

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
June 2008

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

**PHY1BP**



**PHYSICS**  
**Unit Physics P1b (Radiation and the Universe)**

Monday 23 June 2008 Afternoon 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

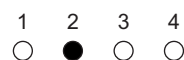
**Instructions**

- 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**

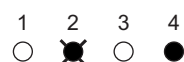
- Use a **black ball-point pen**.

- 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.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.  
The Higher Tier starts on page 14 of this booklet.

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**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.

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**QUESTION ONE**

This question is about electromagnetic radiation.

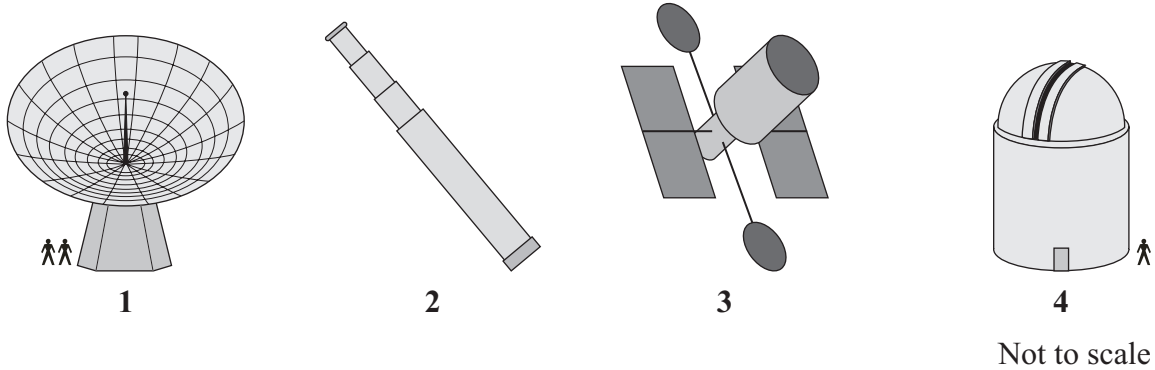
Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

- A** infra red
- B** ultraviolet
- C** visible light
- D** gamma

can be used to send messages using a torch	<b>1</b>
can cause a suntan	<b>2</b>
can be used in a television remote control	<b>3</b>
can travel through a person's body	<b>4</b>

**QUESTION TWO**

The diagrams show different types of telescope. They are not drawn to scale.



Match statements, **A**, **B**, **C** and **D**, with the diagrams **1–4**.

- A** This telescope is used in space and detects light.
- B** This telescope is used on Earth and detects radio waves.
- C** This telescope is used on Earth and can be held in the hand.
- D** This telescope is used on Earth to view distant stars.

**Turn over for the next question**

**Turn over ►**

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**QUESTION THREE**

This question is about the particles that make up an atom.

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

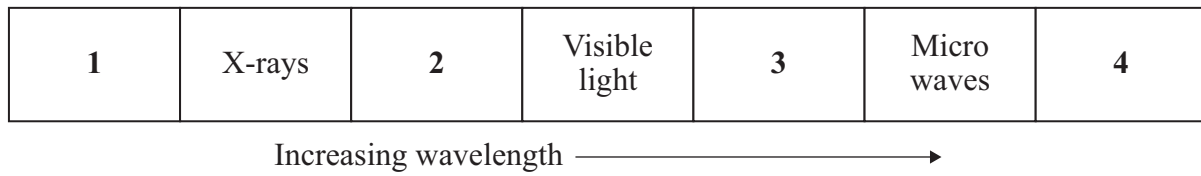
- A** electrons
- B** neutrons
- C** protons and electrons
- D** protons and neutrons

are outside the nucleus	<b>1</b>
are present in different numbers in isotopes of the same element	<b>2</b>
are the only particles in the nucleus	<b>3</b>
their numbers tell you to which element an atom belongs	<b>4</b>

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**QUESTION FOUR**

The diagram shows the electromagnetic spectrum.



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

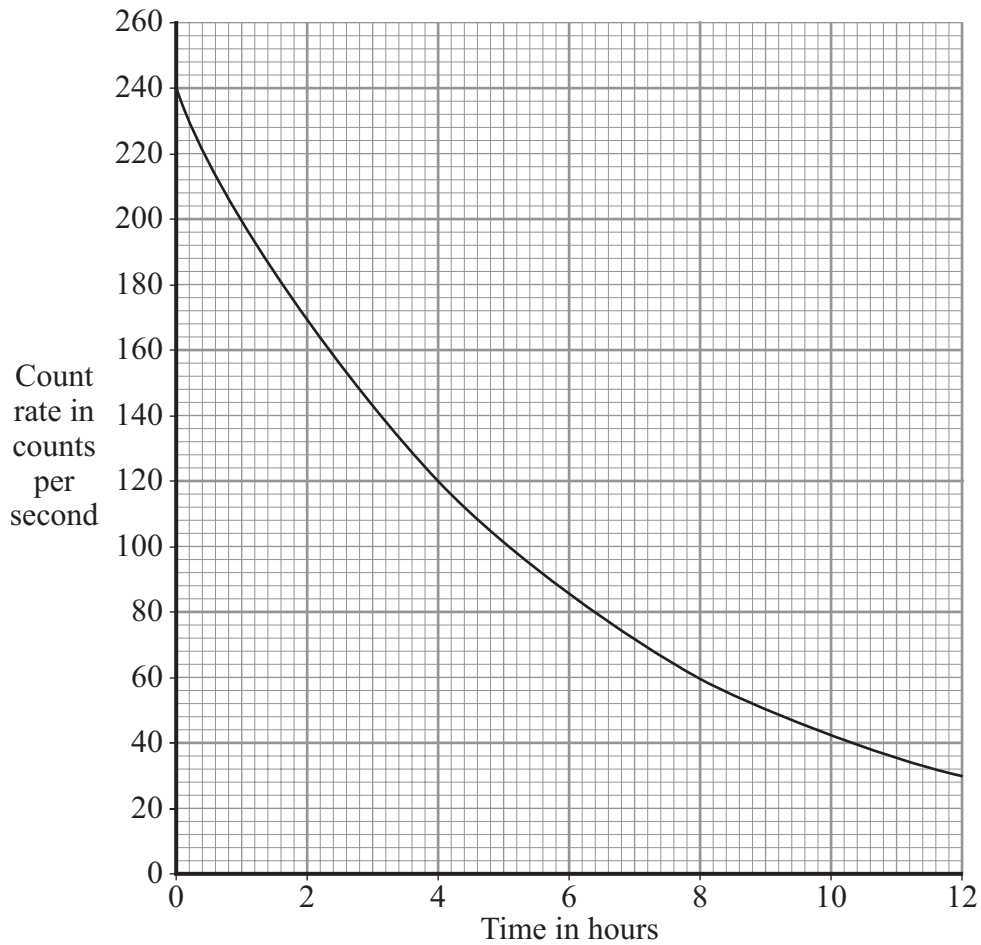
- A** gamma
- B** infra red
- C** radio waves
- D** ultraviolet

**Turn over for the next question**

**Turn over ►**

### QUESTION FIVE

The graph shows the count rate of a radioactive isotope over 12 hours.



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

- A** 4
- B** 12
- C** 60
- D** 90

the count rate at 8 hours	<b>1</b>
the number of hours it took the count rate to fall to 30	<b>2</b>
the decrease in count rate between 4 and 12 hours	<b>3</b>
the number of hours it took for the count rate to halve	<b>4</b>

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**QUESTION SIX**

This question is about what scientists know about the universe.

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

- A** a false statement
- B** an observation
- C** a belief which science cannot prove
- D** a theory

<b>Statement about the universe</b>	
God created the universe.	<b>1</b>
Red-shift, which suggests that galaxies are moving apart.	<b>2</b>
The universe was created by a 'big bang'.	<b>3</b>
You can see the universe expanding by looking through a telescope.	<b>4</b>

**Turn over for the next question**

**Turn over ►**

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**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.

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**QUESTION SEVEN**

Radon is a radioactive gas. It emits alpha particles and has a half-life of 4 days. It occurs naturally in certain rocks and can become trapped in houses built on these rocks.

**7A** What is meant by describing radon as a *radioactive gas*?

- 1 It is a very reactive chemical.
- 2 It emits radio waves when it decays.
- 3 It emits radiation when it decays.
- 4 It reacts chemically only when exposed to radio waves.

**7B** What is meant by the *half-life* of a radioactive substance?

- 1 The time taken for its count rate to fall to half its initial value.
- 2 The time taken for all of the atoms to halve in size.
- 3 The time taken for half of an atom to decay.
- 4 The time taken for half of the atoms to become radioactive.

**7C** Why is it important to remove radon gas that becomes trapped in houses?

- 1 Alpha radiation can cause illnesses such as cancer.
- 2 Alpha radiation can weaken the rock structure.
- 3 Radioactivity will cause television interference.
- 4 Radon gas is highly flammable.



- 7D** A sheet of plastic is often built into the foundations of houses built on these rocks to stop . . .
- 1** alpha particles rising through the rocks into the houses.
  - 2** radon gas rising into the houses.
  - 3** gamma radiation rising into the houses.
  - 4** all forms of radiation rising into the houses.

**Turn over for the next question**

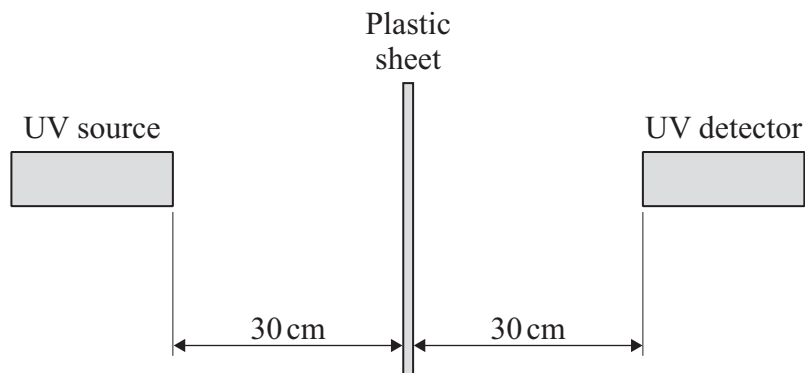
**Turn over ►**

**QUESTION EIGHT**

A scientist investigated the different plastics used to make sunglasses. She wanted to find out which plastic was best at absorbing ultraviolet (UV) radiation.

She used sheets of four different types of plastic, **W**, **X**, **Y** and **Z**. Each plastic sheet was the same thickness. The plastic sheet, a UV source and a UV detector were set up as shown in the diagram.

The scientist recorded the intensity of the UV radiation reaching the detector through each type of plastic.



**8A** What kind of variable was the type of plastic used in this investigation?

- 1 categoric
- 2 continuous
- 3 discrete
- 4 ordered

**8B** What was the dependent variable in this investigation?

- 1 the type of plastic
- 2 the distance from the UV source to the plastic sheet
- 3 the intensity of the UV radiation leaving the source
- 4 the intensity of the UV radiation reaching the detector

- 8C** The table shows the intensity of UV radiation reaching the detector for each of the four types of plastic.

Type of plastic	Intensity of UV radiation reaching the detector in arbitrary units
<b>W</b>	15
<b>X</b>	13
<b>Y</b>	18
<b>Z</b>	16

Which plastic would give most protection to the eyes when used to make sunglasses?

- 1 **W**
  - 2 **X**
  - 3 **Y**
  - 4 **Z**
- 8D** The results of the investigation would have been more reliable if the scientist had . . .
- 1 used a range of thicknesses for each plastic.
  - 2 used different intensities of UV radiation for each plastic.
  - 3 varied the distance between the UV source and the plastic.
  - 4 measured the intensity of UV radiation reaching the detector several times for each plastic.

**Turn over for the next question**

**Turn over ►**

**QUESTION NINE**

The table gives some information about four radioactive isotopes, **P**, **Q**, **R** and **S**.

	<b>Radioactive isotope</b>	<b>Type of radiation emitted</b>	<b>Half-life</b>
<b>P</b>	americium-237	alpha	78 minutes
<b>Q</b>	americium-241	alpha	432 years
<b>R</b>	technetium-99	gamma	6 hours
<b>S</b>	krypton-78	beta	10.7 years

**9A** Which isotope emits an electron from the nucleus?

- 1 P
- 2 Q
- 3 R
- 4 S

**9B** Which isotope emits radiation with the longest range in air?

- 1 P
- 2 Q
- 3 R
- 4 S

**9C** Which isotope would be the most suitable for use in a system for controlling paper thickness in a paper factory?

- 1 P
- 2 Q
- 3 R
- 4 S

**9D** Which isotope would be most suitable for monitoring the flow of blood through the heart?

**1 P**

**2 Q**

**3 R**

**4 S**

**END OF TEST**

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

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**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.

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**QUESTION ONE**

This question is about what scientists know about the universe.

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

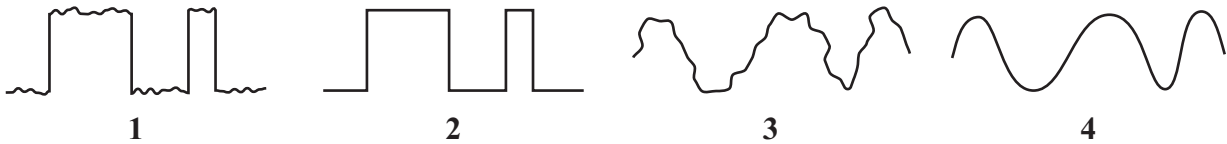
- A** a false statement
- B** an observation
- C** a belief which science cannot prove
- D** a theory

<b>Statement about the universe</b>	
God created the universe.	<b>1</b>
Red-shift, which suggests that galaxies are moving apart.	<b>2</b>
The universe was created by a 'big bang'.	<b>3</b>
You can see the universe expanding by looking through a telescope.	<b>4</b>

**QUESTION TWO**

Communication signals may be either analogue or digital.

Between a signal transmitter and a signal receiver, interference occurs which distorts both types of signal.



Match the descriptions of the signals, **A**, **B**, **C** and **D**, with the visual displays 1–4.

- A** analogue signal reaching a receiver
- B** analogue signal sent from a transmitter
- C** digital signal reaching a receiver
- D** digital signal sent from a transmitter

**Turn over for the next question**

**Turn over ►**

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**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.

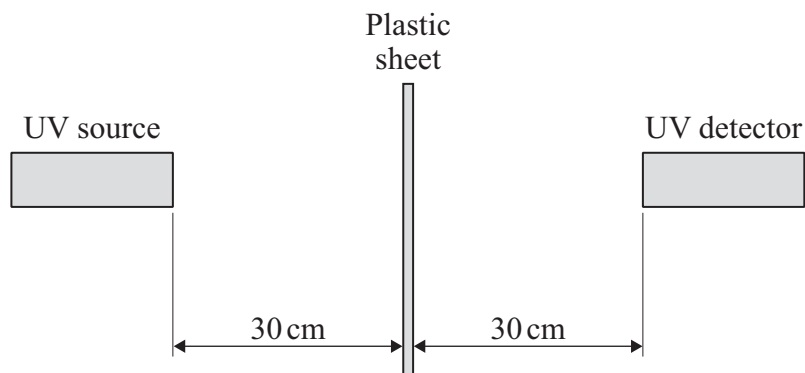
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**QUESTION THREE**

A scientist investigated the different plastics used to make sunglasses. She wanted to find out which plastic was best at absorbing ultraviolet (UV) radiation.

She used sheets of four different types of plastic, **W**, **X**, **Y** and **Z**. Each plastic sheet was the same thickness. The plastic sheet, a UV source and a UV detector were set up as shown in the diagram.

The scientist recorded the intensity of the UV radiation reaching the detector through each type of plastic.



**3A** What kind of variable was the type of plastic used in this investigation?

- 1   categoric
- 2   continuous
- 3   discrete
- 4   ordered



**3B** What was the dependent variable in this investigation?

- 1 the type of plastic
- 2 the distance from the UV source to the plastic sheet
- 3 the intensity of the UV radiation leaving the source
- 4 the intensity of the UV radiation reaching the detector

**3C** The table shows the intensity of UV radiation reaching the detector for each of the four types of plastic.

Type of plastic	Intensity of UV radiation reaching the detector in arbitrary units
<b>W</b>	15
<b>X</b>	13
<b>Y</b>	18
<b>Z</b>	16

Which plastic would give most protection to the eyes when used to make sunglasses?

- 1 **W**
- 2 **X**
- 3 **Y**
- 4 **Z**

**3D** The results of the investigation would have been more reliable if the scientist had . . .

- 1 used a range of thicknesses for each plastic.
- 2 used different intensities of UV radiation for each plastic.
- 3 varied the distance between the UV source and the plastic.
- 4 measured the intensity of UV radiation reaching the detector several times for each plastic.

**Turn over ►**

**QUESTION FOUR**

The table gives some information about four radioactive isotopes, **P**, **Q**, **R** and **S**.

	<b>Radioactive isotope</b>	<b>Type of radiation emitted</b>	<b>Half-life</b>
<b>P</b>	americium-237	alpha	78 minutes
<b>Q</b>	americium-241	alpha	432 years
<b>R</b>	technetium-99	gamma	6 hours
<b>S</b>	krypton-78	beta	10.7 years

**4A** Which isotope emits an electron from the nucleus?

- 1 P
- 2 Q
- 3 R
- 4 S

**4B** Which isotope emits radiation with the longest range in air?

- 1 P
- 2 Q
- 3 R
- 4 S

**4C** Which isotope would be the most suitable for use in a system for controlling paper thickness in a paper factory?

- 1 P
- 2 Q
- 3 R
- 4 S

**4D** Which isotope would be most suitable for monitoring the flow of blood through the heart?

**1 P**

**2 Q**

**3 R**

**4 S**

**Turn over for the next question**

**Turn over ►**

**QUESTION FIVE**

The table gives information about some telescopes.

<b>Name of telescope</b>	<b>Arecibo</b>	<b>COBE</b>	<b>Spitzer</b>	<b>Keck</b>	<b>Hopkins</b>
<b>Type of radiation detected</b>	radio waves	microwaves	infra red	visible light	ultraviolet
<b>Location of telescope</b>	on the Earth's surface	in space	in space	high on the Earth's surface	in space

**5A** Why is the Keck telescope located high on the Earth's surface?

- 1 so that astronomers are not disturbed
- 2 it is cheaper to build in this location
- 3 to be closer to the stars it is observing
- 4 to be above clouds and dust in the Earth's atmosphere

**5B** The Hopkins telescope is located in space . . .

- 1 so that the astronomers are not exposed to ultraviolet radiation.
- 2 because not all ultraviolet radiation penetrates the Earth's atmosphere.
- 3 to be closer to the stars it is observing.
- 4 because there is not enough land on the Earth to build telescopes.

**5C** Which of the telescopes in the table might provide evidence of the red-shift of light from distant galaxies?

- 1 COBE
- 2 Spitzer
- 3 Keck
- 4 Hopkins

**5D** The longer the wavelength of the radiation being absorbed, the larger the telescope needs to be.

Which telescope is the largest?

- 1    Arecibo
- 2    Spitzer
- 3    Keck
- 4    Hopkins

**Turn over for the next question**

**Turn over ►**

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**QUESTION SIX**

This question is about a smoke detector which contains a radioactive source.

Americium-241 is used because it emits alpha particles and has a half-life of 432 years.

**6A** Why is an alpha source the safest one to use in a domestic smoke detector?

- 1 Alpha particles are absorbed by a few centimetres of air.
- 2 Alpha particles do not cause any ionisation.
- 3 Alpha particles are completely harmless to humans.
- 4 Alpha particles are not deflected by a magnet.

**6B** What is an alpha particle?

- 1 a helium nucleus
- 2 a hydrogen nucleus
- 3 a proton
- 4 an electron

**6C** Why is the half-life of americium-241 considered to be suitable for use in a smoke detector?

- 1 It has a long half-life, and so will not need replacing.
- 2 An isotope with a very short half-life would not provide enough energy.
- 3 An isotope with a much longer half-life would give off too much energy.
- 4 An isotope with a much shorter half-life would give off beta particles.

**6D** The half-life of americium-241 is 432 years.

A source contains 1 gram of americium-241.

How long will it be before only 0.25 g of americium-241 remains?

- 1 108 years
- 2 216 years
- 3 648 years
- 4 864 years

**Turn over for the next question**

**Turn over ►**

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**QUESTION SEVEN**

In 1927, the Belgian priest Georges Lemaitre proposed that the universe began with an explosion. His proposal came after astronomers had observed red-shift in light from distant galaxies.

**7A** Red-shift is . . .

- 1 a decrease in wavelength of the light due to a galaxy moving away from the Earth.
- 2 an increase in wavelength of the light due to a galaxy moving away from the Earth.
- 3 a decrease in wavelength of the light due to a galaxy moving towards the Earth.
- 4 an increase in the wavelength of the light due to a galaxy moving towards the Earth.

**7B** In 1929, Edwin Hubble found experimental evidence that distant galaxies are moving away from us with speeds that are proportional to their distance from the Earth.

This suggests that . . .

- 1 the universe is contracting.
- 2 the universe started from a small initial point.
- 3 the universe has always been the same.
- 4 the galaxies are getting slower.

**7C** Later, in 1948, it was suggested that if the universe started with an explosion there should still be cosmic (microwave) background radiation in space left over from the explosion. This microwave radiation was discovered in 1964.

Its discovery . . .

- 1 proves that the universe started with a 'big bang'.
- 2 proves that the universe is expanding.
- 3 provides strong evidence that the universe started with a 'big bang'.
- 4 finally disproves all other theories of the origin of the universe.



**7D** According to the latest theory, the universe was created 13.7 billion years ago.

This figure . . .

- 1 is both accurate and precise.
- 2 is a guess.
- 3 is an estimate based on reliable data.
- 4 is an estimate based on unreliable data.

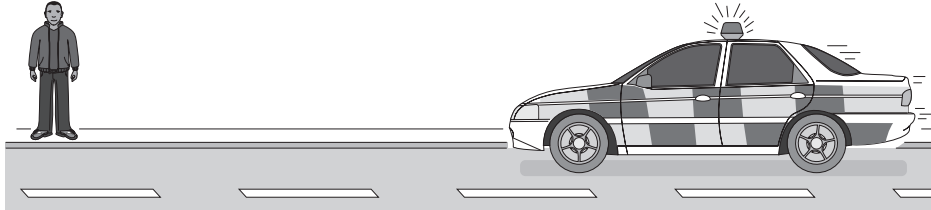
**Turn over for the next question**

**Turn over ►**

**QUESTION EIGHT**

The diagram shows a police car moving towards a person who is standing at the side of the road.

The siren on the police car is sounding.



**8A** As the police car approaches, the person notices that the frequency of the note changes.

The frequency becomes . . .

- 1 lower because the wavelength increases.
- 2 lower because the wavelength decreases.
- 3 higher because the wavelength increases.
- 4 higher because the wavelength decreases.

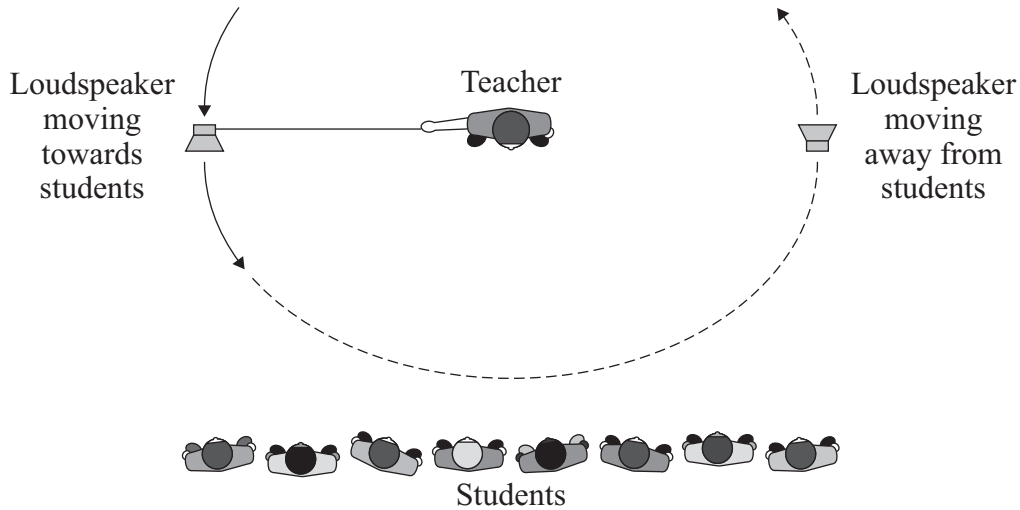
**8B** A driver in another car on the same road did not notice any change in the frequency of the note emitted by the siren.

This was because the cars were travelling in . . .

- 1 the same direction at the same speed.
- 2 opposite directions at the same speed.
- 3 the same direction at different speeds.
- 4 opposite directions at different speeds.

A teacher wanted to demonstrate this effect in her laboratory.

She connected a loudspeaker to a signal generator. The loudspeaker produced a note of constant frequency. The teacher then swung the loudspeaker above her head, as shown in the diagram. The students in the class listened to the sound produced by the loudspeaker.



**8C** What sound will the students hear as the loudspeaker goes round and round?

- 1 a note of constant frequency
- 2 a note of higher frequency
- 3 a note of lower frequency
- 4 a note of varying frequency

**8D** This demonstration is a model for spinning galaxies.

What is the purpose of a model in science?

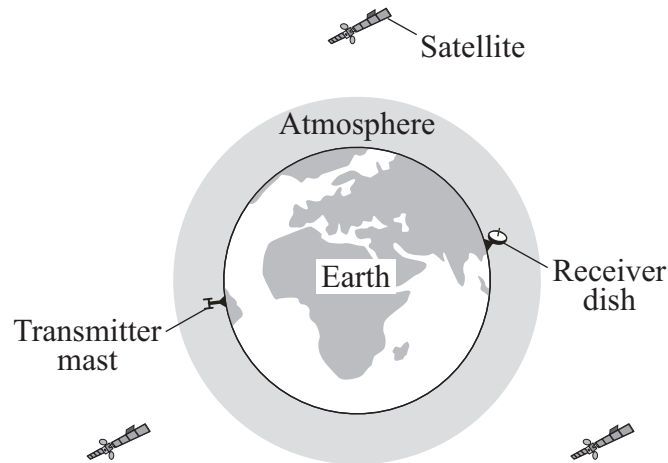
- 1 It helps to explain a phenomenon.
- 2 It proves that a theory is correct.
- 3 It allows more data to be collected.
- 4 It is to generate new ideas.

Turn over ►

## QUESTION NINE

Satellite television broadcasts are transmitted as microwaves. In a vacuum, the microwaves travel at 300 million metres per second.

Television stations are changing the transmission method from analogue signals to digital signals. In a few years' time there will be no analogue television transmissions.



- 9A** Microwaves are used for transmissions to and from satellites because they . . .
- 1 are never affected by interference.
  - 2 are regarded as 100% safe by scientists.
  - 3 cannot be seen by the human eye.
  - 4 pass through the Earth's atmosphere easily.
- 9B** Digital signals are better than analogue signals for transmitting satellite television programmes because digital signals . . .
- 1 can only be ON or OFF and so are less prone to distortion by interference.
  - 2 do not need the use of a computer to process them.
  - 3 pass through clouds and are not affected by weather.
  - 4 travel at a higher speed in a vacuum.

**9C** It is necessary to transmit from the transmitter mast to the receiver dish via a satellite because . . .

- 1 microwaves will not travel far.
- 2 microwaves do not travel in a curved path.
- 3 the Earth is rotating.
- 4 the waves spread out from the transmitter in all directions into space.

**9D** A new television channel will transmit via satellites using microwaves with a wavelength of 400 millimetres.

$\begin{array}{l} \text{wave speed} \\ \text{(metre/second, m/s)} \end{array} = \begin{array}{l} \text{frequency} \\ \text{(hertz, Hz)} \end{array} \times \begin{array}{l} \text{wavelength} \\ \text{(metre, m)} \end{array}$ $1 \text{ MHz} = 1\,000\,000 \text{ Hz}$
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The frequency of the microwaves will be . . .

- 1 0.75 Hz
- 2 750 Hz
- 3 0.75 MHz
- 4 750 MHz

**END OF TEST**

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