Surname		Other Names									
Centre Number						Candidate Number					
Candidate Signature											

General Certificate of Secondary Education
November 2007

SCIENCE A **PHY1B**
Unit Physics P1b (Radiation and the Universe)

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Thursday 22 November 2007 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 'Radiation and the Universe' 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: 1 2 3 4
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown: 1 2 3 4
- 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: 1 2 3 4

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 **SIX**.

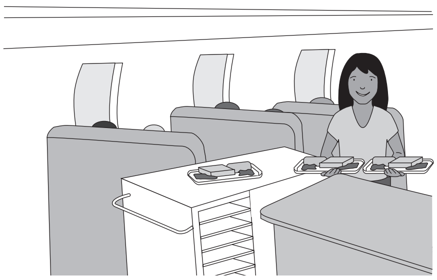
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The drawing shows meals being served on an aircraft.



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

A gamma rays

B infra red rays

C radio waves

D visible light

The food was heated in ovens by . . . **1** . . . .

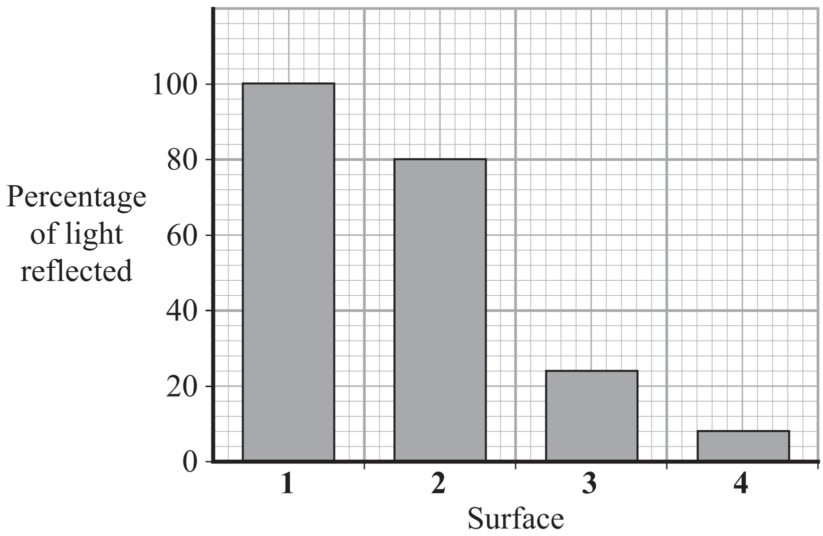
The fruit in the meal pack does not go mouldy because it has been treated with . . . **2** . . . .

The lamps in the cabin are designed to give off . . . **3** . . . .

The pilot keeps in touch with air traffic control by using . . . **4** . . . .

QUESTION TWO

The bar chart shows how much light is reflected by four different surfaces when white light shines on them.



Match surfaces, **A**, **B**, **C** and **D**, with the bars **1–4** on the bar chart.

A black-painted surface

B mirror

C white-painted surface

D blue-painted surface

Turn over for the next question

QUESTION THREE

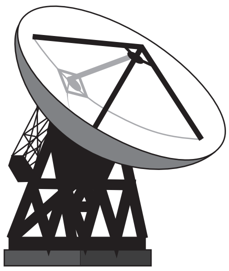
The diagram shows part of the electromagnetic spectrum.

Increasing wavelength →

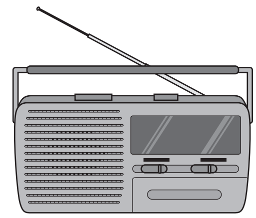
1	Visible light	**2**	**3**	**4**

← Increasing frequency

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

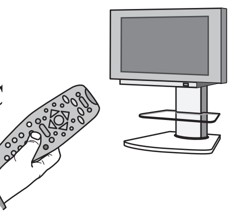


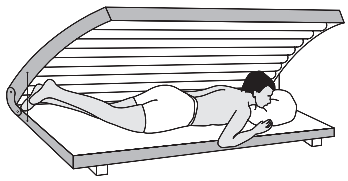
A



B

C



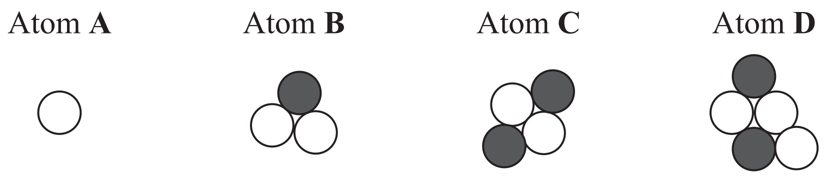


D

QUESTION FOUR

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

Two of the atoms are isotopes of the same element.



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

1	the nucleus contains one proton
2	the nucleus contains three protons
3	the nucleus is an alpha particle
4	the atom is an isotope of atom **C**

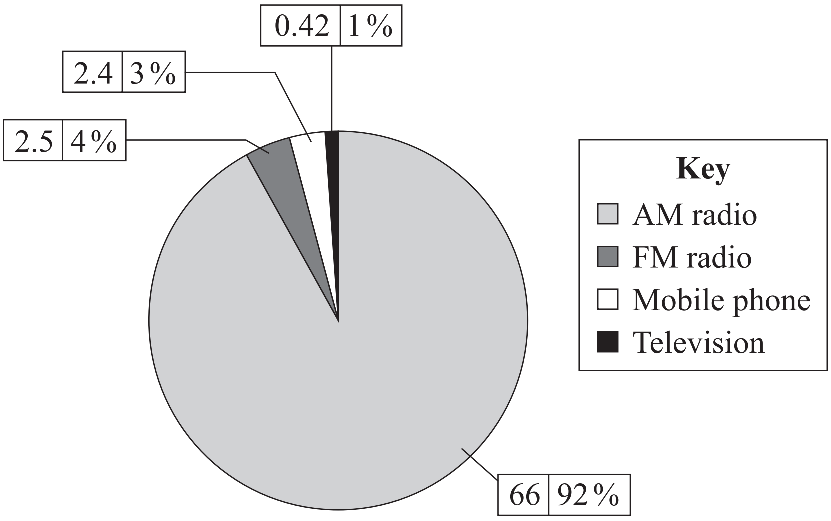
Turn over for the next question

QUESTION FIVE

The pie chart shows the power of four types of electromagnetic radiation received by people living in a small town near both a radio/TV mast and a mobile phone mast. It also shows the percentage of the total power from each source.

The units for the power are microwatts per m^2 of skin surface.

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



A 0.42

B 3

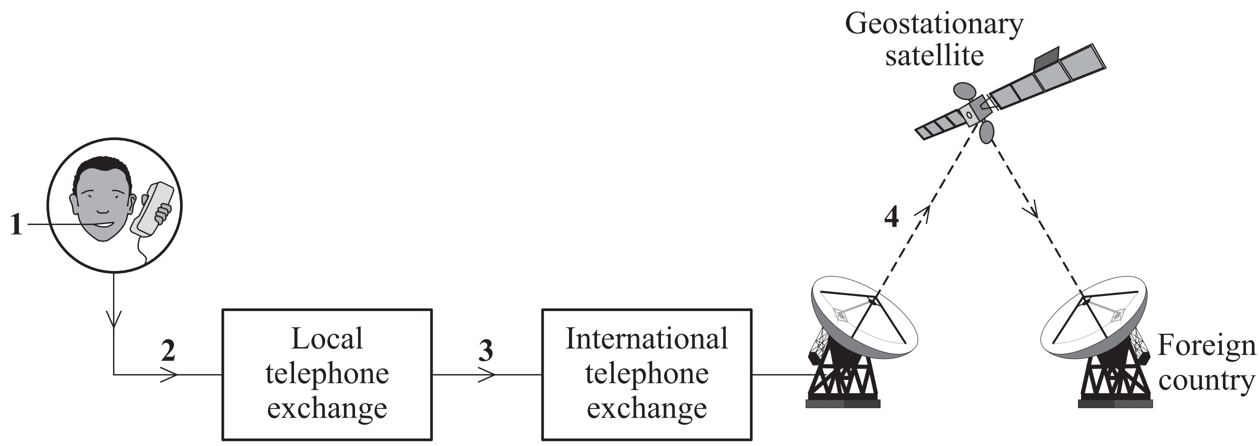
C 27.5

D 68.5

1	the power of the radiation received from TV in microwatts per m^2
2	the percentage of the radiation received from mobile phones
3	the total power received from AM and FM radio waves in microwatts per m^2
4	the number of times greater the power received from AM radio is than that received from mobile phones

QUESTION SIX

The diagram shows how a telephone call can be made to a foreign country.



Match waves and signals, **A**, **B**, **C** and **D**, with the numbers **1–4** on the diagram.

A analogue electrical signal

B digital light signal

C microwaves

D sound waves

Turn over for the next question

SECTION TWO

Questions **SEVEN** to **NINE**.

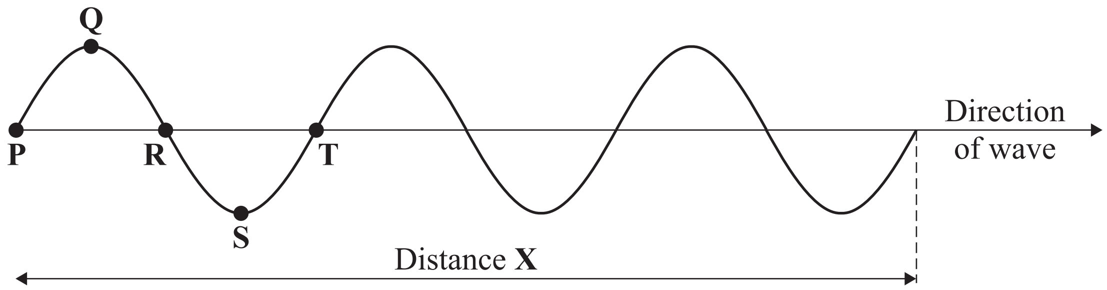
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SEVEN

The diagram shows part of a wave.



7A The wavelength of this wave is . . .

1 **PR**

2 **PT**

3 **RT**

4 **QS**

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

The frequency of the wave is . . .

1 1 Hz

2 2 Hz

3 3 Hz

4 6 Hz

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

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

2 an increase in the intensity of the ultraviolet radiation.

3 that light travels in straight lines.

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

7D Scientists have analysed light from distant galaxies.

Their conclusion is that . . .

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

2 galaxies are moving towards each other at high speed.

3 galaxies are stationary.

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

Turn over for the next question

QUESTION EIGHT

Radon is a radioactive gas which seeps up from the ground into houses in some parts of the country.

The table shows the results of a survey of radioactive emissions due to radon gas in four houses in one local authority.

House	Radioactive emissions in Bq per m^3 of air
1	11
2	33
3	15
4	21

8A What was the average of the radioactive emissions in the four houses?

1 20.0 Bq per m^3

2 26.6 Bq per m^3

3 40.0 Bq per m^3

4 80.0 Bq per m^3

8B The local authority wanted a more reliable average for the houses in their area.

Scientists could obtain more reliable results by . . .

1 increasing the number of houses sampled.

2 measuring radioactive emissions in 1 cm^3 of air in each house.

3 using a different unit for the radioactive emissions.

4 sampling the air outside the houses.

8C Radon gas causes cancer.

Which part of the body is most likely to be the site of a cancer caused by radon gas?

1 brain

2 legs

3 stomach

4 lungs

8D What advice would you give to a householder whose house has a high level of radioactive emissions from radon gas?

1 keep the house well ventilated

2 fit double glazing

3 take up all the carpets

4 place draught excluders around all the windows and doors

Turn over for the next question

Turn over ▶

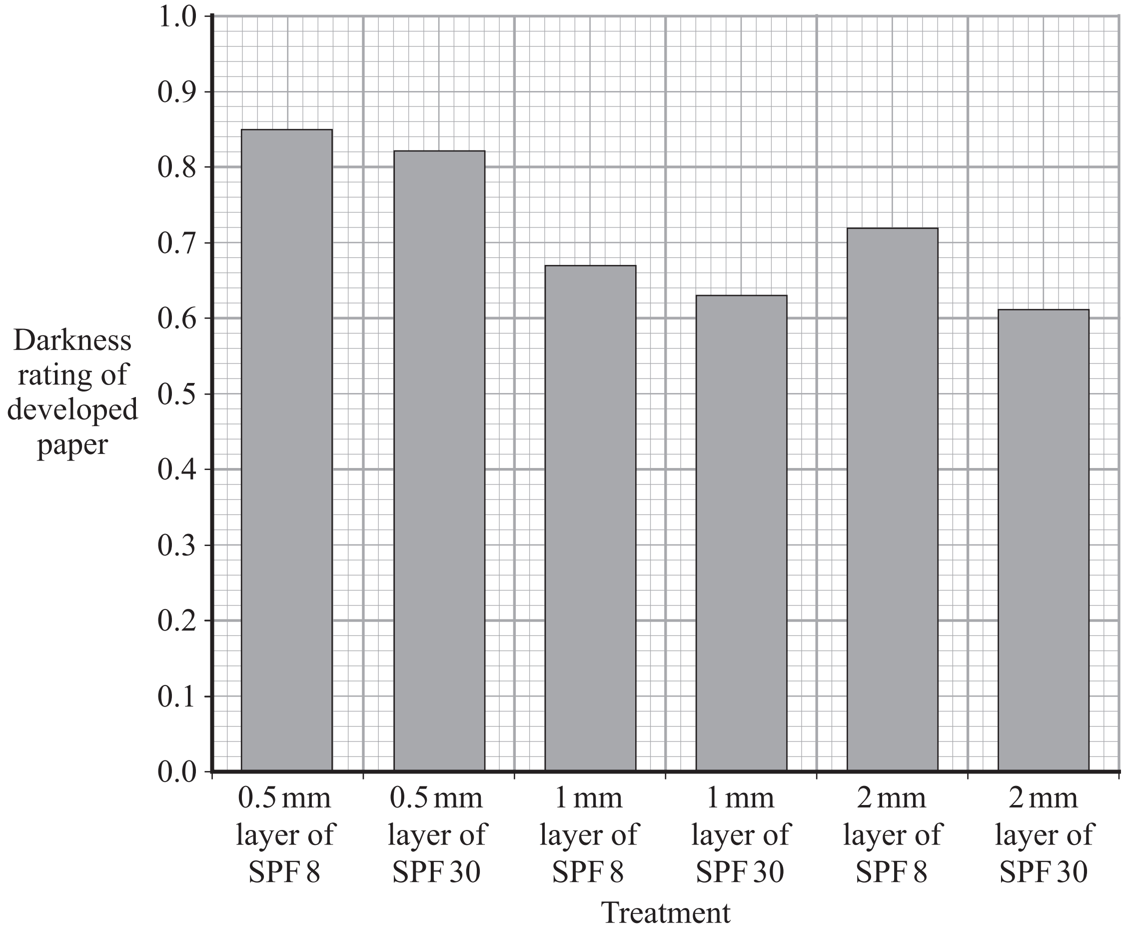
QUESTION NINE

Doctors recommend that a 2 mm layer of sun cream with a sun protection factor (SPF) of 30 should be placed on the skin when you sunbathe.

A student investigated the effectiveness of sun creams in absorbing ultraviolet (UV) rays. She carried out her investigation in a dark room.

- She used sheets of a photographic paper sensitive to UV rays, wrapped in clear polythene.
- She applied two different sun creams, SPF 8 and SPF 30, to the polythene covering the photographic paper.
- She applied the creams in three different thicknesses, 0.5 mm, 1 mm and 2 mm.
- In a dark room, she exposed each piece of photographic paper to UV rays for 1 second.
- She then developed the photographic paper and measured the darkness of each piece of paper.
- A darkness rating of 1 means that all the UV rays penetrated the layer of sun cream; a darkness rating of 0 means that none of the UV rays penetrated the sun cream.

The graph shows her results.



9A What was the dependent variable in this investigation?

1 SPF value of sun cream

2 thickness of sun cream

3 time of exposure to UV rays

4 darkness rating of developed paper

9B Which treatment absorbed most UV rays?

1 0.5 mm layer of SPF 8 sun cream

2 0.5 mm layer of SPF 30 sun cream

3 1 mm layer of SPF 30 sun cream

4 2 mm layer of SPF 30 sun cream

9C Which treatment seemed to produce an anomalous result?

1 0.5 mm layer of SPF 8 sun cream

2 0.5 mm layer of SPF 30 sun cream

3 2 mm layer of SPF 8 sun cream

4 1 mm layer of SPF 30 sun cream

9D The data from this investigation . . .

1 proves that the doctors' recommendations are correct.

2 does **not** support the doctors' recommendations.

3 supports the doctors' recommendations.

4 turns a hypothesis into a theory.

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**.

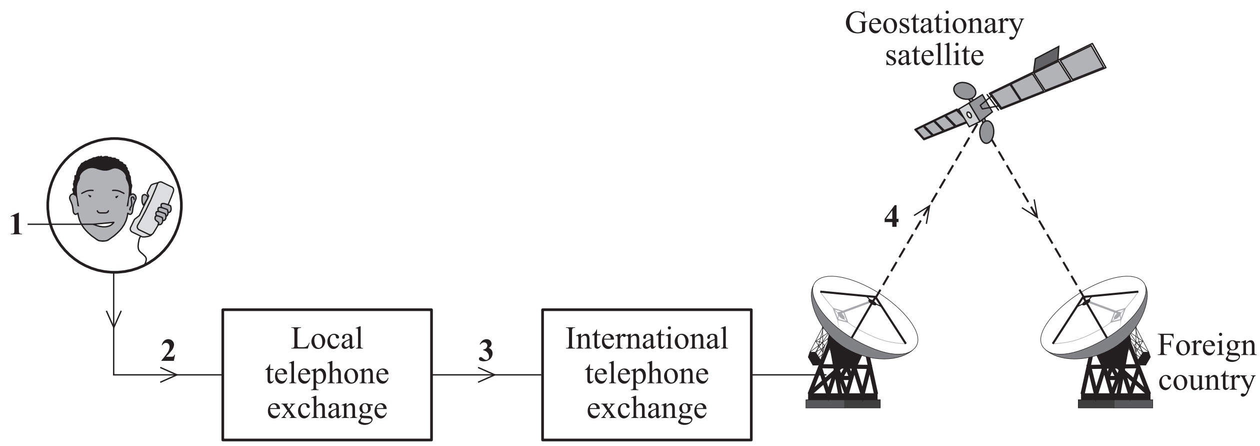
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows how a telephone call can be made to a foreign country.



Match waves and signals, **A**, **B**, **C** and **D**, with the numbers **1–4** on the diagram.

A analogue electrical signal

B digital light signal

C microwaves

D sound waves

QUESTION TWO

The table gives typical frequencies for different types of electromagnetic radiation.

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

A infra red radiation

B ultraviolet radiation

C visible light

D X-rays

Type of electromagnetic radiation	**Typical frequency in Hz**
1	100 000 billion
2	1 000 000 billion
3	10 000 000 billion
4	100 000 000 billion

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

Radon is a radioactive gas which seeps up from the ground into houses in some parts of the country.

The table shows the results of a survey of radioactive emissions due to radon gas in four houses in one local authority.

House	Radioactive emissions in Bq per m^3 of air
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2	33
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3A What was the average of the radioactive emissions in the four houses?

1 20.0 Bq per m^3

2 26.6 Bq per m^3

3 40.0 Bq per m^3

4 80.0 Bq per m^3

3B The local authority wanted a more reliable average for the houses in their area.

Scientists could obtain more reliable results by . . .

1 increasing the number of houses sampled.

2 measuring radioactive emissions in $1\,cm^3$ of air in each house.

3 using a different unit for the radioactive emissions.

4 sampling the air outside the houses.

3C Radon gas causes cancer.

Which part of the body is most likely to be the site of a cancer caused by radon gas?

1 brain

2 legs

3 stomach

4 lungs

3D What advice would you give to a householder whose house has a high level of radioactive emissions from radon gas?

1 keep the house well ventilated

2 fit double glazing

3 take up all the carpets

4 place draught excluders around all the windows and doors

Turn over for the next question

QUESTION FOUR

Doctors recommend that a 2 mm layer of sun cream with a sun protection factor (SPF) of 30 should be placed on the skin when you sunbathe.

A student investigated the effectiveness of sun creams in absorbing ultraviolet (UV) rays. She carried out her investigation in a dark room.

- She used sheets of a photographic paper sensitive to UV rays, wrapped in clear polythene.
- She applied two different sun creams, SPF 8 and SPF 30, to the polythene covering the photographic paper.
- She applied the creams in three different thicknesses, 0.5 mm, 1 mm and 2 mm.
- In a dark room, she exposed each piece of photographic paper to UV rays for 1 second.
- She then developed the photographic paper and measured the darkness of each piece of paper.
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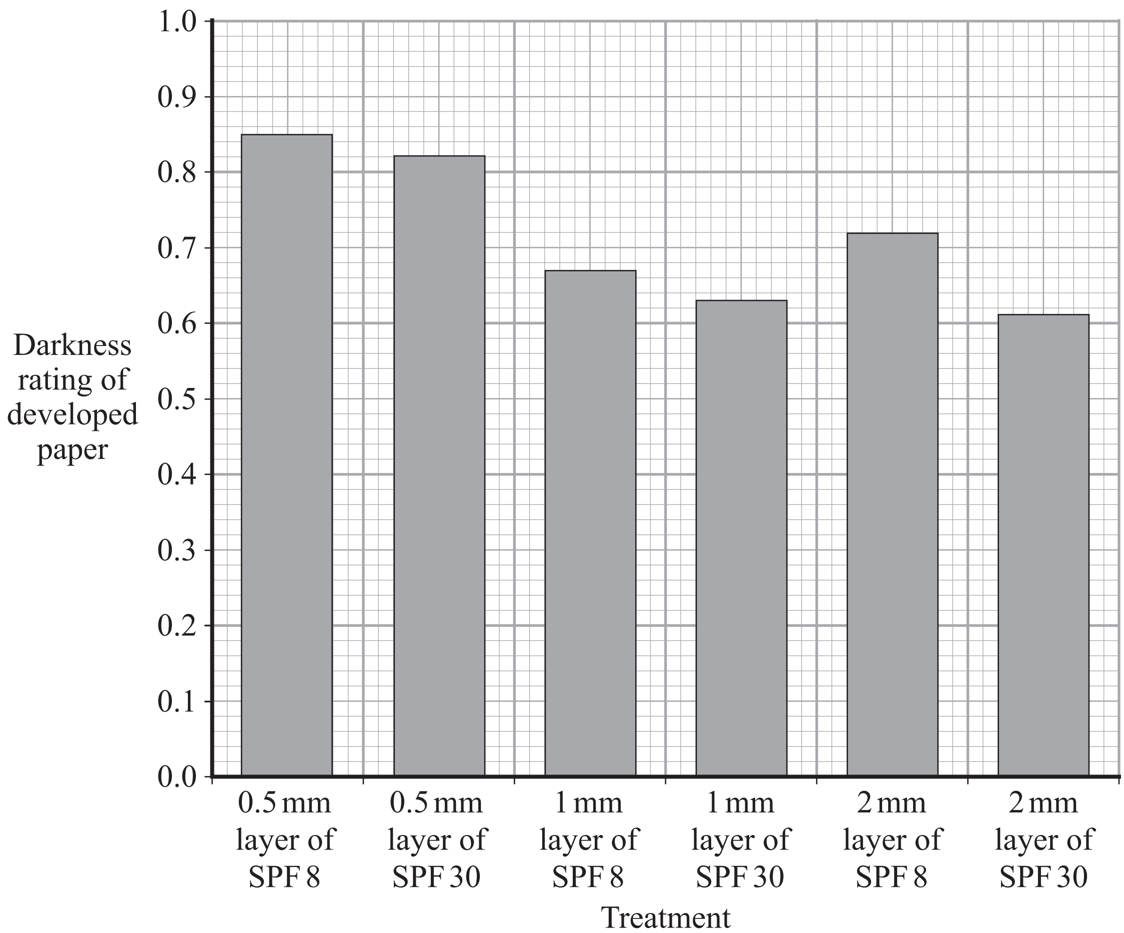
The graph shows her results.



4A What was the dependent variable in this investigation?

1 SPF value of sun cream

2 thickness of sun cream

3 time of exposure to UV rays

4 darkness rating of developed paper

4B Which treatment absorbed most UV rays?

1 0.5 mm layer of SPF 8 sun cream

2 0.5 mm layer of SPF 30 sun cream

3 1 mm layer of SPF 30 sun cream

4 2 mm layer of SPF 30 sun cream

4C Which treatment seemed to produce an anomalous result?

1 0.5 mm layer of SPF 8 sun cream

2 0.5 mm layer of SPF 30 sun cream

3 2 mm layer of SPF 8 sun cream

4 1 mm layer of SPF 30 sun cream

4D The data from this investigation . . .

1 proves that the doctors' recommendations are correct.

2 does **not** support the doctors' recommendations.

3 supports the doctors' recommendations.

4 turns a hypothesis into a theory.

QUESTION FIVE

There are different types of electromagnetic radiation and nuclear radiation.

5A Which one of the following types of radiation is **not** used for communication?

1 infra red radiation

2 microwaves

3 visible light

4 X-rays

5B Which one of the following types of radiation has the longest wavelength?

1 infra red radiation

2 microwaves

3 visible light

4 X-rays

5C Which one of the following statements is **not** true of **both** ultraviolet radiation and infra red radiation?

1 They can be seen by the human eye.

2 They are members of the electromagnetic spectrum.

3 Each can have a range of different wavelengths and frequencies.

4 They travel at the same speed in a vacuum.

5D Which type of radiation is emitted by the nucleus of an atom of a radioactive isotope?

1 gamma radiation

2 X-rays

3 microwave radiation

4 ultraviolet radiation

Turn over for the next question

QUESTION SIX

Nitrogen-16 is a radioactive isotope of nitrogen. It decays to stable oxygen-16 by beta (β) emission.

6A A beta particle is . . .

1 a helium nucleus.

2 a neutron.

3 a proton.

4 an electron.

6B The rate of emission of beta particles from the nitrogen-16 would . . .

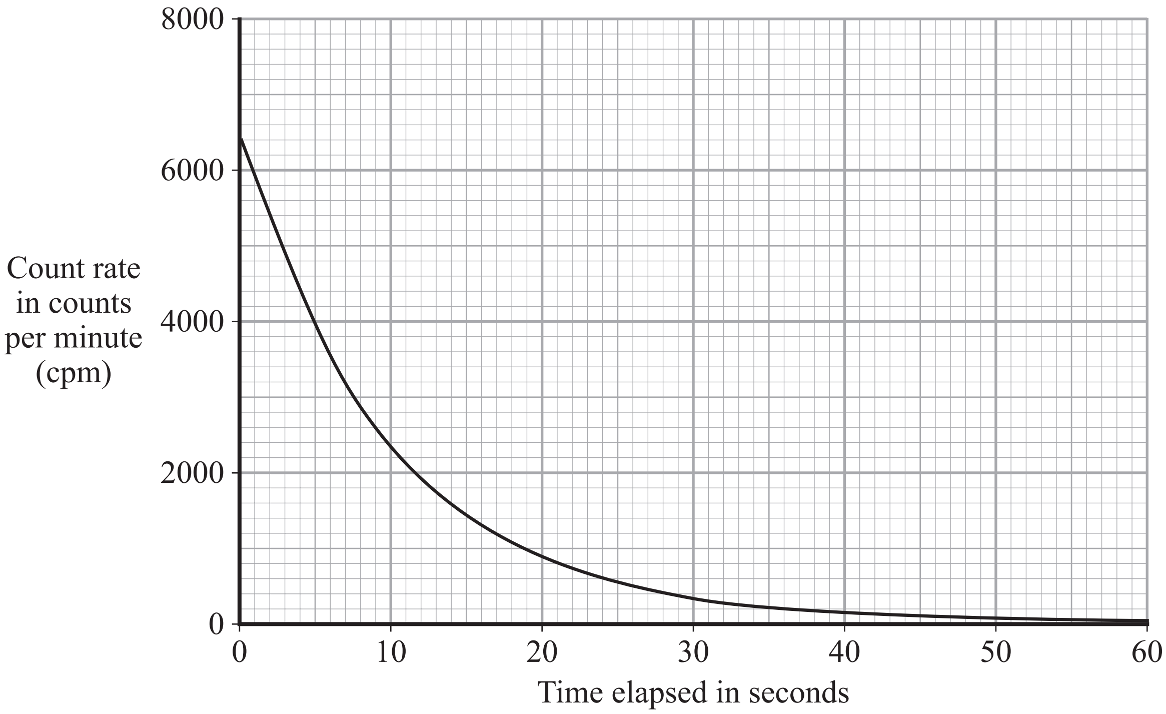
1 be increased by increasing its temperature.

2 be reduced by increasing the pressure of the air around it.

3 be reduced by liquefying it.

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

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



6C Using information from the graph, calculate the approximate half-life of nitrogen-16.

1 7 seconds

2 30 seconds

3 60 seconds

4 3200 seconds

6D According to the graph, what is the approximate value to which the count rate of the nitrogen-16 would have fallen after four half-lives?

1 3200 cpm

2 1600 cpm

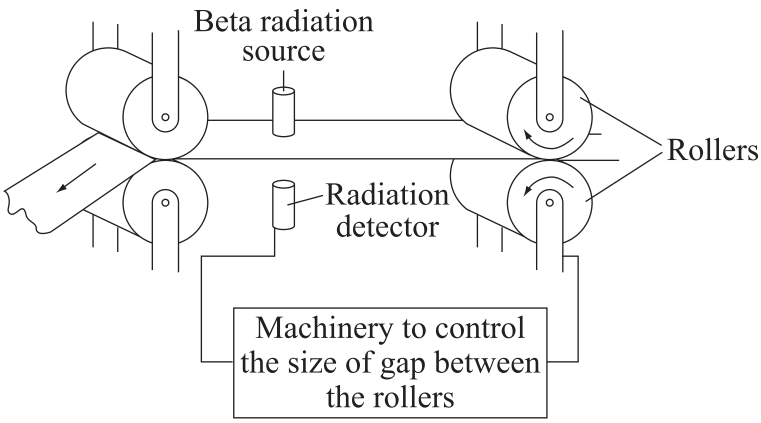
3 800 cpm

4 400 cpm

Turn over for the next question

QUESTION SEVEN

The diagram shows a system used in a paper mill to control the thickness of the paper.



The paper passes through a narrow gap between a beta (β) radiation source and a detector.

7A Beta radiation passes through the paper more easily than alpha radiation because beta radiation . . .

1 consists of smaller particles than alpha radiation.

2 has a negative charge.

3 has a shorter frequency than alpha radiation.

4 has a longer wavelength than alpha radiation.

7B A radioactive source producing only gamma rays would be unsuitable because . . .

1 gamma radiation consists of rays rather than particles.

2 the paper would **not** stop any of the gamma rays reaching the radiation detector.

3 gamma rays are **not** affected by magnetic fields.

4 gamma rays are too dangerous to use.

7C Beta particles are less dangerous to workers than alpha particles because they . . .

1 are deflected by magnetic fields.

2 are much less strongly ionising.

3 cannot penetrate skin.

4 have a much shorter range.

7D The most suitable half-life for the beta source in the system is . . .

1 six hours.

2 six days.

3 six months.

4 six years.

Turn over for the next question

QUESTION EIGHT

A former spy was poisoned with the radioactive isotope polonium-210.

8A Some of the spy's friends were found to be contaminated with polonium-210. They were safe from the radiation unless they had taken some of the polonium-210 into their bodies.

This is because the radiation given off by polonium-210 is . . .

1 alpha particles.

2 beta particles.

3 gamma rays.

4 X-rays.

8B It is difficult to detect the radiation given off by polonium-210 using a detector outside the body because the radiation has . . .

1 high penetrating power.

2 a long range in air.

3 low ionising power.

4 low penetrating power.

8C Scientists carried out many tests at restaurants, hotels and airports. This caused much public anxiety.

Which one of the following statements is true?

1 The particles emitted by polonium-210 are radioactive.

2 Anyone too close to a polonium-210 source will become radioactive.

3 If you swallow polonium-210, it will damage cells in the body.

4 The radiation from polonium-210 makes clothes glow in the dark.

8D Another isotope of polonium is polonium-208.

Compared with polonium-210, polonium-208 has . . .

1 more neutrons.

2 fewer neutrons.

3 more protons.

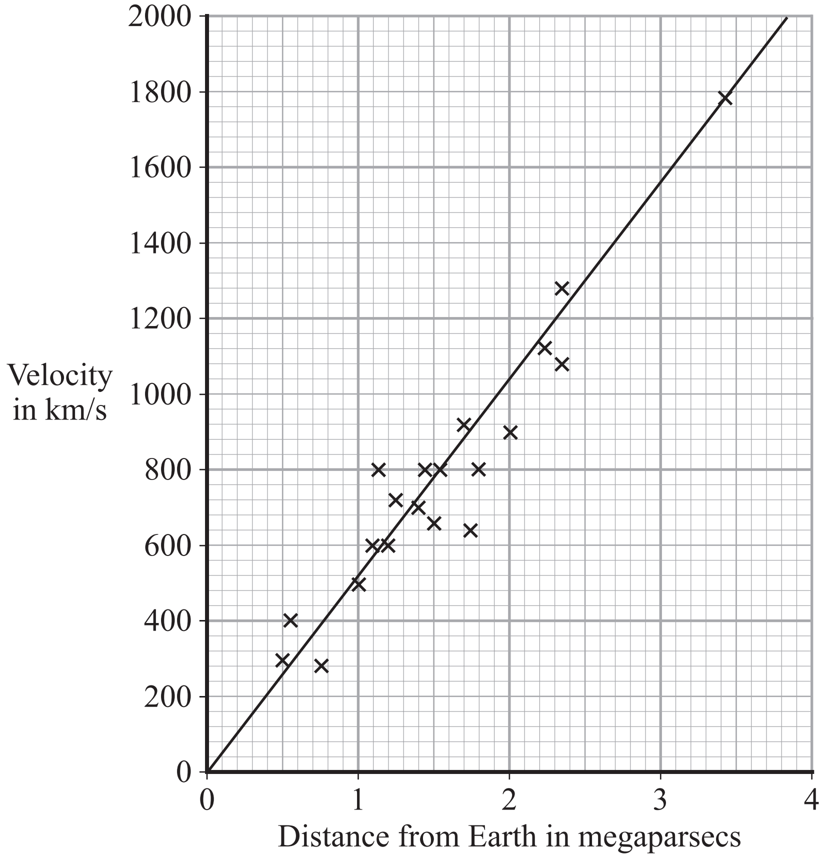
4 fewer protons.

Turn over for the next question

QUESTION NINE

The astronomer Hubble calculated the distance of many galaxies from Earth. He also calculated the velocity at which many galaxies are moving away from Earth.

The graph shows some of his results. The distance is given in megaparsecs. One parsec is approximately equal to 30 000 000 000 km.



9A The data in the graph suggests that . . .

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

2 all galaxies move at different velocities.

3 the velocity of a galaxy is proportional to its distance away from Earth.

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

9B 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.

9C Modern astronomers calculate that the **actual** value of the Hubble constant is somewhere between 46 and 80 km/s per megaparsec.

This is very different from the number calculated from the graph.

This is because Hubble's measurements had . . .

1 random errors.

2 systematic errors.

3 zero errors.

4 lack of precision.

9D The Andromeda galaxy is moving towards our own Milky Way galaxy.

This means that, as viewed from Earth, light from the Andromeda galaxy will . . .

1 be shifted towards the red end of the spectrum.

2 show an increase in wavelengths.

3 be shifted towards the blue end of the spectrum.

4 show a decrease in frequencies.

END OF TEST

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There are no questions printed on this page

There are no questions printed on this page