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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 2024 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 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 OCR.

Paper 1 series overview

J250/01 is the first Biology Foundation Tier paper in the Gateway GCSE Combined Science suite. This paper assesses content from specification topics B1-B3 and CS7. To perform well on this paper, candidates need to have a sound knowledge of the theory covered in topics B1-B3 and be able to apply this to novel situations. They also need to apply the skills and understanding that they have developed in the practical activities covered in topic CS7. The last two questions on this paper overlap with the Higher Tier paper.

Most candidates attempted all questions and overall very few questions were omitted. Questions 14 (b) and 15 (c) had high omission rates but were still attempted by most candidates.

Candidates should be encouraged to show their working in full when carrying out mathematical calculations as many just write down the final answer without showing any working which often leads to the loss of marks. When answering Question 13 (b) (ii) candidates often did not give their final answer to the correct number of significant figures. However, a large majority of answers to Question 12 (c) (i) were correctly rounded to the nearest whole number.

It is important that candidates highlight the command words within questions. In particular, when asked to give an explanation many candidates gave a description. Very few candidates gave explanations when answering Questions 14 (b) and 15 (c).

Candidates who did well on this paper demonstrated good subject knowledge across all of the topics. They read questions carefully, noting the information provided within the question, and applied their knowledge and understanding appropriately.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• performed calculations, showing their working, and rounding the answer to the correct number of significant figures (Question 13 (b) (ii)) • described how to improve the experimental method in Question 12 (c) (ii) addressing each of the bullet points • correctly interpreted the data provided in Question 14 to explain why a large surface area to volume ratio is an advantage to a tapeworm • recalled key biological knowledge such as the hormones controlling the menstrual cycle (Question 11 (d)) and the reactants in photosynthesis (Question 12 (a)) • understood the meaning of terms such as 'dependent variable' (Question 16 (a) (i)), accurate (Question 16 (b) (ii) and precise (Question 16 (c) (ii)).	• did not recall the key features of the human heart (Question 11 (c)) • did not make use of the information provided within the question to answer the question on the reflex arc (Question 13 (a)) • could not recall the substances transported in phloem and xylem vessels correctly (Question 15 (b)) or explain why water uptake is faster on hot day (Question 15 (c)) • did not understand how red blood cells are adapted to perform their function (Question 11 (a)) • did not extract information from tables (Question 16 (b) (i)) or read graphs correctly (Question 16 (c) (i)).

Section A overview

This section contains ten multiple choice questions that focus on Assessment Objectives 1 and 2. This section was attempted by all candidates with very few omissions. Most questions were answered correctly by a majority of candidates with Questions 1 and 4 having the highest proportion of correct responses. Questions 3 and 10 were the most challenging and were correctly answered by just under half of the candidates.

Very few candidates annotated the scripts to show how they had worked through distractors. Candidates should be encouraged to cross out incorrect responses and write a replacement alongside the answer box as it can be difficult to distinguish between letters if they are overwritten.

Question 1

1 A student prepares a microscope slide to view colourless plant cells.

Which type of substance is used to colour the cells?

A Acid

B Hormone

C Lipid

D Stain

Your answer ☐ **[1]**

A majority of candidates correctly identified stain as the correct answer. Lipid was most commonly selected for candidates who answered the question incorrectly. This question assessed A01.

Question 2

2 The total magnification of an image viewed using a light microscope is calculated using a formula.

What is the correct formula for total magnification?

A Total magnification = eyepiece lens magnification × objective lens magnification

B Total magnification = eyepiece lens magnification – objective lens magnification

C Total magnification = eyepiece lens magnification + objective lens magnification

D Total magnification = eyepiece lens magnification ÷ objective lens magnification

Your answer ☐ **[1]**

Most candidates identified Statement A as being correct. This question assessed A01.

Question 3

3 Plasmids are small rings of genetic material.

Which row describes where plasmids are found?

	Where they are found	Type of cell
A	cytoplasm	eukaryotic
B	cytoplasm	prokaryotic
C	nucleus	eukaryotic
D	nucleus	prokaryotic

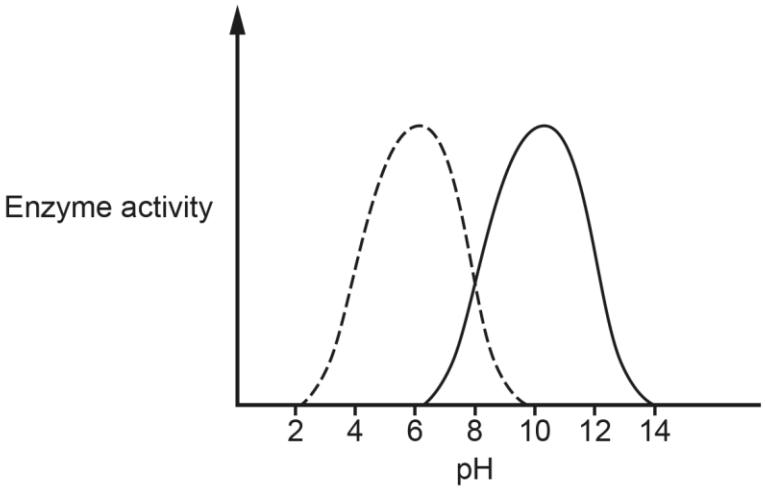
Your answer ☐ **[1]**

Around half of the candidates identified plasmids are found in the cytoplasm of prokaryotic cells. Candidates who answered this question incorrectly selected the other options in equal proportions. This question assessed AO1

Question 4

4 The graph shows the effect of pH on the activity of two enzymes.

Identify the pH where both enzymes are active.



A pH 4

B pH 6

C pH 8

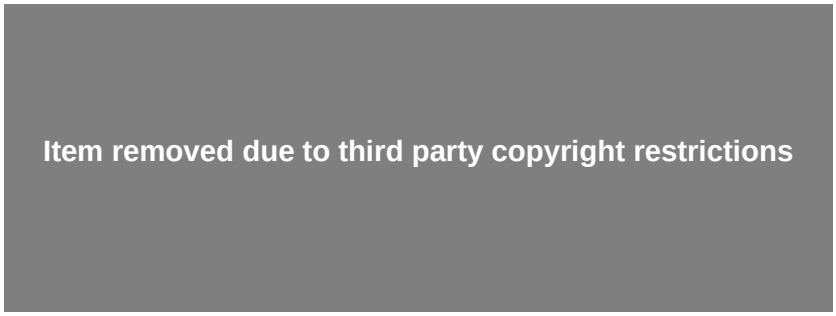
D pH 10

Your answer ☐ **[1]**

Few candidates were unable to identify that pH 8 is where both enzymes are active. This question assessed AO2.

Question 5

5 The model represents a molecule found inside human cells.



Which of these describes this model?

A Monomer and a double helix

B Monomer and a double twist

C Polymer and a double helix

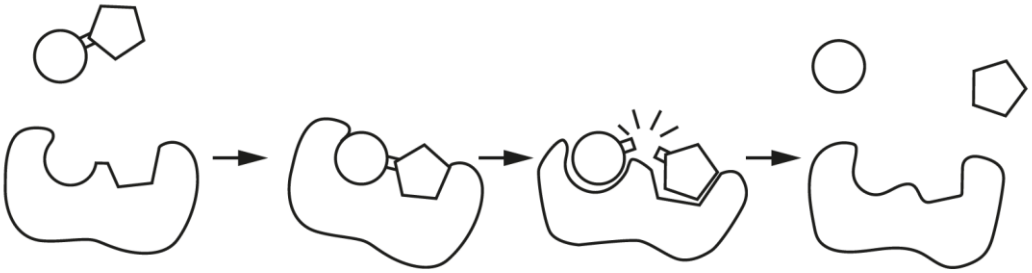
D Polymer and a double twist

Your answer ☐ **[1]**

Most candidates identified Item C as being correct. Almost all of the incorrect answers selected Item A. This question assessed AO2.

Question 6

6 The diagrams show stages in the hypothesis used to explain the mechanism of enzyme action.



Which term describes this hypothesis?

A Active site

B Denaturing

C Enzyme specificity

D Lock and key

Your answer ☐ **[1]**

Over half of candidates identified the diagram represents the lock and key hypothesis. A and B were selected by most of the remaining candidates in roughly equal proportions. This question assessed AO1

Question 7

7 The table shows information about transport of substances.

Which row describes active transport?

	Movement across a cell membrane	Movement down a concentration gradient	Requires energy
A	yes	yes	no
B	no	yes	no
C	yes	no	yes
D	no	no	yes

Your answer ☐ **[1]**

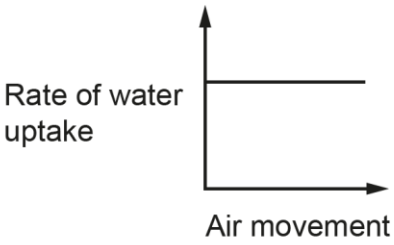
Over half of candidates identified active transport as corresponding to Item C. The remaining options were selected in roughly equal proportions suggesting they did not link active transport to the need for energy. This question assessed AO1

Question 8

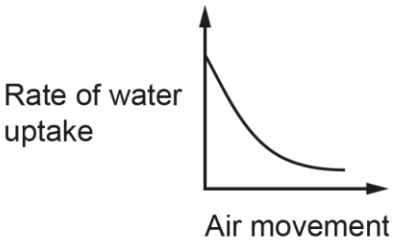
8 The graphs show how the rate of water uptake in plants can change.

Which graph shows the correct effect of **increased** air movement on the rate of water uptake?

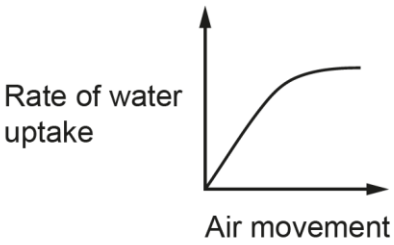
A



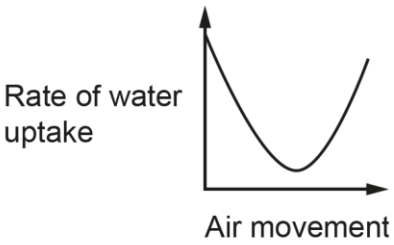
B



C



D



Your answer ☐ **[1]**

Many candidates correctly identified Graph C. Option D was the most common incorrect answer. This question assessed AO2.

Question 9

9 The table shows some information about insulin in the body.

Which row shows the correct information about insulin?

	Organ that produces insulin	Type of signal	Target organ
A	liver	chemical	pancreas
B	liver	electrical	pancreas
C	pancreas	chemical	liver
D	pancreas	electrical	liver

Your answer ☐ **[1]**

Many candidates correctly identified Option C. Option A accounted for most incorrect answers suggesting candidates had mixed up the organ that produces insulin with the target organ. This question assessed AO1.

Question 10

10 The length of a bacteria cell is 5.3 μm.

What is the length of this cell in **mm**?

(1 mm = 1000 μm)

A 5.3×10^{-6}

B 5.3×10^{-3}

C 5.3×10^{3}

D 5.3×10^{6}

Your answer ☐ **[1]**

Around half of candidates identified Option B as being correct. Option C was the most common incorrect answer. This question assessed AO1.

Section B overview

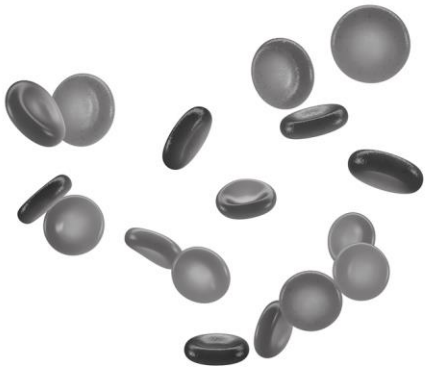
Section B covers all of the assessment objectives and consists of short one mark questions in addition to questions requiring longer answers and a single Level of Response question. Questions 15 and 16 overlap with the Higher Tier paper and have a common mark scheme.

Almost all candidates attempted this section in full and very few questions were omitted. Candidates need to make sure they make full use of the information given within the question such as the annotated diagram of the reflex arc in Question 13 (a) and the details of the investigation in Question 16 (a). The Level of Response question was the lowest scoring for most candidates and little use was made of the data provided within the question.

Candidates should be encouraged to highlight key process words within the question. Final answers to mathematical questions should be given to an appropriate number of significant figures with working shown in full.

Question 11 (a)

11 The diagram shows drawings of red blood cells.



(a) Complete the sentences about red blood cells.
Use words from the list.

biconcave	**chlorophyll**	**haemoglobin**	**helix**
nitrogen	**oxygen**	**water**	

Red blood cells are adapted to transport ..... around the body.

One adaptation is the red pigment ..... found inside the cells.

Another adaptation is their ..... shape.

[3]

Many candidates gained maximum marks on this question and very few candidates did not gain any marks on this question. Oxygen was correctly identified as being transported by red blood cells by a large majority of candidates. Chlorophyll and helix were the most common incorrect answer for the adaptations. This question assessed AO1.

Question 11 (b)

(b) Bone marrow cells inside human bones differentiate to form red blood cells.

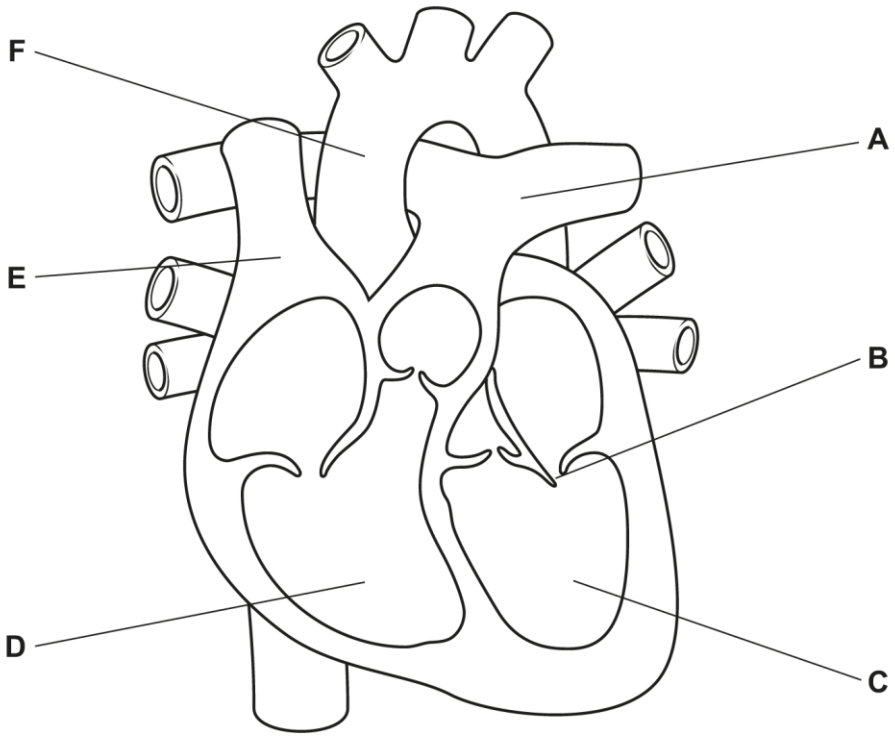
What name describes cells that can differentiate?

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

Few candidates correctly stated stem cells as the response. Specialised cells was commonly given as an incorrect response. Many candidates also selected words from the box in part (a). This question assessed AO1.

Question 11 (c)

(c) This diagram shows the human heart.



The table shows some information about the heart.

Use the diagram to complete the table.

Label letter	Name of part labelled	Description of part labelled
A	pulmonary artery	takes blood to the .....
B	.....	prevents backflow of blood in the heart
.....	vena cava	has a thin wall and a large ..... to transport blood at low pressure

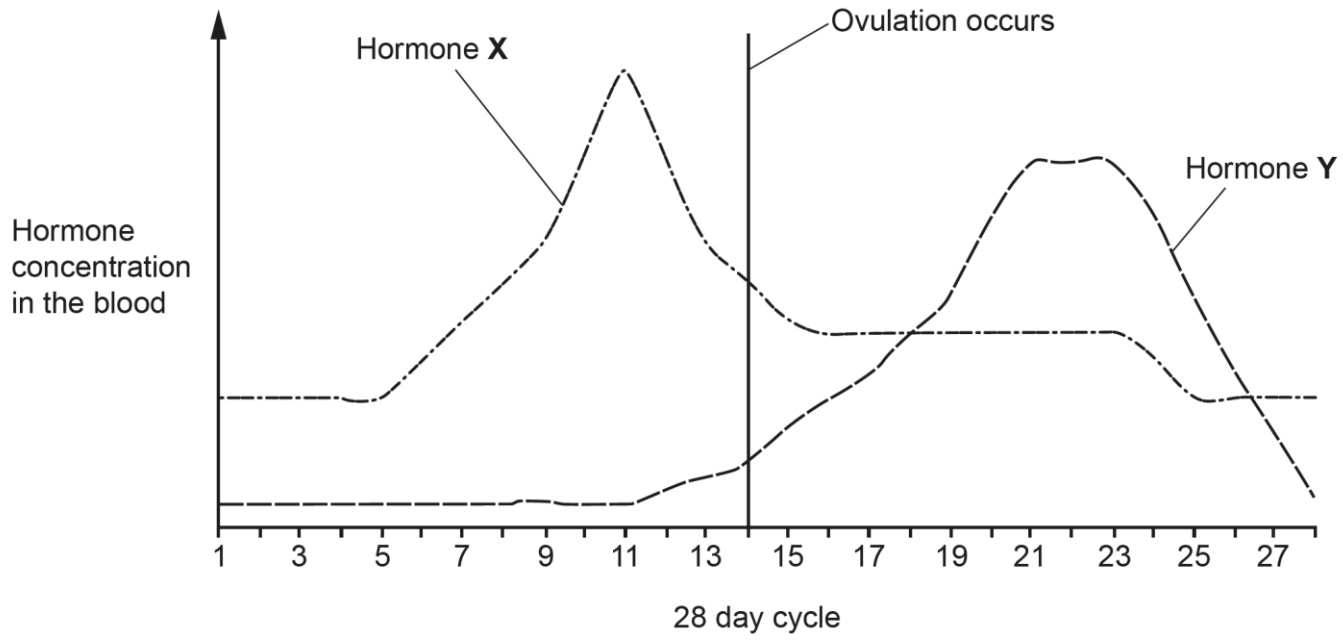
[4]

Most candidates gained zero or one mark on this question and few candidates, who were often the higher performing overall, gained all four marks. Each of the four correct answers were given in fairly even proportions. This question assessed AO1.

Question 11 (d) (i)

(d) Hormones are transported in the blood.

The graph shows the changes that occur to female hormone concentrations in the blood during the menstrual cycle.



(i) Which day of the cycle does hormone **X** reach its peak?

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

A majority of candidates correctly read day 11 from the graph. This question assessed AO2.

Question 11 (d) (ii)

(ii) Draw a line from each hormone to its correct name.

	insulin
Hormone **X**	oestrogen
Hormone **Y**	progesterone
	testosterone

[2]

Around half of all candidates gained at least one mark on this question with a large majority of these gaining both marks. The most common incorrect answers were mixing up oestrogen and progesterone. Some candidates who gained zero marks drew multiple lines from each hormone to match all four options on the right. This question assessed AO2.

Question 12 (a)

12 Plants photosynthesise to produce food.

(a) Oxygen is a product of photosynthesis.

What are the **two** reactants in photosynthesis?

1 .....

2 .....

[2]

The majority of candidates gained at least one mark. Glucose and sunlight were frequently given as incorrect responses. This question assessed AO1.

Question 12 (b)

(b) Which statements about photosynthesis are **true** and which are **false**?

Tick (✓) **one** box in each row.

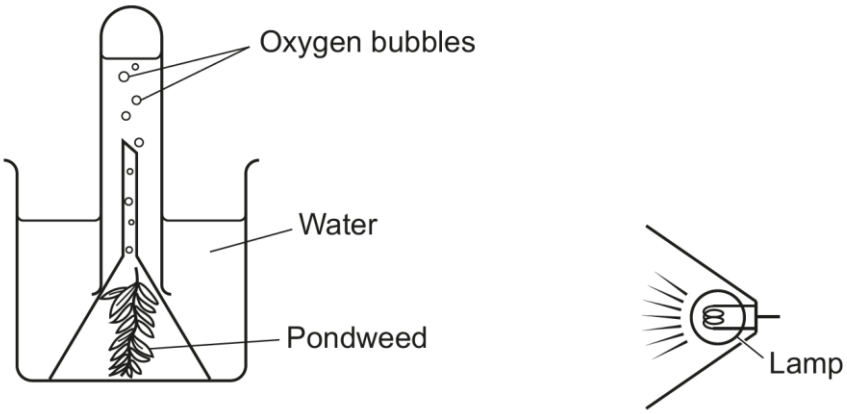
	True	False
Carbohydrates are produced in photosynthesis.		
Photosynthesis is an exothermic reaction.		
Photosynthesis is a two-stage process.		
Photosynthesis takes place in the mitochondria.		

[2]

A large majority of candidates gained at least one mark on this question with a small number gaining both marks. The most common cause for the not being given a mark was not identifying the statement that carbohydrates are produced in photosynthesis as being true. This question assessed AO1.

Question 12 (c) (i)

(c) The diagram shows apparatus used to investigate photosynthesis.



The number of oxygen bubbles released each minute indicate the rate of photosynthesis.

(i) A student counts the number of oxygen bubbles released from the pondweed.

They count 23 bubbles in 3 minutes.

Calculate the rate of photosynthesis.

Give your answer to the **nearest whole number**.

Rate = ... bubbles per minute **[2]**

Most candidates gained both marks on this question. Candidates should be encouraged to show their working as around half of the candidates who scored zero showed no working and wrote down an answer such as 7 or 7.6 which gains no marks on its own. Very few candidates omitted this question.

Question 12 (c) (ii)

(ii) The student develops their investigation to find the effect of light intensity on the rate of photosynthesis.

Describe how they should develop their investigation.

In your answer include:

- any additional apparatus they will need that is **not** shown in the diagram
- one variable they will need to control
- how they will change light intensity.

.....

.....

.....

.....

.....

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

The majority of candidates gained one or two marks on this question. Candidates should be encouraged to address each bullet point in turn. Many candidates who gained one mark just suggested moving the lamp and did not address the other two bullet points. More successful candidates followed the guidance and addressed all three bullet points. This question assessed AO2 and AO3.

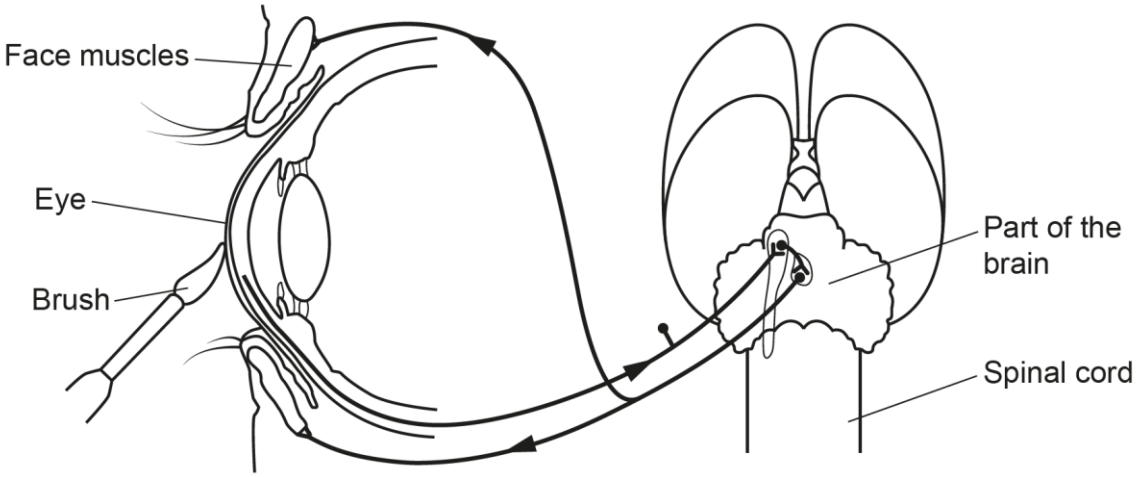
OCR support

The Practical Support Guide outlines a range of activities that can be used to support the teaching of this topic including online activities which are useful for revision.

Question 13 (a)

13

(a) Doctors can test your eye reflexes by touching the eye to make you blink.
The diagram shows the reflex arc involved in blinking.



Complete the sentences to describe the reflex arc.

Use the diagram.

The stimulus is the brush ..... the eye.

The stimulus is detected by ..... in the eye.

Nerve impulses are sent along the sensory neurone to the ..... .

The nerve impulses then pass along the motor neurone to the effectors which are the

..... .

[4]

Most candidates gained at least one mark with a majority gaining two or three marks. This question assessed AO1 and AO2.

Assessment for learning

Candidates should be encouraged to study information provided within the question carefully. Two of the correct responses ('part of the brain' and 'face muscles') are labelled within the diagram and candidates could follow the arrows to the correct part of the reflex arc.

Question 13 (b) (i)

(b) A study recorded the reaction time of people of different ages.

The table shows the mean reaction times for the different age groups.

Age group (years)	Mean reaction time (seconds)
25–34	0.185
35–44	0.210
45–54	0.225
55–64	0.230
65+	0.245

(i) Which age group had the fastest mean reaction time?

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

Almost all candidates correctly identified the youngest age group as having the fastest mean reaction time. Incorrect responses selected the 65+ age group in most cases.

Question 13 (b) (ii)

(ii) Calculate the **percentage increase** from the **25–34** age group's mean reaction time and the **65+** age group.

Give your answer to **3** significant figures.

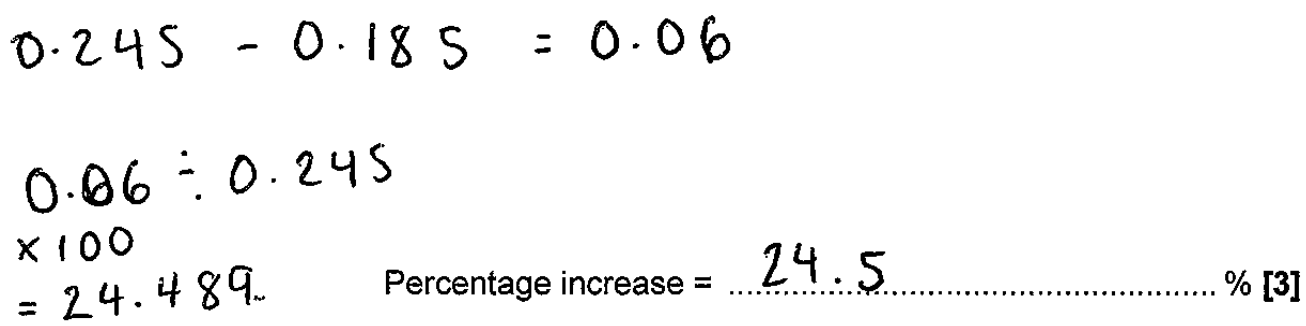
Percentage increase = ... % **[3]**

The majority of candidates scored zero marks on this question and some did not attempt it. Many candidates who scored zero marks did not show any working and those candidates who showed some working were more likely to gain marks. Most answers were not given to the correct number of significant figures. Marks were available to candidates who carried forward an error and rounded their answer to the correct number of significant figures. This question assessed A02.

OCR support

The Mathematical Skills Handbook can be used to support the teaching of skills such as significant figures. It can also be shared with students to support their own learning and revision.

Exemplar 1



In this exemplar, the candidate has gained two marks. They have correctly worked out the difference in the reaction time between the two age groups. However, the next step in the calculation is incorrect but they have rounded this answer to three significant figures. Many candidates wrote the same answer (24.5) on the answer line without showing any working and this gains zero marks. This highlights the importance of showing the working in full.

Assessment for learning

Candidates should be encouraged to show clear working as they may gain marks even if their final answer is incorrect.

Question 13 (b) (iii)

(iii) When drivers are at the UK limit for blood alcohol content it increases their reaction time by 0.12 s.

A 25 year old drives at the UK limit.

Which age group has a mean reaction time closest to this 25 year old driver?

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

Fewer than half of the candidates correctly identified the 65+ age group. Around half of the candidates who gave the correct answer showed their working on the script. Many selected the 35-44 age group as it was next to the 25-34 age group in the table. This question assessed AO3.

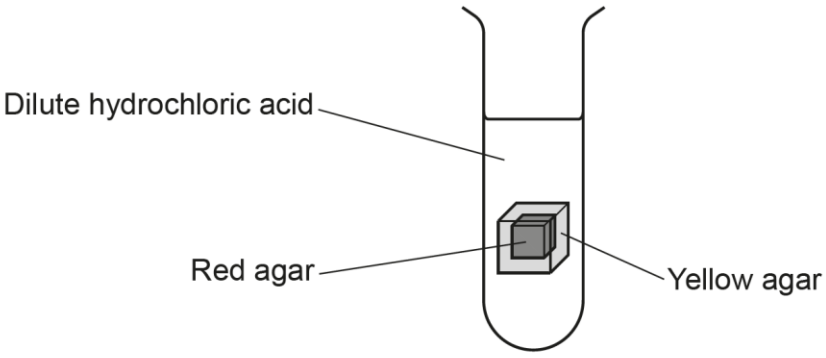
Question 14 (a) (i)

14 A student investigates diffusion. They use agar jelly stained red with a pH indicator.

This is the method they use:

- Cut the agar into cubes of different sizes.
- Place each agar cube into a different boiling tube.
- Add dilute hydrochloric acid to each boiling tube.
- Record the time taken for each agar cube to turn yellow.

The diagram shows one of their boiling tubes when the agar cube has started to turn yellow.



The table shows their results.

Agar cube	Surface area (cm^2)	Volume (cm^3)	Surface area to volume ratio	Time taken to turn yellow (seconds)
A	6	1	6 : 1	320
B	24	8	3 : 1	(122) 552
C	54	27	.....	833
D	96	64	1.5 : 1	1289

(a)
(i) Calculate the surface area to volume ratio of agar cube **C**.

Write your answer in the table.

[2]

Many candidates gave the correct answer here. A small number did not round the answer in its simplest form and gained one mark. This question assessed AO1 and AO2.

Question 14 (a) (ii)

(ii) The student has two results for their agar cube **B** experiment. The result for their first attempt was 122 seconds.

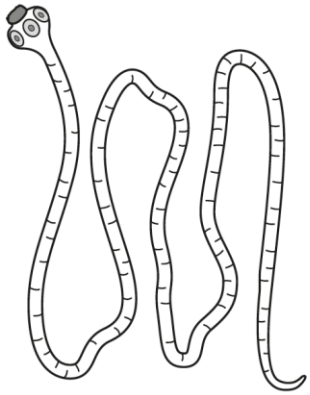
Suggest why the student repeated the experiment to obtain a second result.

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

Fewer than half of the candidates identified the result as an anomaly or suggested it was much lower than the other results. This question assessed AO3.

Question 14 (b)

(b)* Tapeworms live in the digestive system of a host animal.



- They feed by absorbing nutrients directly from their animal host.
- The nutrients diffuse across the outer surface of the tapeworm to all the cells in their body.
- The tapeworm has a surface area to volume ratio similar to agar cube **A**.

Explain why having a surface area to volume ratio similar to agar cube **A** is an advantage to the tapeworm.

Use data from the table.

.....

.....

.....

.....

.....

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

Almost half of the candidates gained zero marks on this question and some omitted it. Candidates who reached Level 1 either attempted to interpret the data, e.g. stating cube A turned yellow in the least amount of time or identified the tapeworm will be able to absorb nutrients more quickly. If they linked the data to an explanation of an advantage they were able to reach Level 2. No candidates reached Level 3 where detailed interpretation of data and detailed explanations were required. When describing the pattern in the data many candidates focused on describing how the volume and surface area changed rather than looking at the surface area to volume ratios. Many candidates who scored zero marks described the tapeworm as being able to fit into small spaces. This question assessed AO2 and AO3.

Exemplar 2

By the tape worm having a surface area to volume ratio similar to agar cube A, it is an advantage because as the time taken for the cube to turn yellow was the least amount, this means the tapeworm can feed by absorming nutrients quick and efficiently as the nutrients diffuse across the outer surface of the tapeworm. This will be a big advantage because the tapeworm will be able to have a lot of energy and grow with how quickly it is getting the nutrients.

Exemplar 2 shows a response that was placed in Level 2, four marks as they have identified cube A has turned yellow in the least amount of time and linked this to an advantage for the tapeworm.

Question 15 (a)

15 **Fig. 15.1** and **Fig. 15.2** show two different transport vessels in plants.

Fig. 15.1

Xylem vessels

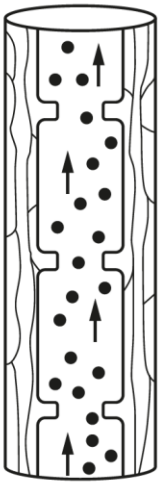


Fig. 15.2

Phloem vessels

(a) The arrows show direction of movement inside the vessels.

Give **two** reasons why **Fig. 15.2** shows phloem vessels.

1 .....

.....

2 .....

.....

[2]

Around half of the candidates identified movement inside phloem vessels is in both directions. A small number gained the second mark for stating phloem vessels contain sieve plates or giving an appropriate description. This question assessed AO2.

Question 15 (b)

(b) Compare the type of substances transported in xylem and phloem vessels.

.....

.....

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

Very few candidates correctly identified substances that are transported, or confused the substances transported in each vessel. Glucose was frequently named as being transported. This question assessed AO1.

Question 15 (c)

(c) Explain how the transport of substances through **xylem** changes on a warm day compared with a cold day.

.....

.....

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

Almost half of the candidates identified substances travel faster on a warm day. Very few explained the reason for this. This question assessed AO1 and AO2.

Question 16 (a) (i)

16 A teacher investigates the effect of different enzymes on starch. They want to find out if the enzyme breaks down the starch into sugar.

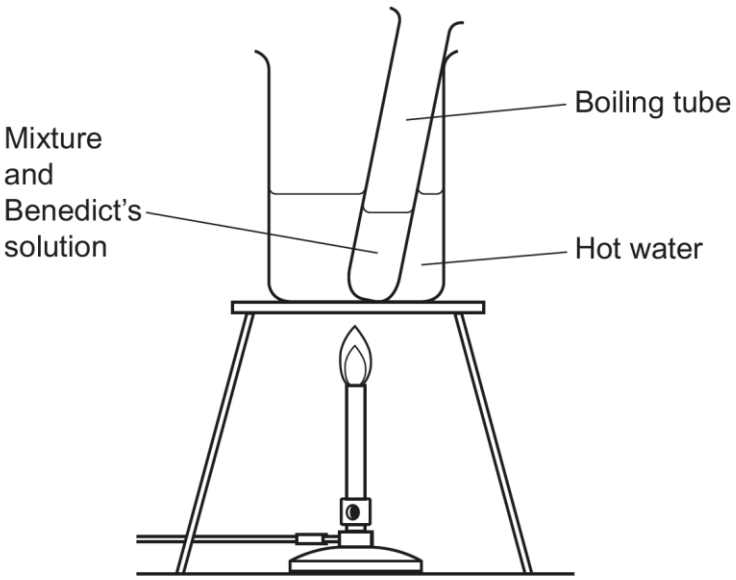
This is the method they use:

- Add 1 cm^3 of an enzyme to 5 cm^3 of starch solution in a boiling tube.
- Leave the mixture for 5 minutes.
- Add Benedict's solution to the mixture.
- Place the boiling tube in a hot water bath.
- Record the colour of the Benedict's solution after heating.

Benedict's solution is a blue solution that, when heated, forms a coloured precipitate if sugar is present.

Fig. 16.1 shows how the teacher tested for the presence of sugar in the mixture.

Fig. 16.1



(a) The teacher repeats the method with different enzymes.

(i) Identify the dependent variable in this investigation.

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

Very few candidates identified the dependent variable in this experiment. This question assessed AO2.

Assessment for learning

Candidates should make sure they understand key scientific terms such as 'dependent variable' and read all of the information given within the question. Very few candidates answered this question correctly. The dependent variable is stated within the question (final bullet point).

OCR support

The Language of Measurement in Context: Biology resource can be used to support students with understanding language of measurement terminology used, including identifying variables.

Question 16 (a) (ii)

(ii) Suggest **one** hazard in this investigation and the precaution the teacher should take.

Hazard .....

Precaution .....

.....

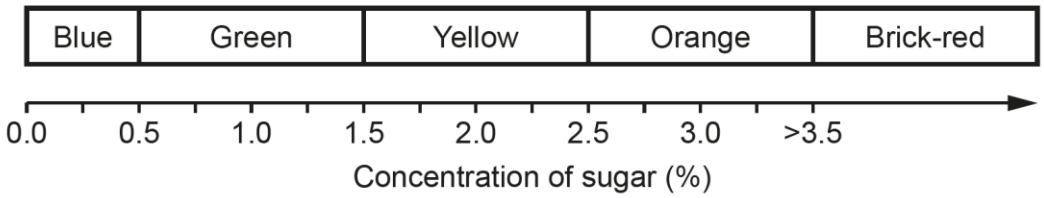
[1]

Fewer than half of the candidates were able to correctly identify a hazard and link it to an appropriate precaution. This question assessed AO3.

Question 16 (b) (i)

(b) **Fig. 16.2** is a chart that shows the colour of Benedict's solution after heating in different concentrations of sugar solution.

Fig. 16.2



The table shows the results recorded by the student.

Mixture of enzyme and starch	Colour of the Benedict's solution after heating	Sugar concentration in mixture (%)
A	brick-red	.....
B	blue	.....
C	orange	2.5–3.5
D	yellow	.....

(i) Complete the table. **[1]**

The majority of candidates correctly filled in the table. Many candidates who did not gain marks often used a less than symbol in place of the greater than.

Question 16 (b) (ii)

(ii) The concentration of sugar in mixture **C** stated in the table is **not** an accurate value.

How can the student tell that it is **not** an accurate value?

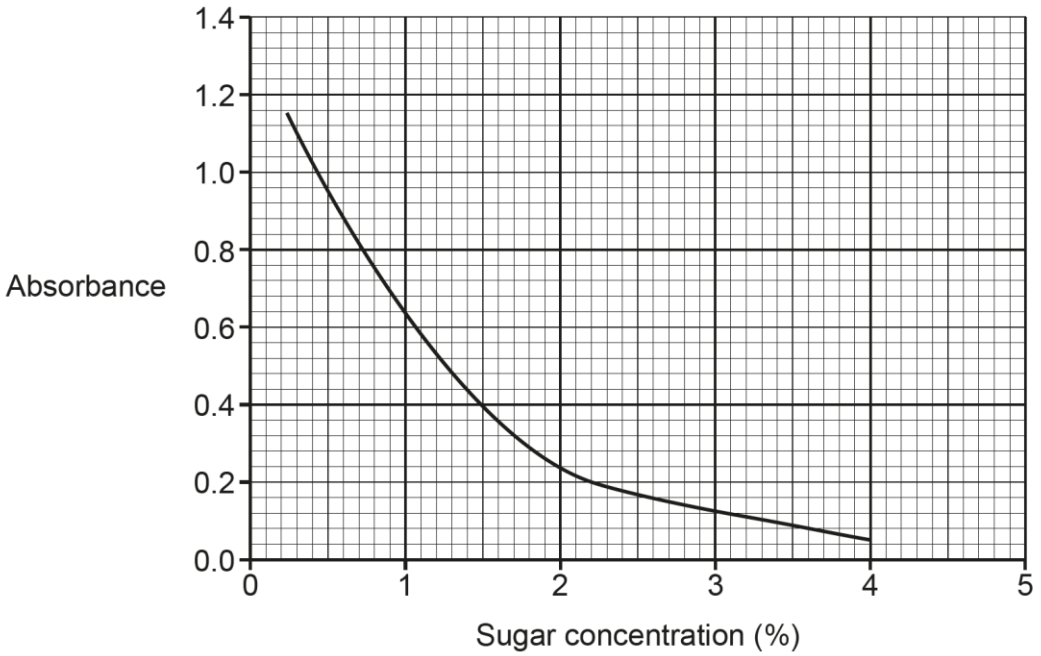
..... **[1]**

Very few candidates identified that the values given are a range. This question assessed AO3.

Question 16 (c) (i)

(c) The amount of light absorbed by different colours can be measured.

The graph compares absorbance with the percentage of sugar concentration.



(i) The teacher investigates the light absorbed by the different coloured mixtures.

They record an absorbance of 0.2 for mixture **C**.

Use the graph to find the sugar concentration of mixture **C**.

Sugar concentration = ... % **[1]**

The majority of candidates correctly read the value from the graph. This question assessed AO2.

Question 16 (c) (ii)

(ii) The answer to **(i)** is outside the range stated in the results table.

Suggest how the student could improve their method to find out how **precise** their measurement is for mixture **C**.

.....

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

Very few candidates identified the need to repeat the experiment and find a mean. This question assessed AO3.

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