Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

ASSESSMENT AND QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education
Foundation Tier and Higher Tier
June 2010

Science A
Unit Physics P1b (Radiation and the Universe)

Physics
Unit Physics P1b (Radiation and the Universe)

PHY1BP

Monday 28 June 2010 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 plus your additional time allowance.**

At the top of the page write your surname and other names, your centre number, your candidate number and add your signature.

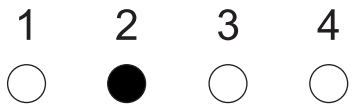
[Turn over]

INSTRUCTIONS

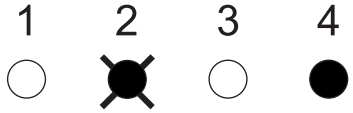
- **Check that your name, candidate number and centre number are printed on the separate answer sheet.**
- **Check that the separate answer sheet has the title 'Physics Unit 1b' printed on it.**
- **Attempt ONE TIER ONLY, EITHER the Foundation Tier OR the Higher Tier.**
- **Make sure that you use the 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

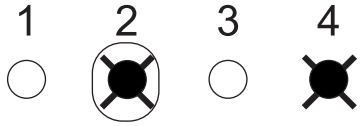
- **Use a BLACK BALL-POINT PEN.**
- **For each answer COMPLETELY FILL IN THE CIRCLE as shown:**



- **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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

You must do ONE TIER only, EITHER the Foundation Tier OR the Higher Tier.

The Higher Tier starts on page 25 of this booklet.

FOUNDATION TIER

SECTION ONE

Questions ONE to FIVE.

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 can be grouped into types. Each type has a different range of wavelengths.

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

A gamma rays

B microwaves

C visible light

D X-rays

... 1 ...	shortest wavelength
... 2 ...	
ultraviolet waves	
... 3 ...	
infra red waves	
... 4 ...	
radio waves	longest wavelength

QUESTION TWO

Four students are describing the properties of different types of radiation.

1

Passes through paper and aluminium

2

Passes through paper but not through aluminium

3

Travels only a few centimetres in air

4

Is not from the nucleus of a radioactive atom

Match types of radiation, A, B, C and D, with the descriptions 1–4.

A alpha

B beta

C gamma

D X-rays

QUESTION THREE

The table gives uses for four types of radiation.

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

A alpha

B beta

C gamma

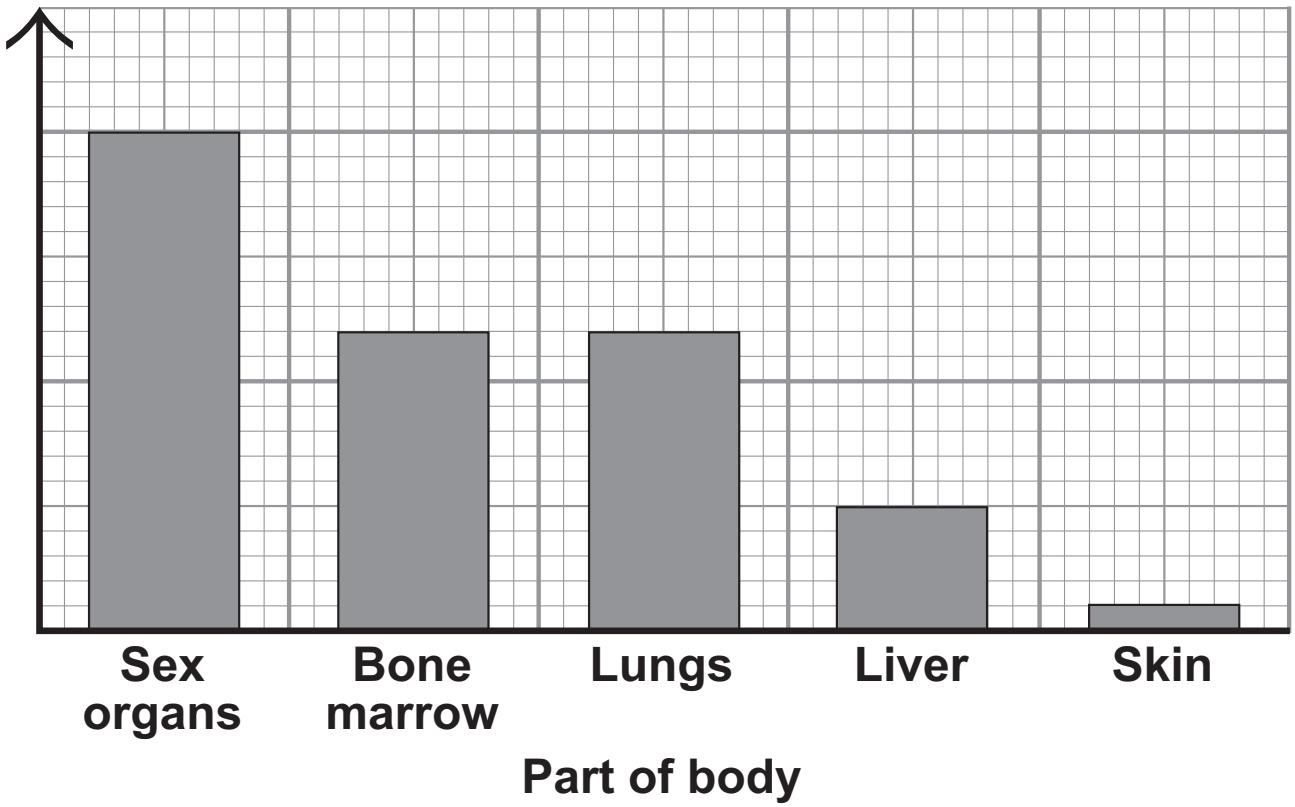
D X-rays

	USE
1	in medical tracers
2	in smoke detectors
3	to control the thickness of paper during manufacture
4	usually used to take shadow photographs of bones

QUESTION FOUR

In 1920, scientists investigated the effect of radiation on different parts of the body. They found that some parts of the body were more affected by radiation than others.

The bar chart compares the relative amounts of damage to different parts of the body when they were exposed to the same radiation dose.



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

A categoric

B control

C dependent

D reliable

The radiation dose to which the body is exposed is the . . . 1 . . . variable.

The data is shown as a bar chart because one of the variables is . . . 2 . . . .

The relative amount of damage is the . . . 3 . . . variable.

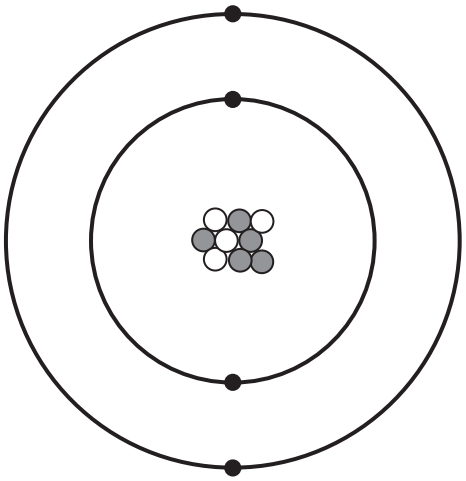
If scientists repeated the investigation today and got similar results, this would show that the original data was . . . 4 . . . .

[Turn over for the next question]

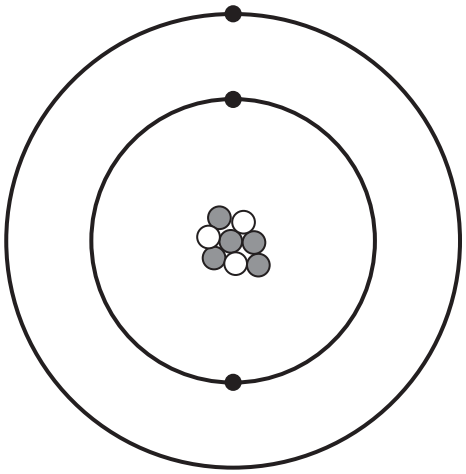
QUESTION FIVE

The diagram shows four atoms, W, X, Y and Z.

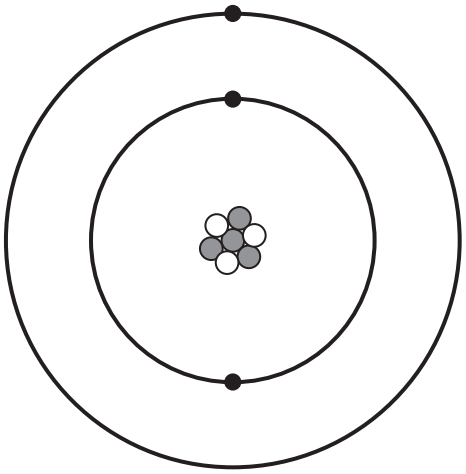
Atom W



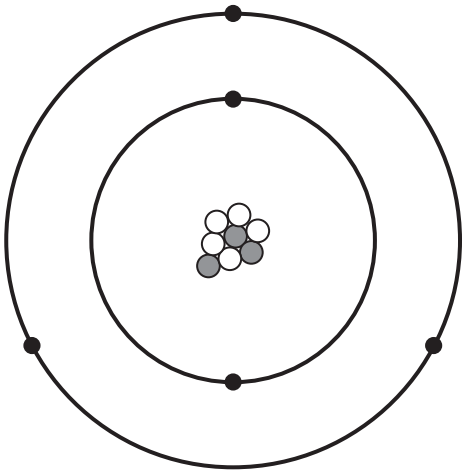
Atom X



Atom Y



Atom Z



Atoms X and Y are isotopes of the same element.

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

A three

B four

C five

D eight

Atom W contains . . . 1 . . . electrons.

Atom X contains . . . 2 . . . neutrons.

Atom Y contains . . . 3 . . . protons.

Atom Z's nucleus contains . . . 4 . . . particles.

[Turn over for the next question]

SECTION TWO

Questions SIX to NINE.

Each of these questions has four parts.

In each part choose only ONE answer.

Mark your choices on the answer sheet.

QUESTION SIX

In 1896, Henri Becquerel was doing an experiment with uranium.

6A Becquerel thought that uranium absorbed energy from the Sun, and then re-emitted the energy as X-rays.

This was . . .

1 a conclusion.

2 an estimate.

3 an observation.

4 a theory.

6B Becquerel found that the uranium emitted radiation even when the sample was sealed in black paper.

He had discovered radioactivity.

Becquerel had to change his ideas because . . .

1 the Sun does not provide energy on a cloudy day.

2 sunlight could not pass through the black paper.

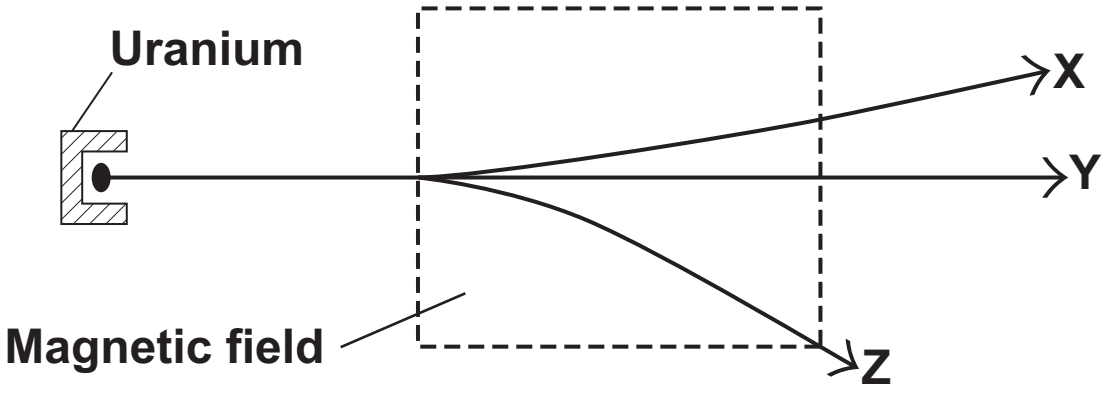
3 X-rays could not pass through the black paper.

4 radiation could not pass through the black paper.

[Question 6 continues on the next page]

6C When Becquerel passed the radiation emitted by uranium through a magnetic field, he found that there were three different types of radiation.

The diagram shows the paths of the three types of radiation, X, Y and Z, in the magnetic field.



Which of the following is the path of gamma radiation?

1 X

2 Y

3 Z

4 X and Z

6D Two types of radiation were deflected in the magnetic field.

These two types of radiation were deflected because they are . . .

1 electrically charged.

2 electrically neutral.

3 have a smaller mass than the third type of radiation.

4 have a bigger mass than the third type of radiation.

[Turn over for the next question]

QUESTION SEVEN

Light is given out by the Sun and by galaxies.

7A Compared with the light from the Sun, the light from many galaxies has moved towards the red end of the spectrum.

What name is given to this effect?

1 light-move

2 light-shift

3 red-move

4 red-shift

7B The light from many galaxies is moved towards the red end of the spectrum.

This fact gives scientists evidence that . . .

1 galaxies are shrinking.

2 galaxies are changing colour.

3 the universe is expanding.

4 the universe is shrinking.

7C Scientists have a theory that the universe began from a very small point.

What name is given to this theory?

1 Big Bang

2 Big explosion

3 Expansion of space

4 Steady state

7D Scientists think that the universe began from a very small point because . . .

1 it can be proved using equations.

2 it is the only way of explaining how the universe began.

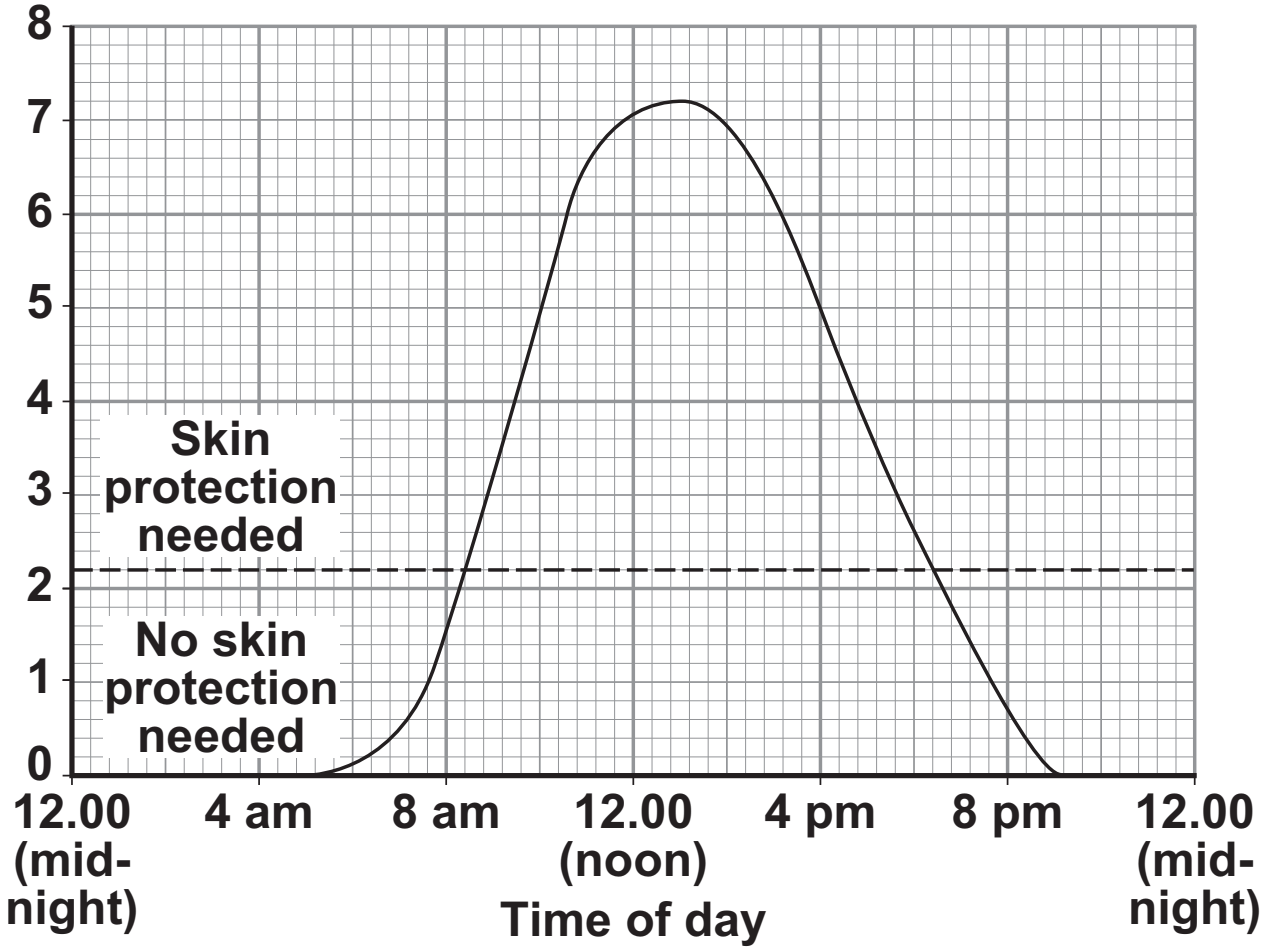
3 powerful telescopes enable us to see the small point.

4 at the moment it is the best way of explaining our observations.

[Turn over for the next question]

QUESTION EIGHT

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.



8A The intensity of UV radiation reaches a maximum at . . .

1 9·30 am

2 12·00 noon

3 1·00 pm

4 5·00 pm

8B The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

1 0 hours

2 7 hours

3 10 hours

4 16 hours

8C For a typical day in December in the UK, how would you expect the graph to be different?

	PEAK	AREA UNDER THE GRAPH
1	higher	the same
2	lower	the same
3	higher	bigger
4	lower	smaller

[Question 8 continues on the next page]

8D **UV radiation travels as an electromagnetic wave.**

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

	SPEED OF UV COMPARED WITH VISIBLE LIGHT	FREQUENCY OF UV COMPARED WITH VISIBLE LIGHT
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

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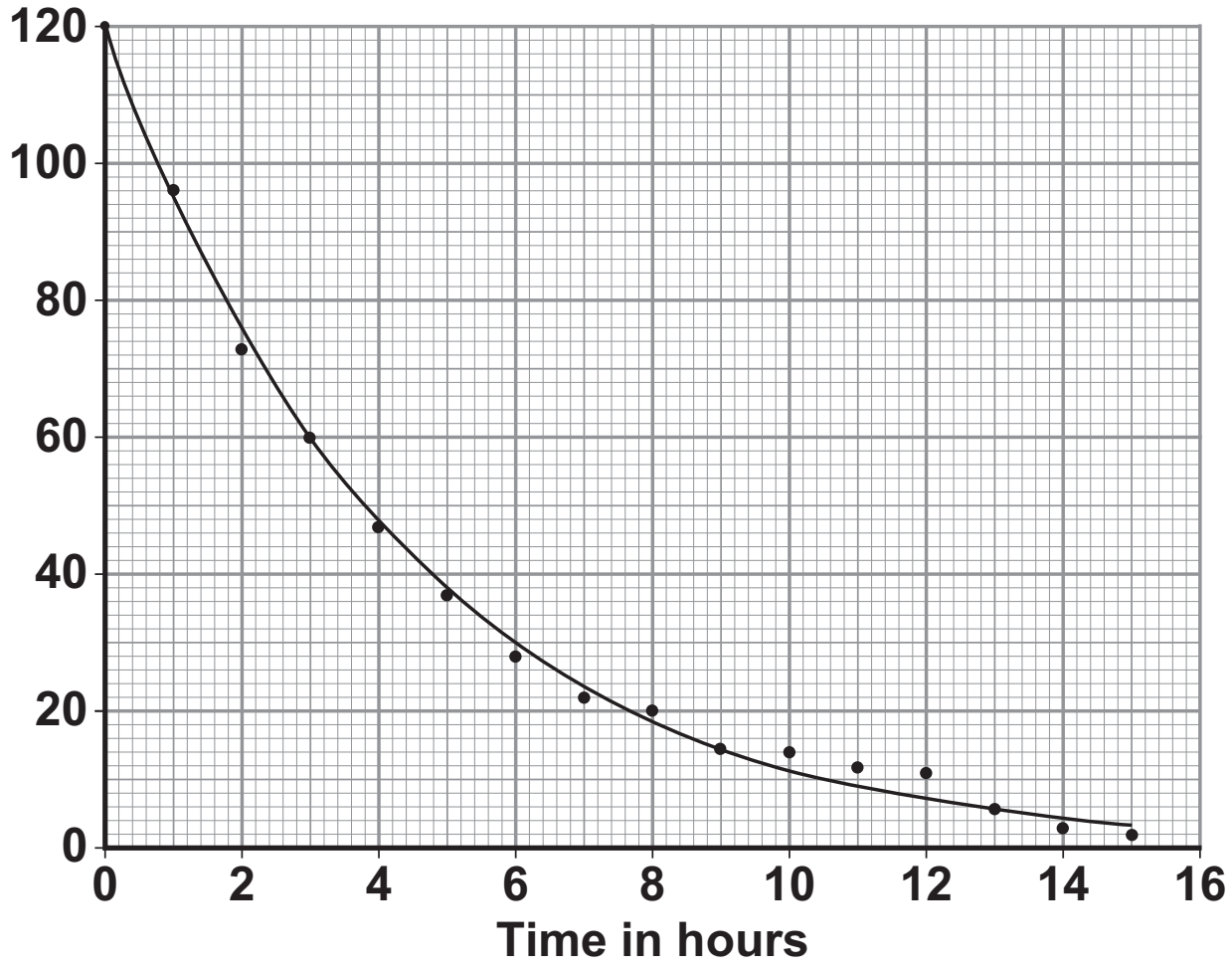
TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

The graph shows the count rate of a radioactive isotope over 15 hours.



9A Which row in the table describes correctly the types of variable?

	COUNT RATE	TIME
1	categoric	categoric
2	categoric	continuous
3	continuous	categoric
4	continuous	continuous

9B Not all the points of the graph lie on the drawn curve.

The line drawn is called . . .

1 a discrete line.

2 a line of best fit.

3 a line of least resistance.

4 an error line.

9C The half-life of the radioactive isotope is . . .

1 2 hours.

2 3 hours.

3 5 hours.

4 7 hours.

9D A different radioactive isotope has a half-life of 10 hours.

What fraction of the original mass of isotope will be left after 30 hours?

1 $\frac{1}{3}$

2 $\frac{1}{8}$

3 $\frac{1}{30}$

4 $\frac{7}{8}$

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.

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.

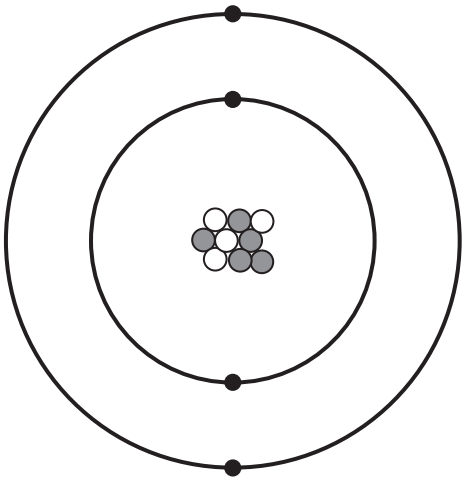
Mark your choices on the answer sheet.

[Turn over for Question 1]

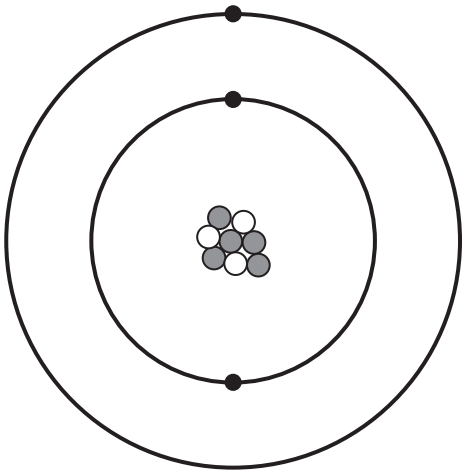
QUESTION ONE

The diagram shows four atoms, W, X, Y and Z.

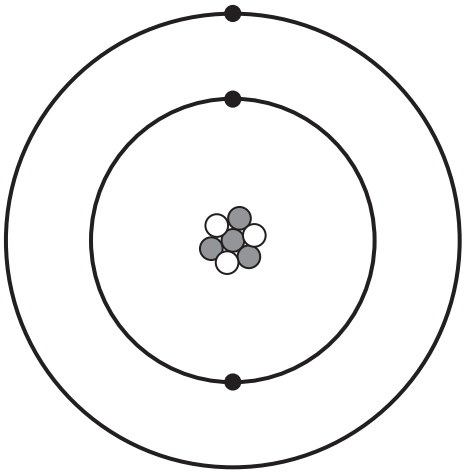
Atom W



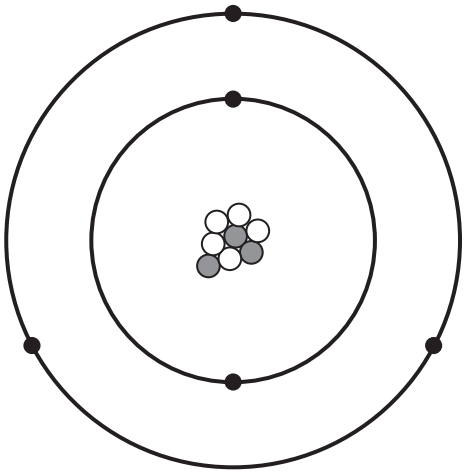
Atom X



Atom Y



Atom Z



Atoms X and Y are isotopes of the same element.

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

A three

B four

C five

D eight

Atom W contains . . . 1 . . . electrons.

Atom X contains . . . 2 . . . neutrons.

Atom Y contains . . . 3 . . . protons.

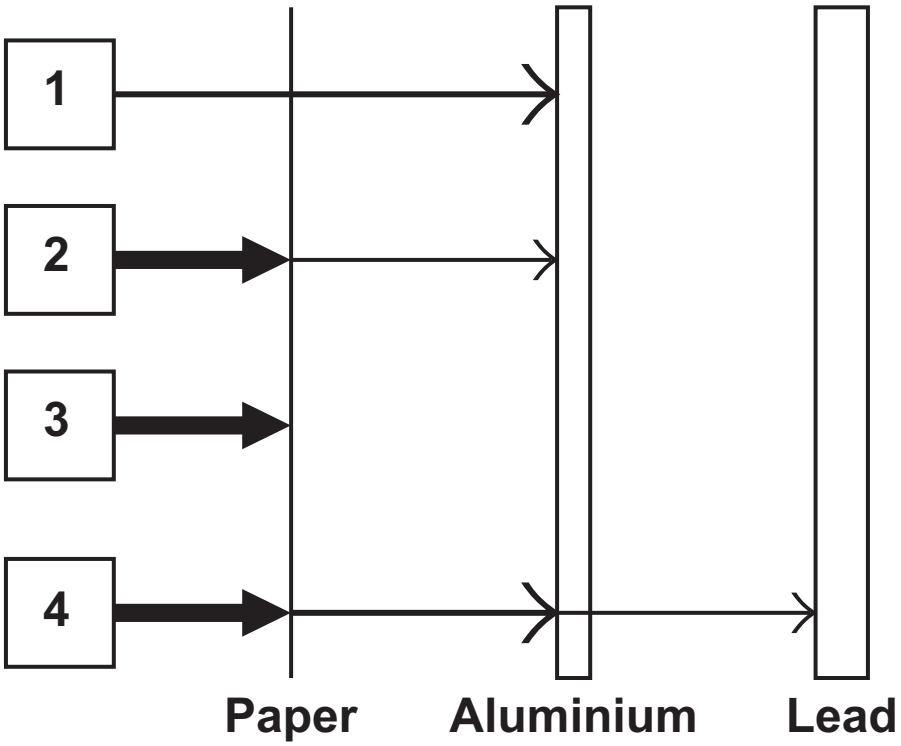
Atom Z's nucleus contains . . . 4 . . . particles.

[Turn over for the next question]

QUESTION TWO

Three absorbers are placed in front of four sources of radiation, 1, 2, 3 and 4.

The amount of radiation is represented by the thickness of the horizontal arrows.



Match statements, A, B, C and D, with the labels 1–4 on the diagram.

A Source gives off alpha radiation only.

B Source gives off alpha and beta radiation only.

C Source gives off alpha, beta and gamma radiation.

D Source gives off beta radiation only.

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TURN OVER FOR THE NEXT SECTION

SECTION TWO

Questions THREE to NINE.

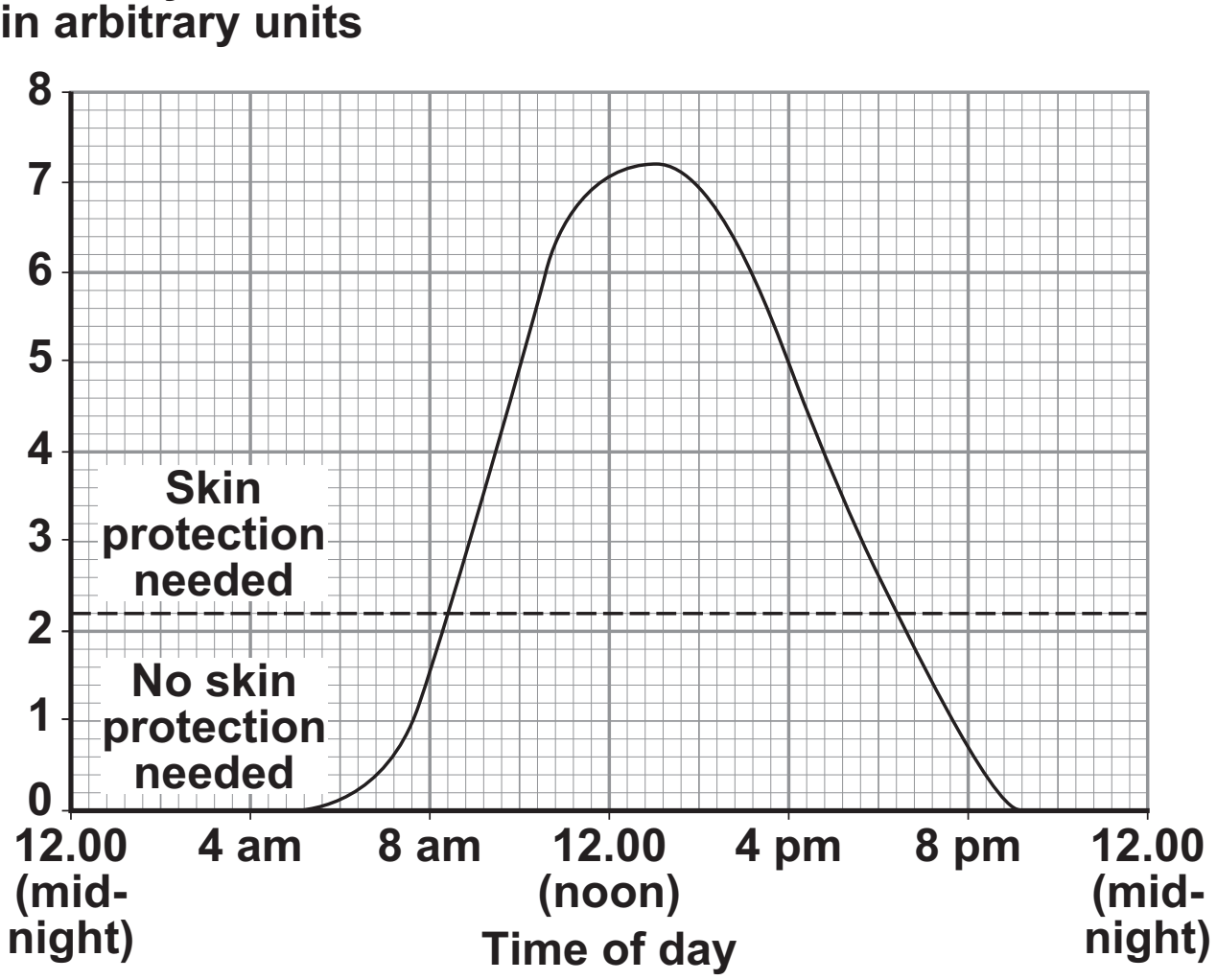
Each of these questions has four parts.

In each part choose only ONE answer.

Mark your choices on the answer sheet.

QUESTION THREE

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.



3A The intensity of UV radiation reaches a maximum at . . .

1 9·30 am

2 12·00 noon

3 1·00 pm

4 5·00 pm

3B The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

1 0 hours

2 7 hours

3 10 hours

4 16 hours

3C For a typical day in December in the UK, how would you expect the graph to be different?

	PEAK	AREA UNDER THE GRAPH
1	higher	the same
2	lower	the same
3	higher	bigger
4	lower	smaller

[Question 3 continues on the next page]

3D **UV radiation travels as an electromagnetic wave.**

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

	SPEED OF UV COMPARED WITH VISIBLE LIGHT	FREQUENCY OF UV COMPARED WITH VISIBLE LIGHT
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

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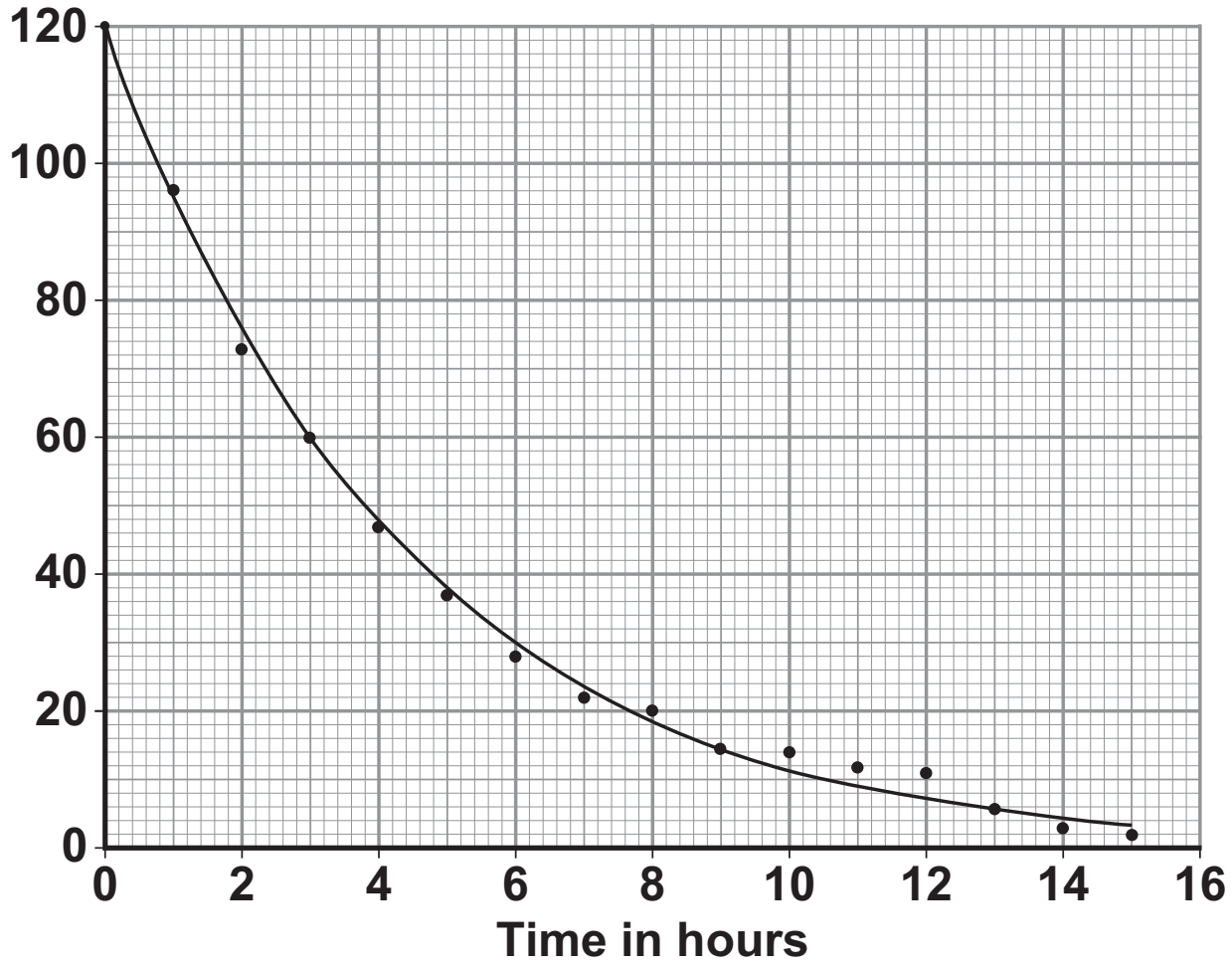
TURN OVER FOR THE NEXT QUESTION

QUESTION FOUR

The graph shows the count rate of a radioactive isotope over 15 hours.



4A Which row in the table describes correctly the types of variable?

	COUNT RATE	TIME
1	categoric	categoric
2	categoric	continuous
3	continuous	categoric
4	continuous	continuous

4B Not all the points of the graph lie on the drawn curve.

The line drawn is called . . .

1 a discrete line.

2 a line of best fit.

3 a line of least resistance.

4 an error line.

4C The half-life of the radioactive isotope is . . .

1 2 hours.

2 3 hours.

3 5 hours.

4 7 hours.

4D A different radioactive isotope has a half-life of 10 hours.

What fraction of the original mass of isotope will be left after 30 hours?

1 $\frac{1}{3}$

2 $\frac{1}{8}$

3 $\frac{1}{30}$

4 $\frac{7}{8}$

QUESTION FIVE

Some radioactive isotopes emit alpha particles. Other radioactive isotopes emit beta particles.

5A What is an alpha particle?

1 a helium nucleus

2 an electron from outside the nucleus

3 an electron from inside the nucleus

4 one proton and one neutron

5B What is a beta particle?

1 a helium nucleus

2 an electron from outside the nucleus

3 an electron from inside the nucleus

4 two protons and two neutrons

5C The half-life of a radioactive isotope is 1 second.

This means that after 2 seconds . . .

1 the count rate will have fallen to zero.

2 the count rate will have halved.

3 the number of nuclei of this isotope will have halved.

4 three-quarters of the nuclei of this isotope will have decayed.

5D **Two scientists measured the half-life of another radioactive isotope. One obtained a value of 3·8 hours. The second scientist obtained a value of 4·65 hours.**

What conclusion could you make?

1 **The second scientist is correct because his answer shows greater precision.**

2 **You cannot tell which scientist is correct.**

3 **This isotope has a variable half-life.**

4 **The half-life is too short to measure accurately.**

[Turn over for the next question]

QUESTION SIX

Radio and television programmes are transmitted through the air over long distances.

The information is carried by electromagnetic waves.

6A Compared with light waves, radio waves . . .

1 have a shorter wavelength and a higher speed.

2 have a lower frequency and the same speed.

3 have a longer wavelength and a lower speed.

4 have a higher frequency and the same speed.

6B A radio programme is broadcast on a wavelength of 1500 metres. The speed of the wave is 300 000 000 m/s.

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

The frequency of these waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

6C Over the next few years, all television signals will be changed from analogue to digital.

One advantage to television broadcasters of using digital signals instead of analogue signals is that . . .

1 they are easier to generate.

2 they are less prone to interference.

3 they can travel faster.

4 they can travel further.

6D Some people are worried about the effects of living close to a powerful radio transmitter.

Close to one transmitter, it was found that the number of children with leukaemia was slightly higher than normal. Leukaemia is a type of cancer of the blood.

What conclusion could you make from this observation?

1 Radio waves cause leukaemia.

2 There may be a connection between radio waves and leukaemia.

3 Adults are less likely than children to develop leukaemia.

4 Children should not be allowed to live near a radio transmitter.

QUESTION SEVEN

In 1896, Henri Becquerel was doing an experiment with uranium. He first thought that uranium absorbed energy from the Sun and then re-emitted the energy as X-rays. Then, on a cloudy day, he found that the uranium emitted radiation even when the uranium sample was wrapped in black paper.

7A This suggests that . . .

1 his original theory was wrong and further investigation was needed.

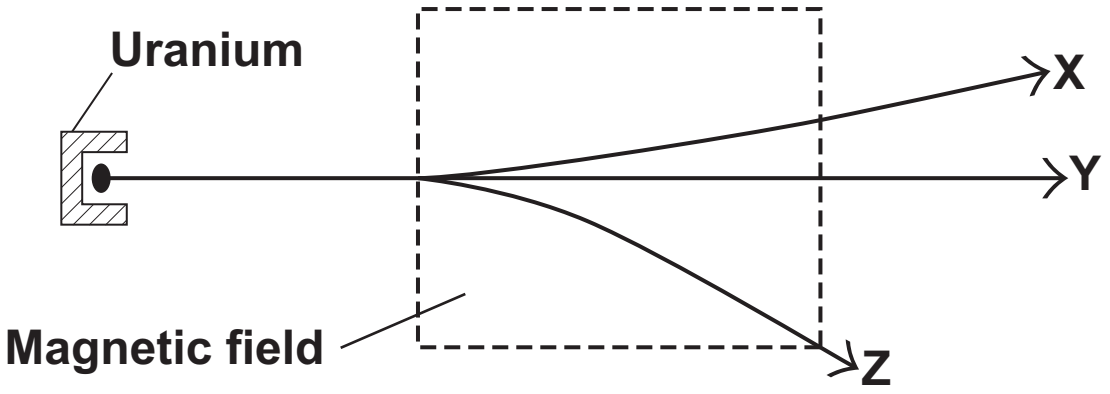
2 his test was fair but more variables needed to be controlled.

3 his original theory was correct and further investigation was needed.

4 his test was not fair and more variables needed to be controlled.

7B Becquerel passed the radiation emitted by uranium through a magnetic field. He found that there were three different types of radiation.

The diagram shows the paths of the three types of radiation, X, Y and Z, in the magnetic field.



Later, Ernest Rutherford called the three types of radiation alpha, beta and gamma.

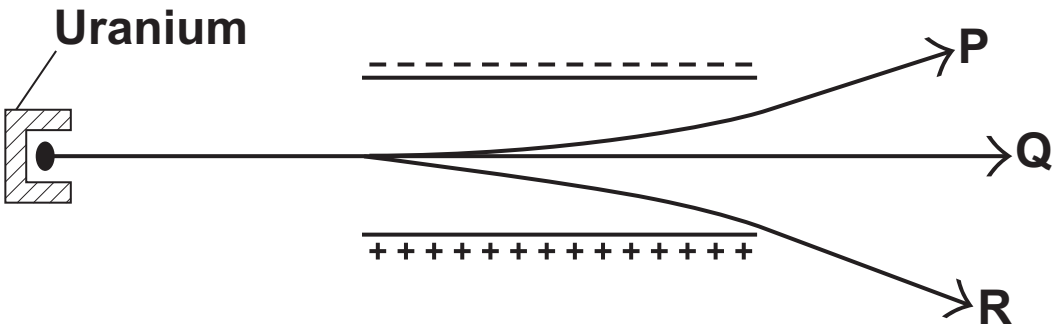
Which is the correct row in the table?

	X	Y	Z
1	alpha	beta	gamma
2	alpha	gamma	beta
3	beta	alpha	gamma
4	beta	gamma	alpha

[Question 7 continues on the next page]

7C **The radiation emitted by uranium can also be deflected in an electric field between two charged plates.**

The diagram shows the paths taken by the three types of radiation, P, Q and R, in an electric field.



The explanation for the different paths is that . . .

1 **P and R have the same electric charge and Q is uncharged.**

2 **P and R are oppositely charged and P has a larger mass than R.**

3 **P and R are oppositely charged and R has a larger charge than P.**

4 **Q is uncharged and has a larger mass than both P and R.**

7D Rutherford measured the range in air of the three types of radiation.

Which row of the table gives the correct order of range?

	Shortest range ⟶ Longest range		
1	alpha	beta	gamma
2	alpha	gamma	beta
3	beta	alpha	gamma
4	beta	gamma	alpha

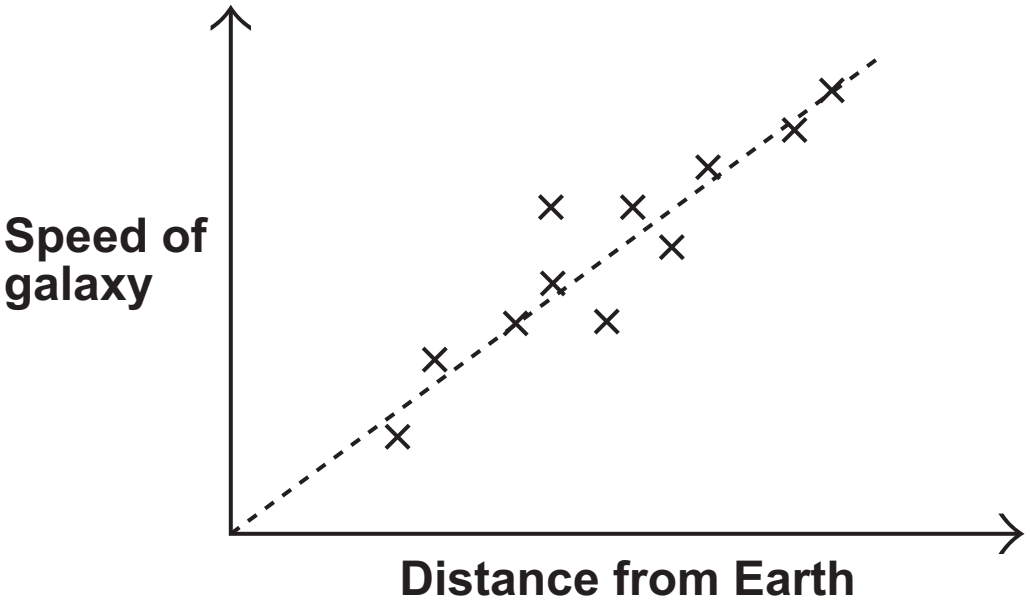
[Turn over for the next question]

QUESTION EIGHT

Red-shift measurements can be used to calculate the speed at which a galaxy is moving relative to the Earth.

Astronomers have also measured the distance of some galaxies from the Earth.

They have drawn their results on a graph.



8A The graph shows that . . .

1 all galaxies have the same speed.

2 distant galaxies are moving faster than nearer galaxies.

3 nearer galaxies are moving faster than more distant galaxies.

4 there is no relationship between how far galaxies are from the Earth and how fast they move.

8B Which of the following is the best description of red-shift? . . .

1 The light from galaxies is coloured red.

2 The light from galaxies is mainly at the red end of the spectrum.

3 The wavelength of light from galaxies shows a movement away from the red end of the spectrum.

4 The wavelength of light from galaxies shows a movement towards the red end of the spectrum.

8C Red-shift is described as . . .

1 the increased speed of the electromagnetic radiation as it travels from the galaxy.

2 the observed increase in frequency of the electromagnetic radiation leaving the galaxy.

3 the observed increase in wavelength of the electromagnetic radiation leaving the galaxy.

4 the decreased speed of the electromagnetic radiation as it travels from the galaxy.

[Question 8 continues on the next page]

8D The observation of red-shift gives evidence to support the ‘big bang’ theory.

This theory states that . . .

1 the stars in each galaxy are moving further apart.

2 galaxies started to rotate after the ‘big bang’.

3 new galaxies are created by an explosion in space.

4 the universe started from a single initial point.

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TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

Thermal imaging cameras are used by rescue workers to search for people trapped under rubble after an earthquake. Like all warm objects, the living human body emits infra red radiation. The cameras detect this infra red radiation. Electronic circuits in the camera produce a colour image in which different colours correspond to different wavelengths of infra red radiation.

The table shows the image colour, infra red wavelength and the temperature of the object.

IMAGE COLOUR	INFRA RED WAVELENGTH IN MICROMETRES	TEMPERATURE OF OBJECT IN ºC
Red	9·51	32
Red-orange	9·45	34
Orange	9·4	36
Orange-yellow	9·32	38
Yellow	9·26	40
Yellow-white	9·2	42

9A Two of the values of wavelength in the table show a lower . . .

1 calibration.

2 precision.

3 range.

4 reliability.

9B A scientist wanted to display this data as a line graph.

Which row in the table below shows the scales which would best display the data?

	x-axis (wavelength in micrometres)	y-axis (temperature in ^{o}C)
1	0 to 10	0 to 50
2	0 to 10	30 to 50
3	9 to 10	0 to 50
4	9 to 10	30 to 50

9C A thermal image of a small boy is mainly orange.

Under identical conditions, the thermal image of a much larger man would be . . .

1 mainly yellow because the man's body has a greater mass.

2 mainly red because the man's body has a larger surface area.

3 a mixture of red, orange and yellow because the man's body has a larger mass and a larger surface area.

4 mainly orange because the man and the boy have approximately the same body temperature.

[Question 9 continues on the next page]

9D At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

These cameras work better at night than during the day because at night . . .

1 the criminals emit more infra red radiation.

2 the cooler surroundings emit less infra red radiation.

3 the cooler surroundings emit less visible light.

4 the criminals wear black clothes.

END OF TEST