

**GCSE (9-1)**

**Examiners' report**

# **GATEWAY SCIENCE COMBINED SCIENCE A**

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**J250**

For first teaching in 2016

**J250/07 Summer 2024 series**

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## Introduction

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

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

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

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

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## Paper 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. It 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 of the specification.

There was clear evidence of knowledge and understanding (AO1) shown by candidates. Candidates did not perform as well when required to apply their knowledge to answer questions (AO2) or analyse information and ideas (AO3). Candidates appear to have had sufficient time to complete the paper, with the majority attempting most of the questions in Section B.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> <li>showed an understanding of practical procedures and how to develop investigations in Question 15 (b)</li> <li>made use of the diagrams provided to help them to structure their responses correctly (Questions 11 (a) and 14 (a))</li> <li>showed a solid understanding of endocrine control within the human body (Question 14)</li> <li>were able to apply their knowledge and understanding of the human heart to a different organism (Question 16).</li> </ul>	<ul style="list-style-type: none"> <li>found it difficult to describe how to develop investigations (Question 15 (b))</li> <li>showed a lack of knowledge and understanding of the circulatory system (Question 16)</li> <li>showed a lack of knowledge and understanding of endocrine control within the human body (Question 14)</li> <li>were unable to sequence the reflex arc (Question 14 (a)).</li> </ul>

## Section A overview

Section A contains multiple-choice questions. This section of the paper is worth 10 marks. Candidates performed particularly well this series on the multiple-choice section of this paper. Questions 1, 3, 4 and 5 were usually answered correctly. Question 8 proved to be quite a challenging question in this section, with only some candidates showing knowledge of anaerobic respiration in fungi.

Where candidates decide to change their answer, they should be encouraged to cross out their original answer. They should then write the correct answer next to the box, rather than try to write one letter on top of another.

### Question 1

- 1 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]

The majority of candidates answered this correctly. Where there was an incorrect response, candidates tended to select A or D.

## Question 2

2 The length of a bacteria cell is  $5.3\text{ }\mu\text{m}$ .

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

(1 mm = 1000  $\mu\text{m}$ )

A  $5.3 \times 10^{-6}$

B  $5.3 \times 10^{-3}$

C  $5.3 \times 10^3$

D  $5.3 \times 10^6$

Your answer

[1]

The majority of candidates answered this correctly. The most common incorrect response was C.

### OCR support



The [Science Mathematical Skills Handbook](#) would be useful to share with candidates or incorporate into lessons to practise using standard form and rearranging equations, among other mathematical skills.

## Question 3

3 What are two characteristics of a cell membrane?

A Non-selective barrier and contains plasmids

B Non-selective barrier and contains receptors

C Selective barrier and contains plasmids

D Selective barrier and contains receptors

Your answer

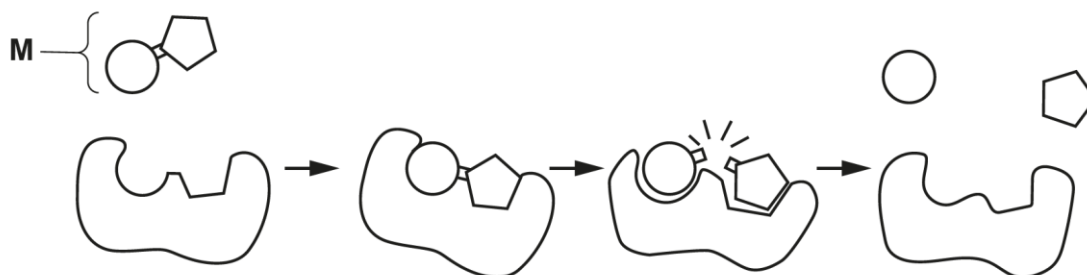
[1]

The majority of candidates answered this correctly. The most commonly seen incorrect response was C.

## Question 4

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

Which term describes the molecule labelled **M**?



- A Active site
- B Enzyme
- C Lock and key
- D Substrate

Your answer

[1]

The majority of candidates answered this correctly. The most commonly seen incorrect response was B.

## Question 5

5 What is a difference between embryonic stem cells and adult stem cells?

- A Adult stem cells are less likely to be rejected when used in transplants.
- B Only embryonic stem cells can differentiate.
- C Only embryonic stem cells produce a full range of different cell types.
- D There are more ethical issues in the use of adult stem cells.

Your answer

[1]

The majority of candidates answered this correctly. The most commonly seen incorrect response was B.



## Question 6

- 6** The resolution of a microscope is limited to **half** the wavelength of light used to see the image.

Our eyes only detect light with a wavelength greater than 400 nm.

What is the approximate resolution of a light microscope?

(1000 nm = 1  $\mu\text{m}$ )

- A** <0.2  $\mu\text{m}$
- B** ~0.2  $\mu\text{m}$
- C** ~0.4  $\mu\text{m}$
- D** >0.4  $\mu\text{m}$

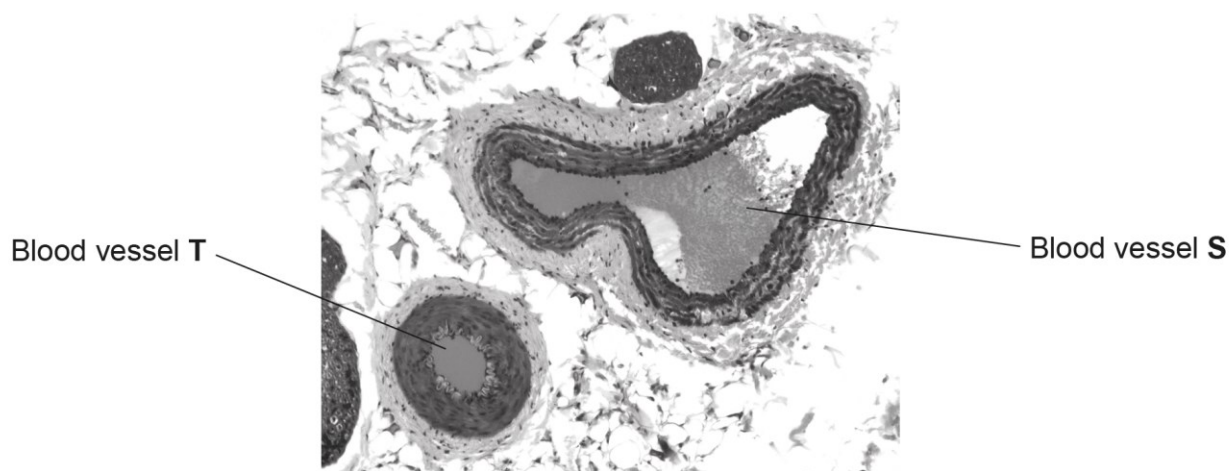
Your answer

[1]

This was the most challenging question in this section, with over half of all candidates selecting an incorrect response. The most commonly seen incorrect response was A.

## Question 7

7 The photograph shows two different blood vessels.



Which statement about these blood vessels is correct?

- A Blood flows through blood vessel T at a slower rate.
- B Blood vessel S has a thinner muscular wall.
- C Blood vessel T has a larger lumen diameter.
- D Both blood vessels transport blood to the heart.

Your answer

[1]

Over half of all candidates answered this correctly. The most commonly seen incorrect response was A.

## Question 8

8 The table shows some information about respiration.

Which row is correct about anaerobic respiration in fungi?

	Products	Site of reaction	Endothermic or Exothermic
<b>A</b>	carbon dioxide and ethanol	mitochondria	endothermic
<b>B</b>	lactic acid and water	cytoplasm	exothermic
<b>C</b>	carbon dioxide and ethanol	cytoplasm	exothermic
<b>D</b>	lactic acid and water	mitochondria	endothermic

Your answer

[1]

This was a challenging question in this section, with only some candidates showing knowledge of anaerobic respiration in fungi. The most commonly seen incorrect response was A.

## Question 9

9 Which statement correctly compares mitosis and DNA replication in eukaryotic cells?

- A** Only DNA replication is part of the cell cycle.
- B** Only DNA replication occurs inside sub-cellular structures.
- C** Only mitosis is needed to produce new cells.
- D** Only mitosis is part of the cell cycle.

Your answer

[1]

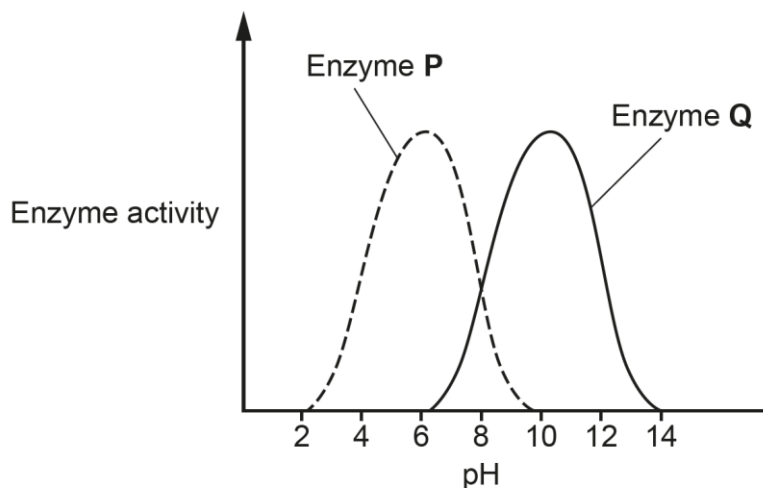
This question was quite challenging, with just over half of all candidates gaining the mark. The most commonly seen incorrect response was C.

## Question 10

**10** The pH inside the small intestine of the human digestive system is between pH 7 and pH 8.

The pH inside the stomach of the human digestive system is between pH 1 and pH 2.

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



Which statement about the enzymes is correct?

- A** Both enzymes would be denatured inside the small intestine.
- B** Enzyme **Q** would be more efficient inside the small intestine compared to enzyme **P**.
- C** Neither enzyme would work at its highest activity inside the stomach or small intestine.
- D** Only enzyme **P** would be active in the stomach.

Your answer

☐

[1]

Over half of all candidates selected the correct response. The most commonly seen incorrect response was A.

## 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. Many candidates made good use of the additional pages at the back of the paper, especially when answering the Level of Response question. However, some candidates continued their answers below the answer lines provided or, in some cases, along the edges of the page.

Candidates scored well on the first two questions. Question 14 (a) proved quite challenging: candidates that worked through the nervous pathway carefully often annotated the diagram to help themselves. Question 14 (d) (iii) also proved quite challenging, with some candidates confusing glycogen with glucagon.

In questions involving practical skills the responses were mixed. In Question 13 (b) (ii) most candidates gave answers relating to human error, rather than random error. In Question 15 (b) many candidates did not fully develop the investigation, and explanations about how the change in light intensity affects the rate of photosynthesis were often muddled.

## Question 11 (a)

11 Fig. 11.1 and Fig. 11.2 show two different transport vessels in plants.

Fig. 11.1

Xylem vessels

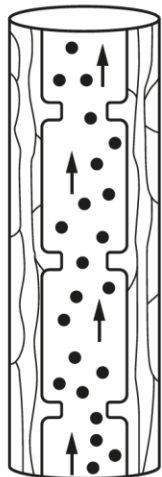


Fig. 11.2

Phloem vessels



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

Give **two** reasons why Fig. 11.2 shows phloem vessels.

- 1 .....
- .....
- 2 .....
- .....

[2]

Approximately half of all candidates scored 2 marks on this question. Where 1 mark was scored, it was usually for the idea of bi-directional flow in the phloem. Incorrect answers included membranes between cells, thin walls and narrow cells. Some candidates did not use Fig.11.2 but just wrote about the substances carried in the phloem or osmosis and active transport.

## Question 11 (b)

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

.....

.....

..... [2]

Many candidates gave the incorrect answer of glucose for phloem, some incorrectly gave minerals for phloem, and a few just food for phloem. Very few candidates gave the answer of water in both phloem and xylem with just water in xylem being mentioned. Where 1 mark was scored, it was usually for xylem transporting minerals, or phloem transporting sugars.

### Misconception



Transport in phloem involves sucrose. Many candidates incorrectly assume the sugar transported is glucose. Others confuse the function of phloem and xylem, incorrectly assuming mineral ions are transported by the phloem.

## Question 11 (c)

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

.....

.....

..... [2]

The majority of candidates scored 1 mark. Where 1 mark was given, it was usually for identifying that transport would be faster on a warmer day. Many answers were seen that linked higher temperature to more energetic particles and so faster movement. Some candidates thought that higher temperatures resulted in less water available for uptake from the soil. Those that explained that evaporation would be greater usually did not specify that it was evaporation from leaf cells or from the leaves.

## Question 12 (a) (i)

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

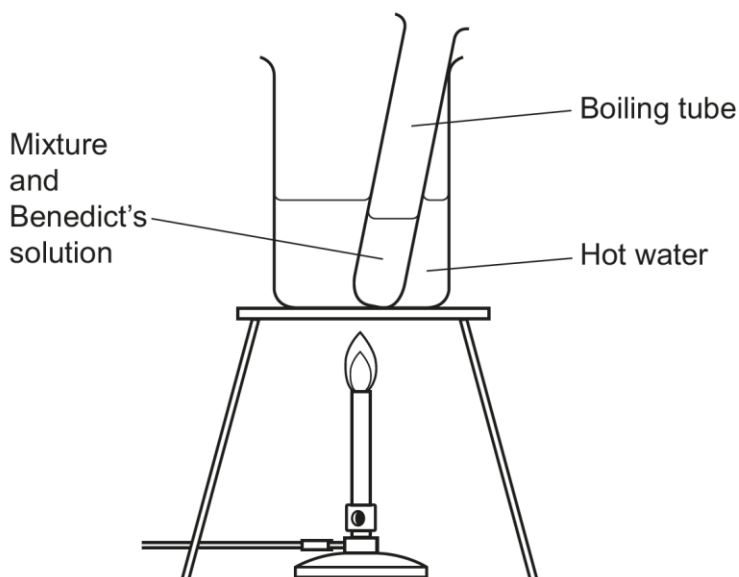
This is the method they use:

- Add  $1\text{ cm}^3$  of an enzyme to  $5\text{ cm}^3$  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. 12.1** shows how the teacher tested for the presence of sugar in the mixture.

**Fig. 12.1**



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

- (i)** Identify the dependent variable in this investigation.

..... [1]

This was not well answered by the majority of candidates, with many different answers, including enzymes, time, concentration of  $\text{HCl}$  and amount of  $\text{HCl}$ . Candidates that gave colour of Benedict's solution usually did not specify that it was the colour at the end of the experiment or the colour after heating.



## Question 12 (a) (ii)

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

Hazard .....

Precaution .....

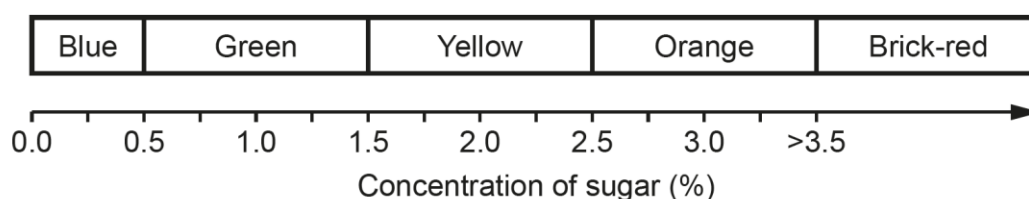
[1]

About half of all candidates gained this mark. Candidates that gained this mark usually explained that the apparatus was hot and therefore heatproof gloves were required. Many just named the Bunsen burner as a piece of apparatus and linked this to 'being careful', 'don't touch' or 'use a heatproof mat'. The meaning of the word 'hazard' was not well understood.

## Question 12 (b) (i)

(b) Fig. 12.2 is a chart that shows the colour of Benedict's solution after heating in different concentrations of sugar solution.

Fig. 12.2



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]

This was generally well answered, the >3.5 being the one that was incorrect. Incorrect answers included <3.5, 3.5<, 3.5 > and just 3.5.

### Question 12 (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?

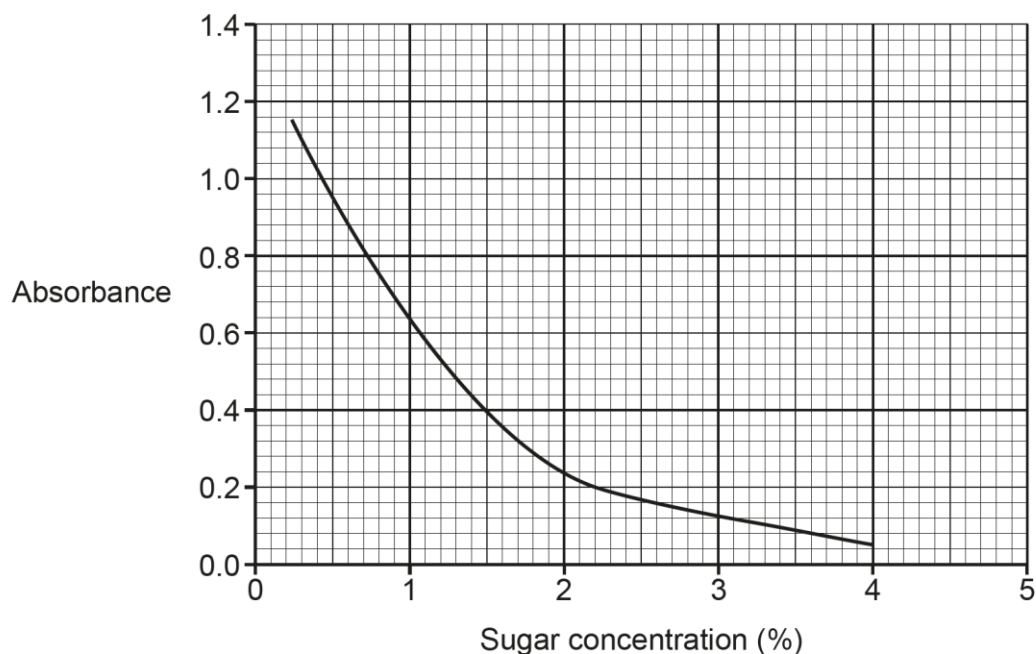
..... [1]

This was generally not well answered. Many candidates just explained what the > symbol means, explained that it does not fit the trend or said just because the colour is orange.

### Question 12 (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 vast majority of candidates answered this correctly.

## Question 12 (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]

This was generally not well answered. Many candidates gave the answer of repeating but then did not state that the average/mean needed to be calculated. Many just gave the answer of repeating to check the results.

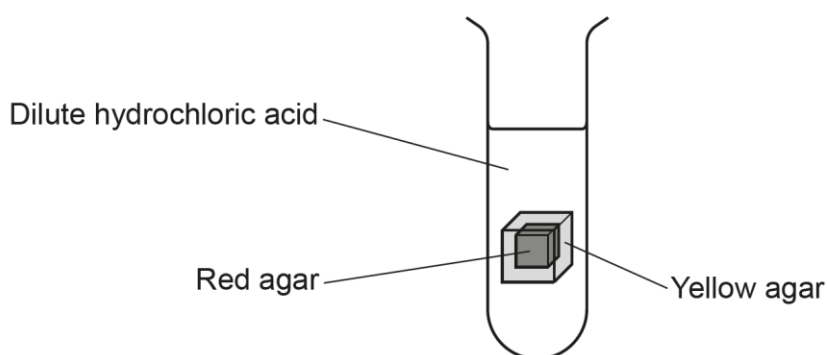
### Question 13 (a)

**13** 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	Length of one side (cm)	Surface area (cm <sup>2</sup> )	Volume (cm <sup>3</sup> )	Surface area to volume ratio	Time taken to turn yellow (seconds)
<b>A</b>	1	6	1	6 : 1	320
<b>B</b>	2	24	8	3 : 1	552
<b>C</b>	3			.....	833
<b>D</b>	4	96	64	1.5 : 1	523
<b>E</b>	5	150	125	1.2 : 1	1145
<b>F</b>	6	216	216	1 : 1	1408

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

Write your answer in the table.

[3]

This was answered correctly by the majority of candidates. A few candidates did not express the ratio as x:1 (in this case, 2:1) or calculated the surface area and volume incorrectly. For these candidates there was an ECF given if they divided the surface area by the volume they had given. This highlights the importance of showing the workings in calculations.

### Question 13 (b) (i)

- (b) One of the times recorded is an anomaly.

- (i) Identify this anomalous result.

..... [1]

This was answered correctly by the majority of candidates. A few candidates gave the answer incorrectly as A or C.

### Question 13 (b) (ii)

- (ii) The anomaly was due to random error.

Suggest **one** random error that could have caused the anomaly.

..... [1]

This was not well answered, with most candidates giving answers about human error, e.g. forgetting to start or stop the stopwatch, using too much HCl, temperature changes and not measuring the agar correctly.

## Question 13 (c)

(c) Describe and explain the pattern in the results.

.....

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.....

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..... [3]

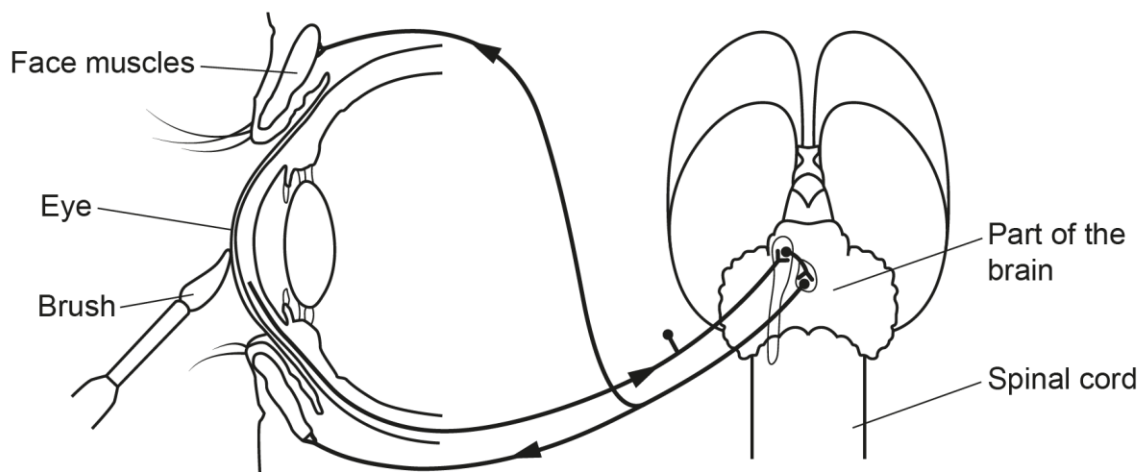
The majority of candidates only gained 1 mark on this question, for linking an increase in size to an increase in time taken. Where a second mark was gained, it was usually for identifying that as size increases, the SA:V ratio decreases. Not many candidates recognised that as size increases, the diffusion distance increases. Many thought the rate of diffusion changed.

## Question 14 (a)

14

- (a) Doctors can test your eye reflexes by touching the eye to make you blink. Fig. 14.1 shows the reflex arc involved in blinking.

Fig. 14.1



Explain how the components of the nervous system produce the response of blinking. Use Fig. 14.1.

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.....

..... [4]

Only a small number of candidates scored full marks. Candidates that worked through the pathway carefully often annotated the diagram to help themselves. Main misconceptions seen were that the sensory neurone or the eye itself detected the change in the stimulus, there was a message or electrical signal rather than an impulse and that the spinal cord was involved. Most candidates did explain that the eye muscles were the effector that caused the blinking.

### Question 14 (b) (i)

(b) The endocrine system also controls the body.

(i) Which endocrine gland releases thyroxine into the blood?

..... [1]

The majority of candidates gave the correct answer of thyroid. Commonly seen incorrect responses included adrenaline, pancreas, pituitary and progesterone.

### Question 14 (b) (ii)

(ii) Describe **two** effects of adrenaline on the human body.

1 .....

.....

2 .....

.....

[2]

This was usually well answered, with increase in breathing rate and increase in heart rate as the most commonly seen correct answers. Incorrect answers included the fight or flight response, being more alert, blood moving to different parts of the body without specifying which parts, bursts of energy and not feeling pain.



## Question 14 (c)

(c) Hormones are used in the contraceptive pill.

Explain how the **progesterone** contraceptive pill prevents pregnancy.

.....

.....

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.....

..... [3]

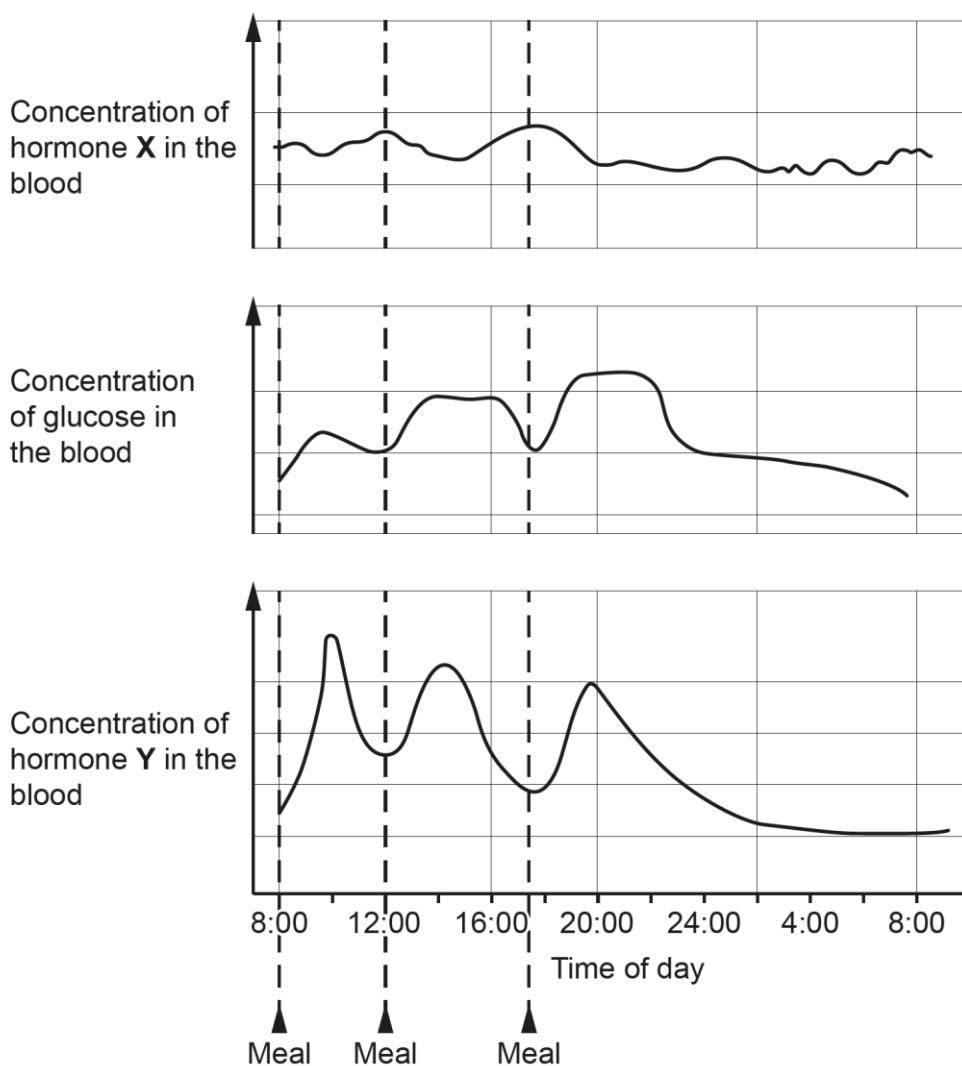
Over half of all candidates gained at least 1 mark on this question. The usual correct answers were prevents ovulation, prevents development of follicle, and thick mucus in cervix to prevent sperm getting into the uterus. Many candidates explained that progesterone inhibited FSH or LH but did not explain it inhibited the release of FSH/LH. Many only explained the action of FSH and LH rather than what would happen if FSH/LH were not present. Other incorrect answers included the uterus having mucus to stop the sperm, the sperm not being able to fertilise the egg, the body thinking it was already pregnant and stopping periods.

## Question 14 (d) (i)

- (d) Scientists used a computer model to predict the changes in concentration of glucose and two hormones in the blood before and after eating a meal.

Fig. 14.2 shows the results when three meals were included in the computer model.

Fig. 14.2



- (i) Identify hormone Y.

..... [1]

This was usually well answered. Frequently seen incorrect responses included progesterone, adrenaline, glucagon, thyroxine and sugar.

### Question 14 (d) (ii)

(ii) Explain why hormone **X** is glucagon.

.....

.....

.....

..... [2]

This was generally not well answered. Many candidates did not make the link with the information on the graph, Fig 14.2, and just wrote about what glucagon does. Many only mentioned sugar or meals rather than blood glucose levels.

### Question 14 (d) (iii)

(iii) Compare the functions of glucagon and hormone **Y**.

.....

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..... [3]

Many candidates found this challenging. Many only mentioned the actions of insulin or glucagon and did not compare the two hormones. Some candidates confused glycogen with glucagon.

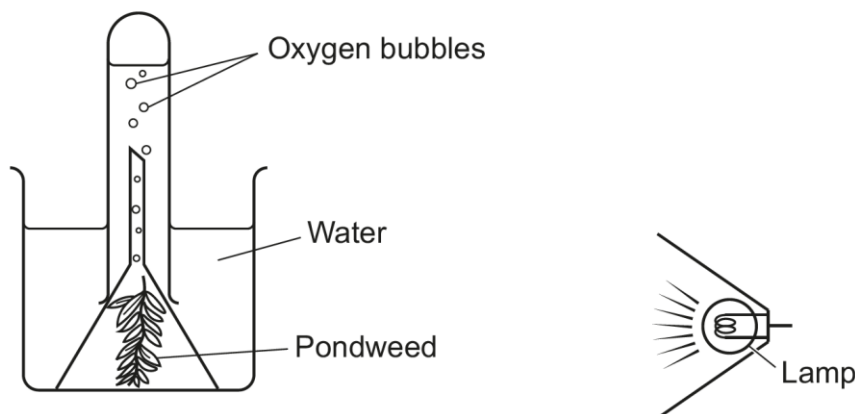
## Exemplar 1

...glucagon raises blood glucose by converting ~~glu~~ glycogen into  
 ...glucose whereas insulin lowers blood glucose by converting  
 ...glucose back into glycogen.

Exemplar 1 shows an answer that was given 2 out of the 3 marks. The response shows the candidate clearly comparing the actions of the two hormones. The candidate could have gained the third mark by comparing the conditions under which insulin and glucagon are released.

## Question 15 (a)

15 The diagram shows apparatus used to investigate photosynthesis.



The number of oxygen bubbles released each second indicates the rate of photosynthesis.

(a) A student counts the number of oxygen bubbles released from the pondweed in 2 minutes.

They use their result to correctly calculate a rate of 0.525 bubbles per second.

How many bubbles did the student count in the 2 minutes?

Number of bubbles = ..... [2]

The majority of candidates answered this correctly.

## Question 15 (b)\*

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

Describe how they should develop their investigation.

Explain how a change in light intensity will affect the rate of photosynthesis.

.....

.....

.....

.....

.....

.....

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

Many candidates did not fully develop the investigation and only wrote about moving the lamp towards or away from the plant. These candidates did not consider measurements of the different distances, repeats, a method of controlling other factors, e.g. temperature, using a gas syringe to measure volume of oxygen rather than counting bubbles. Some candidates only considered putting the plant in the light and then in the dark or switching the light on and off. The explanations about how the change in light intensity affects the rate of photosynthesis were often muddled. Some candidates had glucose or oxygen being needed for photosynthesis and carbon dioxide being made, the further the distance of the lamp the more photosynthesis, photosynthesis just being 'affected' without stating whether the rate had increased or decreased. Many answers included reference to light affecting the rate of enzyme action or increasing the energy of the particles.

### OCR support



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

## Exemplar 2

They could use an LED lamp to make sure temperature doesn't effect the results. Using a meter ruler and a timer, they would set the lamp at 10cm away from the pondweed and count the bubbles within 2 minutes and repeat at 10cm distance 3 times to make sure it's accurate by finding the mean. They could also use a gas syringe for a more accurate measure of the amount of oxygen released. Then they would need to repeat these steps at 20cm away, 30cm away and so [6] on, recording their results in a table so they can compare how light intensity effects the rate of the reaction. Their results would show that the closer the lamp, the faster the rate of photosynthesis because the light means the substrates are broken down by the enzymes quicker. as there will be more frequent collisions.

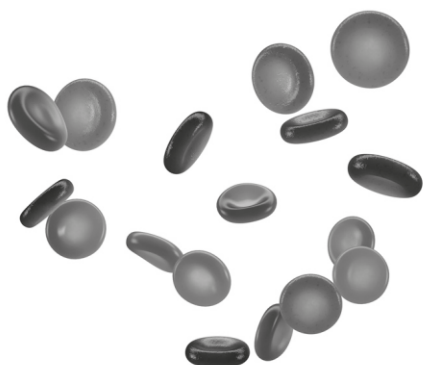
Exemplar 2 shows a response that was given Level 3, 5 marks. The response is well constructed and mostly relevant. The candidate has developed the investigation fully, as they have identified that temperature may affect the results and given a suggestion as to how to control it; they have explained how to alter light intensity; they have the idea of doing repeats and finding a mean; and they have given a suggestion for improving the accuracy of their measurements. The candidate has also made the link between light intensity and rate of photosynthesis.

The exemplar also shows the incorrect response that was commonly seen that refers to light affecting the rate of enzyme action and increasing the energy of the particles. This was what led to the candidate being given 5 marks rather than 6 marks.

## Question 16 (a)

16

(a) The diagram shows drawings of red blood cells.



Explain **two** ways red blood cells are adapted to their function.

1 .....

.....

2 .....

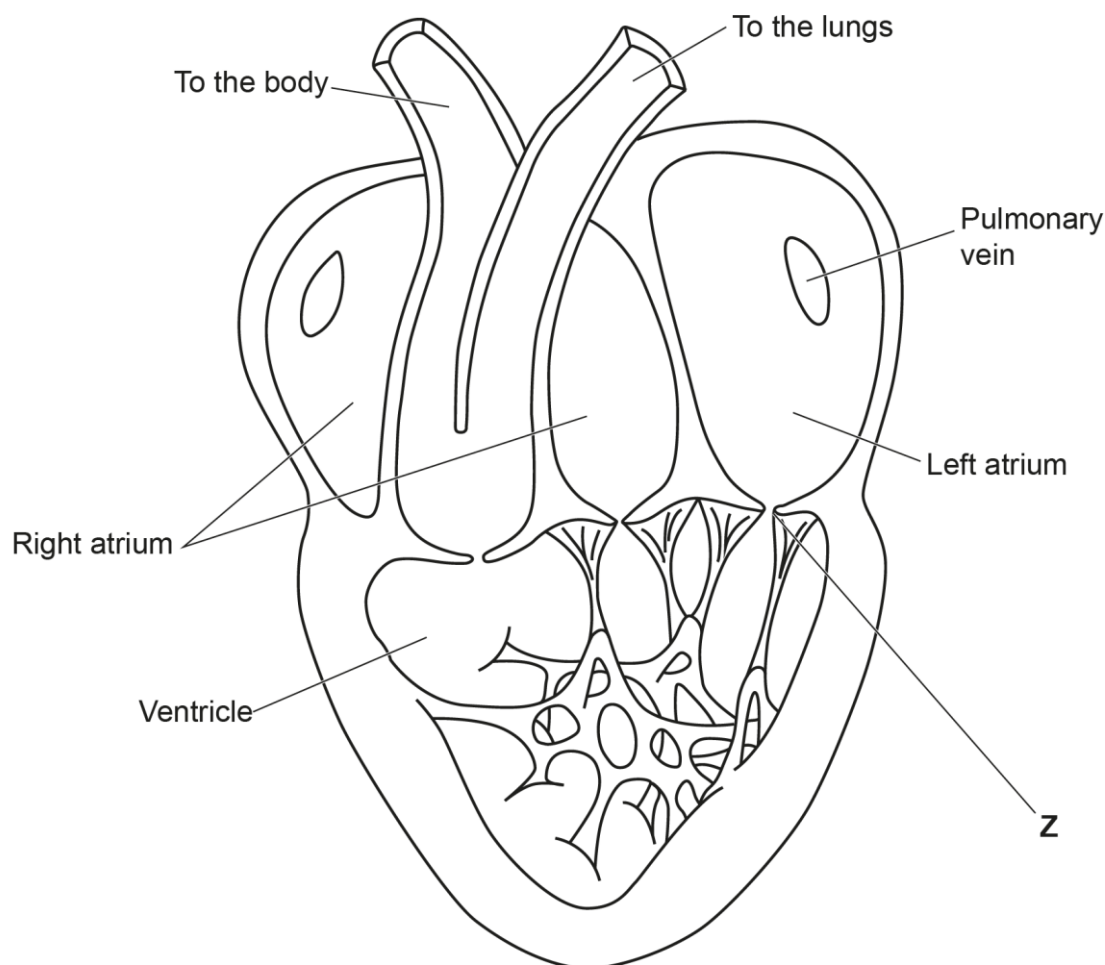
.....

[2]

This was generally well answered, with biconcave being linked to increasing surface area and no nucleus being linked to more haemoglobin. Some candidates thought that the biconcave shape allowed the red blood cell to store more oxygen and the red blood cells were small to fit through blood vessels.

**Question 16 (b) (i)**

**(b)** This diagram shows a frog heart.



**(i)** Describe the function of the structure labelled Z.

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

This was generally well answered but a few candidates thought the valves controlled the flow of blood, kept the oxygenated blood and deoxygenated blood separate, pumped the blood, and just open and close.



## Question 16 (b) (ii)

(ii) Explain why the structure of the frog heart makes it **less** efficient than a human heart.

.....

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.....

..... [3]

Only half of all candidates scored any marks on this question. More successful responses saw candidates gaining a mark for stating that there was one ventricle. Some candidates only gave the answer that there were three chambers in the frog's heart. Fewer mentioned that the frog's heart would allow mixing of oxygenated blood and deoxygenated blood and fewer still that this would cause a reduction of the oxygen available to the body cells. Many concentrated on the idea that humans have a double circulatory system and frogs have a single circulatory system.

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Question 7: Blood vessels, © Steve Gschmeissner/Science Photo Library.

Question 16 (a): Red blood cells, © NOBEASTSOFIERCE/Science Photo Library.

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