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OCR
Oxford Cambridge and RSA

AS LEVEL

Examiners' report

BIOLOGY A

H020

For first teaching in 2015

H020/01 Summer 2022 series

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 are 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.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 1 series overview

H020/01 Breadth in Biology is one of two examined components of AS Level Biology A. The component tests content from four modules:

- Module 1: Development of practical skills in biology
- Module 2: Foundations in biology
- Module 3: Exchange and transport
- Module 4: Biodiversity, evolution, and disease

To do well in this component candidates need to have a good level of knowledge and understanding of the basic concepts underlying biology. These include cell biology, biological chemistry, exchange structures, transport systems, biodiversity, and evolution. Candidates should also have experience of carrying out practical work including planning, use of equipment to measure and model the processes occurring in living things.

Candidates must read questions carefully, interpret the question and write in clear concise language, to allow them to become more confident in their answers. It is also important that candidates understand and use scientific terms and language effectively.

Candidates who did well on this component used suitable scientific terminology in clear concise answers. This could be seen in the longer response questions such as Question 21 (c) (iii) where good outlines of protein synthesis were given sufficient detail and in Question 25 (a) (ii) where descriptions of the properties of water were applied to the transport of substances in plants. Candidates who did well also gave brief working in the mathematical questions such as Questions 22 (b) (i) and 24 (b).

Candidates who did less well on this component did not provide detailed answers or correct definitions of key principles. They were also not able to use scientific terminology accurately. This could be seen clearly in Question 22 (a).

Overall candidates did well at the mathematical aspects in this paper, many candidates appeared confident in their maths skills. They also appeared to have a good appreciation of the requirements for biological chemistry. Many were able to demonstrate a good understanding of the genetic code and protein synthesis in Question 21 as well as a good knowledge of the structure and properties of water in Question 25 (a).

In general candidates struggled with the concepts of population genetics in Question 22. It was apparent that they had a good grounding in natural selection and conservation, but they were less successful in expanding those concepts. Another area where candidates showed a lower performance was in the more practical based questions such as the model of sucrose loading in the phloem (Question 24). Candidates did not appear to have a deep understanding of the behaviour of molecules in solutions so they were less likely to predict what would happen in the model. This could be due to insufficient experience of practical work and interpretation of models.

Centres should be aware of the need to cover all parts of the specification content for this component including the practical skills as outlined in Module 1.

Centres should also be aware that OCR provides a range of teaching and learning resources via their website, such as schemes of work, teaching activities, MCQ (word and digital) quizzes, delivery guides and handbooks: https://ocr.org.uk/qualifications/as-and-a-level/biology-a-h020-h420-from-2015/

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• read the questions thoroughly • used suitable scientific terms correctly • related theoretic ideas to what occurs inside living things • used clear, concise language • had learned the details of biological processes.	• did not read the question carefully • did not interpret the question fully • repeated the question in their response • used imprecise language with few scientific terms • left blank spaces rather than attempting an answer.

Section A overview

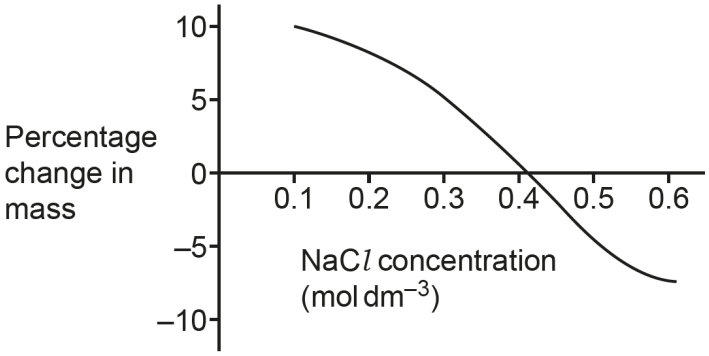
There was a wide variation in ability displayed in Section A. This section gave a good discrimination between candidates.

Some candidates still alter their responses and leave a letter which is illegible. Candidates should be advised to clearly cross out any incorrect response and re-write their response next to the answer box.

A few candidates leave the answer box blank when they are unsure of the correct answer. Candidates should be advised to complete all questions as, even if they are unsure, they will still have a chance of guessing the correct response.

Question 1

1 The graph below shows the results of an osmosis experiment investigating the effect of changing the concentration of sodium chloride (NaC*l*) on mass of potatoes.



Which concentration of NaC*l* causes equal movement of water into and out of the potato?

A 0.36 mol dm^{-3}

B 0.40 mol dm^{-3}

C 0.42 mol dm^{-3}

D 0.62 mol dm^{-3}

Your answer [ ] **[1]**

Most candidates correctly identified C as the required value. The most common incorrect response appeared to be B.

Assessment for learning

Candidates should read the axes of graphs carefully and read all the possible responses before committing to an answer.

Question 2

2 The reaction between carbon dioxide and water forms carbonic acid. This reaction is catalysed by the enzyme carbonic anhydrase. To catalyse this reaction, carbonic anhydrase needs a cofactor that attaches to its active site as a prosthetic group.

What is the correct cofactor for carbonic anhydrase?

A Ca^{2+}

B Cl^{-}

C H^{+}

D Zn^{2+}

Your answer ☐ **[1]**

Only a minority of candidates chose the correct response (D). There was no obvious pattern to the incorrect answers which suggests this was a matter of guesswork for many candidates.

Question 3

3 The table shows the numbers of different species of invertebrates found in four different areas in a woodland.

Area	Invertebrate species			
	Woodlice	**Spiders**	**Beetles**	**Millipedes**
A	15	20	1	0
B	2	7	6	7
C	25	1	7	3
D	8	0	2	17

Which row shows the area that has the greatest species richness **and** greatest species evenness?

Your answer ☐ **[1]**

Most candidates gave the correct response (B). The most common incorrect response appeared to be C. Option C was the distractor in this question, where it shows a great species richness but it doesn't have the greatest species evenness, with 'Spiders' having only one species.

Question 4

4 The table shows the chemical symbols for some inorganic ions involved in biological processes.

	Ammonium ion	**Calcium ion**	**Nitrate ion**
A	NH_4^+	Ca^+	NO_2^-
B	NH_4^-	Ca^{2+}	NO_3^-
C	NH_4^+	Ca^{2+}	NO_3^-
D	NH_4^+	Ca^{2+}	NO_2^-

Which row gives the correct chemical symbols for all of these inorganic ions?

Your answer ☐ **[1]**

Most candidates gave the correct response (C). The most common incorrect responses appeared to be D and B.

Question 5

5 Researchers have calculated that the probability of bacterial DNA having a mutation is 1/333 in a single division.

A gene has DNA that codes for amino acids and is called coding DNA. The rest of the DNA in a genome has base sequences that do not code for amino acids and is called non-coding DNA.

Bacterial genome studies have shown that the average proportion of a bacterial genome that has non-coding DNA is 3/25.

What is the probability of a dividing bacterium having a mutation in a gene that codes for a protein in a single division?

A 1/2775

B 22/8325

C 1024/8325

D 7351/8325

Your answer ☐ **[1]**

Most candidates gave the correct response (B). The most common incorrect responses appeared to be A and C. Candidates who chose A as the correct option, didn't read the question carefully. Instead of calculating the probability of having a mutation in a gene that codes for a protein they calculated the probability of a non-coding DNA.

In order for candidates to get the correct answer they had to first identify the proportion of coding DNA (22/25) and multiply that with the probability of having a mutation (22/25 * 1/333).

Question 6

6 Restriction endonucleases are a group of enzymes that carry out hydrolysis reactions that cut long DNA molecules into shorter lengths.

Which of the options describes how restriction endonucleases carry out hydrolysis reactions on a DNA molecule?

A They break the glycosidic bond between a ribose and a phosphate group.

B They break the hydrogen bonds between nitrogenous bases.

C They break the phosphodiester bond between a deoxyribose and a phosphate group.

D They break the phosphodiester bond between a ribose and a phosphate group.

Your answer ☐ **[1]**

Most candidates gave the correct response (C). The most common incorrect response appeared to be B, which was the distractor in the question. Candidates who did chose B misinterpreted the question, with unzipping of DNA rather than cutting the DNA molecule.

Misconception

Candidates seem to have a misconception with the function of restriction endonuclease enzymes and how sections of DNA can be obtained.

Question 7

7 A student carried out an investigation to see the effect of changing the concentration of the enzyme maltase. They used two different maltase concentrations (concentration **P** and **Q**) to break down the disaccharide maltose for 10 minutes. The student carried out the reducing sugar test and recorded the percentage absorbance of each solution using a colorimeter.

Their results are shown in the table.

Absorbance (arbitrary units)	
Maltase concentration P	**Maltase concentration Q**
0.235	0.452
0.253	0.523
0.436	0.541
0.258	0.361
0.224	0.256
0.236	0.236

Which statistical test would be used to determine if there was a significant difference between the mean glucose concentration produced by maltase concentration **P** and maltase concentration **Q**?

A Chi-squared test

B Spearman's rank correlation coefficient

C *t*-test – paired

D *t*-test – unpaired

Your answer ☐ **[1]**

Many candidates recognised that the t-test was the most appropriate test to compare two mean values. However, fewer were able to select between paired and unpaired tests correctly.

OCR support

The use of paired and unpaired t-tests is described in the Mathematical Skills Handbook available at:

https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf

OCR has also additional support on statistics:

https://www.ocr.org.uk/Images/346170-graphs-tables-and-drawings-student-checklists.doc

https://www.ocr.org.uk/subjects/science/maths-for-biology/handling-data/

Question 8

8 International trade in parts of the rhinoceros including rhino horn has been illegal since 1977.

Which organisation regulates this trade?

A CBD

B CITES

C CSS

D IUCN

Your answer ☐ **[1]**

The vast majority of candidates correctly identified B as the correct organisation.

Question 9

9 The following passage has four key terms missing, which are names of molecules involved in protein synthesis.

The enzyme .....**1**..... joins nucleotides together to make a copy of the gene. This makes the molecule .....**2**..... , which leaves through the nuclear pore to bind to an organelle that is made of protein and .....**3**..... . The amino acids are assembled here when .....**4**..... brings the specific amino acid to be joined to the polypeptide.

Which row gives the correct names of these missing molecules?

	1	2	3	4
A	DNA polymerase	(t)RNA	(m)RNA	(r)RNA
B	RNA polymerase	(m)RNA	(r)RNA	(t)RNA
C	RNA polymerase	(m)RNA	(t)RNA	(r)RNA
D	RNA polymerase	(r)RNA	(t)RNA	(m)RNA

Your answer ☐ **[1]**

Most candidates gave the correct response (B). The most common incorrect responses appeared to be A and C.

Question 10

10 *Victoria cruziana* is a tropical species of flowering plant, native to South America. Its leaves have stomata only on their upper surface and contain a large amount of aerenchyma tissue, which contains air spaces.

Which group of plants does *Victoria cruziana* belong to?

A Epiphytes

B Halophytes

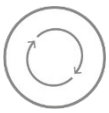
C Hydrophytes

D Xerophytes

Your answer ☐ **[1]**

Most candidates gave the correct response (C). The most common incorrect response appeared to be D.

Assessment for learning



It is important for candidates to be able to understand scientific words rather than just memorise them. In this case breaking down scientific words into prefixes would have helped them identify plants' habitats, when choosing between C and D.

The glossary from OCR, can be used to expand the scientific words students identify throughout the course:

https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/Images/123-235347-asa-biologya-cell-structure-dg-lr4.pdf

Alternative resources:

http://www.biologyreference.com/

Question 11

11 The temperature coefficient (Q_{10}) for catalase is recorded in a data book as 1.15.

A student carries out an experiment to test if this Q_{10} value is correct and collects data with a high level of precision and accuracy.

Which row shows the correct definition of both precision and accuracy for their data?

	Precision	Accuracy
A	results have a small standard deviation	mean result is close to 1.15
B	results have a small standard deviation	repeated readings close together
C	results recorded to a high number of decimal places	mean result is close to 1.15
D	results recorded to a high number of decimal places	repeated readings close together

Your answer [ ] **[1]**

Relatively few candidates gave the correct response (A). All other distractors were seen. Candidates must learn and understand these definitions.

For this question candidates are required to have a good understanding of the Language of measurement as well as other maths skills such as standard deviation.

Precise results are clustered together, while standard deviation gives an indication of how spread the data is around the mean and accuracy is a property of a single result.

OCR support

Definitions of these terms are provided in the Practical Skills Handbook available at: https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

OCR has also produced a specific resource on 'Language of measurement' within a biology context: https://www.ocr.org.uk/Images/577369-language-of-measurement-in-context-biology.docx

Question 12

12 The table shows the dimensions of a dividing ball of cells and their surface area to volume ratios.

Number of divisions	Number of cells	Radius (mm)	Surface area (mm^2)	Volume (mm^3)	Surface area to volume ratio
0	1	0.5	3.14	0.52	6 : 1
3	8	1.0	12.57	4.19	3 : 1
5	32	1.5	28.27	14.14	2 : 1
6	64	2.0	50.27	33.51	

What is the best estimate of the surface area to volume ratio after the cell has divided six times?

A 7 : 4

B 3 : 2

C 5 : 4

D 1 : 1

Your answer ☐ **[1]**

Relatively few candidates gave the correct response (B). The most common incorrect responses were D and C.

OCR support

There is more support on 'Ratios' on OCR 'Maths for Biology' website, under the 'Ratios, fraction and percentages' tutorial:

https://www.ocr.org.uk/subjects/science/maths-for-biology/arithmetic-and-numerical-computation/

Question 13

13 Cells in the leaves of plants synthesise amino acids.

Which of the statements explains why plants need a vascular system to support amino acid synthesis?

A To transport amino acids to the roots using xylem tissue

B To transport nitrates to the leaves using phloem tissue

C To transport nitrates to the leaves using xylem tissue

D To transport sucrose to the leaves using phloem tissue

Your answer [ ] **[1]**

Relatively few candidates gave the correct response (C). The most common incorrect response appeared to be D. Candidates need to think carefully and link different parts of the syllabus together – here they should appreciate that nitrates are required to manufacture amino acids, and also the fact that xylem tissue doesn't carry only water but also essential mineral ions.

Question 14

14 Fick's Law describes the relationship between the rate of diffusion and factors that affect this rate.

This can be simplified as the equation:

$$\text{Rate of diffusion } \alpha \frac{\text{surface area} \times \text{concentration gradient}}{\text{thickness of surface}}$$

Inhalation of asbestos dust can cause a thickening of the alveolus wall.

Which option shows the change in the rate of diffusion if the alveolus wall increases from a thickness of 2.0 μm to 2.5 μm?

A Decreases by 20%

B Decreases by 50%

C Increases by 20%

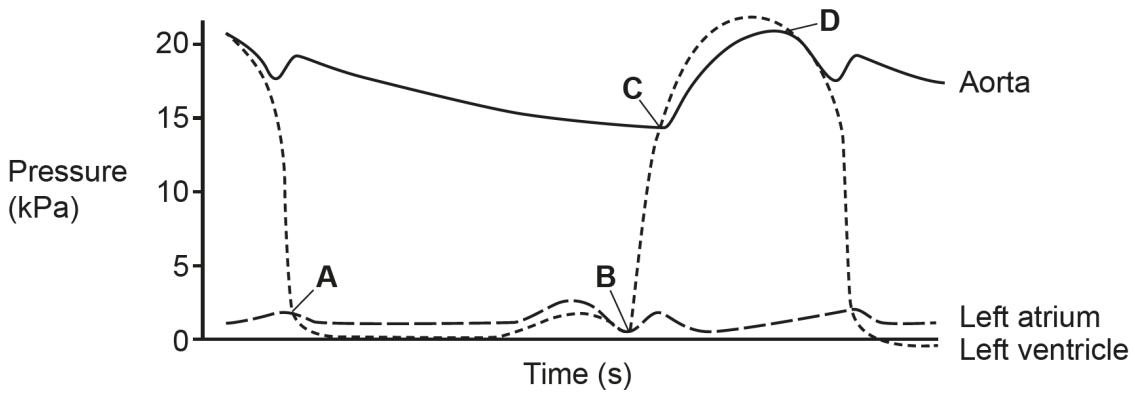
D Increases by 50%

Your answer ☐ **[1]**

Most candidates gave the correct response (A). The most common incorrect response appeared to be C showing that candidates had thought about the correct proportion (20%) but did not understand the significance of the effect of increasing the thickness. Alternatively, candidates may have misread the question as 'what is the % change in thickness of the alveolus wall'.

Question 15

15 The diagram shows the changes in pressure in the left atrium, left ventricle and aorta in a single cardiac cycle.



Which letter shows the point at which the semilunar valve opens?

Your answer [ ] **[1]**

Only a minority of candidates gave the correct response (C). The most common incorrect responses were B and D. Candidates need to practice at interpreting this sort of diagram and relating it to the action of the heart.

Question 16

16 Diseases can be caused by many different types of pathogen.

Which row matches the disease to the correct pathogen?

	Fungus	Protoctist	Virus
A	black sigatoka	tomato late blight	influenza
B	black sigatoka	tomato late blight	ring rot
C	tomato late blight	black sigatoka	influenza
D	tomato late blight	black sigatoka	ring rot

Your answer [ ] **[1]**

Most candidates gave the correct response (A). The most common incorrect response appeared to be C.

Question 17

17 Which option describes the correct process of blood clotting?

A Platelets convert into insoluble fibrin to trap erythrocytes.

B The insoluble plasma protein fibrinogen converts into soluble fibrin to trap erythrocytes.

C The soluble plasma protein fibrinogen converts into insoluble fibrin to trap erythrocytes.

D The soluble plasma protein fibrinogen converts into soluble fibrin to trap erythrocytes.

Your answer [ ] **[1]**

Most candidates gave the correct response (C). The most common incorrect response appeared to be A. Candidates need to read all the answer options before committing to a response.

Question 18

18 A student is studying three unicellular organisms: the bacterium *Escherichia coli*, the protoctist *Euglena gracilis* and the fungus *Saccharomyces cerevisiae*.

Which feature is common to all three unicellular organisms?

A Cell wall

B Mitochondria

C Nucleus

D Ribosomes

Your answer [ ] **[1]**

Only a minority of candidates gave the correct response (D). The most common incorrect responses were A and B. Candidates should appreciate that protein synthesis is one of the most fundamental requirements for life and therefore all organisms possess ribosomes.

Question 19

19 Convalescent plasma immunity is one method used to treat patients infected with Ebola virus disease (EVD). In this method, blood plasma is taken from a person who has recovered from EVD and is injected into the patient with the EVD infection.

Which of the options describes this form of immunity?

A Artificial active immunity

B Artificial passive immunity

C Natural active immunity

D Natural passive immunity

Your answer ☐ **[1]**

Only a minority of candidates gave the correct response (B). The most common incorrect responses were A and C.

Question 20

20 An enzyme hydrolyses a phospholipid molecule to release a fatty acid.

What is the name of the bond that is broken in this hydrolysis reaction?

A Ester

B Glycosidic

C Peptide

D Phosphodiester

Your answer ☐ **[1]**

The majority of candidates gave the correct response (A).

Section B overview

The questions in Section B covered a wide range of topics and tested each topic at different levels of demand. This enabled the more able candidates to display the depth of their knowledge and understanding while even the less able candidates were able to score well.

Too many candidates are still not using scientific terminology precisely or correctly. In particular there is evident confusion over the correct use of terms in genetics, for example many candidates appear to use the terms 'allele' and 'gene' interchangeably. Also, many candidates did not appear to understand what was meant by a 'polymorphic gene locus'.

Candidates find it hard to understand and relate to the modelling of systems such as the model of how sucrose is loaded into the sieve tubes seen in Question 24. They need to be exposed to such models/representations so that they can appreciate how they are related to the theory they have learned or the process that occurs in the living organism.

While maths skills have improved, many candidates seem to lack confidence in interpreting and manipulating numerical data. This was seen in scripts where the answer space was covered in long and complex calculations.

Question 21 (a)

21 Human insulin is a globular protein with a quaternary structure. One insulin molecule has 51 amino acids.

Fig. 21.1 shows the sequence of amino acids in one molecule of human insulin.

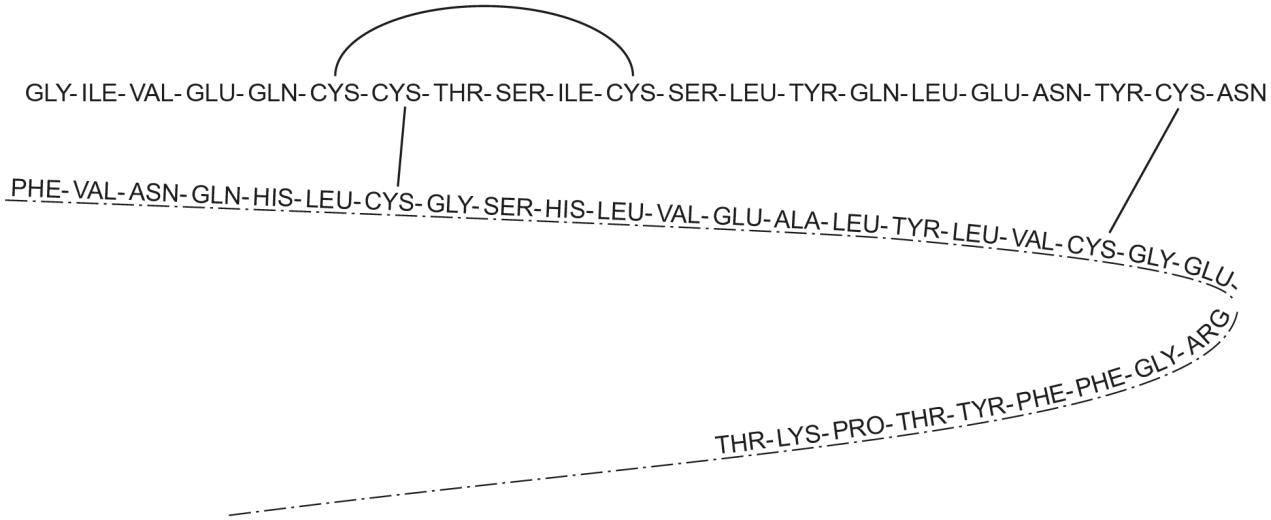


Fig. 21.1

(a) The amino acid cysteine is abbreviated to 'CYS' in **Fig. 21.1**. The side chain (R group) found in cysteine is shown in **Fig. 21.2**.

Complete **Fig. 21.2** to show the structure of the amino acid cysteine.

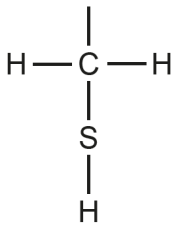


Fig. 21.2

[3]

Many candidates knew the general formula for an amino acid and drew this to the side, but they didn't gain any marks as the question specifically stated to 'complete Fig. 21.2'. Only a few candidates were able to interpret the figure provided as just the R group and clearly added the remainder of the molecule. A common error was to use the carbon atom of the R group as the central carbon atom of the amino acid and convert the hydrogen atoms into amine groups or carboxylic acid groups.

Question 21 (b)

(b) Explain how **Fig. 21.1** shows that insulin has a quaternary structure.

.....

.....

.....

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

The figure clearly shows two polypeptide chains, and the chains are joined by bonds between cysteine residues. Many candidates simply described what is meant by a quaternary structure as having 'more than one' or 'many' polypeptide chains. Many candidates also correctly stated that there were disulfide bonds between cysteine residues but did not point out that these were on separate chains and therefore joined the chains together. Only a minority of candidates were able to appreciate the detail provided in figure 21.1 and state correctly the two required features.

Assessment for learning

Candidates should read the question carefully. They should appreciate that the question refers to the insulin molecule in the figure rather than to a generalised protein with a quaternary structure. A reference to the figure is essential to gain marks.

Question 21 (c) (i)

(c) Insulin is a hormone that regulates blood glucose concentration. People with type 1 diabetes need to inject insulin, to reduce their blood glucose concentration, as they are unable to produce their own insulin.

Diabetics need to inject insulin before every meal as insulin has a short half-life. Enzymes in the liver cells break down insulin, which removes it from the blood.

Insulin glargine is a modified version of human insulin that lasts much longer in the blood.

Fig. 21.3 shows the sequence of amino acids in one molecule of human glargine with the modifications in **bold**.

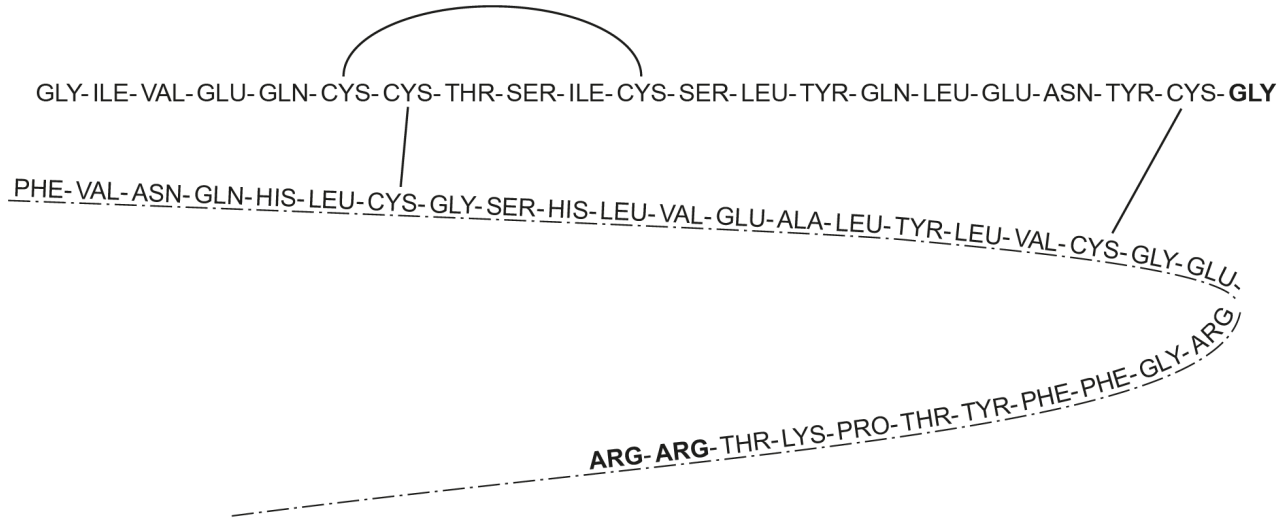


Fig. 21.3

(i) Suggest why insulin glargine is long-lasting.

.....

.....

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

The most able candidates were able to spot that there would be a change in the tertiary structure which would mean the molecule was no longer fully complementary in shape to the active site of the enzyme. However, this was often worded simply as 'the molecule is harder to break down'. This simplified mark point was accessed by many more candidates.

Very few candidates were able to make the link between the change in primary structure and the resulting change in the tertiary structure. Many suggested that simply making the polypeptide longer meant there were more bonds to break and so this would take longer.

Question 21 (c) (ii)

The table shows some of the DNA triplet codes for amino acids.

1st base of DNA triplet	2nd base of DNA triplet								3rd base of DNA triplet
	T		C		A		G		
A	ATT	(ILE) Isoleucine	ACT	(THR) Threonine	AAT	(ASN) Asparagine	AGT	(SER) Serine	T
	ATC		ACC		AAC		AGC		C
	ATA		ACA		AAA	(LYS) Lysine	AGA	(ARG) Arginine	A
	ATG	(MET) Methionine	ACG		AAG		AGG		G
G	GTT	(VAL) Valine	GCT	(ALA) Alanine	GAT	(ASP) Aspartic acid	GGT	(GLY) Glycine	T
	GTC		GCC		GAC		GGC		C
	GTA		GCA		GAA	(GLU) Glutamic acid	GGA		A
	GTG		GCG		GAG		GGG		G

In order to produce insulin glargine, the human insulin gene is modified by genetic engineering. This is a process which can change the genetic code of the gene. The genetic code of DNA triplet 21 is changed so that the amino acid it codes for is glycine instead of asparagine.

(ii) With reference to the table, predict how the genetic code of DNA triplet 21 is changed so that it codes for the amino acid glycine instead of the amino acid asparagine.

.....

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

Most candidates were able to extract the correct information from the table and gain full credit. The most common error was not making it clear that <u>both</u> adenine bases were replaced by guanine.

A small number of candidates seemed to be unfamiliar with using DNA code data tables and referred to ASN (Asparagine) or GLY (Glycine) as the code or codon being altered; they were apparently unaware that these are just the accepted abbreviations for amino acids. Other candidates misread the question and used the code for arginine rather than the code for asparagine.

Question 21 (c) (iii)

(iii) The modified polypeptides that form insulin glargine are made inside cells.

The process of making the modified polypeptides that form insulin glargine involves several steps. The process starts with the modified gene for insulin glargine.

Outline the steps involved in the process of making the modified polypeptides that form insulin glargine, starting with the gene for insulin glargine until when the modified polypeptides are made.

.....

.....

.....

.....

.....

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

Those candidates that read the question correctly often did very well, gaining 3 or 4 marks. Some excellent responses were seen with well-sequenced and detailed accounts. The majority of the candidates showed good knowledge and understanding of the production of mRNA followed by leaving the nucleus or going to the ribosomes. Less well known was the fact that the tRNA has a specific anticodon and brings a specific amino acid to the ribosome. The formation of peptide bonds was often missed out.

Many of the more able candidates continued beyond the requirement of the question, (e.g., to the point where the polypeptide is made) and gave details of the transformations required to produce the quaternary structure of the protein.

Many candidates did not use the terms 'transcription' and 'translation'.

Unfortunately, a relatively large number of candidates did not read the question with sufficient care. Having seen the references to genetic engineering they then gave an account of that process to describe how the gene could be modified to produce insulin glargine.

Another common error was that candidates described DNA replication rather than transcription.

Exemplar 1

- DNA molecules in the nucleus are unzipped by DNA helicase and free nucleotides attach to each base by complementary base pairing making an mRNA molecule
- This leaves the nucleus through the nuclear pores and attaches to a ribosome.
- The tRNA brings specific amino acid to be joined on to the peptide.
- tRNA breaks off and an amino acid has formed

..... [4]

Exemplar 1 shows a typical response that gives a clearly sequenced outline, but that could with more detail to gain full marks. This response was given 2 marks for production of mRNA and the mRNA leaving the nucleus. More marks could have been achieved if more detail of translation had been given. For example, stating that the tRNA has a specific anticodon that is complementary to the codon on the mRNA which ensures the specific amino acid is held in the correct position. Naming the peptide bond used to join the amino acids together would also gain credit.

Question 22 (a)

22 A student gives a definition of one level of biodiversity as:

The number of different alleles for all the genes in a population.

(a) Name **and** define **two** other levels of biodiversity.

Name .....

Definition .....

.....

Name .....

Definition .....

.....

[2]

Many more able candidates scored well here. However, less successful candidates did not read the question with sufficient care and defined the terms 'species' and 'habitat'. Others used 'species richness' and 'species evenness' as their types of biodiversity. A few candidates did not know their definitions well and confused the issue by writing things like 'the number of species in a population'.

Question 22 (b) (i)

(b) During the 20th Century, there was a very large decrease in the size of wild populations of the cheetah, *Acinonyx jubatus*. This decrease was largely due to hunting. Recent research shows that wild populations of the cheetah have a very low number of polymorphic genes.

There are 17 863 gene loci in the genome of the cheetah and now only 10% of these gene loci are polymorphic in wild populations.

Scientists investigated the genetic biodiversity of cheetah populations in European zoos. They sampled 256 gene loci and found 18 gene loci to be polymorphic.

(i) Calculate the proportion of polymorphic gene loci in the European zoo population.

Proportion = ... **[2]**

The majority of candidates were able to calculate the correct proportion. In common with other questions of this type, however, there were a significant number of candidates who are not confident with the manipulation of numerical data.

There are still too many candidates who do not show their working and so potentially lose a mark if they get the incorrect answer.

Question 22 (b) (ii)

(ii) A second group of scientists carried out a separate investigation to calculate the proportion of polymorphic gene loci of cheetahs in European zoos and found that their results were different. These new results were accepted as being accurate.

Suggest **two** reasons why the calculated proportion of polymorphic gene loci in the European zoo population of cheetahs might have been less accurate in the investigation carried out by the first group of scientists.

1 .....

.....

.....

2 .....

.....

.....

[2]

Many candidates appreciated that sample size was important but, in general, this question has a low performance. Most candidates attempted a response but, more often than not, this revealed a lack of understanding of the topic.

A lot of candidates did not read the question carefully and thought some of the cheetahs sampled were in the wild rather than in zoos. Less able candidates seem to think that there are lots of different species of cheetah.

Misconception

Two common misconceptions were seen: that technology / equipment in the 20th Century was at a primitive level compared to now and that natural selection and evolution has changed the appearance and genotypes of cheetahs significantly since the 20th Century.

Question 22 (b) (iii)

(iii) Suggest **and** explain reasons why, in the 21st Century, only 10% of the gene loci are polymorphic in wild populations of cheetah.

.....

.....

.....

.....

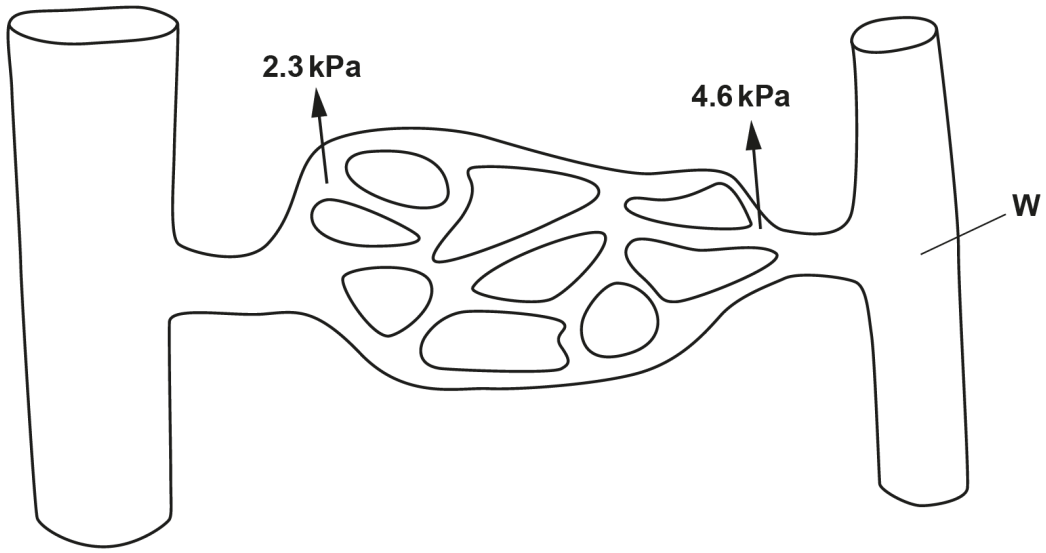
.....

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

The majority of candidates seemed to interpret the question as 'give reasons why the cheetah populations declined'. Those candidates that ventured into population genetics revealed a poor understanding. Few seemed to appreciate that if the population becomes very small then the gene pool is small. This means that genetic diversity is significantly reduced due to the loss of alleles, and it follows that the proportion of polymorphic loci would be lower. Less successful candidates seemed to think that a polymorphic gene locus was a type of allele that gave a selective advantage or disadvantage to the possessor.

Question 23 (a) (i)

23 The diagram shows the change in hydrostatic pressure across a capillary network in muscle tissue.



(a) (i) **On the diagram**, draw an arrow to show the direction of movement of blood through the capillary network. **[1]**

Most candidates were able to give the correct direction of flow but less able candidates did not realise that the blood would flow from the higher hydrostatic pressure toward the lower pressure or that the relative width of the main blood vessels revealed which was the arterial side and which was the venous side.

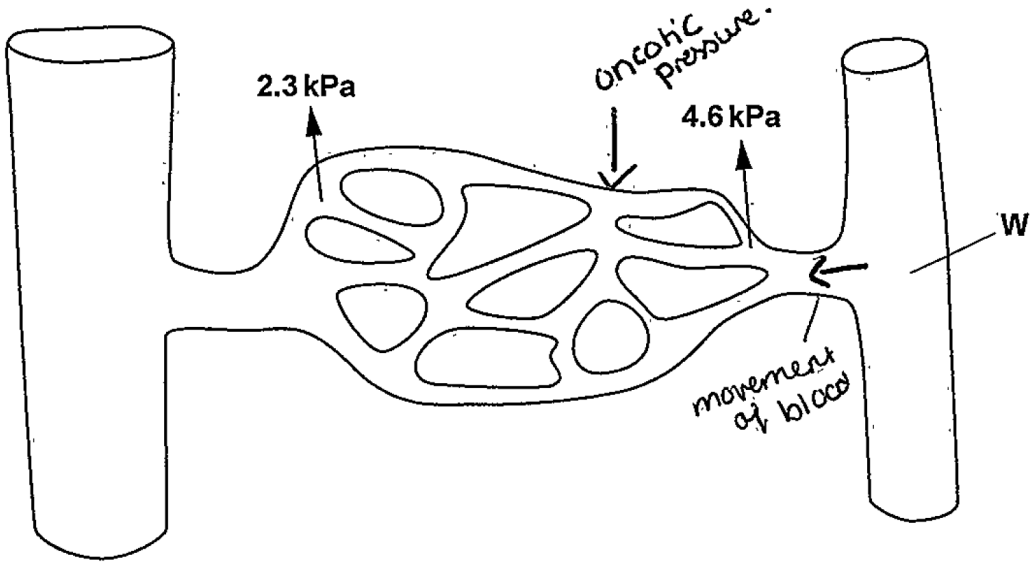
Question 23 (a) (ii)

(ii) **On the diagram**, draw an arrow to show the direction in which oncotic pressure is acting **and** suggest a value for oncotic pressure.

Write the value for oncotic pressure next to the arrow. **[2]**

The most able candidates drew correct arrows and labelled each arrow to make it clear which arrow answered which question – as shown in the exemplar below. However, few candidates were able to gain any credit here. It seems that many candidates were not confident with the term oncotic pressure (this is reinforced by their responses to 23b seen below). Commonly an arrow going across the diagram in the opposite direction to blood flow was given. Where a correct arrow was shown it was rare that a suitable value for the pressure was stated.

Exemplar 2



Exemplar 2 shows an example of correctly drawn arrows.

Question 23 (a) (iii)

(iii) Name the structure labelled **W**.

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

A low proportion of candidates scored the mark here. It seems that candidates are not familiar with the term 'arteriole'. Responses included 'artery', 'vein' and 'blood vessel'.

Question 23 (b)

(b) Describe how oncotic pressure is established.

.....

.....

.....

.....

.....

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

It was clear that very few candidates were confident with what oncotic pressure is. Most of the candidates either left this blank or explained it as being blood pressure or hydrostatic pressure. The majority of answers made no mention of 'plasma proteins' or 'water potential'.

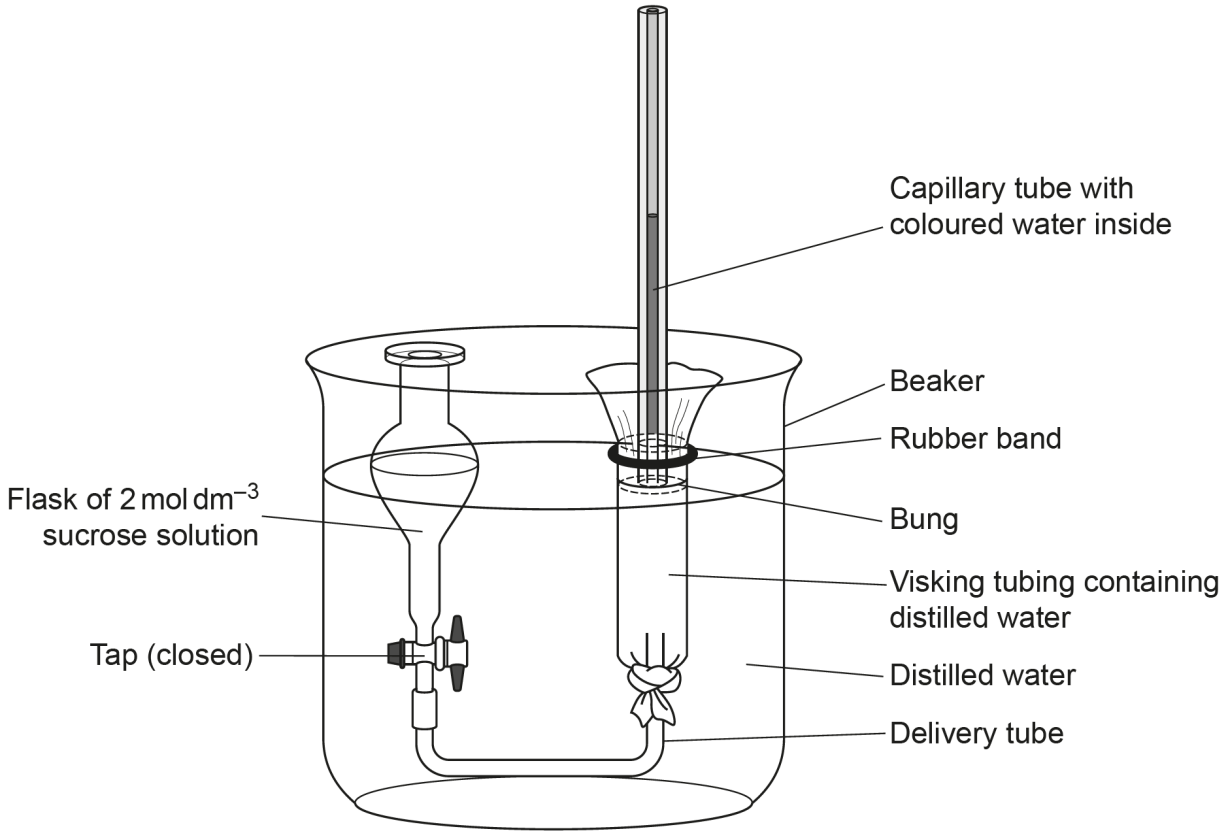
It was not clear whether the term 'oncotic pressure' was unfamiliar to candidates or whether the detail of tissue fluid formation was simply unknown to them. Candidates did not understand the role of plasma proteins in creating a water potential gradient nor the implication of the reduced hydrostatic pressure at the venule end of the capillary bed. Even the most able candidates who had the idea of a water potential gradient being created often referred to tissue fluid or blood moving in and out of capillaries.

Question 24 (a) (i)

24 A student is investigating how sucrose is loaded into phloem sieve tubes by companion cells, using a model of phloem tissue.

To create the model, the student added distilled water to a bag made from Visking tubing (an artificial partially permeable membrane). They inserted a capillary tube into one end of the Visking tubing and connected the other end to a flask containing 2 mol dm^{-3} sucrose solution.

They placed the Visking tubing and connected flask into a beaker of distilled water, as shown in the diagram.



The capillary tube, the flask and the beaker of distilled water represent plant tissues involved in the active loading of sucrose. The Visking tubing represents the cell surface membrane of the phloem sieve tube.

The student opens the tap on the flask and the level of the coloured water in the capillary remains the same. After a few minutes, the water level in the capillary tube starts to rise. The tap is then closed after 5 minutes.

(a) (i) Describe what happens inside the model, immediately after the tap on the flask is opened.

.....

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

Only the most able candidates scored well here. The uncertainty about the role of osmosis continued into this question. It was clear that many candidates were not confident with the nature of an aqueous solution, osmosis or diffusion. Most candidates did not understand that sucrose molecules diffused from the flask into the Visking tubing. Many suggested that the sucrose solution moved or even diffused into the Visking tubing.

Question 24 (a) (ii)

(ii) Explain why the water level in the capillary tube starts to rise after a few minutes.

.....

.....

.....

.....

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

Only a few candidates gave excellent answers with correct references to water potential and the relative differences or gradients. Some candidates realised that the sucrose lowered the water potential in the tubing but did not link that to movement of water by osmosis or did not make it clear that the water moved into the Visking tubing. Most responses, however, simply talked about the sucrose solution moving through the apparatus or capillary action moving fluid up the capillary tube. Quite a few candidates referred to active transport or facilitated diffusion being responsible for the observed changes showing a misunderstanding of the question.

Question 24 (a) (iii)

(iii) With reference to the diagram, name the plant cells or tissues that are represented by:

The capillary tube

.....

The beaker of distilled water

.....

The flask

.....

[3]

Many candidates were able to identify the capillary as representing the phloem or the sieve tube, but few were able to identify the other tissues represented. Indeed, many candidates identified plant organs (the leaf, the root) or abiotic factors, such as soil, rather than plant cells or tissues as asked in the question. It was clear that few candidates were able to correctly match the model to sucrose movement in a plant. This suggests that few have had access to similar models or used apparatus to demonstrate sucrose transport.

Question 24 (b)

(b) The student measured the increase in the level of the coloured liquid in the capillary tube after 2 minutes. It had risen by 8 mm. The capillary tube has a diameter of 1 mm.

Calculate the rate of osmosis as the volume of water moved per second.

Use the formula: Volume of cylinder = $\pi r^2 l$

Rate of osmosis = ... $mm^3 s^{-1}$ **[2]**

Most candidates gained at least one mark here with many getting full credit. The most common errors were mistakes with substitution into the given formula (using diameter rather than radius) or for dividing by 2 (mins) rather than 120 (secs). Where candidates gained only one mark it was usually because they did not divide by time to calculate the rate.

OCR support

Math for Biology website has a range of tutorials to support with mathematical skills:
https://www.ocr.org.uk/subjects/science/maths-for-biology/geometry-and-trigonometry/

Question 25 (a) (i)

25 (a) Water molecules are transported in the stem of a sunflower. Water molecules are polar and are therefore attracted to each other.

(i) Draw **two** water molecules **and** label the bond between the two molecules.

[3]

Many candidates were able to draw correct diagrams of two water molecules and most went on to gain full credit for both the bond and labelling. Occasional errors included water molecules with two oxygen atoms to one hydrogen and bonds drawn between two hydrogen atoms on separate molecules.

Question 25 (a) (ii)

(ii) Explain how the properties of water are related to the transport role of water in a stem.

.....

.....

.....

.....

.....

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

There was a lot of good knowledge about the properties of water, but the wording used often lacked scientific precision. In particular many candidates had an understanding of both cohesion and adhesion. However, answers were imprecise and often did not relate to the role of water as a transport medium in plants. Many candidates did not specify that water 'molecules' stick together or that water 'molecules' adhere to the walls of the xylem. Very few candidates mentioned specific transport vessels merely saying things like 'water forms a column that allows it to move up the stem.

Some candidates included properties of water unrelated to transport functions such as specific heat capacity.

Misconception

Some candidates have a basic misunderstanding of solutions and wrote phrases such as 'water is soluble' while others wrote about water 'wanting' to go up the stem. This was the same with Question 24.

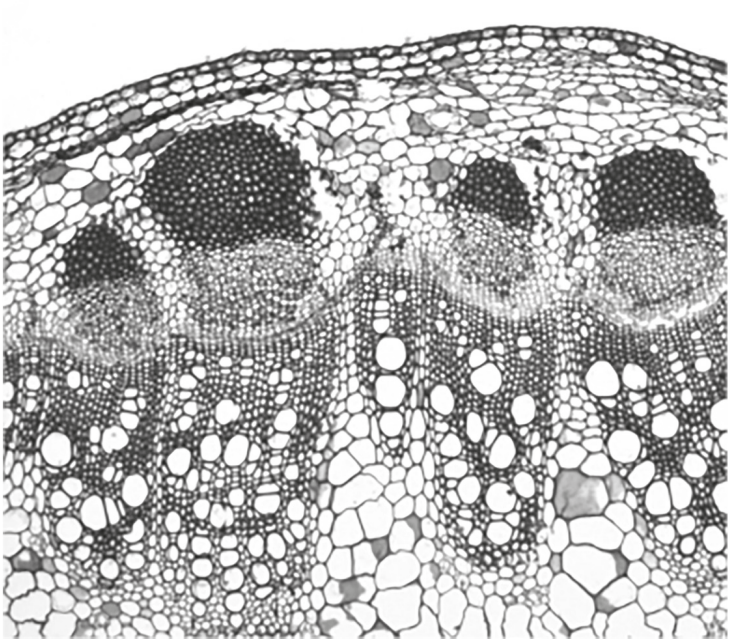
Exemplar 3

water has cohesive and adhesive properties. Cohesion means that water can form bonds with other water molecules and adhesion means that it can is also attracted to surfaces in the stem, water molecules are attracted to each other and the walls of the xylem which creates a column of water which can then be drawn up.

The exemplar shows a clear script that uses scientific terms correctly.

Question 25 (b) (i)

(b) The photomicrograph is of a transverse section of a stem of a sunflower, *Helianthus annuus*.



(i) **On the photomicrograph**, label the location of meristem tissue. **[2]**

Relatively few candidates gained credit here. Most were unable to identify the correct area of the image as meristem, possibly because they were confused by the sclerenchyma. Many candidates also did not use a ruler for the label line or added an arrowhead.

OCR support

Guidance on how to correctly label images is given in the drawing skills handbook available at: https://www.ocr.org.uk/Images/251799-biology-drawing-skills-handbook.pdf

Question 25 (b) (ii)

(ii) Name the type of microscope used to produce the photomicrograph **and** explain the reasons for your choice.

Name of microscope .....

Reasons for your choice .....

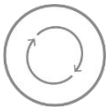
.....

.....

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

A good proportion of candidates knew that a light microscope was used and gave valid reasons for their choice. However, a high proportion of candidates suggested that an electron microscope was used and suggested that organelles were visible. This suggests that they have had little experience of viewing specimens with a light microscope and/or interpreting photomicrographs and electron micrographs. Candidates must be able to use the evidence provided for them.

Assessment for learning



Biology is a practical subject. It is essential that candidates have the opportunity to view and interpret slides and make biological drawings along with many other practical tasks.

Question 25 (c)

(c) Explain the role of meristem tissue in a stem.

.....

.....

.....

.....

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

Most candidates correctly stated that these are undifferentiated cells and that they had the ability to produce specialised cells. However, less able candidates suggested that these cells had either a transport or support role in the plant.

Question 25 (d)

(d) Name **one** potential use of stem cells in medicine.

.....

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

Many candidates gave a suitable response to gain credit. However, too many were imprecise in their wording stating that these cells could be used to 'treat cancer' or 'treat diabetes' without giving any indication that tissues were needed to be replaced to achieve this aim.

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