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Examiners' report

GCSE

COMBINED SCIENCE B (TWENTY FIRST CENTURY SCIENCE)

OCR Level 1/Level 2 GCSE (9-1) in Combined Science B (Twenty First Century Science)

J260

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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 responses 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 Teach Cambridge.

Paper 4 series overview

This paper is the fourth and final paper in the foundation level GCSE Combined Science B (Twenty First Century) Foundation Tier suite..

It includes short (1-mark) questions, longer questions requiring answers containing more detail and one (6-mark) Level of Response question and can include questions drawn from any area of the specification.

The overlap questions with the higher paper are Questions 8 and 9.

Questions 3 (a), 3 (b), 5 (c) (ii), 6 (b) (ii), 6 (c), and 6 (d) all had higher omit rates than other questions – more candidates left these questions blank than any others.

Candidates are reminded that they need to use the information provided in questions and not just repeat it. It is good practice to show all working in calculations and this can score compensation marks should the final answer be incorrect. Most candidates made at an attempt at all the questions.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• used a suitable level of scientific language, e.g. avoided words like 'pollution' and used 'acid rain' instead in Question 8 or 'time increases' as opposed to 'slower time' in Question 1 • gave the direction of a change (increased/decreased) rather than just saying a quantity changed • carefully structured their answers to the Level of Response question to make sure they mentioned everything asked for in the question • considered the number of marks available for each question and wrote an appropriate level of detail in their answer • considered the underlying experimental procedure in the chromatography question rather than just thinking about their own experience of chromatography in their lessons.	• only gave the final answer in calculations and did not show their working out • confused terms like accuracy, precision and repeatability in the questions about experimental procedure • quoted data from the question rather than 'adding value' to this by expanding on it, e.g. in Questions 7 (b) and 8 (a) • drew inaccurate lines of best fit and did not plot points on the graph accurately in Question 1 (c) • gave superficial answers about repeating measurements in Questions 4 (b) (ii) rather than tailoring their answers to what they question was asking • tried to complicate answers rather than going for the obvious correct answer, e.g. Question 5 (a) (ii).

Question 1 (a) (i)

1 This question is about acids and metals.

(a) This is the symbol equation for the reaction between magnesium, and hydrochloric acid:

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

(i) Which gas is made when magnesium reacts with hydrochloric acid?

Tick (✓) **one** box.

- Carbon dioxide ☐
- Hydrogen ☐
- Oxygen ☐
- Steam ☐

[1]

The majority of candidates chose the correct answer here. The most common incorrect answer was carbon dioxide.

Question 1 (a) (ii)

(ii) Which salt is made when magnesium reacts with hydrochloric acid?

Tick (✓) **one** box.

- Magnesium carbonate ☐
- Magnesium chloride ☐
- Magnesium hydroxide ☐
- Magnesium oxide ☐

[1]

Around half of candidates got the right answer to this question. Candidates should look carefully at any equations given in the stem of the question as it appeared that many attempted to guess the answer.

Question 1 (a) (iii)

(iii) Complete the sentences to describe how magnesium bonds with chlorine.

Use words from the list.

gaining	**ions**	**losing**	**molecules**	**polymers**	**sharing**

Each Mg atom becomes Mg^{2+} by ..... two electrons.

Each Cl atom becomes Cl^- by ..... one electron.

The new particles formed, Mg^{2+} and Cl^-, are called ..... .

[3]

This question proved challenging for many candidates and the first two answers 'losing' and 'gaining' we're often the wrong way around. Many candidates thought the final answer was polymers.

Question 1 (b) (i)

(b)

(i) Hydrochloric acid is made by dissolving hydrogen chloride in water.

What forms when acids dissolve in water?

Tick (✓) **one** box.

Cl^- ☐

Cl^+ ☐

H^- ☐

H^+ ☐

[1]

This question revealed a potential area of the syllabus teachers may wish to emphasise in their teaching. Only a few candidates recognised that H^+ is the defining feature of an acid.

Question 1 (b) (ii)

(ii) The list shows the order of reactivity of some elements from most reactive to least reactive.

Most –	Rubidium
	Potassium
	Magnesium
	Aluminium
	Carbon
	Zinc
	Iron
Least –	Copper

Why is magnesium extracted by electrolysis and **not** by reaction with carbon?

.....

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

Slightly more than half of candidates could explain why magnesium is extracted by electrolysis. Candidates who did not gain this mark tended to use absolute statements such as 'magnesium is reactive' or 'very reactive' (or the reverse for carbon) rather than comparing the reactivities of the two elements.

Question 1 (c) (i)

(c) A student investigates the reaction between magnesium and different concentrations of hydrochloric acid.

The student times how long it takes to collect 50 cm^3 of gas.

The results are shown in the table:

Concentration of hydrochloric acid (mol/dm^3)	Time taken (s)
0.2	60
0.4	30
0.6	10
0.8	5.0
1.0	2.5

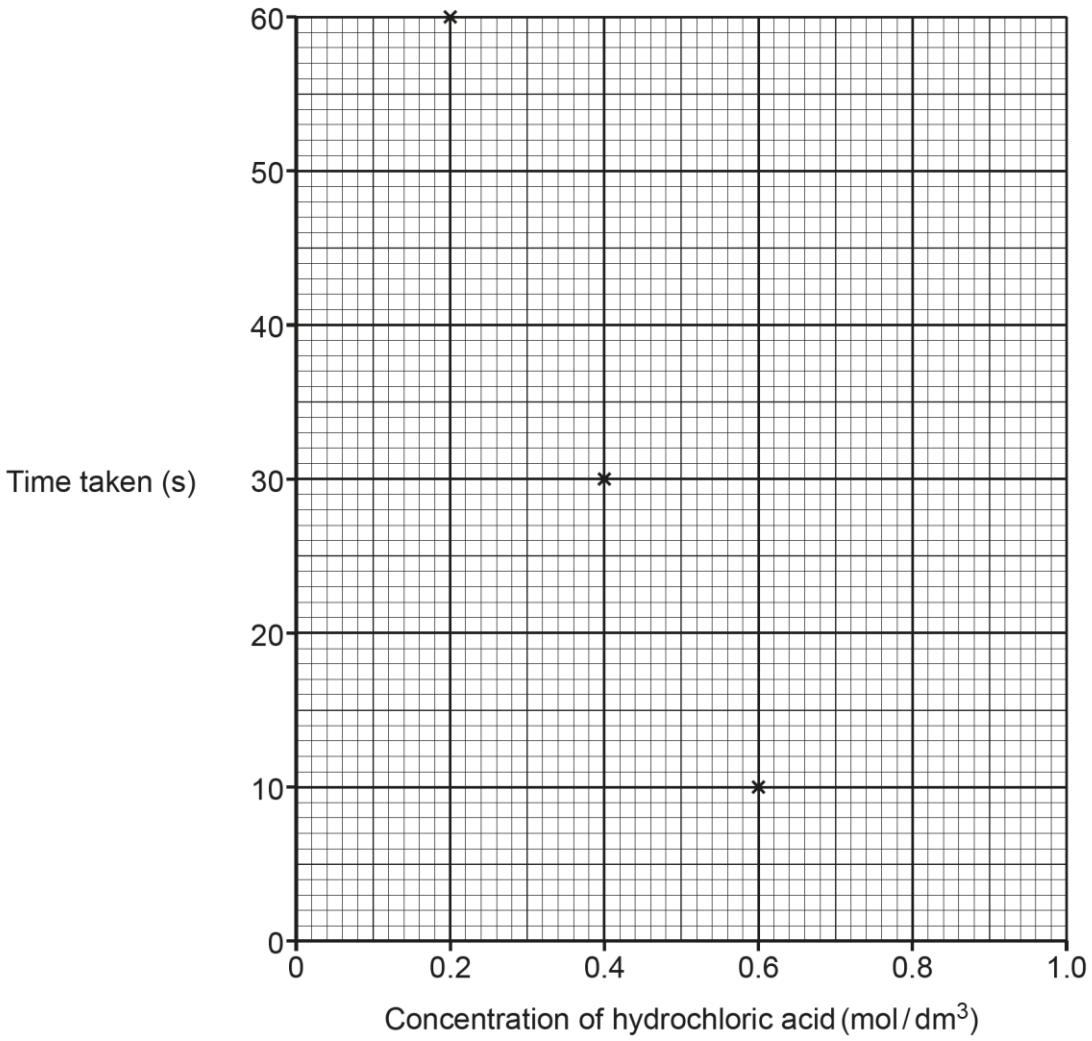
(i) Plot the results from the table on the graph.

Three points have already been plotted. **[1]**

The majority of candidates correctly plotted the two points. Some candidates used overly large crosses or blobs so it was difficult for examiners to judge where the point was actually placed.

Question 1 (c) (ii)

(ii) Draw a curve of best fit on the graph. **[1]**



Most candidates could draw a reasonable freehand curve of best fit. Those who did not score this mark tended to join the points with a ruler, had overly wobbly lines, lines that were too thick or 'feathered' the line that they drew so that it became scruffy.

Question 1 (c) (iii)

(iii) Describe the effect of changes in concentration on the time taken.

.....

.....

.....

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

Few candidates gained the second mark on this question.

Just over half could describe the trend shown by the line but hardly any candidates developed their answer further to explain that the size of the change in time was smaller for higher concentrations than for lower concentrations.

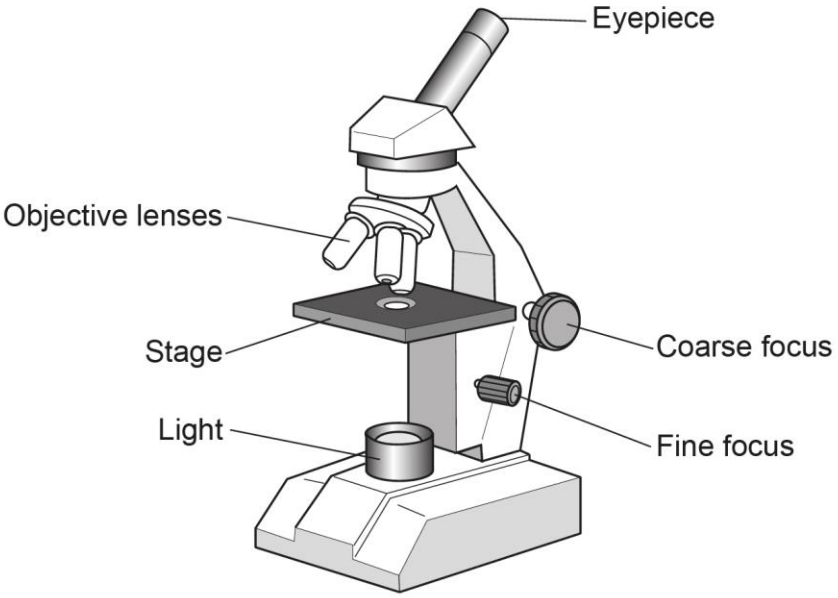
Most candidates tried the question but those who gained no marks here gave vague answers along the lines of 'it decreases' without specifying variables.

When answering questions that ask about the relationship between two variables, candidates need to state both variables in their answer and then mention the link between the two.

Candidates should avoid phrases like 'faster time' or 'slower time' (as time is not a quantity that can be faster or slower, only longer or shorter) or mention of 'correlation'.

Question 2 (a)

2 A student is looking at stomata from a leaf using an optical microscope.



(a) This is the student's method but it is **not** in the correct order:

A Focus using the coarse focus knob.

B Spread nail varnish on the underside of a leaf and allow to dry.

C Place the glass slide in the middle of the stage.

D Focus using the fine focus knob.

E Peel off the dried nail varnish and place it on a glass slide.

Write the letters in the boxes to show the correct order of the statements.

The first one has been done for you.

B				

[2]

Most candidates gained at least 1 mark on this question.

Question 2 (b)

(b) The magnification of the microscope's eyepiece is ×10. The objective lens is ×40.

What is the total magnification?

Use the equation:
total magnification = magnification of eyepiece lens × magnification of objective lens

Tick (✓) **one** box.

×10 ☐

×40 ☐

×50 ☐

×400 ☐

[1]

This question was highly scoring, with most candidates choosing x400.

Question 2 (c)

(c) The student looks down the microscope and counts how many stomata they can see.
They repeat this measurement in four other areas of the leaf.

The table shows their results:

Area sampled	**1**	**2**	**3**	**4**	**5**
Number of stomata	36	35	32	33	34

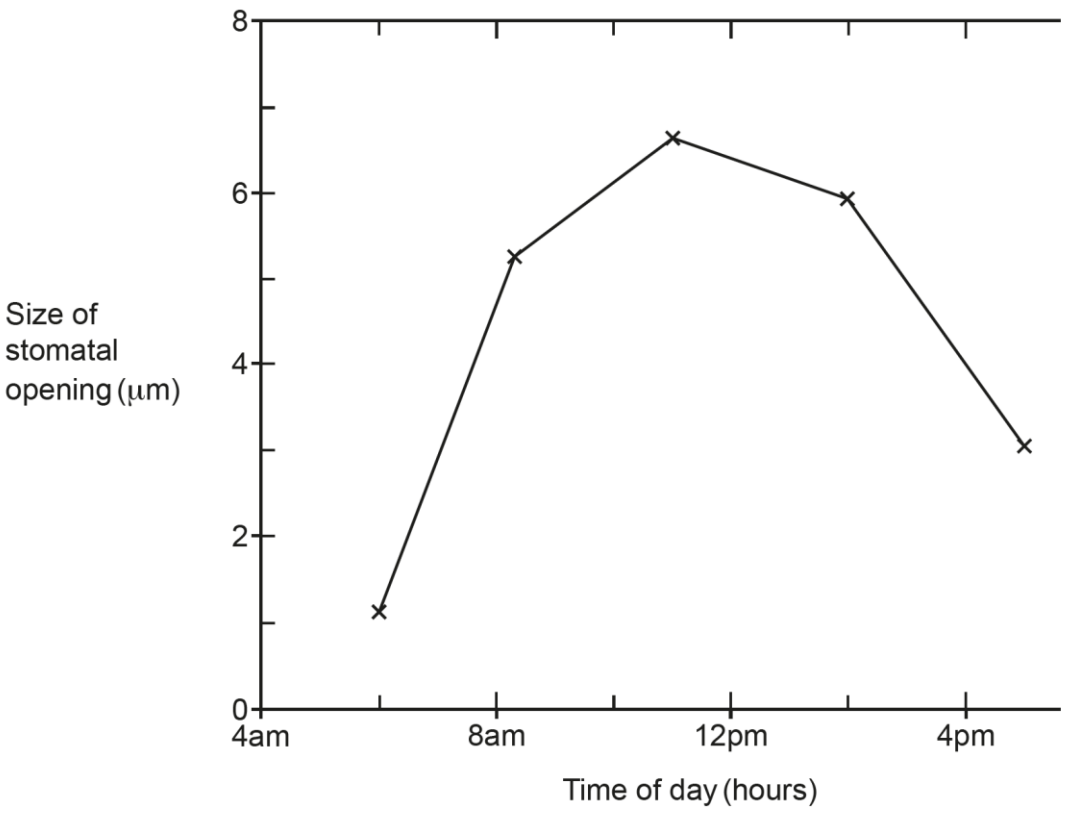
Calculate the mean number of stomata.

Mean number of stomata = ... **[2]**

Candidates were generally able to calculate the mean from a set of data, with the majority of candidates gaining both marks on this question. It was rare for candidates to try the calculation and then get it wrong.

Question 2 (d) (i)

(d) Scientists have examined how the size of a stomatal opening changes during the day. Their results are shown in the graph.



(i) Describe the trend shown by the graph.

.....

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

Many candidates tried to explain the shape of the curve rather than just to describe what it was showing. Some candidates explained that the peak was at midday and this was considered insufficient to describe the trends shown in the graph.

Assessment for learning

Candidates often confuse the command words 'describe' and 'explain'.

Broadly speaking, 'describe' means say *what* happens and 'explain' means say *why* it happens.

Question 2 (d) (ii)

(ii) Stomata may open and close in response to environmental conditions.

Use the graph to suggest **one** environmental condition that may cause stomata to open.

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

Most candidates gained the mark on this question. The most common reason for not doing so was not answering about why the stomata opened, in terms of an environmental factor, and instead stating that it was something to do with the time of day itself rather than the amount of light or heat at that particular time of day.

Question 2 (e)

(e) Studies have shown that some plant species in **warming climates** have reduced the number of stomata on their leaves.

Complete the sentences to explain how this change occurred through evolution.

Use terms from the list.

chloroplasts	**die**	**natural selection**	**no change**
nucleus	**selective breeding**	**survive**	**variation**

In a population of plants, there is ..... in the number of stomata each plant has.

Plants with lower numbers of stomata lose less water. This makes them more likely to ..... and reproduce. Some plant species have evolved to have fewer stomata through the process of ..... .

Plants rely on stomata for gas exchange.

Carbon dioxide is used in the ..... as a reactant in photosynthesis.

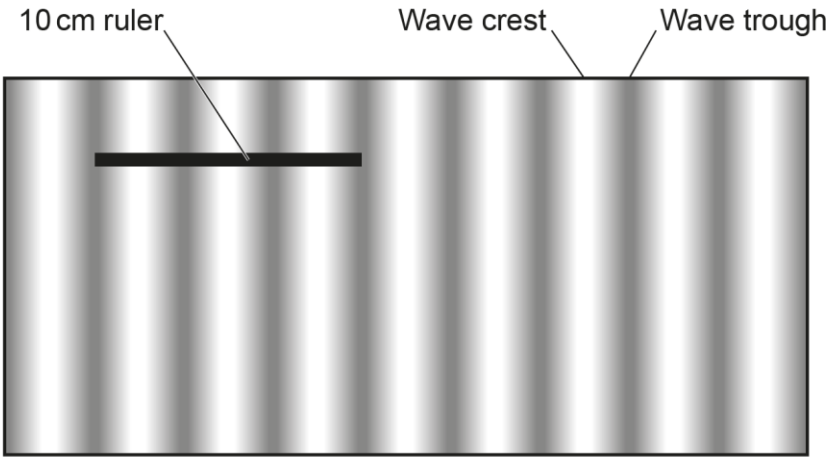
[4]

This question proved to be a good differentiator. The most common correct answer was 'survive' in the second gap, variation in the first gap was the next most common, followed by chloroplasts in the last, but many candidates were confused between natural selection and selective breeding, hinting at a possible misconception.

Question 3 (a)

3 A student is using a ripple tank to investigate how the speed of water waves depends on the depth of the water.

(a) The image shows the observations from one experiment.



Estimate the wavelength of the waves.

Wavelength = ... cm **[2]**

This question proved to be challenging for the majority of candidates with very few gaining any marks at all on the question. This could possibly indicate that candidates did not recall seeing a ripple tank before. It was not uncommon to see candidates attempting to incorrectly use $v = f\lambda$.

Question 3 (b)

(b) The waves are generated by a vibrating bar.

The mean number of waves leaving the vibrating bar in five seconds is 18.3.

Calculate the frequency of the waves.

Frequency = ... Hz **[2]**

Very few candidates were able to do this question. Some candidates attempted to calculate the frequency by dividing 18.3 by seemingly random numbers that were not included in the question. This could potentially indicate that candidates do not know that frequency is the number of waves passing a point in one second. Again it was not uncommon to see candidates attempting to incorrectly use $v = f\lambda$.

Question 3 (c)

(c) The student repeats the experiment with a different depth of water, and obtains new results:

Wavelength (cm)	2.5
Frequency (Hz)	4.0

Calculate the speed of these water waves.

Give your answer in **cm/s**.

Use the Data and Equation Sheet.

Speed of water waves = ... cm/s **[3]**

Most candidates scored all of the marks on this question by ending up with the final correct answer Indicating that candidates are familiar with the use of the formula $v = f\lambda$.

Question 4 (a)

4 This question is about cardiovascular health and fitness.

(a) A student is measuring their pulse rate. They count their pulse over 60 seconds.

Describe how the student can measure their pulse.

.....

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

This was well answered by the majority of candidates who could correctly describe how to take a pulse. Those who did not get the mark tended to give vague answers in terms of touching various parts of the body rather than the usual places where one might take a pulse. For example 'place your fingers on your skin' or 'touch your neck'.

Question 4 (b) (i)

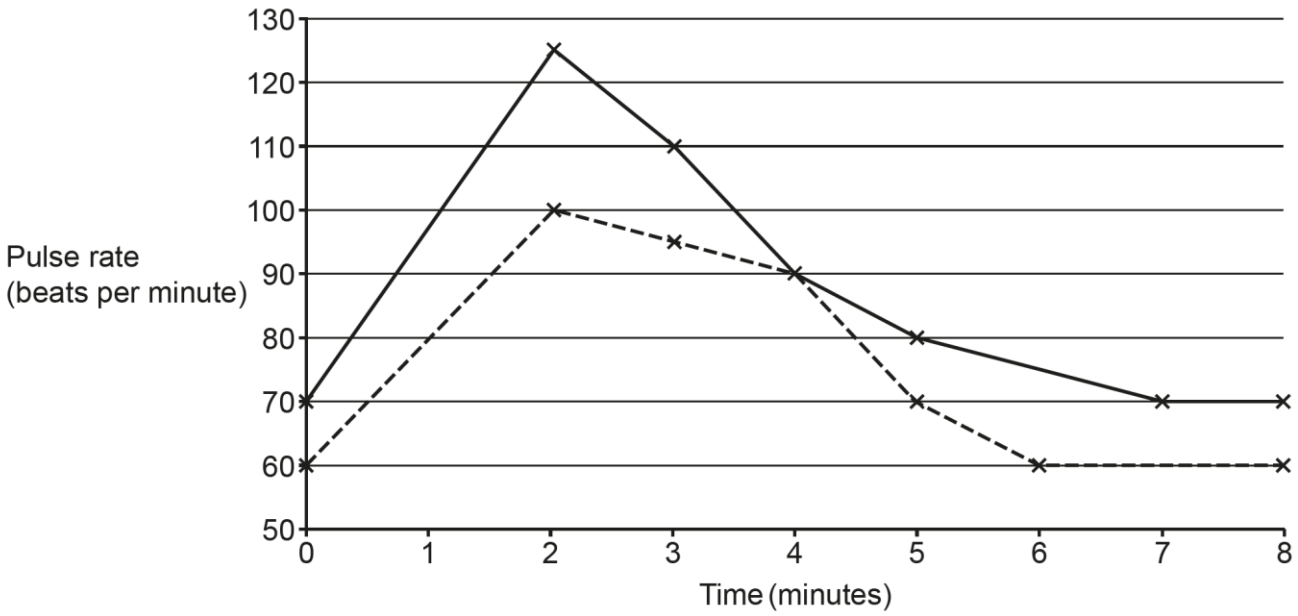
(b) Two students are investigating recovery rates using this method:

- Measure resting pulse rates.
- Exercise for 2 minutes.
- Measure pulse rate immediately after exercise.
- Measure pulse rate every minute until it returns to the resting pulse rate.

The graph shows their results.

—— Student A

---- Student B



(i) The students conclude that student **B** had a greater fitness level.

Which **two** statements support this conclusion?

Tick (✓) **two** boxes.

Student B has a lower resting pulse rate. ☐

Student B's pulse rate increased faster. ☐

Student B's pulse rate peaked at a higher value. ☐

Student B's pulse rate returned to resting sooner. ☐

[2]

This was answered correctly with many candidates choosing the two correct options.

Question 4 (b) (ii)

(ii) To be more confident in their conclusion, they decide to repeat their experiment.

Suggest **one** improvement to their method to increase the validity of their conclusion.

.....

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

A minority of candidates were able to explain that both subjects would need to do the same thing in order to make the investigation more valid. Most candidates wrote about repeating the procedure and checking it rather than standardising what the people were doing. Some candidates thought that doing more exercise, rather than the same exercise, would make the procedure more valid. Some candidates thought that ensuring both people had the same heart rate at the beginning of the exercise would help. Examiners considered this to be difficult to achieve with two different people and so it was not worthy of credit.

Question 4 (c) (i)

(c) High blood pressure is a risk factor for cardiovascular disease.

Enalapril is a drug that can lower blood pressure. A doctor has recommended a patient begin taking this drug.

(i) Suggest **one** health-related question the **patient** may ask the doctor before they begin taking this drug.

.....

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

Most candidates were able to come up with a reasonable question that a patient would ask a doctor before taking a new drug. Consideration of side effects was the most common answer, with questions about dosage and whether they were able to continue their everyday activities being the other common answers.

Question 4 (c) (ii)

(ii) Suggest **one** question the **doctor** should ask the patient before they prescribe them this drug.

.....

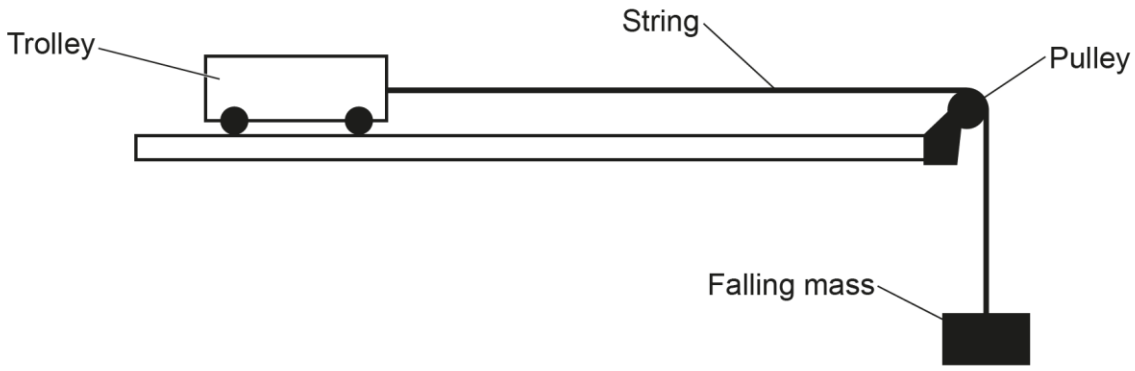
..... **[1]**

Similarly to the previous question most candidates were able to come up with a question a doctor would ask of a patient before prescribing them a new drug, although some candidates gave a further example of a question that a patient would ask the doctor instead.

Question 5 (a) (i)

5 A student is investigating how the resultant force acting on a trolley affects its acceleration.

The diagram shows the apparatus used by the student in their investigation.



(a)
(i) Describe how the pulling force of the string on the trolley can be increased.

.....

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

Most candidates got the idea of adding masses to the string but some candidates omitted to mention where to put the extra weights, which was too vague. Other candidates incorrectly added them to the top of the trolley.

Question 5 (a) (ii)

(ii) Describe how the friction of the wheels of the trolley can be reduced.

.....

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

Few candidates said to lubricate the surface. Many candidates wanted to change a feature of the trolley, for example, use larger wheels or remove mass from the body of the trolley. Some candidates gave features that would increase, rather than decrease, the friction, e.g. using rubber wheels.

Question 5 (b) (i)

(b) The student measures the time taken for the trolley to travel a distance of 1.0 m.

(i) Why does the student repeat this time measurement three times and then calculate the mean?

Tick (✓) **one** box.

To reduce the effect of air resistance on the result. ☐

To reduce the effect of friction on the result. ☐

To reduce the effect of random errors on the result. ☐

To reduce the effect of systematic errors on the result. ☐

[1]

Approximately half of candidates selected the correct answer.

Question 5 (b) (ii)

(ii) For a particular resultant force, it takes the trolley a mean time of 2.0 s to travel a distance of 1.0 m.

Calculate the acceleration of the trolley.

Use the equation: acceleration = $\frac{2 \times \text{distance}}{\text{time}^2}$.

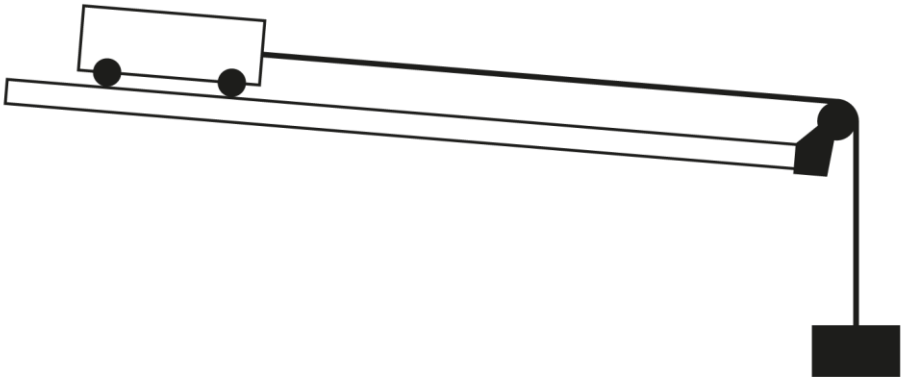
Acceleration = ... m/s^2 **[2]**

This was well answered by candidates, with the majority of those who tried gaining both marks. The most common error was to not square the time.

Question 5 (c) (i)

(c) The student raises one end of the table to compensate for friction so that the resultant force acting on the trolley is equal to the pulling force of the string.

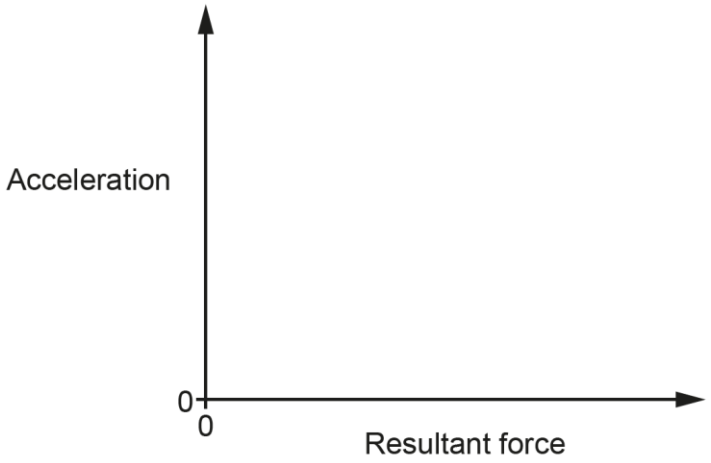
The diagram shows this change.



(i) When the pulling force of the string is zero, the trolley travels at a constant speed down the slope.

The student repeats the experiment by changing the pulling force of the string multiple times.

Draw a line on the axes to show the expected results of the student's experiment.



[2]

Around half of candidates gained both marks, with around few gaining 1 mark, most commonly for a non-linear graph that went through the origin. Examiners were generous here and marked the candidates' intent rather than needing perfectly straight lines, small gaps and accuracy. A sketch was all that was required.

Question 5 (c) (ii)

(ii) Explain your answer to **(c)(i)**.

.....

.....

.....

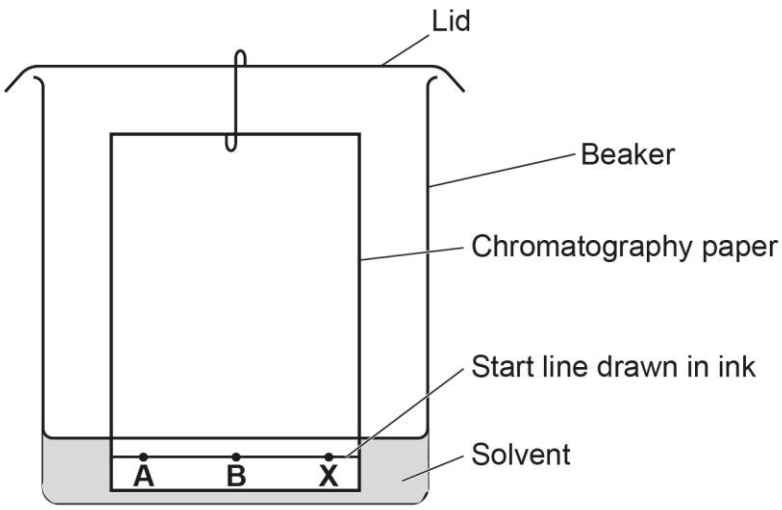
..... **[2]**

It was rare to see any mention of direct proportion in candidates' answers but many candidates did what was required in Question 1 (c) (iii) for 1 mark – i.e. stated the names of the two variables and then linked them with the relationship.

Question 6 (a)

6 A student is investigating the composition of some ink samples **A**, **B** and **X**, using chromatography.

(a) The student sets up the experiment as shown in the diagram.



Identify **two** mistakes that the student has made.

1. .....

.....

2. .....

.....

[2]

Most candidates were able to demonstrate their familiarity with chromatography. A small number of candidates thought the lid would pose a problem or thought that the label X should have been C to complete the sequence A, B, C. Others avoided using one piece of chromatography paper for all three samples.

Question 6 (b) (i)

(b) The student corrects their mistakes.

Ink Sample **A** is pure.

(i) Ink Sample **X** is a mixture.

One of the substances in Ink Sample **X** travels 24 mm on the chromatogram.
The solvent travels 39 mm.

Calculate the Rf value of this substance in Ink Sample **X**.

Use the equation: $Rf = \frac{\text{distance travelled by the solute}}{\text{distance travelled by the solvent}}$

Give your answer to **2** significant figures.

Rf value = ... **[3]**

Most candidates score some of the marks on this question, with a plurality scoring all 3 marks. Those who incorrectly rounded to 0.61 were usually given 2 marks for correct working to three significant figures or better, rather than the final answer. We are still seeing some candidates write only the final incorrect answer and this makes it hard to compensate them for working. Some candidates tried to do the division upside down.

Question 6 (b) (ii)

(ii) How could you conclude from the chromatogram that Ink Sample **X** is a mixture?

.....

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

This question proved to discriminate across the mark distribution with only one-fifth of candidates able to explain why sample X is a mixture. Some candidates tried to link the answer to Rf values or distance up the paper and others used vague terms such as being able to see the colour (rather than colours) of the ink.

Question 6 (c)

(c) Another substance in Ink Sample **X** does **not** travel up the chromatography paper.

Suggest **one** change to the experiment that would cause this substance to travel up the paper.

.....

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

This question also proved challenging for most candidates with most writing in terms of using more or less solvent rather than a different one. The question does not name the solvent, so examiners ignored references to using water. Candidates seem well-versed on the basics behind chromatography but found it more challenging to understand in more depth.

Question 6 (d)

(d) Ink Sample **B** is also a mixture. All of the components of Ink Sample **B** have similar solubility in the solvent, but have different boiling points.

Explain why simple distillation should be used instead of chromatography to separate this ink sample.

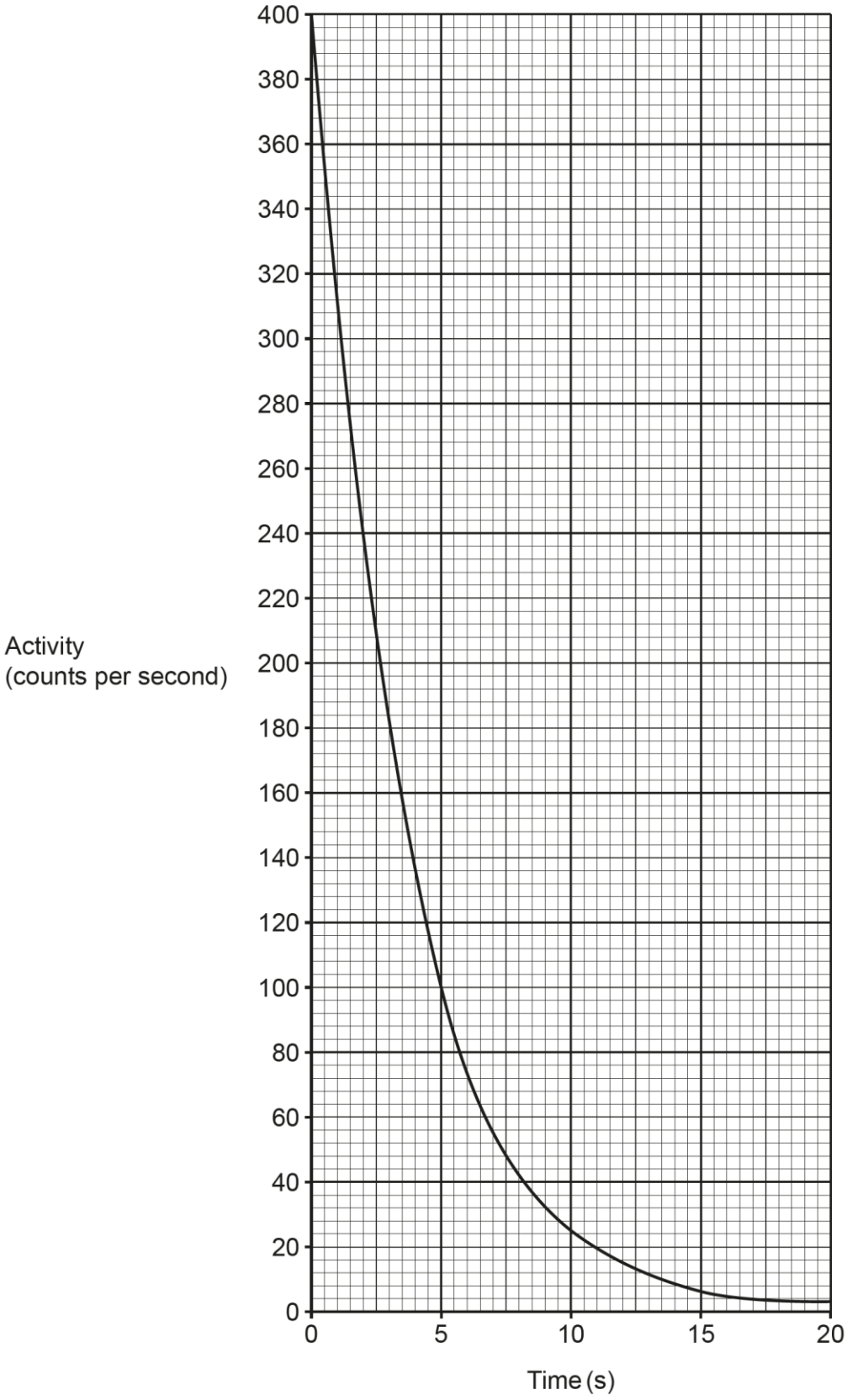
.....

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

Very few candidates were able to explain why distillation would be unsuitable with most repeating information already given in the question rather than trying to apply their knowledge.

Question 7 (a)

7 Carbon-15 is a radioactive isotope that emits beta particles.
The graph shows the activity of a sample of carbon-15.



(a) Use the graph to find the half-life of carbon-15.

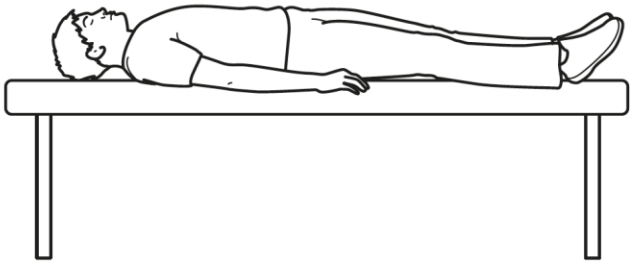
Half-life = ... s **[2]**

Candidates seemed to be unfamiliar with finding half-life from a graph with only around one-third of candidates scoring any marks. Candidates should be trained to show on the graph how they obtain their answer by adding lines from the point to the axes in both vertical and horizontal directions.

Question 7 (b)*

(b)* A patient goes to a radiology department in a hospital to have a kidney scan.

A radioactive tracer is injected into the patient's arm. After a few hours, a set of images are taken on a camera. The camera uses the radiation emitted by the radioactive tracer to form an image of the kidney.



The table shows information about some radioactive isotopes that are used in radioactive tracers.

Isotope	Radiation emitted	Half-life
actinium-225	alpha particles	10 days
bromine-82	beta particles	36 hours
iodine-131	beta particles and gamma radiation	8 days
technetium-99m	gamma radiation	6 hours

Which isotope should be used for injection into the patient's arm?

Explain your answer.

You should also consider:

- penetrating power
- ionising power.

.....

.....

.....

.....

.....

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

Most candidates tried this question with varying degrees of success.

The most common incorrect approach was to think that an alpha source would be best as it is 'weak' or that gamma is 'strong', so gamma must be somehow more 'dangerous', thereby using vague, non-technical vocabulary. Others thought that alpha would be best as it cannot leave the body. Better answers applied the properties of the radiation to the scenario provided in the question i.e. needing a source that could be detected outside the body and was not overly ionising and with a low half-life.

Some candidates thought the radiation was being used to treat some kind of disease rather than being used as a diagnostic tool

The very best answers were structured logically and only took up a few lines, often bullet points. Candidates often feel the need to fill the space but a succinct answer of a few words, structured using the headings in the question often score the highest marks.

Less successful responses tended to repeat the information from the table or give incorrect science.

Assessment for learning

The best Level of Response answers tend to be ones where the candidate has structured their answer before thinking about the science content, as opposed to writing a page full of dense text.

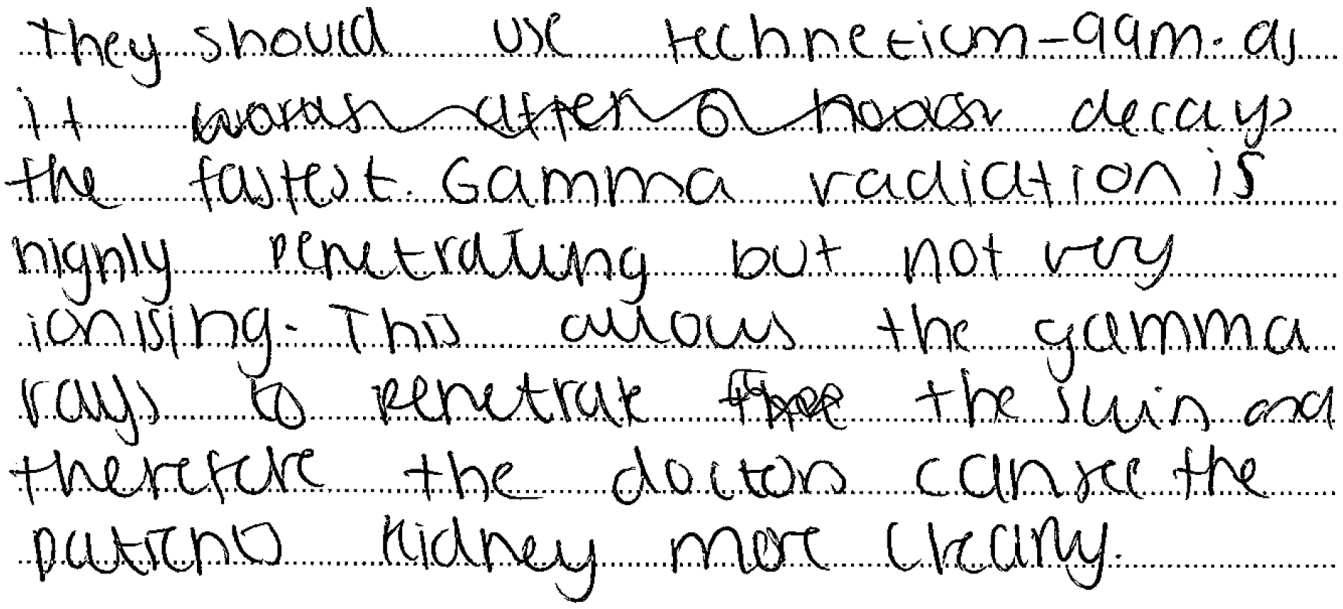
For example here, we are being asked about which isotope should be used in this situation and to link this to the penetrating properties and the ionisation power.

A structure like the one below would make sure candidates mention everything required by the mark scheme in order to maximise their chance of getting 6 marks:

- Isotope chosen
- Suitable penetrating properties
- Ionisation power

Level of Response questions are not designed to be any more difficult than other questions but some candidates do not attempt them, perhaps because they see a page full of blank space and don't know how to proceed. Structuring the answer may be a useful tactic for some candidates.

Exemplar 1



Exemplar 1 gained all 6 marks and is a good example of a succinct, high scoring response.

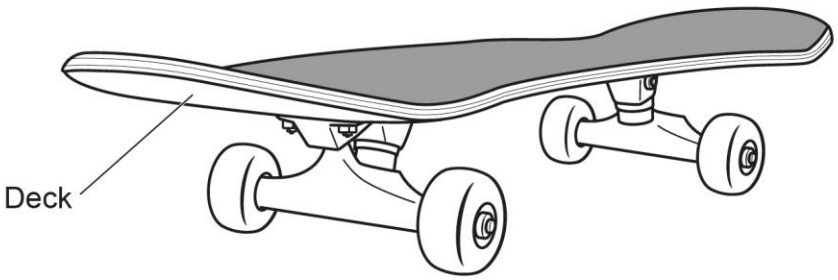
Exemplar 2

The isotope that should be used for injection into the patient's arm should be the technetium-99m isotope. this is because a half-life should remain in the body for about 6 hours, which would be perfect for this isotope. this is as if it's in the body for not that long, then the radioactive tracer wouldn't work and it would not be useful, however and if it's in the body for too long, it can be dangerous for the human body as it could kill you due to the radiation. in the body for a long period of time However 6 hours would be a good amount as you are able to form an image from the radiation, but also it wouldn't last long in your body, so less penetrating and ionising power and it would be more advantageous [6] than the rest of the other isotopes. Although gamma radiation can be harmful, there would be less side effects in the human body as there would be only one emitted, so quicker recovery in the body. The other isotopes either has much stronger radiation(s) or a longer half-life, which is more dangerous for the body and the kidney.

Exemplar 2 also gained all 6 marks but likely took much longer to write and involved a greater use of space.

Question 8 (a)

8 A skater wants to buy a new skateboard.



The table shows information about three different skateboards.

Skateboard	Deck material	Tensile strength (MPa)	Stiffness (GPa)	Density (kg / m^3)
A	Wood	4	10	700
B	Glass	3400	75	2500
C	Composite	350	10	900

(a) Suggest why the skater chooses to buy Skateboard **C**.

.....

.....

.....

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

Most candidates performed well on this question.

The best answers used the information from the table and applied it to the use of a skateboard.

Less successful responses used terminology such as 'good stiffness' and 'best density' rather than using comparatives such as higher and lower.

Some candidates just quoted numbers from the table and did not 'add value' to what they had been presented with. Candidates should be trained to 'add value' by saying something about the data they quote.

Question 8 (b)

(b) State why the development of composite materials is beneficial when designing new products.

.....

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

There were few correct answers to this question. We wanted a definition of a composite material, whereas most candidates answered in terms of composite materials being somehow better for the environment, more sustainable or in terms of a composite materials' suitability for a particular task rather than being focused on combining the properties of more than one material. Others answered in terms of the skateboard rather than the more general way in which the question was phrased.

Question 8 (c)

(c) The skater decides to recycle the old skateboard so that it does not take up space in landfill.

State **one** other factor that should also be considered when disposing of a skateboard.

.....

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

This question was well answered with many candidates applying their knowledge of the life cycle of a product to its disposal.

Question 8 (d) (i)

(d) The skateboards are transported to shops in lorries that burn diesel.

(i) One gas that forms when diesel burns is sulfur dioxide.

Explain **one** problem caused by increased amounts of sulfur dioxide in the atmosphere.

.....

.....

.....

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

Most candidates did not appreciate the link between sulfur dioxide and acid rain. Answers tended to be in terms of 'pollution', climate change, greenhouse effects or ozone depletion. This may point towards a misconception.

The most common answer was related to respiratory problems from breathing in the SO_2.

Misconception

Candidates seem to think that all pollutant gases have the same effects on the environment.

CO_2, NO_X and SO_2 all have different effects and candidates should be aware of these.

Question 8 (d) (ii)

(ii) Carbon monoxide and nitrogen monoxide are also formed when diesel burns.

Catalytic converters help to decrease these emissions into the atmosphere by converting:

- nitrogen monoxide into nitrogen
- carbon monoxide into carbon dioxide.

Complete the equation to show the reaction that occurs in a catalytic converter.

$$2CO + 2NO \longrightarrow 2CO_2 + ...$$

[1]

Few candidates were credited the mark, with many writing an answer that did not contain an N.

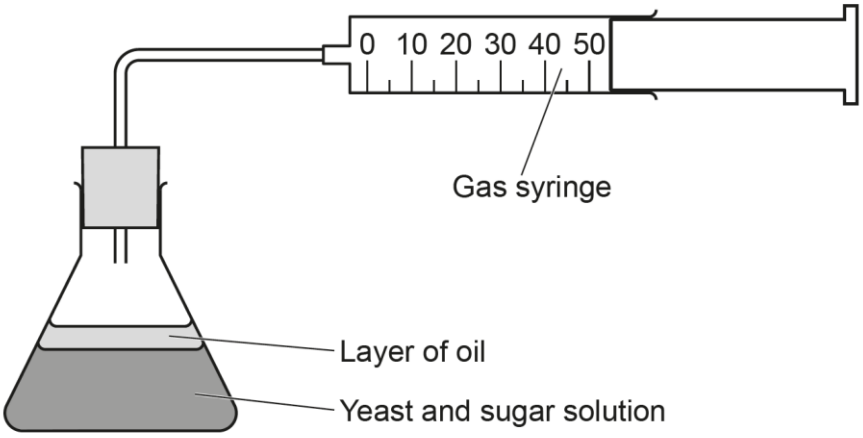
Candidates should be encouraged to work logically through the complete side of the equation and look for what is missing on the incomplete side.

The closest answer some candidates gave was 2N.

Question 9 (a)

9 A student is investigating the rate of anaerobic respiration in yeast using this method and the apparatus shown:

- Add glucose to a yeast solution.
- Add a layer of oil on top to prevent oxygen reaching the yeast.
- Measure the volume of carbon dioxide made in 20 minutes.
- Repeat using sucrose and maltose.



(a) The student controls the temperature of the yeast and sugar solution to make sure their comparisons are valid.

Describe **how** the student should control the temperature.

.....

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

The student's results are shown in the table:

Type of sugar	**Volume of carbon dioxide collected in 20 minutes (cm^3)**
Glucose	35
Sucrose	25
Maltose	30

Candidates needed to tell the examiner *how* to keep the temperature constant. Just repeating the question and saying 'keep the temperature constant' was insufficient, as was the idea of leaving the flask at room temperature. We needed to know *how* the room temperature might have been kept constant. Some candidates said to use a thermometer, but this would only measure the temperature and not control it.

Candidates seemed to be very unfamiliar with the use of water baths.

Question 9 (b)

(b) Explain how the student could improve the accuracy of the gas volume measurements.

.....

.....

.....

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

Issues using the terms accuracy, reliability, repeatability, etc. showed up in most answers to this question.

Some candidates understood the idea of using a syringe with smaller divisions but the most common answer was repeating the experiment three times and finding an average.

Question 9 (c)

(c) Calculate the rate of carbon dioxide production for the yeast and **glucose** solution.

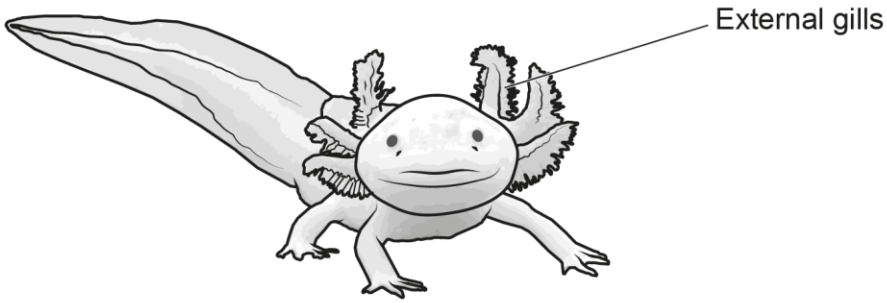
Rate of carbon dioxide production = ... cm^3 / minute **[2]**

Some candidates attempted to multiply the numbers rather than divide them. Candidates can use the units as an indication as to which mathematical operation to undertake.

Question 9 (d)

(d) Yeast cells absorb oxygen across their cell membranes.

An axolotl is a multicellular animal that lives in water. It has external gills for gas exchange.



Explain why an axolotl needs external gills for gas exchange.

Use ideas about surface area to volume ratios in your answer.

.....

.....

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.....

.....

..... **[3]**

This question, while mostly attempted, proved challenging.

Candidates tried to link the axolotl to the yeast from the previous question. Others thought that just mentioning surface area (given in the question) would gain a mark. Again, candidates need to add value to the information they are given.

The most common mark given was for saying the gills gave a larger surface area. It was very rare for examiners to see anything beyond this.

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