

**GCSE (9-1)**

*Examiners' report*

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

**J250**

For first teaching in 2017

## **J250/08 Summer 2018 series**

Version 1

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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.

## 3-3 grade

Like all exam boards, we have awarded a 'safety net' grade of 3-3 for higher tier GCSE Combined Science candidates in 2018 where appropriate so that they are not disadvantaged by being the first to sit a new GCSE. To help teachers making difficult decisions about higher versus foundation tiers in 2019, OCR will be providing further guidance and extra webinars during the Autumn term.

## Paper J250/08 series overview

J250/08 is the second 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 B4-B6 and B7. This paper is synoptic and so does contain material covered by topics B1-3. 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, 2, 7 and 9 and less well on questions 4, 6, and 10. Question 4 proved the most challenging question. There did not seem to be any pattern into the incorrect answers given.

### Question 1

- 1 A farmer chooses the healthiest of their beef cattle. They mate these repeatedly over many generations to increase resistance to disease.

What is the name of this type of process?

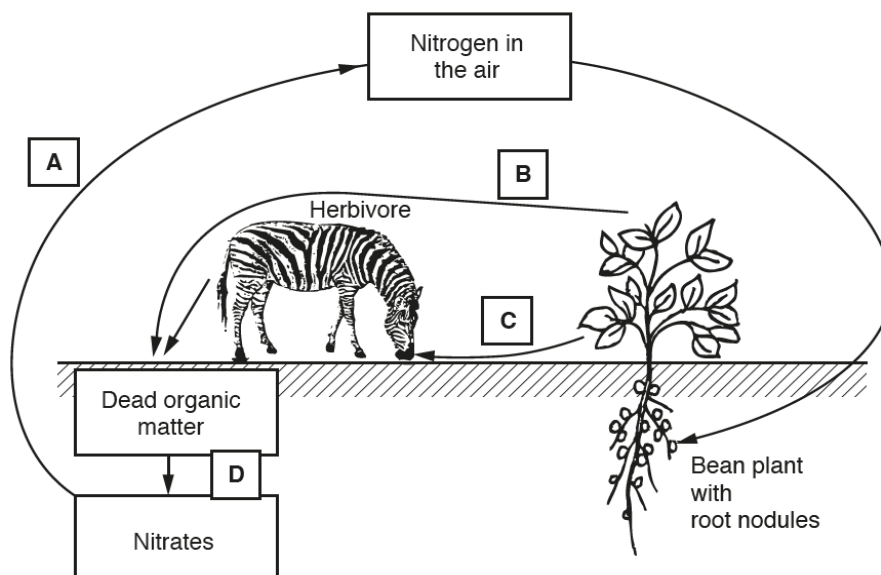
- A Environmental selection
- B Genetic engineering
- C Natural selection
- D Selective breeding

Your answer

[1]

### Question 2

- 2 Look at the diagram showing parts of the nitrogen cycle.



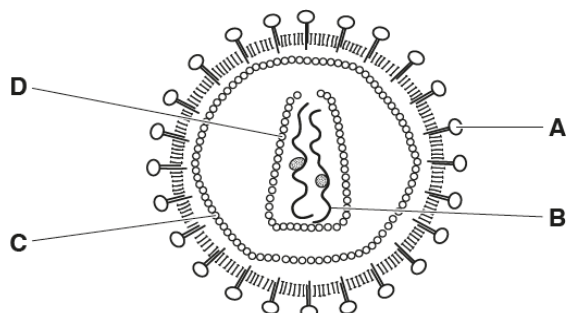
Which part of the nitrogen cycle involves bacteria as decomposers?

Your answer

[1]

### Question 3

- 3 The diagram shows a virus.



Which structure **A**, **B**, **C** or **D** is the **antigen** when the virus invades a host?

Your answer

[1]

### Question 4

- 4 If a person has one disease, it is sometimes more likely that they will develop another disease.

Which pair of diseases affects each other this way?

- A HIV infection and cervical cancer
- B HPV infection and cervical cancer
- C HPV infection and tuberculosis
- D Tuberculosis and cervical cancer

Your answer

[1]

### Question 5

- 5 The number of deaths in the UK in 2012 was 569024.

It is estimated that 165 818 of these were cancer-related deaths.

What percentage of the deaths in the UK in 2012 were cancer-related?

- A 0.29
- B 3.43
- C 29.14
- D 34.32

Your answer

[1]

## Question 6

- 6 Some bacteria have evolved to become resistant to antibiotics.

Which statement is true about the evolution of these bacteria?

- A Antibiotics killed the resistant bacteria.
- B Bacteria reproduce slowly allowing the resistance to have affect.
- C Mutations in some bacteria were an advantage.
- D Mutations occurred within the nucleus of the bacteria.

Your answer

[1]

## Question 7

- 7 Countries can compensate for their greenhouse gas emissions by planting new trees.

Why does planting new trees help compensate for their greenhouse gas emissions?

- A Produces biomass
- B Removes carbon dioxide from the air
- C Releases oxygen into the air
- D Water absorbed from the soil prevents flooding

Your answer

[1]

## Question 8

- 8 Which statement is **not** true about line transects?

- A They allow study of a linear habitat like a roadside verge.
- B They can be used to study which species are present in a habitat.
- C They give an exact measure of how many of each species is present in a habitat.
- D They show how the abundance of a species changes across a particular habitat.

Your answer

[1]



## Question 9

9 Testing drugs using a double blind trial improves reliability.

Why is reliability improved?

- A Observer and volunteer bias is not removed.
- B Observer and volunteer bias is removed.
- C Volunteer bias is removed but not observer bias.
- D Observer bias is removed but not volunteer bias.

Your answer

[1]

## Question 10

10 Antiviral drugs can work in different ways.

Which statement shows how an antiviral drug can work?

- A It acts as a vaccine against the virus.
- B It causes phagocytosis of the virus.
- C It contains antibiotics to destroy the virus.
- D It stops the virus releasing its genetic material.

Your answer

[1]

## Section B overview

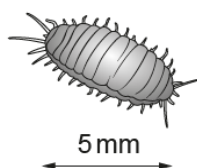
Section B consisted of structured questions ranging from 1 to 6 marks. There was clear evidence that candidates struggled with knowledge and understanding (AO1) of the concepts being examined in this section. They performed better when required to apply their knowledge to answer questions (AO2). This may in part be due to the topics they were required to understand being difficult concepts. Candidates did not perform well when required to analyse information and ideas (AO3). Candidates appeared to have had sufficient time to complete the paper, with the majority attempting most of the questions in section B.

The majority of 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.

Throughout section B many candidates did not make clear comparisons. When asked to make a comparison, candidates should be encouraged to use terms such as higher or lower rather than just high or low to give a more precise answer.

### Question 11(a)

- 11 The picture shows a mealybug insect.



This mealybug is a pest for orange tree growers.

The scientists compared the number of mealybugs found on two trees, **tree A** and **tree B**.

For each tree they:

- Collected a sample of mealybugs from the tree
- Counted the number of mealybugs in each sample
- Marked the mealybugs
- Released the mealybugs back onto the tree they were collected from.

The next day another sample was collected from each tree.

- (a) Describe how the scientists should **collect** and **mark** the mealybugs.

Include the equipment they need to use.

You may include a diagram with your answer.

.....

.....

..... [3]

The majority of candidates gained at least one mark, usually for describing how to mark the mealybugs. Many candidates did not use the information in the question that explained the mealybugs were found on the trees so they incorrectly used a pitfall trap instead of a pooter.

Exemplar 1

Pooter  
 ← breath in through  
 mesh stops bugs being sucked up  
 longer flaccid tube

Pooter allows us to count ground insects by sucking through the shorter tube for a few minutes, the tiny bugs go through the longer flaccid tube and into a container. Do this at different areas for the same amount time and compare. [3]

This candidate has applied their knowledge of how to carry out a field investigation to this situation. They have chosen the pooter and described how to use it. The diagram drawn supports their answer but as their description on the answer lines was good the diagram was not required to gain any more marks. They were one of very few candidates who understood that the samples should be taken from different areas.

Question 11(b)

(b) Write down **three** precautions that should be taken when deciding how to **mark** the mealybugs.

- 1 .....
- .....
- 2 .....
- .....
- 3 .....
- .....

[3]

Most candidates understood that the mark should not harm the mealybug and were credited at least one mark. Some candidates provided three answers that were all about not harming the mealybugs so could only be credited one mark. Higher ability candidates often gave three correct answers. Some lower ability candidates understood the mark should not be visible but they confused predators with prey.

### Question 11(c)(i)

(c) The table shows the results for **tree A**.

Total number of mealybugs collected on day 1	Total number of mealybugs collected on day 2	Number of marked mealybugs collected on day 2
150	60	18

(i) Estimate the population size of mealybugs on **tree A**.

Use the formula:

$$\text{Estimated population size} = \frac{\text{Number in 1st sample} \times \text{Number in 2nd sample}}{\text{Number in 2nd sample previously marked}}$$

Answer = ..... [1]

Most of the candidates were able to correctly calculate the answer.

### Question 11(c)(ii)

(ii) When using this method to estimate population, the scientists make several assumptions.

One assumption is that there was no immigration of mealybugs between day 1 and 2.

Suggest two **other** assumptions they would make.

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

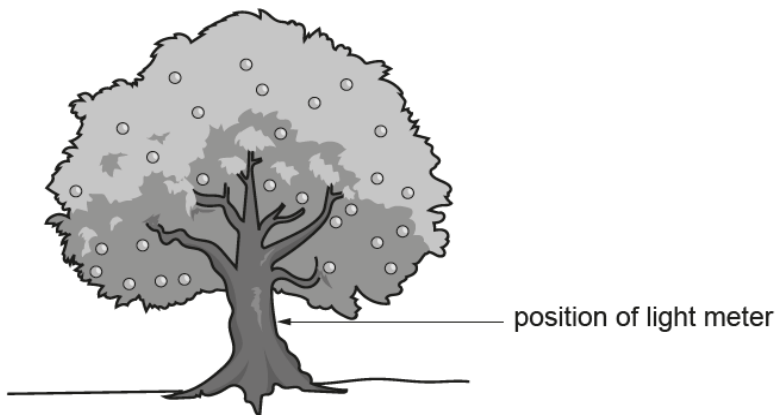
[2]

Although most of the candidates were credited at least one mark some candidates provided answers that were completely opposite to the required assumptions. The example given states that one assumption would be no immigration, this was given to help guide the candidates. However some candidates did not use this information. They suggested that there would be births and deaths instead of no births or no deaths. Candidates should be encouraged to read all the information provided in the question and to use that information to help them answer similar application questions.

### Question 11(d)(i)

(d) The number of mealybugs on each tree may be affected by the light intensity.

The scientists measured the light intensity for each tree at midday on day 1 of their investigation. Light intensity is measured using a light meter.



(i) **Tree B** had an estimated population of 250 mealybugs at the end of the investigation. **Tree B** had a **higher** light intensity reading than **tree A**.

Read this statement.

The mealybugs are thought to breed rapidly in **low light** conditions.

Do the results for the two trees support this statement?

Use the information above and your answer to (c)(i).

Explain your answer.

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

Those candidates that did not gain this mark tended not provide a full explanation. To be credited the mark they needed to link light intensity to population as the question asked them to use the information above and their answer to (c)(ii). Stating 'the population in tree A was higher' was not sufficient alone; they also needed to say 'tree A had a lower light intensity'. Linking dependent and independent variables within an explanation is something candidates struggle with.

Some candidates incorrectly suggested that they could not answer this as they had not been told how many mealybugs were on tree A, even though they had just correctly calculated that number. This again suggests they had not read all of the question.

### Question 11(d)(ii)

(ii) Errors can occur when taking light meter readings.

Explain how errors occur and write down **one** way to take more precise readings.

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

Only the higher ability candidates were able to provide a correct answer to this question. Many provided vague answers such as human error and take repeats without explaining what the error was or when to take the repeats.

### Exemplar 2

Explain how errors occur and write down **one** way to take more precise readings.

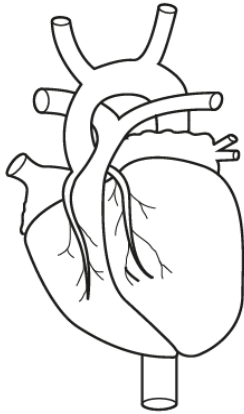
The light meter is only positioned in one side of the tree meaning it's only read light coming from that side, to take more precise readings more meter should be positioned around the tree.

In this example the candidate demonstrates an understanding that the readings may vary around the tree and that just taking one reading in one place is not enough.

## Question 12(a)(i)

12 (a) Cardiovascular disease (CVD) is a major cause of death in the UK.

Look at the diagram of the external features of a heart.



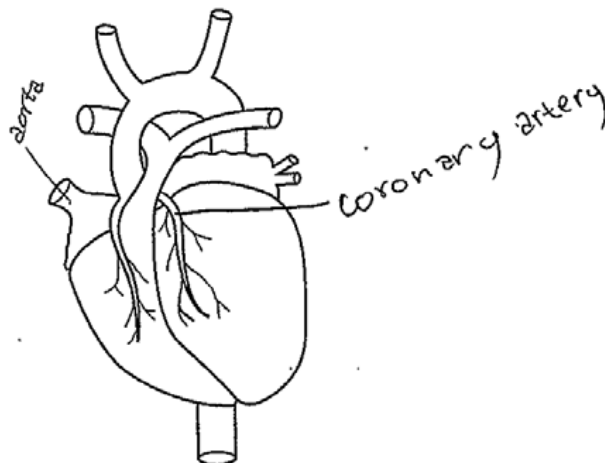
(i) The coronary artery supplies the cardiac muscle with oxygen.

Label the diagram to show the position of **one** of the coronary arteries.

[1]

Very few candidates were able to identify the coronary artery on the external diagram of the heart. Many candidates incorrectly labelled the aorta. When labelling diagrams candidates should be encouraged to use a single line with no arrow head. The line should end on the coronary artery and include the name of the coronary artery at the other end of the label.

### Exemplar 3



This response has a clear line that touches the coronary artery and included the name. The incorrect aorta label is ignored as it is irrelevant to the question.

### Question 12(a)(ii)

- (ii) Angina is a symptom of CVD. Pain from angina is caused by cardiac muscle respiring **anaerobically**.

Explain why angina causes pain.

.....

.....

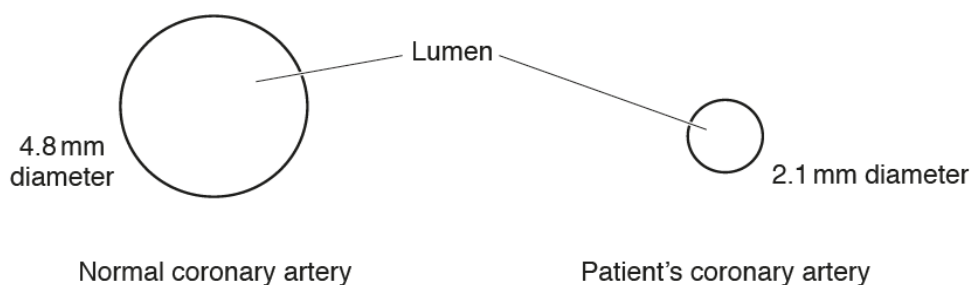
..... [2]

Only the higher ability candidates linked angina to pain in the muscle caused by the build-up of lactic acid. Many candidates simply repeated the stem of the question or suggested it was due to lack of oxygen.

### Question 12(b)(i)

- (b) (i) A 55 year old patient has severe chest pains due to a narrowed coronary artery.

The diagram shows the cross-section of a normal coronary artery and the patient's artery.



The cross-sectional area of the normal coronary artery lumen is 18.1 mm<sup>2</sup>.

Calculate the cross-sectional area of the lumen of **the patient's** artery.

Use the equations:  
 Area of a circle =  $\pi r^2$   
 $\pi = 3.14$

Give your answer to 2 significant figures.

Answer = ..... mm<sup>2</sup> [3]

Most candidates attempted the calculation. Some of these confused significant figures with decimal places and gave an answer of 3.46 instead of 3.5. This is a required mathematical skill M2a (use an appropriate number of significant figures). A few candidates did not convert diameter to radius before completing the calculation.



### Question 12(b)(ii)

- (ii) Calculate the **percentage reduction** in cross-sectional area for the lumen of the patient's artery.

Answer = ..... % [1]

There was clear evidence that candidates find calculating percentage change difficult. Less than half the candidates provided the correct answer. Many did not subtract the 3.5 from the 18.1 before calculating a percentage. This gave them an answer of 19.3% instead of 80.7%. A common error occurs in the rounding of decimal places. Candidates rounded down instead of up, changing a correct answer of 80.66% to an incorrect one of 80% or 80.6%

### Question 12(b)(iii)

- (iii) CVD can be treated by different combinations of lifestyle changes, medicine and surgery.

Look at the information on CVD and how much the coronary artery has been narrowed in (b)(ii).

	Percentage decrease in lumen diameter		
	< 50%	50 to 80%	> 80%
Severity of CVD	Mild	Moderate	Severe

Justify why the patient would need surgery.

.....

.....

..... [2]

This AO3 question was challenging for many candidates. They either did not use the information provided or they did not make a comparison. Many candidates correctly stated the patient had severe CVD but they did not compare their answer to the table. Instead they stated their answer to 12(b)(ii)

### Exemplar 4

Justify why the patient would need surgery.

Percentage decrease is over 80% ✓  
 so the CVD is severe ✓  
 and therefore requires surgery [2]

In this response the candidate has made a clear comparison with their answer and the values in the table so they can be credited two marks.

### Question 12(c)\*

(c)\* Doctors rely on different types of surgery to treat cardiovascular disease.

The table shows features of **three** surgical treatments.

Name of treatment	Description of treatment	Features of treatment
<b>Coronary angioplasty</b>	A small balloon is used to widen an artery.  A wire tube (stent) prevents artery narrowing again.	<ul style="list-style-type: none"> <li>Relieves symptoms that fail to respond to medication</li> <li>Short recovery time</li> <li>1 in 25 cases, the coronary artery narrows</li> <li>May require further surgery</li> </ul>
<b>Coronary artery bypass graft</b>	A blood vessel is removed from a part of your body, usually your chest or leg.  This blood vessel is used to direct blood flow around a blocked artery.	<ul style="list-style-type: none"> <li>Long recovery time</li> <li>Pain after the operation</li> <li>May require further surgery</li> </ul> <p>Effective in people:</p> <ul style="list-style-type: none"> <li>Aged over 65</li> <li>With diabetes</li> <li>With extensive disease</li> <li>With poor heart muscle function</li> </ul>
<b>Heart transplant</b>	A diseased or damaged heart is replaced with a healthy donor heart.	<ul style="list-style-type: none"> <li>Further surgery is unlikely to be needed</li> <li>Increases life expectancy especially in patients 55 years old or under</li> <li>Donor hearts needed</li> <li>Long recovery time</li> <li>Arteries connected to the new heart can narrow</li> </ul>

Evaluate the **three** surgical treatments and decide which would be the best type of surgery for the 55 year old patient.

.....

.....

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

The majority of candidates provided a level two answer. Candidates made a choice based on both positive and negative aspects of that choice, thus providing a balanced explanation for their choice. Only a few higher ability candidates evaluated the treatments in enough detail to be credited level 3. These candidates not only picked out features of the treatments but they went onto apply their knowledge and evaluate how the treatment would improve blood flow to the heart.

Some candidates did not provide a balanced evaluation, only highlighting the positives of their chosen treatments and ignoring the negatives.

## Exemplar 5

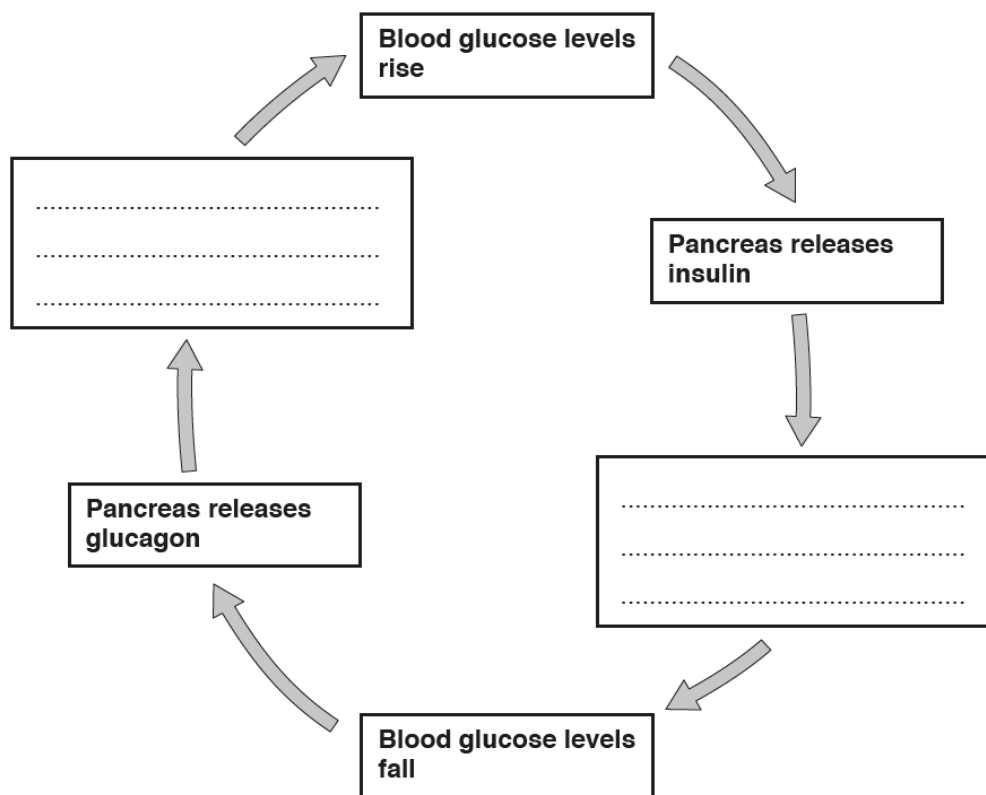
Coronary angioplasty prevent narrowing of the arteries again, and it requires further surgery. Coronary artery bypass graft is where the blood vessel in one part of the body are used somewhere else in the body to make blood flow go back to normal. Where there are blocked arteries, it has long recovery time, but is effective for patients over 65, and the patient we are looking at is 55 years old, so it is not effective. I think the best type of surgery for the patient is heart transplant because patients will receive a healthy donor heart and the new heart can narrow the arteries. Adding on, the surgery is effective for those aged between 55 and under and there is an unlikelyhood that further surgery will be need.

This response shows one of the Level 3 answers. The candidate has identified positives and negatives for each treatment and made a clear choice based on the evidence in the table. Although, like many candidates they have put a lot of emphasis on the age of the patient without realising that if something is effective for a 65 year old, it may also be effective for someone who is 55. This statement is irrelevant and one of the reasons they were only credited five marks. They have however attempted to apply their knowledge by explaining that the bypass graft would restore normal blood flow to the heart. This was enough to take them into level 3, although a more well-developed line of reasoning would have included ideas about increased blood flow.

### Question 13(a)(i)

13 Insulin and glucagon are hormones that control blood sugar levels in the body.

The diagram shows interactions between these two hormones.



(a) (i) Complete the diagram to show how insulin and glucagon work together to control blood sugar levels. [2]

Only the higher ability candidates provided correct answers to this question. Many candidates confuse glucagon with glycogen and stated that glucagon is converted to glucose and that insulin caused glucose to be converted to glucagon rather than glycogen.

### Question 13(a)(ii)

(ii) This type of control system is an example of negative feedback.

Explain why.

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

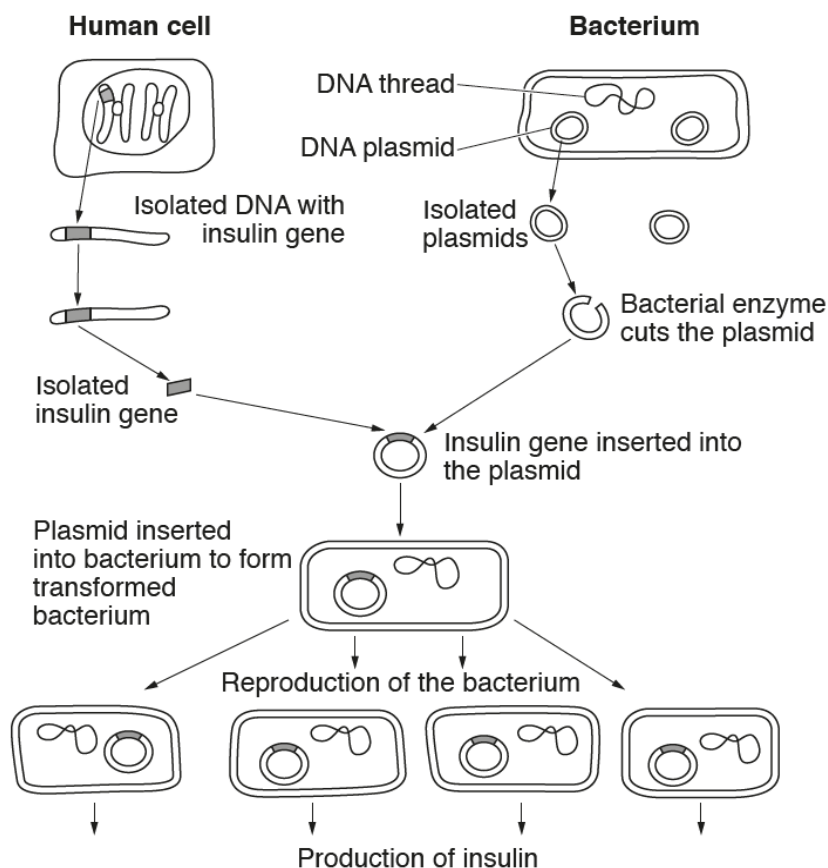
Candidates found it difficult to express why this example showed negative feedback. They tended to provide vague answers such as 'it is maintaining blood glucose levels' or 'your body reacts to changes'. Only the higher ability candidates provided the full answer of a control system returning glucose levels back to normal if they change.

### Question 13(b)

(b) In some people the pancreas is unable to make insulin.

Human insulin can be made by genetic engineering.

The diagram shows how bacteria are genetically engineered to make human insulin.



Enzymes are used to genetically engineer the bacteria.

Write down the names of the **two** enzymes used in this process and explain what they do.

.....

.....

.....

..... [4]

Candidates that demonstrated knowledge of the main steps in the process of genetic engineering tended to provide perfect answers worth all four marks. A large number of candidates used the term bacterial enzyme instead of restriction enzyme as they just repeated the information in the diagram. Candidates were often not precise in their descriptions referring to the gene being isolated instead of being cut out of the DNA by restriction enzyme. A few candidates used the incorrect term of restrictive enzyme or confused ligase with lipase. Incorrect references to active sites and denaturing were also seen. A considerable proportion of candidates omitted the question entirely.

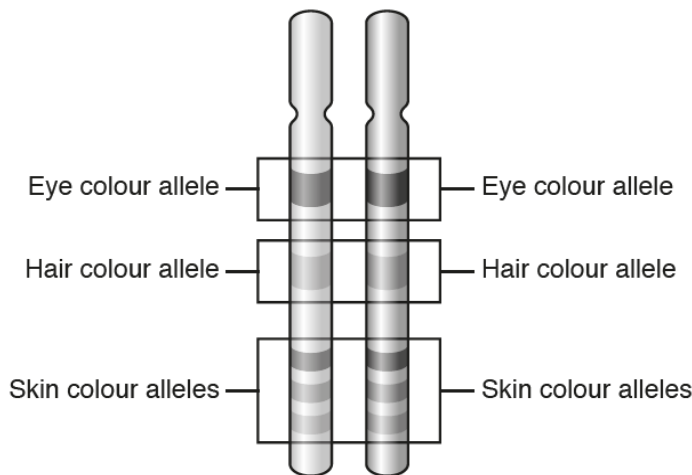
Exemplar 6

Restriction enzyme is what cuts the desired gene out of the human DNA and also cuts open the bacterial plasmid. Ligase is the enzyme that sticks the isolated desired gene into the gap cut into plasmid by the restriction enzyme.

In this response the candidate shows a clear understanding of the process. They have identified both enzymes and stated their function in the process. They have used the correct terminology of 'cut' and 'stick' rather than vague terms such as 'take out' the gene or 'put' the gene in the plasmid.

Question 14(a)

14 (a) Look at the diagram of a pair of human chromosomes.



Phenotypes for skin colour are inherited differently to that of eye and hair colour.

Use the diagram to explain why.

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

Many candidates were unable to give a correct answer to this question. Most of these candidates did not use a comparison, simply stating skin colour is controlled by multiple genes without saying eye and hair colour were controlled by a single gene. A simple comparison using the term 'more' genes for skin colour would have been sufficient. Some candidates did not gain a mark as they did not use the terms gene or allele. Other candidates incorrectly answered in terms of environmental influences when the question asks for how they are inherited differently.

### Question 14(b)(i)

- (b)** Type 1 diabetes is a disorder caused by lack of insulin production in the pancreas. Type 1 diabetes has a genetic link.

In humans the haploid number of chromosomes is 23. Insulin is a hormone controlled by a single gene found on chromosome number 11.

- (i)** How many chromosomes are there in a single human pancreas cell?

..... [1]

The majority of candidates gave the correct answer of 46. A large number of candidates were confused by the context of the question and gave 11 as their answer.

### Question 14(b)(ii)

- (ii)** Some individuals have a copy of the gene that would cause diabetes but do not have the disorder.

Suggest a reason why.

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

Although many candidates determined that the gene was recessive, they did not go onto explain that the individuals may be carriers or that they also had the dominant gene.

### Question 14(c)(i)

- (c)** Some people can inherit a rare condition called ADPKD that results in kidney disease.

The PKD1 gene provides instructions for making a protein called polycystin-1. Polycystin-1 controls kidney cell differentiation.

In ADPKD, polycystin-1 does not work properly.

- (i)** What name is given to a change in the PKD1 gene that causes ADPKD?

..... [1]

Approximately half the candidates applied their knowledge to determine that this was a mutation. The lower ability candidates tended to omit this question.

### Question 14(c)(ii)

- (ii)** Explain why the ADPKD version of polycystin-1 prevents the kidney working properly.

..... [1]

Only the higher ability candidates were able to determine that the kidney cells would not differentiate or become specialised. Many candidates simply stated a faulty protein would be made but they could not explain the consequences of having this faulty protein.

### Question 14(c)(iii)

- (iii) A pregnant woman is heterozygous for ADPKD. The baby's father does not have ADPKD and is homozygous recessive.

ADPKD is caused by a dominant allele (**D**).

What is the probability of their baby having ADPKD?

Use a labelled genetic diagram to explain your answer.

..... [2]

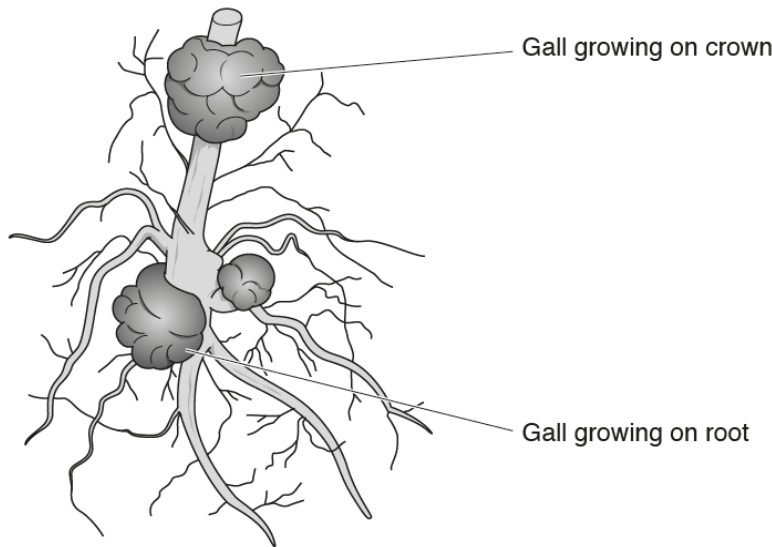
The majority of candidates were able to draw the genetic diagram and determine the correct probability. A few candidates were unable to use the terms heterozygous and homozygous recessive correctly, so used the incorrect genotypes for the parents. However, they were still able to gain one mark for correctly interpreting the genetic diagram they drew to give a probability that matched their diagram.



### Question 15(a)

15 The bacteria, *Agrobacterium tumefaciens*, causes crown gall disease that affects walnut trees.

Galls form on the parts of the plant growing above ground (crown) or on the roots.



(a) Describe how the galls form and cause damage to the walnut tree.

.....

.....

.....

.....

.....

..... [4]

This question was based on a concept that had not been covered in past specifications. The specification requires candidates to describe and explain how diseases are spread in animals and plants and crown gall disease is given as the example of a plant disease. Most candidates gained at least one mark for stating that flow or water or nutrients would be restricted or that there would be less growth or even death. There were a few complete answers that referred to rapid reproduction of bacteria after infection and the galls being tumours. A common misconception was to assume the galls were parasitic and that that they would take the nutrients for the tree.

Exemplar 7

The galls form a tumour like growth. <sup>Bacteria causes</sup> ~~uncontrollable~~ <sup>uncontrollable</sup> cell division ~~which causes~~ <sup>which causes</sup> the growths. ~~It can~~ <sup>it can</sup> cause damage as it may prevent water uptake <sup>uptake</sup> so the plant can't function properly. It may also stop sunlight getting to the plant so it is unable to photosynthesise properly so it can't produce food [4]

This response shows an answer that was credited three marks. The candidate identifies that the galls are tumours caused by uncontrollable cell division. They also understand that this could prevent uptake of water. The irrelevant comment about photosynthesis was a common misconception. However if they had gone onto say the lack of food production results in poor growth they could have gained a fourth mark.

Question 15(b)(i)

(b) Scientists investigate how the disease is spread.

They use two groups of young trees without galls taken from a field.

The first group had originally grown next to trees with galls, the second group had not. All the trees are transplanted into a new disease-free field.

They damage half the trees in each group by wounding the crown and root region with a blade.

The table shows their results.

Originally grown next to a tree with galls	Wounded before transplanting	Percentage (%)		
		Trees with galls	Trees with galls on crown	Trees with galls on roots
No	No	17	2	16
No	Yes	24	3	21
Yes	No	26	13	21
Yes	Yes	34	14	26

The scientists made this hypothesis.

'Wounded trees would have more disease than unwounded trees.'

(i) Explain **one** reason why the scientists thought this would happen.

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

In this question many candidates incorrectly used the data thinking they were looking for evidence for the hypothesis being correct instead of identifying a scientific reason why the hypothesis had been suggested. Some candidates referred to increased chance of getting the disease instead of explaining why there would be more chance. Only a few candidates answered in terms of the wounds providing easier access for the bacteria into the plant tissue.

### Question 15(b)(ii)

(ii) To what extent does the evidence support their hypothesis?

Explain your answer.

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

Candidates found it difficult to use the evidence in the table to support the hypothesis. Many candidates provided confused answers that included references to the trees being originally grown next to trees with galls instead of comparing the data for wounded trees and non-wounded trees. Many candidates incorrectly answered in terms of more likely to get disease, which was simply repeating the hypothesis. As this was not using the evidence of gall numbers they could not be credited the marks.

### Question 15(b)(iii)

(iii) Write down **two** other conclusions that can be made from the data.

1 .....  
.....  
2 .....  
..... [2]

Most candidates correctly identified that trees grown next to trees with galls were more likely to have galls. Fewer candidates recognised that trees were more likely to get root galls than crown galls.

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