

Surname		Other Names	
Centre Number			Candidate Number
Candidate Signature			

General Certificate of Secondary Education
November 2006



SCIENCE A
Unit Physics P1b (Radiation and the Universe)

PHY1B

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Wednesday 22 November 2006 Morning Session

For this paper you must have:

- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

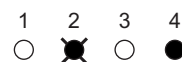
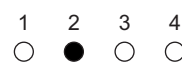
Time allowed: 30 minutes

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:
- 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 **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.

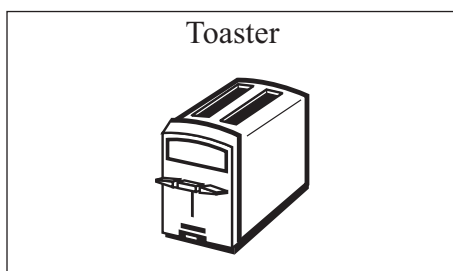
QUESTION ONE

Electromagnetic radiation has many uses.

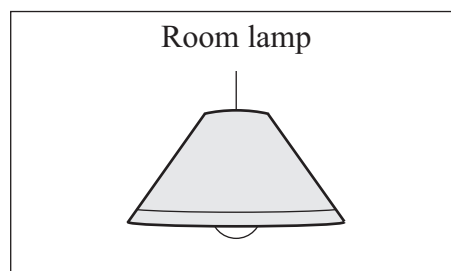
Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the drawings labelled **1–4**.

- A** infra red rays
- B** ultraviolet waves
- C** visible light
- D** X-rays

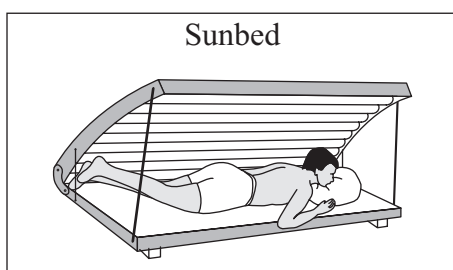
1



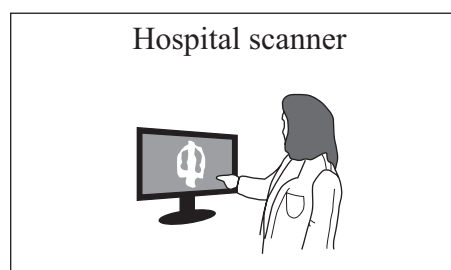
2



3



4

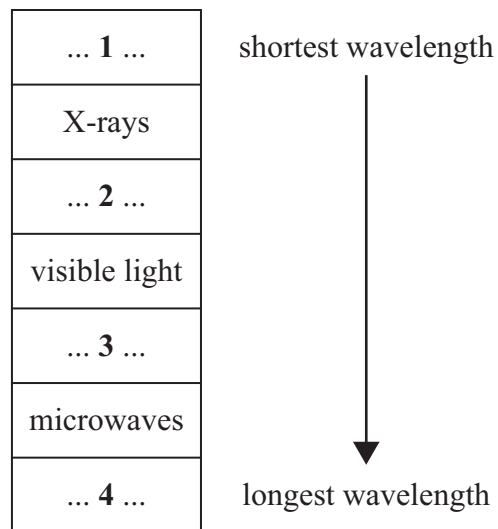


QUESTION TWO

Electromagnetic radiation can be grouped into types, each with a different range of wavelengths.

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

- A** gamma rays
- B** infra red rays
- C** radio waves
- D** ultraviolet waves



Turn over for the next question

Turn over ►

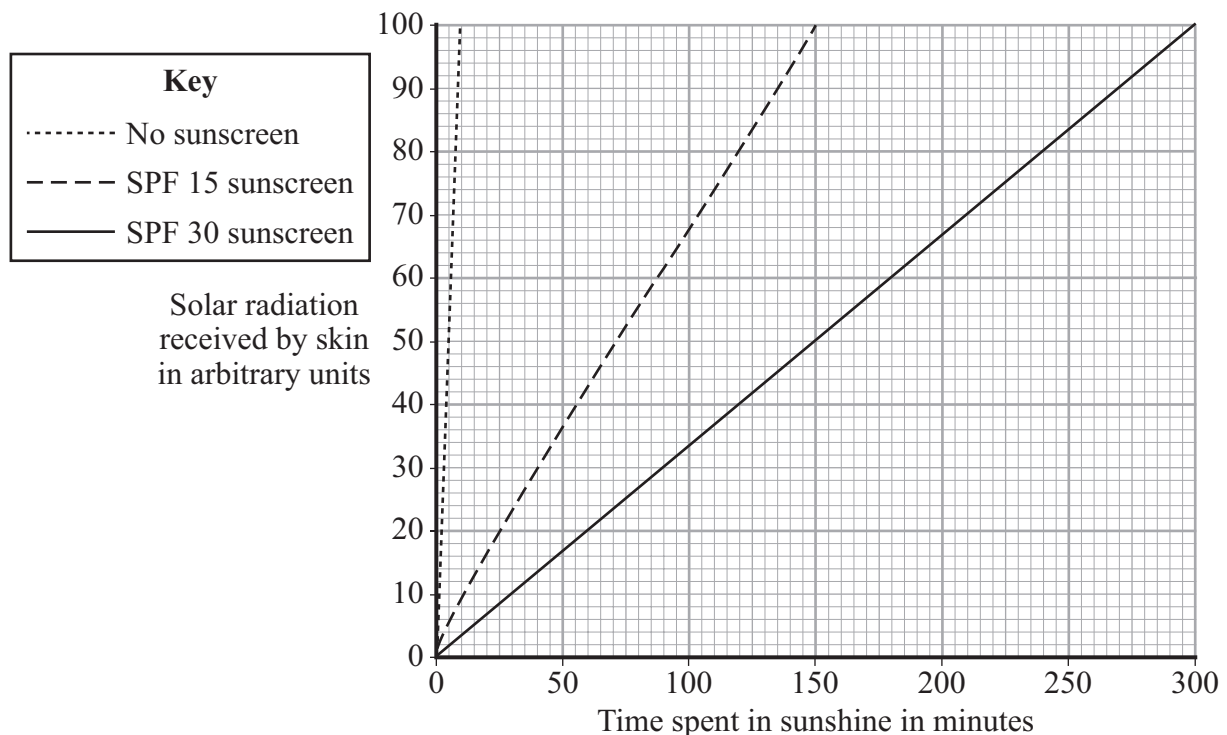
QUESTION THREE

The longer you stay in sunshine, the more sunburnt you are likely to get.

Sunscreen lotions give some protection against sunburn. The lotions are labelled with a skin protection factor (SPF) number.

The graph shows how the amount of solar radiation received by the skin is related to time.

The skin gets sunburnt if it receives 100 units of solar radiation.



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

A 10

B 15

C 60

D 200

Without sunscreen, it takes . . . **1** . . . minutes to get sunburnt.

After 180 minutes, skin protected by SPF 30 lotion has received . . . **2** . . . units of solar radiation.

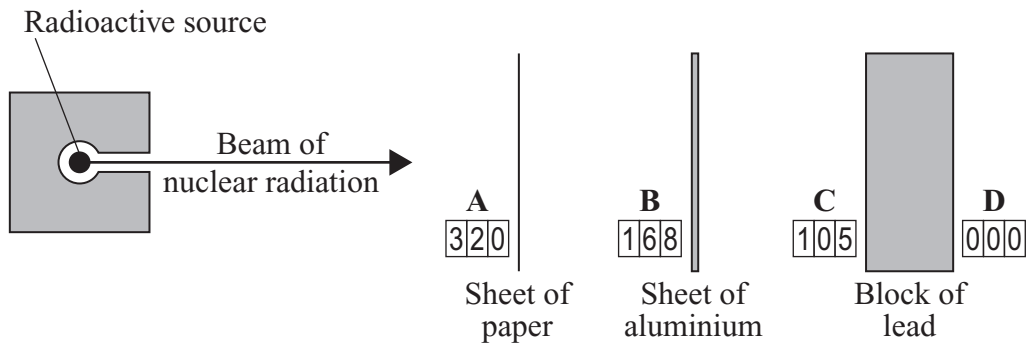
If you protect your skin with SPF 15 lotion, you can stay . . . **3** . . . times longer in sunshine without getting sunburnt than you can with unprotected skin.

If you apply SPF 20 sunscreen it will take . . . **4** . . . minutes to get sunburnt.

QUESTION FOUR

A radioactive source gives out a beam of nuclear 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 placed at positions **A**, **B**, **C** and **D**.



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

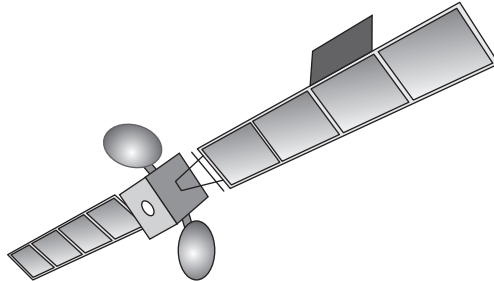
	Type of radiation
1	gamma only
2	gamma and beta only
3	gamma, beta and alpha
4	no radiation

Turn over for the next question

Turn over ►

QUESTION FIVE

The drawing shows a satellite which carries a telescope used to observe 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

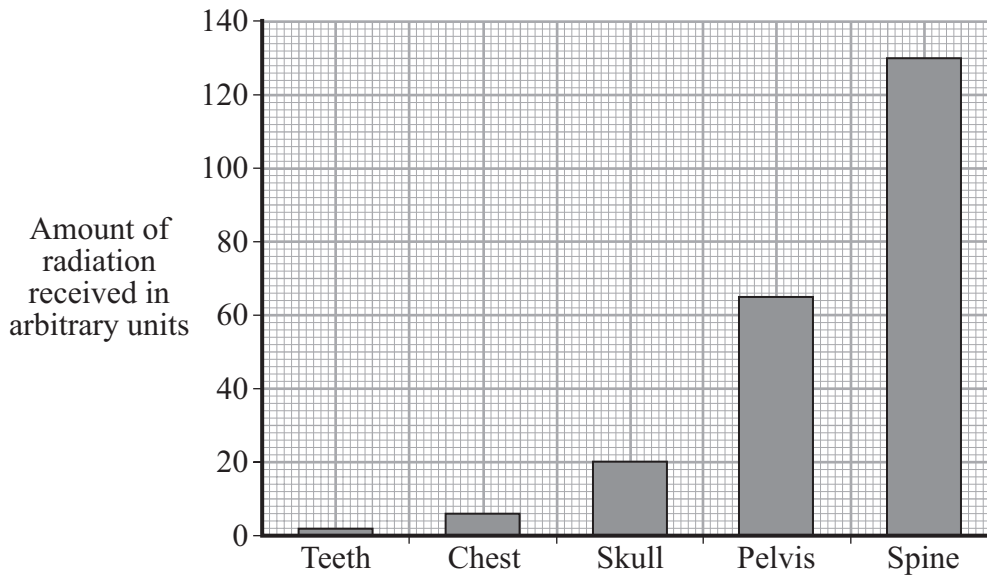
D the Universe

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

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

QUESTION SIX

The graph shows the amount of radiation received by the body when different parts of the body are X-rayed.



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

- A** bar
- B** categoric
- C** dependent
- D** reliable

The part of the body X-rayed is described as a . . . **1** . . . variable.

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

The data is displayed as a . . . **3** . . . chart.

Increasing the number of patients surveyed would make the data more . . . **4**

Turn over ►

SECTION TWOQuestions **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

Hospital patients are sometimes injected with radioactive tracers.



- 7A** The purpose of a radioactive tracer is . . .
- 1 to identify the patient's blood group.
 - 2 to sedate the patient before an operation.
 - 3 to track the movement of substances in the patient's body.
 - 4 to track the patient's movements in the hospital.
- 7B** Which of the following is the most suitable radioactive substance to use as a tracer?
- 1 a gamma emitter with a long half-life
 - 2 a gamma emitter with a short half-life
 - 3 an alpha emitter with a long half-life
 - 4 an alpha emitter with a short half-life

7C Which of the following statements is correct for gamma radiation?

- 1 It is a stream of electrons.
- 2 It is a stream of protons.
- 3 It is deflected by an electric field.
- 4 It is **not** deflected by a magnetic field.

7D Which description is correct for the nucleus of a medium-sized atom?

It is a group of . . .

- 1 electrons and neutrons.
- 2 electrons, neutrons and protons.
- 3 electrons and protons.
- 4 neutrons and protons.

Turn over for the next question

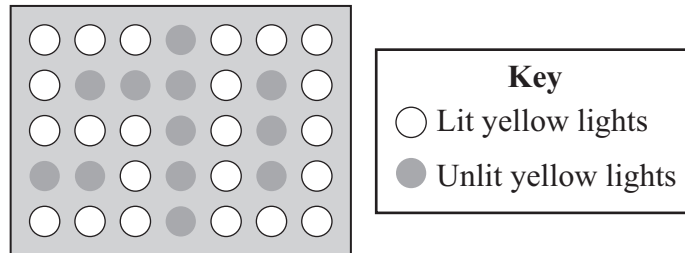
Turn over ►

QUESTION EIGHT

Vehicles on motorways often travel at high speeds. It is important that clear warning signs are used.

Tests were carried out to find the most suitable colour for the lights in the warning sign.

The drawing shows a sign which has yellow lights.



8A Suggest why yellow light is used for the sign.

- 1 It has a higher frequency than all other colours.
- 2 It has a longer wavelength than all other colours.
- 3 It is easier to see than all other colours.
- 4 It 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.

What is the likely value of the wavelength of the yellow light from the sign?

- 1 250 nm
- 2 350 nm
- 3 600 nm
- 4 750 nm

- 8D** The warning sign is switched on by sending a radio signal. The frequency of the signal is 2 000 000 hertz and its wavelength is 150 metres.

Calculate the wave speed of the signal in metres/second.

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

- 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

Turn over ►

QUESTION NINE

Read this extract from a science magazine.

Stone Age campfire found in Norfolk

Material made from something which was once alive can be dated by measuring its radioactivity. This is because all living things contain a small proportion of radioactive carbon-14 atoms.

Carbon-14 decays by emitting beta (β) particles and its half-life is 5730 years.

9A An example of something which can be dated by using carbon-14 measurements is . . .

- 1 a copper coin.
- 2 a gold brooch.
- 3 a leather belt.
- 4 an iron horseshoe.

9B A sample of charcoal from the Stone Age campfire contains 12 billion carbon-14 atoms.

Approximately how many carbon-14 atoms would the sample have contained 6000 years ago?

- 1 6 billion
- 2 12 billion
- 3 24 billion
- 4 48 billion

9C Carbon-14 **cannot** be used to date samples more than 45 000 years old.

Four students discuss this.

Which student, **1**, **2**, **3** or **4**, has the correct explanation?

- 1** 'It will take too long to make the measurements.'
- 2** 'No carbon-14 atoms will be left in the specimen.'
- 3** 'The proportion of carbon-14 atoms will be too small to measure.'
- 4** 'There are no samples more than 45 000 years old.'

9D A beta (β) particle from an atom of carbon-14 is . . .

- 1** an electron from the inner part (nucleus) of the atom.
- 2** an electron from the outer part of the atom.
- 3** a helium nucleus.
- 4** a neutron.

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**.

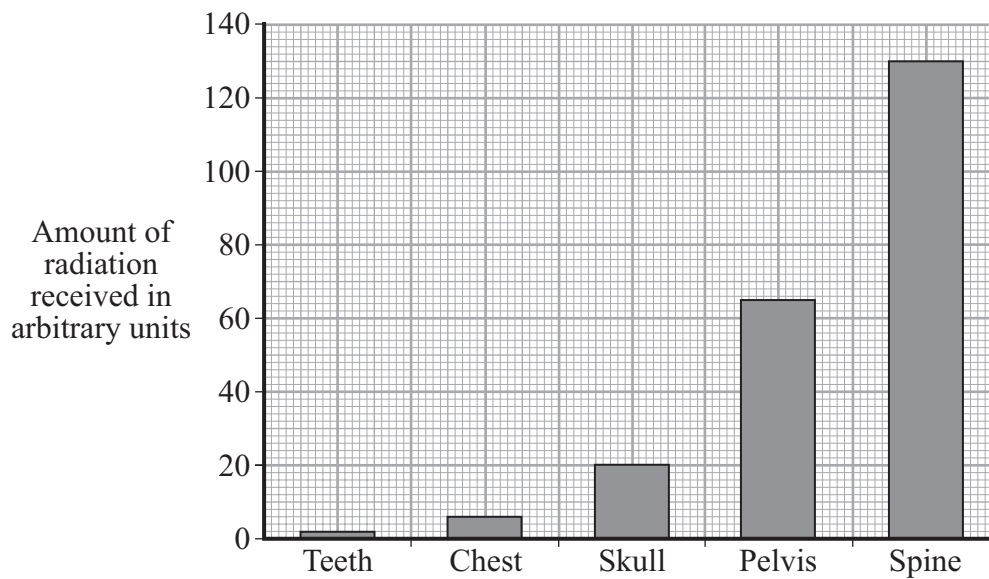
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

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QUESTION ONE

The graph shows the amount of radiation received by the body when different parts of the body are X-rayed.



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

- A** bar
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The part of the body X-rayed is described as a . . . **1** . . . variable.

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

The data is displayed as a . . . **3** . . . chart.

Increasing the number of patients surveyed would make the data more . . . **4**

QUESTION TWO

Electromagnetic radiation is often absorbed.

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

A current

B energy

C frequency

D substance

When electromagnetic radiation is absorbed, the . . . **1** . . . which absorbs it becomes hotter. This is because the radiation carries . . . **2** The radiation may create an alternating . . . **3** . . . with the same . . . **4** . . . as the radiation itself.

Turn over for the next question

Turn over ►

SECTION TWOQuestions **THREE** to **NINE**.

Each of these questions has four parts.

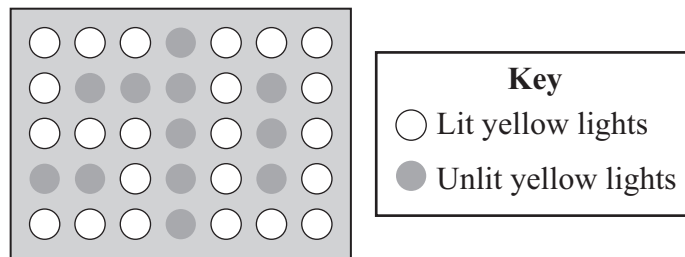
In each part choose only **one** answer.Mark your choices on the answer sheet.

QUESTION THREE

Vehicles on motorways often travel at high speeds. It is important that clear warning signs are used.

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**3A** Suggest why yellow light is used for the sign.

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QUESTION FOUR

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- 1** an electron from the inner part (nucleus) of the atom.
- 2** an electron from the outer part of the atom.
- 3** a helium nucleus.
- 4** a neutron.

Turn over for the next question

Turn over ►

QUESTION FIVE

Some substances give out radiation from the nuclei of their atoms.

5A A radioactive source emits alpha, beta and gamma radiation.

Which row in the table is correct?

	Deflected by a magnetic field?		
	Alpha	Beta	Gamma
1	no	no	yes
2	no	yes	no
3	yes	yes	no
4	yes	yes	yes

5B Americium oxide is used in smoke alarms. Atoms of americium can exist as different isotopes.

Which row in the table correctly describes the number of particles in the nucleus of an atom of each of two different isotopes of americium?

	Particles in each isotope	
1	different number of neutrons	different number of protons
2	different number of neutrons	same number of protons
3	same number of neutrons	different number of protons
4	same number of neutrons	same number of protons

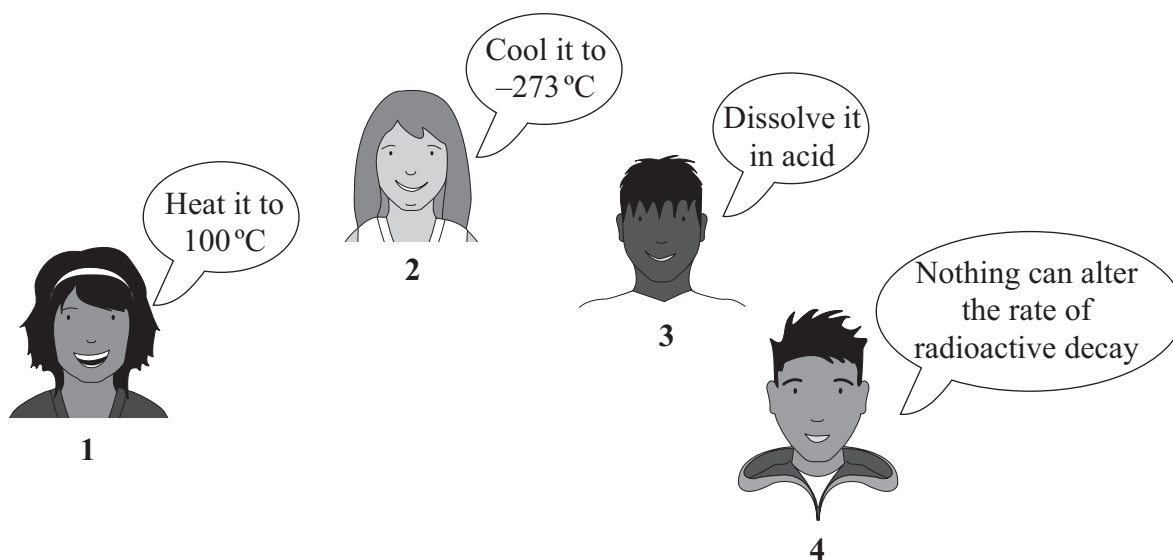
5C The radioactive americium oxide used in a smoke alarm emits alpha particles.

These particles . . .

- 1 add electrons to the air.
- 2 add neutrons to the air.
- 3 add protons to the air.
- 4 ionise particles in the air.

5D Four students discuss how to alter the rate of decay of a radioactive source.

Which student, **1**, **2**, **3** or **4**, is correct?



Turn over for the next question

Turn over ►

QUESTION SIX

Skiers have an increased risk of damage from harmful rays from the Sun.



- 6A** The best explanation of why the risk is increased is that . . .
- 1 the Sun's rays penetrate the skin more at a lower temperature.
 - 2 the atmosphere absorbs more of the Sun's rays.
 - 3 the skier moves at a high speed and this makes the rays penetrate the skin more.
 - 4 the Sun's rays are reflected from the snow so more rays reach the skier.
- 6B** Some skiers put special cream on the skin on their faces.
- One reason this is done is so that the cream can . . .
- 1 absorb gamma rays.
 - 2 keep the skier's skin warm.
 - 3 produce an even suntan.
 - 4 absorb ultraviolet radiation.

6C The skier falls and has a suspected broken leg.

He is taken to hospital for an X-ray.

At the hospital, the X-ray technicians wear protective clothing and a badge that records exposure to X-rays.

They wear the badge to monitor their exposure because . . .

- 1 excess exposure to X-rays can damage body tissue.
- 2 the X-ray equipment gives off radioactive particles.
- 3 X-ray film contains toxins.
- 4 X-rays could make them glow in the dark.

6D The patient being X-rayed is not protected in the way that X-ray technicians are.

Why is this?

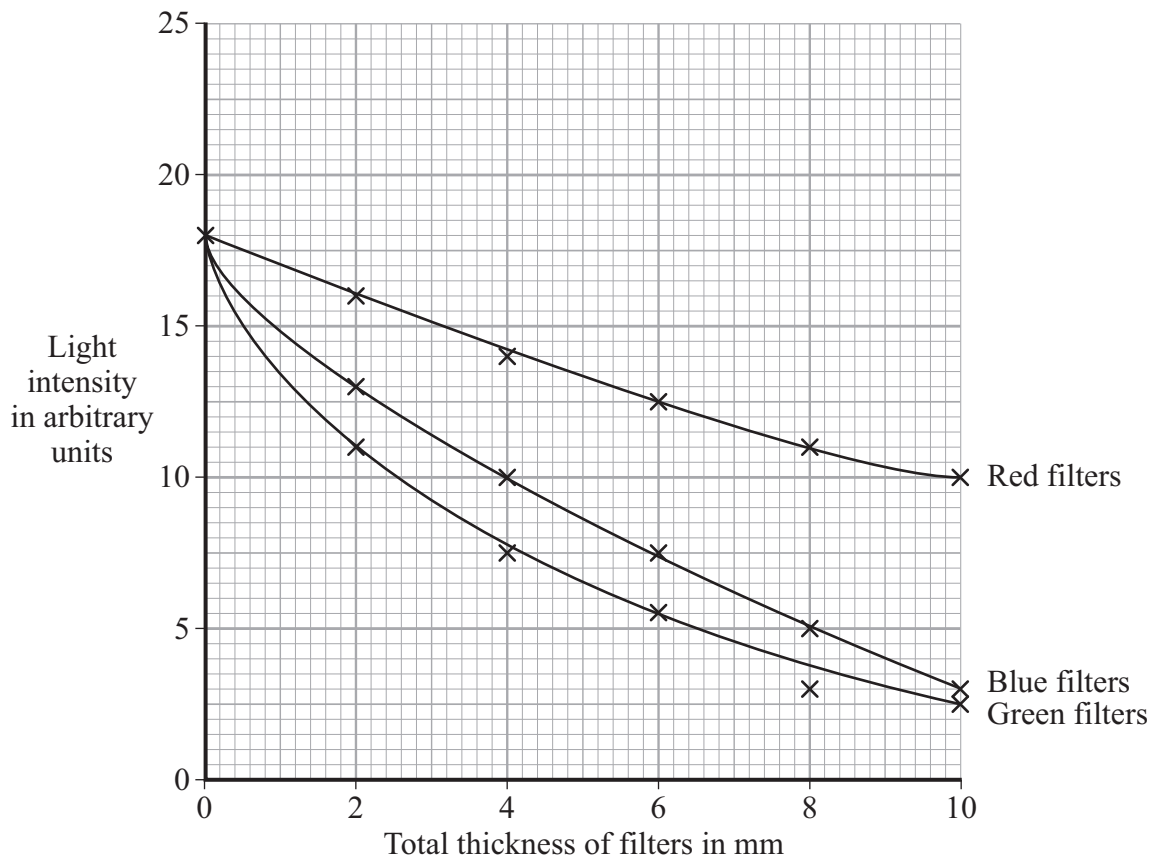
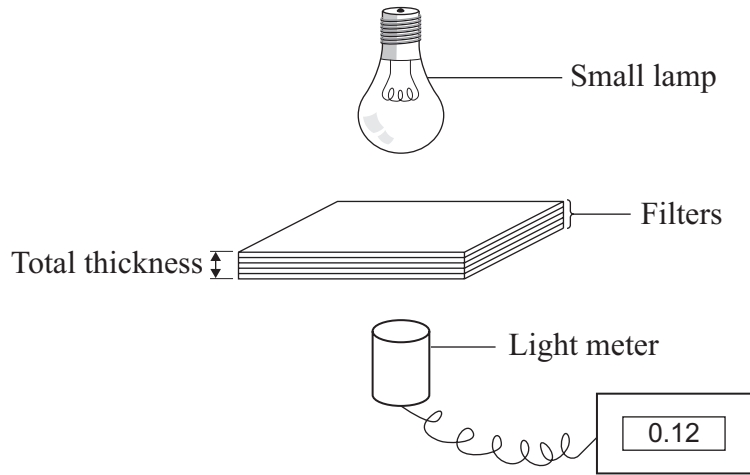
- 1 Images would not be obtained if the patient were fully protected.
- 2 Patients are not in contact with X-ray equipment.
- 3 The cost to provide protection for patients would be too high.
- 4 The time taken to protect each patient would be too long.

Turn over for the next question

Turn over ►

QUESTION SEVEN

The graph shows the light intensity readings when different numbers of coloured filters were placed between a small lamp and a light meter. Each filter was 1 mm thick.



7A What is the light intensity reading when seven blue filters are used?

- 1 4.5
- 2 6.2
- 3 6.5
- 4 6.6

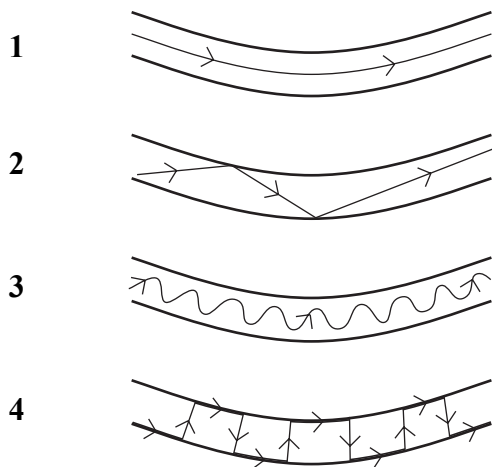
7B Which is the best description of the pattern for all the coloured filters shown on the graph?

- 1 As the total thickness of the filters increases, the light intensity transmitted decreases.
- 2 As the total thickness of the filters increases, the light intensity transmitted increases.
- 3 The light intensity transmitted is directly proportional to the total thickness of the filters.
- 4 The light intensity transmitted is inversely proportional to the total thickness of the filters.

7C Which types of electromagnetic radiation can be 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

7D Which diagram shows the path of electromagnetic radiation along an optical fibre?



Turn over ►

QUESTION EIGHT

Scientists have observed light from different galaxies. They have evidence for a red-shift in the light.

8A What change has occurred to the speed and wavelength of the light to cause the red-shift?

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

8B Light from a galaxy with a very large red-shift would indicate that the galaxy was . . .

- 1** close and moving towards the Earth.
- 2** close and moving away from the Earth.
- 3** distant and moving towards the Earth.
- 4** distant and moving away from the Earth.

8C Many scientists support the ‘big bang’ theory.

This theory states that . . .

- 1** the galaxies are in fixed positions in space.
- 2** the galaxies rotate around a central point.
- 3** the stars are formed when planets collide.
- 4** the Universe began from a small initial point.

8D Observations are taken by satellites in space.

The information is sent back to Earth using . . .

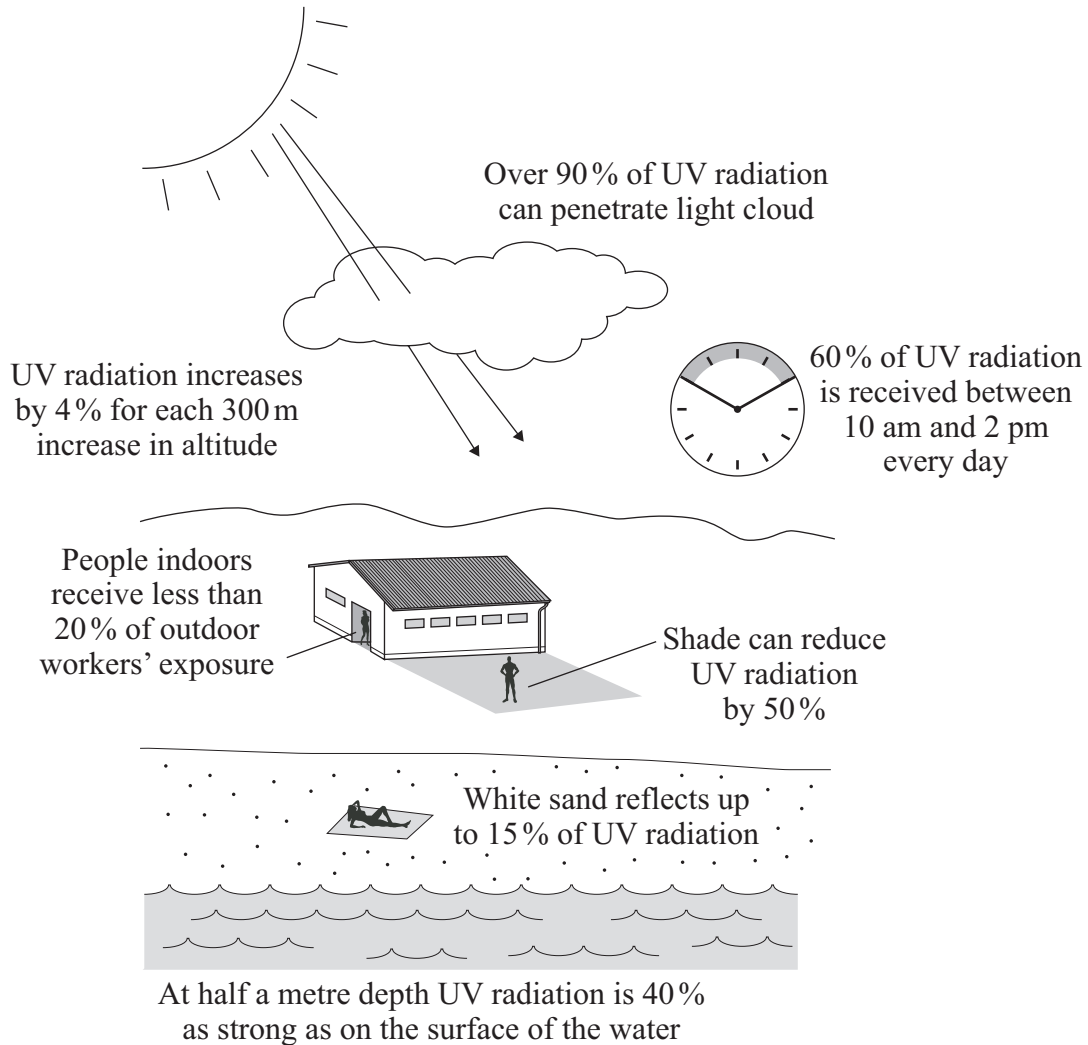
- 1 gamma rays.
- 2 microwaves.
- 3 ultraviolet rays.
- 4 X-rays.

Turn over for the next question

Turn over ►

QUESTION NINE

The diagram shows data about the reflection and absorption of ultraviolet (UV) radiation from the Sun. Excess exposure to UV radiation causes a variety of medical conditions including skin cancer.



Use information in the diagram to help you to answer the questions.

9A Compared with open fields at sea level, we would expect the UV radiation exposure at an altitude of 900 m to be increased by approximately . . .

- 1 4%
- 2 12%
- 3 30%
- 4 36%

- 9B** What valid conclusion can be drawn from the information in the diagram?
- 1 More outdoor workers than indoor workers will develop skin cancer.
 - 2 Outdoor workers are more likely than indoor workers to develop skin cancer.
 - 3 Twice as many outdoor workers as indoor workers will develop skin cancer.
 - 4 Working in the shade eliminates all risk of skin cancer caused by exposure to UV radiation.
- 9C** Which of the following situations gives the **least** exposure to UV radiation?
- 1 in the shade between 3 pm and 4 pm on a cloudless day
 - 2 in the shade between 3 pm and 4 pm on a cloudy day
 - 3 on a beach between 1 pm and 2 pm on a cloudless day
 - 4 on a beach between 1 pm and 2 pm on a cloudy day
- 9D** Which one of the following is correct?
- 1 Outdoor swimming reduces the health risk due to UV radiation exposure equally over all parts of the body.
 - 2 Mountain climbers have an increased risk of skin damage due to UV radiation exposure but to a smaller area of the body than swimmers.
 - 3 There is no UV radiation in daylight on a cloudy day.
 - 4 Working indoors eliminates exposure to UV radiation.

END OF TEST

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