Exemplar Candidate Work

GATEWAY SCIENCE
COMBINED SCIENCE A

J250
For first teaching in 2016

J250/07 Summer 2018
examination series

Version 1

www.ocr.org.uk/combinedsciencea
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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 2

Exemplar 1

2 The graph shows how one limiting factor affects the rate of photosynthesis.

Which limiting factor is having the effect shown in the graph?

A Carbon dioxide concentration
B Humidity
C Light intensity
D Temperature

Your answer C  [1]

Examiner commentary

A limiting factor graph for light intensity would level off, not drop. This candidate has not understood that increasing the temperature too much will cause the rate of photosynthesis to decrease.
Question 3

Exemplar 1

3 The picture shows cells from the centre of a root, seen using a light microscope.

Which type of transport cell is labelled X?

A Phloem
B Root hair
C Stomata
D Xylem

Your answer D

Examiner commentary

The candidate has correctly interpreted an image of root cells to identify the xylem. As the image may not be familiar, the candidate was able to apply their knowledge of root structure. Exposing candidates to several different microscope images of cells and tissues will help them become more familiar with cell structure.

The annotation by the candidate suggests that they may have eliminated the other options rather than just make a straight choice. This method of answering multiple choice questions can be very helpful to candidates and could be introduced by the teacher as part of their exam preparation.
Question 5

Exemplar 1

5 A student investigates an enzyme controlled reaction. She collects the gas produced during the reaction in a gas syringe.

The diagrams show the volume of gas in the gas syringe at the start and after five minutes.

What is the rate of the reaction?

A 0.625 cm³/min
B 1.6 cm³/min
C 3.6 cm³/min
D 8 cm³/min

Your answer: B

Examiner commentary

The candidate has clearly shown how they arrived at the correct answer by dividing cm³ by minutes to calculate the rate. They seem to have initially got confused by the units on the gas syringe but may have realised that 0.8 cm³ would not provide them with an answer from the options available.
Question 6

Please note an erratum notice was issued for this question: Candidates were asked to change ‘3.84’ to ‘3.84:1’ so that the second sentence was changed to read:

The surface area to volume ratio of the elephant is 3.84:1

Exemplar 1 1 mark

6  An elephant has a volume of 4.80 m$^3$.

The surface area to volume ratio of the elephant is 3.84:1

Calculate the surface area of this elephant.

A  0.80 m$^2$
B  1.25 m$^2$
C  8.64 m$^2$
D  18.43 m$^2$

Your answer: D [1]

Examiner commentary

This candidate has clearly set out their working to arrive at the correct answer. This shows that they were able to rearrange the more familiar S:A:V ratio to calculate volume. Rearranging equations for many candidates is difficult and requires practice.
Question 7

Exemplar 1 1 mark

The graph shows blood glucose levels of one individual after they have eaten a meal.

7. Explain the change in blood glucose levels after 120 minutes.

A. Glucagon is released to convert the glucose to glycogen.
B. Glucagon is released to convert the glycogen to glucose.
C. Insulin is released to convert the glucose to glycogen.
D. Insulin is released to convert the glycogen to glucose.

Your answer [B] [1]

Examiner commentary

Very few candidates were able to interpret the graph, many assuming the changes were due to insulin rather than glucagon. This candidate has annotated the graph to help them understand the changes that occurred. This is because candidates are more familiar with an increase in blood glucose levels that occur after eating rather than a decrease that happens later. By working out what happens straight after the meal is eaten they could then go onto work out what was happening after 120 minutes.
Question 8

Exemplar 1

1 mark

The candidate has annotated the question to help them, by first defining translocation as the transport of sugar they can then eliminate answers B and C. When answering multiple choice questions candidates should be encouraged to use notes and annotations if it helps them to work out the correct answer.
Question 10

Exemplar 1

10 The table shows the dietary intake of four amino acids by one individual. It also shows the recommended daily allowance (RDA) for the same individual.

<table>
<thead>
<tr>
<th>Amino acid</th>
<th>Dietary Intake (g/day)</th>
<th>RDA (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.52</td>
<td>0.95</td>
</tr>
<tr>
<td>B</td>
<td>3.98</td>
<td>2.85</td>
</tr>
<tr>
<td>C</td>
<td>2.08</td>
<td>2.58</td>
</tr>
<tr>
<td>D</td>
<td>2.32</td>
<td>1.36</td>
</tr>
</tbody>
</table>

The individual has taken in more than 100% of the RDA for each of the four amino acids.

Which amino acid in their diet has the highest percentage of the RDA?

Your answer: B  [1]

Examiner commentary

The exemplar shows a common error by many of the candidates. They have calculated the difference between the dietary intake and the RDA not the percentage. The correct answer is D as the dietary is 171% of the RDA. Candidates can often be confused by answers that are greater than 100%. They also find calculating percentage difference difficult.
Question 11 (a)

Exemplar 1

2 marks

11 This question is about circulatory systems.

(a) The picture shows three different blood vessels X, Y and Z, seen using a light microscope.

Compare blood vessels X and Z and describe the differences that can be seen in the picture.

Z has the largest lumen (so is a vein). X is smaller (so is an artery) and Y is tiny (so is a capillary). X however has thick muscular walls compared to the others so it can carry blood at high pressure.

Examiner commentary

The candidate has used the correct terminology in their answer. Identifying the lumen and the muscular wall, they have then gone onto make clear comparisons using words such as smaller or largest. When referring to the thickness of the muscular wall they have not said X has a thicker wall, however they were given benefit of doubt as they had stated ‘it was thick compared to the others’.

When a question has the command word ‘compare’ candidates should be encouraged to use comparative words such as larger, smaller, thicker, thinner. It is common for candidates to not be credited the mark for such questions as they very often fail to make the comparison. An answer such as ‘Z has a large lumen’ is not enough unless they follow this up with the statement ‘X has a small lumen’. Some candidates did not make the correct comparison as they stated that ‘X has a thick muscle wall and Y has a thin muscle wall’ therefore comparing X and Y instead of X and Z. Highlighting the two letters in the question in some way, such as circling or underlining may help avoid this error.
**Question 11 (b) (i)**

**Exemplar 1**

11. The diagram shows the circulatory system of a lungfish.

![Diagram of lungfish circulatory system]

The lungfish circulatory system is different to that of humans.

Blood in the lungfish can flow through gills and lungs, humans only have lungs.

(i) Write down one other way the structure of the lungfish circulatory system is different to that of humans.

Humans have a double circulatory system whereas lungfish have a single circulatory system [1]

**Examiner commentary**

The candidate has used their knowledge rather than the diagram to provide an acceptable answer. Although the circulatory system of lungfish is not technically a single circulatory system like those found in other fish it was felt this was an acceptable answer at this level. Single circulatory systems are not part of the J250 specification, which is why the candidates were expected to identify differences seen in the diagram. Candidates should be encouraged to use the information they are provided with. The diagram clearly shows that there is only one ventricle as opposed to two in humans.
**Exemplar Candidate Work**

**Question 11 (b) (ii)**

**Exemplar 1**

11 (b) (ii) When lungfish and humans are on land, the human circulatory system is more efficient than that of lungfish.

Suggest why the human circulatory system is more efficient.

The double pump system means that blood is moved in higher pressures and so exchange can happen more frequently. [2]

**Examiner commentary**

Again the candidate has used their knowledge of the difference between single and double circulatory systems. This was not a required answer as it is not on the J250 specification but was felt to be acceptable. Candidates were expected to use the diagram which shows that with only one ventricle, oxygenated and deoxygenated blood would not be separated. In humans, oxygenated and deoxygenated blood are separated (1 mark) so it can be assumed that the system is more efficient as more oxygen can be transported to the body cells (1 mark). The candidate did not mention the idea of more oxygen being transported so only gained 1 mark for increased pressure.
Question 12 (a) (i)

Exemplar 1

12 (a) The diagram shows a cell during one stage of mitosis.

(i) Describe two things that happen to the chromosomes in the next stage of mitosis.

The chromosomes get pulled apart and a nucleus will build up around each, creating two identical daughter cells. [2]

Examiner commentary

This candidate has used the correct terminology, making it clear that the chromosomes are pulled apart. The second marking point expected is the idea that the separated halves (chromatids) move to opposite ends. Although this candidate did not state this they were given a mark for the acceptable answer of new nuclei forming.

Some candidates were not clear in their answers stating that chromosomes moved to the opposite ends of the cell. Such answers are not clear enough to award both marks as the whole chromosome is not moving during mitosis. Instead they would be credited 1 mark for movement to the opposite ends of the cell.

Exemplar 2

12 (a) The diagram shows a cell during one stage of mitosis.

(i) Describe two things that happen to the chromosomes in the next stage of mitosis.

in the next stage... new daughter cells... split... into... identical cells... [2]

Examiner commentary

This candidate seems to have made a simple guess and used words associated with cells but incorrect in this instance.
Question 12 (a) (ii)

Exemplar 1

12 (a) (ii) Chromosomes are made of DNA.

Describe the structure of DNA.

DNA has a double helix structure and is made up of 4 bases which pair up, known as complementary based pairing.

[2]

Examiner commentary

The expected answer from the specification is that DNA is a polymer and a double helix. This candidate like many others referred to the bases.
Question 12 (b)

Exemplar 1

12 (b) After mitosis, cell differentiation takes place.

What is meant by the term cell differentiation?

...cell differentiation...is...when...a...cell...is...differentiated...........

(specialized)...to...and...adapt...to...carry...out...a...specific........[1]

function.

Examiner commentary

In this exemplar the candidate used the term specialised in their answer so has been given the mark. They have said that the 'cells adapt', an answer that on its own would not be sufficient, although 'adapting to carry out a specific job' would be enough to be given the mark. Candidates often find defining terms in the specification difficult. They should be encouraged to produce a glossary of the key terms as defining a term is a common question.
Question 13 (a)

Exemplar 1

13 The picture shows plant cells as they are seen using a light microscope.

(a) The actual length of plant cell X is 75 µm. You can use this fact to calculate the magnification of the image.

Explain how.

75 µm is 0.075 mm

first you would measure the image with a ruler to get a number and then divide it by the actual size — getting the magnification [2]

Examiner commentary

The candidate has started their answer by writing out the formula triangle. On its own this is not sufficient as they need to state how to use the formula. Which this candidate has done as they make it clear the image is divided by the actual size. The second mark was given as they show that the image and actual size should be measured in the same units. They have done this by clearly converting 75 µm to 0.075 mm. As they were asked to explain how to calculate the magnification rather than actually calculate it they would also have been given this mark if they had stated ‘convert actual length to mm’ or ‘convert length of X in the picture to µm’. They were not required to do the actual conversion as the command word here was ‘explain’ rather than ‘calculate’. Understanding the meaning of the command words is an important part of exam preparation.
Question 13 (b)

Exemplar 1

The same cells can be observed using an electron microscope.

Magnification of the cells can be increased using an electron microscope.

Explain how and why the image may also look different.

Electron microscopes work by... They have a... resolution so the... images will be... detailed. By... the... at... the... will... show a... type... image... showing depth... shape of... [3]

Subcellular structures

Examiner commentary

In this exemplar the candidate has recalled that electron microscopes have a higher resolution and that they produce a 3D image. The statement 'more detail' is insufficient on its own to be credited a third mark. They would need to state that more or different organelles would become visible or name examples of organelles that become visible such as ribosome. As chloroplast and the nucleus are seen using a light microscope they are not valid answers. Alternatively they could explain that the internal detail of organelles become visible such as the structure of the membrane or the internal structure of the chloroplasts.
Question 13 (c) (i)

Exemplar 1

3 marks

13  (c) A student investigates different conditions that affect photosynthesis.

He sets up four different sets of apparatus, A, B, C and D.

A

Glass cover

Plant

Light

Soda lime
(to remove carbon dioxide)

B

Light

Alkaline pyrogallol
(to remove oxygen)

C

Light

D

Black cover

The plants used are all of a similar age and size. Each plant is left under cover at room temperature.

After three days one leaf from each plant is tested for the presence of starch.

(i) Describe all the stages required to test the leaves for the presence of starch.

First put the leaf in boiling water to kill it... then...

Put the leaf in boiling ethanol to get rid of the...

Chlorophyll! Next you wash the leaf to get rid of all... ethanol... than... put in on a white tile and...

Add a few drops of iodine... if starch is present...[3]... will turn yellow/brown to blue/black.

Examiner commentary

This exemplar shows a complete description of how to test a leaf for starch. The candidate has included the use of both boiling water and boiling ethanol in their answer - steps that most candidates missed. The majority of candidates tended to gain only 2 marks for the use of iodine solution and the colour change. Candidates are expected to describe experiments to investigate photosynthesis. Testing a leaf for starch is a standard procedure linked to experiments on photosynthesis. Candidates find it easier to recall the procedure if they have had practical experience of the methods involved.
Exemplar 2

3 marks

13 (c) A student investigates different conditions that affect photosynthesis.

He sets up four different sets of apparatus, A, B, C and D.

The plants used are all of a similar age and size. Each plant is left under cover at room temperature.

After three days one leaf from each plant is tested for the presence of starch.

(i) Describe all the stages required to test the leaves for the presence of starch.

1. Take a thin sample of epidermal layer with forceps.
2. Put the leaf in a boiling tube with water and boil for 15 minutes.
3. Once boiled, put the leaf in ethanol covered with making it white.
4. When white add few drops of iodine solution making leaf turn black/blue meaning starch is present.

Examiner commentary

This exemplar shows how a candidate can set out a method in clear steps. The actual timings are not required but they do show that the candidate has a clear understanding of the procedure. The omission mark (^) has been added by the examiner because the candidate did not use hot or boiling ethanol. They can still be given full marks as they have gone onto say iodine solution is used and given the correct colour change.
**Question 13 (c) (ii)**

Exemplar 1

3 marks

13 (ii) What are the expected results of the starch test on each plant?

Write down reasons for your answers.

A: no starch...Plants need carbon dioxide to photosynthesise.

B: Starch present...both water, light and CO₂ are present...Photosynthesis occurs, creating starch.

C: Starch present...all reactants and energy (light) present...Photosynthesis occurs, creating starch.

D: no starch...light is needed in order for photosynthesis to occur.

Examiner commentary

This candidate has produced a well structured answer worth full marks. The question asks them to provide both the expected result and a reason for each plant. By setting it out this way the examiner can clearly see the answer of all four plants. Many candidates did not provide a reason why there would be starch present in C and B. One common misconception was the idea that B would contain no starch as oxygen is required for photosynthesis.
Question 14 (a)

Exemplar 1

14 The diagrams show the molecular structure of glucose and sucrose.

(a) Compare the structures of these two carbohydrates.

Glucose has a simple structure.

whereas sucrose is more complex.

Examiner commentary

This exemplar shows a very simple answer to the question that cannot be credited any marks. The candidate needs to say what they mean by simple or complex. This question expected the candidates to use the diagrams as well as their knowledge. Many candidates incorrectly assumed sucrose was made up of two molecules. Only the more able candidates fully understood the term monomer.
Question 14 (b) (i)

Exemplar 1

14 (b) Two students investigate anaerobic respiration using yeast with sucrose solution.

They measure the volume of gas collected every 5 minutes for 40 minutes.

The students then repeat the investigation using yeast with glucose solution.

(i) Explain how and why the temperature of the solution could change during the investigation and how this could be controlled.

- Temperature could change... thus affecting solution...
- Temperature. Place... the... beaker... in a... water bath... to... maintain... temperature...

Examiner commentary

This exemplar shows the most common 1 mark answer where a candidate has identified the need for a water bath to control the temperature. Very few candidates understood that the temperature would rise as anaerobic respiration is an exothermic reaction. There was a lot of confusion about the presence of the oil affecting the temperature when it's only purpose is to maintain anaerobic conditions.
Question 14 (b) (ii)

Exemplar 1

Level 2, 4 marks

Examiner commentary

The candidate has attempted to explain the patterns in the graph as opposed to just describing them. They understand that the increase in volume is due to the production of carbon dioxide, which the majority of candidates did not mention. They also understand that the glucose graph levels off after 25 minutes as the glucose is used up. This is a good example of the 'what happens, when it happens and why it happens' idea of explaining a graph: 'what happens - hits a plateau, when it happens- at 25 minutes and why it happens - glucose has been used up'.

To achieve Level 3 the candidate needed to explain the difference between the sucrose and glucose. For example the idea that sucrose does not produce any carbon dioxide in the first minute as it has to be converted to glucose which is the substrate more commonly used in anaerobic respiration. They are almost there with the equation on the last line but they needed to go on to say that the sucrose is converted to glucose and then it can be used.
Exemplar 2

14 (b) (ii)* The graph shows the results of the investigation.

Explain the patterns seen in the results.

...Glucose... came... approximately... 5... minutes... to...

...begin... to... react... and... the... volume... of... gas... increased...

...rapidly... for... approximately... 20... minutes... whereas...

...the... volume... of... gas... doesn’t... increase... or... decrease.

However... the... sucrose... volume... of... gas... very... slowly... increased... reaching... a...

...high... point... of... 1.3... cm³... compared... to... glucose...

...3... cm³....

[6]

Examiner commentary

The candidate has clearly described the difference between the glucose and sucrose line however they have made no attempt to explain the differences. To reach Level 2 they could have explained that glucose levels off as it is used up in the reaction. Many candidates find the command words ‘describe’ and ‘explain’ confusing. Lots of very detailed descriptions including data were seen, however they were all Level 1 answers as no attempt to explain the shapes of the graphs were made. Candidates require guidance on how to answer similar questions. One suggested way of doing this is to inform the candidates that if they are asked to explain the shape of the graph they need to be answering it terms of ‘what happens, when it happens and why it happens’, and for the describing of a graph only ‘what happens and when’ is required.
Question 15 (a)

Exemplar 1

15 A student investigates the effect of concentration on osmosis.

He cuts out five potato chips of similar mass. The student measures the mass of each potato chip.

He then places the potato chips in different concentrations of sugar solution.

After 30 minutes he removes the potato chips from the solution. He dries them with a paper towel before measuring the new mass. They will have lost mass, be flagged.

(a) The potato chips are dried before the new mass is measured.

Explain why.

As any solution...just on the outside of the potato would mean the measurement isn't accurate.

Examiner commentary

This candidate understands that the solution on the outside of the potato chip would be included in the mass making the measurement inaccurate. Many candidates gave vague answers such as 'the solution on the outside would affect the mass' without saying it would increase the mass.
Question 15 (b)

Exemplar 1

2 marks

15 (b) The table shows his results.

<table>
<thead>
<tr>
<th>Concentration of sugar solution (mol/dm³)</th>
<th>Mass of potato chip (g)</th>
<th>Change in mass (g)</th>
<th>Percentage change in mass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At start</td>
<td>After 30 minutes</td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td>2.1</td>
<td>2.7</td>
<td>+0.6</td>
</tr>
<tr>
<td>0.2</td>
<td>2.2</td>
<td>2.3</td>
<td>+0.1</td>
</tr>
<tr>
<td>0.4</td>
<td>2.0</td>
<td>1.8</td>
<td>-0.2</td>
</tr>
<tr>
<td>0.6</td>
<td>2.0</td>
<td>1.6</td>
<td>-0.4</td>
</tr>
<tr>
<td>0.8</td>
<td>2.3</td>
<td>1.7</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

Calculate the percentage change of mass for the potato chip in 0.8 mol/dm³ sugar solution.

Record your answer to 1 decimal place.

$\frac{2.3 - 0.6}{0.6} \times 100\% = 26.1\%$

Answer: $-26.1\%$ [2]

Examiner commentary

This candidate has correctly calculated percentage change in mass and identified it as a loss in mass by placing the -ve sign in front of the number. A common error observed were the candidates that calculated -0.6 as the change in mass and then assumed the answer was -27.3% as they used the answer for 1.0 mol/dm³. Percentage change in mass is a concept that only the more able candidates seem to be able to cope with.
Question 15 (c)

Exemplar 1

15  (c) Plot a graph of the percentage change in mass against concentration of sugar solution and draw a line of best fit.

Examiner commentary

This exemplar shows a graph that has been given full marks. The candidate has plotted the percentage change in mass on the X axis when convention would place it on the Y axis but as this was a very difficult graph it was thought to be acceptable at this level. Many candidates found plotting negative numbers difficult and just converted them all to positive numbers. A high number of candidates missed the units off the axis labels and some even plotted the change in mass rather than the percentage change in mass.
Exemplar 2

Examiner commentary

This candidate has managed to plot the graph correctly and label the axis with the units. However they have used a straight line for the line of best fit. This is a common error when drawing graphs associated with biology. When there is a clear curve in the points, candidates should be encouraged to draw a curved line through most of the points. Graph drawing is a skill that needs practice and should be encouraged whenever a practical investigation produces quantitative results if possible.
Question 15 (d) (ii)

Exemplar 1

Use ideas about osmosis to explain the patterns in the results.

Examiner commentary

This exemplar shows a candidate that clearly understands this practical investigation. They have explained what happens to the mass of the potato chip when the sugar concentration increases. Unlike many candidates they understand that it is the water molecules that move and not the sugar solution. They have also made it clear that it is the water concentration that is higher inside the chip and not just the concentration. The current specification expects the candidates to answer this type of question in terms of water potentials rather than water concentrations. The majority of candidates answered in terms of concentrations which often resulted in very confusing answers where it is not clear if they were describing high water concentration or concentrated solutions. Centres are encouraged to teach osmosis in terms of water potentials as it will help candidates to provide clearer answers.
Question 16 (a) (ii)

Exemplar 1

16 The diagram shows the position of the pituitary gland and hypothalamus in the body.

(a) (i) Two hormones released by the pituitary are involved in controlling the menstrual cycle.

Write down the names of these two hormones.

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

(ii) The graph shows the levels of these two hormones during the menstrual cycle.

Use the graph to explain how these two hormones work together to cause ovulation.

[Diagram showing hormone levels over time, with key points]

Examiner commentary

The candidate shows a clear understanding of the role of follicle stimulating hormone and luteinising hormone. They have also used the graph when they identify that the egg is released on day 14. Many candidates did not refer to the graph so could only be credited one mark. Others confused the hormones with progesterone and answered in terms of the thickness of the uterus wall.
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