Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature								

General Certificate of Secondary Education
March 2008

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

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Wednesday 5 March 2008 Morning Session

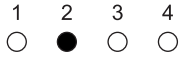
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

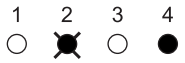
Time allowed: 30 minutes

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.

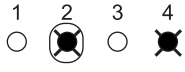
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 16 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

We use electromagnetic radiation in many different ways.

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

A infra red radiation

B gamma radiation

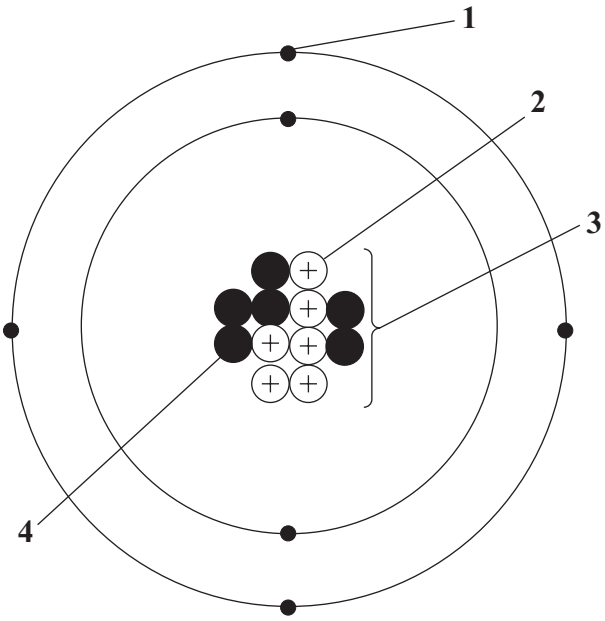
C visible light

D ultraviolet radiation

1	is used to send messages using a torch
2	is used in sunbeds
3	is used in heaters
4	is used to treat cancer

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

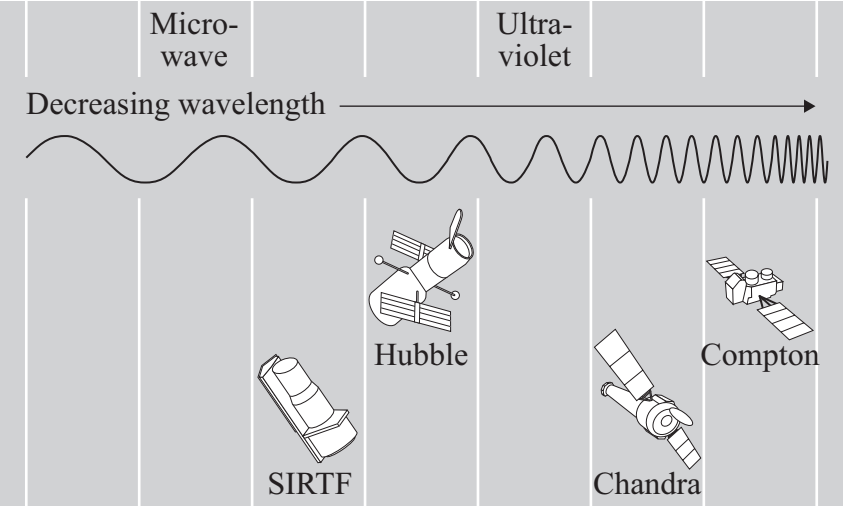
D proton

Turn over for the next question

QUESTION THREE

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 is designed to detect.

A SIRTF

B Hubble

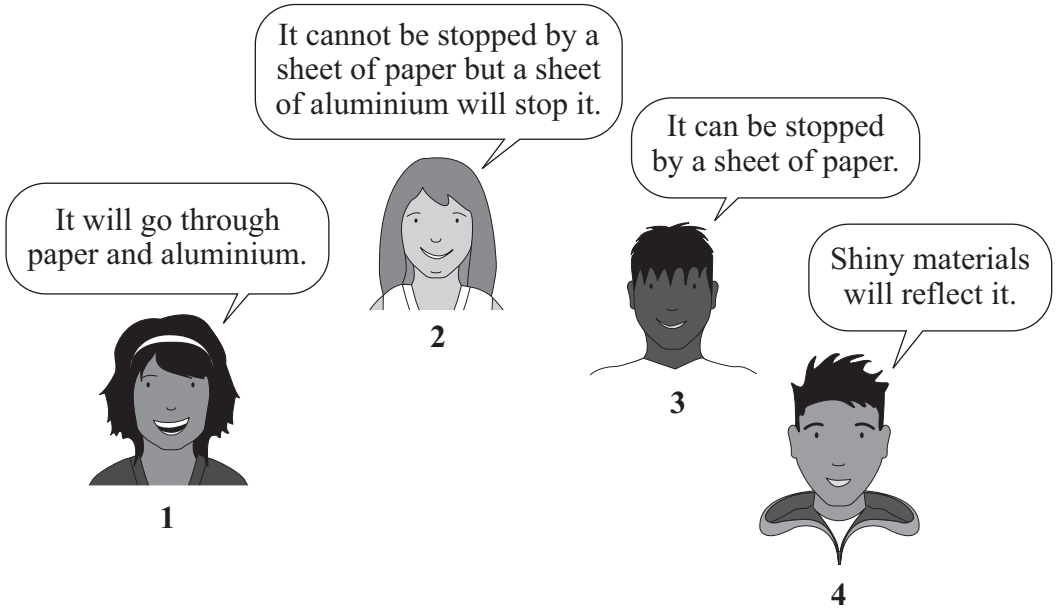
C Chandra

D Compton

	Type of electromagnetic radiation
1	gamma radiation
2	infra red radiation
3	X-rays
4	visible light

QUESTION FOUR

Some students are talking about radiation.



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

A alpha

B beta

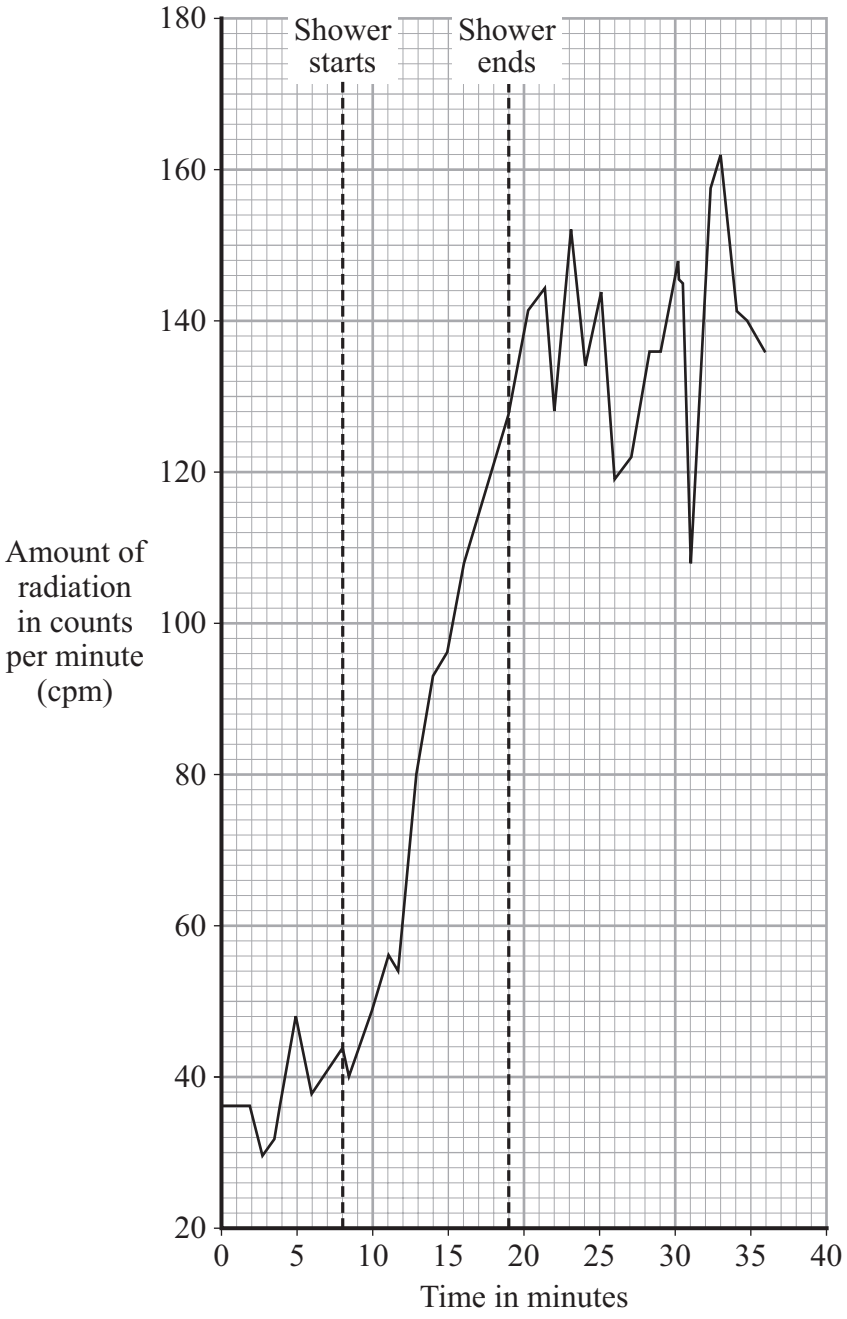
C gamma

D visible light

Turn over for the next question

QUESTION FIVE

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



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

A 11

B 33

C 44

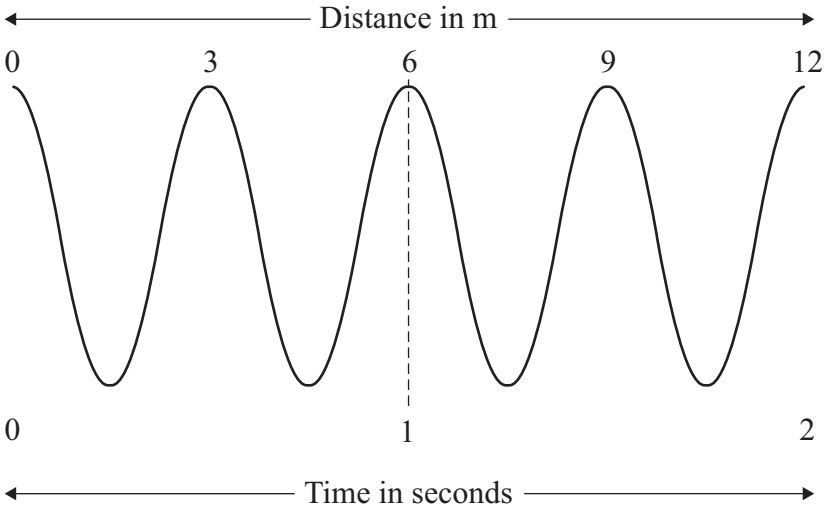
D 84

1	the length of time of the shower in minutes
2	the amount of radiation at the start of the shower in cpm
3	the time at which the radiation in the bathroom reaches a maximum
4	the rise in the amount of radiation during the shower in cpm

Turn over for the next question

QUESTION SIX

The diagram shows a wave.



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

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

A 2

B 3

C 4

D 6

1	the number of complete waves shown in the diagram
2	the wavelength in metres
3	the frequency in hertz
4	the speed of the wave in metres per second

Turn over for the next question

SECTION TWO

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

Each of these questions has four parts.

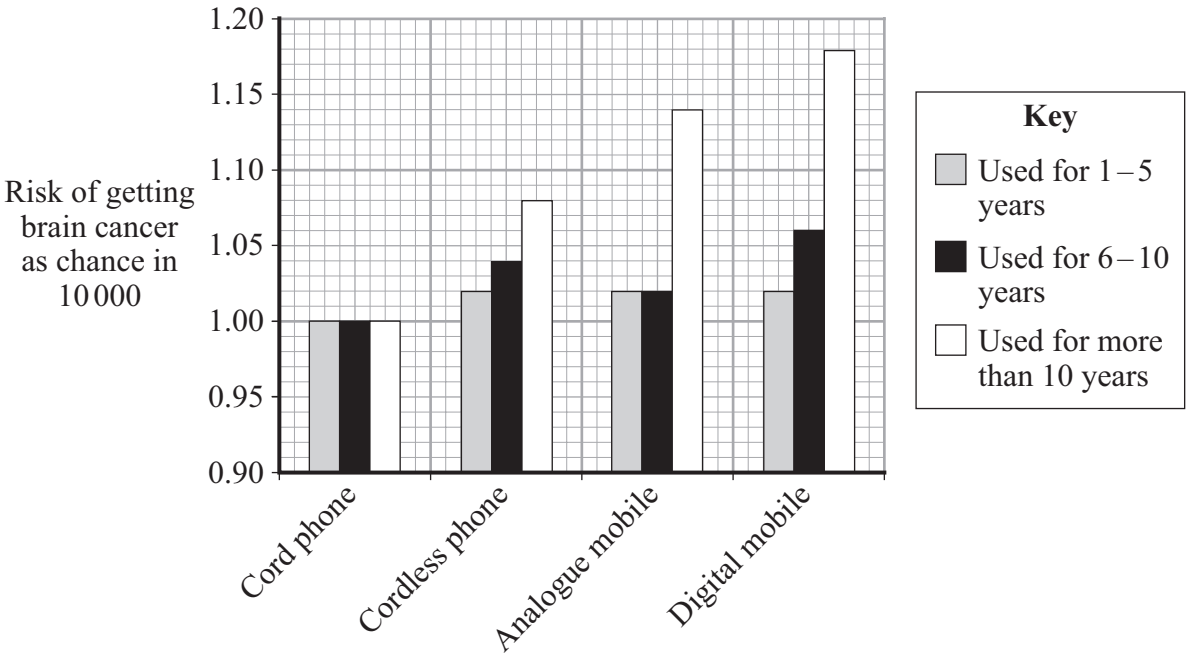
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SEVEN

Scientists investigated whether the use of different kinds of phone increased the risk of getting brain cancer.
They compared a group of people who used only cord phones with another group who used cordless phones and mobile phones. The two groups were matched by age, sex and health.

The bar chart shows the results of the investigation.



7A The group who used only cord phones was . . .

1 a variable group.

2 a control group.

3 a theoretical group.

4 a valid group.

7B The categoric variable in the investigation was . . .

1 the type of phone used.

2 the age of the people.

3 the risk of getting brain cancer.

4 the length of time the phone was used.

7C From this data, which type of phone is associated with the greatest risk of getting brain cancer?

1 cord phone

2 cordless phone

3 analogue mobile

4 digital mobile

7D A town has a population of 100 000.

How many people who have used cord phones for 1–5 years would you expect to develop brain cancer?

1 1

2 10

3 100

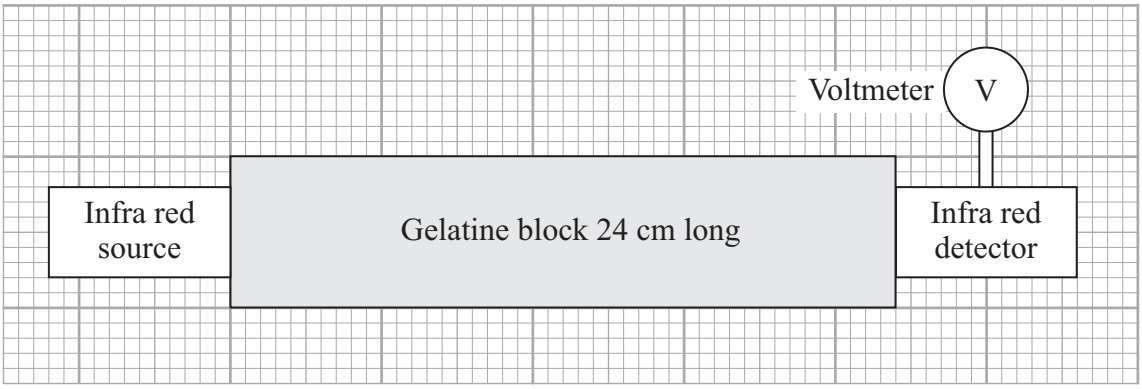
4 1000

Turn over for the next question

QUESTION EIGHT

A student investigated the absorption of infra red radiation by a block of gelatine.

She placed a block of gelatine on a piece of graph paper and cut the block to a length of 24 cm. She then placed an infra red source touching one end of the block and an infra red detector touching the other end as shown in the diagram.

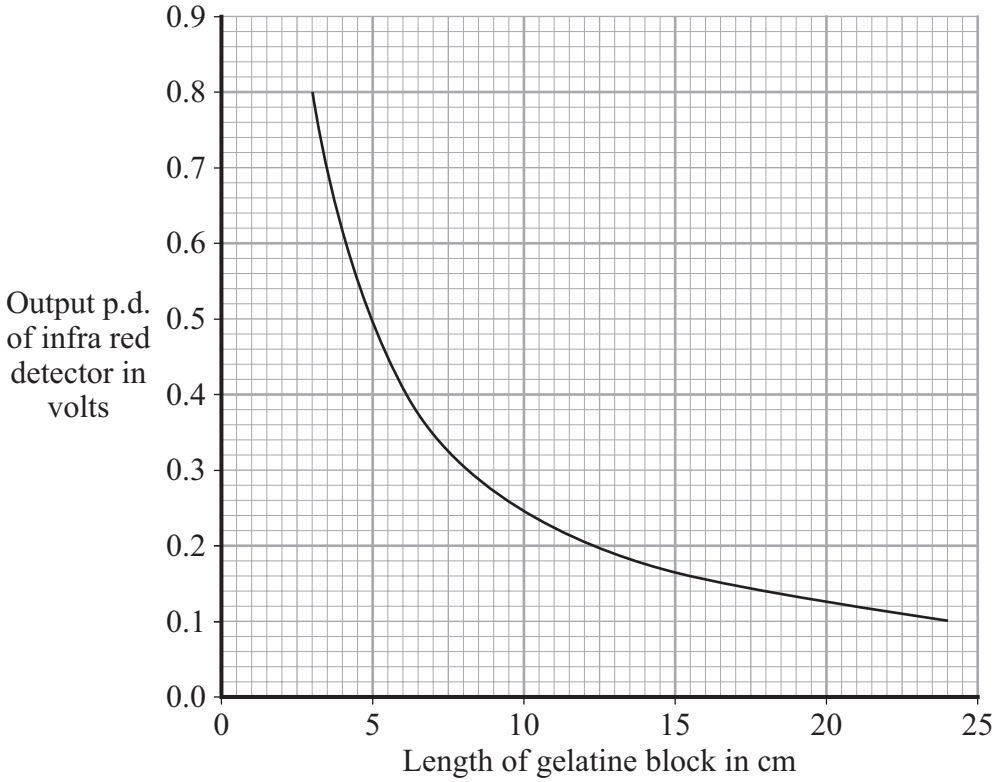


She recorded the output potential difference (p.d.) from the infra red detector.

She then repeated the experiment several times. Each time, she cut 2 cm off the gelatine block and set up the apparatus as shown in the diagram.

The graph shows her results.

The higher the intensity of infra red radiation received by the detector, the greater the output p.d.



8A What was the dependent variable in this experiment?

1 the position of the infra red source

2 the length of the gelatine block

3 the position of the infra red detector

4 the output p.d. from the infra red detector

8B Which is the best description of the pattern shown by the graph?

1 As the length of the gelatine block increases, the intensity of infra red radiation received by the detector decreases.

2 As the length of the gelatine block increases, the intensity of infra red radiation received by the detector decreases by a similar amount.

3 The longer the gelatine block, the larger the effect of cutting off 2 cm on the increase in the intensity of infra red radiation received by the detector.

4 There is no relationship between the length of the gelatine block and the intensity of infra red radiation received by the detector.

8C The table shows the student's results.

Length of gelatine block in cm	Output p.d. in V
24.0	0.1
12.0	0.2
6.0	0.4
3.0	0.8

Based on the data that the student recorded, what was the sensitivity of the voltmeter?

1 0.1 V

2 0.2 V

3 0.4 V

4 1.0 V

Question 8 continues on the next page

8D Scientists carried out a similar investigation using glass optical fibres in place of the gelatine block. They found that there was no significant reduction in the output p.d. of the infra red detector until the fibre was several kilometres long.

This shows that . . .

1 gelatine absorbs infra red radiation much more strongly than glass.

2 glass is more transparent than water.

3 infra red radiation passes through solids faster than through liquids.

4 infra red radiation can pass through bent optical fibres.

QUESTION NINE

Microwaves have many uses.

9A Microwaves can be used to cook food because they . . .

1 are at a high temperature when they leave the source in the oven.

2 travel straight through the food.

3 encourage the food to combine with oxygen.

4 transfer kinetic energy to the water molecules in the food.

9B Microwaves are used to transmit television broadcasts via a satellite because . . .

1 they can penetrate the atmosphere without significant loss of energy.

2 they do not interfere with aircraft navigation systems.

3 they have a longer wavelength than radio waves.

4 they have a lower frequency than radio waves.

9C More and more television and telephone transmissions use digital signals because digital signals . . .

1 are cheaper to use than analogue signals.

2 cause less risk to health.

3 are less prone to interference.

4 travel faster than analogue signals.

9D Some scientists think that mobile phones may be a health risk.

Their main concern is that the microwaves emitted by mobile phones . . .

1 may cause blistering of the ears.

2 may cause blindness.

3 may cause deafness.

4 may cause damage to genetic material in cells.

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**.

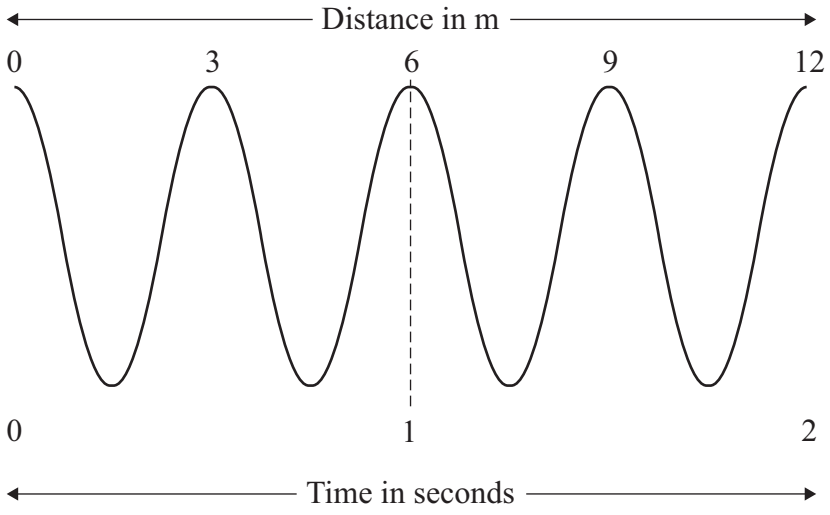
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a wave.



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

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

A 2

B 3

C 4

D 6

1	the number of complete waves shown in the diagram
2	the wavelength in metres
3	the frequency in hertz
4	the speed of the wave in metres per second

QUESTION TWO

The electromagnetic spectrum is continuous but the wavelengths within it can be grouped into types.

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

A gamma rays

B radio waves

C ultraviolet waves

D visible light

The type of electromagnetic radiation which can be used to send signals along optical fibres

is . . . **1** . . . .

The type of electromagnetic radiation which has the highest frequency is . . . **2** . . . .

The type of radiation that has the longest wavelength is . . . **3** . . . .

The type of electromagnetic radiation used in sunbeds for tanning is . . . **4** . . . .

SECTION TWO

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

Each of these questions has four parts.

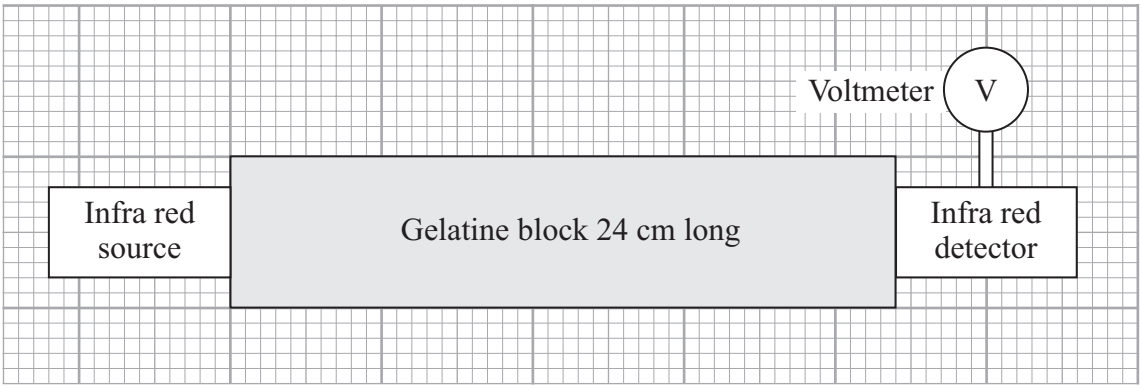
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

A student investigated the absorption of infra red radiation by a block of gelatine.

She placed a block of gelatine on a piece of graph paper and cut the block to a length of 24 cm. She then placed an infra red source touching one end of the block and an infra red detector touching the other end as shown in the diagram.

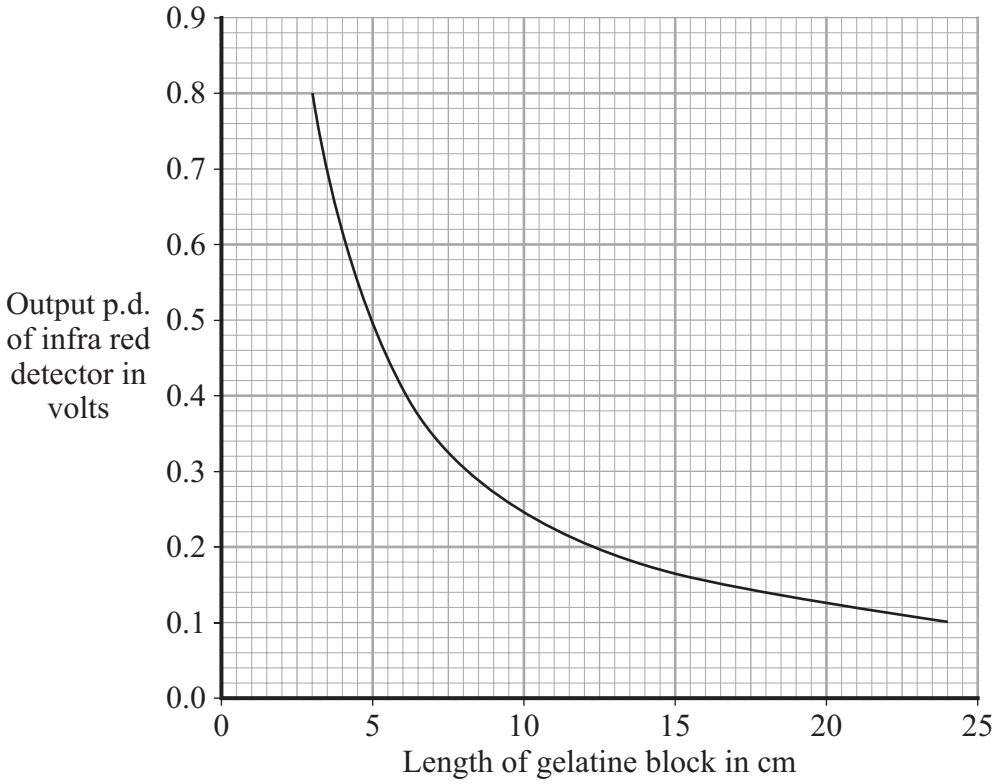


She recorded the output potential difference (p.d.) from the infra red detector.

She then repeated the experiment several times. Each time, she cut 2 cm off the gelatine block and set up the apparatus as shown in the diagram.

The graph shows her results.

The higher the intensity of infra red radiation received by the detector, the greater the output p.d.



3A What was the dependent variable in this experiment?

1 the position of the infra red source

2 the length of the gelatine block

3 the position of the infra red detector

4 the output p.d. from the infra red detector

3B Which is the best description of the pattern shown by the graph?

1 As the length of the gelatine block increases, the intensity of infra red radiation received by the detector decreases.

2 As the length of the gelatine block increases, the intensity of infra red radiation received by the detector decreases by a similar amount.

3 The longer the gelatine block, the larger the effect of cutting off 2 cm on the increase in the intensity of infra red radiation received by the detector.

4 There is no relationship between the length of the gelatine block and the intensity of infra red radiation received by the detector.

Question 3 continues on the next page

3C The table shows the student's results.

Length of gelatine block in cm	Output p.d. in V
24.0	0.1
12.0	0.2
6.0	0.4
3.0	0.8

Based on the data that the student recorded, what was the sensitivity of the voltmeter?

1 0.1 V

2 0.2 V

3 0.4 V

4 1.0 V

3D Scientists carried out a similar investigation using glass optical fibres in place of the gelatine block. They found that there was no significant reduction in the output p.d. of the infra red detector until the fibre was several kilometres long.

This shows that . . .

1 gelatine absorbs infra red radiation much more strongly than glass.

2 glass is more transparent than water.

3 infra red radiation passes through solids faster than through liquids.

4 infra red radiation can pass through bent optical fibres.

QUESTION FOUR

Microwaves have many uses.

4A Microwaves can be used to cook food because they . . .

1 are at a high temperature when they leave the source in the oven.

2 travel straight through the food.

3 encourage the food to combine with oxygen.

4 transfer kinetic energy to the water molecules in the food.

4B Microwaves are used to transmit television broadcasts via a satellite because . . .

1 they can penetrate the atmosphere without significant loss of energy.

2 they do not interfere with aircraft navigation systems.

3 they have a longer wavelength than radio waves.

4 they have a lower frequency than radio waves.

4C More and more television and telephone transmissions use digital signals because digital signals . . .

1 are cheaper to use than analogue signals.

2 cause less risk to health.

3 are less prone to interference.

4 travel faster than analogue signals.

4D Some scientists think that mobile phones may be a health risk.

Their main concern is that the microwaves emitted by mobile phones . . .

1 may cause blistering of the ears.

2 may cause blindness.

3 may cause deafness.

4 may cause damage to genetic material in cells.

QUESTION FIVE

This question is about the structure of atoms and radioactive decay.

5A Where is an electron found in the basic structure of an atom?

1 in orbit around the nucleus

2 on its own in the nucleus

3 with neutrons in the nucleus

4 with protons in the nucleus

5B Which type of radiation consists of helium nuclei?

1 alpha radiation

2 beta radiation

3 delta radiation

4 gamma radiation

5C Which one of the following statements is true for alpha radiation?

1 It is emitted by all radioactive substances.

2 It is identical to an electron.

3 It is **not** deflected by an electric field.

4 It is deflected by a magnetic field.

5D The table shows the half-lives of four radioactive sources which all emit the same type of radiation.

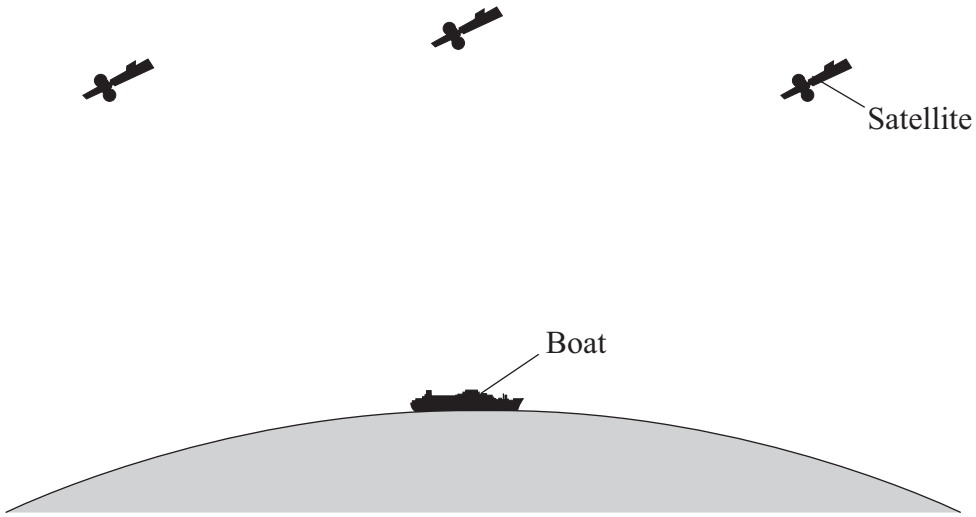
Which source is the most suitable for use as a medical tracer?

Source	Half-life
1	6 hours
2	6 weeks
3	6 months
4	6 years

Turn over for the next question

QUESTION SIX

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



6A 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 forms of electromagnetic radiation travel at the same speed through space.

The correct statements are . . .

1 **X** only.

2 **Y** only.

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

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

6B 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 electrical current

6C The electromagnetic radiation has a speed of 300 000 000 m/s and a wavelength of 0.1 m.

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

What is its frequency?

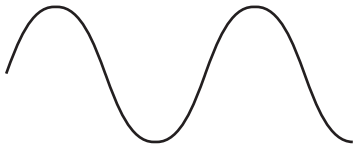
1 3.33 Hz

2 30 000 000 Hz

3 33 000 000 Hz

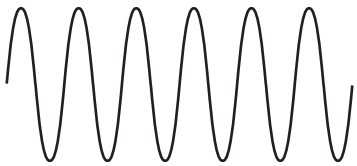
4 3 000 000 000 Hz

6D Which of these signals could be processed by a computer within the navigation system?



1

2

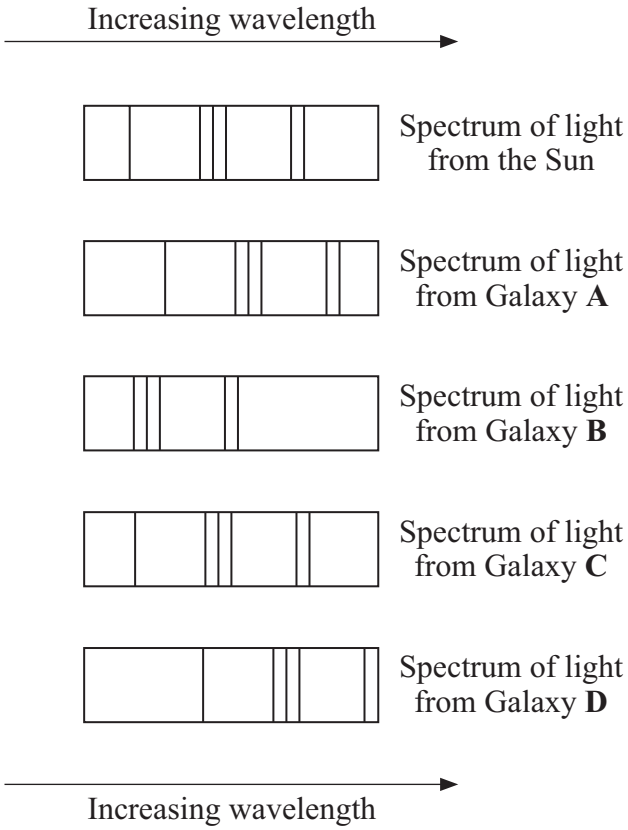


3

4

QUESTION SEVEN

The visible part of the electromagnetic spectrum from galaxies includes dark lines. These lines are at specific wavelengths. The diagram shows the position of the dark lines in the spectrum from the Sun and in the spectra from four distant galaxies **A**, **B**, **C** and **D**.



7A What is the name of the phenomenon shown in the spectrum from Galaxy **A**?

1 blue shift

2 green shift

3 yellow shift

4 red shift

7B Which one of the galaxies is furthest away from Earth?

1 Galaxy **A**

2 Galaxy **B**

3 Galaxy **C**

4 Galaxy **D**

7C Which galaxy is moving towards the observer?

1 Galaxy **A**

2 Galaxy **B**

3 Galaxy **C**

4 Galaxy **D**

7D Data from similar investigations shows that . . .

1 most galaxies are moving towards Earth.

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

3 all galaxies move at a constant speed.

4 all galaxies were created at the same time.

Turn over for the next question

QUESTION EIGHT

Carbon-14 is a radioactive isotope of carbon. It is a beta (β) particle emitter with a half-life of approximately 5750 years. Carbon-14 makes up a tiny proportion of all naturally occurring carbon on our planet.

When living things die the carbon-14 they contain continues to decay and is not replaced. So the approximate age of the object which was once part of a living plant or animal, can be calculated by measuring the proportion of carbon-14 which it now contains.

8A An organism has been dead for 17 000 years.

Approximately how many half-lives of carbon-14 have passed during this time?

1 2

2 3

3 4

4 5

8B A small sample of material taken from a plant contains 32 billion atoms of carbon-14.

Approximately how many of these atoms will it contain in 13 000 years time?

1 4 billion

2 7 billion

3 15 billion

4 30 billion

8C It is difficult to date samples more than 50 000 years old using carbon-14.

This is because . . .

1 all the carbon-14 will have decayed away.

2 carbon-14 did not exist more than 50 000 years ago.

3 so little carbon-14 remains that it is very difficult to detect and measure.

4 from the start there was no carbon-14 in samples of this age.

8D Carbon-14 dating **cannot** be used for . . .

1 a cotton cloak.

2 a gold plate.

3 a paper scroll.

4 a wooden mast.

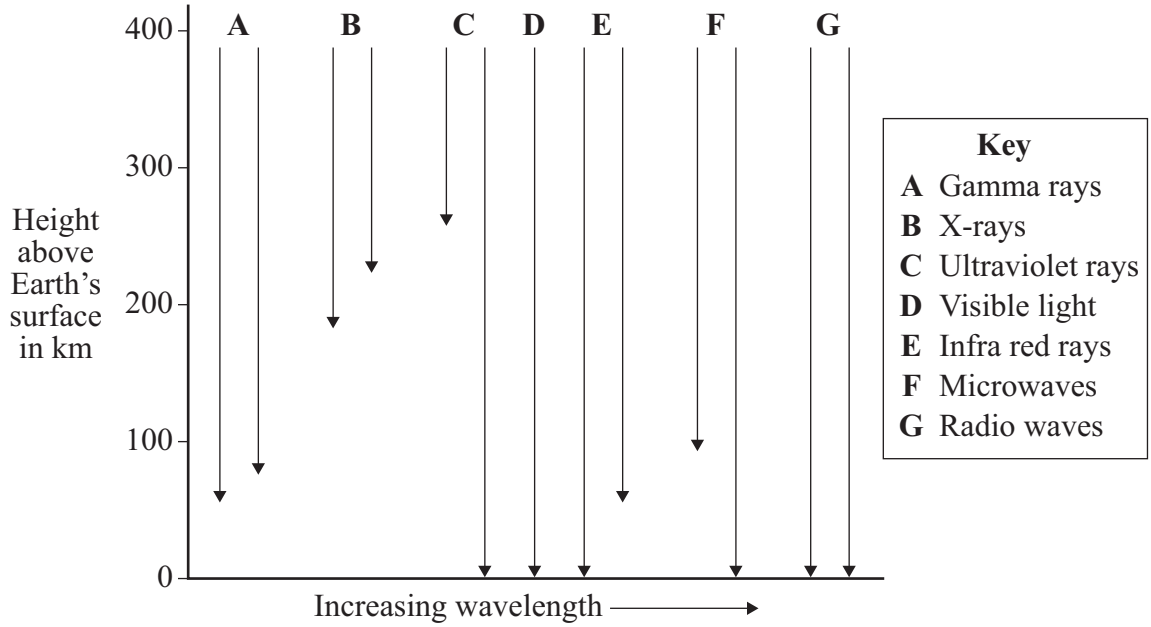
Turn over for the next question

QUESTION NINE

All forms of electromagnetic radiation from space are used by scientists to explore the Universe.

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.



9A Which one of the following statements is true?

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

2 All frequencies of microwaves reach Earth's surface.

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

4 Higher frequencies of ultraviolet radiation are completely absorbed by the atmosphere.

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

1 50 km

2 70 km

3 180 km

4 230 km

9C Which one of the following correctly describes the data on the diagram?

1 The absorption of electromagnetic radiation by the atmosphere is directly proportional to wavelength.

2 The absorption of electromagnetic radiation by the atmosphere is inversely proportional to wavelength.

3 The shorter the wavelength of electromagnetic radiation, the greater the absorption by the atmosphere.

4 Absorption of electromagnetic radiation does **not** depend only on wavelength.

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

The Spitzer space telescope uses liquid helium to keep its scientific instruments at a very low temperature.

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

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

There are no questions printed on this page