

**GCSE (9-1)**

*Examiners' report*

# ***GATEWAY SCIENCE COMBINED SCIENCE A***

**J250**

For first teaching in 2016

## **J250/07 Summer 2019 series**

Version 1

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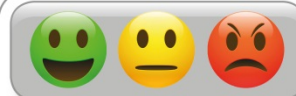
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## Introduction

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. 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 can be downloaded from OCR.

## 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 B4-6. There are also questions that involve the assessment of key mathematical requirements from Appendix 5f of the specification.

## Section A overview

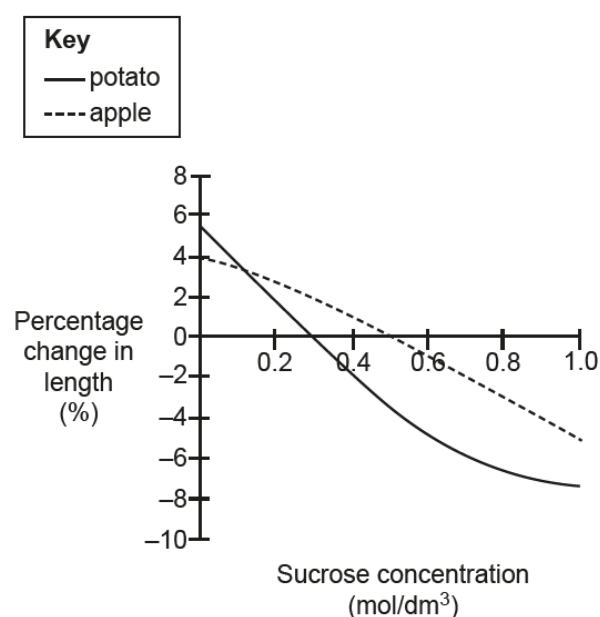
Section A consisted of multiple-choice questions. It was encouraging to see that most candidates attempted all these questions. Of these questions, candidates tended to do better on Questions 1, 3 and 6 and less well on Questions 7, 8 and 9. Question 9 proved the most difficult, as this is a concept that candidates find particularly difficult.

### Question 1

- 1 A student investigates osmosis by placing chips of potato and apple into different concentrations of sucrose solution.

The student calculates the percentage change in length for each chip of potato and apple.

The graph shows the student's results.



Estimate the concentration of sucrose inside the cells of the **apple**.

- A 0.0 mol/dm<sup>3</sup>
- B 0.3 mol/dm<sup>3</sup>
- C 0.5 mol/dm<sup>3</sup>
- D 1.0 mol/dm<sup>3</sup>

Your answer

[1]

## Question 2

- 2 Which row shows the correct pathway of oxygen from the lungs to the body tissues?

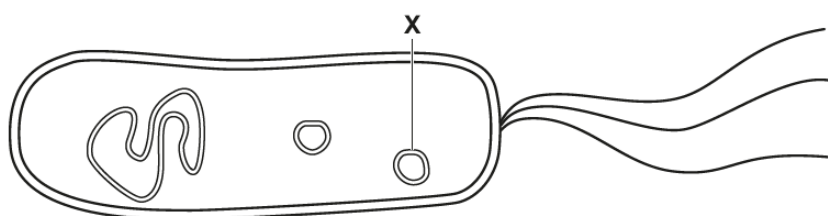
<b>A</b>	artery	atrium	ventricle	vein
<b>B</b>	atrium	artery	vein	ventricle
<b>C</b>	vein	atrium	ventricle	artery
<b>D</b>	vein	ventricle	artery	atrium

Your answer

[1]

## Question 3

- 3 Look at the diagram of a bacterial cell.



What is the name of the structure labelled **X**?

- A** Mitochondrion
- B** Nucleus
- C** Plasmid
- D** Receptor molecule

Your answer

[1]

## Question 4

- 4 The photograph shows the structure of specialised plant tissue.



Which statement **best** describes the plant tissue in the photograph?

- A Phloem used to transport mineral ions
- B Phloem used to transport sugars
- C Xylem used to transport mineral ions
- D Xylem used to transport sugars

Your answer

[1]

## Question 5

- 5 Which statement about **both** Type 1 and Type 2 diabetes is correct?

- A Insulin injections are always needed.
- B Regulating diet and exercise will help to control the symptoms.
- C The body becomes intolerant to insulin.
- D The pancreas stops producing insulin.

Your answer

[1]



## Question 6

- 6 What is the correct definition of water potential?
- A The ability of dissolved glucose molecules to move to different areas.
  - B The ability of dissolved water molecules to move to different areas.
  - C The ability of free glucose molecules to move to different areas.
  - D The ability of free water molecules to move to different areas.

Your answer

[1]

## Question 7

- 7 The resolution of an electron microscope is  $1 \times 10^{-10}$  m.

The resolution of a light microscope is  $2 \times 10^{-7}$  m.

How many times greater is the resolution of the electron microscope compared to the light microscope?

- A  $5 \times 10^{-4}$
- B  $2 \times 10^{-3}$
- C  $5 \times 10^2$
- D  $2 \times 10^3$

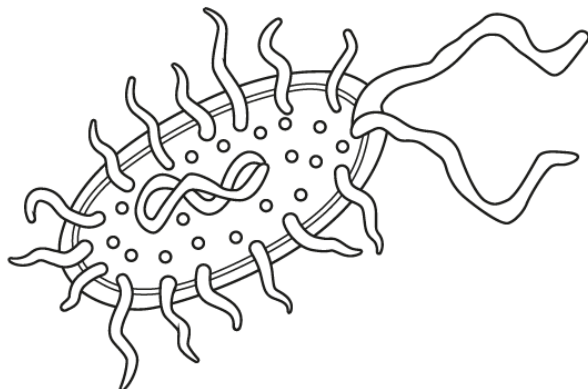
Your answer

[1]

Higher ability candidates did well on this question. Others tended to provide A or B as the answer. Choosing A suggests that they divided the electron microscope by the light microscope instead of the other way round. Choosing B suggested that they subtracted -7 from -10.

## Question 8

- 8 A student draws this image of a prokaryotic cell.



The cell image drawn by the student is 55 mm long.

The actual length of the prokaryotic cell is 1  $\mu\text{m}$ .

What is the magnification of the student's drawing?

- A 55 $\times$
- B 550 $\times$
- C 5500 $\times$
- D 55 000 $\times$

Your answer

[1]

Candidates find it difficult to convert  $\mu\text{m}$  to mm. There was no clear pattern in their incorrect answers.

## Question 9

- 9 Which statement describes how water is lost from the leaf?


- A Diffusion of water from cells followed by diffusion through the stomata.
- B Diffusion of water from cells followed by evaporation through the stomata.
- C Evaporation of water from cells followed by diffusion through the stomata.
- D Evaporation of water from cells followed by evaporation through the stomata.

Your answer

[1]

This concept is challenging for candidates; many assumed that the answer was B as they knew it involved both evaporation and diffusion but not the correct order.

?	<b>Misconception</b>	Candidates need to be aware of the difference between evaporation and diffusion in the leaf.
---	----------------------	--

	<b>AfL</b>	Water evaporates from the cells in the leaf into the leaf spaces. The water then diffuses out of the leaf through the stomata due to a concentration gradient.
---	------------	--

## Question 10

- 10** The rate of photosynthesis is affected by light intensity.

When you increase distance between a light source and a plant, light intensity decreases.

The relative light intensity can be calculated using the inverse square law:

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

The relative light intensity is 6.25.

Calculate the distance from the light source.

- A** 0.08m
- B** 0.16m
- C** 0.32m
- D** 0.40m

Your answer

[1]

## Section B overview

Section B consisted of structured questions ranging from 1 to 6 marks. There was clear evidence of knowledge and understanding (AO1). Candidates did not perform as well when required to apply their knowledge to answer questions (AO2) or analyse information and ideas (AO3). Candidates appeared to have had enough time to complete the paper, with the majority attempting most of the questions in Section B.

Most candidates attempted the level of response question. Throughout Section B a large proportion of the candidates provided very long answers that tended to repeat what they had already said and, in some cases, contradicted their answers. They should be encouraged to use the number of lines within a question as a guide to the length of answer required.

The additional pages at the back of the paper are available for those candidates who do need extra room to answer a question. Candidates are encouraged to use all space available before moving onto the extra pages, especially when this involves simply fitting one or two words to the end of a line. Candidates must number any answers on the additional pages correctly so that the examiners can award marks appropriately. If an examiner cannot identify which question the work is supposed to be for, it makes it very difficult to award credit where it is due.

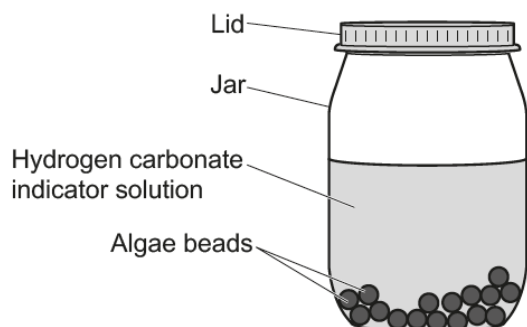
## Question 11 (a) (i)

11 A student investigates photosynthesis.

The student uses small organisms called algae, trapped inside beads.

The algae beads are put inside a jar containing hydrogen carbonate indicator solution.

A lid is placed on the jar to stop any air getting in.



At the start of the investigation the hydrogen carbonate indicator solution is red showing the presence of carbon dioxide. This changes to purple when there is no carbon dioxide present.

The student times how long it takes the indicator solution to turn purple.

She repeats the investigation using different numbers of algae beads.

The table shows her results.

Number of algae beads	Time for indicator solution to turn purple (minutes)			
	Trial 1	Trial 2	Trial 3	Mean
0	No change	No change	No change	No change
10	56	57	55	56
20	32	36	33	34
30	19	8	17	18
40	6	7	9	

(a) (i) Calculate the mean for **40** beads.

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

Mean = ..... [1]

Most candidates successfully calculated the mean. However, a minority provided an answer of 7.3 and not 7 so they could not be given the mark.

## Question 11 (a) (ii)

- (ii) Look at the mean for **30 beads**.

Explain why the student did **not** use the result for **trial 2** when calculating the mean.

.....

.....

.....

..... [2]

Most of the candidates identified the result as being an anomaly and therefore were given 1 mark. Very few went on to explain that using the anomaly would result in an inaccurate mean. Many incorrectly assumed that it would affect the reliability of results.

## Question 11 (b)

- (b) Look at the results for 10, 20 and 40 beads.

Which set of data is the most **precise**?

Explain your answer.

.....

..... [1]

Most of the candidates correctly chose '10' as their answer. However, they were unable to back up their choice with a valid reason. Most assumed it was due to the results being closer to the mean. Only the higher ability candidates were able to explain that it was due to there being a smaller range of results compared to the others.

## Question 11 (c)

- (c) Explain why the student sets up a bottle with **zero** algae beads in.

.....

..... [1]

Most of the candidates were able to explain the idea of a control used to show that the change was due to the algae beads and nothing else. A common misconception was to assume that the idea was to make sure that no carbon dioxide was present at the start.

## Question 11 (d)

- (d) Use ideas about photosynthesis to explain the pattern in the results.

.....

.....

.....

.....

..... [3]

Most candidates were able to interpret the data and were given 1 mark for the idea of the more algae/algal/beads present the faster the rate of photosynthesis. However very few could extend their answer to form a valid conclusion using ideas about photosynthesis. Only the higher ability candidates used ideas about increased numbers of chloroplasts being present so therefore more light is absorbed.

## Question 11 (e) (i)

- (e) The student wants to investigate the effect of temperature on the rate of photosynthesis.

The student uses a stop watch and a bottle of hydrogen carbonate indicator solution containing 20 algae beads.


- (i) The student also uses a large beaker and a kettle of hot water.

Explain why the student uses the beaker and kettle of hot water.

.....

..... [1]

Candidates found the concept of a water bath difficult to explain. Many incorrectly assumed the beaker could be used to measure the volume of water. Others assumed the beads could be placed inside the kettle. The use of a water bath is a required practical activity and is part of PAG 3, and candidates should have experience of using them first-hand where possible.

	<b>Misconception</b>	Centres should make sure that candidates are aware that beakers are not an accurate measure of volume
---	----------------------	---

## Question 11 (e) (ii)

- (ii) Describe how the student could develop her method to find the best temperature for photosynthesis.

.....

.....

.....

.....

.....

.....

..... [3]

Most candidates were given at least one mark for the idea of placing the beads in different temperatures. Very few could describe in detail the method they would use. As part of WS1.2b, candidates are expected to plan experiments. Writing methods is something they find very difficult and centres should be encouraged to practice this with candidates.

## Exemplar 1

She could put the jar in a ~~warm~~ room  
and ~~measure~~ ~~at~~ the beaker containing hot  
water and measure how long it takes for  
the indicator to go purple, she should repeat this  
the 3 times making sure there is the same  
amount of algae each time and ~~same~~ calculate  
the mean. Then she can measure at different [3]  
temperatures

In this response the candidate has set out a clear concise answer that covers all the necessary points. They have first described what they intend to measure to obtain their results. They have then made a correct comment about control of a variable and finally shown they understand the procedure is repeated using different temperatures.

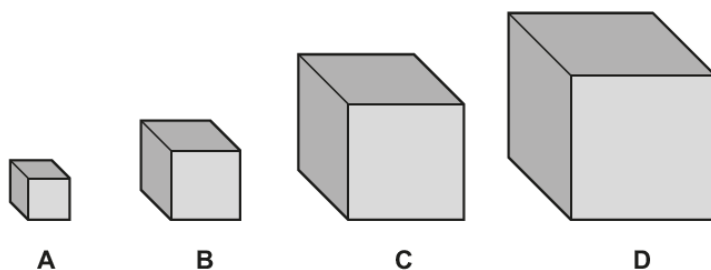


## Question 12 (a)

**12** Surface area is important for transport in plants.

Scientists investigate the relationship between surface area and volume.

(a) The diagram in **Fig. 12.1** shows four cubes.



**Fig. 12.1**

The table shows some data about the cubes in **Fig. 12.1**.

Cube	Height of cube (cm)	Surface area (cm <sup>2</sup> )	Volume (cm <sup>3</sup> )	Surface area to volume ratio
A	2	24	8	3.0 : 1
B	4	96	64	1.5 : 1
C	6	216	216	1.0 : 1
D	8			

Calculate the surface area to volume ratio for cube **D**.

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

Surface area to volume ratio = ..... [3]

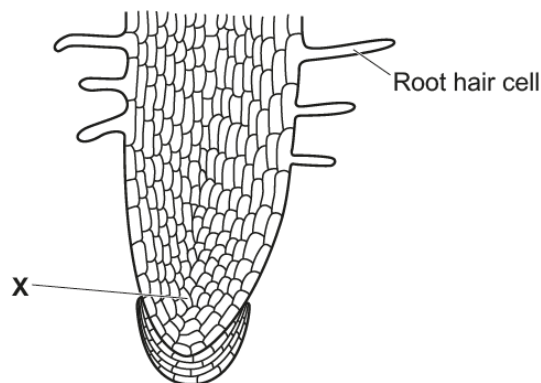
Most of the candidates were given at least 2 marks for calculating a correct ratio. Many however did not provide an answer to one significant figure. Many candidates were given only 2 marks as they gave an answer of 3:4. An answer of 0.75:1 was also very common. Candidates should be encouraged to look at the table to provide clues as to how to present their final ratio.

Some candidates were able to calculate volume but not surface area. An answer of 64cm<sup>2</sup> was common where the candidates did not multiply by 6.

## Question 12 (b) (i)

- (b) Roots are important for transport in plants.

The diagram in **Fig. 12.2** shows a root tip, with a root hair cell labelled.



**Fig. 12.2**

- (i) The root hair cell is adapted for its function.

Explain why the adaptation is needed.

.....

.....

.....

..... [2]

Many candidates were able to state the function of the root hair cell, but they did not link the function to the adaptation of larger surface area. Only some candidates understood that a larger surface area would increase rate of water or mineral uptake.

## Question 12 (b) (ii)

- (ii) Look at the area of the root tip labelled **X** in **Fig. 12.2**.

Describe the type and function of the cells found in area **X**.

.....

.....

.....

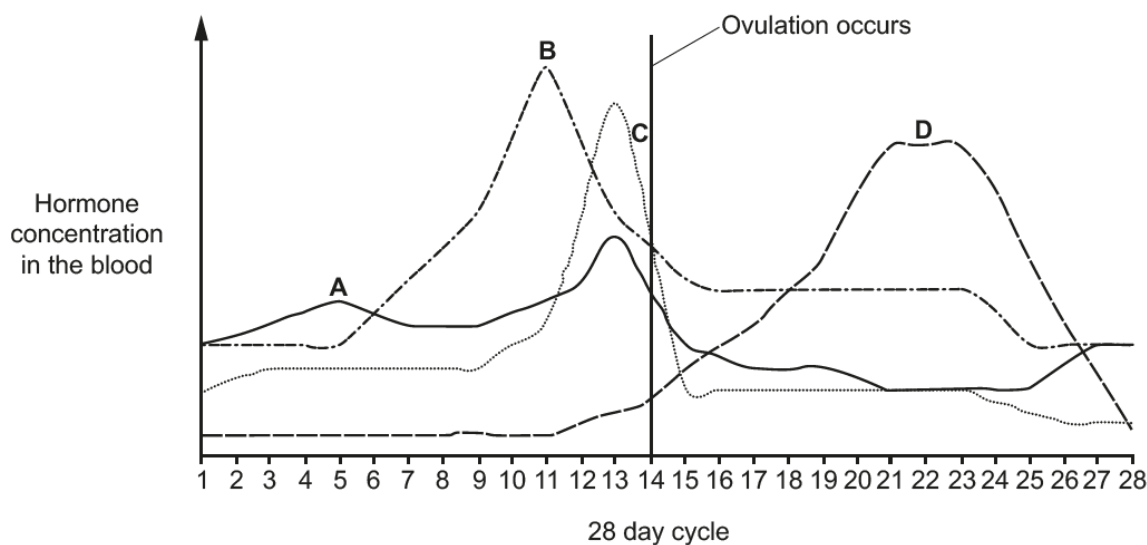
..... [2]

Only higher attaining candidates understood the concept of meristems and stem cells. The most common misconception on this question was to assume the cells were xylem or phloem.

	<b>AfL</b>	Candidates are expected to know that stem cells are present in meristems, as well as needing to know where the meristem of a plant can be found.
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## Question 13 (a) (i)

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



- (a) (i) Draw lines to the correct name for hormones **A**, **B**, **C** and **D** labelled in the diagram.

<b>A</b>	<b>Oestrogen</b>
<b>B</b>	<b>FSH</b>
<b>C</b>	<b>LH</b>
<b>D</b>	<b>Progesterone</b>

[4]

This question showed good discrimination with lower ability candidates being given at least 1 mark, usually for identifying either oestrogen or progesterone, and higher ability candidates identifying all four hormones correctly.

## Question 13 (a) (ii)

- (ii) Explain how the hormones **FSH** and **LH** work to help control the menstrual cycle.

.....

.....

.....

..... [2]

Most candidates were able to identify the role of at least one of the hormones. Some understood that they were involved in maturing and releasing the egg but got it the wrong way around. A few candidates just described the changes to the uterus lining and therefore could not be given any credit.

## Question 13 (b)

- (b) Hormones can be used in the contraceptive pill to prevent pregnancy.

Explain how hormones in the contraceptive pill prevent pregnancy.

.....

.....

.....

..... [2]

Most candidates were given at least 1 mark for this question, usually for identifying that the contraceptive pill contained progesterone or that no egg would be released. Some candidates confused the role of progesterone use in the contraceptive pill, incorrectly believing that it maintained the lining of the uterus. Only higher ability candidates understood that due to the levels of progesterone in the pill it actual thins the uterus lining to prevent implantation. Some candidates referred to the thickening of mucus but incorrectly assumed this prevented sperm entering the egg rather than the cervix.

### Exemplar 2

Progesterone is often used in contraception pills. It causes the body to contract a thick cervical mucus to prevent sperm cells from reaching the egg. Its presence also inhibits the production of FSH and LH so the Menstrual cycle does <sup>not occur</sup> [2]

This response from a higher attaining candidate and shows a clear understanding of the role of progesterone in the production of thicker mucus. The question does not ask them to name the hormones although credit was given for the names. Therefore, they were not penalised for assuming progesterone and not oestrogen inhibits the production of FSH and LH. The role of specific hormones had already been tested in Q13(a)(i) and Q13(a)(ii). However, it should be noted that if the question had asked for the role of progesterone then this candidate would not have been given both marks.

## Question 14 (a) (i)

14 A student investigates coordination.

They set up the apparatus shown in diagram Fig. 14.1.

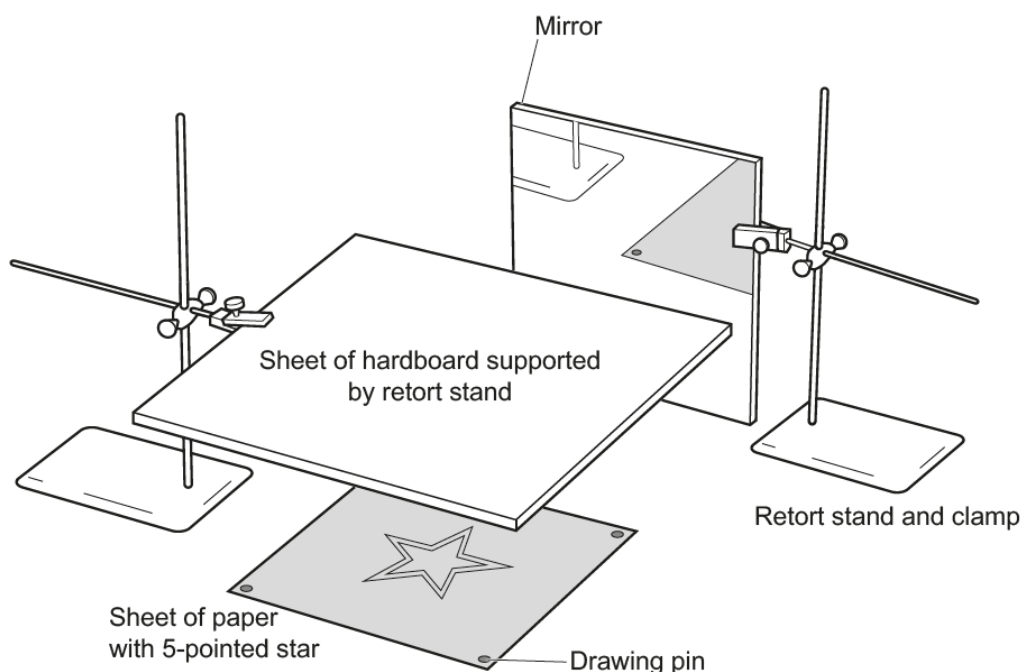


Fig. 14.1

The student asks a friend to draw around the star, keeping between the two lines.

The friend can only see the star in the mirror.

The student measures how many seconds it takes the friend to draw around the star. He also counts the number of errors they make.

This is repeated five times.

(a) The student records the results in Table 14.1.

Attempt	Time to draw around the star(s)	Number of errors
1	57	15
2	56	10
3	46	8
4	44	6
5	39	4

Table 14.1

(i) The student investigates how the number of attempts affects the accuracy of drawing the star.

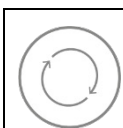
What are the **independent** variable and **dependent** variables for this investigation?

independent variable .....

dependent variables ..... and .....

[2]

Candidates had more success at identifying the dependent variables than the independent variables.



**AfL**

Candidates should be encouraged to use the headings in a table to identify the independent and dependent variables. Convention is that the first column is most likely to be the independent variable.

### Question 14 (a) (ii)

- (ii) The friend has improved their time and the number of errors they make.

Calculate percentage change in the number of errors in **Table 14.1**.

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

Percentage change = .....%  
[3]

Only the higher ability candidates were given credit for all 3 marks. Lower ability candidates found percentage change calculations challenging. They did not subtract 4 from 15 before finding the percentage. Many just calculated 4 as a percentage of 15 and not 11. Most of those that did calculate the correct percentage also managed to provide an answer to two significant figures. There were a few, however, who assumed this meant two decimal places and gave an answer of 73.33%.

### Question 14 (b)

- (b) The student makes this conclusion about their results.

**My results show that practising a task will always help you improve.**

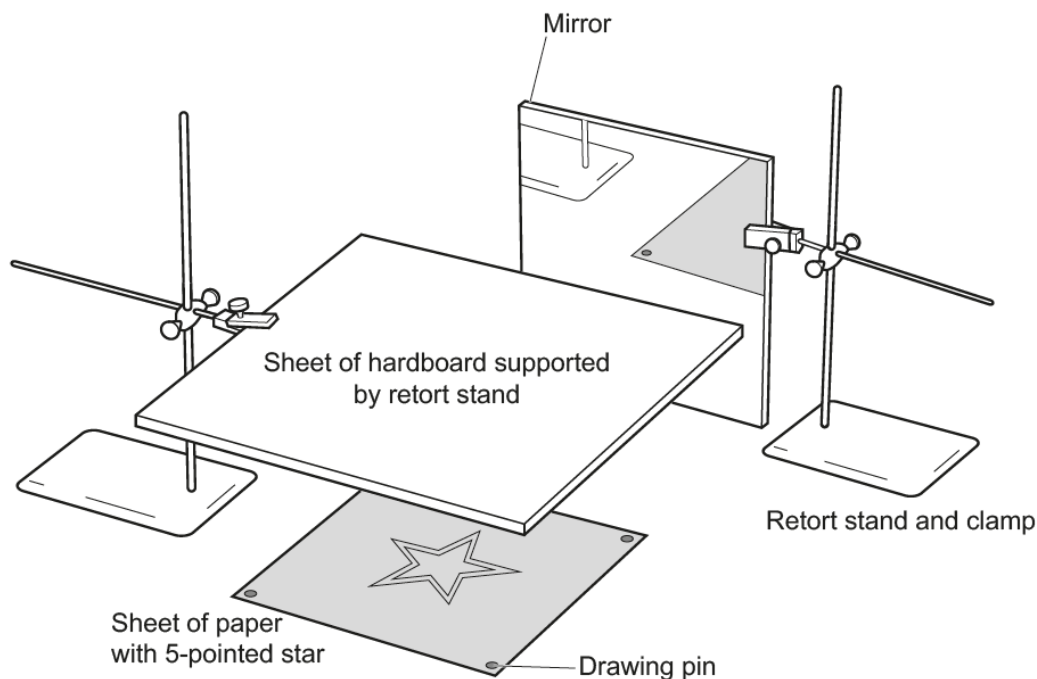
Explain why this conclusion may **not** be valid.

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

Candidates found it challenging to explain why the conclusion might not be valid. Some candidates realised the investigation had not been repeated on more than one student, but they did not go on to say it had not been repeated using different task and may only be valid for this task.

## Question 14 (c)

\*(c) The diagram in **Fig. 14.1** and **Table 14.1** are repeated below.



**Fig. 14.1**

Attempt	Time to draw around the star (s)	Number of errors
1	57	15
2	56	10
3	46	8
4	44	6
5	39	4

**Table 14.1**

Drawing around the star is a coordinated response.

Explain how the body coordinates the response **and** suggest an explanation for the pattern in the results in **Table 14.1**.

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

Most candidates provided at least a Level 1 answer. These were candidates that either referred to how the body coordinates the response or suggested an explanation for the pattern. The question was a high demand question, and Level 3 answers were rare as candidates were not providing detailed explanations for the pattern.

## Exemplar 3

Your eyes which is receptor detect this and convert it into an electrical impulse and it travels down the sensory neurone to the central nervous system, this coordinates a response. It sends it to the right motor neurone and you have a response. As the student ~~after~~ keeps on attempting to draw around the start, his time is getting faster and the number of errors are reducing. This is because the student kept on practising it so, he ~~as~~ became accustomed to doing it. That is why this table follows this pattern.

This exemplar shows a Level 2 response. The candidate has applied their knowledge of the nervous response to identify the receptor being in the eyes and the effectors in the hands. They demonstrate enough knowledge to use the correct terminology of electrical impulses rather than the more common 'messages' being sent along the correct pathway. Lower attaining candidates tended to use the correct names of the neurones but in any random order.

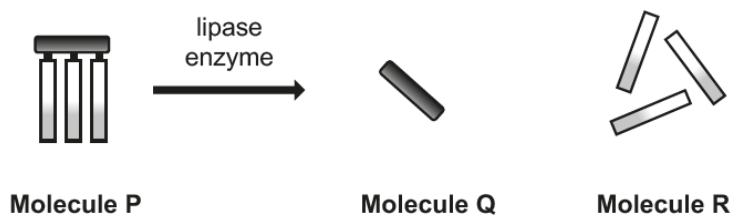
They have then tried to analyse the results to make judgements about why the patterns show a reduction in the number of errors.

To obtain 6 marks they needed to suggest detailed explanations, such as new pathways form in CNS/brain or ideas about the brain having to adjust the response if the eyes see the hand moving the wrong way.



## Question 15 (a)

15 Look at the diagram. It shows the breakdown of a lipid by the enzyme lipase.



(a) What type of molecules are **Q** and **R**?

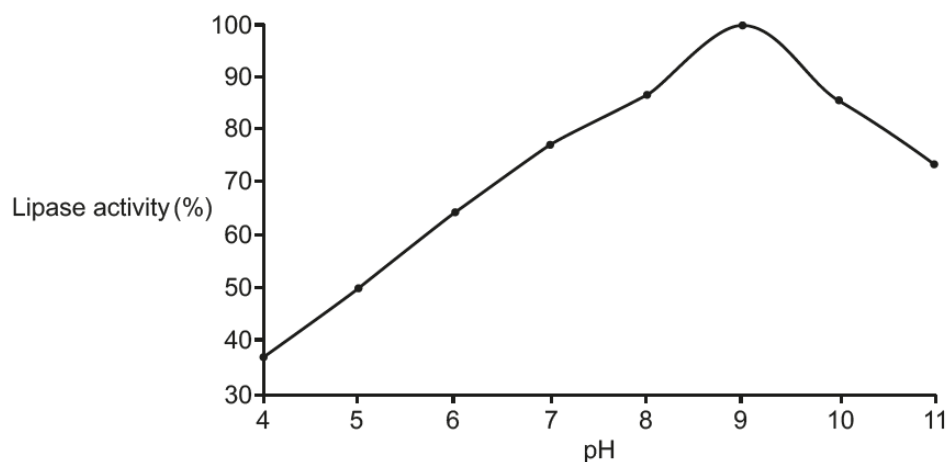
Molecule **Q** .....

Molecule **R** ..... [1]

Only the minority of candidates applied their knowledge of importance of fatty acids and glycerol in the synthesis of and breakdown of lipids to correctly identify molecules **Q** and **R**.

## Question 15 (b) (i)

(b) Look at the graph. It shows the effect of pH on the activity of lipase enzyme.



(i) Human lipase is **most** active in the small intestine.

The pH of the small intestine is pH7.5.

The lipase used to produce the results in the graph is **not** human lipase.

How can you tell this from the graph?

.....

..... [1]

Most candidates understood that the enzyme was most active at pH 9 and therefore could not be from the human digestive system.

## Question 15 (b) (ii)

- (ii) The lock and key hypothesis can explain the pattern in the graph.

Explain the lock and key hypothesis for enzyme specificity.

.....

.....

.....

.....

.....

..... [2]

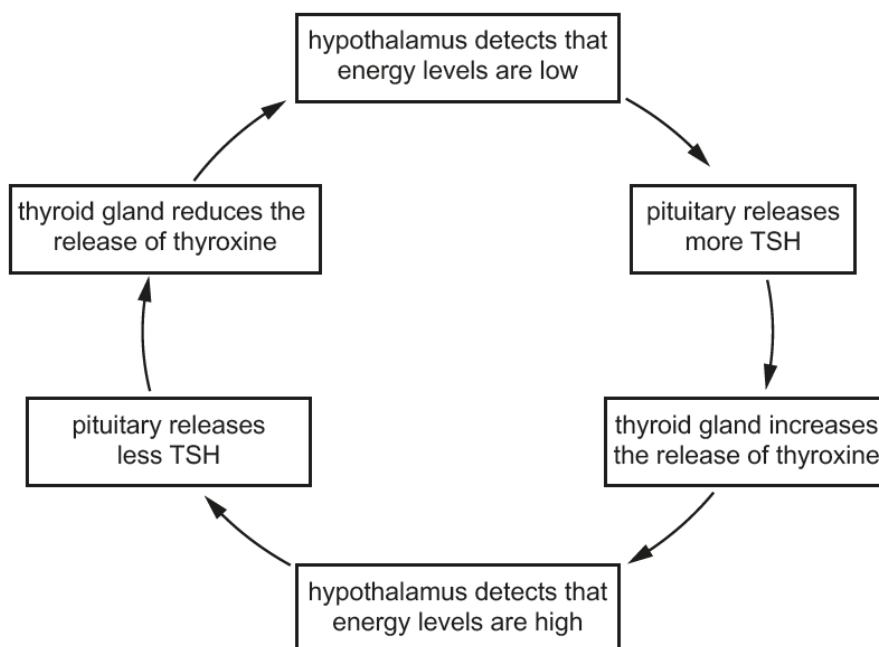
Most candidates were given at least 1 mark, usually for the mention of substrates fitting into active sites of enzymes. Only the higher ability candidates were able to explain the specificity in terms of the substrate having a shape that matched that of the active site. Lower ability candidates either didn't answer in terms of active sites and substrates or incorrectly assumed the active site was on the substrate.

## Question 16 (a)

16 This question is about hormones.

(a) The hormone thyroxine helps to control the amount of energy available to cells.

Look at the diagram. It shows how energy levels in the body are controlled.



Explain why controlling energy levels is an example of negative feedback.

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

This question was a high demand question. A few candidates were able to gain both marks, but most found the concept of negative feedback difficult to explain and instead just described the diagram.

## Exemplar 4

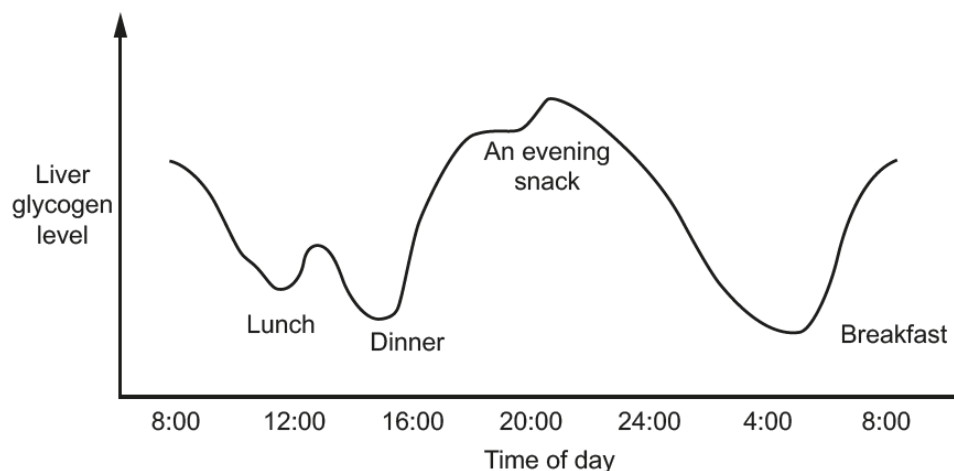
...Maintaining the body functions is homeostasis. Controlling  
 ...energy levels is an example of negative feedback because  
 ...a change is detected then the endocrine system proceeds  
 ...to restore the body to the appropriate level of energy. [2]  
 ...using hormones. The brain is not involved.

This exemplar shows the minimum a candidate needed to say to be given 2 marks. They have not referred to the hormones involved but have shown an understanding of detecting changes and returning them back to normal levels.

### Question 16 (b)

**(b)** Look at the graph.

It shows how the levels of glycogen stored in the liver changes during the day.



Explain the changes seen in the graph between **12:00** and **16:00**.

Include **named** hormones in your answer.

..... [4

Some candidates did very well on this question usually being given 3 or 4 marks. Those candidates who were given fewer marks were confused by the concept of glycogen levels rather than glucose level.

## Exemplar 5

9 At 12:00 the person had already eaten lunch and so the  
 glucose levels would be high <sup>in the blood</sup>. To reduce these levels,  
 the pancreas produced insulin which converted the glucose  
 to glycogen and <sup>was</sup> stored in the liver, explaining the increase of glycogen on the  
 graph. Just before 16:00, the level of glycogen <sup>decreased</sup> ~~drop~~ because  
 the body had started to lack glucose so the pancreas had  
 released glucagon to convert the glycogen back into  
 glucose so reducing the levels of glycogen in the liver. [4]  
 Because the person hadn't eaten for a while.

This response shows clear understanding of the control of blood glucose levels. The candidate has applied their knowledge of glucose levels to glycogen levels and used all the correct terminology.

## Copyright information

## Question 16b

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