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Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

J250/01 Summer 2023 series

Version 1

ocr.org.uk/science

Contents

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.

Paper 1 series overview

This paper examines the Foundation Level Biology content within topics B1, B2, B3 and CS7 of GCSE Gateway Combined Science A. The paper links together different areas of biology within different contexts – some familiar, and some novel – including practical applications/techniques. To do well on this paper, candidates require:

- good subject knowledge, and to be able to apply their knowledge and understanding to unfamiliar contexts, including the interpretation of data, construction of graphs, and the completion of mathematical calculations
- familiarity with the appropriate range of practical techniques detailed within topic CS7.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• correctly performed mathematical calculations in both Section A and Section B, showing working where required • produced clear and concise answers to the level of response question – Question 14(a)(ii) – which followed a logical structure • showed familiarity with the appropriate practical techniques and had a good understanding of scientific method, including the interdependence of variables and the need to control variables • demonstrated competency when constructing graphs; scales were logical, axes labelled (with appropriate units), coordinates accurately plotted, and lines-of-best-fit carefully drawn with thin, continuous lines to pass through appropriate points • read questions carefully, paying attention to command words • demonstrated an ability to apply knowledge and understanding to questions framed within unfamiliar contexts.	• did not perform mathematical calculations correctly, and frequently did not show working (thereby missing substitution/calculation/ evaluation marks) • struggled with formulating answers to the level of response question – Question 14(a)(ii) – which were clear and followed a logical structure • seemed to lack familiarity with practical techniques and had less understanding of scientific method, and were unclear about the interdependence of variables or how variables might be controlled • were unable to demonstrate competency when constructing graphs; inconvenient scales were selected or incorrectly plotted, units were omitted from axis labels, coordinates were carelessly plotted, and lines-of-best-fit drawn without careful attention to appearance • did not always address answers to the question asked • found it difficult to apply knowledge and understanding to questions framed within unfamiliar contexts.

OCR support

A *Mathematical Skills Handbook* and *Check In* worksheet for GCSE sciences can be found on Teach Cambridge. These can be used with candidates to practice the maths skilled required for GCSE Combined Science.

OCR support

Support for the development of practical skills and knowledge and understanding of scientific method through the six required practical activities specified in topic CS7 is available through a range of support materials under "Practical activities groups (PAGs)" on Teach Cambridge.

Section A overview

Candidates coped well with selecting choices, demonstrating good examination technique; almost all candidates selected only one choice for each question, and almost all candidates attempted every question.

Question 1

1 Which of these substances is transported **out** of the human body as waste?

A Blood

B Food molecules

C Oxygen

D Urea

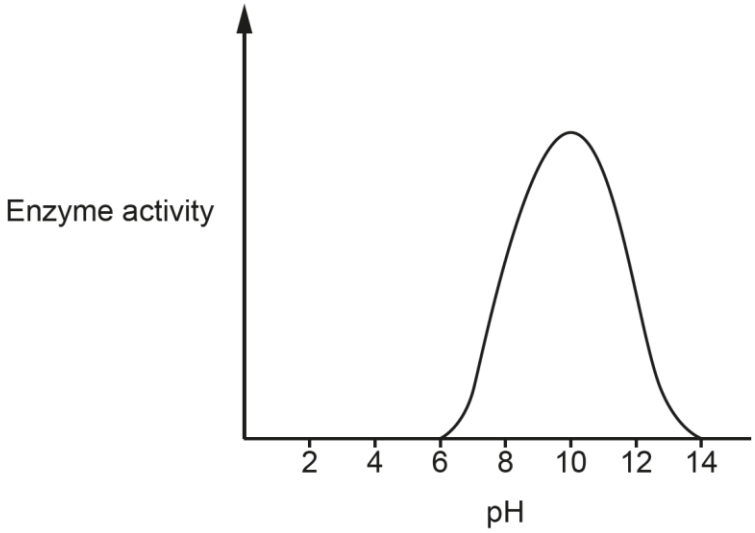
Your answer ☐ **[1]**

The correct answer is D. The majority of the responses correctly identified urea (D) as being transported out of the body as waste; a significant minority suggested food molecules (B), with only a handful of candidates selecting either blood (A) or oxygen (C). This question assessed AO1.

Question 2

2 The graph shows the effect of pH on enzyme activity.

What is the pH when enzyme activity is **highest**?



A pH 2

B pH 6

C pH 10

D pH 14

Your answer ☐ **[1]**

The correct answer is C. Nearly all responses correctly identified pH 10 (C) as the pH at which enzyme activity was highest, with the overwhelming majority of those who did not selecting pH 14 (D). Only a handful of candidates selected either pH 2 (A) or pH 6 (B). This question assessed AO2.

Question 3

3 Which term describes cells that have the ability to differentiate into **all** types of body cells?

A Adult stem cells

B Bone marrow stem cells

C Embryonic stem cells

D Skin stem cells

Your answer ☐ **[1]**

The correct answer is C. The majority of responses correctly identified that, of the cell types listed, embryonic stem cells are pluripotent, while a minority suggested bone marrow stem cells (B). Only a few candidates suggested either adult stem cells (A) or skin stem cells (D). This question assessed AO2.

Question 4

4 Which cell size in the table is the **mode**?

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

A 0.3 mm

B 0.4 mm

C 0.5 mm

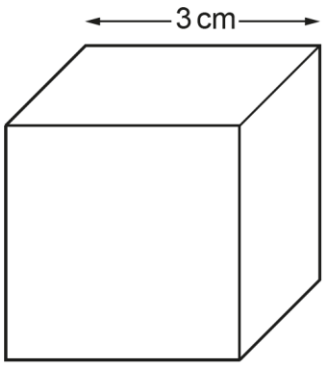
D 0.6 mm

Your answer ☐ **[1]**

The correct answer is A. Nearly all responses correctly identified the mode as 0.3 mm (A). The minority of candidates who were incorrect in their choice, were roughly evenly split between 0.4 mm (B), 0.5 mm (C), and 0.6 mm (D). This question assessed AO2.

Question 5

5 A student uses a cube to model the size of an organism.



not to scale

Which row shows the correct calculation of the surface area to volume ratio?

	Surface area (cm^2)	Volume (cm^3)	SA:V ratio
A	6	27	2:9
B	9	27	1:3
C	54	27	2:1
D	162	27	6:1

Your answer ☐ **[1]**

The correct answer is C. Only a small minority of responses selected the correct SA:V ratio of 2:1 (C). The most common suggestion for SA:V ratio was 1:3 (B). 2:9 (A) and 6:1 (D) were selected much less frequently than the correct response (C). This question assessed AO1.

Question 6

6 Which sentence describes **one** correct adaptation of phloem?

A They are made of dead cells.

B They contain large amounts of cytoplasm.

C They have a thick cell wall.

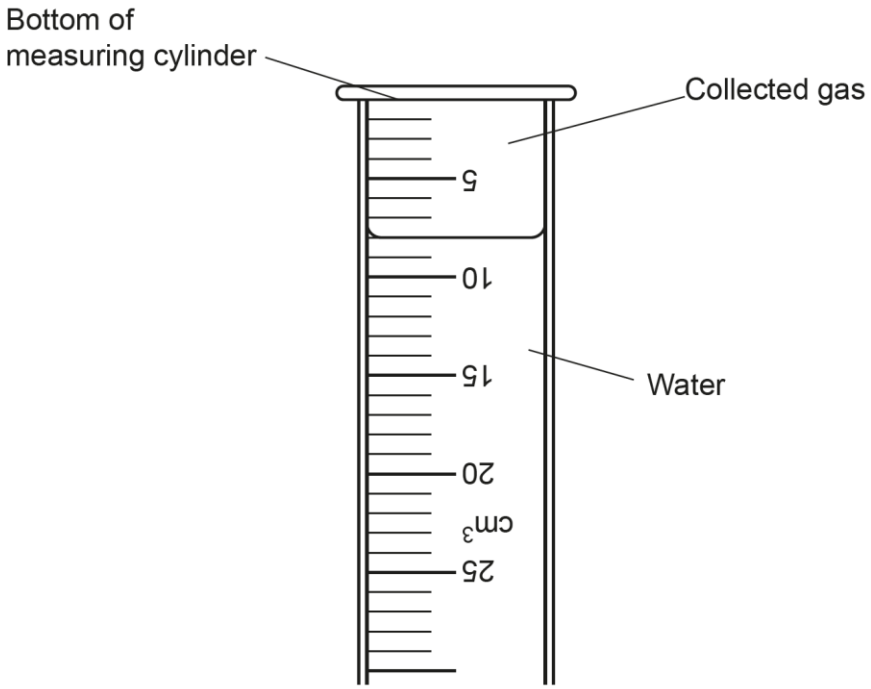
D They have sieve plates with holes in.

Your answer ☐ **[1]**

The correct answer is D. The majority of responses correctly identified that phloem vessels contain sieve plates with holes in (D). Roughly equal numbers suggested that phloem vessels are made of dead cells (A) or possess a thick cell wall (C). Very few responses suggested that phloem vessels contain large amounts of cytoplasm (B). This question assessed AO1.

Question 7

7 The diagram shows the volume of gas collected during an enzyme reaction in an upside down measuring cylinder.



What is the volume of collected gas in the measuring cylinder?

A 6 cm^3

B 8 cm^3

C 12 cm^3

D 14 cm^3

Your answer ☐ **[1]**

The correct answer is B. A large majority of responses were able to correctly read the volume of gas in the measuring cylinder as 12 cm^3 (B). Those candidates who suggested incorrect responses selected 6 cm^3 (A), 12 cm^3 (C), and 14 cm^3 (D), in roughly equal numbers; those candidates who suggested 12 cm^3 (C) had not taken into account that the measuring cylinder had been inverted, while those candidates who suggested 6 cm^3 (A) or 14 cm^3 (D) were possibly guessing. This question assessed AO2.

Question 8

8 What is the function of FSH in the female body?

A It causes the eggs to mature.

B It inhibits the release of progesterone.

C It maintains the uterus lining.

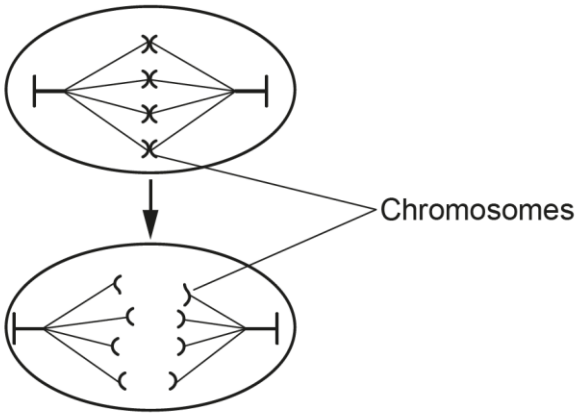
D It prevents pregnancy.

Your answer ☐ **[1]**

The correct answer is A. The majority of responses were able to correctly identify the function of FSH in females being to stimulate maturation of the eggs. Roughly equal numbers selected either inhibition of release of progesterone (B), maintenance of the uterus lining (C), or prevention of pregnancy (D). This question assessed AO1.

Question 9

9 Which stage of the cell cycle is represented by the diagram?



A Differentiation of cell

B DNA replication

C Growth of cell

D Movement of chromosomes

Your answer ☐ **[1]**

The correct answer is D. Many responses were able to identify that the phase of the cell cycle represented by the diagram was anaphase (D). Of the candidates who selected incorrect responses the overwhelming majority suggested that the diagram showed DNA replication (B), presumably mistaking the separating chromosomes for the unwinding, and separating of the two polynucleotide strands of a DNA molecule (while demonstrating a potential lack of understanding of the process of DNA replication). Very few candidates identified the diagram as representing either cell differentiation (A) or cell growth (C) – those candidates that did were clearly guessing. This question assessed AO2.

Question 10

10 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]**

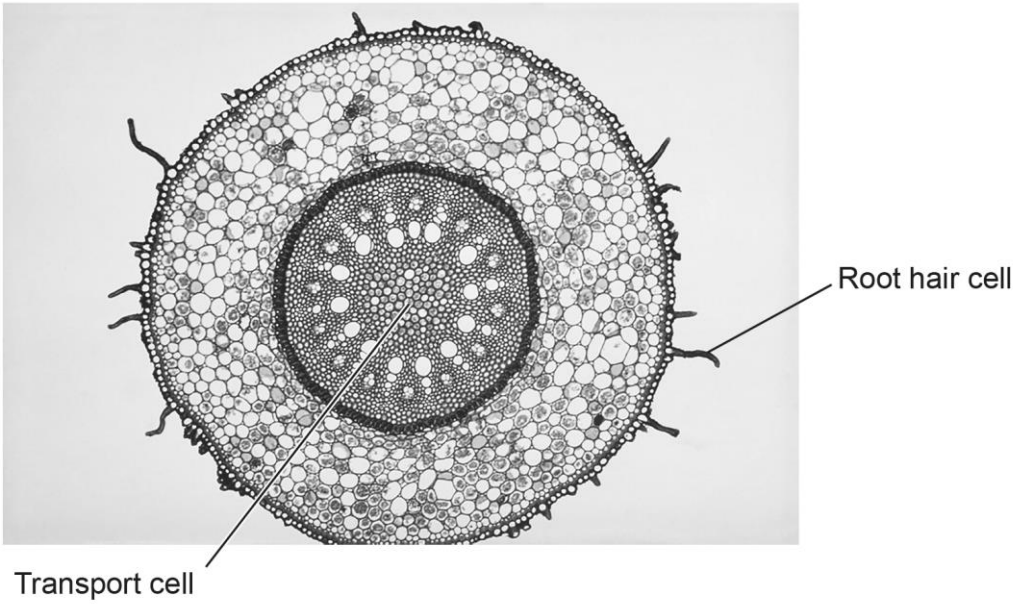
The correct answer is A. The majority of responses correctly identified the most effective method of contraception as having a percentage pregnancy of 1% (A). Most candidates who selected other responses chose 18% (D) – presumably because it was the largest number in the list – while very few selected 8% (B) or 9% (C). This question assessed AO2.

Section B overview

This section assessed AO1, AO2, and AO3. Certain questions required candidates to make use of stimulus material, and to use analytical and observational skills to determine answers. Where questions addressed practical skills and understanding of scientific method it was apparent that candidates' knowledge and understanding in this area needs to be developed. Many responses lost marks when it came to the application and use of mathematical skills; candidates frequently omitted to show working for calculations. Question 16 was the overlap question with the Higher Tier paper and was marked in line with the marking on that paper.

Question 11 (a) (i)

11 (a) The photograph shows a cross section of a root seen under a light microscope.



(i) Complete each sentence about root hair cells. Use words from the list.

active transport	**glucose**	**mineral ions**
osmosis	**surface area**	**volume**

Root hair cells take in water and ..... from the soil.

Water is taken in by the process of ..... .

For more efficient uptake, the root hair cell has a large ..... .

[3]

The overwhelming majority of responses correctly identified that root hair cells have a large surface area, meeting mark-point 3 (MP3). There was frequently confusion about the correct selections for the substance taken in by root hair cells (MP1) and/or the process by which water is taken in (MP2). This question assessed AO1.

Question 11 (a) (ii)

(ii) Water moves from the root hair cells into the transport cells of the roots.

Describe how water travels to the leaves of the plant from the roots.

.....

.....

.....

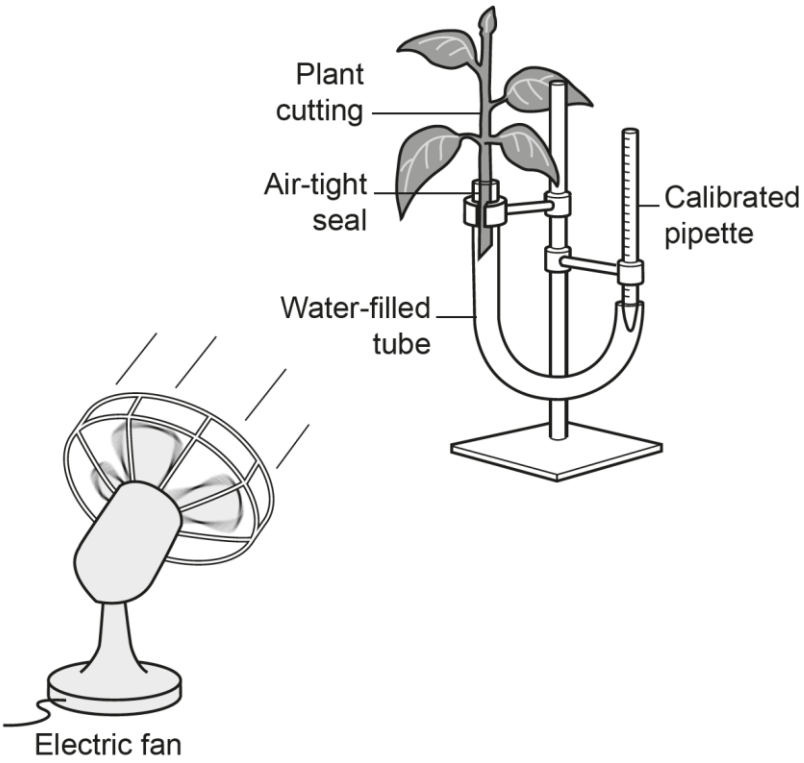
..... **[2]**

The majority of responses did not gain any marks on this question, with a minority scoring 1 mark – very few candidates scored both marks. The most common mark-point seen was MP2, which was invariably the mark-point identified by those candidates scoring 1 mark – MP3 was seen only once or twice, the handful of candidates who gained 2 marks doing so by scoring MP1 and MP2. Many responses, taken as a whole, demonstrated a lack of understanding of the movement of water within plants. This question assessed AO1.

Question 11 (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 25 minutes.
- Repeat investigation with the fan switched off.

The table shows their results.

	Level of water in calibrated pipette (cm^3)		
	At the start	**After 25 minutes**	**Change in level**
Electric fan switched on	20	8	12
Electric fan switched off	22	16	

(i) Describe the effect of air movement on water uptake.

.....

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

Few responses correctly stated that increased air movement increases water uptake by plants. Many candidates referred, correctly, to the decrease in water level in the pipette, but the question required candidates to describe water uptake by the plant. This question assessed AO3.

Examination technique

Candidates should be encouraged to frame their answers to address the question posed, and not simply re-present data or information with which they have been provided.

Question 11 (b) (ii)

(ii) Calculate the rate of water uptake when the fan is **switched off**.

Give your answer to **1** significant figure.

Rate of water uptake = ... cm^3/min **[3]**

The majority of responses did not score any marks on this question – many candidates offered "6" as their answer, having not taken into account that the water loss had taken place over twenty-five minutes. Many responses showed a lack of working. A significant number of otherwise correct answers were not presented to the required number of significant figures. A small number of candidates gained 1 mark for an incorrect calculation correctly rounded to two significant figures. This question assessed AO2.

Examination technique

Candidates should be encouraged to show working for all calculations, so that substitution and/or calculation and/or evaluation marks may be still gained where other errors in the calculation have been made.

Question 11 (b) (iii)

(iii) Suggest **one** way the student could now investigate the effect of light intensity on water uptake.

.....

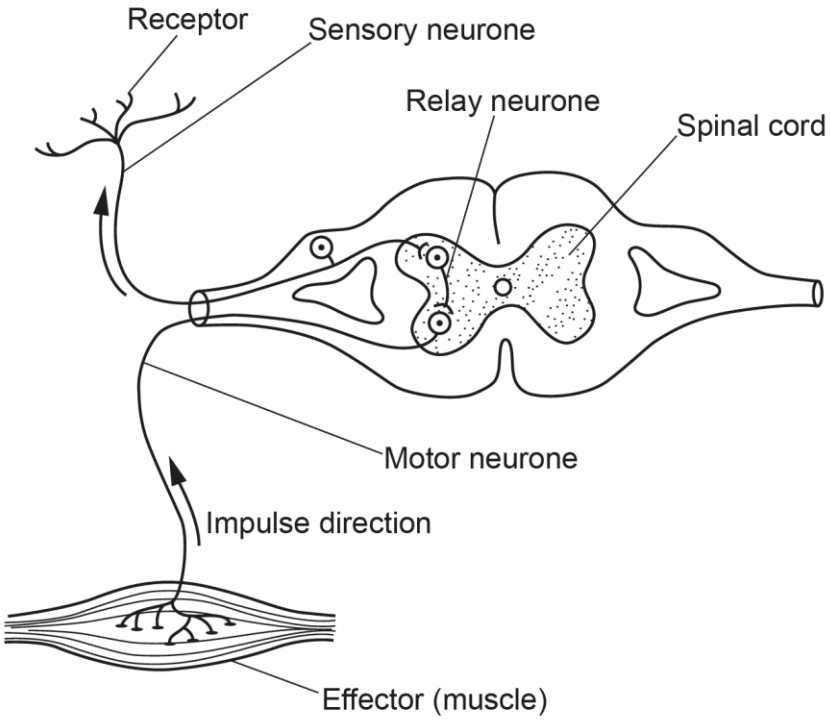
..... **[1]**

The majority of responses were not given this mark; many had identified the need to replace the fan with a light source but did not state the need to use different light intensities. A significant number of candidates who did gain the mark did so by simply referring to the need to do conduct the investigation in both the light and dark – the more successful responses referred to varying the light intensity either by placing the light source at different distances from the plant or by changing the power of the light source. This question assessed AO3.

Question 12 (a) (i)

12 (a) A student draws and labels a diagram of a reflex arc.

The diagram shows their labelled drawing.



(i) What mistake has the student made in their drawing?

Tick (✓) **one** box.

- Labelling the effector as muscle instead of the receptor. ☐
- The arrows showing impulse direction should point downwards. ☐
- The relay neurone should connect the spinal cord to the effector. ☐
- The sensory neurone and motor neurone labels have been swapped. ☐

[1]

The minority of responses correctly identified that the arrows showing impulse direction should point downwards. Incorrect responses were almost evenly split across the other three alternatives. This question assessed AO3.

Question 12 (a) (ii)

(ii) The spinal cord coordinates nervous responses.

Which **other** part of the central nervous system coordinates responses?

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

Only half of the candidates correctly stated that the brain is a part of the nervous system that coordinates responses. A small number of candidates suggested relay neurones, which was ignored, but a significant number of candidates suggested parts of the nervous system – motor/sensory neurones and receptors – which are not part of the central nervous system. This question assessed AO1.

Question 12 (b)

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

Complete the table to show **two** differences between the nervous system and the endocrine system.

	Nervous system	**Endocrine system**
How message is sent	electrical impulses	..... messengers called hormones
How message travels around body	along neurones	in the .....

[2]

The majority of responses did not score any marks – there were also a significant number of null responses to this question. A common error seen was the suggestion that endocrine messages travel around the body "in the nervous system" – these candidates had misunderstood the table and read along the rows rather than down the columns; in doing so they found it almost impossible to complete the first row of the table. A number of candidates seemed unaware that the endocrine system uses chemical messengers to transmit messages. This question assessed AO1.

Question 12 (c)

(c) Oestrogen and testosterone are both hormones.

Write down **one** role of oestrogen and **one** role of testosterone in the body.

Oestrogen .....

.....

Testosterone .....

.....

[2]

Candidates who gained 1 mark generally did so for stating a role of testosterone in the body. Many responses referred to the roles of the hormones in the development of named secondary sexual characteristics - commonly hair distribution, muscle development, or voice pitch. Common misconceptions were testosterone promoting release of sperm, rather than production; oestrogen stimulating follicle development; oestrogen stimulating ovulation, which is not a direct effect of oestrogen but a consequence of high concentrations of LH; and oestrogen maintaining, rather than thickening, the endometrium, which is an effect of progesterone. Many responses referred to oestrogen having an effect on the uterus wall, rather than the uterus lining. This question assessed AO1.

Question 12 (d)

(d) A person with type 1 diabetes tests their blood sugar level before they eat any food.

The diagram shows their results. The units for blood sugar level are mmol/l.

The person then compares their results with the information in this table.

	Blood sugar level (mmol/l)
too low	<4
healthy target	4–7
too high	>7

Explain why the person will need to take insulin.

.....

.....

.....

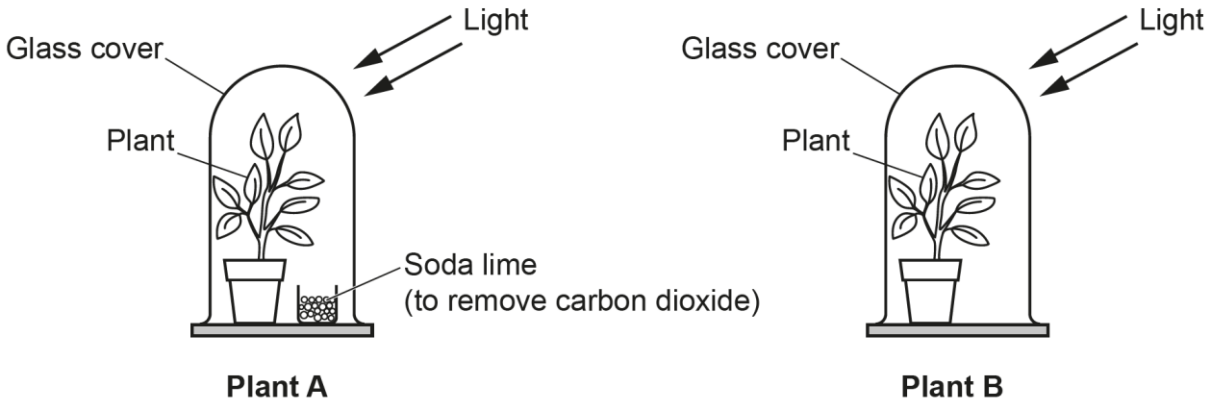
..... **[2]**

Candidates who gained 1 mark tended to do so by correctly identifying that the blood glucose concentration was too high (MP1), but then omitted to mention the effect of insulin (MP2) or referred to insulin "regulating" or "stabilising" the blood sugar concentration, which was too vague to be credited. This question assessed AO1 and AO2.

Question 13 (a) (i) and 13 (a) (ii)

13 (a) **Fig. 13.1** shows the apparatus used to prove that carbon dioxide is needed for photosynthesis.

Fig. 13.1



(i) Describe how this apparatus and iodine solution are used to prove that carbon dioxide is needed for photosynthesis.

.....

.....

.....

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

(ii) What is the expected result for this experiment?

Result for **Plant A** .....

Result for **Plant B** .....

[1]

Very few responses gained any mark for Question 13(a)(i); those that did so gained MP2 for referring to the need to test for starch – no candidate gained both marks. This question was misunderstood by nearly all candidates, who described the role of soda lime in the investigation – which was a repeat of information in the question stem – and the effect of removal of carbon dioxide on the rate of photosynthesis. The role of iodine in the investigation – despite this being specifically asked in the question – was not addressed by the overwhelming majority of candidates.

Candidates then misunderstood what was being asked by Question 13(b)(ii) and – apart from one or two of the candidates who had referred to the need to test for starch in Question 13(a)(i), and who provided the expected results of the iodine test – described the relative states of health of the two plants. Nearly all candidates had taken forward their answer for Question 13 (a)(i) to make a sensible suggestion for Question 13(a)(ii) in that context. This demonstrates good examination technique.

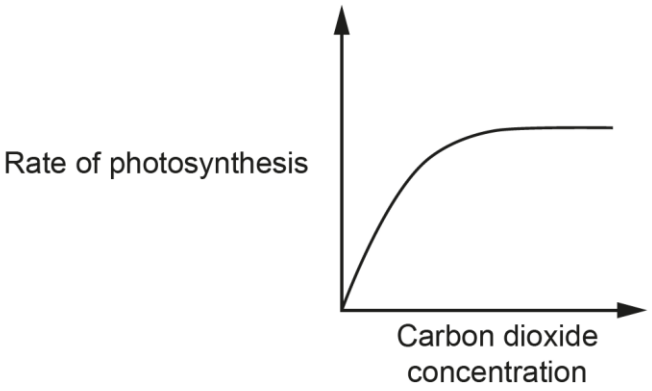
Questions 13(a)(i) and 13(a)(ii) both assessed AO2.

Question 13 (b) (i)

(b) (i) A student then investigates the effect of changing the carbon dioxide concentration on the rate of photosynthesis.

Fig. 13.2 is a sketch of the expected results.

Fig. 13.2



Describe the pattern in the graph.

.....

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

A minority of responses correctly described the trend shown by Fig. 13.2. Many responses described only the increase in rate of photosynthesis at low concentrations of carbon dioxide, while others struggled to describe the plateauing at higher concentrations, using terms such as "evens out", "peaks", "remains balanced". Some candidates thought that the rate of photosynthesis stopped, while others referred to the concentration of carbon dioxide increasing and plateauing/etc. This question assessed AO2.

Question 13 (b) (ii)

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

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

A minority of responses correctly identified the independent variable as the rate of photosynthesis; nearly all the incorrect responses identified the independent variable as the concentration of carbon dioxide. This question assessed AO2.

Question 13 (c)

(c) Oxygen is one product of photosynthesis. The other product of photosynthesis is a monomer.

This monomer is then used to make a polymer. The polymer is then used as an energy store by the plant.

Name the monomer and polymer.

Monomer .....

Polymer .....

[2]

Very few candidates were able to name both the monomer and polymer. Only a minority were able to gain 1 mark through correctly identifying either the monomer or polymer – of those that did the overwhelming majority correctly identified the monomer as glucose. There were very few candidates who identified the polymer as starch. A common mistake made by candidates who had correctly identified glucose as the monomer was to suggest the polymer was glycogen. Other incorrect suggestions for both monomer and polymer were much less logical, such as: light, chlorophyll, water, carbon dioxide, amino acid(s), oxygen, and bell jar. There were a significant number of null responses for this question. This question assessed AO2.

Question 14 (a) (i)

14 (a) **Fig. 14.1** is a diagram of a healthy heart. **Fig. 14.2** shows a heart with a defect.

Fig. 14.1

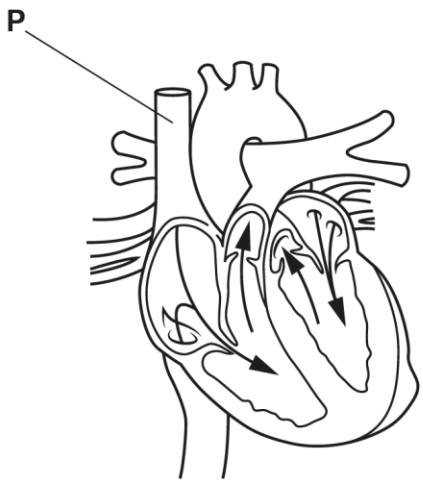
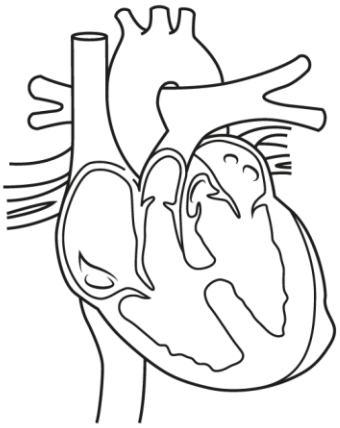


Fig. 14.2



(i) Identify the blood vessel labelled **P** in **Fig. 14.1**.

Put a (ring) around the correct answer.

aorta **pulmonary artery** **pulmonary vein** **vena cava**

[1]

A minority of responses correctly identified the blood vessel P as the vena cava. Incorrect responses were almost evenly split between the other three alternatives. This question assessed AO1.

Question 14 (a) (ii)*

(ii)* Describe the heart defect shown in **Fig. 14.2**.
Explain how this defect would affect oxygen transportation around the body.

Include the names of the chambers affected by the defect.

.....

.....

.....

.....

.....

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

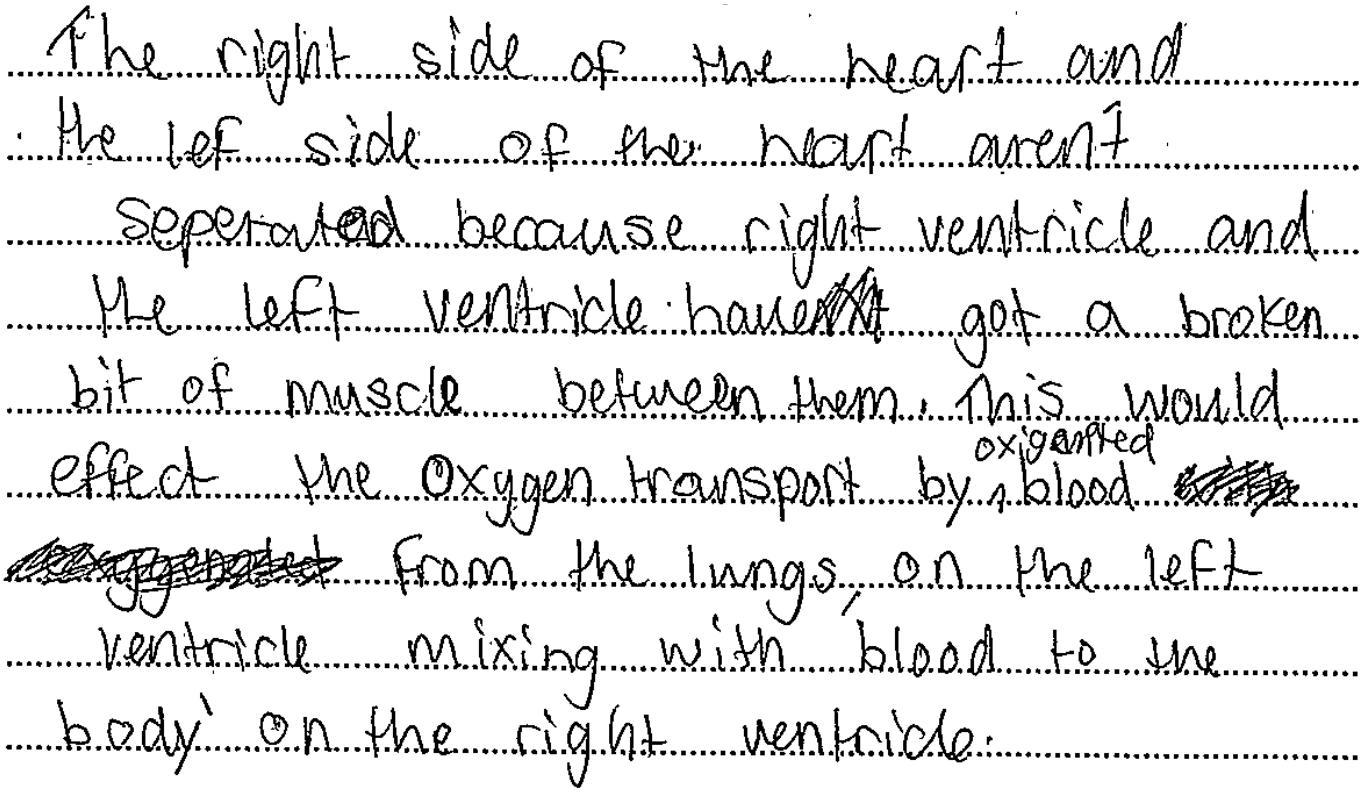
This question assessed AO2 and AO3. Candidates could access marks within Level 1 by addressing either AO2 or AO3; in order to access marks within Level 2 and Level 3 candidates needed to address both AO2 and AO3. As with previous series this question proved challenging to the vast majority of candidates: the majority did not gain any marks, and within each level significantly more candidates were awarded the lower mark within the level. Candidates needed to identify the defect in the heart shown in Fig. 14.2: a simple description referring to a hole, a detailed description including the names of the chambers affected; describe the effect on blood flow through the heart: a simple description referring to mixing of blood, a detailed description including reference to oxygenated and deoxygenated blood; and explain the effect on the body: a simple description referring to reduced oxygen transport to the body, a detailed description including reference to the effect of this or the organs affected. Consideration of one topic allowed candidates to access Level 1, consideration of any two topics allowed candidates to access Level 2, while consideration of all three topics was required to access Level 3. To be given the higher mark within a level the topic(s) considered had to be addressed in detail. Some responses simply described the sequence of blood flow through the vessels and chambers of the heart. Others identified the defect as being the absence of blood vessels connected to the heart.

Exemplar 1

The diagram shows that a healthy heart's left and right ventricles are seperate. This is because the right side deals with pumping deoxyginated blood to the lungs whilst the left side of the heart supplies the rest of the body with oxyginated blood. With fig 14.2, the ~~chambers~~ ventricles are connected. Thus, deoxyginated blood may be re-circulated around the body, causing oxygen debt within cells. Oxygen ~~m~~ will be transported less efficiently meaning heart rate may increase to compensate. Deoxyginated and Oxyginated are now ~~see~~ mixing. [6]

This response is worth Level 3, 6 marks – all three topic areas have been described in detail. In lines 6-7 the candidate identifies in detail that the defect is a connection between the ventricles. In lines 7-10 the candidate explains in detail that the consequence for the body is reduced oxygen transport leading to oxygen debt within cells. In lines 10-12 there is an alternative detailed explanation that oxygen would be transported less efficiently, leading to the need for the heart rate to increase. Somewhat out of order, in lines 12-13 the candidate provides a detailed description of the effect of the defect on the flow of blood, referring to the mixing of oxygenated and deoxygenated blood. In lines 2-6 the candidate has already described how in a healthy heart deoxygenated blood is restricted to the right-hand side while oxygenated blood is restricted to the left-hand side, although this detail was not necessary for the response to be given marks.

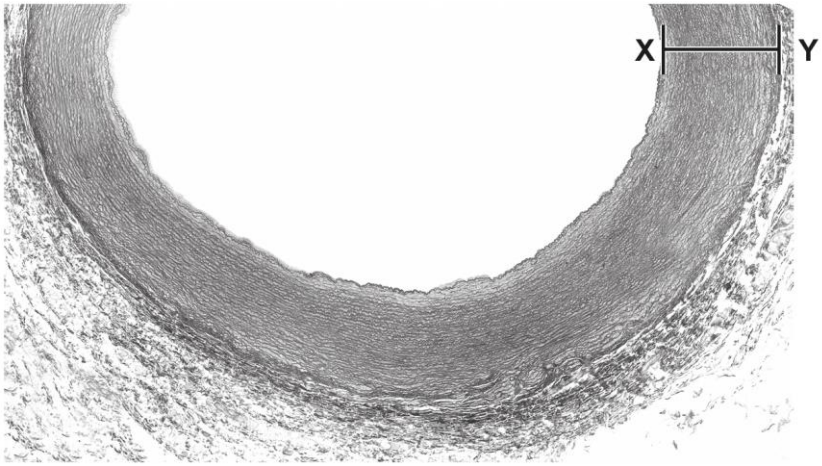
Exemplar 2



This response is worth Level 2, 3 marks – two topic areas have been described, allowing entry to Level 2, but only one of the topic areas has been described in detail, limiting the response to the lower mark within the Level. In lines 1-6 the candidate identifies in detail that the left and right ventricle are separated by a "broken bit of muscle" (a description of a hole in the septum). Lines 5-9 are somewhat confused, but the candidate refers to mixing of blood between the sides of the heart – although there is a correct reference to oxygenated blood in the left-hand side of the heart the confused reference to the blood in the right hand side does not state whether this is oxygenated or deoxygenated blood . Without a clear reference to oxygenated or deoxygenated blood this can only be accepted as a simple description of the effect of the defect on blood flow within the heart.

Question 14 (b)

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



The actual thickness of the wall at **X–Y** is 2 mm.

Calculate the magnification of the image.

Magnification = × ..... **[2]**

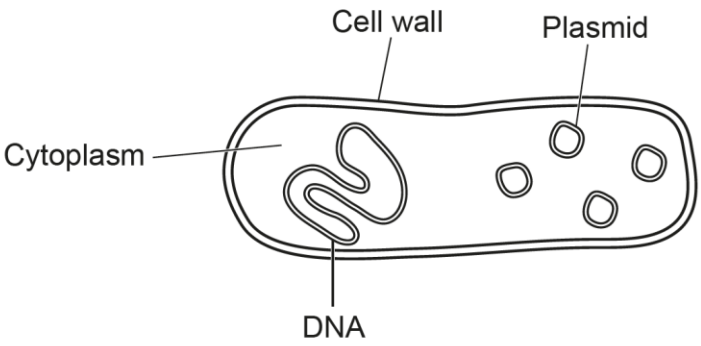
A large majority of candidates did not gain either mark on this question. A few candidates gained both marks for correctly calculating the magnification, while a small number of candidates scored 1 mark for correct substation of values or for the number 15 appearing somewhere within an often confused calculation. This question assessed AO1 and AO2.

Examination technique

Candidates should be encouraged to show working for all calculations, so that substitution and/or calculation and/or evaluation marks may be still given where other errors in the calculation have been made.

Question 15 (a)

15 The diagram shows a prokaryotic cell.



(a) Which structure labelled in the diagram would **not** be found in a eukaryotic plant cell?

Tick (✓) **one** box.

- Cell wall ☐
- Cytoplasm ☐
- DNA ☐
- Plasmid ☐

[1]

Some responses correctly identified plasmid as the structure that would not be found in a eukaryotic plant cell. Cytoplasm was the most common incorrect response, with cell wall and DNA being less common. This question assessed AO1.

Question 15 (b)

(b) Prokaryotic cells are much smaller than most eukaryotic plant cells.

Explain why an electron microscope is used to view smaller prokaryotic cells instead of a light microscope.

.....

.....

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

A minority of candidates gained 2 marks for correct references to both the higher magnification and resolution of electron microscopes. More candidates gained 1 mark, usually for reference to the higher magnification (MP1) of electron microscopes. The majority of candidates did not score any marks; many of these answers referred to electron microscopes being able to get a "Better picture", having a "better zoom", or being able to "zoom in more closely", which are not sufficiently technical alternatives to the ideas of higher magnification or resolution. A small, but significant, number of candidates simply rephrased the question stem and stated that electron microscopes were used to view prokaryotic cells because they were smaller than eukaryotic cells. This question assessed AO1.

Question 15 (c)

(c) Some prokaryotic cells contain chlorophyll in their cytoplasm.

Where is chlorophyll found inside eukaryotic plant cells?

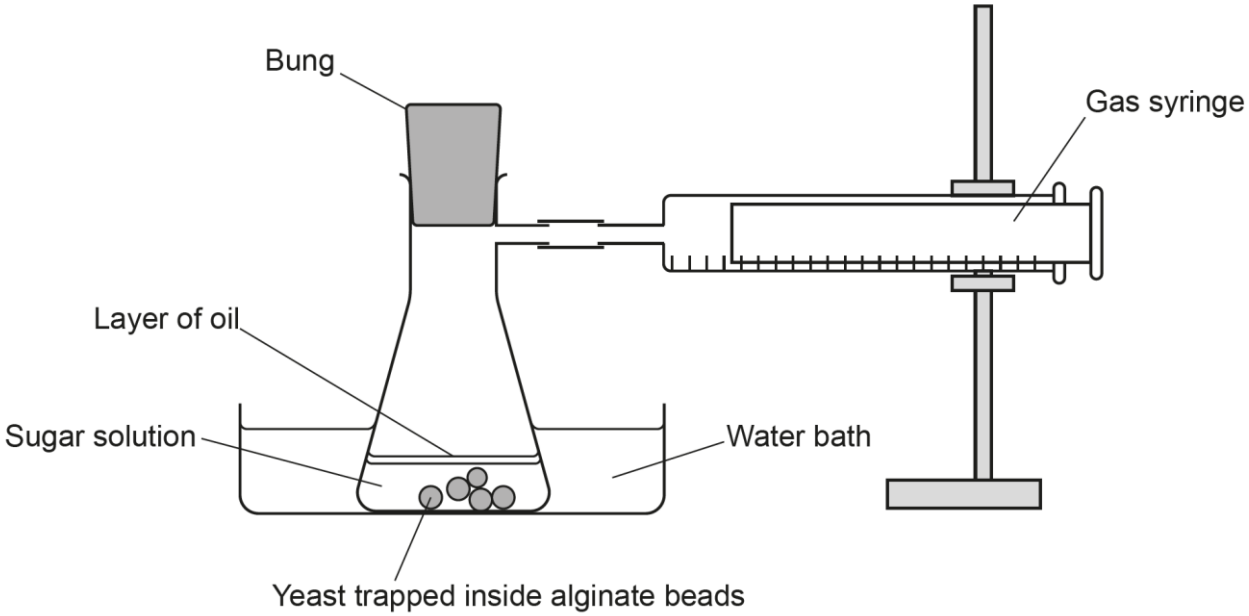
..... **[1]**

A small number of responses correctly stated that chlorophyll is found in chloroplasts. Virtually every cellular organelle was suggested, while some candidates were clearly influenced by Question 15(a) and suggested cytoplasm, cell wall, and, occasionally, DNA. This question assessed AO1.

Question 16 (a) (i)

16 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]**

Only a small proportion of responses correctly identified either that the sugar is used up in the experiment or that the starting sugar solution needs to be the same each time – more successful candidates tended to link both ideas together in the same response. The vast majority of candidates simply suggested that using fresh sugar solution was necessary for a "fair test". This question addressed AO2.

Question 16 (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]

Just under half of the responses correctly identified that of the options the one variable that should be kept constant is the number of alginate beads. Of the incorrect option, temperature of the water bath was the most commonly selected, followed by position of the gas syringe at the start, with only a handful of candidates selecting volume of gas collected. The overwhelming majority of candidates clearly understood that the volume of gas collected was being measured at different temperatures and could not be kept constant. This question assessed AO2.

Question 16 (a) (iii)

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

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

Just under half of the responses correctly identified the gas collected in the gas syringe as carbon dioxide (some candidates who offered the formula incorrectly represented it as variously CO2, CO^2, Co2, or Co^2). The most common incorrect suggestion by far was oxygen, with a small – but significant – number of candidates suggesting hydrogen. Other responses seen occasionally, despite the word "gas" appearing twice in the question, were ethanol, glucose, and yeast. This question assessed AO1.

Examination technique

Candidates should be encouraged to read examination questions carefully, and to make sure that their answers make sense within the context of the question being asked.

Question 16 (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]**

Many responses correctly stated that the result for trail 1 was an outlier/anomaly or that it did not fit the pattern/was too high. Incorrect responses generally offered vague ideas such as the result being a "mistake", "wrong", or "unreliable". This question assessed AO3.

Question 16 (b) (ii) and 16 (b) (iii)

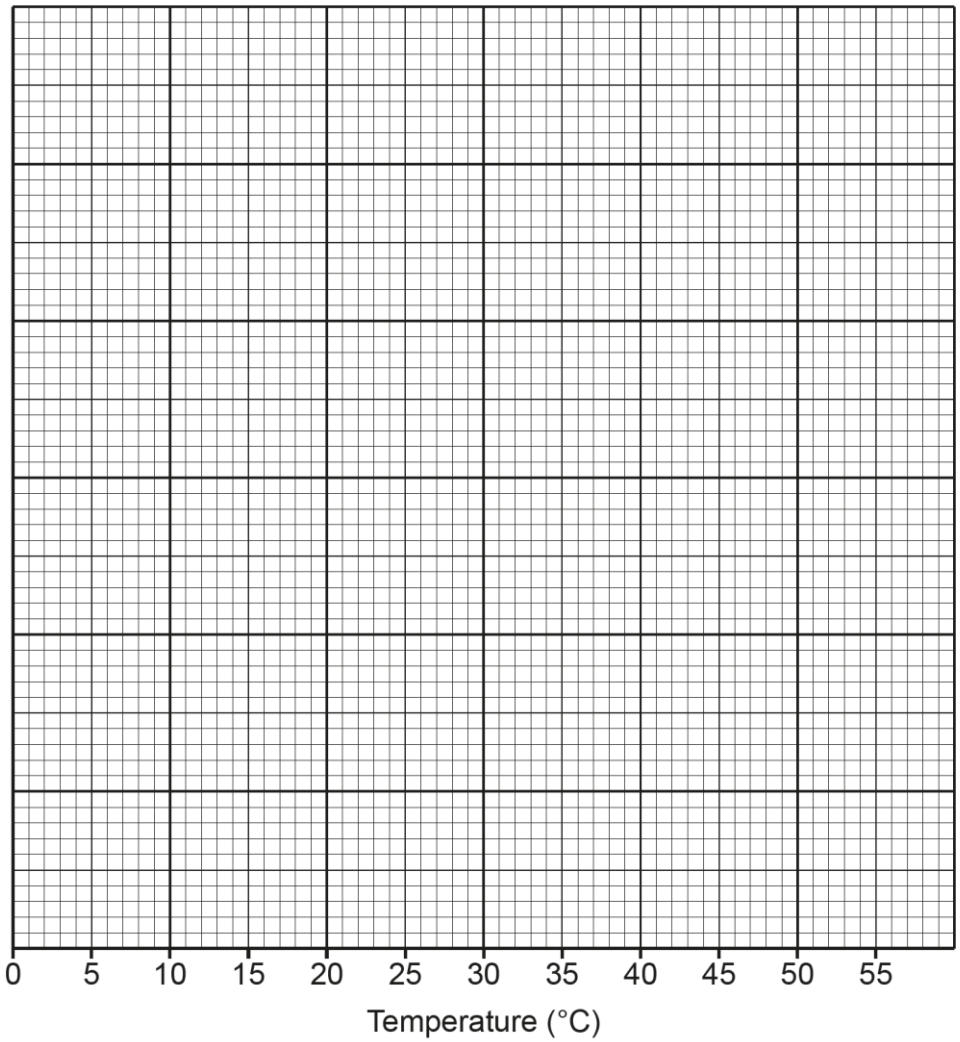
(ii) Plot the mean values from the table on the graph. **[3]**

(iii) Draw a curve of best fit. **[1]**

.....

.....

.....

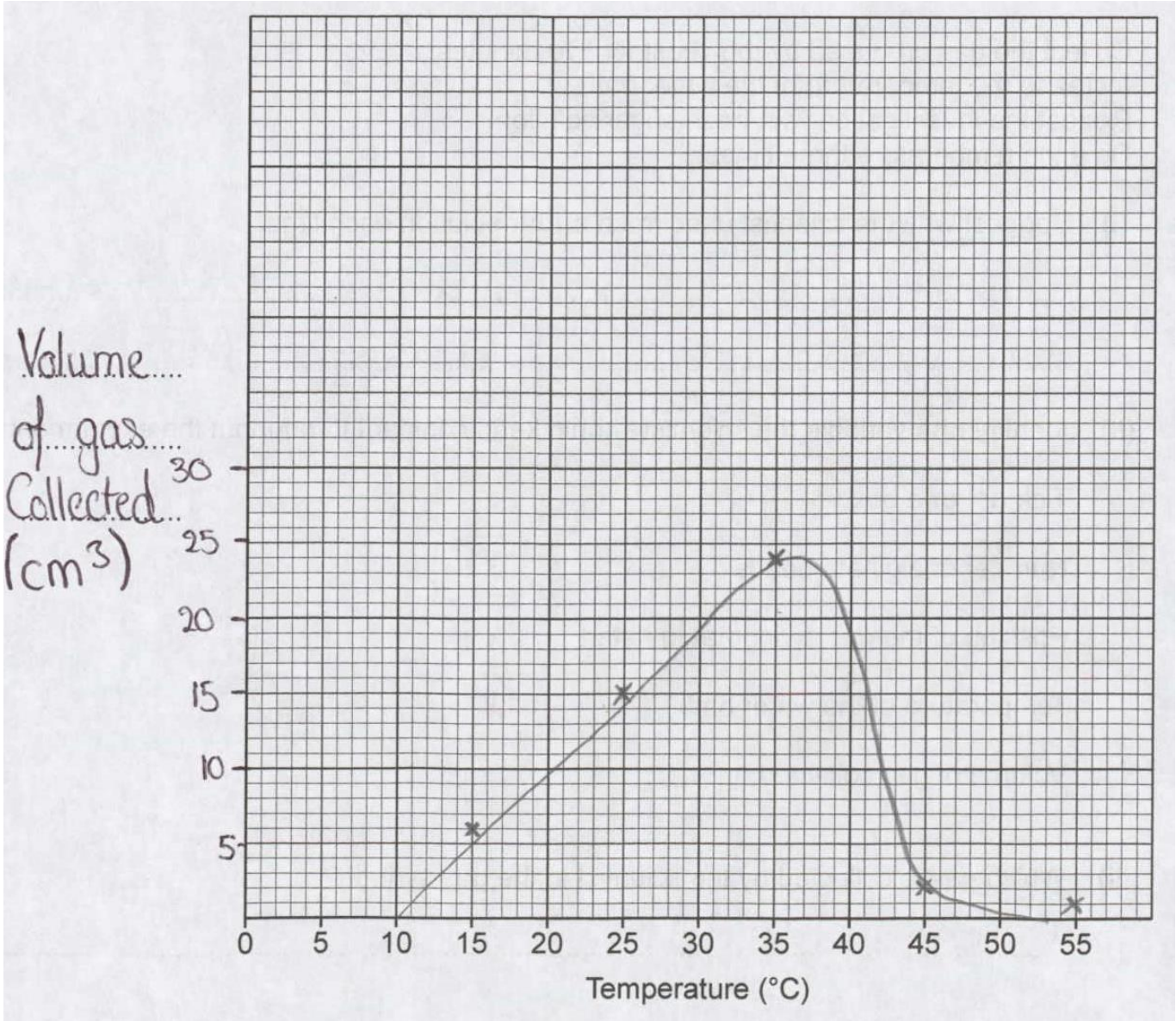


Generally, a suitable scale was chosen for the y-axis, and coordinates were accurately plotted. A suitable scale for the y-axis (MP1) required a minimum of one small square per cm^3. Accurate plotting of coordinates required points to be plotted within +/- half a small square. The most common error was the omission of units from the labelling of the y-axis (MP2). Candidates who only scored 1 mark had generally omitted units from the labelling of the y-axis and made an error with the plotting of, usually, one coordinate. Inaccurate plotting of coordinates also accounted for a number of the 2-mark scores. Despite being told to plot the mean values from the table (Question 16(b)(i)), some candidates plotted all three values separately, thereby not only losing MP3 but also the mark for Question 16(b)(iii) when they plotted three separate curves.

Some responses were then able to draw a suitable curve of best fit through most of the plotted points to address Question 16(b)(iii). This was a difficult curve to draw, especially from 35,24 down through 45,2 and 55,1 so a degree of leniency was allowed in both the shape of the curve and in the quality of the line drawn. Centres are, however, reminded that lines should be thin (drawn with a sharp pencil), continuous, smooth, and not feathered/sketched. Any extrapolation of the line drawn to 0,0 was ignored, but no marks were awarded for lines that intentionally missed the point at 45,2 – candidates may have been inclined to treat this point as an outlier, but the results of the three trials shown in Question 16(b)(i) were all in close agreement, suggesting otherwise. In general, candidates who did not gain the mark for this question either ignored the point at 45,2 or joined the points using straight lines – other errors were not attempting to draw a curve, drawing three curves as a result of plotting the individual trials when answering Question 16(b)(i), or not taking the curve beyond 35,24.

Questions 16(b)(ii) and 16(b)(iii) assessed AO2.

Exemplar 3



This response was awarded 3 marks for Question 16(b)(ii) but no mark for Question 16(b)(iii).

For Question 16(b)(ii): the y-axis has been drawn to the minimum of one small square per cm^3 (MP1); the y-axis has been correctly labelled, with units; and all coordinates have been plotted within +/- one small square.

For Question 16(b)(iii): the straight line-of-best fit from 0,10 to 35,24 is acceptable as extrapolation beyond 15,6 was ignored and a curve is drawn at 35,24; however, having passed through the point at 45,2 the candidate then misses the point at 55,1 – consequently the mark is not given. The quality of the line – smooth, continuous, thin, and without sketching/feathering – is exactly what candidates should be aiming for.

Question 16 (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]**

The majority of candidates who responded to this question did not gain marks and there were a significant number of null responses. Candidates who gained 1 mark did so by referring to either an increase of kinetic energy as temperature increases (MP1) or an increase in the frequency of collisions as temperature increases (MP2) – there were no references to enzyme-substrate complexes forming. Only a handful of candidates linked both ideas to gain 2 marks. A majority of answers were framed around the idea of denaturation, completely ignoring the increase in enzyme activity evident over the temperature range specified. Some candidates simply described/restated the data quoted in Question 16(b)(i) and plotted in Question 16(b)(ii)/(iii). This question assessed AO3.

Examination technique

Candidates should be encouraged to read examination questions carefully, and to make sure that their answers make sense within the context of the question being asked.

Question 16 (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]**

Many responses did not gain a mark on this question and again there were a significant number of null responses on this question. Candidates who gained 1 mark did so for suggesting that measurements should be made at more temperatures (MP1), but only a minority also identified the correct range over which such measurements should be made (MP2). The vast majority of candidates simply referred to taking repeat measurements or taking more accurate measurements. This question assessed AO2.

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