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Examiners' report

GATEWAY SCIENCE BIOLOGY A

J247
For first teaching in 2016

J247/03 Summer 2018 series

Version 1

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. 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 3 series overview

J247/03 is the first higher tier paper in the Gateway GCSE Biology suite. It assesses content from specification topics B1-B3 and B7. Therefore, 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 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.

Candidate performance

Candidates who did well on this paper generally did the following:

- Performed calculations involving standard form: Q12, Q20(d)(i), calculations of means or medians: Q16(d)(i), Q19(b)(i), use of specific number of decimal places: Q16(d)(i), Q20(d)(i), the significance of ranges in data Q16(d)(ii).
- Demonstrated their knowledge of the potometer in measuring water update Q4 and the use of the inverse square law in photosynthesis Q8.
- Applied their knowledge of experimental skills to novel situations Q16(a)(b)(c), Q19(a).
- Used data from experimental situations to make conclusions Q16(d)(i), Q19(b)(ii).
- Applied knowledge and understanding to explain observations Q17(a), Q18(b), Q20(a), Q21(d)(i), Q21(e).

Candidates who did less well on this paper generally did the following:

- Found it difficult to give numerical answers to the correct number of decimal places Q16(d)(i), Q20(d)(i), could not calculate a median Q19(b((i) or draw a line of best fit 21(b).
- Could not recall knowledge of kidney structure Q18(a) or stomatal opening mechanisms Q21(d)(i).
- Did not give safety precautions beyond taking care or not dropping equipment Q16(c).
- Could not analyse the effects of limiting factors on the rate of photosynthesis Q21(c).
- There was no evidence that any time constraints had led to a candidate underperforming.

Section A overview

Questions 1 to 5 in this section proved to be good discriminators with many higher ability candidates answering correctly. Questions 6-7 and 9-15 were answered well by candidates with many correct answers.

Question 8

8 A light source is placed 0.5 m from a plant. The relative light intensity falling on the plant is 2 units.

The light source is moved to 1 m away.

What is the relative light intensity falling on the plant now?

A 0.125

B 0.25

C 0.5

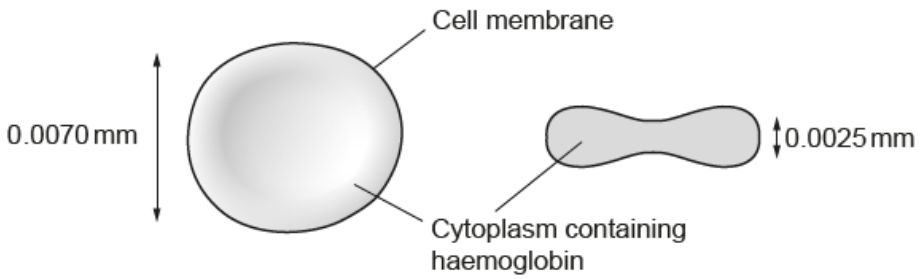
D 1.0

Your answer ☐ **[1]**

Question 8 proved to be the most challenging question in section A. Many candidates did not apply the inverse square law and chose the answer D rather than C.

Question 13

13 The diagram shows a red blood cell.



	Distance oxygen travels to get to haemoglobin from blood plasma	Surface area to volume ratio	Nucleus present
A	Large	Small	Yes
B	Short	Large	Yes
C	Short	Large	No
D	Large	Large	No

Which row in the table shows how red blood cells are adapted for transport of oxygen?

Your answer ☐ **[1]**

This question was the most accessible question in section A, with most candidates correctly answering C.

Section B overview

Many candidates had clearly prepared for the mathematical aspects of the questions in this section and there were many numerically correct answers. Detailed subject knowledge was often lacking which meant that some candidates could not apply this to the situations in some of the questions. This was particularly the case in Q21(d) and (e).

Question 16(a)

16 Students investigate how to extract DNA from peas.

Stage 1:

- Chill 10 cm^3 of ethanol. Keep it on ice throughout the method for use in stage 2.
- Make a thick 'soup' by blending 100 cm^3 of peas with salt and cold water. Blend for 15 seconds in an electric blender.
- Strain the 'soup' through a mesh strainer and collect the liquid part in a beaker.
- Add 30 cm^3 of washing-up liquid and swirl to mix.
- Let the mixture settle for 5–10 minutes in a water bath at 60 °C.

(a) One group of students made a water bath using a beaker of water, thermometer and Bunsen burner. Another group used an electric water bath.

Write down **two** advantages of using an electric water bath.

1 .....

.....

2 .....

.....

[2]

Many candidates correctly focussed on the fact that an electric water bath will maintain a constant temperature. Fewer candidates stated the need to prevent ethanol from being near a naked flame. Exemplar 1 contains both these points, therefore achieved both marks.

Exemplar 1

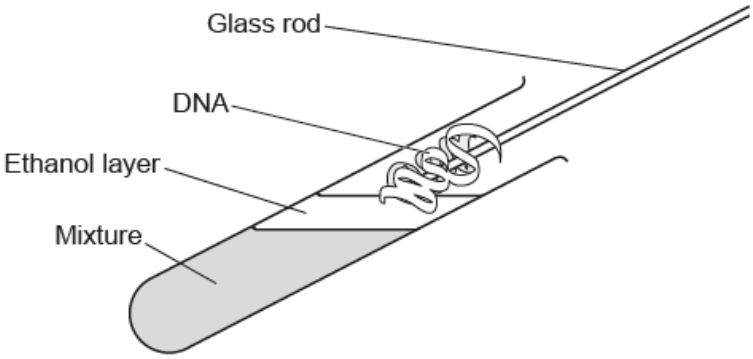
1 When you use an electric water bath it's easier to set the temperature and maintain the temperature.

2 Electric water bath is safer than using bunsen burner especially when substance you are heating is flammable.

[2]

Question 16(c)

Stage 2 isolates the DNA.



- Pour the mixture collected from stage **1** into a test tube until a third full. Add protease enzymes to the test tube.
- Slowly pour cold ethanol at an angle of 45° into the tube. Ethanol will float on top.
- DNA is soluble in water, but salted DNA does not dissolve in ethanol and will form white clumps where the water and ethanol layers meet.
- Twirl a glass rod and the DNA will collect on the rod.
- Dry the sample on a pre-weighed filter paper and measure the mass of product.

(c) Suggest **two** safety precautions which should be taken at stage **2**.

Explain why each safety precaution is needed.

1 Safety precaution: .....

Explanation: .....

2 Safety precaution: .....

Explanation: .....

[2]

Lower ability candidates did not gain marks in this question as they often gave vague answers such as references to being careful or not dropping equipment. An example of an answer that did not receive credit is seen in exemplar 2.

Exemplar 2

1 Safety precaution: Do not shake the ~~test~~ testtube.

Explanation: This may spill the mixture and DNA.

2 Safety precaution: Do not place the testtube down.

Explanation: This may break it.

[2]

Question 16(d)(i)

(d) Look at the table. It shows the results from the two groups of students in the investigation.

Type of water bath used	Mass of DNA collected (mg)			
	Test 1	Test 2	Test 3	Mean
Beaker of water and Bunsen burner				22.9
Electric	33.6	32.3	33.3	.....

(i) Calculate the mean mass collected in the investigation using the electric water bath.

Give your answer to **1** decimal place.

Answer = ... mg **[2]**

The majority of candidates could correctly calculate the mean mass and give the answer to one decimal place. A small but significant number only gained one mark as they quoted too many decimal places.

Question 16(d)(ii)

(ii) The range of the three test readings for the beaker of water and Bunsen burner was 3.4.

Does the evidence support using an electric water bath instead of a beaker of water and Bunsen burner?

Explain your answer.

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

There were many correct references to the differences in the ranges of readings, although in some cases the range for the water bath was incorrectly calculated. Fewer candidates commented on the differences between the mean mass of DNA obtained.

Question 17(a)

17 A girl walks from a sunny beach into a dark café.

Diagram **A** shows the girl's left eye on the beach.

A

B

(a) Diagram **B** shows the girl's left eye after she enters the café.

Explain how you can tell this and how this change happens.

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.....

.....

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

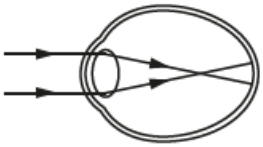
Many candidates gained two marks here for the dilation of the pupil and the need to increase the ability of light to enter the eye. There were a significant number of candidates that tried to link this to the action of the ciliary muscles, rather than the radial muscles of the iris.

Question 17(b)

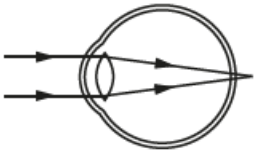
(b) Look at the diagrams.

They show how light is focused in people with different eye defects.

Person **X**



Person **Y**



Question 17(b)(ii)

(ii) Identify the type of corrective lens needed by person **X** and **Y** and explain how the lenses work.

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

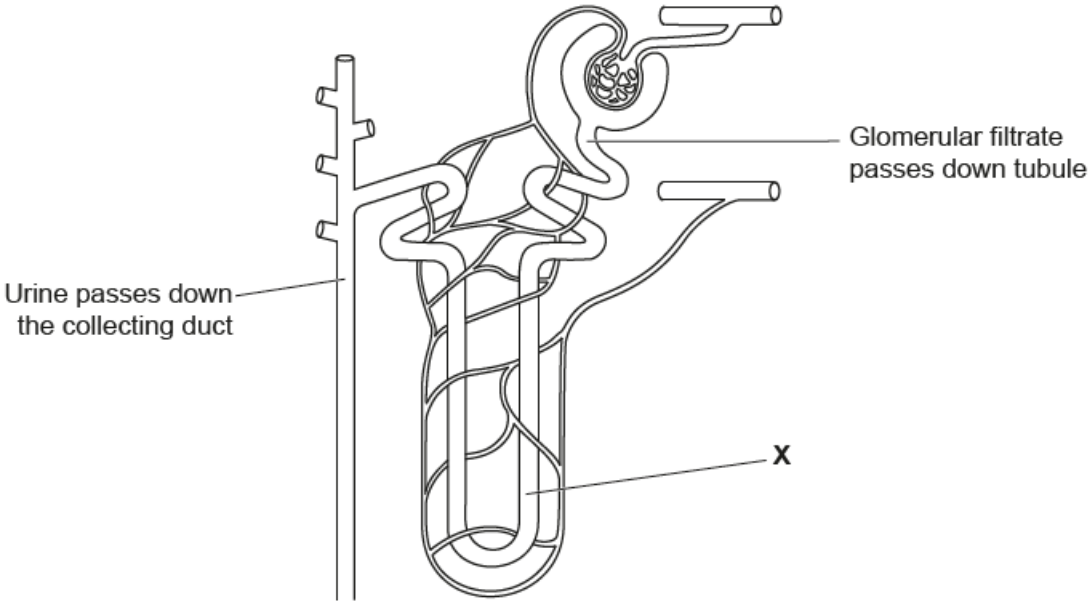
Many candidates could correctly state the type of lens needed to correct each eye defect. For 'explain how the lens works', the most common error was to refer to the extent of bending or refraction of the light rather that the direction of the refraction. This is seen in exemplar 3, which would gain 1 mark.

Exemplar 3

X, needs concave lenses, because the focus is before the retina. Concave lenses partially refract the light less, letting the focus be on the retina. Y, needs convex, because the focus is after the retina, so it refracts the light more. **[3]**

Question 18(a)(i)

18 The diagram shows a kidney tubule (nephron).



(a) (i) What is the name of part **X**?

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

The name of this part of the tubule was correctly recalled by many of the higher ability candidates.

Question 18(a)(ii)

(ii) The hormone ADH affects the permeability of part of the kidney tubule.

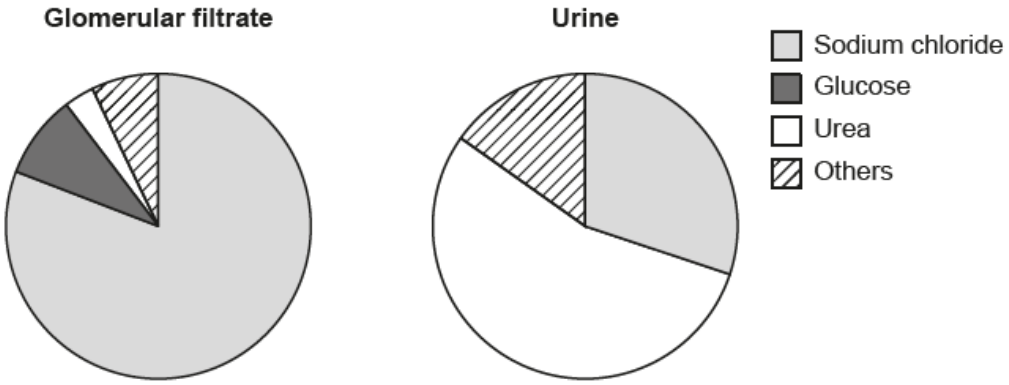
Name the part of the tubule affected by ADH.

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

Fewer candidates could answer correctly in part ii), often stating the glomerulus as their answer.

Question 18(b)

(b) The diagram shows the composition of glomerular filtrate and urine.



What evidence is there to suggest that selective reabsorption occurs in the kidney tubule?

Use evidence from the diagram to support your answer.

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..... **[4]**

This question differentiated quite well. Some candidates used data from the two pie charts to back up their answers, whereas less successful candidates answered in general terms.

Question 18(c)

(c)* Sports drinks are usually one of three types. Look at the table of information on these types of sports drink.

Sports drink	Concentration of solutes relative to body fluids	Mass of carbohydrates (g) (mainly sugars)	Order of how quickly the drink is absorbed
Hypotonic	Less	<4	1
Isotonic	Same	4 – 8	2
Hypertonic	More	>8	3

An athlete is going to run a 10 000 metre race. About an hour before the race the athlete drinks a hypertonic sports drink.

The athlete completes the 10 000 metre race. After the race the athlete drinks an isotonic sports drink.

Explain how the race causes changes in water, salt and sugar levels in the athlete's body and explain the athlete's choice and timing of drinks.

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

This is the Level of Response question on this paper. For a level three answer, examiners were looking for an explanation of why the water, salt and sugar levels would change during the race. This should then be coupled with the function of the drinks before and after the race. An explanation for the timing and choice of the drinks should also be included. Exemplar 4 shows a level 2 answer, which does not explain the choice of the isotonic drink after the race.

Exemplar 4

L2

The race causes him to sweat which releases water and salt, leaving him with less. whilst running his body would have respired using glucose stores that decreases his sugar levels. The HYPertonic drink contains more sugars which provide him with more energy, it is also absorbed over a longer time which will help him through the Long race. After the race he drinks an Isotonic drink which regulates his sugar levels to the optimum. This is done over a quicker period of time as he will not be using as much energy needing [6]

Question 19(a)

19 A class of students investigate if right handed people are faster with their dominant right hand.

Student **A** drops a ruler while student **B** catches it.

They then measure the position of student **B**'s thumb on the ruler, this is the drop distance.

The diagram shows how the measurements were taken.

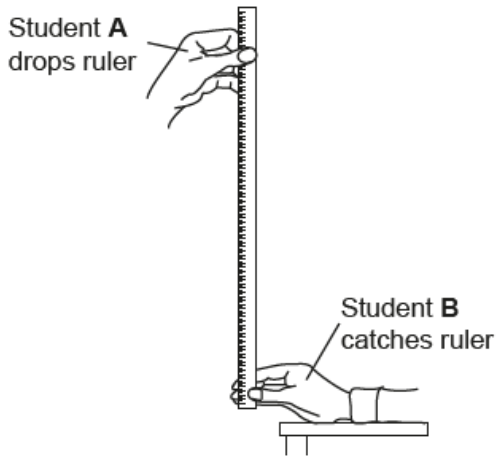

Fig. 19.1

The drop distance is converted into a reaction time. The reaction time in seconds for each hand is recorded in a table.

Question 19(a)(ii)

(ii) A second method of measuring reaction time involves a computer reaction time program shown in **Fig. 19.2**.

Each student is asked to click the "Start" button. After a 3-second delay a number randomly flashes up. The student moves the mouse to click on the flashing number.

Left hand is used first then the right hand.

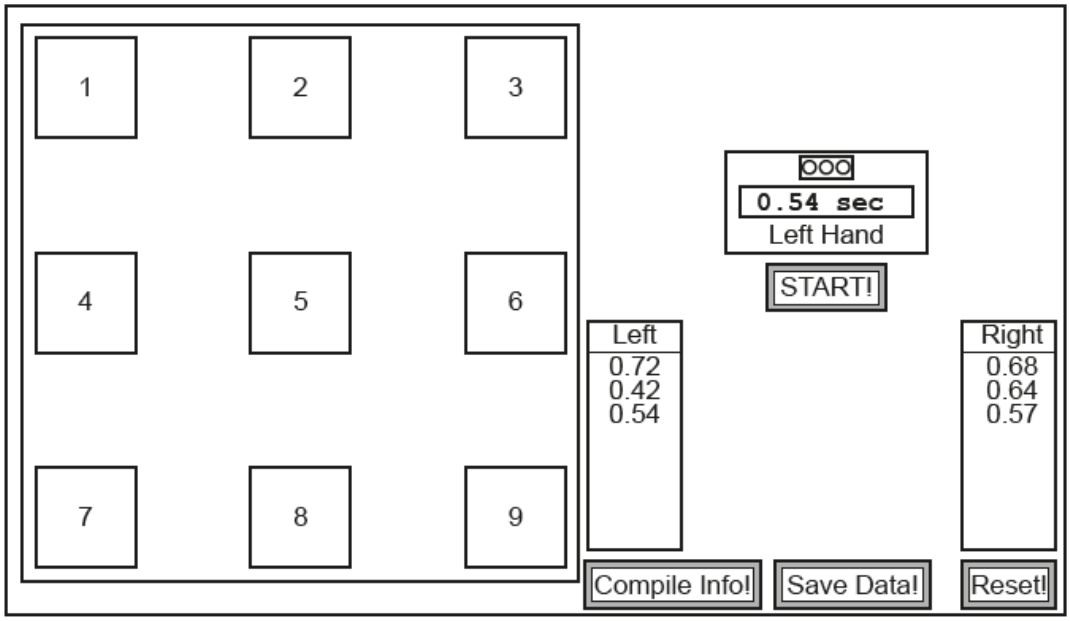

Fig. 19.2

This second method is a better design than the first method but it could still be improved.

Explain why it is a better designed experiment than the first method and suggest how this second method could be improved.

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

A number of candidates could identify a reason why method two was better than method one. They often went on to state a problem with method two but did not suggest an improvement.

Question 19(b)(i)

(b) The table shows the results for ten **right handed** students in the class.

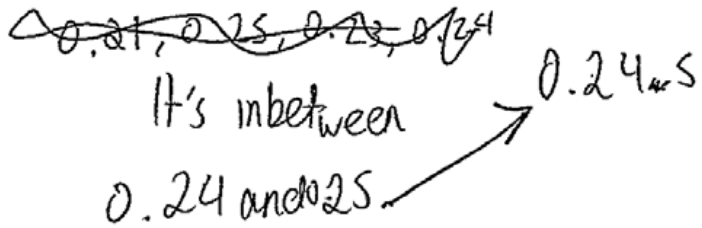
Reaction time (seconds)	
Left non-dominant hand	**Right dominant hand**
0.22	0.21
0.23	0.25
0.27	0.23
0.24	0.24
0.25	0.24
0.25	0.25
0.25	0.26
0.25	0.26
0.25	0.26
0.27	0.28
Mean = 0.25	Mean = 0.25

(i) Calculate the **median** for the right dominant hand.

Answer = ... **[2]**

Most candidates appreciated that the median is the middle value but then a significant number did not put the figures in order first and so therefore calculated a value between 0.24 and 0.25. This error is seen in exemplar 5.

Exemplar 5



Answer = 0.245 **[2]**

Question 19(b)(ii)

(ii) The mean and median for the left non-dominant hand are identical.

What **other** conclusions can be made about reaction times in these ten students?

.....

.....

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

A small number of candidates incorrectly thought that the experiment was comparing right-handed and left-handed people and so lost marks here.

Question 19(c)(i)

(c) (i) Motor neurone disease (MND) is a condition that affects reaction times. MND affects the speed of nerve impulse in motor neurones.

Stem cells taken from the skin of people with MND are used in research. The stem cells can be grown in the lab and used to measure the speed of the nerve impulse.

Which special feature of stem cells makes this possible?

.....

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

This question was referring to the ability of stem cells to be able to produce nerve cells that could be used to measure the speed of impulses. Most candidates did not refer to nerve cells in their answers. This is shown in exemplar 6, which gained 1 mark.

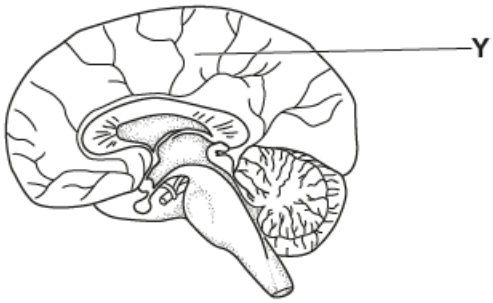
Exemplar 6

Stem cells are undifferentiated

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

Question 19(c)(ii)

(ii) The diagram shows the brain.



Name part **Y** and explain why it is an important area of the brain in the research of MND.

Part **Y**: .....

Explanation: ..... **[2]**

The region labelled Y was correctly identified by many candidates, although there was some confusion with the cerebellum. The explanation did not always gain marks, as many candidates simply listed all the functions of the cerebrum.

Question 19(c)(iii)

(iii) Measuring the speed of the nerve impulse in the brain is more difficult than using stem cells.

Suggest **two** reasons why.

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.....

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

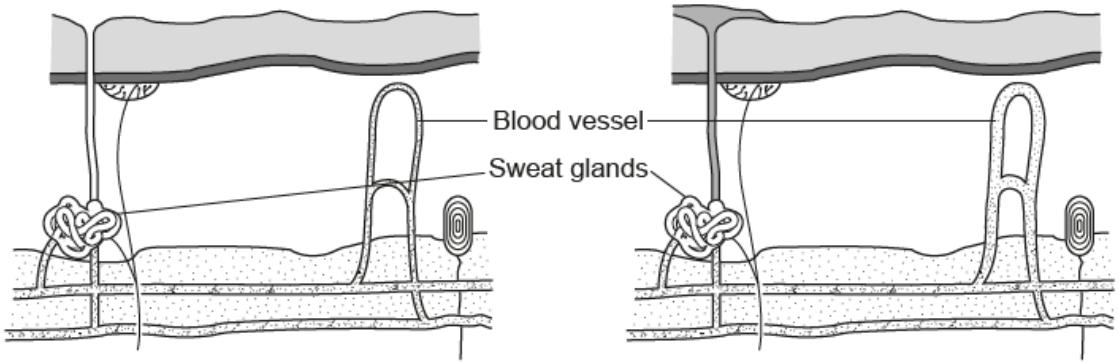
There were many correct references to the difficulty of access to the brain and the risk of damage. Some candidates incorrectly referred to differences in conduction velocities in the two types of cell.

Question 20(a)

20 (a) This question is about control and coordination.

The diagrams show a section through the skin in two different conditions.

Diagram A Diagram B



Which diagram shows the skin in a hot, humid environment?

Explain your answer.

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

This was a well answered question, with many candidates gaining three marks. The lack of reference to sweat evaporating to cool the skin down was the most common omission.

Question 20(b)

(b) Adrenaline is an important hormone in the body. It helps to prepare the body for a 'fight or flight' response.

Sports injuries which involve cuts and bleeding are often treated with a dilute solution of adrenaline.

Explain why.

.....

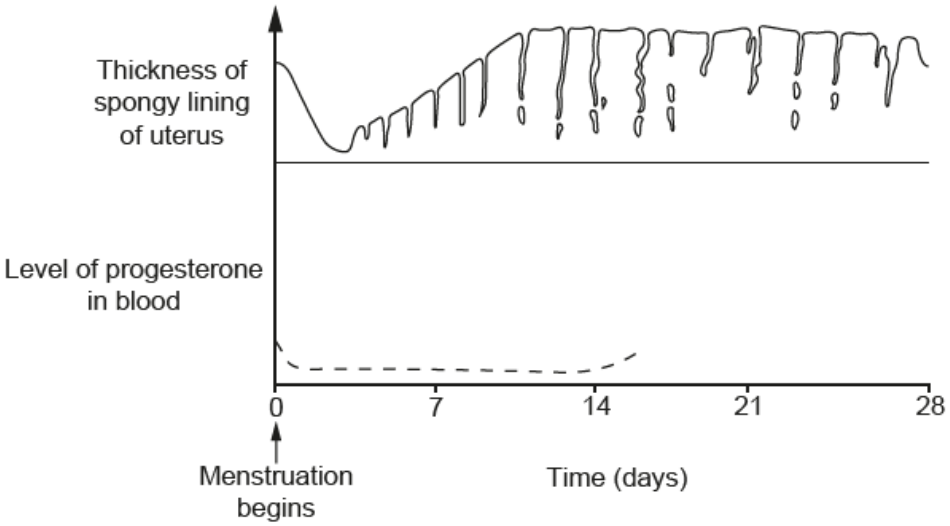
.....

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

Very few candidates appreciated that adrenaline would reduce the blood flow to the skin. Many assumed that it would simply increase heart rate and that this would somehow make the blood more likely to clot at the wound.

Question 20(c)(i)

(c) The graph shows how the lining of the uterus changes during the menstrual cycle and also shows the level of progesterone in the blood.



(i) Where in the ovary is progesterone produced?

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

There were a number of correct references to corpus luteum, yellow body or empty follicle.

Question 20(c)(ii)

(ii) Draw a line to continue the graph to show the levels of progesterone until day 28 (assume that an egg has not been fertilised). **[2]**

Most candidates correctly appreciated that the line should increase, plateau and then fall.

Question 20(d)(i)

(d) **(i)** An egg develops in a follicle before ovulation. The follicle has a diameter of 25×10^{-3} mm at the start. This follicle grows to 20 mm in diameter just before the egg is released.

Calculate the increase in size of the diameter of the follicle.

Give your answer to **2** decimal places.

Answer = ... mm **[3]**

The manipulation of standard form was often correct in this question.

Question 20(d)(ii)

(ii) The failure of a follicle to increase in size can result in less production of oestrogen.

Explain what effect this may have on the uterus.

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

There was some confusion in the answers between the roles of progesterone and oestrogen. Common incorrect answers referred to the breaking down of the uterus lining.

Question 20(d)(iii)

(iii) Explain how hormones can be used to treat infertility in women.

.....

.....

.....

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

Candidates often gave the hormones that might be given to women to treat infertility, i.e. LH and FSH but did not specifically link them to their function. This is illustrated in exemplar 7, which would only gain one mark for naming the two hormones.

Exemplar 7

(iii) Explain how hormones can be used to treat infertility in women.

Drugs with menstrual hormones in - eg: FSH and LH complete negative feedback to produce more oestrogen and increase the number of eggs matured & developed. **[3]**

Question 20(d)(iv)

(iv) Infertility can also be caused by problems in the male.

Plasmin is a protease enzyme important in sperm movement.

Explain how changes to the structure of DNA could result in the plasmin enzyme being faulty.

.....

.....

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

Many candidates correctly linked changes in the DNA base sequence to alterations in the amino acids in the protein or the shape of the protein molecule.

Question 21(a)

21 (a) Photosynthesis involves reactions that are endothermic.

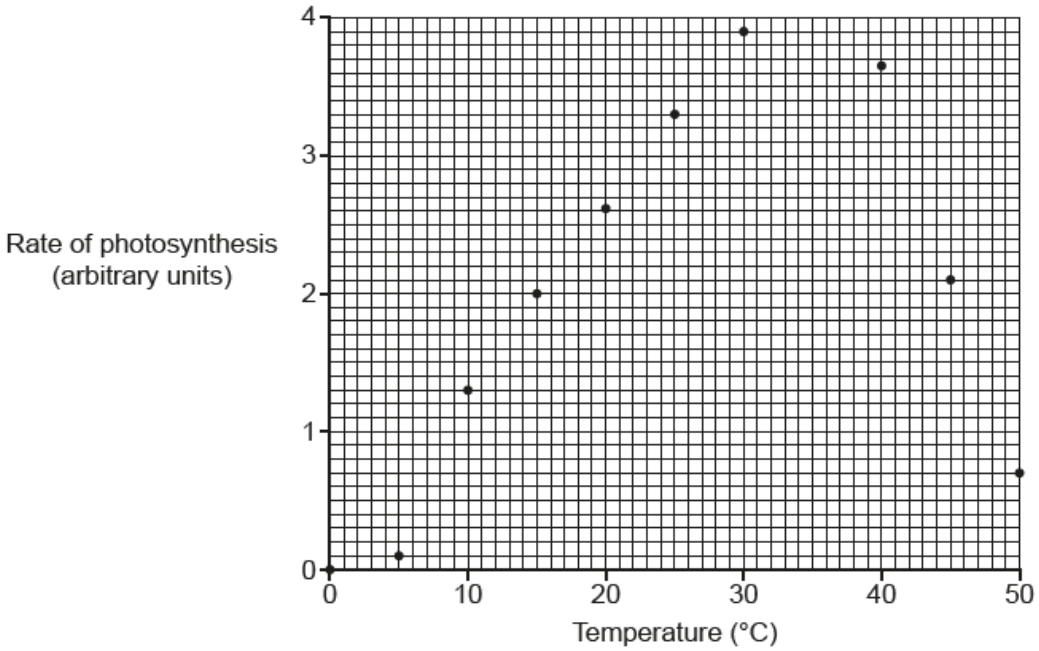
What is meant by the term endothermic reaction?

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

Very few candidates confused endothermic with exothermic in this question.

Question 21(b)

(b) The graph is from an experiment to show the effect of temperature on the rate of photosynthesis.



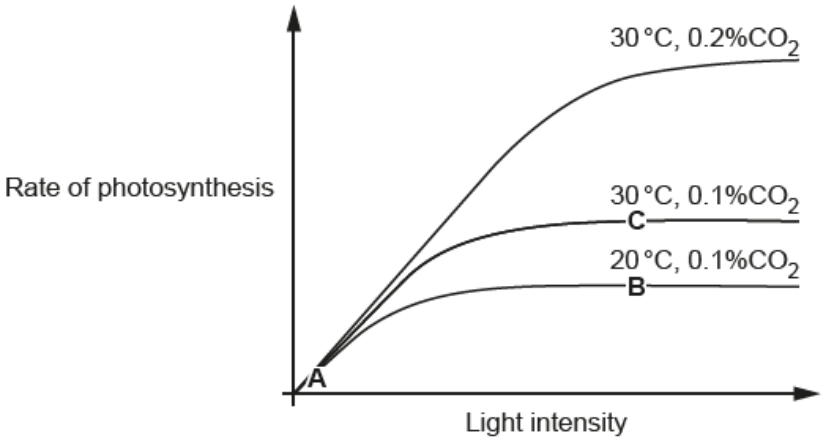
Draw a line of best fit. **[1]**

The construction of a smooth curve seemed very challenging for candidates. Many candidates attempted to draw a straight line for part of the curve. Others just joined the points. Double lines were often seen.

Question 21(c)

(c) Look at the graph. It shows how light intensity affects the rate of photosynthesis.

The lines show different carbon dioxide concentrations and temperatures.



Explain what is limiting the rate of photosynthesis at the three points **A**, **B** and **C** on the graph.

Use evidence from the graph in your answer.

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.....[3]

This question challenged many of the candidates and was a good discriminator for high ability candidates. Whilst some candidates could identify the limiting factors at the three points, few backed this up with explanations using evidence from the graph. An example of a candidate lacking full explanations and therefore only scoring 1 mark is shown in exemplar 8.

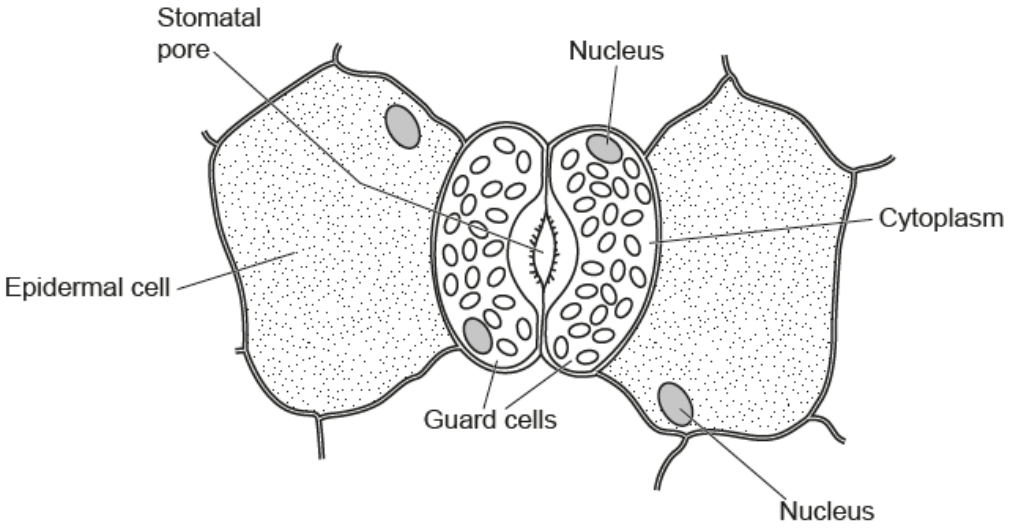
Exemplar 8

At A, the light intensity is very low and is the limiting factor. At point B, the temperature prevents the rate of photosynthesis from increasing and at point C, the CO_2 levels are the limiting factor, and is stopping the photosynthesis rate from increasing ✓

.....[3]

Question 21(d)(i)

(d) The diagram shows structures on the surface of a leaf.



(i) Photosynthesis occurs in the guard cells but not the epidermal cells.

Explain why this is important in the control of the rate of transpiration in the plant.

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..... **[4]**

Candidates found this question one of the most challenging on the paper. Few candidates demonstrated a good knowledge of the mechanism of stomatal opening. Many candidates seemed to reverse the question and tried to explain how the rate of transpiration controlled photosynthesis in guard cells.

Question 21(d)(ii)

(ii) Explain why guard cells are an example of specialised cells.

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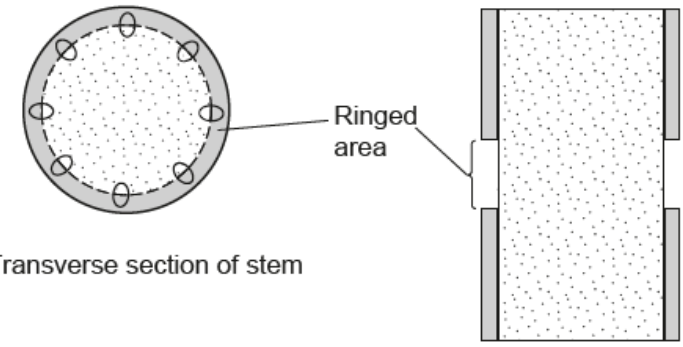
..... **[2]**

There were some good answers focussing on the structural differentiation of guard cells and the fact that they have a specific role.

Question 21(e)

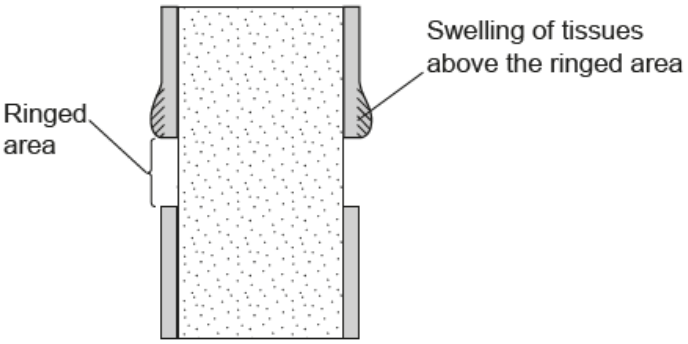
(e) An experiment was done to look at the effect of 'ringing' on a tree trunk. Ringing removes a strip of plant tissue from around the stem of the tree.

The diagram shows where the stem is ringed.



The results were recorded after one week.

The diagram shows the results.



What conclusions can be made about the results?

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

This was another challenging question for many candidates. They needed to observe from the transverse section, that it was the phloem that was removed from the stem. Candidates needed to apply that information to the build-up of sugar on the pathway down the stem. A number of candidates explained the swelling as a defence mechanism. Others such as exemplar 9, put the swelling change down to xylem and phloem and did not gain marks.

Exemplar 9

Ringing removes vital parts of the xylem and phloem The swelling is evendence of this as ~~water~~ water and succose is trying to travel to the root hair cells below [3]
the ringed area, but cant pass beyond.

Supporting you

For further details of this qualification please visit the subject webpage.

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It allows you to:

- Review reports on the **performance of individual candidates**, cohorts of students and whole centres
- **Analyse results** at question and/or topic level
- **Compare your centre** with OCR national averages or similar OCR centres.
- Identify areas of the curriculum where students excel or struggle and help **pinpoint strengths and weaknesses** of students and teaching departments.

http://www.ocr.org.uk/administration/support-and-tools/active-results/

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The small print

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