Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
March 2012

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Thursday 1 March 2012 Morning Session

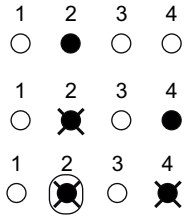
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

Time allowed
- 30 minutes

Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Physics Unit 1b' printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown.
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown.
- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown.



Information
- The maximum mark for this paper is 36.

Advice
- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 16 of this booklet.

FOUNDATION TIER

Section One

Questions **ONE** to **FIVE**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

Electromagnetic waves can be used for communications.

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

A infra red waves

B microwaves

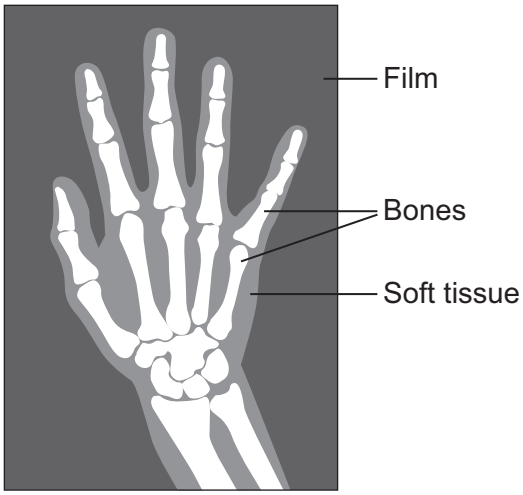
C radio waves

D visible light

1	used to communicate with satellites
2	used to send a signal between a remote control and a television
3	used to transmit television programmes
4	used to see someone waving a flag

QUESTION TWO

Electromagnetic radiation is used to detect broken bones. The picture shows a photograph of a broken wrist.



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

A bones

B film

C soft tissue

D X-ray tube

The electromagnetic radiation is produced by the . . . **1** . . . .

The electromagnetic radiation is detected by the . . . **2** . . . .

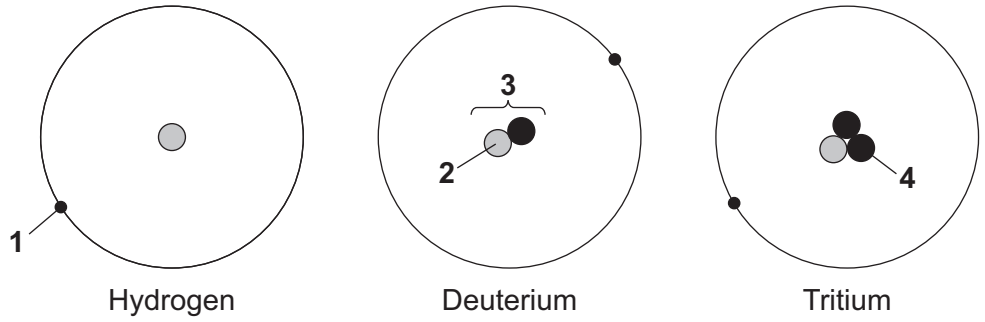
The electromagnetic radiation is transmitted by the . . . **3** . . . .

The electromagnetic radiation is absorbed by the . . . **4** . . . .

Turn over for the next question

QUESTION THREE

The diagrams show three isotopes of hydrogen.



Match the parts of atoms, **A**, **B**, **C** and **D**, with the labels **1**–**4** on the diagrams.

A electron

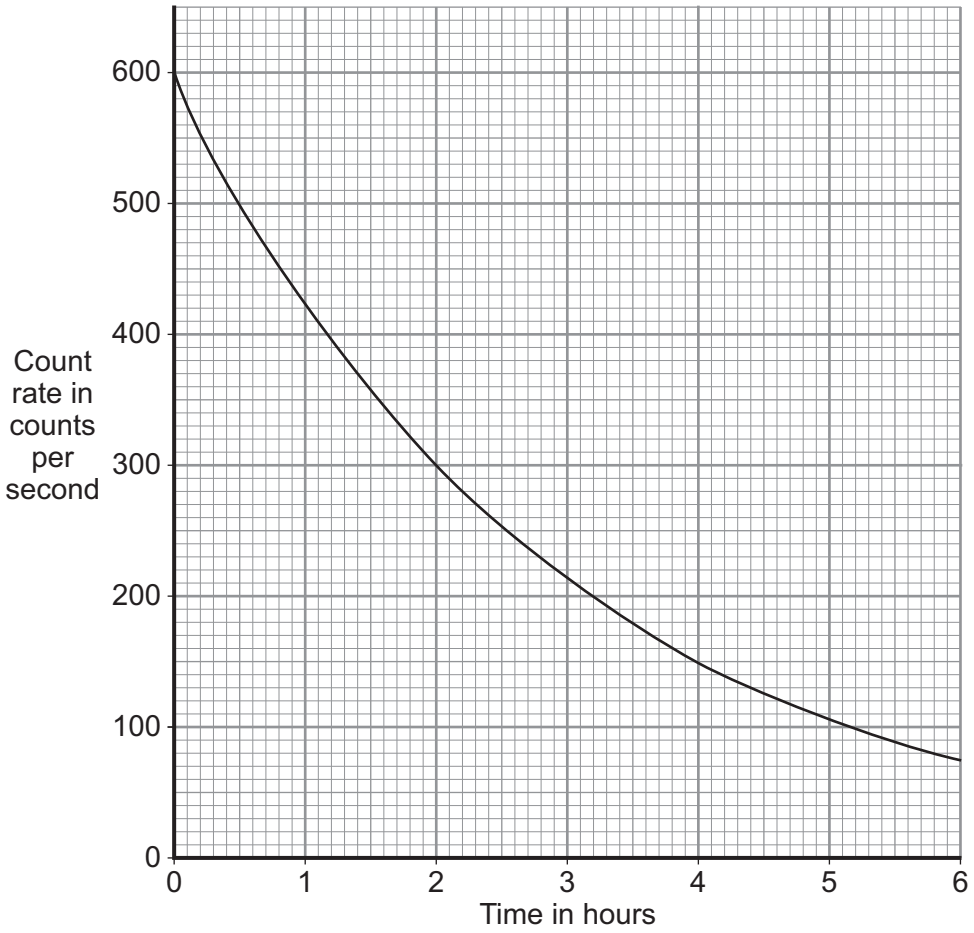
B neutron

C nucleus

D proton

QUESTION FOUR

The graph shows the count rate of a radioactive source over 6 hours.



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

A 2

B 6

C 150

D 600

1	the initial count rate in counts per second
2	the count rate, in counts per second, after 4 hours
3	the number of hours it took the count rate to fall to 75 counts per second
4	the number of hours it took the count rate to halve

QUESTION FIVE

This question is about nuclear radiation and electromagnetic radiation.

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

A alpha

B beta

C gamma

D X-ray

	Description
1	fast moving particle; can travel through a few metres of air before being absorbed
2	travels at the speed of light; emitted by radioactive nuclei
3	travels at the speed of light; not emitted by radioactive nuclei
4	a charged particle; can travel through only a few centimetres of air before being absorbed

Turn over for the next question

Section Two

Questions **SIX** to **NINE**.

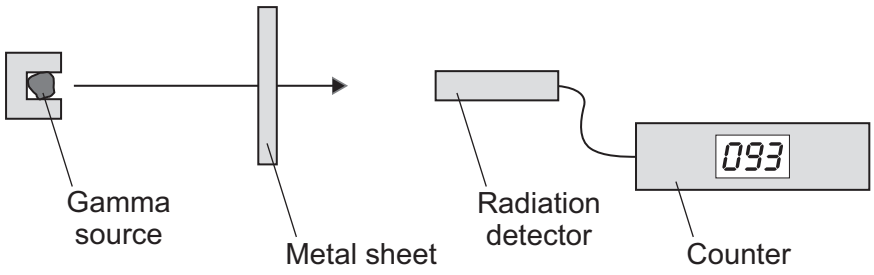
Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SIX

A source of gamma radiation is placed near a radiation detector. Four different metal sheets are placed in turn at the position shown on the diagram. The count rate is measured for each sheet.



6A Which row in the table correctly describes the variables used in the investigation?

	Metal sheet used	Count rate
1	dependent	independent
2	dependent	dependent
3	independent	independent
4	independent	dependent

6B The control variable in the investigation is the distance between the . . .

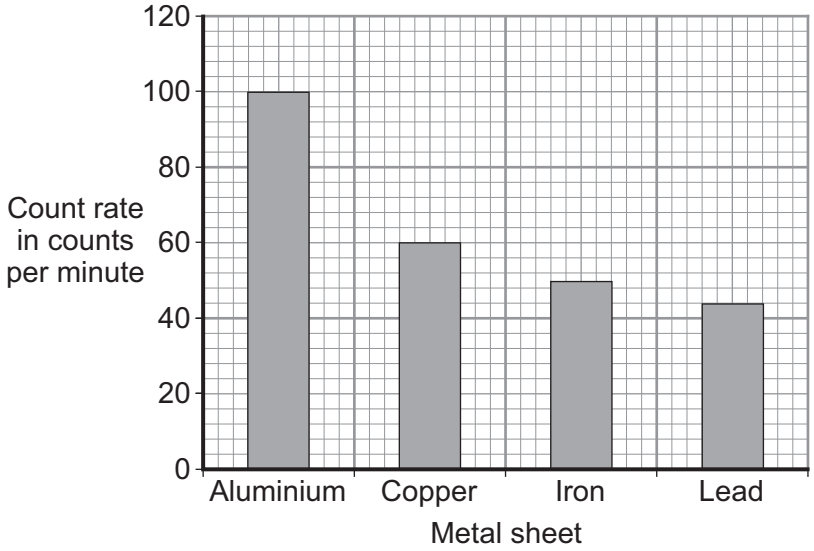
1 gamma source and the counter.

2 gamma source and the radiation detector.

3 metal sheet and the counter.

4 radiation detector and the counter.

The bar chart shows the results of the investigation.



6C A bar chart is used to show the results because . . .

1 both variables are categoric.

2 both variables are continuous.

3 one variable is categoric.

4 one variable is controlled.

6D The bar chart shows that the best absorber of gamma radiation is . . .

1 aluminium.

2 copper.

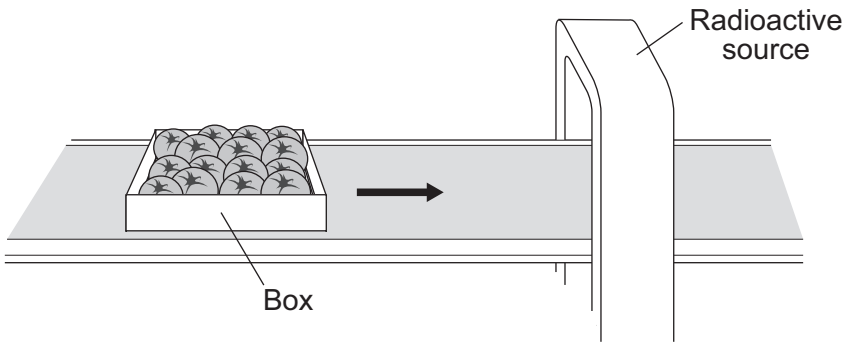
3 iron.

4 lead.

Turn over for the next question

QUESTION SEVEN

The shelf-life of fruit can be increased by exposing the fruit to radiation emitted by a radioactive source. The radiation kills the microbes in the fruit. These microbes would make the fruit decay.



7A The diagram shows some fruit in a box.

To penetrate all the way through the box of fruit, the best type of radiation to use would be . . .

1 alpha radiation only.

2 beta radiation only.

3 gamma radiation only.

4 either alpha or beta radiation.

7B Each box of fruit is exposed to radiation for 20 minutes.

The radioactive source should have a half-life of about . . .

1 2 minutes.

2 20 minutes.

3 2 days.

4 20 years.

7C The workers at the fruit processing factory need to be protected from exposure to the radiation.

Which of the following would **not** reduce the exposure of the workers to radiation?

1 wearing lead-lined clothing

2 working remotely from behind a shield

3 wearing a radiation film badge

4 working near the radioactive source for a shorter time

7D The governments of some countries do not allow any food to be exposed to radiation to increase its shelf-life. These governments are concerned that there would be a negative response from the public if this were allowed.

What sort of decision have these governments made?

1 economic

2 ethical

3 political

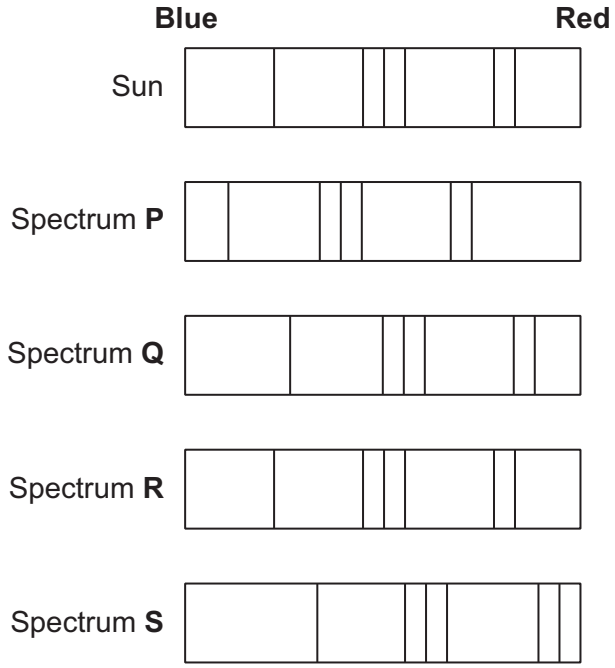
4 scientific

Turn over for the next question

QUESTION EIGHT

The visible spectra from stars and galaxies include dark lines. These lines are at specific wavelengths.

The diagram shows the positions of the dark lines in the spectrum from the Sun and in four other spectra, **P**, **Q**, **R** and **S**.



8A Which spectra show a red-shift?

1 **P** and **S**

2 **Q** and **S**

3 **R** and **S**

4 **Q** and **R**

8B To cause a red-shift, what happens to the speed and wavelength of the light?

1 The speed increases and the wavelength remains the same.

2 The speed decreases and the wavelength remains the same.

3 The speed remains the same and the wavelength increases.

4 The speed remains the same and the wavelength decreases.

8C Which spectrum is from a galaxy moving towards us?

1 **P**

2 **Q**

3 **R**

4 **S**

8D Edwin Hubble observed that the further away the galaxy, the bigger the red-shift.

Which spectrum is from the galaxy furthest from us?

1 **P**

2 **Q**

3 **R**

4 **S**

Turn over for the next question

QUESTION NINE

The table gives information about some telescopes.

Name of telescope	Telescope diameter in metres	Type of radiation detected	Location of telescope
Chandra	1.2	X-rays	in space
Hubble	2.4	visible light	in space
Lovell	76.2	radio waves	on Earth's surface
South Pole	10.0	microwaves	on Earth's surface

9A Which telescope detects electromagnetic radiation with the lowest frequency?

1 Chandra

2 Hubble

3 Lovell

4 South Pole

9B There are telescopes in space that detect electromagnetic radiation with wavelengths shorter than the radiation in the table.

This electromagnetic radiation is . . .

1 gamma.

2 infra red.

3 sound.

4 ultraviolet.

9C The Hubble telescope is located in space so that . . .

1 it is closer to the stars it is observing.

2 it will produce clearer images than Earth-based telescopes.

3 it can have a smaller diameter than an Earth-based telescope.

4 it is not affected by gravity.

9D The table gives the diameters of the telescopes.

The data in the table shows that . . .

1 there is no relationship between the diameter and the type of radiation detected.

2 the smaller the diameter, the longer the wavelength detected.

3 the larger the diameter, the shorter the wavelength detected.

4 the larger the diameter, the longer the wavelength detected.

END OF TEST

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Foundation Tier is earlier in this booklet.

HIGHER TIER

Section One

Questions **ONE** and **TWO**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

This question is about nuclear radiation and electromagnetic radiation.

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

A alpha

B beta

C gamma

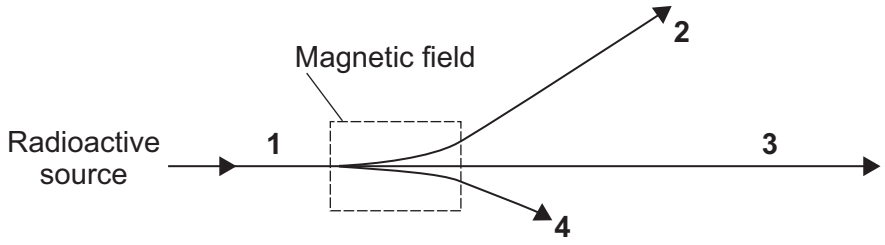
D X-ray

	Description
1	fast moving particle; can travel through a few metres of air before being absorbed
2	travels at the speed of light; emitted by radioactive nuclei
3	travels at the speed of light; not emitted by radioactive nuclei
4	a charged particle; can travel through only a few centimetres of air before being absorbed

QUESTION TWO

A beam of radiation from a radioactive source is passed through a magnetic field.

The paths taken by the radiation are shown in the diagram.



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

A alpha particles

B beta particles

C gamma rays

D alpha, beta and gamma radiation

Turn over for the next question

Section Two

Questions **THREE** to **NINE**.

Each of these questions has four parts.

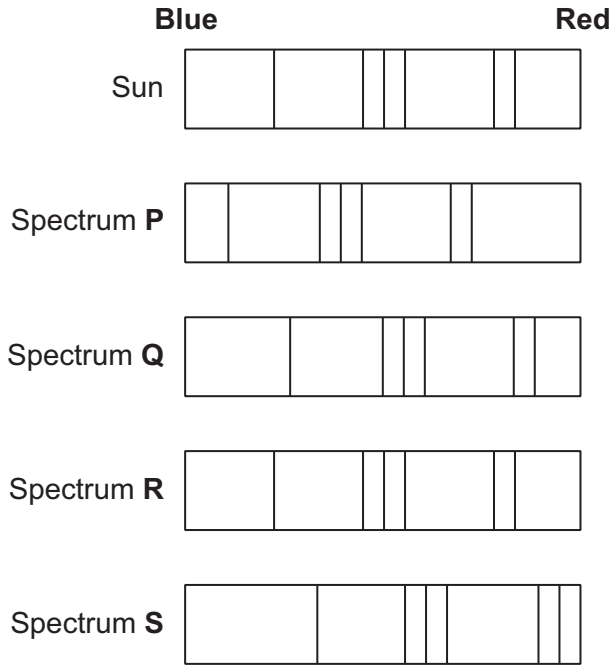
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

The visible spectra from stars and galaxies include dark lines. These lines are at specific wavelengths.

The diagram shows the positions of the dark lines in the spectrum from the Sun and in four other spectra, **P**, **Q**, **R** and **S**.



3A Which spectra show a red-shift?

1 **P** and **S**

2 **Q** and **S**

3 **R** and **S**

4 **Q** and **R**

3B To cause a red-shift, what happens to the speed and wavelength of the light?

1 The speed increases and the wavelength remains the same.

2 The speed decreases and the wavelength remains the same.

3 The speed remains the same and the wavelength increases.

4 The speed remains the same and the wavelength decreases.

3C Which spectrum is from a galaxy moving towards us?

1 **P**

2 **Q**

3 **R**

4 **S**

3D Edwin Hubble observed that the further away the galaxy, the bigger the red-shift.

Which spectrum is from the galaxy furthest from us?

1 **P**

2 **Q**

3 **R**

4 **S**

Turn over for the next question

QUESTION FOUR

The table gives information about some telescopes.

Name of telescope	Telescope diameter in metres	Type of radiation detected	Location of telescope
Chandra	1.2	X-rays	in space
Hubble	2.4	visible light	in space
Lovell	76.2	radio waves	on Earth's surface
South Pole	10.0	microwaves	on Earth's surface

4A Which telescope detects electromagnetic radiation with the lowest frequency?

1 Chandra

2 Hubble

3 Lovell

4 South Pole

4B There are telescopes in space that detect electromagnetic radiation with wavelengths shorter than the radiation in the table.

This electromagnetic radiation is . . .

1 gamma.

2 infra red.

3 sound.

4 ultraviolet.

4C The Hubble telescope is located in space so that . . .

1 it is closer to the stars it is observing.

2 it will produce clearer images than Earth-based telescopes.

3 it can have a smaller diameter than an Earth-based telescope.

4 it is not affected by gravity.

4D The table gives the diameters of the telescopes.

The data in the table shows that . . .

1 there is no relationship between the diameter and the type of radiation detected.

2 the smaller the diameter, the longer the wavelength detected.

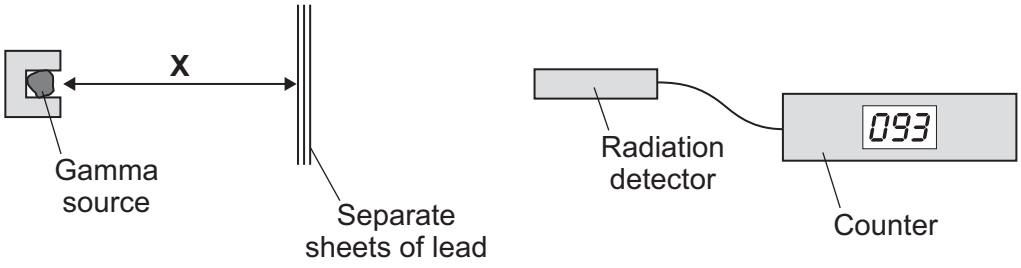
3 the larger the diameter, the shorter the wavelength detected.

4 the larger the diameter, the longer the wavelength detected.

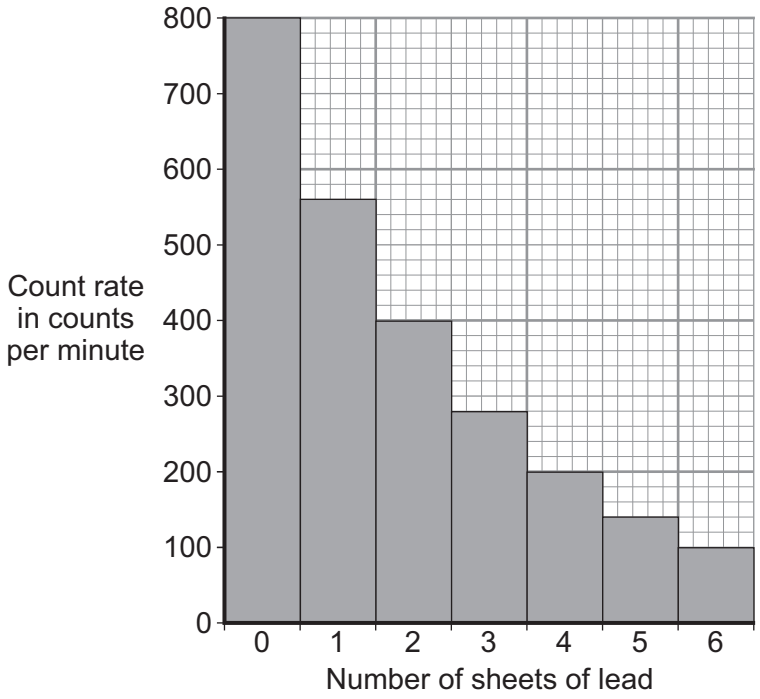
Turn over for the next question

QUESTION FIVE

A teacher demonstrated to her class the effectiveness of lead for absorbing gamma radiation. The diagram shows the apparatus she used.



The detector measured the count rate each time a sheet of lead was added. The distance **X** was kept constant. The class drew a bar chart of her results.



5A Although a bar chart was drawn, the class could have drawn either a bar chart or a line graph because . . .

1 the independent variable is continuous and the dependent variable is discrete.

2 the independent variable is discrete and the dependent variable is continuous.

3 both the independent and dependent variables are categoric.

4 both the independent and dependent variables are continuous.

5B The bar chart shows that the count rate is halved . . .

1 when the thickness is halved.

2 when the thickness is doubled.

3 each time a sheet of lead is added.

4 each time two sheets of lead are added.

5C The teacher measured the thickness of the lead sheets with a micrometer, which measures to 0.01 mm.

She used a micrometer rather than a ruler with a millimetre scale because the micrometer . . .

1 is more reliable than the ruler.

2 is more precise than the ruler.

3 is less likely to produce random errors.

4 is less likely to produce systematic errors.

5D The average thickness of the lead sheets was 2.50 mm.

What thickness of lead, in mm, is needed to reduce the count rate from 800 counts per minute to 200 counts per minute?

1 4.00

2 5.00

3 10.00

4 12.50

Turn over for the next question

QUESTION SIX

This information is about the digital switchover.

The Big Switchover

By the end of 2012, all television communication in the UK will have been switched over to digital. You will need special digital equipment to watch it.

Radio will continue to be broadcast in both analogue and digital for the time being.

6A Which of the following statements describes a digital signal?

1 a sequence of pulses with discrete values of amplitude

2 a sequence of pulses with continuously varying amplitude

3 a wave with continuously varying amplitude

4 a wave with discrete values of frequency

6B Which of the following statements, comparing analogue and digital signals, is correct?

1 Analogue signals are easy to process with computers and are less prone to interference.

2 Analogue signals are difficult to process with computers and are less prone to interference.

3 Digital signals are easy to process with computers and are less prone to interference.

4 Digital signals are difficult to process with computers and are more prone to interference.

6C Television signals are carried by electromagnetic waves. The energy carried by the electromagnetic waves is absorbed by television aerials.

What happens in a television aerial when the energy is absorbed?

1 The aerial becomes alternately hot and cold.

2 An alternating current of frequency higher than that of the carrier wave is created.

3 An alternating current of frequency lower than that of the carrier wave is created.

4 An alternating current of frequency the same as that of the carrier wave is created.

6D The *special digital equipment* needed could be either a new digital television or a digital set-top box used with an existing analogue television.

What is the environmental disadvantage of replacing analogue televisions with new digital televisions?

1 Digital televisions are more expensive to buy than analogue televisions.

2 Digital televisions may be assembled by children in developing countries.

3 Analogue televisions containing toxic chemicals need to be disposed of.

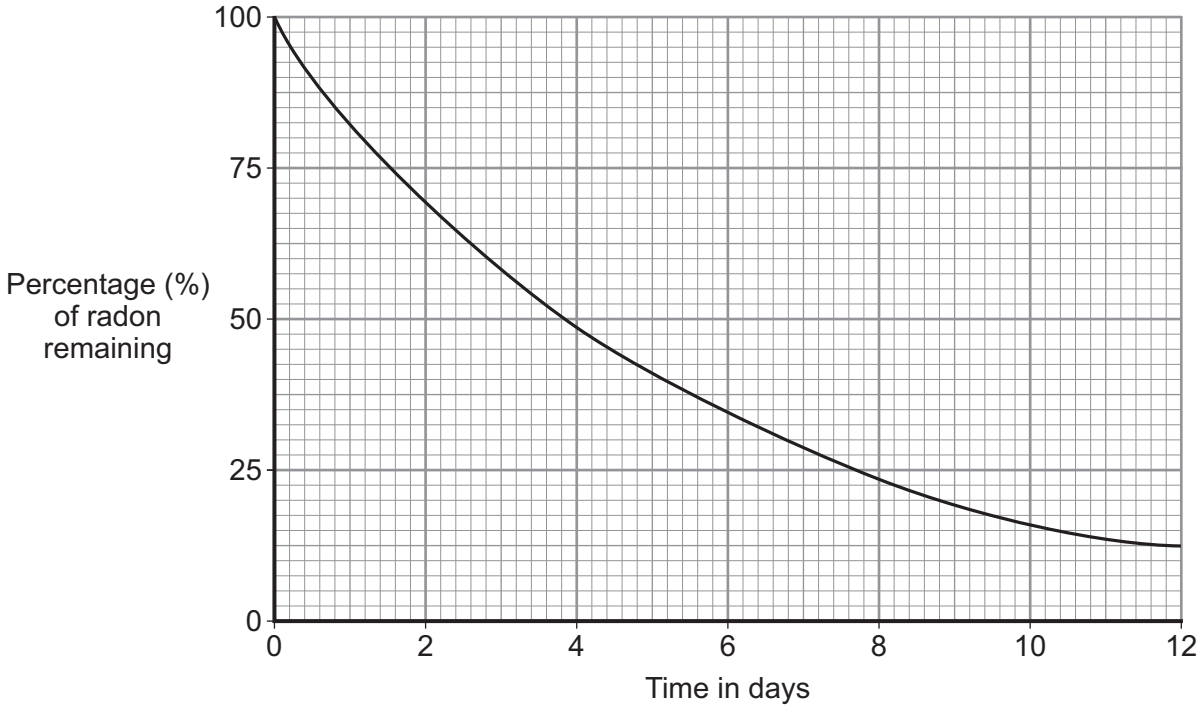
4 Analogue televisions are always much smaller than digital televisions.

Turn over for the next question

QUESTION SEVEN

Radon is a radioactive gas.

The graph shows how one isotope of radon decays with time.



7A What is the half-life of this isotope of radon?

1 3.8 days

2 6.0 days

3 11.4 days

4 50.0 days

7B The count rate at the start was 240 counts per second.

What was the count rate after 11.4 days?

1 0 counts per second

2 12.5 counts per second

3 30 counts per second

4 80 counts per second

7C When a nucleus of radon decays, it produces a nucleus of polonium and a nucleus of helium.

What type of radiation is produced by radon when it decays?

1 alpha radiation

2 beta radiation

3 gamma radiation

4 infra red radiation

7D Radon gas is given off by certain rocks in the ground. In some areas of the UK, radon gas can collect in houses as it rises through gaps in the floor.

Why is radon particularly dangerous to health?

1 Because it is a gas, it can easily catch fire.

2 Because it is a gas, it is difficult to detect.

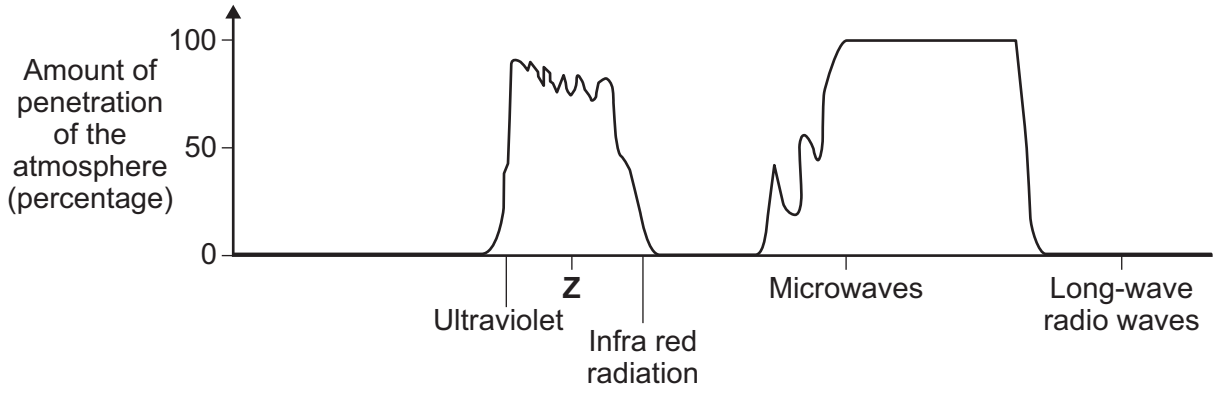
3 Because it is a gas, it is impossible to see it.

4 Because it is a gas, it can easily enter the body.

Turn over for the next question

QUESTION EIGHT

The graph shows the relative ability of all the different parts of the electromagnetic spectrum to penetrate the Earth's atmosphere.



8A What type of electromagnetic radiation would be found at position **Z**?

1 X-rays

2 gamma rays

3 short-wave radio waves

4 visible light

8B X-ray telescopes are usually placed on satellites orbiting the Earth.

What is the reason for this?

1 X-rays would be too dangerous to use on the Earth's surface.

2 X-rays cannot penetrate the Earth's atmosphere.

3 The Earth's atmosphere would distort the image produced by the X-rays.

4 The X-ray telescope has to be much nearer to the stars to form an image.

8C Microwaves are used for long-distance mobile phone communication because . . .

1 they are high frequency waves that can travel long distances.

2 they can pass through the Earth's atmosphere to satellites orbiting the Earth.

3 they can travel along optical fibres and so travel in curved paths.

4 they can be reflected by a layer of the atmosphere called the ionosphere.

8D Some people are concerned that the use of mobile phones might affect people's health.

What should scientists do to try to find out if there is a link?

1 Advise the government to ban the use of mobile phones.

2 Make 1000 people use a mobile phone continuously for a week to see if it affects their health.

3 Survey everyone who is ill to see if they use a mobile phone.

4 Compare the health of 1000 people who use a mobile phone with 1000 people who do not.

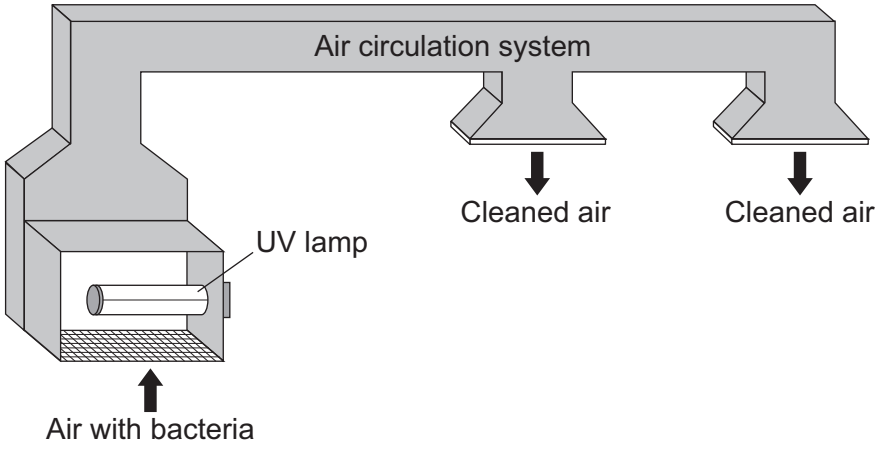
Turn over for the next question

QUESTION NINE

Tuberculosis (TB) is caused by bacteria. A recent study found that ultraviolet lights in hospitals can reduce the spread of TB by up to 70 %.

The study showed that TB bacteria can be killed by hanging a short-wave ultraviolet (UV) lamp from the ceiling. An air circulation system moves air infected with bacteria past the UV lamp. The cleaned air is then returned to the room.

The arrangement is shown in the diagram.



9A Which other part of the electromagnetic spectrum is also used to kill bacteria?

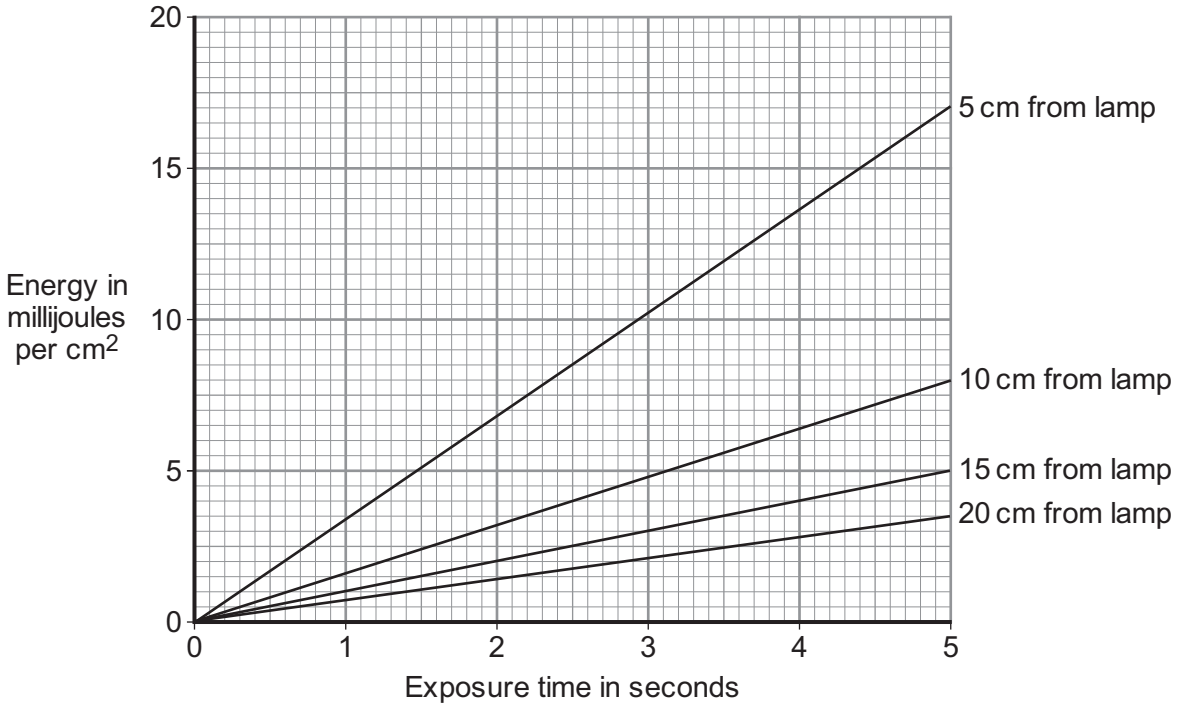
1 gamma rays

2 microwaves

3 radio waves

4 visible light

9B The graph shows how the energy from a UV lamp that falls on a surface of area 1 cm^2 varies with exposure time and distance from the lamp.



The graph shows that the energy that falls on 1 cm^2 . . .

1 increases with exposure time and increases with distance from the lamp.

2 decreases with exposure time and decreases with distance from the lamp.

3 increases with exposure time and decreases with distance from the lamp.

4 decreases with exposure time and increases with distance from the lamp.

9C The minimum energy required to kill most of the TB bacteria is 6.5 millijoules per cm^2.
The infected air is exposed to the UV radiation for 4 seconds.

To kill the bacteria, what is the maximum distance the air can be from the lamp?

1 5 cm

2 10 cm

3 15 cm

4 20 cm

9D The study used UV radiation with a wavelength of 260 nm.

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

The speed of electromagnetic waves is 300 000 000 m/s
1 nanometre, nm = 0.000 000 001 metre, m
1 gigahertz, GHz = 1 000 000 000 hertz, Hz

The frequency of this radiation is about . . .

1 87 000 GHz

2 115 000 GHz

3 870 000 GHz

4 1 150 000 GHz

END OF TEST

There are no questions printed on this page