AQA GCSE SCIENCE A (PHYSICS)

PHYSICS



EXAM QUESTION PACK

UNIT P1b OBJECTIVE TEST PHY1BP PAPERS

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Tuesday 6 November 2012 Afternoon Session

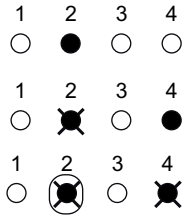
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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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**.

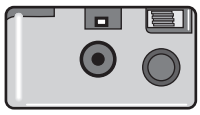
Mark your choices on the answer sheet.

QUESTION ONE

Each of these devices uses electromagnetic radiation.

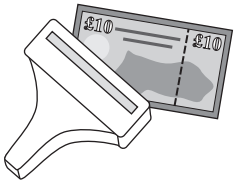
1

Camera



2

Forgery detector



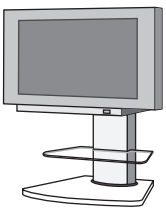
3

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

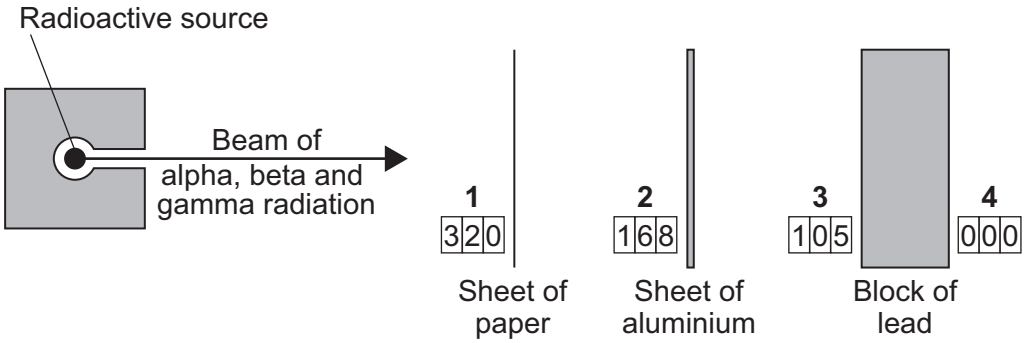
D visible light

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QUESTION TWO

A radioactive source gives out a beam of alpha, beta and gamma radiation.

The diagram shows three different absorbers in the path of the beam. The diagram also shows the readings, in counts per second, on radiation detectors at positions **1**, **2**, **3** and **4**.



Match the radiation detected, **A**, **B**, **C** and **D**, with the positions **1**–**4** in the diagram.

A gamma only

B gamma and beta only

C gamma, beta and alpha

D no radiation

Turn over for the next question

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QUESTION THREE

The Earth's atmosphere absorbs almost all electromagnetic waves but not waves 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 detected . . . **2** . . . .

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

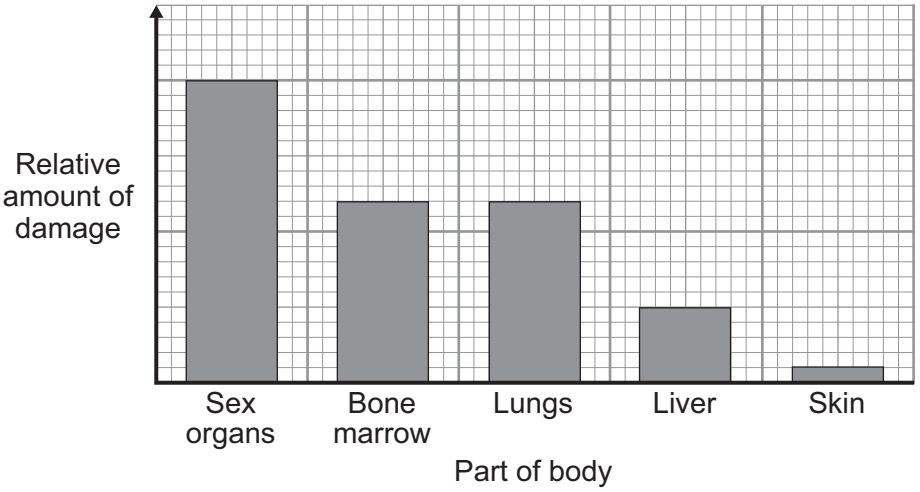
The satellites send images back to Earth using . . . **4** . . . .

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QUESTION FOUR

In 1920, scientists investigated the effect of radiation on different parts of the body. They found that radiation affects some parts of the body more than it affects other parts of the body.

The bar chart compares the relative amounts of damage to different parts of the body when they were exposed to the same radiation dose.



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

A categoric

B control

C dependent

D reliable

The radiation dose the body is exposed to is a . . . **1** . . . variable.

The data is shown as a bar chart because one of the variables is . . . **2** . . . .

The relative amount of damage is a . . . **3** . . . variable.

If this investigation was repeated, giving similar results, this would show that the original data was . . . **4** . . . .

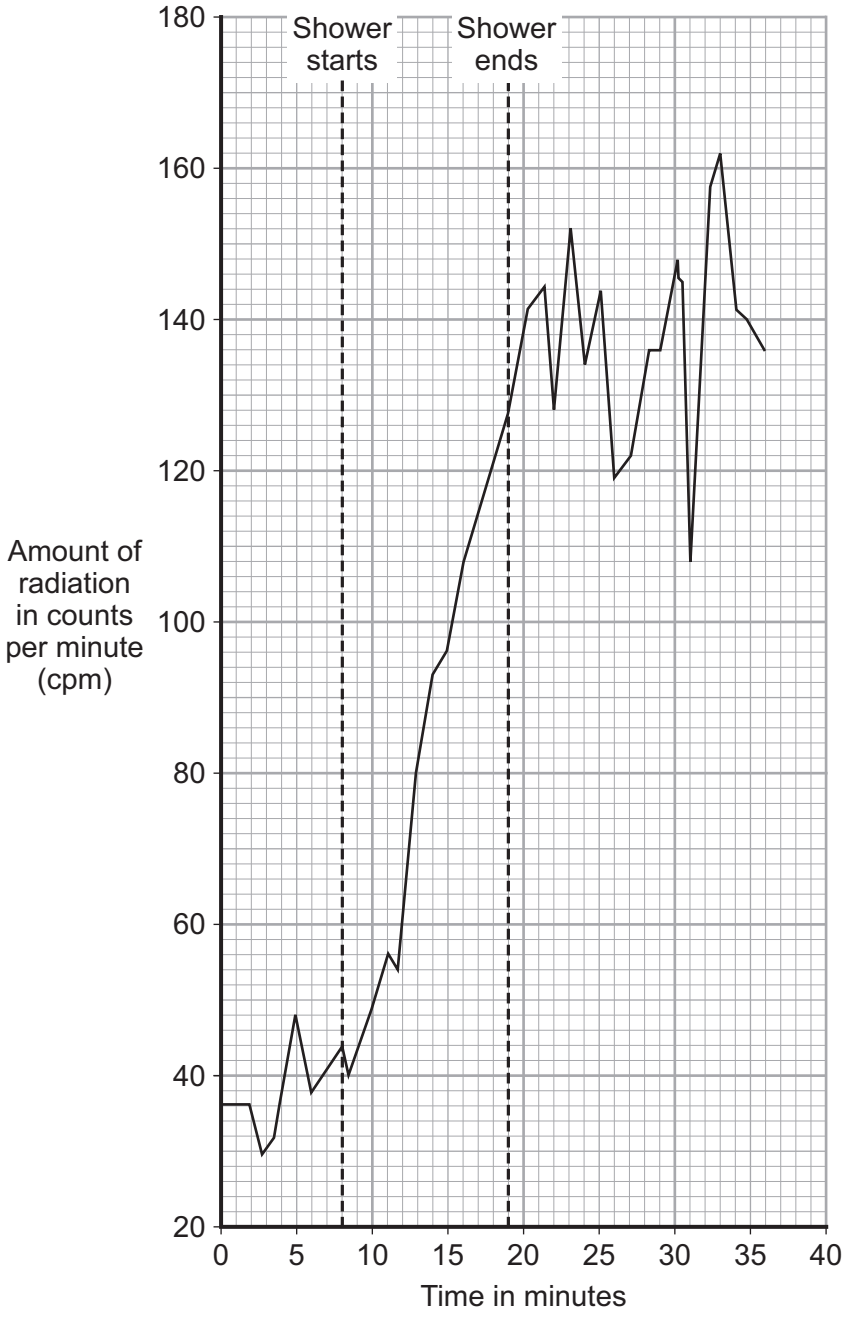
Turn over for the next question

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QUESTION FIVE

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

The data is recorded before, during and after someone having a shower.



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

A 11

B 33

C 44

D 84

1	the time the shower took in minutes
2	the amount of radiation at the start of the shower in cpm
3	the time when the radiation in the bathroom reached a maximum in minutes
4	the increase in the amount of radiation during the shower in cpm

Turn over for the next question

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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

The radioactive isotope phosphorus-32 emits beta particles.

Scientists use phosphorus-32 to help them to understand how plants use phosphorus to grow.

6A A material is described as radioactive if it gives out . . .

1 radio waves all the time.

2 nuclear radiation all the time.

3 radio waves when heated.

4 nuclear radiation when heated.

6B Phosphorus-32 is one of the isotopes of phosphorus.

Atoms of the other isotopes of phosphorus have different numbers of . . .

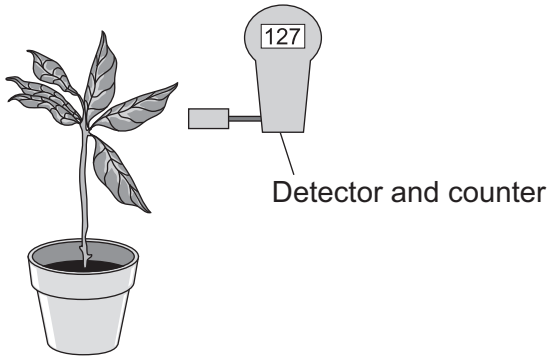
1 electrons.

2 neutrons.

3 nuclei.

4 protons.

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6C The path of the phosphorus-32 in the plant can be traced because the detector can detect . . .

1 beta particles.

2 phosphorus atoms.

3 phosphorus nuclei.

4 ultraviolet radiation.

6D Phosphorus-32 has a half-life of 14 days.

This means that the number of phosphorus-32 nuclei will . . .

1 fall to zero in 14 days.

2 halve in 14 days.

3 double in 14 days.

4 be unchanged in 14 days.

Turn over for the next question

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QUESTION SEVEN

Scientists have observed that light from distant galaxies seems to have increased in wavelength.

7A What is this apparent increase in wavelength called?

1 black hole formation

2 blue-shift

3 red-shift

4 the Hubble effect

7B What does the apparent increase in wavelength suggest about the universe?

1 The universe is expanding.

2 The universe is contracting.

3 The universe was expanding but is now contracting.

4 The universe was contracting but is now expanding.

7C What does the apparent increase in wavelength suggest about the origin of the universe?

1 The universe started from one small point.

2 The universe was formed by gravity pulling material together.

3 The universe was formed by two galaxies colliding.

4 The universe had no starting point; it has always existed.

7D What name is given to the theory about the origin of the universe that has been developed from these observations?

1 big bang theory

2 steady state theory

3 relativity theory

4 gravitational theory

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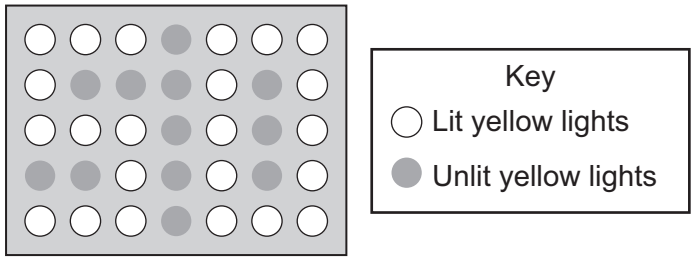
Turn over for the next question

QUESTION EIGHT

It is important that warning signs on motorways are very clear, because vehicles on motorways often travel at high speed.

Tests were done to find the most suitable colour for the lights in a warning sign.

The diagram shows a sign with yellow lights.



8A Which of the following is the most likely reason that yellow light is used for the sign?

1 Yellow light has a higher frequency than all other colours.

2 Yellow light has a longer wavelength than all other colours.

3 Yellow light is easier to see than all other colours.

4 Yellow light travels faster than all other colours.

8B What determines the colour of the light from the display?

1 its brightness

2 its frequency

3 its power

4 its speed in a vacuum

8C The wavelength of red light is 700 nm and the wavelength of violet light is 300 nm.

Which of the following could be the value of the wavelength of the yellow light from the sign?

1 250 nm

2 350 nm

3 600 nm

4 750 nm

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8D A radio signal is used to switch on the warning sign. The frequency of the radio signal is 2 000 000 hertz and the wavelength is 150 metres.

What is the wave speed of the radio signal in metres per second?

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

1 13 333 m/s

2 1 333 333 m/s

3 300 000 000 m/s

4 3 000 000 000 m/s

Turn over for the next question

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QUESTION NINE

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

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

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

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

9A Which of these was **not** a control variable in this investigation?

1 the number of beads

2 the distance of the bottle from the UV radiation

3 the intensity of the UV lamp

4 the type of plastic used for the bottle

The table shows her results.

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

9B Which bottle would be best for storing pills?

1 **W**

2 **X**

3 **Y**

4 **Z**

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9C The clock that she used did not go back to zero when RESET was pressed.

This produced an error that was . . .

1 caused by a faulty technique.

2 caused by human error.

3 random.

4 systematic.

9D If the scientist had used a clock measuring to the nearest second, instead of to the nearest minute, her results would have been more . . .

1 accurate.

2 precise.

3 systematic.

4 valid.

END OF TEST

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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**.

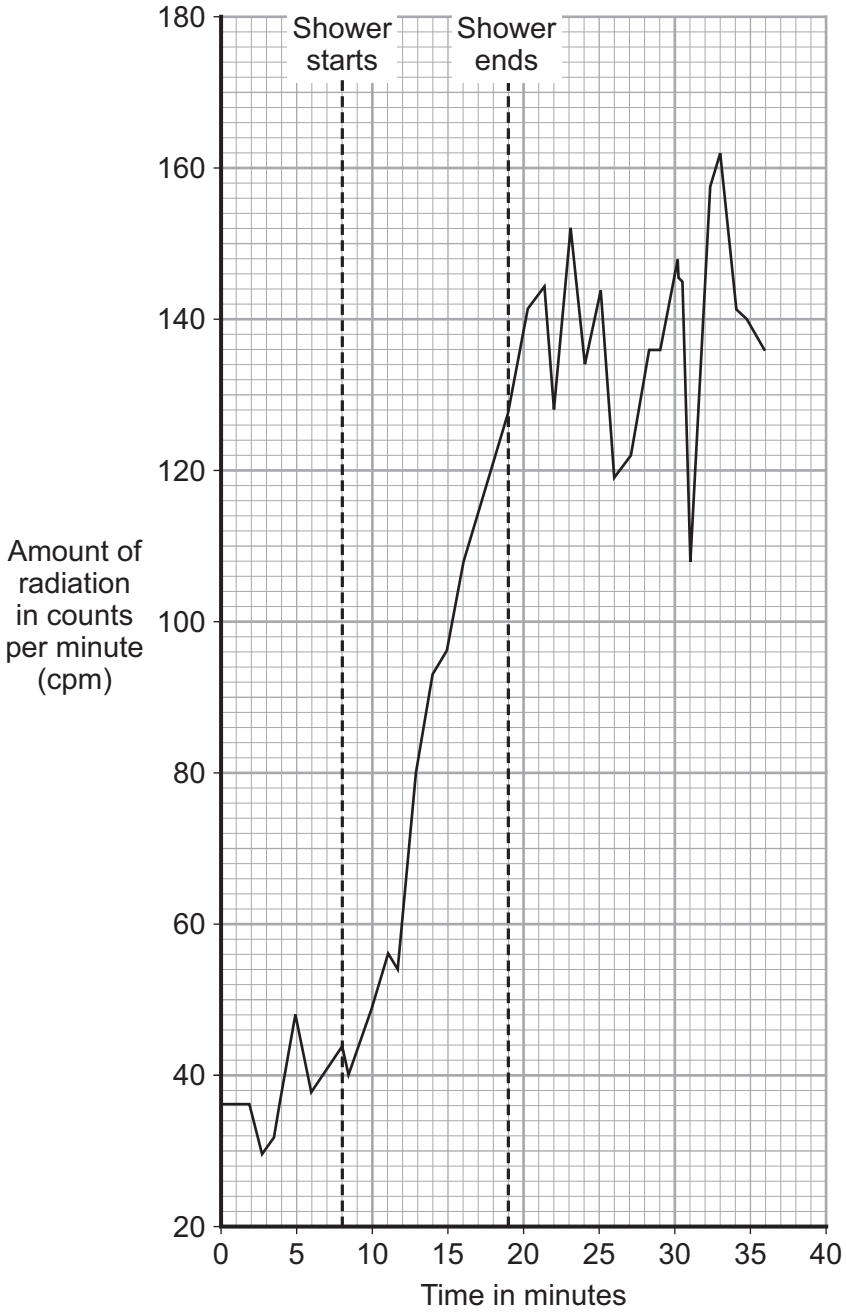
Use **each** answer only **once**.

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QUESTION ONE

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

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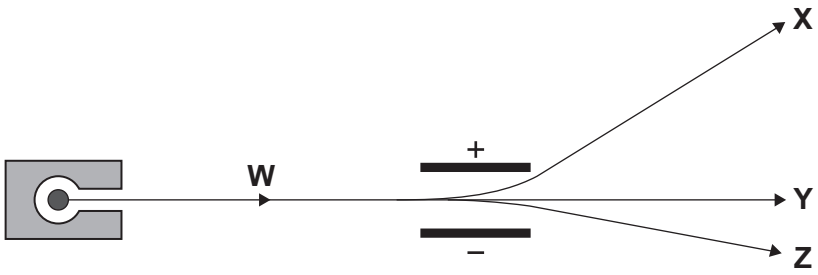
1	the time the shower took in minutes
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3	the time when the radiation in the bathroom reached a maximum in minutes
4	the increase in the amount of radiation during the shower in cpm

Turn over for the next question

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QUESTION TWO

A source emits nuclear radiation. This radiation passes through an electric field.



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

A alpha

B beta

C gamma

D alpha, beta and gamma

Path **W** is the path of . . . **1** . . . radiation.

Path **X** is the path of . . . **2** . . . radiation.

Path **Y** is the path of . . . **3** . . . radiation.

Path **Z** is the path of . . . **4** . . . radiation.

Turn over for the next question

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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.

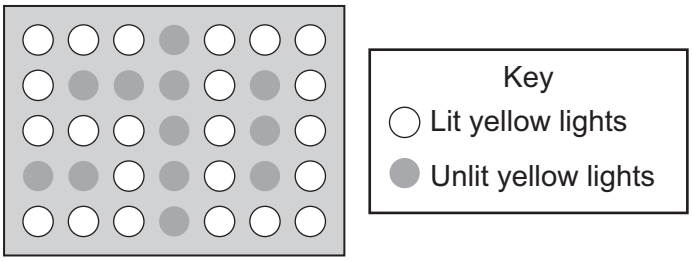
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QUESTION THREE

It is important that warning signs on motorways are very clear, because vehicles on motorways often travel at high speed.

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3A Which of the following is the most likely reason that yellow light is used for the sign?

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3B What determines the colour of the light from the display?

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3D A radio signal is used to switch on the warning sign. The frequency of the radio signal is 2 000 000 hertz and the wavelength is 150 metres.

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Turn over for the next question

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QUESTION FOUR

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4B Which bottle would be best for storing pills?

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2 **X**

3 **Y**

4 **Z**

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4C The clock that she used did not go back to zero when RESET was pressed.

This produced an error that was . . .

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2 caused by human error.

3 random.

4 systematic.

4D If the scientist had used a clock measuring to the nearest second, instead of to the nearest minute, her results would have been more . . .

1 accurate.

2 precise.

3 systematic.

4 valid.

Turn over for the next question

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QUESTION FIVE

Nitrogen-16 is a radioactive isotope of nitrogen. This isotope decays to stable oxygen-16 by beta emission.

5A A beta particle is . . .

1 a helium nucleus.

2 a neutron.

3 a proton.

4 an electron.

5B The rate of emission of beta particles from the nitrogen-16 would . . .

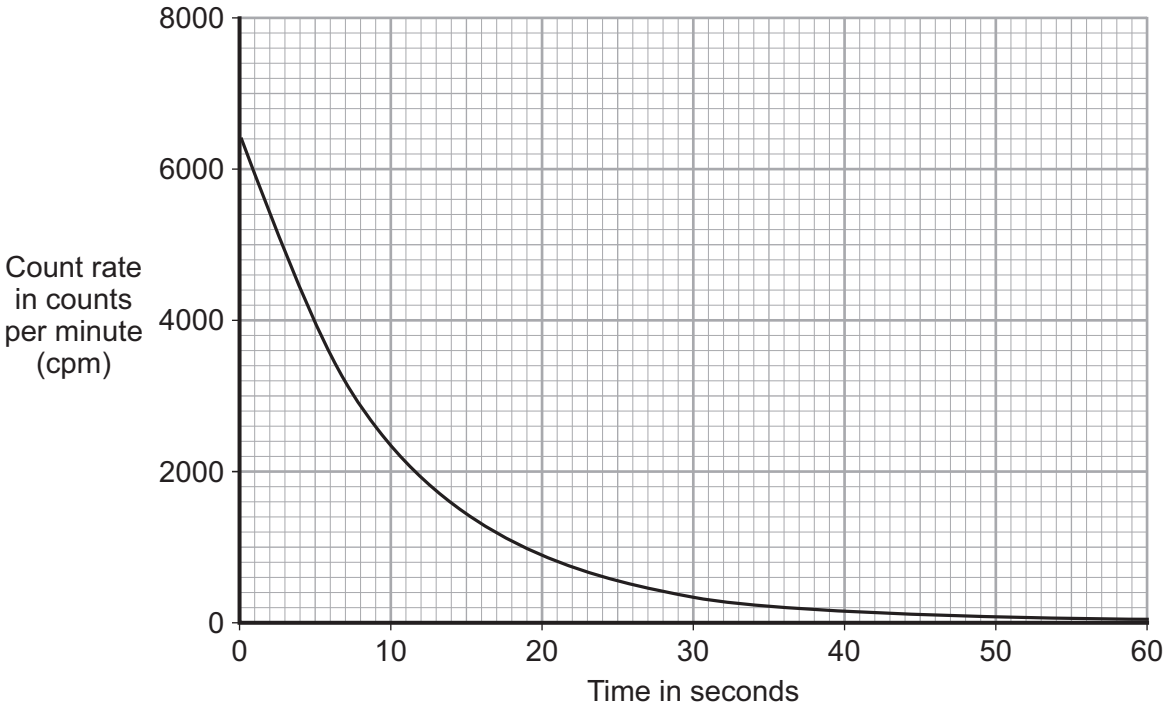
1 be increased by increasing the temperature.

2 be reduced by increasing the pressure of the surrounding air.

3 be reduced by liquefying the nitrogen-16.

4 be unaffected by changes in temperature, pressure or state.

The graph shows the radioactive decay curve for a sample of nitrogen-16.



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5C Using information from the graph, what is the approximate half-life of nitrogen-16?

1 7 seconds

2 30 seconds

3 60 seconds

4 3200 seconds

5D The initial count rate of the nitrogen-16 sample is 6400 counts per minute.

What is the approximate value of the count rate after four half-lives?

1 3200 cpm

2 1600 cpm

3 800 cpm

4 400 cpm

Turn over for the next question

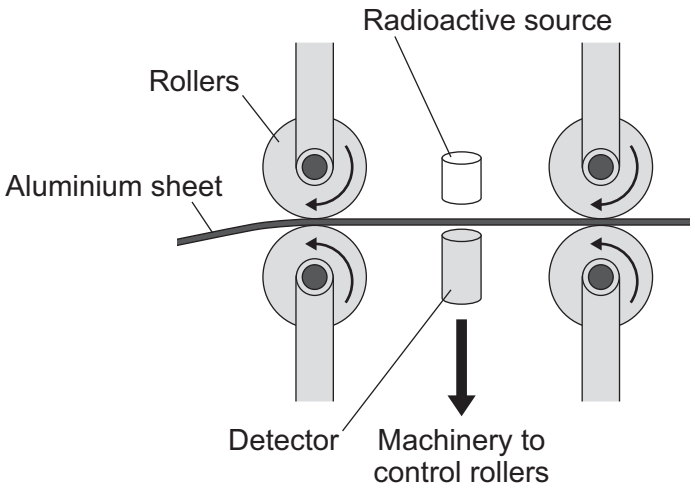
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QUESTION SIX

The table shows the type of radiation emitted by, and the half-life of four radioactive isotopes, **P**, **Q**, **R** and **S**.

Radioactive isotope	Radiation emitted	Half-life
P	beta	6000 years
Q	alpha	400 years
R	gamma	6 hours
S	beta	30 seconds

6A The diagram shows how a radioactive isotope is used to monitor the thickness of aluminium in the continuous manufacture of aluminium sheet.



Which of the isotopes should be used?

1 **P**

2 **Q**

3 **R**

4 **S**

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6B A smoke alarm uses a small amount of a radioactive isotope. Isotope **Q** is used so that the smoke alarm can be used safely in a house.

This is because isotope **Q** is an alpha emitter . . .

1 with a short half-life and alpha particles have a short range in air.

2 with a short half-life and alpha particles have a long range in air.

3 with a long half-life and alpha particles have a short range in air.

4 with a long half-life and alpha particles have a long range in air.

6C Radioactive isotopes can be injected into the human body to act as tracers in medical diagnosis.

The isotope used is . . .

1 **P** because it has a very long half-life and beta particles can reach the detector.

2 **Q** because it has a long half-life and alpha particles are relatively safe outside the body.

3 **R** because it has a short half-life and gamma rays can reach the detector.

4 **S** because it has a short half-life and beta particles can reach the detector.

6D Trees contain the radioactive isotope carbon-14. After a tree has been chopped down, the count rate from the carbon-14 it contains gradually decreases. By measuring the count rate and knowing the half-life of the isotope, the age of the dead wood can be estimated.

Which isotope could be used to estimate the age of a wooden box thought to be about 18000 years old?

1 **P** because its half-life is 6000 years so the box has existed for 3 half-lives.

2 **Q** because its half-life is 400 years so the box has existed for 45 half-lives.

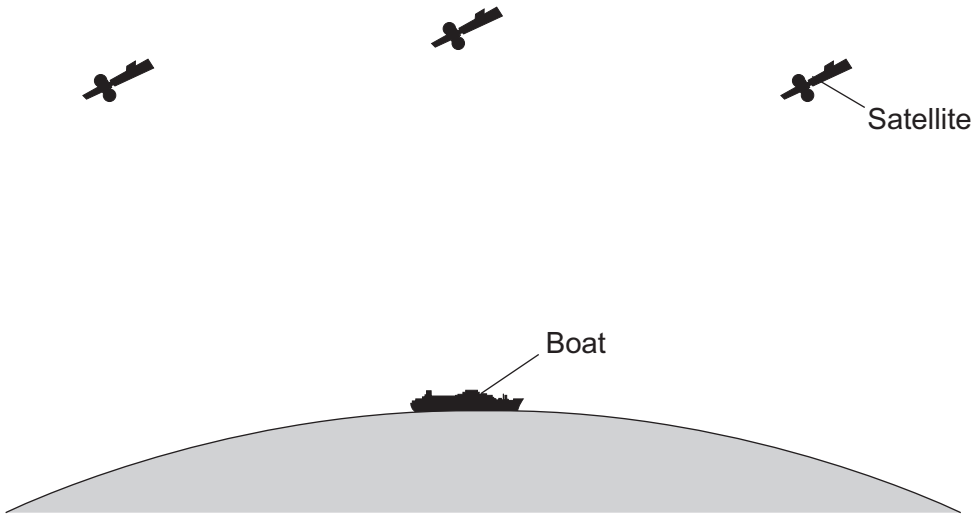
3 **R** because its half-life is 6 hours so it is safe to do the estimation.

4 **S** because its half-life is 30 seconds and this is enough time to do the estimation.

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QUESTION SEVEN

Geostationary satellites can be used for navigation. These satellites stay in the same position above the Earth as the Earth spins on its axis. For navigation, the signals from three satellites are needed.



7A Electromagnetic radiation is used to communicate with the satellites.

Here are two statements about electromagnetic radiation.

X All electromagnetic radiation travels as waves.

Y All electromagnetic radiation travels at the same speed through space.

Which statements are correct?

1 **X** only

2 **Y** only

3 both **X** and **Y**

4 neither **X** nor **Y**

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7B What effect will signals from the satellite have on the metal aerial on the boat?

1 heat up the metal and destroy some of its atoms

2 heat up the metal and set up an alternating electric current

3 produce microwaves which carry the information to be displayed

4 produce microwaves which set up an alternating electric current

7C The electromagnetic radiation used has a speed of 300 000 000 m/s and a wavelength of 20 cm.

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

What is its frequency?

1 15 000 000 Hz

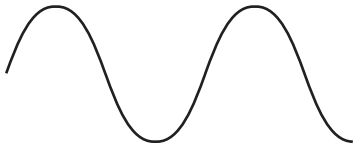
2 60 000 000 Hz

3 1 500 000 000 Hz

4 6 000 000 000 Hz

7D Which of these signals could a computer process easily?

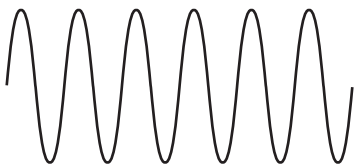
1



2



3



4



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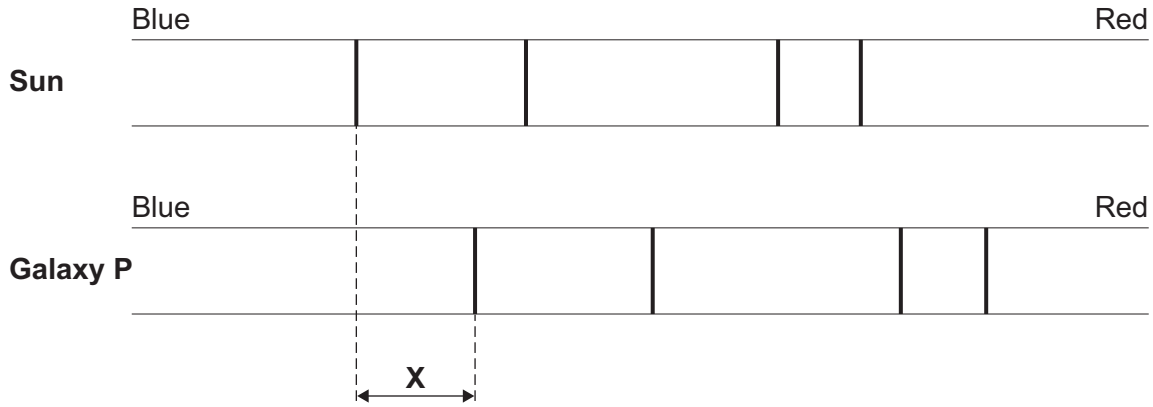
QUESTION EIGHT

The visible part of the electromagnetic spectrum from a galaxy includes dark lines. These lines are at specific wavelengths.

The diagrams show the positions of the dark lines in the spectrum from the Sun and in the spectrum from a distant galaxy, **P**.

Galaxy **P** is moving away from the observer.

The dark lines in **P**'s spectrum are shown to be displaced.



8A The displacement marked **X** in the diagram is called the red-shift.

What apparent change has occurred to the speed and frequency of the light to cause red-shift?

	Speed	Frequency
1	decreased	stayed the same
2	increased	stayed the same
3	stayed the same	decreased
4	stayed the same	increased

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8B A different galaxy, **Q**, is nearer to the observer than galaxy **P** and is moving towards the observer.

The displacement in **Q**'s spectrum, compared with the displacement in **P**'s spectrum, is . . .

1 smaller and in the opposite direction.

2 bigger and in the opposite direction.

3 smaller and in the same direction.

4 bigger and in the same direction.

8C Edwin Hubble made measurements of the dark lines in the spectra from distant galaxies.

His observations led to the idea that the universe is expanding.

He observed that . . .

1 the further away the galaxy, the smaller the red-shift.

2 the further away the galaxy, the bigger the red-shift.

3 the most distant galaxies show a blue-shift.

4 the red-shift does not change with distance.

8D Scientists are interested in how the universe began.

Which one of the following statements is correct?

1 We now definitely know that the universe began with a 'big bang'.

2 There is no evidence about how the universe began.

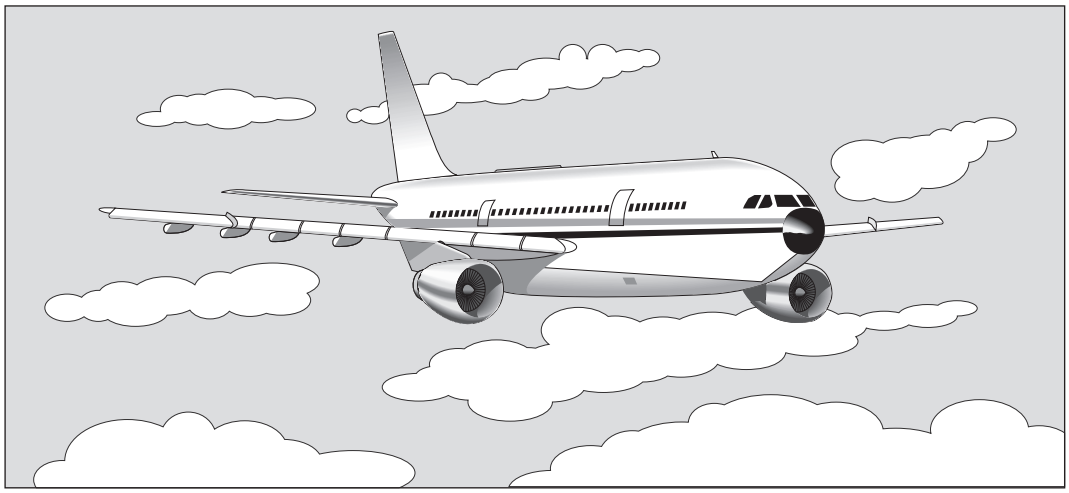
3 The evidence we have now suggests that the universe began at a small point.

4 We now know that the galaxies will continue to get further apart.

Turn over for the next question

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QUESTION NINE



Everyone is exposed to some nuclear radiation.

Cabin crews are exposed to extra nuclear radiation because they spend lots of time at high altitudes. The doses they receive can be measured in millisieverts (mSv).

The average dose of extra nuclear radiation for a member of the cabin crew is 2 mSv per year.
A pregnant member of the cabin crew will be given a work programme to avoid a total dose higher than 1 mSv per year.

Here is a table of doses per flight from London to different destinations.

Destination	Flight time (h)	Dose (mSv)
Kiev	4	0.020
Los Angeles	13	0.065
Madrid	2	0.010
New York	7	0.035
Paris	1	0.005
Rome	3	0.015
Tokyo	14	0.070

9A To be able to compare the flight data, it must have been collected under controlled conditions.

Which is the most important factor to control?

1 air temperature

2 altitude

3 wind speed

4 colour of the aircraft

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9B The flight time from London to Dallas is 10 hours.

The most likely dose of radiation a member of the cabin crew receives on this flight is . . .

1 0.040 mSv

2 0.045 mSv

3 0.050 mSv

4 0.060 mSv

9C The data in the table shows that . . .

1 the dose is directly proportional to the flight time.

2 the dose is inversely proportional to the flight time.

3 the longer the flight, the lower the dose.

4 the shorter the flight, the higher the dose.

9D How many times can a pregnant member of the cabin crew fly from London to Madrid and back before she has received the maximum permitted dose of radiation?

1 20 times

2 40 times

3 50 times

4 100 times

END OF TEST

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There are no questions printed on this page

There are no questions printed on this page

There are no questions printed on this page

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GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2012 Examination – November Series

The blank answer sheet for this component can be found at the end of this document.

This component is an objective test for which the following list indicates the correct answers used in marking the students' responses.

Further copies of this Mark Scheme are available to download from aqa.org.uk

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

November 2012

Foundation Tier

Question	Key		
One	**A**	infra red	**3**
	B	radio waves	**4**
	C	ultraviolet	**2**
	D	visible light	**1**
Two	**A**	gamma only	**3**
	B	gamma and beta only	**2**
	C	gamma, beta and alpha	**1**
	D	no radiation	**4**
Three	**A**	microwaves	**4**
	B	radio waves	**2**
	C	visible light	**1**
	D	X-rays	**3**
Four	**A**	categoric	**2**
	B	control	**1**
	C	dependent	**3**
	D	reliable	**4**
Five	**A**	11	**1**
	B	33	**3**
	C	44	**2**
	D	84	**4**

	A	**B**	**C**	**D**
Six	**2**	**2**	**1**	**2**
Seven	**3**	**1**	**1**	**1**
Eight	**3**	**2**	**3**	**3**
Nine	**4**	**3**	**4**	**2**

GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

November 2012

Higher Tier

Question	Key		
One	**A** 11		**1**
	B 33		**3**
	C 44		**2**
	D 84		**4**
Two	**A** alpha		**4**
	B beta		**2**
	C gamma		**3**
	D alpha, beta and gamma		**1**

	A	B	C	D
Three	**3**	**2**	**3**	**3**
Four	**4**	**3**	**4**	**2**
Five	**4**	**4**	**1**	**4**
Six	**1**	**3**	**3**	**1**
Seven	**3**	**2**	**3**	**2**
Eight	**3**	**1**	**2**	**3**
Nine	**2**	**3**	**1**	**3**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

OTQ3

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : BG12

06-NOV-12

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions ONE to NINE Choose one response 1 - 4 for each of the parts A - D

QUESTION ONE		1	2	3	4
1A	11	○	○	○	○
1B	33	○	○	○	○
1C	44	○	○	○	○
1D	84	○	○	○	○

QUESTION TWO		1	2	3	4
2A	alpha	○	○	○	○
2B	beta	○	○	○	○
2C	gamma	○	○	○	○
2D	alpha, beta and gamma	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE	1	2	3	4
1A infra red	○	○	○	○
1B radio waves	○	○	○	○
1C ultraviolet	○	○	○	○
1D visible light	○	○	○	○

QUESTION TWO	1	2	3	4
2A gamma only	○	○	○	○
2B gamma and beta only	○	○	○	○
2C gamma, beta and alpha	○	○	○	○
2D no radiation	○	○	○	○

QUESTION THREE	1	2	3	4
3A microwaves	○	○	○	○
3B radio waves	○	○	○	○
3C visible light	○	○	○	○
3D X-rays	○	○	○	○

QUESTION FOUR	1	2	3	4
4A categoric	○	○	○	○
4B control	○	○	○	○
4C dependent	○	○	○	○
4D reliable	○	○	○	○

QUESTION FIVE	1	2	3	4
5A 11	○	○	○	○
5B 33	○	○	○	○
5C 44	○	○	○	○
5D 84	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Friday 22 June 2012 Afternoon Session

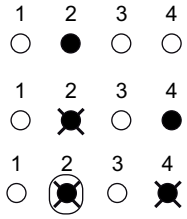
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 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

Some types of radiation are more penetrating than other types.

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

A alpha

B beta

C gamma

D X-rays

	Penetrating power
1	stopped by a thin sheet of paper
2	passes through a sheet of paper but stopped by aluminium
3	stopped by bone but not by flesh
4	only stopped by many centimetres of lead

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QUESTION TWO

Nuclear radiation and electromagnetic radiation have many different uses.

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

A alpha

B gamma

C infra red

D ultraviolet

	Use
1	in smoke detectors
2	for heat-sensitive photography
3	in sunbeds
4	for sterilising medical equipment

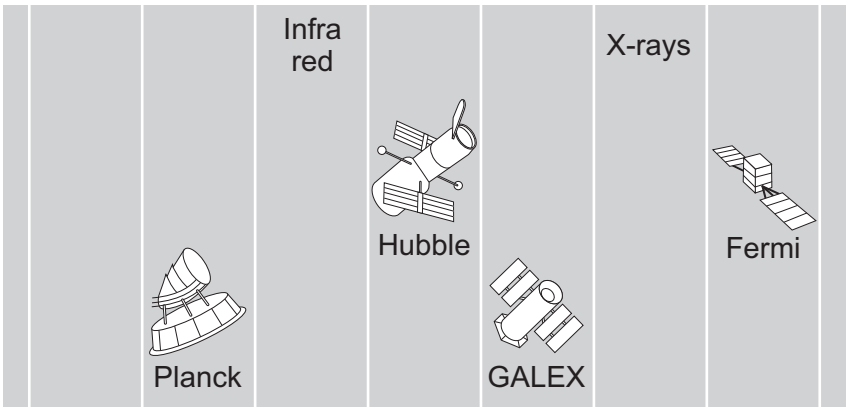
Turn over for the next question

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QUESTION THREE

Different 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 telescope is designed to detect.

A Fermi

B GALEX

C Hubble

D Planck

	Type of electromagnetic radiation
1	gamma radiation
2	microwave
3	ultraviolet
4	visible light

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QUESTION FOUR

Read this extract from a magazine article.

X-rays and health

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

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

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

A conclusion

B confidentiality

C control

D evidence

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

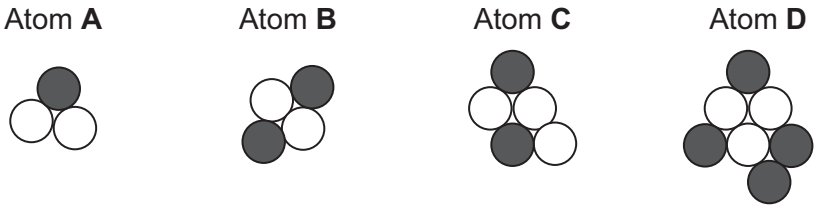
The data in the health records is the . . . **2** . . . .

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

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

QUESTION FIVE

The diagram shows the nuclei of four different atoms, **A**, **B**, **C** and **D**. The protons and neutrons are shaded differently.



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

1	The nucleus contains one neutron.
2	The nucleus contains four neutrons.
3	The nucleus is the same as an alpha particle.
4	The atom is an isotope of atom **D**.

Turn over ▶

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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 report on the safety of mobile phones was published. It suggested that people who use a mobile phone for an hour every day are twice as likely to get brain cancer as people who do not use a mobile phone.

6A Which type of electromagnetic radiation is used to send messages between mobile phones?

1 gamma rays

2 microwaves

3 ultraviolet rays

4 visible light

6B A student, concerned about brain cancer, read some other reports on the safety of mobile phones.

The most reliable reports on the safety of mobile phones will be produced by . . .

1 advertising companies.

2 other students of his age.

3 independent scientists.

4 mobile phone makers.

6C Mobile phones use digital signals rather than analogue signals.

Which row in the table correctly describes the two types of signal?

	Analogue	Digital
1	Easily processed by computers	Less prone to interference
2	Not easily processed by computers	More prone to interference
3	Less prone to interference	Not easily processed by computers
4	More prone to interference	Easily processed by computers

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6D In the UK, mobile phone companies use three different frequencies.

Frequency	900 MHz	1800 MHz	2100 MHz
Name used for frequency	GSM 900	GSM 1800	IMT 2000

What physical property is shared by all three frequencies?

1 They have the same wavelength.

2 They have the same speed in a vacuum.

3 Their name shows the frequency.

4 They cannot travel through a vacuum.

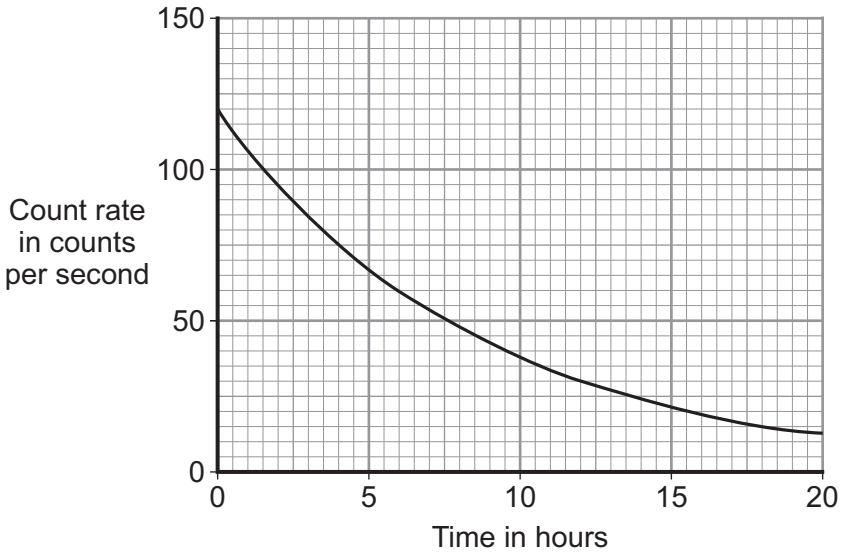
Turn over for the next question

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QUESTION SEVEN

Technetium-99 is a radioactive isotope. A scientist investigated how the count rate of technetium-99 changes with time.

The graph shows her results.



7A Which row in the table correctly describes the variables in the investigation?

	Count rate	Time
1	control	independent
2	control	dependent
3	dependent	independent
4	independent	dependent

7B The results have been displayed as a line graph because both variables are . . .

1 categoric variables.

2 continuous variables.

3 control variables.

4 dependent variables.

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7C After three hours the count rate of the technetium-99 is . . .

1 70

2 80

3 85

4 90

7D The half-life of the technetium-99 is . . .

1 6.0 hours.

2 7.5 hours.

3 9.0 hours.

4 18.0 hours.

Turn over for the next question

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QUESTION EIGHT

This question is about electromagnetic waves.

8A Which type of electromagnetic wave is used in a handheld remote control for a television?

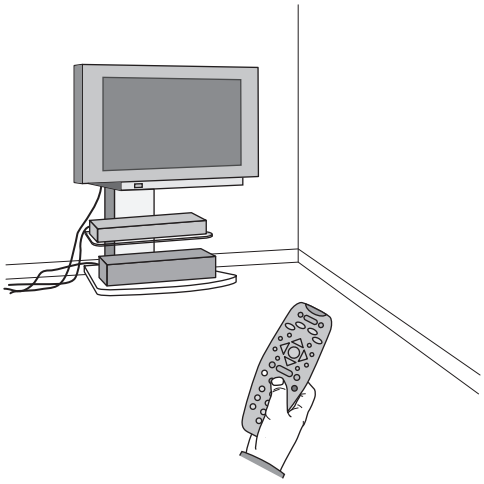
1 infra red

2 radio

3 visible light

4 X-rays

8B The diagram shows a handheld remote control unit being used to change a television channel. The unit is pointing at a surface and not directly at the television.



The signal from the remote control unit reaches the television because the surface . . .

1 absorbs the signal.

2 refracts the signal.

3 reflects the signal.

4 transmits the signal.

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8C Television signals can be transmitted using cable networks. These networks usually contain optical fibres.

Which of the following two types of electromagnetic radiation can be transmitted through optical fibres?

1 infra red and microwaves

2 infra red and visible light

3 radio waves and microwaves

4 visible light and radio waves

8D The behaviour of waves is often demonstrated using waves on water. In one demonstration, waves of wavelength 5 cm were produced by a vibrating piece of wood. The frequency of the waves was 10 Hz.

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

What was the wave speed, in m/s?

1 0.5

2 2.0

3 15.0

4 50.0

Turn over for the next question

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QUESTION NINE

Early in the twentieth century, astronomers first observed an apparent change in wavelength of light from distant galaxies. This observation led to the suggestion that the universe began with an explosion.

It was then predicted that if the universe began with an explosion there should be background microwave radiation in space, left over from the explosion.

Background microwave radiation from space was discovered in 1964.

9A What is the apparent change in wavelength of light from distant galaxies?

1 an increase in the wavelength caused by a galaxy moving away from the Earth

2 an increase in the wavelength caused by a galaxy moving towards the Earth

3 a decrease in the wavelength caused by a galaxy being a long way from the Earth

4 a decrease in the wavelength caused by a galaxy moving away from the Earth

9B The suggestion that the universe began with an explosion is called . . .

1 a fact.

2 an investigation.

3 an observation.

4 a theory.

9C Compared to visible light, microwave radiation has . . .

1 the same wavelength and a lower frequency.

2 a longer wavelength and a lower frequency.

3 a shorter wavelength and the same frequency.

4 a shorter wavelength and a higher frequency.

9D The discovery of background microwave radiation from space . . .

1 proves that the universe is expanding.

2 proves that the universe began with an explosion.

3 does not support the suggestion that the universe is expanding.

4 supports the suggestion that the universe began with an explosion.

END OF TEST

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There are no questions on this page

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**.

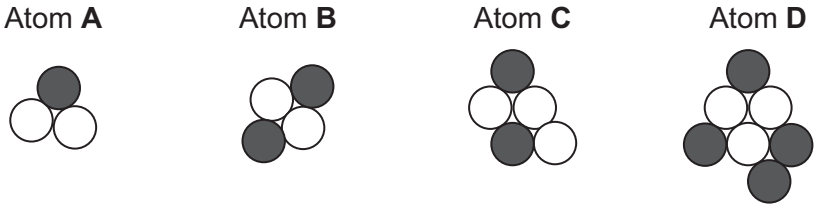
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows the nuclei of four different atoms, **A**, **B**, **C** and **D**. The protons and neutrons are shaded differently.



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

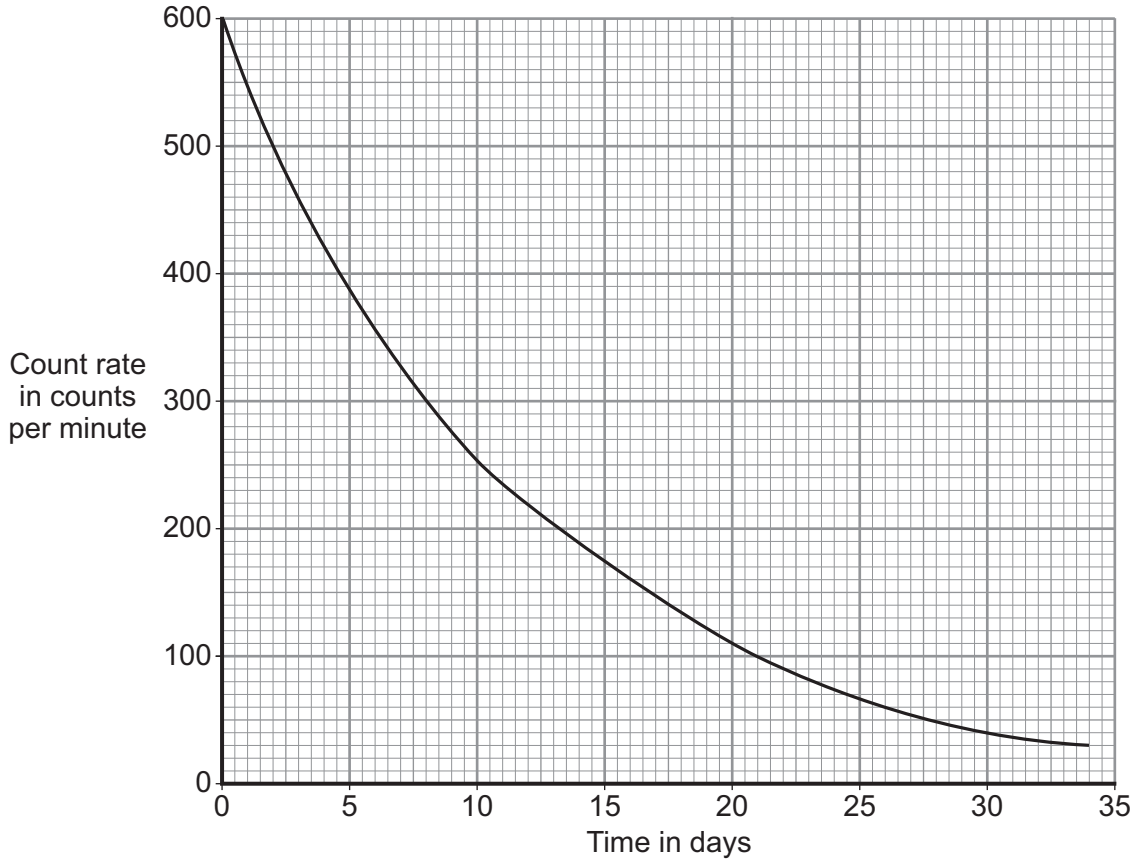
1	The nucleus contains one neutron.
2	The nucleus contains four neutrons.
3	The nucleus is the same as an alpha particle.
4	The atom is an isotope of atom **D**.

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QUESTION TWO

Iodine-131 is a radioactive isotope. It is used in hospitals.

The graph shows how the count rate of a sample of iodine-131 changes with time.



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

A 3

B 8

C 21

D 252

The count rate after 10 days is . . . **1** . . . counts per minute.

The time taken for the count rate to fall from 600 to 100 counts per minute is . . . **2** . . . days.

The half-life of the iodine-131 is . . . **3** . . . days.

A patient is given 32 mg of iodine-131. This will decay to 4 mg in . . . **4** . . . half-lives.

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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

This question is about electromagnetic waves.

3A Which type of electromagnetic wave is used in a handheld remote control for a television?

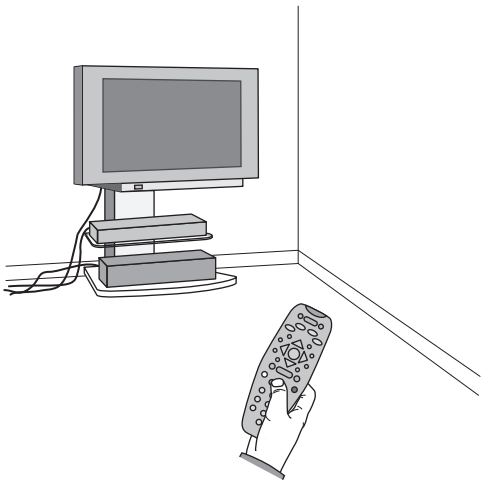
1 infra red

2 radio

3 visible light

4 X-rays

3B The diagram shows a handheld remote control unit being used to change a television channel. The unit is pointing at a surface and not directly at the television.



The signal from the remote control unit reaches the television because the surface . . .

1 absorbs the signal.

2 refracts the signal.

3 reflects the signal.

4 transmits the signal.

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3C Television signals can be transmitted using cable networks. These networks usually contain optical fibres.

Which of the following two types of electromagnetic radiation can be transmitted through optical fibres?

1 infra red and microwaves

2 infra red and visible light

3 radio waves and microwaves

4 visible light and radio waves

3D The behaviour of waves is often demonstrated using waves on water. In one demonstration, waves of wavelength 5 cm were produced by a vibrating piece of wood. The frequency of the waves was 10 Hz.

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

What was the wave speed, in m/s?

1 0.5

2 2.0

3 15.0

4 50.0

Turn over for the next question

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QUESTION FOUR

Early in the twentieth century, astronomers first observed an apparent change in wavelength of light from distant galaxies. This observation led to the suggestion that the universe began with an explosion.

It was then predicted that if the universe began with an explosion there should be background microwave radiation in space, left over from the explosion.

Background microwave radiation from space was discovered in 1964.

4A What is the apparent change in wavelength of light from distant galaxies?

1 an increase in the wavelength caused by a galaxy moving away from the Earth

2 an increase in the wavelength caused by a galaxy moving towards the Earth

3 a decrease in the wavelength caused by a galaxy being a long way from the Earth

4 a decrease in the wavelength caused by a galaxy moving away from the Earth

4B The suggestion that the universe began with an explosion is called . . .

1 a fact.

2 an investigation.

3 an observation.

4 a theory.

4C Compared to visible light, microwave radiation has . . .

1 the same wavelength and a lower frequency.

2 a longer wavelength and a lower frequency.

3 a shorter wavelength and the same frequency.

4 a shorter wavelength and a higher frequency.

4D The discovery of background microwave radiation from space . . .

1 proves that the universe is expanding.

2 proves that the universe began with an explosion.

3 does not support the suggestion that the universe is expanding.

4 supports the suggestion that the universe began with an explosion.

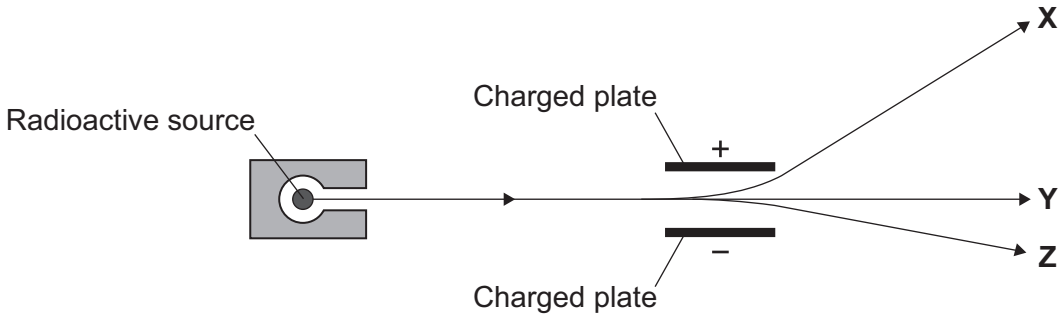
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Turn over for the next question

QUESTION FIVE

A radioactive source emits alpha, beta and gamma radiation.

The diagram shows the radiation passing through a powerful electric field.



5A Compared to **X**, which row in the table shows the charges on **Y** and **Z**?

	Y	**Z**
1	no charge	opposite
2	no charge	same
3	opposite	no charge
4	same	no charge

5B Which row of the table correctly identifies the radiations **X**, **Y** and **Z**?

	X	**Y**	**Z**
1	alpha	beta	gamma
2	beta	gamma	alpha
3	beta	alpha	gamma
4	alpha	gamma	beta

5C **X** is deflected more than **Z** because **X** has . . .

1 a higher charge than **Z**.

2 a higher mass than **Z**.

3 a lower charge than **Z**.

4 a lower mass than **Z**.

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5D Which row in the table shows the correct order of ionising power?

	Least ionising	→	**Most ionising**
1	alpha	beta	gamma
2	gamma	alpha	beta
3	beta	alpha	gamma
4	gamma	beta	alpha

Turn over for the next question

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QUESTION SIX

When the James Webb space telescope (JWST) is launched, it will orbit the Earth at a distance of about 1.5 million kilometres.

It will detect wavelengths from 0.6 to 27 micrometres.

One micrometre = one millionth of a metre

The diagram shows part of the electromagnetic spectrum with some typical wavelengths.

Ultra violet	Violet	Indigo	Blue	Green	Yellow	Orange	Red	Infra red
0.10	0.40	0.45	0.48	0.51	0.57	0.59	0.65	50.0

Typical wavelengths in micrometres

6A Which two regions of the electromagnetic spectrum is the JWST designed to detect?

1 blue and indigo

2 green and yellow

3 red and infra red

4 violet and ultraviolet

6B Which one of the following is **not** an advantage of the JWST being in such a high orbit?

1 Experiencing less gravity means that maintenance will be easier.

2 Heat from the Earth does not interfere with its detectors.

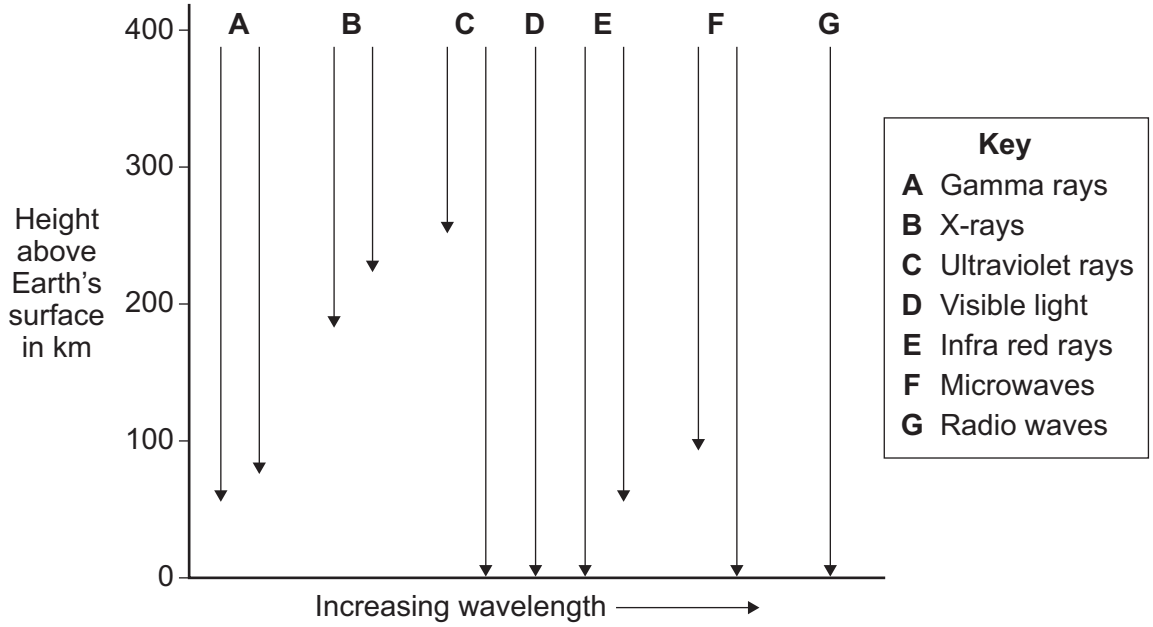
3 Radiation received is not distorted by the Earth's atmosphere.

4 Wavelengths, which are absorbed by the Earth's atmosphere, can be detected.

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6C The diagram shows how far different electromagnetic waves from space penetrate the Earth's atmosphere.

Where two arrows are shown for a type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



For which of the following types of radiation do all wavelengths reach the Earth's surface?

1 infra red and radio

2 ultraviolet and X-rays

3 visible and radio

4 visible and X-ray

6D What is the minimum height for a telescope which detects all wavelengths of ultraviolet radiation and X-rays?

1 75 km

2 180 km

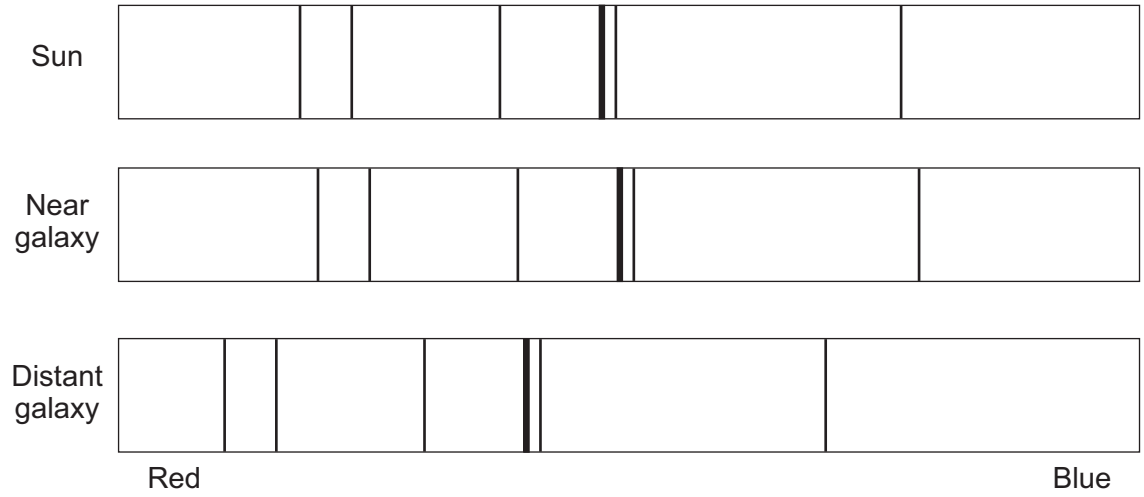
3 230 km

4 250 km

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QUESTION SEVEN

The diagrams show the spectra of light observed from two galaxies, compared with light from the Sun.



7A How do these diagrams show that red-shift has occurred in the light from the distant galaxy?

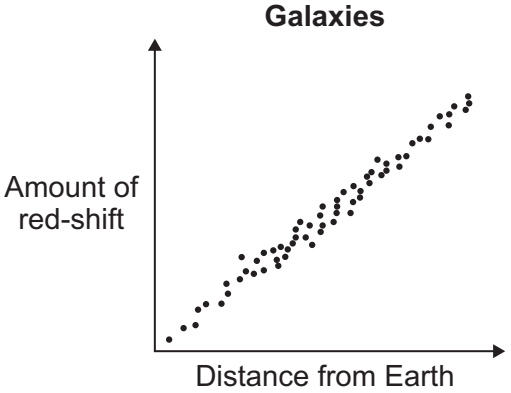
1 There is more red light in the spectrum from the near galaxy.

2 There are more dark lines in the spectrum from the distant galaxy.

3 The dark lines in the spectrum from the distant galaxy have moved towards the red end.

4 The dark lines in the spectrum from the near galaxy have moved towards the blue end.

7B The scattergram shows how the amount of red-shift is related to the distance from Earth for galaxies.



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What conclusion could be made from the scattergram about the relationship between the amount of red-shift and the distance from Earth?

1 The amount of red-shift is inversely proportional to the distance from Earth.

2 The amount of red-shift is directly proportional to the distance from Earth.

3 Red-shift and distance from Earth are unrelated.

4 There is insufficient evidence to draw a conclusion.

7C Evidence from red-shift has led scientists to develop the 'Big Bang' theory.

What does the 'Big Bang' theory state?

1 The universe will end with a big bang.

2 The universe has expanded and then contracted since it was first formed.

3 The universe was created by a massive explosion of material.

4 The universe began from a very small initial point.

7D If some scientists discover evidence in the future that does not agree with the 'Big Bang' theory, what should they do?

1 completely reject the theory

2 ignore the new evidence

3 check the new evidence

4 alter the new evidence to match the old theory

Turn over for the next question

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QUESTION EIGHT

Television signals are now digital and not analogue.

8A Which row in the table correctly describes the two types of signal?

	Analogue	Digital
1	signal varies continuously and can be processed easily by computers	signal is ON/OFF and cannot be processed easily by computers
2	signal is ON/OFF and cannot be processed easily by computers	signal varies continuously and can be processed easily by computers
3	signal varies continuously and cannot be processed easily by computers	signal is ON/OFF and can be processed easily by computers
4	signal is ON/OFF and can be processed easily by computers	signal varies continuously and cannot be processed easily by computers

8B Many people bought new digital televisions to replace their old analogue televisions. Other people spent less money by buying a signal converter which lets them continue to use their analogue television. The old analogue televisions must be disposed of.

Buying new digital televisions rather than signal converters raises . . .

1 economic and political issues.

2 economic and environmental issues.

3 environmental and ethical issues.

4 ethical and political issues.

8C Microwaves are used for communication in satellite television networks and in digital mobile phone networks.

Which row in the table correctly explains the reasons?

	Why microwaves?	Why digital and not analogue?
1	can be converted to digital	carry more energy
2	can be converted to digital	experience less interference
3	can pass through the atmosphere	carry more energy
4	can pass through the atmosphere	experience less interference

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8D Some microwaves have a frequency of 3000 MHz. Electromagnetic waves travel at 300 000 km/s.

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

1MHz = 1 million hertz

What is the wavelength of these microwaves?

1 10 cm

2 10 m

3 100 m

4 1 km

Turn over for the next question

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QUESTION NINE

This question is about radioactive isotopes technetium-99 (Tc-99) and lanthanum-142 (La-142).

The isotope Tc-99 has a half-life of 6 hours.

9A What fraction of Tc-99 will have decayed after 18 hours?

1 $\frac{1}{8}$

2 $\frac{1}{3}$

3 $\frac{2}{3}$

4 $\frac{7}{8}$

9B Depending on the type of radiation it emits, for which of the following applications might the radioactive isotope Tc-99 be suitable?

1 implanting close to a cancerous growth for several months

2 fitting inside smoke alarms

3 determining the date of an ancient wooden box

4 tracing the flow of blood through the body

9C The isotope La-142 emits beta particles and has a half-life of 1.5 hours.

Beta particles are . . .

1 electrons emitted from the nuclei of atoms.

2 part of the electromagnetic spectrum.

3 nuclei of helium atoms.

4 electrons from outside the nuclei of atoms.

9D The count rate of a sample of La-142 is measured. The count rate is 8000 counts per second.

The count rate of this isotope, 3 hours before the experiment began, was . . .

1 8000 counts per second.

2 16000 counts per second.

3 24000 counts per second.

4 32000 counts per second.

END OF TEST

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GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2012 Examination – June Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the students' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

June 2012

Foundation Tier

Question	Key		
One	**A**	alpha	**1**
	B	beta	**2**
	C	gamma	**4**
	D	X-rays	**3**
Two	**A**	alpha	**1**
	B	gamma	**4**
	C	infra red	**2**
	D	ultraviolet	**3**
Three	**A**	Fermi	**1**
	B	GALEX	**3**
	C	Hubble	**4**
	D	Planck	**2**
Four	**A**	conclusion	**3**
	B	confidentiality	**4**
	C	control	**1**
	D	evidence	**2**
Five	**A**	Atom **A**	**1**
	B	Atom **B**	**3**
	C	Atom **C**	**4**
	D	Atom **D**	**2**

	A	**B**	**C**	**D**
Six	**2**	**3**	**4**	**2**
Seven	**3**	**2**	**3**	**1**
Eight	**1**	**3**	**2**	**1**
Nine	**1**	**4**	**2**	**4**

GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

June 2012

Higher Tier

Question	Key		
One	**A**	Atom **A**	**1**
	B	Atom **B**	**3**
	C	Atom **C**	**4**
	D	Atom **D**	**2**
Two	**A**	3	**4**
	B	8	**3**
	C	21	**2**
	D	252	**1**

	A	B	C	D
Three	**1**	**3**	**2**	**1**
Four	**1**	**4**	**2**	**4**
Five	**1**	**2**	**4**	**4**
Six	**3**	**1**	**3**	**4**
Seven	**3**	**2**	**4**	**3**
Eight	**3**	**2**	**4**	**1**
Nine	**4**	**4**	**1**	**4**

OTQ3

GCSE SCIENCE

AQA

Unit : PHY1BP **PHYSICS UNIT 1B**

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 6M12

22-JUN-12

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	Atom A	○	○	○	○
1B	Atom B	○	○	○	○
1C	Atom C	○	○	○	○
1D	Atom D	○	○	○	○

QUESTION TWO		1	2	3	4
2A	3	○	○	○	○
2B	8	○	○	○	○
2C	21	○	○	○	○
2D	252	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	alpha	○	○	○	○
1B	beta	○	○	○	○
1C	gamma	○	○	○	○
1D	X-rays	○	○	○	○

QUESTION TWO		1	2	3	4
2A	alpha	○	○	○	○
2B	gamma	○	○	○	○
2C	infra red	○	○	○	○
2D	ultraviolet	○	○	○	○

QUESTION THREE		1	2	3	4
3A	Fermi	○	○	○	○
3B	GALEX	○	○	○	○
3C	Hubble	○	○	○	○
3D	Planck	○	○	○	○

QUESTION FOUR		1	2	3	4
4A	conclusion	○	○	○	○
4B	confidentiality	○	○	○	○
4C	control	○	○	○	○
4D	evidence	○	○	○	○

QUESTION FIVE		1	2	3	4
5A	Atom A	○	○	○	○
5B	Atom B	○	○	○	○
5C	Atom C	○	○	○	○
5D	Atom D	○	○	○	○

QUESTION SIX		1	2	3	4
6A		○	○	○	○
6B		○	○	○	○
6C		○	○	○	○
6D		○	○	○	○

QUESTION SEVEN		1	2	3	4
7A		○	○	○	○
7B		○	○	○	○
7C		○	○	○	○
7D		○	○	○	○

QUESTION EIGHT		1	2	3	4
8A		○	○	○	○
8B		○	○	○	○
8C		○	○	○	○
8D		○	○	○	○

QUESTION NINE		1	2	3	4
9A		○	○	○	○
9B		○	○	○	○
9C		○	○	○	○
9D		○	○	○	○

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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

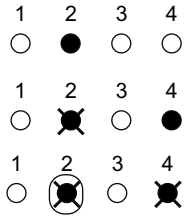
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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

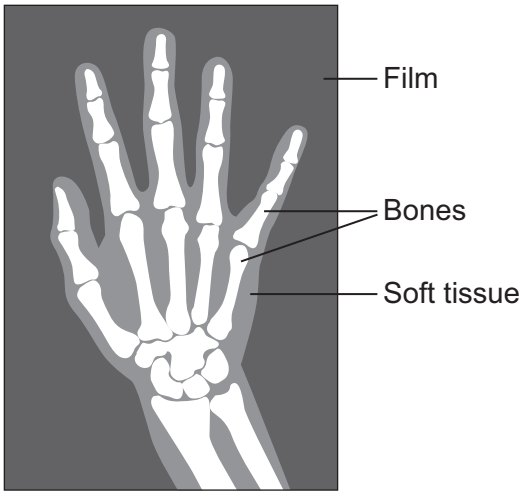
D visible light

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

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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** . . . .

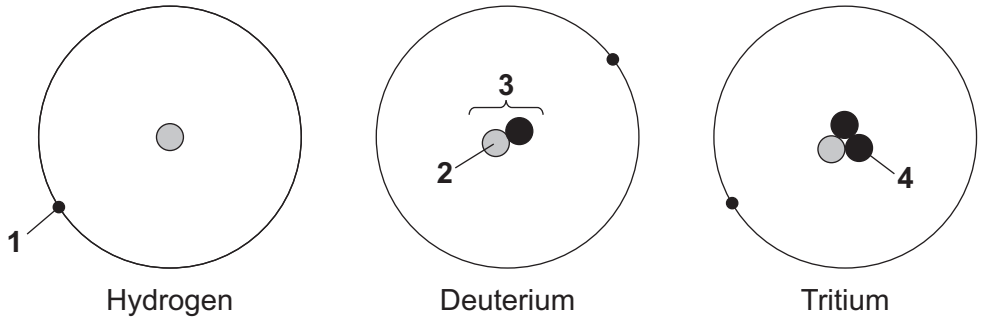
The electromagnetic radiation is absorbed by the . . . **4** . . . .

Turn over for the next question

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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

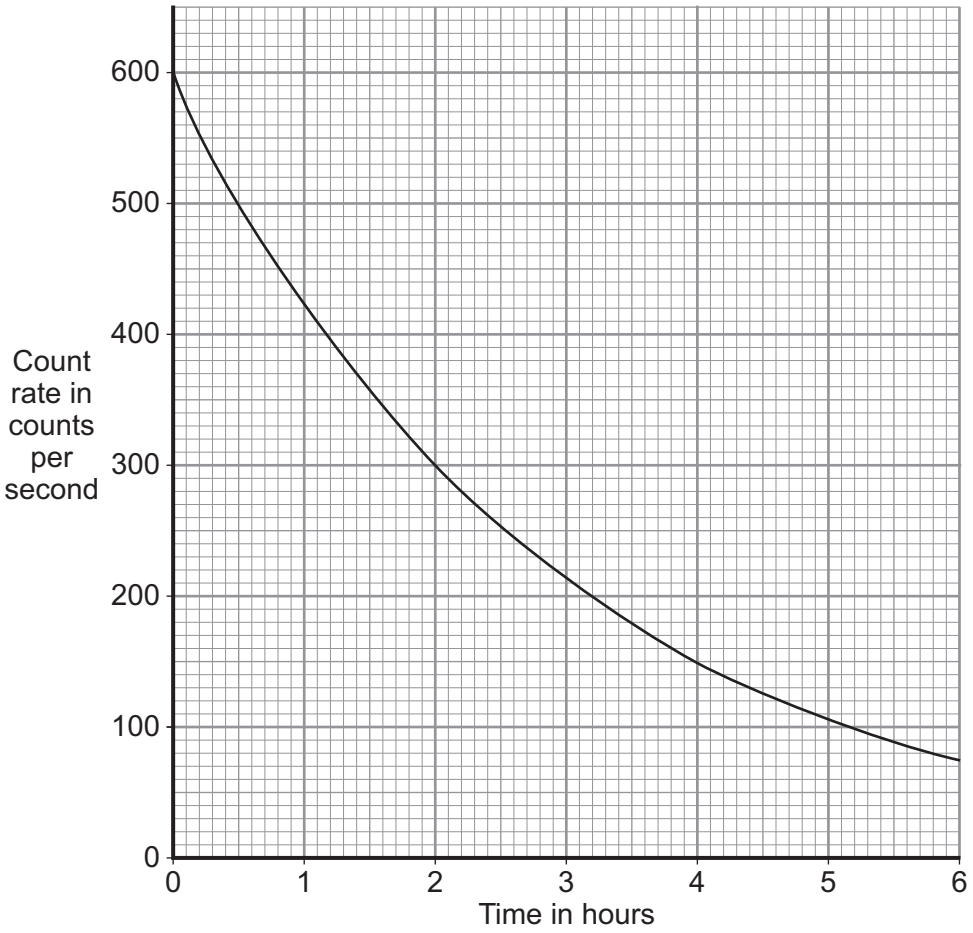
C nucleus

D proton

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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

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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

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Turn over for the next question

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Section Two

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

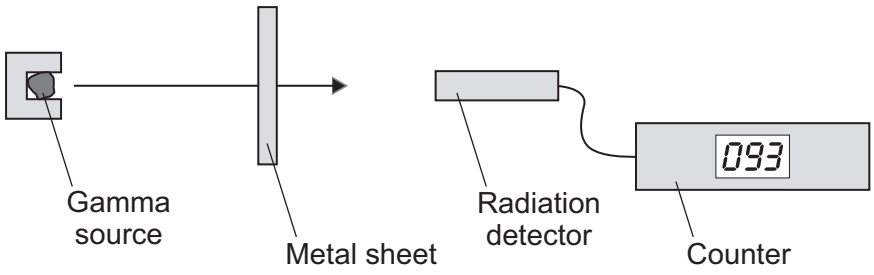
Each of these questions has four parts.

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.

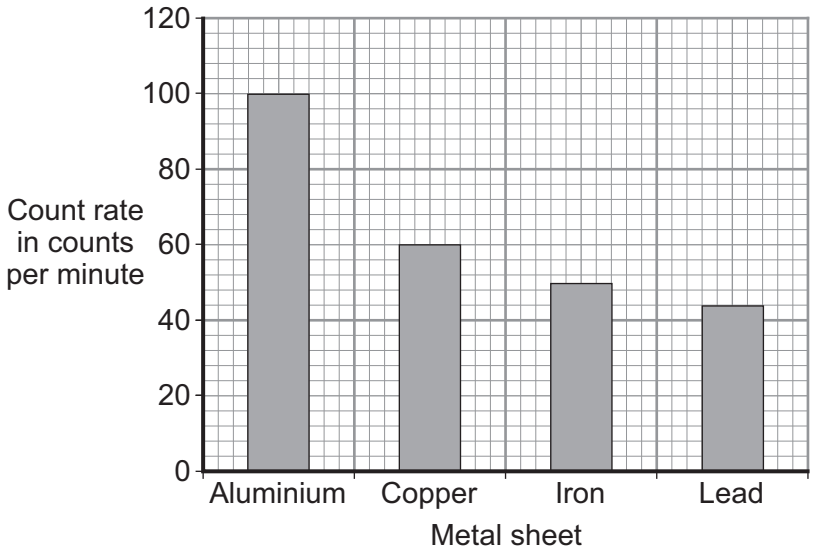
2 gamma source and the radiation detector.

3 metal sheet and the counter.

4 radiation detector and the counter.

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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.

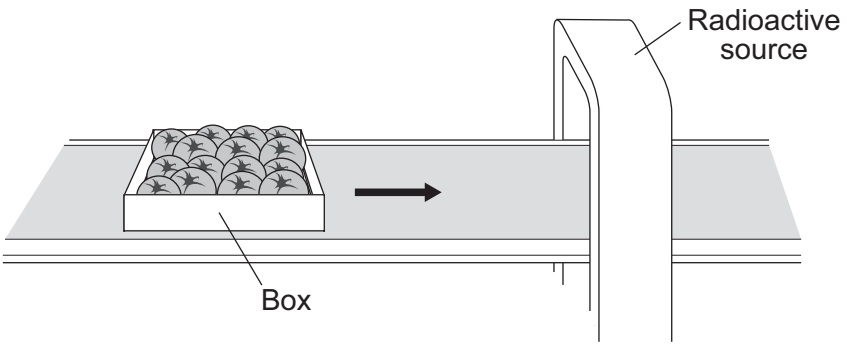
4 lead.

Turn over for the next question

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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.

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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

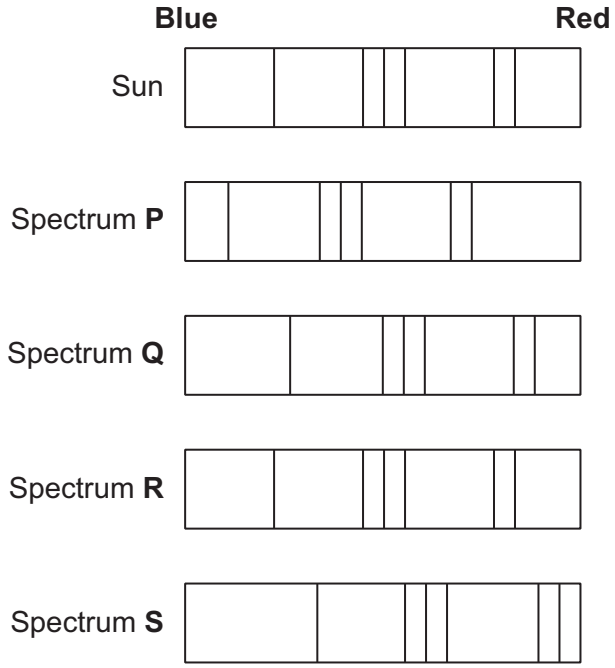
Turn over for the next question

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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.

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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

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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.

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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

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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

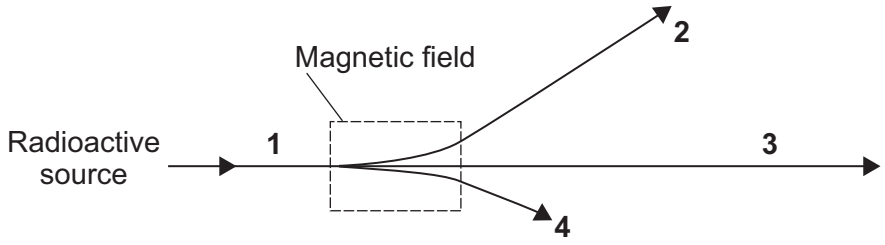
	Description
1	fast moving particle; can travel through a few metres of air before being absorbed
2	travels at the speed of light; emitted by radioactive nuclei
3	travels at the speed of light; not emitted by radioactive nuclei
4	a charged particle; can travel through only a few centimetres of air before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

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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

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Section Two

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

Each of these questions has four parts.

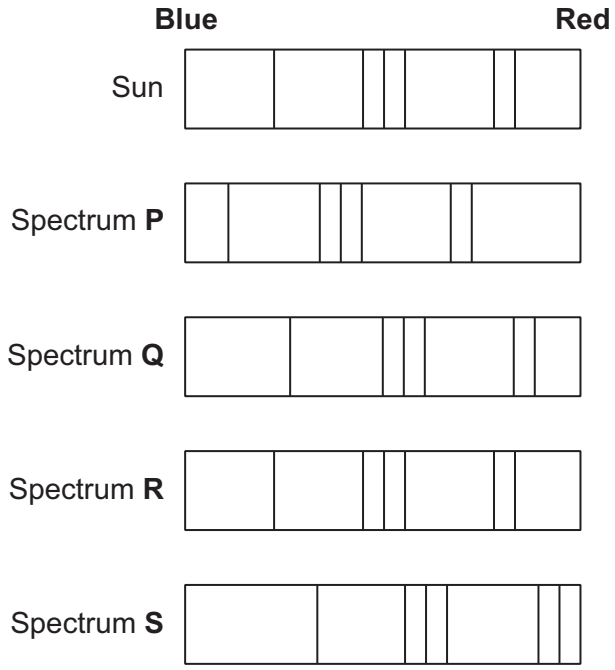
In each part choose only **one** answer.

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**

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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

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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.

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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.

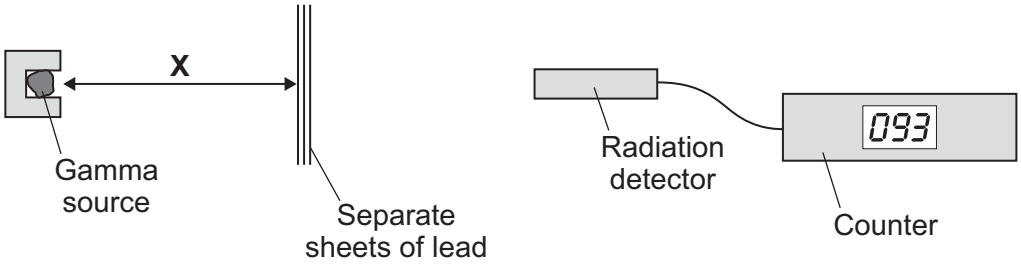
4 the larger the diameter, the longer the wavelength detected.

Turn over for the next question

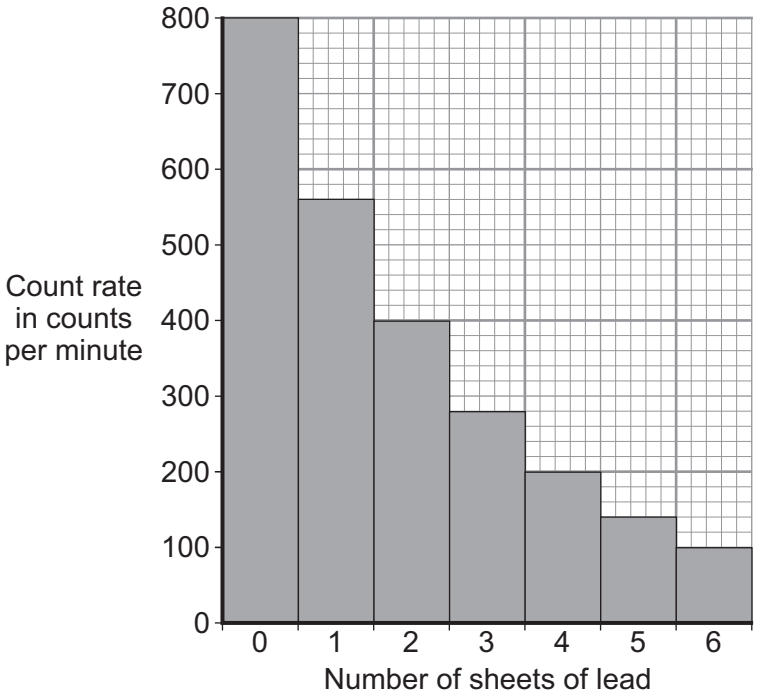
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QUESTION FIVE

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.

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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

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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.

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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.

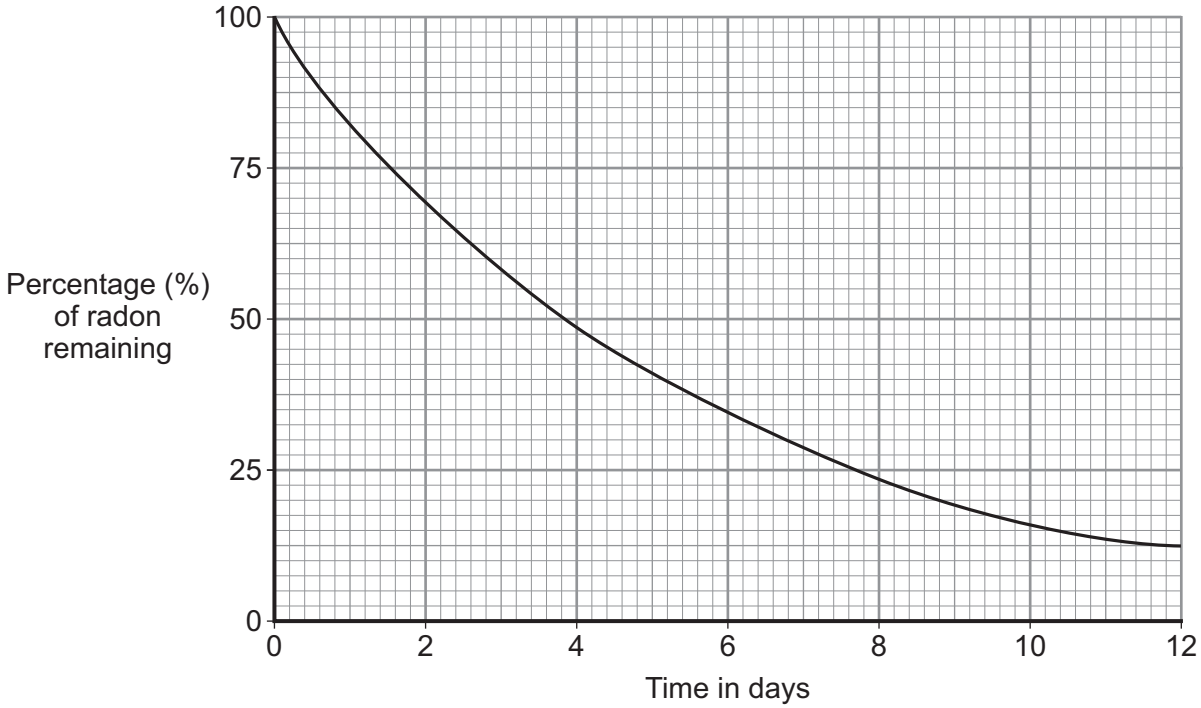
Turn over for the next question

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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

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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.

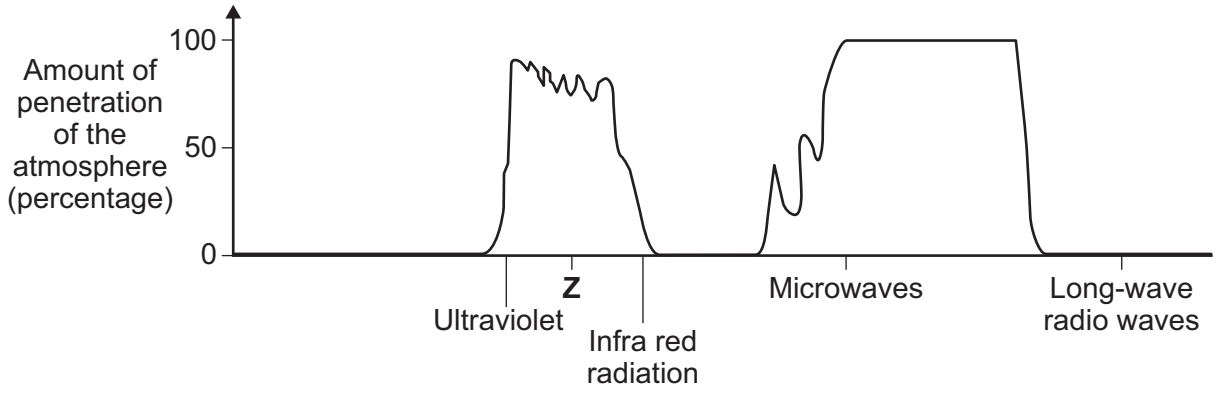
4 Because it is a gas, it can easily enter the body.

Turn over for the next question

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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.

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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

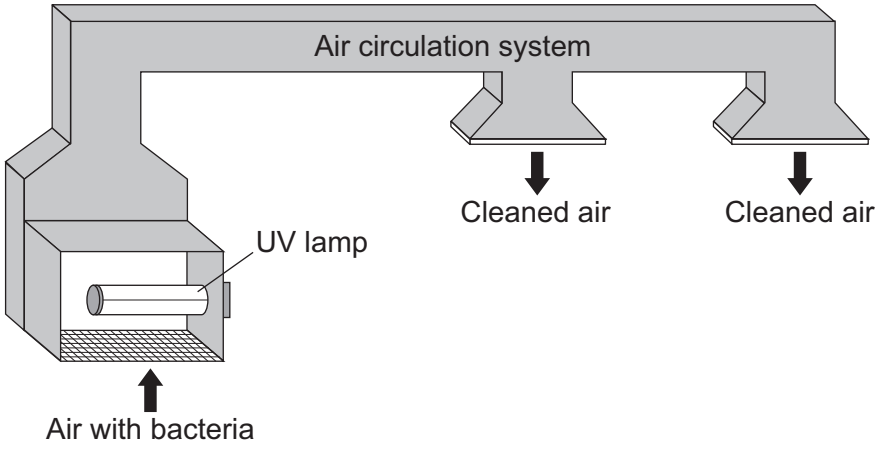
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QUESTION NINE

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?

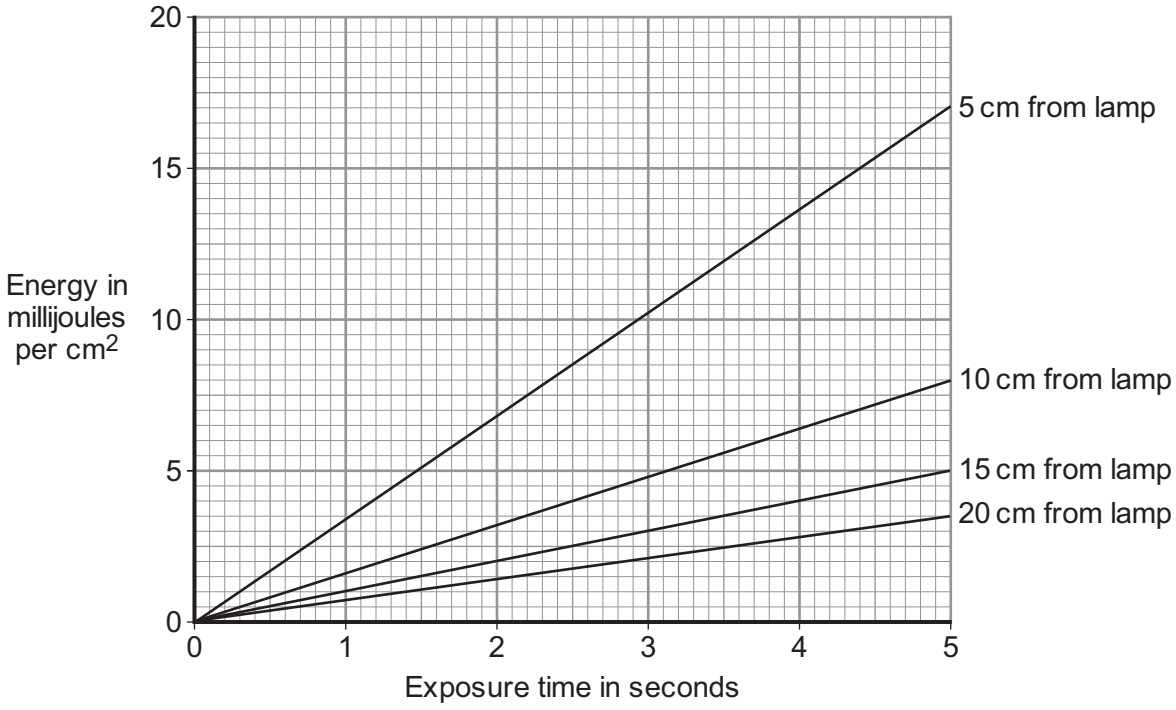
1 gamma rays

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.



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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

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GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2012 Examination – March Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the students' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE
SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2012

Foundation Tier

Question	Key		
One	**A**	infra red waves	**2**
	B	microwaves	**1**
	C	radio waves	**3**
	D	visible light	**4**
Two	**A**	bones	**4**
	B	film	**2**
	C	soft tissue	**3**
	D	X-ray tube	**1**
Three	**A**	electron	**1**
	B	neutron	**4**
	C	nucleus	**3**
	D	proton	**2**
Four	**A**	2	**4**
	B	6	**3**
	C	150	**2**
	D	600	**1**
Five	**A**	alpha	**4**
	B	beta	**1**
	C	gamma	**2**
	D	X-ray	**3**

	A	B	C	D
Six	**4**	**2**	**3**	**4**
Seven	**3**	**4**	**3**	**3**
Eight	**2**	**3**	**1**	**4**
Nine	**3**	**1**	**2**	**4**

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2012

Higher Tier

Question	Key		
One	**A**	alpha	**4**
	B	beta	**1**
	C	gamma	**2**
	D	X-ray	**3**
Two	**A**	alpha particles	**4**
	B	beta particles	**2**
	C	gamma rays	**3**
	D	alpha, beta and gamma radiation	**1**

	A	B	C	D
Three	**2**	**3**	**1**	**4**
Four	**3**	**1**	**2**	**4**
Five	**2**	**4**	**2**	**3**
Six	**1**	**3**	**4**	**3**
Seven	**1**	**3**	**1**	**4**
Eight	**4**	**2**	**2**	**4**
Nine	**1**	**3**	**2**	**4**

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OTQ3

GCSE SCIENCE

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 3G12

01-MAR-12

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	alpha	○	○	○	○
1B	beta	○	○	○	○
1C	gamma	○	○	○	○
1D	X-ray	○	○	○	○

QUESTION TWO		1	2	3	4
2A	alpha particles	○	○	○	○
2B	beta particles	○	○	○	○
2C	gamma rays	○	○	○	○
2D	alpha, beta and gamma radiation	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	infra red waves	○	○	○	○
1B	microwaves	○	○	○	○
1C	radio waves	○	○	○	○
1D	visible light	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	bones	○	○	○	○
2B	film	○	○	○	○
2C	soft tissue	○	○	○	○
2D	X-ray tube	○	○	○	○

QUESTION THREE

		1	2	3	4
3A	electron	○	○	○	○
3B	neutron	○	○	○	○
3C	nucleus	○	○	○	○
3D	proton	○	○	○	○

QUESTION FOUR

		1	2	3	4
4A	2	○	○	○	○
4B	6	○	○	○	○
4C	150	○	○	○	○
4D	600	○	○	○	○

QUESTION FIVE

		1	2	3	4
5A	alpha	○	○	○	○
5B	beta	○	○	○	○
5C	gamma	○	○	○	○
5D	X-ray	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Tuesday 15 November 2011 Morning Session

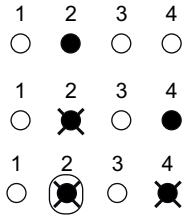
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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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

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** . . . .

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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

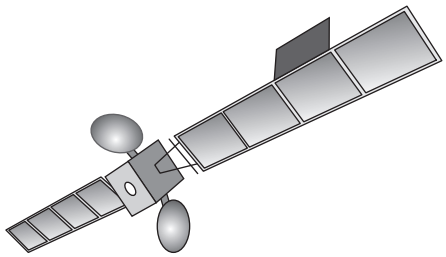
1	an electromagnetic wave emitted from the nucleus of an atom
2	an electron from the nucleus of an atom
3	absorbed by bone but not absorbed by soft tissue
4	very good at ionising the atoms of a gas

Turn over for the next question

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QUESTION THREE

The drawing shows a satellite that carries a telescope used to look at objects in space.



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

A a distant galaxy

B a satellite

C the Earth

D the Universe

Observations of space using visible light are better made from . . . **1** . . . because clouds may block observations made from . . . **2** . . . .

The red-shift in light from . . . **3** . . . provides evidence of the 'big bang' theory of the start of . . . **4** . . . .

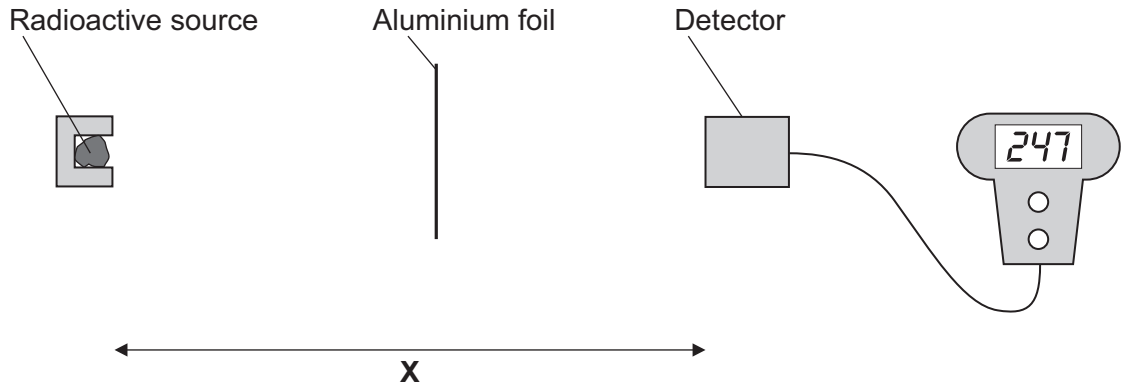
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QUESTION FOUR

A student investigated how much beta radiation was absorbed by aluminium foil.

He used several different thicknesses of aluminium foil.

He plotted a graph of his results.



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

A conclusion

B control variable

C independent variable

D prediction

1	He thought that the amount of radiation absorbed would decrease with increasing thickness.
2	From his graph, he decided that the amount of radiation absorbed increased with increasing thickness.
3	He changed the thickness of the aluminium foil.
4	He kept the distance **X** the same.

Turn over for the next question

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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.

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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 visible light and infra red rays.

6A Which statement is true for both visible light and infra red rays?

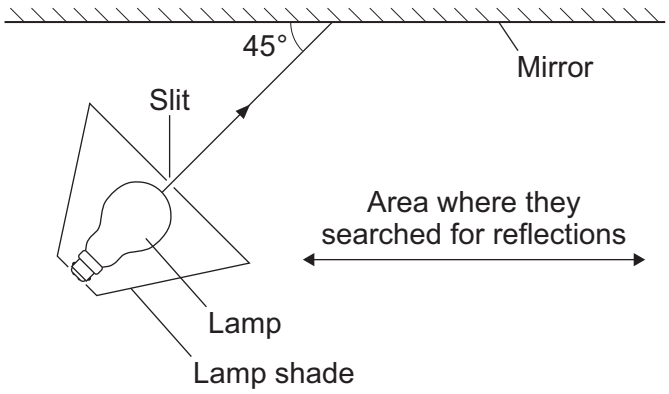
1 They have the same wavelength.

2 They have the same speed in a vacuum.

3 Only visible light can travel along an optical fibre.

4 Only infra red rays can be absorbed.

Some students wanted to see if visible light and infra red rays reflect at the same angle from a mirror. They set up a lamp pointing at 45 ° to a mirror. They then searched for reflections in the area shown in the diagram. Their investigation was carried out in a dark room.



6B The students carried out their investigation in a dark room because . . .

1 visible light travels faster in the dark.

2 it cuts out any other sources of visible light.

3 it allows them to do their investigation safely.

4 you can only see visible light in a dark room.

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6C To minimise random errors, the students should have . . .

1 used a curved mirror.

2 plotted a graph of the angles they measured.

3 repeated the measurements several times and calculated the average.

4 carried out the investigation in a room with the lights on.

6D When a household lamp was used, the students saw a reflection of the light at 45° to the mirror.

When an infra red source was used, they could not see the rays. Using an infra red detector, they did find a reflection at 45°.

This is because . . .

1 infra red rays are not reflected by a mirror.

2 infra red rays are absorbed by the mirror.

3 human eyes are not sensitive to infra red rays.

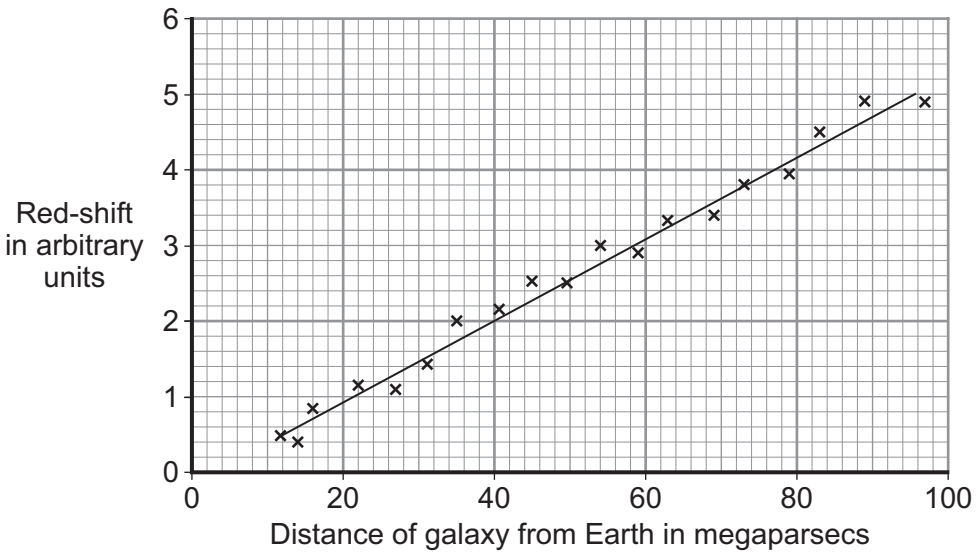
4 visible light and infra red rays reflect in different ways.

Turn over for the next question

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QUESTION SEVEN

The graph shows the red-shift for a number of galaxies.



A megaparsec is a unit of distance used by astronomers.

7A The graph shows that . . .

1 the further away from Earth a galaxy is, the smaller the red-shift.

2 the further away from Earth a galaxy is, the bigger the red-shift.

3 the amount of red-shift is the same however far from Earth the galaxy is.

4 there is no relationship between red-shift and the distance from Earth.

7B A scientist is concerned that not all the points on the graph lie on the straight line.

How can the scientist check that the results are reliable?

1 ignore the results that do not fit on the line

2 use more precise measuring instruments

3 make the observations from space telescopes

4 compare the data with that obtained by other scientists

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7C A galaxy produces a red-shift of 2 units.

How far from Earth is it?

1 20 megaparsecs

2 40 megaparsecs

3 60 megaparsecs

4 80 megaparsecs

7D Data is obtained for another distant galaxy that shows red-shift. This data does not fit the pattern of the other galaxies.

Data such as this that does not fit the pattern is called . . .

1 accurate.

2 anomalous.

3 precise.

4 sensitive.

Turn over for the next question

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QUESTION EIGHT

X-rays are useful for obtaining images of internal parts of the body. However, there are dangers from exposure to X-rays.

8A Why is exposure to X-rays dangerous?

1 X-rays are poisonous.

2 X-rays can damage cells.

3 Your body can store up X-rays.

4 Your body becomes immune to X-rays.

8B There is a maximum dose of radiation from X-rays that you should not exceed each year.

The table shows the percentage of this maximum that you receive from X-ray scans of different parts of the body.

Part of the body being X-rayed	Percentage of maximum yearly allowed dose
Chest	5
Teeth	1
Pelvis	24
Spine	40

What is the best way to display the data in the table?

1 a bar chart, because one of the variables is categoric

2 a bar chart, because both of the variables are continuous

3 a line graph, because one of the variables is categoric

4 a line graph, because both of the variables are continuous

8C A patient has two chest X-rays and one spine X-ray taken in one year.

How much of the maximum yearly allowed dose has he received?

1 45 %

2 50 %

3 70 %

4 85 %

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8D A dentist taking an X-ray of a patient's teeth needs to protect himself from the radiation.

He does this by . . .

1 taking no more than 1000 X-rays in a year.

2 operating the X-ray machine from outside the room.

3 making sure that the patient wears a lead apron.

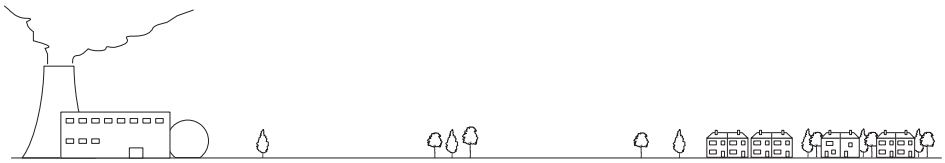
4 wearing special gloves.

Turn over for the next question

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QUESTION NINE

A nuclear power station is built a few miles away from a village.



The nuclear power station uses radioactive uranium as its fuel. After a few years, there are more cases of cancer than usual occurring in the village. The villagers think that this is because of radiation from the power station.

9A Any radiation reaching the village directly from the power station will be . . .

1 alpha radiation only.

2 beta radiation only.

3 gamma radiation only.

4 alpha, beta and gamma radiation.

9B The increased number of cancer cases near the power station . . .

1 proves that the power station is the only cause of these cancers.

2 proves that the power station is one possible cause of these cancers.

3 suggests that the power station is the only cause of these cancers.

4 suggests that the power station is one possible cause of these cancers.

9C Checks are to be made for any link between the power station and the increased number of cancer cases in the village.

This is most likely to be done by . . .

1 shutting down the power station to see if the number of cases decreases.

2 re-housing the villagers away from the power station to see if the number of cancer cases decreases.

3 re-housing the villagers closer to the power station to see if the number of cancer cases increases.

4 comparing the villagers' health records with those of people who do not live near nuclear power stations.

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9D Exposure to radiation from radioactive sources used in schools must be kept to a minimum.

The best way to do this is to store the source in a box lined with . . .

1 aluminium.

2 glass.

3 lead.

4 wood.

END OF TEST

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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

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

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D ultraviolet rays

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QUESTION TWO

Communication signals may be either analogue or digital.

Between a signal transmitter and a signal receiver, interference occurs. The interference distorts both types of signal.

Match the descriptions of the signals, **A**, **B**, **C** and **D**, with the visual displays **1**–**4**.

A analogue signal reaching a receiver

B analogue signal sent from a transmitter

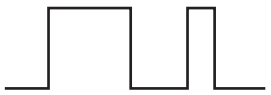
C digital signal reaching a receiver

D digital signal sent from a transmitter

1



2



3



4



Turn over for the next question

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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

X-rays are useful for obtaining images of internal parts of the body. However, there are dangers from exposure to X-rays.

3A Why is exposure to X-rays dangerous?

1 X-rays are poisonous.

2 X-rays can damage cells.

3 Your body can store up X-rays.

4 Your body becomes immune to X-rays.

3B There is a maximum dose of radiation from X-rays that you should not exceed each year.

The table shows the percentage of this maximum that you receive from X-ray scans of different parts of the body.

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2 a bar chart, because both of the variables are continuous

3 a line graph, because one of the variables is categoric

4 a line graph, because both of the variables are continuous

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3C A patient has two chest X-rays and one spine X-ray taken in one year.

How much of the maximum yearly allowed dose has he received?

1 45 %

2 50 %

3 70 %

4 85 %

3D A dentist taking an X-ray of a patient's teeth needs to protect himself from the radiation.

He does this by . . .

1 taking no more than 1000 X-rays in a year.

2 operating the X-ray machine from outside the room.

3 making sure that the patient wears a lead apron.

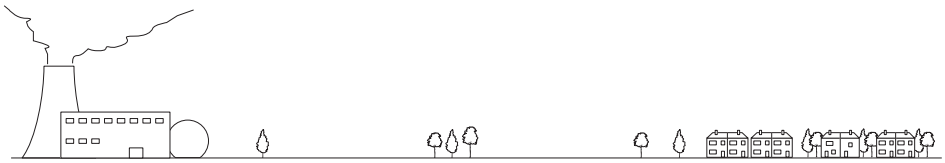
4 wearing special gloves.

Turn over for the next question

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QUESTION FOUR

A nuclear power station is built a few miles away from a village.



The nuclear power station uses radioactive uranium as its fuel. After a few years, there are more cases of cancer than usual occurring in the village. The villagers think that this is because of radiation from the power station.

4A Any radiation reaching the village directly from the power station will be . . .

1 alpha radiation only.

2 beta radiation only.

3 gamma radiation only.

4 alpha, beta and gamma radiation.

4B The increased number of cancer cases near the power station . . .

1 proves that the power station is the only cause of these cancers.

2 proves that the power station is one possible cause of these cancers.

3 suggests that the power station is the only cause of these cancers.

4 suggests that the power station is one possible cause of these cancers.

4C Checks are to be made for any link between the power station and the increased number of cancer cases in the village.

This is most likely to be done by . . .

1 shutting down the power station to see if the number of cases decreases.

2 re-housing the villagers away from the power station to see if the number of cancer cases decreases.

3 re-housing the villagers closer to the power station to see if the number of cancer cases increases.

4 comparing the villagers' health records with those of people who do not live near nuclear power stations.

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4D Exposure to radiation from radioactive sources used in schools must be kept to a minimum.

The best way to do this is to store the source in a box lined with . . .

1 aluminium.

2 glass.

3 lead.

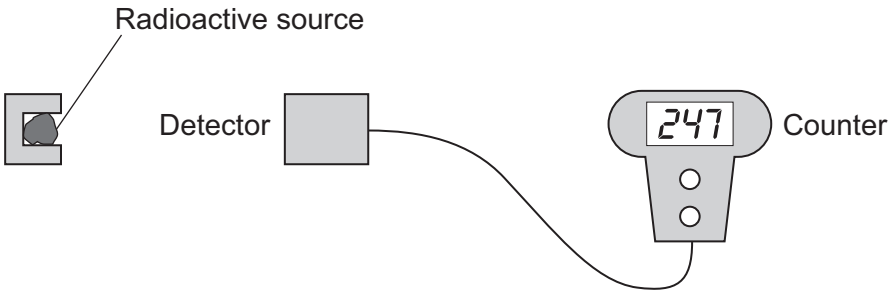
4 wood.

Turn over for the next question

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QUESTION FIVE

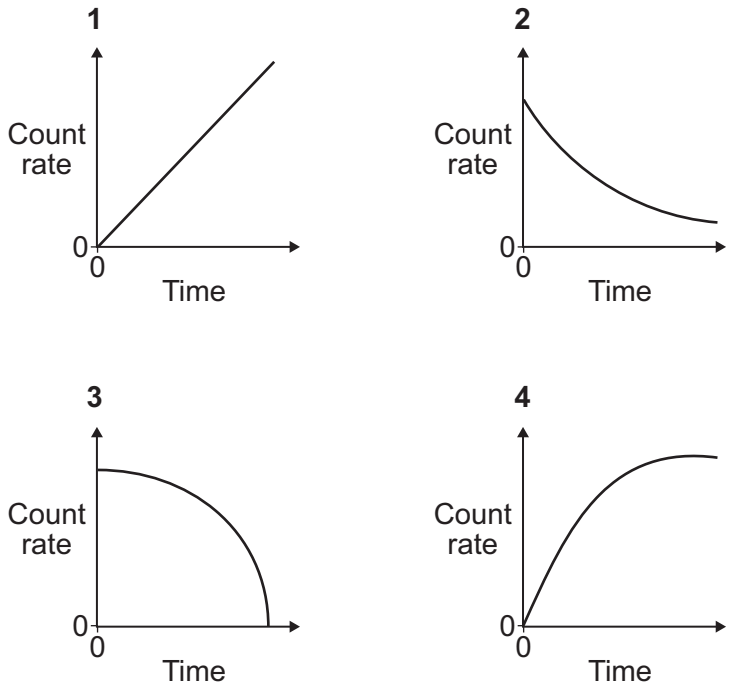
A teacher used the apparatus shown in the diagram to measure the count from a radioactive source.



She put the radioactive source near the detector. She measured the number of counts in 20 seconds. She reset the counter to zero and measured the number of counts in the next 20 seconds. She continued this for 10 minutes.

5A The teacher asked the students to plot a graph of the count rate against time.

Which of the following could be the expected shape of the graph?



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5B The students can use their graphs to find the half-life of the radioactive source.

What is meant by *half-life*?

1 half the time it takes for the count rate to fall to zero

2 half the time it takes for the number of nuclei in the sample to halve

3 the time it takes for the count rate to halve

4 the time it takes for the number of nuclei in the sample to fall to zero

5C Which of the following will affect the initial count rate in the sample?

1 the pressure in the room

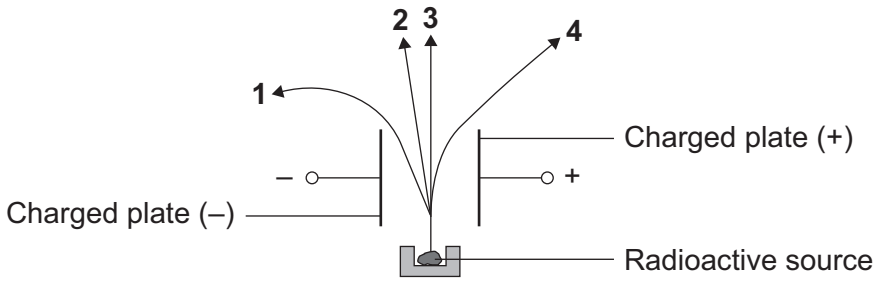
2 the original number of nuclei in the sample

3 the temperature of the room

4 the temperature of the sample

5D A radioactive source is placed close to a pair of charged parallel plates with an electric field between them.

Which of the lines, **1**, **2**, **3** or **4**, on the diagram shows the path of the beta particles emitted by the source?



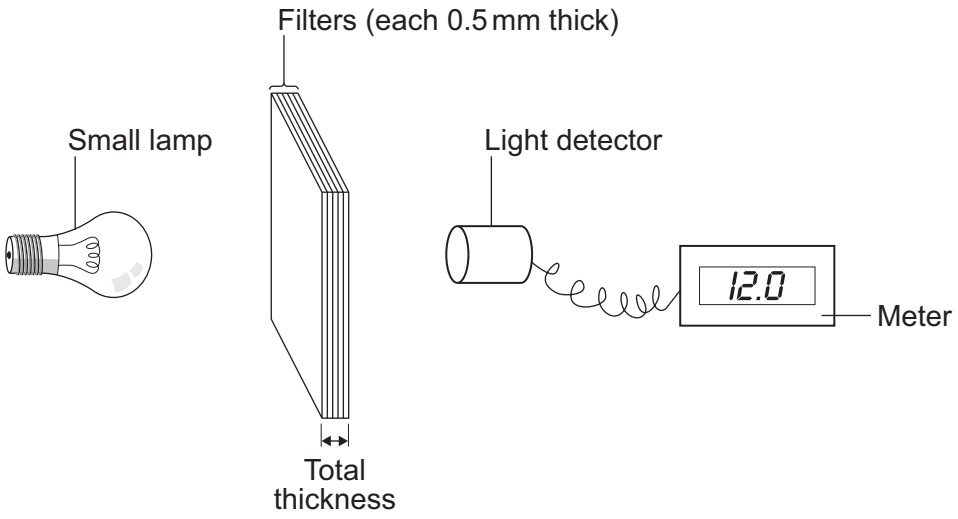
Turn over for the next question

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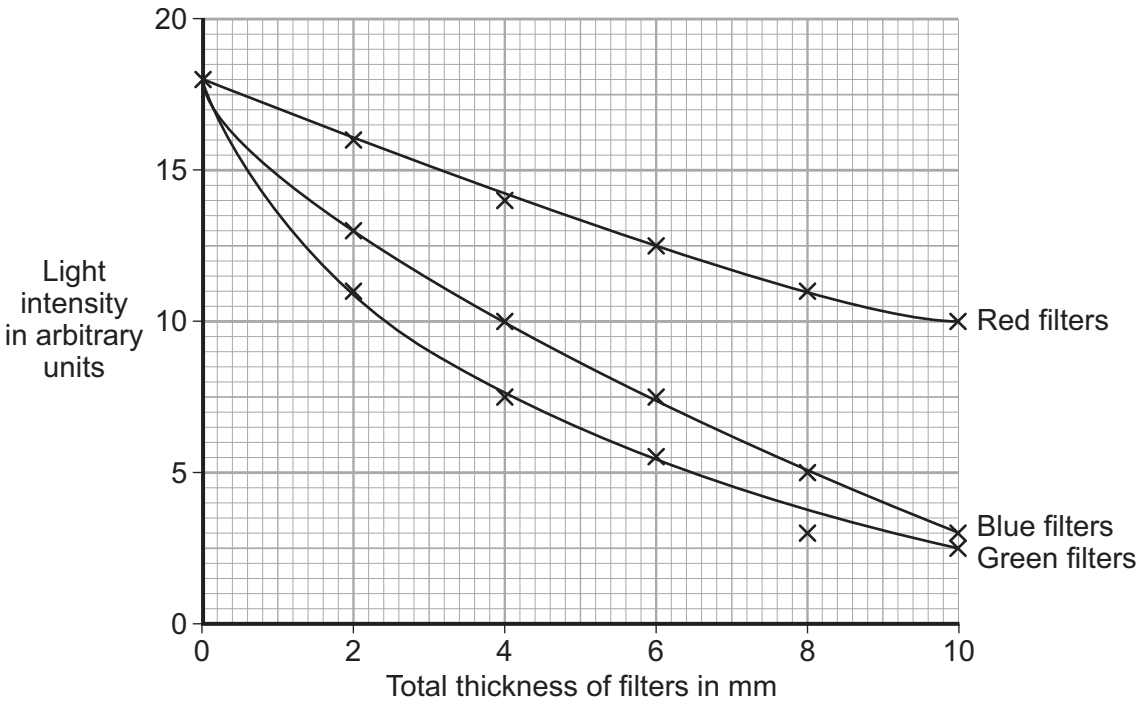
QUESTION SIX

Different numbers of coloured filters were placed between a small lamp and a light detector. Each filter was 0.5 mm thick.

The meter showed the intensity of the light reaching the detector.



The graph shows how the light intensity changes as the thickness of the filters changes.



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6A Which is the best description of the pattern shown by the graph considering all the coloured filters?

1 The light intensity transmitted is directly proportional to the total thickness of the filters.

2 The light intensity transmitted is inversely proportional to the total thickness of the filters.

3 As the total thickness of the filters increases, the light intensity transmitted increases.

4 As the total thickness of the filters increases, the light intensity transmitted decreases.

6B What is the light intensity reading when 14 blue filters are used?

1 4.5 units

2 6.2 units

3 6.5 units

4 6.6 units

6C How many green filters would be needed to reduce the initial light intensity by 50 %?

1 three

2 five

3 six

4 seven

6D Which types of electromagnetic radiation are used to send signals along optical fibres?

1 infra red rays and ultraviolet rays

2 infra red rays and visible light

3 infra red rays, ultraviolet rays and visible light

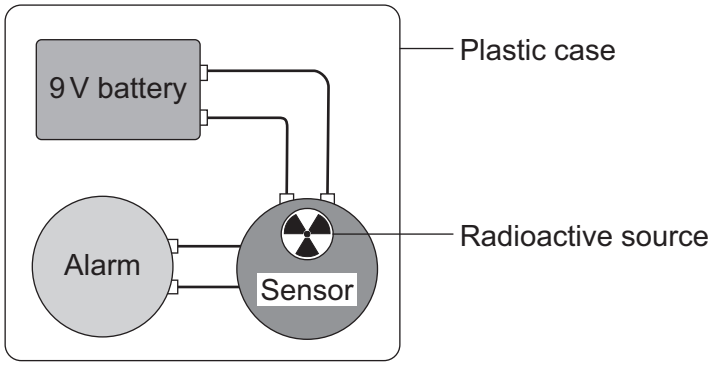
4 visible light and ultraviolet rays

Turn over for the next question

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QUESTION SEVEN

The diagram shows the parts of a smoke detector. The radioactive source emits alpha particles.



The alpha particles ionise the air inside the sensor, which causes a small electric current. Any smoke getting into the sensor will absorb alpha particles. This reduces the current. The change in current sets off the alarm.

7A A source that emits alpha particles will not harm people in the same room as the detector.

This is because alpha particles . . .

1 do not damage human cells.

2 are highly ionising.

3 will not pass through the plastic case.

4 are deflected by the Earth's magnetic field.

7B The smoke detector would **not** work if a radioactive source that emitted only gamma rays was used.

This is because gamma rays . . .

1 would pass through the plastic case.

2 would not ionise the air inside the sensor sufficiently.

3 travel through the air at the same speed as light.

4 would be affected by the battery.

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7C An alpha particle consists of . . .

1 2 electrons and 2 neutrons.

2 2 electrons and 2 protons.

3 2 neutrons and 2 protons.

4 2 neutrons only.

7D The radioactive source has a half-life of about 400 years.

What fraction of the nuclei in the source will have decayed in 1200 years?

1 $\frac{1}{8}$

2 $\frac{1}{3}$

3 $\frac{2}{3}$

4 $\frac{7}{8}$

Turn over for the next question

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QUESTION EIGHT

The light given out by distant galaxies has the same features as light from a very hot gas in a laboratory. However, the light from distant galaxies is shifted to longer wavelengths. This is called red-shift.

8A Red-shift occurs because . . .

1 the frequency of light increases as it travels through space.

2 the speed of light from galaxies decreases as it travels through space.

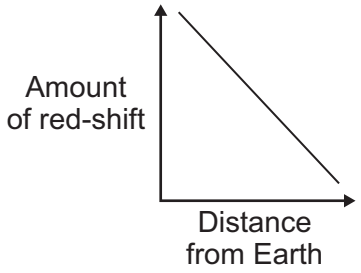
3 distant galaxies have a relative movement away from the Earth.

4 distant galaxies have a relative movement towards the Earth.

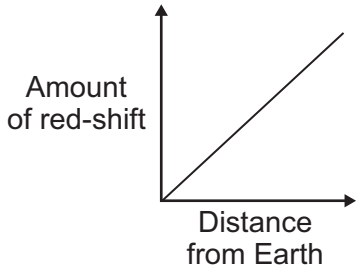
8B Distant galaxies show an amount of red-shift which is directly proportional to their distance from the Earth.

Which graph shows this relationship?

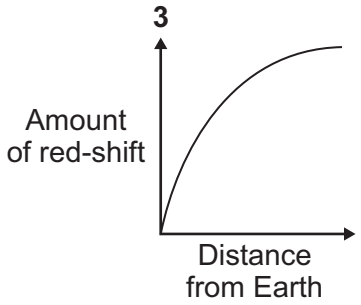
1



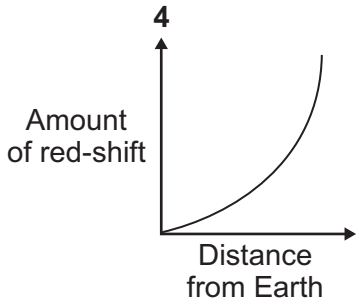
2



3



4



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8C The amount of red-shift can be used to estimate the speed of a galaxy relative to Earth.

This led to the discovery that distant galaxies are . . .

1 moving faster than nearer galaxies and the universe is contracting.

2 moving faster than nearer galaxies and the universe is expanding.

3 moving slower than nearer galaxies and the universe is contracting.

4 moving slower than nearer galaxies and the universe is expanding.

8D There are some galaxies close to the Earth that are moving towards the Earth.

Light from these galaxies has . . .

1 an observable decrease in its frequency.

2 an observable decrease in its wavelength.

3 smaller red-shifts than distant galaxies.

4 no change in its wavelength.

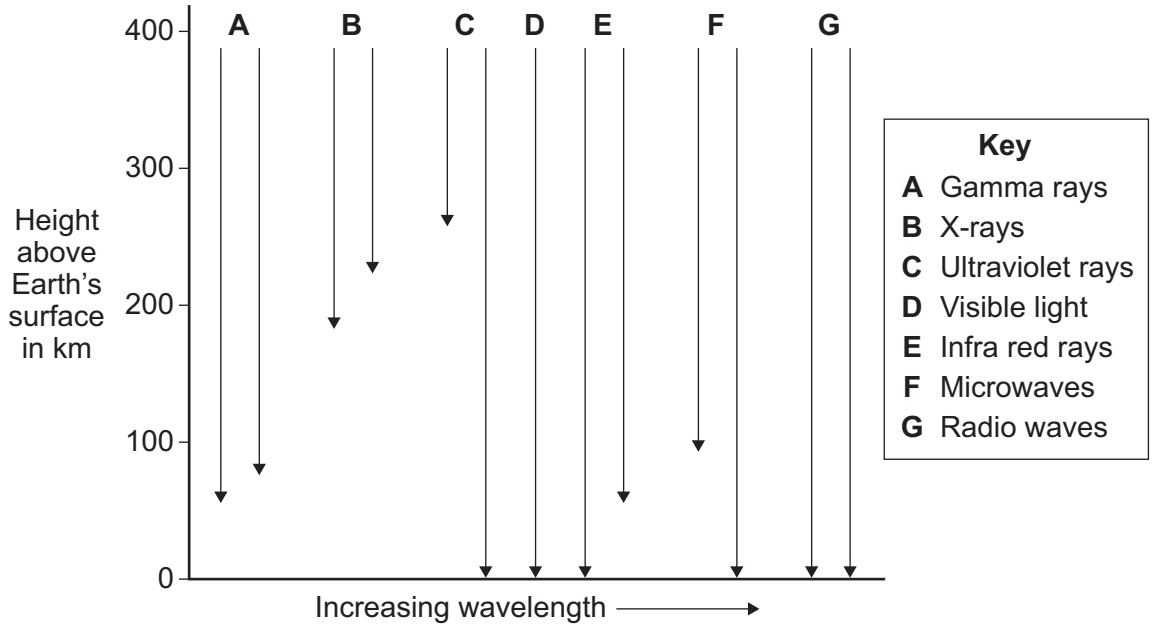
Turn over for the next question

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QUESTION NINE

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a particular type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Which one of the following statements is true?

1 Gamma rays penetrate the atmosphere further than all other types of electromagnetic radiation.

2 All frequencies of ultraviolet radiation reach the Earth's surface.

3 No frequencies of radio waves reach the Earth's surface.

4 Higher frequencies of microwaves are completely absorbed by the atmosphere.

9B What would be the minimum height above the Earth for a satellite carrying telescopes designed to detect gamma rays, X-rays and ultraviolet radiation of all wavelengths?

1 50 km

2 70 km

3 180 km

4 260 km

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9C Optical telescopes used to observe objects in space are limited because they can be used only . . .

1 as ground-based telescopes.

2 at night.

3 to observe a small region of the electromagnetic spectrum.

4 to observe one region of the sky.

9D Electromagnetic radiation from distant galaxies is very weak and is therefore very difficult to detect.

Some space telescopes use liquid helium to keep scientific instruments at a very low temperature.

Which type of weak electromagnetic radiation would best be detected by instruments kept at a very low temperature?

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

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There are no questions printed on this page

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GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2011 Examination – November Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the students' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

November 2011

Foundation Tier

Question	Key		
One	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	visible light	**2**
Two	**A**	alpha particle	**4**
	B	beta particle	**2**
	C	gamma ray	**1**
	D	X-rays	**3**
Three	**A**	a distant galaxy	**3**
	B	a satellite	**1**
	C	the Earth	**2**
	D	the Universe	**4**
Four	**A**	conclusion	**2**
	B	control variable	**4**
	C	independent variable	**3**
	D	prediction	**1**
Five	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**2**
	D	ultraviolet rays	**4**

	A	**B**	**C**	**D**
Six	**2**	**2**	**3**	**3**
Seven	**2**	**4**	**2**	**2**
Eight	**2**	**1**	**2**	**2**
Nine	**3**	**4**	**4**	**3**

GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

November 2011

Higher Tier

Question	Key		
One	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**2**
	D	ultraviolet rays	**4**
Two	**A**	analogue signal reaching a receiver	**3**
	B	analogue signal sent from a transmitter	**4**
	C	digital signal reaching a receiver	**1**
	D	digital signal sent from a transmitter	**2**

	A	B	C	D
Three	**2**	**1**	**2**	**2**
Four	**3**	**4**	**4**	**3**
Five	**2**	**3**	**2**	**4**
Six	**4**	**2**	**3**	**2**
Seven	**3**	**2**	**3**	**4**
Eight	**3**	**2**	**2**	**2**
Nine	**4**	**4**	**3**	**3**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

OTQ3

GCSE SCIENCE

AQA

Unit : PHY1BP **PHYSICS UNIT 1B**

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : BG11

15-NOV-11

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	gamma rays	○	○	○	○
1B	infra red rays	○	○	○	○
1C	radio waves	○	○	○	○
1D	ultraviolet rays	○	○	○	○

QUESTION TWO		1	2	3	4
2A	analogue signal reaching a receiver	○	○	○	○
2B	analogue signal sent from a transmitter	○	○	○	○
2C	digital signal reaching a receiver	○	○	○	○
2D	digital signal sent from a transmitter	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE	1	2	3	4
1A gamma rays	○	○	○	○
1B infra red rays	○	○	○	○
1C radio waves	○	○	○	○
1D visible light	○	○	○	○

QUESTION TWO	1	2	3	4
2A alpha particle	○	○	○	○
2B beta particle	○	○	○	○
2C gamma ray	○	○	○	○
2D X-rays	○	○	○	○

QUESTION THREE	1	2	3	4
3A a distant galaxy	○	○	○	○
3B a satellite	○	○	○	○
3C the Earth	○	○	○	○
3D the Universe	○	○	○	○

QUESTION FOUR	1	2	3	4
4A conclusion	○	○	○	○
4B control variable	○	○	○	○
4C independent variable	○	○	○	○
4D prediction	○	○	○	○

QUESTION FIVE	1	2	3	4
5A gamma rays	○	○	○	○
5B infra red rays	○	○	○	○
5C radio waves	○	○	○	○
5D ultraviolet rays	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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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

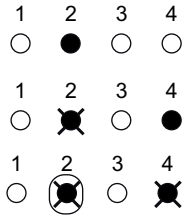
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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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.

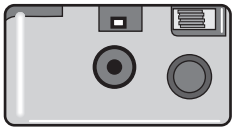
1

Toaster



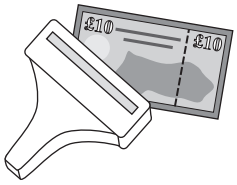
2

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

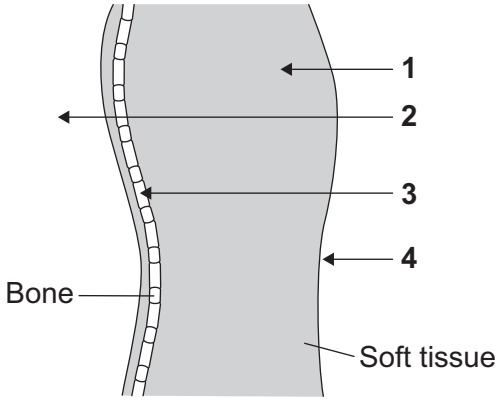
D X-rays

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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

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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** . . . .

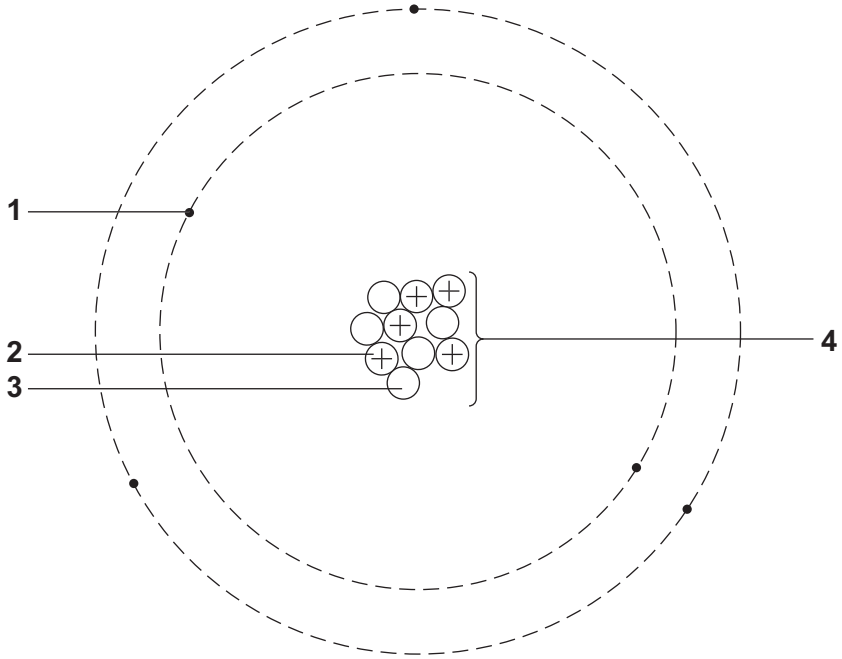
A steelworker opening the door of a furnace protects himself by . . . **3** . . . .

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

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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

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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** . . . .

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Turn over for the next question

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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

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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

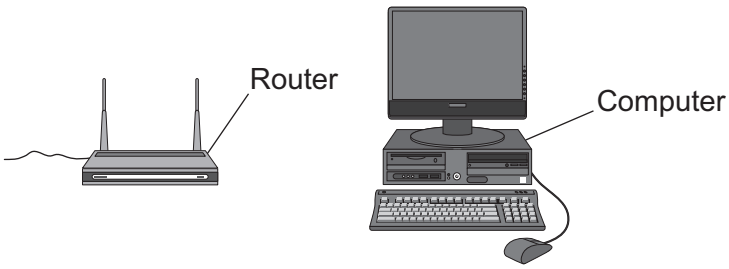
4 putting on sunglasses

Turn over for the next question

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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

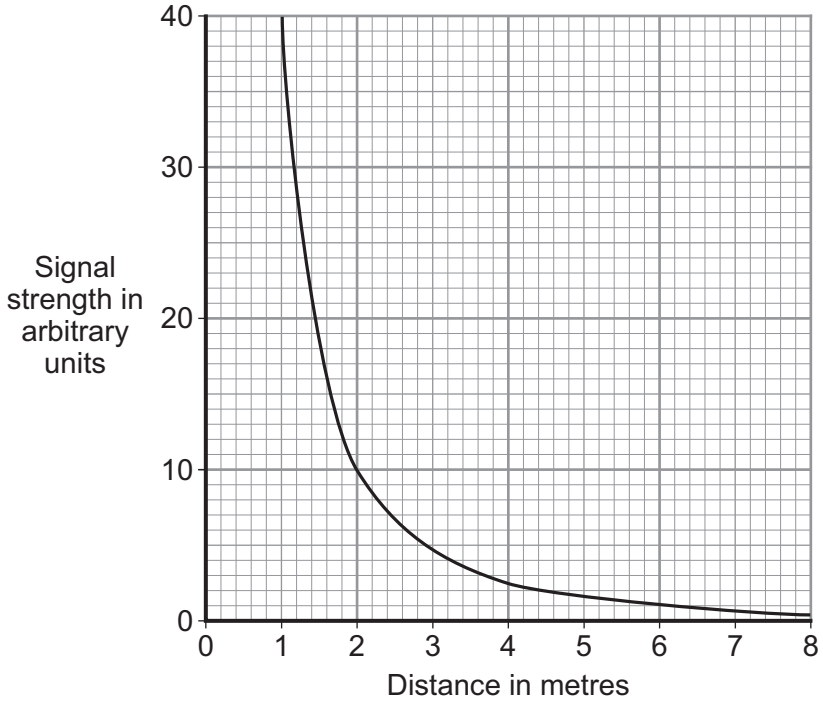
2 frequency

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.



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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

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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.

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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

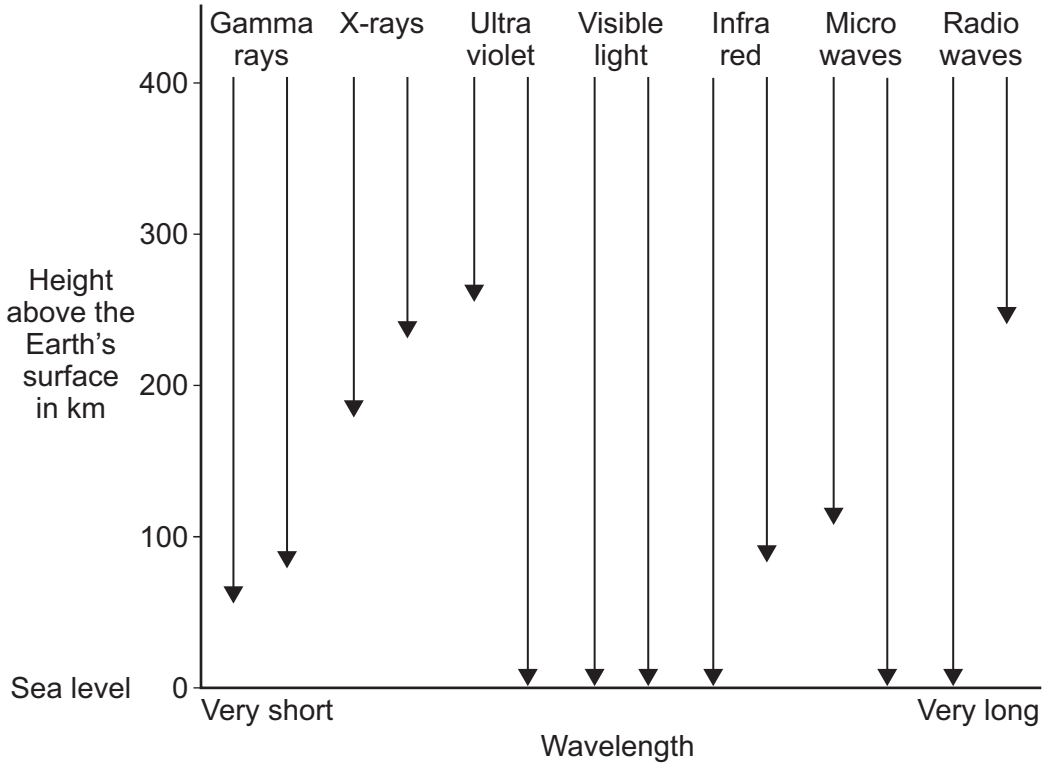
Turn over for the next question

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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.

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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

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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** . . . .

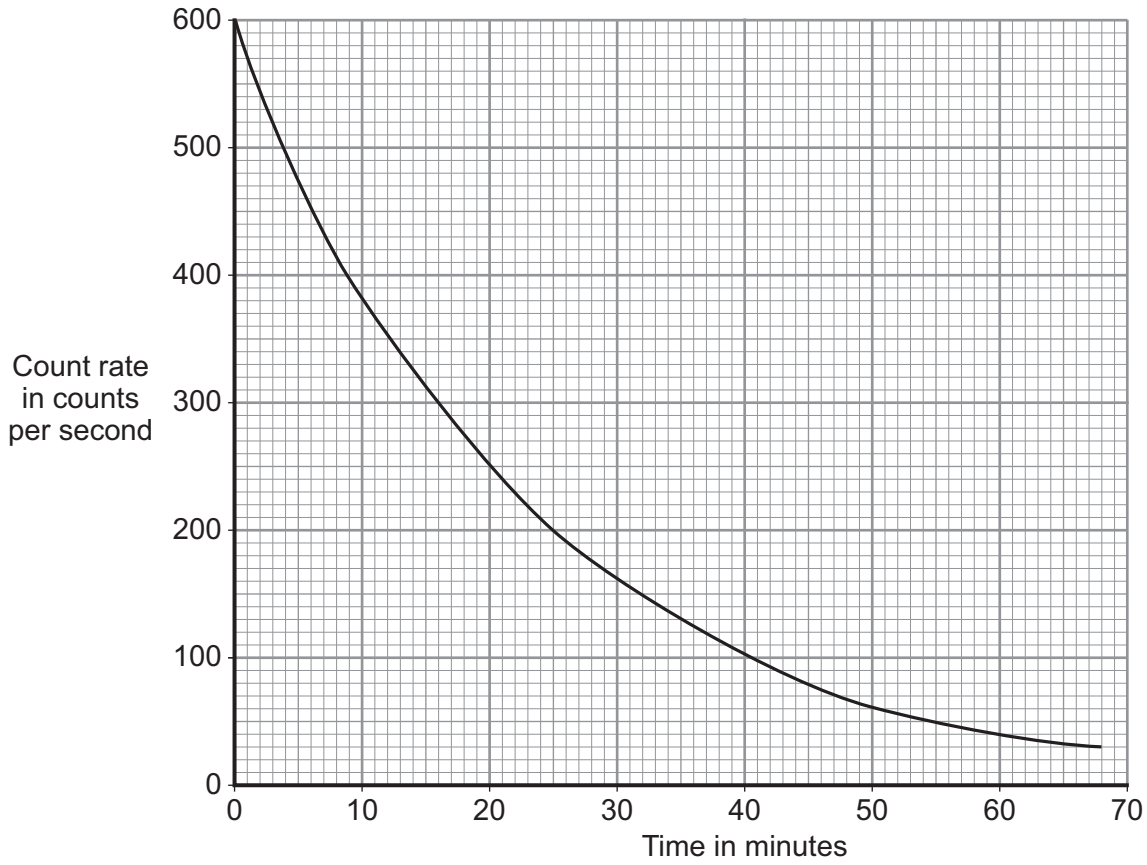
There is no change in the . . . **3** . . . .

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

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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.

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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.

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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

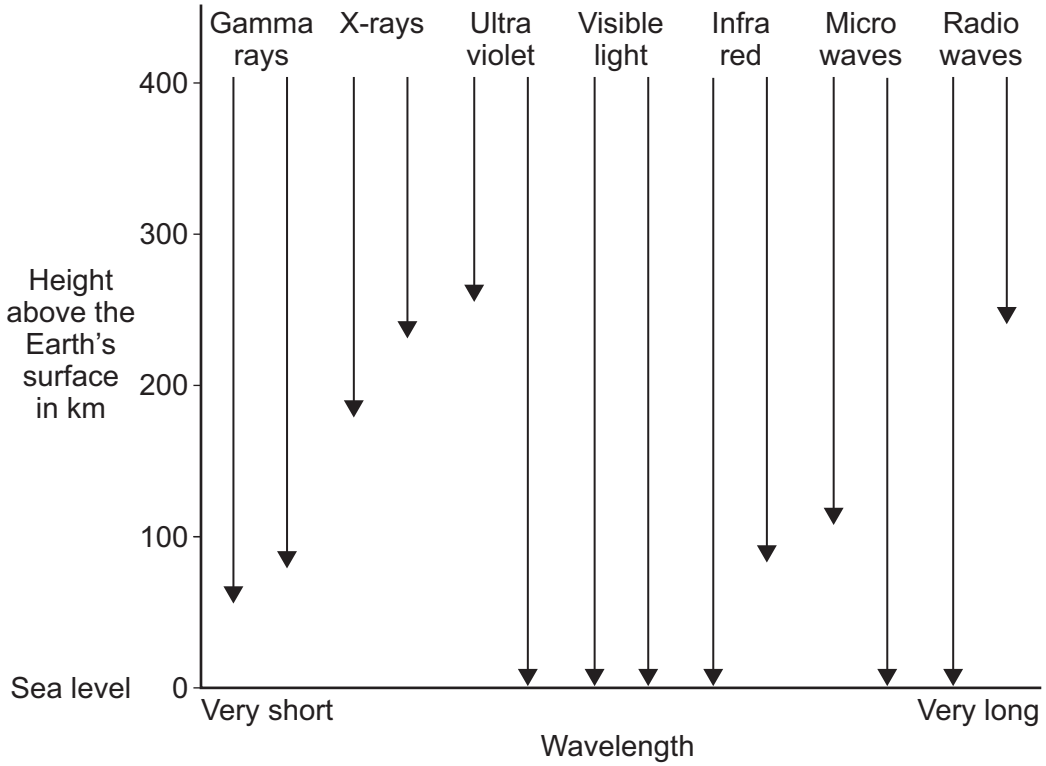
Turn over for the next question

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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.

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.

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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

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

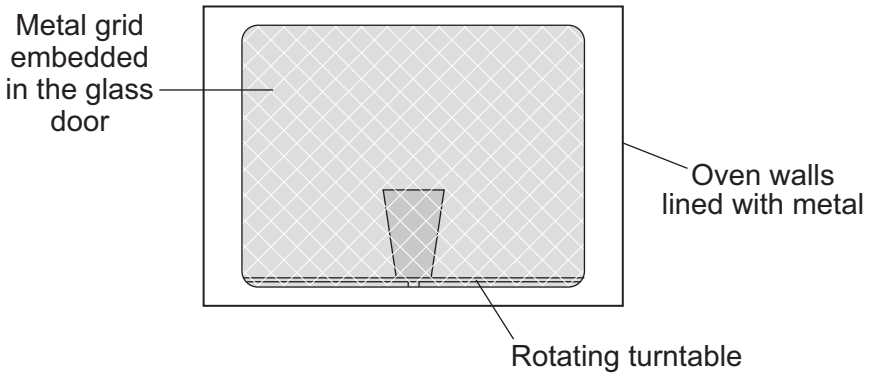
4 Spitzer

Turn over for the next question

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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.

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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

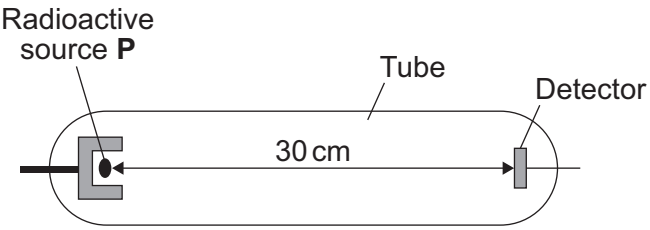
Turn over for the next question

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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.

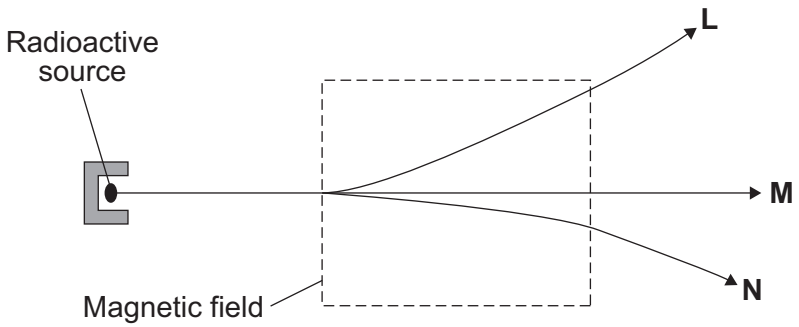
2 alpha particles and gamma rays.

3 beta particles only.

4 gamma rays only.

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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?

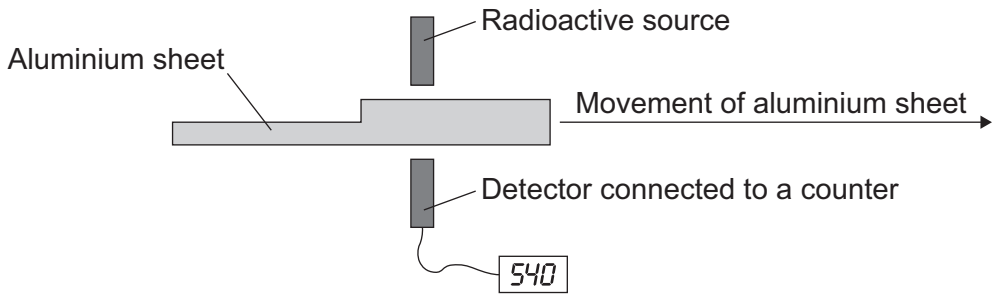
	Alpha	**Beta**	**Gamma**
1	an electron	a helium nucleus	an electromagnetic wave
2	a helium nucleus	an electromagnetic wave	an electron
3	a helium nucleus	an electron	an electromagnetic wave
4	an electron	an electromagnetic wave	an electron

Turn over for the next question

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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.

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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

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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 . . .

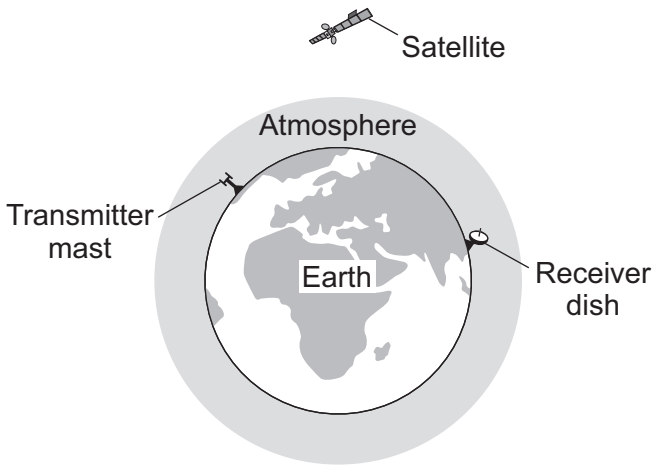
1 radio waves travel faster in glass than they do in air.

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.



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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.

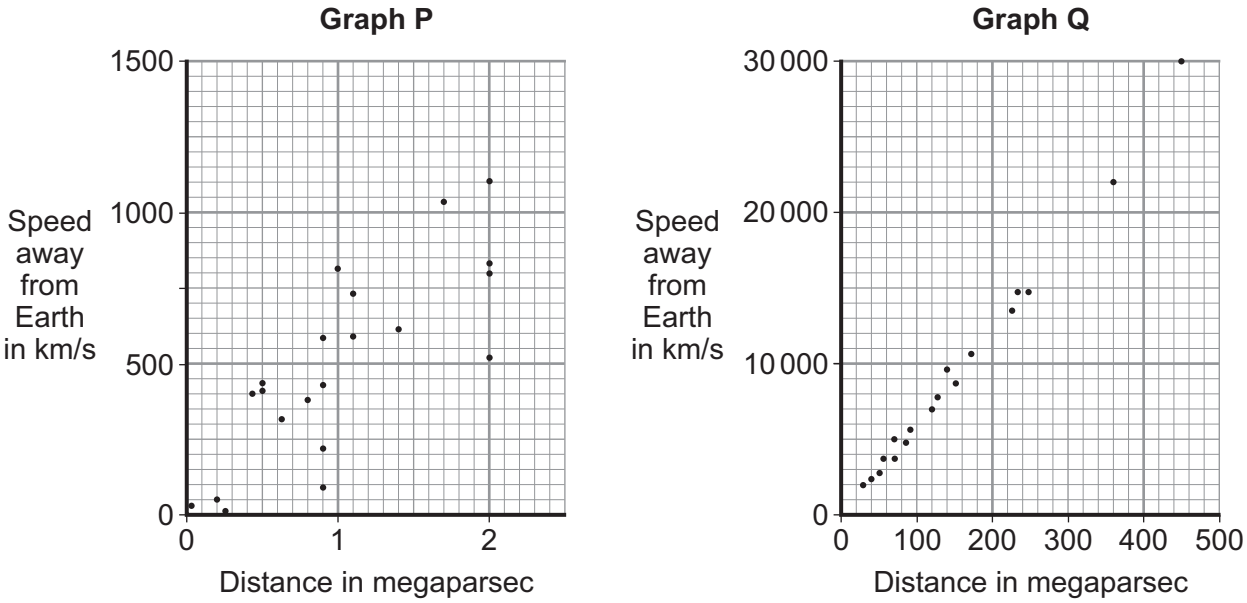
Turn over for the next question

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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.



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.

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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

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GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2011 Examination – June Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

June 2011

Foundation Tier

Question	Key		
One	**A**	infra red	**1**
	B	ultraviolet	**3**
	C	visible light	**2**
	D	X-rays	**4**
Two	**A**	alpha	**4**
	B	beta	**1**
	C	gamma	**2**
	D	X-rays	**3**
Three	**A**	leaving the room to switch on the equipment	**2**
	B	looking through blackened glass	**1**
	C	wearing thick, insulating gloves	**3**
	D	using remotely controlled equipment	**4**
Four	**A**	electron	**1**
	B	neutron	**3**
	C	nucleus	**4**
	D	proton	**2**
Five	**A**	frequency	**2**
	B	red-shift	**4**
	C	wavelength	**1**
	D	wave speed	**3**

	A	**B**	**C**	**D**
Six	**4**	**3**	**4**	**4**
Seven	**2**	**4**	**2**	**4**
Eight	**3**	**1**	**2**	**4**
Nine	**2**	**3**	**4**	**1**

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

June 2011

Higher Tier

Question	Key		
One	**A**	frequency	**2**
	B	red-shift	**4**
	C	wavelength	**1**
	D	wave speed	**3**
Two	**A**	16	**3**
	B	25	**2**
	C	150	**4**
	D	600	**1**

	A	B	C	D
Three	**3**	**1**	**2**	**4**
Four	**2**	**3**	**4**	**1**
Five	**1**	**4**	**2**	**3**
Six	**1**	**4**	**4**	**3**
Seven	**2**	**2**	**1**	**3**
Eight	**3**	**4**	**2**	**3**
Nine	**4**	**3**	**3**	**1**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

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AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 6M11

28-JUN-11

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	frequency	○	○	○	○
1B	red-shift	○	○	○	○
1C	wavelength	○	○	○	○
1D	wave speed	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	16	○	○	○	○
2B	25	○	○	○	○
2C	150	○	○	○	○
2D	600	○	○	○	○

QUESTION THREE

	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR

	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE

	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	infra red	○	○	○	○
1B	ultraviolet	○	○	○	○
1C	visible light	○	○	○	○
1D	X-rays	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	alpha	○	○	○	○
2B	beta	○	○	○	○
2C	gamma	○	○	○	○
2D	X-rays	○	○	○	○

QUESTION THREE

		1	2	3	4
3A	leaving the room to switch on the equipment	○	○	○	○
3B	looking through blackened glass	○	○	○	○
3C	wearing thick, insulating gloves	○	○	○	○
3D	using remotely controlled equipment	○	○	○	○

QUESTION FOUR

		1	2	3	4
4A	electron	○	○	○	○
4B	neutron	○	○	○	○
4C	nucleus	○	○	○	○
4D	proton	○	○	○	○

QUESTION FIVE

		1	2	3	4
5A	frequency	○	○	○	○
5B	red-shift	○	○	○	○
5C	wavelength	○	○	○	○
5D	wave speed	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

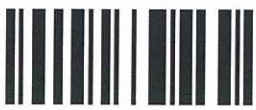
	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Wednesday 2 March 2011 Morning Session

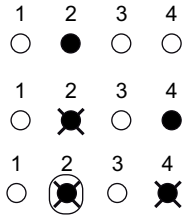
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 of this booklet.

FOUNDATION TIER

Section One

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

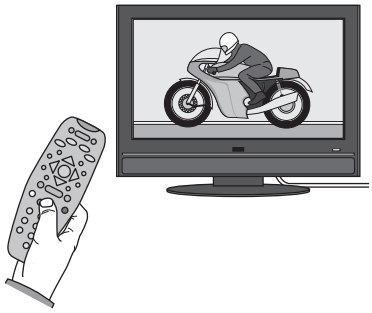
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

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** . . . .

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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** . . . .

QUESTION THREE

This question is about gamma radiation.

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

A bacteria

B cells

C isotopes

D particles

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

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

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

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

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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

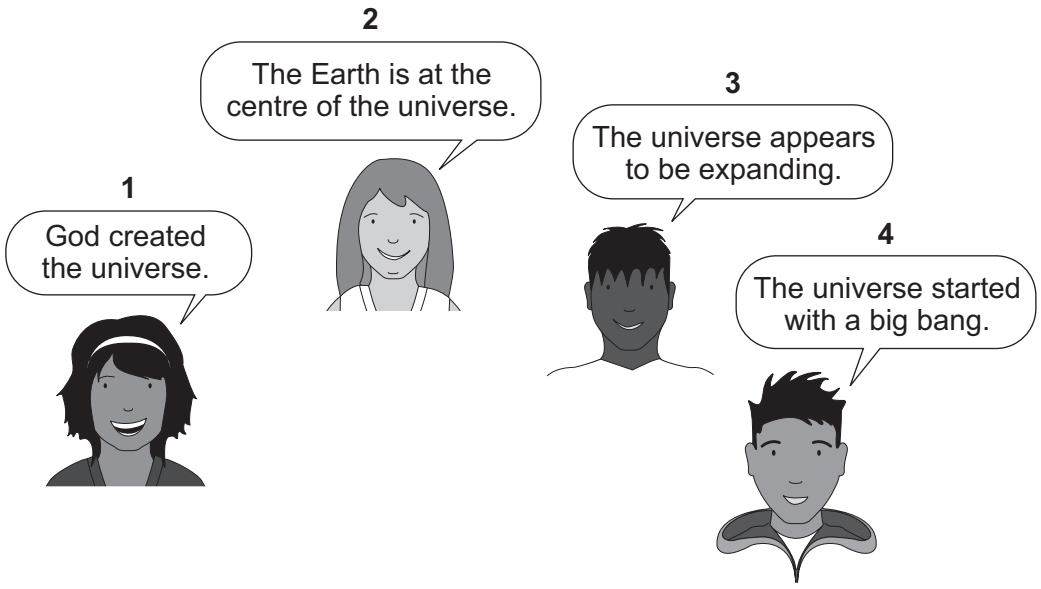
D ultraviolet rays

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

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QUESTION FIVE

Some students are talking about the universe.



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

A a belief that science cannot disprove

B a conclusion based on observations of red-shift

C a theory supported by scientific evidence but not direct observations

D a theory that science has disproved

Turn over for the next question

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Section Two

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

Each of these questions has four parts.

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

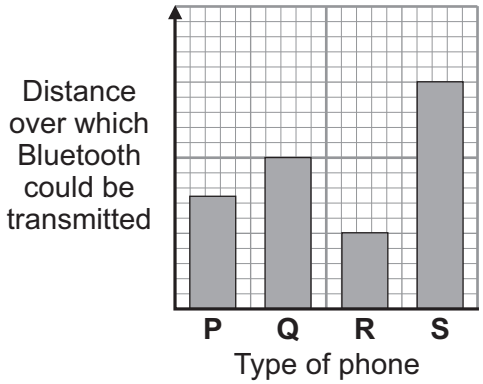
Mark your choices on the answer sheet.

QUESTION SIX

'Bluetooth' is a type of radio communication that can be used between mobile phones over short distances.

A group of students investigated the distance over which four different types of mobile phone could transmit *Bluetooth*.

Their results are shown below.



6A The data is displayed as a bar chart because one of the variables is . . .

1 a categoric variable.

2 a control variable.

3 a continuous variable.

4 an independent variable.

6B What was the independent variable in the students' investigation?

1 distance over which the signal could be transmitted

2 length of time for which the signal was sent

3 strength of signal used

4 type of phone used

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6C Which phone could transmit *Bluetooth* over the biggest distance?

1 **P**

2 **Q**

3 **R**

4 **S**

6D Most mobile phones use digital signals rather than analogue signals.

Why is this?

1 Digital signals are less prone to interference.

2 Digital signals travel faster.

3 Digital signals can travel further.

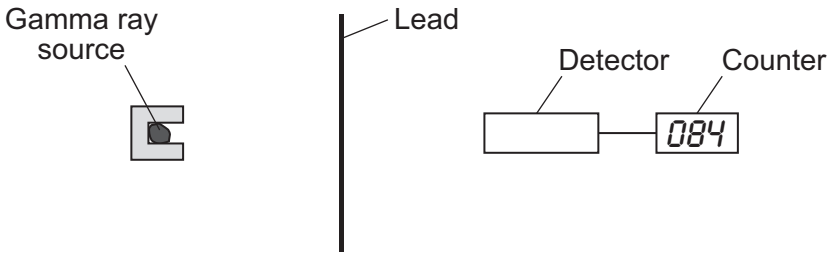
4 Digital signals vary continuously.

Turn over for the next question

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QUESTION SEVEN

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



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

His results are shown in the table.

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

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

1 1 mm

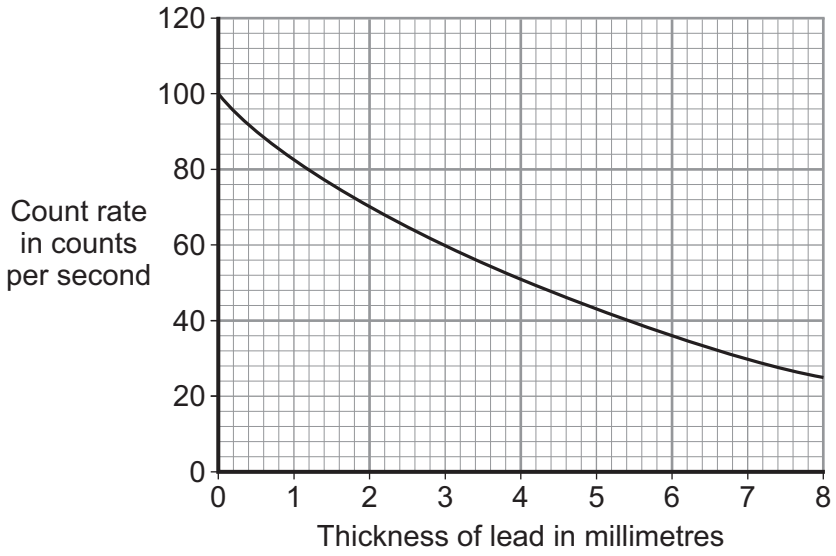
2 2 mm

3 5 mm

4 10 mm

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The graph shows the results.



7B The graph shows that . . .

1 doubling the thickness of lead doubles the count rate.

2 there is no relationship between thickness and count rate.

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

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

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

1 30 counts per second.

2 40 counts per second.

3 50 counts per second.

4 70 counts per second.

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

1 1 mm

2 4 mm

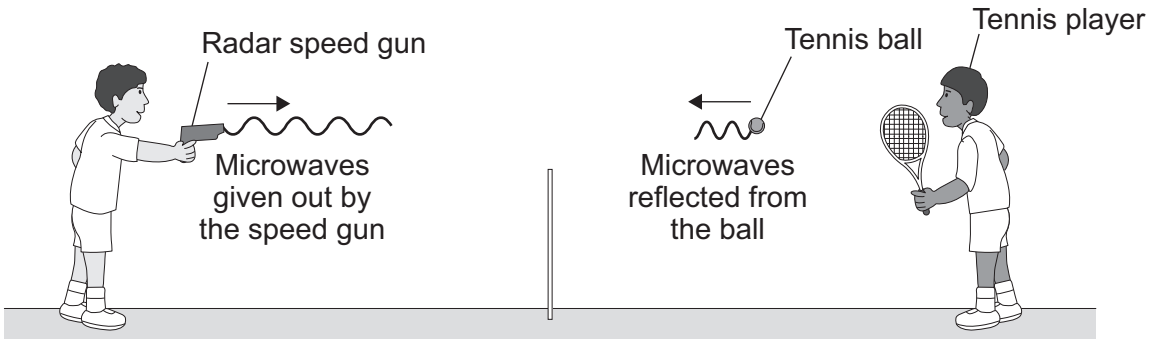
3 9 mm

4 10 mm

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QUESTION EIGHT

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



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

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

1 The temperature of the ball will increase slightly.

2 The ball will go faster.

3 The temperature of the ball will decrease slightly.

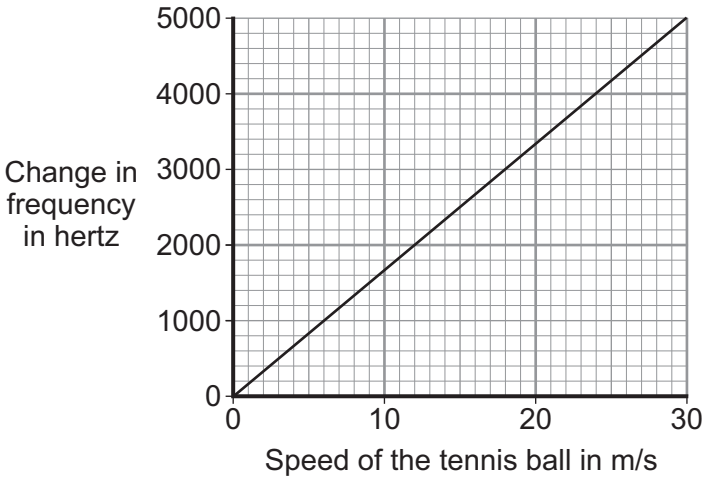
4 The ball will go slower.

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

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

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



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

1 frequency and speed are both categoric variables.

2 frequency and speed are both continuous variables.

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

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

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

What is the speed of the ball?

1 18 m/s

2 20 m/s

3 21 m/s

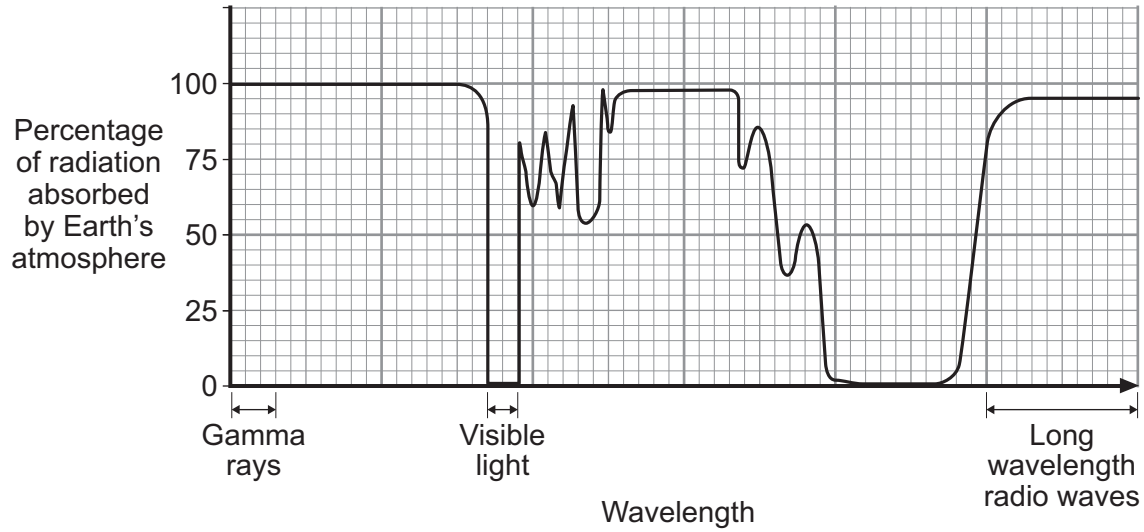
4 22 m/s

Turn over for the next question

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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

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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

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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** to **TWO**.

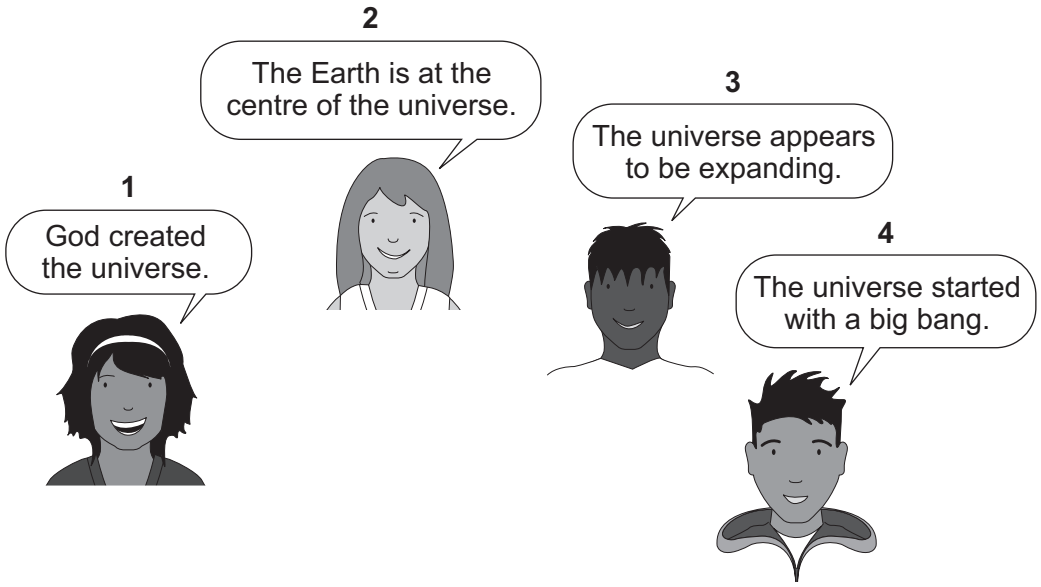
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

Some students are talking about the universe.



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

A a belief that science cannot disprove

B a conclusion based on observations of red-shift

C a theory supported by scientific evidence but not direct observations

D a theory that science has disproved

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QUESTION TWO

Radioactive isotopes have many uses.

The table gives the types of radiation emitted and the half-lives of four radioactive isotopes, **A**, **B**, **C** and **D**.

Isotope	Radiation emitted	Half-life
A	alpha	432 years
B	beta	29 years
C	gamma	6 hours
D	gamma	5 years

Match isotopes, **A**, **B**, **C** and **D**, with the most appropriate uses **1**–**4** in the table below.

	Use
1	controlling the thickness of aluminium foil as it is produced
2	sterilising medical instruments used in an operating theatre
3	injecting into a patient as a medical tracer
4	used inside a smoke detector

Turn over for the next question

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Section Two

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

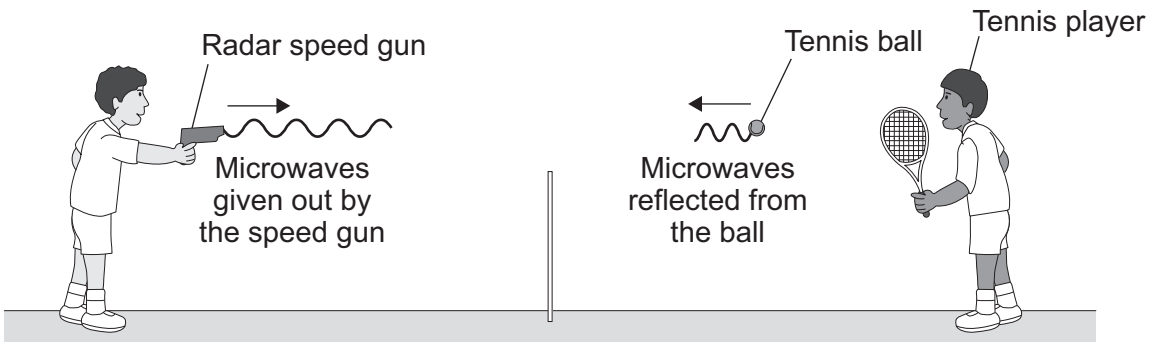
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In each part choose only **one** answer.

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QUESTION THREE

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



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

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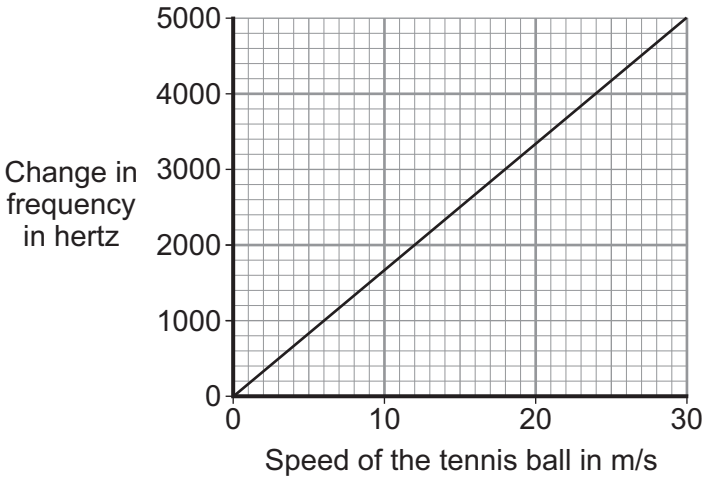
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1 18 m/s

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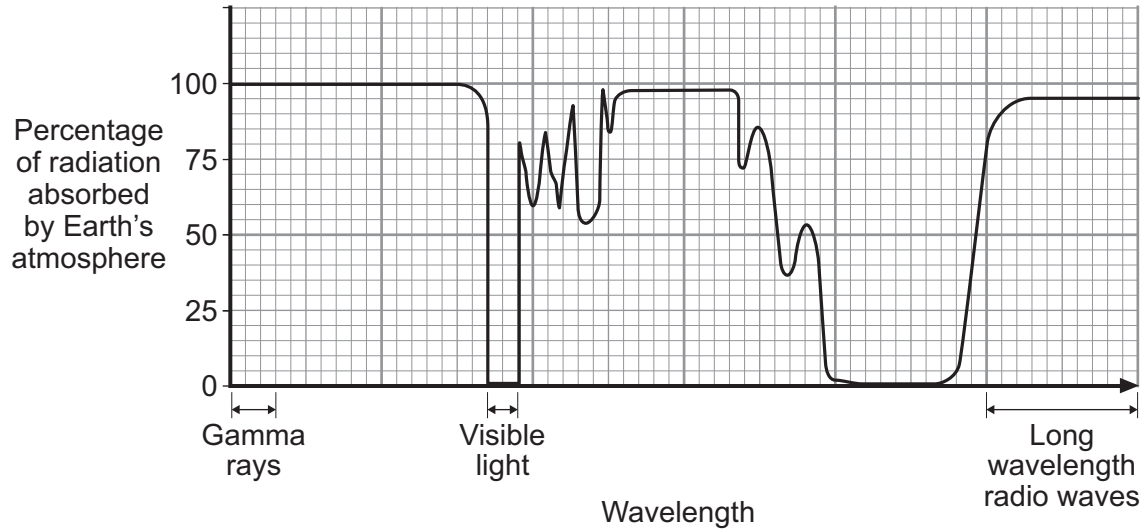
4 22 m/s

Turn over for the next question

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QUESTION FOUR

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



4A 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.

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

1 above the Earth's atmosphere

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3 They are all in space at present.

4 They were all used to study the Earth.

4D 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

Turn over for the next question

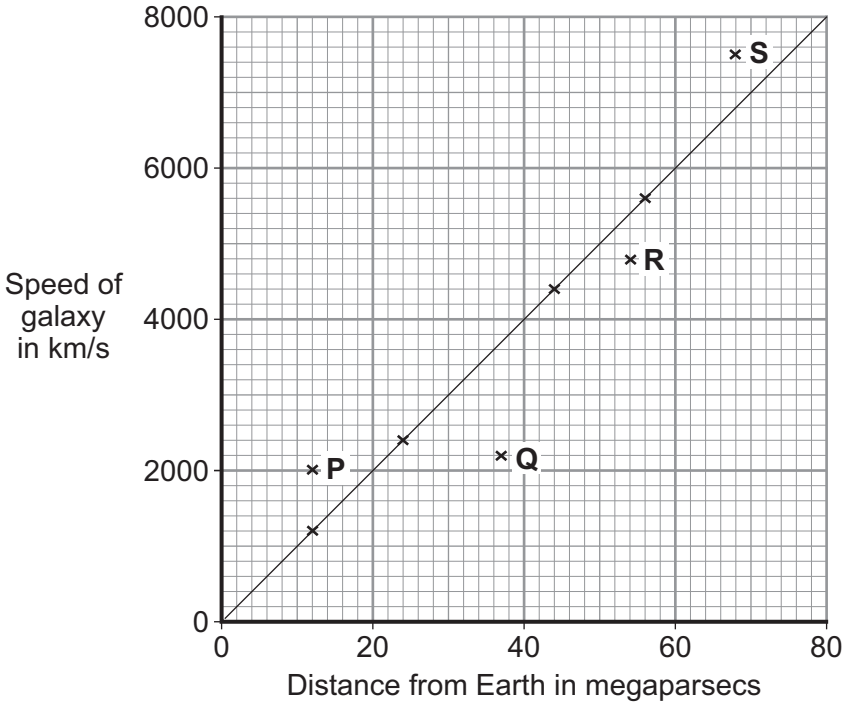
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QUESTION FIVE

In the early part of the twentieth century, Edwin Hubble made the discovery that distant galaxies are moving away from Earth.

He calculated the speeds at which the galaxies are moving away from Earth and their distances from Earth.

The graph shows Hubble's results.



A megaparsec is a unit of distance

5A Which one of the following statements describes what the graph shows?

1 All galaxies have different but constant speeds.

2 Galaxies will eventually reach a maximum speed.

3 Nearer galaxies have the highest speeds.

4 The speed of a galaxy is directly proportional to its distance from Earth.

5B What is the approximate speed, in km/s, of a galaxy 120 megaparsecs away from Earth?

1 10 000

2 11 000

3 12 000

4 13 000

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5C The light from four galaxies, **P**, **Q**, **R** and **S**, is examined for red-shift.

Which one of the following statements about the amount of red-shift is correct?

1 **P** produces the biggest red-shift.

2 **P**, **Q**, **R** and **S** produce the same red-shift.

3 **Q** and **R** produce the smallest red-shift.

4 **S** produces the biggest red-shift.

5D Some galaxies show a blue-shift.

These galaxies . . .

1 are the most distant galaxies from the Earth.

2 are stationary.

3 are moving towards the Earth.

4 have only just been formed.

Turn over for the next question

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QUESTION SIX

Some radioactive substances emit beta particles.

6A What is a beta particle?

1 an electron from outside the nucleus

2 an electron from inside the nucleus

3 a neutron from inside the nucleus

4 a proton from inside the nucleus

6B Which row in the table correctly describes the properties of beta particles?

	Range in air	Penetration through materials
1	a few centimetres	stopped by thin paper
2	about a metre	stopped by thin paper
3	about a metre	stopped by thin aluminium
4	several kilometres	stopped by thick lead

6C Beta particles cause ionisation.

What does this mean?

1 They make non-radioactive sources become radioactive.

2 They produce charged particles when they collide with atoms.

3 They remove charged particles from the air.

4 They stop other radioactive sources from emitting radiation.

6D How is a beta particle different from an alpha particle?

1 Alpha particles do not cause ionisation but beta particles do.

2 Alpha particles are deflected by magnetic fields and beta particles are not.

3 Beta particles are deflected by electric fields and alpha particles are not.

4 Beta particles have a much smaller mass than alpha particles.

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Turn over for the next question

QUESTION SEVEN

In 2009, the European Space Agency launched two space telescopes: the Herschel and the Planck.

Also in 2009, the US space shuttle Atlantis was launched. Atlantis carried seven astronauts to service the Hubble space telescope.

The table gives information about the three space telescopes.

	Hubble	Herschel	Planck
Distance from Earth	560 km	1.5 million km	1.5 million km
Radiation detected	Visible light, ultraviolet	Infra red	Microwaves
Cost of 2009 launch	£1 billion (for servicing)	Total for the 2 telescopes - £1.7 billion	
Objects observed	Distant stars and galaxies	Early development of galaxies	Radiation left over from the 'Big Bang'

7A The Hubble and Herschel telescopes both contain mirrors. The diameter of the mirror in the Herschel telescope is 50 % larger than the diameter of the main mirror in the Hubble telescope.

This means that the . . .

1 Herschel mirror is capable of collecting more energy each second than the Hubble mirror.

2 cost of the Herschel telescope is higher than the cost of the Hubble servicing mission.

3 Herschel telescope is much lighter than the Hubble telescope.

4 orbit of the Herschel telescope is much larger than the orbit of the Hubble telescope.

7B The larger the diameter of a telescope mirror, the longer the wavelength of radiation it can detect.

The order of increasing diameters for the space telescopes in the table is . . .

1 Herschel; Hubble; Planck.

2 Hubble; Herschel; Planck.

3 Planck; Herschel; Hubble.

4 Planck; Hubble; Herschel.

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7C The table refers to radiation left over from the 'Big Bang'.

What is the 'Big Bang'?

1 a theory that the light from distant galaxies shows a red-shift

2 an observation that the universe is expanding

3 a theory that the universe began from a very small initial point

4 evidence that distant galaxies are moving away from the Earth

7D A survey showed that a lot of people living in the UK think that the money spent on the launches in 2009 would have been better spent on feeding starving people in the developing world.

The people in the survey are concerned about . . .

1 political and scientific issues.

2 political and environmental issues.

3 economic and environmental issues.

4 economic and ethical issues.

Turn over for the next question

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QUESTION EIGHT

An isotope, **X**, is radioactive and decays into isotope **Y**, which is not radioactive.

Rocks such as granite contain both of these isotopes.

The half-life of isotope **X** is 4 million years.

8A A sample of granite is found to contain one atom of **Y** for each atom of **X**.

The age of the rock is about . . .

1 1 million years.

2 2 million years.

3 4 million years.

4 6 million years.

8B Another sample of rock is known to be 8 million years old.

The ratio of the number of atoms of **X** to the number of atoms of **Y** would be . . .

1 1 : 2

2 1 : 3

3 1 : 4

4 2 : 1

8C A sample of rock contains atoms of isotope **X**, but no atoms of isotope **Y**.

This is because . . .

1 all the atoms of **Y** have decayed.

2 the atoms of **X** in this sample are not radioactive.

3 the half-life of atoms of **X** in this sample is greater than 4 million years.

4 the rock has only recently been formed.

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8D Isotope **X** decays by emitting alpha particles.

An alpha particle consists of . . .

1 2 electrons only.

2 2 protons and 2 neutrons.

3 2 neutrons only.

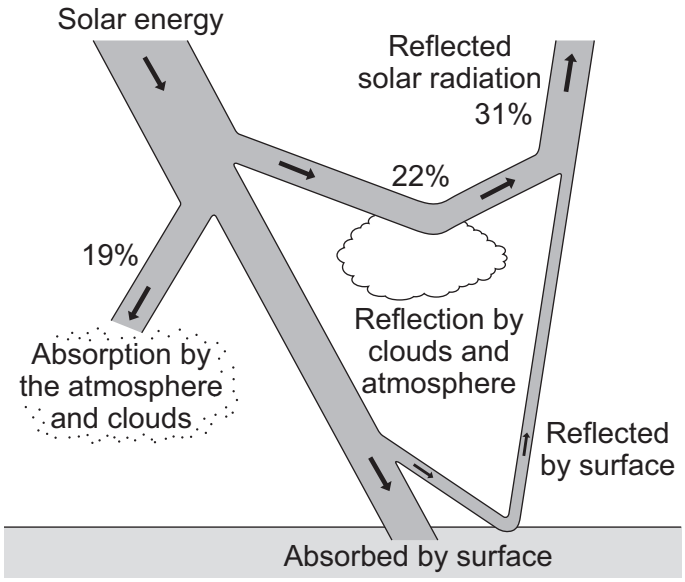
4 2 protons and 2 electrons.

Turn over for the next question

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QUESTION NINE

The diagram shows what happens to solar energy as it enters the Earth's atmosphere on one day.



9A What percentage of the energy is absorbed by the Earth's surface?

1 28 %

2 50%

3 72 %

4 78 %

9B Solar radiation consists of different groups from the electromagnetic spectrum. In the ultraviolet region there are three main types, as shown in the diagram below.

Gamma	X-ray	Ultraviolet **UVC UVB UVA**	Visible	Infra red	Microwave	Radio

Which of the following statements is correct?

1 UVA rays have the same frequency, longer wavelength and travel at a faster speed than UVB rays.

2 UVB rays have a lower frequency, the same wavelength and travel at the same speed as UVC rays.

3 UVB rays have a lower frequency, a longer wavelength and travel at the same speed as UVC rays.

4 UVB rays have a higher frequency, a shorter wavelength and travel at a slower speed than UVC rays.

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A measure of the ability of a surface to reflect sunlight is called the 'albedo' of the surface.

The *albedo* has a range of values from 0 (no reflection) to 1 (total reflection).

The table below gives the *albedo* values for some surfaces on the Earth.

Surface	Albedo
forest	0.06 – 0.14
crops	0.15 – 0.25
dry soil	0.24 – 0.35
ice	0.33 – 0.38
dry sand	0.36 – 0.44
old snow	0.42 – 0.60
new concrete	0.50 – 0.60
fresh snow	0.80 – 0.90

9C From the table, which of the following surfaces has the biggest range of *albedo* values?

1 crops

2 dry sand

3 dry soil

4 old snow

9D The average *albedo* of the Earth – atmosphere system is currently about 0.30. Scientists think that this value may rise over the next 50 years.

Which one of the following statements supports their idea?

1 More crops are being produced.

2 The Earth is getting further away from the Sun.

3 There is a decrease in forest area and an increase in urban areas.

4 Less fresh snow is being deposited because of climate change.

END OF TEST

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There are no questions printed on this page

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Version 1.0: 01/04/2011

GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2011 Examination – March Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2011

Foundation Tier

Question	Key		
One	**A**	infra red	**3**
	B	microwaves	**2**
	C	radio waves	**1**
	D	visible light	**4**
Two	**A**	infra red	**3**
	B	microwaves	**2**
	C	visible light	**1**
	D	X-rays	**4**
Three	**A**	bacteria	**3**
	B	cells	**2**
	C	isotopes	**1**
	D	particles	**4**
Four	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet rays	**2**
Five	**A**	a belief that science cannot disprove	**1**
	B	a conclusion based on observations of red-shift	**3**
	C	a theory supported by scientific evidence but not direct observations	**4**
	D	a theory that science has disproved	**2**

	A	**B**	**C**	**D**
Six	**1**	**4**	**4**	**1**
Seven	**1**	**4**	**1**	**2**
Eight	**1**	**3**	**2**	**1**
Nine	**4**	**1**	**2**	**2**

GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2011

Higher Tier

Question	Key		
One	**A**	a belief that science cannot disprove	**1**
	B	a conclusion based on observations of red-shift	**3**
	C	a theory supported by scientific evidence but not direct observations	**4**
	D	a theory that science has disproved	**2**
Two	**A**	Isotope **A**	**4**
	B	Isotope **B**	**1**
	C	Isotope **C**	**3**
	D	Isotope **D**	**2**

	A	**B**	**C**	**D**
Three	**1**	**3**	**2**	**1**
Four	**4**	**1**	**2**	**2**
Five	**4**	**3**	**4**	**3**
Six	**2**	**3**	**2**	**4**
Seven	**1**	**2**	**3**	**4**
Eight	**3**	**2**	**4**	**2**
Nine	**2**	**3**	**4**	**3**

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 3G11

02-MAR-11

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	a belief that science cannot disprove	○	○	○	○
1B	a conclusion based on observations of red-shift	○	○	○	○
1C	a theory supported by scientific evidence but not.....	○	○	○	○
1D	a theory that science has disproved	○	○	○	○

QUESTION TWO		1	2	3	4
2A	Isotope A	○	○	○	○
2B	Isotope B	○	○	○	○
2C	Isotope C	○	○	○	○
2D	Isotope D	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE	1	2	3	4
1A infra red	○	○	○	○
1B microwaves	○	○	○	○
1C radio waves	○	○	○	○
1D visible light	○	○	○	○

QUESTION TWO	1	2	3	4
2A infra red	○	○	○	○
2B microwaves	○	○	○	○
2C visible light	○	○	○	○
2D X-rays	○	○	○	○

QUESTION THREE	1	2	3	4
3A bacteria	○	○	○	○
3B cells	○	○	○	○
3C isotopes	○	○	○	○
3D particles	○	○	○	○

QUESTION FOUR	1	2	3	4
4A gamma rays	○	○	○	○
4B infra red rays	○	○	○	○
4C radio waves	○	○	○	○
4D ultraviolet rays	○	○	○	○

QUESTION FIVE	1	2	3	4
5A a belief that science cannot disprove	○	○	○	○
5B a conclusion based on observations of red-shift	○	○	○	○
5C a theory supported by scientific evidence but not...	○	○	○	○
5D a theory that science has disproved	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2010

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Thursday 11 November 2010 Afternoon Session

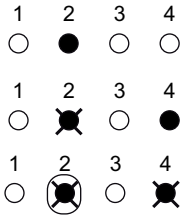
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 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

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

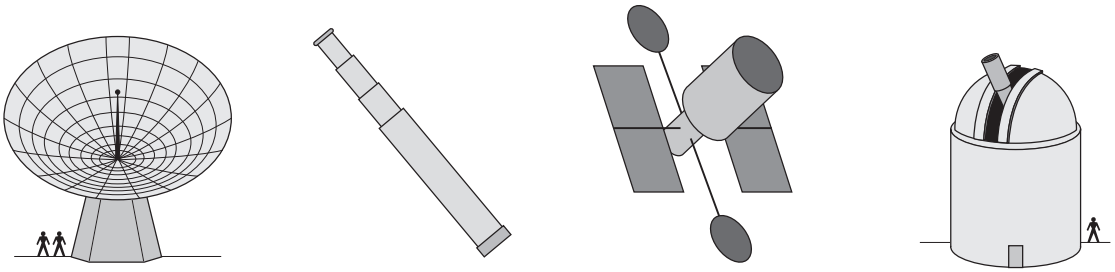
D X-rays

	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.

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QUESTION TWO

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



1 2 3 4

Not to scale

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

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

B in orbit around the Earth

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

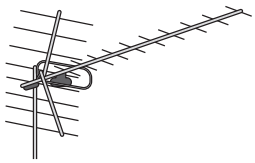
D used by scientists to detect radio waves from space

Turn over for the next question

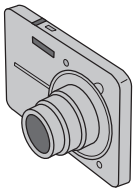
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QUESTION THREE

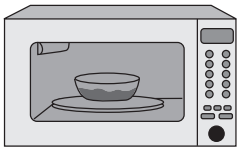
The drawings show devices that use electromagnetic waves.



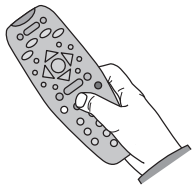
1



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

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

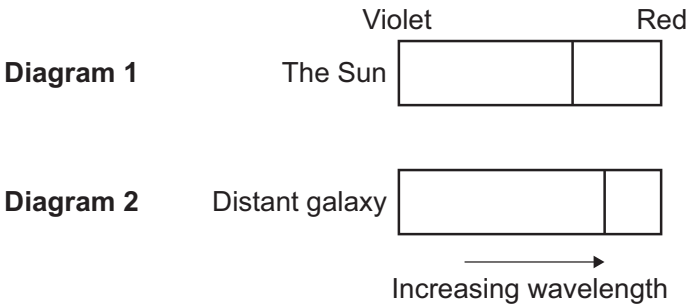
D ultraviolet

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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** . . . .

Turn over for the next question

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Section Two

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

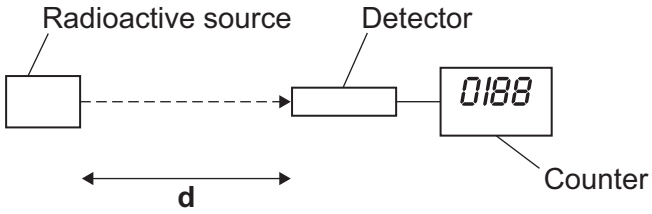
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

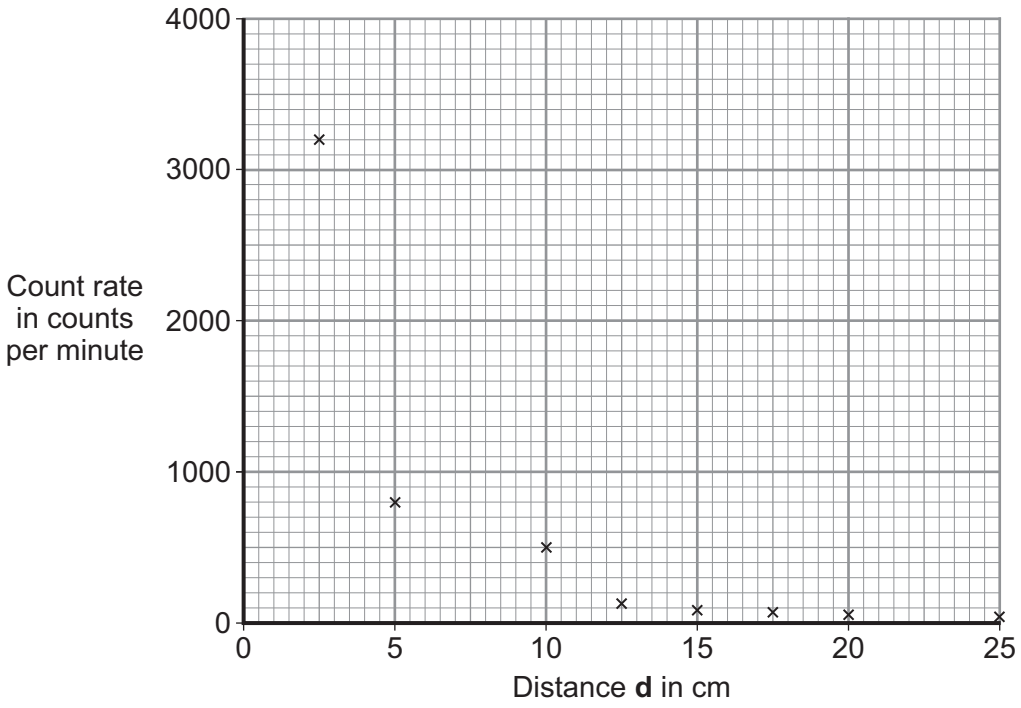
QUESTION SIX

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



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

The student plotted the results on graph paper.



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

1 both variables are categoric.

2 both variables are continuous.

3 both variables are ordered.

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

6B The range of distance measurements is . . .

1 2.5 – 5.0 cm

2 2.5 – 10.0 cm

3 2.5 – 20.0 cm

4 2.5 – 25.0 cm

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

This made the data more . . .

1 accurate.

2 discrete.

3 reliable.

4 sensitive.

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

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

2 was caused by a systematic error in the ruler.

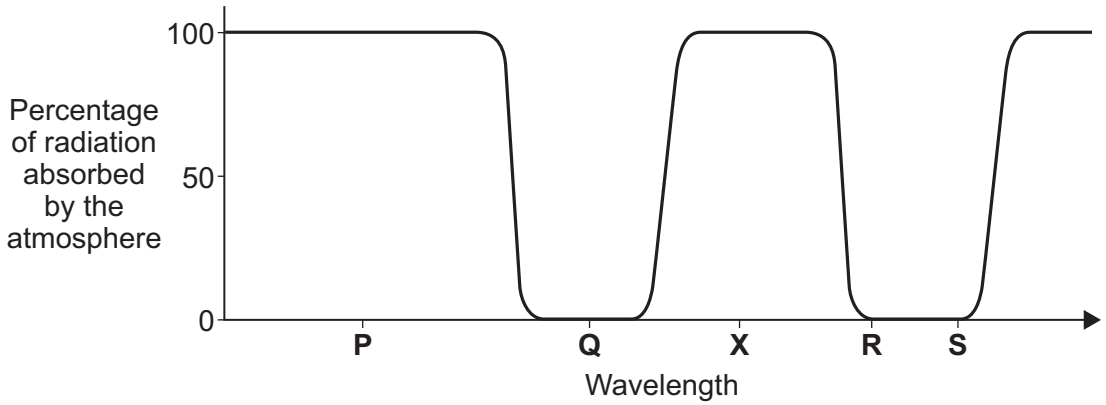
3 was caused by a systematic error in the counter.

4 should be ignored when drawing the graph line.

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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

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- 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.

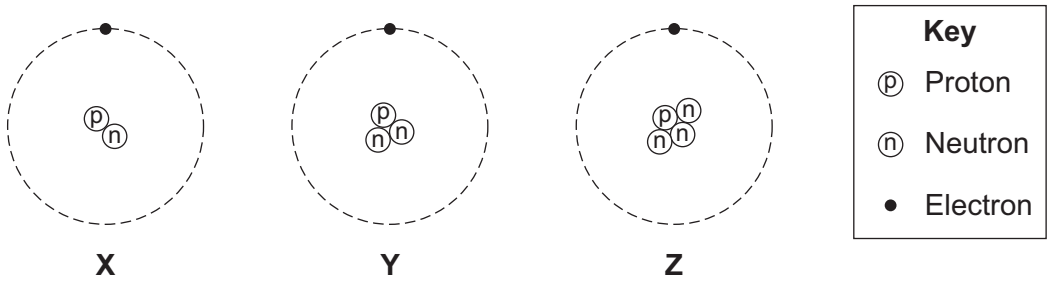
4 waves are in the visible light region.

Turn over for the next question

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QUESTION EIGHT

The diagram shows three atoms, **X**, **Y** and **Z**.



8A Which of these atoms are isotopes of the same element?

1 **X**, **Y** and **Z**

2 **X** and **Y** only

3 **X** and **Z** only

4 **Y** and **Z** only

8B Some substances are radioactive.

What does this mean?

1 Radio signals make these substances emit radiation.

2 These substances can take part in chemical reactions.

3 These substances emit radiation from the nuclei of their atoms.

4 These substances glow in the dark.

8C Some substances emit beta radiation.

What is beta radiation?

1 a helium nucleus

2 an electron from outside the nucleus

3 an electron from inside the nucleus

4 an electromagnetic wave

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8D The warning label is from a smoke detector.

Warning!
This device contains a source that emits alpha radiation.
Do not take this device apart.

What is the reason for this warning?

1 Alpha radiation is very dangerous if the source gets inside the body.

2 Alpha radiation can travel very long distances in the air.

3 Alpha radiation has the longest half-life.

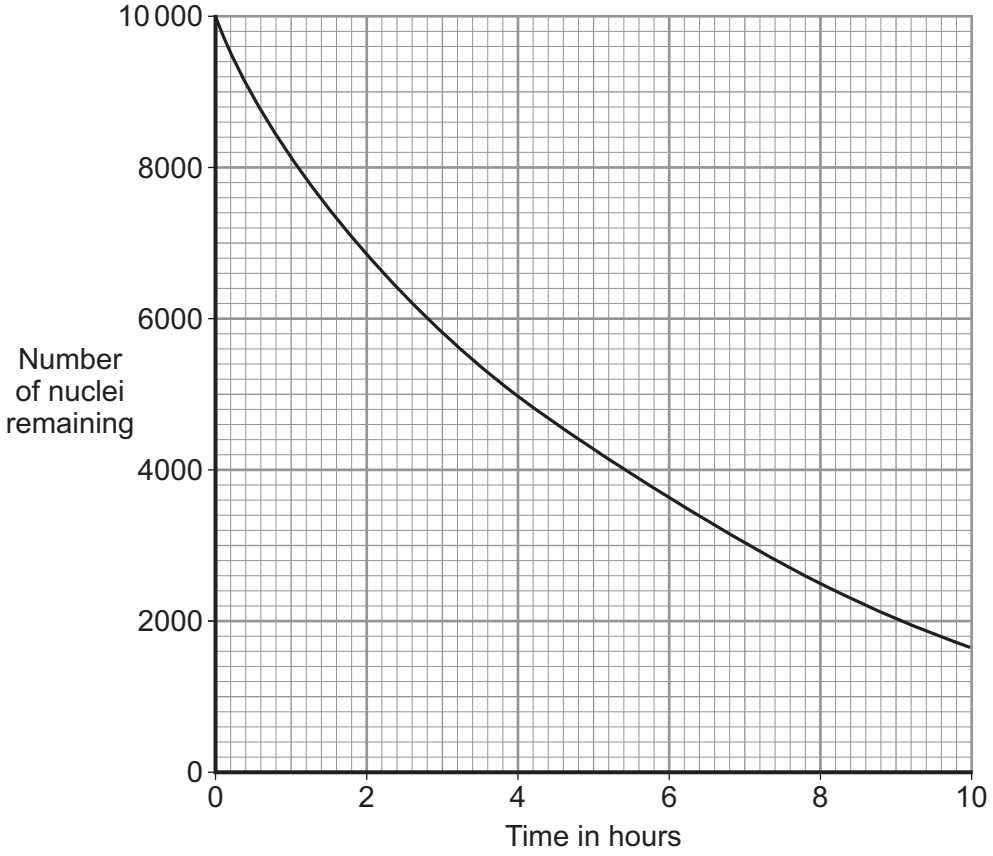
4 Alpha radiation is the most penetrating of all radiations.

Turn over for the next question

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QUESTION NINE

The graph shows the decay of a small sample of radioactive isotope. At the start, the sample contains 10 000 nuclei.



9A What is the half-life of the isotope shown in the graph?

1 2 hours

2 4 hours

3 6 hours

4 8 hours

9B How many of the original nuclei would remain after three half-lives?

1 1250

2 2500

3 3333

4 none

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9C This radioactive isotope may be suitable . . .

1 as a source of radiation in a smoke alarm.

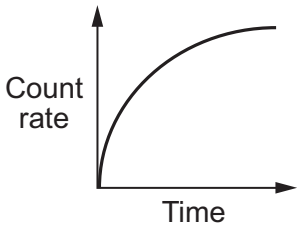
2 as a source of radiation to monitor the thickness of paper in a paper mill.

3 as a medical tracer in the human body.

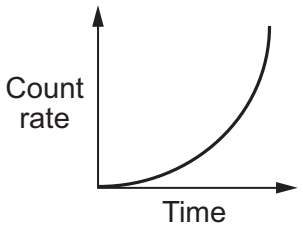
4 to use in finding the age of an ancient bone.

9D Which one of the following graphs would show how the count rate for this isotope changes with time?

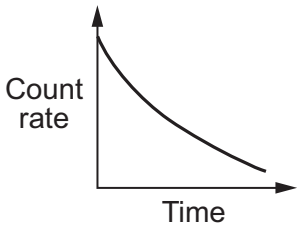
1



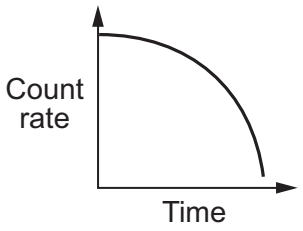
2



3



4



END OF TEST

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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**.

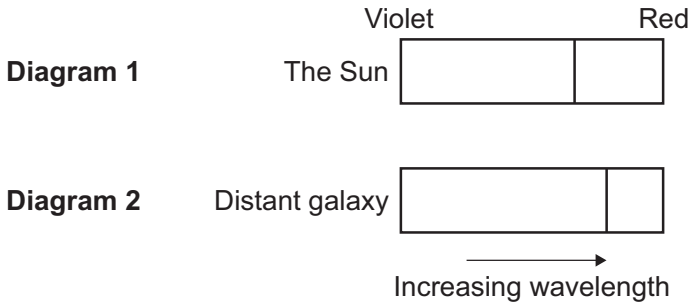
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

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** . . . .

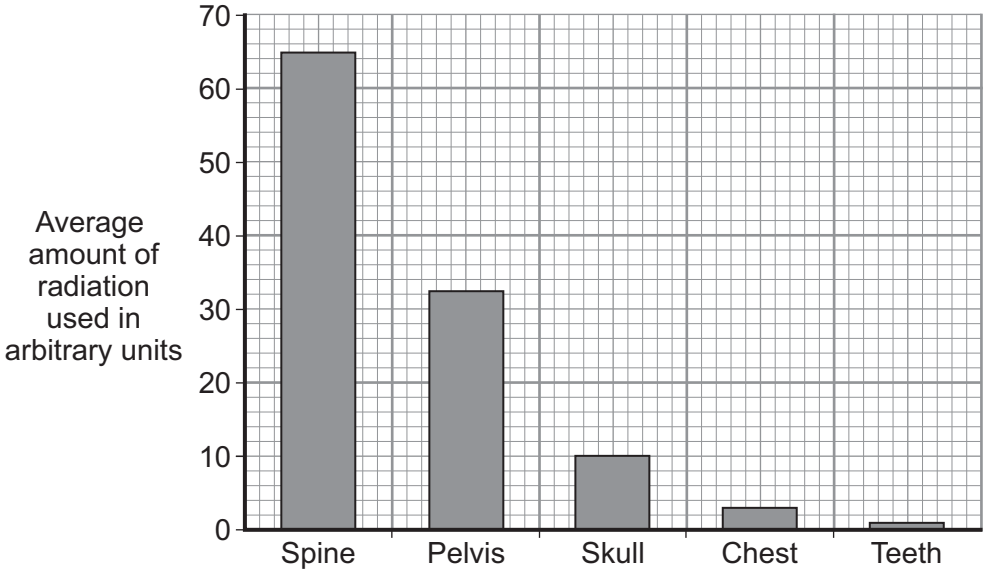
The frequency of the observed light had . . . **3** . . . .

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

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QUESTION TWO

A survey was carried out on patients having X-rays taken at a hospital.
The graph shows the average amount of radiation used when X-rays were taken of different parts of the body.



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

A categoric

B continuous

C dependent

D reliable

The data is **not** shown as a line graph because only one variable is . . . **1** . . . .

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

The part of the body of which an X-ray is taken is a . . . **3** . . . variable.

Surveying more patients would make the data more . . . **4** . . . .

Turn over for the next question

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Section Two

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

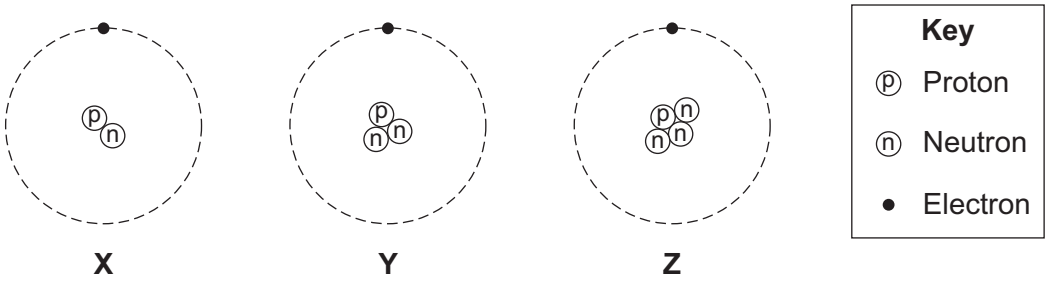
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

The diagram shows three atoms, **X**, **Y** and **Z**.



3A Which of these atoms are isotopes of the same element?

1 **X**, **Y** and **Z**

2 **X** and **Y** only

3 **X** and **Z** only

4 **Y** and **Z** only

3B Some substances are radioactive.

What does this mean?

1 Radio signals make these substances emit radiation.

2 These substances can take part in chemical reactions.

3 These substances emit radiation from the nuclei of their atoms.

4 These substances glow in the dark.

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3C Some substances emit beta radiation.

What is beta radiation?

1 a helium nucleus

2 an electron from outside the nucleus

3 an electron from inside the nucleus

4 an electromagnetic wave

3D The warning label is from a smoke detector.

Warning!
This device contains a source that emits alpha radiation.
Do not take this device apart.

What is the reason for this warning?

1 Alpha radiation is very dangerous if the source gets inside the body.

2 Alpha radiation can travel very long distances in the air.

3 Alpha radiation has the longest half-life.

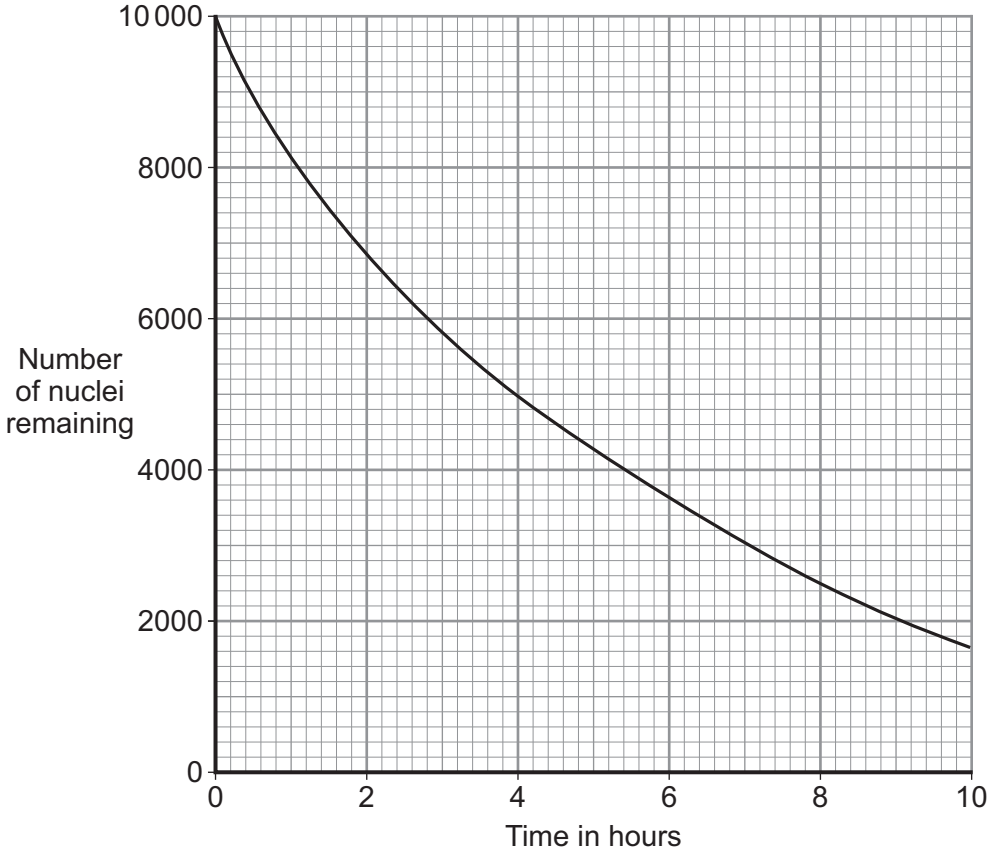
4 Alpha radiation is the most penetrating of all radiations.

Turn over for the next question

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QUESTION FOUR

The graph shows the decay of a small sample of radioactive isotope. At the start, the sample contains 10 000 nuclei.



4A What is the half-life of the isotope shown in the graph?

1 2 hours

2 4 hours

3 6 hours

4 8 hours

4B How many of the original nuclei would remain after three half-lives?

1 1250

2 2500

3 3333

4 none

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4C This radioactive isotope may be suitable . . .

1 as a source of radiation in a smoke alarm.

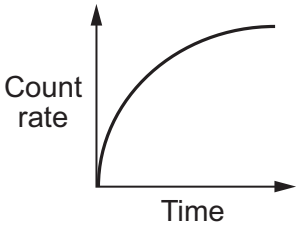
2 as a source of radiation to monitor the thickness of paper in a paper mill.

3 as a medical tracer in the human body.

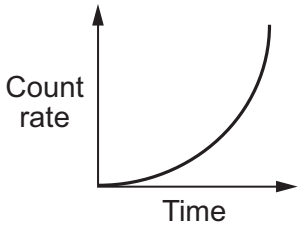
4 to use in finding the age of an ancient bone.

4D Which one of the following graphs would show how the count rate for this isotope changes with time?

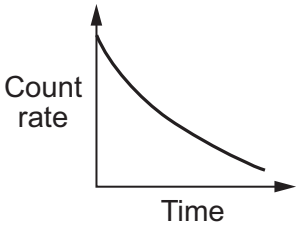
1



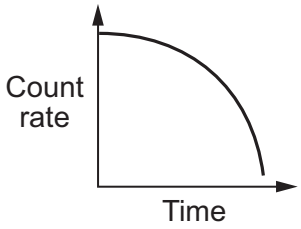
2



3



4



Turn over for the next question

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QUESTION FIVE

Fluorescers are substances that are used to make objects look brighter. Fluorescers absorb ultraviolet radiation and re-emit it as visible light. This makes the object glow when exposed to ultraviolet radiation.

- Laundry detergents contain fluorescers to make 'white look even whiter'.
- Dental compounds contain fluorescers to make teeth look brighter.
- Since 1950, fluorescers have been added to white paper to brighten it.

5A A white shirt has been washed in detergent containing a fluorescer.

The white shirt will . . .

1 be much cleaner.

2 glow in the dark.

3 look cleaner.

4 stay cleaner for longer.

5B A dentist paints someone's teeth with enamel containing a fluorescer.

The enamel absorbs ultraviolet radiation from sunlight and then emits light with . . .

1 a higher frequency and a longer wavelength.

2 a higher frequency and a shorter wavelength.

3 a lower frequency and a longer wavelength.

4 a lower frequency and a shorter wavelength.

5C A document is dated 1805. The document glows when it is viewed in ultraviolet light.

The document is likely to . . .

1 be a forgery.

2 have been printed before 1805.

3 have a dull surface.

4 have a shiny surface.

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5D The ultraviolet radiation used to view the document has a wavelength of 0.000 000 1 metres.

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

Speed of electromagnetic waves = 300 000 000 m/s

What is the frequency of ultraviolet radiation of wavelength 0.000 000 1 metres?

1 30 Hz

2 3 000 000 Hz

3 3 000 000 000 Hz

4 3 000 000 000 000 000 Hz

Turn over for the next question

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QUESTION SIX

Waves from different parts of the electromagnetic spectrum are used for communications.

6A Optical fibres can bend light around corners.

This is because the light . . .

1 is absorbed in the optical fibre.

2 is transmitted through the walls of the optical fibre.

3 is reflected inside the optical fibre.

4 travels faster in the optical fibre.

6B A metal aerial absorbs the energy carried by radio waves. This creates an alternating current (a.c.) in the metal and may produce a temperature change.

Which row in the table is correct?

	Frequency of a.c. produced	Temperature of metal
1	higher than the frequency of the radio waves	increases
2	the same as the frequency of the radio waves	increases
3	lower than the frequency of the radio waves	decreases
4	the same as the frequency of the radio waves	decreases

6C Television and telephone signals sent via satellites use microwaves rather than long wavelength radio waves.

This is because microwaves . . .

1 can pass easily through the Earth's atmosphere.

2 can travel through a vacuum.

3 have longer wavelengths than radio waves.

4 travel faster than radio waves.

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6D Digital signals are replacing analogue signals in television and telephone transmissions.

Which one of the following statements is correct?

1 Digital signals have discrete values only and are more prone to interference than analogue signals.

2 Digital signals have discrete values only and are less prone to interference than analogue signals.

3 Digital signals vary continuously and are more prone to interference than analogue signals.

4 Digital signals vary continuously and are less prone to interference than analogue signals.

Turn over for the next question

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QUESTION SEVEN

In 1927, a scientist proposed that the universe began with an explosion. His proposal came after astronomers had observed red-shift in light from distant galaxies.

7A Red-shift is an apparent . . .

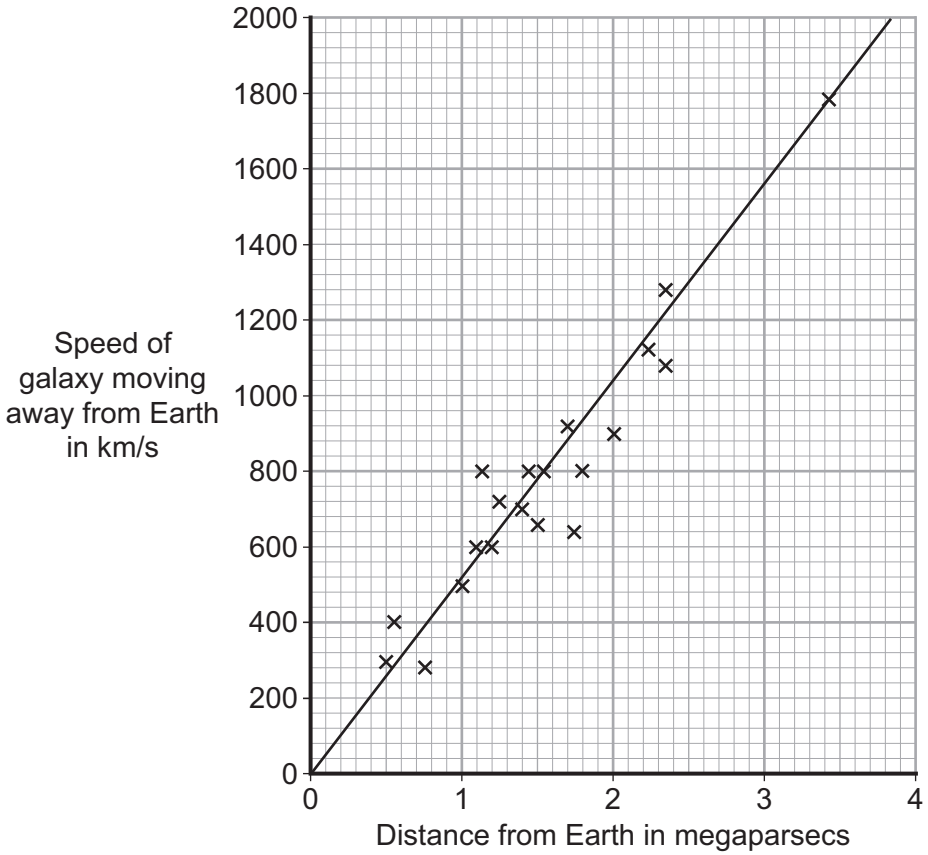
1 decrease in wavelength of the light due to a galaxy moving away from the Earth.

2 increase in wavelength of the light due to a galaxy moving away from the Earth.

3 decrease in wavelength of the light due to a galaxy moving towards the Earth.

4 increase in the wavelength of the light due to a galaxy moving towards the Earth.

The graph shows the results of calculations made by the astronomer Edwin Hubble. He plotted the speed at which the galaxies are moving away from Earth against their distance from Earth. The distance is given in megaparsecs. One parsec is approximately equal to 30 000 000 000 000 km.



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7B Hubble's results suggest that . . .

1 more results are needed before we can say there is a relationship between the speed of a galaxy and the distance of the galaxy from Earth.

2 there is a negative relationship between the speed of a galaxy and the distance of the galaxy from Earth.

3 the speed of a galaxy is directly proportional to the distance of the galaxy from Earth.

4 the graph points are too scattered to give a meaningful relationship.

7C The gradient of the line of best fit on the graph is known as the Hubble constant. The Hubble constant can be used to estimate the age of the universe.

From this data, the approximate value of the Hubble constant in km/s per megaparsec is . . .

1 4

2 500

3 1000

4 2000

7D Hubble's calculations support the 'big bang' theory. The 'big bang' theory says that the universe is expanding.

In 1948, George Gamow predicted that there should be microwave radiation left over from the 'big bang'. This radiation was discovered in the 1960s, and was confirmed by the Cosmic Background Explorer satellite in the early 1990s.

This discovery . . .

1 disproves the involvement of a god in the origin of the universe.

2 gives information to help us know what happened before the 'big bang'.

3 provides evidence which eliminates all other theories of the origin of the universe.

4 provides evidence in support of the 'big bang' theory.

Turn over for the next question

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QUESTION EIGHT

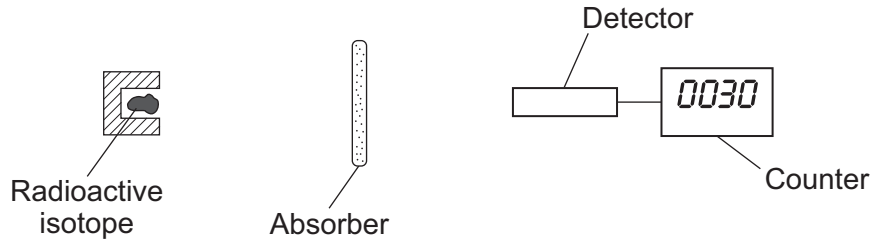
Radioactive isotopes may emit alpha, beta or gamma radiation.

A sixth-form student carried out experiments on different radioactive isotopes, **S**, **T** and **V**.

She was told that:

- all three types of radiation are emitted
- the experiments must be done in a vacuum.

In the first experiment, she put different absorbers in turn between each of the isotopes and a detector. She measured the count rate from each isotope.



The results are shown in **Table 1**.

Table 1

Isotope	Count rate in counts per second			
	No absorber	Sheet of paper	10 mm of aluminium	100 mm of lead
S	40	40	40	2
T	60	20	18	4
V	75	74	0	0

8A From these results, it can be concluded that isotope **V** emits . . .

1 alpha radiation only.

2 beta radiation only.

3 gamma radiation only.

4 alpha and gamma radiation.

8B Which source emits more than one type of radiation?

1 **S**

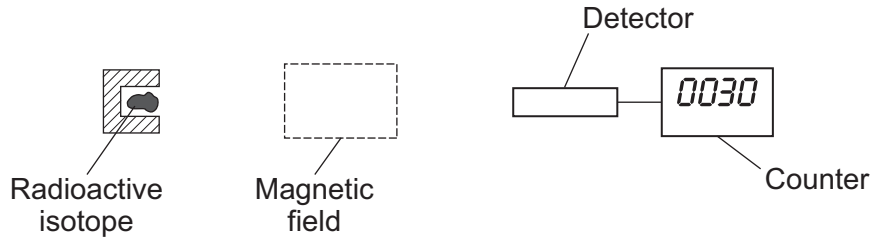
2 **T**

3 **V**

4 none of them

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8C In a second experiment, the absorber was replaced by a magnetic field.



The results are shown in **Table 2**.

Table 2

Isotope	Count rate in counts per second	
	Without magnetic field	With magnetic field
S	40	40
T	60	20
V	75	0

Which one of the following conclusions from the experiment is correct?

1 **V** could be a gamma emitter and a beta emitter.

2 **V** and **T** both emit gamma radiation.

3 **S** is either an alpha emitter or a beta emitter.

4 **T** could be an alpha emitter and a gamma emitter.

8D Some types of radiation are deflected by a magnetic field.

This is because the radiation . . .

1 is like a wave.

2 has a positive charge or a negative charge.

3 has north poles and south poles.

4 has no mass.

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QUESTION NINE

Four hundred years ago, Galileo pointed his small, primitive telescope at the night sky.

His telescope had lenses to focus light from the stars.

Today, much larger optical telescopes use large curved mirrors to focus light. The largest single-piece mirror has a diameter of 8.4 m. If the diameter was made any larger, the mirror would deform under its own weight. Very large telescopes use smaller mirrors linked together.

The table gives the effective diameters of the mirrors in several large optical telescopes.

Telescope	Keck	Giant Magellan Telescope (GMT)	Thirty Metre Telescope(TMT)	Very Large Telescope (VLT)
Effective diameter of mirror in metres	10.0	27.0	30.0	32.8

9A The TMT has nine times the light-collecting power of the Keck telescope mirror.

This is because the light-collecting power of a telescope is . . .

1 directly proportional to the diameter of the mirror.

2 inversely proportional to the diameter of the mirror.

3 directly proportional to the square of the diameter of the mirror.

4 inversely proportional to the square of the diameter of the mirror.

9B The VLT is located in a desert high in the mountains of South America.

The VLT produces sharp images because . . .

1 the VLT is nearer to the stars than optical telescopes at sea level.

2 light rays are more easily reflected higher in the atmosphere.

3 the night sky in the desert is clear and dark.

4 at the top of a mountain the telescope weighs less.

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9C Some telescopes are put into orbit round the Earth.

This is so that the telescopes . . .

1 can detect only visible light.

2 can detect only the electromagnetic waves that the Earth's atmosphere absorbs.

3 can detect visible light and sound waves.

4 can detect electromagnetic waves that do not reach the Earth's surface.

9D The smaller the diameter of a telescope, the higher the frequency of the waves that it can detect.

Pulsars are objects in space that emit radio waves. Pulsars were discovered using radio telescopes based on Earth.

The telescope that first detected the radiation from a pulsar had a diameter . . .

1 about the same size as the diameter of an optical telescope because the frequencies it detects are about the same.

2 smaller than the diameter of an optical telescope because the frequencies it detects are lower.

3 larger than the diameter of an optical telescope because the frequencies it detects are higher.

4 larger than the diameter of an optical telescope because the frequencies it detects are lower.

END OF TEST

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There are no questions printed on this page

There are no questions printed on this page

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ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A (4461) / Physics (4451)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2010 Examination – November Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1B (Radiation and the Universe)

November 2010

Foundation Tier

Question			Key	
One	**A**	infra red	**1**	
	B	ultraviolet	**4**	
	C	visible light	**3**	
	D	X-rays	**2**	
Two	**A**	can be used by anyone to view the surface of the moon		**2**
	B	in orbit around the Earth		**3**
	C	built on the top of a mountain and can be used to view planets		**4**
	D	used by scientists to detect radio waves from space		**1**
Three	**A**	infra red	**4**	
	B	microwaves	**3**	
	C	radio waves	**1**	
	D	visible light	**2**	
Four	**A**	gamma	**1**	
	B	infra red	**3**	
	C	radio	**4**	
	D	ultraviolet	**2**	
Five	**A**	decreased	**3**	
	B	increased	**2**	
	C	shifted	**1**	
	D	not changed	**4**	

	A	**B**	**C**	**D**
Six	**2**	**4**	**3**	**4**
Seven	**1**	**1**	**2**	**3**
Eight	**1**	**3**	**3**	**1**
Nine	**2**	**1**	**3**	**3**

GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1B (Radiation and the Universe)

November 2010

Higher Tier

Question	Key		
One	**A**	decreased	**3**
	B	increased	**2**
	C	shifted	**1**
	D	not changed	**4**
Two	**A**	categoric	**3**
	B	continuous	**1**
	C	dependent	**2**
	D	reliable	**4**

	A	B	C	D
Three	**1**	**3**	**3**	**1**
Four	**2**	**1**	**3**	**3**
Five	**3**	**3**	**1**	**4**
Six	**3**	**2**	**1**	**2**
Seven	**2**	**3**	**2**	**4**
Eight	**2**	**2**	**4**	**2**
Nine	**3**	**3**	**4**	**4**

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Series : BG10

Candidate Name :

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	decreased	○	○	○	○
1B	increased	○	○	○	○
1C	shifted	○	○	○	○
1D	not changed	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	categoric	○	○	○	○
2B	continuous	○	○	○	○
2C	dependent	○	○	○	○
2D	reliable	○	○	○	○

QUESTION THREE

	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR

	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE

	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE	1	2	3	4
1A infra red	○	○	○	○
1B ultraviolet	○	○	○	○
1C visible light	○	○	○	○
1D X-rays	○	○	○	○

QUESTION TWO	1	2	3	4
2A can be used by anyone to view the surface of the Moon	○	○	○	○
2B in orbit around the Earth	○	○	○	○
2C built on top of a mountain, can be used to view planets	○	○	○	○
2D used by scientists to detect radio waves from space	○	○	○	○

QUESTION THREE	1	2	3	4
3A infra red	○	○	○	○
3B microwaves	○	○	○	○
3C radio waves	○	○	○	○
3D visible light	○	○	○	○

QUESTION FOUR	1	2	3	4
4A gamma	○	○	○	○
4B infra red	○	○	○	○
4C radio	○	○	○	○
4D ultraviolet	○	○	○	○

QUESTION FIVE	1	2	3	4
5A decreased	○	○	○	○
5B increased	○	○	○	○
5C shifted	○	○	○	○
5D not changed	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
June 2010

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Monday 28 June 2010 Morning Session

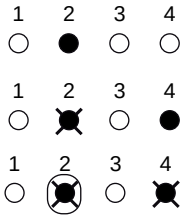
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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.

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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 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

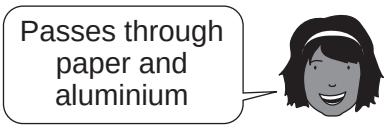
... **1** ...	shortest wavelength
... **2** ...	↓
ultraviolet waves	
... **3** ...	
infra red waves	
... **4** ...	
radio waves	longest wavelength

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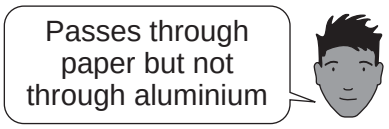
QUESTION TWO

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

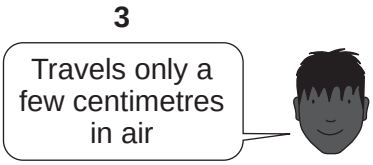
1



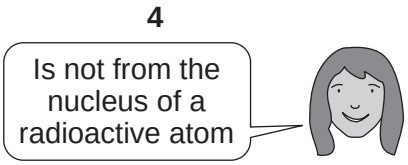
2



3



4



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

A alpha

B beta

C gamma

D X-rays

Turn over for the next question

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QUESTION THREE

The table gives uses for four types of radiation.

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

A alpha

B beta

C gamma

D X-rays

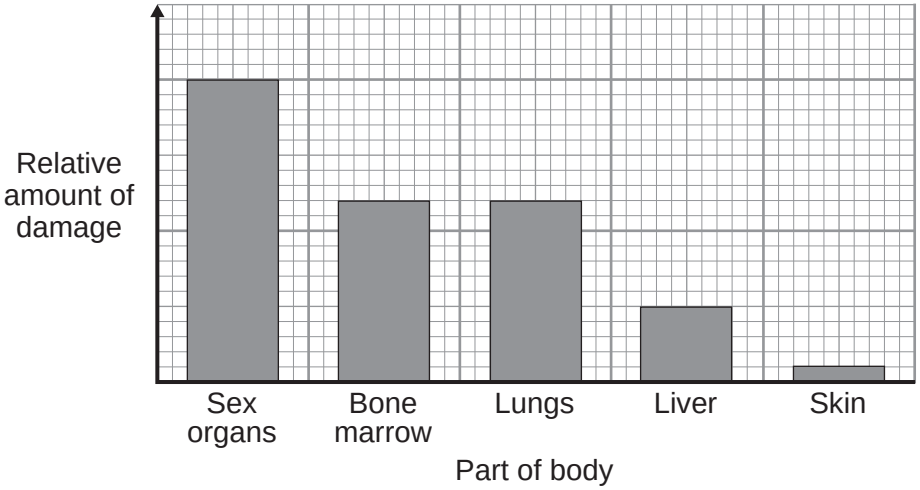
	Use
1	in medical tracers
2	in smoke detectors
3	to control the thickness of paper during manufacture
4	usually used to take shadow photographs of bones

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QUESTION FOUR

In 1920, scientists investigated the effect of radiation on different parts of the body. They found that some parts of the body were more affected by radiation than others.

The bar chart compares the relative amounts of damage to different parts of the body when they were exposed to the same radiation dose.



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

A categoric

B control

C dependent

D reliable

The radiation dose to which the body is exposed is the . . . **1** . . . variable.

The data is shown as a bar chart because one of the variables is . . . **2** . . . .

The relative amount of damage is the . . . **3** . . . variable.

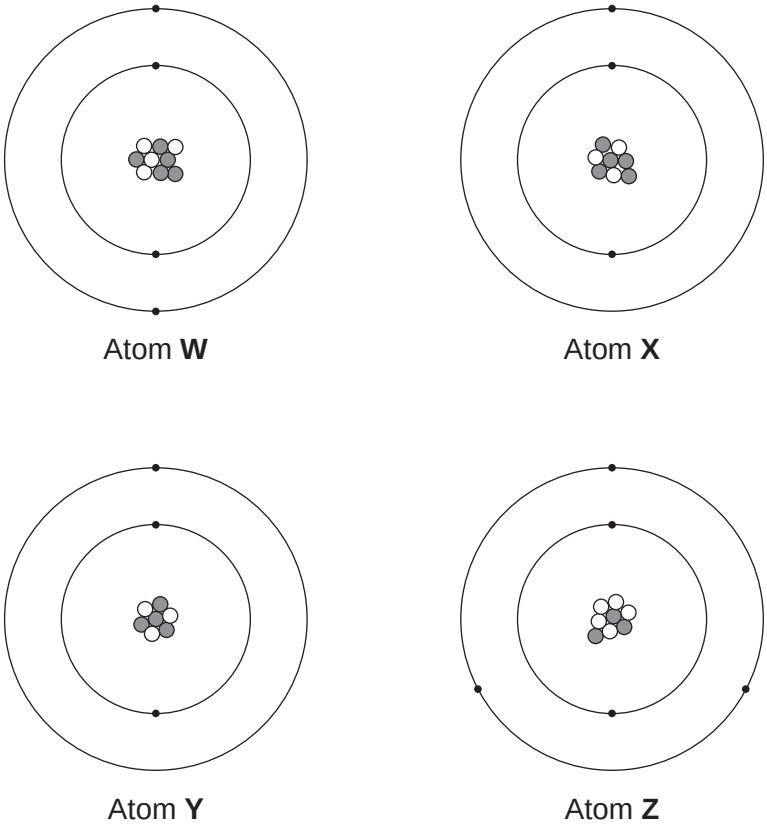
If scientists repeated the investigation today and got similar results, this would show that the original data was . . . **4** . . . .

Turn over for the next question

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QUESTION FIVE

The diagram shows four atoms, **W**, **X**, **Y** and **Z**.



Atom **W**

Atom **X**

Atom **Y**

Atom **Z**

Atoms **X** and **Y** are isotopes of the same element.

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

A three

B four

C five

D eight

Atom **W** contains . . . **1** . . . electrons.

Atom **X** contains . . . **2** . . . neutrons.

Atom **Y** contains . . . **3** . . . protons.

Atom **Z**'s nucleus contains . . . **4** . . . particles.

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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

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

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

This was . . .

1 a conclusion.

2 an estimate.

3 an observation.

4 a theory.

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

He had discovered radioactivity.

Becquerel had to change his ideas because . . .

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

2 sunlight could not pass through the black paper.

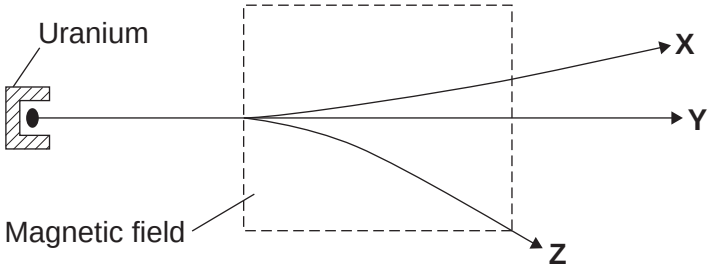
3 X-rays could not pass through the black paper.

4 radiation could not pass through the black paper.

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

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



Which of the following is the path of gamma radiation?

1 **X**

2 **Y**

3 **Z**

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

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

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

1 electrically charged.

2 electrically neutral.

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

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

Turn over for the next question

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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.

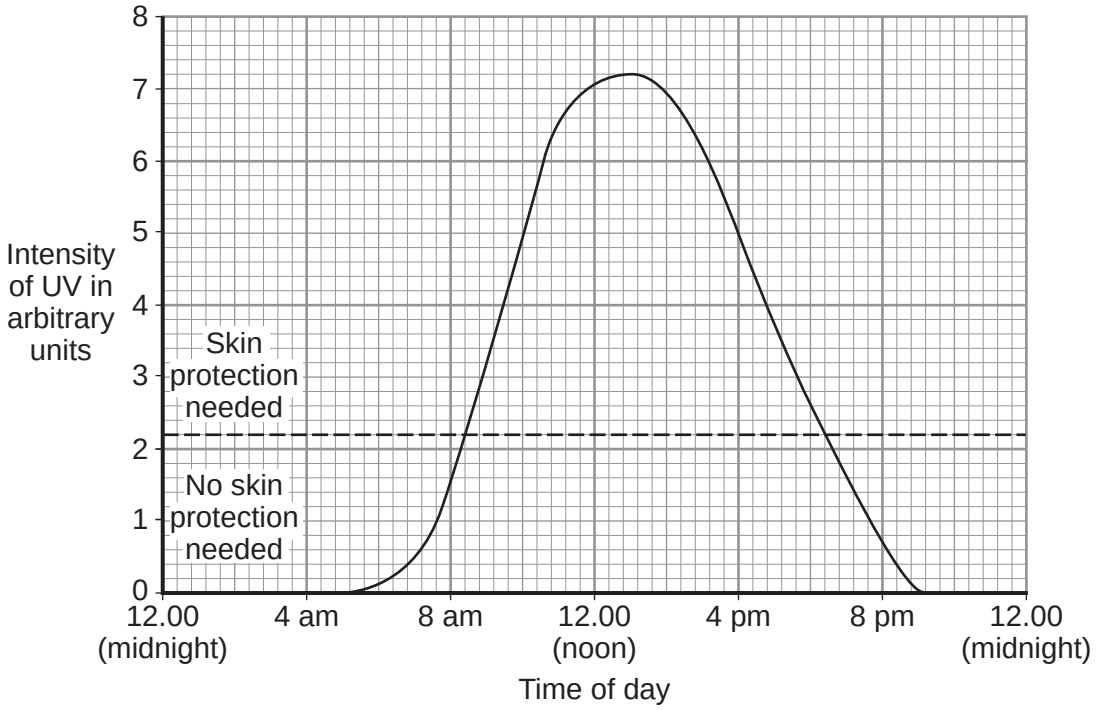
4 at the moment it is the best way of explaining our observations.

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Turn over for the next question

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

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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?

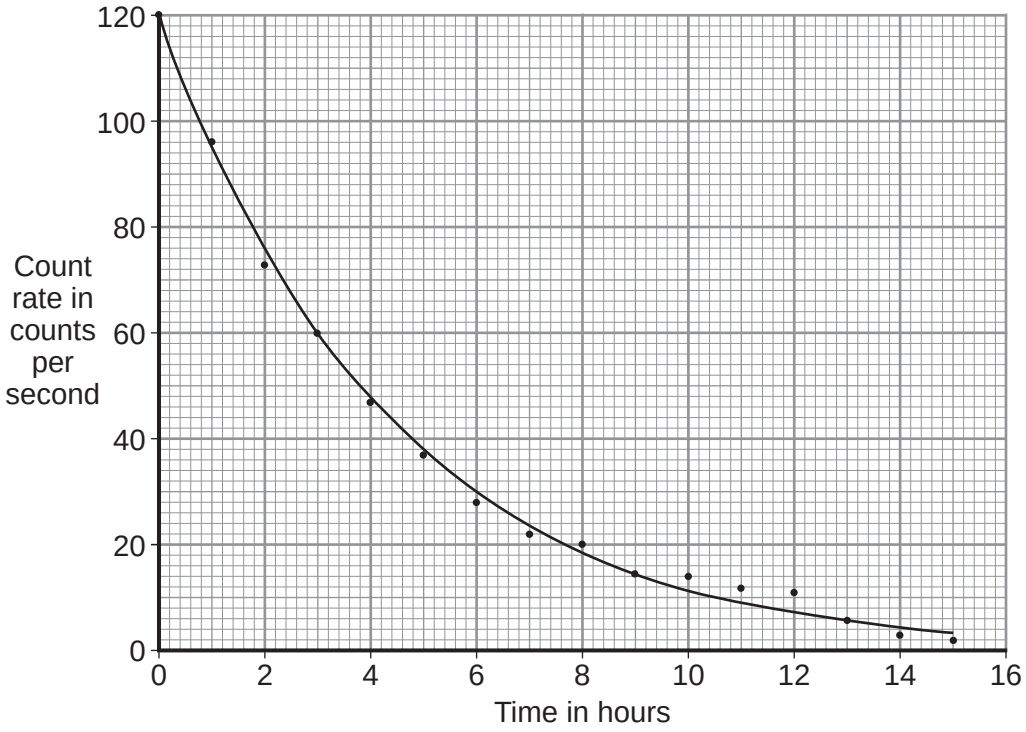
	Speed of UV compared with visible light	Frequency of UV compared with visible light
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

Turn over for the next question

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QUESTION NINE

The graph shows the count rate of a radioactive isotope over 15 hours.



9A Which row in the table describes correctly the types of variable?

	Count rate	Time
1	categoric	categoric
2	categoric	continuous
3	continuous	categoric
4	continuous	continuous

9B Not all the points of the graph lie on the drawn curve.

The line drawn is called . . .

1 a discrete line.

2 a line of best fit.

3 a line of least resistance.

4 an error line.

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9C The half-life of the radioactive isotope is . . .

1 2 hours.

2 3 hours.

3 5 hours.

4 7 hours.

9D A different radioactive isotope has a half-life of 10 hours.

What fraction of the original mass of isotope will be left after 30 hours?

1 $\frac{1}{3}$

2 $\frac{1}{8}$

3 $\frac{1}{30}$

4 $\frac{7}{8}$

END OF TEST

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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**.

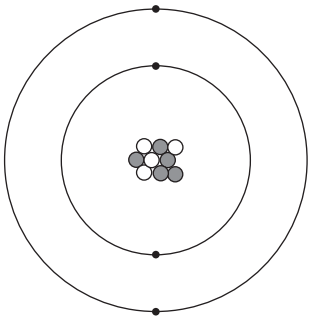
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

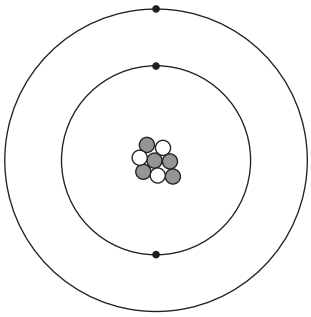
Mark your choices on the answer sheet.

QUESTION ONE

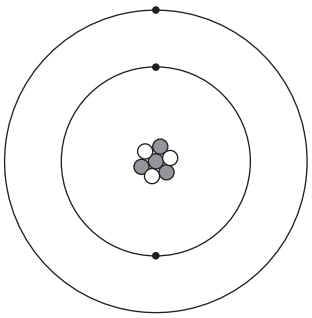
The diagram shows four atoms, **W**, **X**, **Y** and **Z**.



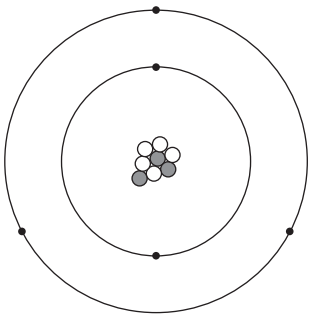
Atom **W**



Atom **X**



Atom **Y**



Atom **Z**

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Atoms **X** and **Y** are isotopes of the same element.

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

A three

B four

C five

D eight

Atom **W** contains . . . **1** . . . electrons.

Atom **X** contains . . . **2** . . . neutrons.

Atom **Y** contains . . . **3** . . . protons.

Atom **Z**'s nucleus contains . . . **4** . . . particles.

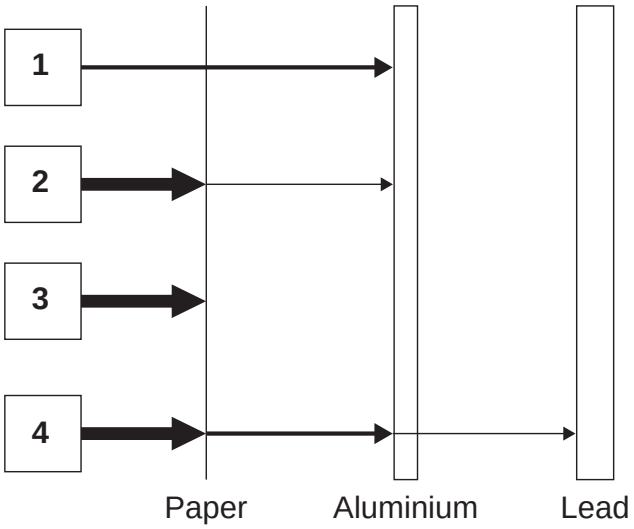
Turn over for the next question

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QUESTION TWO

Three absorbers are placed in front of four sources of radiation, **1**, **2**, **3** and **4**.

The amount of radiation is represented by the thickness of the horizontal arrows.



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

A Source gives off alpha radiation only.

B Source gives off alpha and beta radiation only.

C Source gives off alpha, beta and gamma radiation.

D Source gives off beta radiation only.

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Turn over for the next question

Section Two

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

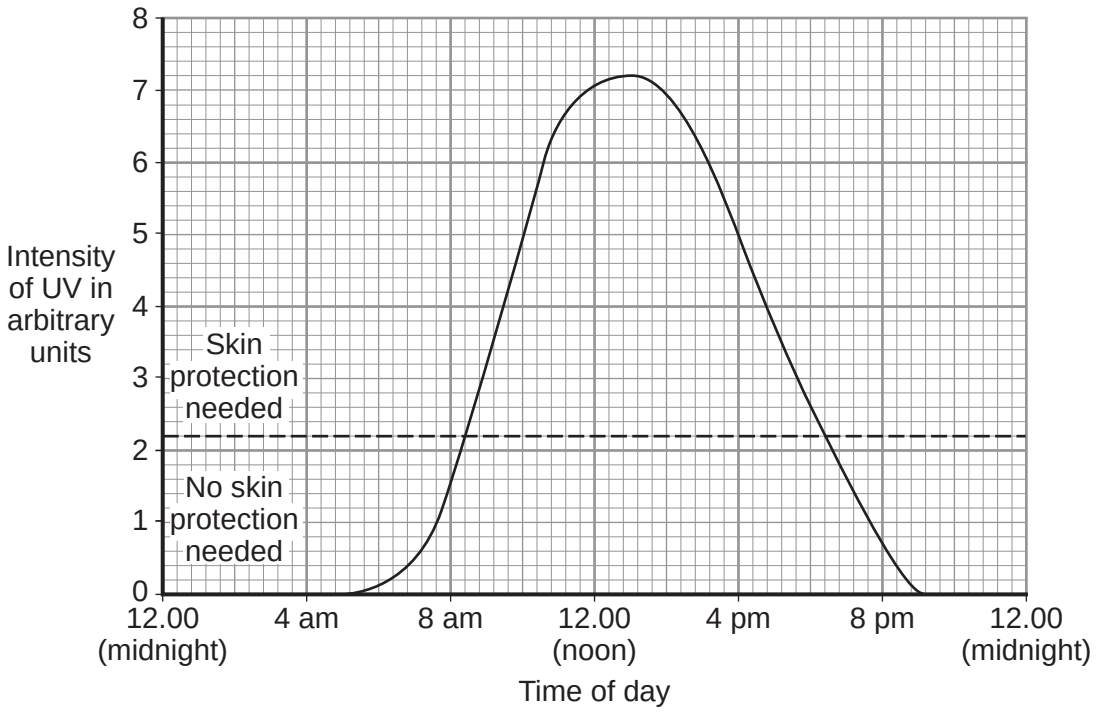
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

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



3A 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

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3B 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

3C 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

3D 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?

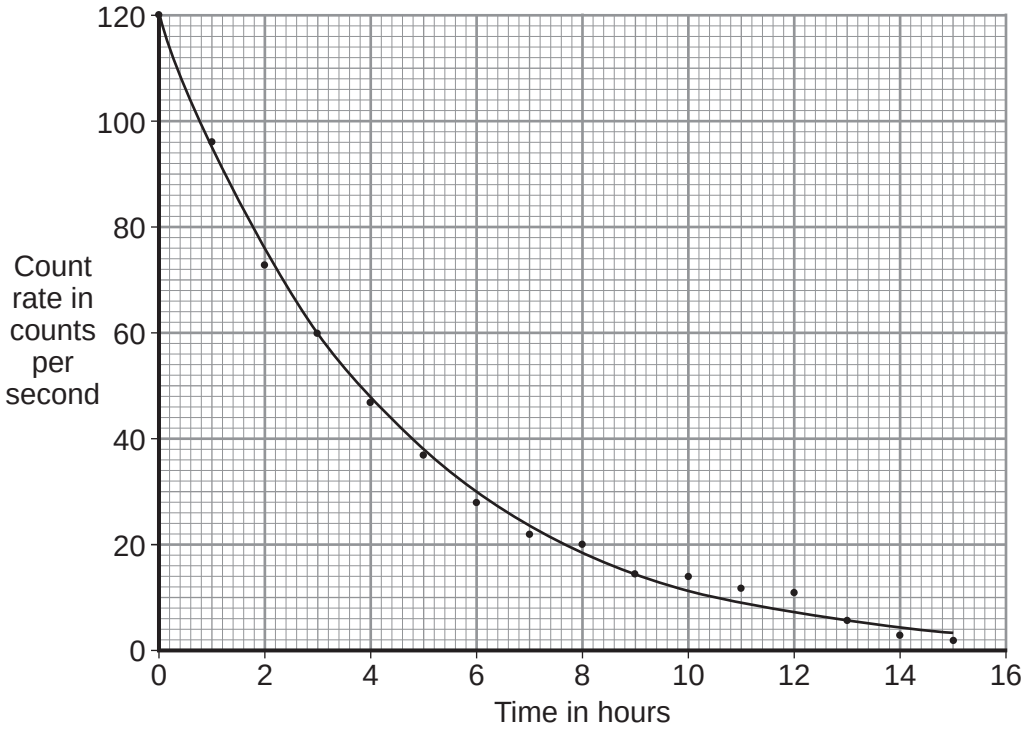
	Speed of UV compared with visible light	Frequency of UV compared with visible light
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

Turn over for the next question

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QUESTION FOUR

The graph shows the count rate of a radioactive isotope over 15 hours.



4A Which row in the table describes correctly the types of variable?

	Count rate	Time
1	categoric	categoric
2	categoric	continuous
3	continuous	categoric
4	continuous	continuous

4B Not all the points of the graph lie on the drawn curve.

The line drawn is called . . .

1 a discrete line.

2 a line of best fit.

3 a line of least resistance.

4 an error line.

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4C The half-life of the radioactive isotope is . . .

1 2 hours.

2 3 hours.

3 5 hours.

4 7 hours.

4D A different radioactive isotope has a half-life of 10 hours.

What fraction of the original mass of isotope will be left after 30 hours?

1 $\frac{1}{3}$

2 $\frac{1}{8}$

3 $\frac{1}{30}$

4 $\frac{7}{8}$

Turn over for the next question

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QUESTION FIVE

Some radioactive isotopes emit alpha particles. Other radioactive isotopes emit beta particles.

5A What is an alpha particle?

1 a helium nucleus

2 an electron from outside the nucleus

3 an electron from inside the nucleus

4 one proton and one neutron

5B What is a beta particle?

1 a helium nucleus

2 an electron from outside the nucleus

3 an electron from inside the nucleus

4 two protons and two neutrons

5C The half-life of a radioactive isotope is 1 second.

This means that after 2 seconds . . .

1 the count rate will have fallen to zero.

2 the count rate will have halved.

3 the number of nuclei of this isotope will have halved.

4 three-quarters of the nuclei of this isotope will have decayed.

5D Two scientists measured the half-life of another radioactive isotope. One obtained a value of 3.8 hours. The second scientist obtained a value of 4.65 hours.

What conclusion could you make?

1 The second scientist is correct because his answer shows greater precision.

2 You cannot tell which scientist is correct.

3 This isotope has a variable half-life.

4 The half-life is too short to measure accurately.

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Turn over for the next question

QUESTION SIX

Radio and television programmes are transmitted through the air over long distances.

The information is carried by electromagnetic waves.

6A Compared with light waves, radio waves . . .

1 have a shorter wavelength and a higher speed.

2 have a lower frequency and the same speed.

3 have a longer wavelength and a lower speed.

4 have a higher frequency and the same speed.

6B A radio programme is broadcast on a wavelength of 1500 metres. The speed of the wave is 300 000 000 m/s.

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

The frequency of these waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

6C Over the next few years, all television signals will be changed from analogue to digital.

One advantage to television broadcasters of using digital signals instead of analogue signals is that . . .

1 they are easier to generate.

2 they are less prone to interference.

3 they can travel faster.

4 they can travel further.

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6D Some people are worried about the effects of living close to a powerful radio transmitter.

Close to one transmitter, it was found that the number of children with leukaemia was slightly higher than normal. Leukaemia is a type of cancer of the blood.

What conclusion could you make from this observation?

1 Radio waves cause leukaemia.

2 There may be a connection between radio waves and leukaemia.

3 Adults are less likely than children to develop leukaemia.

4 Children should not be allowed to live near a radio transmitter.

Turn over for the next question

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QUESTION SEVEN

In 1896, Henri Becquerel was doing an experiment with uranium. He first thought that uranium absorbed energy from the Sun and then re-emitted the energy as X-rays. Then, on a cloudy day, he found that the uranium emitted radiation even when the uranium sample was wrapped in black paper.

7A This suggests that . . .

1 his original theory was wrong and further investigation was needed.

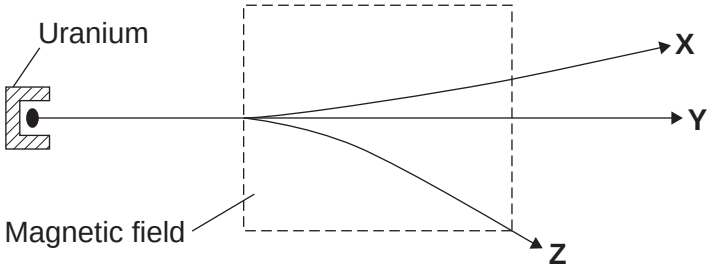
2 his test was fair but more variables needed to be controlled.

3 his original theory was correct and further investigation was needed.

4 his test was not fair and more variables needed to be controlled.

7B Becquerel passed the radiation emitted by uranium through a magnetic field. He found that there were three different types of radiation.

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



Later, Ernest Rutherford called the three types of radiation alpha, beta and gamma.

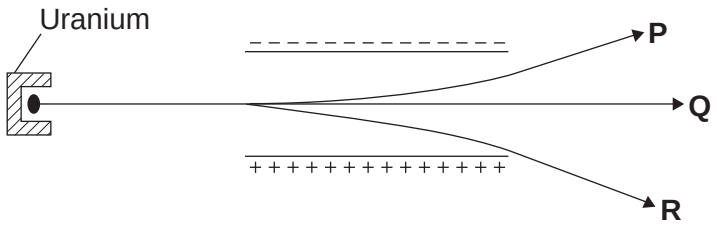
Which is the correct row in the table?

	X	Y	Z
1	alpha	beta	gamma
2	alpha	gamma	beta
3	beta	alpha	gamma
4	beta	gamma	alpha

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7C The radiation emitted by uranium can also be deflected in an electric field between two charged plates.

The diagram shows the paths taken by the three types of radiation, **P**, **Q** and **R**, in an electric field.



The explanation for the different paths is that . . .

1 **P** and **R** have the same electric charge and **Q** is uncharged.

2 **P** and **R** are oppositely charged and **P** has a larger mass than **R**.

3 **P** and **R** are oppositely charged and **R** has a larger charge than **P**.

4 **Q** is uncharged and has a larger mass than both **P** and **R**.

7D Rutherford measured the range in air of the three types of radiation.

Which row of the table gives the correct order of range?

	Shortest range → **Longest range**		
1	alpha	beta	gamma
2	alpha	gamma	beta
3	beta	alpha	gamma
4	beta	gamma	alpha

Turn over for the next question

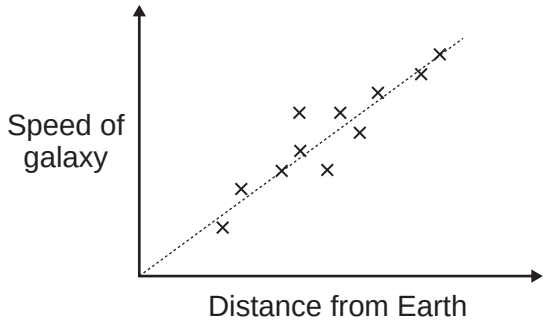
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QUESTION EIGHT

Red-shift measurements can be used to calculate the speed at which a galaxy is moving relative to the Earth.

Astronomers have also measured the distance of some galaxies from the Earth.

They have drawn their results on a graph.



8A The graph shows that . . .

1 all galaxies have the same speed.

2 distant galaxies are moving faster than nearer galaxies.

3 nearer galaxies are moving faster than more distant galaxies.

4 there is no relationship between how far galaxies are from the Earth and how fast they move.

8B Which of the following is the best description of red-shift? . . .

1 The light from galaxies is coloured red.

2 The light from galaxies is mainly at the red end of the spectrum.

3 The wavelength of light from galaxies shows a movement away from the red end of the spectrum.

4 The wavelength of light from galaxies shows a movement towards the red end of the spectrum.

8C Red-shift is described as . . .

1 the increased speed of the electromagnetic radiation as it travels from the galaxy.

2 the observed increase in frequency of the electromagnetic radiation leaving the galaxy.

3 the observed increase in wavelength of the electromagnetic radiation leaving the galaxy.

4 the decreased speed of the electromagnetic radiation as it travels from the galaxy.

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8D The observation of red-shift gives evidence to support the ‘big bang’ theory.

This theory states that . . .

1 the stars in each galaxy are moving further apart.

2 galaxies started to rotate after the ‘big bang’.

3 new galaxies are created by an explosion in space.

4 the universe started from a single initial point.

Turn over for the next question

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QUESTION NINE

Thermal imaging cameras are used by rescue workers to search for people trapped under rubble after an earthquake. Like all warm objects, the living human body emits infra red radiation. The cameras detect this infra red radiation. Electronic circuits in the camera produce a colour image in which different colours correspond to different wavelengths of infra red radiation.

The table shows the image colour, infra red wavelength and the temperature of the object.

Image colour	Infra red wavelength in micrometres	Temperature of object in °C
Red	9.51	32
Red-orange	9.45	34
Orange	9.4	36
Orange-yellow	9.32	38
Yellow	9.26	40
Yellow-white	9.2	42

9A Two of the values of wavelength in the table show a lower . . .

1 calibration.

2 precision.

3 range.

4 reliability.

9B A scientist wanted to display this data as a line graph.

Which row in the table below shows the scales which would best display the data?

	x-axis (wavelength in micrometres)	y-axis (temperature in °C)
1	0 to 10	0 to 50
2	0 to 10	30 to 50
3	9 to 10	0 to 50
4	9 to 10	30 to 50

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9C A thermal image of a small boy is mainly orange.

Under identical conditions, the thermal image of a much larger man would be . . .

1 mainly yellow because the man's body has a greater mass.

2 mainly red because the man's body has a larger surface area.

3 a mixture of red, orange and yellow because the man's body has a larger mass and a larger surface area.

4 mainly orange because the man and the boy have approximately the same body temperature.

9D At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

These cameras work better at night than during the day because at night . . .

1 the criminals emit more infra red radiation.

2 the cooler surroundings emit less infra red radiation.

3 the cooler surroundings emit less visible light.

4 the criminals wear black clothes.

END OF TEST

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Version 1:0: 26/07/10

ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A (4461)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2010 Examination – June Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE
SCIENCE A (4461) / PHYSICS (4451)
Objective Test Answer Key
PHY1BP (Radiation and the Universe)
June 2010
Foundation Tier

Question	*Key*		
One	**A**	gamma rays	**1**
	B	microwaves	**4**
	C	visible light	**3**
	D	X-rays	**2**
Two	**A**	alpha	**3**
	B	beta	**2**
	C	gamma	**1**
	D	X-rays	**4**
Three	**A**	alpha	**2**
	B	beta	**3**
	C	gamma	**1**
	D	X-rays	**4**
Four	**A**	categoric	**2**
	B	control	**1**
	C	dependent	**3**
	D	reliable	**4**
Five	**A**	three	**3**
	B	four	**1**
	C	five	**2**
	D	eight	**4**

	A	**B**	**C**	**D**
Six	4	2	2	1
Seven	4	3	1	4
Eight	3	3	4	2
Nine	4	2	2	2

GCSE
SCIENCE A (4461) / PHYSICS (4451)
Objective Test Answer Key
PHY1BP (Radiation and the Universe)
June 2010
Higher Tier

Question	*Key*		
One	**A**	three	**3**
	B	four	**1**
	C	five	**2**
	D	eight	**4**
Two	**A**	Source gives off alpha radiation only.	**3**
	B	Source gives off alpha and beta radiation only.	**2**
	C	Source gives off alpha, beta and gamma radiation.	**4**
	D	Source gives off beta radiation only.	**1**

	A	**B**	**C**	**D**
Three	3	3	4	2
Four	4	2	2	2
Five	1	3	4	2
Six	2	2	2	2
Seven	1	2	2	1
Eight	2	4	3	4
Nine	2	4	4	2

OTQ3

GCSE SCIENCE

AQA

Unit : PHY1BP **PHYSICS UNIT 1B**

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 6M10

28-JUN-10

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	three	○	○	○	○
1B	four	○	○	○	○
1C	five	○	○	○	○
1D	eight	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	Source gives off alpha radiation only.	○	○	○	○
2B	Source gives off alpha and beta radiation only.	○	○	○	○
2C	Source gives off alpha, beta and gamma radiation.	○	○	○	○
2D	Source gives off beta radiation only.	○	○	○	○

QUESTION THREE

	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR

	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE

	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	gamma rays	○	○	○	○
1B	microwaves	○	○	○	○
1C	visible light	○	○	○	○
1D	X-rays	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	alpha	○	○	○	○
2B	beta	○	○	○	○
2C	gamma	○	○	○	○
2D	X-rays	○	○	○	○

QUESTION THREE

		1	2	3	4
3A	alpha	○	○	○	○
3B	beta	○	○	○	○
3C	gamma	○	○	○	○
3D	X-rays	○	○	○	○

QUESTION FOUR

		1	2	3	4
4A	categoric	○	○	○	○
4B	control	○	○	○	○
4C	dependent	○	○	○	○
4D	reliable	○	○	○	○

QUESTION FIVE

		1	2	3	4
5A	three	○	○	○	○
5B	four	○	○	○	○
5C	five	○	○	○	○
5D	eight	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
March 2010

Science A
Unit Physics P1b (Radiation and the Universe)

Physics
Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Wednesday 3 March 2010 Morning Session

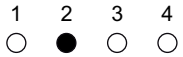
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

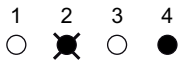
Time allowed
- 30 minutes

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.

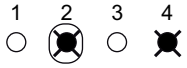
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown.



- 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.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 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

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

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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** . . . .

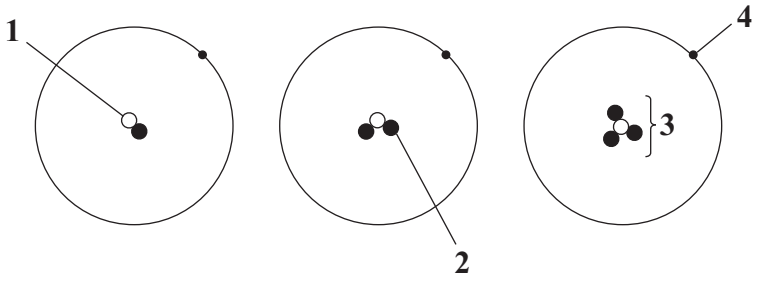
Between X-rays and visible light in the electromagnetic spectrum is . . . **2** . . . radiation.

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

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

QUESTION THREE

The diagrams show three isotopes of hydrogen.



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

A electron

B neutron

C nucleus

D proton

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QUESTION FOUR

This question is about types of radiation.

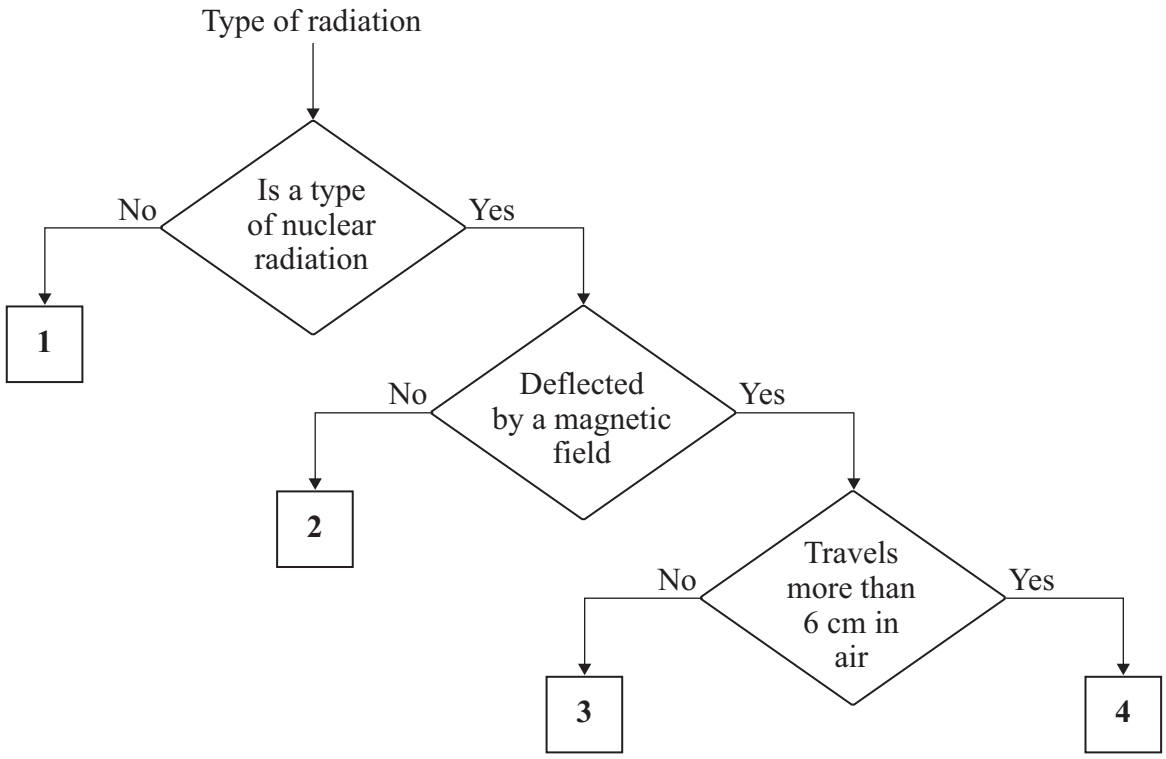
Match radiations, **A**, **B**, **C** and **D**, with the boxes **1–4** on the flow diagram.

A alpha

B beta

C gamma

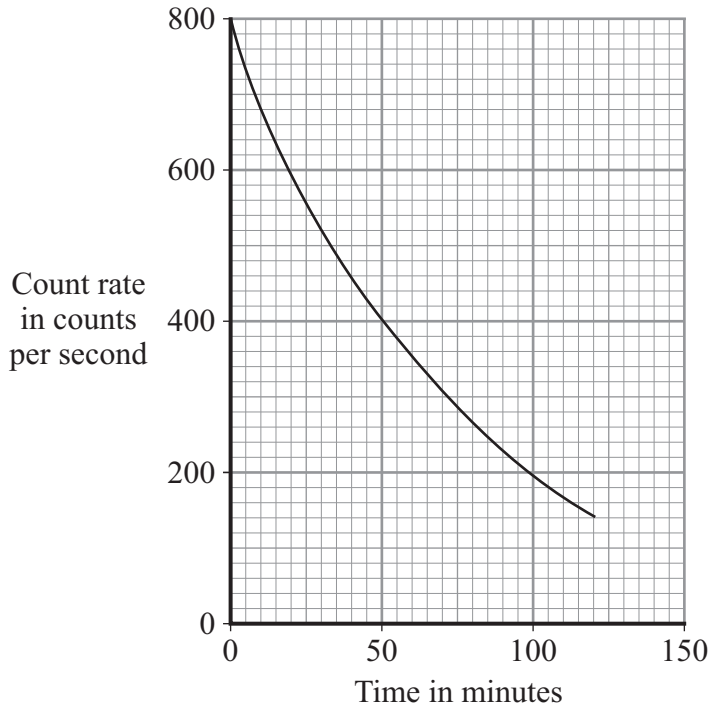
D X-rays



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QUESTION FIVE

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



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

A 50

B 100

C 400

D 800

1	the initial count rate of the substance
2	the count rate after one half-life
3	the half-life of the substance in minutes
4	the count rate after three half-lives

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SECTION TWO

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

Each of these questions has four parts.

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

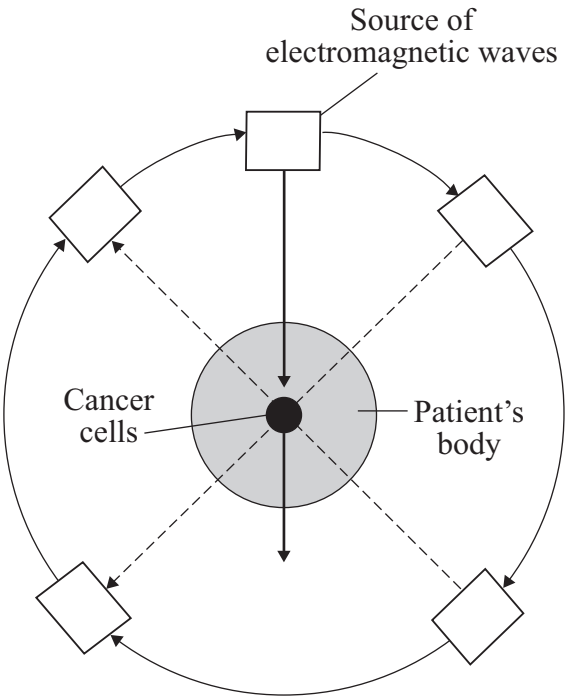
Mark your choices on the answer sheet.

QUESTION SIX

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

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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

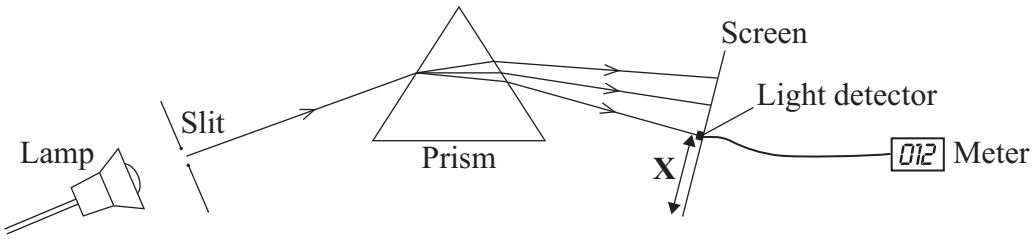
4 social

Turn over for the next question

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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

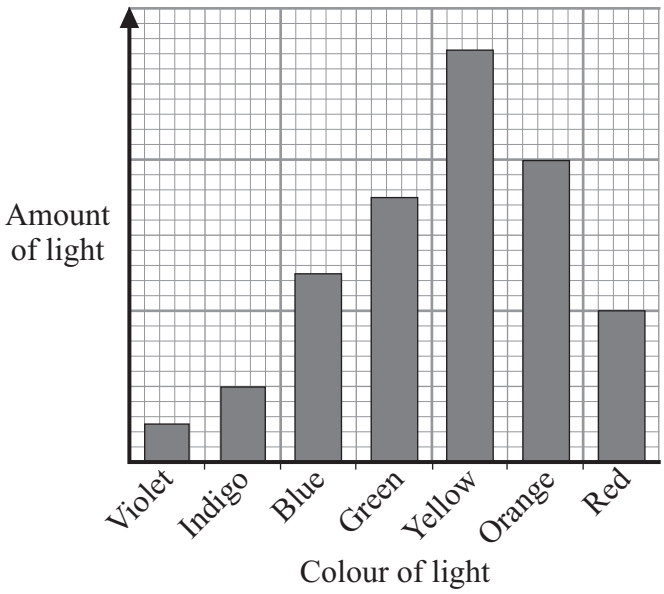
4 the distance **X** from the end of the screen to the detector

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

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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.

Turn over for the next question

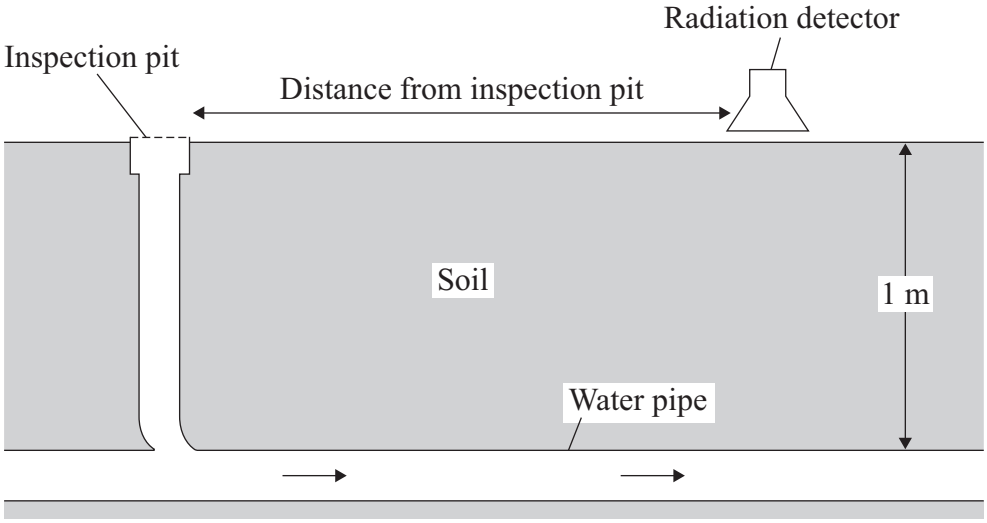
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QUESTION EIGHT

Some engineers investigated a problem with the flow of water through an underground pipe.
The pipe was 1 metre below the ground.

The engineers put a small amount of radioactive liquid into the pipe through an inspection pit.
The radioactive liquid had a half-life of two days.

A radiation detector was used to measure the count rate at different distances from the inspection pit.



The results are shown below.

Distance from the inspection pit in metres	Count rate in counts per minute
1	23
2	21
3	23
4	28
5	32
6	27
7	20
8	18
9	19
10	20

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8A The engineers would use a radioactive liquid that emits . . .

1 alpha radiation.

2 beta radiation.

3 gamma radiation.

4 X-radiation.

8B The readings suggest that . . .

1 the pipe was clear and water was flowing normally.

2 the pipe was not level.

3 the pipe had a leak.

4 the pipe had a blockage.

8C To improve the reliability of the data, the engineers should . . .

1 use a more sensitive counter.

2 re-calibrate the counter.

3 repeat their investigation and calculate the means.

4 decide whether the variables are continuous or discrete.

8D To fix the problem, workmen were asked to dig a hole down to the pipe.

The best place for the workmen to dig the hole is . . .

1 3 m from the inspection pit.

2 5 m from the inspection pit.

3 7 m from the inspection pit.

4 9 m from the inspection pit.

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QUESTION NINE

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

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

	Digital signal pattern	Analogue signal pattern
1		
2		
3		
4		

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

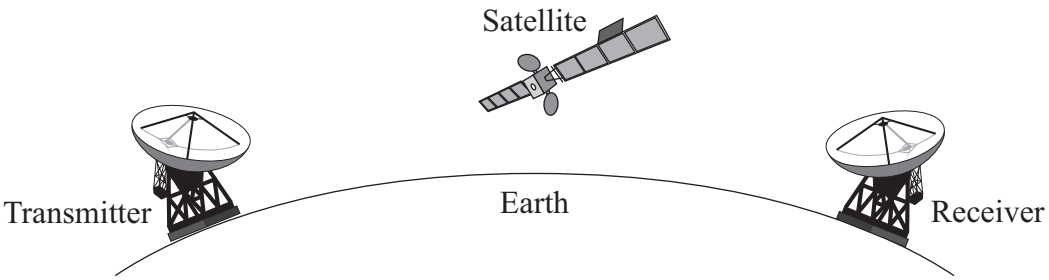
1 analogue signals are less prone to interference.

2 analogue signals can have only two values.

3 digital signals are continuously variable.

4 digital signals can be easily processed by computers.

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



Microwaves are used because . . .

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

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

3 they follow the curvature of the Earth.

4 they travel faster than radio waves.

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

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

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

At what speed do the waves travel?

1 1 m/s

2 25 m/s

3 100 m/s

4 2500 m/s

END OF TEST

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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**.

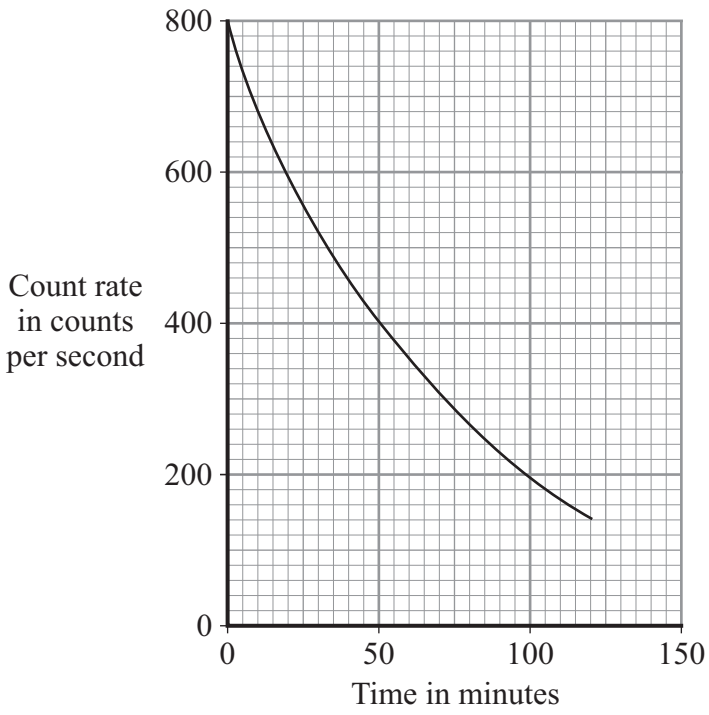
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1– 4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

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



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

A 50

B 100

C 400

D 800

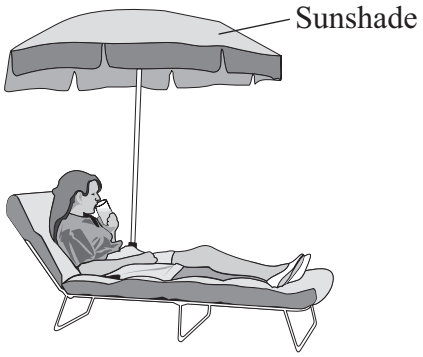
1	the initial count rate of the substance
2	the count rate after one half-life
3	the half-life of the substance in minutes
4	the count rate after three half-lives

Turn over for the next question

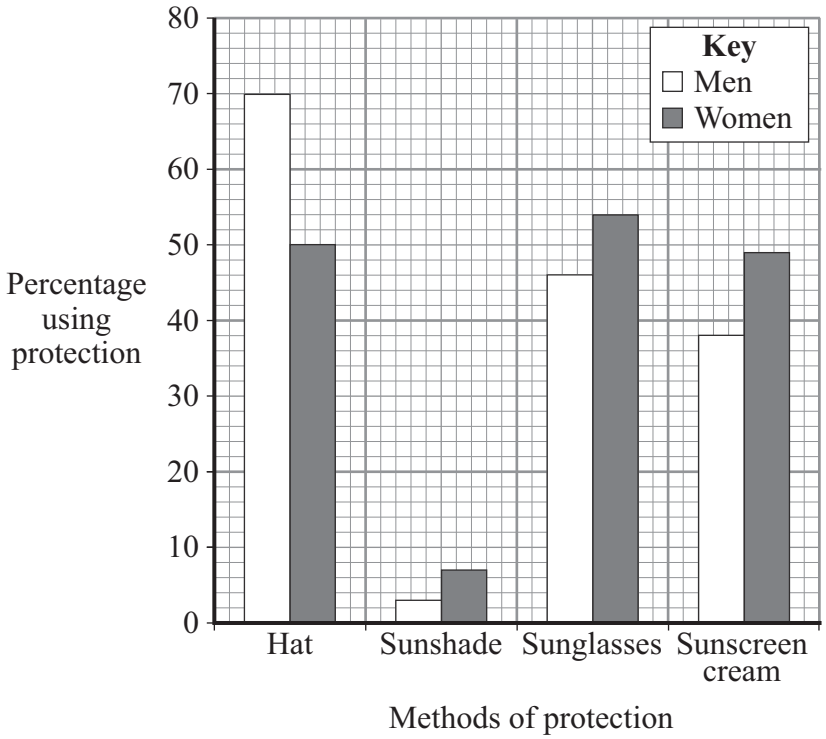
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QUESTION TWO

There are several ways of protecting ourselves from the Sun's radiation.



The bar chart shows how men and women in Australia protect themselves from the Sun's radiation.



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

A hat

B sunshade

C sunglasses

D sunscreen cream

1	used by more men than women
2	would be used by 27 women in a sample of 50
3	used by 49% of women
4	would give protection to the whole body

Turn over for the next question

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SECTION TWO

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

Each of these questions has four parts.

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

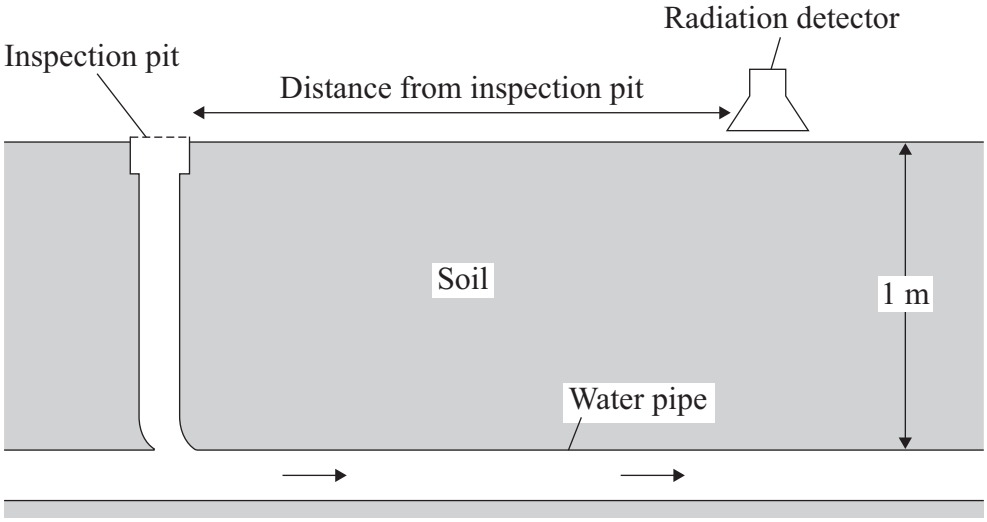
Mark your choices on the answer sheet.

QUESTION THREE

Some engineers investigated a problem with the flow of water through an underground pipe.
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A radiation detector was used to measure the count rate at different distances from the inspection pit.



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3A The engineers would use a radioactive liquid that emits . . .

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4 X-radiation.

3B The readings suggest that . . .

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2 the pipe was not level.

3 the pipe had a leak.

4 the pipe had a blockage.

3C To improve the reliability of the data, the engineers should . . .

1 use a more sensitive counter.

2 re-calibrate the counter.

3 repeat their investigation and calculate the means.

4 decide whether the variables are continuous or discrete.

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The best place for the workmen to dig the hole is . . .

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2 5 m from the inspection pit.

3 7 m from the inspection pit.

4 9 m from the inspection pit.

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QUESTION FOUR

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

4A Which pair of diagrams correctly shows the patterns for digital and analogue signals?

	Digital signal pattern	Analogue signal pattern
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2		
3		
4		

4B One reason for using digital signals rather than analogue signals for communication is that . . .

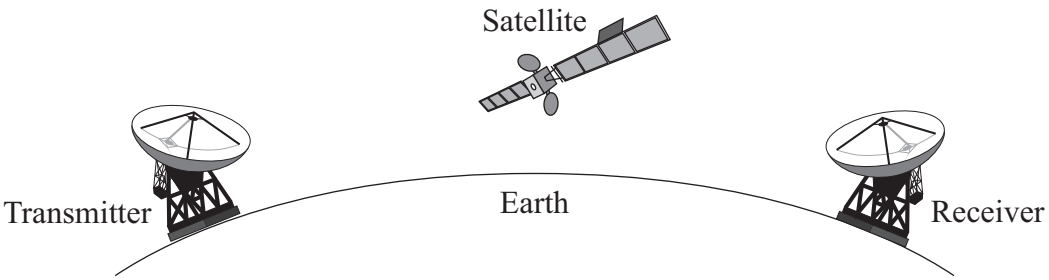
1 analogue signals are less prone to interference.

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3 digital signals are continuously variable.

4 digital signals can be easily processed by computers.

4C Satellites in orbit around the Earth receive and transmit microwave signals for international telephone communication.



Microwaves are used because . . .

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

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

3 they follow the curvature of the Earth.

4 they travel faster than radio waves.

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4D Properties of waves are often demonstrated in schools using waves on water.

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

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

At what speed do the waves travel?

1 1 m/s

2 25 m/s

3 100 m/s

4 2500 m/s

Turn over for the next question

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QUESTION FIVE

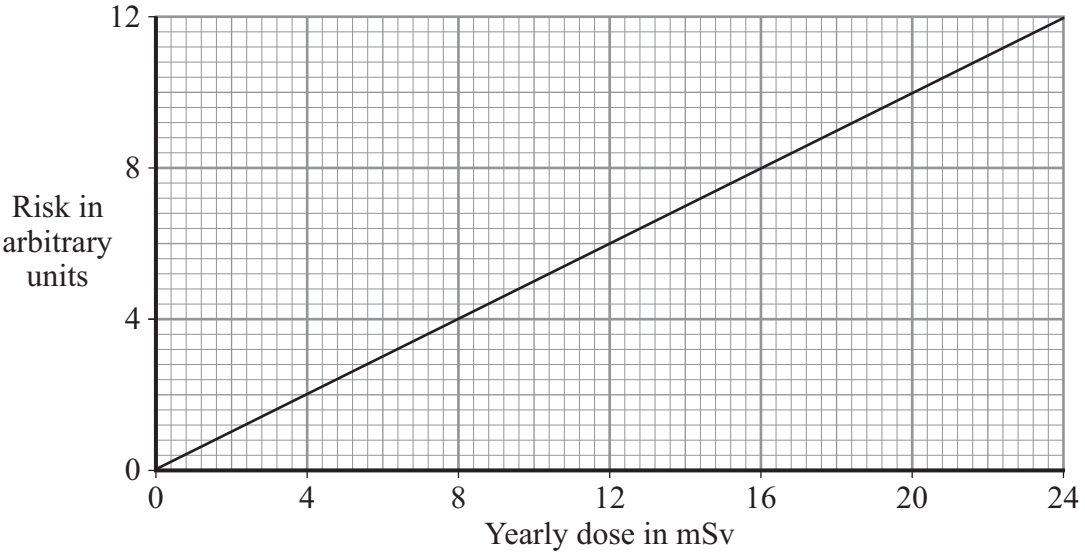
Workers in industries that use radioactive materials have the amount of radiation they receive carefully monitored. The amount of radiation received is called the dose. The industries set dose limits.

The table shows the maximum yearly dose that is allowed for three groups of people. The higher the dose of radiation received, the greater the risk of developing cancer.

Description	Yearly dose limit in millisieverts (mSv)
Member of the public	1
Worker under 18 years	6
Pregnant adult worker	4

A millisievert is a unit of radiation dose.

5A The graph shows how the risk changes with the yearly dose.



The graph shows that the risk . . .

1 does not depend on the yearly dose.

2 is 2 arbitrary units for a member of the public.

3 is inversely proportional to the yearly dose.

4 is directly proportional to the yearly dose.

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5B The yearly dose limit for an adult worker is five times that of a pregnant adult worker.

What is the risk (in arbitrary units) for an adult worker?

1 3

2 10

3 15

4 20

5C Nuclear power stations produce radiation.

Which one of the following does **not** reduce the risk to power station workers?

1 building power stations far from centres of population

2 giving the workers protective clothing

3 monitoring the dose each worker receives to ensure that radiation limits are not exceeded

4 shielding the workers from the source of radiation

5D Workers may be subjected to alpha, beta or gamma radiation.

Outside the body, alpha is less dangerous to workers than beta because alpha radiation . . .

1 cannot penetrate the skin.

2 is deflected by electric fields.

3 is much less strongly ionising.

4 has a much longer range.

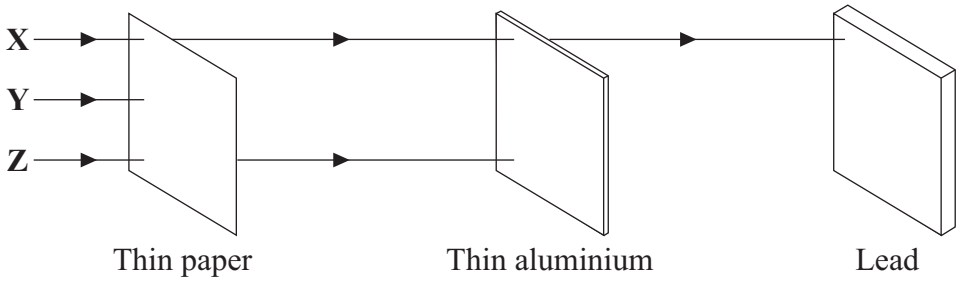
Turn over for the next question

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QUESTION SIX

This question is about radioactive substances and the radiation they emit.

The diagram shows how each type of radiation, **X**, **Y** and **Z**, is absorbed by different materials.



6A Which row in **Table 1** shows the correct radiation types?

Table 1

	X	Y	Z
1	beta	alpha	gamma
2	gamma	alpha	beta
3	beta	gamma	alpha
4	gamma	beta	alpha

6B When gamma radiation is absorbed, . . .

1 the absorber increases in mass.

2 the absorber shows a rise in temperature.

3 the radiation will become helium gas.

4 the radiation will transform into light.

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6C Which row in **Table 2** correctly describes the three types of radiation?

Table 2

	Alpha	Beta	Gamma
1	an electron from outside the nucleus	a helium nucleus	a short wavelength electromagnetic wave
2	a short wavelength electromagnetic wave	an electron from outside the nucleus	a helium nucleus
3	a helium nucleus	an electron from inside the nucleus	a high frequency electromagnetic wave
4	a helium nucleus	a short wavelength electromagnetic wave	an electron from inside the nucleus

6D The radioactive gas thoron, which has a half-life of 50 seconds, is used in an experiment. At the end of the experiment, the count rate had fallen to $\frac{1}{32}$ of the count rate at the beginning.

The time taken to carry out the experiment was . . .

1 200 seconds.

2 250 seconds.

3 300 seconds.

4 1600 seconds.

Turn over for the next question

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QUESTION SEVEN

Some of the world's best telescopes are placed on the tops of mountains. These telescopes detect infra red and visible light waves from distant stars and galaxies.

Some space telescopes detect X-rays from these galaxies. These telescopes are placed above the Earth's atmosphere.

7A The Hubble Space Telescope (HST) has been in orbit around the Earth since 1990. The HST is an optical telescope.

What is the advantage of placing the HST in orbit around the Earth?

1 Light, gathered by the HST, has not been distorted by the atmosphere.

2 Once the HST goes into orbit, it costs nothing to run.

3 The HST can observe the whole sky in one orbit.

4 The HST picks up clearer pictures because it is nearer to space.

7B A ground-based telescope could not detect X-rays from space because . . .

1 there are no X-rays in space.

2 the Earth's atmosphere absorbs X-rays.

3 X-rays are harmful to people.

4 X-rays are digital signals.

7C The longer the wavelength of the radiation being received, the larger the diameter of the receiving dish of the telescope needs to be.

The telescopes with the largest dishes are those detecting . . .

1 gamma rays.

2 radio waves.

3 visible light.

4 X-rays.

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7D Images of distant galaxies produced by the Hubble telescope provide evidence to support the idea that the universe . . .

1 has a definite edge.

2 is contracting.

3 is expanding.

4 is neither expanding nor contracting.

Turn over for the next question

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QUESTION EIGHT

For many years, scientists have been investigating the universe and how it continues to change.

8A Why is the 'Big Bang' theory currently the most widely accepted theory of the origin of the universe?

1 It has been proved correct by using mathematical models.

2 It has not been revised or changed by scientists for many years.

3 It is based on a combination of scientific and religious facts.

4 It is the best explanation of the current scientific data.

8B Red-shift of light provides evidence about how the universe is changing.

When red-shift is detected, it means that . . .

1 galaxies are moving rapidly away from Earth.

2 galaxies furthest away from Earth are expanding.

3 some galaxies are approaching the Earth.

4 stars in the nearest galaxies are becoming red giants.

8C Red-shift involves a change in frequency and wavelength.

Which row in the table correctly describes these changes?

	Frequency	**Wavelength**
1	decreases	decreases
2	decreases	increases
3	increases	decreases
4	increases	increases

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8D Which one of the following is a similar effect to red-shift?

1 Red light from a lamp being reflected by a mirror.

2 As a police car moves away from you, the sound from the siren seems lower in frequency than it really is.

3 As a train approaches a station, the sound of the train gets louder.

4 Light from the setting Sun becomes increasingly redder.

Turn over for the next question

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QUESTION NINE

This question is about electromagnetic radiation.

9A Electromagnetic radiations are . . .

1 disturbances in an electric field.

2 disturbances of the air between source and receiver.

3 waves caused by pressure changes in a vacuum.

4 waves of very high frequency.

9B When electromagnetic radiation reaches a substance, . . .

1 all wavelengths will be absorbed by the substance.

2 all wavelengths will be reflected by the substance.

3 all wavelengths will be transmitted through the substance.

4 some wavelengths may be absorbed, some reflected and some transmitted.

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

All electromagnetic waves travel at 300 000 km/s.

9C Most schools have microwave generators that produce microwaves with a wavelength of 3 cm.

What is the frequency of these microwaves?

1 900 kHz

2 10 000 kHz

3 900 000 kHz

4 10 000 000 kHz

9D BBC Radio 4 transmits radio waves at a frequency of 200 kHz.

What is the wavelength of Radio 4?

1 1.5 m

2 600 m

3 1500 m

4 60 km

END OF TEST

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There are no questions printed on this page

There are no questions printed on this page

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Version 1:0: 09/04/10

ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A (4461)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2010 Examination – March Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE
SCIENCE A (4461)/PHYSICS (4451)
Objective Test Answer Key
PHY1BP (Radiation and the Universe)
March 2010
Foundation Tier

Question	Key		
One	**A**	microwaves	**4**
	B	ultraviolet rays	**1**
	C	visible light	**2**
	D	X-rays	**3**
Two	**A**	gamma	**3**
	B	infra red	**4**
	C	radio	**1**
	D	ultraviolet	**2**
Three	**A**	electron	**4**
	B	neutron	**2**
	C	nucleus	**3**
	D	proton	**1**
Four	**A**	alpha	**3**
	B	beta	**4**
	C	gamma	**2**
	D	X-rays	**1**
Five	**A**	50	**3**
	B	100	**4**
	C	400	**2**
	D	800	**1**

	A	B	C	D
Six	**1**	**2**	**2**	**1**
Seven	**3**	**2**	**2**	**4**
Eight	**3**	**3**	**3**	**2**
Nine	**2**	**4**	**2**	**1**

GCSE
SCIENCE A (4461)/PHYSICS (4451)
Objective Test Answer Key
PHY1BP (Radiation and the Universe)
March 2010
Higher Tier

Question	*Key*		
One	**A**	50	**3**
	B	100	**4**
	C	400	**2**
	D	800	**1**
Two	**A**	hat	**1**
	B	sunshade	**4**
	C	sunglasses	**2**
	D	sunscreen cream	**3**

	A	**B**	**C**	**D**
Three	**3**	**3**	**3**	**2**
Four	**2**	**4**	**2**	**1**
Five	**4**	**2**	**1**	**1**
Six	**2**	**2**	**3**	**2**
Seven	**1**	**2**	**2**	**3**
Eight	**4**	**1**	**2**	**2**
Nine	**1**	**4**	**4**	**3**

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 3G10

03-MAR-10

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	50	○	○	○	○
1B	100	○	○	○	○
1C	400	○	○	○	○
1D	800	○	○	○	○

QUESTION TWO		1	2	3	4
2A	hat	○	○	○	○
2B	sunshade	○	○	○	○
2C	sunglasses	○	○	○	○
2D	sunscreen cream	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	microwaves	○	○	○	○
1B	ultraviolet rays	○	○	○	○
1C	visible light	○	○	○	○
1D	X-rays	○	○	○	○

QUESTION TWO		1	2	3	4
2A	gamma	○	○	○	○
2B	infra red	○	○	○	○
2C	radio	○	○	○	○
2D	ultraviolet	○	○	○	○

QUESTION THREE		1	2	3	4
3A	electron	○	○	○	○
3B	neutron	○	○	○	○
3C	nucleus	○	○	○	○
3D	proton	○	○	○	○

QUESTION FOUR		1	2	3	4
4A	alpha	○	○	○	○
4B	beta	○	○	○	○
4C	gamma	○	○	○	○
4D	X-rays	○	○	○	○

QUESTION FIVE		1	2	3	4
5A	50	○	○	○	○
5B	100	○	○	○	○
5C	400	○	○	○	○
5D	800	○	○	○	○

QUESTION SIX		1	2	3	4
6A		○	○	○	○
6B		○	○	○	○
6C		○	○	○	○
6D		○	○	○	○

QUESTION SEVEN		1	2	3	4
7A		○	○	○	○
7B		○	○	○	○
7C		○	○	○	○
7D		○	○	○	○

QUESTION EIGHT		1	2	3	4
8A		○	○	○	○
8B		○	○	○	○
8C		○	○	○	○
8D		○	○	○	○

QUESTION NINE		1	2	3	4
9A		○	○	○	○
9B		○	○	○	○
9C		○	○	○	○
9D		○	○	○	○

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2009

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Thursday 19 November 2009 Morning Session

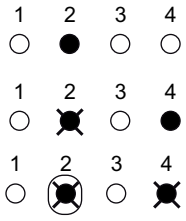
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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

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

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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** . . . .

Turn over for the next question

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QUESTION THREE

This question is about a radioactive isotope that emits alpha particles.

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

A count rate

B half-life

C penetrating power

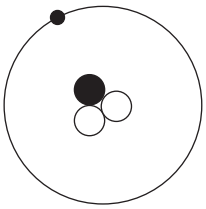
D range

	Description
1	the number of alpha particles detected per second
2	the distance the alpha particles travel before being fully absorbed
3	the time it takes for half of the nuclei of the isotope to decay
4	the ability of the alpha particles to pass through matter

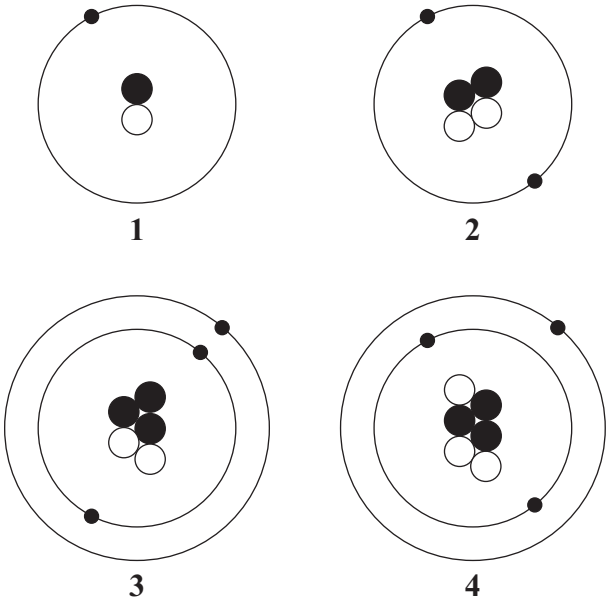
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QUESTION FOUR

The diagram shows an isotope of hydrogen. It contains one electron, one proton and two neutrons.



Four other atoms are labelled **1–4**.



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

A contains 5 particles in its nucleus

B has a nucleus that is identical in structure to an alpha particle

C has the same number of electrons as atom **3**

D is a different isotope of hydrogen

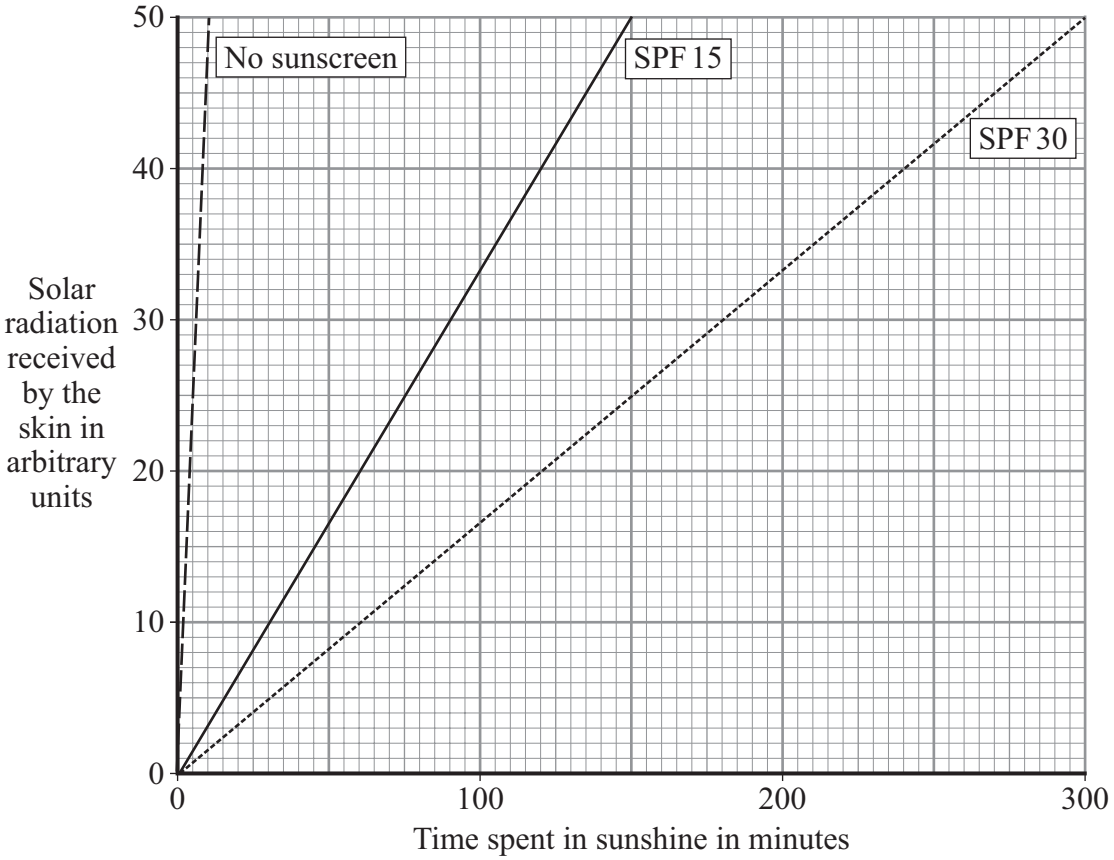
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QUESTION FIVE

The longer you sunbathe, the more solar radiation your skin receives. Sunscreen lotions absorb some of this radiation. The lotions are given a skin protection factor (SPF) number.

The graph shows how the amount of radiation received by a person's skin is related to how long they are outside on a sunny day.

The skin gets sunburnt if it receives 50 units of solar radiation.



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

A 10

B 15

C 25

D 200

After 150 minutes, the skin protected by SPF 30 sunscreen lotion has received . . . **1** . . . units of solar radiation.

Without sunscreen lotion, it takes . . . **2** . . . minutes to get sunburnt.

If you protect your skin with SPF 15 sunscreen lotion, you can stay . . . **3** . . . times longer in sunshine without getting sunburnt than you can with unprotected skin.

If you put on SPF 20 sunscreen lotion, it would be . . . **4** . . . minutes before you got sunburnt.

Turn over for the next question

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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

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

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

Diagram 1

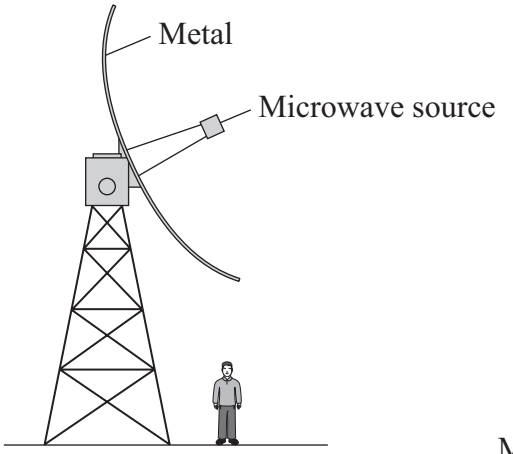
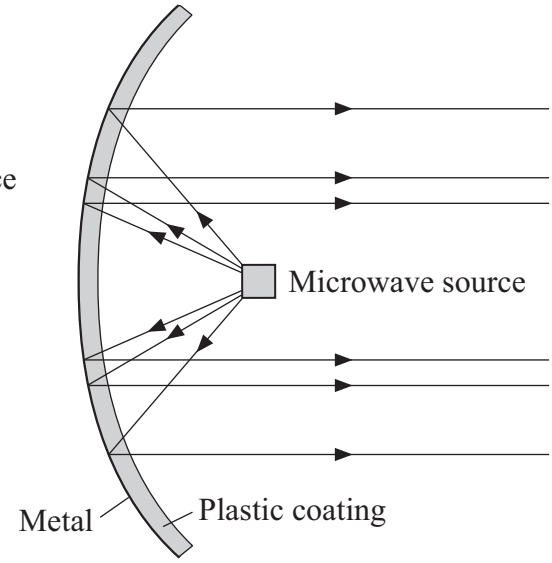


Diagram 2



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

1 absorbed by plastic.

2 changed to an alternating current by plastic.

3 reflected by plastic.

4 able to pass through plastic.

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

1 are absorbed by metals.

2 are reflected by metal.

3 give an alternating current with a different frequency.

4 interfere with the digital signals produced.

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

This is to prevent the maintenance workers from . . .

1 becoming deaf from the analogue signals used.

2 causing interference to the digital signals used.

3 having their bodies heated by the microwaves.

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

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

1 As the frequency decreases, the wavelength decreases.

2 As the frequency decreases, the wavelength increases.

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

4 As the frequency increases, the wavelength increases.

Turn over for the next question

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QUESTION SEVEN

Astronomers studying light from distant galaxies notice that the light from them seems to increase in wavelength.

7A The increase in wavelength is known as . . .

1 blue-shift.

2 contraction.

3 expansion.

4 red-shift.

7B The increase in wavelength . . .

1 is smaller the further away the galaxy is.

2 is larger the further away the galaxy is.

3 becomes zero for very distant galaxies.

4 is the same whether galaxies are moving towards us or away from us.

7C The unit of wavelength is the . . .

1 hertz.

2 metre.

3 metre per second.

4 second.

7D Most astronomers think that the universe began from a very small initial point.

Since then, the universe has . . .

1 been contracting.

2 been contracting then expanding.

3 been expanding.

4 stayed unchanged.

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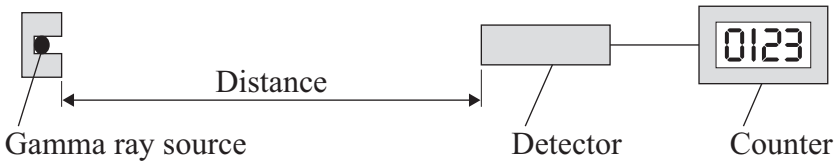
Turn over for the next question

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QUESTION EIGHT

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

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



Her results are shown in the table.

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

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

1 0.2 m

2 0.4 m

3 0.8 m

4 1.0 m

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

1 accurate.

2 controlled.

3 varied.

4 reliable.

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

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

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

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

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

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

1 reduce the air temperature between the source and detector.

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

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

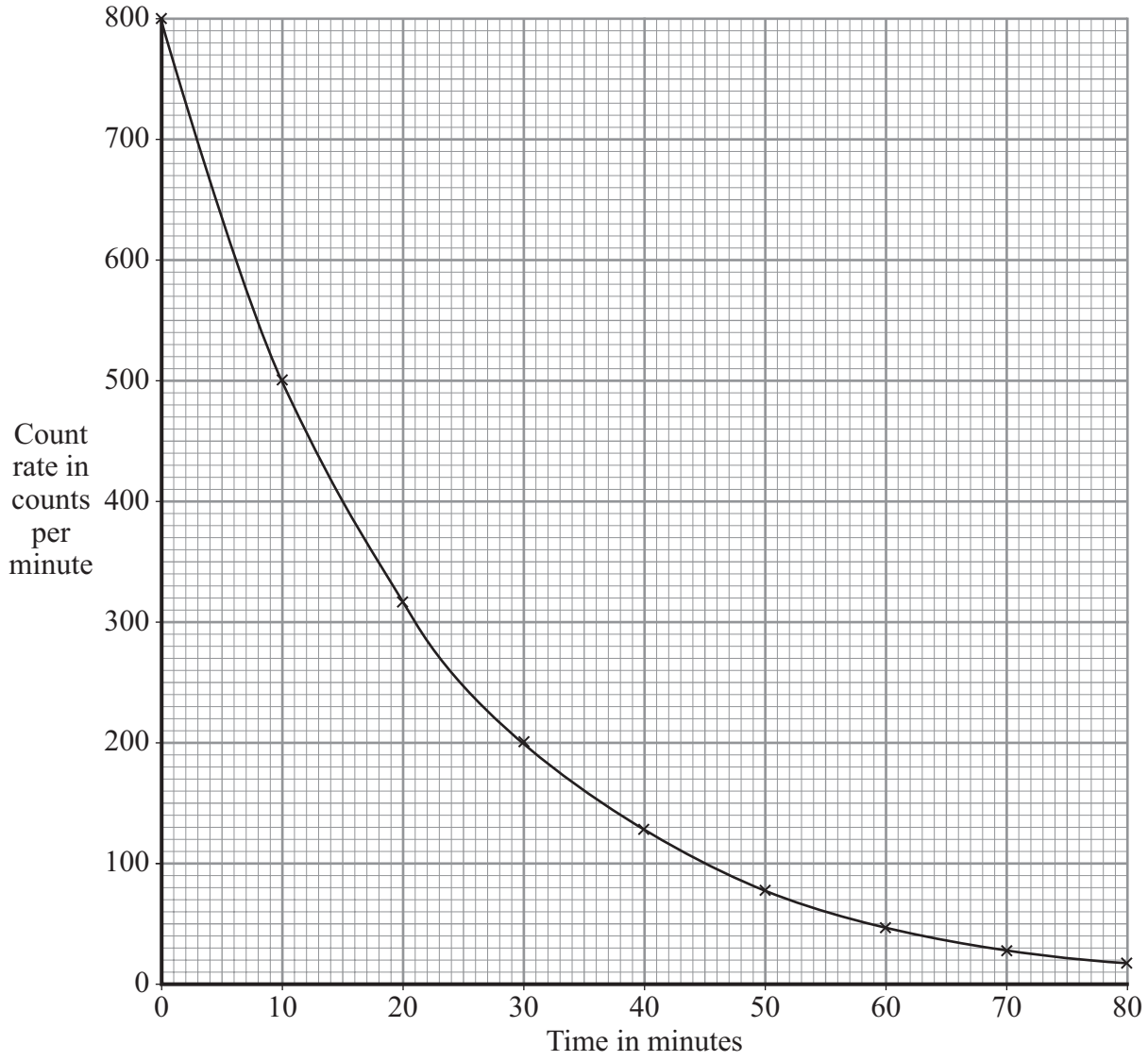
4 produce a strong magnetic field between the source and detector.

Turn over for the next question

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QUESTION NINE

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



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

1 10 minutes

2 15 minutes

3 20 minutes

4 80 minutes

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

What is the reason for this?

1 Both the count rate and time are continuous variables.

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

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

4 Both the count rate and time are discrete variables.

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

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

1 it has a long half-life.

2 alpha particles travel only a few centimetres in air.

3 smoke alarm batteries are replaced regularly.

4 its nucleus has 146 neutrons.

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

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

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

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

1 Rubidium is a rare metallic element.

2 Gamma radiation is part of the electromagnetic spectrum.

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

4 There is no risk in using radioactive materials.

END OF TEST

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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**.

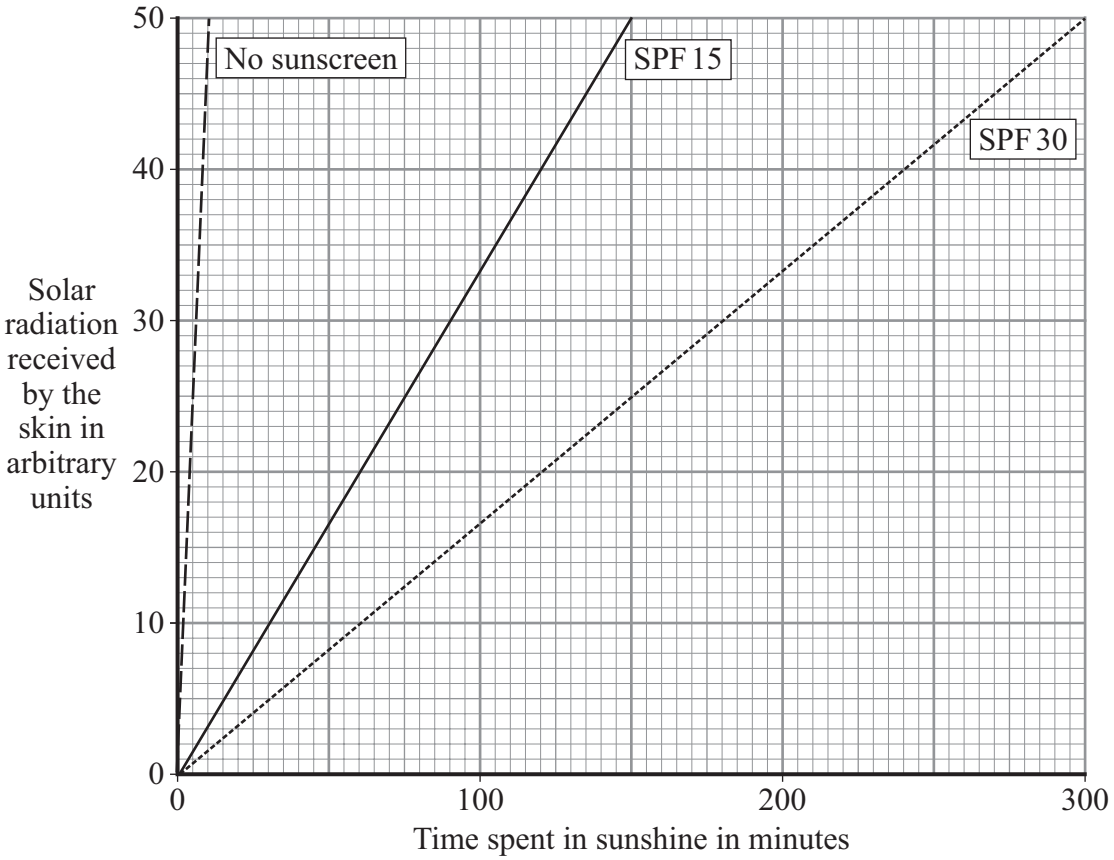
Mark your choices on the answer sheet.

QUESTION ONE

The longer you sunbathe, the more solar radiation your skin receives. Sunscreen lotions absorb some of this radiation. The lotions are given a skin protection factor (SPF) number.

The graph shows how the amount of radiation received by a person's skin is related to how long they are outside on a sunny day.

The skin gets sunburnt if it receives 50 units of solar radiation.



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

A 10

B 15

C 25

D 200

After 150 minutes, the skin protected by SPF 30 sunscreen lotion has received . . . **1** . . . units of solar radiation.

Without sunscreen lotion, it takes . . . **2** . . . minutes to get sunburnt.

If you protect your skin with SPF 15 sunscreen lotion, you can stay . . . **3** . . . times longer in sunshine without getting sunburnt than you can with unprotected skin.

If you put on SPF 20 sunscreen lotion, it would be . . . **4** . . . minutes before you got sunburnt.

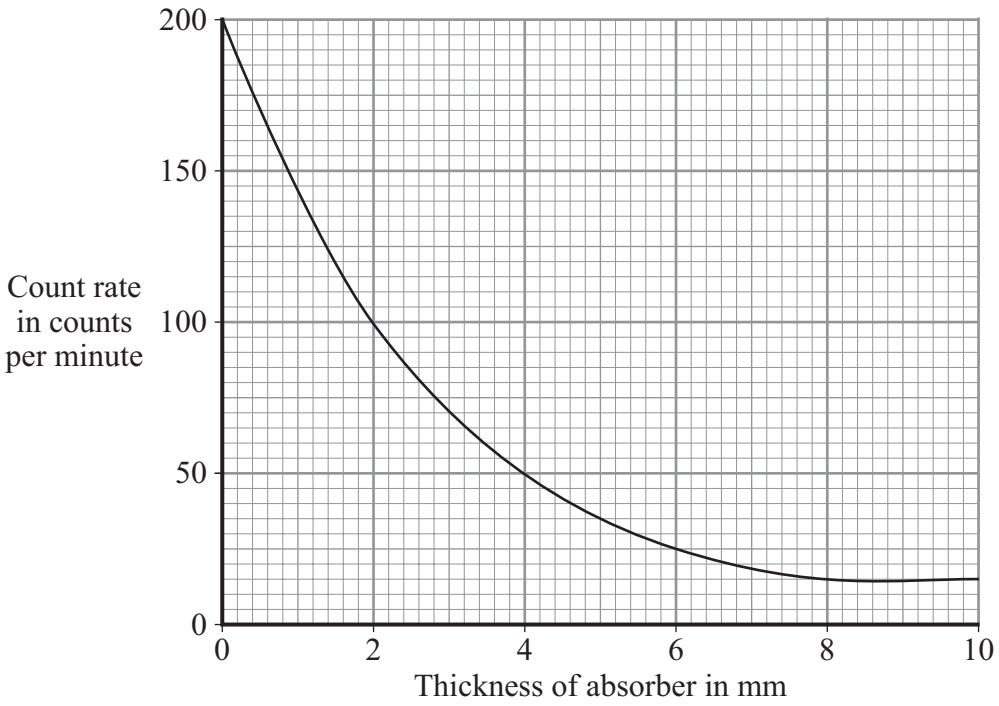
Turn over for the next question

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QUESTION TWO

A source of beta radiation is placed in front of a detector. Pieces of aluminium of different thicknesses are placed between the source and the detector. The thickness of the absorber and the count rate are measured.

The results are shown on the graph.



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

A 2

B 9

C 70

D 200

The count rate with no absorber is . . . **1** . . . counts per minute.

The count rate when the absorber is 3 mm thick is . . . **2** . . . counts per minute.

The thickness needed to reduce the count rate by half is . . . . **3** . . . mm.

The thickness needed to absorb all the radiation from the source is . . . **4** . . . mm.

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Turn over for the next question

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SECTION TWO

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

Each of these questions has four parts.

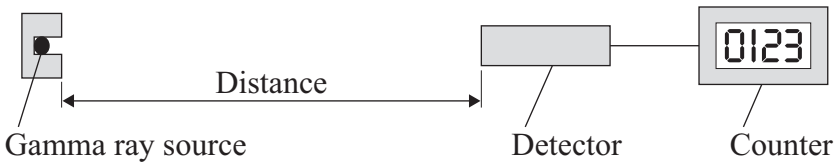
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

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

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



Her results are shown in the table.

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

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3A The results with the greatest range of count rate occur at a distance from the source of . . .

1 0.2 m

2 0.4 m

3 0.8 m

4 1.0 m

3B She repeated the experiment and calculated the mean to make her results more . . .

1 accurate.

2 controlled.

3 varied.

4 reliable.

3C A valid conclusion based on her results would be that . . .

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

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

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

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

3D Another way in which the count rate could be reduced would be to . . .

1 reduce the air temperature between the source and detector.

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

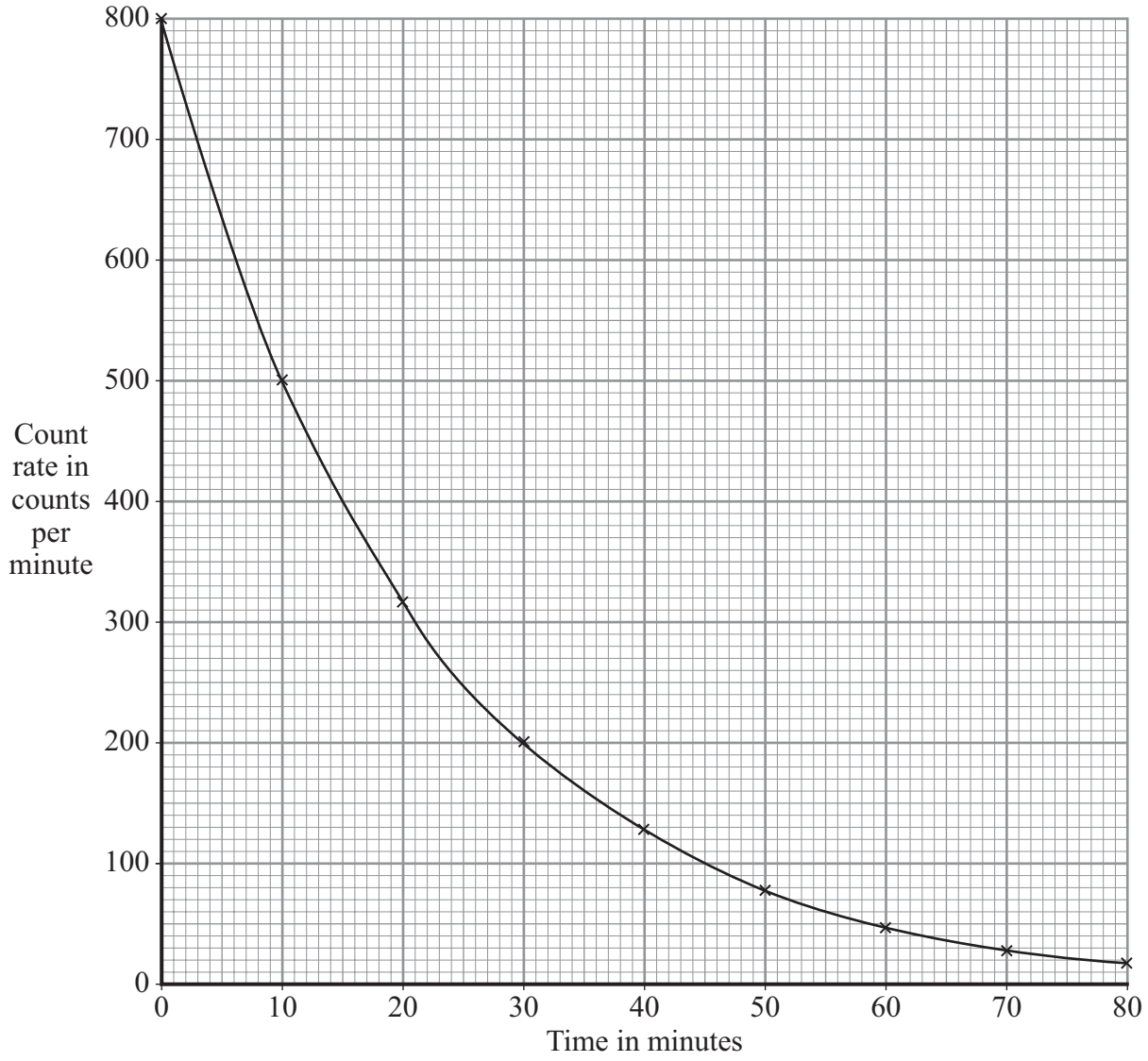
3 produce a strong electric field between the source and detector.

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

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QUESTION FOUR

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



4A What is the half-life of the isotope?

1 10 minutes

2 15 minutes

3 20 minutes

4 80 minutes

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4B The person who plotted the graph has drawn a line graph rather than a bar chart.

What is the reason for this?

1 Both the count rate and time are continuous variables.

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

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

4 Both the count rate and time are discrete variables.

4C The government recommends that all homes are fitted with smoke alarms. Americium-241 is used in these alarms. Americium-241 emits alpha particles and has a half-life of 460 years.

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

1 it has a long half-life.

2 alpha particles travel only a few centimetres in air.

3 smoke alarm batteries are replaced regularly.

4 its nucleus has 146 neutrons.

4D This information is about the isotope technetium-99.

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

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

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

1 Rubidium is a rare metallic element.

2 Gamma radiation is part of the electromagnetic spectrum.

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

4 There is no risk in using radioactive materials.

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QUESTION FIVE

The Sun emits different types of radiation. These types of radiation travel from the Sun until they reach the Earth's atmosphere. In the atmosphere, some types of radiation are reflected, some are absorbed and some are transmitted to the Earth's surface, where they cause the Earth to warm up.

Human activity has produced large amounts of carbon dioxide gas which has increased the amount of carbon dioxide in the atmosphere. The carbon dioxide helps to trap the Earth's heat and so contributes to the 'greenhouse' effect, which results in the Earth becoming hotter.

5A On their journey from the Sun to the Earth, all the types of radiation travel with the same . . .

1 energy.

2 frequency.

3 speed.

4 wavelength.

5B The ozone layer in the Earth's atmosphere absorbs some of the Sun's ultraviolet radiation.

Ultraviolet radiation can . . .

1 be detected by your eyes.

2 give your skin a suntan.

3 cool your skin.

4 pass through flesh but not bone.

5C Most of the Sun's infra red radiation is emitted with a wavelength of about 0.5 micrometres. Most of the Earth's infra red radiation is emitted with a wavelength of about 10 micrometres.

Carbon dioxide molecules in the atmosphere can absorb infra red radiation with wavelengths between 2 micrometres and 17 micrometres.

1 micrometre = 1 millionth of a metre

Therefore, the carbon dioxide will . . .

1 absorb the Sun's infra red radiation and absorb the Earth's infra red radiation.

2 absorb the Sun's infra red radiation and transmit the Earth's infra red radiation.

3 transmit the Sun's infra red radiation and absorb the Earth's infra red radiation.

4 transmit the Sun's infra red radiation and transmit the Earth's infra red radiation.

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5D As an object gets hotter, its main infra red emission wavelength gets shorter.

If human activity continues to increase the amount of carbon dioxide gas in the atmosphere, then the Earth will emit . . .

1 more energy, with a shorter main emission wavelength.

2 more energy, with the same main emission wavelength.

3 the same energy, with a shorter main emission wavelength.

4 the same energy, with the same main emission wavelength.

Turn over for the next question

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QUESTION SIX

Astronomers have observed many distant galaxies and found that the radiation from the galaxies shows a red-shift.

6A What happens to the radiation in red-shift?

1 The observed wavelength decreases and the frequency increases.

2 The observed wavelength increases and the frequency decreases.

3 The observed wavelength increases and the frequency increases.

4 The observed wavelengths merge together to form red light.

6B The astronomers realised that these galaxies are moving away from us.

This led them to produce a theory in which . . .

1 the galaxies are contracting towards a small point.

2 the galaxies are moving towards each other.

3 the universe is contracting towards a small point.

4 the universe is expanding from an initial small point.

6C The data in the table below shows the red-shift of different galaxies. (They are all for the same spectral line.)

Name of galaxy	Red shift in nm
M60	18.8
M99	32.1
NGC 2366	1.3
NGC 2976	0.04

Which galaxy is furthest from Earth?

1 M60

2 M99

3 NGC 2366

4 NGC 2976

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6D Astronomers have found that the light from the Sun shows an increase in frequency on one edge and a decrease in frequency on the opposite edge.

What does this suggest is happening to the Sun?

1 It is gradually expanding.

2 It is moving away from us.

3 It is moving towards us.

4 It is rotating.

Turn over for the next question

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QUESTION SEVEN

There are two types of radio wave that carry television signals, VHF and UHF.

7A Some UHF waves have a frequency that is ten times bigger than some VHF waves.

The wavelength of these UHF waves, in comparison to the VHF ones, is . . .

1 ten times as big because they travel faster.

2 one tenth as big because they travel faster.

3 ten times as big because they travel at the same speed.

4 one tenth as big because they travel at the same speed.

7B One television channel transmits using waves of frequency 1000 MHz.

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

Speed of electromagnetic waves in a vacuum = 300 000 km/s

1 MHz = 1 million hertz

What is the wavelength of these waves?

1 0.3 m

2 3.0 m

3 0.3 km

4 3.0 km

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7C All television transmitters in the UK are going to be switched from analogue to digital signals.

Which row in the table is correct?

	Analogue signals	**Digital signals**
1	continuously varying	more prone to interference and cannot be processed by a computer
2	less prone to interference and can be easily processed by a computer	discrete values only, generally on and off
3	continuously varying	less prone to interference and can be easily processed by a computer
4	discrete values only, generally on and off	continuously varying

7D An aerial receives television signals.

The energy transferred by an electromagnetic wave carrying the television signal . . .

1 makes the aerial hotter so that it can detect the signal.

2 makes the aerial colder so that it can detect the signal.

3 creates an alternating current in the aerial with the same frequency as the wave.

4 creates a direct current in the aerial with the same frequency as the wave.

Turn over for the next question

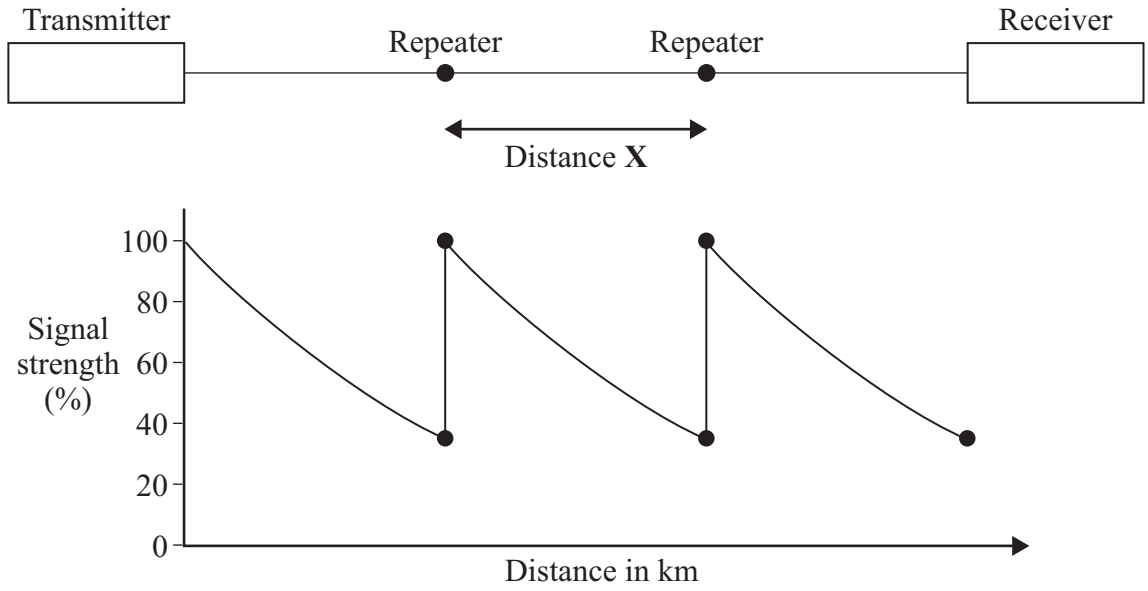
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QUESTION EIGHT

Information can be sent along optical fibres in the form of pulses. These pulses become weaker as they pass along the fibre.

In the early development of the fibres, the signal strength halved every 10 km. To overcome this, devices called 'repeaters' were inserted into the optical fibre system to boost the signal to its original strength.

The diagram shows one of the early systems. The graph shows how the signal strength changes with distance.



8A A signal is transmitted along the optical fibre. The power at the transmitter is 2 mW.

In the absence of any 'repeater', what would the power of the signal be after 30 km?

1 0.000 mW

2 0.125 mW

3 0.250 mW

4 0.333 mW

8B Using the graph, the distance **X** between the 'repeaters' is between . . .

1 0 – 10 km

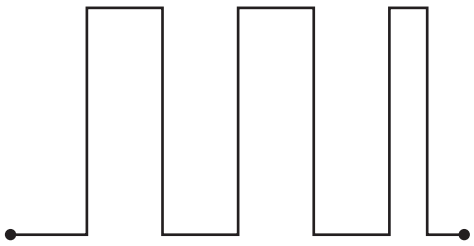
2 10 – 20 km

3 20 – 30 km

4 30 – 40 km

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8C The transmitter sends out three pulses as shown. (All diagrams are drawn to the same scale.)

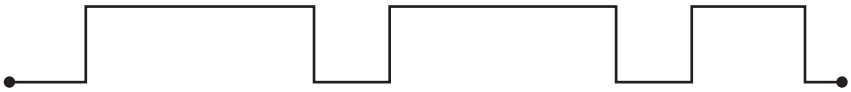


Just before the pulses reach the first 'repeater', they would look like . . .

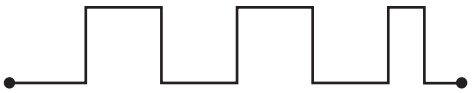
1



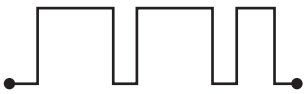
2



3



4



8D The use of optical fibres, between transmitter and receiver, has had a significant effect on the transmission of signals in . . .

1 landline phones.

2 mobile phones.

3 satellite communication.

4 wifi (wireless communication).

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QUESTION NINE

Visible light from space can be gathered and focused by optical telescopes.

9A Optical telescopes used to observe objects in space are limited because they can only be used . . .

1 as ground-based telescopes.

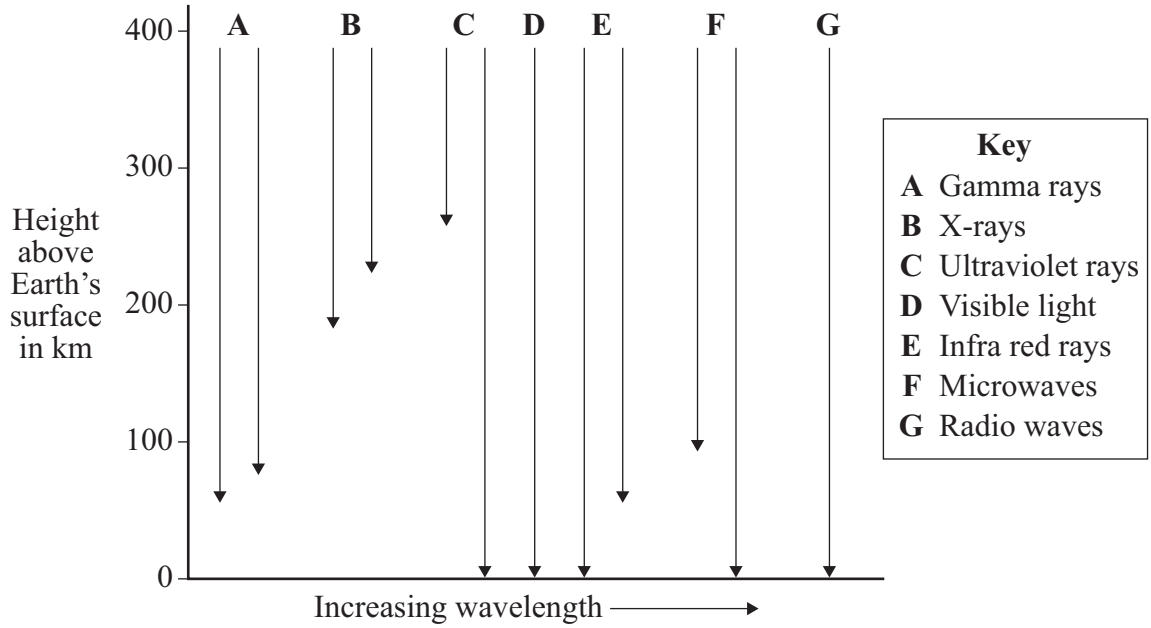
2 at night.

3 to observe a small region of the electromagnetic spectrum.

4 to observe one region of the sky.

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9B Radio telescopes are sited on the ground.

This is because radio waves . . .

1 are emitted by many stars.

2 can penetrate the atmosphere.

3 have a shorter wavelength than microwaves.

4 have more energy than infra red waves.

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9C The types of radiation collected by four telescopes, **M**, **N**, **P** and **Q**, are given in the table.

Telescope	Radiation collected
M	infra red waves
N	gamma rays
P	X-rays
Q	microwaves

Which telescopes could be operated from an aircraft flying at an altitude of 12 km?

1 **M** and **N**

2 **N** and **P**

3 **P** and **Q**

4 **Q** and **M**

9D What is the minimum height above the Earth for a satellite to be able to use telescope **P**?

1 50 km

2 70 km

3 180 km

4 250 km

END OF TEST

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Version 1:0: 21/11/09

ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A (4461)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2009 Examination – November Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

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GCSE
SCIENCE A (4461)/PHYSICS (4451)
Objective Test Answer Key
PHY1BP (Radiation and the Universe)
November 2009
Foundation Tier

Question			
		Key	
One	**A**	infra red	**2**
	B	microwaves	**1**
	C	ultraviolet	**4**
	D	X-rays	**3**
Two	**A**	gamma	**2**
	B	infra red	**3**
	C	radio	**1**
	D	visible light	**4**
Three	**A**	count rate	**1**
	B	half-life	**3**
	C	penetrating power	**4**
	D	range	**2**
Four	**A**	contains 5 particles in its nucleus	**3**
	B	has a nucleus that is identical in structure to an alpha particle	**2**
	C	has the same number of electrons as atom 3	**4**
	D	is a different isotope of hydrogen	**1**
Five	**A**	10	**2**
	B	15	**3**
	C	25	**1**
	D	200	**4**

	A	**B**	**C**	**D**
Six	**4**	**2**	**3**	**2**
Seven	**4**	**2**	**2**	**3**
Eight	**2**	**4**	**2**	**2**
Nine	**2**	**1**	**2**	**3**

GCSE
SCIENCE A (4461)/PHYSICS (4451)
Objective Test Answer Key
PHY1BP (Radiation and the Universe)
November 2009
Higher Tier

Question	Key		
One	**A**	10	**2**
	B	15	**3**
	C	25	**1**
	D	200	**4**
Two	**A**	2	**3**
	B	9	**4**
	C	70	**2**
	D	200	**1**

	A	B	C	D
Three	**2**	**4**	**2**	**2**
Four	**2**	**1**	**2**	**3**
Five	**3**	**2**	**3**	**1**
Six	**2**	**4**	**2**	**4**
Seven	**4**	**1**	**3**	**3**
Eight	**3**	**2**	**3**	**1**
Nine	**3**	**2**	**4**	**3**

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : BG09

19-NOV-09

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE		1	2	3	4
1A	10	○	○	○	○
1B	15	○	○	○	○
1C	25	○	○	○	○
1D	200	○	○	○	○

QUESTION TWO		1	2	3	4
2A	2	○	○	○	○
2B	9	○	○	○	○
2C	70	○	○	○	○
2D	200	○	○	○	○

QUESTION THREE	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE	1	2	3	4
1A infra red	○	○	○	○
1B microwaves	○	○	○	○
1C ultraviolet	○	○	○	○
1D X-rays	○	○	○	○

QUESTION TWO	1	2	3	4
2A gamma	○	○	○	○
2B infra red	○	○	○	○
2C radio	○	○	○	○
2D visible light	○	○	○	○

QUESTION THREE	1	2	3	4
3A count rate	○	○	○	○
3B half-life	○	○	○	○
3C penetrating power	○	○	○	○
3D range	○	○	○	○

QUESTION FOUR	1	2	3	4
4A contains 5 particles in its nucleus	○	○	○	○
4B ...nucleus identical in structure to an alpha particle	○	○	○	○
4C has the same number of electrons as atom 3	○	○	○	○
4D is a different isotope of hydrogen	○	○	○	○

QUESTION FIVE	1	2	3	4
5A 10	○	○	○	○
5B 15	○	○	○	○
5C 25	○	○	○	○
5D 200	○	○	○	○

QUESTION SIX	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
June 2009

SCIENCE A **PHY1BP**
Unit Physics P1b (Radiation and the Universe)

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Monday 22 June 2009 Morning Session

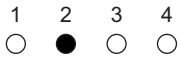
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

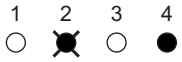
Time allowed: 30 minutes

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.

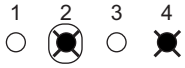
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 14 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**.

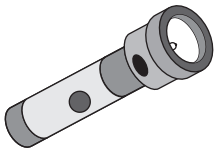
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

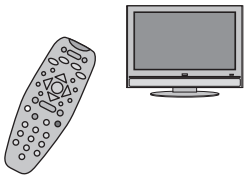
Many everyday devices use electromagnetic waves.

Torch



1

Remote control



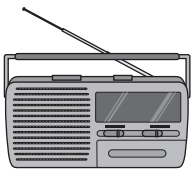
2

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

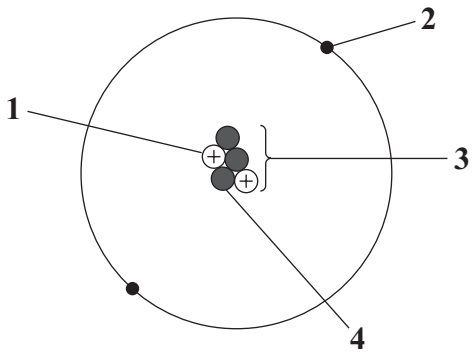
C radio waves

D visible light

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QUESTION TWO

The diagram shows an atom.



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

A electron

B neutron

C nucleus

D proton

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** . . . .

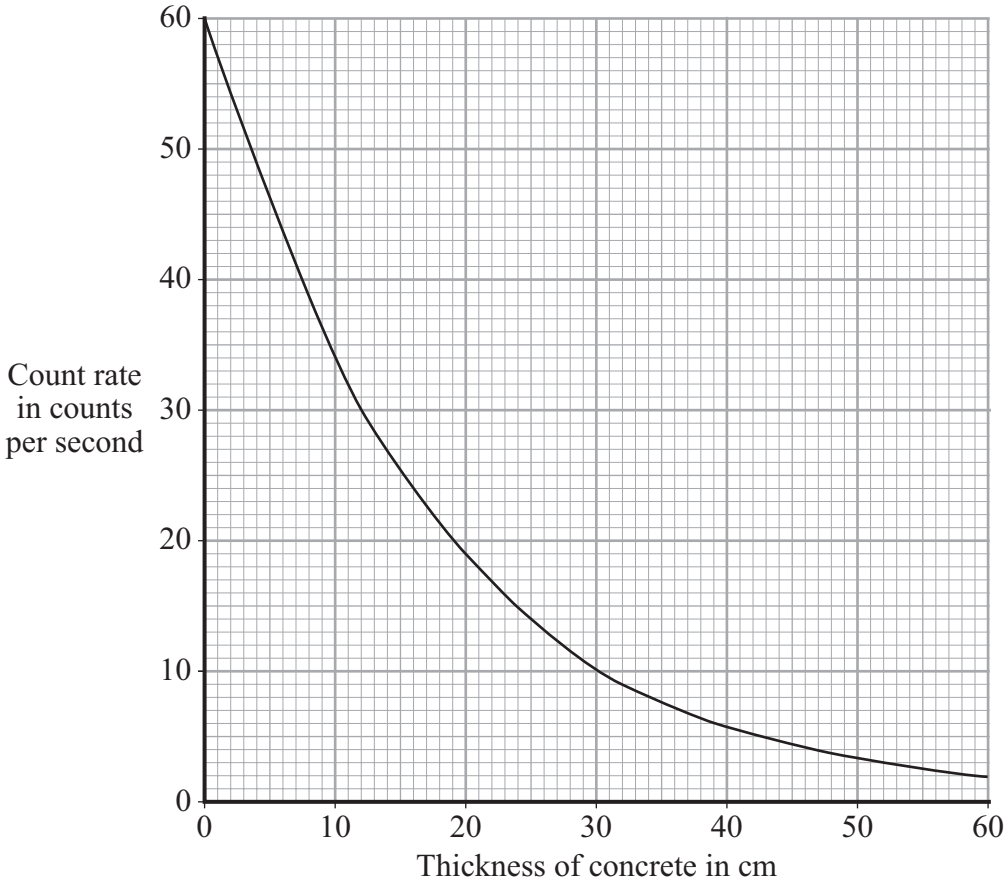
A man taking a metal bar out of a furnace protects himself by . . . **4** . . . .

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QUESTION FOUR

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

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



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

A 8

B 12

C 30

D 60

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

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

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

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

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QUESTION FIVE

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

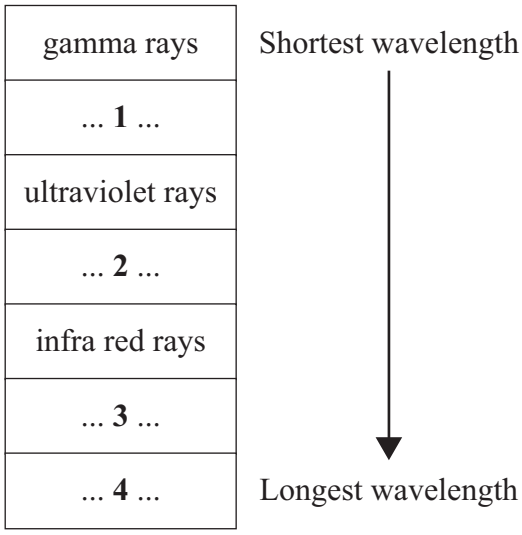
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A microwaves

B X-rays

C visible light

D radio waves



Turn over for the next question

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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

The radioactive isotope phosphorus-32 emits beta particles.

Scientists use phosphorus-32 to help them to understand how plants use phosphorus to grow.

6A A material is described as radioactive if it gives out . . .

1 radio waves all the time.

2 nuclear radiation all the time.

3 radio waves when heated.

4 nuclear radiation when heated.

6B Phosphorus-32 is one of the isotopes of phosphorus.

Atoms of the other isotopes of phosphorus have different numbers of . . .

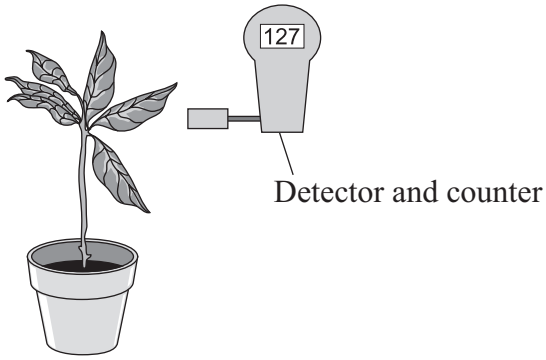
1 electrons.

2 neutrons.

3 nuclei.

4 protons.

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6C The path of the phosphorus in the plant can be traced because the detector can detect . . .

1 beta particles.

2 phosphorus atoms.

3 phosphorus nuclei.

4 ultraviolet radiation.

6D Phosphorus-32 has a half-life of 14 days.

This means that the number of phosphorus-32 nuclei will . . .

1 fall to zero in 14 days.

2 halve in 14 days.

3 double in 14 days.

4 be unchanged in 14 days.

Turn over for the next question

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QUESTION SEVEN

Scientists studying distant galaxies have noticed that light from them appears to have increased in wavelength.

7A What is this apparent increase in wavelength called?

1 black hole formation

2 blue-shift

3 red-shift

4 the Hubble effect

7B What does the apparent increase in wavelength suggest about the universe?

1 It is expanding.

2 It is contracting.

3 It was expanding but is now contracting.

4 It was contracting but is now expanding.

7C What does the apparent increase in wavelength suggest about the origin of the universe?

1 It all started from one small point.

2 It was formed by gravity pulling material together.

3 It was formed by two galaxies colliding.

4 It had no starting point; it has always existed.

7D What name is given to the theory about the origin of the universe that has been developed from these observations?

1 big bang theory

2 steady state theory

3 relativity theory

4 gravitational theory

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Turn over for the next question

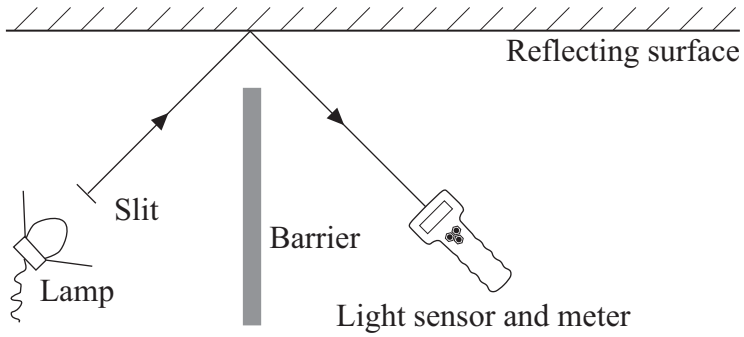
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QUESTION EIGHT

A student investigated how different surfaces reflect light.

The student set up the apparatus shown below.

She did the experiment in a darkroom where the only light was from the lamp.



She used different reflecting surfaces. They were:

- shiny black
- shiny white
- matt white
- matt black.

For each surface, she took the meter reading.

8A What type of variable was the reflecting surface?

1 continuous

2 control

3 dependent

4 independent

8B What type of variable was the meter reading?

1 control

2 dependent

3 categoric

4 independent

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8C The student noticed that when she switched off the lamp, the meter reading did not return to zero.

This caused her meter readings to be different from the true meter readings.

This is called . . .

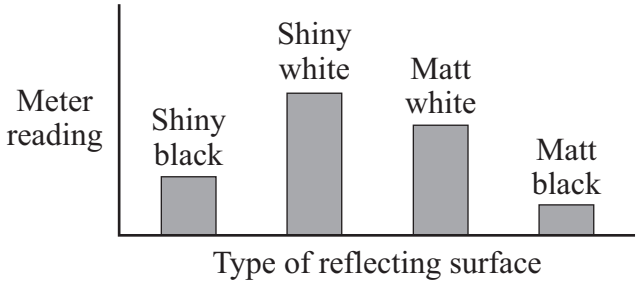
1 an anomalous result.

2 a best fit.

3 a random error.

4 a systematic error.

8D The bar chart shows her results.



She displayed her results as a bar chart because the type of reflecting surface was a . . .

1 continuous variable and so was the meter reading.

2 continuous variable and the meter reading was a categoric variable.

3 categoric variable and the meter reading was a continuous variable.

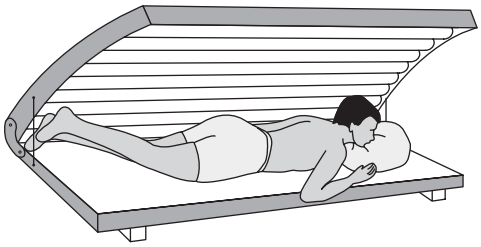
4 categoric variable and so was the meter reading.

Turn over for the next question

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QUESTION NINE

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



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

The table gives their results.

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

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

1 acted as the control group.

2 ensured that the results were reliable.

3 acted as the independent variable.

4 ensured that the results were accurate.

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

1 reliable.

2 precise.

3 biased.

4 random.

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9C These results show that . . .

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

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

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

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

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

1 the sunbed industry is not regulated properly.

2 sunbeds contain cancer-producing chemicals.

3 there are no health benefits from using sunbeds.

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

END OF TEST

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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

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

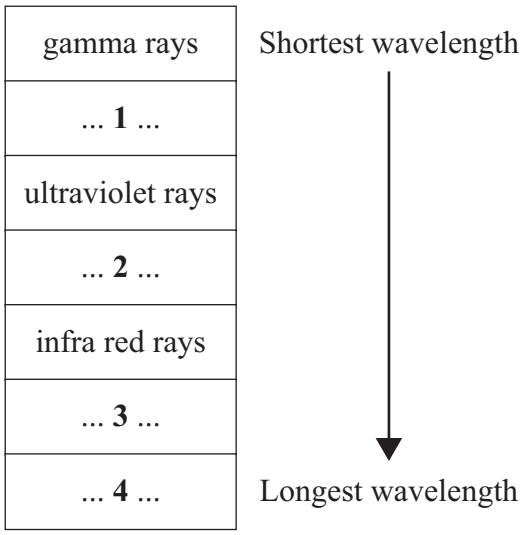
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A microwaves

B X-rays

C visible light

D radio waves



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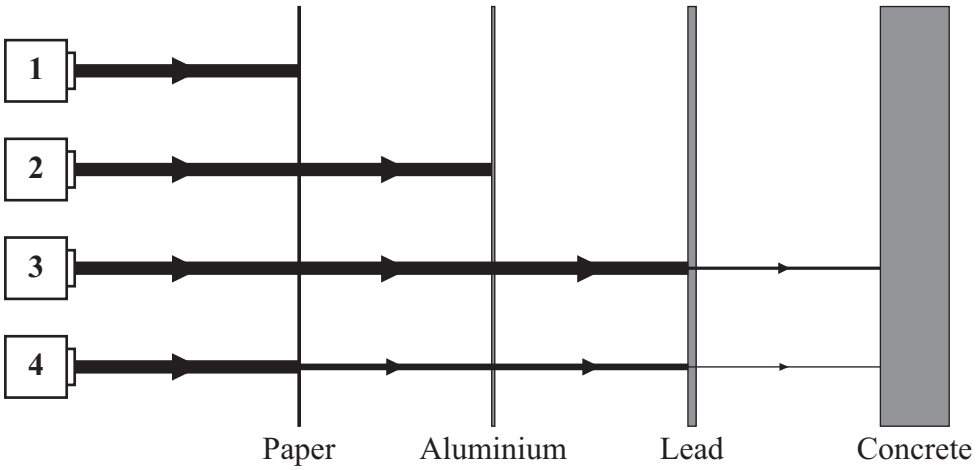
QUESTION TWO

The diagram shows four radioactive sources, **1**, **2**, **3** and **4**, each producing different types of nuclear radiation.

The thicker the horizontal lines in the diagram, the greater the intensity of the radiation.

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

Radioactive sources



A alpha only

B beta only

C gamma only

D alpha and gamma

Turn over for the next question

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SECTION TWO

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

Each of these questions has four parts.

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

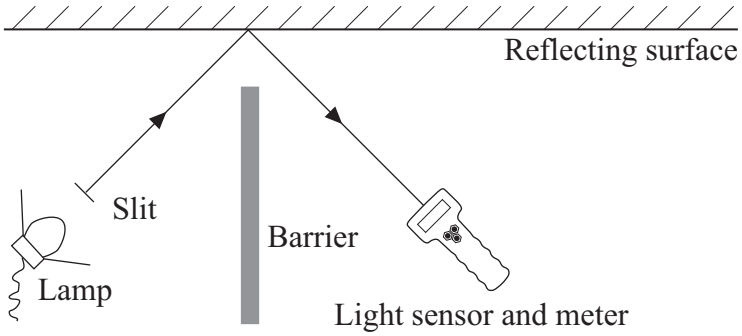
Mark your choices on the answer sheet.

QUESTION THREE

A student investigated how different surfaces reflect light.

The student set up the apparatus shown below.

She did the experiment in a darkroom where the only light was from the lamp.



She used different reflecting surfaces. They were:

- shiny black
- shiny white
- matt white
- matt black.

For each surface, she took the meter reading.

3A What type of variable was the reflecting surface?

1 continuous

2 control

3 dependent

4 independent

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3B What type of variable was the meter reading?

1 control

2 dependent

3 categoric

4 independent

3C The student noticed that when she switched off the lamp, the meter reading did not return to zero.

This caused her meter readings to be different from the true meter readings.

This is called . . .

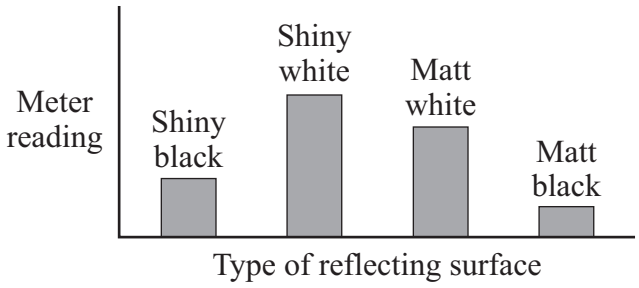
1 an anomalous result.

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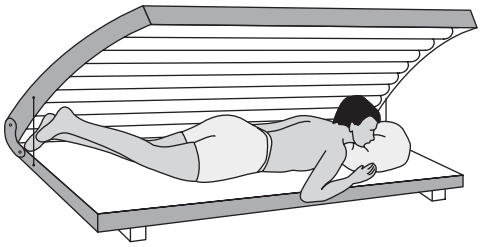
3 categoric variable and the meter reading was a continuous variable.

4 categoric variable and so was the meter reading.

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QUESTION FOUR

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



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

The table gives their results.

	Regular users of sunbeds	**Non-users of sunbeds**
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4A The group that did not use sunbeds . . .

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2 ensured that the results were reliable.

3 acted as the independent variable.

4 ensured that the results were accurate.

4B Repeating the investigation with another group of people would make the results more . . .

1 reliable.

2 precise.

3 biased.

4 random.

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4C These results show that . . .

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

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

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

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

4D The government is concerned about the health of regular users of sunbeds because . . .

1 the sunbed industry is not regulated properly.

2 sunbeds contain cancer-producing chemicals.

3 there are no health benefits from using sunbeds.

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

Turn over for the next question

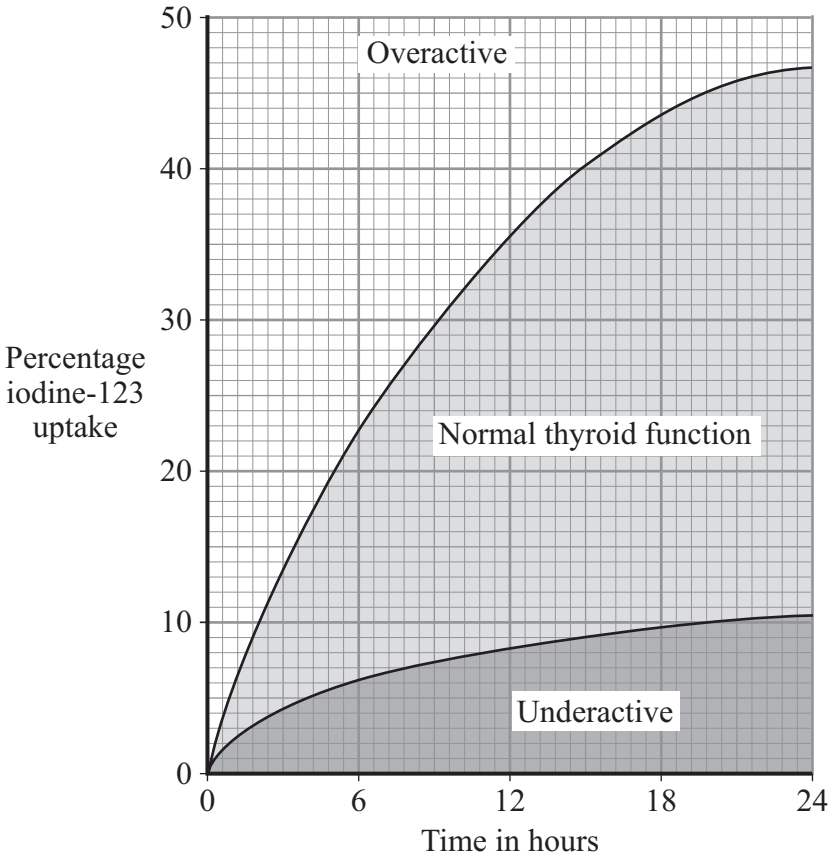
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QUESTION FIVE

The thyroid gland uses iodine to produce hormones (chemicals) which help to control the body's functions. If too much iodine is absorbed, the thyroid becomes overactive. If too little iodine is absorbed, the thyroid becomes underactive.

A radioactive isotope, iodine-123, is used as a tracer in the diagnosis of thyroid disease. Iodine-123 is a gamma emitter.

A patient having a diagnostic test is given a drink of sodium iodide which contains a small amount of iodine-123. A detector measures the gamma emission from the thyroid. The iodine uptake by the thyroid is measured and displayed, as shown in the graph.



5A A gamma emitter is used because gamma rays . . .

1 are not affected by electric fields.

2 can pass through body tissue easily.

3 travel at the speed of light.

4 have very long wavelengths.

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5B A patient is worried about drinking the radioactive liquid. The doctor tells him that the half-life of iodine-123 is 13 hours.

She explains that after 48 hours . . .

1 there will be no iodine-123 left in the body.

2 there will be less than 1/16 of the iodine-123 left in the body.

3 there will be less than 1/8 of the iodine-123 left in the body.

4 there will be no gamma radiation left in the body.

5C Three patients, **P**, **Q** and **R**, undergo the same diagnostic test. Their results are shown in the table.

Patient	Percentage of iodine-123 uptake after 6 hours	Percentage of iodine-123 uptake after 24 hours
P	1.0	5.0
Q	10.0	25.0
R	25.0	50.0

Using the graph, which one of the following statements is a correct conclusion?

1 All three patients are normal.

2 **P** and **Q** are normal; **R** is 'overactive'.

3 **P** and **R** are normal; **Q** is 'underactive'.

4 Only **Q** is normal.

5D Some medical students suggest that the rate of gamma emission from the iodine-123 is affected by different factors.

Which student is correct?

Student	Factor affecting rate of gamma emission
1	body temperature
2	age and sex of patient
3	length of time after the drink is taken
4	chemical composition of sodium iodide

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QUESTION SIX

Mobile phones make use of microwaves.

Microwave ovens use microwaves of a similar wavelength. These microwaves are absorbed by the water molecules in food.

Human and animal body tissues contain a lot of water molecules. Some people are worried that using mobile phones for long periods of time could lead to some form of brain damage.

Scientists have investigated this worry by exposing laboratory mice to mobile phone radiation and monitoring the mice for signs of brain abnormality.

6A Electromagnetic waves travel at a speed of 300 000 km/s. Some microwaves have a wavelength of 10 cm.

What is the frequency of these microwaves?

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

1 30 000 000 Hz

2 300 000 000 Hz

3 3 000 000 000 Hz

4 30 000 000 000 Hz

6B Electromagnetic waves that ionise may cause cancer. The higher the frequency of a wave, the more ionising the radiation.

Which type of radiation is most likely to cause cancer?

1 microwaves

2 infra red

3 ultraviolet

4 X-rays

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6C The power output of a microwave oven is at least 500 W.

The power output of mobile phones is limited to 2 W.

What is the most likely reason why this power limit was introduced?

1 to reduce interference between phones

2 to reduce heating effects on the brain

3 to allow phones to use the GPS (Global Positioning System)

4 to allow phones to use a digital signal

6D The tests on mice showed no evidence of brain abnormalities in the mice.

From this, the public can conclude that . . .

1 the results are not accurate because the tests were not carried out on humans.

2 as there is no evidence of danger to mice, there is probably no danger to humans.

3 as there is no evidence of danger to mice, there is no danger to humans.

4 the tests were not sensitive enough to record any evidence.

Turn over for the next question

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QUESTION SEVEN

Some types of electromagnetic radiation from space are absorbed by the Earth's atmosphere.

	Short wavelength radio	Short wavelength microwaves	Infra red	Visible light	Ultraviolet	X-rays	Gamma rays
Percentage absorbed by atmosphere	0	95	96	5	98	100	100

Different objects or events in the universe emit different types of electromagnetic radiation.

	Gamma ray bursts	Nebulae	Pulsars	Stars	Universe background radiation
Radiation emitted	gamma rays	infra red	radio	all types	short wavelength microwaves

The planets and moons of the solar system reflect light from the Sun.

7A Early civilisations observed the sky with the naked eye.

Which objects did they see?

1 moons, nebulae and pulsars

2 gamma ray bursts, moons and planets

3 nebulae and pulsars

4 moons, planets and stars

7B Telescopes that could detect electromagnetic waves of the lowest frequency were built in the 20th century. These telescopes are on the surface of the Earth.

From the information in the tables, which of the following, which could not have been observed before, could then be easily observed from the Earth's surface?

1 pulsars

2 gamma ray bursts

3 nebulae

4 stars

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7C In 1989, the background radiation from the universe was mapped from a telescope in space.

Why was this **not** done with telescopes based on Earth?

1 Because only 2% of ultraviolet radiation penetrates Earth's atmosphere.

2 Because only 4% of infra red radiation penetrates Earth's atmosphere.

3 Because only 5% of short wavelength microwave radiation penetrates Earth's atmosphere.

4 Because only 95% of visible radiation penetrates Earth's atmosphere.

7D The first table suggests that, with the exception of . . .

1 radio, the percentage of radiation absorbed by the atmosphere, increases with increasing wavelength.

2 radio, the percentage of radiation absorbed by the atmosphere, decreases with increasing wavelength.

3 visible light, the percentage of radiation absorbed by the atmosphere, increases with increasing wavelength.

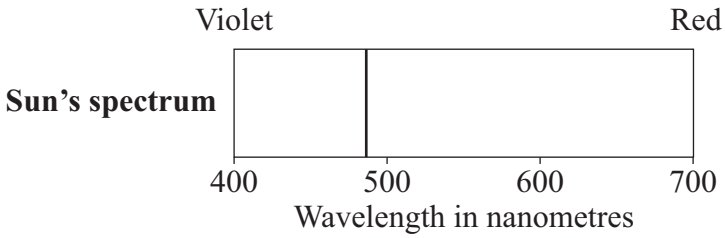
4 visible light, the percentage of radiation absorbed by the atmosphere, decreases with increasing wavelength.

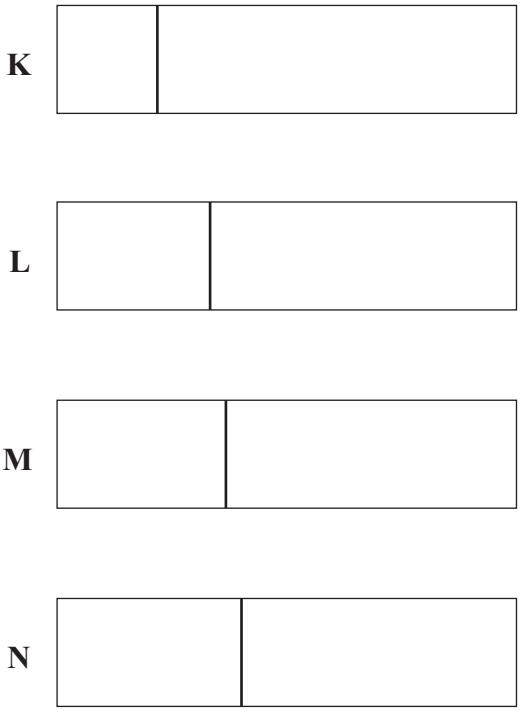
Turn over for the next question

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QUESTION EIGHT

Dark lines on the spectra of light from galaxies represent chemical elements. The lines occur at specific wavelengths.





The line shown on the Sun's spectrum represents hydrogen. **K**, **L**, **M** and **N** are spectra of light from distant galaxies showing the same line.

8A Which galaxy is furthest from the Sun?

1 **K**

2 **L**

3 **M**

4 **N**

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8B Which galaxy is moving towards the Sun?

1 **K**

2 **L**

3 **M**

4 **N**

8C Observation and analysis of red-shift suggests that . . .

1 the universe began from a very small initial point and has been expanding ever since.

2 the universe contracted initially and then began to expand.

3 the universe expanded initially and then began to contract.

4 the universe has always existed as it is now.

8D What causes red-shift?

1 a decrease in the frequency of light due to the galaxies moving closer to the Earth

2 a decrease in the frequency of light due to the galaxies moving away from the Earth

3 an increase in the frequency of light due to the galaxies moving closer to the Earth

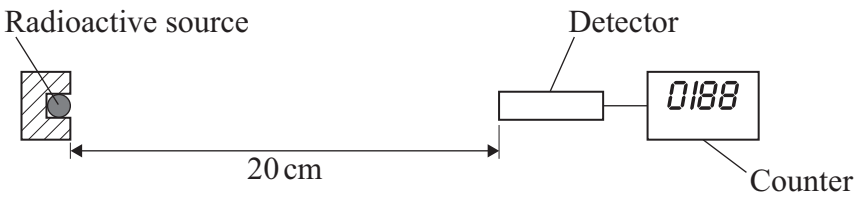
4 an increase in the frequency of light due to the galaxies moving away from the Earth

Turn over for the next question

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QUESTION NINE

A scientist investigated how the count rate of the nuclear radiation emitted by a particular radioactive source changed with time.



She placed a radiation detector 20 centimetres from the source.

She recorded the count rate every 10 minutes for 2 hours.

These are her results.

Time in min	10	20	30	40	50	60	70	80	90	100	110	120
Count rate in counts per minute	188	160	132	112	94	80	69	56	47	40	33	28

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

1 30 minutes

2 40 minutes

3 50 minutes

4 60 minutes

9B The count rate at 70 minutes does not fit the same pattern as the other results.

Which one of the following is the most likely reason that this count rate does not fit the pattern?

1 The sensitivity of the detector is too low.

2 After 70 minutes, there was a rise in room temperature.

3 Radioactive decay is a random process.

4 After a certain time, the half-life of a source changes.

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9C The scientist should have recorded the count rate at the beginning of the investigation at 0 minutes.

What was the count rate most likely to have been at 0 minutes?

1 192 counts per minute

2 188 counts per minute

3 224 counts per minute

4 376 counts per minute

9D Another radioactive material has a half-life of 6 years. A 64 g sample of the radioactive material is stored in a container.

What mass of this radioactive material will have decayed in 24 years?

1 4 g

2 16 g

3 48 g

4 60 g

END OF TEST

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Version 1:0: 21/07/09

ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A (4461)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2009 Examination – June Series

The blank answer sheet for this component can be found at the end of this document.

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This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

June 2009

Foundation Tier

Question	Key		
One	**A**	infra red	**2**
	B	microwaves	**3**
	C	radio waves	**4**
	D	visible light	**1**
Two	**A**	electron	**2**
	B	neutron	**4**
	C	nucleus	**3**
	D	proton	**1**
Three	**A**	wearing thick, insulating gloves	**4**
	B	leaving the room	**1**
	C	looking through blackened glass	**3**
	D	using sun cream	**2**
Four	**A**	8	**4**
	B	12	**3**
	C	30	**2**
	D	60	**1**
Five	**A**	microwaves	**3**
	B	X-rays	**1**
	C	visible light	**2**
	D	radio waves	**4**

	A	B	C	D
Six	**2**	**2**	**1**	**2**
Seven	**3**	**1**	**1**	**1**
Eight	**4**	**2**	**4**	**3**
Nine	**1**	**1**	**3**	**4**

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

June 2009

Higher Tier

Question	Key		
One	**A**	microwaves	**3**
	B	X-rays	**1**
	C	visible light	**2**
	D	radio waves	**4**
Two	**A**	alpha only	**1**
	B	beta only	**2**
	C	gamma only	**3**
	D	alpha and gamma	**4**

	A	B	C	D
Three	**4**	**2**	**4**	**3**
Four	**1**	**1**	**3**	**4**
Five	**2**	**3**	**4**	**3**
Six	**3**	**4**	**2**	**2**
Seven	**4**	**1**	**3**	**4**
Eight	**4**	**1**	**1**	**2**
Nine	**2**	**3**	**3**	**4**

GCSE SCIENCE

AQA

Unit : PHY1BP PHYSICS UNIT 1B

Centre :

Candidate Number : **UCI :**

Candidate Name :

Series : 6M09

22-JUN-09

For completion by the Examination Invigilator. **Please fill this circle if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	microwaves	○	○	○	○
1B	X-rays	○	○	○	○
1C	visible light	○	○	○	○
1D	radio waves	○	○	○	○

QUESTION TWO

		1	2	3	4
2A	alpha only	○	○	○	○
2B	beta only	○	○	○	○
2C	gamma only	○	○	○	○
2D	alpha and gamma	○	○	○	○

QUESTION THREE

	1	2	3	4
3A	○	○	○	○
3B	○	○	○	○
3C	○	○	○	○
3D	○	○	○	○

QUESTION FOUR

	1	2	3	4
4A	○	○	○	○
4B	○	○	○	○
4C	○	○	○	○
4D	○	○	○	○

QUESTION FIVE

	1	2	3	4
5A	○	○	○	○
5B	○	○	○	○
5C	○	○	○	○
5D	○	○	○	○

QUESTION SIX

	1	2	3	4
6A	○	○	○	○
6B	○	○	○	○
6C	○	○	○	○
6D	○	○	○	○

QUESTION SEVEN

	1	2	3	4
7A	○	○	○	○
7B	○	○	○	○
7C	○	○	○	○
7D	○	○	○	○

QUESTION EIGHT

	1	2	3	4
8A	○	○	○	○
8B	○	○	○	○
8C	○	○	○	○
8D	○	○	○	○

QUESTION NINE

	1	2	3	4
9A	○	○	○	○
9B	○	○	○	○
9C	○	○	○	○
9D	○	○	○	○

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2239

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FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

Questions **ONE** to **NINE** Choose one response **1 - 4** for each of the parts **A - D**

QUESTION ONE

		1	2	3	4
1A	infra red				
1B	microwaves				
1C	radio waves				
1D	visible light				

QUESTION TWO

		1	2	3	4
2A	electron				
2B	neutron				
2C	nucleus				
2D	proton				

QUESTION THREE

		1	2	3	4
3A	wearing thick, insulating gloves				
3B	leaving the room				
3C	looking through blackened glass				
3D	using sun cream				

QUESTION FOUR

		1	2	3	4
4A	8				
4B	12				
4C	30				
4D	60				

QUESTION FIVE

		1	2	3	4
5A	microwaves				
5B	X-rays				
5C	visible light				
5D	radio waves				

QUESTION SIX

	1	2	3	4
6A				
6B				
6C				
6D				

QUESTION SEVEN

	1	2	3	4
7A				
7B				
7C				
7D				

QUESTION EIGHT

	1	2	3	4
8A				
8B				
8C				
8D				

QUESTION NINE

	1	2	3	4
9A				
9B				
9C				
9D				

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature								

General Certificate of Secondary Education
March 2009

SCIENCE A **PHY1BP**
Unit Physics P1b (Radiation and the Universe)

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Wednesday 4 March 2009 Morning Session

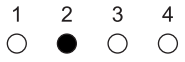
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

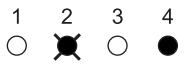
Time allowed: 30 minutes

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.

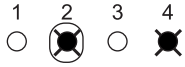
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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**.

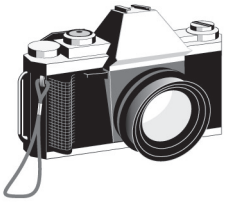
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

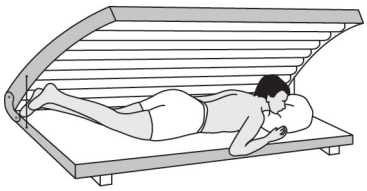
Different devices use different types of electromagnetic waves.



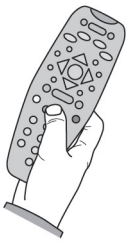
1
Camera



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

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QUESTION TWO

A radioactive material gives out radiation all the time.

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

A alpha

B beta

C electron

D gamma

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

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

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

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

Turn over for the next question

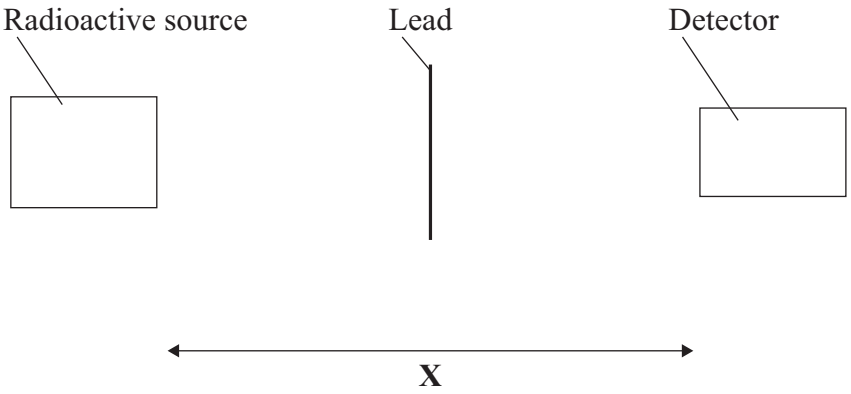
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QUESTION THREE

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

She used different thicknesses of lead.

She plotted a graph of her results.



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

A conclusion

B control variable

C prediction

D independent variable

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

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QUESTION FOUR

This question is about the structure of the atom.

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

A electrons

B neutrons

C nuclei

D protons

The central part of the atom is surrounded by a number of . . . **1** . . . .

In the central part of the atom, there are positive particles called . . . **2** . . . .

The central parts of atoms are called . . . **3** . . . .

Isotopes of the same element contain different numbers of . . . **4** . . . .

Turn over for the next question

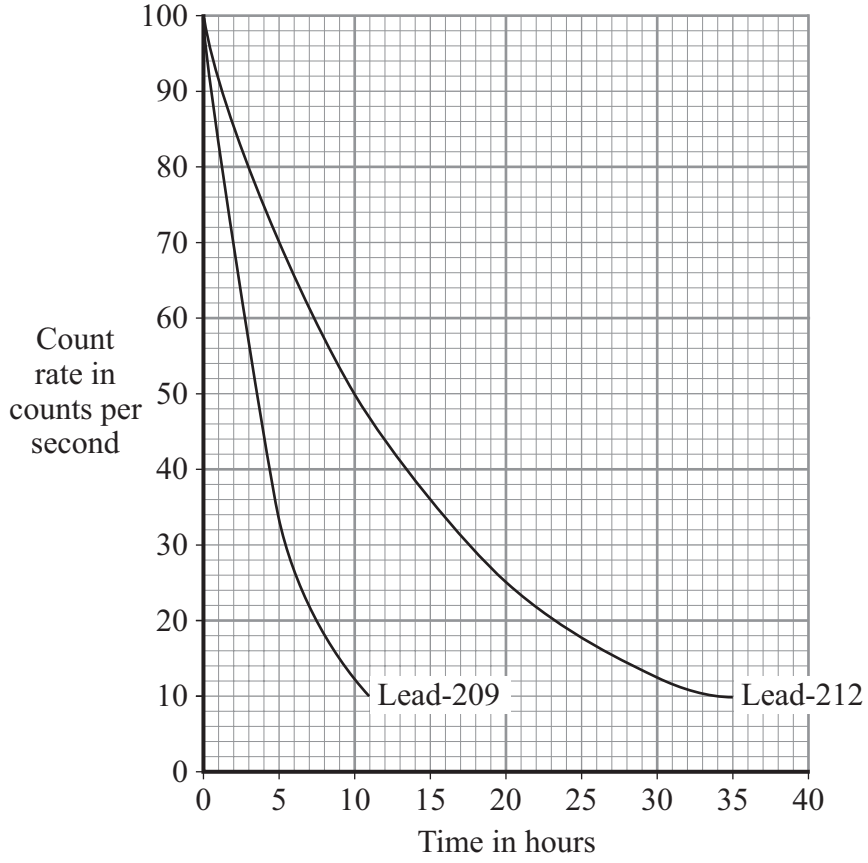
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QUESTION FIVE

The graph shows the radioactive decay of two isotopes of lead.

In lead-209, the total number of protons and neutrons is 209.

In lead-212, the total number of protons and neutrons is 212.



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

A 3

B 10

C 12

D 60

The half-life of lead-212 is . . . **1** . . . hours.

After 10 hours, the count rate of lead-209 is . . . **2** . . . counts per second.

When the count rate of lead-209 has dropped to 20 counts per second, the count rate of lead-212 has dropped to . . . **3** . . . counts per second.

Lead-212 has . . . **4** . . . more neutrons than lead-209.

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Turn over for the next question

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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

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

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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

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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

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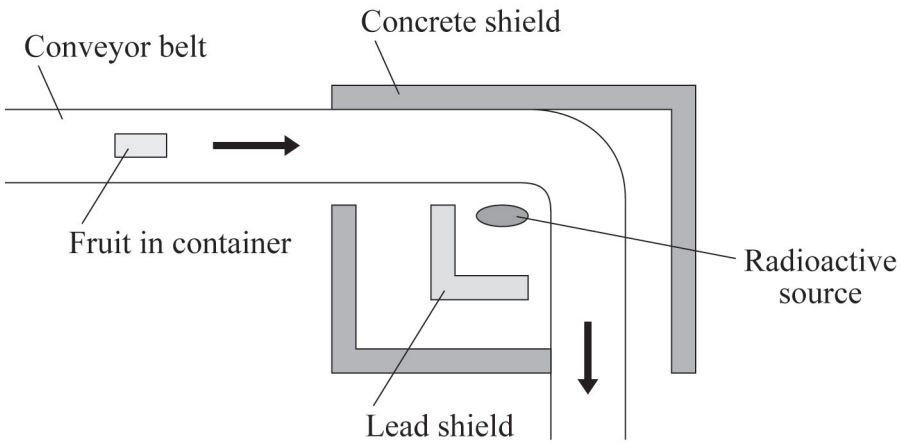
Turn over for the next question

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QUESTION EIGHT

In some countries, fruit is passed in front of a radioactive source. The gamma radiation from the source kills bacteria. This keeps the fruit fresh for longer.

The main process is shown in the diagram.



8A Gamma radiation is used because it is . . .

1 able to penetrate the container and fruit.

2 stopped by the lead shield.

3 not harmful to people.

4 the only radiation that can kill bacteria.

8B The amount of radiation absorbed by the fruit can be increased by . . .

1 moving the source further from the fruit.

2 packing the fruit in thicker containers.

3 slowing down the conveyor belt.

4 speeding up the conveyor belt.

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8C Some fruit growers use X-ray machines instead of gamma ray sources.

The X-rays are safer to work with because . . .

1 gamma ray sources are used in hospitals.

2 X-ray machines can be switched on and off.

3 gamma rays have a lower frequency than X-rays.

4 X-rays have a shorter wavelength than gamma rays.

8D Some scientists investigated the effect of radiation on the vitamin C content of fruit.

They measured the amount of radiation absorbed by some fruit.

They also measured the amount of vitamin C in the fruit before and after the radiation treatment.

Which row of the table describes the variables for a fair test?

	Amount of radiation absorbed	**Amount of vitamin C lost during irradiation**	**Size and type of fruit**
1	independent	dependent	control
2	independent	control	dependent
3	dependent	independent	control
4	control	independent	dependent

Turn over for the next question

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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.

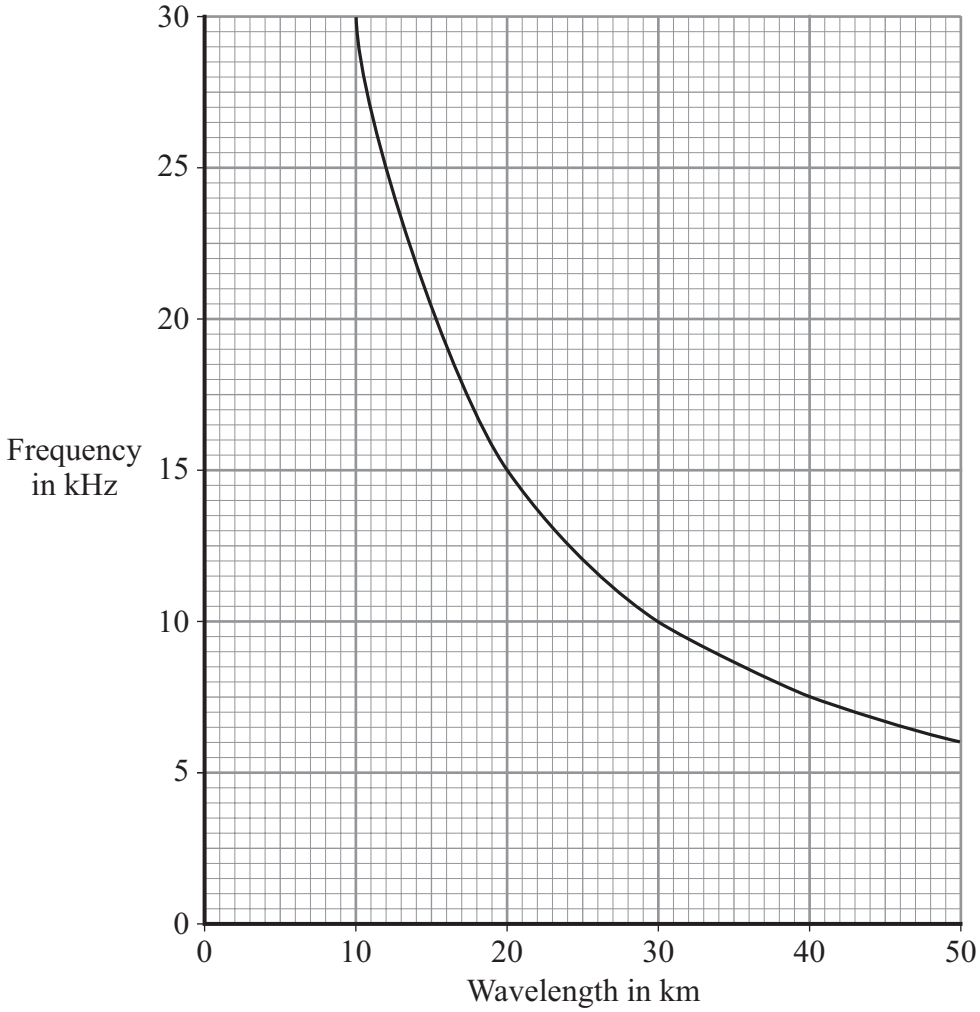
2 interfered with by the atmosphere.

3 reflected by the atmosphere.

4 stopped by the atmosphere.

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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

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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**.

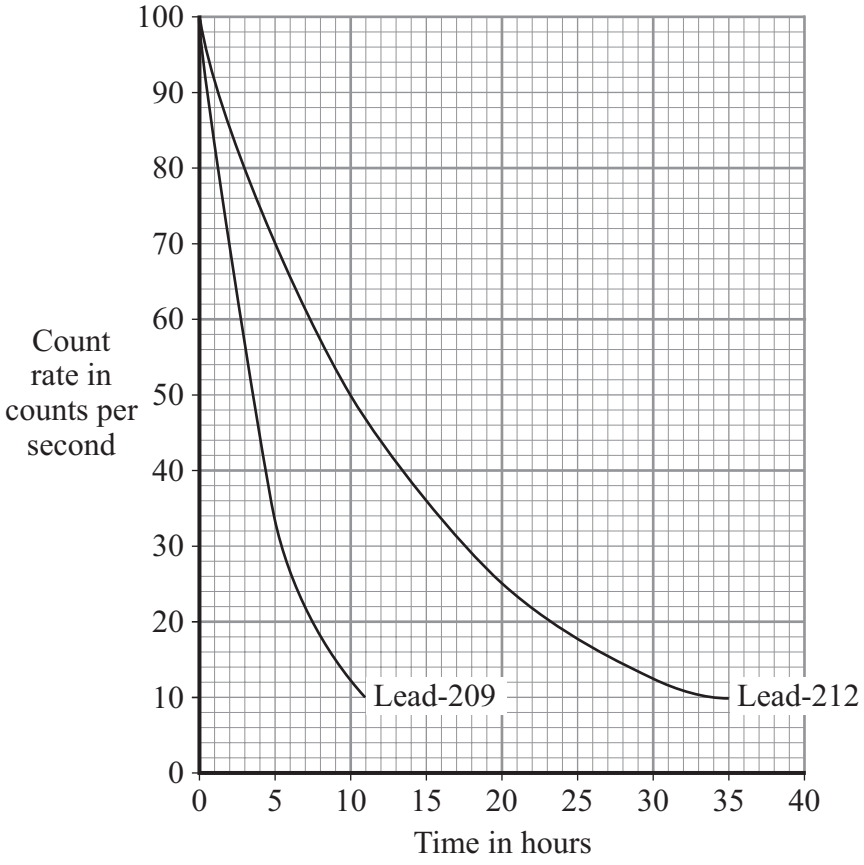
Mark your choices on the answer sheet.

QUESTION ONE

The graph shows the radioactive decay of two isotopes of lead.

In lead-209, the total number of protons and neutrons is 209.

In lead-212, the total number of protons and neutrons is 212.



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

A 3

B 10

C 12

D 60

The half-life of lead-212 is . . . **1** . . . hours.

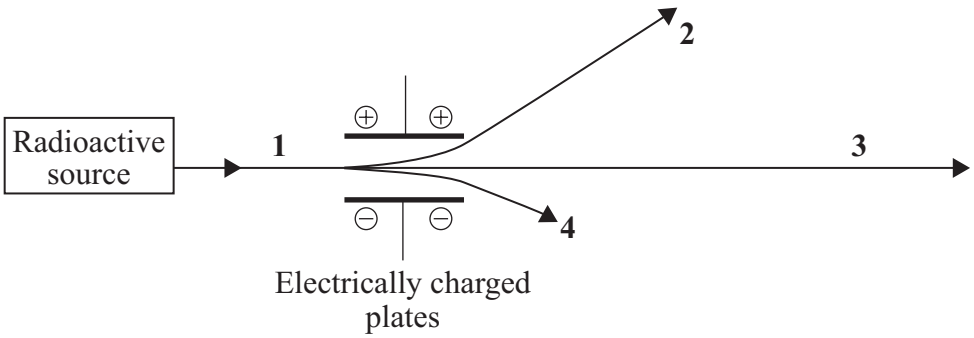
After 10 hours, the count rate of lead-209 is . . . **2** . . . counts per second.

When the count rate of lead-209 has dropped to 20 counts per second, the count rate of lead-212 has dropped to . . . **3** . . . counts per second.

Lead-212 has . . . **4** . . . more neutrons than lead-209.

QUESTION TWO

A beam of radiation from a radioactive source is passed between two electrically charged plates. 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

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SECTION TWO

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

Each of these questions has four parts.

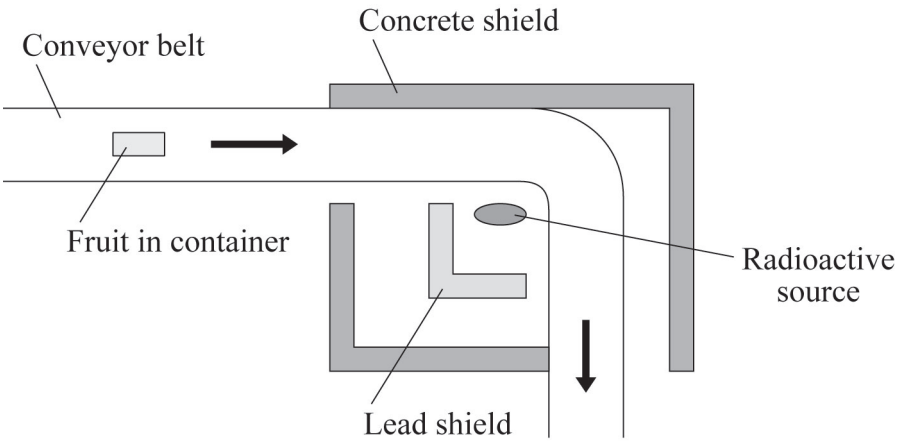
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

In some countries, fruit is passed in front of a radioactive source. The gamma radiation from the source kills bacteria. This keeps the fruit fresh for longer.

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3 not harmful to people.

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1 gamma ray sources are used in hospitals.

2 X-ray machines can be switched on and off.

3 gamma rays have a lower frequency than X-rays.

4 X-rays have a shorter wavelength than gamma rays.

3D Some scientists investigated the effect of radiation on the vitamin C content of fruit.

They measured the amount of radiation absorbed by some fruit.

They also measured the amount of vitamin C in the fruit before and after the radiation treatment.

Which row of the table describes the variables for a fair test?

	Amount of radiation absorbed	**Amount of vitamin C lost during irradiation**	**Size and type of fruit**
1	independent	dependent	control
2	independent	control	dependent
3	dependent	independent	control
4	control	independent	dependent

Turn over for the next question

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QUESTION FOUR

This question is about electromagnetic waves.

4A 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

4B 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.

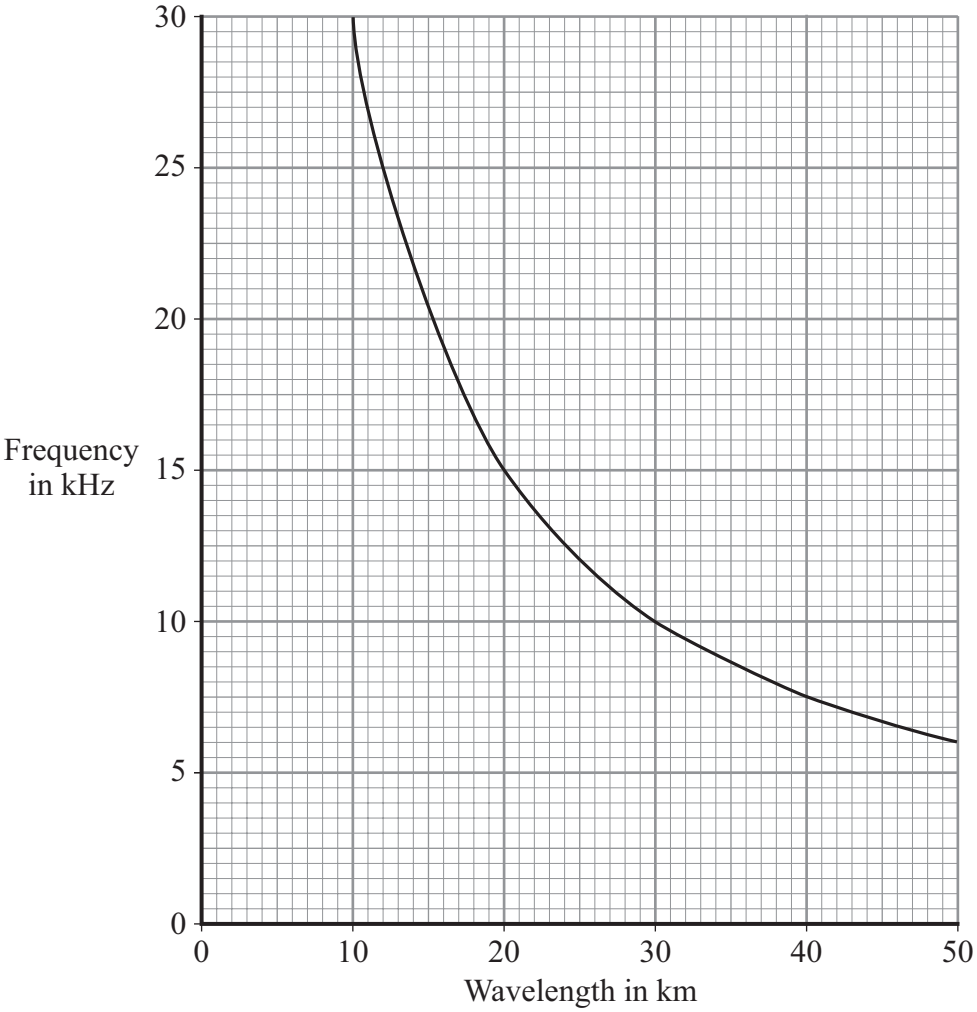
2 interfered with by the atmosphere.

3 reflected by the atmosphere.

4 stopped by the atmosphere.

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



4C The graph shows that when the wavelength doubles, the frequency . . .

1 doubles.

2 halves.

3 quadruples.

4 stays the same.

4D What is the frequency of electromagnetic waves of wavelength 25 000 metres?

1 1.2 kHz

2 1.4 kHz

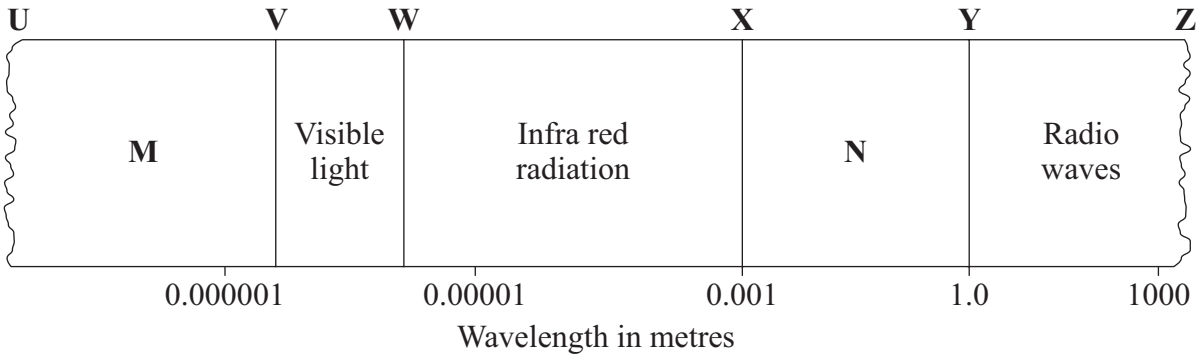
3 12 kHz

4 14 kHz

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QUESTION FIVE

The diagram shows part of the electromagnetic spectrum.



5A Which row of the table gives the types of electromagnetic radiation that are present in **M** and **N**?

	M	**N**
1	gamma	microwaves
2	gamma	ultraviolet
3	ultraviolet	gamma
4	ultraviolet	microwaves

5B Which section of the electromagnetic spectrum can be used for communications?

1 **U** to **Z**

2 **V** to **Z**

3 **W** to **Z**

4 **X** to **Z**

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

All electromagnetic waves travel at a speed of 300 000 000 m/s.

5C BBC Radio 4 is carried by radio waves with a wavelength of 1500 m.

What is the frequency of these waves?

1 0.000 005 Hz

2 0.005 Hz

3 200 kHz

4 450 000 000 kHz

5D Compact fluorescent lamps (CFLs) emit infra red radiation. This radiation can interfere with the infra red signal emitted by remote controls for televisions.

An article about CFLs says that the infra red rays are emitted at a frequency of about 300 kHz.

This is incorrect because this frequency would mean that the wavelength is in . . .

1 the gamma ray part of the electromagnetic spectrum.

2 the microwave part of the electromagnetic spectrum.

3 the radio wave part of the electromagnetic spectrum.

4 the ultraviolet part of the electromagnetic spectrum.

Turn over for the next question

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QUESTION SIX

Radium is an element with many isotopes. All of the isotopes of radium are radioactive. Natural radium emits alpha, beta and gamma radiation.

6A Alpha radiation is . . .

1 a very fast electron from the nucleus.

2 an electromagnetic wave of very high frequency.

3 a particle containing protons and neutrons.

4 a particle containing only neutrons.

6B Beta radiation has a longer range in air than alpha particles.

One of the reasons is that beta radiation is . . .

1 more highly ionising than alpha due to its larger electric charge.

2 more highly ionising than alpha due to its smaller electric charge.

3 less highly ionising than alpha due to its larger electric charge.

4 less highly ionising than alpha due to its smaller electric charge.

6C Gamma radiation is not electrically charged.

We know that it is not electrically charged because gamma radiation is . . .

1 deflected in magnetic fields but not in electric fields.

2 deflected in electric fields but not in magnetic fields.

3 deflected in both electric and magnetic fields.

4 not deflected in either electric or magnetic fields.

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6D A sample of natural radium contains 8 g of isotope radium-211. Radium-211 has a half-life of 13 seconds.

After 26 seconds, . . .

1 half of the radium-211 atoms will have decayed.

2 all of the radium-211 atoms will have decayed.

3 only 2 g of radium-211 will remain.

4 the detected count rate from radium-211 will be zero.

Turn over for the next question

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QUESTION SEVEN

This question is about the behaviour of waves as the source of the wave moves, and what this can tell us about the universe.

7A At an air show, an aircraft flies at a steady speed in a straight line over the crowd of spectators.

As the aircraft approaches, how do the wavelength and frequency of the sound wave heard by the spectators differ from the sound emitted by the aircraft?

	Wavelength	**Frequency**
1	shorter	higher
2	longer	lower
3	longer	the same
4	the same	lower

7B Scientists observing the Andromeda galaxy see that its light is undergoing a blue-shift.

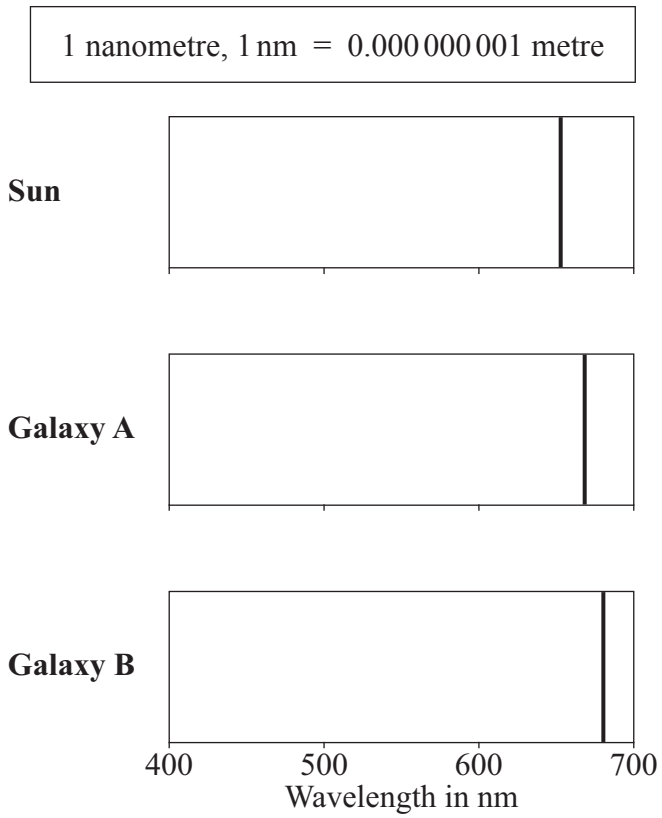
What does this tell them about the wavelength of light arriving on Earth from this galaxy and the movement of Andromeda relative to Earth?

	Wavelength	**Movement relative to Earth**
1	decreasing	moving away
2	decreasing	moving towards
3	increasing	moving away
4	increasing	moving towards

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The visible part of the electromagnetic spectrum from stars includes dark lines. They correspond to chemical elements in the stars and occur at specific wavelengths.

The line in the spectra shown below, from three different sources, represents hydrogen which is found in the Sun's spectrum at a wavelength of 656.3 nm.



7C What does this indicate about galaxies **A** and **B**?

1 Galaxy **A** is colder than galaxy **B**.

2 Galaxy **A** is further away from Earth than galaxy **B**.

3 Galaxy **B** is colder than galaxy **A**.

4 Galaxy **B** is further away from Earth than galaxy **A**.

7D Which of the following theories about the universe does red-shift information support?

1 The universe began from a small initial point and has been expanding ever since.

2 The universe expanded initially, but is now contracting.

3 The universe has always been the size it is now.

4 The universe will eventually run out of energy and collapse.

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QUESTION EIGHT

Airline pilots and people who live at high altitude have an increased exposure to radiation from space.

Scientists measured the annual radiation dose received by people who lived at different altitudes. They repeated the experiment two more times and obtained the following results.

	Annual radiation dose in mSv		
Height above sea level in metres	**First time**	**Second time**	**Third time**
1000	2.9	3.0	2.9
2000	4.44	4.54	4.57
3000	5.90	5.78	6.01
4000	7.46	7.49	7.51

1 millisievert (mSv) is a unit of radiation dose

The scientists also investigated the exposure due to air travel. They found that pilots receive a radiation dose of 0.10 mSv for every 100 hours of flight.

8A Which is the least precise set of results?

1 1000 m

2 2000 m

3 3000 m

4 4000 m

8B Airline pilots should not receive an annual radiation dose of more than 6 mSv.

A pilot should restrict his flying hours because an annual exposure to radiation of more than 6 mSv produces . . .

1 a reduced level of long-term concentration.

2 an increased risk of developing visual impairments.

3 reduced levels of oxygen to the brain.

4 an increased risk of damage to body tissues.

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8C A pilot who lives in Switzerland at a height of 2000 m should restrict his annual flying hours to about . . .

1 500 hours.

2 1500 hours.

3 2500 hours.

4 6000 hours.

8D A pilot averages 1000 hours of flying a year.

The maximum altitude at which he could safely live is . . .

1 1000 m.

2 2000 m.

3 3000 m.

4 4000 m.

Turn over for the next question

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QUESTION NINE

Ultraviolet radiation is next to X-rays in the electromagnetic spectrum. Ultraviolet radiation consists of three regions: UVA, UVB, and UVC, as shown in the table.

	UVA	UVB	UVC	X-rays	

9A The UVA region of the spectrum has wavelengths between 315 and 400 nm. The visible light region of the spectrum extends to wavelengths of 700 nm.

In what wavelength region will violet light be found?

1 nanometre, 1 nm = 0.000 000 001 metre

1 360 – 400 nm

2 400 – 430 nm

3 620 – 700 nm

4 700 – 760 nm

9B Different types of electromagnetic radiation will penetrate materials to different depths. UVA will penetrate the top and middle layers of human skin. UVB will penetrate the top layer only.

This is surprising because gamma rays . . .

1 penetrate less than X-rays and have a lower frequency than X-rays.

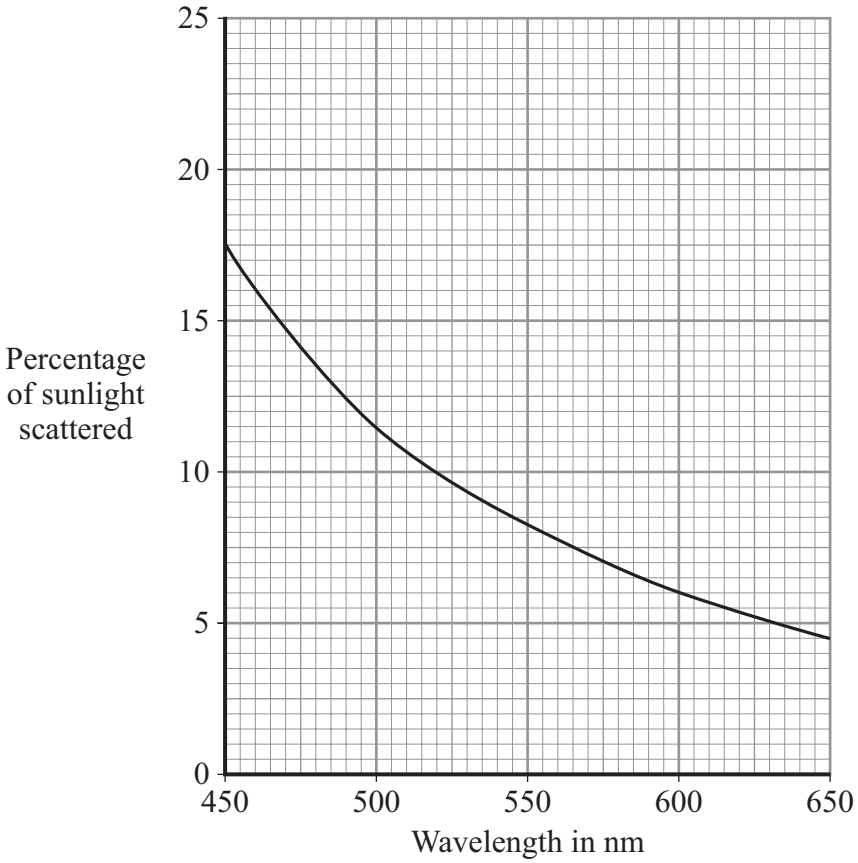
2 penetrate less than X-rays and have a higher frequency than X-rays.

3 penetrate more than X-rays and have a shorter wavelength than X-rays.

4 penetrate more than X-rays and have a longer wavelength than X-rays.

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9C The scattering of sunlight by the atmosphere causes the daylight colour of the sky to be blue. The graph shows how the scattering of sunlight changes with the wavelength.



What percentage of direct sunlight reaches the Earth **unscattered** at a wavelength of 500 nm?

1 11.5 %

2 37.5 %

3 62.5 %

4 88.5 %

9D How much scattering would you expect from ultraviolet rays?

1 less scattering than from visible light because ultraviolet rays have a lower frequency than visible light.

2 less scattering than from visible light because ultraviolet rays travel more slowly than visible light.

3 more scattering than from visible light because ultraviolet rays have a shorter wavelength than visible light.

4 the same scattering as from visible light because they both travel at the same speed.

END OF TEST

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ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A (4461)

Specification A

PHY1BP, PH1BSF & PH1BSH

Mark Scheme

2009 Examination – March Series

STEMUP.CO.UK

This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2009

Foundation Tier

Question	Key		
One	**A**	infra red	**4**
	B	visible light	**1**
	C	ultraviolet	**3**
	D	X-rays	**2**
Two	**A**	alpha	**2**
	B	beta	**3**
	C	electron	**4**
	D	gamma	**1**
Three	**A**	conclusion	**4**
	B	control variable	**2**
	C	prediction	**1**
	D	independent variable	**3**
Four	**A**	electrons	**1**
	B	neutrons	**4**
	C	nuclei	**3**
	D	protons	**2**
Five	**A**	3	**4**
	B	10	**1**
	C	12	**2**
	D	60	**3**

	A	B	C	D
Six	**2**	**1**	**2**	**1**
Seven	**4**	**2**	**2**	**4**
Eight	**1**	**3**	**2**	**1**
Nine	**2**	**3**	**2**	**3**

GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2009

Higher Tier

Question	Key		
One	**A**	3	**4**
	B	10	**1**
	C	12	**2**
	D	60	**3**
Two	**A**	alpha particles	**4**
	B	beta particles	**2**
	C	gamma rays	**3**
	D	alpha, beta and gamma radiation	**1**

	A	B	C	D
Three	**1**	**3**	**2**	**1**
Four	**2**	**3**	**2**	**3**
Five	**4**	**2**	**3**	**3**
Six	**3**	**4**	**4**	**3**
Seven	**1**	**2**	**4**	**1**
Eight	**1**	**4**	**2**	**2**
Nine	**2**	**3**	**4**	**3**