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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260

For first teaching in 2016

J260/05 Summer 2024 series

Version 1

ocr.org.uk/science

Contents

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. A selection of candidate answers is also provided. 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 and the mark scheme can be downloaded from OCR.

Paper 5 series overview

J260/05 is the first of four papers taken for the GCSE Twenty First Century Science Combined Science B specification. It covers content from the topics B1 to B6 along with ideas in science and practical skills. The paper comprises short answer styles and extended response, including one Level of Response question (structured questions, problem solving, calculations and practical investigations). This paper requires candidates to apply their knowledge and understanding of scientific principles and be familiar with a range of practical equipment and techniques that they are required to be able to describe. Questions 1 and 2 overlap with the Foundation Tier paper.

Candidates generally attempted all questions and there was little evidence that the candidates ran out of time. Candidates were able to follow the instructions but should be reminded to always check the number of boxes they should tick and that the ticks should fit in boxes.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• could recall the role of hormones in reproduction – Questions 1 (a), 1 (b) (i), 1 (b) (ii) and 1 (b) (iii) • could link damaged neurons to speed of reactions – Question 5 (a) • could explain how enzymes are used in practical situations such as washing powders – Questions 6 (a), 6 (b) and 6 (c) • could explain natural selection and could explain the importance of mutation in evolution – Questions 7 (c) and 7 (d) • could explain the full process of genetic engineering – Questions 7 (e) (i) and 7 (e) (ii) • could link limiting factors to the rate of photosynthesis – Question 8 (a) (i) • carried out correct calculations and showed all working out • wrote concise answers using correct scientific terminology.	• did not know the hormones of reproduction – Questions 1 (a), 1 (b) (i), 1 (b) (ii) and 1 (b) (iii) • could explain a reflex action but could not link how a damaged motor neuron would affect impulses – Question 5 (a) • could not explain how enzymes are used in a practical situation such as washing powders – Questions 6 (a), 6 (b) and 6 (c) • confused selective breeding and natural selection with each other – Questions 7 (c) and 7 (d) • could not fully explain the process of genetic engineering – Questions 7 (e) (i) and 7 (e) (ii) • could not explain how the limiting factors of photosynthesis actually slow photosynthesis – Question 8 (a) (i) • did not show working out for calculations throughout the paper • wrote unclear explanations for key concepts.

Question 1 (a)

1 Charlie knows that hormones are important in human reproduction.

(a) Describe **one** role of hormones in human reproduction.

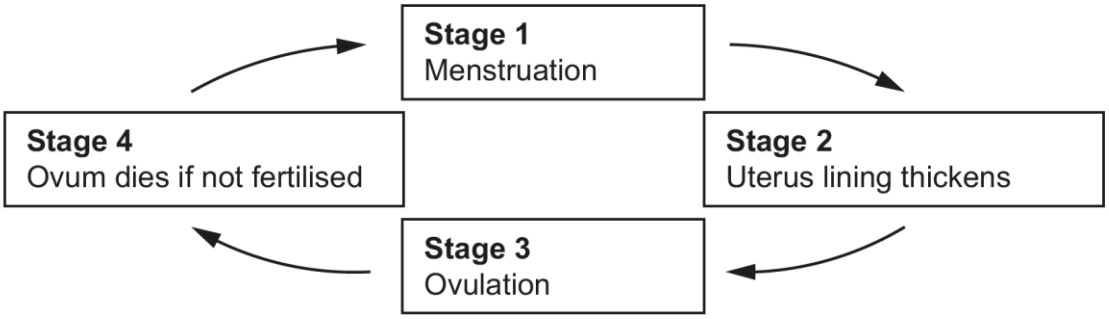
..... **[1]**

This question was misunderstood by a number of candidates, many of whom linked a hormone to other roles, e.g. diabetes and emotions. There were lots of vague responses that just named menstruation or individual hormones.

Question 1 (b) (i)

(b)

(i) The diagram shows four stages in the menstrual cycle.



Charlie has a contraceptive implant under their skin. The implant releases hormones.

Complete the sentence to explain why the hormones released by the implant disrupt the menstrual cycle.

Put a (ring) around the correct option.

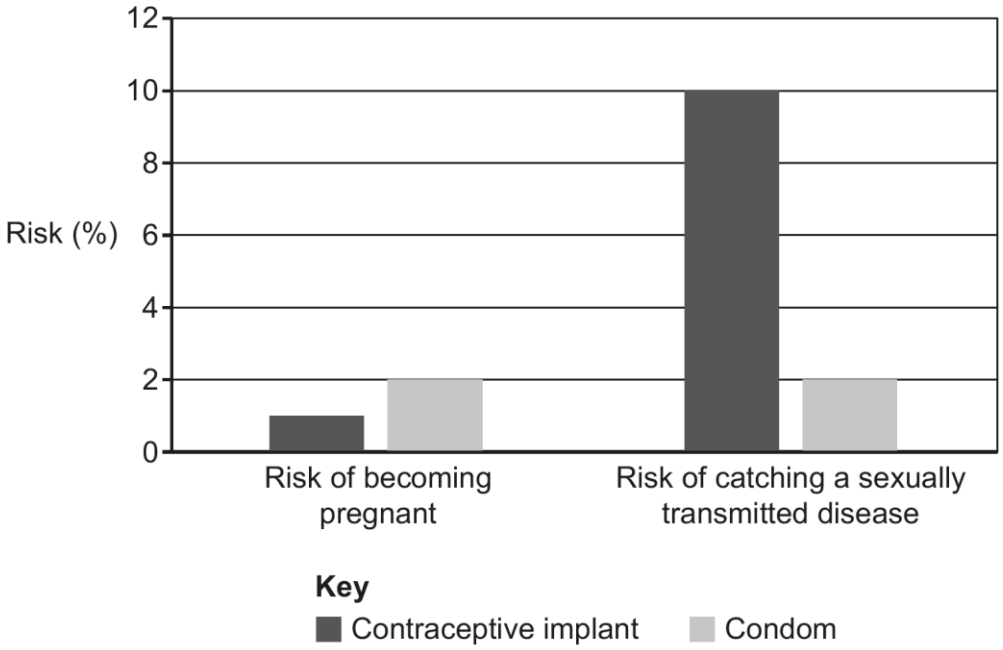
The hormones prevent stage **1 / 2 / 3 / 4** from taking place. **[1]**

Question 1 (b) (ii)

(ii) A clinical trial compared the contraceptive implant with a condom.

The trial compared:

- the risk of becoming pregnant
- the risk of catching a sexually transmitted disease.



Charlie looks at the chart and decides to use a condom instead of the contraceptive implant.

Evaluate Charlie's decision, using the information from the chart.

.....

.....

.....

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

This question was generally well answered by candidates. Where the response did not gain any marks, it was usually because the candidate had just quoted figures without an obvious comparison.

Question 1 (b) (iii)

(iii) Suggest why the risk of becoming pregnant and the risk of catching a sexually transmitted disease are equal when using a condom.

.....

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

Candidates believed that the risk was equal due to the chance of the condom breaking rather than a condom providing a barrier.

Question 2 (a) (i)

2 Alex has cereal for breakfast.

(a)
(i) The cereal is made of carbohydrate.

Which small molecule does the body get by breaking down the carbohydrate from the cereal?

Put a (ring) around the correct option.

Amino acid **Fatty acid** **Glycerol** **Sugar**

[1]

Many candidates gave glycerol as an answer rather than sugar.

Question 2 (a) (ii)

(ii) Small molecules are used by cells in aerobic respiration.

Complete the table.

Tick (✓) **one** box in each row.

Small molecule	**Needed** for aerobic respiration	**Produced** by aerobic respiration	**Not** needed for or produced by aerobic respiration
Oxygen			
Urea			
Water			

[2]

Many candidates achieved full marks on this question. Where candidates only achieved 1 mark, it was usually because urea had been placed in the incorrect box.

Question 2 (b)

(b) Explain how the partially-permeable cell membrane controls movement of small molecules into and out of a cell.

Put a (ring) around each correct option.

Gases such as oxygen and carbon dioxide move across the cell membrane by **active transport / diffusion / osmosis**.

When water moves across the cell membrane by diffusion, we call it **active transport / osmosis / translocation**.

Molecules can be moved against a concentration gradient using energy in a process called **active transport / diffusion / osmosis**.

[3]

Many candidates scored full marks on this question.

Question 2 (c)

(c) Small molecules move into and out of the blood.

Which statements about how this happens are **true**, and which are **false**?

Tick (✓) **one** box in each row.

	True	False
Carbon dioxide and urea move out of cells into the blood.	☐	☐
Oxygen and carbon dioxide move between blood in capillaries and air in alveoli.	☐	☐
Urea is filtered into the blood by the kidneys.	☐	☐
Water and food molecules are absorbed from the digestive system into blood in capillaries.	☐	☐

[3]

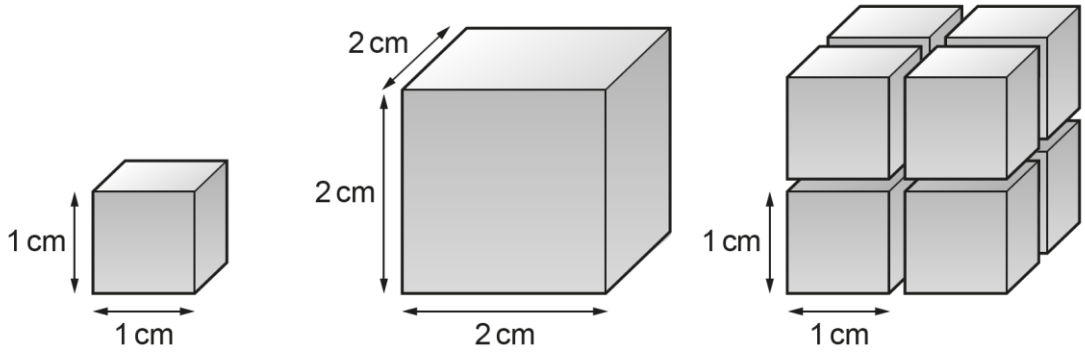
Many candidates scored 2 marks on this question. The most common incorrect answer was row 2.

Question 2 (d) (i)

(d) Exchange surfaces affect the surface area:volume ratio of multicellular organisms.

Alex uses cubes as models for different organisms.

Organism **A** represents a small organism.
Organism **B** represents a large organism **without** exchange surfaces.
Organism **C** represents a large organism **with** exchange surfaces.



(i) Calculate the surface area:volume ratio of organism **B**.

Give your answer in its simplest form.

Surface area:volume ratio = ... : ..... **[4]**

This question was well answered by candidates, with many scoring full marks. The most common error seen was an incorrect surface area calculation. When candidates were unsure of how to perform the calculation, there appeared to be lots of random numbers.

Question 2 (d) (ii)

(ii) The surface area:volume ratio of organism **A** is 6:1.

Explain why the surface area:volume ratio of organism **C** is also 6:1.

.....

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

This question was not well answered. Candidates struggled to explain why the surface area was the same. There were many responses about C being cut up, but this had not been linked to A.

Question 3 (a)

3

(a) Complete the table about sub-cellular structures.

Tick (✓) **one** box for each row.

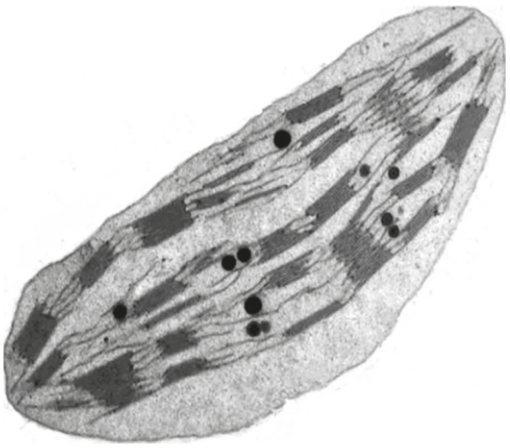
Structure	**Only** found in eukaryotic cells	**Only** found in prokaryotic cells	Found in **both** types of cell
Chloroplast			
Mitochondria			
Nucleus			
Plasmid			

[3]

Mitochondria was commonly placed in the 'both types of cell' column, meaning that candidates only scored 2 marks.

Question 3 (b) (i)

(b) The image is of a chloroplast.

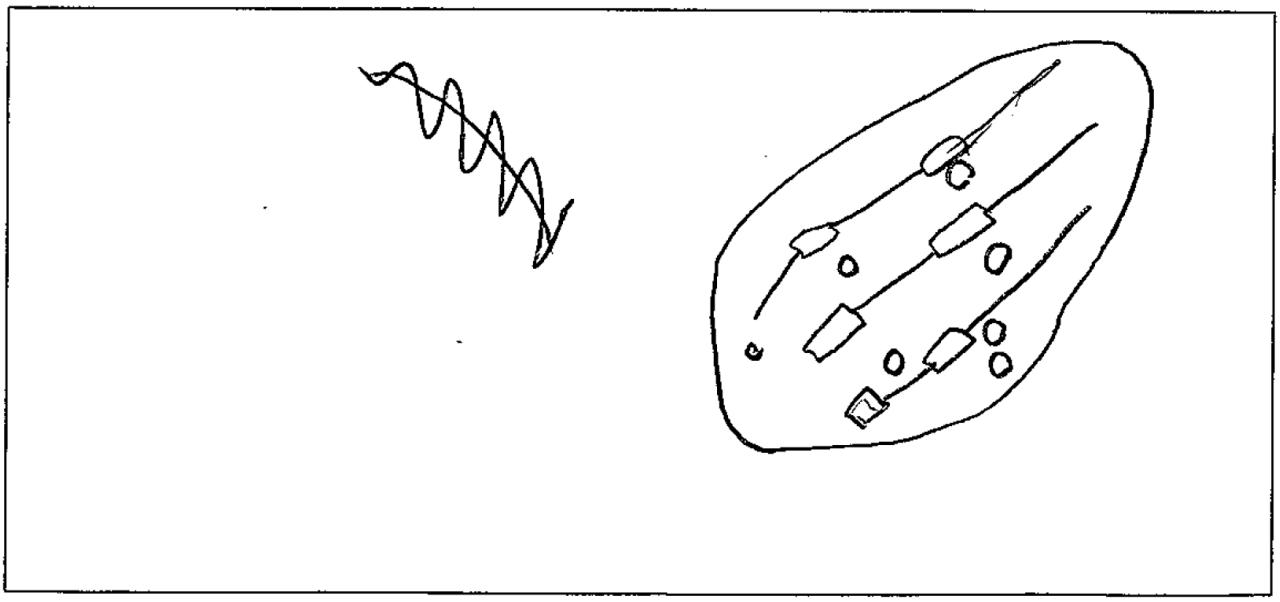


(i) Draw a scientific drawing of the chloroplast in the box.

[2]

Candidates did not perform well on this question. Many appeared not to have knowledge on scientific drawing. Many candidates drew plant cells rather than the diagram. The following exemplar shows a successful response that scored both marks.

Exemplar 1



In this exemplar the outline is clear, unbroken and the same shape as the image. The inside of the diagram resembles the inside of the image. Many candidates did not include the detail in the middle, with many drawing a diagram of a plant cell.

Question 3 (b) (ii)

(ii) An electron microscope was used to create the image of the chloroplast.

Explain why electron microscopy is needed to increase our understanding of sub-cellular structures.

.....

.....

.....

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

Candidates performed well on this question. They were good at explaining how the electron microscope could see smaller images but did not always use the terms magnification or resolution.

Question 3 (c)

(c) The chloroplast has been magnified 11 500 times. In the image, the length of the chloroplast is 65 mm.

Calculate the actual length of the chloroplast in **µm**.

Use the equation: magnification = $\frac{\text{image length}}{\text{actual length}}$

Give your answer to **2** significant figures.

1 mm = 1000 µm

Actual length of chloroplast = ... µm **[4]**

Many candidates scored full marks on this question. The most common error seen was incorrect rearrangement of the calculation.

Question 4 (a)

4 Scientists study communicable diseases.

(a) Describe what is meant by **communicable disease**.

.....

.....

.....

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

This question was well answered, with many candidates being able to clearly describe what a communicable disease is.

Question 4 (b)

(b) HIV is a communicable disease.

Complete the sentences to explain how HIV is spread.

HIV is a .....-transmitted disease.

HIV is transmitted in ..... .

[2]

Many candidates correctly stated that HIV is a sexually transmitted disease but did not identify how it was transmitted. In sexual intercourse was a frequently seen response.

Question 4 (c) (i)

(c) The table shows the number of people living with HIV/AIDS and the number of deaths due to HIV/AIDS, from 1990 to 2020.

Year	Number of people living with HIV/AIDS (millions)	Number of deaths due to HIV/AIDS (millions)
1990	7.5	0.3
1995	17.6	0.9
2000	25.7	1.6
2005	28.3	1.8
2010	29.9	1.4
2015	33.6	1.0
2020	37.5	0.9

(i) Calculate the percentage change in the number of people living with HIV/AIDS from 1990 to 2020.

Percentage change = ... % **[2]**

Very few correct answers were seen for this question. Most candidates did not divide by 7.5, instead using 37.5, or they didn't calculate the difference between 37.5 and 7.5. A commonly seen response for this question was 500.

OCR support

The Science Mathematical Skills Handbook provides both teachers and students support on the use of mathematical skills in GCSE sciences.

Question 4 (c) (ii)

(ii) A doctor reports that people living with HIV/AIDS have had access to better medicines for their condition over the last 20 years.

Identify evidence from the table that supports the doctor's statement.

.....

.....

.....

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

Most candidates clearly identified that the death rate has dropped but did not recognise that the number of cases had gone up.

Question 4 (c) (iii)

(iii) The number of new infections with HIV has been decreasing since 1995.

Suggest **one** reason why.

.....

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

This question was generally well answered. The most common error seen was that contraception had improved (no reference to barriers).

Question 5 (a)*

5 Organisms need to detect and respond to changes in their internal and external environment to survive.

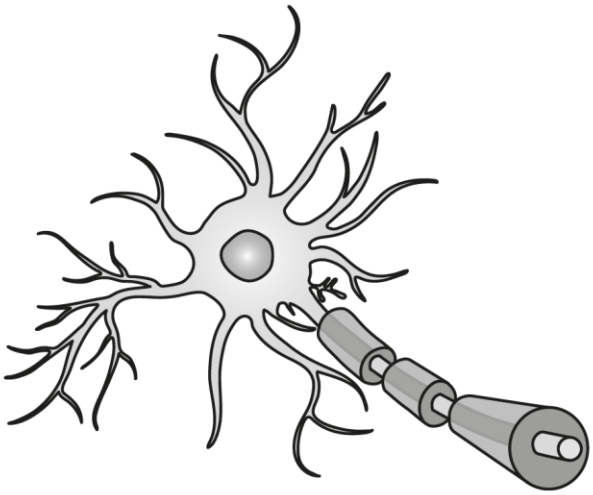
(a)* Multiple sclerosis (MS) is a condition that affects motor neurons.

Symptoms of MS include:

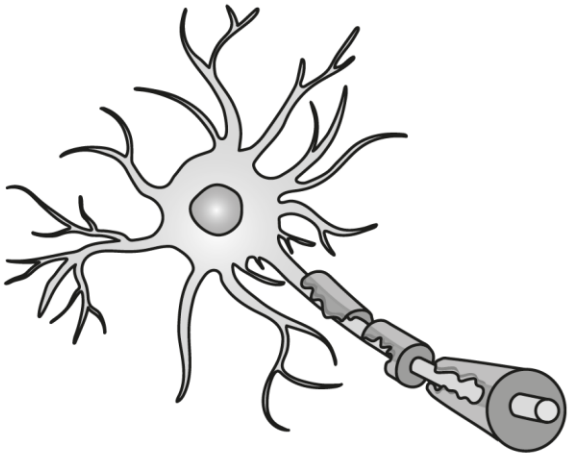
- slow muscle contractions in the arms and legs
- unwanted muscle contractions.

The images show a healthy motor neuron and a motor neuron affected by MS.

Healthy motor neuron



Motor neuron affected by MS



Explain how the structure of a motor neuron relates to its function **and** why MS causes the symptoms described.

.....

.....

.....

.....

.....

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

This question was well attempted by candidates, with many responses achieving Level 3, 6 marks. These responses had addressed all parts of the motor neuron both structure and function of a healthy neuron. They had then linked the parts to the damaged motor neuron in MS and how it would affect muscle contractions.

Candidates that did not perform as well generally tended to explain how a reflex action worked. This was often due to incorrectly using incorrect scientific language. Many candidates thought the insulation provided heat to allow impulses to travel quickly.

The following exemplar shows a successful response that was awarded Level 3, 6 marks.

Exemplar 2

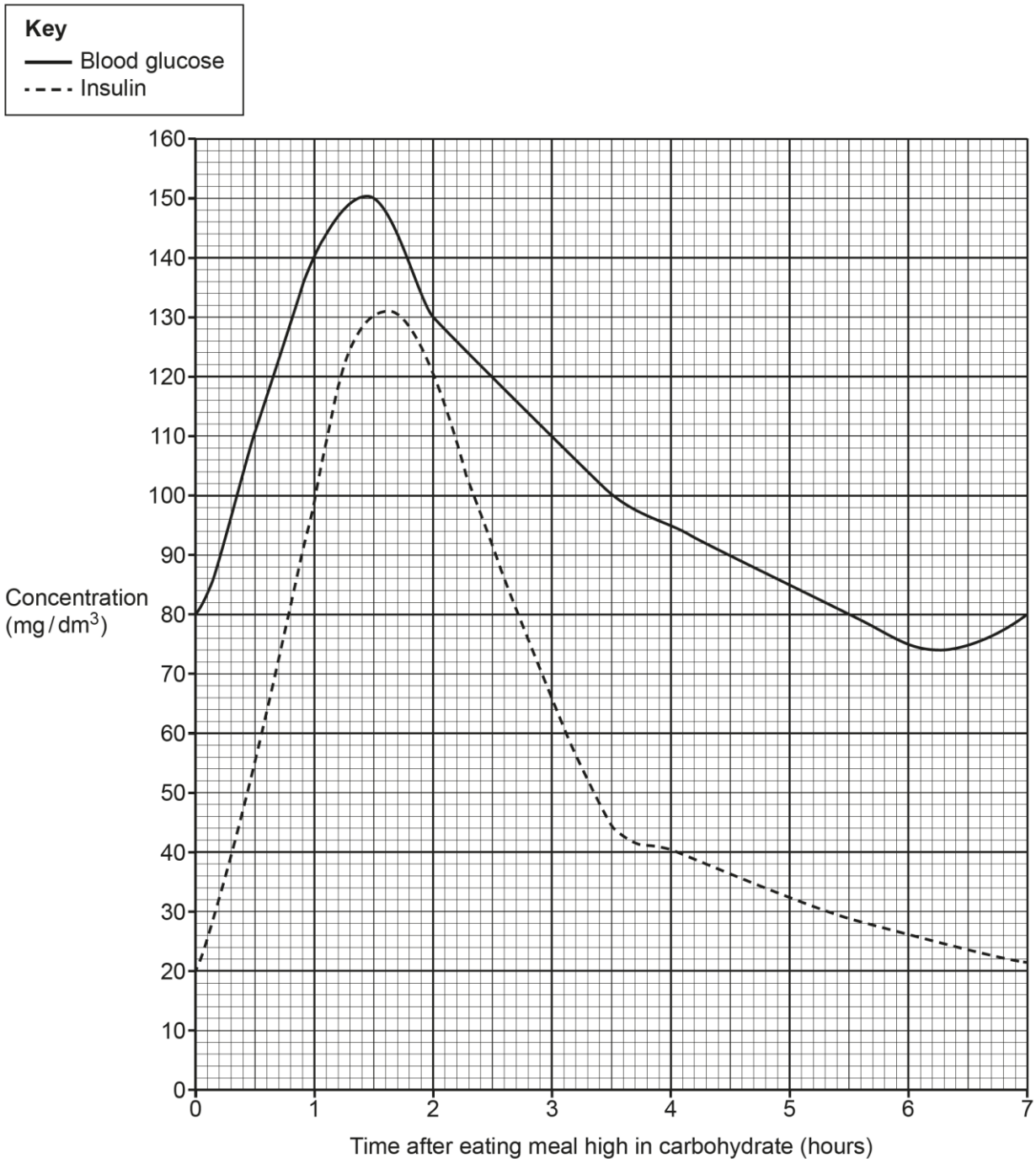
A motor neuron has a myelin sheath to protect and [redacted] insulate the axon, this also helps speep up reactions/transmisions between neurons. MS has damaged the myelin sheath, therefore leading to slower muscle contractions because the axon does not have the insulation and protection to speed it up, it is also having unwanted muscle contractions because there is nothing to protect the neuron. Motor neuron also has a long axon to help it move faster and dendrites to send electrical impulses to other neurons.

This exemplar describes a healthy neuron and explains that it speeds up transmissions between neurons. It then states that MS has damaged the myelin sheath in the neuron so this leads to slower muscle contractions. It also includes extra detail about the neuron that explain the symptoms given in the question, i.e. slow muscle contraction and unwanted muscle contraction.

Question 5 (b) (i)

(b) The pancreas responds to changes in blood glucose concentration.

The graph shows the blood glucose and insulin concentration after eating a meal high in carbohydrate.



(i) Calculate the **rate** of change in insulin concentration during the first hour after the high carbohydrate meal was eaten.

Give your answer to **2** decimal places.

Rate = ... $mg/dm^3/min$ **[3]**

Many candidates gained marks on this question. Marking point 3 was frequently given as many answers were given to 2 decimal places.

Question 5 (b) (ii)

(ii) Describe the relationship between the blood glucose and insulin concentrations between hours **6** and **7**.

.....

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

Candidates scored well on this question and could correctly interpret the graph.

Question 5 (b) (iii)

(iii) Explain why the glucose concentration changes between hours **6** and **7**.

Use ideas about insulin and glucagon in your answer.

.....

.....

.....

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

Many candidates did not gain any marks on this question. Many gave a vague description of insulin lowering blood sugar and glucagon increasing glucose. Very few candidates mentioned the liver or glucagon converting glycogen into glucose.

Question 6 (a)

6 Biological washing powders contain digestive enzymes.

Washing powders need to remove food stains from clothes.

(a) Explain how digestive enzymes remove food stains.

.....

.....

.....

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

The most commonly given mark was breaking down the stain. Very few candidates gave more information about enzymes or how they work.

Question 6 (b) (i)

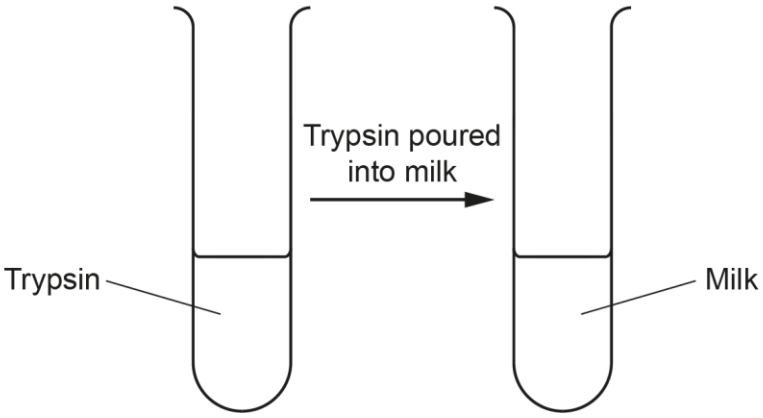
(b) Trypsin is a digestive enzyme which can remove milk stains.

When trypsin digests milk, the appearance of the milk changes from cloudy white to clear and colourless.

A student investigates the effect of temperature on the rate of digestion of milk by trypsin.

They write this method:

- Put 2 cm^3 of milk and 2 cm^3 of trypsin into test tubes.
- Pour the trypsin into the milk.
- Time how long it takes for the milk to go clear and colourless.
- Repeat the test at 10 °C, 20 °C, 30 °C, 40 °C and 50 °C.
- Test each temperature three times.



(i) Suggest **one** reason for repeating the test three times at each temperature.

.....

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

Many candidates gave increase in accuracy for a reason for the repeats which was insufficient. Candidates did include reliability but did not really include precision.

OCR support

Language of measurement in context: Biology provides both teachers and students support on the use of terminology surrounding practicals in GCSE sciences.

Question 6 (b) (ii)

(ii) Identify **three** different variables in this investigation:

Independent variable .....

Dependant variable .....

A variable that should be controlled .....

.....

[2]

Candidates could generally identify the independent variable but struggled more with the others, frequently mixing up the variables.

Question 6 (b) (iii)

(iii) Explain **two** improvements to the student's method that would help to increase the accuracy of the results.

1 .....

.....

2 .....

.....

[2]

This question was well attempted by candidates, with many writing to increase the number of measurements taken by decreasing the increments. Many candidates are still stating repeats as an improvement to improve processing rather than how to improve the procedure.

Question 6 (c)

(c) The milk went clear and colourless fastest at 40 °C.

Explain why some washing powders containing trypsin are recommended to be used at 40 °C.

Use ideas about enzyme action in your answer.

.....

.....

.....

.....

.....

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

Many candidates were able to identify 40 degrees as the optimum temperature. Many responses were about general enzyme activity rather than specific to trypsin.

Question 6 (d) (i)

(d) Aerobic respiration in living cells is catalysed by enzymes.

(i) Which sub-cellular structure does aerobic respiration take place in?

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

This question was well answered by candidates.

Question 6 (d) (ii)

(ii) Explain why respiration occurs continuously in all living cells.

.....

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

Misconception

Although the previous question was answered well, there were many responses linking lungs and the alveoli to respiration despite the question asking for cellular respiration in the mitochondria and not ventilation.

Question 7 (a)

7 All organisms contain genetic material.

(a) Complete the sentences to explain how the genetic material controls how cells develop and function.

The entire genetic material of an organism is called the ..... .

The genetic material is stored in pairs of structures called ..... , which are made of a polymer called ..... .

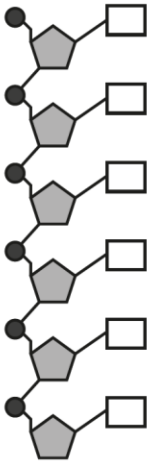
Genes are instructions for the production of ..... , which are made of chains of ..... .

[3]

Many candidates successfully named the genome as the entire genetic material but then did not identify the correct pairs for the final 2 marks of this question.

Question 7 (b)

(b) The diagram shows one strand of the polymer that makes up the genetic material.



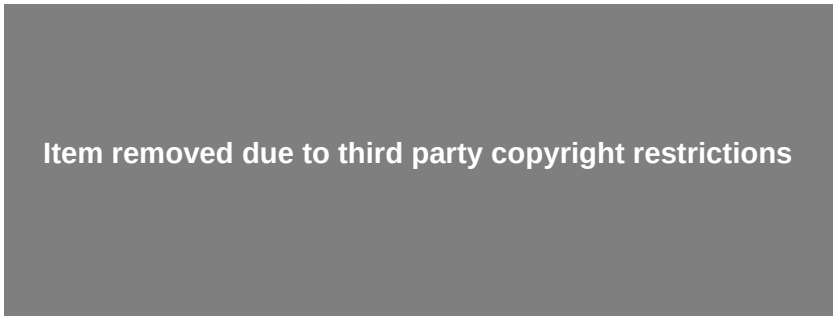
Put a (ring) around **one** nucleotide on the diagram. **[1]**

This question was not well answered. Candidates only circled one component (usually the phosphate) on the nucleotide rather than the whole nucleotide.

Question 7 (c)

(c) Over the past 150 years several new populations of wild dogs have evolved to be more genetically similar to wolves.

This has happened even though wild dogs separated from their wolf ancestor 18 000 years ago.



Explain how some populations of wild dogs are developing wolf-like features.

Use ideas about natural selection in your answer.

.....

.....

.....

.....

.....

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

Candidates seemed to generally have an idea of natural selection and how it produces variation. However, lots of the responses given were vague, e.g. they discussed general wolf features rather than specific advantageous characteristics. Many candidates did not link the features to survival and reproduction. Commonly awarded marks were marking point 1 and marking point 3.

Question 7 (d)

(d) All pet dogs are descendants of wolves.

Pet dogs are a product of selective breeding.

Describe how humans have produced pet dogs from wolves.

.....

.....

.....

.....

.....

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

Candidates generally appeared to understand the concept of selective breeding. However, many candidates thought wolves were being bred with dogs. Candidates did not explain that offspring with the desired characteristic are then selected for further breeding, and vague comments such as the process continues or is repeated were frequent.

Question 7 (e) (i)

(e) Humans have produced 22 new breeds of dogs in the last 10 years.

New breeds can be produced even faster using genetic engineering.

(i) Describe what is meant by **genetic engineering**.

.....

.....

.....

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

Many candidates had a basic understanding of genetic engineering and were aware that genes can be modified.

Question 7 (e) (ii)

(ii) Describe the **four** main steps in the process of genetic engineering.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

Many candidates had a basic understanding of genetic engineering but did not explain it well. Candidates were aware that genes are removed and inserted into a vector but after that, the responses tended to become unclear.

Question 8 (a) (i)

8

(a) The world's human population is due to reach 10 billion by 2050.

Farmers need to produce more food to feed all those people.

(i) Explain why increasing the rate of photosynthesis would increase the amount of food available for humans.

.....

.....

.....

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

Many candidates correctly linked increased photosynthesis to increased growth. Responses were very generalised, with few linking this to increased biomass or increased food produced.

Question 8 (a) (ii)

(ii) Temperature and water can be limiting factors of photosynthesis.

Complete the table to describe **two other** limiting factors and explain why increasing the amount of each factor increases the rate of photosynthesis.

Limiting factor	Why increasing the amount of this factor increases the rate of photosynthesis
.....	....
.....	....

[2]

Many candidates correctly identified the limiting factors but could not explain why increasing the amount of the factor would increase the rate of photosynthesis.

Question 8 (b)

(b) Explain how chemicals used in farming can affect local biodiversity.

.....

.....

.....

.....

.....

..... **[4]**

Candidates generally knew that biodiversity would be reduced. Many used the term chemicals rather than naming specific chemicals, e.g. fertilisers, and were therefore unable to describe the effect on the environment. The following exemplar shows a successful response.

Exemplar 3

•Chemicals (e.g. pesticides and fertilizers) can harm biodiversity in ponds / rivers due to eutrophication. The fertilizers can cause algae to grow, preventing plants photosynthesising and both respiring. This means they die. Furthermore, these chemicals can bioaccumulate, which can build up and kill larger organisms which feed on the smaller organisms. This will disrupt the food chains in the local biodiversity, as predators won't eat the consumers. Also, insecticides kill smaller insects, contributing to the disruption of the food chain [4]
as there will be less for consumers - they die aswell.

(•Biodiversity - the genetic variation in living organisms)

This response scored 4 marks. It gives the chemicals used, pesticides and fertilisers. It then goes on to link to eutrophication and bioaccumulation. Many candidates gave less successful explanations for the effects on the environment. There were many attempts to explain eutrophication (without naming) that stopped at algal bloom and did not go on to explain the effects that occur after. Many candidates were aware that biodiversity would decrease but could not justify this conclusion.

Question 9 (a)

9

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

1 .....

.....

2 .....

.....

[2]

Many candidates knew that fossils could be used for comparison but did not say the comparison was with living organisms.

Question 9 (b) (i)

(b) Scientists have discovered a new species of dinosaur called *Natovenator polydontus*.

(i) The discovery was published in a scientific journal.

Explain why it is important for scientific ideas and research to be published in scientific journals.

.....

.....

.....

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

Candidates answered this question well, with many explaining the importance of peer review.

Question 9 (c)

(c) The rapid development of antibiotic resistance in bacteria is an example of modern day evolution.

Bacteria reproduce by simple cell division. This can happen every 20 minutes.

Explain why bacteria can evolve quickly.

.....

.....

.....

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

This question was not answered well. Candidates were aware that bacteria can reproduce quickly but did not link this to shorter generation times, mutation or how this would affect evolution.

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