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A LEVEL

Examiners' report

BIOLOGY B (ADVANCING BIOLOGY)

H422

For first teaching in 2015

H422/03 Summer 2022 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. 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.

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 3 series overview

H422/03 is one of the three examination units for the Advanced Level examination for GCE Biology B. This Practical Skills unit uses a range of short, structured questions and extended response questions to test:

- candidates' knowledge and understanding of the entire specification subject content and related practical outcomes
- candidates' ability to apply their knowledge to novel practical scenarios and to solve problems and perform calculations
- candidates' ability to analyse, interpret and evaluate scientific information. Compared to both H420/01 and H420/02 there are proportionally more marks for the practical skills including planning, data interpretation and application.

The 2022 paper provided many opportunities for candidates to apply their knowledge within novel contexts, including practical scenarios and interpret data. To do well on this paper candidates need to be able to integrate new ideas and data with their existing knowledge to make and/or evaluate conclusions.

Practical work should be an integral part of the study of Biology. Where candidates had extensive practice of practicals in laboratory situations, this clearly allowed them to answer questions on this paper more confidently. It is a requirement that all centres provide sufficient practical opportunities to help students to not only undertake assessments for their practical skills components (CPACs) but also develop their understanding of the theory of such practical activities. Centres are reminded that it is not mandatory to use OCR PAG practical activities. Any practical activities that provide candidates with opportunities to develop both practical skills and theoretical understanding are beneficial. Centres must be aware of the need to cover the whole of the specification content for this component.

Support and guidance with practicals and developing a positive practical experience can be found at:

https://www.ocr.org.uk/subjects/science/positive-about-practical/

There are also resources available on OCR interchange to help develop students' confidence and ability in answering examination questions based on practicals:

https://interchange.ocr.org.uk/Downloads/H420_H422_Biology_PAG_Practice_Question_Sets.zip

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Successfully described a suitable practical to investigate the effect of caffeine on human reaction time in Question 2 (c) • Successfully interpreted the data • Demonstrated practical experience and theoretical an understanding of chromatography in Questions 3 (a) (i), (ii) and (iii) • Demonstrated an understanding of logarithmic graph paper in Question 4 (b) (i) • Have well developed mathematical skills enabling them to perform calculations and present answers to the specified number of significant figures	• Demonstrated a lack of understanding of command words such as describe versus explain (Question 4 (b) (ii)) and evaluate (Question 2 (a)) • Showed poor understanding of the ability to suggest changes and improvements to the thistle funnel investigation in Question 5 (a) (i) • Were unclear in their demonstration of the steps taken in calculations such as in Questions 1 (a) (iii) and 3 (a) (i) • Found it difficult to apply what they had learnt to unfamiliar situations, scoring most of their marks on questions involving recall and understanding

Question 1 (a) (i)

1 (a) **Fig. 1.1** shows a light micrograph of pancreatic tissue.

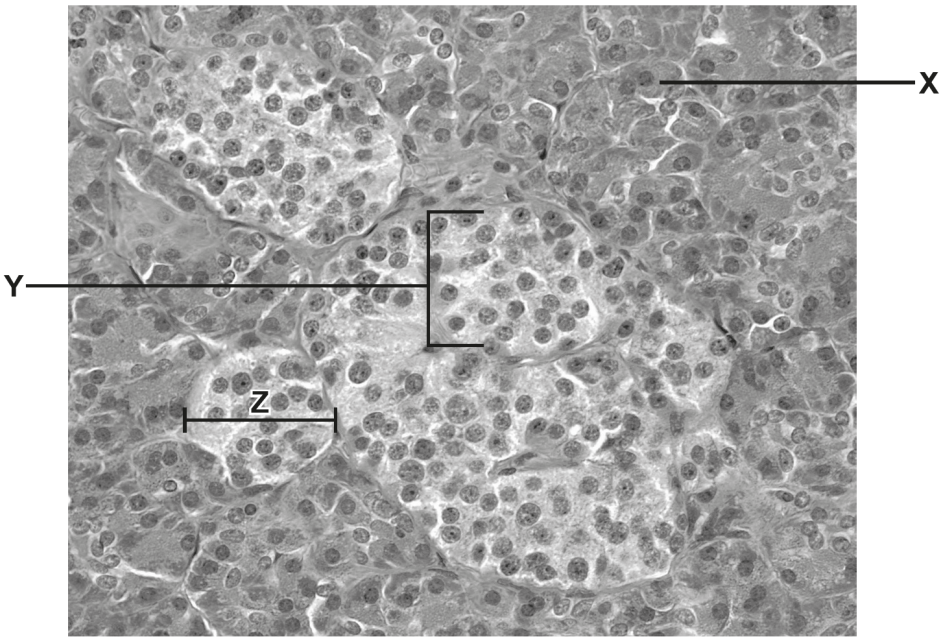

Fig. 1.1

(i) State **one** function of the cell labelled **X**.

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

Many candidates could not interpret the photomicrograph in Fig 1.1, and so could not describe the function of cell X. Some candidates correctly identified the role of cell X as the production and secretion of digestive enzymes, with some providing named examples such as pancreatic amylase. However, many candidates incorrectly referred to the production of (named) hormones mistaking cell X as a cell within an Islet of Langerhans.

Assessment for learning

Showing students images of photomicrographs from which they need to identify structures and describe what they see may help them to answer similar questions in the future.

Question 1 (a) (ii)

(ii) Name the **two** different types of cell in the region labelled **Y**.

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

Most candidates correctly identified the α and β cells correctly. Some candidates did not accurately draw the appropriate symbol(s) and so did not gain marks.

Assessment for learning

There were occasionally some candidates who wrote incorrectly formatted answers which could be easily overcome through developing examination technique.

Question 1 (a) (iii)

(iii) The diameter of one region of pancreatic tissue is represented by the line **Z**.

Calculate the actual diameter of the region labelled **Z**.

Give your answer in μm and to **3** significant figures.

Actual diameter = ... μm **[2]**

Many candidates accurately calculated the diameter and provided their answer to 3sf. Some candidates made inaccurate measurements of the image and/or incorrectly converted between units. A common error was converting from cm to μm by multiplying by 1000 and missing out the step of converting cm to mm first.

OCR support

The 'Maths for Biology' website can be used to support students with conversion of units. https://www.ocr.org.uk/subjects/science/maths-for-biology/arithmetic-and-numerical-computation/

Question 1 (a) (iv)

(iv) A stage micrometer can be used when measuring the linear dimensions of cells, such as those of the pancreatic tissue, viewed under a light microscope.

Outline how a stage micrometer is used to measure the linear dimensions of cells.

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.....

.....

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

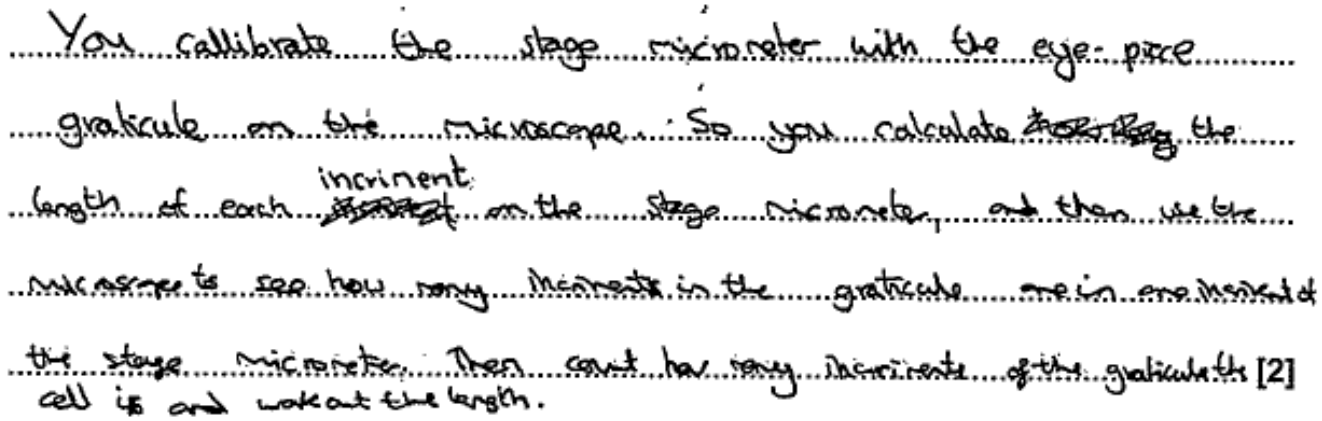
Most candidates were aware of the need to use the stage micrometer in conjunction with an eye piece graticule to determine the dimension of cells. However, it appeared candidates had had limited practical experience in using the pieces of apparatus resulting in poor descriptions. In several cases candidates incorrectly described a process to calibrate the stage micrometer, rather than sing the stage micrometer to calibrate the eye piece graticule.

OCR support

Support and guidance on calibrating microscopes can be found on page 10, including two video links and written instructions :

https://www.ocr.org.uk/Images/597719-practical-activities-support-guide.pdf

Exemplar 1



This candidate incorrectly describes calibrating the stage micrometer with the EPG and calculating the length of each graduation on the stage micrometer and so scored 0 marks. This confusion with the idea that the stage micrometer has divisions of known lengths and the divisions on the EPG having divisions which needed to be determined at each magnification was common.

Question 1 (b)

(b) The pancreas has an essential role in controlling blood glucose concentration.

A person was given a glucose tolerance test. Two months later, the same person was given a fasting blood glucose test. The table shows the results of the two tests.

	Glucose tolerance test	**Fasting blood glucose test**
Blood glucose concentration 2 hours after the beginning of the test (mmol dm^{-3})	10.7	7.0

Suggest what conclusions can be made from the results of the two tests.

.....

.....

.....

.....

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

This 'suggest' question posed a challenge to candidates. Many responses showed a misunderstanding in the sequence of the tests and the interpretation of the numerical values. Many candidates described the difference in the values and incorrectly deduced the ability to regulate blood glucoses levels was improving due to a decrease in the values. Candidates did not appreciate that the glucose tolerance test was carried out 2 months before the fasting blood glucose test but mistakenly thought the 2 tests were carried out 2 hours apart. Few candidates were able to recall the ranges for the two difference tests and so were unable to deduce the correct conclusion from each test namely:

* people with impaired glucose tolerance will have a glucose tolerance test at 2 hours will have a score of 7.9 to 11.0 mmol/L

* people with diabetes will have a fasting glucose test score of 7.0 mmol/L or above

Question 1 (c)

(c) An incomplete structure of **α-glucose** is shown in **Fig. 1.2**.

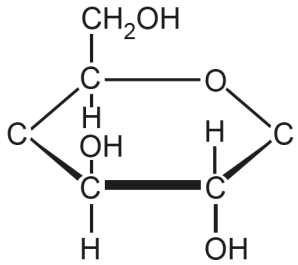


Fig. 1.2

Complete the structure of α-glucose **in Fig. 1.2** to show all of the atoms in the structure. **[1]**

Candidates did not always score well on this question due to poor presentation of the location of the bonds between ^{1}C and ^{4}C and the relevant groups. It appeared that some candidate did not appreciate the significance of the bond forming between the C atom and the O atom (which then bonds to the H atom) in the hydroxyl group.

There were occasionally some candidates who had 'No Response' answers which could be easily overcome through developing examination technique.

Question 1 (d)

(d) The table lists glucose and two other carbohydrate molecules: lactose and amylose.

Fill in the table to show, for each carbohydrate, a reagent that would give a positive result when used in a test to help identify the carbohydrate **and** the number of glycosidic bonds in each molecule.

Carbohydrate molecule	Reagent used in test for identification	Number of glycosidic bonds per molecule
Glucose		
Lactose		
Amylose		many

[2]

Candidates performed less well on this question than expected. Many gave incorrect reagents such as Biuret for testing for the presence of lactose and others did not refer to potassium iodide (or iodine) solution. The term reagent was used in the column heading and as such was not given marks in this question. Column 3 was also only accurately completed by higher attaining candidates, with many incorrectly stating glucose had glycosidic bonds present within its structure.

Question 2 (a)

2 Drugs such as alcohol, heroin and caffeine produce psychological and physical effects in people.

(a) A group of scientists assessed the harm caused by various drugs, including alcohol and heroin.

The scientists produced weighted 'harm scores' for the drugs in several categories.

Some of the scientists' harm scores for alcohol and heroin are shown in **Fig. 2.1**.

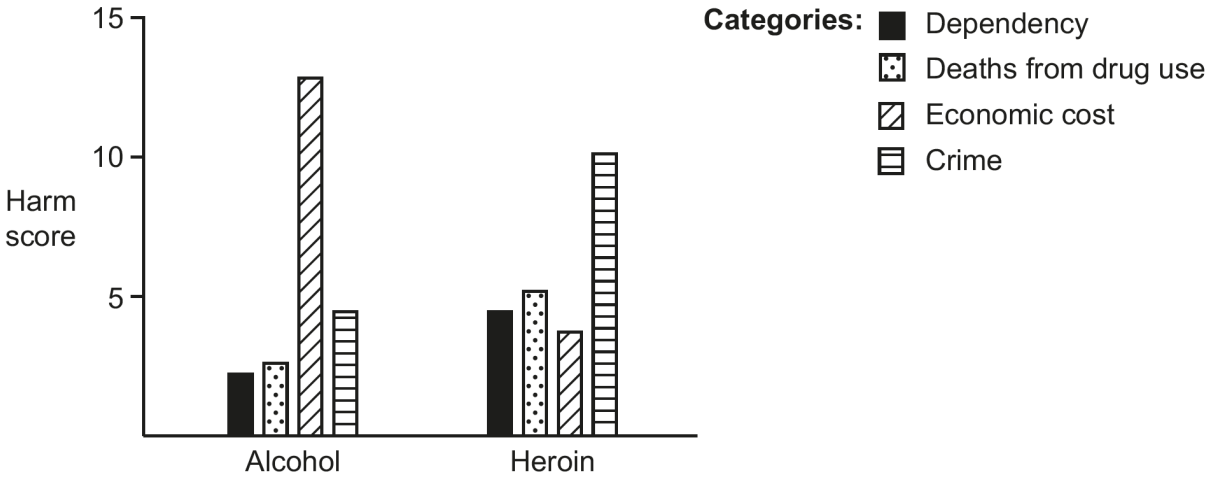


Fig. 2.1

A student looked at **Fig. 2.1** and concluded that 'heroin is more harmful than alcohol'.

Evaluate the student's conclusion.

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.....

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

Candidates showed confidence in interpreting the data presented in the bar charts but frequently did not interpret the command word of the question, to evaluate the conclusion drawn by the student. Candidates should have identified data which supported the student's conclusion and data which undermined the student's conclusion.

Misconception

Candidates may have missed the command word 'evaluate' and thought they needed to describe the data instead.

OCR support

An exhaustive list of command words used is provided in this resource. It illustrates how to recognise and interpret the different command words:

https://www.ocr.org.uk/news/how-important-are-command-words/

Exemplar 2

Student is correct because:

- heroin has almost twice the level of dependancy, which leads to its increased crime rates
- the death rate is higher than alcahol, and the increased dependancy means that whoever takes it is more likely to overdose.
- the overall score for heroin is around 27, where alcahol is around 24-25, so it is more harmfull.

Student ~~is~~ may be wrong because:

- alcahol is not illegal to own, use or sell, so more people have ~~access~~ acsess to it. [4]
- the economic harm of alcohol is much higher than heroin.

This candidate has interpreted the data accurately and made clear reference to which data supports the student's conclusion and the data that does not. The structure and layout of this response is very good and should be encouraged as examination technique.

Assessment for learning

Students could be shown the command words resource and be asked to make their own Biology version, by

- listing all the command words used on this examination paper

Question 2 (b) (i)

(b) Alcohol and heroin both affect the activity of neurones.

Fig. 2.2 shows the binding sites of alcohol and heroin at a synapse that uses the neurotransmitter GABA.

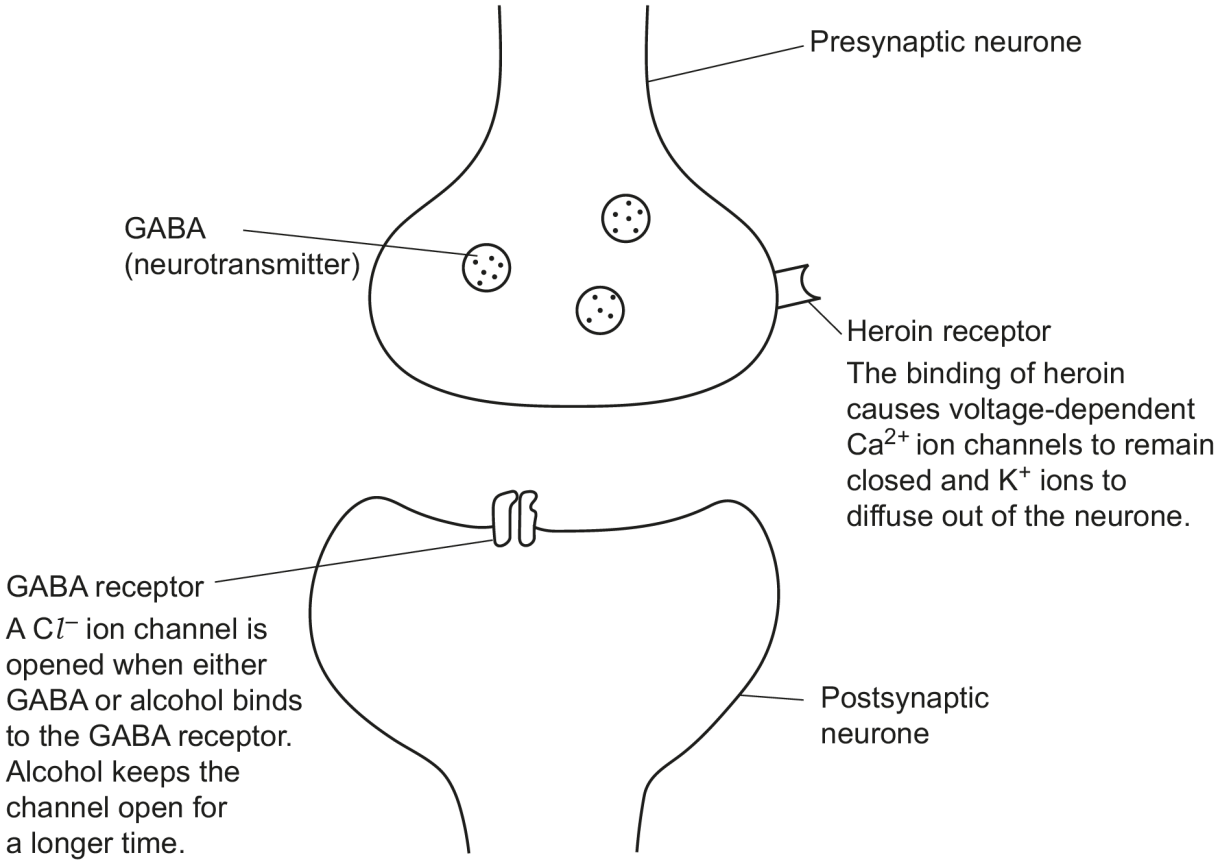

Fig. 2.2

(i) State the type of membrane protein represented by the GABA receptor.

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

Candidates mostly suggested that the membrane protein was a channel protein, which was not given marks as this was given in the text on Fig. 2.2. Candidates were expected to deduce that the protein was spanning the postsynaptic membrane and as such was an intrinsic (or integral) protein.

Question 2 (b) (ii)

(ii) Compare **and** explain the effects of alcohol and heroin on the postsynaptic neurone in **Fig. 2.2**.

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

This stretch and challenge question proved to be demanding for many candidates. Candidates often recalled the information provided in the figure and did not focus their answer on the effects on the postsynaptic neurone.

High level responses linked the effects of the two drugs to the impact on the postsynaptic membrane receptor and the subsequent consequences on the resulting action potential. Some candidates recognised that this question related to an inhibitory synapse, with the neurotransmitter GABA resulting in hyperpolarisation of the postsynaptic neurone, meaning an action potential is unable to be triggered.

Question 2 (c)*

(c)* A student planned to test the effect of caffeine on reaction time.

The student decided to assess reaction time using a 'ruler drop' test. They planned to record the time taken for each participant to catch a ruler after it was dropped.

The student had access to standard laboratory equipment, including rulers, and a caffeinated drink of known concentration.

Outline an experimental plan that the student could use to investigate **and** statistically test the effect of caffeine on reaction time.

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

Many candidates scored well in this question and demonstrated a good understanding of key areas to consider such as variables, repeats and suitable sample size. A key feature of a high-scoring answer was providing a method that also considered the safety of the participants as well as the inclusion of a control experiment. Some candidates suggested he use of an inappropriate statistical test for the data collection technique they proposed. Responses that mentioned standard deviation or the use of statistical tests often gained higher level marks.

Misconception

There was a lot of misunderstanding here when using the statistical tests. It is worth noting that using Student's t-test (paired or unpaired) allows us to assess the significance of a difference between two means, not whether the results are significant or not. Also standard deviation cannot, on its own, tell us if a difference is significant.

OCR support

Centres can find extra help with maths skills in the OCR Maths Skills Handbook, as well as the Mathematical skills statistics booklet:

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

https://www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc

Appendix 4 of the Practical Skills Handbook provides information on terms used in measurement and conventions for recording and processing experimental measurements. This is in line with the 'The Language of measurement' booklet:

https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

Question 3 (a) (i)

3 Photosynthetic pigments absorb light energy, which is used during the production of ATP and NADPH in the light-dependent reactions of photosynthesis.

(a) **Fig. 3.1** shows a paper chromatogram produced with four photosynthetic pigments.

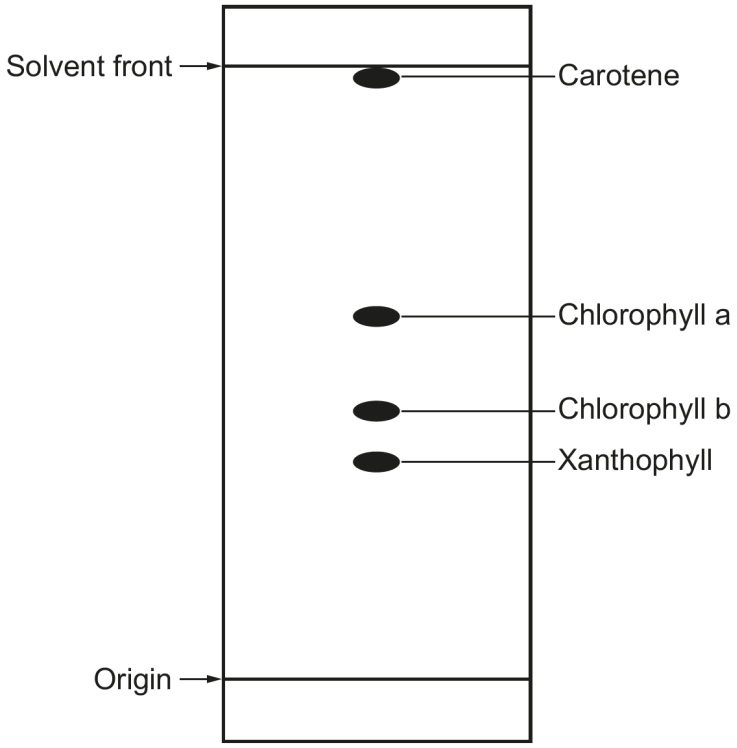

Fig. 3.1

(i) Use **Fig. 3.1** to calculate the Rf value of chlorophyll a.

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

Rf = ... **[2]**

Candidates were mostly successful in tackling this calculation. In this session, a tolerance of +/-0.5mm was allowed for the measurement of the solvent front and the distance travelled by chlorophyll a. Some candidates did not write their answer to 2 significant figures.

OCR support

The Maths for Biology website provides guidance on to use significant figures.

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

Question 3 (a) (ii)

(ii) Another student carried out paper chromatography on the four photosynthetic pigments but they used a different solvent.

Suggest why the Rf values obtained by the student would have been different to those obtained from the chromatogram shown in **Fig. 3.1**.

.....

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

This question was answered well by most candidates.

Question 3 (a) (iii)

(iii) Photosynthetic pigments have colours that make them visible on a chromatogram.

Amino acids that are separated on a chromatogram are not visible.

State the name of the chemical that is used to make amino acids visible on a chromatogram.

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

This question was not answered correctly by many candidates and suggests that they were not aware of this specific practical as stated in the specification, specification reference 2.1.3aii; "the use of chromatography in the separation and identification of amino acids".

Question 3 (b) (i)

(b) The student used DCPIP solution to test the activity of photosynthetic pigments in the light-dependent stage of photosynthesis.

The student used a pestle and mortar to grind spinach plant leaves. The student then obtained extracts from the spinach in two forms:

- leaf extract pellets (solid green pellets)
- supernatant (containing liquid and a low concentration of organelles from the spinach cells).

The student stored the leaf extracts in an ice-cold water bath before adding DCPIP solution to four test tubes:

- Tube 1: sucrose solution + DCPIP (in light)
- Tube 2: resuspended leaf extract pellet + DCPIP (in light)
- Tube 3: resuspended leaf extract pellet + DCPIP (in dark)
- Tube 4: supernatant + DCPIP (in light).

(i) Describe **and** explain how the student obtained the leaf extract pellets and supernatant.

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.....

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

It appeared that few candidates had carried out this experiment or similar experiments investigating the Hill Reaction (light dependent reaction) using DCPIP, specification reference 4.3.1. (dii). Few candidates referred to the use of a centrifuge to spin the contents at a high speed. Many just stated that a centrifuge was used. Some correctly referred to the basis of the technique as a method of separating the contents according to density.

OCR support

The practicals provided by OCR to support the practical endorsement include Practical Activity Group (PAG) 5 in which examples of colorimetry investigations are included. These practicals include extension questions that can be used to help prepare students for questions of this type in the examination. PAG activities are available on OCR interchange:

https://interchange.ocr.org.uk/Modules/ControlledMaterials/ControlledM aterialsGCEFrom2015.aspx

Question 3 (b) (ii)

(ii) Explain why the student stored the leaf extracts in an ice-cold water bath before they added the DCPIP solution.

.....

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

Some candidates appeared to misinterpret the question and gave details of control variables rather than recognising the need to reduce the activity of enzymes in the light dependent reactions before the start of the investigation.

Question 3 (b) (iii)

(iii) The student monitored the colour change in the four tubes using colorimetry.

State **and** explain the colour of filter that the student should have placed in the colorimeter during this experiment.

.....

.....

.....

.....

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

Many candidates achieved at least one mark here for the correct identification of the filter colour (red or orange). However, the second mark was specifically a 'stretch and challenge' with few candidates gaining marks.

Assessment for learning

Teachers should make sure candidates understand which colour filters should be used, and why, when using colorimetry to follow the course of a reaction by changes in % transmission or absorbance of light.

Exemplar 3

The student monitored the colour change in the four tubes using colorimetry.

State **and** explain the colour of filter that the student should have placed in the colorimeter during this experiment. Red ie: Blue → Green

The colour of the filter should be red, as this is the complement of the colour of the DCPIP solution, and therefore will enable maximum light absorption as it passes through the sample placed in the colorimeter (absorbance will decrease as the intensity of the blue decreases as DCPIP decolourises). [2]

This candidate clearly links the correct use of the red filter to the ability to detect the decreasing intensity of the blue colour as the DCPIP is reduced and gains 2 marks.

Question 3 (b) (iv)

(iv) The sentences below describe some of the details of the colorimetry procedure used by the student.

Complete the sentences using the most appropriate words or phrases.

Every minute, the student transferred a sample of the solution from each tube into a small container called a ..... , which they placed in the colorimeter.

The DCPIP changed colour in two tubes because it was ..... by electrons from the light-dependent reactions of photosynthesis. The student did not observe a colour change in the tubes numbered ..... and ..... .

[3]

This question was generally answered well by candidates. Those candidates who did not score full marks, tended to be unable to recall the term cuvette for the container used in the colorimeter which may have been a result of less hands-on practical experience.

Question 4 (a)

4 The structure of bacterial cells determines how they are identified and the type of antibiotics that are used against them.

(a) The table shows some of the features of Gram-positive and Gram-negative bacteria.

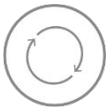
Use ticks (✓) to indicate in the table whether each feature is observed in Gram-positive bacteria, Gram-negative bacteria, or both. The first row has been filled in for you.

Feature	Gram-positive bacteria	Gram-negative bacteria
Peptidoglycan cell wall	✓	✓
Lipopolysaccharide outer envelope		
Plasma membrane		
Stained with crystal violet during the Gram staining procedure		
Final colour of pink after Gram staining		

[3]

Many candidates gained full marks on this question, although some did not complete all rows or gave hybrid ticks & crosses so could not gain marks.

Assessment for learning

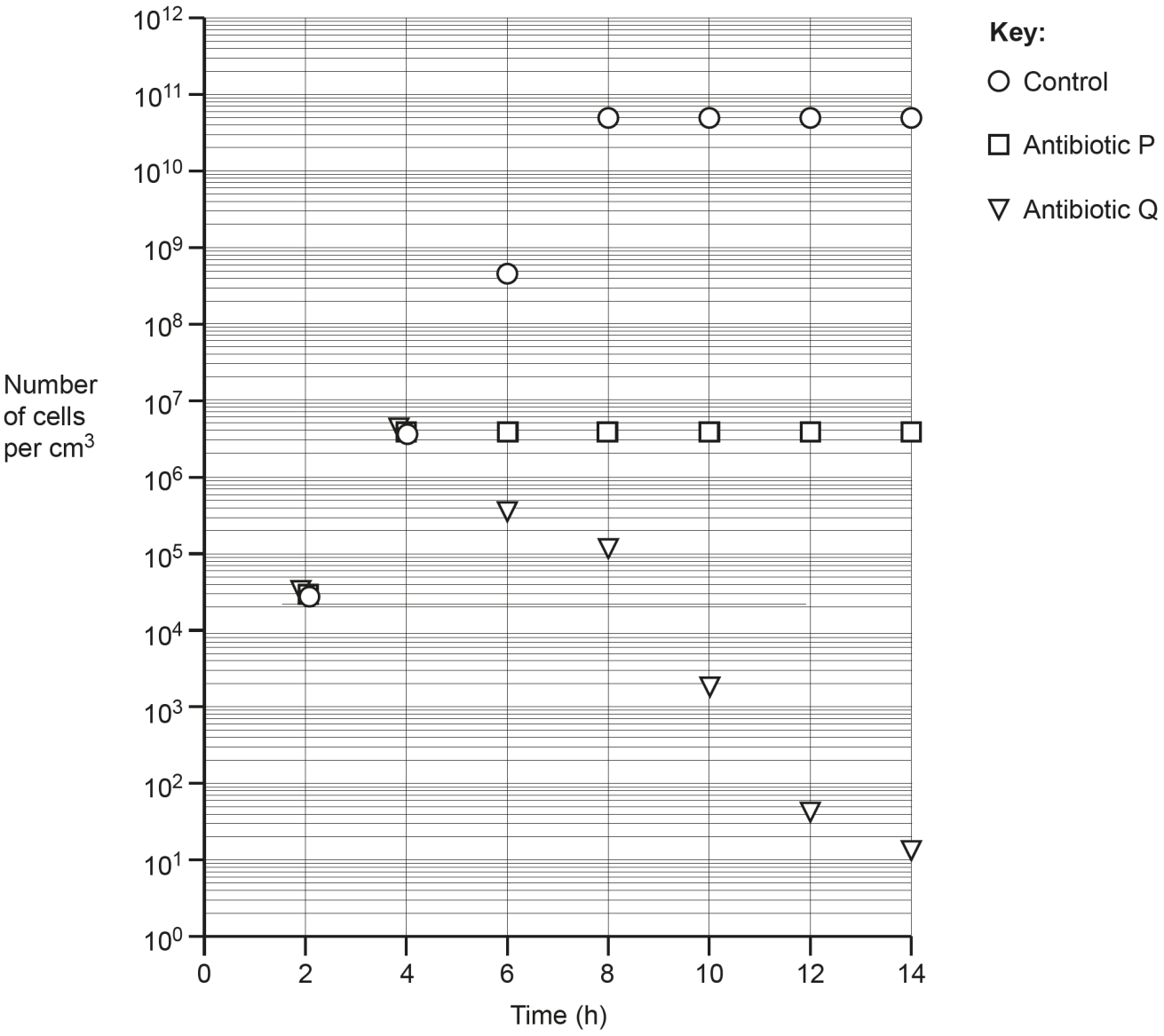


Candidates should not try to change a tick into a cross (or vice versa) They should just cross out their first response and write it again.

Question 4 (b) (i)

(b) A scientist analysed the effect of two different antibiotics, P and Q, on a particular bacterium. The scientist set up three separate populations of the bacterium, one to test antibiotic P, one to test antibiotic Q, and one as a control which was not exposed to an antibiotic.

The results are shown in the graph.



(i) The bacteria in the control group were suspended in 10 cm^3 of a nutrient solution at the beginning of the experiment.

Estimate the number of bacterial cells in the control group population at the beginning of the experiment.

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

Number of cells = ... **[2]**

Some candidates achieved both marks. Some marks were not given because of incorrect use of the log scale on the y-axis, incorrect rounding and/or inappropriate use of significant figures.

Misconception

A common misconception by candidates was the assumption that each y-grid line was a decimalisation of the log scale, e.g. $10^{2.1}$ for the first y-grid line above 10^2 rather than each interval above this being multiples of 100, so in effect the first y-grid line represents 200

OCR support

When the measurements taken in a single experiment range over a very wide range, with some differing by very small quantities and others by very large quantities, it is highly valuable to be able to use powers and logs to discuss and present the information. Guidance on the use of power, exponential and logarithmic functions can be found at:

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

Question 3 (b) (v)

(v) **Fig. 3.2** shows the results from two of the student's tubes.

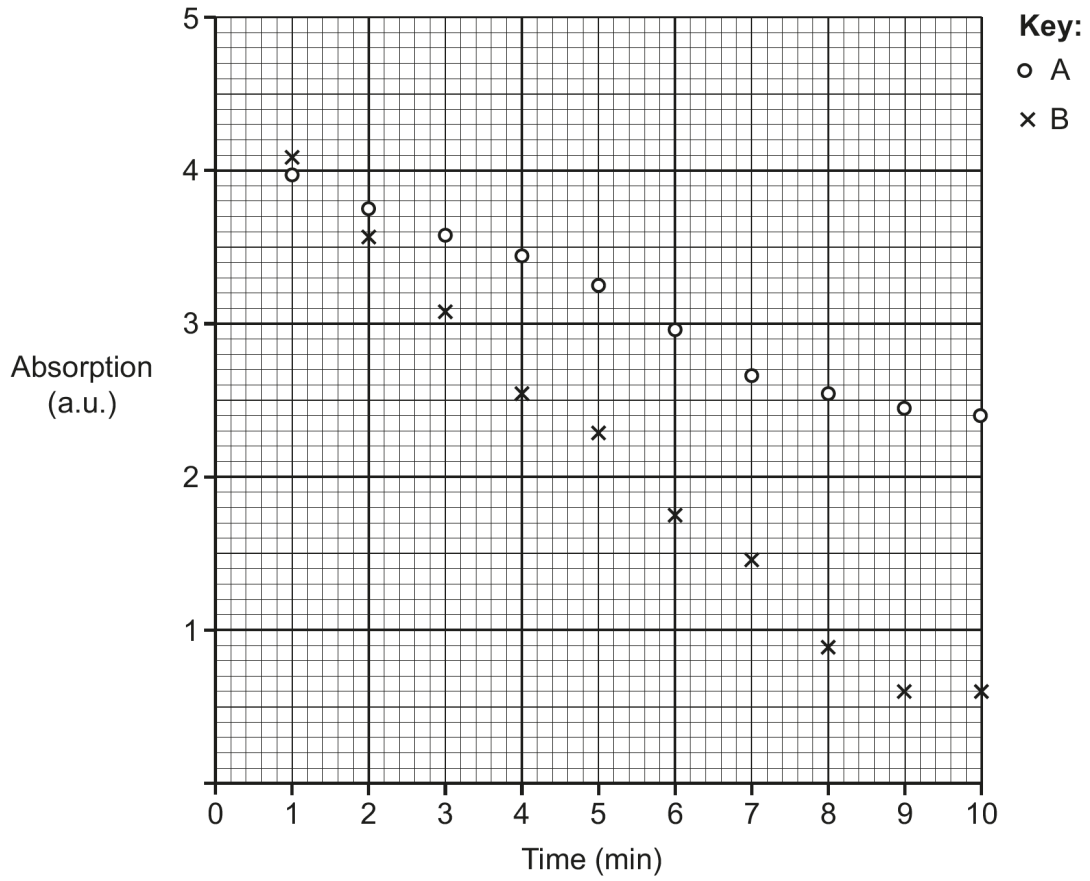


Fig. 3.2

The student forgot to label the two tubes for which the results are shown in **Fig. 3.2**.

Identify the two tubes and explain your conclusion.

A ..... B .....

Explanation .....

.....

.....

.....

.....

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

Many candidates gained at least one mark here, usually for the correct identification of the 2 tubes. However, only a few gained all 3 marks. Many described the differences rather than applying their knowledge of the light dependent reactions to link the difference in chloroplast numbers to the level of photolysis leading to the changes in the DCPIP.

Question 4 (b) (ii)*

(ii)* Describe **and** explain the results for the three bacterial populations shown in the graph.

.....

.....

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.....

.....

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

This level of response question could be answered well using very few of the available answer lines. However, many candidates filled the answer lines with irrelevant material and there was no logical line of reasoning in their answer. Hence, they didn't achieve the communication mark within a given level, particularly at Levels 2 and 3.

This question was answered well by many candidates. However, some did show evidence of both aspects of the question i.e. description of the data AND explanation(s) of the trends. A significant number of candidates did not give time references to their descriptions and to that end were not given marks for these comments. For example "*for antibiotic P the population size increased and then remained constant*" lacked references to the increase occurring between 0 to 4 hours and the plateau occurring between 4 to 14 hours.

Responses in Level 3 gave detailed descriptions and explanations for all three bacterial populations.

Assessment for learning

Teachers should encourage students to include at least 2 data quotes (with supporting units when appropriate) for all describe questions. When describing trends presented on a line graph students should consider identifying clear change in the gradients of the trend line, e.g. increase, peak, decrease and/or plateaus where appropriate.

Past examination questions can be used to practice this skill and develop examination technique.

Question 4 (c) (i)

(c) (i) Many bacterial species can produce ATP only through anaerobic respiration.

Explain why the rate of ATP production in these bacterial species is relatively low.

.....

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

Many students did not recognise the command word 'explain' but simply described the differences in ATP yield in aerobic compared to anaerobic respiration.

Question 4 (c) (ii)

(ii) Some bacterial species can produce ATP through aerobic respiration, using electron transport chains and ATP synthase.

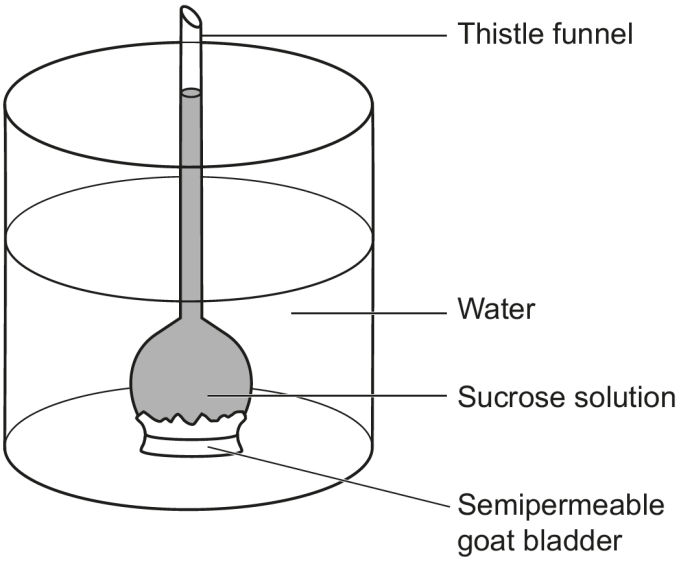
Suggest the location of electron transport chains and ATP synthase in bacterial cells.

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

Few candidates gained this mark with most candidates incorrectly referring to mitochondria because of not identifying that the question is set in the context of prokaryotes. Some candidates correctly stated the location as the mesosome.

Question 5 (a) (i)

5 The factors affecting osmosis can be investigated using a thistle funnel, which is shown in the diagram.



(a) A student wanted to investigate the factors affecting osmosis and used the experimental set-up shown.

(i) Suggest **and** explain **three** changes that the student could make to the experimental set-up that would **increase** the rate of osmosis.

Change .....

Explanation .....

.....

Change .....

Explanation .....

.....

Change .....

Explanation .....

.....

[3]

Candidates did not always gain full marks here due to the lack of appropriate scientific terminology for example referring to water concentration gradient rather than water potential gradient. A lot of candidates wrote about increasing temperature and the impact on the kinetic energy of the water molecules gaining 1 mark.

Question 5 (a) (ii)

(ii) The student decided to measure the rate of osmosis by measuring how the height of the solution changed over time in the thistle funnel.

Suggest appropriate units for the student's dependent variable in the investigation.

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

Candidates who recognised that the dependent variable was indeed the change in the height of the solution correctly suggested units such as mm or cm. Many students however misinterpreted the question and suggested units for the rate of change incorrectly giving a unit for the processed data rather than the raw data.

Question 5 (a) (iii)

(iii) Suggest a semipermeable material that the student could use instead of the goat bladder.

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

Only a few candidates scored marks in this question. Most suggested either a bladder from a different animal or inappropriate materials such as filter paper, cloth or a plastic bag.

Question 5 (b) (i)

(b) Osmosis occurs in several parts of a kidney nephron.

(i) State the part of a kidney nephron in which most of the water is reabsorbed.

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

The most common answer for this question was the Loop of Henle with candidates failing to recognise that most of the water is reabsorbed in the proximal convoluted tubule.

Question 5 (b) (ii)

(ii) State a part of a kidney nephron in which ADH can change the permeability to water.

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

More candidates were able to identify the collecting duct as the region containing the target cells that respond to ADH. Several candidates muddled key terms incorrectly referring to the convoluted duct.

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