

Surname		Other Names	
Centre Number			Candidate Number
Candidate Signature			

General Certificate of Secondary Education
March 2007



SCIENCE A
Unit Physics P1b (Radiation and the Universe)

PHY1B

PHYSICS
Unit Physics P1b (Radiation and the Universe)

Monday 12 March 2007 Morning Session

For this paper you must have:

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

You may use a calculator.

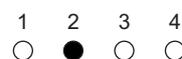
Time allowed: 30 minutes

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:



- 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

Each of these devices uses electromagnetic radiation.

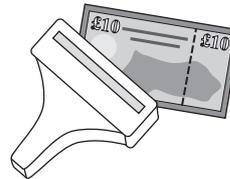
1

Camera



2

Forgery detector



3

Toaster



4

Television



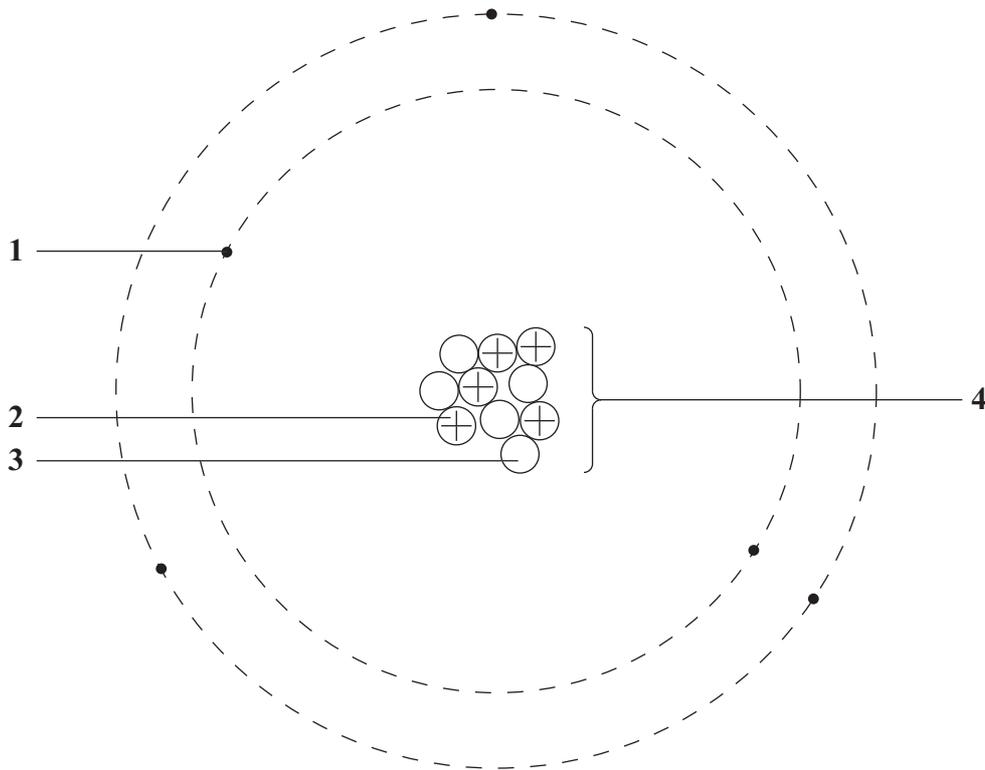
Match the parts of the electromagnetic spectrum, **A**, **B**, **C** and **D**, with the drawings labelled **1–4**.

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

QUESTION TWO

Match words, **A**, **B**, **C** and **D**, with the labels **1–4** on the diagram of an atom.

- A** electron
- B** nucleus
- C** neutron
- D** proton



Turn over for the next question

Turn over ►

QUESTION THREE

Optical telescopes may be on Earth or in space. Each of these has both advantages and disadvantages.

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

- A** Clouds may limit the telescope's use.
- B** Easy for astronomers to get to the telescope.
- C** Not easy to service and repair the telescope.
- D** Quality of data is not reduced by the atmosphere.

Telescope location	Advantage	Disadvantage
space	1	2
Earth	3	4

QUESTION FOUR

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

- A** away from
- B** beyond
- C** furthest
- D** towards

The light that reaches us from distant galaxies shows a shift . . . **1** . . . the red end of the electromagnetic spectrum. This is evidence that these galaxies are moving . . . **2** . . . us at a very high speed.

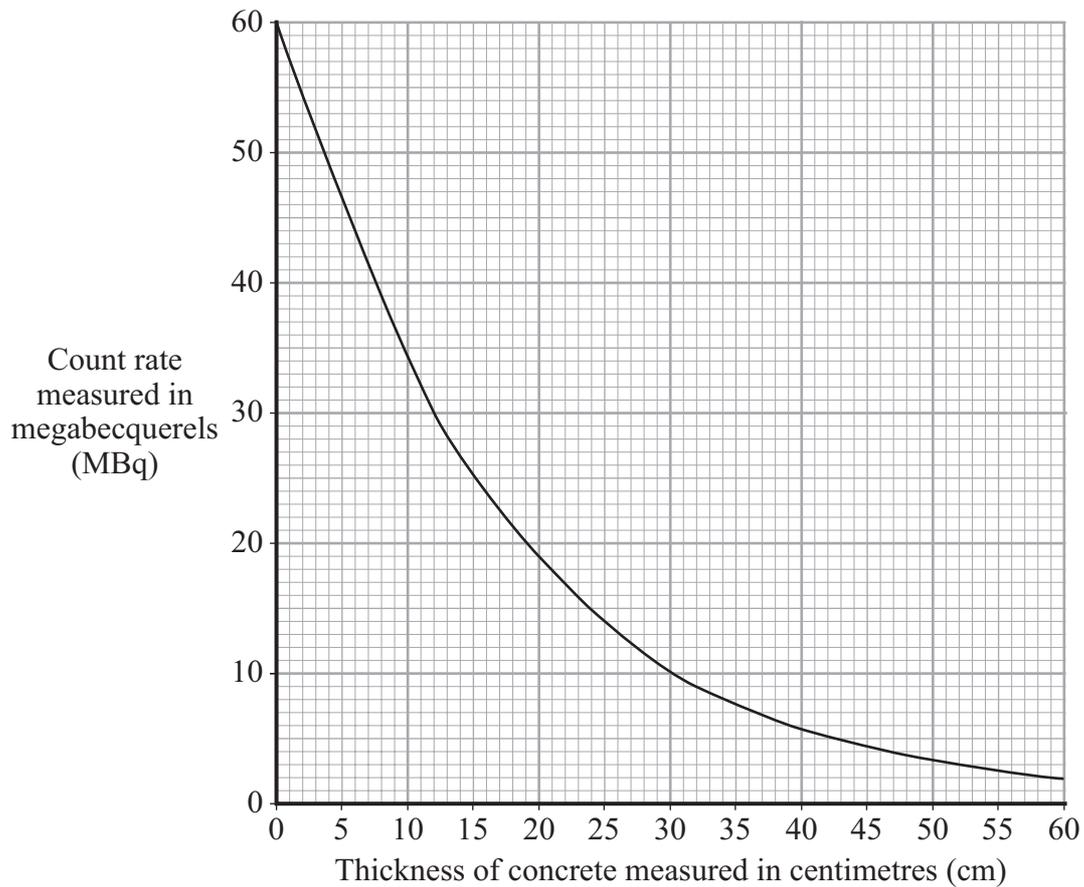
Telescopes orbiting outside the Earth's atmosphere can detect infra red radiation from the . . . **3** . . . galaxies. This is . . . **4** . . . the capability of telescopes on the Earth's surface.

QUESTION FIVE

Gamma radiation is the most penetrating type of ionising radiation.

Concrete is sometimes used to protect people from the harmful effects of gamma radiation.

The graph shows the count rate from a source of gamma radiation after it has passed through various thicknesses of concrete.



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

A 6

B 8

C 12

D 19

Count rate when the thickness is 20 cm = . . . **1** . . . MBq.

Thickness when count rate is 39 MBq = . . . **2** . . . cm.

Reduction in count rate when thickness is increased from 12 cm to 16 cm = . . . **3** . . . MBq.

Thickness needed to reduce the original count rate by half = . . . **4** . . . cm.

Turn over ►

QUESTION SIX

Read this extract from a magazine article.

X-rays and health

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

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

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

- A** conclusion
- B** confidentiality
- C** control
- D** evidence

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

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

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

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

Turn over for the next question

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

Electromagnetic radiation fills the Universe

Electromagnetic radiations belong to a spectrum of radiations which have many features in common.

- 7A** In the box, the electromagnetic radiations are meant to be in order of increasing wavelength from left to right. Which one is in the wrong position?

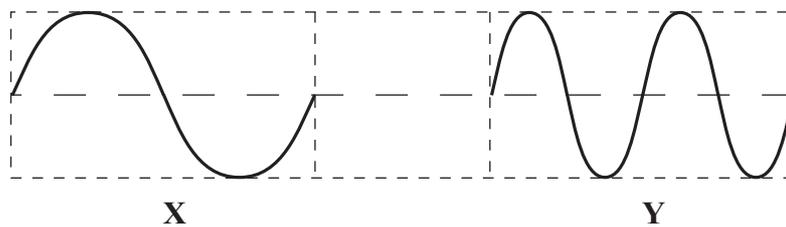
X-rays 1	Infra red rays 2	Radio waves 3	Gamma rays 4
--------------------	----------------------------	-------------------------	------------------------

- 1** X-rays
 - 2** infra red rays
 - 3** radio waves
 - 4** gamma rays
- 7B** Which statement is correct?
- 1** All electromagnetic radiation can travel through a vacuum.
 - 2** All electromagnetic radiation is visible to the human eye.
 - 3** No electromagnetic radiation can travel through a vacuum.
 - 4** No electromagnetic radiation is visible to the human eye.

7C Which statement about the wavelength of microwaves is correct?

- 1 longer than both infra red rays and ultraviolet rays
- 2 longer than infra red rays but shorter than ultraviolet rays
- 3 shorter than both infra red rays and ultraviolet rays
- 4 shorter than infra red rays but longer than ultraviolet rays

7D Two electromagnetic waves are shown in the diagrams, which are drawn to the same scale.



Which sentence is correct?

- 1 The frequency of wave X is double that of wave Y.
- 2 The frequency of wave Y is double that of wave X.
- 3 The wavelength of wave Y is double that of wave X.
- 4 The wavelength of wave Y is four times that of wave X.

Turn over for the next question

Turn over ►

QUESTION EIGHT

What was that again?

A scientist investigated the claim that the use of mobile phones leads to hearing loss.

She investigated two groups of young adults aged 20 to 24 years old. One group said that they used mobile phones frequently. The other group was the control group. They said that they did not use mobile phones.

She found that, on average, the mobile phone users experienced a 5 % hearing loss over a two-year period.

- 8A** What valid conclusion can she come to on the basis of this evidence?
- 1 that excessive sound levels lead to hearing loss
 - 2 that some members of her group of mobile phone users experienced a hearing loss
 - 3 that microwaves lead to hearing loss
 - 4 that most younger people have better hearing than most older people
- 8B** A criticism of her investigation made by other scientists is likely to be that . . .
- 1 mobile phones are not significantly different from other phones.
 - 2 she used the wrong age group and should have chosen a younger group.
 - 3 some people in the group had a lower than average hearing loss.
 - 4 we cannot be sure that people have described their mobile phone use correctly.
- 8C** Other scientists said that the two groups would not be well matched.
- This is because . . .
- 1 it is difficult to find people in the 20–24 age group who do not use mobile phones.
 - 2 people objected to being controlled.
 - 3 some people changed their mobile phones during the two-year period.
 - 4 the control group did not get on with the others.

8D Newspapers reported her findings, but most of their readers did not alter their mobile phone use.

The most likely reason was that most people . . .

- 1 considered all the scientific arguments, both for and against.
- 2 did not believe that she had measured the hearing loss correctly.
- 3 experience some hearing loss as they get older.
- 4 were prepared to take the possible risk.

Turn over for the next question

Turn over ►

QUESTION NINE

A student has been learning about the electromagnetic spectrum.

9A Which part(s) of the electromagnetic spectrum can be used for communication?

- 1 radio waves only
- 2 radio waves and microwaves only
- 3 radio waves, microwaves and infra red rays only
- 4 radio waves, microwaves, infra red rays and visible light

9B Waves of the electromagnetic spectrum travel through space.

When they do, which property is the same for all of them?

- 1 energy
- 2 penetration
- 3 power
- 4 speed

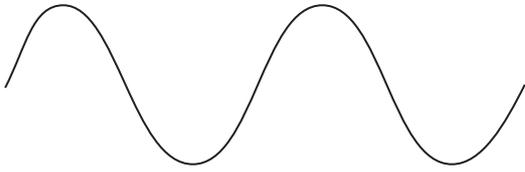
9C The frequency of a radio signal is increased.

Which is correct?

- 1 Its speed decreases.
- 2 Its speed increases.
- 3 Its wavelength decreases.
- 4 Its wavelength increases.

9D Communication signals are often digital. The diagrams show four signals.

E



F



G



H



Which two could be digital?

- 1 E and F
- 2 F and G
- 3 G and H
- 4 H and E

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

Read this extract from a magazine article.

X-rays and health

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

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

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

- A** conclusion
- B** confidentiality
- C** control
- D** evidence

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

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

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

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

QUESTION TWO

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

- A** gamma rays
- B** microwaves
- C** ultraviolet rays
- D** X-rays

Properties of radiation	
1	do not penetrate human tissue below skin depth but can cause severe burns
2	penetrate only a few centimetres into human tissue but produce a lot of heat
3	pass through all types of human tissue, including bones, and can kill all types of cell
4	pass easily through soft human tissue without much absorption

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**What was that again?**

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- 3A** What valid conclusion can she come to on the basis of this evidence?
- 1 that excessive sound levels lead to hearing loss
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- 3B** A criticism of her investigation made by other scientists is likely to be that . . .
- 1 mobile phones are not significantly different from other phones.
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 - 3 some people in the group had a lower than average hearing loss.
 - 4 we cannot be sure that people have described their mobile phone use correctly.

3C Other scientists said that the two groups would not be well matched.

This is because . . .

- 1 it is difficult to find people in the 20–24 age group who do not use mobile phones.
- 2 people objected to being controlled.
- 3 some people changed their mobile phones during the two-year period.
- 4 the control group did not get on with the others.

3D Newspapers reported her findings, but most of their readers did not alter their mobile phone use.

The most likely reason was that most people . . .

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- 3 experience some hearing loss as they get older.
- 4 were prepared to take the possible risk.

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Turn over ►

QUESTION FOUR

A student has been learning about the electromagnetic spectrum.

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4B Waves of the electromagnetic spectrum travel through space.

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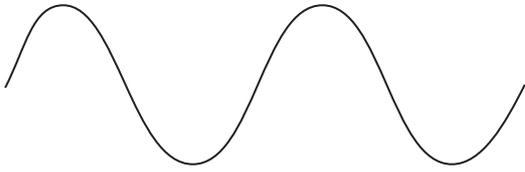
4C The frequency of a radio signal is increased.

Which is correct?

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- 3 Its wavelength decreases.
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Which two could be digital?

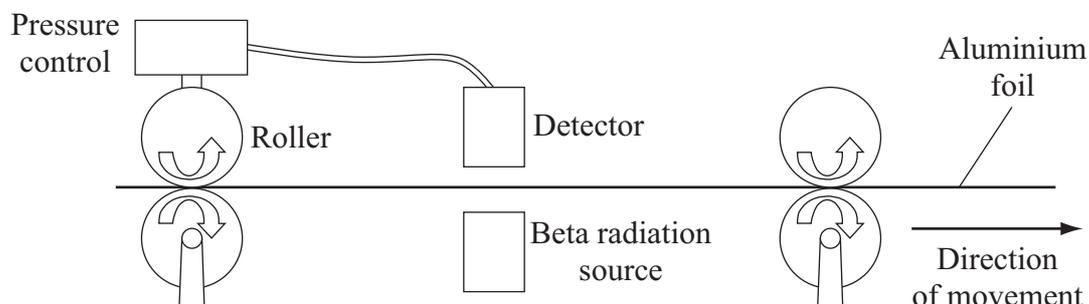
- 1 E and F
- 2 F and G
- 3 G and H
- 4 H and E

Turn over for the next question

Turn over ►

QUESTION FIVE

The diagram shows how the thickness of aluminium foil is controlled during its manufacture. The thicker the aluminium foil, the more radiation it absorbs.



5A A beta particle consists of . . .

- 1 one electron.
- 2 one proton.
- 3 two protons.
- 4 two protons and two electrons.

5B Starting with the most penetrating radiation, which is the correct order?

- 1 alpha → beta → gamma
- 2 beta → alpha → gamma
- 3 beta → gamma → alpha
- 4 gamma → beta → alpha

5C Which sentence correctly explains why alpha and gamma radiation sources are unsuitable for use in this machine?

- 1 Alpha particles would be stopped by the foil but gamma rays would not be stopped.
- 2 Both would be stopped by the foil.
- 3 Gamma rays would be stopped by the foil but alpha particles would not be stopped.
- 4 Neither would be stopped by the foil.

5D A worker accidentally receives a short exposure to the beta radiation.

A day later, this is most likely to have caused . . .

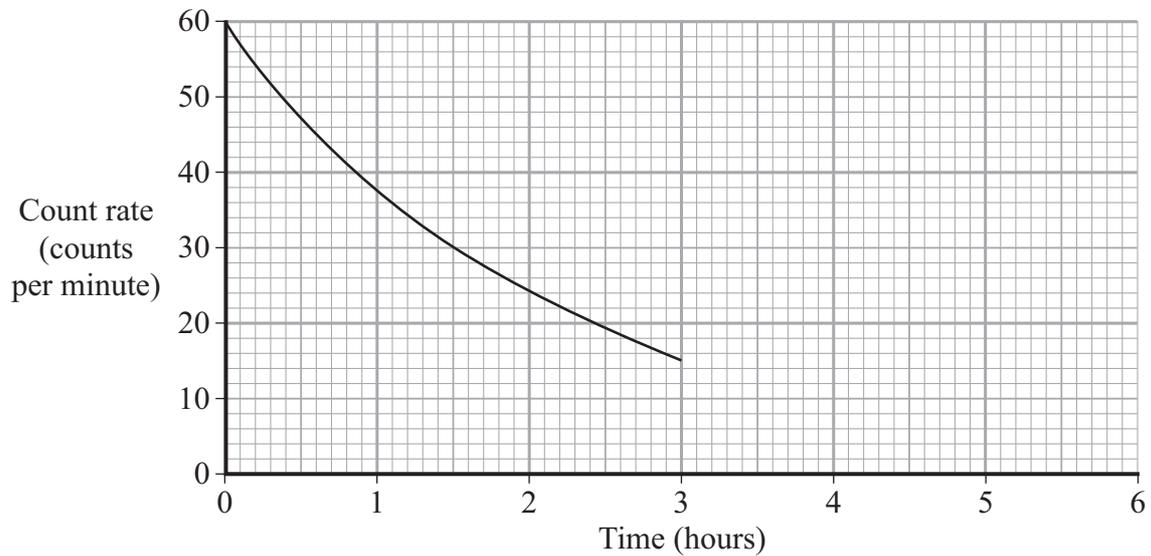
- 1 cancer.
- 2 death.
- 3 hair loss.
- 4 skin burns.

Turn over for the next question

Turn over ►

QUESTION SIX

The graph shows how the count rate of a radioactive sample changes over a period of 3 hours.



6A The half-life of this isotope is . . .

- 1 $\frac{1}{2}$ hour
- 2 1 hour
- 3 $1\frac{1}{2}$ hours
- 4 3 hours

6B If the count rate of the sample was x counts per minute at the start of the experiment, what value would it have fallen to after 6 hours?

- 1 $\frac{x}{4}$
- 2 $\frac{x}{6}$
- 3 $\frac{x}{8}$
- 4 $\frac{x}{16}$

- 6C** The radioactive sample used in the experiment . . .
- 1 must be an alpha particle emitter.
 - 2 will become totally inactive after about 12 hours.
 - 3 would emit radiation at a higher rate if heated.
 - 4 would produce the same shape of graph if it had been reacted with acid before the start.
- 6D** A radioactive isotope should **not** have a long half-life if it is used . . .
- 1 as a source of energy in a submarine.
 - 2 as a tracer injected into someone's small intestine.
 - 3 in a smoke detector.
 - 4 to monitor the thickness of a roll of paper as it is being manufactured.

Turn over for the next question

Turn over ►

QUESTION SEVEN

Use the equation to answer parts of this question.

$$\begin{array}{ccccc} \text{wave speed} & = & \text{frequency} & \times & \text{wavelength} \\ \text{(metres/second, m/s)} & & \text{(hertz, Hz)} & & \text{(metres, m)} \end{array}$$

7A A radio signal is broadcast at a frequency of 1500 kilohertz (kHz) and its speed is 300 million m/s.

What is its wavelength?

- 1 2 m
- 2 200 m
- 3 20 000 m
- 4 200 000 m

7B A microwave has a wavelength of 10 cm and its speed is 300 million m/s.

What is its frequency?

- 1 3 million Hz
- 2 30 million Hz
- 3 300 million Hz
- 4 3000 million Hz

7C Infra red signals can be sent through optical fibres.

This is because they are . . .

- 1 bent by a magnetic field in the optical fibre.
- 2 diffused through the optical fibre.
- 3 reflected from the inside surface of the optical fibre.
- 4 trapped in the centre of the optical fibre.

7D Which statement is true of radio waves?

- 1** They are mostly absorbed by soft tissue.
- 2** They do not include television signals.
- 3** They are not affected by the Earth's atmosphere.
- 4** They can create an alternating current in an electrical conductor.

Turn over for the next question

Turn over ►

QUESTION EIGHT

Light from every star, in every distant galaxy which has been observed, shows a red-shift.

8A Why has the feature been given this name?

- 1 Blue light has a longer wavelength than red light.
- 2 Red light has a higher frequency than blue light.
- 3 Red light travels at a higher speed than blue light.
- 4 Red light has a longer wavelength than blue light.

8B Which row in the table correctly describes the movement of galaxies at the present time?

	Relative to Earth	Relative to each other
1	moving away	moving away
2	moving away	moving closer
3	moving closer	moving away
4	moving closer	moving closer

8C Scientists have used their calculations to deduce the movement of galaxies hundreds of millions of years ago.

Which row in the table correctly describes the movement of galaxies hundreds of millions of years ago?

	Relative to Earth	Relative to each other
1	moving away	moving away
2	moving away	moving closer
3	moving closer	moving away
4	moving closer	moving closer

8D Red-shift provides direct evidence that the Universe . . .

- 1 is expanding.
- 2 is expanding and must have started at the 'big bang'.
- 3 is expanding and must have started from a tiny starting point.
- 4 is expanding and must have started from a tiny starting point at the 'big bang'.

Turn over for the next question

Turn over ►

QUESTION NINE

Everyone is exposed to some nuclear radiation.

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

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

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

Destination	Flight time (h)	Dose (mSv)
Kiev	4	0.018
Los Angeles	13	0.069
Madrid	2	0.010
New York	7	0.042
Paris	1	0.004
Rome	3	0.014
Tokyo	14	0.078

9A In order to compare the flight data, it must have been collected under controlled conditions.

Which is the most important factor to control?

- 1 air temperature
- 2 altitude
- 3 wind speed
- 4 colour of the aircraft

9B The connection, in the given data, between flight time and dose is . . .

- 1 longer flight, higher dose.
- 2 longer flight, lower dose.
- 3 shorter flight, higher dose.
- 4 that there is no connection.

9C The flight time to Dallas is 10 hours.

The most likely dose of radiation which a member of the air crew receives is . . .

- 1 0.045 mSv
- 2 0.050 mSv
- 3 0.055 mSv
- 4 0.065 mSv

9D How many times can a pregnant crew member fly **return** from London to Madrid before she has received 1 mSv of radiation?

- 1 20 times
- 2 40 times
- 3 50 times
- 4 100 times

END OF TEST

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