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# A LEVEL

*Examiners' report*

# *BIOLOGY A*

**H420**
For first teaching in 2015

# H420/01 Summer 2019 series

Version 1

# Contents

# Introduction

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

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

# Paper 1 series overview

H420/01 is one of three components of the GCE A Level Biology A specification assessed during this examination session. For H420/01 candidates needed to demonstrate breadth and depth of knowledge across modules 1, 2, 3 and 5 with 15 multiple choice and two Level of Response questions included in the 100 marks.

Mathematical and practical skills continue to be embedded within the multiple-choice questions in section **A** and the longer responses of section **B**. The question paper appeared to be accessible to candidates across the ability range, and there was no evidence to suggest that candidates were under any time constraints towards the end of the paper.

Candidates who performed well on this paper were able to apply their knowledge to new situations and were also able to demonstrate their advanced practical and mathematical skills, particularly with regards to effective analysis and evaluation of data.

Candidates who performed less well did not apply their knowledge or use information provided, e.g. diagrams, graphs or figures included in the questions, to support their answers.

Overall, candidates demonstrated a wide range of ability with higher ability candidates giving succinct responses and appearing more adept at coping with the demands of the paper's mathematical and practical content to gain higher level marking points. Lower ability candidates were able to demonstrate their ability to learn and recall facts.

## Note

From this series students have been provided with a fixed number of answer lines and an additional answer space. The additional answer space will be clearly labelled as additional, and is only to be used when required. Teachers are encouraged to keep reminding students about the importance of conciseness in their answers. Please follow this link to our SIU (https://www.ocr.org.uk/administration/support-and-tools/siu/alevel-science-538595/)

# Section A overview

As in previous years, this section of the examination consisted of 15 multiple choice questions covering a range of topics across the assessed modules for this component. Only **AO1** and **AO2** were assessed in section **A**. Some questions involved recall, while others required the use of mathematical, practical and/or analytical skills; some questions needed more time than others.

Section **A** achieved a good spread of marks across the range of abilities. Higher ability candidates were able to demonstrate knowledge of the subject content without being distracted by the alternative options offered alongside the correct response.

Candidates had been advised to spend no longer than 20 minutes on this section and the majority of candidates appeared to have managed their time effectively with very few omissions.

It was noticeable this year that there were fewer ambiguous responses with candidates clearly showing the option intended; often by crossing out the response in the box and clearly writing the corrected choice of answer alongside or even redrawing a box for their response.

## Question 5

**5** Both of the cell types **P** and **Q** develop from haematopoetic stem cells in the bone marrow.

Which of the following statements, **A** to **D**, correctly describes haematopoetic stem cells?

**A** They are neither pluripotent nor multipotent.

**B** They are pluripotent but not multipotent.

**C** They are both pluripotent and multipotent.

**D** They are multipotent but not pluripotent.

Your answer ☐ **[1]**

It is evident that despite having knowledge of the terms pluripotent and multipotent many candidates still struggle to distinguish between them in context. Option B therefore provided the distractor and most common incorrect response to the correct option D.

## Question 7

**7** The following passage outlines the process of phototropism in plants:

Auxin is synthesised in cells at the ..... of the shoot. Auxin causes the cells to ..... on one side, so the stem bends.

Scientists originally thought auxin was ..... by light but this was disproved by the fact that plants growing in the dark and plants growing in unilateral light had ..... auxin levels.

Which option, **A** to **D**, is the correct sequence of missing words?

**A** meristem, shorten, destroyed, different

**B** tip, elongate, destroyed, similar

**C** meristem, shorten, synthesised, raised

**D** tip, elongate, synthesised, similar

Your answer ☐ **[1]**

Many candidates completed the gap fill here to aid their decision-making. It appeared, therefore, that the majority had come down to a final choice between options B and D. Candidates then needed to apply their knowledge of the involvement of auxin in phototropic responses to this new situation regarding the original scientific ideas about how it works. Option B is correct because if light shining on the upper side of the shoot '*destroyed'* auxin then there would be more auxin on the underside so it would bend towards the light, which does. If auxin was originally thought to be *'synthesised'* by light the stems would bend downwards because auxin would be accumulating in the upper surface i.e. upper surface cells would elongate. So option D cannot be the correct option.

## Question 10

**10** Many trees drop their leaves in the autumn.

Which of the following plant hormones is/are thought to be involved in the control of leaf drop?

1 auxin
2 ethene
3 gibberellin

**A** 1, 2 and 3

**B** only 1 and 2

**C** only 2 and 3

**D** only 1

Your answer ☐ **[1]**

Knowledge of the functions of plant hormones caused problems for some candidates throughout this paper. Candidates that were aware of the effects of auxin and ethene in controlling leaf drop correctly gave option B as their response. While not a recognised role of gibberellins it is reported that there is some evidence of involvement in leaf senescence, it was therefore decided to also credit candidates who chose option A.

## Question 12

**12** Damage to the hypothalamus results in lower water potential of the blood.

Which of the following, **A** to **D**, explains these observations?

**A** ADH release increases the water potential of blood.

**B** Mineralocorticoids affect cells in the loop of Henle.

**C** Fewer water channels are inserted into the cell surface membranes of the collecting duct.

**D** The anterior pituitary releases hormones into the blood.

Your answer ☐ **[1]**

Candidates showed good knowledge and understanding of the role of the hypothalamus in the production of ADH and its role in osmoregulation.

## Question 13

**13** Collagen is found in tendons. Tendons attach muscles to bones.

Which of the following lists of properties, **A** to **D**, makes collagen suitable for this role?

**A** strong, inflexible, insoluble

**B** strong, flexible, soluble

**C** strong, inflexible, soluble

**D** strong, flexible, insoluble

Your answer ☐ **[1]**

Many candidates are showing improvement in their knowledge of biochemical concepts. The majority of candidates were aware that collagen is strong and insoluble. However, large number of candidates chose A rather than the correct option D in their response.

| | | |
|---|---|---|
| ? | **Misconception** | There is a common misconception that collagen is 'inflexible'. |

## Question 14

**14** Cyanobacteria are photosynthetic prokaryotes.

A scientist exposed cyanobacteria to light of different colours and intensities and made the following observations:

- Most cyanobacteria are blue in colour.
- At low light intensities, glucose production in cyanobacteria is low.
- When light intensity reaches a certain level the rate of glucose production in cyanobacteria stops increasing.

Which of the following statements, **A** to **D**, correctly explains these observations?

**A** The pigments in cyanobacteria absorb blue light and light intensity is a limiting factor for the rate of photosynthesis.

**B** The pigments in cyanobacteria absorb red light and light intensity is not a limiting factor for the rate of photosynthesis.

**C** The pigments in cyanobacteria absorb blue light and light intensity is not a limiting factor for the rate of photosynthesis.

**D** The pigments in cyanobacteria absorb red light and light intensity is a limiting factor for the rate of photosynthesis.

Your answer ☐ **[1]**

Candidates that understood the principles of light absorption by pigments chose D as the correct option. However, the question proved challenging for some candidates and there was confusion as to which wavelengths of light (blue or red) were absorbed or reflected by the blue pigments in the Cyanobacteria.

## Question 15

**15** The hormone aldosterone is produced by the adrenal cortex. Excess production of aldosterone can result in high blood pressure.

The following statements describe processes that occur as a result of aldosterone secretion:

1 $Na^+/K^+$ pumps in the collecting duct of the kidney move three $Na^+$ ions into the blood and two $K^+$ ions out of the blood.
2 $Cl^-$ ions enter the blood to maintain electrochemical balance.
3 $H^+$ ions enter cells lining the kidney tubules.

Which of the above statements explain(s) why excess aldosterone production can result in high blood pressure?

**A** 1, 2 and 3

**B** only 1 and 2

**C** only 2 and 3

**D** only 1

Your answer ☐ **[1]**

This question provided a significant challenge for some candidates. Candidates needed to process information in the three statements about the movement of ions in response to aldosterone secretion. Only statements 1 and 2 were correct and higher ability candidates often deduced that option B was the correct response. Option C was the most common incorrect response.

# Section B overview

Mathematical and practical skills were embedded throughout the structured questions in section **B**.

Assessment objectives **AO1**, **AO2** and **AO3** were addressed throughout **Q16** to **Q22** with concepts from across the specification including the cardiac cycle, analysis of biological molecules, photosynthesis and communication with regards to the roles of hormones.

## Question 16 (a) (i)

**16 (a)** Fig. 16 shows pressure changes during the cardiac cycle.

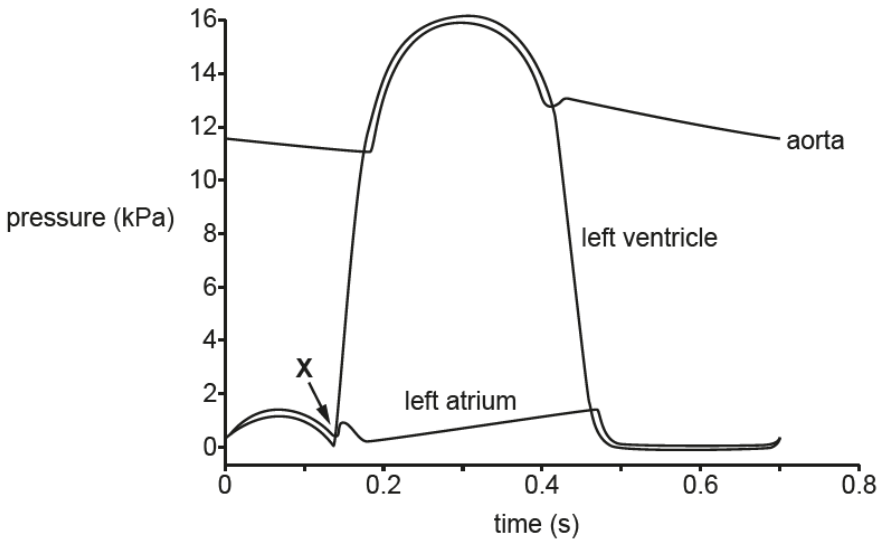



**Fig. 16**

**(i)** Using Fig. 16, compare the changes in pressure in the left ventricle with the changes in pressure in the left atrium.

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

Good responses demonstrated the ability to compare the changes in pressure between the two heart chambers. The increase in pressure being greater in the (left) ventricle than in the atrium was recognised by many candidates, and those who gave figures for the pressure changes often gained two marks. Good responses also used approximate times when comparing increases and decreases of pressure at the different stages shown in Fig.16.Many candidates gave descriptions or explanations of what was happening during the cardiac cycle, detail of blood flow through the heart and valve action. Despite being accurate, these responses did not address what was being asked by the question and could not be credited.

Candidates are reminded to use units e.g. (kPa) and (s) in this case, when using figures to support their responses.

## Exemplar 1

**16 (a)** Fig. 16 shows pressure changes during the cardiac cycle.

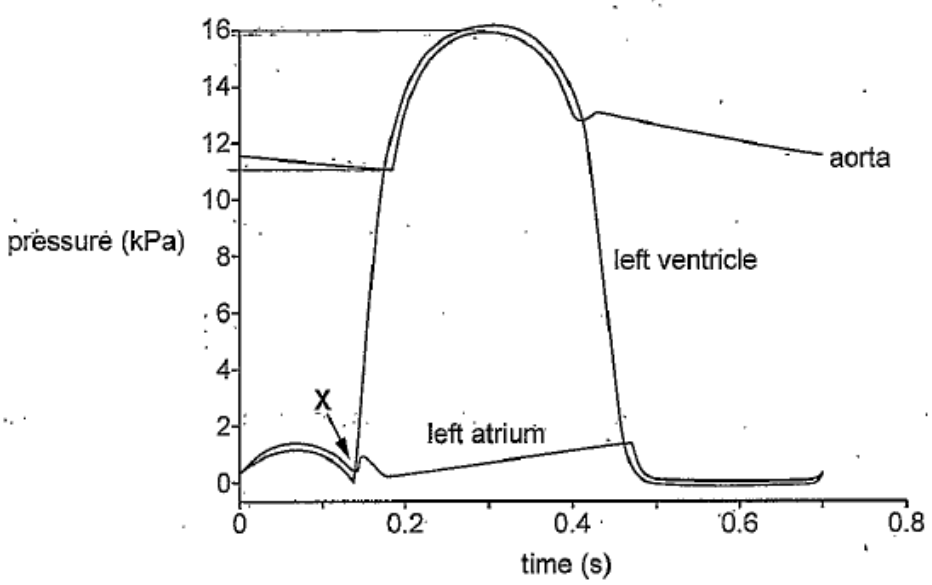



**Fig. 16**

**(i)** Using Fig. 16, compare the changes in pressure in the left ventricle with the changes in pressure in the left atrium.

In the first 0·15 seconds, the left ventricle & left atrium both have a similar pressure, this is atrial systole. From 0·15 seconds to 0·3 seconds, the pressure at the left ventricle increases rapidly from 0kPa to 16kPa, this is during ventricular systole. At the same time, the pressure in the left atrium increases steadily to a pressure of 1·5kPa at ~0·18 seconds. The ventricular pressure decreases rapidly from 16kPa to 0kPa from 0·3s to 0·5s, before ventricular and atrial pressure remain roughly the same from 0·5s to 0·7s. **[4]**

This response identifies a high attaining response where the candidate has clearly compared pressure changes and included the use of figures and units from Fig.16.

## Question 16 (a) (ii)

**(ii)** Using Fig. 16, calculate the heart rate of this individual.

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

heart rate = ..... **[1]**

The majority of candidates demonstrated that they could use Fig.16 to extract the information and perform a heart rate calculation. Some candidates were not credited for this single mark question because they did not give their answer to two significant figures or did not include units e.g. beats $min^{-1}$

| | | |
|---|---|---|
| i | **OCR support** | The 'Maths for Biology' website provides support on the correct use of significant figures:<br>https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/ |

## Question 16 (a) (iii)

**(iii)** Using Fig. 16, calculate the percentage change between minimum and maximum pressure in the aorta.

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

percentage change = ..... **[2]**

The mathematical skill of calculating percentage change is still proving challenging for many candidates. As in Q16(a)(ii) some candidates did not give their answer to two significant figures which was a requirement of the question to achieve both marks.

| | | |
|---|---|---|
| i | **OCR support** | The 'Maths for Biology' website provides support on how to calculate percentage change:<br>https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/<br><br>The mathematical Skills Handbook can also be used to assist candidates with the maths skill 'M0.3':<br>https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf |

## Question 16 (a) (iv)

**(iv)** Name the valve which closes at point **X** on Fig. 16.

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

Many candidates gave atrioventricular (valve) as the correct response with a few also gaining credit for bicuspid (valve).

## Question 16 (b)

**(b)** The heart supplies oxygenated blood to the tissues.

$VO_2^{max}$ is a measurement of the maximum volume of oxygen that an individual can use during intense exercise in a given time.

Smart watches can estimate the $VO_2^{max}$ of an individual by measuring heart rate while exercising.

Having a higher $VO_2^{max}$ is associated with improved aerobic fitness.

Two male students exercised for 30 min and used smart watches to record their $VO_2^{max}$. Table 16 shows their masses and the $VO_2^{max}$ values they recorded.

| Student | Mass (kg) | $VO_2^{max}$ ($cm^3 kg^{-1} min^{-1}$) |
|---|---|---|
| 1 | 65 | 50.4 |
| 2 | 57 | 48.2 |

**Table 16**

Student 1 drew the following conclusion from this result:

My $VO_2^{max}$ is higher because my mass is greater. I have more cells than Student 2. Each cell needs oxygen to carry out respiration.

Student 2 said that this conclusion is invalid because several variables have not been controlled.

State **three** variables necessary for a valid comparison that have **not** been controlled in the above experiment.

1 .....

.....

2 .....

.....

3 .....

.....

**[3]**

Many candidates gained at least two marks here with the most common responses being 'temperature' (of the environment) and 'age' or 'fitness' of the students. There were some responses that were too vague to be credited often referring to the 'health' or 'diet' of the students without being specific.

## Question 17 (a)

**17** Gibberellin causes stem elongation in plants.

Fig. 17.1 shows the effect of gibberellin on cabbage plants.

without gibberellin with gibberellin

**Fig. 17.1**

Gibberellin causes an increase in the distance between the leaves on the stem, which is known as the internodal length.

**(a)** Explain why gibberellin is classed as a plant **hormone**.

.....

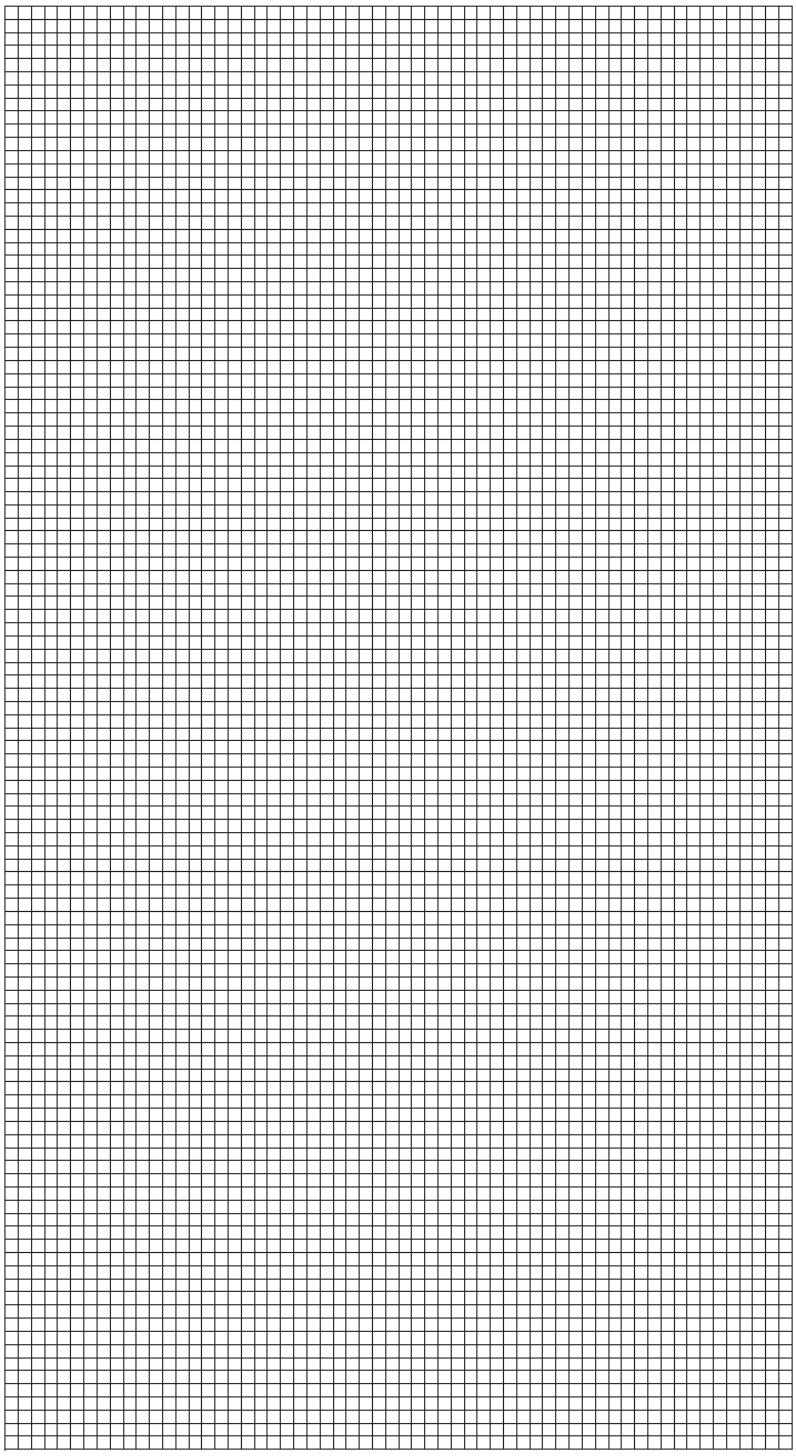
..... **[3]**

Good responses recognised the need to explain why gibberellin is classed as a hormone to achieve maximum marks. However, many candidates misunderstood the question and offered descriptions about **how** hormones work when they reach target cells or described the role of gibberellin in plants.

## Question 17 (b) (i)

**(b)** A scientist carried out an investigation into the effect of gibberellin on cabbage plants.

**(i)** Plot the results from Table 17 as a suitable graph.



**[4]**

Candidates who had acquired skills in practical techniques with regards to presenting data often achieved all four marks here. However, there is still uncertainty among some candidates of how to draw a line of best fit or which variables to assign to the *x* and *y* axes.

| | | |
|---|---|---|
| i | **OCR support** | The mathematical Skills Handbook provides support on plotting graphs:<br>https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf |

## Question 17 (b) (ii)

**(ii)** Gibberellin causes an increase in internodal length.

State one **other** role of gibberellin in plants.

.....

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

Many candidates gained credit here. Seed germination was the most commonly seen correct response.

## Question 17 (c) (i)

**(c)** A student carried out chemical tests on cabbage leaves to investigate which molecules were present.

The student's method was as follows:

- Add 50 $cm^3$ of distilled water to 2 large cabbage leaves and blend into a smooth liquid using a food mixer.
- Place 1 $cm^3$ of the blended cabbage leaf liquid into 5 test tubes:
  - Tube **1**: Add 5 drops of biuret reagent and mix.
  - Tube **2**: Add 2 $cm^3$ of Benedict's solution, mix, then place tube into a water bath for 5 min. Remove and cool.
  - Tube **3**: Add 2 drops of iodine solution and mix.
  - Tube **4**: Add 2 $cm^3$ of ethanol and mix. Then add 2 $cm^3$ of distilled water and mix.
  - Tube **5**: Insert a glucose test strip into the liquid then compare the colour to the colour chart provided (see Fig. 17.2 **on the Insert**).

**(i)** Name a **type** of food molecule that the student will **not** be able to detect using these chemical tests.

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

The majority of candidates gave 'non-reducing sugar' as the correct response for this part of the question with a few opting for 'vitamins' or the correctly named disaccharide, 'sucrose', which were also credited.

## Question 17 (c) (ii)

**(ii)** The table below is a summary of some of the student's findings.

Complete the table by writing in the missing observations and conclusions.

| Tube | Observation | Conclusion |
|---|---|---|
| 1 | ..... | Protein present |
| 2 | Yellow colour | ..... |
| 3 | Pale brown colour | ..... |
| 4 | ..... | Fat present |
| 5 | ..... | Glucose concentration small (15 mg $dm^{-3}$) |

**[2]**

There were some excellent responses from candidates who were able to complete both 'observation' and 'conclusion' columns demonstrating good knowledge of tests for biological 'food' molecules. However, some candidates did confuse the different tests with a common error to give brick-red precipitate for the expected observation in Tube 1.

| | | |
|---|---|---|
| i | **OCR support** | Practical work should be an integral part of the study of Biology. The practicals provided by OCR to support the practical endorsement include Practical Activity Group (PAG) 9 in which there are a series of qualitative tests. PAG activities are available on OCR interchange:<br>https://interchange.ocr.org.uk/Downloads/PAG9.zip |

## Question 17 (c) (iii)

**(iii)** The student then used a colorimeter to measure the absorbance of the contents of Tube **2**.

Explain how the use of a colorimeter could improve the student's conclusion.

.....

.....

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

The majority of candidates understood the use of the colorimeter in giving quantitative or non-subjective results. However, there are still many candidates using the terms accuracy and precision in the wrong context (such as here) when responding to AO3 practical- based questions.

| | | |
|---|---|---|
| | **OCR support** | 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:<br>https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf |

## Question 18 (a)

**18** Mammals and fish both need circulatory systems to transport oxygen to respiring tissues. They have different circulatory systems because they have different oxygen requirements.

**(a)*** Compare and contrast the circulatory systems of mammals and fish.

.....

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

This Level of Response question assessed AO1 in the context of comparing circulatory systems in mammals and fish. There were some excellent concise responses as shown by the Level 3 exemplar where candidates expressed their knowledge of closed circulations either double as in the mammal or single as in the fish. Level 3 responses included other similarities and differences, such as differences in heart structure or metabolic rate, to provide a well-balanced comparison. It was a common error for candidates to confuse the circulation of a fish with that of an insect describing an open circulation. Reponses that included lengthy detail about gaseous exchange systems rather than circulatory systems were credited with the lower communications mark within a level.

### Exemplar 2

**(a)*** Compare and contrast the circulatory systems of mammals and fish.

Both mammals and fish have closed circulatory systems. However, fish have a single closed circulatory system and mammals have a double closed. By having a closed circulatory system the blood of mamals and fish are contained within vessels. By having a single closed circulatory system the blood needs to travel through two sets of capillaries in fish but in a double closed system in ~~mamal~~ mammals only travels through one set of capillaries. Because of this in fish the blood returns ~~and~~ to the hart under a lower pressure than in mammals as when the blood travels through capillaries due to narrowing pressure drops. In mammals blood... **[6]**

Additional answer space if required.

travels through the heart twice for one circulation, in fish it only travels through the heart once. A double circulatory system is more efficient than single for active animals but as fish don't control own temp, and their weight is held by water, and they have the counter-current multiplier system it doesn't affect them that much.

This exemplar shows an excellent Level 3 response for Science content. Many candidates were able to complete their responses within the space allocated with very few using the additional pages at the end of the question paper.

## Question 18 (b)

**(b)** Acetylcholine (ACh) is a neurotransmitter in mammals. Studies have suggested that it also functions as a hormone in some invertebrate species, such as squid.

When ACh comes into contact with specialised cells in squid skin, it causes them to change colour. These colour changes allow the squid to communicate and to camouflage itself.

ACh is made by cells in the centre of the squid's body.

Explain how it is possible for ACh to have an effect on cells in the skin of the squid.

.....

.....

.....

.....

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

This part of the question was generally well-answered provided candidates had not been side-tracked into describing ACh function as a neurotransmitter. Many candidates correctly suggested that ACh could bind to skin cells to trigger secondary messengers within the cell and other good responses applied their knowledge to this unfamiliar situation to suggest that ACh would be carried through the circulatory system or blood of the squid.

## Question 18 (c)

**(c)** Squid blood contains a blue oxygen-carrying protein called haemocyanin.

High partial pressures of carbon dioxide reduce the affinity for oxygen of haemocyanin.

Suggest a mechanism by which carbon dioxide could reduce the affinity for oxygen of haemocyanin.

.....

.....

.....

.....

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

There were some excellent responses that included information about carbonic acid formation and how this was linked to a change in the tertiary structure of haemocyanin. There were some good step by step descriptions of the production of hydrogen ions ($H^+$) and their subsequent binding to the protein. Many candidates thought that carbon dioxide would bind to the haemocyanin directly, displacing or blocking the oxygen which did not gain credit. It was also common to see the Bohr shift being described as the mechanism for reducing affinity for oxygen without further detail but this didn't score any marks

## Question 19 (a)

**19** Resistance training with weights can increase muscle mass in the body. It can also lead to vascularisation, where blood vessels become more visible through the skin. Fig. 19.1 shows vascularisation.

**Fig. 19.1**

Vascularisation occurs in bodybuilders because blood vessels are pushed to the surface by increased muscle mass. They can also become more visible due to reduced body fat and dehydration.

**(a)** Explain why the visible blood vessels are likely to be veins.

.....

.....

.....

.....

.....

.....

.....

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

This part of the question, which was assessing AO2, proved challenging and there were few correct responses with many candidates repeating information from the stem of the question. Many candidates gained one mark for realising the implied comparison with arteries, and for stating that arteries are found further away from the skin surface (to protect them). Those candidates who didn't gain this mark often used inappropriate wording such as veins 'travelling' 'pushing' or 'moving' closer to the skin. It was common for candidates to state that veins had a large lumen or thin walls, but they did not continue their response with an explanation as to why this would make them more visible.

## Exemplar 3

**(a)** Explain why the visible blood vessels are likely to be veins.

Veins are wider than arteries as hold large volume of blood. If they were arteries the pumping of blood would be visible. ~~Arteries are deeper in the body.~~ Veins have right surges but cannot be seen. Arteries lie deeper in the body. They're blue showing deoxygenated blood.

[3]

This exemplar shows a good response achieving two out of the three marks. Few candidates achieved full marks.

## Question 19 (b)

**(b)** Some bodybuilders use anabolic steroids to increase their muscle mass.

Suggest why anabolic steroids are effective when applied to the surface of the skin.

[2]

Candidates achieving both marks for this part of the question understood that steroid hormones were lipid-soluble and would therefore cross the phospholipid bilayer in cell membranes. Other good responses included the idea that there would be a short diffusion distance between muscles and the skin surface. Some candidates often suggested that steroids could diffuse into the veins or blood stream. This was possibly due to confusion with the previous question and the proximity of veins to the skin surface.

# Question 19 (c) (i)

**(c)** Illegal use of steroids is widespread in professional sport.

The International Olympic Committee (IOC) tests the urine of athletes to help prevent steroid abuse.

Fig. 19.2 is a graph showing tests carried out by the IOC between 1986 and 1994.

- The bars represent the number of urine samples tested.
- The line shows the percentage of samples testing positive for the steroid testosterone.

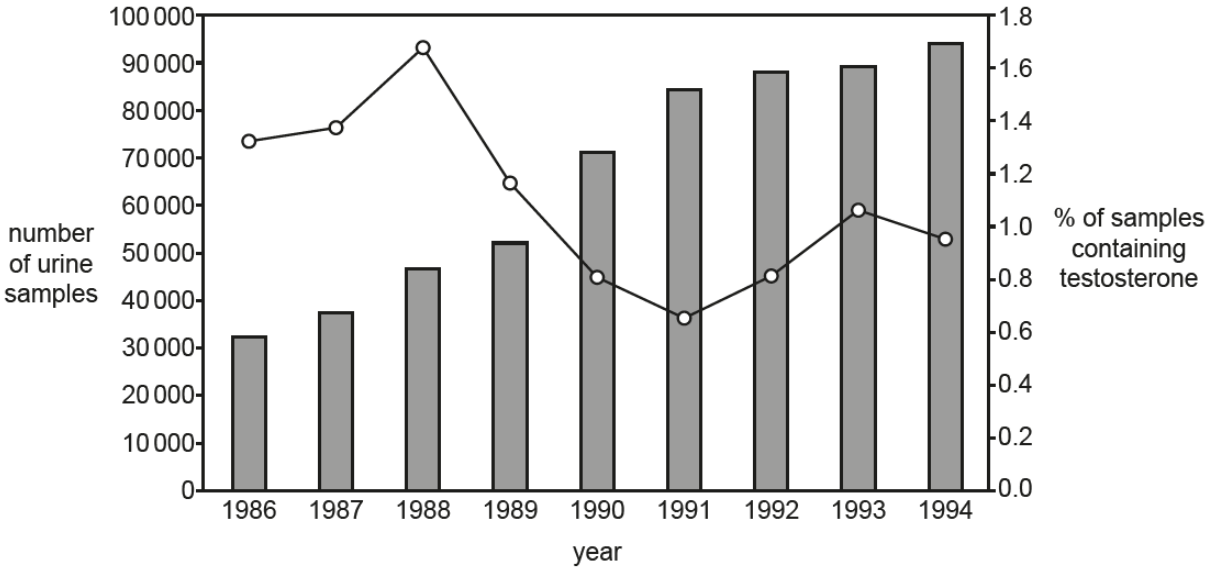



**Fig. 19.2**

**(i)** Calculate the change in the **number** of samples testing positive for testosterone between 1988 and 1991.

number of samples = ..... **[3]**

The graph in Fig.19.2 proved difficult to decipher for some candidates. However, this was taken into account and a range of answers were accepted for this calculation; many candidates achieved all three marks.

## Question 19 (c) (ii)

**(ii)*** Based on the findings in Fig. 19.2, the head of the IOC stated that:

"The IOC is succeeding in reducing the level of steroid abuse in professional sport."

Evaluate this statement using the data in Fig. 19.2.

.....

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

This Level of Response question assessed candidate skills in AO3 by using secondary data to formulate an evaluation. The majority of candidates understood the need to discuss 'something for' and 'something against' the statement to provide a balanced argument. There were some excellent responses that included points such as 'correlation doesn't mean causation' and also went on to include statements about validity issues with the data. Such statements often mentioned the limited time span for the study and that steroids other than testosterone may have been in use but not tested for.

### Exemplar 4

"The IOC is succeeding in reducing the level of steroid abuse in professional sport."

For + Against.

Evaluate this statement using the data in Fig. 19.2.

They are correct in the fact that there was a decrease in testosterone abuse from 1988 - 1991 (1.7% - 0.64%) *

But we can here however it is unsure as to whether the testosterone abuse has decreased from 1991 - 1994 as the number of samples is not even.

There was also increase in testosterone usage from 1991 - 1993 (0.64% - 1.4%.) and so they have not always continuously reduced the level of steroid abuse.

They are not specific about testorone - the abuse of a different steroid may have increased

No statistical tests used to back up data also no repeats.

**[6]**

Additional answer space if required.

* And from 1993 - 1994 (1.3% - 0.98%.)

This is a good example of a Level 3, 6 mark response. The candidate provided a concise, well-written response to the question in the available space provided.

# Question 20 (a) (i)

**20** Rubredoxin is a protein found in bacteria. It contains around 50 amino acids. One iron ion is bound by the sulphur atoms of four cysteine amino acids.

The structure of rubredoxin is shown in Fig. 20.1.

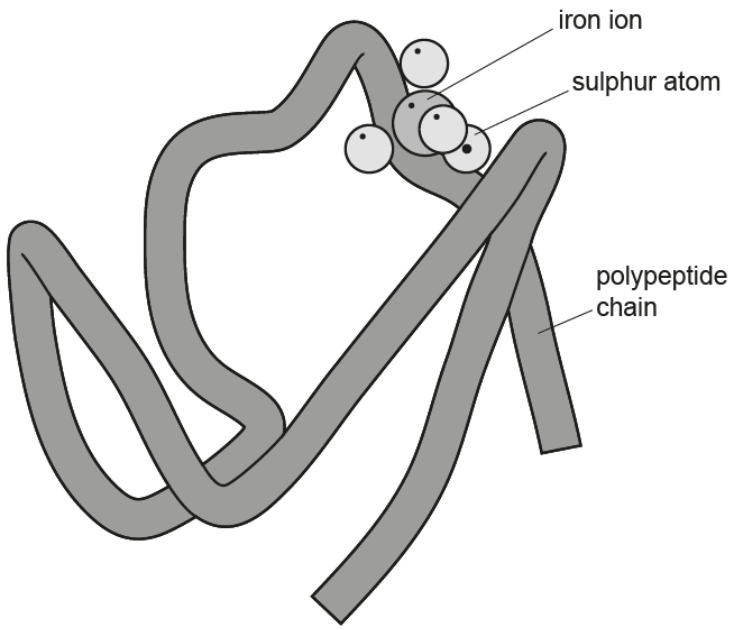



**Fig. 20.1**

**(a) (i)** Rubredoxin is known as a **conjugated protein**.

Use Fig. 20.1 to explain what is meant by the term conjugated protein.

.....

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

Some candidates knew this term and gained two or three marks for this part of the question, others simply described the general structure of a protein, which gained no marks. Many candidates referred to a prosthetic group as inorganic rather than non-protein. There were some misspellings of the word 'prosthetic'. Many candidates refer to 'iron' groups, atoms or molecules, rather than as an ion.

| | | |
|---|---|---|
| ? | **Misconception** | A common misconception was the idea that all conjugated proteins have quaternary structure or a haem group. |

## Question 20 (a) (ii)

**(ii)** Using the information provided about rubredoxin, state **two** similarities between the structures of rubredoxin and haemoglobin.

similarity 1 .....

.....

similarity 2 .....

.....

**[2]**

This part of the question was generally well-answered with many candidates across the ability range gaining both marks for describing similarities between the two molecules. The most common response was that both were proteins or contained polypeptides.

## Question 20 (a) (iii)

**(iii)** Rubredoxin and haemoglobin have different secondary and tertiary structures.

Using the information provided about rubredoxin, state **two other** differences between the structures of rubredoxin and haemoglobin.

difference 1 .....

.....

difference 2 .....

.....

**[2]**

As with the similarities in Q20(a)(iii), many candidates could gain marks for the differences between the two molecules. Many correct responses stated that haemoglobin had more than one polypeptide chain and more than one prosthetic group or iron ions.

# Question 20 (b) (i)

**(b)** Ferritin is a protein that is used to regulate iron levels within plant tissues.

It is a large spherical structure which can hold many iron ($Fe^{3+}$) ions at its centre.

Iron can be toxic to plant tissues. Ferritin prevents the build-up of iron.

Fig. 20.2 shows the internal structure of ferritin.

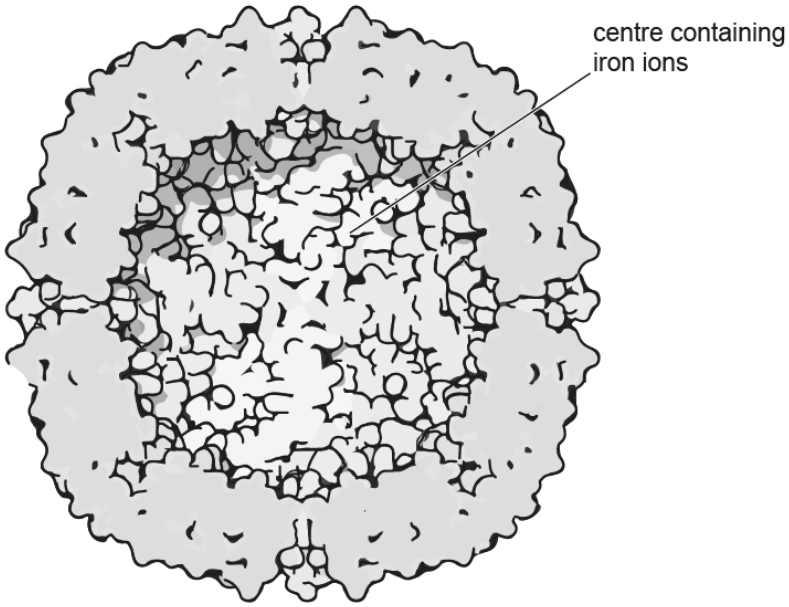



**Fig. 20.2**

**(i)** Ferritin molecules can hold 4500 $Fe^{3+}$ ions in the inner sphere.

It is thought that the $Fe^{3+}$ ions are unable to occupy the total available volume of the inner sphere because other molecules are present in the inner sphere.

The volume of the inner sphere of the ferritin molecule is 268 $nm^3$.

The volume of an $Fe^{3+}$ ion is $9.04 \times 10^{-4}$ $nm^3$.

Calculate the volume of the inner sphere **not** occupied by $Fe^{3+}$ ions.

volume = ..... $nm^3$ **[3]**

Many candidates coped well with this calculation and gained full marks. There was no requirement to express answers to a number of significant figures, so candidates were credited for a range of answers including those with decimal places. Some candidates made errors in copying the required data from the question and others appeared not to realise that the volume of the sphere had already been calculated for them. There were some errors seen where candidates lacked confidence with using standard form and this is a mathematical skill that possibly still needs practice.

| | | |
|---|---|---|
| i | **OCR support** | The 'Maths for Biology' website offers support on the correct use of standard form:<br>https://www.ocr.org.uk/subjects/biology/maths-for-biology/arithmetic-and-numerical-computation/ |

## Question 20 (b) (ii)

**(ii)** Explain how hydrophilic and hydrophobic interactions contribute to the spherical shape of ferritin.

.....

.....

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

The majority of candidates understood the nature of the terms 'hydrophobic' and 'hydrophilic' with regards to molecules. However, many responses included reference to the arrangement of 'heads' and 'tails' in phospholipids rather than the protein molecule, ferritin which could not be credited.

## Question 21 (a) (i)

**21** Fig. 21.1 shows a transverse section of a human adrenal gland.

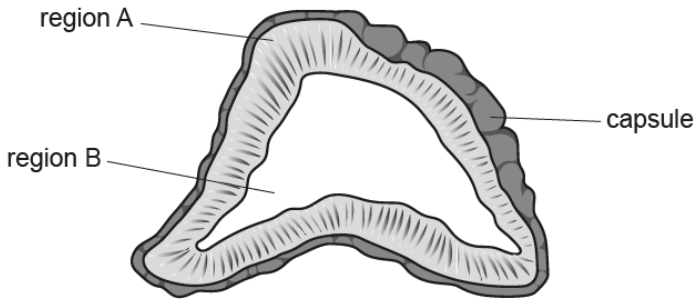



**Fig. 21.1**

**(a) (i)** The table below describes the functions of some hormones produced by different regions of the adrenal gland.

Complete the table using Fig. 21.1 and your own knowledge.

| Hormone produced | Functions of hormone |
|---|---|
| adrenaline | ..... ..... ..... |
| ..... | • increases heart rate<br>• increases blood pressure<br>• widens pupils |
| androgens | regulation of sexual characteristics and cell growth |
| ..... | regulation of metabolism |

**[2]**

Generally, candidates performed better on the second column and were able to correctly include functions of adrenaline as increasing heart rate, blood pressure or breathing rate. It was a common error that candidates often did not realise that the question was in the context of the adrenal gland. Therefore, although the majority recognised noradrenaline, many gave hormones such as insulin or thyroxine as a regulator of metabolism in the first column. Mineralocorticoids was another common incorrect answer.

## Question 21 (a) (ii)

**(ii)** Using Fig. 21.1, identify the letter and name of the region of the adrenal gland that secretes adrenaline.

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

There were many correct responses for this part of the question. Some candidates gave **either** the letter **or** the name of the region and, although correct, no credit could be given as both were needed for one mark.

## Question 21 (b) (i)

**(b)** Phaeochromocytoma is a rare tumour of adrenal gland tissue. It causes increased hormone release from the adrenal glands.

Fig 21.2 shows three ECG traces showing the heart rhythms of three different patients.

- Patient **X** has a normal heart rhythm.
- Patient **Y** has phaeochromocytoma.
- Patient **Z** has bradycardia.

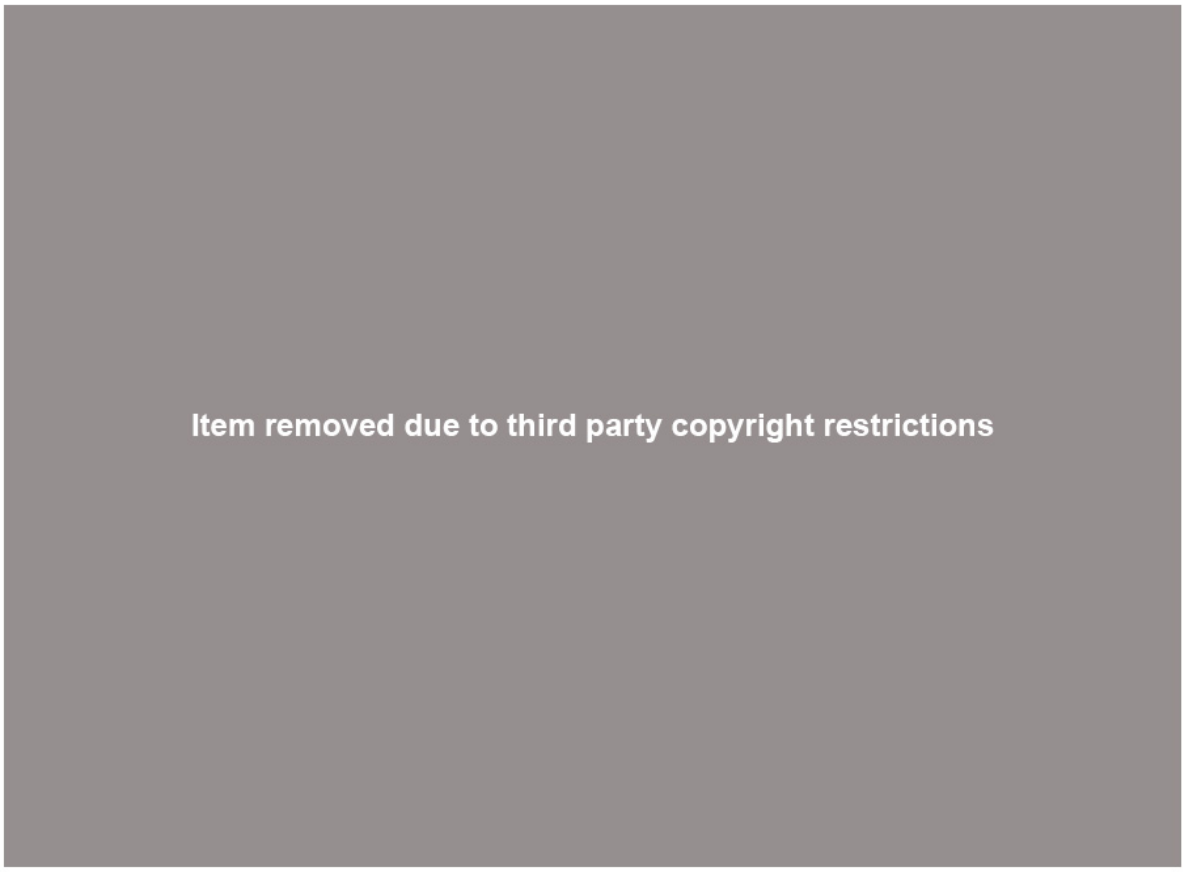


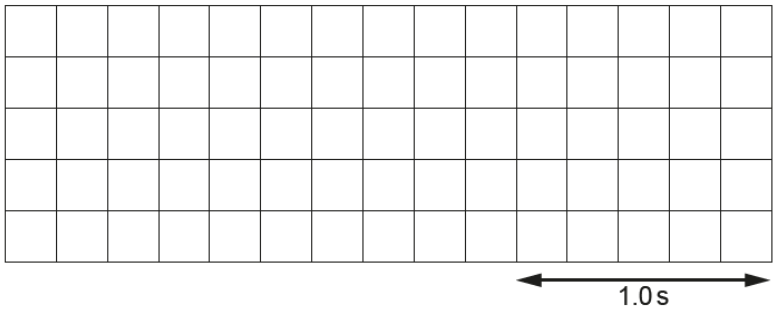

**Fig. 21.2**

**(i)** Identify patients **X**, **Y** and **Z** by labelling the traces in Fig. 21.2. **[2]**

Many candidates ordered the heart rate patterns correctly. Some candidates were able to score one mark by having Y in the right place, even though X and Z had been reversed.

## Question 21 (b) (ii)

**(ii)** Sketch a trace for a patient who has entered atrial fibrillation.

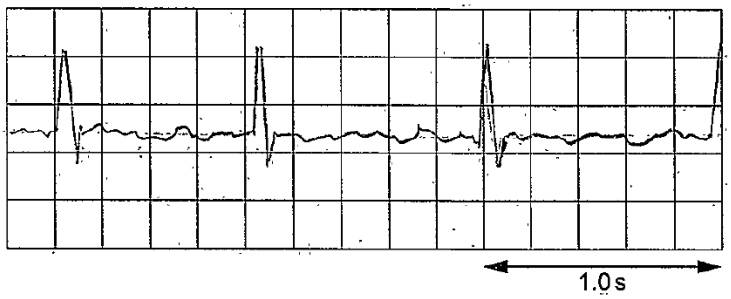



**[2]**

There was a great deal of variation in the traces drawn by candidates. The majority of candidates achieved one mark for drawing taller peaks, but many struggled to produce a reasonable sketch of the trace between the peaks. Some candidates often drew traces in regular rhythm from the previous question and others drew incomplete traces i.e. only showing 1 beat and not using the entirety of the space provided.

### Exemplar 5

**(ii)** Sketch a trace for a patient who has entered atrial fibrillation.




**[2]**

This exemplar shows a good response to this part of the question. The candidate has clearly sketched a trace typical of atrial fibrillation.

## Question 21 (b) (iii)

**(iii)** Suggest why reduced heart rate is sometimes seen in people who are very aerobically fit.

.....

.....

.....

.....

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

Good responses for this part of the question understood that there would be an increased thickness of cardiac muscle and that stroke volume would increase. Few candidates mentioned the increase in ventricular volume.

| | | |
|---|---|---|
| ? | **Misconception** | There appeared to be a misconception amongst many candidates that aerobically fit people would not need as much oxygen delivered to cells, had more red blood cells or needed less ATP. |

# Question 22 (a)

**22** Plants are capable of synthesising a variety of molecules from the products of the light-independent stage of photosynthesis.

Fig 22.1 summarises these processes.

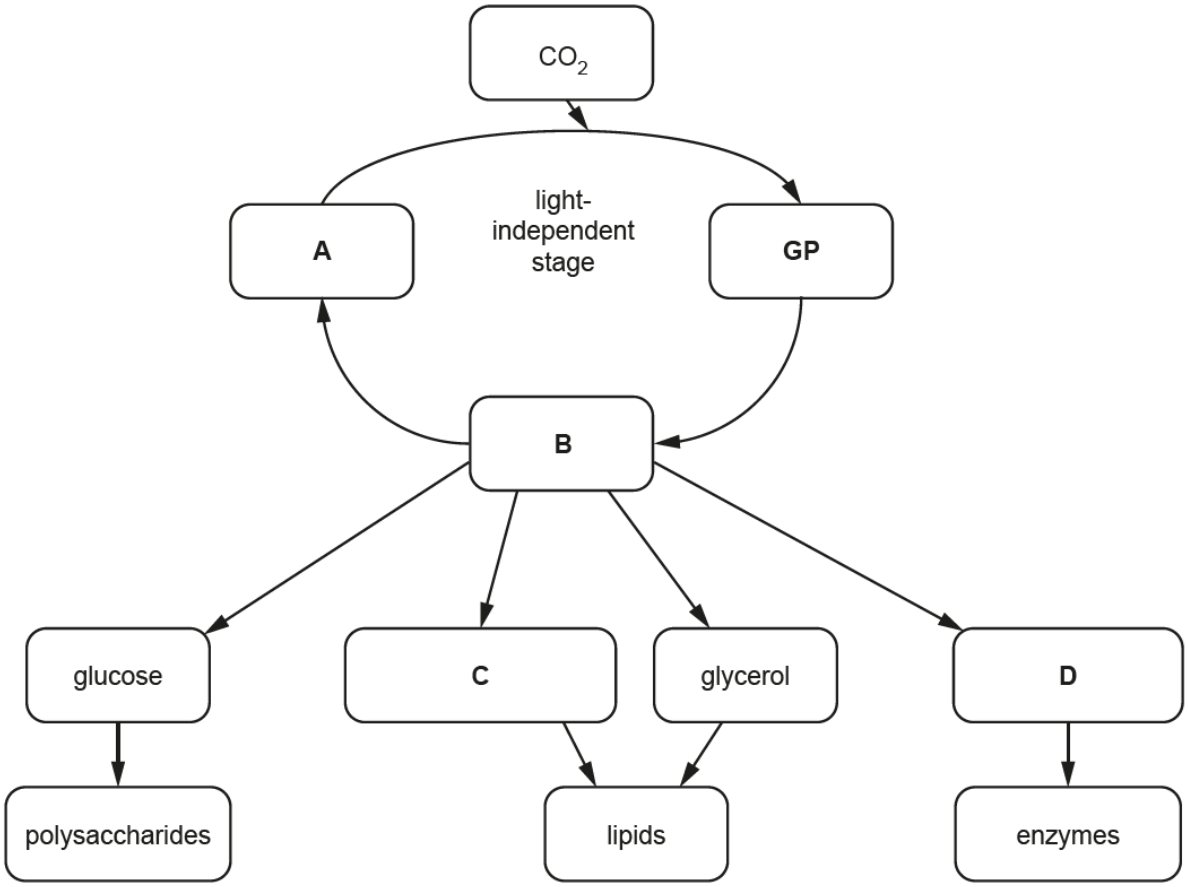



**Fig. 22.1**

**(a)** Identify the molecules represented by the letters **A**, **B**, **C** and **D** in Fig. 22.1

**A** .....

**B** .....

**C** .....

**D** .....

**[4]**

Many candidates appeared confident in their ability to identify the molecules here, often achieving all four marks. Abbreviations for ribulose bisphosphate and triose phosphate were allowed for A and B.

## Question 22 (b) (i)

**(b)** A scientist investigated the rate of photosynthesis in lesser pondweed, *Potamogeton pusillus*.

The method used is outlined below:

- Add 200 $cm^3$ of distilled water to a 300 $cm^3$ glass beaker.
- Dissolve 5 g of $NaHCO_3$ in the water to provide an excess of $CO_2$.
- Place the beaker in a water bath at 10 °C and leave for 10 min to equilibrate.
- Insert an oxygen sensor into the water in the beaker and measure the baseline $O_2$ concentration.
- Place 100 g of *P. pusillus* into the beaker.
- Remove all other light sources from the room and place an LED light source 20 cm above the top of the beaker.
- Use a light intensity meter to ensure the light intensity above the beaker is 5000 lux.
- Measure the concentration of oxygen dissolved in the water using a data logger every 10 min for 200 min.
- Carry out four more repeats at 10 °C.
- Repeat all the above steps in water baths at 15 °C, 20 °C, 25 °C and 30 °C.

**(i)** Identify the following variables from the scientist's method:

independent variable

.....

dependent variable

.....

**one** control variable

.....

**[3]**

This part of the question was generally well-answered with many candidates correctly identifying all three variables thereby gaining three marks. The most common error was in reversing the independent and dependent variables.

## Question 22 (b) (ii)

**(ii)** Identify **one** variable that was **not** controlled in the scientist's method.

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

It is important when discussing variables that candidates avoid using vague terms such as 'amount' or 'same'. Good responses often identified concentration of carbon dioxide or surface area of leaves as variables that were not controlled in this method.

# Question 22 (c)

**(c)** Fig. 22.2 is a graph of the scientist's results.

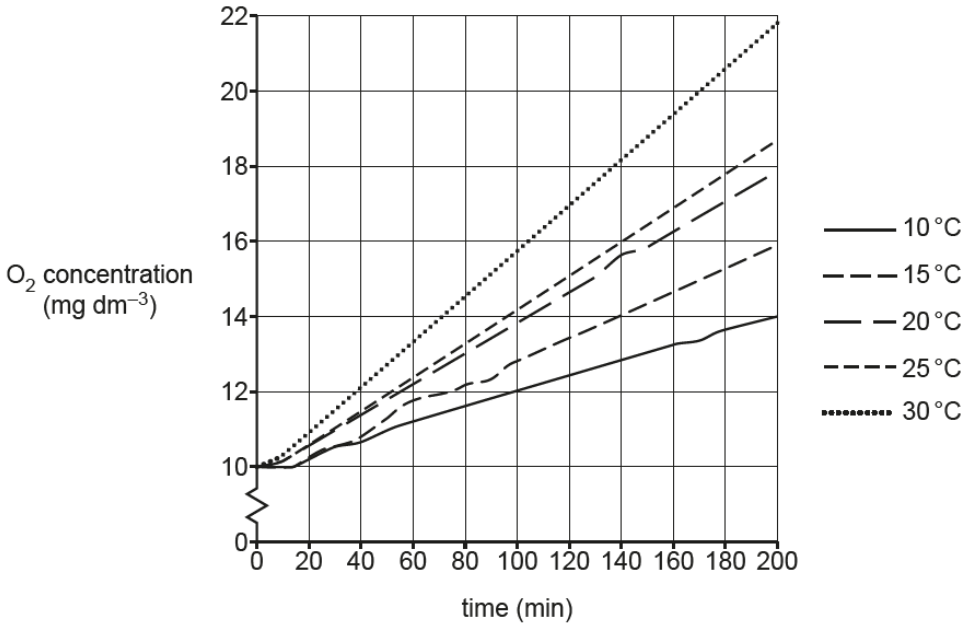



**Fig. 22.2**

Describe **and** explain what these results show about photosynthesis in *P. pusillus*.

.....

.....

.....

.....

.....

.....

.....

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

There were some good comprehensive responses for this question although many did not gain full marks. This was often due to the fact that they gave figures from the graph to support their answer without describing while they explained the general trend. Some candidates did not describe the relationship between the two variables, instead they referred to 'optimum' temperature or used examples of temperatures and rates. Other responses were too descriptive and merely stated the oxygen production at different temperatures without making the connection between temperature and photosynthesis. Very few candidates described the rate of oxygen production/photosynthesis as being constant at each stage or discussed whether there were any limiting factors. Some candidates went into explanations of oxidative phosphorylation and respiration rather than photosynthesis.

## Question 22 (d) (i)

**(d)** The light-independent stage of photosynthesis used to be referred to as the 'dark reaction'.

**(i)** Explain why this is both an accurate **and** an inaccurate way to describe the light-independent stage.

.....

.....

.....

.....

.....

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

There were good responses where candidates clearly understood that light energy wasn't required for the 'dark reaction' but that it was required to synthesise ATP and reduced NADP in the light-dependent reaction. Many candidates did not refer to light energy at all and some correctly pointed out that the products of the light-dependant stage were needed, but then did not name either of them to gain a mark. Unfortunately some candidates also confused NADP with NAD from cell respiration.

## Question 22 (e) (i)

**(e)** The scientist then investigated the effect of auxin on *P. pusillus* stems.

The growing tips of stems were removed and the stems were placed in solutions containing different concentrations of auxin.

The scientist analysed the results and determined the following relationship:

The higher the concentration of auxin in the solution, the fewer side shoots grew on the *P. pusillus* stems.

**(i)** Explain why this relationship occurs in *P. pusillus* stems.

.....

.....

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

Candidates were required to refer to 'apical dominance' to gain credit for this part of the question. Some vague responses were seen where candidates tried to describe apical dominance without using the term. This often resulted in restating the wording from the stem of the question.

## Question 22 (e) (ii)

**(ii)** Give **two** examples of the commercial uses of auxin.

1 .....

2 .....

**[2]**

The majority of candidates gained at least one mark for this part of the question. The most common correct responses gave uses for auxin as 'rooting powders' and 'weed-killers', with a few candidates also describing its use in the formation of seedless fruit sometimes using the correct term, parthenocarpy. There were vague responses that referred to the use of auxin in growing plants for aesthetic reasons, and some candidates thought that it was a fertiliser. There also appeared to be some confusion between auxin and other plant hormones, especially gibberellin which was mentioned in Q17.

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Q19c, Fig. 19.2

OCR is aware that third party material appeared in this exam but it has not been possible to identify and acknowledge the source.

Q19c, Fig. 19.2

© D H Catlin, C K Hatton, S H Starcevic, 'Issues in detecting abuse of xenobiotic anabolic steroids and testosterone by analysis of athletes' urine', pp1280-1288, Fig. 1, Clinical Chemistry, Vol.43.7, July 1997. Reproduced by permission of the American Association for Clinical Chemistry.

Q20, Fig. 20.2

Ferritin exterior and interior cross section', www.pdb101.rcsb.org, RCSB PDB-101.

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