

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.

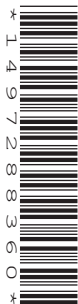
OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour

MODIFIED LANGUAGE



| | | | |
|-----------------------|--|----------------------|--|
| 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.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

$$\text{distance} = \text{wave speed} \times \text{time}$$

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

Sustainable energy

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

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

Explaining motion

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

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

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

Electric circuits

$$\text{power} = \text{voltage} \times \text{current}$$

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

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

Radioactive materials

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

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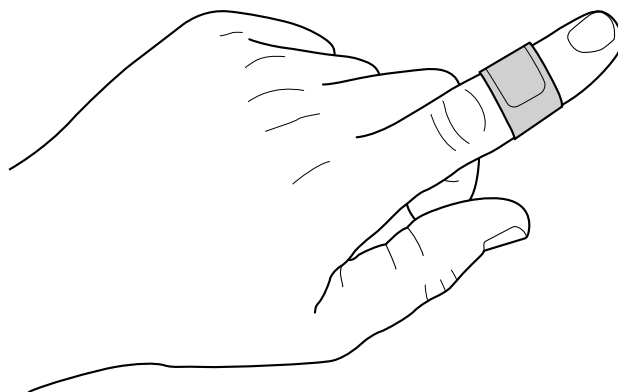
Question 1 begins on page 4

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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 the factor was not controlled.

.....

.....

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..... [2]

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

| | Mass of water absorbed by material in g | | | | |
|---------------|---|-----|-----|-----|-----|
| Sample number | 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.

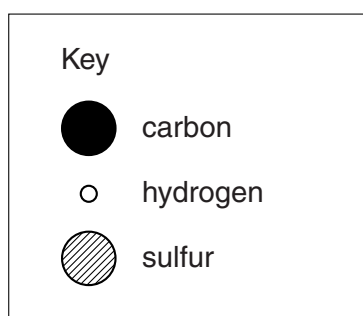
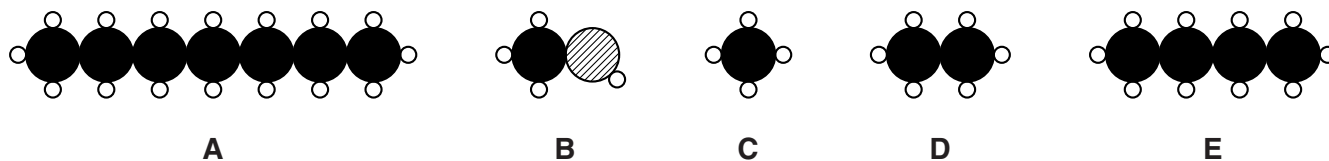
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 [2]

[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) (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]

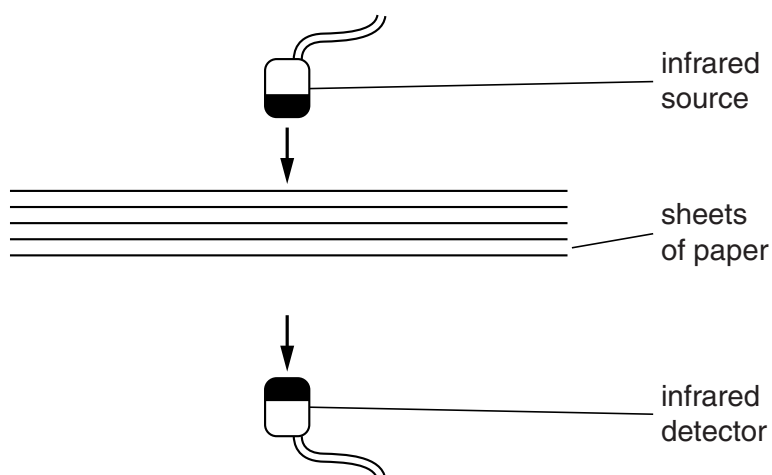
(b) Ethene is a compound made from crude oil.

Ethene is the monomer for making poly(ethene).

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

..... [1]

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



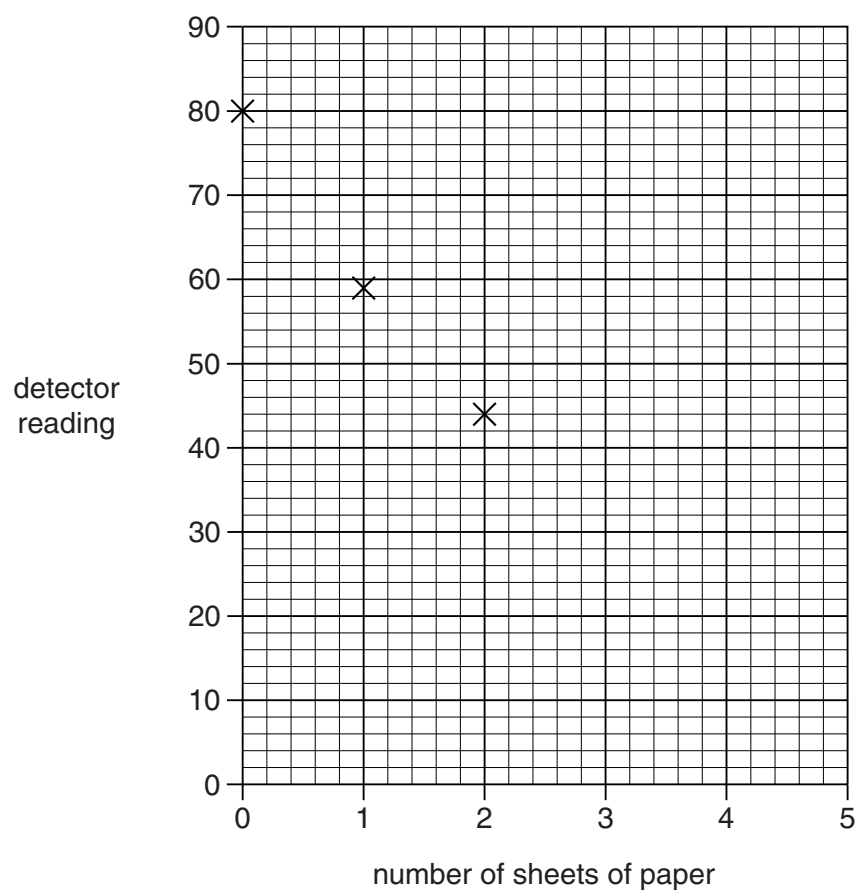
The table below shows the results of Sam's experiment.

| | | | | | | |
|---------------------------|----|----|----|----|----|----|
| 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]



(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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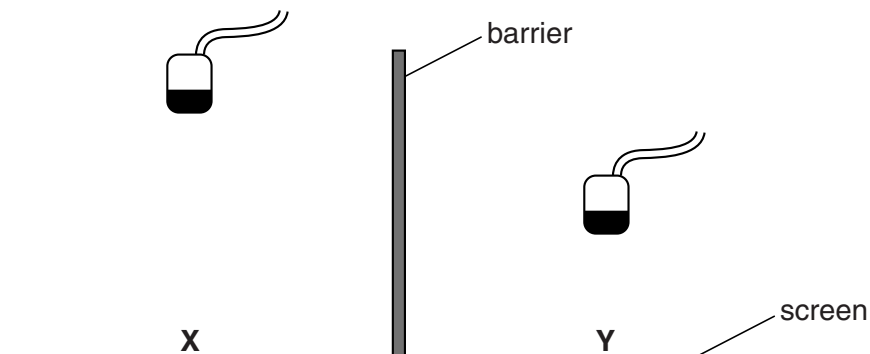
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..... [2]

- (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 of visible light 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]

13
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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 | <input type="checkbox"/> |
| Barry | <input type="checkbox"/> |
| Chris | <input type="checkbox"/> |
| Donna | <input type="checkbox"/> |
| Erik | <input type="checkbox"/> |

[1]

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

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

| | |
|-------|--------------------------|
| Amy | <input type="checkbox"/> |
| Barry | <input type="checkbox"/> |
| Chris | <input type="checkbox"/> |
| Donna | <input type="checkbox"/> |
| Erik | <input type="checkbox"/> |

[1]

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

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

| | |
|-------|--------------------------|
| Amy | <input type="checkbox"/> |
| Barry | <input type="checkbox"/> |
| Chris | <input type="checkbox"/> |
| Donna | <input type="checkbox"/> |
| Erik | <input type="checkbox"/> |

[1]

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

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

| | |
|-------|--------------------------|
| Amy | <input type="checkbox"/> |
| Barry | <input type="checkbox"/> |
| Chris | <input type="checkbox"/> |
| Donna | <input type="checkbox"/> |
| Erik | <input type="checkbox"/> |

[1]

(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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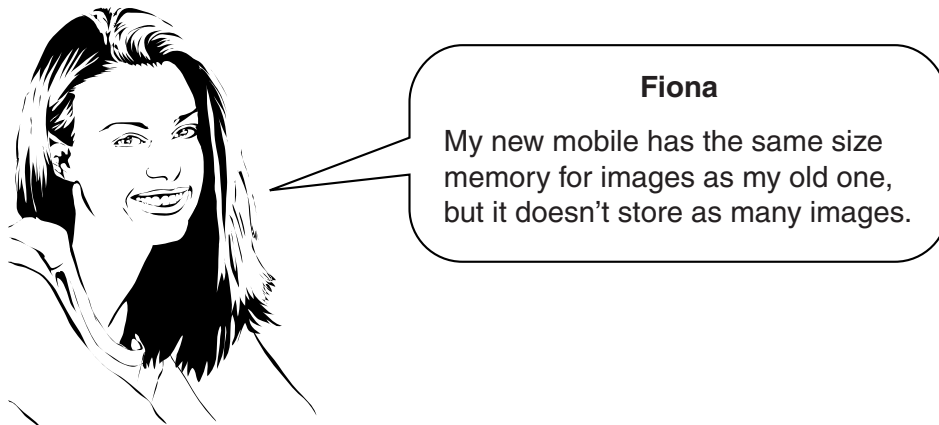
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..... [2]

(ii) Fiona has bought a new mobile phone.



What can you say about the images stored by Fiona's new phone?

Give a reason for your answer.

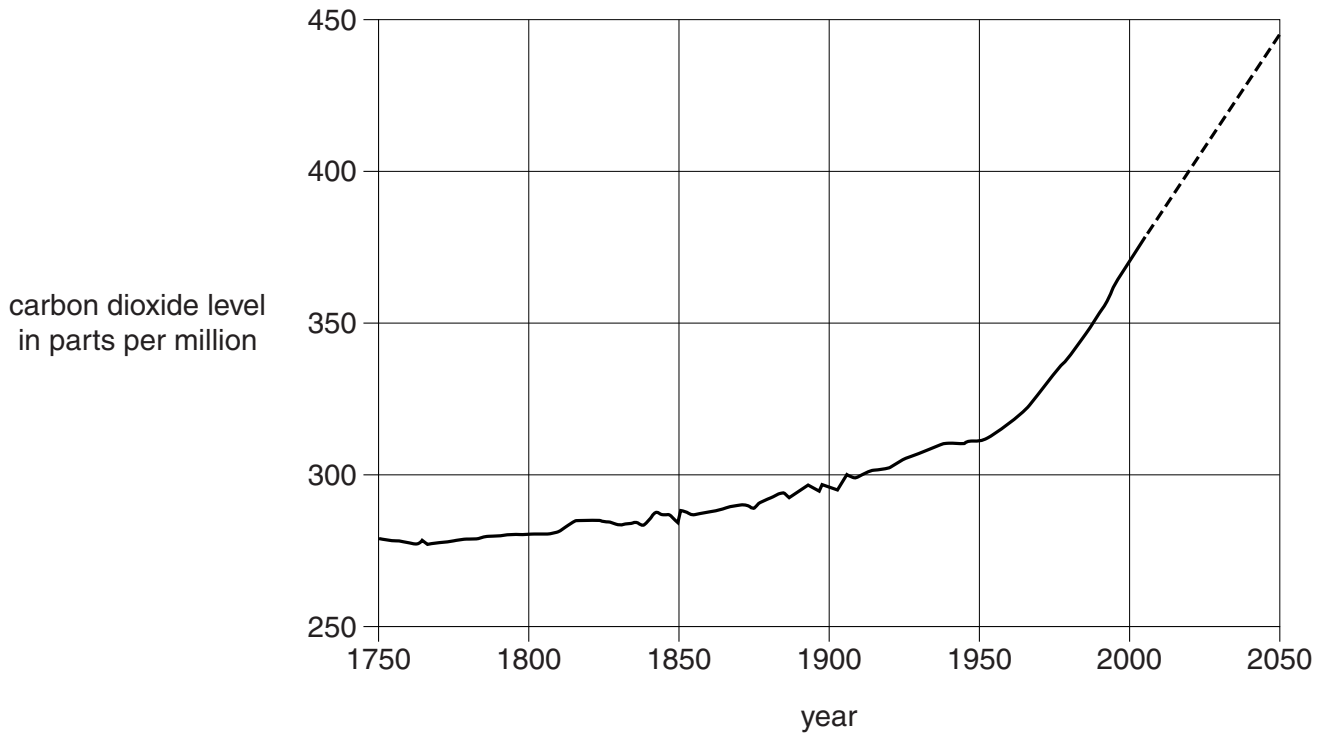
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..... [1]

[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]

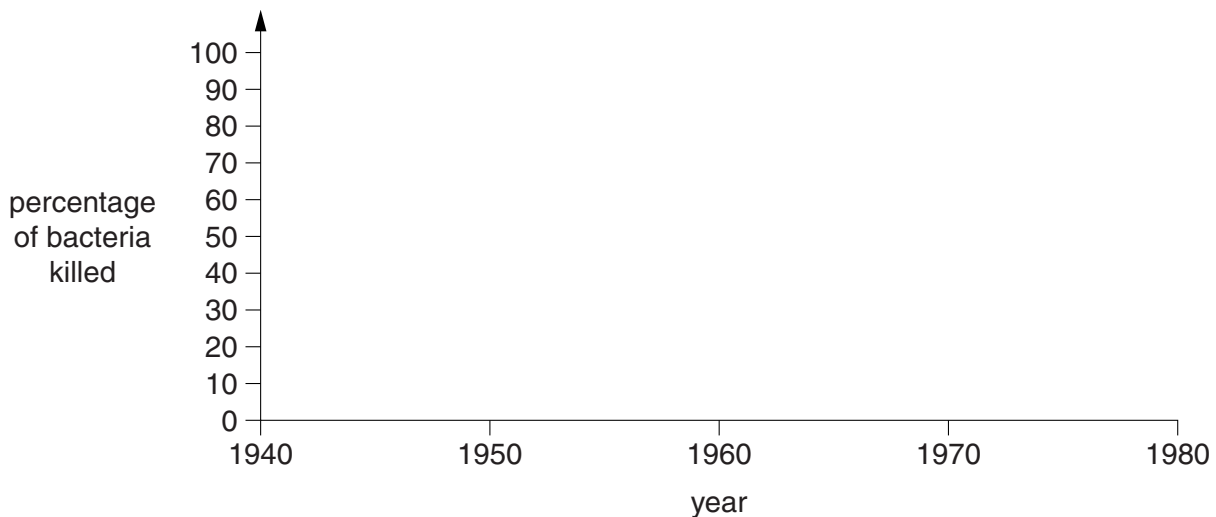
- (b) Penicillin is an example of an antibiotic.

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]



- (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 a graph showing the effect on 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.

Doctors thought these women would not survive for 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.

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..... [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]

- 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]

END OF QUESTION PAPER

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