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Examiners' report

BIOLOGY A

H020
For first teaching in 2015

H020/01 Summer 2018 series

Version 1

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Introduction

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

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

Paper H020/01 series overview

H020/01 is the first of two examination papers for the GCE AS Biology A. This component assesses content from across all four teaching modules. It is split into two sections and candidates must answer all the questions. Section A consists of multiple choice questions. Section B contains short answer questions including structured questions, problem solving, calculations and practical. H020/01 tests Breadth of Biology and it is important that candidates have a good understanding of a wide range of biological topics.

To do well in this examination, candidates need to have a broad knowledge of biology including practical work, suitable mathematical skills and the ability to apply statistical tests to data based results.

Overview of candidate performance

Candidates who did well in this examination showed the following strengths:

- Good recall of straightforward information.
- Ability to write clearly and concisely.
- An understanding of good practical procedure.
- Ability to carry out calculations showing their working.
- Ability to apply their basic knowledge to new contexts.

Candidates who did less well in this examination struggled to:

- Write clearly and concisely.
- Describe patterns seen in results.
- Apply their knowledge to explain such patterns.

There was no evidence that candidates ran short of time.

Section A overview

The multiple choice part of the examination tests a lot of knowledge and understanding in a wide range of contexts. The context of most questions should be familiar to the majority of candidates. In some questions the context may have appeared less familiar. In these questions, such as in questions 11 and 12, candidates could apply familiar knowledge to help them answer the question accurately. More able candidates did this successfully. Less able candidates often made the same mistake as could be seen in questions 4 and 17.

Question 1

1 Which organelle, **A** to **D**, is **not** involved in the production and secretion of enzymes in eukaryotes?

A golgi apparatus

B ribosomes

C smooth endoplasmic reticulum

D vesicle

Your answer ☐ **[1]**

This question tested knowledge about the function of different organelles. Many candidates were successful but some had forgotten that vesicles are used to transport the enzymes to the cell surface membrane and for exocytosis.

Question 2

2 Autoimmune diseases are often treated with a course of antibody injections.

Which of the following statements, **A** to **D**, describes the immunity arising from this treatment?

A active natural immunity

B active artificial immunity

C passive natural immunity

D passive artificial immunity

Your answer ☐ **[1]**

This question tested candidate knowledge about types of immunity. It is clear that many candidates have not focused on what is meant by active immunity. Active immunity is when the specific immune system is activated and produces its own antibodies. Many candidates gave B as an incorrect response.

Question 3

3 A student designed an investigation into the rate of transpiration in plants. They used eight leaves of the same size, age and species. They kept environmental conditions such as wind speed, temperature and humidity constant.

Why did the student take readings from eight different leaves?

A to make their investigation valid

B to increase the accuracy of their readings

C to assess the repeatability of their data

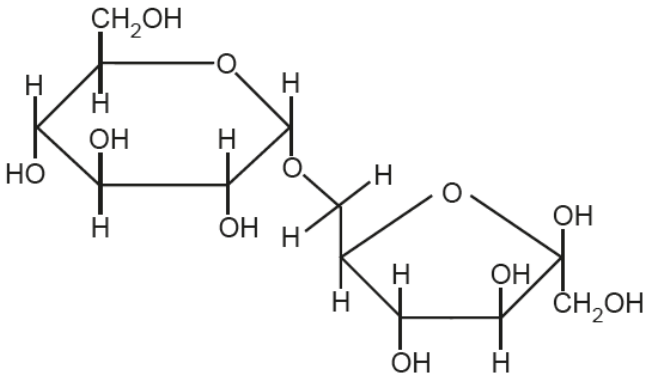
D to improve the precision of their results

Your answer ☐ **[1]**

This question tests understanding of experimental design. Many readings are used to test repeatability but many candidates still believe that it will increase accuracy.

Question 4

4 The image below shows isomaltulose, a disaccharide formed from α-glucose and fructose.



Name the bond that holds the α-glucose and the fructose together.

A 1,6-glycosidic bond

B phosphodiester bond

C ester bond

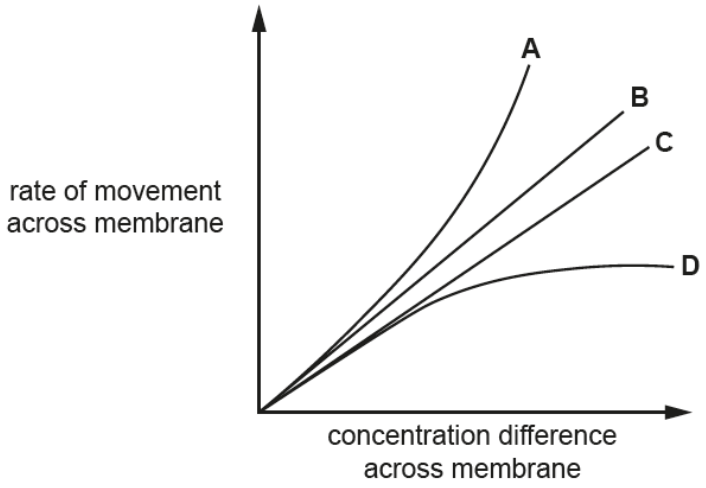
D 1,4-glycosidic bond

Your answer ☐ **[1]**

This question tests knowledge of molecular structure and how bonds are named. Most candidates opted for answer D which is the type of bond found in maltose – the simple disaccharide composed of two alpha glucose units. Only the most able candidates looked closely at the diagram to see that this is actually a 1,6-glycosidic link rather than a 1,4-glycosidic link.

Question 5

5 The graph shows the rate of movement of four different substances across a membrane.



The substances shown in the graph are: carbon dioxide, testosterone (a lipid-based hormone), ethanol and sodium ions.

Which of the lines, **A** to **D**, represents the pattern of movement of sodium ions across a membrane?

Your answer ☐ **[1]**

This question tests understanding of how substances pass through cell membranes. The more able candidates appreciated that sodium ions would pass through channel proteins. If the number of channel proteins in the membrane is limited then this will eventually limit the rate of movement of the ions.

Question 6

6 The aquatic crustacean *Daphnia magna* has a heart that pumps a blood-like liquid called haemolymph around the body cavity.

Which of the statements, **A** to **D**, describes the circulatory system of *Daphnia magna*?

A single closed

B single open

C double open

D double closed

Your answer ☐ **[1]**

Candidates should be well aware that insects have a single open circulatory system. *Daphnia* are small crustaceans closely related to insects. Most candidates were able to spot this link and give the correct response.

Question 7

7 DNA polymerase catalyses the formation of phosphodiester bonds during DNA replication.

Which of the statements, **A** to **D**, will **not** affect the rate of phosphodiester bond formation?

A temperature

B length of DNA molecule

C pH

D free nucleotide availability

Your answer ☐ **[1]**

This question tests understanding of the factors that limit enzyme controlled reactions in the context of a specific enzyme, DNA polymerase. Most candidates will know that changes in temperature, pH and substrate concentration will affect enzymes activity. Here, candidates needed to recognise that free nucleotides were the substrate rather than the DNA molecule. Many candidates were unable to make this distinction correctly and gave B as their response. Candidates also needed to read the question carefully. The question asks for a factor that will not affect the rate of this enzyme's activity.

Question 8

8 Which of the following types of cells is **not** involved in a primary immune response?

A T-memory cells

B T-helper cells

C T-killer cells

D plasma cells

Your answer ☐ **[1]**

Candidates needed to be aware of the difference between the primary and secondary immune responses. The secondary immune response is more rapid and more vigorous because of the presence of memory cells.

Question 9

9 Which of the following, **A** to **D**, is **not** an adaptation to reduce water loss in plants?

A an extensive root system that extends far from the plant

B leaves that are reduced to spines that prevent damage from animals

C the ability to store carbon dioxide so stomata only need to open at night

D the surface covered in reflective hairs

Your answer [ ] **[1]**

Candidates who read the question carefully spotted that it is asking for an adaptation to reduce water loss. Roots have nothing to do with water loss, they are involved in uptake. The other three adaptations refer to leaves where the majority of water loss occurs.

Question 10

10 A scientist was investigating the effect of two different temperatures on the rate of enzyme controlled decomposition of ammonia, in soil bacteria.

They repeated their experiment ten times for each of the two different temperatures.

Which of the following, **A** to **D**, should they use to determine if there was a significant difference between these two sets of times?

A standard deviation

B Student's t-test

C chi squared test

D Spearman's rank correlation coefficient

Your answer [ ] **[1]**

This question tested an understanding of when different statistical tests should be used. The range of responses seen by examiners suggests that many candidates do not have a good understanding of when the student's t-test should be applied.

Question 11

11 The hydroxyl (-OH) group of carbohydrates is polar and makes the molecule soluble in water. The greater the number of free hydroxyl groups as a proportion of the number of carbon atoms, the more soluble the carbohydrate.

Which of the rows, **A** to **D**, lists the carbohydrates in order of most soluble to least soluble?

	Most soluble	⟷		**Least soluble**
A	glucose	ribose	amylose	amylopectin
B	amylose	amylopectin	glycogen	ribose
C	glucose	ribose	amylopectin	amylose
D	ribose	amylose	glucose	amylopectin

Your answer ☐ **[1]**

This question tests knowledge of carbohydrate structure and how candidates apply their knowledge to solubility. Most candidates apparently knew that glucose and ribose are the most soluble. Many candidates found it difficult to assess whether amylose or amylopectin is the least soluble.

Question 12

12 The bacterium *Sorangium cellulosum* and the fungus *Armillaria mellea* are both found in soil.

Which of the rows, **A** to **D**, correctly shows the structures present in each organism?

	Free ribosomes in cytoplasm	**Membrane bound nucleus**	**DNA in a single loop**	**Cell wall present**
A	*S. cellulosum* and *A. mellea*	*A. mellea*	*S. cellulosum*	*S. cellulosum* and *A. mellea*
B	*S. cellulosum* and *A. mellea*	*A. mellea*	*S. cellulosum* and *A. mellea*	*S. cellulosum* and *A. mellea*
C	*S. cellulosum*	*S. cellulosum* and *A. mellea*	*S. cellulosum*	*A. mellea*
D	*A. mellea*	*S. cellulosum*	*S. cellulosum* and *A. mellea*	*S. cellulosum*

Your answer ☐ **[1]**

This question tests knowledge of differences between prokaryote and eukaryote cell structure. The correct response is A. However, many candidates believe that prokaryotes do not have ribosomes. They do not appear to distinguish between ribosomes and membrane bound organelles.

Question 13

13 Carbon dioxide release during respiration can affect the % oxygen saturation of haemoglobin.

The tertiary structure of haemoglobin is affected when carbon dioxide reacts with water to form carbonic acid. This reaction releases hydrogen ions.

Which of the statements, **A** to **D**, explains this change?

A The release of hydrogen ions causes the pH to rise, which reduces haemoglobin's affinity for oxygen.

B The release of hydrogen ions causes the pH to rise, which increases haemoglobin's affinity for oxygen.

C The release of hydrogen ions causes the pH to fall, which increases haemoglobin's affinity for oxygen.

D The release of hydrogen ions causes the pH to fall, which reduces haemoglobin's affinity for oxygen.

Your answer ☐ **[1]**

This question tests understanding of the Bohr effect. Candidates find this a difficult topic and many link more hydrogen ions to higher pH. Those that understand the pH scale then incorrectly link a fall in pH to a rise in affinity of haemoglobin for oxygen. Only the most able candidates reliably got this correct.

Question 14

14 During translocation of photosynthetic products in the phloem sieve tube, hydrogen ions are moved out of companion cells, then sucrose enters the companion cells and moves through plasmodesmata into the sieve tube.

Which of the rows, **A** to **D**, correctly identifies how these substances enter or leave companion cells?

	hydrogen ions out of companion cell	**sucrose into companion cell**	**sucrose out of companion cell**
A	diffusion	facilitated diffusion	diffusion
B	diffusion	active transport	active transport
C	active transport	facilitated diffusion	diffusion
D	active transport	active transport	facilitated diffusion

Your answer ☐ **[1]**

This question tests detail of how sucrose is actively loaded into sieve tube elements. Candidates need to recall the process and apply what they know about how substances cross membranes. This enables them to work out that C is the correct response. Only the more able candidates could achieve this.

Question 15

15 The Millennium Seed Bank has over two billion seeds in storage.

Which of the options, **A** to **D**, describes the type of conservation carried out at the Millennium Seed Bank?

A in-situ conservation of species biodiversity

B in-situ conservation of habitat biodiversity

C ex-situ conservation of species biodiversity

D ex-situ conservation of habitat biodiversity

Your answer ☐ **[1]**

Most candidates gave the correct response to this question testing the meaning of in-situ and ex-situ conservation techniques.

Question 16

16 Plants such as the soybean have a number of defence strategies to prevent infection by pathogens.

Which of the following strategies is a chemical defence against pathogen infection?

A callose deposits at sieve tube ends that prevent pathogen movement in phloem

B hydrolytic enzymes such as chitinase found between cells

C stomata can be closed by guard cells if pathogens are detected

D cell walls can be thickened by lignin, making cell entry very difficult for pathogens

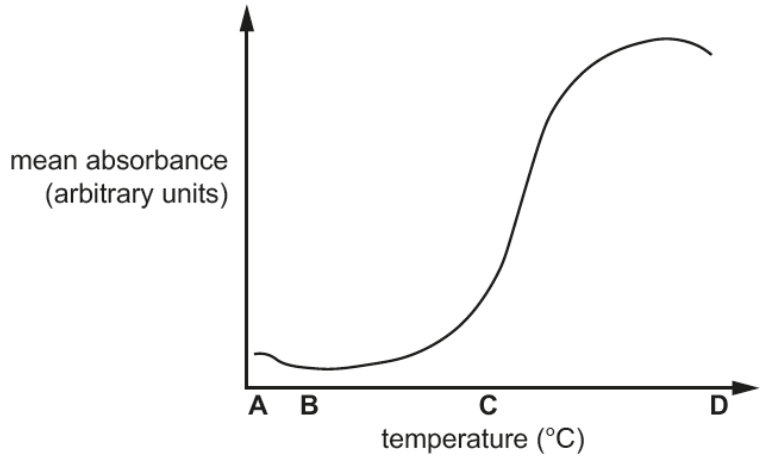
Your answer ☐ **[1]**

The key to answering this question correctly was spotting that the question asks for a chemical defence rather than a barrier type response. Those candidates who read the question carefully could provide the correct response.

Question 17

17 Swiss chard is a leafy green vegetable related to spinach. Some varieties have yellow stalks that have vacuoles containing yellow betaxanthin pigments.

The graph below shows the effect of temperature on the release of these pigments recorded as mean absorbance, when measured with a colorimeter.



It was deduced that the betaxanthins were released from the vacuole due to the denaturing of proteins in the tonoplast (vacuolar membrane).

Which letter, **A** to **D**, shows the temperature at which the proteins denature?

Your answer ☐ **[1]**

This question about the effect of temperature change on membrane structure proved tricky for many candidates who did not think about the process carefully. Almost all the incorrect responses were D. These candidates obviously linked the graph to enzyme activity. In the same way that rising temperature affects enzyme structure, the proteins here are denatured. The difference is that once the membrane proteins are denatured they allow leakage of the betaxanthins. This occurs at point C.

Question 18

18 An investigation into how a change in sodium chloride concentration effects osmosis in potato cells concluded that the isotonic point of the potato was 0.25 M.

Which of the statements, **A** to **D**, describes what is happening at the isotonic point?

A there is a net movement of water from the sodium chloride solution into the potato cells

B there is a net movement of water from the cytoplasm of the potato cells into the sodium chloride solution

C there is no movement of water into or out of the potato cell cytoplasm

D the movement of water into the potato cells is equal to the movement of water out of the potato cells

Your answer ☐ **[1]**

This questions tests understanding of osmosis. Most candidates gave either C or D as their response. More able candidates realised that there may be some movement of water molecules and that the movement would be equal in both directions – response D.

Question 19

19 The table below shows four biological molecules and their component elements.

Which of the rows, **A** to **D**, correctly identifies the elements in each molecule?

	sucrose	**cholesterol**	**insulin**	**ATP**
A	C, H, O	C, H, O, N	C, H, O, N, S	C, H, O, N, P
B	C, H, O, N	C, H, O	C, H, O, N, S	C, H, O, N, S
C	C, H, O	C, H, O	C, H, O, N, S	C, H, O, N, P
D	C, H, O	C, H, O	C, H, O, N, P	C, H, O, N, P

Your answer ☐ **[1]**

This question tested knowledge of molecular structure. Candidates should be aware that carbohydrates and lipids contain only C, H and O. Candidates should also know that insulin is a protein and therefore contains N. ATP being closely related to nucleotides must also contain N as well as P. It appears that many less able candidates became confused by the numbers of letters involved in each row and guessed at the correct response (C).

Question 20

20 In human cells, the tumour suppressor gene *TP53* codes for a protein that interrupts the cell cycle if there is any damage to the DNA and prevents the copying of damaged DNA.

Which of the stages, **A** to **D**, could *TP53* interrupt the cell cycle?

A mitosis

B G_1

C S

D cytokinesis

Your answer ☐ **[1]**

This question tests knowledge and understanding of the cell cycle. Those candidates who realised that synthesis of DNA occurs in the S phase understood that the cycle must be stopped before the S phase to prevent copying of the damaged DNA. Therefore C was the correct response. This was spotted by all but the least able candidates.

Section B overview

The structured question with short answer section of this paper was well answered by many candidates. All questions were attempted and all topic areas were accessible to most candidates. The only obvious areas that caused trouble to many candidates were the mathematical and statistical components. It is clear that candidates would benefit from further guidance in these areas.

Question 21 (a)

21 The Titicaca water frog, *Telmatobius culeus*, is an aquatic amphibian found in Lake Titicaca in sub-tropical South America. The water frog has an unusual appearance with large folds of skin as shown in Fig. 21.1.

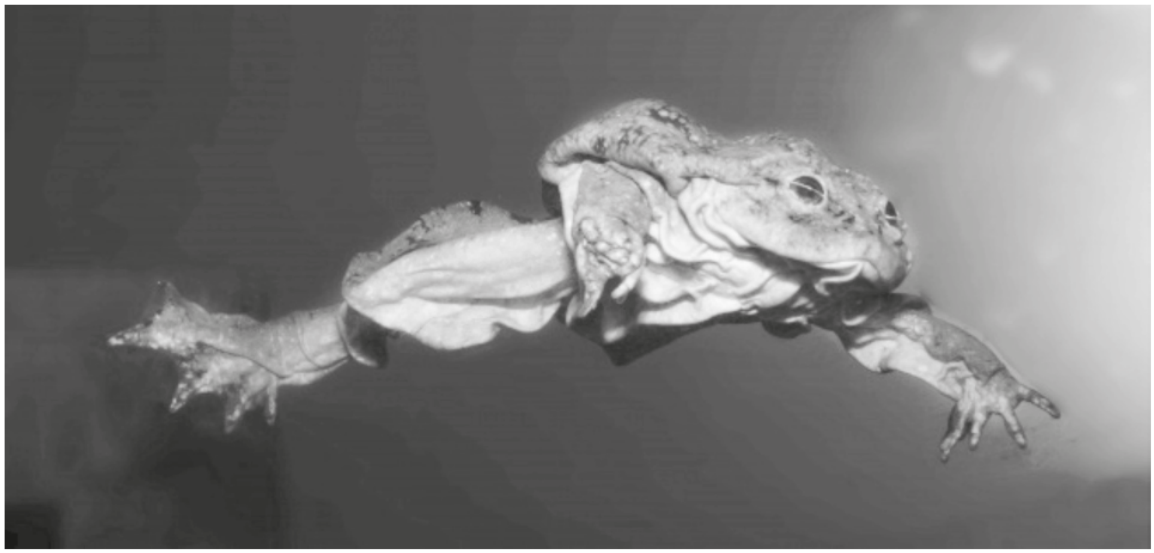


Fig. 21.1

(a) Name the genus of the Titicaca water frog.

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

This was a straightforward starter question about the binomial system for naming organisms. With careful reading the majority of candidates responded correctly with *Telmatobius*. Common errors were to add the species name or to call it 'amphibian'.

Question 21 (b)

(b) Outline the properties of water which make it an ideal habitat for an amphibian.

.....

.....

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

This question asks candidates to match what they know about the properties of water to how this makes water a good habitat. The majority of responses gave 'a high specific heat capacity' as one property. Many candidates added 'ice is less dense than water' or water being a 'good solvent' to gain the second mark.

Question 21 (c) (i)

(c) Like all amphibians, frogs are able to absorb oxygen through the skin as well as their lungs.

(i) Suggest why the Titicaca water frog has evolved the unusually large folds of skin seen in Fig. 21.1.

.....

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

This question relates the properties of a good exchange surface, to the conditions in the lake. The majority of candidates were able to suggest that the skin folds provided a larger surface are or a large surface area to volume ratio. More able candidates added that this enabled the frog to absorb more oxygen from the water.

Candidates should be encouraged to make clear that extra surface area helps to absorb more oxygen, ie they should make their explanations comparative.

Few candidates suggested that this was because the oxygen levels in the lake were not very high. Despite the clear link to oxygen absorption in the stem of the question there were some unusual suggestions. For example: the extra folds might be used like fins to help the frog swim; the folds are due to loss of elasticity in the skin due to old age.

Key:

AfL Guidance to offer for future teaching and learning practice

Question 21 (c) (ii)

(ii) When out of the water, the Titicaca water frog is able to use its lungs to absorb oxygen.

Lungs contain specialised gaseous exchange surfaces.

Describe and explain how **one** feature of the lungs provides an efficient gas exchange surface.

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

This question no longer relates to the Titicaca frog but to a general point about the lungs.

A range of correct responses was seen with large surface area and thin alveolar wall being the most common. Less able candidates often gave poor descriptions of a thin alveolar wall – simply stating 'thin surface'. Examiners were hoping to see more detail than this for a mark to be credited. In general candidates had a good understanding of the features of a good exchange surface and could provide valid explanations.

When one feature is asked for, the examiner will mark the first feature described. Candidates should be encouraged to read the question carefully and not add additional features as this takes time that they may use better elsewhere in the examination.

Question 21 (d) (i)

(d) A student was investigating the effect of cell size on the rate of diffusion into model cells. They had two cubes of agar containing phenolphthalein indicator as shown in Fig. 21.2.

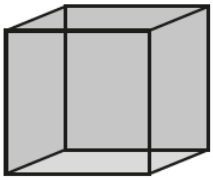


Fig. 21.2

The student placed the cubes in beakers of dilute hydrochloric acid, which caused the indicator to become colourless. They then measured how much of each cube became colourless over time.

(i) State **two** ways the student could have ensured they had confidence in their results.

1 .....

.....

2 .....

.....

[2]

The question asks how the student could ensure confidence in the results. Confidence is a qualitative judgement expressing the extent to which a conclusion is justified by the quality of the evidence. The majority of candidates gained one mark here for repeating the readings. Only the more able candidates gained a second mark. This second mark was usually credited for calculating a mean. Many candidates described how the student could improve the validity of the results.

Definitions of the terms associated with practical work are available in the practical skills handbook.

Key:

OCR support Identifiable issue or misconception

Question 21 (d) (ii)

(ii) In Fig. 21.2, Cube A is 10 mm along each side and Cube B is 4 mm along each side. Calculate the surface area to volume ratio (SA:V) for both cubes A and B.

Show your working. Give your answers to **one** decimal place.

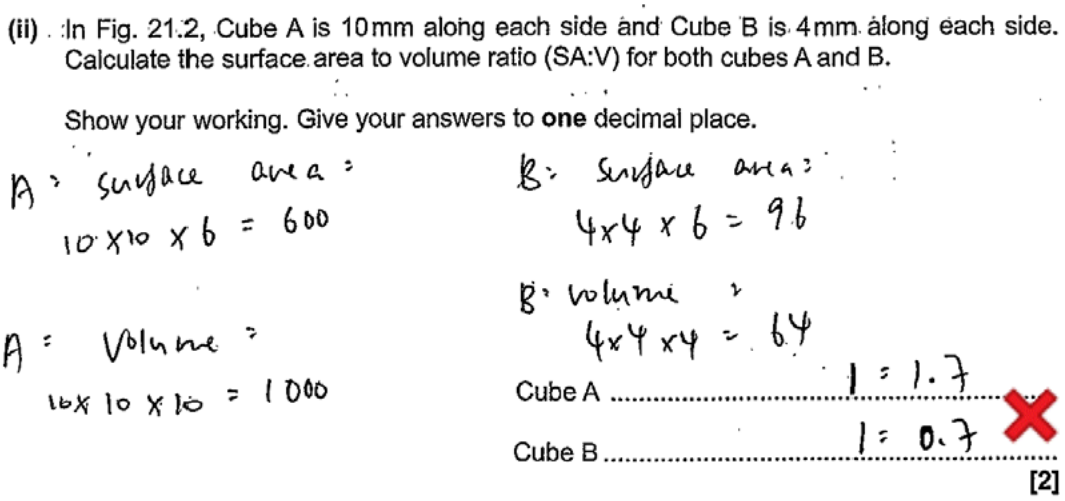
Cube A .....

Cube B .....

[2]

This question asked for the surface area to volume ratio of two cubes to be calculated. Less able candidates have always struggled with this concept and this still seems to be true. Surface area to volume ratios should always be calculated as a surface area to one unit of volume (0.6 :1 rather than 0.6). Less able candidates often calculated it the other way around – a volume for one unit of surface area.

Exemplar 1



As seen in Exemplar 1, candidates often know how to calculate the surface area and the volume. Less able candidates then struggle to put these two components together properly to calculate the surface area to volume ratio. This exemplar shows the ratio stated incorrectly as a volume to one unit of surface area.

Question 21 (d) (iii)

(iii) Explain why the surface area to volume ratio of an organism determines whether it needs a circulatory system.

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

Many candidates knew that large organisms have a small surface area to volume ratio. These candidates successfully linked the concept of a small surface area to volume ratio with the need for a circulatory system. More able candidates could explain the need in terms of a slower rate of diffusion which meant that insufficient oxygen reached the tissues for respiration or metabolism. Less able candidates often confused the concept of a surface area to volume ratio, with surface area.

Exemplar 2

(iii) Explain why the surface area to volume ratio of an organism determines whether it needs a circulatory system.

Small organisms dont need a circulatory system because it has large surface area to volume ratio, therefore the cells can be supplied with oxygen quickly just through diffusion from atmosphere, however large organisms have small SA:V ratio and **[3]**

without a circulatory system not all cells would be supplied quick enough to carry out their function

This exemplar is a good response because it clearly explains that a small organism has a large surface area to volume ratio. This allows rapid diffusion. But in a larger organism with a small surface area to volume ratio, the cells will not be supplied quickly enough.

Question 22 (a)

22 Fig. 22 shows a triglyceride molecule found in sunflower oil.

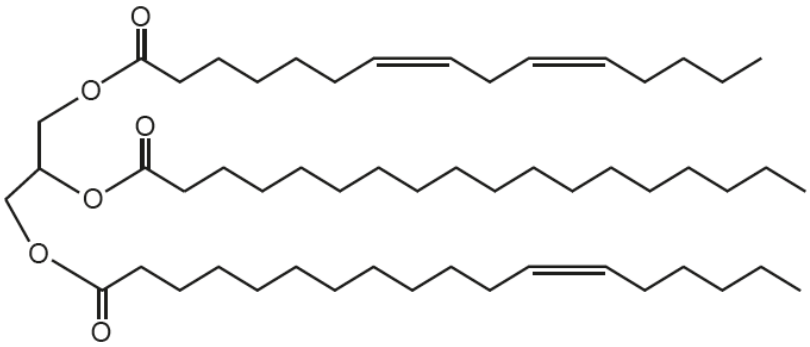


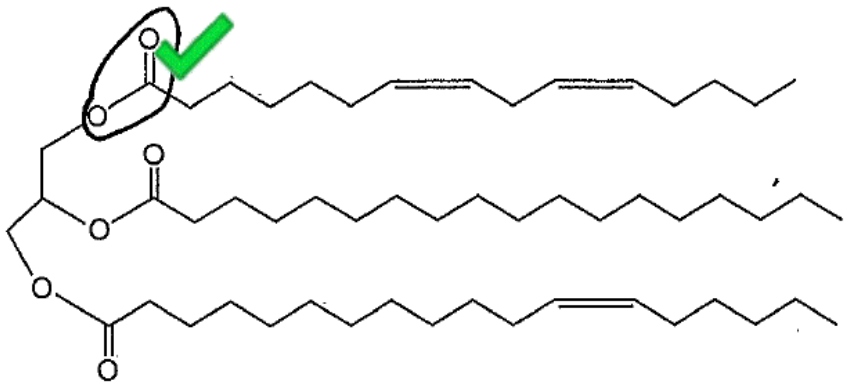
Fig. 22

(a) On Fig. 22 circle an ester bond.

[Answer on Fig. 22] **[1]**

This question asked candidates to identify the ester bond. The majority of candidates were unable to answer this correctly.

Exemplar 3



This response shows clearly what was expected.

Question 22 (b)

(b) Sunflower oil is used to make biodiesel, which contains methyl esters. The fatty acids in the triglyceride molecule are reacted with methanol in a process called transesterification.

After the reaction, two liquid products form which naturally separate from each other. The methyl esters float on top of a more dense liquid.

Name the part of the molecule seen in Fig. 22 that forms this more dense liquid.

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

In this question candidates were expected to recall that triglycerides consist of glycerol and fatty acids. The stem of the question states that the fatty acids are reacted with methanol and these methyl esters float on top. That leaves glycerol as the more dense liquid. Less able candidates were not able to deduce this correctly.

Question 22 (c) (i)

(c) Living organisms have many uses for triglycerides, one of which is the production of phospholipids.

(i) Name three **other** functions of triglycerides in living organisms.

1 .....

2 .....

3 .....

[3]

This question required simple recall. The majority of candidates were credited one or two marks. Only the most able achieved all three marks. Single word responses were seldom successful. Candidates were expected to provide sufficient detail to, for example, distinguish between electrical insulation and thermal insulation.

Question 22 (c) (ii)

(ii) Table 22 shows the melting points of some of the methyl esters made from the transesterification of sunflower oil fatty acids.

Methyl ester	Formula	Melting point (°C)
Methyl sterate	$C_{19}H_{38}O_2$	39.1
Methyl oleate	$C_{19}H_{36}O_2$	–19.9
Methyl linoleate	$C_{19}H_{34}O_2$	–35.0

Table 22

Describe and explain the pattern of the melting points of these three methyl esters.

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.....

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.....

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

Candidates were expected to deduce a pattern in the results shown and to explain that pattern. Less able candidates tended to describe the results, often naming the individual methyl esters. More able candidates spotted that as the number of hydrogen atoms decreased, so did the melting point. Many candidates thought that there were more hydrogen bonds between the molecules with more hydrogen atoms and this raised the melting point. Only the most able candidates correctly explained that less hydrogen atoms meant more double bonds which caused the fatty acid chains to kink or bend. This caused less uniform packing of the molecules.

Exemplar 4

Describe and explain the pattern of the melting points of these three methyl esters.

As the number of hydrogen increases melting point increase. This is because there are more hydrogen bond which take more energy to overcome as they absorb the energy so melting point increases. **[2]**

This exemplar shows a typical response. A correct pattern identified but an incorrect explanation of that pattern.

Question 22 (d)

(d) Phospholipid molecules also contain fatty acids.

Explain how the fatty acids in phospholipids allow the formation of membranes.

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.....

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

This question was asking about the structure of cell membranes. Candidates were expected to recall that fatty acids are hydrophobic. As part of a phospholipid this hydrophobic nature causes the fatty acid tails to orientate towards the middle of the bilayer.

Question 23 (b) (i)

23 Fig. 23 shows a microscope image of a cross section taken from the stem of a sunflower, *Helianthus annuus*.

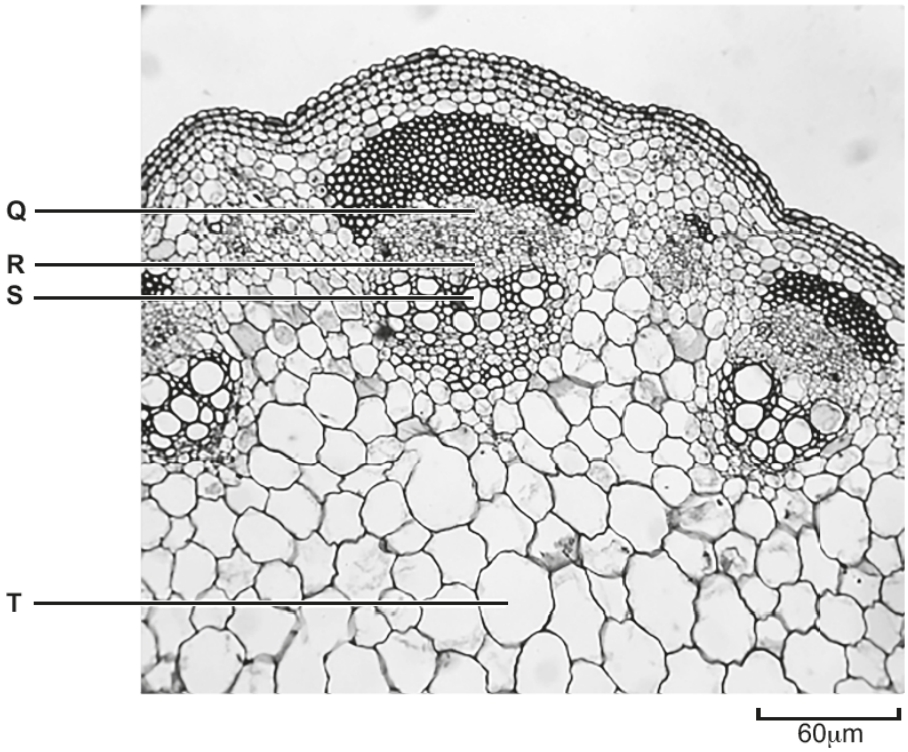

Fig. 23

(b) (i) The cell labelled **T** on Fig. 23 is a parenchyma cell which carries out photosynthesis and stores starch. Suggest why cell **T** and the cells surrounding it, can be classified as parenchyma **tissue**.

.....

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

This question is asking for a definition of a tissue in the context of the parenchyma. Many candidates gave a detailed definition although some candidates did not include the idea that the cells are working together.

Question 23 (b) (ii)

(ii) **Name** the two tissues labelled **Q** and **S** on Fig. 23.

Q .....

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

This question should have been straightforward recall for candidates that were familiar with images or slides showing a cross section of a stem. Most candidates managed to interpret the photomicrograph accurately. Some less able candidates named other tissues and were presumably simply writing any name they could recall.

Question 23 (c)

(c) The tissues labelled **Q** and **S** in Fig. 23 are produced by mitosis from the tissue labelled **R** on Fig. 23. Identify the tissue labelled **R**.

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

Again, the majority of candidates were able to name the cambium or stated 'meristem'.

Question 24 (a) (i)

24 Fig. 24 shows a DNA nucleotide.

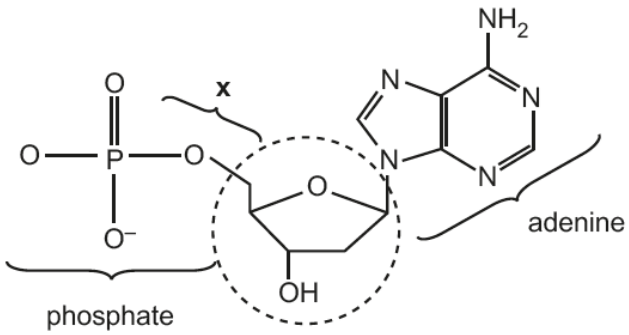

Fig. 24

(a) **(i)** Name the circled component in Fig. 24.

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

Many candidates correctly identified the circled component as deoxyribose sugar. Pentose sugar or ribose were common responses that were not credited a mark.

Question 24 (a) (ii)

(ii) Name the bond labelled **x** in Fig. 24.

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

The majority of candidates correctly named the bond as a phosphodiester bond. Weaker candidates gave other names that they could recall such as 'hydrogen bond' or 'covalent bond' which were not given credit.

Question 24 (b)

(b) Identify two similarities and two differences between the DNA nucleotide shown in Fig. 24 and a molecule of ATP.

Similarities .....

.....

.....

.....

Differences .....

.....

.....

.....

[4]

This question differentiated well. Candidates needed to recall the structure of ATP and compare that to the nucleotide shown in figure 24. Many candidates accurately identified two similarities and two differences. The most commonly stated similarities 'contain adenine' and 'contain phosphate'. Other similarities were given by more able candidates such as 'contain pentose sugars'. The most commonly stated differences were 'ATP contains three phosphates against one in the nucleotide' and 'ribose compared to deoxyribose'. Very few candidates went into further detail to describe the difference between ribose and deoxyribose. A few candidates lost credit as they did not make a clear comparison under the 'differences' section. The least able candidates appeared to have little concept that ATP is quite similar in structure to a nucleotide.

Exemplar 5

(b) Identify two similarities and two differences between the DNA nucleotide shown in Fig. 24 and a molecule of ATP.

Similarities ..... Both have an adenine base .....

Both contain a pentose sugar, a phosphate group(s) and a nitrogenous base

Differences ..... ATP has 3 phosphate groups, the DNA nucleotide has only 1. .....

ATP has ribose sugar, DNA has deoxyribose.

[4]

This exemplar shows that a good candidate can gain full marks for very simple statements worded in simple English.

Question 25 (a)

25 The downy birch tree, *Betula pubescens*, produces varying numbers of leaf hairs.

These hairs are between 200 μm and 500 μm long in response to different environmental conditions.

(a) State the **pattern** of variation shown by leaf hair density.

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

This question asked for the pattern of variation shown. The correct pattern is 'continuous' variation. There was a wide range of responses and lower ability candidates simply described the pattern rather than stating a name for the pattern.

Question 25 (b)

(b) Leaf hair density can be measured in the laboratory.

Outline a practical method that could be used to determine the density of hairs on the underside of a leaf.

.....

.....

.....

.....

.....

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

This question asked for candidates to describe a practical technique. It is not something they are expected to have done before, but they were required to use skills and techniques with which they should be familiar. The question discriminated very well. Some less able candidates misunderstood the meaning of the term 'leaf hair density'. These candidates attempted to describe a method to measure the volume of a single hair, weigh the hair and calculate density. Many less able candidates attempted to relate leaf hair density to rate of transpiration and used transpiration rate as a measure of leaf hair density. More able candidates described counting hairs over an area and then multiplying up to calculate the total number of hairs on the leaf. Only the most able candidates accurately described using a microscope to count hairs in a particular area and then dividing by that area to calculate a hair density per unit area.

Exemplar 6

(b) Leaf hair density can be measured in the laboratory.

Outline a practical method that could be used to determine the density of hairs on the underside of a leaf.

a section of the leaf could be put under a microscope to be able to count the individual hairs in that section and then times by how many sections there would be, and this would give you an estimate as to how many hairs are on the leaf. **[3]**

This exemplar shows a typical response for a middle ability candidate. Marks are credited for using a microscope to count leaf hairs in a particular area (section) but the response then goes on to do the wrong thing with that hair count. The candidate is trying to calculate the total number of hairs on the leaf rather than the leaf hair density.

Question 25 (c) (i)

(c) A group of students investigated the relationship between the distance of different trees from a river and the mean leaf hair density.

Table 25 shows the results of their investigation.

Distance from river (m)	Rank of distance	Mean leaf hair density (number mm^{-2})	Rank of hair density	Difference in ranks (d)	Difference squared (d^2)
9.1	4	33.1			
13.7	1	34.8			
5.5	7	11.3			
0.3	10	3.4			
5.4	8	27.3			
11.5	3	30.3			
1.7	9	6.3			
6.0	6	22.9			
11.9	2	5.7			
6.8	5	23.2			

Table 25

(i) Complete Table 25 by calculating the difference between the ranks and then squaring the difference.

[Answer on Table 25] **[2]**

Candidates were asked to complete the table by making a number of simple calculations. Most able candidates did this successfully. A number of candidates were unable to rank the hair density correctly and therefore the difference in ranks was incorrect. These candidates could still achieve a mark if they correctly squared the difference they had calculated. A few made errors in calculating the square of the difference.

Question 25 (c) (ii)

(ii) Use the formula below to calculate Spearman's rank correlation coefficient for this data.

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$

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

Candidates were asked to calculate Spearman's rank correlation coefficient. Many candidates managed to do this successfully. If the values in the table were incorrect the error was carried forward to enable candidates to achieve these marks using their own data from the table in part (i). Less able candidates often struggled to carry out this calculation correctly. Sometimes this was because they did not transfer data accurately into the table.

Question 25 (d) (i)

(d) The students concluded that there is a positive correlation between distance of the tree from the river and mean leaf hair density.

(i) Suggest reasons for this positive correlation.

.....

.....

.....

.....

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

This question asked candidates to explain how leaf hairs enabled the plant to conserve water in the context of differing water availability at different distances from the river. More able candidates had a good idea that leaf hairs could reduce water loss. They also understood that this was required because there was less water available further from the river. Less able candidates often became confused and wrote about leaf hairs absorbing water from the less humid environment. Some even seemed to think that leaves closer to the river had more hairs which helped the leaf to lose water.

Exemplar 7

(d) The students concluded that there is a positive correlation between distance of the tree from the river and mean leaf hair density.

(i) Suggest reasons for this positive correlation.

As you get further from the river, less water is available from the soil so the plant trees would need hairy leaves so as to reduce the rate of transpiration by trapping water & to stop it from leaving via stomata as vapour. [2]

In this exemplar the candidate has written a clear and concise response. It shows a clear understanding that water is less available further away from the river and that the leaf hairs will reduce transpiration. The candidate goes on to explain that transpiration is loss of water vapour via the stomata.

Question 25 (d) (ii)

(ii) For this investigation, the students randomly selected leaves from ten downy birch trees at varying distances from the river.

Suggest **three** ways in which the students could improve the validity of their sampling method.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

This question asked for candidates to describe ways to improve the validity of their sampling techniques. Validity is all about controlling the variables around the collection of data so that the data are not affected by inconsistencies. The technique is valid if it measures what it is supposed to measure. There was a wide range of responses. It was clear that many candidates did not really understand the meaning of the term 'validity'. Few candidates achieved full credit and many responses described ways to improve repeatability. In many cases the responses were not well phrased.

Exemplar 8

Suggest **three** ways in which the students could improve the validity of their sampling method.

1 Use leaves from the same height from the trees. ✓

2 Use similar size trees ✓

3 Use ~~similar~~ leaves of a similar area. ✓

[3]

In this exemplar the candidate has given three clear statements. Each statement describes a way to remove a variable to ensure the data collected are comparable. This makes the sampling techniques valid.

Question 25 (e)

(e) Another group of students repeated this investigation and calculated r_s = 0.589. The critical value of r_s at the 5% level for 9 degrees of freedom is 0.600.

They concluded that their results showed a weak positive correlation between leaf hair density and distance of the tree from the river.

Evaluate the conclusion of this group of students.

.....

.....

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

Candidates were asked to evaluate a conclusion. It was clear that many candidates did not really know how to interpret the results of a statistical test. If the calculated value of Spearman's rank is below the critical value then we can say that there is no correlation. Many candidates seemed to suggest that because the calculated value was close to the critical value that was OK. Less able candidates become very confused and compared the calculated value to 5% or even to 9.

ⓘ Definitions of the terms associated with practical work are available in the practical skills handbook.

Exemplar 9

Evaluate the conclusion of this group of students.

The rs value is blow the critical value so there isn't a no significant correlation and it may be due to chance so their conclusion is wrong. [2]

This exemplar shows a rare case where the candidate has a good understanding of how to interpret the results of a statistical test. The candidate makes clear that the calculated result is below the critical value and states that this means there is no significant correlation.

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