

INTERNATIONAL ADVANCED LEVEL

BIOLOGY

**Exemplars with examiner
commentaries**
Unit 2 - WBI12



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Introduction

1.1 About this booklet

This booklet has been produced to support teachers delivering the Pearson Edexcel International Advanced Level in Biology specification. The Unit 2 exemplar materials will enable teachers to guide their students in the application of knowledge and skills required to successfully complete this course. The booklet looks at questions 3(c)(ii), 5(b)(ii), 6(c)(ii), 7(d), 8(a and 8(b) from the June 2019 examination series, showing real candidate responses to questions and how examiners have applied the mark schemes to demonstrate how student responses should be marked.

1.2 How to use this booklet

Each example covered in this booklet contains:

- Question
- Mark scheme
- Example responses for the selected question
- Example of the marker grading decision based on the mark scheme, accompanied by examiner commentary including the rationale for the decision and guidance on how the answer can be improved to earn more marks.

The examples highlight the achievement of the assessment objectives at lower to higher levels of candidate responses.

Centres should use this content to support their internal assessment of students and incorporate examination skills into the delivery of the specification.

1.3 Further support

A range of materials are available from the Pearson qualifications website to support you in planning and delivering this specification.

Centres may find it beneficial to review this document in conjunction with the [Examiner's Report](#) and other assessment and support materials available on the [Pearson Qualifications website](#).

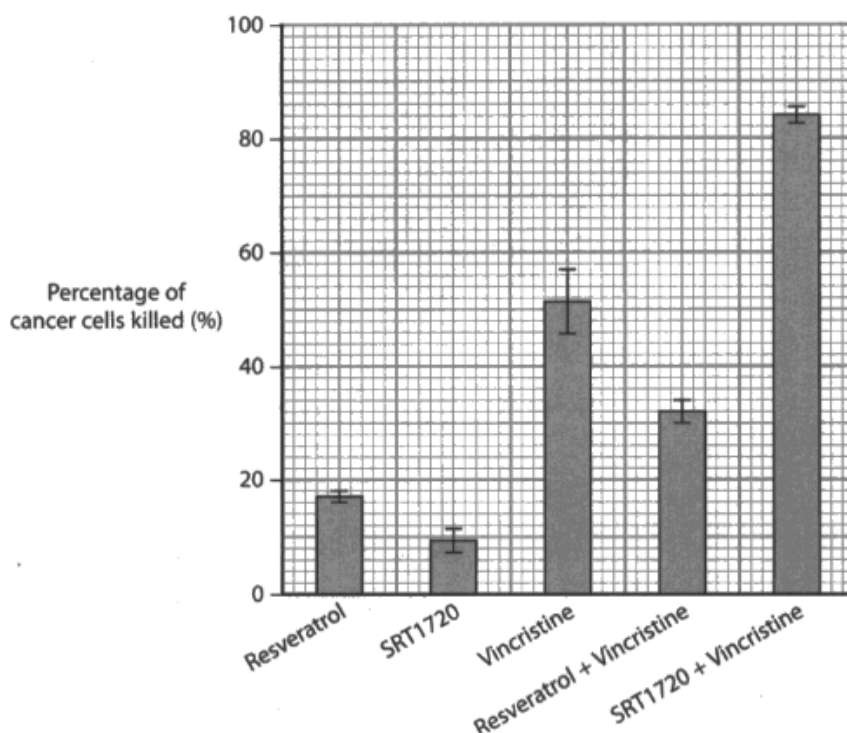
Question 3(c)(ii)

(c) Ewing's sarcoma is a type of cancer.

Resveratrol, SRT1720 and Vincristine are drugs used to kill cancer cells.

An investigation was carried out to determine the most effective treatment for patients with Ewing's sarcoma.

The graph shows the results of this investigation.



(ii) Evaluate the effectiveness of the three drugs used in this investigation.

Use the information in the graph to support your answer.

(4)

Mark scheme

Question Number	Answer	Additional guidance	Mark
3(c)(ii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> Vincristine is the most effective and SRT1720 is the least effective (when given on their own) (1) Resveratrol reduces the effectiveness of Vincristine / Vincristine increases the effectiveness of Resveratrol (1) SRT1720 increases the effectiveness of Vincristine / Vincristine and SRT1720 is the most effective treatment (tested) (1) comment on variability of data (1) 	<p>Accept description of correct order (V>R>SRT) Ignore drug combinations</p> <p>Accept Resveratrol and Vincristine more effective than Resveratrol by itself / Resveratrol and Vincristine less effective than Vincristine by itself</p> <p>e.g. {range / SD / error} bars do not overlap / size of error bars</p>	(4)

Exemplar response A

The experiment is highly reliable since error bars do not overlap. The graph shows that the most effective drug used alone was Vincristine showing ^{the} highest percentage of cancer cells killed of ^{around} 51%, while the least effective drug used was SRT1720 because it showed the least percentage of cancer cells killed of around 19%. However, it is clearly shown that the Resveratrol is the second most effective drug because it has the ^{second} highest percentage of 17% of cancer cells killed. However, it is clearly shown that the highest effect was done reached by the mixture of SRT1720 and Vincristine of 84% cancer cells killed.

Examiner's comments:

This response was given 3 marks.

The command word '**evaluate**' requires candidates to review the given information and then bring it together to form a conclusion.

Candidates were expected to use the percentage of cancer cells killed to help them evaluate the effectiveness of the drugs. The variability of the data was also shown on the graph. Candidates were expected to comment on the size of the {range / SD / error} bars or make a comment about the bars not overlapping. It was expected that candidates reviewed all this information in their answers.

This first sentence of this response was awarded marking point 4 as the candidate has correctly recognised that the error bars do not overlap and that this increases the reliability of the data.

The candidate then evaluated the effectiveness of the drugs when given on their own. The candidate has correctly understood that Vincristine is the most effective drug when used by itself as it killed a larger percentage of cancer cells. The candidate then went on to say which was the least effective. The use of the words 'most' and 'least effective' was crucial here to access marking point 1 if a candidate had not referred to Resveratrol in the following sentence.

The last sentence clearly stated that the most effective treatment was the drug combination of Vincristine and SRT1720 and was awarded marking point 3.

However, the candidate has not fully analysed the graph as they have not referred to one of the bars.

The lack of evaluation of the effectiveness of the drug combination of Vincristine and Resveratrol meant that the candidate was limited to 3 marks out of the available 4 marks.

Exemplar response B

Vincristine is the most effective drug on its own as it killed almost 52% (51.8%) of cancer cells. It has the largest error bar, but it doesn't overlap with other drugs so ^{error bar is significant} it is significant (the difference in percentage of cancer cells killed is significant). Resveratrol has the ~~2nd~~ second highest effectiveness by killing 17% ~~cells~~ which is about 7% more than that killed by SRT1720, which has the worst effectiveness). Vincristine was more effective on its own than being administered ^{in a} combination with Resveratrol, as it killed approximately 19.8% more cancer cells. However, a combination of SRT1720 and Vincristine is the most effective out of all, as it killed **(Total for Question 3 = 10 marks)** 52% more cancer cells than Resveratrol and Vincristine and killed 32.2% more cancer cells than Vincristine alone.

Examiner's comments:

This response was given 4 marks.

This question is within the context of AO2b. It contained one of the new command words, 'evaluate', which required analysis and evaluation of scientific information to make judgements and reach conclusions.

This candidate has fully analysed the scientific information given and used the data to support their answer. The answer gained every marking point.

In the first eight lines the candidate has clearly described the correct order of the three drugs when used by themselves to gain marking point one.

The candidate understood the importance of analysing the error bars for size and to see if they overlap. In the second sentence, the candidate stated that the error bars for Vincristine alone has the largest error bar. This gained marking point 4. Additionally, the candidate gave a higher-level response regarding the error bar, correctly recognising that the difference in the percentage of cancer cells being killed is significant because the error bar does not overlap with any other error bars.

The candidate compared the effectiveness of Vincristine used by itself to the effectiveness when used in combination with Resveratrol on lines 9 and 10. Marking point 2 was awarded for recognition that Vincristine was more effective when used by itself.

Finally, the candidate gained marking point 4 for correctly stating that the combination of Vincristine and SRT1720 was the most effective combination and quantified the increased percentage of cancer cells killed compared to just using Vincristine.

Question 5(b)(ii)

- *(ii) The ironwood tree has wood containing chemical compounds called naphthoquinones. These compounds have antibacterial properties.

Scientists are investigating whether these compounds could be used to develop a drug to treat people infected with *Y. pestis*.

Describe the methods that would be used to trial a drug containing these compounds.

(6)

Mark scheme

Question Number	Answer
5 (b)(ii)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> • compound needs to be extracted from trees and used to make a drug • compounds tested on <i>Y. pestis</i> <i>in vitro</i> • tested on {animals / human cells} • (phase 1 / preliminary) (small scale) tests on healthy {people / volunteers} • review by independent {scientists / medics} to see if work can progress to stage 2 • (phase 2) - drug tested on {small / 100 to 500} groups of {patients / people} who have the {plague / disease} • appropriate concentrations identified • (phase 3) - drug tested on {larger groups of / 1000 to 3000} {patients / people} who have the plague • placed randomly in two groups - one group receives {treatment / drug containing the chemical compounds} and the other receives placebo • double blind test • analyse results with (appropriate) statistical test / test for significant difference <p>(6)</p>

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	<p>Demonstrates isolated elements of biological knowledge related to the given context with generalised comments made.</p> <p>The description will contain basic information with some attempt made to link knowledge and understanding to the given context.</p>	<p>outline of drug test given but no reference to either the plague or <i>Y. pestis</i> or bacteria</p> <p>core practical only = 1 mark other human drug trial = 2 marks</p>
Level 2	3-4	<p>Demonstrates adequate knowledge by selecting and applying some relevant biological facts/concepts to provide the description being presented.</p> <p>The description shows some linkages and lines of scientific reasoning with some structure.</p>	<p>Testing on {animal / human cells} plus at least two other phases correctly described lower mark</p> <p>In context of people having the disease / plague or <i>Y. pestis</i> or bacteria plus reference to double blind test or placebos gives higher mark</p>
Level 3	5-6	<p>Demonstrates comprehensive knowledge by selecting and applying relevant knowledge of biological facts/concepts to provide the description being presented.</p> <p>The description is clear, coherent and logically structured.</p>	<p>Testing on {animal / human cells} plus three phases correctly described including double blind test and placebos In context of people having the disease / plague or <i>Y. pestis</i> or bacteria gives lower mark</p> <p>plus correct ref to use of stats / analysis of significant difference to placebo gives higher mark</p> <p>or in vitro testing of drug on <i>Y. pestis</i> or bacteria gives higher mark</p>

Exemplar response A

First and foremost, the chemical compound, naphthoquinone, is ^{extracted} ~~isolated~~ from the ironwood tree wood and is made into a drug. This drug then undergoes pre-clinical testing where the drug is first tested on tissue samples (humans) to determine whether it is toxic. Then the drug is ^{tested} ~~given~~ to animals such as rats to find out the average dose and to once again check for toxicity. The drug undergoes the 3 phase drug test. In Phase I, the drug is given to 10-40 healthy volunteers to study whether the drug can be easily absorbed, metabolised and ~~excreted~~ ^{excreted} out of the body. The dosage is monitored as well. Then in Phase II, the drug is given to 100-300 patients who are infected by *Y. pestis*. This studies whether the drug is effective on someone having the disease and note any side-effects caused. The final phase, Phase III, involves the double-blind trial. 3000 patients are needed. They are separated into 2 groups with equal number of males and females of the same age. One group is given the placebo (sugar pill or saline), the other is given the drug being tested. The doctor not the patient know what they get. The testing then records the number of people getting cured to see if they get cured by this drug or by a placebo due to psychological reasons.

Examiner's comments:

This response was given 5 marks.

This was an Extended Open Response (EOR) question which targeted both AO1 and AO2. The first part of the mark scheme shows a range of indicative content, which covered methods by which a drug containing naphthoquinones could be trialed to see if it was effective at treating *Y. pestis* infections.

Candidates had to apply their knowledge to this unfamiliar context to be awarded any of the 4 AO2 marks.

This response demonstrated that this candidate applied their knowledge to the given context as they referred to testing on patients infected with *Y. pestis* on line 10. The following sentence on lines 11 and 12 gave further evidence of this. This meant that this candidate could be awarded AO2 marks and access levels 2 and 3 if they described the stages of the drug trial correctly.

The levels-based mark scheme is hierarchical, so the response is first analysed for level 1 content. To achieve the higher mark in level 1, candidates needed to describe a human drug trial.

This response correctly describes testing on human cells before correctly describing phases I, II and III, so level 1 criteria are met.

As the response is in the context of the patients having a *Y. pestis* infection, it can now be analysed for level 2 content. To achieve the lower mark in level 2 the response should correctly describe testing on human cells and at least two other phases. This response does this.

To achieve the higher mark in this level, the response should also include correct reference to either placebos or a double-blind test. This response contains correct reference to a double-blind test on line 13 and placebo on line 15.

This response can then be analysed for level 3 content. To achieve the lower mark in level 3, the response should correctly describe testing on human cells before correctly describing phases I, II, III. There should also be correct reference to both a double-blind test and the use of a placebo. This response meets all these criteria.

To achieve the higher mark in this level, the response should also include correct reference to either in-vitro testing of the drug on *Y. pestis* bacteria (second point of indicative content) or the analysis of results with a statistical test (last indicative content point). There is no mention of either of these in this response so the higher mark in level 3 could not be awarded.

Exemplar response B

Naphthoquinones are extracted from the wood of ironwood trees. First, ^{the drug is} ~~they are~~ tested on individual cells to see their effect. Then it's tested on animals, to determine if it's safe to use and its levels on toxicity and to see its effect on a whole organism. After that, ^{the drug is} ~~a group~~ is tested on a group of healthy people to observe the side-effects of the drug ^{and to determine dosage} and whether its side effects are severe that's phase I. In phase II, a ~~some~~ group of *Y. pestis* patients are tested on the drug. In phase III, a larger group of patients are to test the drug on ^{them} ~~then~~. In phase II and phase III, a double-blind trial ^{happens} ~~is done~~ where a group of patients takes the placebo which is an inactive substance acts as a control in trial and the other group of ^{patients} ~~people~~ take the real drug. The patients and the doctor don't know which patient take placebo or real drug to prevent biased data. The patients are monitored for few months then the effectivity of the drug is determined and if it's suitable for the future.

Examiner's comments:

This response was given 4 marks.

The levels-based mark scheme is hierarchical, so the response is first analysed for level 1 content. To achieve the higher mark in level 1, candidates needed to describe a human drug trial.

This response correctly describes testing on human cells before correctly describing phases I and III, so the level 1 criteria are met.

As the response is in the context of the patients having a *Y. pestis* infection (line 9), the response can now be analysed for level 2 content. To achieve the lower mark in level 2, the response should correctly describe testing on human cells and at least two other phases. This response does this.

To achieve the higher mark in this level, the response should also include correct reference

to either placebos or a double-blind test. This response contains correct reference to a double-blind test on line 11 and placebo on line 12.

This response can then be analysed for level 3 content. To achieve the lower mark in level 3, the response should correctly describe testing on human cells before correctly describing phases I, II, III. There should also be correct reference to both a double-blind test and the use of a placebo. This response does not fulfill all these criteria as it has missed out the sample size for phase 2.

Therefore, this response was limited to the higher mark in level 2 (4 marks).

Exemplar response C

pre-clinical tests is carried out first, where the drug is first tested on cultured cells to see its general effect, then its tested on rats to see its effect on the metabolic reactions, or organs. If pre-clinical test is carried out successfully, they move onto the next stage, which is clinical testing and it involves three phases. ~~At~~ In phase I, the drug is tested on a small group of healthy people of same age, gender, lifestyle and health. To test the effect of drug on humans. In phase II, the drug is given to a small number group of patients, to test the drugs real effect and if it can work. In phase III, double blind trials is carried out, this involves a large number of patients and dividing them into groups. One group will be given the real drug and the other group will be given a placebo which acts here as a control group. Neither the doctor nor the patients ~~are~~ know which is the placebo ~~and~~ which is the real drug, to remove bias.

(Total for Question 5 = 10 marks)

Examiner's comments:

This response was given 2 marks.

The levels-based mark scheme is hierarchical, so the response is first analysed for level 1 content. To achieve the higher mark in level 1, candidates needed to describe a human drug trial. This response correctly describes testing on human cells and animals before describing phases I, II and III, so level 1 criteria are met.

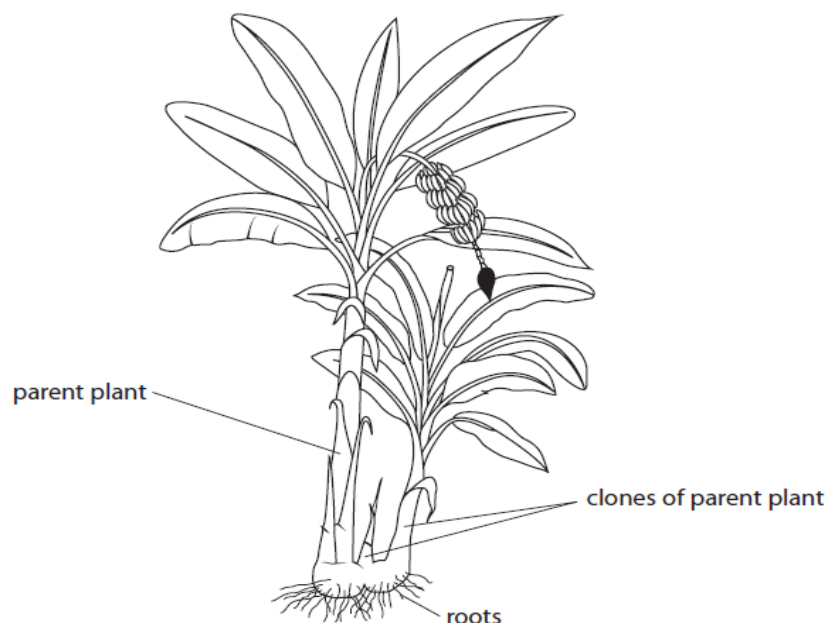
However, although the candidate has given a very good description of a human drug trial, it cannot access the AO2 marks in level 2 and 3. This is because the candidate has not applied their knowledge and understanding to the context given in the question. There is no mention of the plague or *Y. pestis* infection or *Y. pestis* bacteria.

Question 6(c)(ii)

(ii) Banana plants can reproduce asexually.

Most of the bananas grown by farmers around the world are clones from a single parent banana plant called 'The Cavendish'.

The diagram shows a parent banana plant and two clones of this parent plant.



These clones can be removed from the parent plant and grown into new banana plants.

Panama disease is caused by a fungus. It has destroyed Cavendish banana plants in the Philippines. Cavendish banana plants are not resistant to this fungus.

Seed banks around the world have seeds from different varieties of banana.

Scientists are trying to improve the Cavendish banana by breeding it with different varieties of banana.

Explain why scientists are breeding the Cavendish banana with different varieties of banana.

(4)

Mark scheme

Question Number	Answer	Additional guidance	Mark
6(c)(ii)	<p>An explanation that makes reference to four of the following:</p> <ul style="list-style-type: none"> (all Cavendish plants) are susceptible to the fungus because they are {genetically identical / clones} (1) whereas different varieties may have resistance to the fungus / contain an allele for resistance (to fungus) (1) (therefore breeding could) increase genetic {diversity / variation} (1) resulting in (new banana) plants with resistance to {fungus / Panama disease} (1) 	<p>Ignore mutations / immunity</p> <p>Accept do not contain an allele for resistance (to fungus)</p> <p>Accept contain an advantageous allele</p> <p>Ignore 'genes' unless qualified with alleles</p> <p>Accept increase gene pool</p> <p>Accept {offspring / new varieties} survive and reproduce</p>	(4)

Exemplar response A

To increase genetic diversity among the Cavendish banana plants and to increase the size of their gene pool. Other species of banana plants may be able to reproduce sexually so may have a larger gene pool with some advantageous alleles. ^{which make them} They are ~~hoping~~ resistant to the fungus. They are hoping that by interbreeding the 2 species of banana plants they can pass the advantageous alleles into the Cavendish banana plants gene pool for future generations so that they become ^{poor/no} resistant to the ^{to parent plants} fungus. Asexual reproduction leads to ~~low~~ genetic variation in plants so all the non-resistant Cavendish banana plants keep producing more non-resistant Cavendish banana plants which are affected by the ^{that} fungus and may reduce chances of their survival. To improve resistance of Cavendish bananas to the fungus.

Examiner's comments:

This response was given 4 marks.

This question is within the context of AO2a. It required the application of knowledge and understanding of science in familiar and unfamiliar contexts.

This response clearly shows that this candidate has carefully read and understood the given information as they have included asexual reproduction (linking to the clone's information) and referred to resistance to the fungus.

This first sentence of this response was awarded marking point 3 for recognising that breeding the Cavendish banana with other varieties of banana would increase the genetic diversity. The same sentence also gave the acceptable answer in the additional guidance ('increase gene pool').

The next sentences (lines 3-10) explained how the genetic diversity of the Cavendish banana would be increased. The candidate has clearly made the link that some other varieties may contain alleles which confer resistance to the fungus that causes Panama disease. The candidate then explains that breeding these varieties with the Cavendish banana would result in future generations of these banana plants having resistance to the fungus. This allowed marking points 2 and 3 to be awarded.

The next sentence (starting on line 10) links different aspects of information provided on the preceding page to correctly explain that as all Cavendish banana plant offspring are genetically identical to the parent plant, they will also be 'non-resistant' and therefore marking point 1 was awarded.

Exemplar response B

The Cavendish banana is not resistant to the fungus causing Panama disease because it does not have the gene ^{or allele} responsible for the resistance. By breeding the Cavendish banana with other varieties of banana, if the different variety of banana used for breeding is resistant to the fungus causing Panama disease, the first generation of the breeding would have a percentage of Cavendish hybrid banana ^{plants} which are in fact resistant to the fungus causing Panama disease. Therefore these Cavendish banana plants can survive the effect of the fungus to reproduce asexually to form clones of Cavendish banana plants which are resistant to the fungus. Therefore if there is ^{sudden} ~~any~~ increase in the fungus or Panama disease, ~~not all the Cavendish~~ (Total for Question 6 = 11 marks)

Examiner's comments:

This response was given 3 marks.

This candidate read the information provided and linked some of it with their own knowledge and understanding.

This candidate's first sentence stated that the Cavendish banana was not resistant to the fungus because it did not contain the allele for resistance. Therefore, marking point 1 was awarded.

The next sentence was awarded both marking points 2 and 4 as the candidate has described how breeding with resistant varieties would result in hybrid banana plants which would be resistant to the fungus. Unfortunately, the candidate did not link their knowledge of genetic diversity to this question.

Marking point 3 was not awarded because there was no mention that the clones would be genetically identical and that breeding with other varieties would increase the genetic diversity.

Question 7(d)

(d) After fertilisation, the egg cell divides by mitosis to form a blastocyst.

During this process, totipotent cells become pluripotent.

Describe how a totipotent stem cell becomes a pluripotent stem cell.

(3)

Mark scheme

Question Number	Answer	Additional guidance	Mark
7(d)	<p>A description that includes three of the following points:</p> <ul style="list-style-type: none"> • differential gene expression (1) • some genes have been (permanently) {inactivated / switched off} (1) • by epigenetic modification (1) • {proteins / enzymes} {made / synthesised} (from active genes) which permanently modify the cell (1) 	<p>Accept only some genes are {active / switched on} Ignore genes activated</p> <p>Accept named example of modification e.g. histone modification, DNA methylation</p> <p>Accept {proteins / enzymes} {made / synthesised} produce a {structural / functional / metabolic change}</p>	(3)

Exemplar response A

This happens by ~~the~~ differential gene expression where a chemical stimulus is sent and some genes (that code for extra embryonic cells) are switched off. This may happen by DNA methylation preventing those genes from being transcribed.

Examiner's comments:

This response was given 3 marks.

This question was targeted at AO1 and required candidates to demonstrate their knowledge and understanding of specification points 3.18 and 3.20, which include differential gene expression and epigenetic modification.

This candidate has a clear and logical response which met the first three marking points. The candidate has correctly used the emboldened phrase 'differential gene expression' on the first line of the response (scoring marking point 1) and then described how some genes may be switched off via DNA methylation.

This candidate did not describe how the expression of active genes would have resulted in different cell structure or function and therefore marking point 4 was not awarded.

Exemplar response B

Certain stimulus is given so some genes are active and others are not. Active genes are transcribed by the mRNA. mRNA is made from active genes only. mRNA is translated forming proteins that modify the structure of the stem cell. Totipotent cells form the extra embryonic cells and ~~are~~ pluripotent cells. pluripotent cells are unspecialised but they can not form extra embryonic tissues which were already formed by Totipotent cells. Other Totipotent cells that did not form the extra embryonic cells are now pluripotent.

Examiner's comments:

This response was given 2 marks.

The sentence stating that a certain stimulus would result in 'some genes [which] are active and some are not' was sufficient only for marking point 2.

However, the candidate did not give further details about the stimulus which altered the activation of the genes and therefore could not access marking point 3. It is important for candidates to deepen their answer by describing **how** the process occurs.

The second and third sentences described the result of differential gene expression but without using this phrase. Therefore, marking point 1 could not be awarded.

The candidate correctly stated that only active genes are transcribed and the synthesised proteins modify the structure of the cell (scoring marking point 4).

Other parts of the response were not relevant to this question.

Question 8(a)

8 Beavers were hunted to extinction in Scotland in the 16th century.

In mainland Europe, populations of beavers have become isolated from each other.

In 2009, 11 beavers were reintroduced to Scotland from Norway.

Beavers are adapted to live on land and in water. They can cut down trees. They gnaw branches from trees, which they use to build dams.

The photograph shows two beavers and a pond that has been created due to a beaver dam.



(a) Explain how the reintroduction of beavers resulted in a change in the biodiversity in Scotland.

(4)

Mark scheme

Question Number	Answer	Additional guidance	Mark
8(a)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> introduction of new (beaver) species increased the {species richness / biodiversity} (1) reduction in (plant) biodiversity due to trees being cut down / reduction in (animal) biodiversity as {habitat / food} reduced (by the trees being cut down) (1) (increase in biodiversity) due to {pond being created / new habitat / increased space (due to trees being cut down)} (1) (increase in biodiversity) due to new food source (1) 	<p>Accept number of {species/ organisms} for biodiversity</p> <p>Ignore genetic diversity</p> <p>Accept reduction in animal biodiversity due to {competition with / predation from} beavers</p> <p>Accept plant or beaver as food source</p>	(4)

Exemplar response A

Reintroduction of beavers increased the ~~habitat~~ biodiversity as the beaver dam created a new pond, which serves as a shelter for many animals such as fish as well as serving as a water source for other animals living around. However, beavers can cut down trees which reduces biodiversity as this is reduced shelter for many other animals.

Beavers can act as a food source which increases biodiversity

Examiner's comments:

This response was given 4 marks.

This question is within the context of AO2a. It required the application of knowledge and understanding of science in familiar and unfamiliar contexts.

The wording of the question was carefully chosen as it encompassed either an increase or decrease in biodiversity. It was expected that the higher-level responses would consider how the biodiversity could be increased **and** decreased by the reintroduction of beavers whereas weaker responses may just consider either an increase or decrease in biodiversity.

The candidate showed good technique by starting the answer with a statement of what change in biodiversity would result from the reintroduction of the beavers. The first line of this response was awarded marking point 1.

They then explained why the biodiversity would increase, due to the pond being created, using the information given above the photograph and was awarded marking point 3.

The consideration of the biodiversity increasing due to the beavers being a food source showed a deep understanding and was awarded marking point 4.

The candidate also considered that the reintroduction of the beaver could have a negative impact on the biodiversity of Scotland in their second sentence. They have linked their knowledge and understanding to the information provided above the photograph to explain why the cutting down of trees would reduce biodiversity (scoring marking point 2).

Exemplar response B

At first it caused an increase in biodiversity, as it increased the species richness, but later on beavers started to compete with native organisms for food. The dams the beavers built could also lead to habitat destruction of some species. Both competition ~~at~~ and habitat destruction lowers the number of native species decreasing their gene pool. This can lead to a decrease in biodiversity.

Examiner's comments:

This response was given 2 marks.

This response started off well with the recognition that there would be an increase in biodiversity and species richness (scoring marking point 1). However, the candidate did not use any of the given information above the photograph or consider the impacts of this increase in species richness on other organisms and therefore could not access two of the marking points (mark points 3 and 4).

The candidate gave an explanation as to why biodiversity could reduce due to the beavers, which matched more than one alternative for marking point 2. They correctly recognised that the dams built by the beavers could lead to habitat destruction for some species. The candidate also gave the reason of native organisms encountering competition with beavers for food, which was the additional guidance for marking point 2.

Question 8(b)

- 8 Beavers were hunted to extinction in Scotland in the 16th century.

In mainland Europe, populations of beavers have become isolated from each other.

In 2009, 11 beavers were reintroduced to Scotland from Norway.

Beavers are adapted to live on land and in water. They can cut down trees. They gnaw branches from trees, which they use to build dams.

The photograph shows two beavers and a pond that has been created due to a beaver dam.

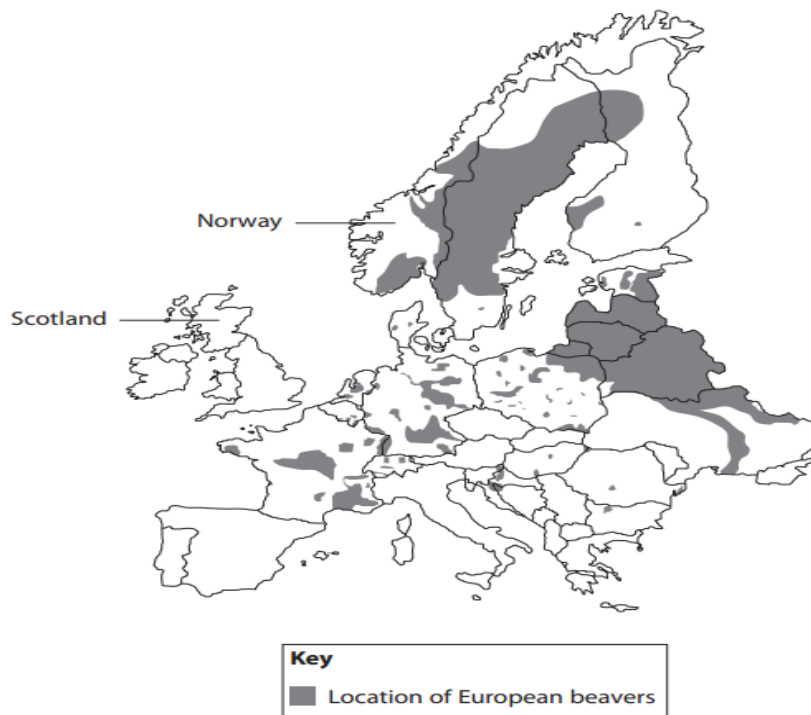


- *(b) Some scientists were concerned that the low numbers of beavers reintroduced into Scotland from Norway could affect the genetic diversity of the population in Scotland.

The scientists proposed two solutions to this concern:

- to introduce more beavers from Norway
- to introduce beavers from several different European locations.

The map shows locations of European beavers before they were reintroduced to Scotland.



Discuss the solutions, proposed by these scientists, to overcome the concern of introducing only 11 beavers into Scotland from Norway.

Use the information in the map to support your answer.

(6)

Mark scheme

Question Number	Answer
8 (b)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> genetic diversity identified as the variety of alleles in the population only small numbers of introduced beavers could reduce the genetic diversity loss of alleles from population increased homozygosity introducing more Norwegian beavers could increase genetic diversity but could have same alleles so no effect on genetic diversity introducing beavers from different European locations could increase genetic diversity could be many different alleles in wider populations of European beavers however the map shows many geographically isolated populations these small populations could also have low genetic diversity reproductive isolation could have occurred preventing introduced beavers mating with Scottish beavers

(6)

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	<p>Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.</p> <p>Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p>The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.</p>	<p>Discussion of at least one solution and the impact on genetic diversity</p> <p>1 solution = 1 mark</p> <p>2 solutions = 2 marks</p>
Level 2	3-4	<p>Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts.</p> <p>Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p>The discussion shows some linkages and lines of scientific reasoning with some structure.</p>	<p>Discussion of both solutions and their impact on genetic diversity</p> <p>plus consideration of effect of geographically isolated populations on genetic diversity 1 mark (accept description e.g. scattered populations)</p> <p>plus alleles 1 mark</p>
Level 3	5-6	<p>Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.</p> <p>Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.</p> <p>The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.</p>	<p>all level 2 content</p> <p>plus reproductive isolation one mark</p> <p>plus inbreeding / heterozygosity index one mark</p>

Exemplar response A

Having only 11 beavers in the Scotland population means that the population will have a very small gene pool and very little genetic variation which can result in the population dying out if environmental conditions are in a disadvantageous manner. Introducing more beavers from Norway will increase the gene pool ~~size~~ ^{region} due to the larger population. The ~~location~~ ^{region} of beavers is very large in the map near Norway which means that the population is healthy and successful in its niche, has advantageous combinations of alleles. Therefore adding more beavers from Norway will make the reintroduction in Scotland more likely to succeed. ~~Inter~~ The regions with beavers in different ^{locations} ~~regions~~ around Europe in the map are of different sizes which ~~are~~ ^{and} isolated from each other which means they will have very different ~~gen~~ genetic combinations. This solution will increase genetic variation and the gene pool and population so that reintroduction is more likely to be successfully producing a healthy population of beavers in Scotland.

Examiner's comments:

This response was given 4 marks.

This question was an Extended Open Response (EOR) item. It is within the context of AO2b and therefore required analysis and evaluation of scientific information to make judgements and reach conclusions.

The question used the command word '**discuss**' and therefore in their answer candidates were expected to explore all aspects of the given situation: how the low numbers of reintroduced beavers could result in a reduction in genetic diversity and how two proposed solutions could address this concern.

This response shows good technique in considering the possible impact on the genetic diversity of the reintroduced beaver population as a result of only 11 beavers as a starting population. If the candidate had extended this to include the concept of heterozygosity index (specification point 4.17) or inbreeding, then this would have provided evidence to move this response into level 3.

The levels-based mark scheme is hierarchical, so the response is first analysed for level 1 content. The second sentence, where the impact of first solution on genetic diversity was discussed meant that this response could be awarded the lower mark in level 1.

There was also a discussion of the impact of second solution on beaver genetic diversity which meant that this response could be awarded the higher mark in level 1 (2 marks).

The response could then be read through again and analysed for level 2 content. The discussion of advantageous allele combinations (third sentence) in addition to the consideration of the effect of geographical isolation on genetic diversity (fifth sentence) meant that the higher mark in level 2 could be awarded (4 marks).

This response did not achieve level 3 as there was no demonstration of comprehensive knowledge and understanding as required in the level 3 descriptor. Candidates had to discuss knowledge relating to reproductive isolation of the geographically isolate populations and inbreeding / heterozygosity index to access 5 or 6 marks.

Exemplar response B

There are many locations where beavers are spread out all across Europe. So, they are geographically isolated from each other. As a result, they are exposed to different selection pressures and so due to speciation they have evolved into new species with different characteristics who are yet closely related to beaver species in Norway.

~~If these beavers are introduced into~~

If ^{more of} these beavers from different parts of Europe are introduced to Scotland, the genetic diversity of the population in Scotland can improve. Once these beavers breed with each other for many generations, ~~a new~~ ~~species with~~ their gene pool will increase so, many advantageous alleles can be present thus ensuring survival of the beaver ~~species~~ population in Scotland.

However, if more beavers from Norway alone are introduced, it can lead to inbreeding depression which can lead to genetic drift in the population. Since no new genes are introduced repeatedly ~~so, if~~ ~~a natural disaster occurs~~ ~~there is~~ or

So, if a disease that kills beavers strikes Scotland they will have a low chance of surviving because they have no advantageous traits. So, introducing beavers from several different European locations to Scotland is ~~the~~ the better option.

Examiner's comments:

This response was given 5 marks.

This response was awarded the lower mark in level 3 as it fulfilled all the requirements for both level 1 and level 2 and part of the requirements for level 3.

The candidate discussed both solutions proposed by the scientists. Unusually, the candidate started with the second solution, the introduction of beavers from several European locations. In the first paragraph, it clearly shows the candidate analysed the map and understood that it gave evidence of geographically isolated populations, which could have led to speciation. However, if the candidate had extended the statement regarding 'different characteristics' to include knowledge about the possible reproductive isolation of the European beaver populations, then the higher mark in level 3 could have been awarded. The candidate discussed how these geographically isolated beavers could have increased the genetic diversity of the Scottish beaver population and correctly referred to alleles.

The candidate considered the first solution proposed by the scientists. Although the candidate incorrectly referred to genes instead of alleles on line 15, the candidate has fulfilled the level 1 criteria by discussing both solutions' impact on the genetic diversity of the Scottish beaver population.

By achieving level 1, the response can also now be awarded the higher mark in level 2. This is because level 2 required the extension of a level 1 response by also considering the effect of geographical isolation on genetic diversity and the correct reference to alleles.

By achieving level 2, the response can also now be awarded the lower mark in level 3. The discussion of inbreeding depression moved the response into level 3.

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