

GCSE (9-1)

Examiners' report

**GATEWAY SCIENCE
COMBINED
SCIENCE A**

J250

For first teaching in 2016

J250/07 Summer 2023 series

Contents

Introduction	4
Paper 7 series overview.....	5
Section A overview	6
Question 1	6
Question 2.....	7
Question 3.....	7
Question 4.....	8
Question 5.....	8
Question 6.....	9
Question 7.....	9
Question 8.....	10
Question 9.....	10
Question 10	11
Section B overview.....	12
Question 11 (a) (i).....	13
Question 11 (a) (ii).....	14
Question 11 (a) (iii).....	14
Question 11 (b) (i).....	15
Question 11 (b) (ii).....	15
Question 11 (b) (iii).....	16
Question 11 (b) (iv).....	17
Question 11 (b) (v).....	18
Question 12 (a) (i).....	18
Question 12 (a) (ii).....	19
Question 12 (b) (i).....	20
Question 12 (b) (ii).....	21
Question 12 (b) (iii).....	21
Question 13 (a) (i).....	22
Question 13 (a) (ii).....	23
Question 13 (b).....	23
Question 13 (c).....	24
Question 14 (a) (i).....	26
Question 14 (a) (ii).....	27
Question 14 (b).....	27

Question 15* (a).....	28
Question 15 (b).....	30
Question 15 (c).....	31
Question 16 (a).....	31
Question 16 (b) (i).....	32
Question 16 (b) (ii).....	32
Question 16 (b) (iii).....	33
Copyright information.....	34

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 7 series overview

J250/07 is the first of two higher tier papers that determine the Biology content of the GCSE (9-1) Gateway Combined Science A course. The paper assesses content from specification topics B1 -B3 and B7. This paper is not synoptic and so does not contain any material covered by topics B4-B6. There are also questions that involve the assessment of key mathematical requirements from Appendix 5f and working scientifically from Appendix 5e of the specification.

Candidates were able to demonstrate some knowledge and understanding (AO1), although use of precise scientific language was not always evident. There seemed to be an improvement in candidate's ability to apply their knowledge to answer questions (AO2) from previous sessions. However, candidates still find it challenging to analyse information and ideas (AO3). There was some evidence that candidates had been entered for the incorrect tier, with a high proportion of candidates being unable to express their knowledge. This was often down to being unable to articulate themselves clearly, perhaps due to their level of written language skills. These candidates may have had a more rewarding exam experience if entered for the foundation tier. Candidates appeared to have had sufficient time to complete the paper, with the majority attempting most of the questions in Section B including the level of response question.

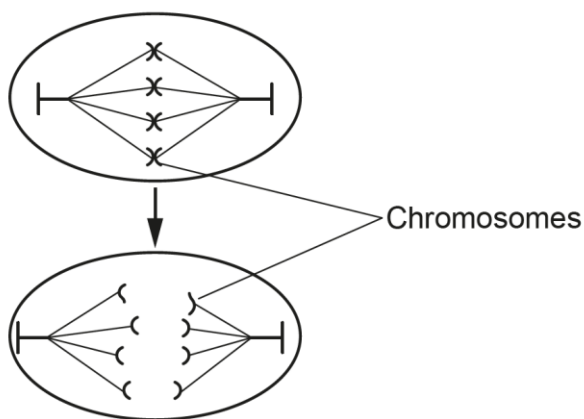
Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> • provided a full explanation of the data in Questions 13 (c) and 14 (b) • were able to explain concepts and apply knowledge and understanding in Questions 11 (b) (iv) and 15 (a) • showed an understanding of practical procedures and how to develop investigations in Questions 11 (b) (v), 14 (a) (i) and 14 (a) (ii) • completed calculations without error in Questions 12 (b) (ii) and 15 (b). 	<ul style="list-style-type: none"> • identified anomalous results in Question 11 (b) (i) and attempted to plot data in Question 11 (b) (ii) • recalled some basic concepts of Biology in Questions 11 (a) (iii) and 15 (a) but were unable to apply their knowledge in Question 11 (b) (iv) • demonstrated a lack of the mathematical skill required for calculations.

Section A overview

Section A consisted of multiple choice questions. It was encouraging to see that all candidates attempted these questions. Of these questions, candidates tended to do better on Questions 2, 5 and 6 and less well on Questions 1, 8 and 9. Where candidates decide to change their answer, they should be encouraged to cross out their original answer and not try to write over the original letter. The preferred answer should then be written next to the box. In some cases it was difficult to determine the letter candidates had written, especially when candidates attempted to change the letter B into the letter D.

Question 1

- 1 Which stage of the cell cycle is represented in the diagram?



- A Differentiation of cell
- B DNA replication
- C Growth of cell
- D Movement of chromosomes

Your answer

[1]

Many responses assumed incorrectly that the answer was B. The diagram in fact shows the movement of chromosomes as they separate during mitosis.

Question 2

2 Which method of contraception is the **most** effective?

Method of contraception	Females who became pregnant while using the method of contraception (%)
A	1
B	8
C	9
D	18

Your answer

[1]

Most of the candidates correctly identified method A.

Question 3

3 What are plasmids?

- A Genetic material found in the cytoplasm of a eukaryotic cell.
- B Genetic material found in the cytoplasm of a prokaryotic cell.
- C Genetic material found in the nucleus of a eukaryotic cell.
- D Genetic material found in the nucleus of a prokaryotic cell.

Your answer

[1]

Most candidates identified B; there was no clear misconception evident from those candidates that did not identify B.

Question 4

4 Which row correctly describes a protein?

	Structure	Acid it is made from
A	monomer	amino acids
B	monomer	fatty acids
C	polymer	amino acids
D	polymer	fatty acids

Your answer

[1]

Candidates usually identified C as the correct answer. A few candidates seemed to misunderstand the terms polymer and monomer, incorrectly choosing A.

Question 5

5 A student measures the effect of light intensity on photosynthesis. They place a lamp at different distances from pondweed in a beaker of water.

The student uses the inverse square law to calculate the relative light intensity.

$$\text{Relative light intensity} = \frac{1}{(\text{distance from light source})^2}$$

What is the distance of the lamp from the beaker when the relative light intensity is 4.00?

- A 0.2m
- B 0.3m
- C 0.4m
- D 0.5m

Your answer

[1]

The majority of candidates were able to rearrange the formula to identify the correct answer of D.

Question 6

6 What is one advantage of a light microscope compared to an electron microscope?

- A Only light microscopes are able to observe live specimens.
- B Only light microscopes are able to use stains.
- C Light microscopes have a greater magnification.
- D Light microscopes have a greater resolution.

Your answer

[1]

Most candidates correctly identified A. A common misconception is that electron microscopes do not use stains.

Question 7

7 The table shows the sizes of different cells.

Cell	1	2	3	4	5	6	7	8	9
Size (mm)	0.4	0.6	0.4	0.5	0.3	0.4	0.6	0.5	0.3

Which statement about the results is correct?

- A The mode and the median size are both 0.3.
- B The mode and the median size are both 0.4.
- C The mode is 0.3 and the median is 0.0.
- D The mode is 0.4 and the median is 0.3.

Your answer

[1]

The majority of candidates understood the terms mode and median to identify B as the correct answer.

Question 8

- 8 Which sentence describes one function of translocation?
- A The transport of mineral ions from the leaf to the meristem.
 - B The transport of mineral ions from the meristem to the leaf.
 - C The transport of sugars from the leaf to the meristem.
 - D The transport of sugars from the meristem to the leaf.

Your answer

[1]

Only the more successful candidates identified C as the correct response. Most candidates understood that translocation is the transport of sugars. However, they incorrectly assumed the sugar is transported from meristem to leaf. The term meristem is a concept many candidates find difficult.

Question 9

- 9 Which row shows correct information about cell membranes?

	Contains receptor molecules	Forms a selective barrier	Found in eukaryotic cells	Found in prokaryotic cells
A		✓	✓	✓
B	✓	✓	✓	✓
C	✓	✓		✓
D	✓		✓	

Your answer

[1]

Less than half the candidates identified the correct answer of B. A seemed to be the most common incorrect answer.

Question 10

10 Which two hormones can be used in contraceptive pills to prevent ovulation during the menstrual cycle?

- A** LH and FSH
- B** LH and progesterone
- C** Oestrogen and FSH
- D** Oestrogen and progesterone

Your answer

[1]

Most candidates correctly identified D. There was no clear pattern to the incorrect answers.

Section B overview

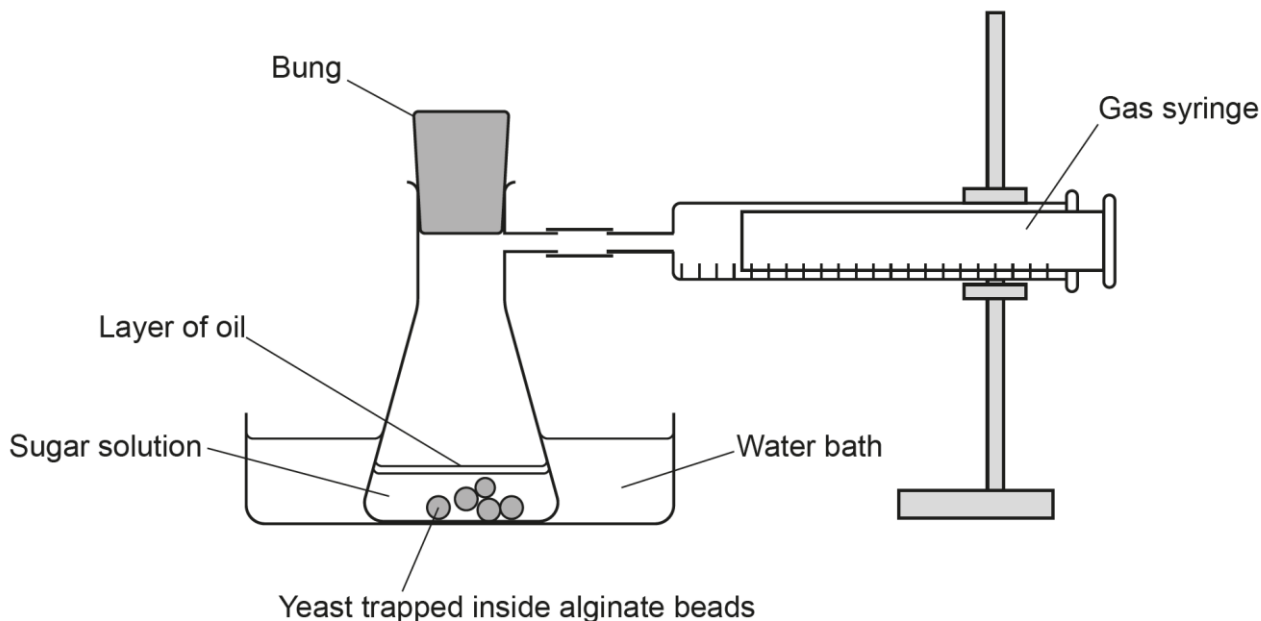
Section B consisted of structured questions ranging from 1 to 6 marks. The majority of candidates attempted the level of response question. Throughout Section B a large proportion of the candidates provided very long answers that tended to repeat parts of the stem of the question. Candidates should be encouraged to use the number of lines within a question as a guide to the length of answer required. This was particularly the case where one answer line had been provided, expecting an answer of no more than three or four words. Many candidates used complete sentences in their answer writing below the answer line and squashing words in making them difficult to read. Question 11 (a) (i) was one example where responses just needed to say the sugar solution had been used up. See further comment on this below. Often candidates provided vague answers where it was unclear as to the subject of the answer, see the comment for Question 13 (c).

Many candidates made good use of the additional pages at the back of the paper especially when answering the level of response question.

Question 11 (a) (i)

11 A scientist investigates the effect of temperature on anaerobic respiration in yeast.

The diagram shows the apparatus they use.



This is the method they follow:

- Collect the gas produced by the yeast for five minutes.
- Increase the temperature of the water bath.
- Repeat the investigation with fresh sugar solution.
- Do each temperature three times.

(a) (i) Suggest why the scientist used fresh **sugar** solution each time.

.....
 [1]

Candidates were expected to apply their knowledge of anaerobic respiration to identify sugar as a reactant in the investigation. This investigation meets the apparatus and skills required for PAG B3. The diagram states that the yeast is trapped inside the alginate beads, yet many responded in terms of contamination of sucrose solution.

Few responses simply stated the sugar had been used up or that sugar is a reactant in anaerobic respiration.

The candidates had been provided with two answer lines, this indicates a short answer is required. However, many candidates used up most of the answer line by repeating the stem of the question before providing an answer squashed below the answer line.

Question 11 (a) (ii)

(ii) Identify **one** variable the scientist should keep constant throughout the experiment.

Tick (✓) **one** box.

Number of alginate beads

Position of the gas syringe at the start

Temperature of the water bath

Volume of gas collected

[1]

The majority of responses correctly identified the number of alginate beads as the control variable.

Question 11 (a) (iii)

(iii) Which gas is collected by the scientist in the gas syringe?

..... [1]

Although most responses correctly identified carbon dioxide, oxygen and ethanol were both common incorrect answers.

Question 11 (b) (i)

(b) The table shows the scientist's results.

Temperature of water bath (°C)	Volume of gas collected (cm ³)			
	Trial 1	Trial 2	Trial 3	Mean
15	5	6	6	6
25	14	16	16	15
35	23	26	24	24
45	1	3	2	2
55	6	1	1	1

(i) When calculating the mean for 55°C, they did **not** include Trial 1.

Give the reason why.

..... [1]

Most responses successfully stated Trial 1 was an anomaly or outlier.

Question 11 (b) (ii)

(ii) Plot the mean values from the table on the graph.

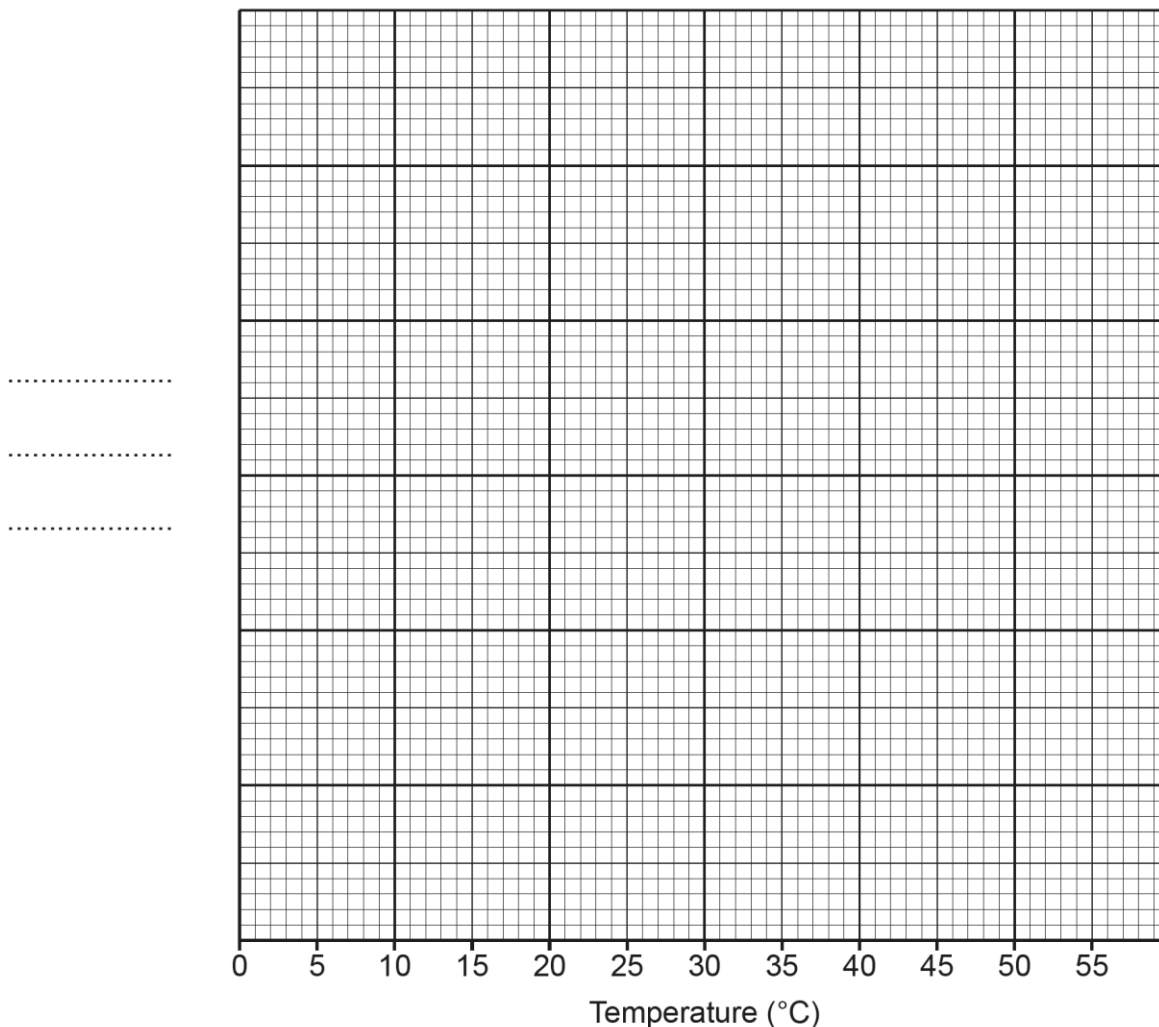
[3]

Candidates generally chose an appropriate scale and plotted the points correctly which was encouraging to see. Where candidates lost marks, it was due to their ability to correctly label axes. Although most candidates labelled the axis as volume of gas collected, many did not include the units.

Question 11 (b) (iii)

(iii) Draw a curve of best fit.

[1]



Most candidates attempted to draw a curve through their points. However, the less successful responses used a single line that missed most of the points. Results from enzyme investigations usually result in a curve. When plotting such results candidates should be encouraged to draw their line of best fit free hand rather than with a ruler.

Question 11 (b) (iv)

(iv) Anaerobic respiration is an enzyme-controlled reaction.

Explain the results between **15°C and 35°C**.
Include ideas about enzyme particles.

.....

.....

.....

..... [2]

Very few candidates answered this question successfully. They often showed knowledge of enzymes; however, they did not explain the results at the temperature range in the question in terms of kinetic energy and collisions. Instead, they concentrated on a temperature of 35°C or above, often referring to optimum temperature, which in the context of this question was irrelevant. This demonstrated that candidates had some knowledge and understanding but could not apply this knowledge.

Misconception



Many candidates incorrectly assume that enzymes denature at lower temperatures. They are able to answer questions about enzyme activity at higher temperatures but find lower temperature concepts more challenging.

Exemplar 1

From 15°C to 35°C the volume of gas
seemed to be increasing however, as the
temperature got too hot (45°C - 55°C) the
enzymes start to denature and lose its [2]
shape due to the heat intensity.

This response shows an understanding of enzymes. However, the response just quoted the data for the temperature range in the question then went on to explain the effect of higher temperatures. Many candidates provided a similar answer, suggesting the need to include the term denature or optimum temperature in an answer to an enzyme question. The candidate was given no marks for this answer.

Question 11 (b) (v)

- (v) The scientist concludes that the best temperature for anaerobic respiration is approximately 40 °C.

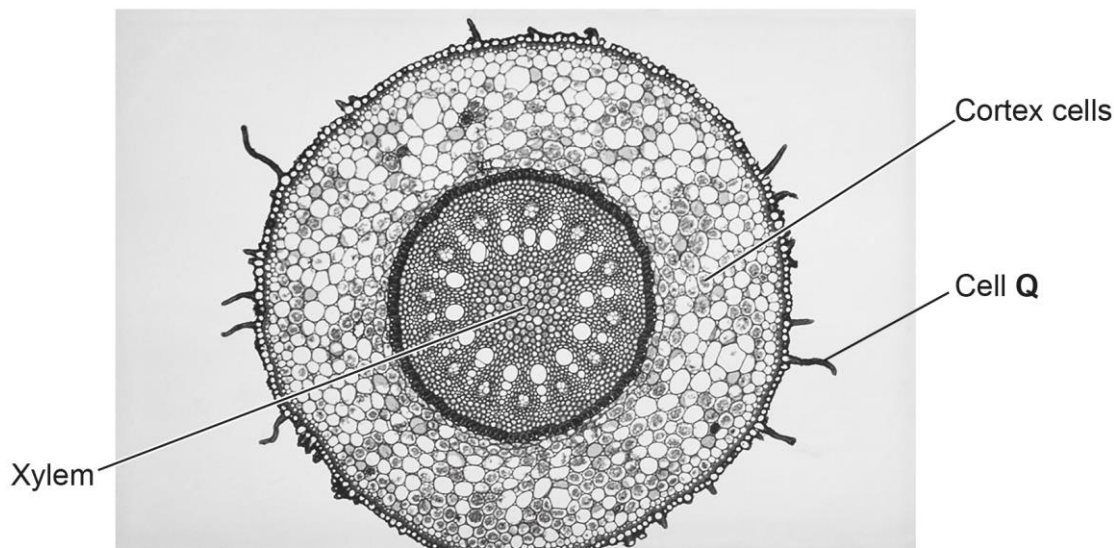
How could they alter their investigation to identify a more **accurate** temperature?

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

The majority of the responses understood the need to increase the range of temperatures. Only the more successful candidates went on to identify a range between 35 – 45 °C.

Question 12 (a) (i)

- 12 (a) The photograph shows a cross section of a root seen with a light microscope.



- (i) The function of cell Q in the photograph is the uptake of water.

Explain how the structure of cell Q is adapted to this function.

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

Very few candidates could provide a complete explanation of how the structure of cell Q is adapted. Although many referred to large surface area, they did not mention increased water uptake. Some candidates answered in terms of active transport and mineral uptake, which in this case was not relevant to the question. Many less successful responses mentioned a partially permeable membrane. Although this is required for osmosis it is not an adaptation specific to cell Q.

Question 12 (a) (ii)

- (ii) Explain how the water moves through the root from cell Q to the xylem. Include ideas about water potential.

.....

.....

.....

.....

.....

..... [3]

Only the more successful responses provided a complete explanation in terms of water potential. Many responses mentioned osmosis and few less successful responses referred to active transport. Some responses demonstrated knowledge of osmosis and water potential; however, they did not provide the complete answer missing out the movement of water through the cortex cells. These responses tended to just mention cell Q and the xylem.

Many candidates attempted to answer the question in terms of concentrations. However, the question specifically asked for water potentials. Therefore, these candidates had not answered the question that had been set.

Assessment for learning

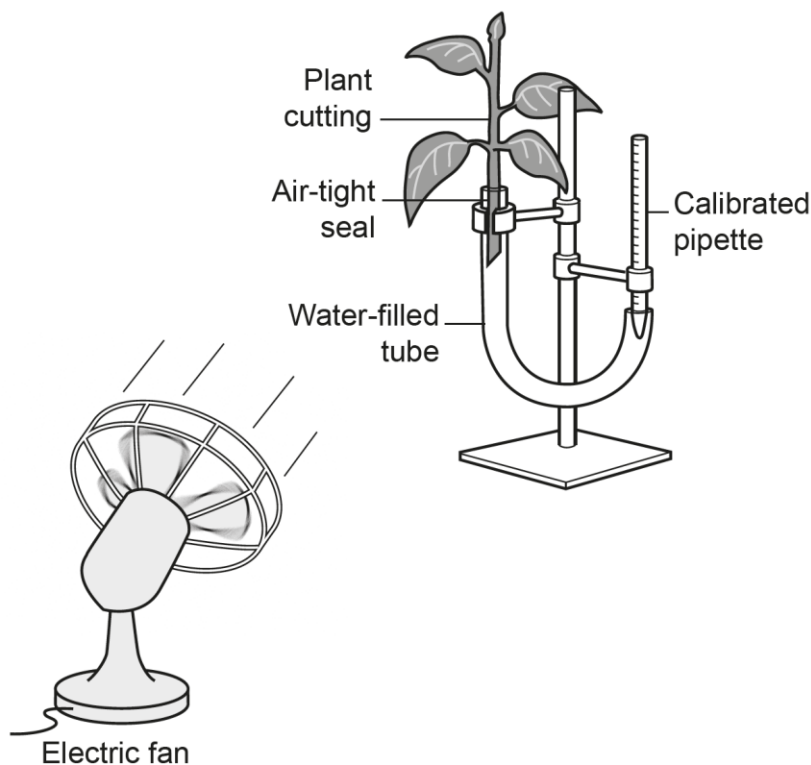


The specification learning outcome B2.1a expects candidates to explain osmosis in terms of water potential. Candidates should be discouraged from answering such questions in terms of concentrations. When candidates do answer in terms of concentrations, they rarely make it clear if they are discussing concentration of solute or water. Using the term water potential provides clear direction of water movement.

Question 12 (b) (i)

- (b) A student investigates the effect of air movement on the rate of water uptake using a plant cutting.

The diagram shows the apparatus they use.



This is the method they follow:

- Measure the level of water in the calibrated pipette.
- Switch on the fan and record the level of water again after 30 minutes.
- Repeat investigation with the fan switched off.

The table shows their results.

	Level of water in calibrated pipette (cm ³)			Rate of water uptake (cm ³ /min)
	At the start	After 30 minutes	Change in level	
Electric fan on	30	7	23	0.8
Electric fan off	32			0.2

- (i) Explain the effect of turning **on** the electric fan upon the rate of water uptake shown in the table.

.....

.....

..... [2]

The majority of responses gained 1 mark for identifying that water uptake had increased. Only the more successful responses explained in terms of increased transpiration or evaporation.

Question 12 (b) (ii)

- (ii) The rate of water uptake when the electric fan is turned **off** is $0.2\text{ cm}^3/\text{min}$.

Use this rate to calculate the level of water after 30 minutes when the fan is switched off.

(The value for this rate has **not** been rounded in any way.)

Level of water after 30 minutes = cm^3 [2]

Very few responses correctly calculated the level of water after 30 minutes. Many responses successfully calculated an increase of 6 cm^3 then did not deduct this from the original level to give 26 cm^3 . A common incorrect answer of 6.4 cm^3 was seen, where candidates had multiplied 0.2 by 32.

OCR support



The [Mathematical Skills Handbook](#) and accompanying [check in worksheet](#) would be useful to share with students or incorporate into lessons to practice using standard form and rearranging equations, amongst other mathematical skills.

Question 12 (b) (iii)

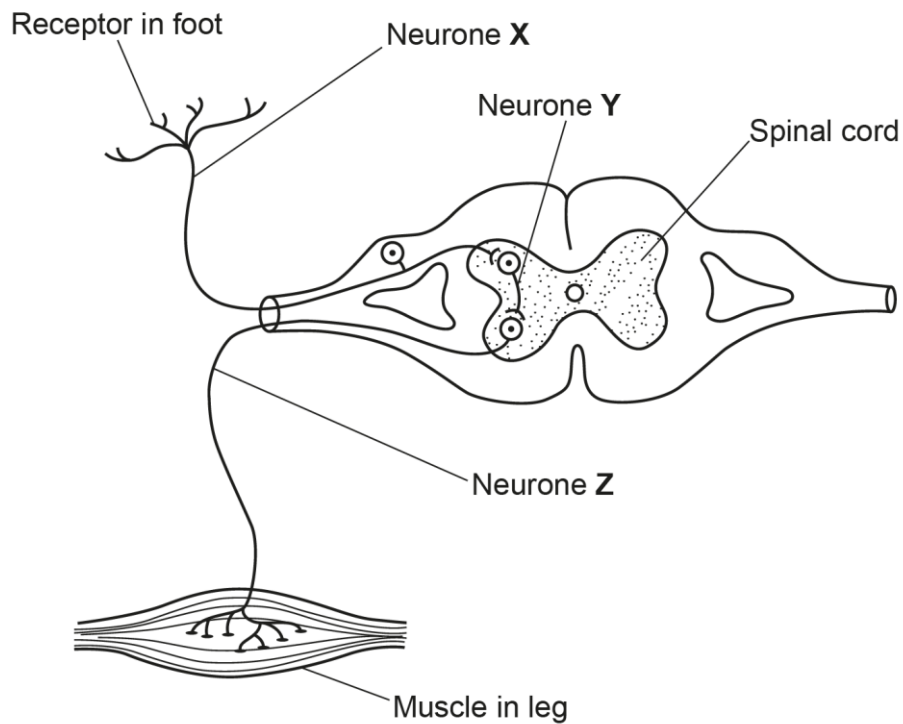
- (iii) Suggest how the student could develop their investigation to explore the effect of changing the **speed** of air movement.

..... [1]

The majority of responses were able to suggest the student used an electric fan with different settings. The less successful responses tended to repeat the stem of the question and state that they should repeat the investigation at a different speed. A few responses suggested moving the investigation outside on a windy day; unfortunately the conditions would not be controlled, so this answer cannot be credited.

Question 13 (a) (i)

13 (a) The diagram shows a reflex arc.



(i) Draw lines to connect the letters, **X**, **Y** and **Z**, to the **correct name** of each neurone.

X

Motor

Y

Relay

Z

Sensory

[1]

Most responses correctly matched the letters to the names of the neurones.

Question 13 (a) (ii)

(ii) The foot steps on a sharp object. The leg is pulled away from the sharp object.

Explain how the reflex arc in the diagram produces this response.

.....

.....

..... [2]

Only the more successful responses used the correct terminology required in this question. Candidates should be encouraged to use terms such as detect and impulse rather than sense and message. Candidates are expected to understand the role of sensory receptors in detecting a stimulus and neurones transmitting electrical impulses to coordinate a response.

Question 13 (b)

(b) The body is also controlled by the endocrine system.

Adrenaline and thyroxine are both hormones.

Compare the roles of adrenaline and thyroxine in the body.

.....

.....

.....


.....

..... [3]

Only the very successful candidates could make a full comparison. Most candidates were able to identify one role of adrenaline. However, they assumed only adrenaline increased heart rate and thyroxine simply controls metabolism. This showed a misunderstanding of the term metabolism.

Although the question asks about the roles of adrenaline and thyroxine many responses compared the site of production and the fact that they were transported in the blood, neither of which are roles.

Misconception

 One common misconception is that the role of thyroxine is opposite to that of adrenaline, that in the same way that insulin is opposite to glucagon. Many responses incorrectly assumed adrenaline increased heart rate while thyroxine decreased heart rate. In many ways their roles are actually similar.

Question 13 (c)

(c) A scientist investigates the effect of glucose on insulin levels in the blood.

They drink glucose dissolved in water. They then measure the level of insulin in their blood.

The table shows their results.

Time after glucose intake (min)	Blood insulin level (mmol/l)
0	165
30	1540
60	1867
90	980
120	160

Explain the change in blood insulin levels between **90 and 120** minutes.

.....

.....

.....

..... [2]

Only the more successful responses explained the change in blood insulin correctly. Many candidates confused their answers by using 'it' rather than glucose or insulin. Therefore, it was difficult to determine if they were describing the change in glucose or the change in insulin levels. Very few candidates seemed to understand that once glucose levels fall insulin is no longer secreted. Many just stated it was no longer needed.

Misconception

Many candidates assume insulin breaks down glucose in the body. The concept of glucose being changed into the larger glycogen molecule is a difficult one. The use of models may help to illustrate the concept for those who prefer a visual approach to learning.

Exemplar 2

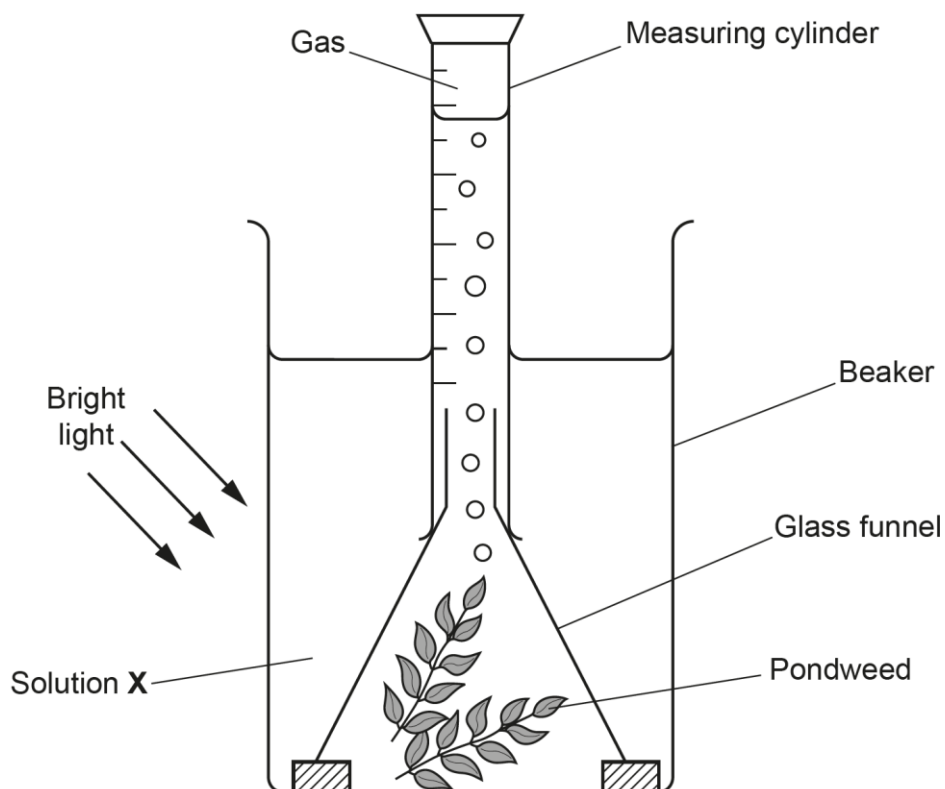
between 90 and 120 minutes the blood
insulin level goes from 980 to 160. This is
because the sugar is nearly fully digested
and gone so the levels decrease. [2]

This exemplar is an example of a candidate who is unsure of the role of insulin in the body. They understand that insulin lowers blood sugar levels; however, they incorrectly refer to digestion. The statement at the end, 'so the levels decrease' does not clearly refer to insulin or sugar and so cannot be credited. The candidate was not given any marks for this response.

Question 14 (a) (i)

- 14 (a) A student investigates the availability of carbon dioxide on the rate of photosynthesis. They use a measuring cylinder to measure the volume of gas collected in 20 minutes.

The diagram shows the apparatus they use.



- (i) Solution X contains a chemical that releases carbon dioxide.

Suggest how solution X could be used to change the availability of carbon dioxide.

..... [1]

Candidates found this concept difficult. They did not appreciate that they were being asked how to change the availability of carbon dioxide. Many answered in terms of carbon dioxide being required for photosynthesis. Of those that did understand they needed to change solution X many changed the volume rather than the concentration.

OCR support



This [Practical support guide](#) has a variety of videos, activities and simulations that can be shared with students. These link to the Practical Activity Groups, and the apparatus and skills students must be aware of. Some of the practicals shown are in a different context than they may be carried out in the classroom, giving students further practice for examinations.

Question 14 (a) (ii)

(ii) What is the **dependent** variable for this investigation?

..... [1]

Most of the candidates attempted to provide an answer, however few seemed to understand the term dependent variable. Many incorrectly identified the light intensity. Some candidates understood that the gas was the dependent variable. However, they did not refer to volume instead using terms like amount or number of bubbles. The stem at the start of the question specifically refers to volume.

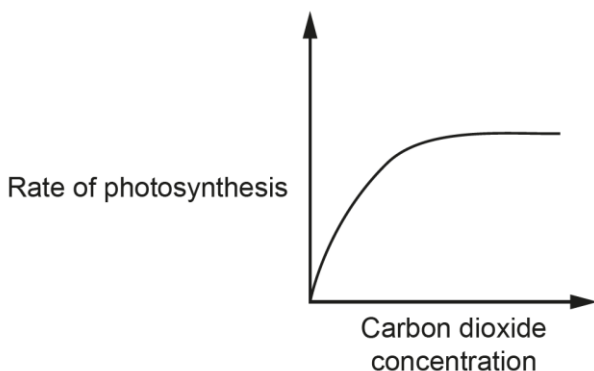
OCR support



Our [Language of Measurement in context](#) resource can be used with students to help familiarise them with terms such as dependent and independent variable, and where to identify them in a practical.

Question 14 (b)

(b) The student sketches this graph to show their results.



Explain the pattern in the graph.

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

Only the more successful candidates were able to provide a complete explanation. Many responses described the pattern in the graph but could not demonstrate clear knowledge of limiting factors.

Misconception

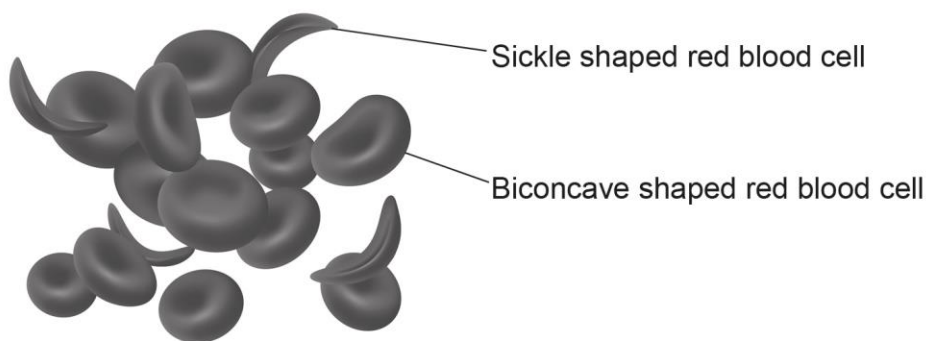


Some candidates incorrectly assume that photosynthesis has stopped when the graph levels off. This is a common misconception as the photosynthesis continues at a constant rate.

Question 15* (a)

15* (a) Sickle cell disease is a blood disorder causing some red blood cells to become sickle shaped.

The diagram shows red blood cells from a person with sickle cell disease.



The change in shape causes the cells to clump together. This makes sickle shaped red blood cells less efficient at carrying out their role.

Symptoms of sickle cell disease are tiredness and a lack of energy.

Explain why someone with sickle cell disease has these symptoms. Include information from the diagram.

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

The majority of candidates provided at least a Level 1 answer. This tended to be demonstrating some knowledge of the function of red blood cells. Only the more successful candidates went on to explain the effects of sickle cells on respiration and include the role of haemoglobin.

A few less successful responses confused the specific function of red blood cells with the more general function of blood. These candidates thought the red blood cells transported nutrients or glucose rather than oxygen.

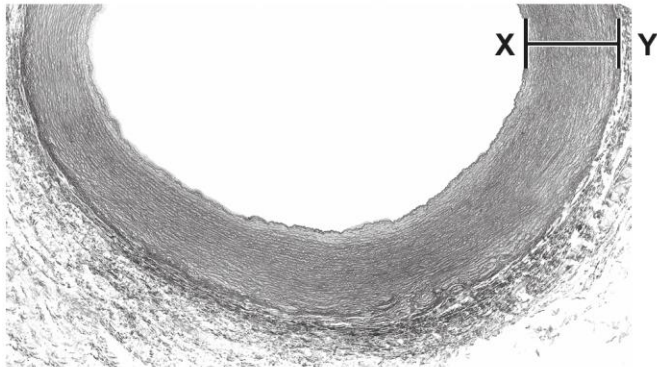
Exemplar 3

Someone with sickle cell will have these symptoms because sickle shaped blood cells don't have an efficient shape. This means the sickle cell cannot carry as much haemoglobin as a biconcave shaped blood cell which means they cannot carry as much oxygen around the body. ~~As~~ ~~they~~ The sickle shaped ~~are~~ cells having less haemoglobin because of their shape means ~~there~~ & they can't carry as much oxygen because there is less haemoglobin for the oxygen to bind to. This lack of oxygen affects the rate at which respiration takes place because respiration needs oxygen to create energy. This results in tiredness and a lack of energy because the body can't carry out respiration fast enough. The shape also makes the cells stick together meaning they can't travel around the body as fast which affects the rate of respiration as well.

This exemplar shows a high level response. The candidate demonstrates a clear understanding of the role of haemoglobin in red blood cells. They have explained the link between sickle cells, respiration, and lack of energy. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Question 15 (b)

(b) The photograph shows part of an artery seen using a light microscope.



The image has been magnified 8 times.

Calculate the actual thickness of the artery between points **X** and **Y** in μm .

Give your answer in **standard form**.

Actual size = μm [3]

Only the more successful responses showed understanding of how to calculate the actual size. Many successfully calculated the image in mm and gave an answer in standard form, however they could not convert their answer to μm . These candidates either gave their answer as 1.5×10^{-1} or they divided by a thousand rather than multiplied. Some candidates made their initial measurement in cm, they then multiplied by 1000 rather than 10000.

Candidates should be encouraged to set their calculations out clearly so that examiners are able to award part marks if the final answer is incorrect. Some candidates have multiple attempts spread across the page making it difficult to determine which part is the actual answer.

Question 15 (c)

(c) Explain how the structure of a **vein** is adapted to its function.

.....

.....

.....

..... [2]

Very few responses gave a full explanation of how veins are adapted to their function. Most attempted to answer the question; however, they tended to answer in terms of wall size rather than lumen size. Candidates were more successful at explaining that veins had valves to prevent backflow. The less successful responses confused the function of veins with capillaries and answered in terms of permeable walls.

Question 16 (a)

16 Adult stem cells found in skin usually only form new skin cells.

- Scientists have developed adult skin cells that can be reprogrammed into 'embryonic – like' stem cells.
- These stem cells are called iPS cells and they can be used as a source of any human cell.

(a) Which process turns stem cells into specialised skin cells?

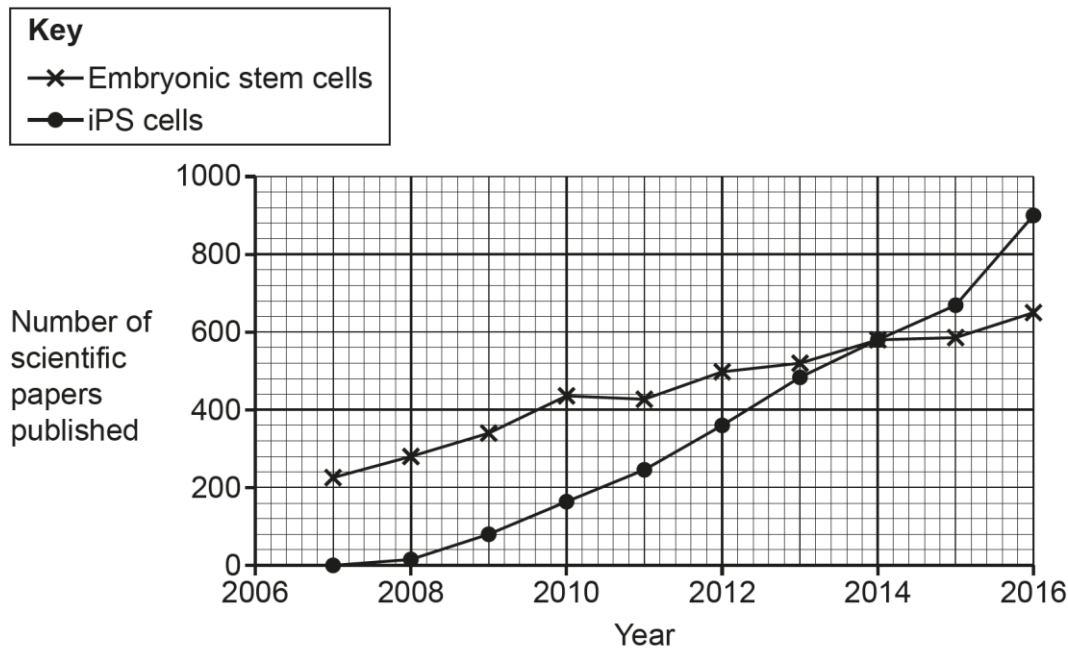
..... [1]

The majority of responses identified differentiation as the correct process.

Question 16 (b) (i)

(b) Both embryonic stem cells and iPS cells are used in medical research.

The graph shows the number of scientific papers published by scientists who have used either embryonic stem cells or iPS cells in their research.



(i) Give **one** reason why it is important for scientists to publish their research.

.....

..... [1]

Candidates were mostly successful at stating a correct reason such as peer review.

Question 16 (b) (ii)

(ii) How many more scientific papers used iPS cells rather than embryonic stem cells in 2016?

Number of scientific papers = [1]

Due to the nature of the graph a wide range of values were considered credit worthy. Most responses were given a mark.

Question 16 (b) (iii)

(iii) Suggest **two** reasons for the difference in use between the two types of stem cells seen in **2016**.

1

.....

2

.....

[2]

Only the more successful responses used their knowledge of stem cells to suggest two reasons. Many responses were given 1 mark for mention of ethical reasons, however very few mentioned less rejection of adult stem cells.

Many responses incorrectly assumed the reasons were down to more research being available.

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