OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A142/01**

SCIENCE A

Unit A142: Modules B2, C2, P2 (Foundation 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 clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✐).
- A list of useful relationships is included on page 2.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	3	
2	9	
3	6	
4	2	
5	8	
6	8	
7	4	
8	5	
9	3	
10	2	
11	6	
12	4	
TOTAL	60	

Turn over

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x 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 x velocity

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

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

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

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

Electric Circuits

power = voltage x 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 x [speed of light in a vacuum]^2

Answer **all** the questions.

1 (a) Some microorganisms cause diseases that make us ill.

What do these microorganisms do that makes us ill?

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

produce toxins ☐

get bigger ☐

spread easily to other people ☐

recognise antibodies ☐

[1]

(b) Norman is infected with 1000 *E. coli* bacteria.

Each bacterium can reproduce every 20 minutes inside the human body.

When each bacterium reproduces it divides into two to produce two bacteria.

(i) How many bacteria would you expect to be present in Norman's body after 1 hour?

Put a (ring) around the correct answer.

    2000   **4000**   **6000**   **8000**

[1]

(ii) The number of bacteria present in Norman's body after 1 hour was actually 7000.

How does this number compare with your answer to part **(b)(i)**?

Suggest a reason for the difference.

....

....

....[1]

[Total: 3]

2 Toby sees this article in a newspaper.

> Heart disease is one of the most common causes of death in the UK.
>
> Some scientists suggest that there is a correlation between the amount of time spent watching TV each day and the risk of dying from heart disease.
>
> They concluded that watching TV increases the risk of dying from heart disease.

(a) Toby wonders if he can believe the suggestion in the article.

He tries to find the same suggestion by looking in other sources of information.

He finds similar reports in

- health magazines

- newspapers

- peer-reviewed journals

- television programmes.

Which source of information can Toby have most confidence in?

Explain your answer.

source of information ....

explanation ....

.... **[2]**

(b) Which graph, **A**, **B**, **C**, or **D**, illustrates the correlation described in the article?

A

risk of
dying from
heart
disease

hours spent watching TV per day

B

risk of
dying from
heart
disease

hours spent watching TV per day

C

risk of
dying from
heart
disease

hours spent watching TV per day

D

risk of
dying from
heart
disease

hours spent watching TV per day
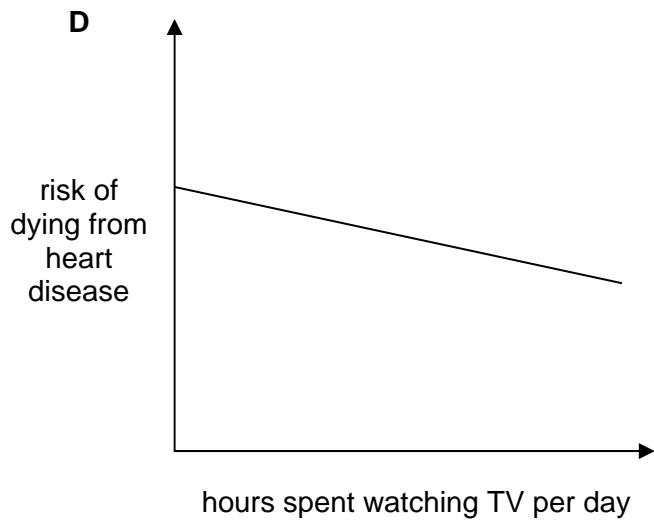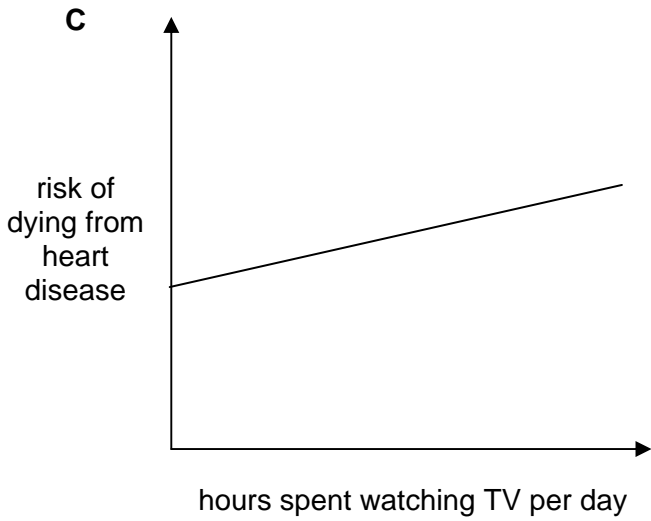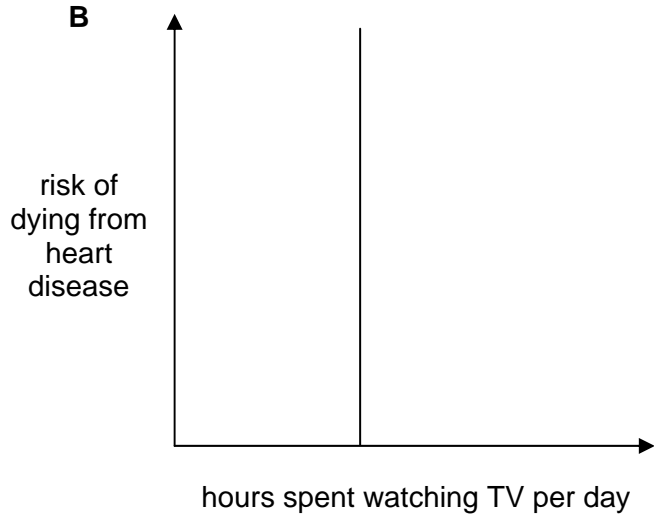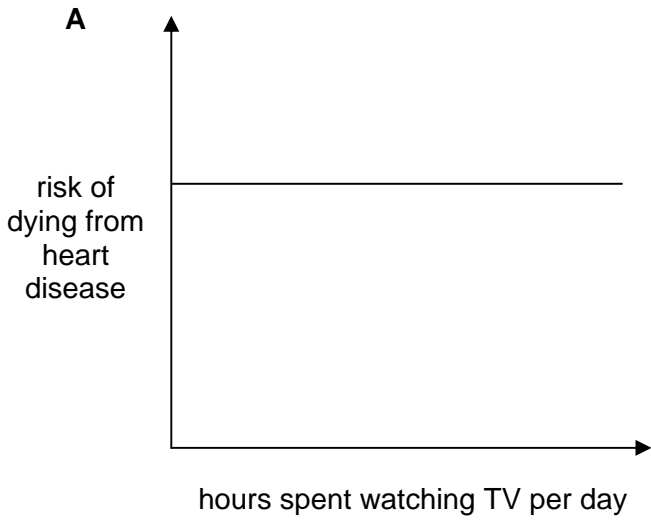
graph .... **[1]**

(c) Toby watches TV every night after work. He is worried about the correlation reported in the article.

He decides to stop watching TV because he believes it will cause heart disease.

What advice would you give Toby about this?

🖉 *The quality of written communication will be assessed in your answer to this question.*

....

....

....

....

....

....

....

.... **[6]**

[Total: 9]

3 **(a)** New drugs for humans have to be tested. Some of these drugs are antimicrobials.

They are tested on **healthy** volunteers before being tested on people with the illness.

Why is this done?

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

It is cheaper than testing the drugs on ill people. ☐

To test that the drugs are safe for humans. ☐

Drugs should not be tested on ill people unless we know they work. ☐

It is easier to find healthy volunteers than people with the illness. ☐

[1]

(ii) Antibiotics are a type of antimicrobial.

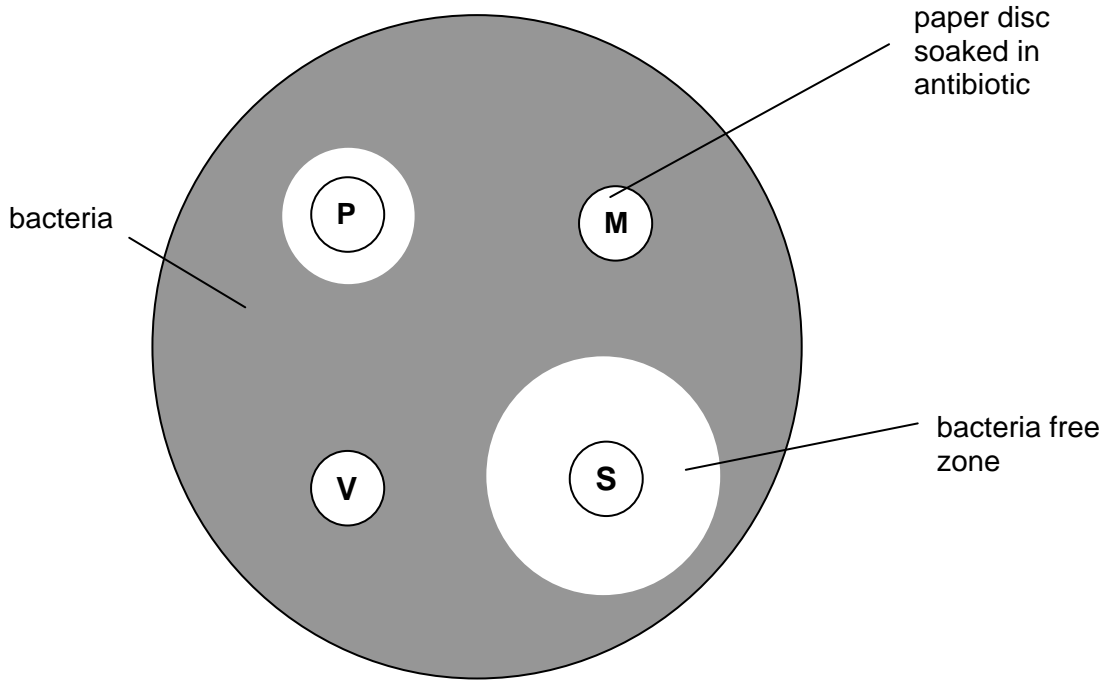Describe **two** ways in which we can reduce the spread of antibiotic resistance.

....

....

....

.... **[2]**

(b) Polly wants to test how well different antibiotics work against a type of bacteria.

She grows the bacteria on a petri dish. She then places four paper discs, **P**, **M**, **S** and **V**, in the dish. Each disc is soaked in a different antibiotic.

This is what Polly sees after she has left the dish for 6 hours.

(i) Polly wants to calculate the area of the bacteria-free zone around disc **P** and the zone around disc **S**. This will allow her to compare how well the antibiotics worked.

Polly uses this formula

$$area = 3.14 \times r^2$$

where r is the distance in cm from the centre of the disc to the edge of the bacteria-free zone.

Complete the table of Polly's results.

disc	r in cm	size of area in cm^2
P	1	
S	2	

[1]

(ii) Which antibiotic, **P**, **M**, **V** or **S** is the most effective against this type of bacteria?

Explain your answer.

....

.... **[2]**

[Total: 6]

4 Maintaining a constant amount of water in the body is important for cell activity.

We gain water by drinking and we lose some water by excreting urine.

State **one** other way we **gain** water and **one** other way we **lose** water from our bodies.

....

....

....

.... **[2]**

[Total: 2]

5 The table shows how the Olympic record height of the pole vault event has increased over the last 60 years.

It also shows the material used to make the pole.

year that record was broken	Olympic record in metres	material used to make the pole
1948	4.45	bamboo
1952	4.55	bamboo
1960	4.70	bamboo
1964	5.10	polymer and glass fibre
1968	5.40	polymer and glass fibre
1972	5.50	polymer and glass fibre
1980	5.80	polymer and glass fibre
1988	5.90	polymer and glass fibre
2004	5.95	polymer and glass fibre
2008	5.96	polymer and glass fibre

(a) Here are four statements about the pole vault Olympic record height.

Use the evidence in the table to evaluate each statement.

Put a tick (✓) in the correct box next to each statement to show whether it is **true** or **false**.

	true	false
The world record doubled between 1948 and 2008.	☐	☐
The record increased by more than 1 m between 1948 and 2008.	☐	☐
The biggest increase over 4 years was between 1960 and 1964.	☐	☐
The record improved when polymer and glass fibre poles were introduced.	☐	☐

[2]

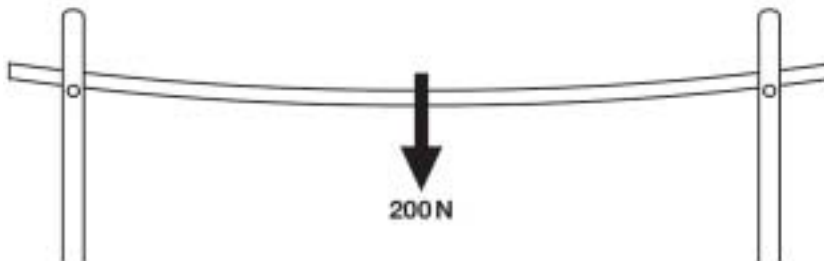**(b)** Anna and Nick are investigating the properties of vaulting poles.

They know that flexibility (how far the pole bends) is an important property.

They support a pole at both ends as shown in the diagram.

They hang a 200 N weight from the centre of the pole and measure how far the pole bends.

(i) They repeat this measurement five times.

Suggest reasons why.

....

.... **[2]**

Here are their results.

test number	1	2	3	4	5
how far the pole bends in cm	11.4	10.9	11.5	11.0	11.2

(ii) Suggest why the results of the five tests are different.

....

....

....

.... **[2]**

(iii) What is the best estimate of the true value of how far the pole bends?

Put a (ring) around the correct answer.

| 10.9 | 11.0 | 11.2 | 11.4 | 11.5 |

[1]

(iv) Within what range does the true value probably lie?

from …………………… to ....[1]

[Total: 8]

6 Read the newspaper article.

Skincare creams use nanotechnology

Nanoparticles of silicon dioxide are put in skincare creams.

This makes the creams easier to apply and invisible on the skin.

At the moment it is impossible for consumers to tell whether the creams contain nanoparticles.

(a) It has been suggested that labelling of these creams should show that they contain nanoparticles.

Why should this information be included?

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

Nanotechnology increases the cost of the creams. ☐

Not all the effects of nanoparticles are fully understood. ☐

Creams containing nanoparticles are easy to apply. ☐

Nanoparticles can occur naturally. ☐

Nanoparticles are too small to see. ☐

[1]

(b) (i) Nanoparticles of silicon dioxide show different properties compared to larger particles of the same material.

Which statement best explains why?

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

Nanoparticles of silicon dioxide should not be put in face creams. ☐

The silicon dioxide nanoparticles are difficult to apply to the skin. ☐

Nanoparticles of silicon dioxide have a large surface area compared to their volume. ☐

It is more expensive to produce nanoparticles of silicon dioxide. ☐

[1]

(ii) Nanoparticles are also added to other materials.

Adding nanoparticles changes the properties of these materials.

Describe **two** examples of products, other than skincare creams, that have nanoparticles added to them.

Explain how adding nanoparticles changes the properties of these products, and suggest why this is useful.

🖉 *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

[Total: 8]

7 (a) The sentences below describe how polymers can be made.

Draw a straight line from the **beginning** of each sentence to its correct **end**.

The first one has been done for you.

beginning	**end**

Synthetic materials can be made from …		… hydrocarbons.
The molecules in crude oil are a mixture of …		… polymers.
Crude oil is refined to make …		… crude oil.
Small molecules can be joined together to make …		… fuels and lubricants.

[2]

(b) Different hydrocarbons vary in size. For example, ethane is only two carbon atoms in length while octane is eight carbon atoms in length.

The boiling point of ethane is -89 °C. The boiling point of octane is 126 °C.

Use ideas about the forces between molecules to explain why the boiling point of octane is much higher than the boiling point of ethane.

....

....

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.... **[2]**

[Total: 4]

8 This question is about carbon dioxide in the atmosphere.

The table shows how the concentration of carbon dioxide in the atmosphere has changed in the past 100 000 years.

years before present	100 000	80 000	60 000	40 000	20 000
carbon dioxide concentration in parts per million	240	190	213	210	222

(a) Which of the following is the mean (average) value of the concentration?

Put a ring around the correct value.

190   **209**   **215**   **240**

[1]

(b) Scientists say that the concentration of carbon dioxide in the atmosphere has been approximately constant for hundreds of thousands of years.

Use the data in the table to explain why the scientists say this.

....

....

.... **[2]**

(c) In the present time, the concentration of carbon dioxide in the atmosphere is 360 parts per million.

Explain why this evidence convinces some scientists that the level of carbon dioxide in the atmosphere has risen significantly in recent times.

....

....

.... **[2]**

[Total: 5]

9 Radio programmes in the United Kingdom are now broadcast as both analogue and digital signals.

Analogue radio   Digital radio

For each statement decide whether it applies to **analogue** signals, **digital** signals or **both**.

Put a tick (✓) in the correct box for each statement.

	analogue signals	digital signals	both analogue and digital
the signal is a code made up of two digits, 1s and 0s			
the signal is transmitted as an electromagnetic wave			
the signal varies continuously			

[3]

[Total: 3]

10 Adam knows that the energy of photons of light increases from the red end of the spectrum to the blue end.

Adam predicts that there will be more energy in a beam of blue light than a beam of red light.

Here are his results.

	energy detected in beam in microjoules per second
red beam	100
blue beam	75

Write down what you would conclude from these data, and suggest an explanation for the data.

....

....

....

.... **[2]**

[Total: 2]

11 This question is about global warming and ozone.

Many people get confused between 'the greenhouse effect' and 'holes in the ozone layer'.

Name the gases involved in each case, and explain what these gases are doing to electromagnetic radiation.

✎ *The quality of written communication will be assessed in your answer to the question.*

....

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....

....

.... **[6]**

[Total: 6]

12 The properties of microwaves mean that they are used for many purposes.

(a) Which of the following statements about microwaves are true?

Put a tick (✓) in the box next to each **correct** statement.

Microwaves can be used to heat food by causing particles to vibrate. ☐

Microwaves are ionising radiation. ☐

The screen on a microwave oven lets light through but blocks microwaves. ☐

Mobile phones produce microwaves. ☐

Microwaves are blocked by the ozone layer. ☐

The higher the intensity of microwaves in a microwave oven, the less the food is heated. ☐

[3]

(b) Microwave photons transfer less energy than light photons.

However, microwaves can be used to cook many foods but light cannot.

Explain why.

....

....

.... **[1]**

[Total: 4]

END OF QUESTION PAPER

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

SCIENCE A **A142/01**

Unit A142: Modules B2, C2, P2 (Foundation Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK **60**

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
not/reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant - applies to neutral answers
allow/accept	=	answers that can be accepted
(words)	=	words which are not essential to gain credit
<u>words</u>.	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
        work done = 0 marks
        work done lifting = 1 mark
        change in potential energy = 0 marks
        gravitational potential energy = 1 mark

5. Annotations:
The following annotations are available on SCORIS.

✓	=	correct response
✗	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt **not** given
ECF	=	error carried forward
^	=	information omitted
I	=	ignore
R	=	reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7.   Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Eg
For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✔) in the two correct boxes.	Put ticks (✔) in the two correct boxes.	Put ticks (✔) in the two correct boxes.
☐	☐	𝄇
☐	☐	𝄇
✔	𝄇	✔
𝄇	𝄇	✔
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8.   The list principle:
If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9.   Marking method for tick boxes:

Always check the additional guidance.

If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✔			✔	✔	✔	✔	
Manchester	✔	✘	✔	✔	✔				✔	
Paris				✔	✔		✔	✔	✔	
Southampton	✔	✘		✔		✔	✔		✔	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

    - Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.

    - Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.

    - *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.

    - *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.

    - *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Marks	Additional guidance
1	(a)		produce toxins ✓	[1]	tick in any other box = 0 marks
	(b)	(i)	8000	[1]	
		(ii)	*it is smaller because:* population size is limited by competition / lack of resources / conditions not optimal / immune attack	[1]	no mark for saying it is smaller
			Total	[3]	

2	(a)		peer-reviewed journals (no mark) because work has been verified/repeated/checked by other scientists/experts (working in the same area)	[2]	**accept** "proved" instead of "verified/repeated/checked"
	(b)		**C**	[1]	

Question			Expected answers	Marks	Additional guidance
2	(c)	✎	**[Level 3]** Answer clearly explains the links between the ideas of correlation, factors and cause, and considers genetic **and** lifestyle factors. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Answer shows limited understanding of correlation, factors and cause, and gives examples of relevant factors. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Answer only gives examples of factors without considering ideas of correlation and cause **OR** only states that TV does not necessarily cause heart disease without considering other factors. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** • idea that an observed correlation does not necessarily mean that watching TV (the factor) causes heart disease (the outcome) • idea that the factor might increase the probability of the outcome, but does not necessarily lead to it (does not make it certain to happen) • idea that other factor(s) may be just as important, or more important • Toby might , be able to / need to , change other factors (to lower his risk of developing heart disease) **ignore** refs. to the article not being trustworthy **ignore** refs. to the study needing to be repeated, etc. *examples of other factors:* • genetic factors / family history of disease • lifestyle factors, e.g. lack of exercise, poor/fatty diet, stress, smoking / excessive nicotine, drinking / excessive alcohol **accept** economic factors if linked to poor diet etc.
			Total	**[9]**	

Question			Expected answers	Marks	Additional guidance
3	(a)	(i)	To test that the drugs are safe... ✓	**[1]**	tick in any other box = 0
		(ii)	always finish a course of antibiotics only take antibiotics when necessary	**[2]**	**accept** regularly change the antibiotic being used (in the population) **accept** use combination of antibiotics
	(b)	(i)	P = 3.14 S = 12.56/12.6	**[1]**	both required for 1 mark
		(ii)	**S** (no mark) because it has larger area of bacteria-free zone so more bacteria have been killed/growth inhibited	**[2]**	ecf for answer based upon the numbers the candidate wrote in the table in part (i)
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
4			<u>gain</u> **any one from:** in food from respiration <u>loss</u> **any one from:** sweat faeces breathing	**[2]**	one mark for gain one mark for loss
			Total	**[2]**	

Question			Expected answers	Marks	Additional guidance
5	(a)		<table><tr><td></td><td>**true**</td><td>**false**</td></tr><tr><td>The world record doubled ...</td><td>☐</td><td>✓</td></tr><tr><td>... between 1948 and 2008</td><td>✓</td><td>☐</td></tr><tr><td>... between 1960 and 1964</td><td>✓</td><td>☐</td></tr><tr><td>The record improved ...</td><td>✓</td><td>☐</td></tr></table>	**[2]**	all 4 correct = 2 marks 3 correct = 1 mark
	(b)	(i)	**any two from:** find the best estimate of the true value identify outliers discard outliers ensure results are reliable	**[2]**	
		(ii)	**any two from:** human error in measuring weight not placed in middle / weight hung from a different place supports move apart or together / pole in a different position on supports pole does not straighten after weight hung on it	**[2]**	
		(iii)	11.2	**[1]**	
		(iv)	10.9 to 11.5	**[1]**	**accept** 11.5 to 10.9
			Total	**[8]**	

Question			Expected answers	Marks	Additional guidance
6	(a)		Not all the effects … ✓	[1]	tick in any other box = 0 marks
	(b)	(i)	large surface area compared to volume ✓	[1]	tick in any other box = 0

Question			Expected answers	Marks	Additional guidance
6	(b)	(ii) ✎	**[Level 3]** Answer gives two different examples, each with clear details of the property that changes and a suggested benefit. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Answer fully describes **one** example **OR** gives **two** examples but omits detail from both. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Answer names **two** examples but gives no further detail about properties or benefits **OR** gives only **one** example and omits either the property that has changed or the benefit. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • fibres / cloths / bandages etc. • (have <u>silver</u> nanoscale particles added) • gives the fibre antibacterial properties (that weren't there before) • keeps the material sterile / used in hospitals / keeps wounds clean / stops the spread of bacteria/germs • sports equipment • makes them stronger (than they were before) • lasts longer / does not break / improves performance • relate changes of properties to much larger surface area compared to their volume **accept** any correct example **reject** any answer related to face/skin creams or sunscreens
			Total	**[8]**	

Question	Expected answers	Marks	Additional guidance
7 (a)	Synthetic materials — hydrocarbons The molecules — polymers Crude oil — crude oil Small molecules — fuels and	**[2]**	3 lines right = 2 marks 2 or 1 line right = 1 mark
(b)	larger hydrocarbons have larger forces between the molecules therefore more energy is needed to break them out of liquid form into a gas so the boiling point occurs at a higher temperature	**[2]**	**accept** converse answers for full marks answer must be coherent and logically link points to address the question
	Total	**[4]**	

Question			Expected answers	Marks	Additional guidance
8	(a)		215	[1]	
	(b)		the mean/average has not changed much and there is no trend of increase or decrease	[2]	
	(c)		360ppm/present concentration is far above the <u>range</u> of the data in the table in addition, the change in concentration in the last 20 000 years is much larger than the changes seen in the previous 20 000-year intervals	[2]	
			Total	**[5]**	

				analogue	digital	both		Marks	Additional guidance
9			0s & 1s		✓			[3]	one mark per correct row reject any row with two or three ticks
			em wave			✓			
			continuous	✓					
			Total					**[3]**	

Question			Expected answers	Marks	Additional guidance
10			prediction is wrong/not supported because blue beam has less energy than red beam / ora red beam may have more photons (than blue beam) / red beam may have had different area (than blue beam) / detector used to measure red beam may have had different area	[2]	**ignore** statements attributing data to measurement error
			Total	**[2]**	

Question	Expected answers	Marks	Additional guidance

11 ✎	**[Level 3]**
	Includes most relevant points in the answer. Correctly differentiates between the greenhouse effect and the hole in the ozone layer . All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling.
	(5 – 6 marks)
	
	[Level 2]
	Will recognise the two gases and the two distinct effects but may confuse the gases responsible. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling.
	(3 – 4 marks)
	
	[Level 1]
	Will either know that carbon dioxide is one of the gases, or recognise that ozone is a gas, but not both. May recognize that one blocks infrared or ultraviolet, but not know which. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science.
	(1 – 2 marks)
	
	[Level 0]
	Insufficient or irrelevant science. Answer not worthy of credit.
	(0 marks)
		[6]	**relevant points include:**
			greenhouse effect
			• carbon dioxide is a greenhouse gas
			• carbon dioxide absorbs/reflects radiation emitted from the Earth
			• the greenhouse effect keeps the earth warmer than it would otherwise be / causes global warming
			
			accept water and methane as greenhouse gases;
			    reflected radiation is lower frequency/longer wavelength than the radiation (from the Sun) absorbed by the Earth
			
			hole in ozone layer
			• ozone layer absorbs ultraviolet radiation
			• the lack of ozone/ozone depletion/hole in the ozone layer results in more harmful UV radiation (reaching the earth).
			
			accept ozone is a gas in the atmosphere
			    pollution (e.g. CFCs) results in ozone reacting to form oxygen
			
			ignore CFCs as greenhouse gases
			    effects of global warming or depleted ozone layer

Total		**[6]**	

            14

Question			Expected answers		Marks	Additional guidance
12	(a)		Microwaves can be used to heat food by causing particles to vibrate.	✓	[3]	
			Microwaves are ionising radiation.	☐		
			The screen on a microwave oven lets light through but blocks microwaves.	✓		
			Mobile phones produce microwaves.	✓		
			Microwaves are blocked by the ozone layer.	☐		
			The higher the intensity of microwaves in a microwave oven, the less the food is heated.	☐		
	(b)		(some / certain) microwaves are strongly absorbed by water molecules, whereas light molecules are not		[1]	
			Total		**[4]**	

Assessment Objectives (AO) Grid

(includes quality of written communication✎)

Question	AO1	AO2	AO3	Total
1(a)		1		1
1(b)(i)		1		1
1(b)(ii)			1	1
2(a)		2		2
2(b)		1		1
2(c) ✎	2	3	1	6
3(a)(i)	1			1
3(a)(ii)	2			2
3(b)(i)		1		1
3(b)(ii)			2	2
4	2			2
5(a)		1	1	2
5(b)(i)	1	1		2
5(b)(ii)	1	1		2
5(b)(iii)		1		1
5(b)(iv)		1		1
6(a)		1		1
6(b)(i)		1		1
6(b)(ii) ✎	4	2		6
7(a)	2			2
7(b)		2		2
8(a)		1		1
8(b)		2		2
8(c)		1	1	2
9	3			3
10			2	2
11 ✎	6			6
12(a)	2	1		3
12(b)		1		1
Totals	**26**	**26**	**8**	**60**