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Examiners' report

BIOLOGY B (ADVANCING BIOLOGY)

H422
For first teaching in 2015

H422/03 Summer 2018 series

Version 1

Contents

Introduction

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

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

Paper H422/03 series overview

H422/03 is one of three examination components for the new revised A Level examination for GCE Biology B (Advancing Biology). This paper focuses on the wide range of experiments and practical skills candidates are expected to have gained throughout the course. Whilst some practicals are identified within the specification such as culturing of *Rhizobium spp.* in vitro 4.3.1 h (ii), candidates are expected to be comfortable and confident in applying their knowledge and understanding to unfamiliar contexts and be familiar with a wide range of practical techniques.

Whilst H422/03 assesses content from across all teaching modules this paper places a particular emphasis on practical skills.

Candidate performance

Candidates who did well on this paper generally did the following:

- Applied knowledge and skills they have developed from the 12 PAG activities to new contexts.
- Performed calculations including statistical tests following the required rubric i.e. clear working, inclusion of correct units and use of significant figures: 1ci, 2di, 3bi, 3bii, 4ci.
- Used and interpreted logarithmic scales accurately: 2diii.
- Produced clear and concise responses for the Level of Response questions: 1bii and 4b.
- Identified key variables accurately and showed an understanding of impact of these variables if they were not controlled: 2c.
- Identified tissues and cells accurately from photomicrographs: 3ai.
- Evaluated different diagnostic tests: 4b.
- Read the command word of the question appropriately e.g. evaluate vs describe.
- Stated an appropriate number of responses in line with the question rubric: 2c, 4aii.

Candidates who did less well on this paper generally did the following:

- Misinterpreted command word of questions e.g. describing the diagnostic test rather than evaluating the tests in 4b.
- Produced responses that lacked depth and repeated information provided in the stem of the question e.g. 4ai, 4cii.
- Demonstrated poor understanding of the effect of key variables e.g. 2c.
- Lacked the ability to use logarithmic graphs e.g. 2dii.
- Lacked the ability to provide answers to the correct number of decimal places or significant figures e.g. 3bii (significant figures), 1ci and 4ci (decimal places).
- Listed more answers than required which could not be considered by the examiners e.g. 2c (only requires 3 variables), 4aii (only requires one improvement).

There was no evidence that any time constraints had led to a candidate underperforming. Nor were there any scripts where there was a no response to the final question that also had large sections of the paper which had not been tackled.

Question 1(a)

1 Farmers rotate different crops on their land to produce higher yields. Crops like beans are used in the rotation to fix atmospheric nitrogen. This reduces the need for synthetic fertilisers.

(a) Name the type of crop, such as beans, that can fix nitrogen.

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

Lower performing candidates did not identify that the question was asking for a **type** of crop and instead gave examples of crops which was not credited.

Question 1(b) (ii)

(ii)* Write a method that could be used to prepare a culture of *Rhizobium* bacteria in the laboratory.

You are provided with:

- plates with agar containing the constituents listed in the table in part **(i)**
- a bean plant
- school or college resources.

In your answer you should describe how you would minimise potential hazards associated with the preparation.

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

Candidates who performed well in this question demonstrated that they had either completed this practical in their centre, or observed a demonstration. These candidates gave details such as the identification of healthy nodules by colour (pink) and how to carry out aseptic techniques. Some candidates did not appreciate the bacterium had to be obtained from the root nodules instead using the "whole plant" or inappropriate parts of the plant e.g. stem.

Question 1(b) (iii)

(iii) After preparation in the laboratory, *Rhizobium* cultures are usually kept at 30 °C.

Explain why this is a suitable temperature.

.....

.....

.....

.....

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

Able candidates recognised that incubating bacteria above this temperature could give lead to the culturing of bacteria that could be harmful and pathogenic to humans. Many candidates referred to the optimal temperature for the bacterial enzymes but did not then link this to increased reproduction rates.

Exemplar 1

This prevents (or rather minimises) the risk of growing cultures that are harmful to humans as the core body temperature = 37°C so bacteria would not to survive at this temperature. Also because this is the temperature at which bacterial enzymes work most efficiently as the optimum. [2]

BOD

Question 1(c) (i)

(c) (i) In response to infection by *Rhizobium*, bean plant nodule cells produce protein called leghaemoglobin.

Researchers wanted to find out more about three genes that code for leghaemoglobin. They used RNA interference (RNAi) to inhibit the production of leghaemoglobin using miRNA. They measured the relative transcript level of the leghaemoglobin genes of bean plants treated with miRNA (RNAi plants) and those of untreated bean plants.

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Transcript levels for gene LjLb2 in the RNAi plants were reduced by 97.4% compared with the untreated plants.

Calculate the relative transcript level for LjLb2 in the RNAi plant.

Show your working.

Answer = ... **[3]**

Candidates should provide answers that are to the same number of decimal places for other data in the same column. In this case the answer should be given to 3 decimal places.

Question 1(c) (ii)

(ii) Describe how miRNA inhibits the mRNA of the treated plants.

.....

.....

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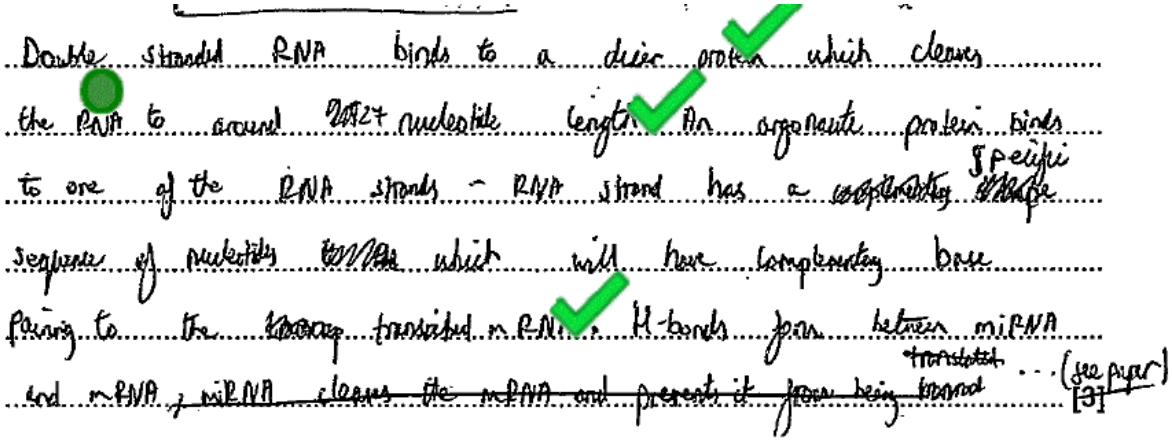
.....

.....

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

Some candidates did not score marks in this questions due to poor expression; for exampling muddling mRNA and miRNA in their answers. Others gave answers that related to enzyme inhibition which did not relate to the question. This area of the specification is new and examiners observed many answers that were lacking depth and detail.

Exemplar 2



Question 1(c) (iii)

(iii) Explain why the researchers chose miRNA rather than siRNA (small interfering RNA) to inhibit the transcription of the leghaemoglobin genes.

.....

.....

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

Again some less able candidates discussed enzyme inhibition rather than the difference between precision of miRNA and siRNA.

Exemplar 3

miRNA is more specific acting - that it will only inhibit one specific gene - siRNA affects is able to affect siRNA is more specific - miRNA is able to [1]
inhibit several of the genes at once / siRNA may only inhibit one.
inhibit one.

Question 2(a) (i)

2 A student investigated the effect of temperature on the rate of diffusion of chloride ions from carrot cells.

This is the student's method for the preliminary experiment.

1. Cut thin sections of carrot.
2. Place the sections of carrot into a boiling tube of distilled water, maintained at a temperature of 100 °C.
3. Remove a sample of water from the boiling tube and add silver nitrate solution. The silver nitrate solution reacts with chloride ions to produce a white precipitate.
4. Measure the absorbance of the sample in a colorimeter. Higher chloride ion concentrations will produce more white precipitate which will increase absorbance.

(a) (i) All equipment and sections of carrot were washed with distilled water before use.

Explain why.

.....

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

This question required candidates to consider impact of chloride ions released onto the outside of the carrot sections when they were cut and if they were not removed by washing. Able candidates related this potential source of error and identified it could affect the validity of the results. Other candidates were vague in their answers and referred to removing dirt and other chemicals.

Question 2(a) (ii)

(ii) The absorbance value obtained in step 4 was used as a reference value for further tests. This absorbance value was considered to represent the highest chloride ion concentration that could be measured in the boiling tube solution.

Explain why.

.....

.....

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

This question required candidates to consider the importance of reference values when using a colorimeter. Some candidates were distracted from the focus of the question and referred to the boiling point of water and commented on the evaporation of the water. Able candidates referred to the maximum disruption to the cell surface membrane and tonoplast and the release of all the chloride ions.

Question 2(c)

(c) The student used the method for the preliminary experiment to plan their investigation into the effect of temperature on the rate of chloride ion diffusion.

Describe **three** variables that the student would need to control when planning this investigation. Include reasons why each of your chosen variables must be controlled.

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

This question covered two key practical skills: the ability to identify key variables and the ability to justify why these variables should be controlled. Candidates should also be aware that the question asks for three variables and as such only the first 3 responses were marked. Some candidates duplicated their answers by, in effect, listing the same variable more than once e.g. size of carrot section and surface area of the carrot section. Candidates who did not perform well in this question did not quantify the impact of the uncontrolled variable, for example stating "volume of distilled water removed in the sample will affect the number of chloride ions" rather than "a **larger** volume will **increase** the number of the chloride ions".

Question 2(d) (i)

(d) Fig. 2.1 shows the results of the student's experiment carried out at different temperatures.

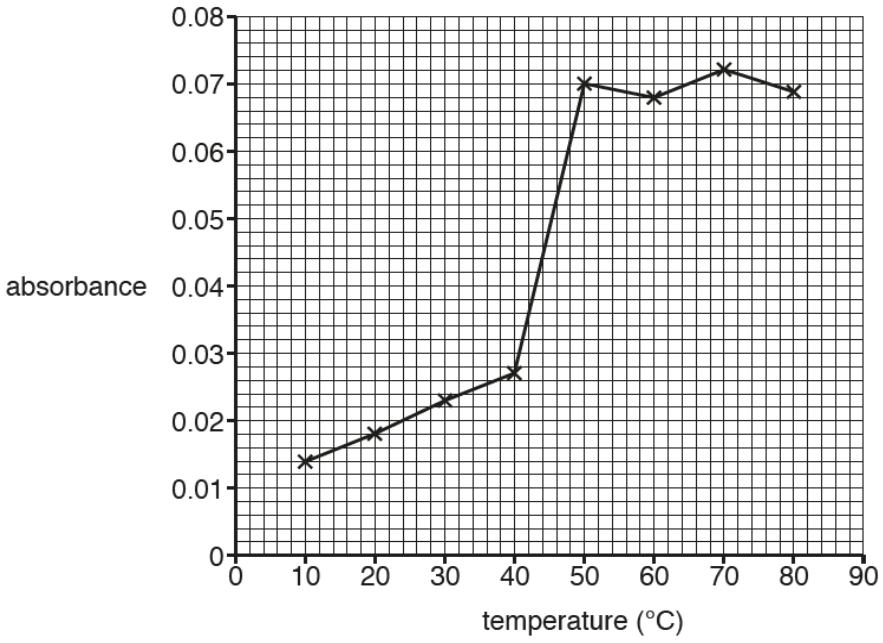


Fig. 2.1

(i) Use Fig. 2.1 to calculate the increase in absorbance between 10 °C and 40 °C.

Answer = ... **[1]**

Several candidates did not read the question carefully and rather than calculating the actual increase in absorbance assumed the question was asking for a percentage increase and to that end did not gain credit.

Question 2(d) (iii)

Fig. 2.2 shows absorbance measured at different concentrations of chloride ions.

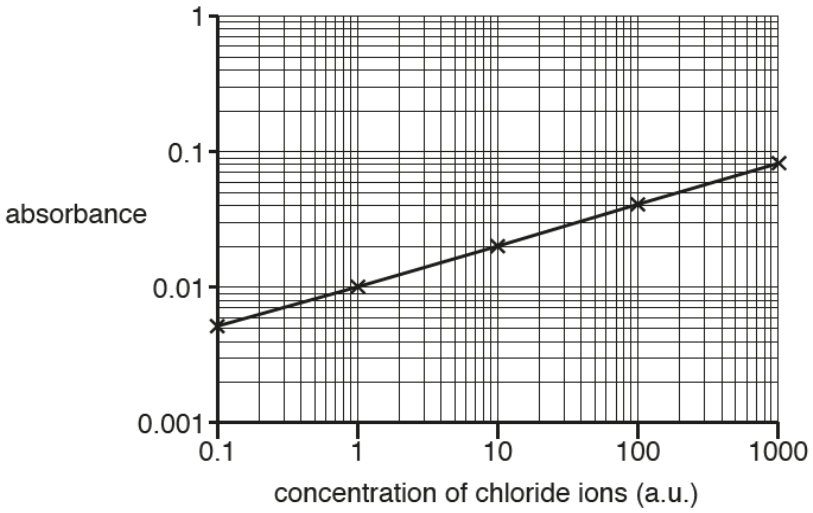


Fig. 2.2

(iii) Using the graph in Fig. 2.1 and the graph in Fig. 2.2, estimate the chloride ion concentration at a temperature of 45 °C.

.....

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

It appeared that some candidates were unfamiliar with the use of log scales and log graph paper. Centres should ensure that all the mathematical requirements of the specification are covered and could be assessed in any of the three examination papers. Those candidates that could estimate the chloride ion concentration did not always give units (a.u) from the x-axis.

Question 3(a) (ii)

Candidates were not all confident in identifying layer Y. A common error in 3aii was the use of incorrect terms for the tissue identified in 3ai e.g. smooth muscle stretching and recoiling or elastic fibres contracting.

(ii) Describe the importance of layer **Y** in the normal functioning of an artery.

.....

.....

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

Question 3(b) (ii)

(ii) Fig. 3.2, **on the insert**, shows a light photomicrograph of a cross-section of a diseased artery. The diseased artery has a diameter 14.3% greater than the healthy artery in Fig. 3.1. The diameter of the healthy artery is 0.40 mm.

Calculate the actual diameter of the diseased artery. Give your answer to 2 significant figures.

Show your working.

Diameter = ... mm **[2]**

Some candidates did not give their answer to 2 significant figures and as such did not score full marks. Candidates should be encouraged to give their working in the space provided. Some candidates gave an incorrect answer, but with no working missed the opportunity to make one mark.

Question 3(c)

(c) Suggest why layer **Y** is much thicker in this diseased artery than in the healthy artery shown in Fig. 3.1.

.....

.....

.....

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

This question required candidates to consider possible reasons for the tunica media to thicken. It mainly assessed AO2. Able candidates gave 2 appropriate suggestions but other candidates gave one suggestion, which diverted away from the question, describing the causes of coronary heart disease. A common error was the deposition of fats/lipids in the lumen or on the wall (rather than **in** the artery wall).

Question 3(d) (i)

(d) (i) Capillaries do not have a layer **Y**.

Explain why the absence of layer **Y** is important in the formation of tissue fluid.

.....

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

Able candidates related the role of fenestrations in the formation of tissue fluid. Some candidates used terms plasma and tissue fluid incorrectly and as such did not gain a mark. Several candidates appreciated the diffusion distance would be reduced but did not then link this to either meeting the demand for nutrients or removing waste products adequately.

Exemplar 4

The absence of muscle or elastic fibres allows water and other molecules to be forced out of the fenestrations in the capillary wall. **[1]**

Question 4(a) (i)

4 The Mantoux test is used to check if a person is immune to tuberculosis (TB) to decide whether they need a BCG vaccination.

A red inflamed lump (induration) may appear three days after the injection of tuberculin.

A person is considered to be immune to TB if they develop an induration that has a diameter of at least 10 mm.

(a) For an induration of 10 mm the percentage error is 10%.

(i) Explain how this percentage error could lead to incorrect decisions about whether a BCG vaccination is needed.

.....

.....

.....

.....

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

This question expected candidates to refer to false positives and/or false negatives. Able candidates used data to support their answer and went on to explain the impact of this error in terms of vaccinating people who were already immune (in the case of a false negative) and vice versa. Other candidates gave vague answers stating answers such as "some people may be vaccinated when they don't need it which is a waste of money".

Question 4(a) (ii)

(ii) A health professional measures the diameter of the induration using a ruler marked in millimetres.

Suggest one way this method for measuring indurations could be improved. Explain your answer.

.....

.....

.....

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

Candidates who did not perform well in this question focussed on the use of the ruler and suggested more 'accurate' rulers which was not accepted. Candidates who had used or observed the use of (vernier) callipers in their practical skills were able to access this question. Some candidates suggested the use of a photograph but without the use of a scale on the photograph this would not in itself result in an improvement,

Question 4(b)*

The Mantoux test requires:

- a solution of tuberculin kept away from the light between 2 °C and 8 °C
- a sterile needle and a sterile syringe.

An alternative to the Mantoux test is a more accurate antibody test called ELISA which requires:

- a fresh blood sample
- full laboratory facilities.

The Mantoux test was used on a sample of 89 people and was followed up with an ELISA. The results are shown in Table 4.1

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(b)* Evaluate the use of the Mantoux test and ELISA for testing whether people are immune to TB.

In your answer you should refer to the data in Table 4.1.

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

The command word in this question is 'evaluate' and to that end candidates were expected to give advantages and disadvantages of both the Mantoux test and the ELISA test. Candidates should be encouraged to give a balanced discussion. Candidates who did not perform well on this question tended to focus on either just advantages or just disadvantages or focus on one type of test.

Also in this question candidates were instructed to refer to data in table 4.1. This was not done by a many candidates.

Exemplar 5

From the table, it appears that the ELISA test identifies 40 positive results, which is ~~mean~~ over 25% more than the Mantaux test. This would suggest ~~it~~ that it is better at giving an accurate, definite result, than the Mantoux test which has a higher number of negatives (61) than ELISA (49), which could perhaps be due to the uncertainty of the health proffessional when measuring the induration, however to be on the safe side they have diagnosed them as negative for immunity. ~~It~~ ELISA is useful because it could prevent people who may already be immune from recieving unnecessary vaccines, which would be economically beneficial to the NHS. However. [6]
ELISA requires fresh blood so must be carried out immediately, and the full lab facilities suggest it is more complicated and expensive than the Mantoux test. This wouldn't be ideal in developing countries where these facilities and funding aren't available. ~~In~~ In these circumstances, Mantoux would be more useful. Mantoux is quicker and cheaper, however there could be a risk of catching TB from the tuberculin if the person isn't already immune. Furthermore, the tuberculin requires ~~a~~ good storage, which could be the fridge, although this may not be possible world-wide.

Question 4(c) (ii)

The null hypothesis used in the study was:

"There is no negative correlation between age at vaccination and length of time immunity was effective."

Table 4.3 shows the critical values for Spearman's rank correlation coefficient.

	Critical values for r_s	
Degrees of freedom	**p = 0.05**	**p = 0.01**
8	0.6429	0.8333
10	0.5636	0.7455
18	0.4014	0.5501
20	0.3805	0.5218

Table 4.3

(ii) Use Table 4.3 to decide if the null hypothesis was correct.

.....

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.....

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

Able candidates identified the correct number of degrees of freedom and could refer to the use of critical and calculated values as well as significance levels to justify the acceptance of the null hypothesis. Other candidates used inappropriate terms such as "proving the hypothesis" and did not use the appropriate degrees of freedom. Error carries forward from 4ci was given in cases where candidates had not calculated the incorrect r value.

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