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OCR
RECOGNISING ACHIEVEMENT

Thursday 17 January 2013 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE
SCIENCE A

A142/02   Modules B2 C2 P2 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
* Pencil
* Ruler (cm/mm)

Duration: 1 hour

Candidate forename		Candidate surname	

Centre number						Candidate number					

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
* Use black ink. HB pencil may be used for graphs and diagrams only.
* Answer **all** the questions.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
* Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

* Your quality of written communication is assessed in questions marked with a pencil (✐).
* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* A list of useful relationships is printed on page 2.
* The total number of marks for this paper is **60**.
* This document consists of **24** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric circuits

power = voltage × current

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

energy = mass × [speed of light in a vacuum]^2

3

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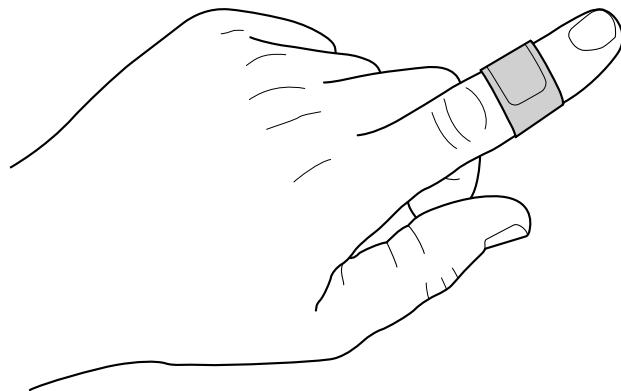
Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 This is a question about nanoparticles.

Some first aid plasters contain nanoparticles of silver that can kill bacteria.

(a) Here are the sizes of some silver particles.

Two of them are nanoparticles.

Put rings around the **two** nanoparticles.

| 0.1 nm | 10 nm | 50 nm | 500 nm | 1000 nm |

[1]

(b) Suggest why silver nanoparticles have different properties to a lump of silver.

....

....

....

.... **[2]**

(c) Some scientists believe there should be restrictions on the use of nanoparticles.

What is the reason for this?

Put a tick (✓) in the box next to the correct answer.

Nanoparticles are always synthetic. ☐

Nanoparticles cannot be seen because they are too small. ☐

The effects of nanoparticles have not been fully investigated. ☐

All nanoparticles damage the environment. ☐

[1]

[Total: 4]

2 Materials used for towels must absorb water.

(a) Some students are testing the absorbency of different materials.

They put pieces of different materials into water and then hang them up.

Once the pieces stop dripping they measure the mass of water absorbed.

Suggest **one** factor that should be controlled to make this a fair test.

Explain how the results might be affected if it was not controlled.

....

....

....

.... **[2]**

(b) Here are their results for **two** types of material, **X** and **Y**.

Sample number	Mass of water absorbed by material in g				
	1	2	3	4	5
Material X	112	96	101	115	111
Material Y	92	102	95	98	103

(i) What is the best estimate of the true value of the mass of water absorbed for material **Y**?

Show your working.

best estimate = ... g **[2]**

(ii) The best estimate of the true value of the mass of water absorbed for material **X** is 107 g.

Do the two materials have different water absorbencies?

Explain your answer.

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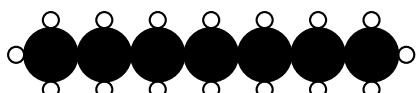
.... **[2]**
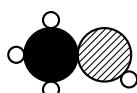
[Total: 6]

3 Compounds **A**, **B**, **C**, **D** and **E** are found in crude oil.

The diagrams show a molecule of each of these five compounds.

| **A** | **B** | **C** | **D** | **E** |

Key

● carbon

○ hydrogen

▨ sulfur
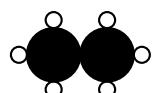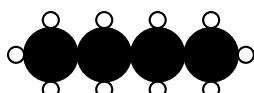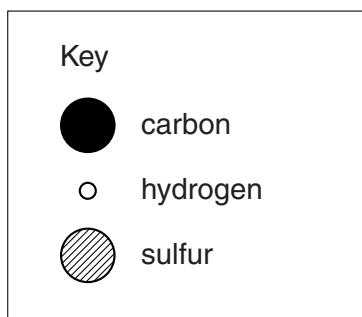
(a) (i) Which compound is **not** a hydrocarbon? ....[1]

(ii) Which compound has the largest forces between its molecules? ....[1]

(iii) Which compound has the lowest boiling point? ....[1]

(b) Ethene is a compound made from crude oil.

Ethene is the monomer for making poly(ethene).

What is the name of the process for making poly(ethene) from ethene?

.... [1]

 (c) **X**, **Y**, and **Z** are different types of the same polymer.

   They are made in different ways.

   The table shows some uses and properties of these polymers.

	Polymer X	Polymer Y	Polymer Z
Use	carrier bags	film for wrapping food	food boxes
Flexibility	flexible	very flexible	stiff
Strength in N/m^2	15	6	31
Melting point in °C	85	60	190

   Suggest how differences in molecular structure and use of additives leads to the different properties of polymers **X**, **Y**, and **Z**.
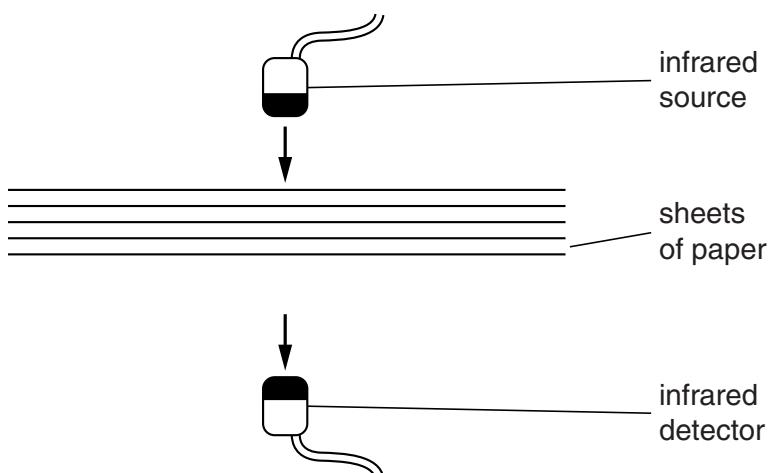
   The quality of written communication will be assessed in your answer.

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   .... **[6]**

   [Total: 10]

Turn over

4 Sam sets up an experiment to investigate how infrared radiation penetrates through paper.

infrared
source

sheets
of paper

infrared
detector
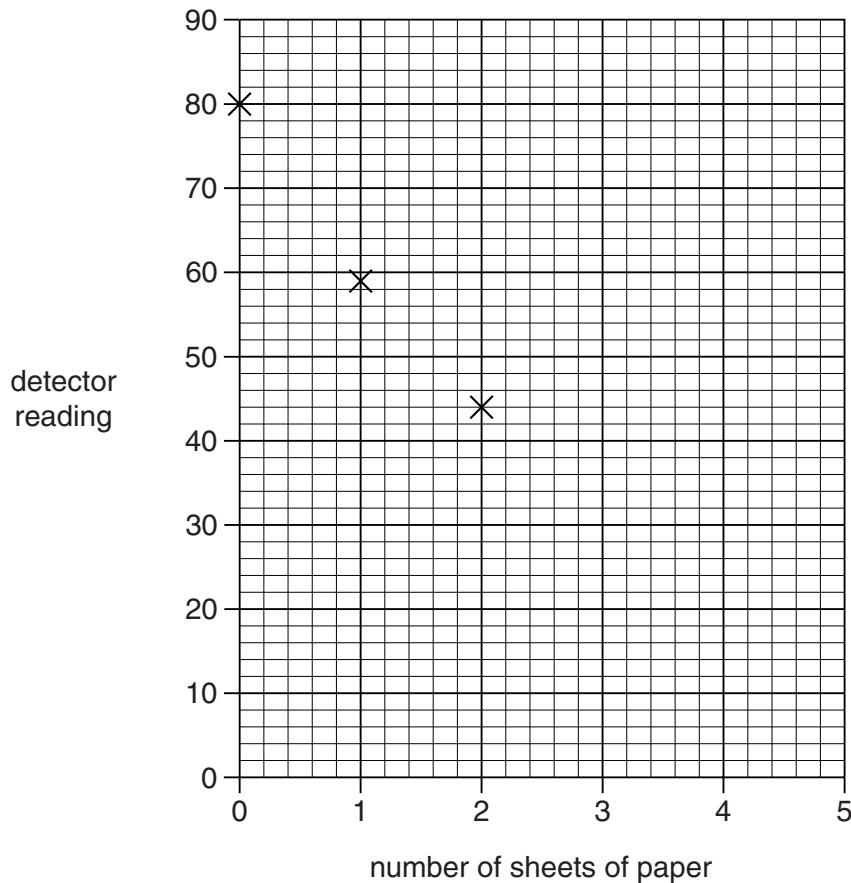
The table below shows the results of Sam's experiment.

Number of sheets of paper	0	1	2	3	4	5
Detector reading	80	59	44	33	24	18

(a) Use the data to complete the graph opposite, drawing a curve of best fit.

Three points have been plotted for you. **[2]**

number of sheets of paper

(b) Sam says that each sheet of paper stops about a quarter of the radiation that falls on it.

Is Sam right?

Use the data in the table or the graph to check Sam's idea.

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.... **[2]**

Turn over
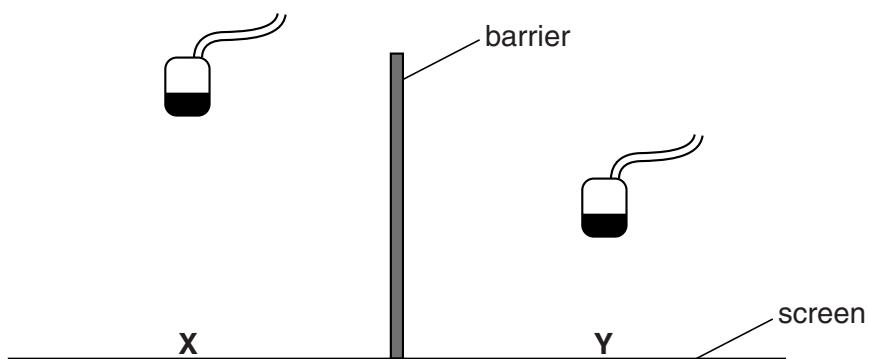
**(c) (i)** Two **identical** infrared sources are placed at different heights above a screen.

A barrier between the infrared sources stops each one from shining on the part of the screen under the other one.

Which of the following statements correctly explain why the intensity of infrared radiation at point **X** is much less than that at point **Y**?

Put ticks (✓) in the boxes next to the **two** correct statements.

The screen absorbs infrared radiation. ☐

Photons arrive over a larger area around **X**. ☐

Photons transfer energy from the source to the screen. ☐

Y absorbs infrared photons with lower energy. ☐

Radiation spreads out as it travels from a source. ☐

[2]

(ii) The infrared source above **Y** is replaced by a source of **visible light**. This source is the same height above point **Y** and it emits the same number of photons each second.

Why does this increase the intensity at **Y**?

....

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.... **[1]**

[Total: 7]

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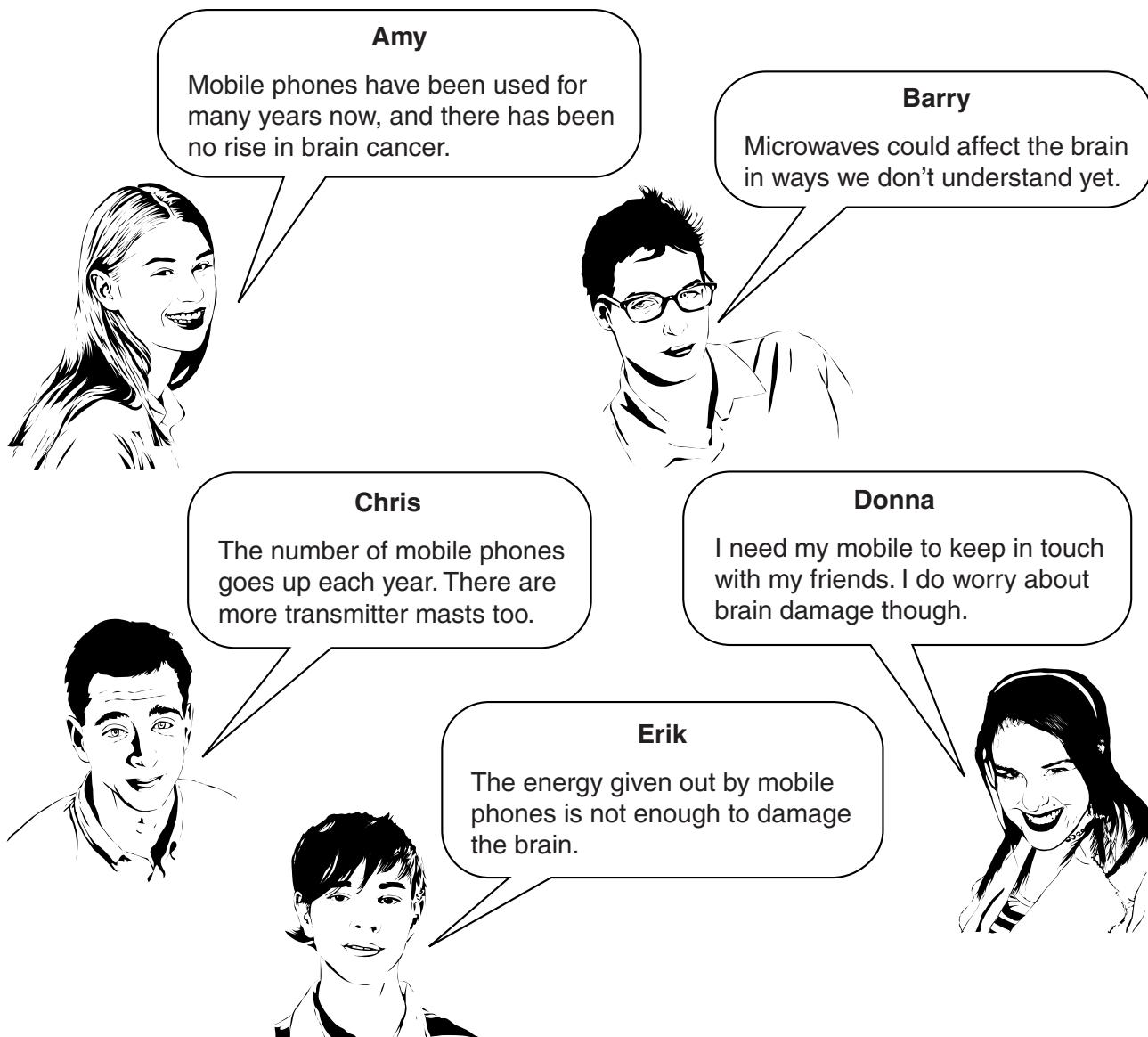
Question 5 begins on page 14

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5 This question is about mobile phones.

(a) Many people worry that mobile phones can cause brain cancer.
Read what these students have to say about this.

Amy

Mobile phones have been used for many years now, and there has been no rise in brain cancer.

Barry

Microwaves could affect the brain in ways we don't understand yet.

Chris

The number of mobile phones goes up each year. There are more transmitter masts too.

Donna

I need my mobile to keep in touch with my friends. I do worry about brain damage though.

Erik

The energy given out by mobile phones is not enough to damage the brain.

(i) Who is talking about both risk and benefit?

Put a tick (✓) in the box next to the correct name.

Amy [ ]

Barry [ ]

Chris [ ]

Donna [ ]

Erik [ ]   **[1]**

(ii) Who suggests that mobile phones cannot cause brain cancer?

Put ticks (✓) in the boxes next to the **two** correct names.

Amy ☐

Barry ☐

Chris ☐

Donna ☐

Erik ☐

[1]

(iii) Who uses data to discuss the possible risk?

Put ticks (✓) in the boxes next to the **two** correct names.

Amy ☐

Barry ☐

Chris ☐

Donna ☐

Erik ☐

[1]

(iv) Who suggests that there is no causal mechanism?

Put a tick (✓) in the box next to the correct name.

Amy ☐

Barry ☐

Chris ☐

Donna ☐

Erik ☐

[1]

Turn over

(b) Mobile phones use digital signals to send text messages and images.

(i) Look at the data below about a typical text message and a typical image.

Type of message	Number of bytes
text	100
image	1 000 000
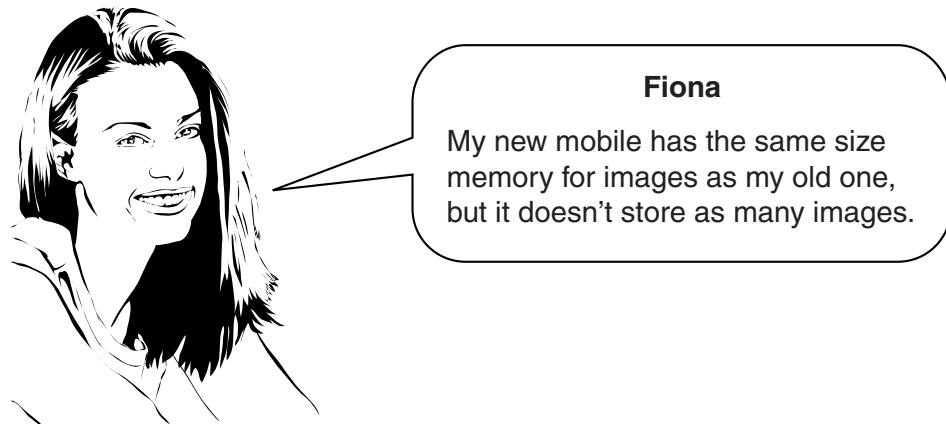
A mobile phone transmits data at 10 000 bytes per second.

Compare the time taken to transmit the text message with the time taken to transmit the image.

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.... **[2]**

(ii) Fiona has bought a new mobile phone.

Fiona

My new mobile has the same size memory for images as my old one, but it doesn't store as many images.

What can you say about the images stored by Fiona's new phone?
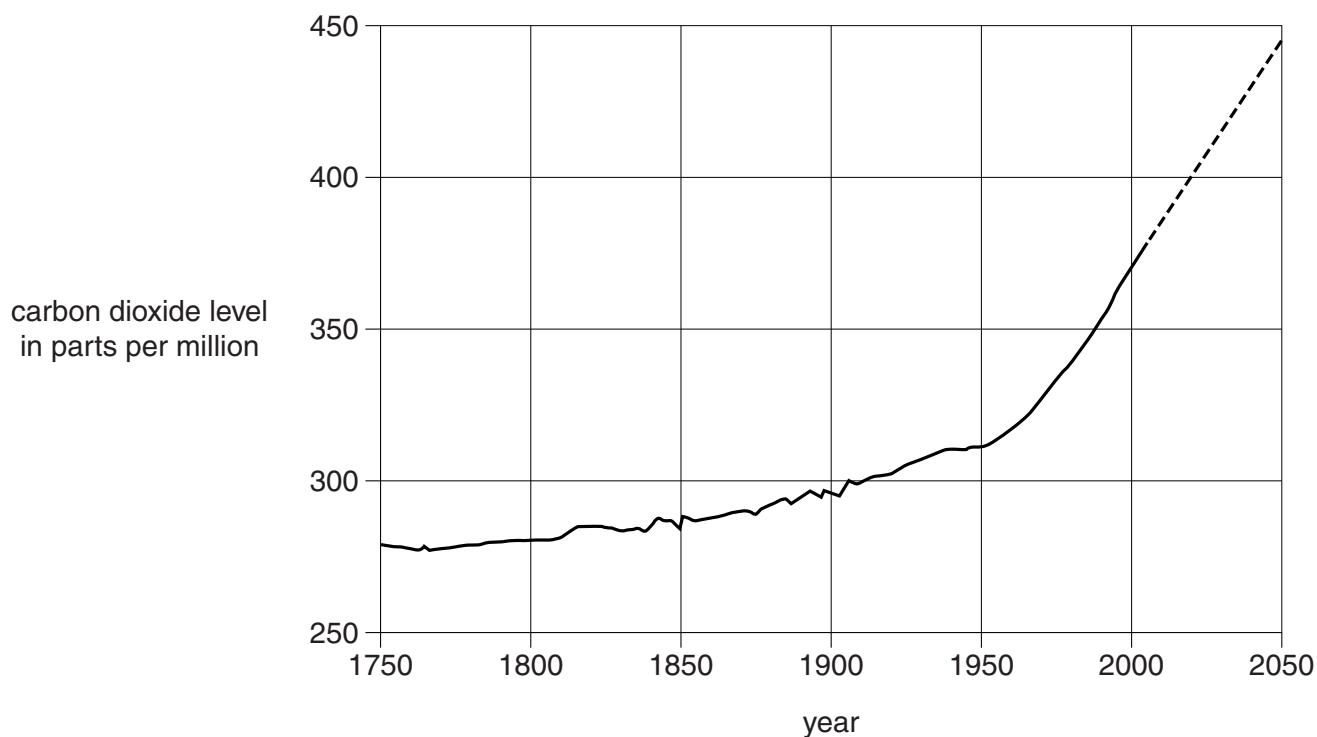
Give a reason for your answer.

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.... **[1]**

[Total: 7]

6 The graph shows how carbon dioxide levels in the atmosphere have increased since 1750. The dashed part shows how the levels are expected to change in the future.

Use the data shown in the graph, together with ideas of correlation and cause, to explain why there has been dispute about the effects of human activities on the environment.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 6]

7 (a) Antibiotics are a type of antimicrobial.

What are antimicrobials?

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.... **[1]**

(b) Penicillin is an example of an antibiotic.

A scientist researches the effect of penicillin on bacteria from 1940 to 1980.

Penicillin was first used as an antibiotic in the early 1940s.

Shortly after the first use of penicillin, 10% of bacteria were found to be resistant to penicillin.

(i) Draw a line on the graph to suggest how the percentage of bacteria killed by penicillin changed between 1940 and 1980. **[2]**

```
        100 ┤
         90 ┤
         80 ┤
         70 ┤
percentage  60 ┤
of bacteria 50 ┤
   killed   40 ┤
         30 ┤
         20 ┤
         10 ┤
          0 ┼────────┬────────┬────────┬────────
          1940     1950     1960     1970     1980
                           year
```

(ii) Explain the line you have drawn and suggest the mechanism involved in the bacteria becoming resistant.

....

....

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.... **[2]**

(iii) The results of this experiment show that it is important to use antibiotics carefully.

Draw a line from each **precaution** to the correct **reason** for its use.

precaution	**reason**

| only prescribe antibiotics when necessary | | so that when a resistant strain develops it will be killed |

| complete the course of antibiotics | | so that bacteria will be exposed to fewer antibiotics |

| regularly develop new antibiotics | | so that it is more likely that all the bacteria are killed |

[1]

(iv) Viruses can also cause disease.

Why would a graph showing the effect of penicillin on viruses differ from that for bacteria?

....

.... **[1]**

[Total: 7]

8 In 2006, a group of women took part in trials to test a new drug for treating skin cancer.

All of the women had skin cancer.

There was no treatment for their cancer at the time.

None of these women had much chance of surviving another year.

The new drug had many side effects. These included sickness and diarrhoea.

There was no guarantee that the new drug would work.

(a) Suggest reasons why, despite the risks, these women were still willing to take part in this drug trial.

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.... **[3]**

(b) These drug trials took place over a five-year period.

Explain why it is important for human drug trials to take place over a long time.

....

....

.... **[2]**

(c) There are several different types of human drug trial that use placebos.

For each type of drug trial, different people know whether the patient has been given the placebo or the drug.

Complete the table by putting a tick (✓) in the correct box for each type of trial to show who knows what the patient has been given.

	doctor only	patient only	both doctor and patient	neither doctor nor patient
Open-label trial				
Blind trial				
Double-blind trial				

[1]

[Total: 6]

Turn over

9 (a) The risk of getting heart disease is affected by different lifestyle factors.

One of these factors is stress.

Describe the correlation between stress and heart disease.

....

.... **[1]**

(b) The table shows some information about the lifestyles of five different people.

Name	Age	Job	Diet	Hobbies	Smoker
Anne	22	PE teacher	low fat	playing football	yes
Mark	36	postman	medium fat	watching TV	no
Norman	51	builder	high fat	going to the cinema	yes
Olive	43	office worker	high fat	going to the pub	yes
Polly	19	student	low fat	jogging	no

Evaluate the data to decide who you think has the highest and lowest risk of suffering from heart disease.

Explain your choices using data from the table to support your answer.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 7]

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