

**GCSE (9-1)**

**Examiners' report**

# **TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B**

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**J260**

For first teaching in 2016

**J260/04 Summer 2024 series**

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## Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

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## Paper 4 series overview

J260/04 is the fourth of four Foundation Tier papers assessing all areas of the specification in the Combined Science B suite. The other three papers assess biology, chemistry, and physics separately. The final two questions on this paper are common questions shared with the Higher tier paper.

To do well on this paper, candidates need to be able to use data presented in different forms and apply their subject knowledge to unfamiliar situations. Candidates should be encouraged to work with data in a variety of forms, such as tables and different types of graph, as well as being comfortable with the use of mathematics, such as calculating percentage change and the use of significant figures.

It is good to see that more candidates are showing their working out in calculation questions, compared to previous years. Candidates should be encouraged to write down the equation as their first step and then substitute in the numbers and clearly write their final answer on the answer line.

The difference between decimal places and significant figures is still challenging for many candidates.

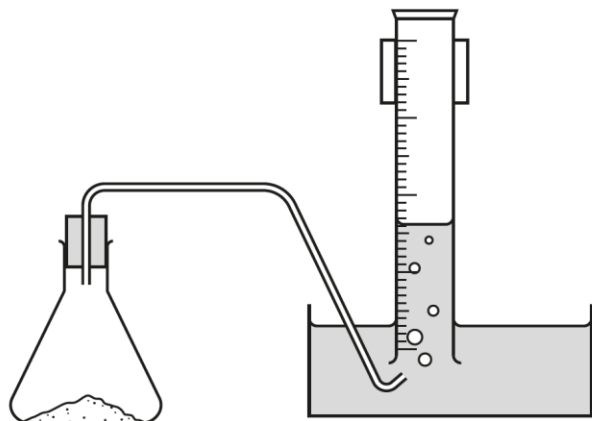
The number of marks available in the right hand margin gives candidates an idea of the number of correct statements we need to see in an answer. For example, if a question is potentially worth 3 marks, then the examiner will normally need to see three correct statements that address the command word in the question.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> <li>• were familiar with the names of common practical equipment, for example, Question 1 (a) and 7 (d)</li> <li>• followed instructions given in the question carefully, for example in Question 1 (c) about drawing one line, Question 4 (a) about two significant figures and Question 2 (e) (ii) about what is happening on the graphs after 1998</li> <li>• used specific scientific vocabulary such as volume or mass rather than amount, for example in Question 1 (d) (ii)</li> <li>• structured their answer to the Level of Response question to make sure they covered all the areas required, Question 2 (d)</li> <li>• applied their knowledge to the specific situation given in the question, for example Question 4 (b).</li> </ul>	<ul style="list-style-type: none"> <li>• changed their minds about an answer, but without making it clear which answer they wanted the examiner to mark; candidates should not use double headed arrows to show the examiner they want to swap answers around and should instead cross out the wrong answer and write the correct answer above it</li> <li>• wrote answers that did not cover what the question had asked, Question 2 (d)</li> <li>• did not write enough clear, different answers to score the highest mark available, Questions 4 (b) (i) and 8 (a)</li> <li>• did not show where the data came from in calculations Question 6 (c).</li> </ul>

## Question 1 (a) (i)

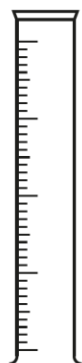
- 1 A student is investigating the rate of reaction between hydrochloric acid (HCl) and calcium carbonate powder ( $\text{CaCO}_3$ ).

The equipment used is shown in the diagram.



(a)

- (i) What is the name of this piece of equipment?



Tick (✓) **one** box.

Beaker

Conical flask

Delivery tube

Measuring cylinder

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

[1]

Most candidates were able to correctly identify the measuring cylinder. The most common incorrect answer was beaker. Candidates need to be exposed to a sufficient amount of practical work in order to become familiar with the equipment they use.

### Question 1 (a) (ii)

(ii) What is the name of this piece of equipment?



Tick (✓) **one** box.

Beaker

Conical flask

Delivery tube

Measuring cylinder

☐☐☐☐

[1]

Most candidates, though fewer than for the previous question, correctly identified the conical flask. Beaker was the most common incorrect answer. Again, candidates should be familiarised with the names of common laboratory equipment through regular practical work.

### Question 1 (b)

(b) Suggest **one** safety precaution the student should take when working with acid.

.....

..... [1]

Virtually all candidates were able to suggest a suitable safety precaution. Where candidates were not given this mark it was usually because they just answered 'wear glasses' without specifying they were safety glasses or gave vague answers about not touching the acid without explaining how skin contact could be avoided, e.g. gloves.

## Question 1 (c)

(c) A gas forms when hydrochloric acid and calcium carbonate powder react.

Draw **one** line from the **gas collected** to the **chemical test** that can identify the gas.

**Gas collected**

Carbon dioxide

Hydrogen

Oxygen

**Chemical test**

Burns with a squeaky pop.

Turns universal indicator blue

Turns lime water cloudy when it is bubbled through.

[2]

Very few candidates were given 2 marks on this question. This was usually because they did not follow the instruction about drawing one line – i.e. from carbon dioxide to the limewater test. Most candidates drew one line from each gas and in this situation they were given 1 mark if carbon dioxide was joined to the limewater test. Candidates are advised to read instructions in questions very carefully.

## Question 1 (d) (i)

(d) The student repeats the experiment with different **concentrations** of hydrochloric acid.

(i) Explain why the rate of reaction increases when the concentration of the hydrochloric acid increases.

Use ideas about collisions in your answer.

.....  
.....  
.....  
..... [2]

Around a third of candidates were given marks on this question. The question was in terms of an increased rate of reaction and not just about why a reaction happens at all. While most candidates seemed to have some understanding of collision theory, answers in terms of comparatives such as *more* particles or *larger number of* collisions were rare.



## Question 1 (d) (ii)

(ii) The student wants to ensure that the data they collect is valid.

State **two** variables that the student needs to control in this experiment.

1 .....

2 .....

[2]

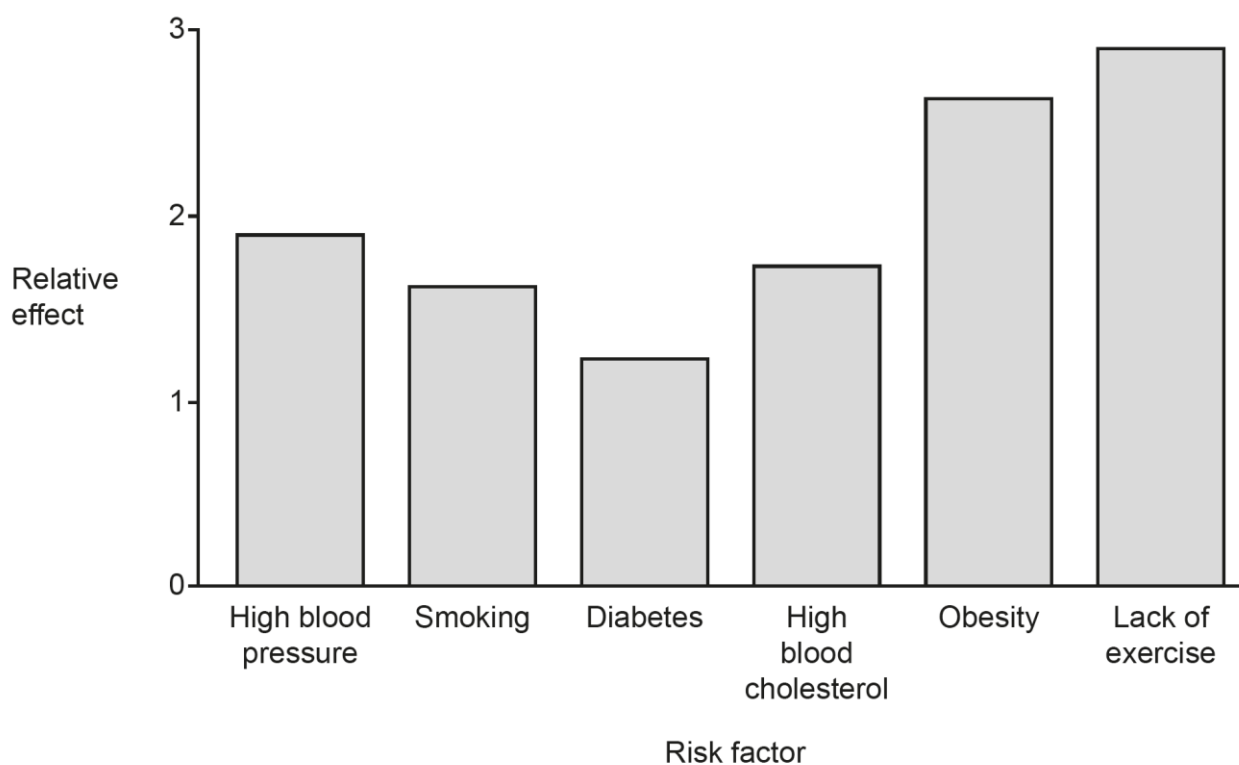
Around a fifth of candidates were given marks on this question, with a large number stating that the concentration should be controlled, despite this being mentioned as the independent variable earlier in the question. Most answers were written in vague terminology such as *amount* of acid rather than volume and *amount* of calcium carbonate rather than mass. Candidates should be careful to use accurate, technical terminology in their answers.

## Question 2 (a)

2 Cardiovascular disease (CVD) is a disease that affects the heart and circulatory system.

Fig. 2.1 shows a bar chart of some risk factors for CVD and their relative effect.

Fig. 2.1



(a) State the risk factor that has the highest relative effect.

..... [1]

Almost all candidates correctly selected lack of exercise as the risk factor with the highest relative effect.

## Question 2 (b)

(b) Charlie is having a health check-up at the doctor's.

Charlie's doctor finds out that Charlie:

- plays hockey three times each week and goes running on a regular basis
- has diabetes
- is **not** obese
- does **not** have high blood pressure
- has high blood cholesterol
- has a high fat diet
- smokes.

State Charlie's **two** biggest risk factors for CVD.

Use **Fig. 2.1**.

- 1 .....
- 2 ..... [2]

The majority of candidates were given both marks for using the information from the diagram to select Charlie's two biggest risk factors. Diabetes was the most common incorrect answer, perhaps showing that candidates were using what they thought was correct subject knowledge rather than the data actually provided in the chart.

## Question 2 (c)

(c) Suggest **one** other health-related question the doctor should ask Charlie to help determine her risk of developing CVD.

.....

..... [1]

Most candidates suggested a suitable question for the doctor to ask Charlie. Those who did not tended to ask questions about things the doctor would already know, for example if she had any existing diseases or was taking any prescription medicine. This an example of candidates not relating their subject knowledge to a specific scenario.

## Question 2 (d)\*

**(d)\*** Charlie is diagnosed with CVD. Charlie has been told she can treat her CVD by changing her lifestyle or using medicines.

Discuss reasons for and against Charlie treating her CVD by:

- changing her lifestyle
- using medicines.

.....

.....

.....

.....

.....

.....

..... **[6]**

This Level of Response question proved to be a good differentiator, with around half of candidates writing a Level 2 or Level 3 answer and most candidates gaining at least 1 mark.

Answers that scored 0 marks tended to repeat the question and told the examiner that Charlie needed to take medicine or change her lifestyle without giving reasons why this would or would not benefit Charlie.

Lower scoring answers tended to give one simple reason why Charlie should, for example stop smoking (such as saving money) or why she should take medicine (such as it being a simple fix).

Higher scoring candidates tended to structure their answer with side headings or even a table so that they wrote a 'for' and 'against' comment for both lifestyle and medicine.

Candidates are advised to review their answer at the end of writing to make sure they have covered everything that the question is asking for.

## Exemplar 1

For: Changing her lifestyle is much better as you can feel yourself feeling mentally and ~~long term~~ physically better. Against: Changing her lifestyle is a lot of effort to do and takes time. For: Using medicines is quicker solution, ~~quicker~~ and much less effort to do. Against: Using medicines, does not help long term and only good to get rid of problem faster.

\*and long term benefits

[6]

This is a good demonstration of structuring the response well and gaining a high mark. On the surface of it, it would appear that this candidate has not written very much, but it's not the quantity of writing that matters.

This candidate has clearly considered the lifestyle changes and used the headings 'for' and 'against'. They have then also done the same thing for medicines. This ensures they address all the demands of the question.

By doing this they have provided us with a range of positives and negatives for each method of controlling the CVD. The only thing missing is a clear disadvantage for medication – they have attempted it, but their answer is a bit lacking. For this reason, the candidate was given the bottom end of a Level 3 and 5 marks. If they had written a clear disadvantage, for example, something about side effects or cost then they would have gained 6 marks.

Other candidates wrote a lot more than this and were given a lower mark because they did not address everything asked for in the question.

## Assessment for learning



Teachers may find it useful to 'train' their candidates to structure their answers for Level of Response questions – using the situation in the question – before candidates actually think about what the answers might be.

For example, we commonly ask for advantages and disadvantages of two things, so training candidates to write side headings for each of the two things, with a column for advantages and a column for disadvantages underneath each heading is likely to lead to candidates gaining more marks than an answer in continuous prose that does not address any of the points.

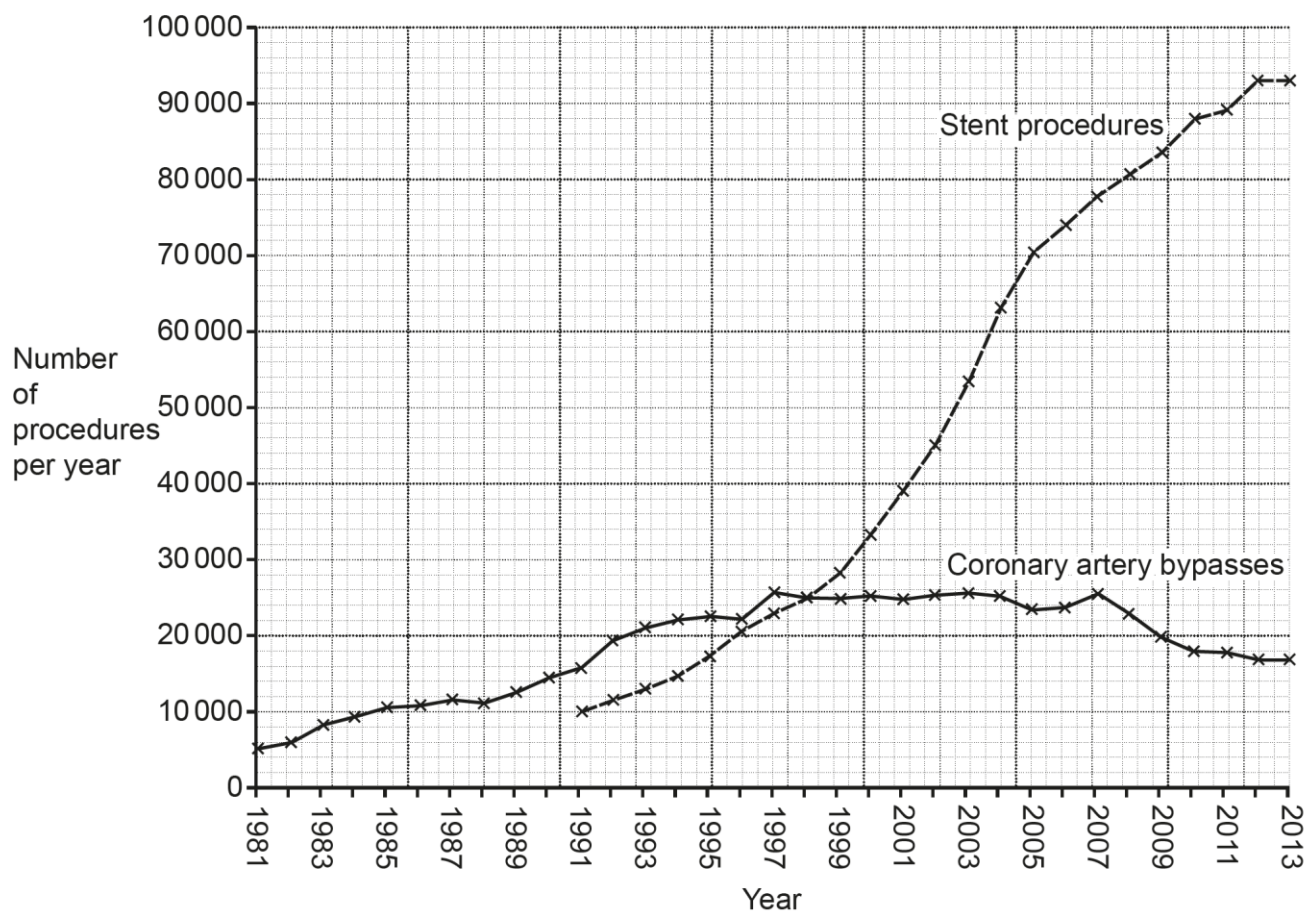
To train candidates, teachers could get students to compare a well-structured high-scoring response and a longer, low scoring more rambling response. The ensuing discussion (about which answer is better and why) may help candidates to understand the benefit of structuring their answer before thinking about the scientific content that will help them to address all points of the question.

## Question 2 (e) (i)

(e) Surgery can be used to help people who have developed CVD.

**Fig. 2.2** shows the number of coronary artery bypasses and stent procedures each year since 1981.

**Fig. 2.2**



(i) What year were stent procedures introduced?

..... [1]

The majority of candidates correctly identified 1991 as the year where stent procedures were introduced. The most common incorrect answer was 1981 which is the beginning of the graph. Candidates should read graph labels carefully.

## Question 2 (e) (ii)

- (ii) Describe how the number of stent procedures and coronary artery bypasses changes from **1998** to **2013**.

.....

.....

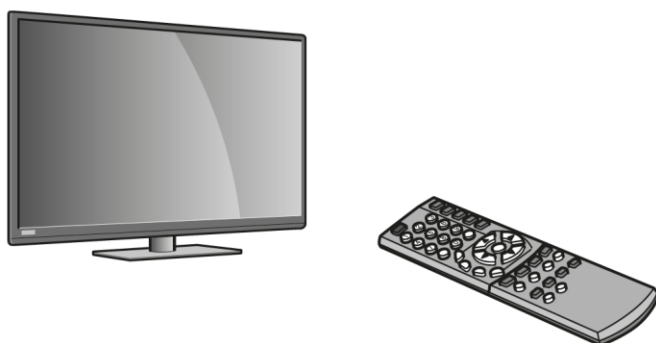
.....

..... [2]

In this question, examiners only needed to see a very simple description, such as the number of stent procedures increasing or the number of coronary artery bypasses decreasing. The majority of candidates correctly identified these features from the graph. Where marks were not given, it tended to be because candidates wrote about answers that related to the graphs before 1998 alone. Again candidates are reminded to read the question carefully.

## Question 3 (a)

- 3 The picture shows a TV and its remote control.



The remote control is pointed at a sensor on the TV.

- (a) Complete the sentences about the remote control.

Use words from the list.

absorbed	electromagnetic	sensor	sound	source	transmitted
----------	-----------------	--------	-------	--------	-------------

When a button is pressed, ..... waves transfer  
energy from the remote control to the .....,  
where it is .....

[3]

The majority of candidates were given either 2 or 3 marks on this question.



### Question 3 (b)

(b) The table shows data for the remote control.

Current (A)	0.1
Potential difference (V)	3.0

Calculate the power of the remote control.

Use the Data and Equation Sheet.

Power = ..... W [3]

The large majority of candidates were given all 3 marks on this question. Where no marks were scored it was usually because the candidates had added the numbers together rather than selecting the correct equation from the Data and Equation Sheet.

### Question 3 (c)

(c) The TV uses mains electricity.

Electrical power is transmitted through the national grid transmission cables at high voltages.

Which row of the table describes the effect of using high voltage on the current in the transmission cables and the efficiency of transmission?

Tick (✓) **one** box.

Current in cables	More efficient because	
Decreased	Less heating	
Decreased	More heating	
Increased	Less heating	
Increased	More heating	

[1]

A minority of candidates were given the mark for selecting the correct current and efficiency. The bottom box was the most common incorrect answer, showing perhaps that many candidates seemed to think that more current in the cables and more heating were good things.

### Question 3 (d)

(d) The TV has a power rating of 110 W.

What is the energy transferred by the TV after being on for 2 hours?

Use the equation: energy transferred = power  $\times$  time

Tick (✓) **one** box.

55 Wh

110 Wh

220 Wh

☐☐☐

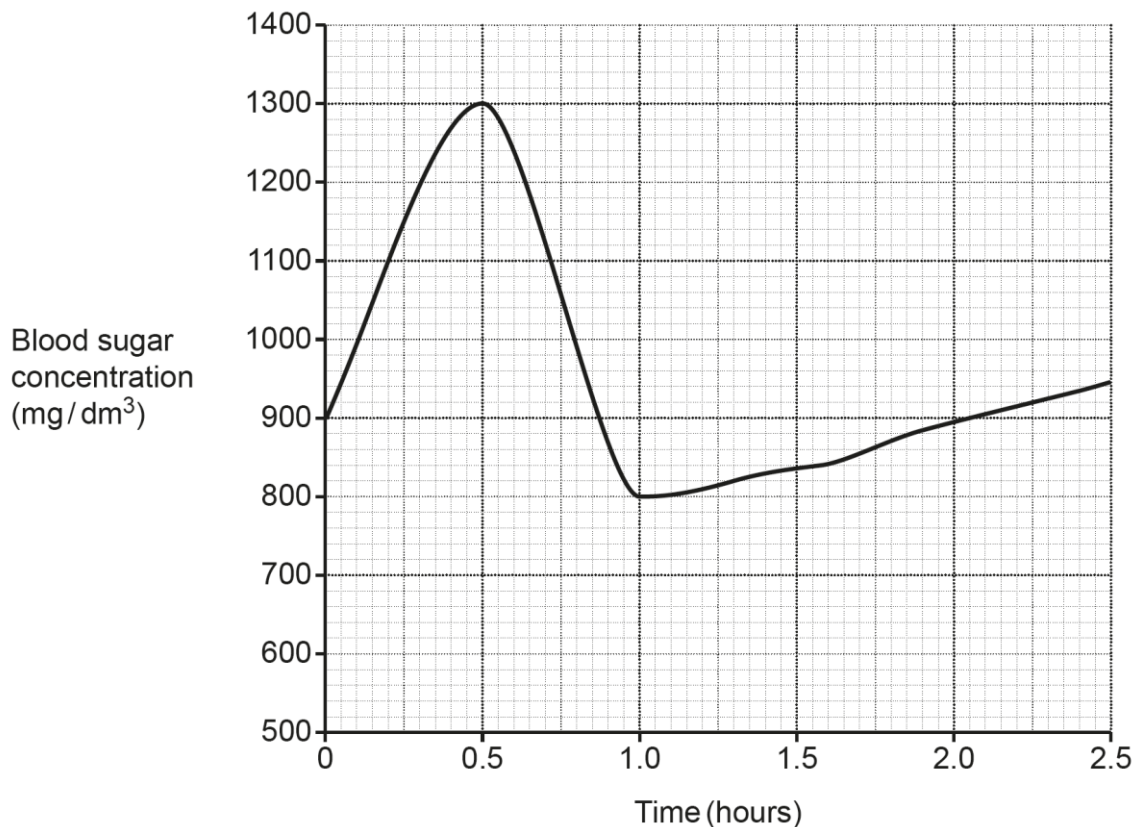
[1]

Most candidates selected the correct option.

## Question 4 (a)

4 Diabetes is a condition that causes a person's blood sugar level to become too high.

(a) The graph shows the changes in blood sugar concentration in a person without diabetes immediately after eating.



Calculate the percentage decrease in blood sugar concentration between 0.5 and 1.0 hours.

Give your answer to **two** significant figures.

Percentage decrease = ..... % **[4]**

Most candidates were able to correctly read off the graph the blood sugar concentrations at 0.5 and 1.0 hours, so were given 1 mark. Some of those then went on to use this in a calculation and arrive at the final answer of 38% to two significant figures. Many candidates misunderstood two significant figures as two decimal places, giving the answer 38.46 instead. A lot of candidates were not able to calculate a percentage change, instead calculating a basic percentage and getting the answer 61.54% or 62% by dividing 800 by 1300.

## Exemplar 2

Give your answer to **two** significant figures.

$$1300 \div 30 = 43.3$$

Percentage decrease = 43 % **[4]**

This candidate demonstrates a good example of why it is important to show the working out in a calculation.

The final answer is wrong and had they only written 43 then their final mark would have been 0.

Here we can see the 43 is the result of a calculation that gives the answer 43.3. The calculation is irrelevant, but we see the candidate has followed the instruction to give the answer to two significant figures and so has gained a mark.

## Question 4 (b) (i)

(b)

- (i) Blood glucose can be measured by doing a finger-prick blood sample. This method uses a needle so that a drop of blood can be taken for testing.

A test strip and testing meter are then used to show the blood glucose level at the time the test is taken. The test should be taken just before a meal or two hours after a meal.

Suggest the **disadvantages** of this method of blood sugar monitoring.

.....

.....

.....

.....

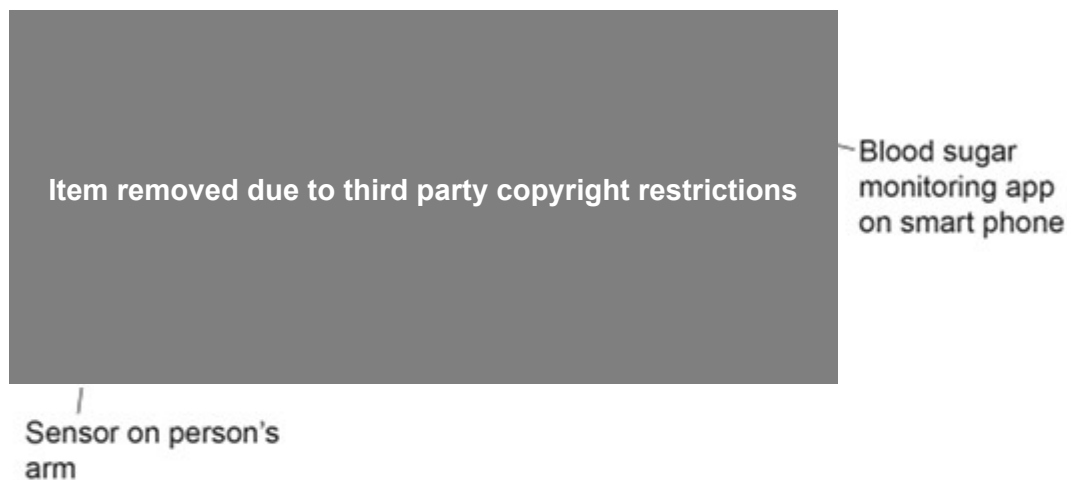
.....

..... [3]

The majority of candidates did not score any marks on this question and often wrote generic answers about the meter being inaccurate or not precise in some way. Candidates should tailor their answer to the situation given in the question rather than reaching for standard words and phrases. Many candidates were able to think of a disadvantage along the lines of pain or infection.

## Question 4 (b) (ii)

- (ii) Blood sugar can also be measured by using a sensor placed on a person's arm which sends information continuously to an app on a smartphone, as shown:



Suggest **two** disadvantages of using this method to monitor blood sugar.

- 1 .....
- 2 .....
- [2]

This question had a better response from candidates than the previous question with the majority being given 1 or 2 marks. The most common answers related to technical problems with the phone or the sensor but other candidates were not given marks for the generic answers about accuracy or precision.

## Question 5 (a)

5 Indium (In) is a metal.

(a) Indium tin oxide is an important component of smartphones. The diagram shows a layer of indium tin oxide on a glass screen.

Indium atoms are approximately  $3.9 \times 10^{-10}$  m in diameter.

The thickness of the layer of indium tin oxide is  $1.5 \times 10^{-9}$  m.



NOT TO SCALE

Calculate the number of whole indium atoms that could fit across the thickness of this layer.

Number of whole indium atoms = ..... [3]

Only the highest scoring candidates were given marks on this question and it proved challenging to most. Many candidates understood the idea that a division needed to be performed, with the majority of them writing the numbers upside down, perhaps showing that they think only a larger looking number can be divided by a smaller looking number – e.g.  $3.9 \div 1.5$ . Some candidates managed to calculate 3 but then added some kind of standard form onto the end.

### Misconception



Lower scoring candidates often think that only larger numbers can be divided by a smaller number. Many often write the correct working out and have a number less than one in their working but then on the final answer line they will write the inverse of this.

## Question 5 (b)

(b) Suggest why the actual number of whole indium atoms across the thickness of the **indium tin oxide** layer is less than the number of whole indium atoms calculated in part (a).

.....  
 ..... [1]

This question was challenging for most candidates, with only a very small number of correct responses being seen.

## Question 6 (a)

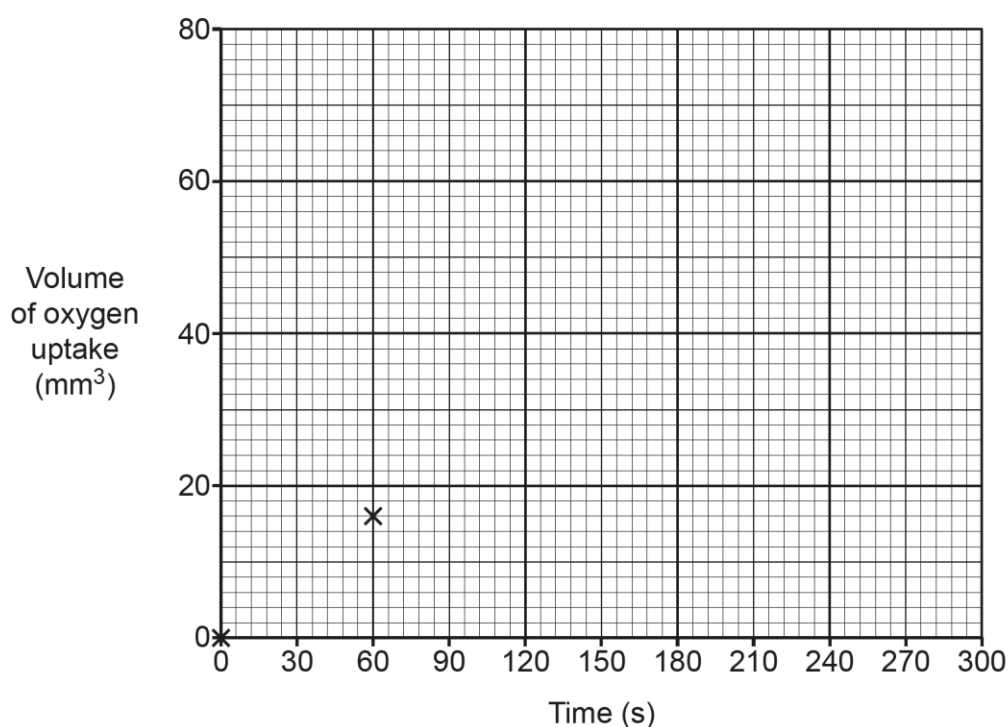
6 A student investigates the rate of cellular respiration in mung beans.

The student's results are shown in the table:

Time (s)	Volume of oxygen uptake (mm <sup>3</sup> )
0	0
60	16
120	33
180	50
240	66

(a) Plot the results from the table on the graph.

Two points have already been plotted.



[2]

This question was well attempted by candidates throughout the whole mark distribution. A large majority were given 2 marks, though some candidates did not attempt the question. Candidates should always check diagrams for marks in brackets, rather than assuming it is just a picture. Where candidates were only given 1 mark it was because the placement of one of the crosses was inaccurate. Candidates were given 0 marks for using large blobs instead of crosses, as it was not possible for the examiner to determine the centre of the plot.



## Question 6 (b)

**(b)** Draw a straight line of best fit.

[1]

A large minority of candidates did not draw a correct line of best fit. Many did not seem to have a ruler available and some did not extend the line to the first and last points on the graph. Other candidates joined the points in a dot to dot fashion or went over the line many times making it thick and imprecise.

## Question 6 (c)

**(c)** Use the graph to calculate the rate of respiration.

Use the equation: rate of respiration =  $\frac{\text{change in volume}}{\text{change in time}}$

Give your answer to an appropriate number of significant figures.

Rate of respiration = ..... mm<sup>3</sup>/s [4]

Candidates mostly were given 2 or 3 marks on this question. The most common errors were not following the instruction about using the graph. Examiners needed to see a clear triangle drawn on the graph identifying two points the candidate would use for their calculation. Most candidates either did not show two points or did not annotate the graph at all. The instruction about an appropriate number of significant figures also caused difficulty for some candidates, though most wrote an answer that produced a number within the correct range.

## Question 6 (d)

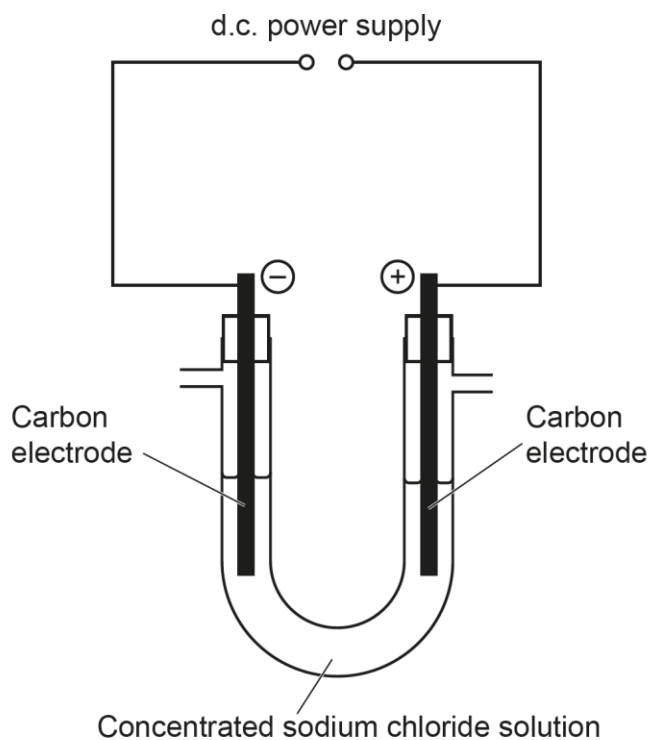
**(d)** Predict the volume of oxygen uptake at 150 seconds.

Volume of oxygen uptake = ..... mm<sup>3</sup> [1]

Most candidates correctly predicted the volume of oxygen.

## Question 7 (a)

7 The diagram shows an electrolysis experiment.



(a) Which ions are present in a concentrated solution of sodium chloride?

Tick (✓) **one** box.

$\text{Cl}^-$     $\text{H}^+$     $\text{Na}^+$     $\text{OH}^-$

$\text{Cl}^-$     $\text{H}^+$     $\text{S}^{2-}$     $\text{OH}^-$

$\text{Cl}^-$     $\text{Na}^+$

$\text{Cl}^-$     $\text{S}^{2-}$

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

[1]

Only a small number of candidates chose the correct option.

**Question 7 (b) (i)****(b)****(i)** Name the gas that forms at the positive electrode...... **[1]**

A minority of candidates were able to correctly identify chlorine gas. Common wrong answers were the chloride ion or the common laboratory tested gases such as oxygen, hydrogen and carbon dioxide.

**Question 7 (b) (ii)****(ii)** Describe a test to identify this gas that forms.

.....  
.....  
.....  
..... **[2]**

Few candidates were able to give the correct test. The only error carried forward that was allowable here was the test for oxygen, as information about the other common gas tests was provided in Question 1 (c).

**Question 7 (c)****(c)** The current in the circuit is 0.01 A.

Calculate the charge that flows in the circuit in 15 minutes.

Use the equation: charge = current  $\times$  timeCharge = ..... C **[3]**

Around three quarters of candidates omitted the unit conversion and were given 2 marks for the answer 0.15 C. A small proportion of candidates included the unit conversion, correctly calculating the final answer of 9 C.

### Question 7 (d) (i)

(d) The student adds two components to the circuit so that they can vary and measure the current.

(i) Name a component that can be used to **vary** the current.

..... [1]

Very few candidates were familiar with a variable resistor. A common answer was 'resistor' alone but this was insufficient as the current could not be varied with a fixed resistor.

### Question 7 (d) (ii)

(ii) Name a component that can be used to **measure** the current.

..... [1]

Less than half of candidates were familiar with an ammeter as a device to measure current. Some lower scoring candidates wrote about rulers, presumably because they saw the word measure.

## Question 8 (a)

- 8 Doctors select radioactive isotopes for imaging scans and for treatments very carefully.

The table shows the radiation emitted and half-lives of 6 radioactive samples.

Sample	Radiation Emitted	Half-life
A	Alpha	10 days
B	Alpha	1600 years
C	Beta	8.0 days
D	Beta	2.7 days
E	Gamma	5.3 years
F	Gamma	8 days

- (a) Which sample is suitable to be used as a radioactive tracer for an imaging scan?

Explain your answer.

Use data from the table.

Sample .....

Explanation .....

.....

.....

.....

.....

[3]

Around half of the candidates were given marks on this question. Those who were not given any marks tended not to use the data from the table and instead gave answers about the three types of radiation and their properties, rather than relating them to the specific isotopes given in the table.

### Misconception



Candidates often get the idea that half-life is related to the rate of decay but many seem to think that the half-life is the time it takes for all the radiation to disappear from the body. In this question for example many candidates wrote about isotope F only lasting 8 days before disappearing entirely.

## Question 8 (b)

(b) Samples A and B emit alpha radiation.

Suggest **two** precautions that should be taken by hospital staff when handling samples A and B.

1 .....

2 ..... [2]

Most candidates were able to identify some safety precautions, though some answers were not detailed enough and were along the lines of reducing exposure but without saying how and wearing safety goggles rather than an appropriate form of PPE.

## Question 8 (c)

(c) One of the samples in the table is radium-226.

Determine the number of neutrons in a nucleus of a radium-226 atom.

Use the Data and Equation Sheet.

Number of neutrons = ..... [2]

Under half of candidates were given marks on this question. The most common was 1 mark for identifying the (atomic) number 88 from the Periodic Table. One common wrong answer was 113, perhaps arrived at by halving the 226 in the question and possibly due to confusion with half-life.

### Question 8 (d)

(d) How many outer shell electrons does each radium-226 atom have?

Explain your answer.

Use the Data and Equation Sheet.

Number of outer-shell electrons .....

Explanation .....

.....

.....

[2]

Very few candidates gave the correct answer of 2 with most of those who attempted the question stating 8 – showing perhaps that they understood the maximum capacity of the outer shell for the first 20 elements they have been taught about is 8 – but not realising that an element in Group 2 must have two outer shell electrons.

### Question 8 (e)

(e) Another of the radioactive isotopes in the table is iodine-131.

Which element will most readily react with iodine-131 to form a salt?

Tick (✓) **one** box.

Copper

☐

Gold

☐

Neon

☐

Sodium

☐

[1]

Most candidates correctly chose sodium.

## Question 9 (a)

9 Some students are learning about radioactivity and radioactive half-life.

(a) What is the definition for the activity of a radioactive source?

Tick (✓) **one** box.

The current produced by the particles.

☐

The purpose the radioactive sample is used for.

☐

The number of decay events per second.

☐

The type of radiation that the substance emits.

☐

[1]

Around a third of candidates could correctly define activity.

## Question 9 (b)

(b) What is the definition of half-life?

Tick (✓) **one** box.

Half of the original activity of a sample.

☐

Half the lifetime of a radioactive substance.

☐

The time for half of a decay to happen.

☐

The time for the activity to fall to half.

☐

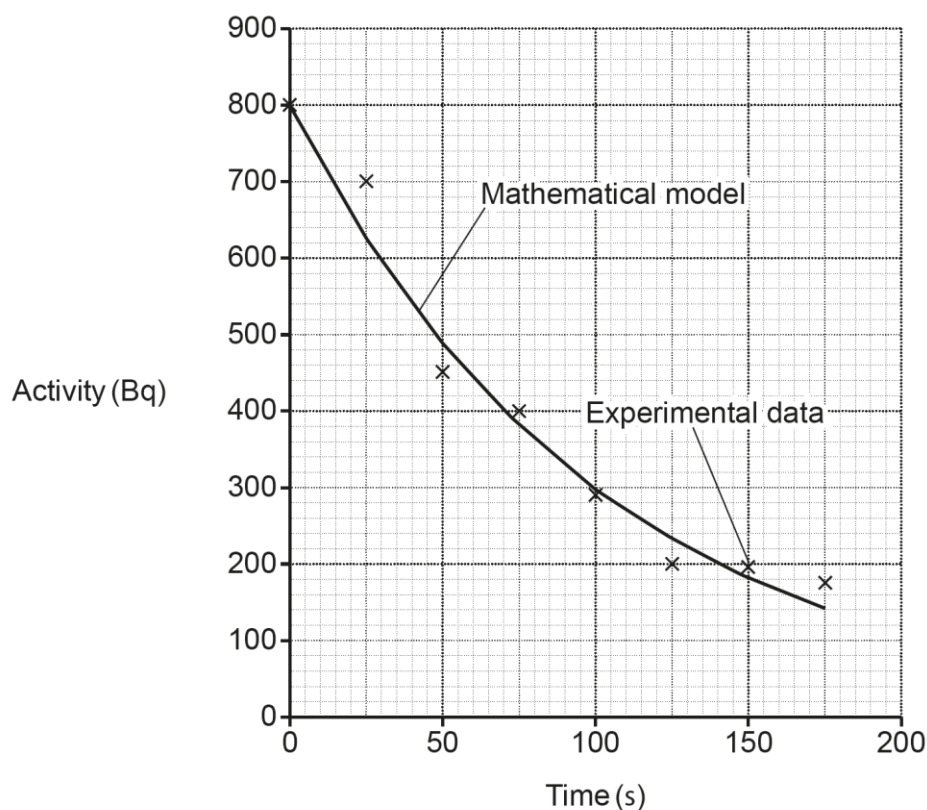
[1]

Very few candidates could correctly define half-life, with a fairly even spread between the other three incorrect answers.



## Question 9 (c)

- (c) The graph shows experimental data from a radiation detector, and a separate mathematical model of decay.



Complete the sentences about radioactive decay.

Use words from the list.

complete	match	random	replace	selective	trend
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Radioactive decay is a ..... process.

Experimental data may not ..... the model results due to chance

but the overall ..... will be the same.

[3]

Around half of candidates correctly chose two words to complete the sentences with around a third choosing all three correct options.

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