Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
November 2008

SCIENCE A **PHY1BP**
Unit Physics P1b (Radiation and the Universe)

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Thursday 20 November 2008 Morning Session

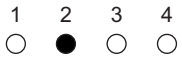
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

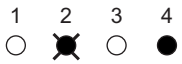
Time allowed: 30 minutes

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.

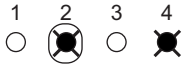
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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

Electromagnetic waves have many uses.

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

A infra red rays

B visible light

C ultraviolet rays

D X-rays

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

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

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

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

QUESTION TWO

The diagram shows parts of the electromagnetic spectrum.

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

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

A gamma rays

B radio waves

C ultraviolet rays

D visible light

QUESTION THREE

Atoms are made up of different parts.

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

A electrons

B neutrons

C nuclei

D protons

All atoms of an element have the same number of positive particles called . . . **1** . . . .

These are located in their . . . **2** . . . .

The central part of an atom is surrounded by . . . **3** . . . .

The atoms of isotopes of the same element have a different number of . . . **4** . . . .

QUESTION FOUR

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

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

A microwaves

B radio waves

C visible light

D X-rays

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

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

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

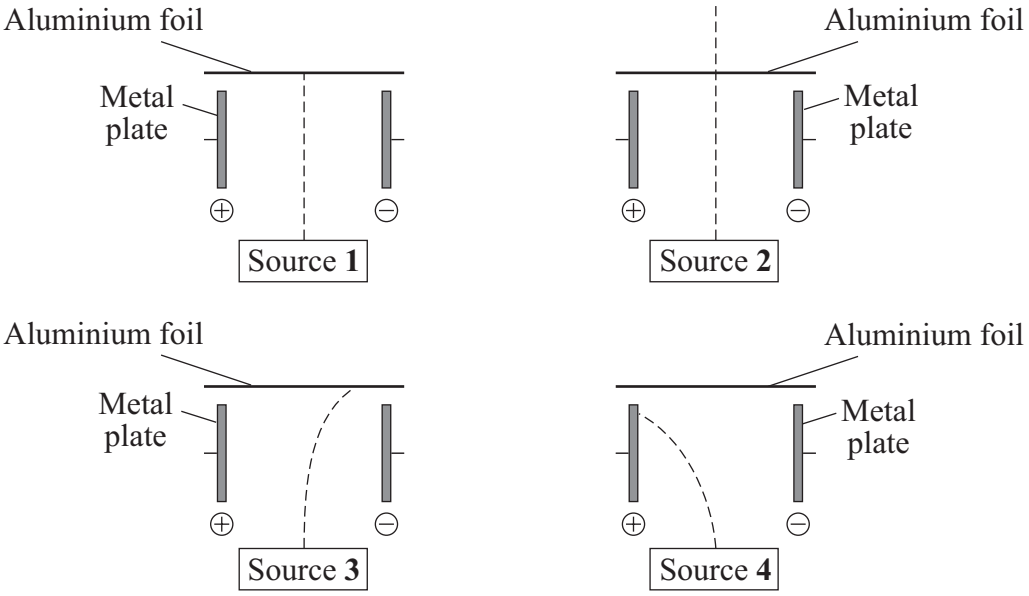
The satellites send images back to Earth using . . . **4** . . . .

QUESTION FIVE

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

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

Light waves are not deflected in electric fields.



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

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

A alpha radiation

B beta radiation

C gamma radiation

D visible light

Turn over for the next question

SECTION TWO

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

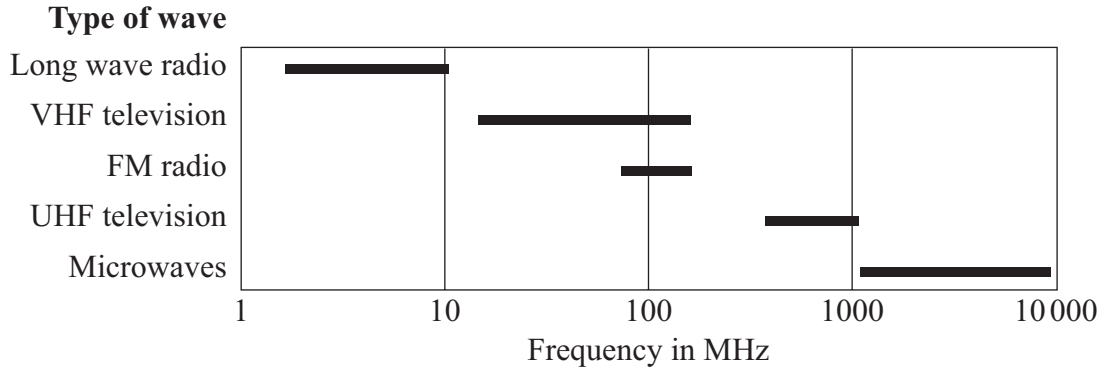
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

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



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

1 electromagnetic waves

2 mechanical waves

3 seismic waves

4 sound waves

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

1 VHF television

2 FM radio

3 UHF television

4 microwaves

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

1 long wave radio and VHF television

2 UHF television and FM radio

3 VHF television and FM radio

4 microwaves and long wave radio

6D What could microwaves be used for?

1 examining broken bones

2 mobile phone networks

3 skin tanning

4 treating cancer

Turn over for the next question

QUESTION SEVEN

Pierre and Marie Curie made many important discoveries about radioactivity.

Pierre was killed in 1906 when he slipped and fell under a horse-drawn cart. He was having dizzy spells at the time. Marie lived until 1934 when she died of leukaemia, a form of cancer.

7A The most likely cause of their sickness was . . .

1 the very long hours they worked.

2 the lack of proper equipment in their laboratory.

3 the cold temperatures in which they worked.

4 the radiation emitted by the radioactive materials they worked with.

7B Marie's notebooks are still so radioactive that they are kept in a lead-lined safe.

The notebooks are radioactive because they . . .

1 are made of radioactive materials.

2 became contaminated with the radioactive materials in her laboratory.

3 absorbed ultraviolet radiation from the radioactive materials in her laboratory.

4 absorbed ultraviolet radiation from the Sun.

7C The safe is lined with thick lead because . . .

1 radioactive materials cannot pass through thick lead.

2 thick lead is needed to stop alpha radiation.

3 thick lead is needed to stop beta radiation.

4 thick lead is needed to stop gamma radiation.

7D The notebooks are removed from the safe occasionally. Careful safety precautions are taken. One safety precaution is to keep people several metres away from the notebooks.

This would provide protection from alpha radiation because alpha particles . . .

1 have a very short half-life.

2 can be stopped by a sheet of paper.

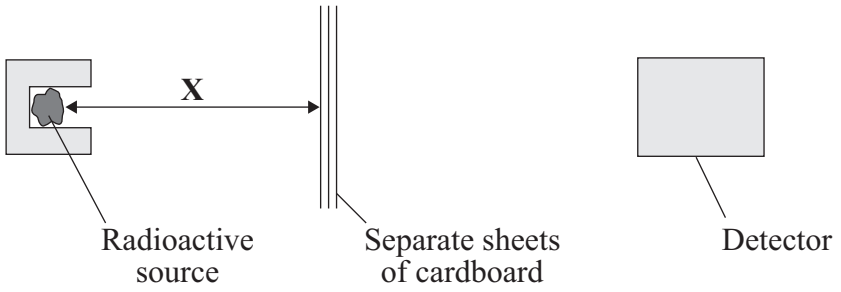
3 have a short range in air.

4 do not kill human body cells.

Turn over for the next question

QUESTION EIGHT

The diagram shows apparatus used by a scientist investigating the effectiveness of cardboard for absorbing radiation.



The detector measured the count rate for different numbers of sheets of cardboard.
The distance **X** was kept constant.

8A Which is the control variable in the experiment?

1 the number of sheets of cardboard

2 the total thickness of the cardboard

3 the distance **X**

4 the count rate

8B Which row of the table gives the correct variables?

	Independent variable	**Dependent variable**
1	count rate	number of sheets
2	number of sheets	count rate
3	distance **X**	count rate
4	count rate	distance **X**

8C The scientist recorded the results of the experiment in a table with the following headings:

Number of sheets of cardboard	Count rate in counts per second

These results were plotted on a graph.

The graph was a . . .

1 bar chart because both variables were categoric.

2 line graph because both variables were continuous.

3 line graph because one variable was categoric.

4 bar chart because one variable was continuous and the other was discrete.

8D Another scientist said that the data used for the graph was not reliable.

How could the reliability of the data be tested?

1 by measuring the distance in millimetres

2 by using sheets of card with different thicknesses

3 by measuring the time to the nearest second

4 by asking another group to carry out the same experiment

Turn over for the next question

QUESTION NINE

Many atoms have nuclei that decay and emit alpha particles. Some of these nuclei have very short half-lives, others have very long ones.

9A What is an alpha particle?

1 an electron from outside the nucleus

2 an electron from inside the nucleus

3 a helium nucleus

4 a proton from inside the nucleus

9B How can the rate, at which a particular radioactive substance decays, be changed?

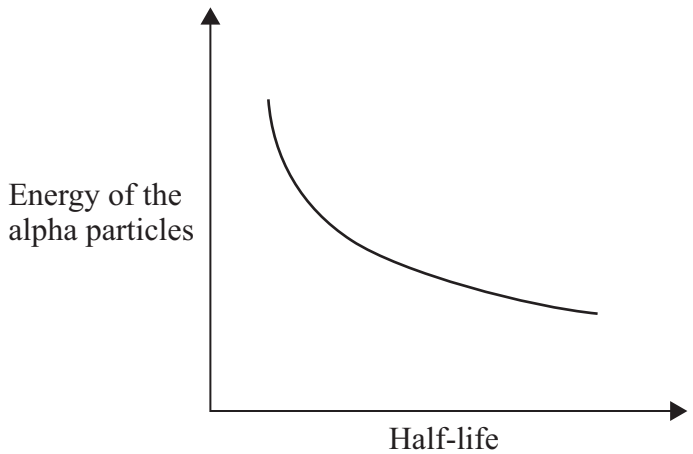
1 by changing the temperature of the nucleus

2 by changing the atmospheric pressure

3 by changing the amount of humidity

4 The rate cannot be changed.

The graph shows the relationship between the energy of the emitted alpha particles and the half-life of the nuclei from which they came.



9C What relationship does the graph show?

1 Alpha particles always have the same amount of energy.

2 The longer the half-life, the less energy the alpha particles have.

3 The longer the half-life, the more energy the alpha particles have.

4 There is no relationship between the half-life and the energy of the alpha particles.

9D What is the meaning of the term *half-life*?

1 half of the time taken for all the atoms originally present to decay

2 the time halfway between when an atom was formed and when it decays

3 the time taken for half of the atoms originally present to decay

4 the time taken for one atom to split in half

END OF TEST

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

HIGHER TIER

SECTION ONE

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

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

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

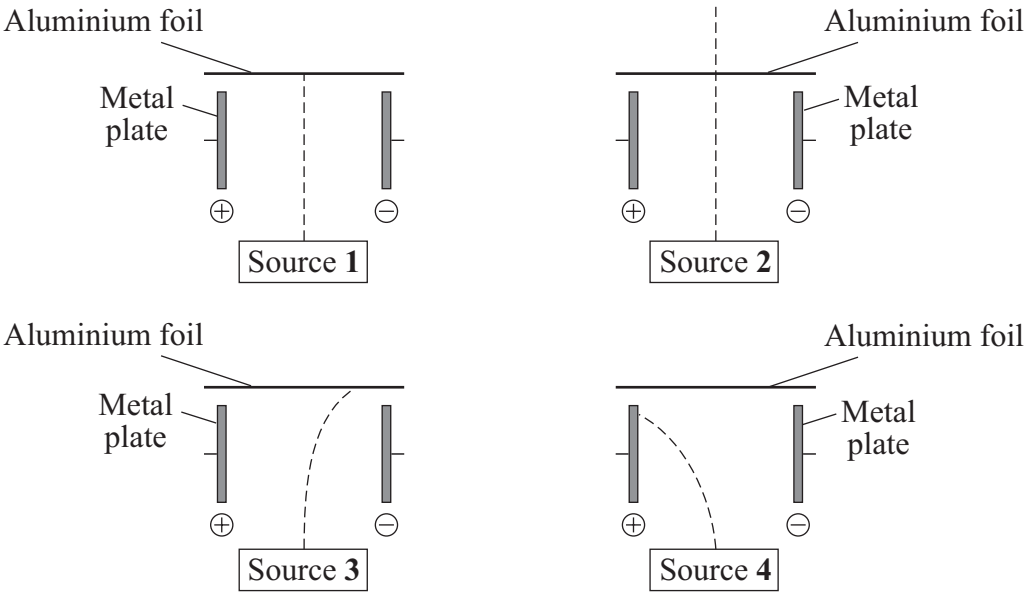
Mark your choices on the answer sheet.

QUESTION ONE

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

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

Light waves are not deflected in electric fields.



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

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

A alpha radiation

B beta radiation

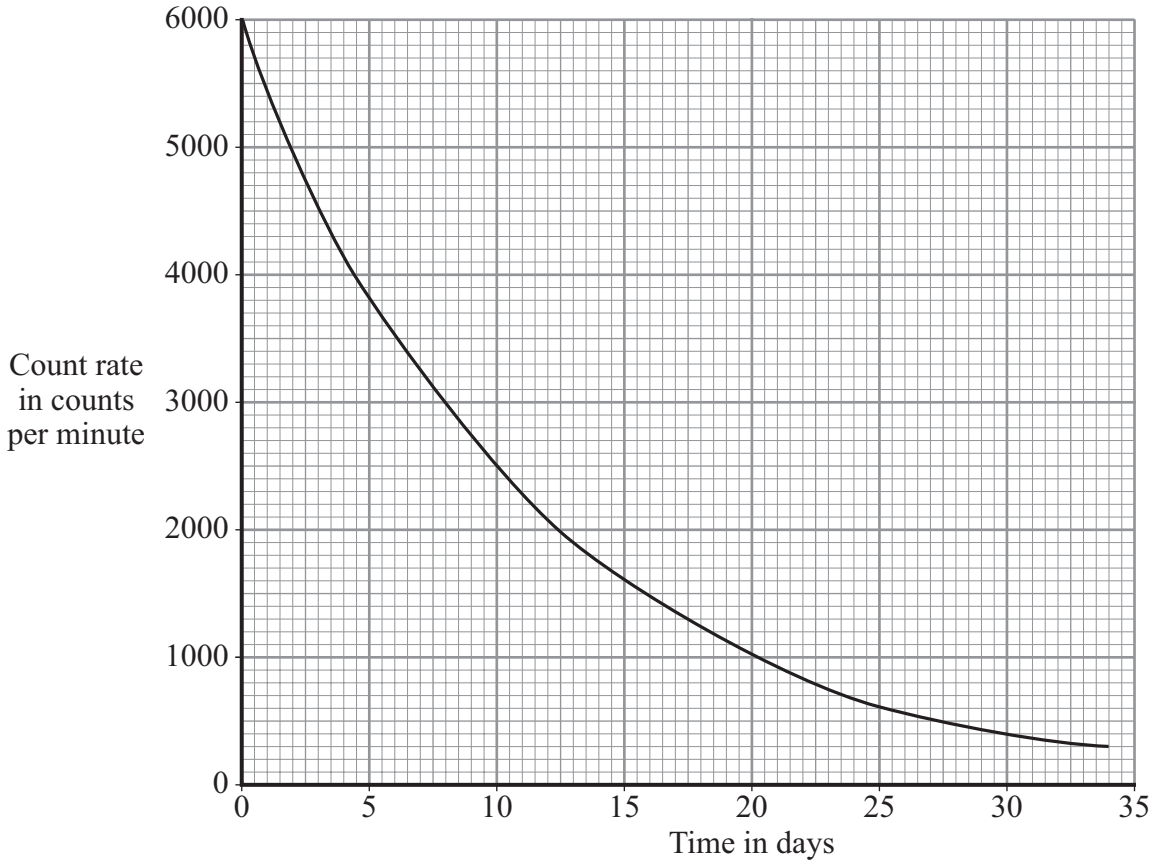
C gamma radiation

D visible light

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

A 4.5

B 8

C 24

D 400

The count rate after 30 days is . . . **1** . . . counts per minute.

The time taken for the count rate to fall to 4000 counts per minute is . . . **2** . . . days.

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

A patient is given 16 mg of iodine-131. This will decay to 2 mg in . . . **4** . . . days.

SECTION TWO

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

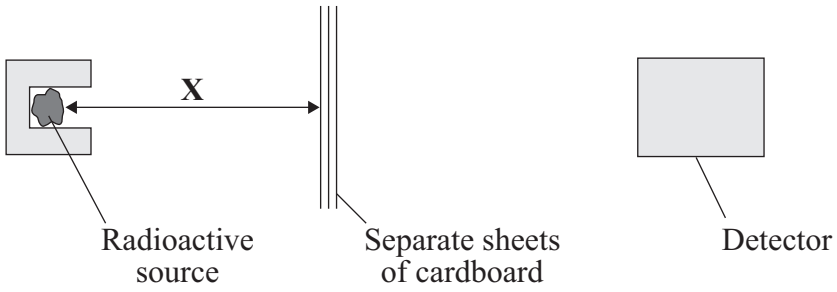
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

The diagram shows apparatus used by a scientist investigating the effectiveness of cardboard for absorbing radiation.



The detector measured the count rate for different numbers of sheets of cardboard.
The distance **X** was kept constant.

3A Which is the control variable in the experiment?

1 the number of sheets of cardboard

2 the total thickness of the cardboard

3 the distance **X**

4 the count rate

3B Which row of the table gives the correct variables?

	Independent variable	Dependent variable
1	count rate	number of sheets
2	number of sheets	count rate
3	distance **X**	count rate
4	count rate	distance **X**

3C The scientist recorded the results of the experiment in a table with the following headings:

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How could the reliability of the data be tested?

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3 by measuring the time to the nearest second

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QUESTION FOUR

Many atoms have nuclei that decay and emit alpha particles. Some of these nuclei have very short half-lives, others have very long ones.

4A What is an alpha particle?

1 an electron from outside the nucleus

2 an electron from inside the nucleus

3 a helium nucleus

4 a proton from inside the nucleus

4B How can the rate, at which a particular radioactive substance decays, be changed?

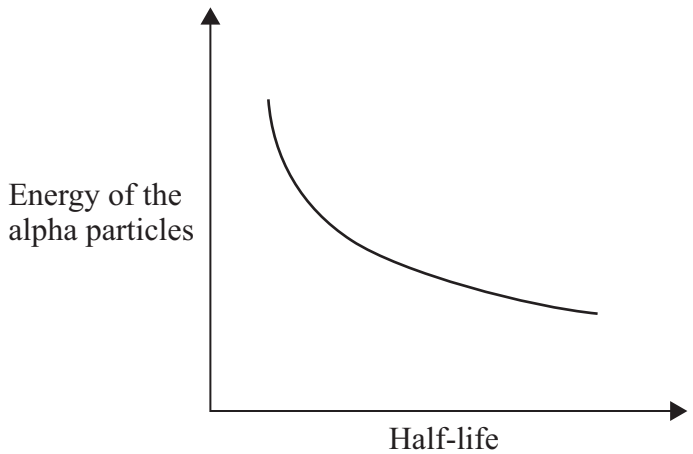
1 by changing the temperature of the nucleus

2 by changing the atmospheric pressure

3 by changing the amount of humidity

4 The rate cannot be changed.

The graph shows the relationship between the energy of the emitted alpha particles and the half-life of the nuclei from which they came.



4C What relationship does the graph show?

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2 The longer the half-life, the less energy the alpha particles have.

3 The longer the half-life, the more energy the alpha particles have.

4 There is no relationship between the half-life and the energy of the alpha particles.

4D What is the meaning of the term *half-life*?

1 half of the time taken for all the atoms originally present to decay

2 the time halfway between when an atom was formed and when it decays

3 the time taken for half of the atoms originally present to decay

4 the time taken for one atom to split in half

Turn over for the next question

QUESTION FIVE

This question is about the electromagnetic spectrum and its use in communications.

5A Which one of the following types of electromagnetic wave would **not** be suitable for communications?

1 infra red

2 microwave

3 gamma

4 visible light

5B Which types of electromagnetic waves can be used to send signals along optical fibres?

1 infra red and ultraviolet

2 infra red and visible light

3 infra red, ultraviolet and visible light

4 ultraviolet and visible light

5C By 2012, all TV signals in the UK will be digital.

This will be an improvement over analogue signals because . . .

1 digital signals are less prone to interference.

2 digital signals pick up interference and amplify it.

3 in an analogue signal, interference is treated as part of the original signal.

4 when analogue signals are amplified, interference is amplified.

5D Electromagnetic waves travel at a speed of 300 000 km/s.

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

A radio station transmits signals at a wavelength of 1.5 km.

The frequency of the waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

Turn over for the next question

QUESTION SIX

The tables show the types of radiation observed by different telescopes, and the types of radiation emitted by different parts of the universe.

Name of telescope	Type of radiation
Arecibo	Radio
COBE	Microwave
Hess	Gamma
Hopkins	Ultraviolet
Keck	Visible light
Spitzer	Infra red
XMM Newton	X-rays

Origin of radiation in universe	Main radiation emitted
Pulsars	Radio
Neutron stars	X-rays
Nebulae	Infra red
Stars	Visible light
Gamma ray bursts	Gamma
Big bang	Microwaves

6A Which telescope could be used to hunt for neutron stars in galaxies?

1 Arecibo

2 Spitzer

3 Hopkins

4 XMM Newton

6B Which telescope could be used to analyse the radiation of the universe left over from the 'big bang'?

1 COBE

2 Spitzer

3 Keck

4 Hopkins

6C Which one of the following emits the longest wavelength radiation?

1 Gamma ray bursts

2 Neutron stars

3 Pulsars

4 Stars

6D Which one of the following emits radiation with the highest frequency?

1 Nebulae

2 Neutron stars

3 Pulsars

4 Stars

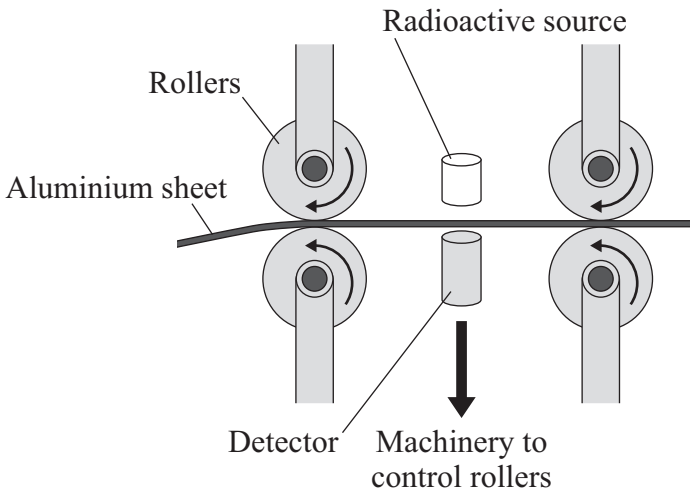
Turn over for the next question

QUESTION SEVEN

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

7A 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**

7B A smoke alarm uses a small mass of a radioactive isotope. So that the alarm can be used safely in a house, isotope **Q** is used.

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

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

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

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

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

7C 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.

7D 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 18 000 years old?

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

2 **Q** because its half-life is about 400 years which means that the box has existed for 45 half-lives.

3 **R** because its half-life is about 30 seconds which means that it is safe to do the estimation.

4 **S** because its half-life is about 6 hours which is enough time to do the estimation.

QUESTION EIGHT

This question is about two space telescopes.

The Hubble space telescope orbits the Earth at a distance of 569 km and detects visible light.

The James Webb space telescope is planned to be launched some time after 2013 and will orbit at about 1.5 million kilometres from the Earth and will detect infra red frequencies (rays).

8A The main advantage of the Hubble telescope being so far from Earth is the improvement in image quality.

This improvement is because . . .

1 there is little atmosphere to distort the data being received.

2 there is no light pollution from cities.

3 there is no gravity to distort the mirror in the telescope.

4 there is no need for access for service or repairs to the mirror in the telescope.

8B The James Webb space telescope should be able to receive data from distant galaxies billions of light years away from the Earth. It is shielded from the Sun to keep it at a temperature of –225°C and will contain a large mirror.

The reason that it is designed to detect infra red frequencies is that . . .

1 all the radiation emitted by the galaxies is in the infra red region of the spectrum.

2 infra red radiation can be detected in the dark.

3 much of the radiation we receive from galaxies is at infra red frequencies due to a significant red-shift.

4 we receive only infra red radiation from the galaxies.

8C The major reason for keeping the mirror so cold is to . . .

1 avoid the need to carry extra fuel to heat it.

2 keep it rigid.

3 minimise the infra red radiation from it which would confuse the data being collected.

4 stop it from melting.

8D There are also radio telescopes on Earth.
The longer the wavelength of the radiation being absorbed, the larger a telescope needs to be.

Which row in the table gives the correct order of size for the telescopes?

	Smallest ◄——————————► **Largest**		
1	James Webb telescope	Hubble telescope	Radio telescope
2	Radio telescope	James Webb telescope	Hubble telescope
3	Hubble telescope	James Webb telescope	Radio telescope
4	Hubble telescope	Radio telescope	James Webb telescope

Turn over for the next question

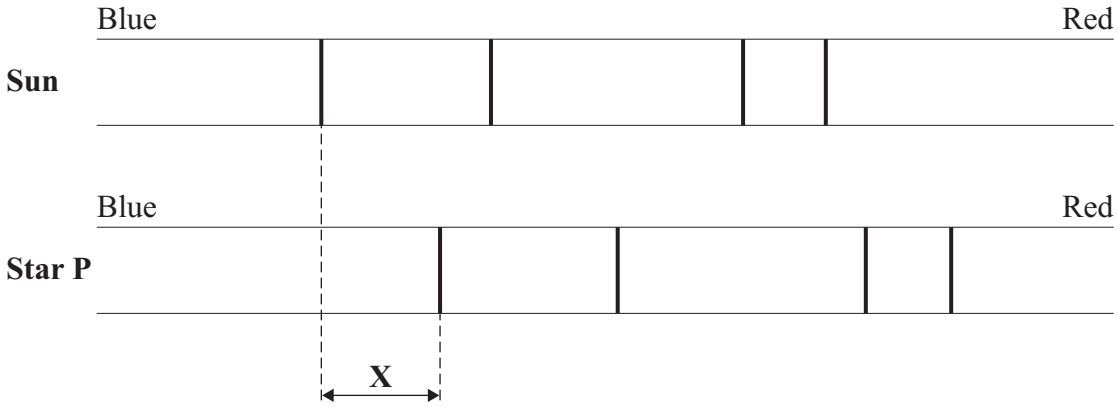
QUESTION NINE

The visible part of the electromagnetic spectrum from a star 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 star, **P**.

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

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



9A The displacement marked **X** in the diagram is called the red-shift.

What 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

9B Another star, **Q**, is further away from the observer than star **P** and is also moving away from the observer.

The displacement **X** in **Q**'s spectrum, compared with that in **P**'s 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.

9C Edwin Hubble made measurements on 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.

9D 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 current evidence suggests that the universe began at a small point.

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

END OF TEST

There are no questions printed on this page

There are no questions printed on this page

There are no questions printed on this page