

## **GCSE (9-1)**

*Examiners' report*

# **TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B**

**J250**

For first teaching in 2016

## **J260/05 Summer 2018 series**

Version 1

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## Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

## 3-3 grade

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

## Paper J260/05 series overview

J260/05 is the first of four papers taken for the revised GCSE examinations for the combined science

The paper comprises of short answer styles and extended response, including one Level of Response question (structured questions, problem solving, calculations, and practical). To be successful on this paper it is expected that candidates will be familiar with key concepts and be able to apply the knowledge to unfamiliar situations. It is also expected that candidates will be familiar with a range of practical techniques and will be able to plan investigations.

### **Candidate performance review**

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

- Performed standard calculations following the required rubric (e.g. clear working, units, significant figures) relating to conversion of figures: 2 (ai), calculation of probability of heart disease :2(bi), blood cholesterol: 2(bii) and calculations for ash dieback:4(bi)
- Had a clear understanding of female hormones and the menstrual cycle: 3(ai / aii) and 3 (b)
- Could explain the role of thyroxine in the human body and link to homeostasis and response: 3(c)
- Were able to evaluate the use of genetic engineering: 4(di and dii)
- Produced clear and concise responses for Level of Response questions: 5(a)
- Knew practical techniques for planning investigations: 6 (aiii)
- Could name limiting factors for photosynthesis and link to data : 6
- Clearly understood and could explain the function of heart valves and link to health conditions : 8 (b)

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

- Found it difficult to apply what they had learnt to unfamiliar situations
- Produced responses that lacked depth, and were often rambling and peripheral to what had been asked, sometimes simply repeating information provided. e.g. 2(c),3(c),4(a), 4bii), 4(c),5(a),5(b)7(ci) and 8(b)
- Showed poor numeracy skill, e.g. 2(bi), 2(bii), 4(bi)6(bi)
- Could not able to link concepts e.g. 4(c)
- Lacked precision in planning practical techniques and could not plan investigations: (ai /aii)
- Did not understand the photosynthesis or respiration : 6(c) , 7(b), 7(ciii)

Most candidates attempted most questions on the paper, no evidence was seen of time constraints leading to poor performance. Where there was no response to the final question the scripts had large sections of the paper with no responses

## Question 1 (a)

1 Read the newspaper headline.

**First girl born into a family for 101 years**

Having only males born into a family for this length of time is very unusual.

(a) Use your knowledge of how human sex is determined to explain why having only males is very unusual.

Use the Punnett square in your answer.


.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

[5]

A high number of candidates scored 4 or 5 marks on this question. The ones who missed mark point 4 usually neglected to identify males / females.

However some candidates scored very badly by not putting the gametes XX and XY in the Punnett square but instead treated it as if working out the probabilities for dominant and recessive alleles. Candidates also did not use X and Y for gametes by using alternative letters that were not creditworthy.

## Question 1 (b)

(b) Gametes are made by cell division.

A fertilised egg divides to make body cells using a different type of cell division.

Complete the table describing the two types of cell division.

Type of cell division		
Type of cells made	gametes	body cells
Number of cells at the start of the process	1	1
Number of cells at the end of the process		
Number of rounds of cell division		
Number of chromosomes in the cell at the start of interphase	46	46
Number of chromosomes in each cell at the end of the process		

[5]

Meiosis (with the usual variety of spellings) and Mitosis headings were the things that scored most marks. Although a number of candidates got the numbers correct but did not seem to notice that they should also have filled the headings in as well. The most common error made by candidates was incorrect identification of the type of cell division in the top columns, e.g. mitosis in the first column and meiosis in the second.

## Question 2 (a) (i)

2 Scientists collected data on blood cholesterol levels and death from heart disease in men.

The graph in **Fig. 2.1** shows the relationship between blood cholesterol and the death rate from heart disease in the United States, Japan and two areas of Europe.

Item removed due to third party copyright restrictions

**Fig. 2.1**

(a) (i) Blood cholesterol levels are measured in millimoles per litre (mmol/l).

How many moles are there in a millimole?

Put a ring around the correct answer.

0.001      0.01      0.1      10      100      1000

[1]

Candidates did not generally perform well on this question, and did not appear to have the tools to be able to calculate the correct conversion.

## Question 2 (a) (ii)

(ii) A student reads off the graph and concludes that the death rate for men with a blood cholesterol level of 5.20 mmol/l is 15 deaths from heart disease per 1000 men.

Is the student's conclusion correct?

Use data from the graph in **Fig. 2.1** to explain your answer.

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

Mark point 1 was generally credited to many candidates for correctly identifying that the data was only correct for Northern Europe. However, many candidates did not use the data in the question to further evidence that the conclusion was only correct for the one area.

## Question 2 (b) (i)

(b) (i) A man in the United States has a blood cholesterol level of 6.50 mmol/l.

The graph in **Fig. 2.1** shows that 15 out of every 1000 men with this blood cholesterol level will die from heart disease.

Calculate the probability that he will die from heart disease.

Give your answer to 1 significant figure.

Probability = ..... [2]

Many candidates scored 1 mark for the correct calculation (0.015) but did not give their answers to 1 significant figure.

## Question 2 (b) (ii)

(ii) In a sample of 1000 men from the United States, 20 died from heart disease.

Use the graph in **Fig. 2.1** to estimate the mean blood cholesterol level of these men.

Blood cholesterol level = ..... mmol/l [1]

## Question 2 (c)

(c) The scientists could collect other information to help explain the data on the graph.

One example of other information they could collect is the ages of the men in the study.

Suggest **other** examples of information they could collect to help explain the data.

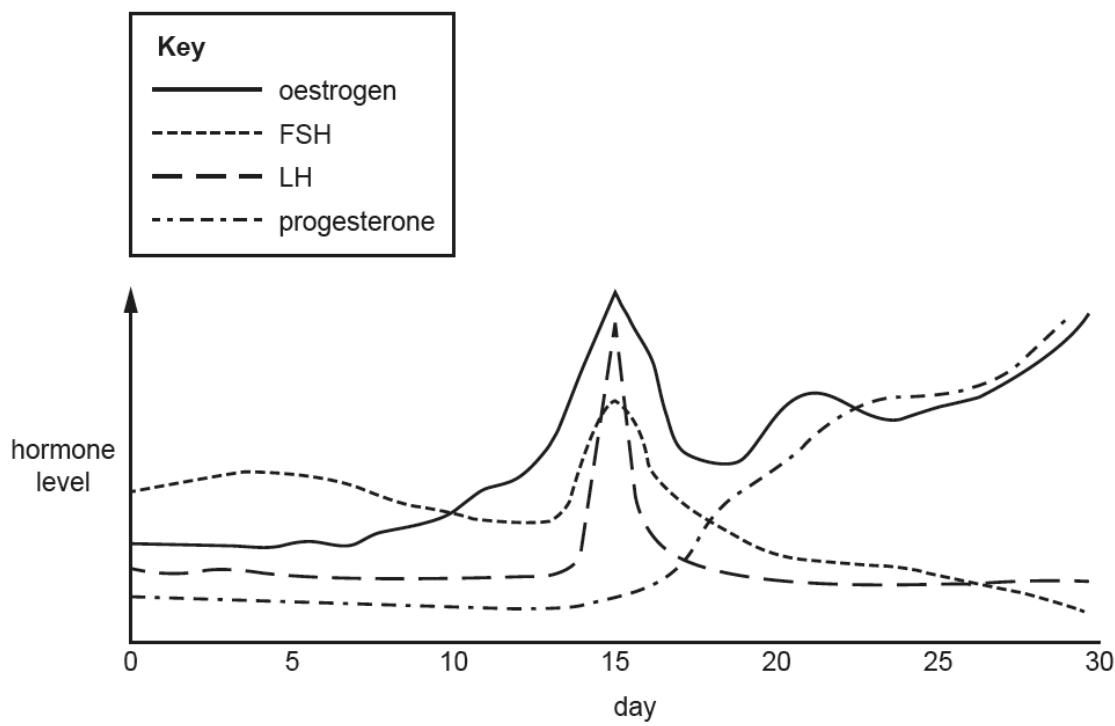
.....  
 .....  
 .....  
 ..... [2]

Candidates generally only scored 1 mark for this answer. Many candidates gave several lifestyle factors that were covered by mark point 1. Few candidates referenced pre-existing health conditions.

## Question 3 (a) (i)

3 Hormones control many processes in the human body.

(a) The graph shows changes in the levels of hormones that control the menstrual cycle in one female human during one complete cycle.



(i) On which day during this menstrual cycle did ovulation take place?

Explain your answer.

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

Many candidates correctly identified day 15 as the day of ovulation. Candidates did link ovulation to the highest points of the hormones in the graph but did not correctly identify LH as the trigger for ovulation.

Some who did realise that it was LH did not get the mark as they did not say that it peaked or was at its highest. Quite a few said "surge" which was not accepted.

Many candidates used vague statements such as all hormones are at their peak or attributed ovulation to progesterone which were not creditworthy.

### Question 3 (a) (ii)

(ii) During this menstrual cycle the egg was fertilised. This caused a change in hormone levels and the female did not menstruate.

Draw **one** line to join the correct **change in hormone levels** to its **effect** to explain why she did not menstruate.

Change in hormone levels	Effect
Oestrogen levels decreased	The uterus wall began to thicken
Oestrogen levels did not decrease	The thickened uterus wall broke down
Progesterone levels decreased	The thickened uterus wall did not break down
Progesterone levels did not decrease	The thickened uterus wall was discharged

[2]

This was a poorly answered question as candidates tended to join up all the boxes rather than using one line as instructed in the question, therefore negating any correct line. This illustrated how important it is for candidates to read the instructions in the question.

### Question 3 (b)

(b) A different female is being treated for infertility. She has to have injections of the hormone FSH.

Explain how these injections will help to treat her infertility.

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

Many candidates correctly identified the role of FSH in maturing follicles but did not link this to increased numbers of eggs produced or the role of IVF.

### Question 3 (c)

(c) Thyroxine is another hormone produced in the human body.

Describe the effects that thyroxine has in the body **and** explain how production of thyroxine is controlled.

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.....  
.....  
.....  
.....  
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.....  
.....

[4]

Some very confused and totally incorrect responses were given by candidates for this question. However it was obvious from many answers that it had been taught but that the candidates had not understood the concept. Many knew that it was to do with metabolism and/or growth. Others knew that it had something to do with negative feedback. Many candidates gave key phrases taught but they were not correctly linked to production of thyroxine. There were some candidates that gave really excellent detailed answers were credited with all 4 marks.

### Question 4 (a)

4 Approximately one quarter of all the trees in Great Britain are ash trees.

In 2012 scientists found trees with a disease called ash dieback.

(a) Describe the cause of ash dieback and how it is spread.

.....  
.....  
.....  
.....  
.....  
.....

[3]

The most commonly given mark was for "carried by wind" Many candidates thought that it was caused by bacteria. Some candidates thought that it was due to pollution (in the air or soil) and seemed to think that it was some sort of ash pollutant that had affected trees.

## Question 4 (b) (i)

(b) Scientists have collected data on the spread of ash dieback since 2012.

The scientists divided Scotland, England and Wales into squares.

Each year they recorded the number of squares in which ash dieback was identified for the first time.

**Table 4.1** shows their results.

Country	Number of squares in which ash dieback identified for first time						% of all squares in country with dieback
	2012	2013	2014	2015	2016	Total	
Scotland	7	5	33	125	10	180	16.4
England	83	63	162	224	314	846	57.6
Wales	0	2	5	31	96	134	50.6

**Table 4.1**

(i) The scientists calculated that 50.6% of all squares in Wales had ash dieback.

Calculate the total number of squares in Wales.

Give your answer to 3 significant figures.

Total number of squares in Wales = ..... [3]

When candidates understood how carry out the calculation, generally all 3 marks were credited.

### Question 4 (b) (ii)

(ii) **Table 4.1** shows that the spread of ash dieback was slower overall in Scotland than in England.

Suggest some possible explanations for this.

.....  
.....  
.....  
.....  
.....  
.....  
.....

[3]

Generally candidates did not compare Scotland with England to account for the differences. Many candidates' responses included ideas that Scotland has vast areas of rocky terrains giving no comparison to the fact that England also has areas like this. To be credited marks candidates needed to explicitly compare the two areas. Successful candidates generally compared the populations of trees in both areas and differences in climate. Candidates did not recognise uncertainty due to sampling errors.

### Question 4 (c)

(c) Research shows that some British ash trees have some resistance to ash dieback.

Describe how ash trees could be selectively bred to increase resistance to ash dieback.

.....  
.....  
.....  
.....  
.....  
.....  
.....

[3]

Many candidates confused selective breeding with genetic engineering. Candidates seemed to be unaware that trees can be bred together. Candidates that did correctly describe the process of selective breeding tended to miss the point that selection can be carried through for generations.

### Question 4 (d) (i)

(d) Some corn plants have been genetically engineered to be resistant to disease.

Genetic material from a different organism was added to the corn. The genetic material allows the corn to make toxins that kill insects.

(i) Complete the sentences to describe the main steps in the process of genetically engineering corn in this way.

Choose the correct words from the list.

Each word may be used once, more than once or not at all.

amino acid      enzyme      gamete      gene  
genome      plasmid

The ..... that codes for the toxin is isolated from the original organism using a specific .....

The isolated ..... is then inserted into a ..... , which is added into a bacterium.

The bacterium is used to infect cells from corn.

The new genetic material becomes part of the ..... in the corn cells.

[5]

### Question 4 (d) (ii)

(ii) Describe some of the risks of growing genetically engineered corn.

.....  
.....  
.....  
.....

[2]

A poorly answered question with candidates failing to identify risks with growing genetically engineered corn. Candidates did give idea of corn breeding with other organisms but did not mention toxins being passed to other organisms. Candidates did identify the risks to food chains to be credited 1 mark, but sometimes the responses lacked the detail to be creditworthy.

## Question 5 (a)

5 Darwin published his theory of evolution by natural selection in 1859.

(a)\* Many scientists have carried out experiments to test Darwin's theory.

In one laboratory experiment a scientist used fruit flies. The diagram illustrates the experiment she did.



The results of the experiment are shown in the table.

Mating pair		Number of fertile offspring
Male	Female	
From tank 1	From tank 1	19
From tank 1	From tank 2	0
From tank 2	From tank 1	0
From tank 2	From tank 2	18

A very wide range of responses was seen for this item. Candidates generally managed to achieve Level 1 by demonstrating knowledge of natural selection for AO1. Many candidates did not interpret the results correctly as they stated that the flies from the two boxes were infertile rather than capable of producing fertile offspring for AO3. Many candidates only commented on two of the AOs making it more difficult to access level 3 marks. Few candidates referenced speciation and isolation but tended to include statements rather than explanations, e.g. many stated, 'natural selection' with no further explanation. Again as in previous questions candidates did not clearly express that genetic variants are passed on through generations.

Many candidates went off subject and wrote responses regarding evolution of giraffes and horses as examples which were not relevant to this question. It was also seen that many answers for this question were lacking clear and logically structured reasoning necessary to award level 3 marks.

The exemplar shown is a good example of a Level 3 response; the response interprets the results and links them to a clear understanding of speciation. Appropriate scientific language is used throughout the response, which explains the process of speciation in a clear and logical manner. This response also demonstrates knowledge using all target AOs and information is relevant.

### Exemplar 1

When two populations of organisms from the same species are physically isolated, their different phenotypes would be beneficial in each environment. When the two fruitflies were put in tanks, the food source was different. This meant that due to variation, a different genotype would be advantageous as a result of mutation. As a result, those with the advantageous phenotype would be more likely to survive and mate, reproducing to produce offspring with the advantageous phenotype. Over many generations, the population of advantaged fruitflies would increase, making the two groups of fruitflies increasingly different in terms of genetics [6] and environment. This causes speciation and it occurs when two organisms cannot breed to produce fertile offspring together. The result shows that speciation has occurred as organisms from the same tank can reproduce with fertile offspring (indicating parents are fertile) but cannot produce any fertile offspring if they mate with a fruitfly from a different tank. This has caused evolution to occur as gradual changes over generations have led to speciation.

## Question 5 (b)

(b) Scientists have found evidence that supports the theory of evolution by natural selection.

Some of this evidence is provided by fossils.

Describe **two** ways in which fossils have provided evidence of evolution.

1 .....

.....

2 .....

.....

[2]

Many candidates demonstrated a clear understanding of what a fossil is, but did not address the question in their responses.

## Question 5 (c)

(c) Living and fossilised organisms can be classified into groups.

Early classification systems put organisms into large groups called kingdoms.

Later evidence suggested that the kingdoms of animals, plants, fungi and protists could be grouped into one large domain. The evidence was the observation of the cell nucleus.

What name is given to the domain that contains all organisms with a cell nucleus?

..... [1]

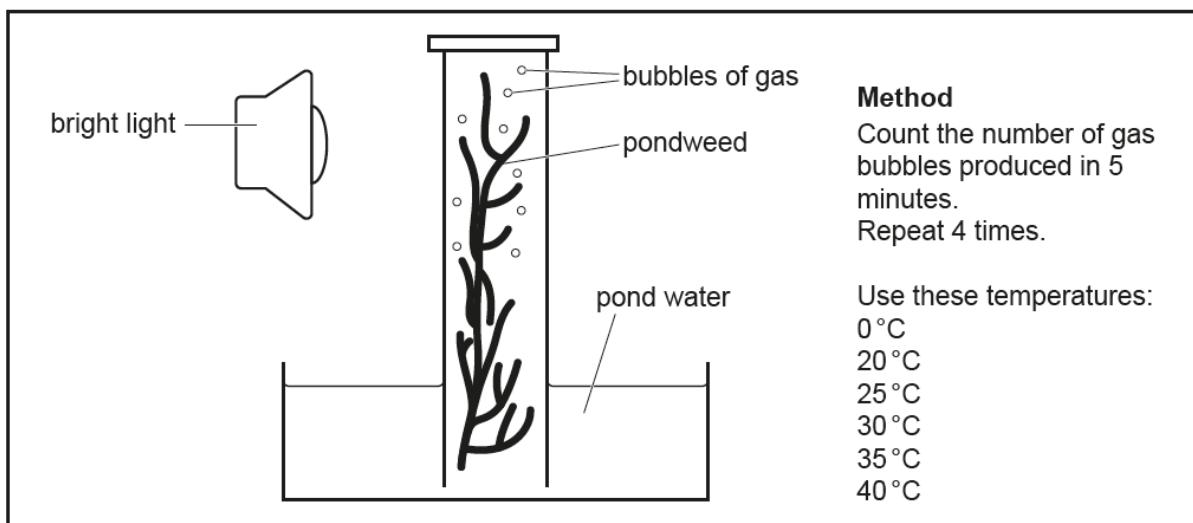
Many incorrect answers were given to this question, demonstrating a lack of understanding of classification.

## Question 6 (a) (i)

6 Amaya is planning an investigation.

She wants to find out how temperature affects the rate of photosynthesis.

The information below is taken from her lab notebook.



(a) (i) The bubbles contain oxygen gas.

During which stage of photosynthesis is oxygen gas formed?

..... [1]

Many candidates did not give the correct stage but gave the products of photosynthesis.

## Question 6 (a) (ii)

(ii) What factors should Amaya keep the same in each repeat to make sure her investigation produces valid data?

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

Many candidates focussed their answers on the light. Giving several control measures to do with light e.g. same light, light same distance away and same intensity, therefore achieving 1 mark. The other commonly credited mark was same pond weed. Many candidates referenced fair testing in their responses which was not creditworthy.

### Question 6 (a) (iii)

(iii) There are different methods that can be used to collect the gas produced by the pondweed.

Describe a different method that Amaya could use **and** explain why it is better than the method shown in Amaya's notes.

.....  
.....  
.....  
.....

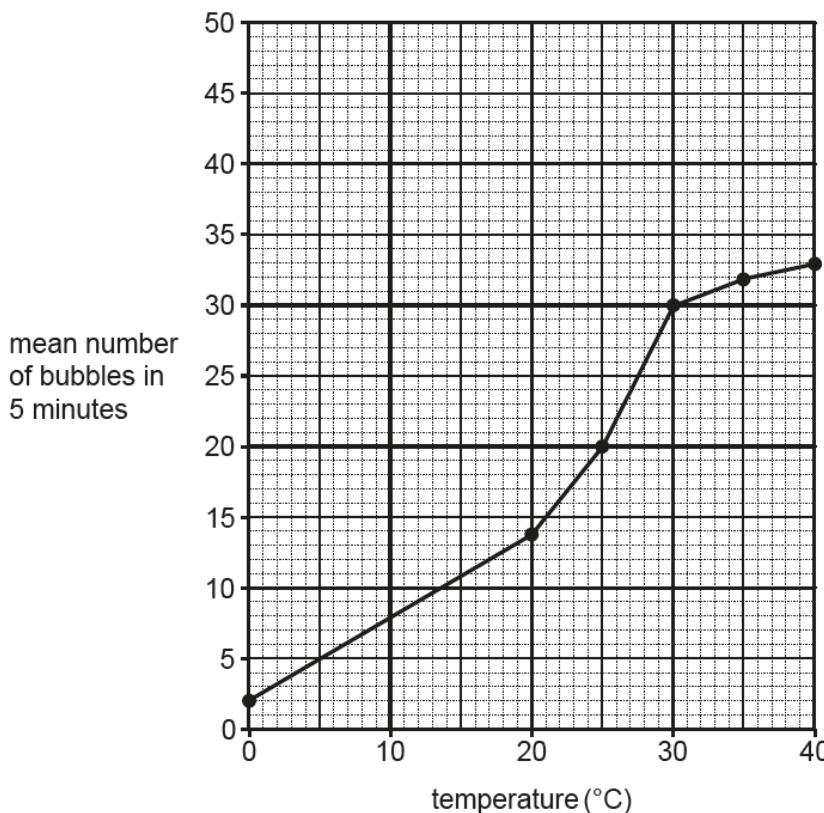
[2]

Candidates described collection of the gas by various methods but did not stipulate a gas syringe, or left out the word gas. Quite a number thought that it was a potometer and described the use of this piece of equipment.

The words accurate unqualified or reliable were seen in responses, but candidates showed little understanding of validity.

## Question 6 (b) (i)

(b) Amaya draws a graph of her results.



(i) Use the graph to calculate the rate of gas production at 40 °C.

Rate = ..... bubbles per minute [2]

Many candidates only referenced 33 in their responses. They did not seem to be aware that they needed to do any further calculations. This provided evidence that candidates did not read the graph and link it to the units given on the answer line.

## Question 6 (b) (ii)

(ii) Amaya concludes that increasing the temperature above 30 °C does **not** cause a large increase in the number of bubbles produced.

Use your knowledge of the requirements of photosynthesis to explain why.

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

Many candidates included an explanation of the denaturing of enzymes rather than identifying other limiting factors and naming them.

## Question 6 (b) (iii)

(iii) Amaya does a second investigation into the effect of temperature on the rate of photosynthesis.

For this investigation she adds sodium hydrogen carbonate to the pond water.

Draw a line on the graph to show the pattern of results you would predict for this investigation.

[2]

Some candidates did not get the 1st mark by drawing the line from the origin; others drew the whole line below the original data line. For the second mark, quite a few failed by drawing a plateau where the original one was. However, many candidates scored both marks for this item.

## Question 6 (c)

(c) Amaya repeats the investigation again, but this time at 60 °C.

Write a testable hypothesis for the investigation at 60 °C and explain why this occurs.

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

Candidates that did not appreciate that it is enzymes that are denatured were not credited marks. Many did not reference the number of bubbles produced as evidence for photosynthesis.

Some thought that the higher temperatures would cause a higher rate of photosynthesis.

## Question 6 (d)

(d) Glucose is a product of photosynthesis.

Write down the name of the reagent you would use to test for the presence of glucose.

.....

[1]

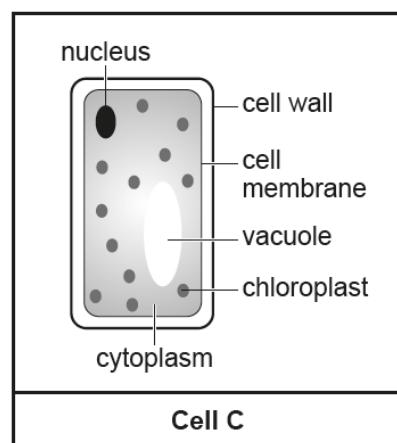
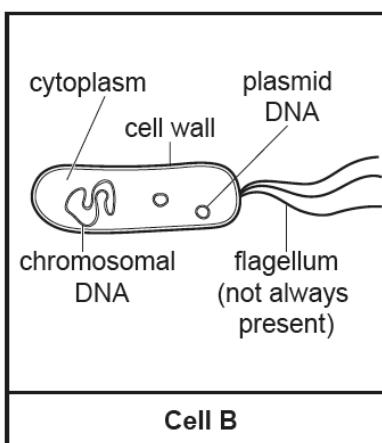
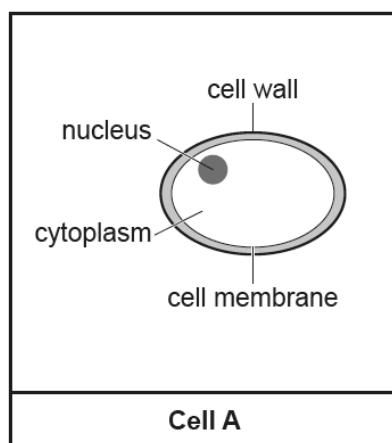
Many candidates answered iodine rather than Benedict's.

Sadly there were very many candidates who obviously had no idea what was meant by a reagent as there were many incorrect answers.

## Question 7 (a) (i)

7 Some students are learning about cells.

They look at some diagrams of different cell types:



Not to scale

(a) Use information in the diagrams to answer the following questions.

(i) Which cell, **A**, **B** or **C**, is a prokaryotic cell?

Cell .....

Explanation .....

..... [2]

## Question 7 (a) (ii)

(ii) Which cell, **A**, **B** or **C**, is a yeast cell?

Cell .....

Explanation .....

..... [2]

### Question 7 (a) (iii)

(iii) Two of the cells also contain an organelle that is not shown in the diagrams. Some of the reactions of aerobic respiration take place in this organelle.

Write down the name of the organelle and which **two** cells, from **A**, **B** and **C**, will contain this organelle.

Name of organelle .....

Found in cells ..... and .....

[2]

The first part of this question was answered very well by candidates but the second was not so successful. Many candidates correctly identified A as the yeast but did not fully explain why, candidates tended to give a feature of yeast or a feature not of yeast, but not both, which was needed for the second mark to fully justify the choice of A. The third part of the question was also well answered with many candidates correctly identifying mitochondria; however ribosome was also frequently seen.

### Question 7 (b)

(b) The students write down simple word summaries of cellular respiration in different types of organisms.

Complete the word summaries in the table.

Type of organism	Type of cellular respiration	Input	Output
All	.....	glucose + oxygen	carbon dioxide + water
Animal	anaerobic	glucose	.....
Yeast	anaerobic	glucose	.....

[3]

The first part of the question was well answered; many candidates correctly identified the type of respiration. The second mark was also commonly given, however, the third point often identified carbon dioxide but not ethanol/alcohol.

### Question 7 (c) (i)

(c) The word summaries are simple models of cellular respiration. In cells, respiration is a complex process involving several reactions.

A paper in a scientific journal includes some more detailed models of anaerobic and aerobic respiration in yeast.

(i) The students have confidence in the information in the paper.

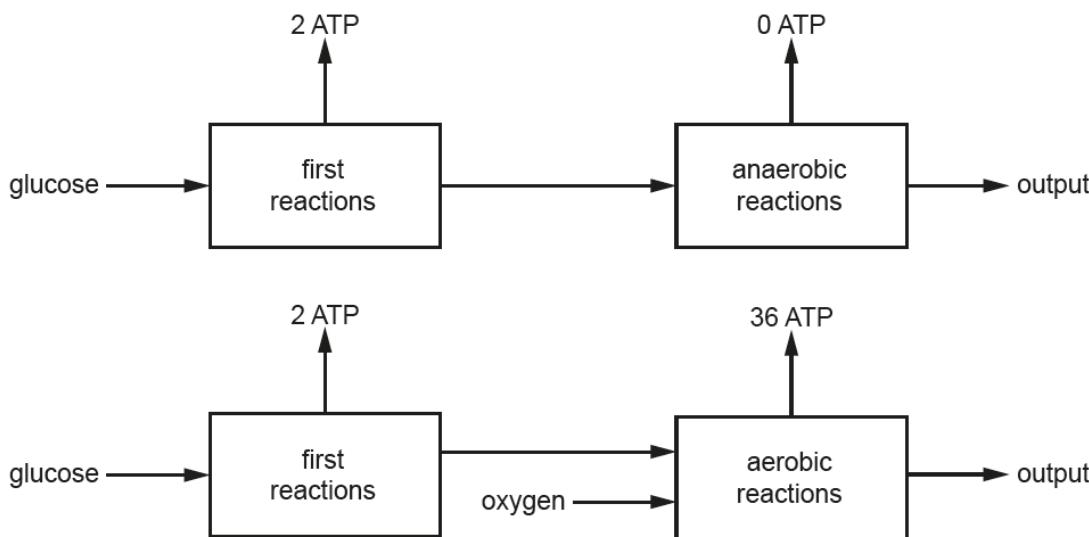
Explain why.

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

Many just thought that being published in a scientific journal was sufficient. Some thought that because they had done experiments and learnt about it in class that was sufficient to have confidence in the paper, or because there were lots of detailed models.

### Question 7 (c) (ii)

The models of anaerobic and aerobic respiration from the paper are shown in the diagram.



These models show that:

- the first reactions of anaerobic and aerobic respiration are the same
- anaerobic and aerobic respiration produce different amounts of ATP.

(ii) Calculate the anaerobic:aerobic ratio of ATP produced by cellular respiration in yeast.

$$\text{anaerobic:aerobic ratio of ATP produced} = \dots : \dots [2]$$

A commonly seen answer was 2:38 (1 mark) with candidates failing to make the final calculation necessary for 2 marks.

**Question 7 (c) (iii)**

(iii) Look at the diagram showing the models of respiration.

Yeast will use **anaerobic** respiration even when oxygen is available.

Which **two** statements, taken together, could explain this?

Tick (**✓**) **two** boxes.

Anaerobic respiration does not need glucose.

Anaerobic respiration does not need oxygen.

Anaerobic respiration has a much faster rate of reaction.

Anaerobic respiration produces less ATP.

Anaerobic respiration produces ATP more quickly.

[2]

Very common answers seen were boxes 2 and 4; candidates showed poor understanding of why anaerobic respiration takes place.

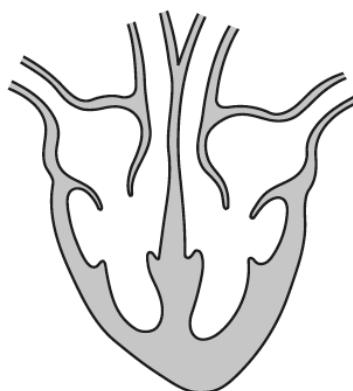
**Question 8 (a)**

8 Jack has been feeling tired and short of breath. He visits his doctor.

The doctor thinks Jack may have a problem with his heart valves and sends him for a scan of the heart.

Jack's scan shows he has a faulty valve between the left atrium and the left ventricle.

(a) Draw a circle on the diagram of the heart around the valve between the left atrium and the left ventricle.



[1]

## Question 8 (b)

(b) Explain to Jack the function of heart valves **and** why his faulty valve is making him feel tired and breathless.

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

For the candidates who only got 1 mark it was mostly for back flow, although quite a number just said that it was to keep the blood flowing in the right direction but did not mention the possibility of it flowing backwards. Candidates did explain that this would make oxygen delivery less efficient (for the second mark) but very few mentioned the word respiration or faster/ deeper breathing.

## Question 8 (c)

(c) Write down one **other** type of structure in the circulatory system that has valves.

..... [1]

Many candidates answered lungs for this item.

## Question 8 (d)

(d) This information is about Jack's circulatory system:

- The volume of blood pumped out by Jack's heart in one beat is  $40\text{ cm}^3$ .
- Jack's resting pulse rate is 80 beats per minute.
- When Jack is exercising, his pulse rate increases by 90%.

Calculate the volume of blood, in **litres**, pumped out by Jack's heart in one minute when he is exercising.

Volume = ..... litres [4]

This question was generally well answered by candidates with many being credited 4 marks. Where candidates did not achieve credit, it was usually due to marking point 1 not being able to be awarded. Candidates here had a tendency to multiply all the numbers in the questions together making subsequent calculation incorrect. The other area that resulted in marks not being credited was marking point 4, as many candidates did not convert cubic centimetres into litres.

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Q3a

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Q4b

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