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Introduction

These exemplar answers have been chosen from the summer 2018 examination series.

OCR is open to a wide variety of approaches and all answers are considered on their merits. These exemplars, therefore, should not be seen as the only way to answer questions but do illustrate how the mark scheme has been applied.

Please always refer to the specification https://www.ocr.org.uk/qualifications/gcse/gateway-science-suite-combined-science-a-j250-from-2016/ for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2018 Examiners’ report or Report to Centres available from Interchange https://interchange.ocr.org.uk/Home.mvc/Index

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2019. Until then, they are available on OCR Interchange (school exams officers will have a login for this and are able to set up teachers with specific logins – see the following link for further information http://www.ocr.org.uk/administration/support-and-tools/interchange/managing-user-accounts/).

It is important to note that approaches to question setting and marking will remain consistent. At the same time OCR reviews all its qualifications annually and may make small adjustments to improve the performance of its assessments. We will let you know of any substantive changes.
Question 1

Exemplar 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: D

Examiner commentary
This candidate like most candidates correctly identified selective breeding as the correct answer.

Question 2

Exemplar 1

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

Which part of the nitrogen cycle involves bacteria as decomposers?

Your answer: D

Examiner commentary
Most candidates were able to interpret the diagram to identify process D.
Question 3
Exemplar 1 1 mark

3. The diagram shows a virus.

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

Your answer [A] [1]

Examiner commentary
Less able candidates confuse antigens and antibodies. This candidate successfully identified A as the antigen.

Question 4
Exemplar 1 1 mark

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 [B] [1]

Examiner commentary
Terminology used in this question caused problems for many candidates. This exemplar is from a higher ability candidate who was able to recall the interaction between HPV and cervical cancer.
**Question 5**

**Exemplar 1**

5. The number of deaths in the UK in 2012 was 569,024.

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: [C] [1]

**Examiner commentary**

This candidate has set out their working, which is something that should be encouraged when completing calculations. Errors often occur if numbers are just put into a calculator without first setting out the process.

**Question 6**

**Exemplar 1**

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: [C] [1]

**Examiner commentary**

This candidate has successfully identified C as the correct answer.
Question 7

Exemplar 1

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 [B] [1 mark]

Examiner commentary

This candidate has linked different aspects of the specification to correctly identify B as the answer.

Question 8

Exemplar 1

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 [C] [1 mark]

Examiner commentary

This candidate demonstrates an understanding of the use of line transects in the study of a habitat. They have correctly identified that line transects cannot provide an exact measure of the number of species present in the habitat.
Question 9

Exemplar 1

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: B

Examiner commentary

This exemplar shows the correct answer of B.

Question 10

Exemplar 1

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: D

Examiner commentary

Very few candidates understood how antiviral drugs work. This candidate has chosen the correct answer of D.
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.
Examiner commentary

This exemplar shows an answer credited with all 3 marks. The candidate has correctly chosen the equipment required. Although they have not used the correct name of pooter, the diagram is sufficient to give them this mark. There are two tubes attached; one to suck through and one for the bugs to pass through. Diagrams with only one tube were not given the mark unless they were named as pooters either on the diagram or in the written description on the answer lines. The second mark is gained for the idea of sucking the bugs into the pooter. The candidate identified the use of a permanent marker to achieve the third mark.

As the bugs were on trees the use of a pit fall trap could not be credited but mention of such did not negate the pooter mark as this question also appeared on the foundation paper.
Question 11 (b)

Exemplar 1

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

1. The substance will not harm the mealybug (make it ill).
2. The substance should not make the bug more visible to predators or they will be eaten.
3. The substance should not kill that mealybug or any other mealybugs nearby.

Examiner commentary

This exemplar shows a common error seen on many papers. The candidate has gained 2 marks for their first two sentences. However, their final sentence is considered as an alternative to their first sentence, the idea of harm or killing the mealybug being the same marking point. To be credited a third mark the candidates needed to explain that the idea that the mark should not be able to be removed for the time of the experiment.

Question 11 (c) (i)

Exemplar 1

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

<table>
<thead>
<tr>
<th>Total number of mealybugs collected on day 1</th>
<th>Total number of mealybugs collected on day 2</th>
<th>Number of marked mealybugs collected on day 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>60</td>
<td>18</td>
</tr>
</tbody>
</table>

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

Use the formula:

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

\[
\frac{150 \times 100}{18} = 500
\]

Answer = 500

Examiner commentary

Most candidates correctly calculated the answer. This exemplar shows good practice as the candidate has shown their working.
Question 11 (c) (ii)

Exemplar 1 2 marks

11 (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. The bugs did not die 

2. The marks did not rub off

Examiner commentary

This candidate has correctly identified two assumptions that would have been made. A common misconception was that the mealybugs would die or leave the area. Vague answers were also common, such as ‘the marker would have no effect’ which could not be credited a mark as the candidate needed to specify the effect, i.e. make them more visible to predators.
Question 11 (d) (i)

Exemplar 1

1 mark

11 (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.

Yes because the tree with the lower light intensity had twice as many mealybugs.

Examiner commentary

This candidate has correctly stated that the results do support the statement and provided a complete explanation for their answer. The less able candidates tended to provide incomplete answers only referring to the number of bugs and not the light intensity or vice versa.
**Question 11 (d) (ii)**

**Exemplar 1**

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

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

Errors occur when the light meter is positioned at a particularly shaded area. Taking multiple readings around the tree would improve precision.

**Examiner commentary**

This exemplar shows one of the few answers credited with both marks. They have identified that different parts of the tree may be more shaded than others and that taking readings from different positions would make the readings more precise. Many candidates confused precision with accuracy or human error, stating that the light meter was faulty or that the scientist had recorded it wrong.

**Question 12 (a) (i)**

**Exemplar 1**

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.

**Examiner commentary**

The candidate was one of few able to identify the coronary artery. Most candidates incorrectly opted for either the aorta or the vena cava. When labelling diagrams encourage candidates to use a single straight line without an arrow head. They should also ensure the line is labelled as this candidate has done.
Question 12 (a) (ii)

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

Explain why angina causes pain.

Because...........anaerobic........respiration........produces................

lactic........acid,............which........causes........pain........in........the........
muscles.___________________________________________________________ [2]

Examiner commentary

The exemplar shows a correct response credited with both marks. The candidate has identified lactic acid as the cause of the pain and that this pain will be in the muscle itself. Many candidates just repeated the question stating 'anaerobic respiration causes the pain.'
Question 12 (b) (i)

Exemplar 1

12 (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 mm².

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.

\[
\frac{1}{2} \cdot 4 \cdot 2.1 = 1.05 \text{ mm}^2
\]

\[
3 \cdot 1.05 \cdot 1.05 = 3 \cdot 1.1025 \text{ mm}^2
\]

Answer: \( 3.3 \text{ mm}^2 \) [3]

Examiner commentary

This candidate has correctly calculated the cross-sectional area and using two significant figures in their answer. They show good practice by setting out their working which if their final answer had not been correct would have been given credit. When calculations are worth more than 1 mark it is very important that candidates show their working. If they just write down an incorrect answer they would not be given any marks, however for this question an incorrect answer but identifying the radius as 1.05 mm would have been credited with 1 mark.

Some candidates gained 2 marks for an answer of 3.46 mm² and they confused significant figures with decimal places. There was also evidence that some candidates struggle to round numbers correctly as an answer of 3.4 mm² was common. Another common error was the use of the diameter and not the radius in the calculation.
**Question 12 (b) (ii)**

**Exemplar 1**

1 mark

12 (b) (ii) Calculate the percentage reduction in cross-sectional area for the lumen of the patient’s artery.

\[
\frac{28.2 - 3.46}{28.2} \times 100 = 80.88\% \\
\text{Answer:} \quad 80.9\% \quad [1]
\]

**Examiner commentary**

This exemplar shows a candidate that gave their answer to 12bi as two decimal places rather than two significant figures. However this has been taken into account and they have been credited the mark for 80.9% when the expected answer was 80.66%. Answers of 80.7% were accepted unlike 80.6% where the candidate had rounded down instead of up.

---

**Question 12 (b) (iii)**

**Exemplar 1**

2 marks

12 (b) (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).

<table>
<thead>
<tr>
<th>Percentage decrease in lumen diameter</th>
<th>Severity of CVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50%</td>
<td>Mild</td>
</tr>
<tr>
<td>50 to 80%</td>
<td>Moderate</td>
</tr>
<tr>
<td>&gt; 80%</td>
<td>Severe</td>
</tr>
</tbody>
</table>

Justify why the patient would need surgery.

**Because... it's higher than 80%, so it's... classed... severe... this means that medicines and a lifestyle change... are unlikely to be... effective.** [2]

**Examiner commentary**

This candidate has correctly identified the severity as being severe. They have also explained this by comparing their answer with the value in the table to gain the second mark. A common error was to assume restating their answer to 12bii was enough to gain the second mark. However as with this candidate, the comparison needed to be made. For example ‘He needs surgery because 80.66% is severe’ can only be credited 1 mark.
Question 12 (c)

Exemplar 1

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

The table shows features of three surgical treatments.

<table>
<thead>
<tr>
<th>Name of treatment</th>
<th>Description of treatment</th>
<th>Features of treatment</th>
</tr>
</thead>
</table>
| Coronary angioplasty  | A small balloon is used to widen an artery. A wire tube (stent) prevents artery narrowing again. | • Relieves symptoms that fail to respond to medication  
• Short recovery time  
• 1 in 25 cases, the coronary artery narrows  
• May require further surgery |
| Coronary artery bypass graft | 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. | • Long recovery time  
• Pain after the operation  
• May require further surgery  
Effective in people:  
• Aged over 65  
• With diabetes  
• With extensive disease  
• With poor heart muscle function |
| Heart transplant      | A diseased or damaged heart is replaced with a healthy donor heart.                      | • Further surgery is unlikely to be needed  
• Increases life expectancy especially in patients 55 years old or under  
• Donor hearts needed  
• Long recovery time  
• Arteries connected to the new heart can narrow |

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

The best type of surgery for the patient would be coronary angioplasty. It will relieve the patient’s symptoms and has a short recovery time. However, 1 in 25 arteries narrow again and should the patient want a higher chance of success, a heart transplant may be the next best option. It will increase his life expectancy and it is unlikely to need further surgery. However, finding a donor heart could be difficult and the recovery time is long. A coronary artery bypass graft would be unrealistic for someone of his age.

Examiner commentary

This exemplar gained 4 marks and shows the most common response to this question. The candidate has made a clear choice on the first line. They have then justified their answer giving both positive and negative sides to their argument. Candidates that made a choice but only described the benefits were demonstrating Level 1 answers. Very few candidates provided a full evaluation that included applying their knowledge to explain why the procedure would work such as ‘coronary angioplasty would increase the diameter of artery to increase blood flow’.
Question 13 (a) (i)

Exemplar 1

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

The diagram shows interactions between these two hormones.

Examiner commentary

This response shows one of the few examples of a candidate that clearly understands the role of insulin and glucagon. The majority of candidates incorrectly assumed glucagon was turned into glucose. Some even assumed glucose was turned into insulin. This is a difficult concept due to the terminology used as most candidates struggle with the words glycogen and glucagon.
Question 13 (b)

Exemplar 1

13 (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.

Human cell

DNA thread

DNA plasmid

Isolated DNA with insulin gene

Bacterium

Isolated plasmids

Bacterial enzyme cuts the plasmid

Insulin gene inserted into the plasmid

Plasmid inserted into bacterium to form transformed bacterium

Reproduction of the bacterium

Production of 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.

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 the plasmid by the restriction enzyme.

Examiner commentary

This candidate demonstrates a clear understanding of the processes involved in genetic engineering. They have used all the correct terminology and identified the role of the restriction enzyme and ligase. Several candidates just repeated information from the diagram assuming that bacterial enzyme was enough for the name of the enzyme that cuts the plasmid. Incorrect enzymes such as lipase and amylase were also seen as answers.
Exemplar 2

(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.

Examiner commentary

This exemplar shows a candidate that has used the incorrect name of the enzyme, confusing lipase with ligase. However the use of the enzyme is clear enough to give benefit of the doubt for identifying that the enzyme they have named sticks the gene into the plasmid. When preparing candidates for an examination it may be important to explain that when asked for the name and function of something don’t miss the question out because if you can’t remember the name only the function, it is still possible to be credited marks for the correct function.
Question 14 (a)

Exemplar 1

1 mark

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

<table>
<thead>
<tr>
<th>Eye colour allele</th>
<th>Eye colour allele</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair colour allele</td>
<td>Hair colour allele</td>
</tr>
<tr>
<td>Skin colour alleles</td>
<td>Skin colour alleles</td>
</tr>
</tbody>
</table>

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

Use the diagram to explain why.

Because there are more than one skin colour alleles but there is only one allele in each chromosome for hair and eye colour.

Examiner commentary

This candidate has interpreted the information from the diagram to answer this question correctly making a clear comparison. Although the question states 'use the diagram', from some answers it was obvious the candidates had ignored this instruction.
Question 14 (b) (i)

Exemplar 1 1 mark

14 (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]

Examiner commentary

The context of this question seemed to confuse most of the candidates with 11 being a common incorrect answer. This candidate clearly understands the term haploid and as given the correct answer of 46 chromosomes.

Question 14 (b) (ii)

Exemplar 1 1 mark

14 (b) (ii) Some individuals have a copy of the gene that would cause diabetes but do not have the disorder. Suggest a reason why.

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

Examiner commentary

This exemplar shows one of few complete answers seen for this question. Like many candidates they state that the gene is recessive but unlike others they explained the individual is a carrier.
### Question 14 (c) (i)

**Exemplar 1**

14 (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? 

mutation

**Examiner commentary**

This candidate has provided the correct answer of mutation. There were a large proportion of candidates that missed out this question.

### Question 14 (c) (ii)

**Exemplar 1**

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

The kidney cells can’t differentiate

**Examiner commentary**

Only the more able candidates interpreted the information to conclude the kidney cells would not differentiate. Many simply repeated the stem of the question stating that the cells would not be able to work or that they would not make the protein.
**Question 14 (c) (iii)**

**Exemplar 1**

2 marks

14 (c) (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.

Examiner commentary

This candidate has set out their answer in a clear way. The genotypes of both parents have been correctly determined from the information given and the correct probability is stated. Candidates should be advised that if they cannot work out the genotypes for such questions it is still important that they construct a genetic diagram and state probability that matches their diagram because they can still be given some of the available marks.
Question 15 (a)

Exemplar 1

4 marks

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.

Galls...form...as...a...mutation...within...a...cell...cliner...
rapidly...and...uncontrollably...causing...a...tumor...They...cause...
damage...to...the...walnut...tree...as...they...stop...and...
minimise...the...growth...of...the...tree...but...also...stop...nutrients...
coming...through...

Examiner commentary

This exemplar shows a candidate that has been given all 4 marks for what proved to be a difficult question. They understand that the bacteria cause a mutation in the cells which results in a tumour. They then go on to explain how the tumour affects the growth of the plant. Many candidates incorrectly thought the gall was a parasite taking nutrients away from the plant - this was common misconception.
Question 15 (b) (i)

Exemplar 1

1 mark

15 (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.

<table>
<thead>
<tr>
<th>Originally grown next to a tree with galls</th>
<th>Wounded before transplanting</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trees with galls</td>
<td>Trees with galls on crown</td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>Yes</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Yes</td>
<td>34</td>
<td>14</td>
</tr>
</tbody>
</table>

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.

The bacteria can easily get into the wound and infect the tree much more.

Examiner commentary

This candidate has applied their knowledge of the non-specific defence systems in humans to plants and concluded that the bacteria could enter through the wound. Many candidates misunderstood the term hypothesis and assumed it was a conclusion based on the results.
**Question 15 (b) (ii)**

**Exemplar 1**

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

Explain your answer.

[Student's answer: It supports it well, the wounded trees do grow more galls overall.]

Examiner commentary

This candidate has identified one piece of evidence to support the hypothesis. It was rare to see a complete answer where candidates also referred the highest number of galls being found on the roots of wounded trees. Many candidates provided irrelevant information about planting next to trees with galls. Highlighting the key word in the question (wounded) may help candidates use the relevant information from the table.

**Question 15 (b) (iii)**

**Exemplar 1**

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

1. Trees with previous exposure to trees with gall are more likely to get gall.
2. Gall is much more common in the cools of a tree than at the crown.

Examiner commentary

This candidate has clearly identified the relevant information in the table to write down two more conclusions. Many candidates repeated the conclusions they had made about wounding and so could not be given full marks.
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