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GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260
For first teaching in 2016

J260/05 Summer 2019 series

Version 1

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. 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.

Paper 5 series overview

J260/05 is the first of four papers taken for the revised GCSE examinations for the combined science; this is the second year of this specification. 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 aware of 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 (PAGS) and will be able to plan and evaluate 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: 1 (ei), calculating rates of reaction: 3(bi), Probability: 3(bii) estimation of deaths.
- Could correctly explain the "Lock and Key Theory": 1(g).
- Knew the meaning of the term 'biodiversity': 2(av), 2(c).
- Had a clear understanding of how vaccination and immunity work, and producing clear and concise responses for the extended question.: 3(di) and 3 (dii)
- Knew the role of alveoli in gaseous exchange and could link changes in alveoli to gas exchange: 3(eiii).
- Knew practical techniques for preparing slides: 7(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. 1(g), 3(aii), 3(di), 3(dii), 3(ei), 3(eiii), 5(a) and 6(aii)
- Showed poor numeracy skill, e.g. 1(ei), 3(bi) and 3(bii).
- Could not link concepts, e.g. 4(c).
- Did not understand the role of neurotransmitters: 6(a).
- Lacked precision in planning practical techniques: 7(b).
- Did not tick the correct number of boxes.

Most candidates attempted most questions on the paper; no evidence was seen of time constraints leading to poor performance.

Question 1 (a)

1 Cellular respiration takes place in living cells.

(a) In which parts of a cell do the reactions of cellular respiration take place?

Tick (✓) **two** boxes.

- Cell wall ☐
- Chloroplasts ☐
- Cytoplasm ☐
- Mitochondria ☐
- Nucleus ☐
- Plasmids ☐

[2]

This question was generally answered well, however many candidates only achieved 1 mark for 1 correct answer.

Question 1 (b)

(b) Which processes need energy from cellular respiration?

Tick (✓) **two** boxes.

- Active transport ☐
- Diffusion ☐
- Gaseous exchange ☐
- Muscle contraction ☐
- Osmosis ☐
- Transpiration ☐

[2]

This question was generally well answered, however many candidates did not tick the correct number of boxes.

Question 1 (c)

All living cells produce hydrogen peroxide (H_2O_2) as a waste product.

The cells in potatoes contain an enzyme called catalase. It breaks down H_2O_2 to water and oxygen, this is the equation for the reaction that takes place.

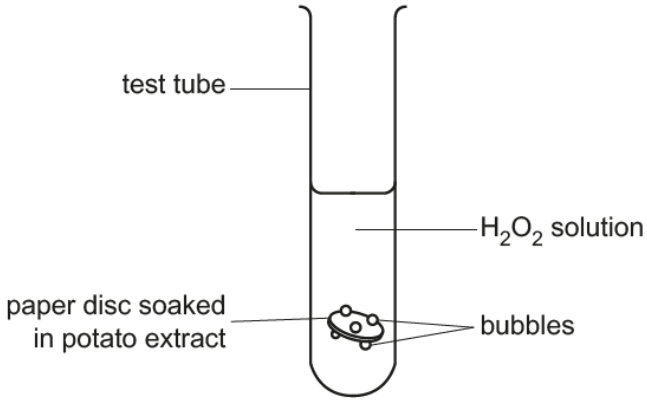
$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$

Mia investigates the effect of H_2O_2 concentration on the rate of this reaction.

She writes out her method.

1. Put a peeled potato in a liquidiser with some water to make potato extract.
2. Dip a paper disc in the potato extract. The potato extract is a source of catalase.
3. Drop the paper disc into a test tube containing H_2O_2 solution.
4. Wait until the disc has sunk to the bottom.
5. Time how long it takes for the disc to rise to the surface of the H_2O_2.

This is a diagram of her apparatus.



(c) Mia's method lacks the detail needed for another scientist to reproduce her findings.

Suggest additional detail which would allow another student to follow the method exactly.

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

Most candidates were credited with marks for this question; however, it was felt that in some cases the language used by the candidates was very simplistic. Candidates should be encouraged to use terms such as 'volume' and 'mass' rather than amount. There also appeared to be confusion over the term 'liquidiser' with many candidates clearly not understanding this term. Very few candidates gave a safety detail.

Question 1 (d)

(d) Bubbles form on the paper disc when it is in the H_2O_2 solution. This causes the disc to rise to the surface of the solution.

Mia thinks that if a disc rises more quickly, this means that the rate of reaction is faster.

Explain why she is correct.

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

The first marking point is for identifying that a gas (oxygen) is being produced, then that more bubbles produced the faster the rate of reaction. Many candidates struggled to link the idea of more bubbles making the disc rise faster.

Question 1 (e) (i)

(e) The table shows Mia's results.

Concentration of H_2O_2 solution (%)	Time taken for paper disc to reach the surface (s)
0.75	19.69
1.50	15.13
3.00	12.90
4.50	10.00
6.00	7.66

(i) Calculate the rate of reaction for 6.00% H_2O_2 solution.

Give your answer to **3** significant figures.

Rate = ... s^{-1} **[3]**

Candidates fund this question was found challenging, with few answers achieving the full 3 marks. Most candidates divided (or multiplied) by 7.66 by 6.

Question 1 (e) (ii)

(ii) Which conclusions are supported by the data in the table?

Tick (✓) **two** boxes.

- Between 0.75% and 6.00% H_2O_2 the reaction rate increases by approximately 2.5 times. ☐
- Doubling the concentration of H_2O_2 halves the time taken for the disc to reach the surface. ☐
- Increasing the concentration of H_2O_2 decreases the rate of reaction. ☐
- Increasing the concentration of H_2O_2 increases the time taken for the disc to reach the surface. ☐
- The biggest difference in time taken for the paper disc to reach the surface is between 0.75 and 1.50% H_2O_2. ☐

[2]

This question was well answered with many candidates scoring 2 marks.

Question 1 (f)

(f) Describe what Mia could do to increase confidence in her data.

.....

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

This question was well answered.

Question 1 (g)

(g) Use the lock and key model to explain why the enzyme catalase can **only** break down H_2O_2.

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

This was a well answered question with many candidates describing the "Lock and Key Theory" to be given 4 marks. Candidates that did not perform as well tended get the terms 'substrate' and 'active site' the wrong way round.

Question 2 (a) (i)

2 Herring are a type of fish. They live in the North Sea.

(a) **Fig. 2.1** shows the food web for a community living in the North Sea.

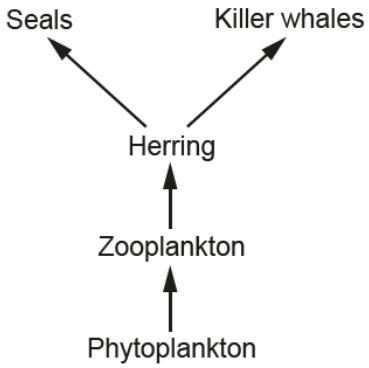

Fig. 2.1

(i) Humans catch and eat herring.

Add **humans** to the food web in **Fig. 2.1**. **[1]**

Most candidates were given the mark.

Question 2 (a) (ii)

(ii) Explain why seals and killer whales are described as competitors.

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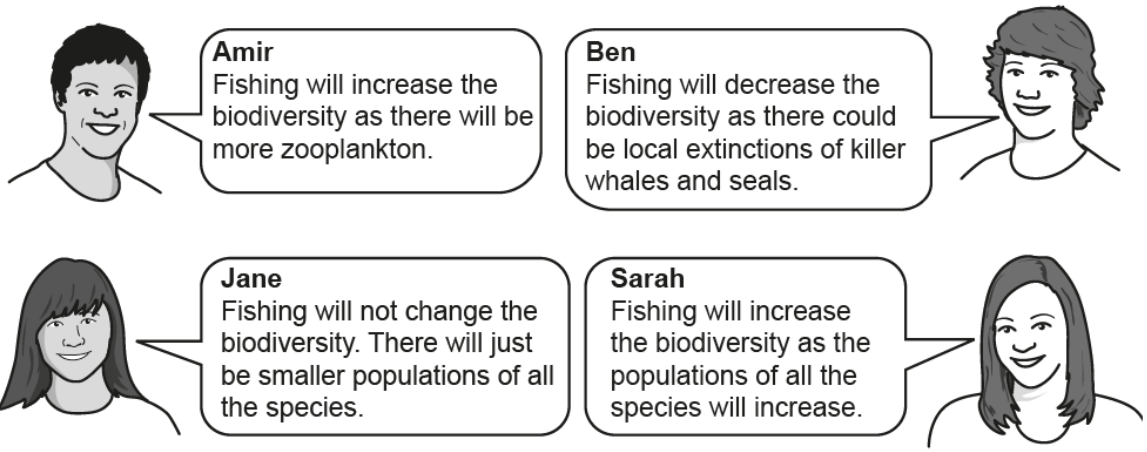
..... **[2]**

Many candidates were given 1 mark for describing why killer whales and seals are described as competitors but far fewer realised that the herring could be in short supply.

Question 2 (a) (v)

(v) Some students are studying the North Sea food web.

They discuss how fishing may affect the biodiversity of the North Sea.



Which student is correct?

Tick (✓) **one** box.

Amir ☐

Ben ☐

Jane ☐

Sarah ☐

Explain your answer.

.....

.....

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

Many candidates realised that Ben was correct but far fewer were able to explain that lower diversity is connected to fewer species. Many candidates did attempt this question but answers only related to seals and killer whales.

Question 2 (b) (i)

(b) The bar chart in **Fig. 2.2** shows how many herring were caught from the North Sea each year from 1960 to 2000.

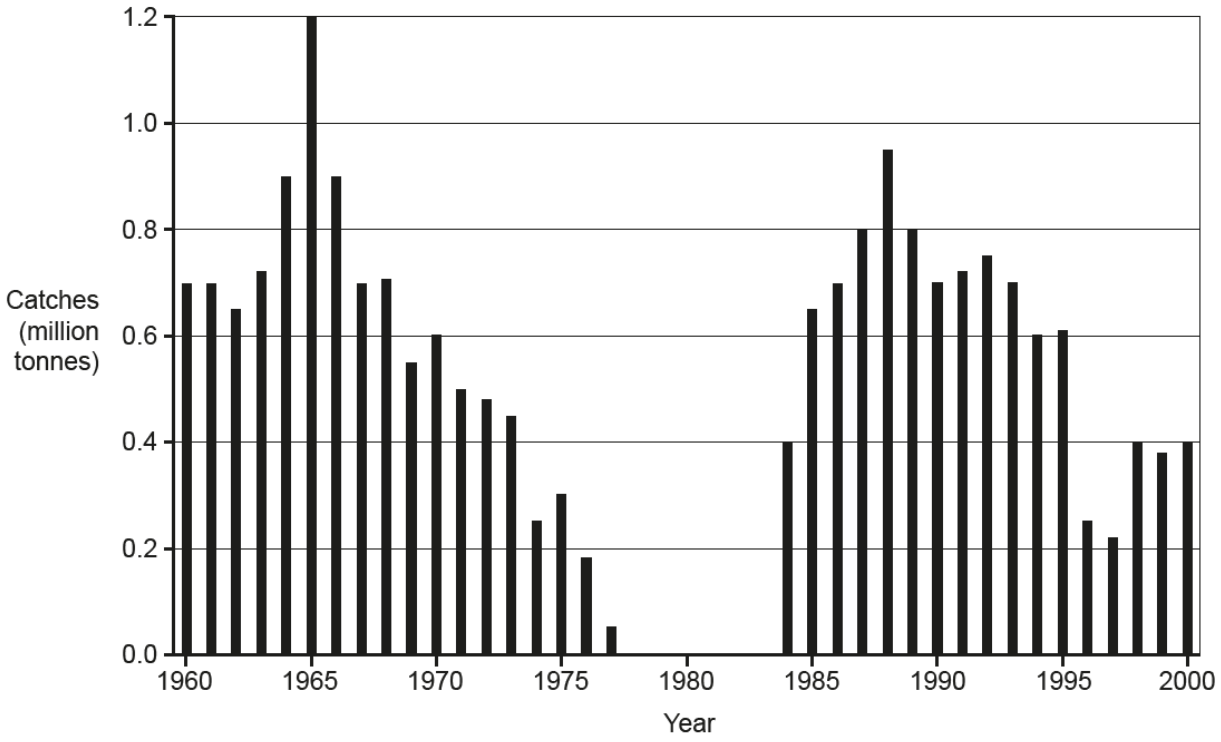


Fig. 2.2

(i) In which year was the catch greatest **and** how big was it?

Year .....

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

This question was very well answered with most candidates being given the mark.

Question 2 (b) (iii)

(iii) Calculate the rate of increase in the herring catch from 1984 to 1988.

Rate = ... million tonnes / year **[3]**

Many candidates were given the full marks for this question. However, many candidates were able to calculate the change for marking points 1 and 2 but then did not divide by four to calculate the rate.

Question 2 (c)

(c) Since 1998 North Sea herring fishing has been described as sustainable.

Explain what sustainable means in this context.

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

This question was found difficult to answer by candidates. Most candidates gave their answers in terms of catch size rather than population size. Where credit was given it was usually for marking point 2.

Question 3 (a) (i)

3 Influenza (flu) is a common human infection.

(a) Infections are caused by pathogens. Pathogens can be spread in different ways.

(i) Draw lines to connect each **pathogen** to **how it is spread**.

Pathogen	How it is spread
Athlete's foot fungus	By contact with contaminated surfaces
Malaria protist	By contaminated food or water
Salmonella bacterium	By mosquitoes
	By sexual intercourse

[1]

Most candidates were given the mark.

Question 3 (a) (ii)

(ii) Coughing and sneezing can spread the virus that causes flu.

Look at the poster in **Fig. 3.1**.

Fig. 3.1

Explain how following the advice in the poster (**Fig. 3.1**) could prevent the spread of flu.

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

Many candidates referenced germs and bacteria in this question. However, many candidates did not explain the advice given on the poster such as using a tissue to catch the virus and putting it in the bin to prevent contact. The most common marking point achieved by candidates was marking point 3.

Question 3 (b) (i)

(b) In 2017 there was a flu epidemic in Australia. 170 000 people in Australia were infected. 72 of these people died. The population of Australia in 2017 was 25 000 000.

(i) Calculate the probability of an individual person in Australia being infected in 2017.

Probability = ... **[2]**

Many candidates gave the correct answer and were given the 2 marks. However, the answer was frequently not given on the answer line and some candidates tried to put their working out on the line. Most candidates did 170,000/25,000,000 for 1 mark.

Question 3 (b) (ii)

(ii) The same flu virus could affect the UK. The population of the UK is approximately 66 000 000.

Assume that the death rate in the UK would be the same as in Australia.

Estimate how many people would die of this flu virus in the UK.

Estimated number of deaths = ... **[3]**

Candidates either got 3 marks or 0 marks for this question. Many lost marks due to mistakes such as incorrect rounding.

Question 3 (d) (i)

(d) (i) Infants under the age of 6 months are too young to be vaccinated against flu.

Doctors recommend that older children and adults are vaccinated. Explain how this helps protect **infants** from flu.

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

Few candidates were given both marks for this question. When only 1 mark was awarded there was a fairly even split between marking points. Some candidates did not recognise that vaccination makes people immune meaning that the disease cannot be caught or spread by vaccinated individuals.

Question 3 (d) (ii)

(ii)* Read the article about flu viruses and vaccination.

> Flu virus proteins change rapidly due to a high mutation rate.
>
> Each year doctors develop a vaccine for the flu virus they expect to be the most common that year.
>
> It takes several months to make a flu vaccine.
>
> In most years a vaccinated person is 40 to 60% **less** likely to develop flu.

Use the information in the article to explain:

- how vaccination and the immune system protect against flu
- why the vaccine is never 100% effective.

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

Exemplar 1

Vaccinations are injections of weakened pathogens into the blood stream. White blood cells use receptors to detect foreign antigens and make complimentary antibodies to disable and mark the pathogen for destruction. Other white blood cells then engulf and digest the pathogen. Some memory cells retain instructions to make antibodies in case the pathogens come again. When they do the response will be faster and symptoms won't be able to show, so the person will be immune.

The vaccination isn't 100% effective because it only targets one flu virus, but there are multiple strains. Also, because it takes a while to make, the virus could have changed antigen shape already, so the memory cells will be ineffective. [6]

There was a varied knowledge of the immune system. Many candidates were confused by the terms antigen and antibody, therefore answers were incorrect. Many appreciated that the vaccine could mutate but they did not give any details beyond what was given in the question. Very few described the selective advantage and the quick spread of new shaped antigens. Again, very few described the importance of vaccinating large numbers of people.

Many gave side effects of vaccinations such as allergic responses which were not creditworthy within the context of the question.

However, a pleasing number of candidates achieved Level 3 of their responses, demonstrating good understanding and application.

This is an example of a Level 3 response for this question.

Question 3 (e) (i)

(e) Flu can increase the risk of other diseases such as pneumonia.

Pneumonia is a disease of the lungs, caused by an infection.

(i) Suggest why having flu increases the risk of catching pneumonia.

.....

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

Many candidates did not use appropriate scientific language in this question, e.g. lots of fighting germs. Some candidates did acknowledge that the immune system had been weakened but very few were given other marking points.

Question 3 (e) (iii)

(iii) Pneumonia causes fluid to collect in the alveoli of the lungs.

The diagram in **Fig. 3.3** shows this happening in one alveolus.

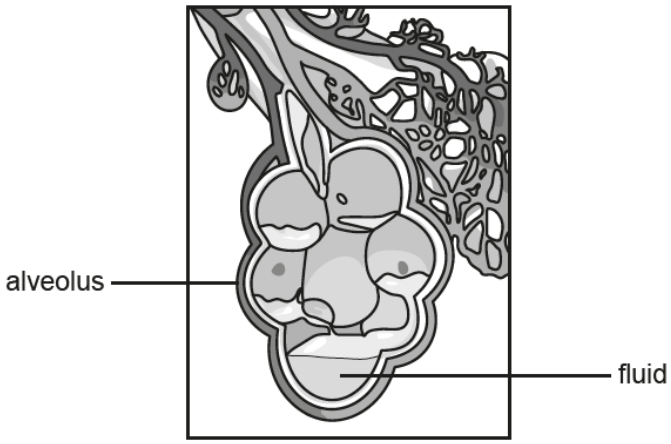

Fig. 3.3

Suggest how the fluid collecting in the alveoli will affect gas exchange **and** explain why the symptoms of pneumonia, include feeling tired and weak.

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

Most candidates attempted this answer but were not able to link the fluid to reduced surface area in the alveoli and the impacts on gas exchange. Many candidates gave answers that implied gas exchange would not happen and therefore no credit was awarded. When credit was given it was more often from describing why people would feel weak and tired and normally was correctly linked to lack of oxygen in the blood stream. However, many candidates were given the full marks for this question.

Question 4 (b) (ii)

(ii) DNA is also a polymer.

Describe the structure of DNA.

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

Most candidates were given marks for this question. Generally, candidates knew that DNA was a double helix.

Question 4 (b) (iii)

(iii) Explain how changes to the DNA polymer can cause changes to the protein polymer.

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

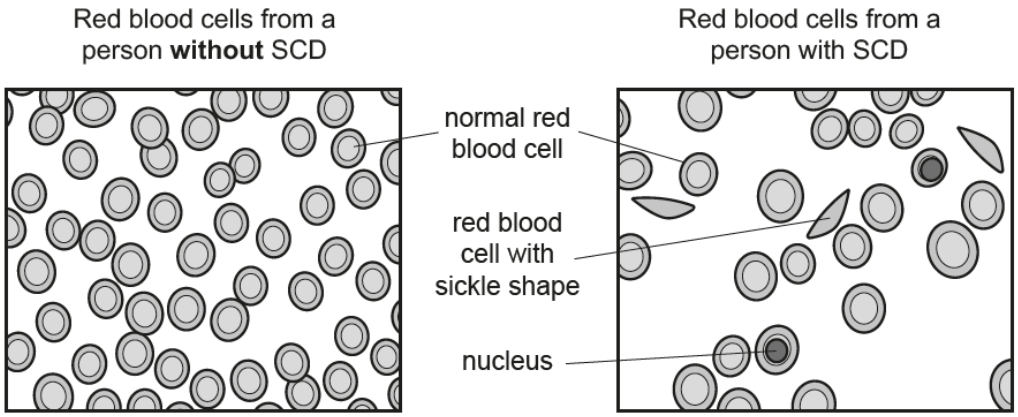
This part of the question was not answered so well as the previous section. Many did not seem to recognise that the order of amino acids or bases was important, and that different orders would make different proteins. Very few gave the idea of changes or mutations in a gene.

Question 5 (a) (i)

5 Sickle cell disease (SCD) is an inherited condition.

People with SCD have faulty red blood cells.

The drawing shows red blood cells in the same volume of blood taken from two different people. The cells were viewed using a light microscope.



(a) (i) The structure of red blood cells is adapted to carry oxygen.

Changes to the red blood cells in people with SCD mean they carry less oxygen. Explain why.

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

Generally, candidates scored on this question, usually from identifying the different shape of the red blood cells. However, candidates did not appear to be able to give a correct explanation for why the shape carries less oxygen.

Many candidates did not appear to know the role of haemoglobin in the blood but rather gave descriptions of what they could see in the diagram, e.g. cells have a nucleus but with no linking to oxygen.

Question 5 (a) (ii)

(ii) What must be added to cells so that the nuclei can be seen using a light microscope?

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

Many candidates wrote dye or indicator rather than stain. Where examples of stains were given iodine was most frequent.

Question 5 (b)

(b) Only red blood cells can contain the protein haemoglobin.

Explain why other specialised cells **cannot** produce haemoglobin.

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

Very few candidates were given marks for their responses to this question. Very few appeared to know that genes can be switched off. Very vague answers were given relating to specialisation of the cell.

Question 5 (c) (i)

(c) A team of scientists claimed to have cured SCD in a man in 2017.

They added an extra gene to some of his stem cells. These stem cells specialise to become red blood cells.

All the blood tests they performed showed that the man had been cured of SCD.

They published their results in a scientific journal so that other scientists could read about the cure.

(i) Evaluate the scientists' claim to have cured SCD.

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

Very few candidates appeared to understand this question with many responses repeating the stem of the question. When credit was given it was generally marking point 2 with very few candidates writing about the idea of peer review.

Question 5 (c) (ii)

(ii) The scientists used adult stem cells from the man for the procedure.

Why does the use of adult stem cells cause fewer ethical issues than the use of embryonic stem cells?

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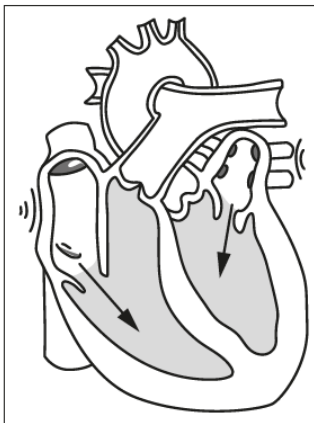
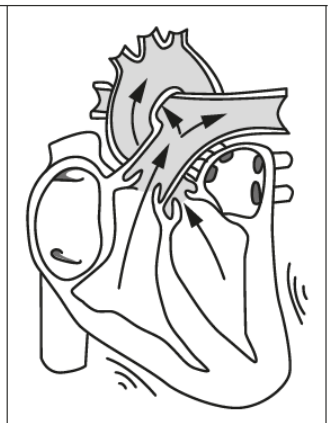
..... **[2]**

This question was mostly answered well but many candidates referenced killing children or babies rather than the idea of potential life for marking point 3. Many candidates did not seem to be aware that the embryos would be killed, and used terms like 'harming embryos'

Question 5 (d)

(d) The diagrams show two stages of the heartbeat. The shading shows which chambers and arteries contain blood at the end of each stage. The arrows show the direction in which the blood moved.

Put ticks (✓) in the boxes that correctly describe each stage.

		
Atria contracting		
Ventricles contracting		
Valves between atria and ventricles shut		

[2]

Many candidates did not appear to understand this diagram. Many candidates only ticked 2 boxes.

Question 6 (a) (i)

6 A scientist investigated how maggots respond to light.

She set up a card circle with a light source on one side. Four areas were marked on the card circle. Maggots were placed on the centre of the circle as shown in **Fig. 6.1**.

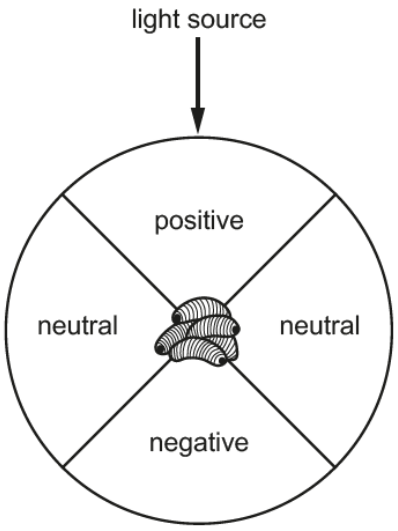


Fig. 6.1

The light was switched on and the maggots moved on the card circle. The number of maggots in the positive, negative and neutral areas was recorded after three minutes.

The experiment was repeated using four different light intensities.

The scientist put her results in a table.

Light intensity (arbitrary units)	Percentage of maggots recorded in each area (%)		
	Positive	Negative	Neutral
1	30	35	36
2	27	56	17
3	18	78	4
4	0	92	8

(a) (i) Use the data in the table to suggest the **lowest** light intensity that can be detected by the maggots.

Explain your answer.

Light intensity ..... arbitrary units

Explanation .....

.....

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

Many candidates identified the correct light intensity but very few were able to correctly identify that over 50% of maggots had moved away from the light. Many candidates just repeated the data; in this case that was not creditworthy.

Question 6 (a) (ii)

(ii) Suggest how the scientist could develop the investigation to find out whether maggots can detect different colours of light.

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

The majority of candidates put use different colours of light but did not give any suggestions as to how to achieve this. Many candidates did recognise that the light intensity should stay the same.

Question 6 (b)

(b) Maggots can respond to stimuli such as light because they have a nervous system. Neurons in the nervous system connect to each other at synapses.

Fig. 6.2 shows a synapse.

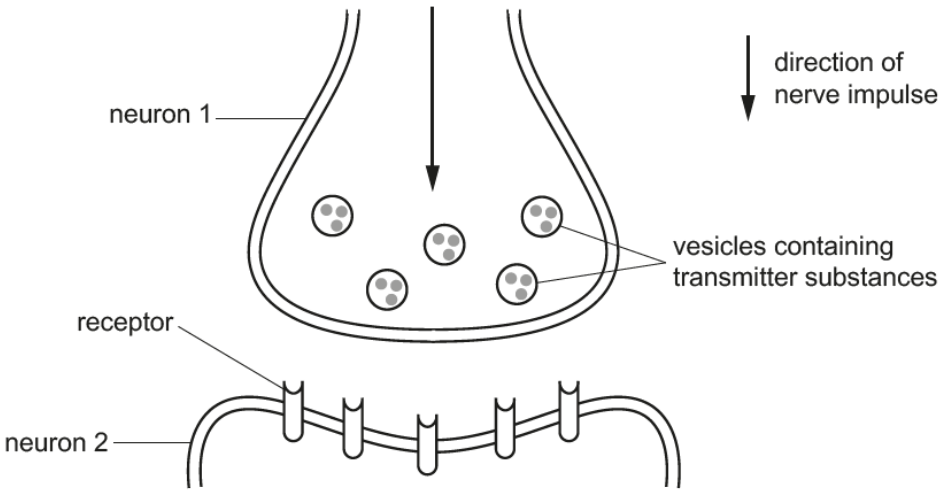

Fig. 6.2

Use **Fig. 6.2** to explain the role of transmitter substances in transmitting impulses between neurons.

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

Candidates did not appear to understand the diagram and very few appeared to realise that the electrical and chemical messages were different. The final marking point was seen very rarely. When candidates did score it was generally from marking points 3 and 4.

Question 7 (a) (i)

7 Plants transport sucrose (sugar) in their phloem vessels by translocation.

Fig. 7.1 shows a model of translocation.

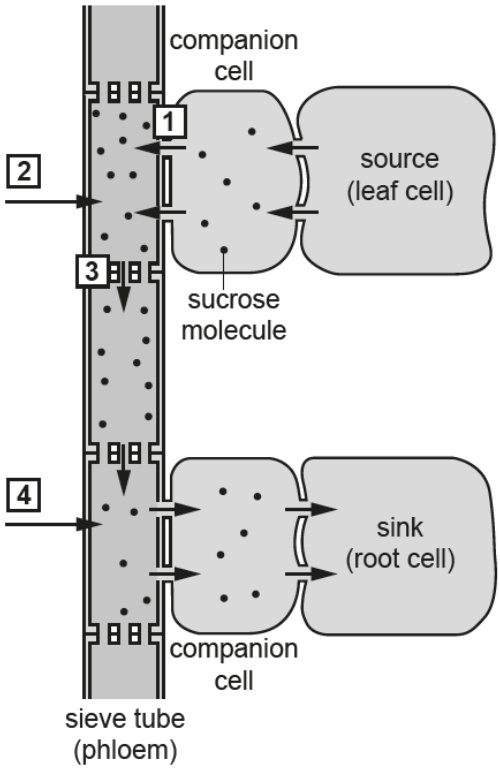

Fig. 7.1

(a) (i) Which numbered arrow in **Fig. 7.1** shows active transport?

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

[1]

Most candidates did not know the answer to this question.

Question 7 (a) (ii)

(ii) Which numbered arrows in **Fig. 7.1** show osmosis?

Tick (✓) **two** boxes.

1 ☐

2 ☐

3 ☐

4 ☐

[1]

The majority of candidates only ticked one box for this response.

Question 7 (a) (iii)

(iii) Explain why active transport can take place in phloem but **not** in xylem.

.....

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

When credit was given it was usually for knowing that xylem is dead. Many candidates did not link respiration to living cells.

Question 7 (a) (iv)

(iv) Companion cells contain soluble proteins.

Explain why these proteins cannot diffuse across the cell membrane into the phloem.

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

Quite a few candidates said that the membranes were not partially permeable. Very few linked the size of the proteins.

Question 7 (b)

(b) **Fig. 7.2** shows a cross section through a leaf, as seen with a light microscope.

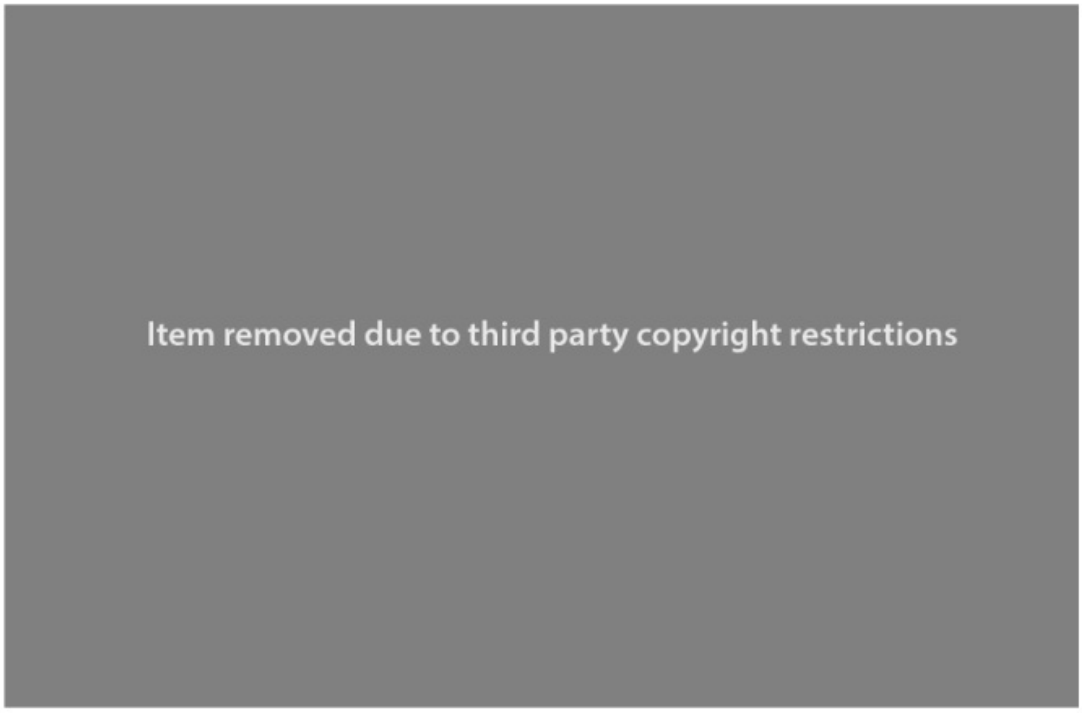

Fig. 7.2

Describe how you could make a temporary slide of a cross section through a leaf.

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

Many candidates described using nail varnish to see cross sections. Candidates who appeared unfamiliar with this practical, found this question challenging.

Copyright information

Q2b, Fig. 2.2

Adapted from 'Herring Stocks - North Sea (North of 53°30'N), from 'Fish and Shellfish Stocks: 2015 Edition', Scottish Government, www.gov.scot, 2015. Reproduced under the terms of the Open Government Licence v3.0.

Q3a(ii), Fig. 3.1

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General qualifications

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