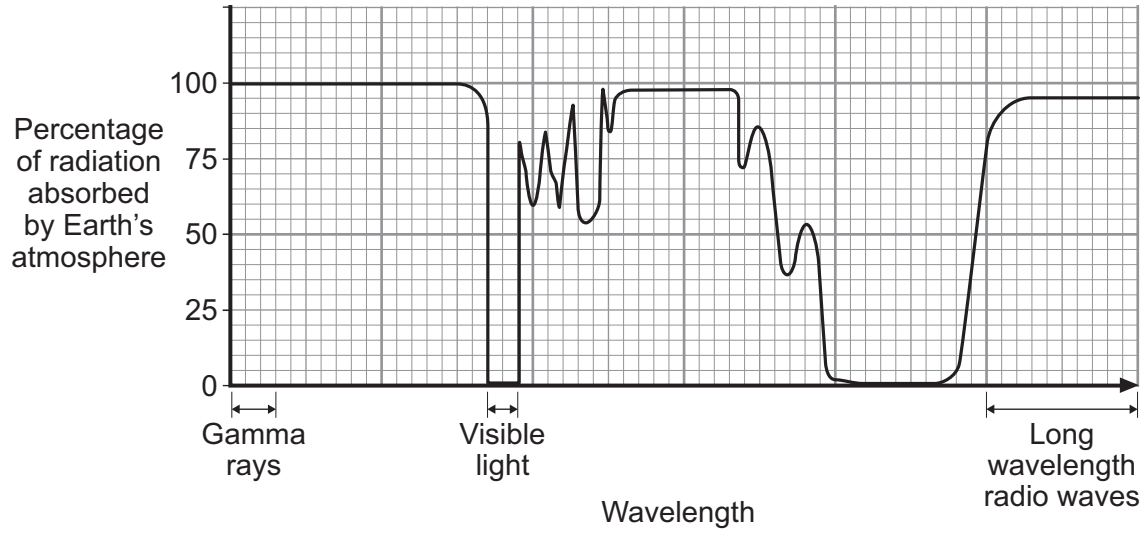
4.6.2.1 Types of electromagnetic waves

Question 64

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

4.6.2.1 Types of electromagnetic waves

Question 64 · continued

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

4.6.2.1 Types of electromagnetic waves

Question 65

June 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Electromagnetic radiation has many uses.

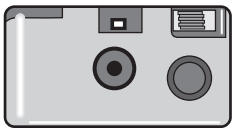
1

Toaster



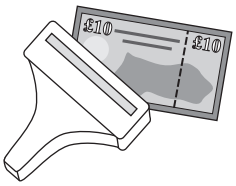
2

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

4.6.2.1 Types of electromagnetic waves

Question 66

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** . . . .

4.6.2.1 Types of electromagnetic waves

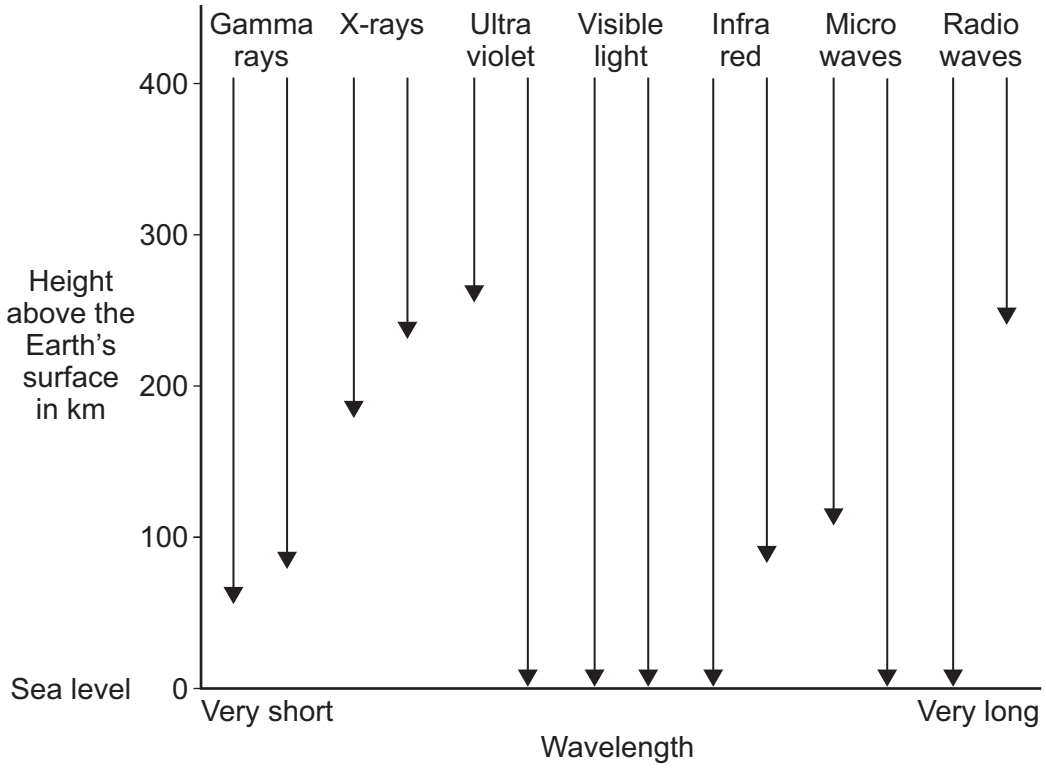
Question 67

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.

4.6.2.1 Types of electromagnetic waves

Question 67 · 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

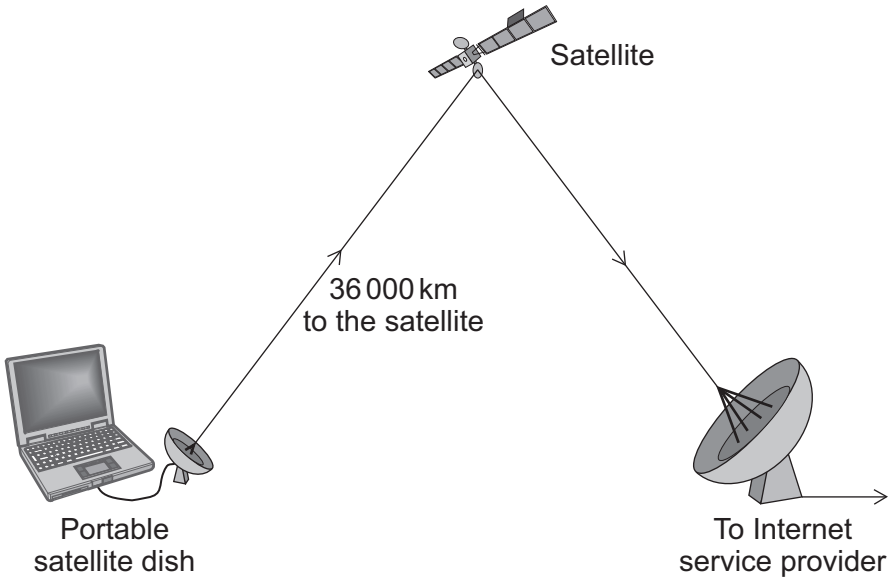
END OF TEST

4.6.2.1 Types of electromagnetic waves

Question 68

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)

4.6.2.1 Types of electromagnetic waves

Question 68 · 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.

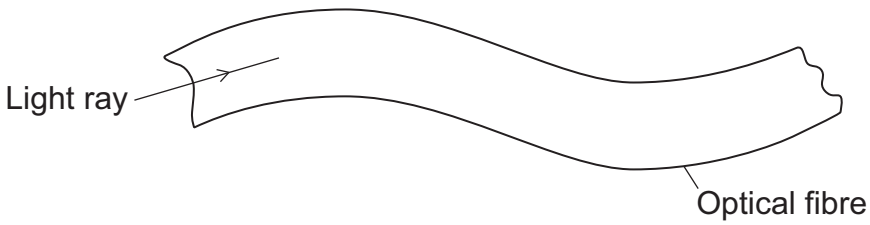
Visible light and

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

4.6.2.1 Types of electromagnetic waves

Question 69

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** . . . .

4.6.2.1 Types of electromagnetic waves

Question 70

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

4.6.2.1 Types of electromagnetic waves

Question 71

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.

4.6.2.1 Types of electromagnetic waves

Question 72

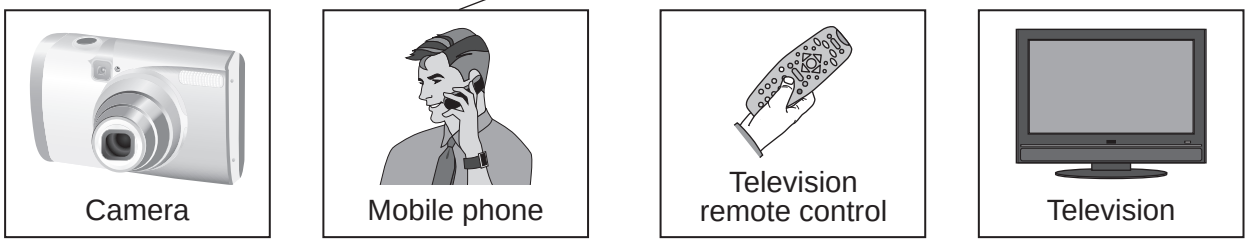
June 2012 | PH1FP | Original Q2 | Legacy

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)

4.6.2.1 Types of electromagnetic waves

Question 72 · continued

2 (d) The two diagrams, **A** and **B**, show a light ray travelling into a glass block.

Diagram A

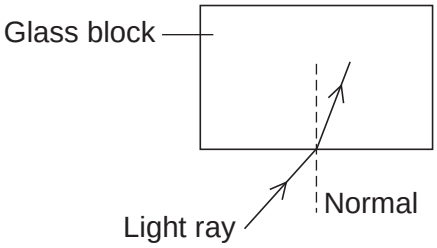
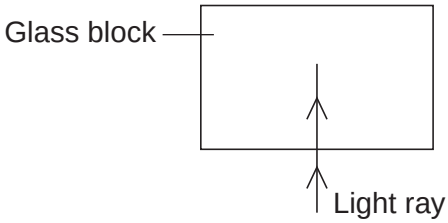


Diagram B



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

4.6.2.1 Types of electromagnetic waves

Question 73

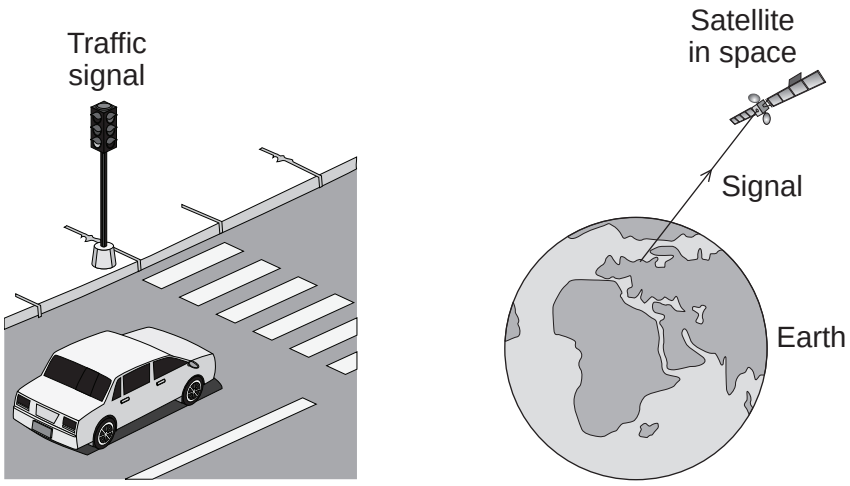
June 2013 | PH1FP | Original Q2 | Legacy

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**

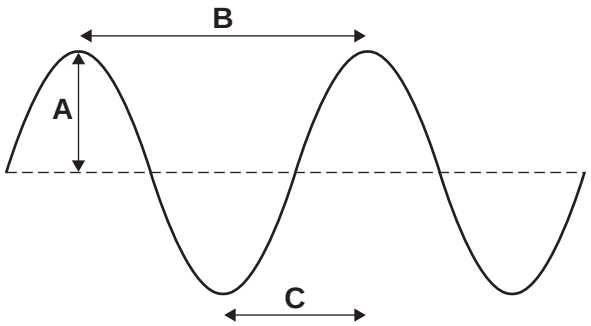
(1 mark)

4.6.2.1 Types of electromagnetic waves

Question 73 · 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

4.6.2.1 Types of electromagnetic waves

Question 73 · 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

4.6.2.1 Types of electromagnetic waves

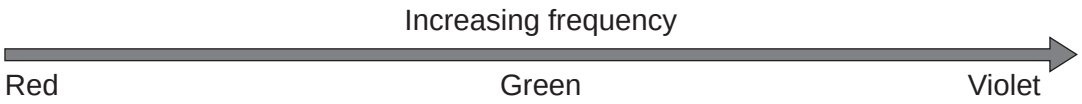
Question 74

June 2014 | PH1FP | Original Q6 | Legacy

6 (a) The visible light spectrum has a range of frequencies.

Figure 8 shows that the frequency increases from red light to violet light.

Figure 8



Use the correct answers from the box to complete the sentence.

decreases	**stays the same**	**increases**

[2 marks]

As the frequency of the light waves increases, the wavelength

of the light waves ..... and

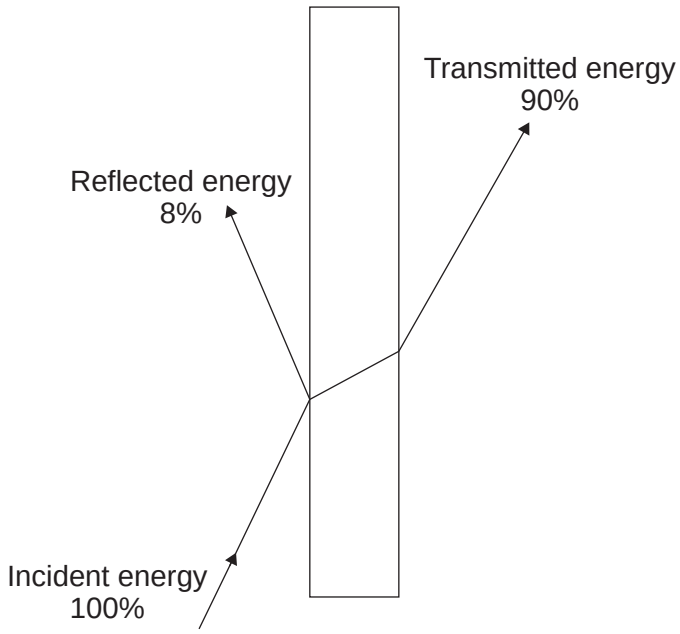
the energy of the light waves ..... .

4.6.2.1 Types of electromagnetic waves

Question 74 · continued

6 (b) **Figure 9** shows what happens to the light energy when a ray of light hits a glass block.

Figure 9



98% of the incident energy is either reflected or transmitted by the glass block.

What happens to the other 2% of the incident energy?

[1 mark]

.....

.....

Question 6 continues on the next page

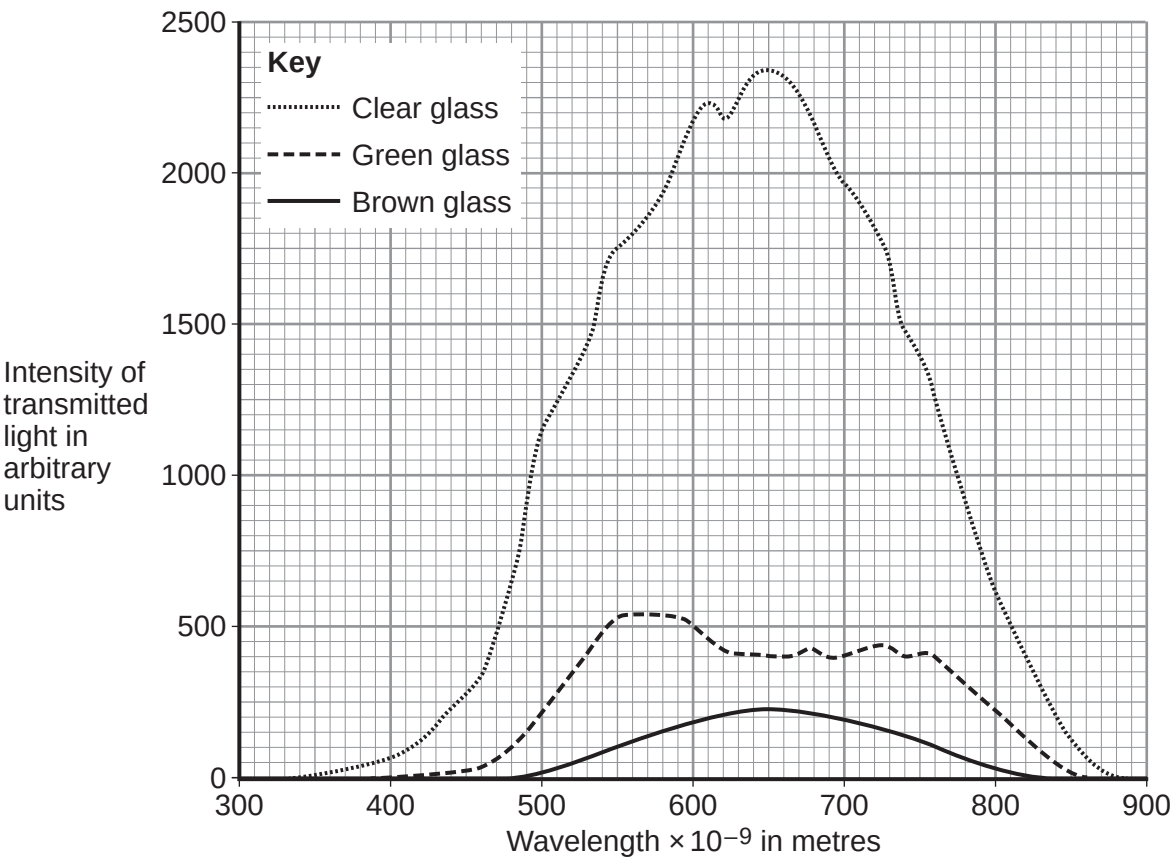
4.6.2.1 Types of electromagnetic waves

Question 74 · continued

6 (c) Bottled beer will spoil if the intensity of the light passing through the glass bottle into the beer is too high.

Figure 10 shows the intensity of the light that is transmitted through three different pieces of glass.

Figure 10



6 (c) (i) The pieces of glass all had the same thickness.

Suggest why.

[1 mark]

.....

.....

6 (c) (ii) Bottles made of brown glass are suitable for storing beer.

Suggest why.

[1 mark]

.....

.....

5

4.6.2.1 Types of electromagnetic waves

Question 75

June 2014 | PH1FP | Original Q8 | Legacy

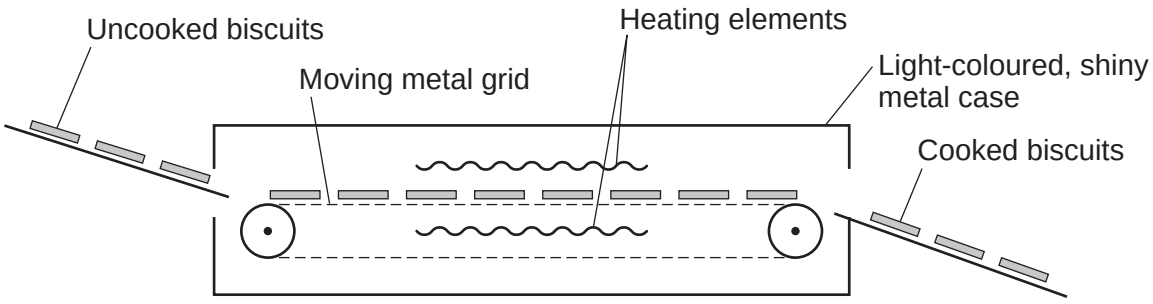
8 **Figure 11** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

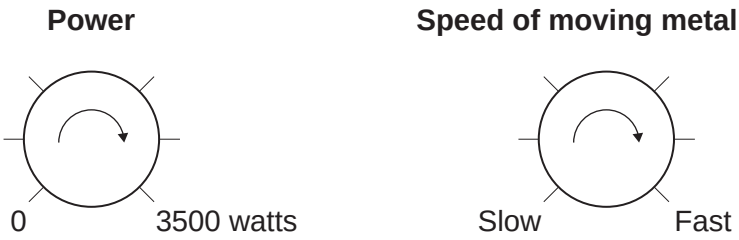
The biscuits turn brown as they cook.

Figure 11



The oven has two control knobs, as shown in **Figure 12**.

Figure 12



8 (a) Which type of electromagnetic radiation makes the biscuits turn brown?

[1 mark]

.....

8 (b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

[2 marks]

1 .....

.....

2 .....

.....

4.6.2.1 Types of electromagnetic waves

Question 75 · continued

June 2014 | PH1FP | Original Q8 | Legacy

8 (c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

6

Turn over for the next question

4.6.2.1 Types of electromagnetic waves

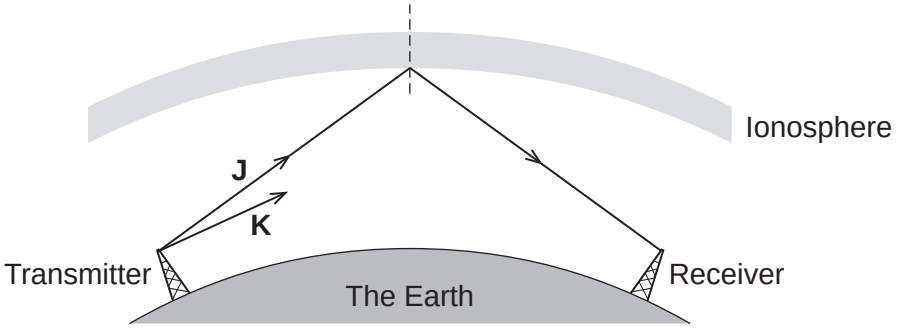
Question 76

June 2015 | PH1FP | Original Q1 | Legacy

1 Different parts of the electromagnetic spectrum are useful for different methods of communication.

1 (a) **Figure 1** shows a transmitter emitting two electromagnetic waves, **J** and **K**.

Figure 1



Wave **J** is reflected by a layer in the atmosphere called the ionosphere.

1 (a) (i) Wave **K** will also be reflected by the ionosphere.
On **Figure 1**, draw the path of wave **K** to show that it **does not** reach the receiver.

[2 marks]

1 (a) (ii) What is the name given to the dashed line in **Figure 1**?

[1 mark]

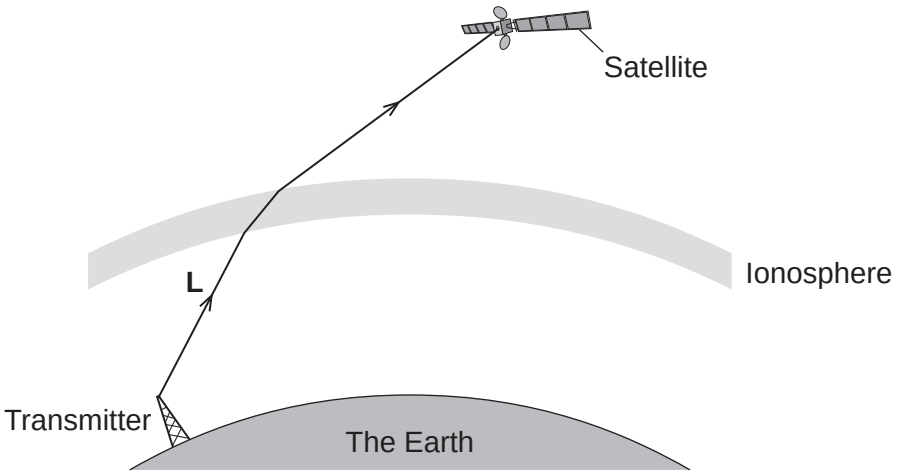
.....

4.6.2.1 Types of electromagnetic waves

Question 76 · continued

1 (b) **Figure 2** shows a transmitter sending a signal to a satellite orbiting the Earth.

Figure 2



1 (b) (i) Which type of electromagnetic wave is used to send a signal to a satellite?

[1 mark]

Draw a ring around the correct answer.

gamma **microwave** **ultraviolet**

1 (b) (ii) What name is given to the process that occurs as wave **L** passes into the ionosphere?

[1 mark]

Draw a ring around the correct answer.

diffraction **reflection** **refraction**

Question 1 continues on the next page

4.6.2.1 Types of electromagnetic waves

Question 76 · continued

1 (c) Waves **J**, **K** and **L** are electromagnetic waves.

What are **two** properties of **all** electromagnetic waves?

[2 marks]

Tick (✓) **two** boxes.

Property	Tick (✓)
All electromagnetic waves are longitudinal.	
All electromagnetic waves are transverse.	
All electromagnetic waves are mechanical.	
All electromagnetic waves have the same speed in a vacuum.	
All electromagnetic waves have the same frequency.	

7

4.6.2.1 Types of electromagnetic waves

Question 77

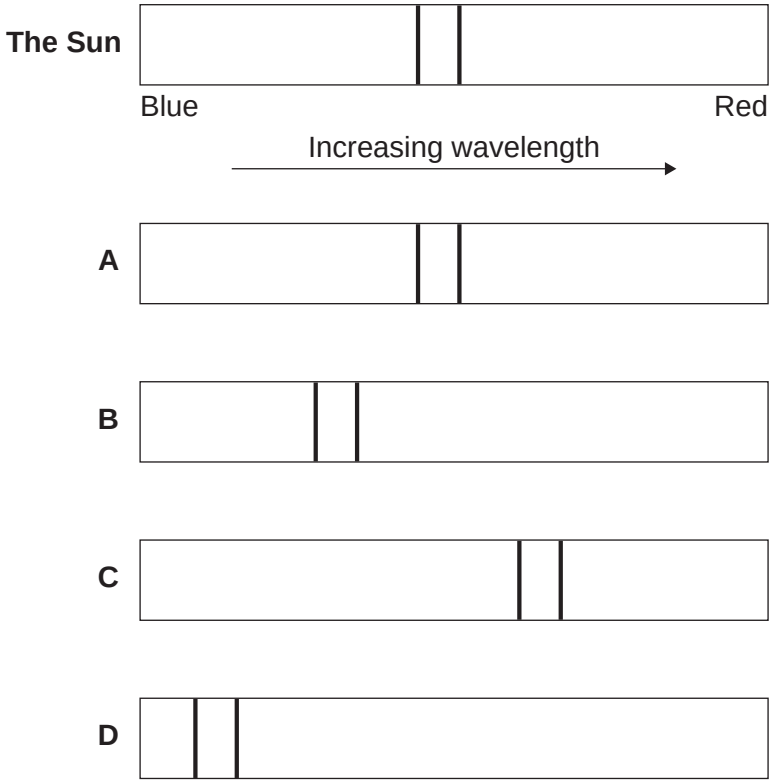
June 2015 | PH1FP | Original Q6 | Legacy

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]

4.6.2.1 Types of electromagnetic waves

Question 77 · 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

4.6.2.1 Types of electromagnetic waves

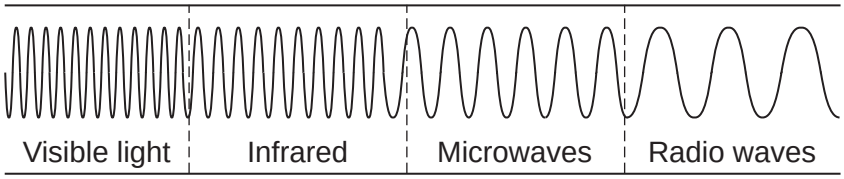
Question 78

June 2016 | PH1FP | Original Q3 | Legacy

3 Infrared and microwaves are two types of electromagnetic radiation.

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

Figure 4



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

[1 mark]

_____

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

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

[3 marks]

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

The wavelength of infrared is _____ the wavelength of microwaves.

The frequency of microwaves is _____ the frequency of infrared.

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

4.6.2.1 Types of electromagnetic waves

Question 78 · continued

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

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

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

[1 mark]

_____

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

[1 mark]

Tick (✓) **one** box.

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

6

4.6.2.1 Types of electromagnetic waves

Question 79

June 2016 | PH3FP | Original Q2 | Legacy

2 **Figure 2** shows an X-ray of an arm with a broken bone.

Figure 2



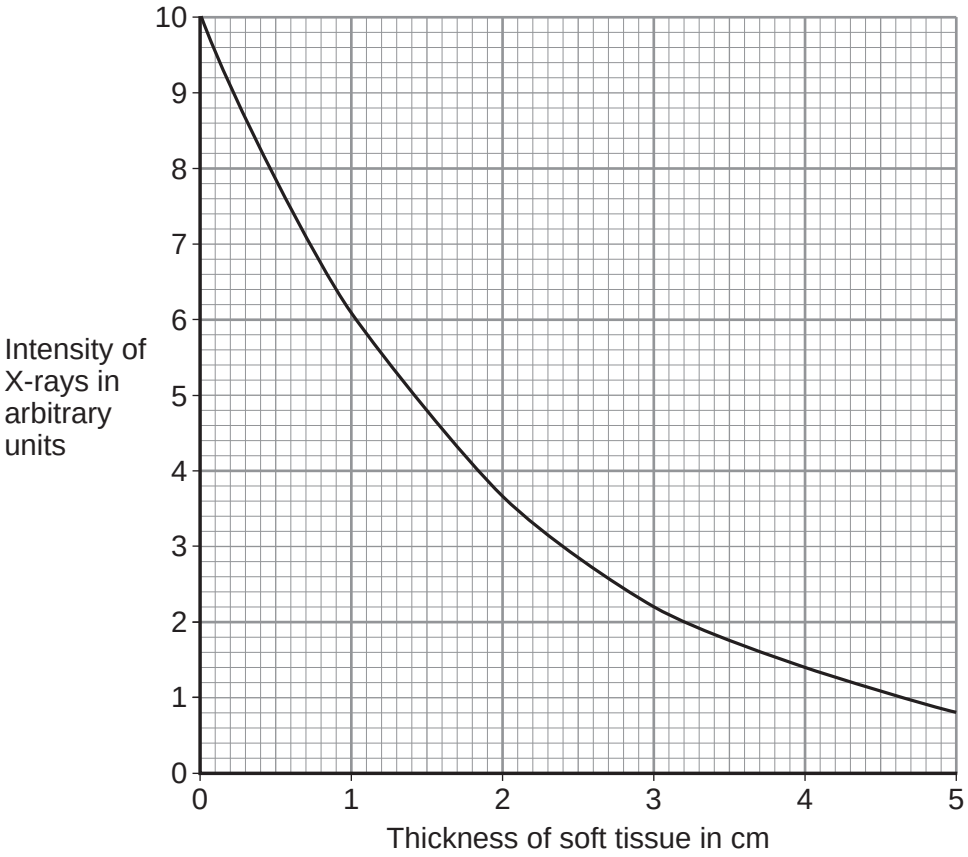
2 (a) Complete the following sentence.

[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



4.6.2.1 Types of electromagnetic waves

Question 79 · 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

4.6.2.1 Types of electromagnetic waves

Question 79 · 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

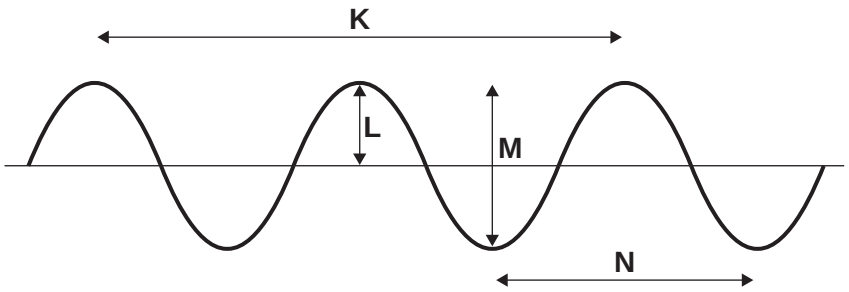
4.6.2.1 Types of electromagnetic waves

Question 80

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?

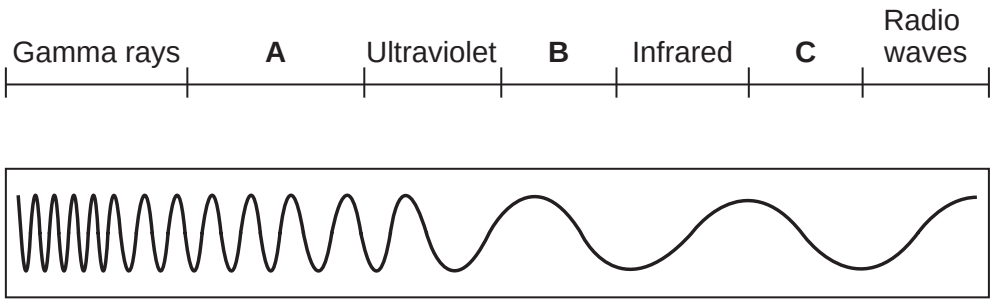
[1 mark]

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]

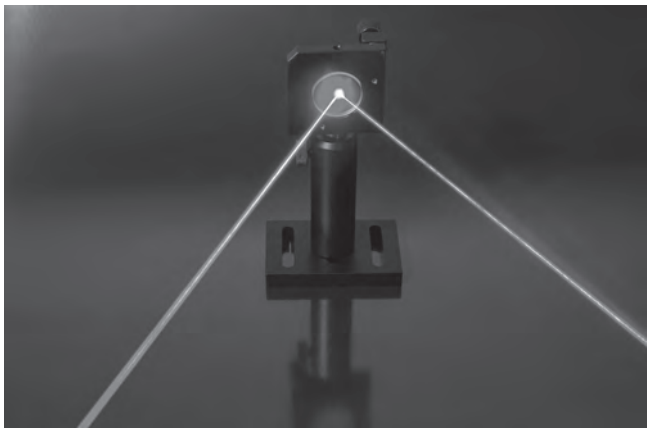
4.6.2.1 Types of electromagnetic waves

Question 80 · 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

4.6.2.1 Types of electromagnetic waves

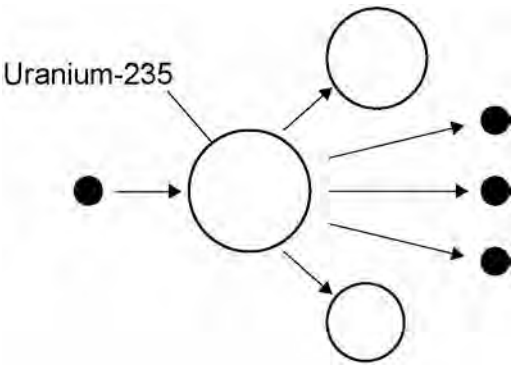
Question 81

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 = _____

4.6.2.1 Types of electromagnetic waves

Question 81 · continued

0 6 . 3 State **two** environmental issues caused by generating electricity using nuclear power stations.

[2 marks]

1 _____

_____

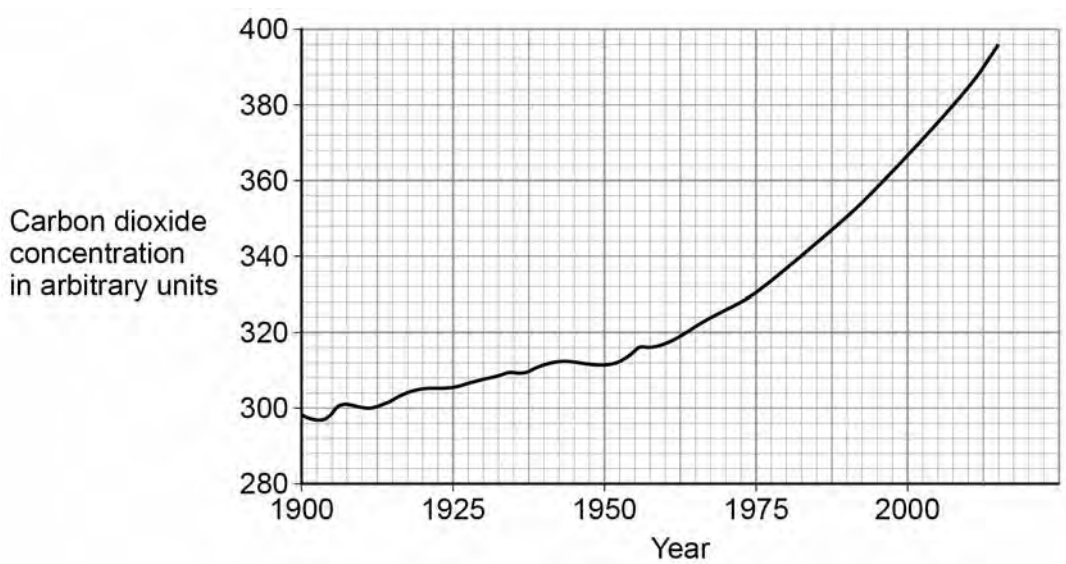
2 _____

_____

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

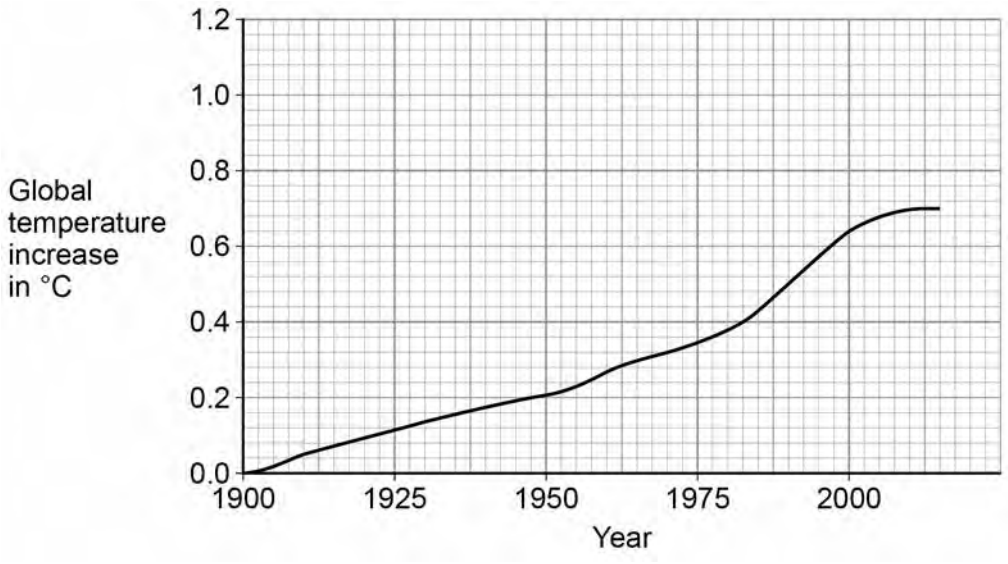


4.6.2.1 Types of electromagnetic waves

Question 81 · 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

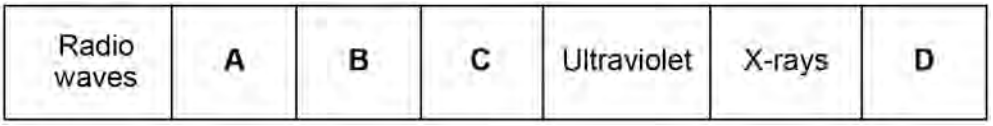
4.6.2.1 Types of electromagnetic waves

Question 82

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]

4.6.2.1 Types of electromagnetic waves

Question 82 · 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

4.6.2.1 Types of electromagnetic waves

Question 83

June 2019 | 8463/2F | Original Q2

0 2 Most galaxies are moving away from the Earth. Scientists can determine the speed of a galaxy by observing the light from the galaxy.

0 2 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

frequency	**speed**	**wavelength**

When scientists observe the light from distant galaxies, they observe an increase in the _____ of light from those galaxies.

4.6.2.1 Types of electromagnetic waves

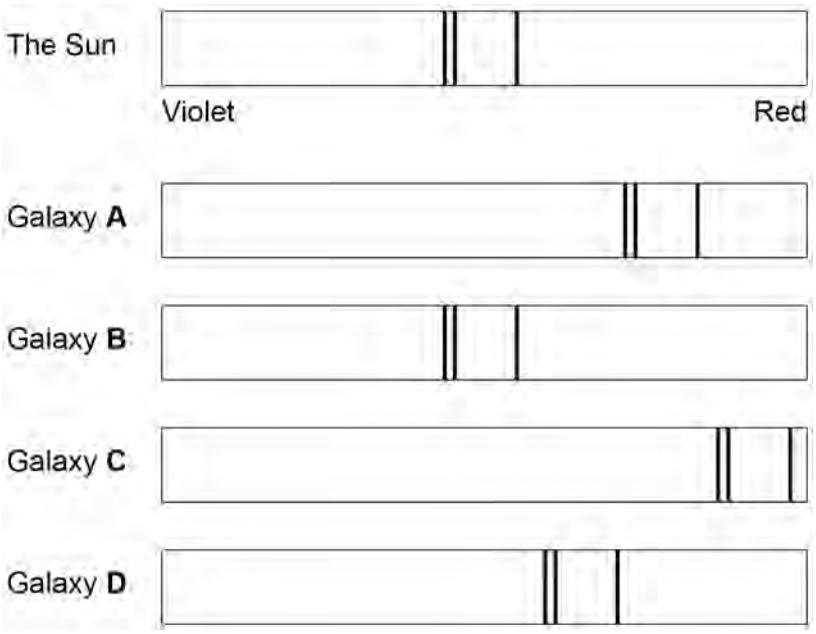
Question 83 · continued

The light spectra from stars and galaxies include dark lines.

The lines have the same pattern.

Figure 3 shows the light spectrum from the Sun and from four galaxies.

Figure 3



0 2 . 2 Which galaxy is moving the fastest away from the Earth?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 3 Which galaxy is the furthest away from the Earth?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

4.6.2.1 Types of electromagnetic waves

Question 83 · continued

0 2 . 4 The Big Bang theory is one way to explain the origin of the universe.

How does the Big Bang theory describe the universe when it began?

[1 mark]

Tick (✓) **one** box.

- Very big and very dense ☐
- Very big and extremely hot ☐
- Very dense and extremely hot ☐
- Very small and extremely cold ☐

0 2 . 5 Which statement about the Big Bang theory is correct?

[1 mark]

Tick (✓) **one** box.

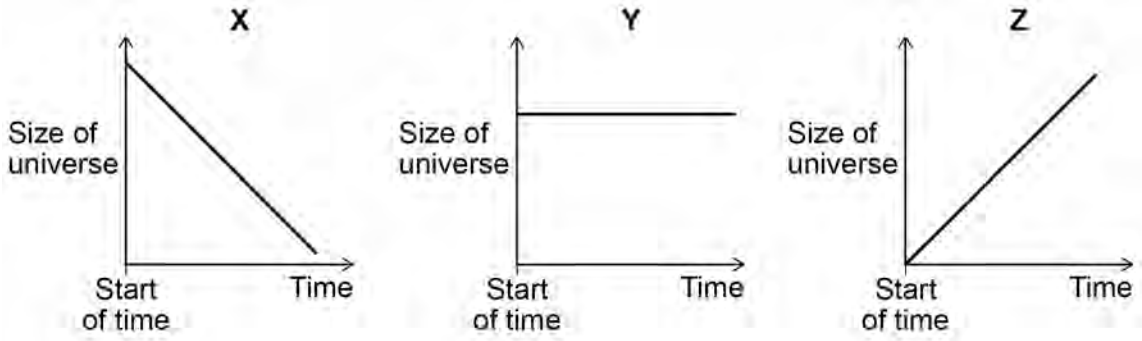
- Scientists have proved that the theory is correct. ☐
- Scientific evidence supports the theory. ☐
- There is no other way to explain the origin of the universe. ☐

4.6.2.1 Types of electromagnetic waves

Question 83 · continued

0 2 . 6 **Figure 4** shows three ways that the size of the universe may have changed with time.

Figure 4



Which graph would the Big Bang theory suggest is correct?

[2 marks]

Tick (✓) **one** box.

X ☐ Y ☐ Z ☐

Give a reason for your answer.

_____

_____

7

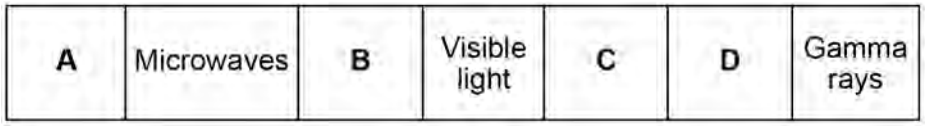
4.6.2.1 Types of electromagnetic waves

Question 84

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 ☐

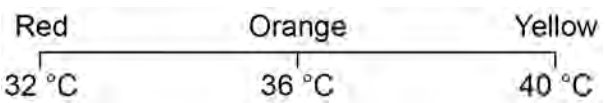
Question 4 continues on the next page

Question 84 · 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]

_____

_____

_____

4.6.2.1 Types of electromagnetic waves

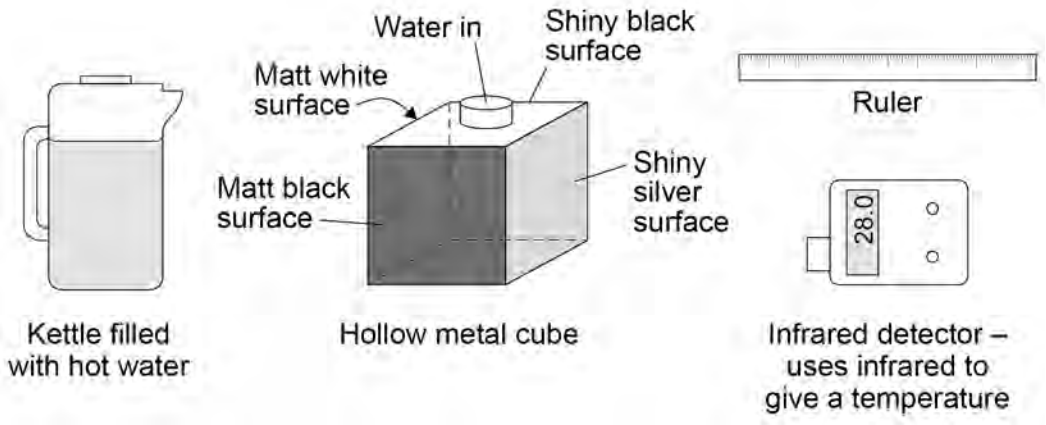
Question 84 · continued

June 2019 | 8463/2F | Original Q4

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]

4.6.2.1 Types of electromagnetic waves

Question 84 · 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 ☐

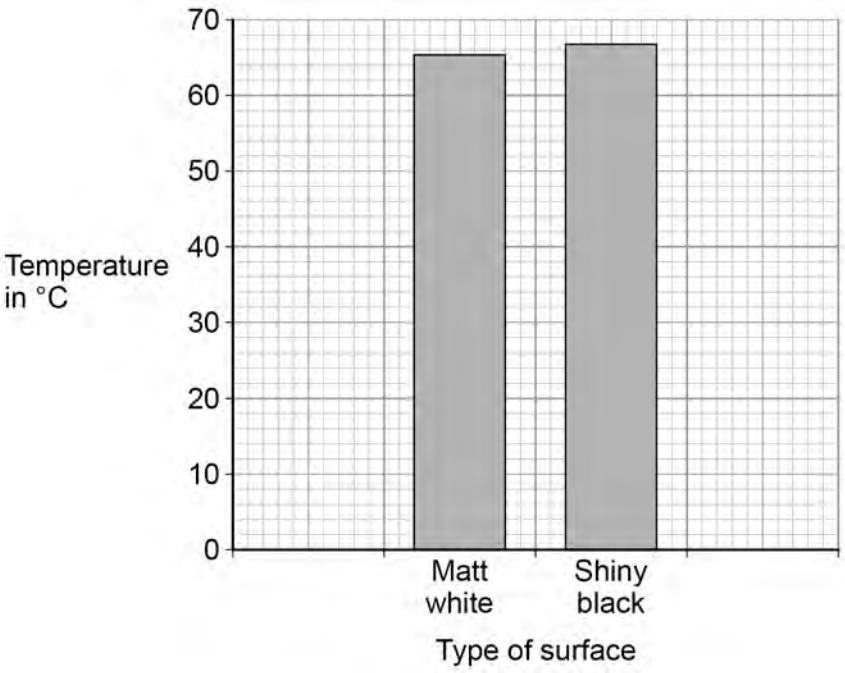
4.6.2.1 Types of electromagnetic waves

Question 84 · continued

June 2019 | 8463/2F | Original Q4

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

4.6.2.1 Types of electromagnetic waves

Question 85

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?

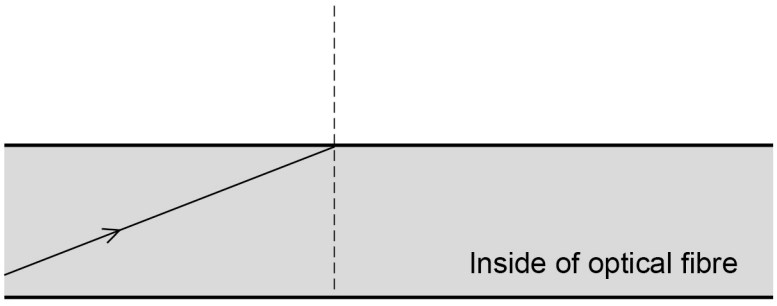
[2 marks]

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

4.6.2.1 Types of electromagnetic waves

Question 85 · 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

4.6.2.1 Types of electromagnetic waves

Question 86

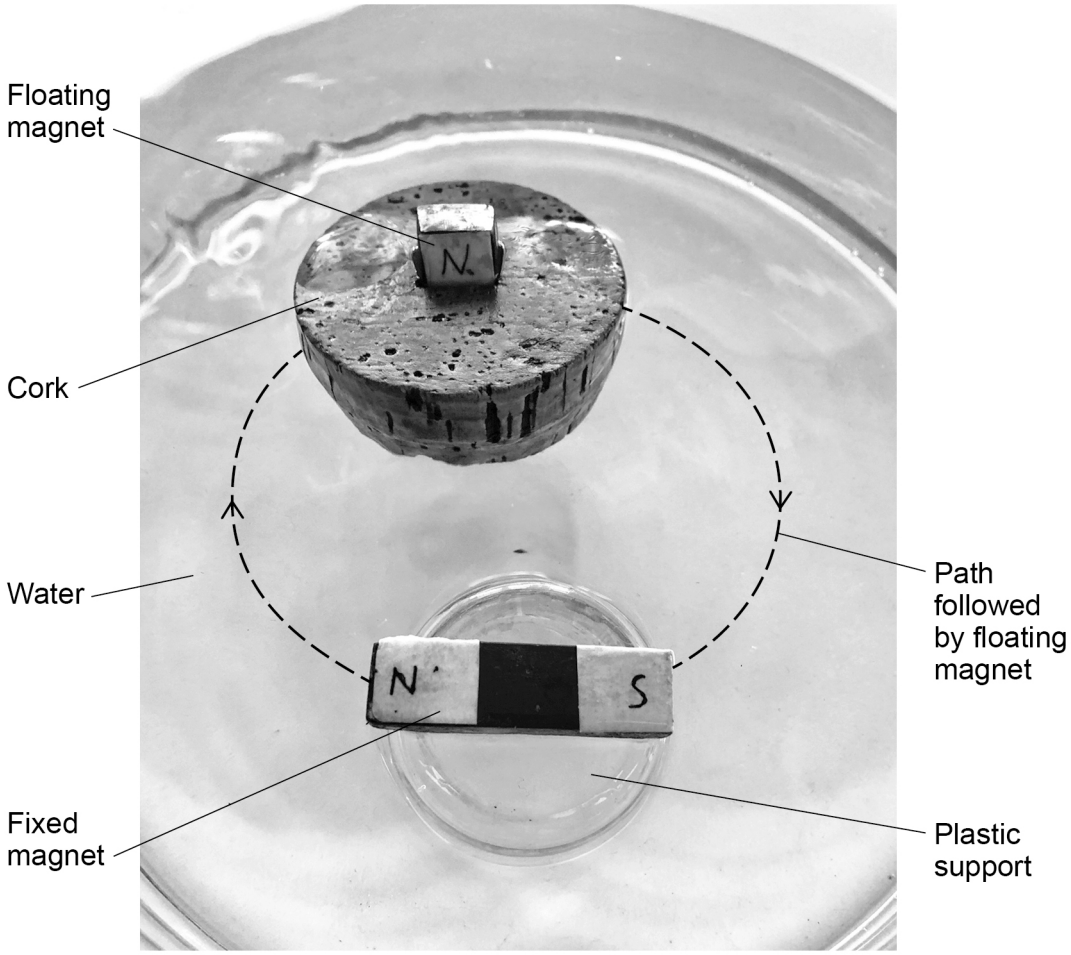
November 2020 | 8463/2F | Original Q5

0 5 A student placed a magnet on top of a plastic support in a bowl of water. This magnet was fixed in position and above the surface of the water.

The student put a second magnet into a piece of cork so that the magnet floated on the water. Only the north pole of the floating magnet was above the surface of the water.

Figure 6 shows the arrangement of the magnets.

Figure 6



0 5 . 1 The floating magnet was placed near to the north pole of the fixed magnet. The floating magnet then moved along the path shown in **Figure 6**.

Explain why.

[2 marks]

4.6.2.1 Types of electromagnetic waves

Question 86 · continued

0 5 . 2 The student replaced the floating magnet with a piece of iron.

What happened to the piece of iron?

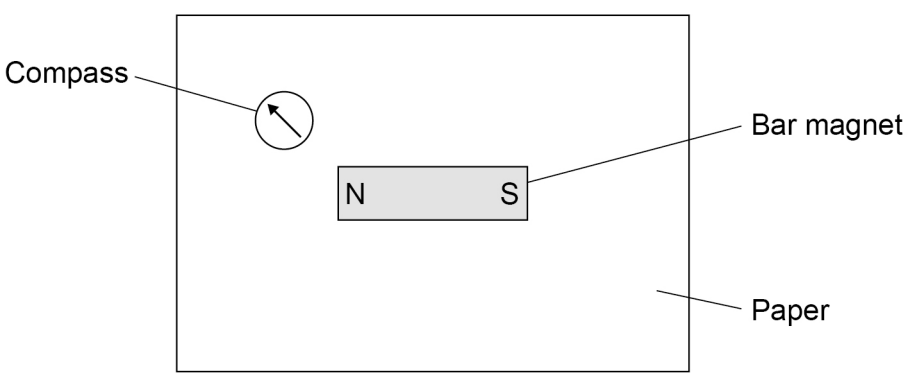
[1 mark]

0 5 . 3 Describe how to use a compass to plot the magnetic field pattern around a bar magnet.

Use **Figure 7** to help you.

[4 marks]

Figure 7

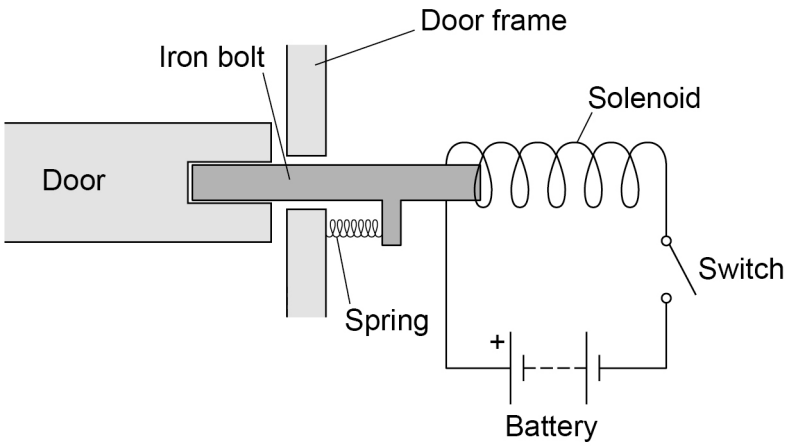


4.6.2.1 Types of electromagnetic waves

Question 86 · continued

Figure 8 shows a diagram of an electromagnetic lock used to secure a door.

Figure 8



0 5 . 4 **Figure 9** shows an incomplete sequence of how the door unlocks.

Figure 9



Write **one** letter in each box to show the correct sequence.

[2 marks]

A The iron bolt moves.

B A magnetic field is created around the solenoid.

C There is a current in the circuit.

Question 5 continues on the next page

4.6.2.1 Types of electromagnetic waves

Question 86 · continued

0 5 . 5 The electromagnetic lock contains a spring.

When the door is unlocked the extension of the spring is 0.040 m.

spring constant = 200 N/m

Calculate the elastic potential energy of the spring when the door is unlocked.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

[2 marks]

Elastic potential energy = _____ J

11

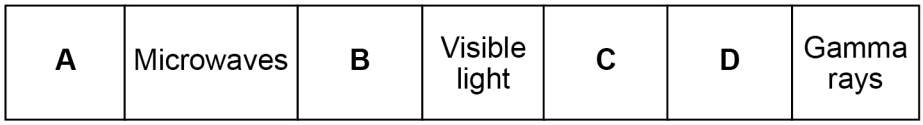
4.6.2.1 Types of electromagnetic waves

Question 87

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

4.6.2.1 Types of electromagnetic waves

Question 87 · 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]

4.6.2.1 Types of electromagnetic waves

Question 87 · continued

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

4.6.2.1 Types of electromagnetic waves

Question 88

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

A	Microwaves	**B**	Visible light	**C**	**D**	Gamma rays

Which letter shows the position of infrared?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 3 continues on the next page

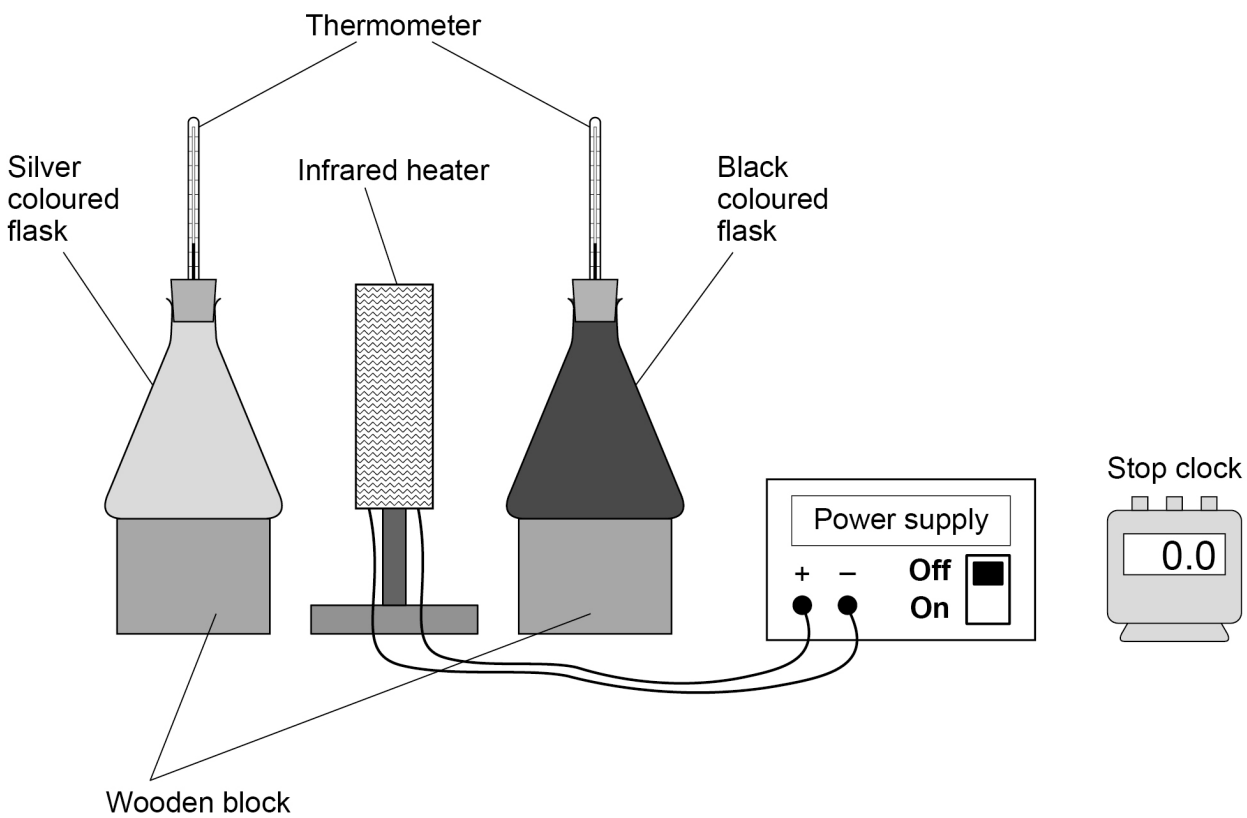
4.6.2.1 Types of electromagnetic waves

Question 88 · 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



4.6.2.1 Types of electromagnetic waves

Question 88 · 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 88 · 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

4.6.2.1 Types of electromagnetic waves

Question 88 · 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

4.6.2.1 Types of electromagnetic waves

Question 89

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 _____

4.6.2.1 Types of electromagnetic waves

Question 89 · 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

4.6.2.1 Types of electromagnetic waves

Question 89 · 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

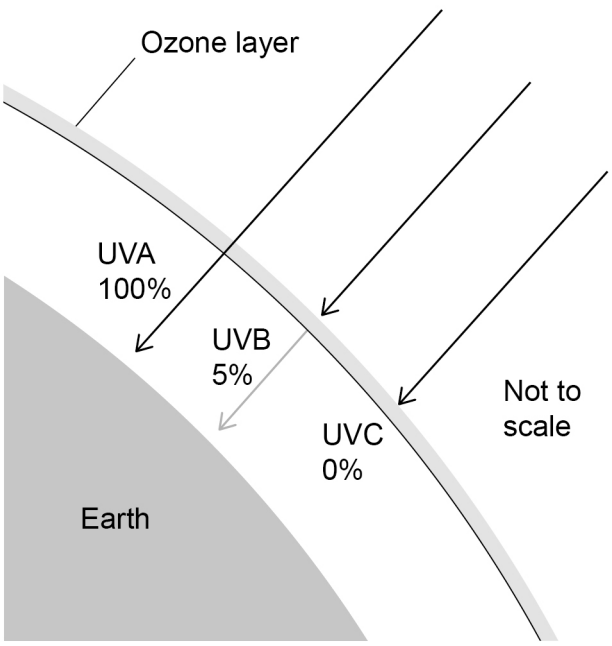


Table 4

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]

Question 89 · continued

0 5 . 5 The Sun emits visible light.

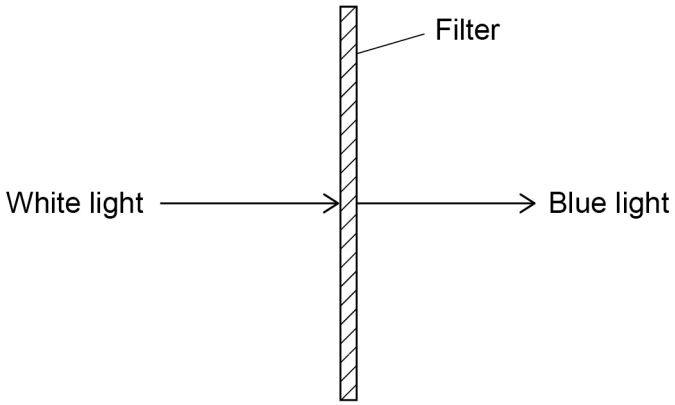
A student concludes that visible light is **not** absorbed by the ozone layer.

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

4.6.2.1 Types of electromagnetic waves

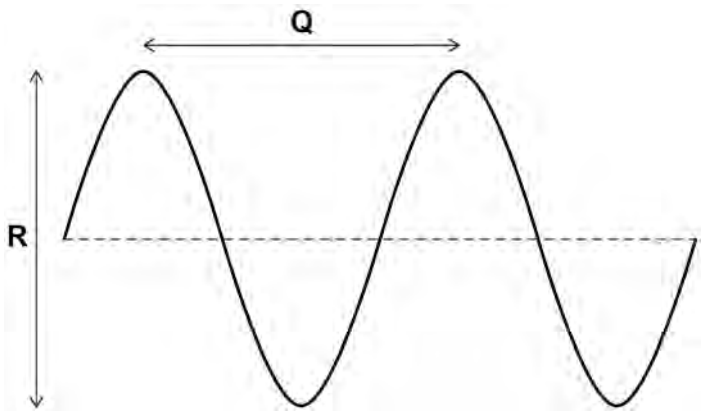
Question 90

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 ☐

4.6.2.1 Types of electromagnetic waves

Question 90 · continued

June 2023 | 8463/2F | Original Q5

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

4.6.2.1 Types of electromagnetic waves

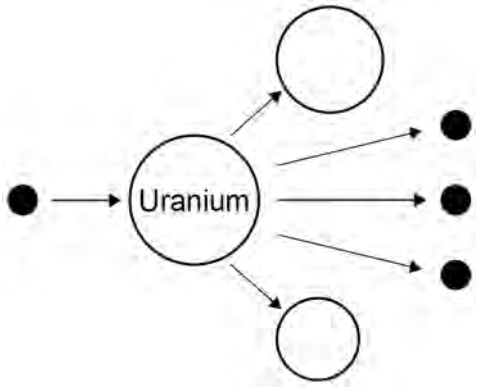
Question 91

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 _____.

4.6.2.1 Types of electromagnetic waves

Question 91 · 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]

4.6.2.1 Types of electromagnetic waves

Question 91 · 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

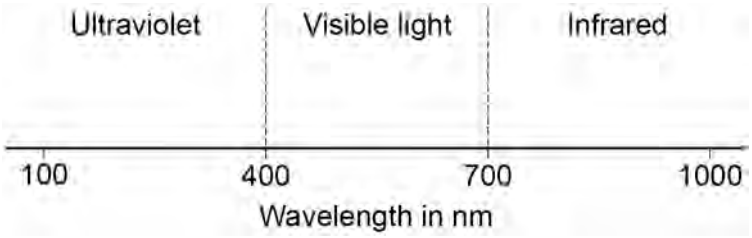
4.6.2.1 Types of electromagnetic waves

Question 92

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 ☐

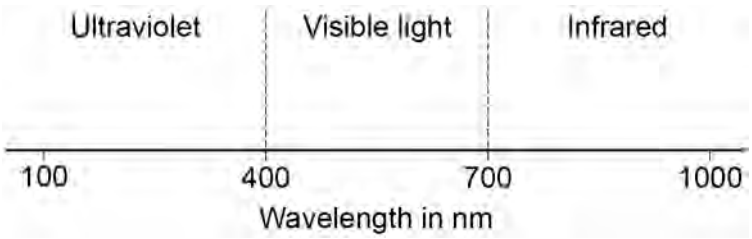
Question 6 continues on the next page

4.6.2.1 Types of electromagnetic waves

Question 92 · 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 _____.

4.6.2.1 Types of electromagnetic waves

Question 92 · 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