Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
June 2011

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Tuesday 28 June 2011 Morning Session

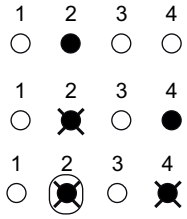
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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

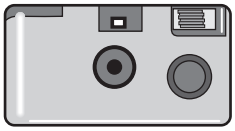
Electromagnetic radiation has many uses.

1

Toaster

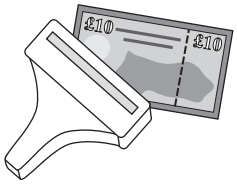
2

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

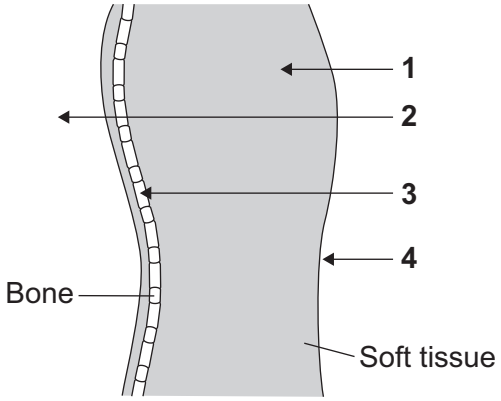
C visible light

D X-rays

QUESTION TWO

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

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



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

A alpha

B beta

C gamma

D X-rays

Turn over for the next question

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** . . . .

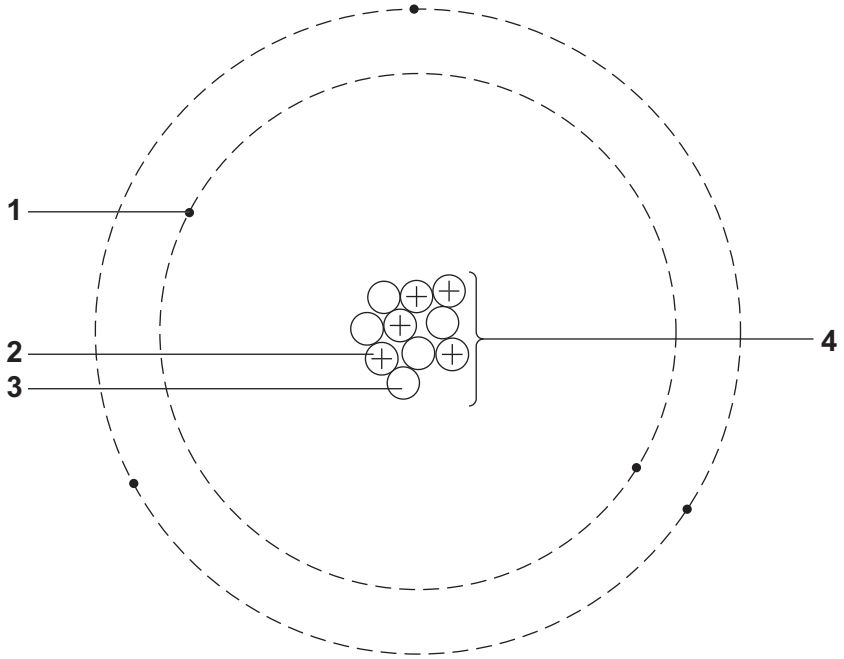
A radiographer taking X-rays of patients protects herself by . . . **2** . . . .

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

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

QUESTION FOUR

The diagram shows the different parts of an atom.



Match words, **A**, **B**, **C** and **D**, with the labels **1**–**4** on the diagram.

A electron

B neutron

C nucleus

D proton

Turn over for the next question

QUESTION FIVE

A source of sound waves is moving away from an observer.

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

A frequency

B red-shift

C wavelength

D wave speed

Compared with the sound that the source emits, the observer hears a sound with a bigger . . . **1** . . . and a smaller . . . **2** . . . .

There is no change in the . . . **3** . . . .

A similar effect is seen with the light from a distant galaxy. This is called . . . **4** . . . .

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

This question is about sunbathing.

6A Which type of radiation causes sunburn?

1 infra red

2 light

3 microwave

4 ultraviolet

6B People who sunbathe a lot are at risk of getting . . .

1 a cold.

2 lung cancer.

3 skin cancer.

4 a brain tumour.

Holidaymakers may protect themselves by using sun cream. The sun protection factor (SPF) of a sun cream shows how much protection the sun cream gives you. The higher the SPF value, the better the protection to the skin.

Factor 15 sun cream allows a person to stay in the Sun without burning 15 times longer than with no sun cream.

Someone using factor 15 sun cream on holiday was able to stay in the Sun without getting burnt for a maximum of 30 minutes.

6C What is the maximum time they would have been able to stay in the Sun without getting burnt if they had used factor 60 sun cream?

1 10 minutes

2 30 minutes

3 60 minutes

4 120 minutes

6D Which of the following actions is the **least** effective way to protect your skin from the Sun's harmful rays?

1 wearing clothing with long sleeves

2 wearing a hat that shades your face and neck

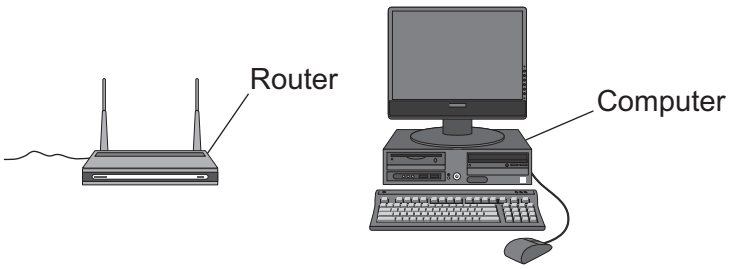
3 staying indoors between 11 am and 3 pm

4 putting on sunglasses

Turn over for the next question

QUESTION SEVEN

Wi-Fi is a type of radio communication that can be used to send internet information to a computer. A device called a router sends a 2.45 megahertz (MHz) radio signal to a computer a short distance away.



7A What quantity is measured in MHz?

1 amplitude

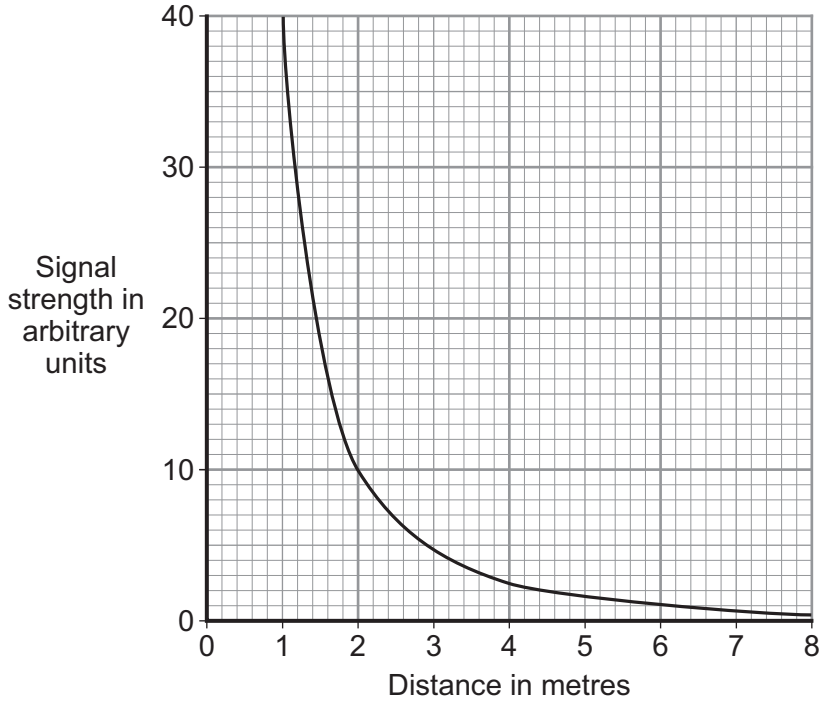
2 frequency

3 speed

4 wavelength

7B A manufacturer tested a router to find the range over which its signal could be detected.

The results are shown on the graph.



What happens to the signal strength if the distance from the router is doubled?

1 It is double the original value.

2 It is four times greater than the original value.

3 It is half the original value.

4 It is one quarter of the original value.

7C Why is the information shown in a line graph rather than a bar chart?

1 because the data is categoric

2 because the data is continuous

3 because the data is discrete

4 because the data is ordered

7D A politician is worried about the safety of Wi-Fi systems in schools.

He said: “I believe that these systems may be harming children.”

What was the politician’s statement?

1 a conclusion

2 a fact

3 a theory

4 an opinion

Turn over for the next question

QUESTION EIGHT

The following article appeared in a newspaper.

Radioactive Fruit!

Some supermarkets sell fresh fruit that has been exposed to radiation.

A spokesperson for the supermarkets explained: "The radiation kills bacteria on the surface and inside the fruit. This means that the fruit stays fresh for longer. Scientists have done tests on the treated fruit and are sure that it is safe to eat."

He added: "Fruit that has been treated in this way will be clearly labelled."

A consumer group has said: "We do not believe that fruit treated with radioactivity is safe. We are trying to stop supermarkets from selling it."

8A To reassure customers that the treated fruit is safe to eat, the supermarket should . . .

1 explain that the treated fruit will stay fresh for longer.

2 sell the treated fruit at a lower price than the untreated fruit.

3 show that the scientists who did the tests were not biased.

4 tell customers that the taste of the fruit has not changed.

8B The government has said that all fruit should be clearly labelled to show if it has been treated with radiation.

This is because . . .

1 people can then decide whether or not they want to eat fruit treated with radiation.

2 the government knows that treated fruit is dangerous to eat.

3 the government wants to encourage people to eat more fruit.

4 the labels can make the fruit more attractive.

8C The headline of the newspaper says that the fruit is radioactive.

What should scientists do to test if this is true?

1 measure the time it takes for the fruit to go rotten

2 put the fruit close to a radiation detector and see if the count rate goes up

3 put the fruit close to a radiation detector and see if the count rate goes down

4 see if the fruit glows when placed in a dark room

8D The radiation used to treat the fruit kills bacteria both on the surface and inside the fruit.

The radioactive isotope used must emit the right type of radiation. It must also have a suitable half-life.

Which row in the table describes the most suitable radioactive isotope to use?

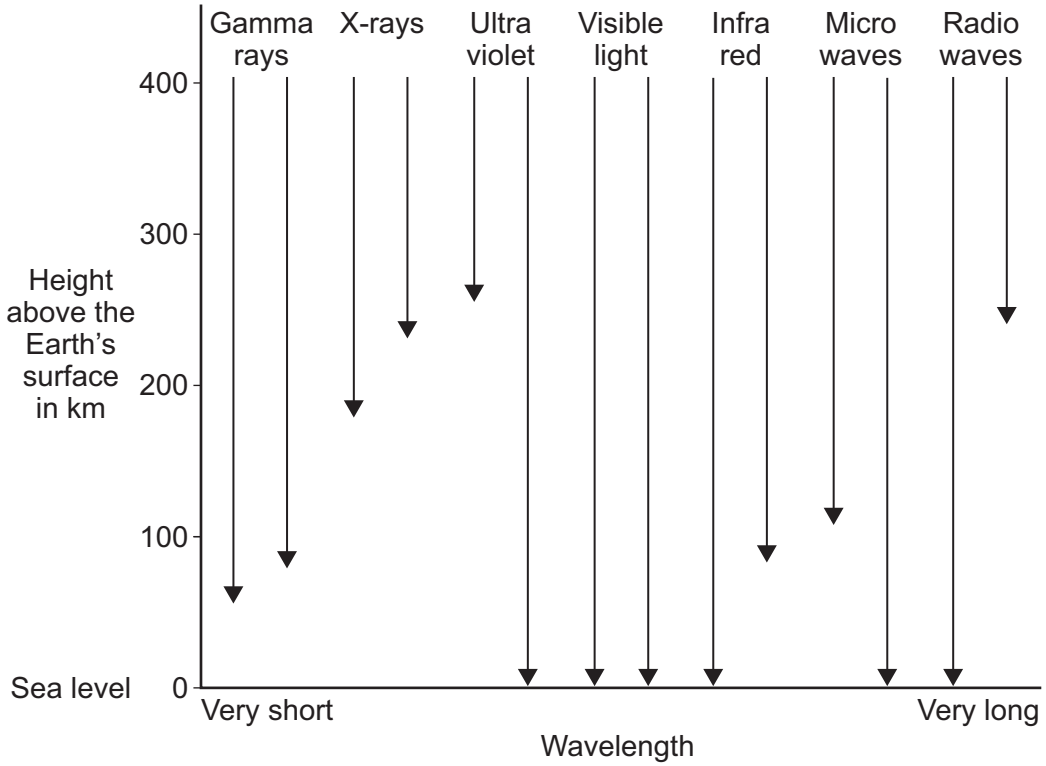
Isotope	Radiation emitted	Half-life
1	alpha	6 hours
2	alpha	60 years
3	gamma	5 hours
4	gamma	5 years

Turn over for the next question

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.

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

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

A source of sound waves is moving away from an observer.

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

A frequency

B red-shift

C wavelength

D wave speed

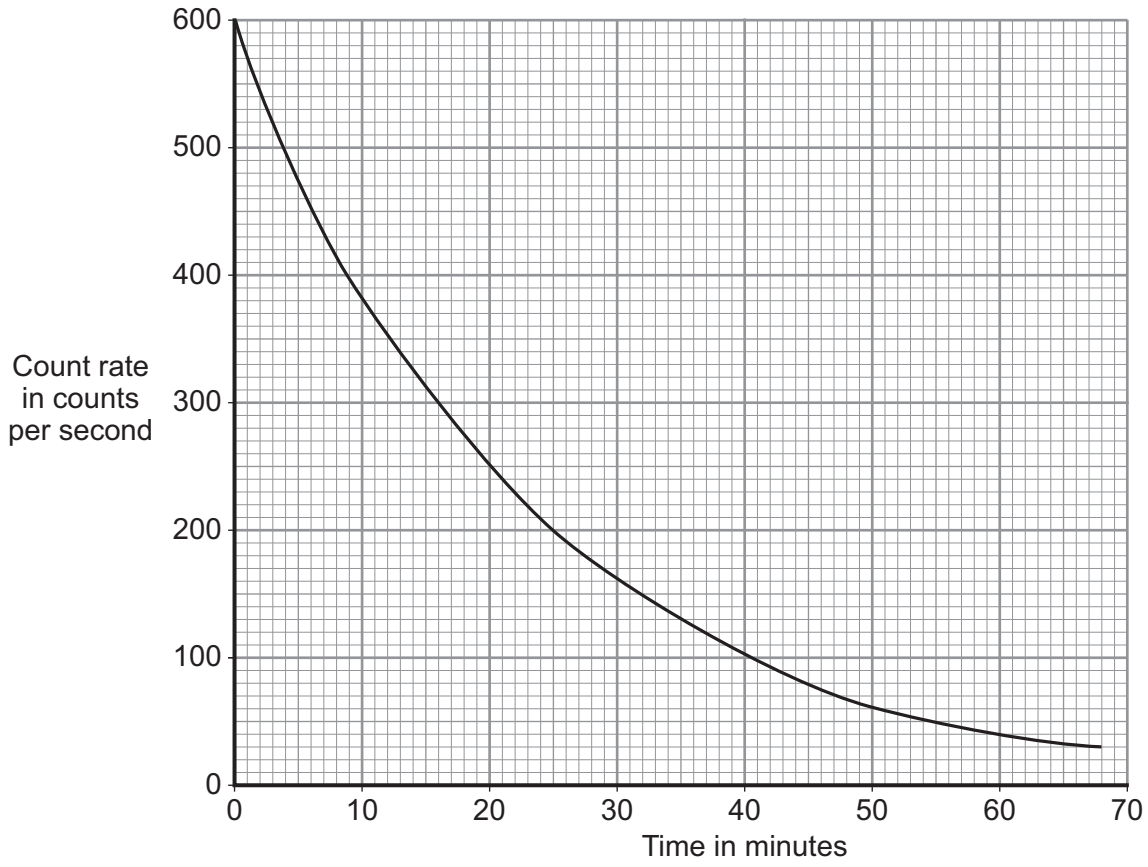
Compared with the sound that the source emits, the observer hears a sound with a bigger . . . **1** . . . and a smaller . . . **2** . . . .

There is no change in the . . . **3** . . . .

A similar effect is seen with the light from a distant galaxy. This is called . . . **4** . . . .

QUESTION TWO

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



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

A 16

B 25

C 150

D 600

The initial count rate was . . . **1** . . . counts per second.

The time taken for the count rate to fall to 200 counts per second is . . . **2** . . . minutes.

The half-life of the radioactive isotope is . . . **3** . . . minutes.

The count rate after two half-lives was . . . **4** . . . counts per second.

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 following article appeared in a newspaper.

Radioactive Fruit!

Some supermarkets sell fresh fruit that has been exposed to radiation.

A spokesperson for the supermarkets explained: "The radiation kills bacteria on the surface and inside the fruit. This means that the fruit stays fresh for longer. Scientists have done tests on the treated fruit and are sure that it is safe to eat."

He added: "Fruit that has been treated in this way will be clearly labelled."

A consumer group has said: "We do not believe that fruit treated with radioactivity is safe. We are trying to stop supermarkets from selling it."

3A To reassure customers that the treated fruit is safe to eat, the supermarket should . . .

1 explain that the treated fruit will stay fresh for longer.

2 sell the treated fruit at a lower price than the untreated fruit.

3 show that the scientists who did the tests were not biased.

4 tell customers that the taste of the fruit has not changed.

3B The government has said that all fruit should be clearly labelled to show if it has been treated with radiation.

This is because . . .

1 people can then decide whether or not they want to eat fruit treated with radiation.

2 the government knows that treated fruit is dangerous to eat.

3 the government wants to encourage people to eat more fruit.

4 the labels can make the fruit more attractive.

3C The headline of the newspaper says that the fruit is radioactive.

What should scientists do to test if this is true?

1 measure the time it takes for the fruit to go rotten

2 put the fruit close to a radiation detector and see if the count rate goes up

3 put the fruit close to a radiation detector and see if the count rate goes down

4 see if the fruit glows when placed in a dark room

3D The radiation used to treat the fruit kills bacteria both on the surface and inside the fruit.

The radioactive isotope used must emit the right type of radiation. It must also have a suitable half-life.

Which row in the table describes the most suitable radioactive isotope to use?

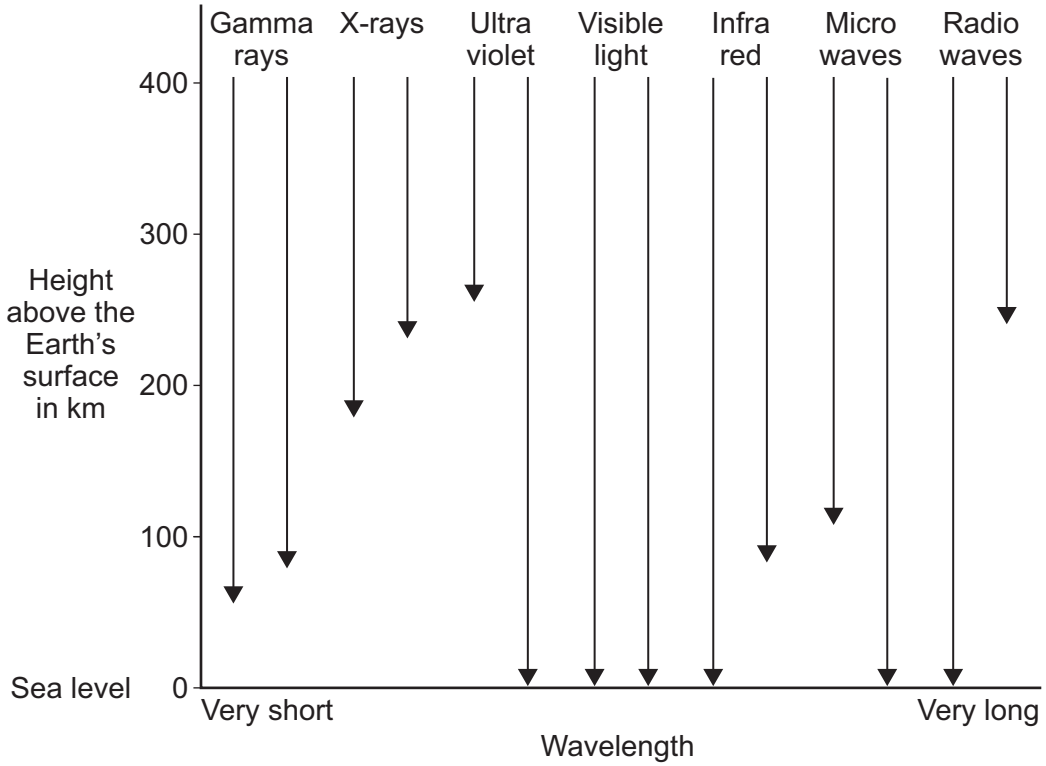
Isotope	Radiation emitted	Half-life
1	alpha	6 hours
2	alpha	60 years
3	gamma	5 hours
4	gamma	5 years

Turn over for the next question

QUESTION FOUR

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.



4A 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.

4B Which of the following statements about the use of telescopes in space is true?

1 The atmosphere distorts the image produced by the telescope.

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4 The telescopes are easy to repair and maintain.

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Spitzer	1000 – 1 000 000

4C The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

4D Which telescope detects X-rays?

1 Chandra

2 FUSE

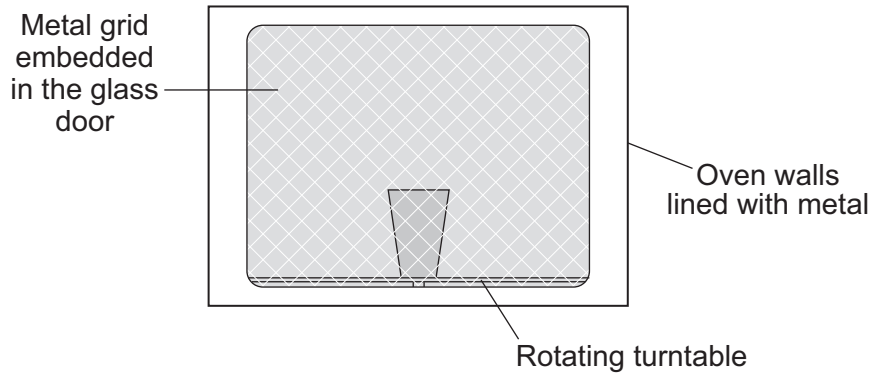
3 INTEGRAL

4 Spitzer

Turn over for the next question

QUESTION FIVE

The diagram shows a microwave oven.



The microwaves have a frequency of 2500 MHz.

1 MHz = 1 000 000 Hz

5A The wave speed of the microwaves is 300 000 000 m/s.

What is the wavelength of the microwaves?

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

1 0.12 m

2 1.2 m

3 7.5 m

4 8.3 m

5B Which one of the following statements about electromagnetic radiations best explains why food can be heated by microwaves?

1 All electromagnetic radiations are disturbances in an electric field.

2 All electromagnetic radiations travel through a vacuum at the same speed.

3 All electromagnetic radiations travel as waves.

4 All electromagnetic radiations move energy from one place to another.

5C The inside walls of the microwave oven are lined with metal. The door has a metal grid embedded in the glass.

The reason for using metal is that . . .

1 microwaves create an alternating current in the metal.

2 microwaves reflect off metal surfaces.

3 microwaves are absorbed by metals.

4 microwaves are transmitted by metals.

5D Microwaves are dangerous to living creatures. Microwaves can also affect radio and television reception.

Which feature of the oven shown in the diagram makes sure that microwaves do not escape through the door?

1 the rotating turntable

2 the metal lining

3 the embedded metal grid

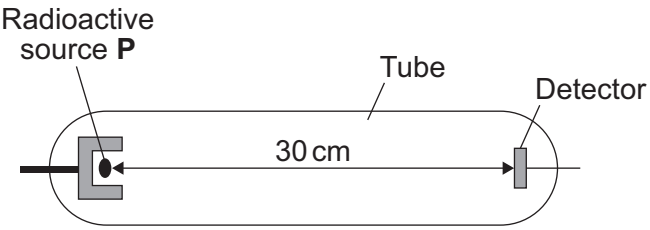
4 the glass

Turn over for the next question

QUESTION SIX

Ernest Rutherford did many experiments in studying the properties of radioactive sources. He gave names to the three types of radiation emitted by radioactive sources.

One experiment used apparatus similar to that shown.



6A Rutherford found that when the air in the tube was removed, the radiation from **P** was detected. When the air was returned to the tube, no radiation was detected.

The radioactive source **P** emitted . . .

1 alpha particles.

2 beta particles.

3 gamma rays.

4 X-rays.

6B Another radioactive source, **Q**, was used. When a magnetic field was applied across the tube with no air inside, it made no difference to the radiation detected.

This shows that **Q** emits . . .

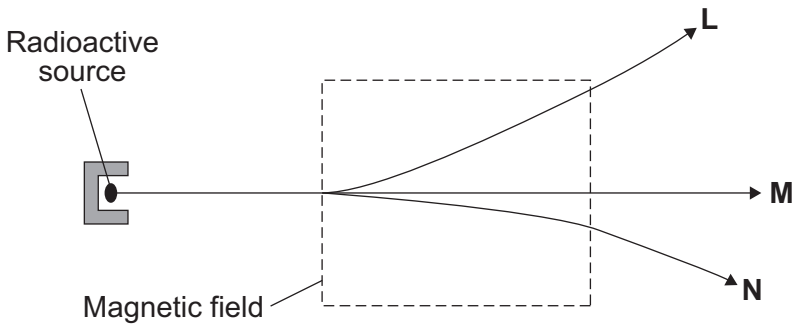
1 alpha and beta particles.

2 alpha particles and gamma rays.

3 beta particles only.

4 gamma rays only.

6C The diagram shows three types of radiation, **L**, **M** and **N**, from a radioactive source. They are passing through a magnetic field.



Radiation **N** is deflected less than radiation **L** and in the opposite direction.

This is because radiation **N** consists of particles which . . .

1 have a smaller mass than **L** and the same charge.

2 have a bigger mass than **L** and the same charge.

3 have a smaller mass than **L** and the opposite charge.

4 have a bigger mass than **L** and the opposite charge.

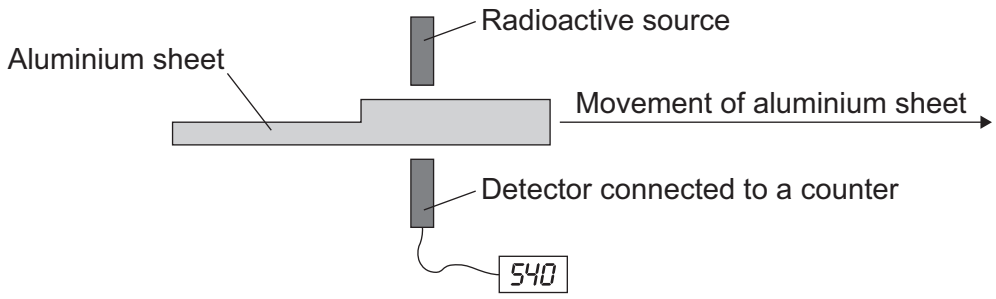
6D Which row in the table correctly identifies the three types of radiation emitted by radioactive materials?

	Alpha	**Beta**	**Gamma**
1	an electron	a helium nucleus	an electromagnetic wave
2	a helium nucleus	an electromagnetic wave	an electron
3	a helium nucleus	an electron	an electromagnetic wave
4	an electron	an electromagnetic wave	an electron

Turn over for the next question

QUESTION SEVEN

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



7A Which type of radioactive source should she choose?

1 an alpha emitter

2 a beta emitter

3 a gamma emitter

4 it does not matter

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

What particles are in the strontium-90 nucleus?

1 38 protons and 50 neutrons

2 38 protons and 52 neutrons

3 40 protons and 50 neutrons

4 42 protons and 48 neutrons

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

1 It increases.

2 It decreases.

3 It stays the same.

4 It falls to zero.

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

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

1 7 years

2 14 years

3 56 years

4 84 years

Turn over for the next question

QUESTION EIGHT

The transmission of television programmes in all areas of the UK is changing from using analogue signals to using digital signals.

8A Which row in the table correctly describes digital signals?

1	continuously variable	can be easily processed by computers
2	continuously variable	cannot be easily processed by computers
3	discrete values only	can be easily processed by computers
4	discrete values only	cannot be easily processed by computers

8B Cable television transmission sends signals along optical fibres made from glass.

One of the reasons for using these fibres is that . . .

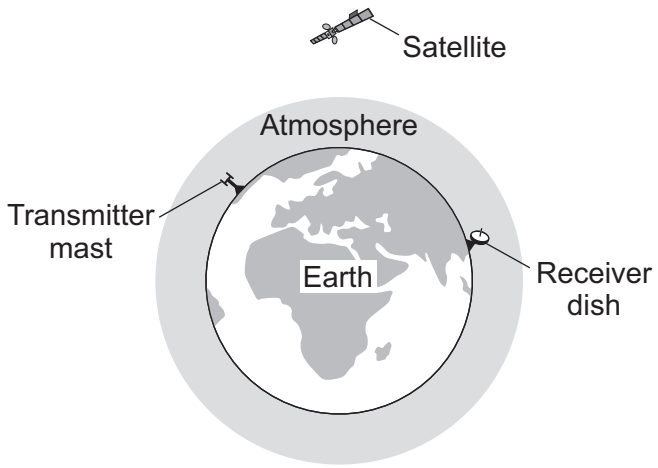
1 radio waves travel faster in glass than they do in air.

2 radio waves can be reflected inside the fibre so that the signal can go round corners.

3 visible light can travel through the walls of the fibre, just as it does through a window.

4 visible light can be reflected inside the fibre so that the signal can go round corners.

8C Satellite television programmes are transmitted from one side of the Earth to the other side.



Which row in the table correctly describes the type of electromagnetic wave used and the reason for using this type of wave?

	Type of electromagnetic wave	Reason for use
1	microwaves	can travel in a curved path
2	microwaves	can pass through the Earth's atmosphere
3	radio waves	can travel in a curved path
4	radio waves	can pass through the Earth's atmosphere

8D Digital signals are better than analogue signals for transmitting satellite television programmes because . . .

1 they travel at a higher speed in a vacuum.

2 they spread out in all directions from the transmitter.

3 they are less prone to distortion by interference.

4 when amplified, any interference they have picked up is not amplified.

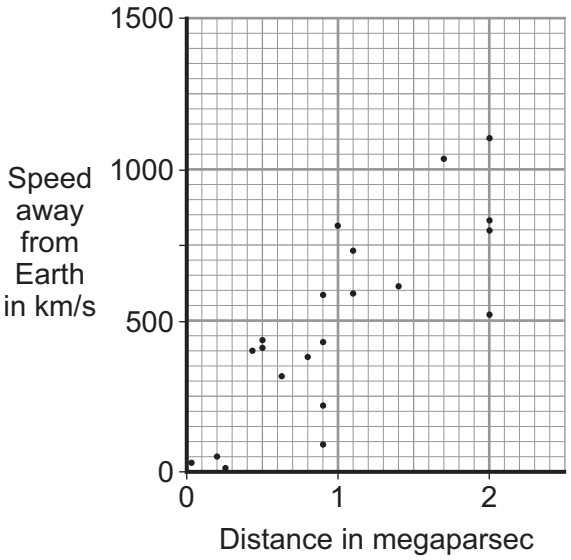
Turn over for the next question

QUESTION NINE

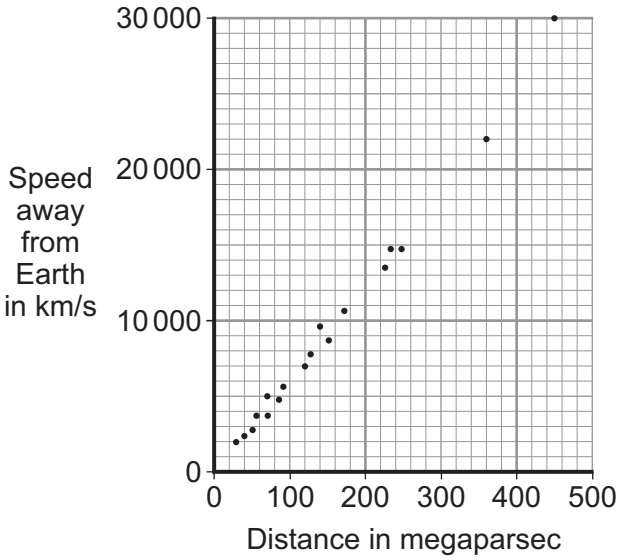
Edwin Hubble investigated the relationship between the speed of a galaxy moving away from the Earth and its distance from the Earth.

Graph P shows his results.

Graph P



Graph Q



A megaparsec is a very large unit of distance used by astronomers.

Other astronomers have confirmed Hubble's results by surveying other galaxies. **Graph Q** shows the other astronomers' results.

9A The data in **Graph P** suggests that . . .

1 there is no relationship between the speed of a galaxy and its distance from Earth.

2 the galaxies closest to Earth move fastest.

3 the further away a galaxy is from Earth, the slower it is moving.

4 the further away a galaxy is from Earth, the faster it is moving.

The gradient (slope) of the line of best fit is called the Hubble constant. Astronomers have used the value of the Hubble constant to calculate the age of the universe.

9B The value of the Hubble constant obtained from **Graph Q** is thought to be more accurate than Hubble's original value.

This is because . . .

1 the data includes galaxies moving towards the Earth.

2 the data gives a line of best fit passing through the origin, (0,0).

3 the data was obtained from a wide range of galaxies.

4 the data was obtained from only very distant galaxies.

9C From the data in **Graph Q**, an approximate value for the Hubble constant in km/s per megaparsec is . . .

1 0.0017

2 0.017

3 60

4 600

9D A teacher used a balloon to model an expanding universe. Some dots were marked on the balloon, which was then inflated.

Which of the following is **not** a reason for using models in science?

1 They prove a theory is correct.

2 They help us to understand a theory.

3 They give similar results to the real experiment.

4 It is easier to take measurements from a model.

END OF TEST

There are no questions printed on this page