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A LEVEL

Examiners' report

BIOLOGY A

H420

For first teaching in 2015

H420/01 Summer 2024 series

Version 1

Contents

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

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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.

In terms of demand and question-style, there have been no changes. Mathematical and practical skills continue to be embedded within the multiple choice questions in section **A** and the longer responses of section **B**. The exam paper continues 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.

Overall, candidates demonstrated a wide range of ability with more successful 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. The positive approach to answering Level of Response questions has been maintained and there is noticeable improvement in the ability of candidates to tackle questions that involve 'evaluate' or 'analyse' command words. Most candidates were able to demonstrate their ability to learn and recall facts and state or name biological terms.

As in previous sessions, candidates who performed less well appeared unable to apply their knowledge, evaluate or use information provided, e.g. diagrams, graphs or figures included in the questions, to support their answers.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• applied their knowledge to new contexts • performed complex mathematical calculations involving more than one step e.g. calculating rate from tangents • were able to analyse data from graphs and tables • provided balanced arguments to question requiring an evaluation.	• named or identified structures / terms using recall • completed simple mathematical calculations • completed tables and gap fill questions • provided responses to one mark short-answer questions.

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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. More successful 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 most candidates appeared to have managed their time effectively with very few omissions.

Previous reports advised candidates not to change multiple choice answer by writing over the top of a previous answer, but instead to re-write the letter fully. Most candidates appear to have taken on board this instruction and with very few unclear responses seen, although several hybrid **B/D**s, **C/Ds** and even **A/C**s were seen.

Some candidates wrote their answer inside the available box and then wrote 'or' and another letter outside e.g.

A or **B**?

It is advised that candidates choose carefully and cross out any other responses once they have completed their thought process so that only one letter is provided as a response.

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Question 1

1 Which statement about lipids is correct?

A Lipids are polar molecules.

B Lipids that contain fatty acids with carbon–carbon double bonds are liquid at room temperature.

C Saturated fatty acids, which are present in some lipids, contain carbon–carbon double bonds.

D The presence of carbon–carbon double bonds in fatty acids allows lipids to pack more closely together.

Your answer ☐ **[1]**

Many candidates selected option B as the correct response. All other incorrect options were seen. This highlighted the need for candidates to ensure they are familiar with appropriate terminology such as polar and saturated when related to the structure of lipids.

Question 2

2 Lipids, polysaccharides, nucleic acids and proteins are all macromolecules.

Which statement about macromolecules is correct?

A All macromolecules are formed in hydrolysis reactions.

B Lipids are not polymers, but polysaccharides, nucleic acids and proteins are polymers.

C Lipids are polymers of fatty acids and glycerol.

D Macromolecules all consist of repeating units of monomers.

Your answer ☐ **[1]**

Many correct responses, option **B** were seen. The idea of lipids being macromolecules but not polymers is a concept that has been tested before, and forms a good discussion point in class when revising biological molecules.

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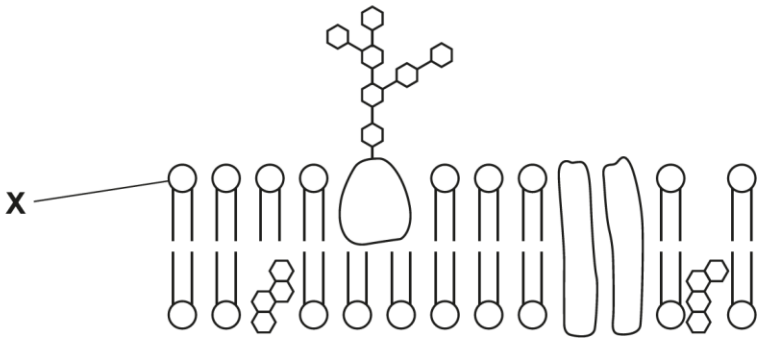
Question 3

3 The diagram shows part of a plasma membrane.



How can molecule **X** be described?

A It has a hydrophilic head and a hydrophobic tail.

B It is formed when the glycerol in a triglyceride is replaced by a phosphate.

C It is non-polar.

D The tails are joined to the head by peptide bonds.

Your answer ☐ **[1]**

The diagram proved a useful aid for candidates in choosing a response and most candidates opted for **A**, the correct response. Option **B** was a common incorrect response, and candidates could be reminded that it is one of the fatty acids that is replaced, not glycerol, when phospholipids are formed.

Question 4

4 Which statement describes a feature of plasma membranes?

A Channel proteins are a type of intrinsic protein.

B Glycolipids are intrinsic proteins that have lipid molecules attached.

C Phospholipids form a rigid bilayer that membrane proteins are attached to.

D The plasma membrane forms an impermeable barrier.

Your answer ☐ **[1]**

Many candidates chose the correct option **A**. The terms intrinsic and extrinsic could be emphasised when teaching the structure of the membrane, along with the idea of fluidity rather than rigidity.

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Question 5

5 The adrenaline receptor is one of a class of receptors known as GPCRs. The glucagon receptor on liver cells is another type of GPCR.

Glucagon stimulates conversion of glycogen to glucose in liver cells.

What is the action of glucagon?

A Cyclic AMP catalyses the conversion of glycogen to glucose.

B Glucagon is a second messenger.

C The glucagon receptor is located in the cytoplasm of liver cells.

D When glucagon binds to its receptor it stimulates the conversion of ATP to cyclic AMP.

Your answer ☐ **[1]**

Options **A** and **B** were the most often seen incorrect responses, highlighting the need for candidates to be secure in their knowledge regarding the mechanisms of hormone action and the associated terminology.

Question 6

6 Lymph and tissue fluid are both formed from the blood.

Which statement describes the composition of these fluids?

A Lymph contains more protein than tissue fluid because of antibody production.

B Lymph is similar in composition to tissue fluid but has more oxygen and nutrients.

C Tissue fluid does not contain hormones such as insulin and glucagon.

D Tissue fluid contains red blood cells and platelets.

Your answer ☐ **[1]**

Many candidates correctly chose option **A**. Option **C** was an incorrect option chosen by some candidates, possibly not realising that insulin and glucagon would need to enter tissue fluid to reach the receptors on the cells of the tissue.

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Question 7

7 Which statement describes features of the mammalian heart?

A Branches of the pulmonary artery supply blood to the heart muscle.

B Semi-lunar valves prevent backflow of blood from the ventricles to the atria.

C The left ventricle pumps deoxygenated blood to the lungs.

D The wall of the left ventricle is thicker because it needs to pump blood around the whole body.

Your answer [ ] **[1]**

Most candidates chose the correct response, option **D**. The most common incorrect response was option **B**, perhaps as candidates could not recall the correct name for the valves between the atria and ventricles. Some candidates confused the left and right sides of the heart, choosing the incorrect option **C**.

Question 8

8 Bumblebees are large insects that have a high demand for oxygen during flight.

What adaptation enables bumblebees to obtain sufficient oxygen during flight?

A Accumulation of lactate in muscles during flight increases the amount of tracheal fluid which increases the surface area for gas exchange.

B Muscle contraction before or during flight increases ventilation of the tracheal system.

C Spiracles take air directly to the respiring tissues.

D Tracheoles can open and close to allow gas exchange and minimise water loss.

Your answer [ ] **[1]**

Candidates who could use their knowledge of insect ventilation chose option **B** as a correct response. They were able to recall that insects use rhythmic abdominal movements to change the volume of their abdomen to move air in and out of their spiracles.

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Question 9

9 Which option is **not** an adaptation that helps fish increase the efficiency of gas exchange?

A Blood capillaries lie close to the surface of the lamellae to minimise the diffusion distance.

B Blood flows in the capillaries in the same direction as the flow of water over the lamellae to maximise gas exchange.

C Gill filaments have many lamellae that increase the surface area for gas exchange.

D Raising and lowering of the floor of the buccal cavity helps maintain a flow of water over the gills.

Your answer ☐ **[1]**

This is an example of a multiple choice question that asks candidates to identify the option that is **not** correct. Most candidates recalled that water and blood in gill capillaries flow in opposite directions due to the counter-current flow system for efficient gas exchange across the entire gill surface and chose option **B** as the correct response.

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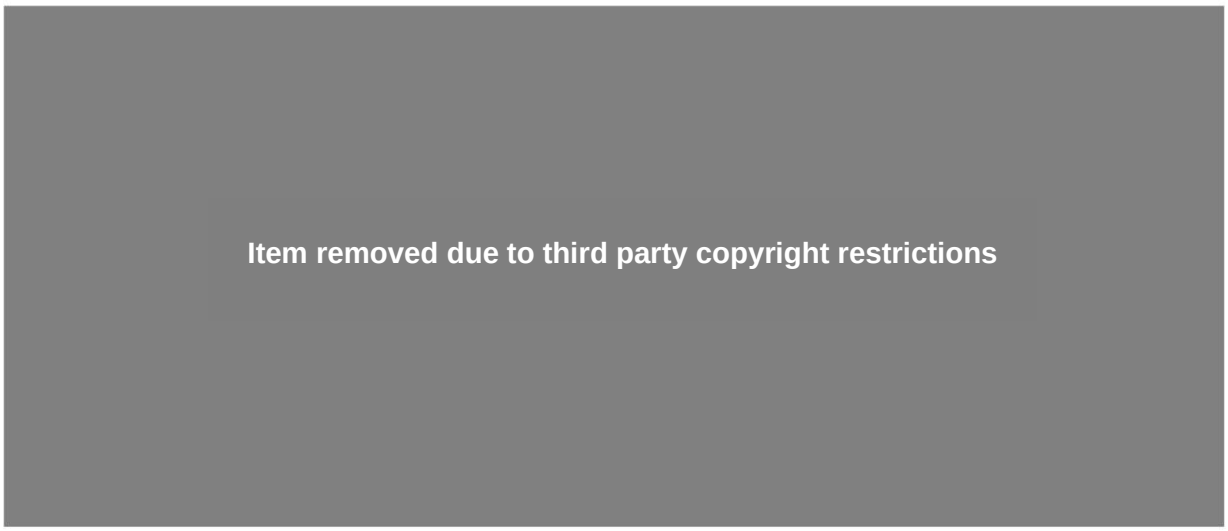
Question 10

10 The diagram shows part of a liver lobule.



Which statement about liver function is correct?

A Blood flows from **I** towards **G**.

B **H** carries blood arriving from the digestive system.

C Hepatocytes produce urea that flows into **F**.

D Toxic substances enter liver cells from the blood at **E**.

Your answer [ ] **[1]**

The question requires knowledge of the structure and function of a liver lobule. Candidates that determined option D as the correct response were able to correctly identify labelled structures in the diagram. Identifying I as the hepatic vein, G as the hepatic portal vein and H as the hepatic artery (recalling that arteries have a narrower lumen).

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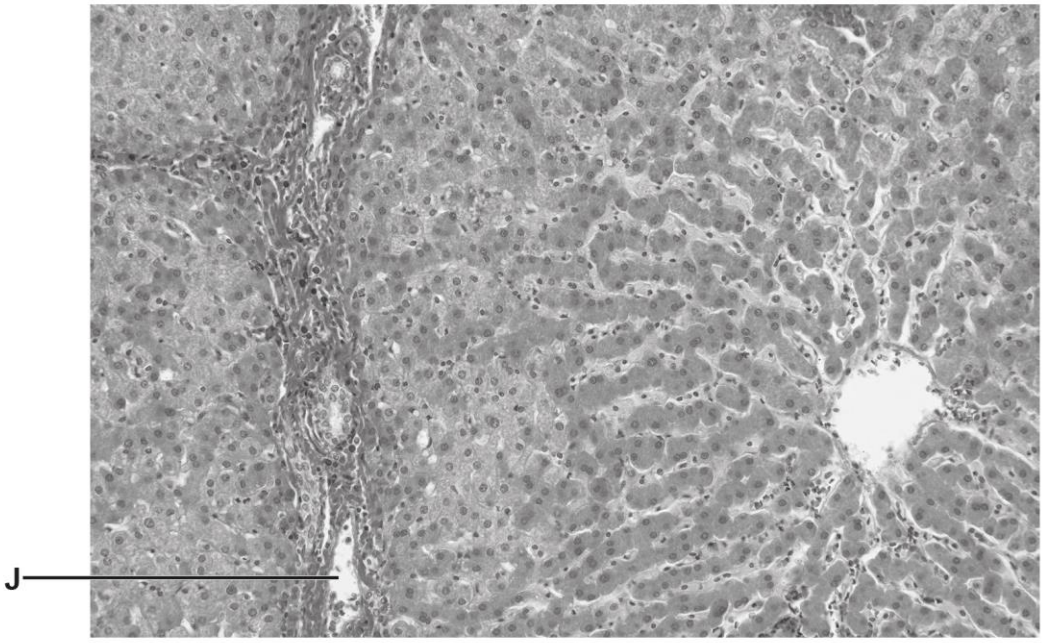
Question 11

11 The photomicrograph shows a stained section of liver tissue.



What is the structure labelled **J**?

A Hepatic artery

B Hepatic portal vein

C Hepatic vein

D Sinusoid

Your answer ☐ **[1]**

Candidates who were able to interpret a stained section of the liver and correctly identify structure **J** as (a branch of) the hepatic portal vein chose option **B** as the correct response.

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.

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Question 12

12 Which statement describes urea production in the liver?

A Amino acids enter the ornithine cycle.

B Ammonia and carbon dioxide combine to make urea in the Krebs cycle.

C Ammonia is produced by the deamination of amino acids.

D The ornithine cycle makes urea less harmful.

Your answer ☐ **[1]**

Many candidates were able to apply knowledge of the ornithine cycle to select option C as a correct response. Some candidates chose incorrect option **D**, perhaps thinking that the ornithine cycle makes urea less harmful. Other chose option **A**, possibly failing to recall the fact that amino acids need to be deaminated before the product, ammonia, enters the ornithine cycle.

Question 13

13 Which of the statements about the effect of light intensity on the concentrations of GP, RuBP and TP is/are correct?

1 At low light intensity, less GP is converted into TP because there is less product of the light dependent stage available.
2 At high light intensity, RuBP concentration is high because it is regenerated from TP.
3 At high light intensity, RuBP accumulates because it cannot be converted to GP.

A 1, 2 and 3 are correct

B Only 1 and 2 are correct

C Only 2 and 3 are correct

D Only 1 is correct

Your answer ☐ **[1]**

Many candidates demonstrated a good understanding of the Calvin cycle and the effect of light intensity on the concentrations of GP, TP and RuBP to choose option **B** as the correct response. Where incorrect responses were chosen, most correctly identified statement 1 as correct, but did not recognise that increased light intensity causes high levels of TP to be regenerated into RuBP due to more ATP and reduced NADP from the light dependent stage.

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Question 14

14 Which of the statements about factors affecting the rate of photosynthesis is/are correct?

1 Lack of water is not usually a limiting factor, although it does cause closure of stomata which reduces carbon dioxide levels.
2 Carbon dioxide concentrations can be low inside greenhouses; therefore, growers will often enrich the atmosphere with carbon dioxide.
3 Between zero and 25 °C the rate of photosynthesis doubles for every 10 °C rise in temperature.

A 1, 2 and 3 are correct

B Only 1 and 2 are correct

C Only 2 and 3 are correct

D Only 1 is correct

Your answer [ ] **[1]**

Candidates were required to have a good understanding of water, carbon dioxide and temperature as potential limiting factors of photosynthesis. All options were seen and candidates who chose incorrect option **C**, often did not realise that water is not usually a limiting factor for the rate of photosynthesis thus excluding statement 1. Statement 3 required candidates to recognise photosynthesis as an enzyme-controlled reaction and therefore apply Q_{10} = 2; those who chose incorrect option **B** or **D** showed a poor understanding of this concept.

Question 15

15 Which option about the relative energy values of different foods is **not** correct?

A Carbohydrates have lower energy values because they have a higher oxygen content.

B Food that has a mixture of carbohydrate, lipid and protein, e.g. chocolate, has a higher energy value than the same mass of sugar.

C Lipids have energy values lower than proteins because they have a low ratio of hydrogen and carbon atoms to oxygen atoms.

D Proteins and carbohydrates have similar energy values.

Your answer [ ] **[1]**

Candidates were required to use their knowledge of respiratory substrates and their energy values to determine which statement was **not** correct. Candidates that were able to recall relative energy values correctly identified option **C** as the **incorrect** answer, hence correct response.

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Section B overview

Mathematical and practical skills continue to be 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 biochemical molecules, photosynthesis, and movement across membranes.

Question 16 (a)

16

(a) The table lists some biological molecules.

Complete the table by putting a tick (✓) in the appropriate box or boxes on each line to show whether the corresponding feature is present.

The first line has been completed for you.

Biological molecule	Is a monomer	Is a polymer	Contains glycosidic bond(s)
Amino acid	✓		
Amylopectin			
Glucose			
Sucrose			

[3]

Many candidates were able to recall the correct features of amylopectin and glucose. Fewer were able to correctly complete the row for sucrose. A common error was to include sucrose as a polymer. Most candidates followed the instructions in the question to place a tick (rather than a cross), and there were very few "hybrid" ticks, with candidates who changed their minds crossing out and rewriting.

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Question 16 (b)

(b) Describe the bond between the two glucose monomers in maltose.

.....

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.....

.....

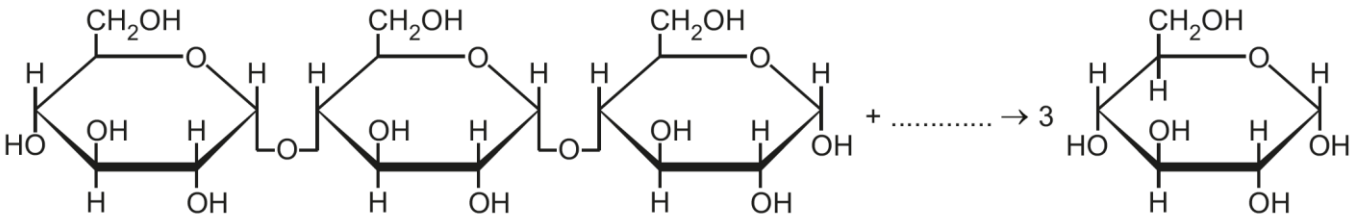
..... **[2]**

Most candidates correctly stated that the bond was glycosidic, and many were able to achieve both marks by recognising it as a 1-4 bond. Some candidates lost the second mark by incorrectly stating that it was a 1-6 glycosidic bond. It is also worthwhile noting the importance of spelling here for the 'glycosidic' bond.

Question 16 (c) (i)

(c) Maltotriose is a trisaccharide formed during the breakdown of starch by amylase. It can be broken down further to produce glucose.

(i) Complete the equation for the conversion of maltotriose to glucose.



[2]

This question was generally well-answered. Most candidates knew that water was used for one mark and many correctly understood that two water molecules would be used in this hydrolysis reaction. Some candidates incorrectly suggested that three molecules of water were used, possibly because there were three glucose molecules. There were several 'no responses' for this question and this may be because candidates simply did not notice it due to lack of an answer line.

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Question 16 (c) (ii)

(ii) The enzyme maltase converts maltose to glucose during the final stages of starch digestion in the small intestine.

Suggest why maltotriose can also be converted to glucose by maltase.

.....

.....

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

This question part was also generally well-answered with the full range of marking points being given as correct responses. Incorrect responses often referred to maltotriose as a polysaccharide or did not include the appropriate scientific terminology for a mark to be given.

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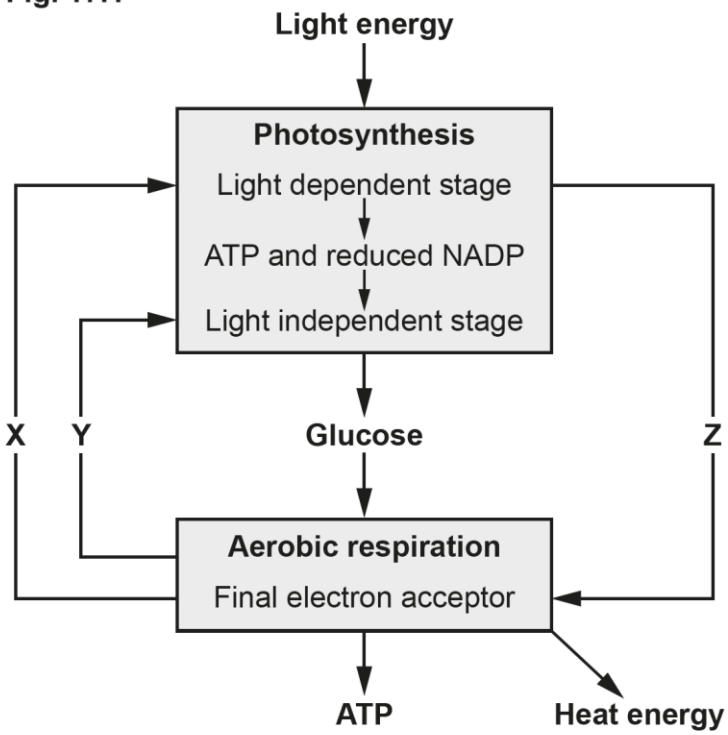
Question 17 (a) (i)

17

(a) **Fig. 17.1** shows the relationship between photosynthesis and aerobic respiration.

Fig. 17.1



(i) Identify the molecules labelled **X**, **Y** and **Z** in **Fig. 17.1**.

X .....

Y .....

Z .....

[2]

Many candidates were able to correctly identify all three molecules in Fig.17.1. Some candidates found it difficult to interpret the diagram and so mixed up the three molecules on the answer lines or answered in terms of ATP, NAD, FAD, NADP, NADPH or electrons.

Misconception

It is a common misconception that candidates consider that ATP produced in respiration is used directly in photosynthesis.

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Question 17 (a) (ii)

(ii) Use the information in **Fig. 17.1** to explain how plants are able to survive in a sealed glass container, such as a terrarium or bottle garden, for many months or even years.

.....

.....

.....

.....

.....

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

Good responses showed good application of knowledge and understanding of photosynthesis and respiration and their interaction in plants. Higher attaining candidates set out their answers in a logical sequence and gave detailed accounts of the production and use of reactants for both processes.

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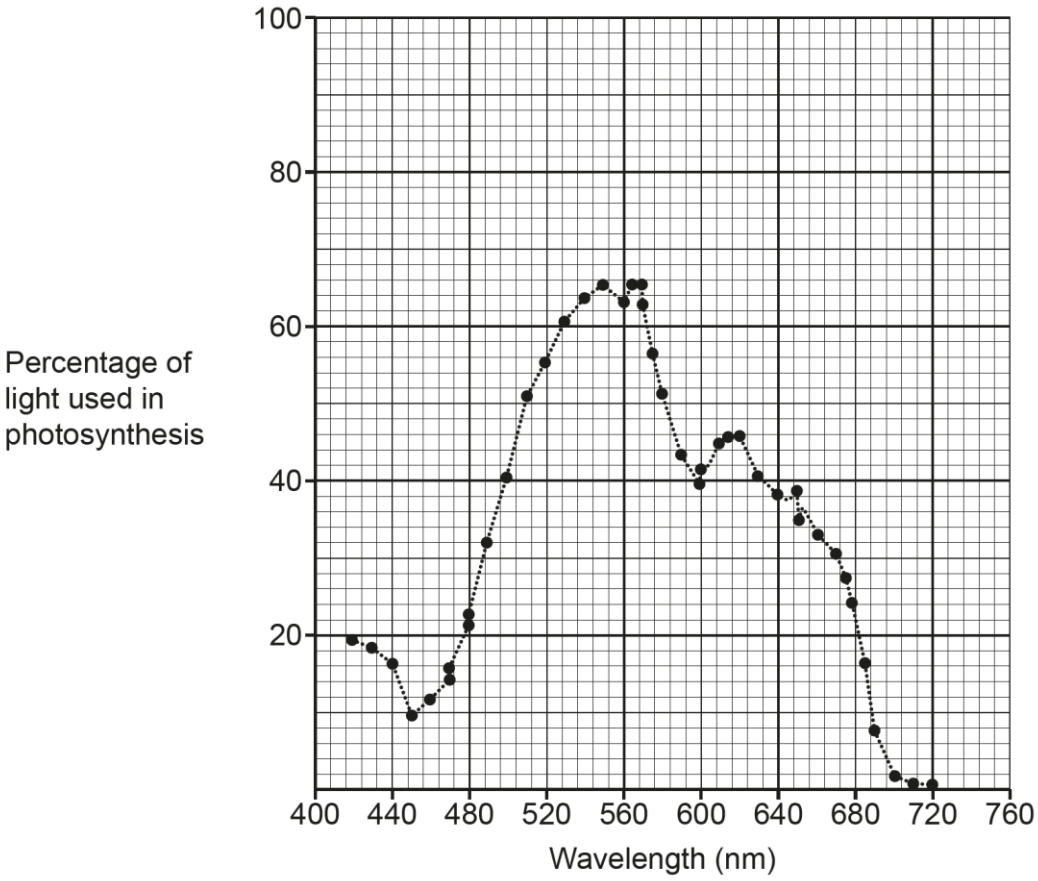
Question 17 (b) (i)

(b) Algae, such as seaweed, can occur in a range of colours. Algae carry out photosynthesis in the same way as plants, using chlorophyll a as the primary photosynthetic pigment.

Fig. 17.2 shows the percentage of light at each wavelength that is used in photosynthesis by the red alga *Porphyra naiadum*.

Fig. 17.2



(i) Chlorophyll a has an absorption peak at 680 nm.

Use **Fig. 17.2** to estimate the percentage of light absorbed by chlorophyll a that is used in photosynthesis by *Porphyra naiadum*.

Percentage absorbed = ... **[1]**

Most candidates correctly read the correct percentage of absorbance at 680nm from the graph in **Fig. 17.2** and gave answers within the accepted range. Some lost the mark for incorrectly reading the graph or for unnecessarily trying to process the data.

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OCR support

The mathematical skills handbook provides further support on estimate results (M0.4), as well as the maths for biology resources which include a tutorial and a quiz.

Question 17 (b) (ii)

(ii) Explain why the percentage of light used in photosynthesis is higher than your answer to part **(i)** at wavelengths other than 680 nm.

.....

.....

.....

.....

.....

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

Some candidates did not recognise that this question was about photosynthetic pigments and described the features of hydrophytes. Marking points 1 and 2 were the most frequently given with only the higher attaining candidates going onto achieving a third mark. Many candidates knew that other pigments would be present, but some did not name them as 'accessory pigments' for marking point 1. Terms such as special chlorophyll, secondary pigments were used in place of accessory pigments.

A common error was to write about different colours or percentages of light instead of wavelength. Credit was not given for stating that a 'wider' range of wavelengths would be absorbed or for failing to mention pigments anywhere in the account. Some candidates referred to the alga absorbing light rather than its pigments.

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Exemplar 1

Accessory pigments are also found in the antenna complex forming a reaction centre. They will absorb alternative wavelengths to maximise photosynthesis as seen by the peak 560nm which is 63% of light used in photosynthesis. Accessory pigments like chlorophyll B will transfer their energy to primary pigments so the electrons can be excited. **[3]**

The exemplar shows a good response, with credit being given for marking points 1, 2 and 4.

Question 17 (b) (iii)

(iii) *Porphyra naiadum* grows in deep water.

Use the data in **Fig. 17.2** to suggest how it is able to survive in conditions where other types of algae or plant cannot.

.....

.....

.....

.....

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

This question proved challenging for many candidates with regards to the use of correct terminology for features of light i.e. wavelength or intensity.

Good responses showed the ability to apply knowledge of photosynthetic pigments to the context of the red alga, *Porphyra naiadum*, describing how the alga would have pigments to absorb shorter wavelengths that could penetrate to greater depths in water.

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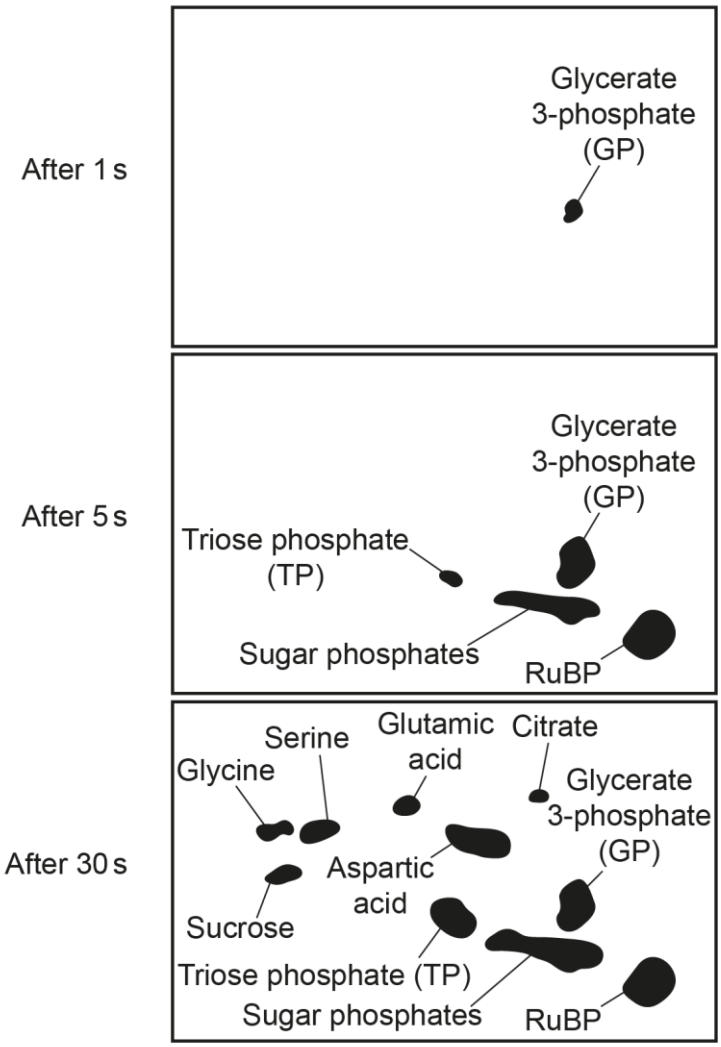
Question 17 (c) (i)

(c) Melvin Calvin and co-workers worked out the reactions of the light independent stage of photosynthesis.

They illuminated a suspension of green algae in the presence of radioactive carbon dioxide. They removed samples of the suspension at different times after addition of the radioactive carbon dioxide and used paper chromatography to identify the compounds in what is now known as the Calvin cycle.

Fig. 17.3 shows their results.

Fig. 17.3



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(i) Calvin concluded that GP was the first product of carbon fixation, and that GP was converted into TP.

Use the data in **Fig. 17.3** to explain how Calvin reached this conclusion.

.....

.....

.....

.....

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

Good responses used the diagram to formulate a response that included times at 1s and 5s. Some candidates did not gain credit for marking point 1 as, although able to state when GP was first seen, they did not mention that it was the *only* compound seen at 1s.

Question 17 (c) (ii)

(ii) State what you can conclude from **Fig. 17.3** about what happens to TP.

.....

.....

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

Generally answered well as candidates knew the fate of TP in the Calvin cycle. Some candidates lost the mark for referring to break down or hydrolysis of TP.

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Question 18 (a) (i)

18

(a) Furosemide is a type of drug known as a diuretic that acts on the nephron to decrease reabsorption of water in the collecting ducts. Diuretics are often prescribed to treat high blood pressure.

Furosemide is on the list of banned substances published by the International Olympic Committee.

(i) State **one** other type of drug on the list of banned substances that can be detected in urine samples.

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

Most candidates were able to name a banned substance and examiners were given a wide range of drugs suggested by candidates that are currently on the IOC list. The most common correct response was anabolic steroid, alternatives included a named steroid hormone e.g. testosterone or named illegal drugs e.g. amphetamines. Some candidates referred to steroids without further qualification which was not awarded.

Question 18 (a) (ii)

(ii) Furosemide can also be misused by jockeys or boxers who need to be below a certain weight.

Explain how a diuretic could help to reduce weight.

.....

.....

.....

.....

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

Most candidates gained at least one mark for this question with credit given for stating that more water would be lost, often expressing this as a loss of 'water weight'. Many candidates then went on to restate the information in the question stem without giving detail of the action of the diuretic leading to the decrease in reabsorption of water in the collecting ducts. Good responses linked the change in reabsorption of water to the drug causing reduction in permeability of collecting duct walls and some went on to include detail of how this happens via aquaporins.

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Question 18 (a) (iii)

(iii) Furosemide is a banned substance because it can be used as a masking agent, to hide the use of performance enhancing drugs.

Suggest how furosemide could act as a masking agent.

.....

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

Good responses were seen where candidates used the information provided and applied it to make a valid suggestion. Responses gaining credit commonly expressed the idea that the larger volume of urine or more dilute urine would lead to the drug being at such low concentration as to be undetectable.

Question 18 (b) (i)

(b) Urine analysis can also be used in medical diagnosis.

(i) Bladder cancer can be diagnosed by surgical removal of a small piece of bladder tissue (a biopsy sample).

State **one** advantage of urine analysis over a biopsy sample.

.....

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

Generally well-answered by most candidates.

Question 18 (b) (ii)

(ii) Give **one** other application of urine analysis in diagnosis.

State the substance measured and the corresponding medical condition.

Substance .....

Medical condition .....

[1]

Most candidates were able to state a substance and relevant medical condition. The most common correct responses were glucose **and** diabetes or hCG **and** pregnancy.

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Question 18 (c) (i)

(c) The formation of tissue fluid has many similarities with the process of ultrafiltration in the kidneys.

The table shows the factors involved in formation of tissue fluid and its return to the blood.

Location	Hydrostatic pressure (kPa)		Oncotic pressure (kPa)	
	Blood	Tissue Fluid	Blood	Tissue Fluid
Arteriole end	4.5	1.1	–3.3	–1.2
Venule end	1.7	1.1	–3.3	–1.2

(i) The net pressure at the arteriole end is +1.3 kPa.

Calculate the net pressure at the venule end.

Net pressure at venule end = ... kPa **[2]**

Good responses included clear working of net hydrostatic pressure and net oncotic pressure before adding these together. Many incorrect responses gave -1.6 or -1.7 responses and one mark for the working was rarely given.

Common errors included:

- calculation of total oncotic pressure values and subtracting these from the total hydrostatic pressure values
- adding the hydrostatic or oncotic pressures of the blood and tissue fluid together instead of calculating the net pressure
- errors in subtraction of the correct negative numbers

Calculation:

net hydrostatic pressure = 1.7 – 1.1 = 0.6

net oncotic pressure = –3.3 – (–1.2) = –2.1

net pressure = 0.6 + (–2.1) = –1.5 (kPa)

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Question 18 (c) (ii)

(ii) Use the information in the table to explain the formation of tissue fluid and its return to the blood.

.....

.....

.....

.....

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

Candidates that completed the calculation in **18(c)(i)** correctly were more likely to gain full marks here. Responses that did not gain credit were unclear about which end (of the capillary bed) they were describing (i.e. arteriole or venule) and some responses only included details about one end.

Many responses referred only to hydrostatic pressure and did not include the idea of the *difference* between hydrostatic pressure and oncotic pressure. Some candidates had difficulty in naming the fluid itself, using terms like 'small molecules' or 'substances' and even 'blood' being stated as an example.

Assessment for learning

The number of incorrect responses suggest that the formation of tissue fluid is not understood well or that candidates were not able to effectively use the information given in the table.

Candidates should be encouraged to learn and use appropriate terminology involved in the formation of tissue fluid and its return to capillaries.

Misconception

A common misconception is that movement of water is by osmosis rather than caused by pressure difference between hydrostatic and oncotic pressures (at arteriole or venule end). The pressure difference forces the water through and is not due to any difference in water potentials on either side of the capillary.

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Question 18 (d)*

(d)* Describe the homeostatic mechanisms that regulate the water content of the blood by changing how much water is reabsorbed from the collecting duct.

You do **not** need to describe how the loop of Henle sets up a water potential gradient in your answer.

.....

.....

.....

.....

.....

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

There were some excellent Level 3 responses to this Level of Response question showing that many candidates had a good knowledge and understanding of the homeostatic mechanisms involved and could describe osmoregulation in detail. Responses given Level 2 most commonly did not mention the role of the (posterior) pituitary gland or gave incorrect accounts of ADH production and release. Other indicative points e.g. movement down axon to posterior pituitary, being stored in vesicles, action potentials causing release from neurosecretory cells by exocytosis, were very rarely seen.

Lower level responses were seen where candidates included vague ideas of ADH acting on the collecting ducts but no relevant detail and so there were omissions or errors in their accounts.

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Exemplar 2

If there is low water potential in the blood it is detected by the osmoreceptors in the hypothalamus. This then causes the secretion of ADH released from the pituatary gland and it travels in the blood to the collecting duct. The ADH binds to the receptors on the collecting duct which release vesicles of aquaporins making the duct more permeable so more water is reabsorped into the capillaries. If the water potential in the blood is high then the osmoreceptors detect it and stop the release of ADH to ~~ether~~ mean less water is reabsorbed ~~and~~ so it leaves in the urine. This is an example of negative feedback as the body is responding to oppose the change it has detected. **[6]**

This Level 3 response makes reference to the role of receptors, both osmoreceptors in the hypothalamus and receptors on the walls of collecting ducts in the nephron. They state that ADH is released from the pituitary gland and describe the action of ADH clearly, including a description of vesicles of aquaporins. There are no science errors, and they refer to negative feedback in their response.

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Question 19 (a) (i)

19

(a) Plants respond to their environments in different ways.

(i) Describe the meaning of the term **tropism**.

.....

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

This meaning of the term tropism proved challenging for many candidates to describe. Most responses lacked the idea of the fact that it is a directional or growth response. Some candidates gave an example of a tropism which was not awarded a mark.

Assessment for learning

As stated in previous reports, definitions and meanings of scientific terms are an important part of the specification and candidates should be encouraged to learn these in full.

Question 19 (a) (ii)

(ii) State **one** named example of a tropism.

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

Generally well-answered with phototropism and geotropism the most used examples.

Question 19 (a) (iii)

(iii) Give **one** example of an abiotic stress and the corresponding plant response.

Example .....

.....

Plant response .....

.....

.....

[2]

Most candidates showed knowledge of plant responses and this was generally well-answered. The most common error was where candidates had misread the question and provided an example of a biotic stress such as predation.

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Question 19 (b) (i)

(b) Mycorrhizae are associations between some types of fungi and the roots of plants, including trees. The fungal hyphae grow into the roots and help the trees take up water and minerals.

Trees respond to insect attack by producing chemicals that defend against insects.

Trees also release pheromones into the air that stimulate nearby trees to produce defensive chemicals in preparation for possible insect attack.

It is now known that communication between trees of the same or different species can also be carried out via the mycorrhizae.

Some scientists investigate this phenomenon using young fir and pine plants.

This is the method that they use:

- grow a 'donor' fir plant together with a 'recipient' pine plant in the same large pot
- repeat to create 40 pairs of plants
- divide the plants into four groups, with ten pairs of plants in each group
- enclose the roots of the 'recipient' plants of each pair in a mesh bag
- simulate insect herbivory by removing the leaves of 'donor' plants in half of the groups.

The treatment groups are summarised in the table.

Group	Leaves of 'donor' removed	Mesh bag around 'recipient' roots
1	No	0.5 μm mesh bag that allowed passage of solutes but blocked passage of roots and hyphae.
2	Yes	
3	No	35 μm mesh bag that allowed passage of solutes and hyphae but blocked passage of roots.
4	Yes	

The scientists measure the concentration of the enzyme polyphenol oxidase (PPO) in the recipient seedlings at the start of the experiment and after 72 hours. PPO is involved in the production of defence chemicals.

(i) Suggest how the scientists could ensure that airborne pheromones did **not** contribute to communication between plants in this investigation.

.....

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

Candidates found this question challenging. Higher ability candidates were able to suggest that a solution to this problem would be to separate the aerial parts of the plant from one another while still allowing communication through the roots. Common incorrect responses involved separating the different plants e.g. in separate rooms or greenhouses.

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Question 19 (b) (ii)*

(ii)* The results are shown in the table.

Group	Mean PPO Activity ± Standard Deviation (Arbitrary Units)	
	At start	After 72 h
1	18 ± 2	20 ± 2
2	16 ± 2	50 ± 4
3	12 ± 2	22 ± 4
4	18 ± 2	116 ± 14

The scientists conclude:

- Removing the leaves of the donor plants leads to a chemical defence response in the recipients.
- This is due to signals carried by the mycorrhizal hyphae.

Evaluate the support given by the results to the scientists' conclusions.

You should comment on the quality of the scientists' data in your answer.

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.....

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

Having data to evaluate two conclusions for two variables (i.e. experimental treatments) proved challenging for many candidates. Good Level 3 responses provided three clear and logical sections often titled: supporting evidence, non-supporting evidence and validity. Most candidates were able to produce a meaningful comparison between all or some of the groups but finding two non-supporting statements proved more challenging and often limited candidates to Level 2. Lower level responses interpreted or repeated the data without clearly stating whether it supported the conclusions or not and were unable to identify trends. Some candidates had difficulty expressing themselves clearly and precisely enough for the point they were making to be understood. The most confusing answers tried to compare too many groups at once and conflated the effect of leaf removal and blocking hyphae. Better responses clearly separated comments about the two conclusions. Not very successful responses gave opinions without the support of data.

Overall, candidates could extract supporting evidence from the data but were less likely to provide non-supporting evidence. Some focused only on a criticism of the validity of the scientists' data limiting themselves to Level 1.

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Exemplar 3

SUPPORT: There is a much larger increase in volume of Pheromones produced after 72 hours when mesh bag allowed hyphae communication and leaves removed. 98 an increase compared to 34 an increase of PPO (more than double). suggests hyphae are responsive to some form of pheromone signalling. higher concentrations of PPO produced when leaves removed compared to when leaves remain. suggests plant sensing leaves loss to a chemical defence. AGAINST: correlation ≠ causation. No statistical tests done. Hyphae may not be 'mycorrhizal hyphae' could be another factor causing chemical defence response. Removing whole leaves is not representative of an insect attack. Mean PPO activity increases even when no leaves removed and also [6]

~~Hyphae~~ increases when hyphae cannot be used as communication.

VALIDITY: Sample size too small. Control variables and methodology unknown. Scientists data has large standard deviation (room for error) and only to 2sf so not precise. 72 hours not long enough. Repeats needed. Graph should be drawn.

The exemplar shows a clear Level 3 response with sections titled by the candidate to help them structure their response.

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Question 20 (a) (i)

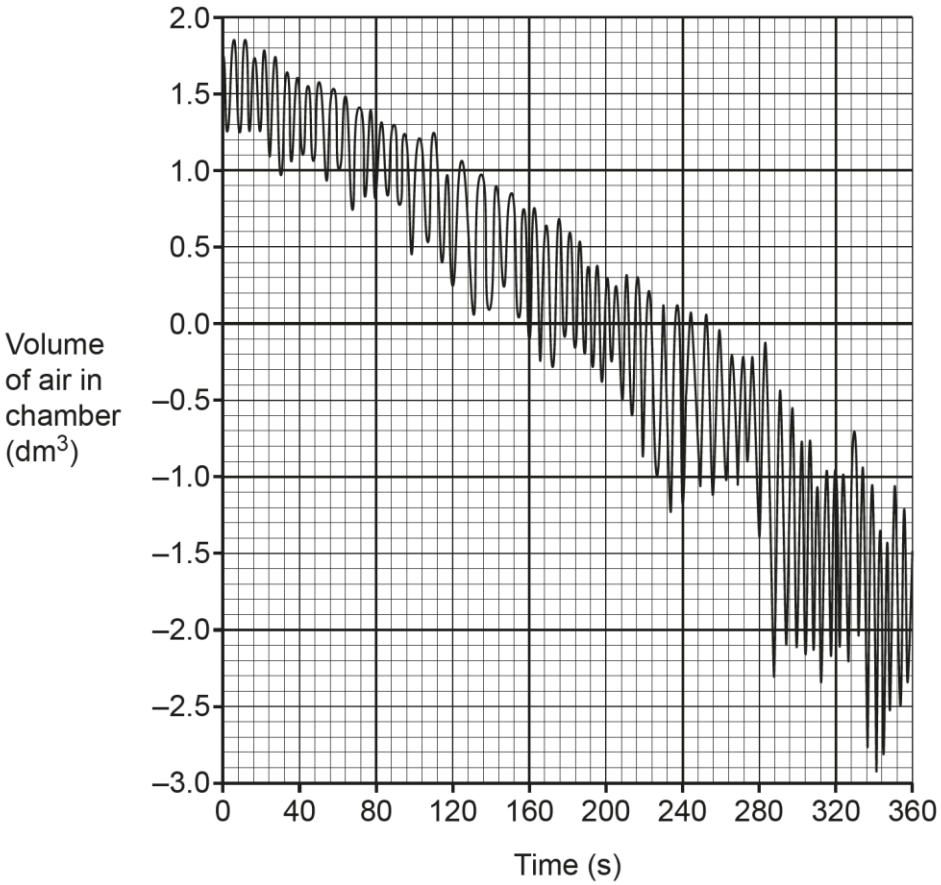
20 A student investigated ventilation and heart rate in a resting subject.

The subject breathed in and out through a spirometer.

The spirometer chamber was filled with room air. Soda lime was present to absorb carbon dioxide.

The results are shown in **Fig. 20.1**.

Fig. 20.1



(a) (i) The downward slope of the spirometer trace in **Fig. 20.1** is due to oxygen consumption.

The subject exhales the same volume of air as they inhale.

State why the trace slopes downwards.

.....

.....

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

Generally well-answered with candidates stating that soda lime absorbs the carbon dioxide produced and/or that oxygen was being used.

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Question 20 (a) (ii)

(ii) The subject had a mass of 75 kg.

Calculate the subject's oxygen consumption in $cm^3 kg^{-1}$ during the first 2 minutes of the experiment.

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

Oxygen consumption = ... $cm^3 kg^{-1}$ **[2]**

This calculation involved three stages. Candidates had to correctly calculate the oxygen consumption from the graph, convert this to cm^3 and then convert this to cm^3/kg by dividing by the mass of the person i.e. 75Kg. Many candidates did not calculate the correct oxygen consumption from the graph. Some graphs showed no annotation suggesting that candidates did a rough estimate without using a ruler to read the volumes accurately. Candidates that realised the requirement of the task could convert dm^3 into cm^3 by multiplying by 1000. An error carried forward mark was available for dividing a stated volume by 75Kg. Most candidates did give their answer to two significant figures as required by the question.

Assessment for learning

Unit conversion is an invaluable mathematical skill included in this specification. Practice in converting units and use of significant figures is a recommended activity.

OCR support

Maths skills handbook can be found to support candidates preparing for assessment.

There is also extra support on maths skills in the 'Maths for Biology' resources.

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Question 20 (a) (iii)

(iii) Using **Fig. 20.1**, compare the breathing pattern between 0–120 s and 120–240 s.

.....

.....

.....

.....

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

It proved challenging for many candidates to read the graph correctly to compare breathing patterns for two different time intervals. Most candidates saw that deeper breaths were visible from 120-240s but did not take the comparison any further.

Assessment for learning

Analysis is an important skill and can be assessed using e.g. graphs, data tables, ECGs and spirometer traces as in this question. Practice in these areas using secondary data is a recommended activity.

OCR support

Maths skills handbook can be found to support candidates preparing for assessment.

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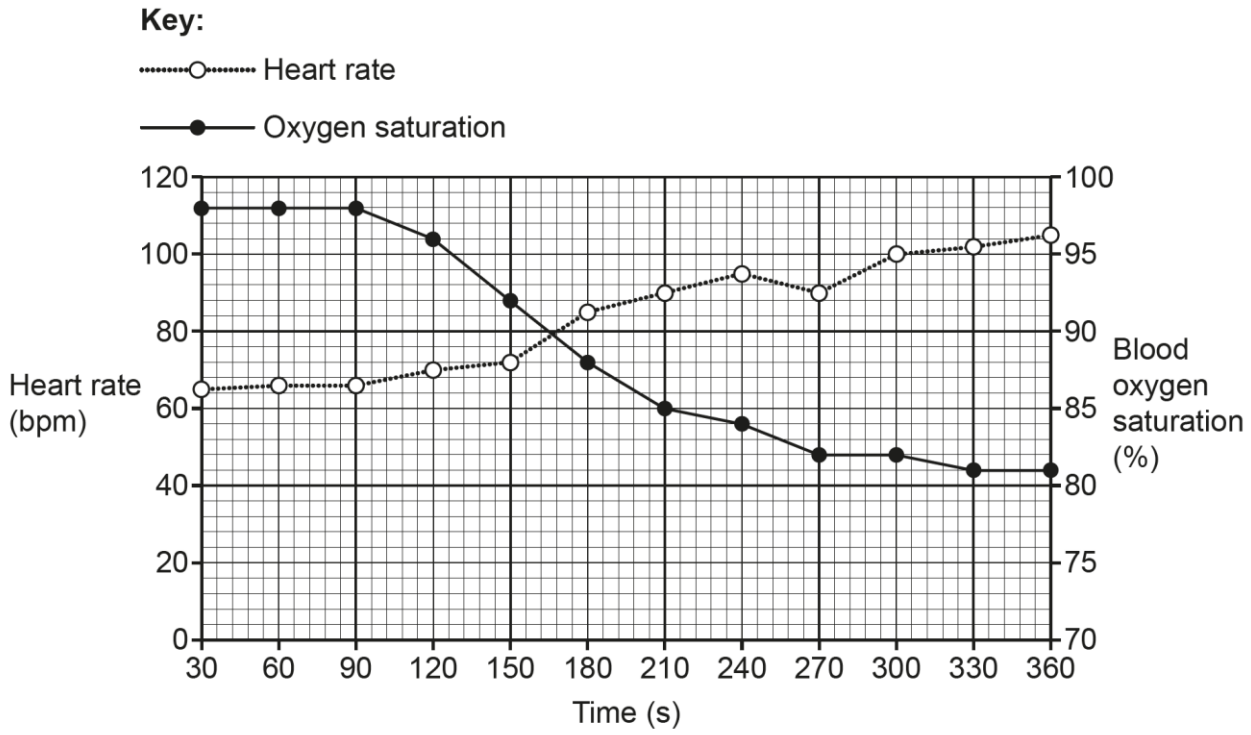
Question 20 (a) (iv)

The student measured the subject's heart rate and blood oxygen saturation every 30 seconds.

The results are shown in **Fig. 20.2**.

Fig. 20.2



(iv) Use the data in **Fig. 20.1** and **Fig. 20.2** and your own knowledge of homeostatic control to explain the changes in breathing rate and heart rate during the experiment.

.....

.....

.....

.....

.....

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

This question required the use of the data from two graphs and the candidate's own knowledge of homeostatic control. Good responses were seen where candidates described the trends shown in both graphs and went on to give a good explanation of homeostatic control to explain the changes seen. Most candidates described the fall in oxygen saturation to gain one mark. Less successful candidates focused on only one figure describing either increased breathing rate **or** heart rate and therefore not achieving marking point 1.

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Question 20 (b)

(b) Blood oxygen saturation of less than 90% can be dangerous.

Explain **one** modification that you could make to the experiment to safely study the effect of extended periods of exercise.

.....

.....

.....

.....

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

Good responses recognised that there needed to be a richer oxygen supply and that this is because the oxygen saturation would need to be kept high. Some candidates did not seem familiar with the safe setting up and use of a respirometer of this design, possibly due to lack of practical activity using the spirometer.

Assessment for learning

Centres are encouraged to complete as many practical activities as possible relating to practical themes within the specification.

OCR support

Practical skills handbook can be found to support candidates preparing for assessment.

Practical PAG materials can also be used to support candidates with developing their indirect assessment of practical skills.

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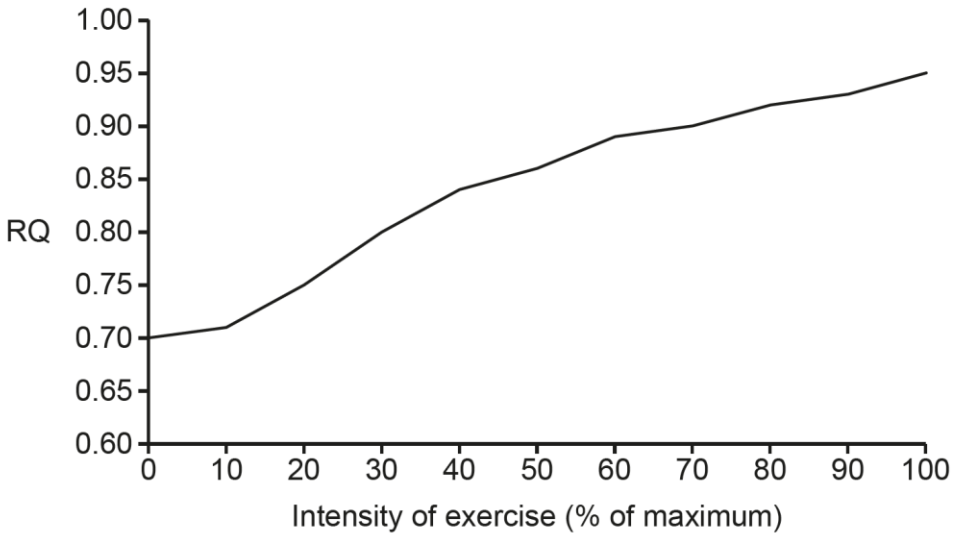
Question 20 (c) (i)

(c) **Fig. 20.3** shows how the respiratory quotient (RQ) of an athlete changed during exercise, from rest (0%) up to 100% maximum effort.

Fig. 20.3



(i) State the **two** measurements that you would need to make during the experiment to calculate RQ.

1 .....

2 .....

[1]

Generally well-answered by most candidates.

Question 20 (c) (ii)

(ii) Explain what **Fig. 20.3** shows about the respiratory substrate(s) used at different intensities of exercise.

.....

.....

.....

.....

.....

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

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Candidates that understood RQ values knew that lipids have an RQ of 0.7 and linked this to their use at low activity levels to gain two marks. Many candidates thought that use of proteins was the reason for the change of the RQ to 0.8 rather than the increasing use of carbohydrates. Only high achieving candidates noticed that the RQ value in Fig. 20.3 did not reach 1 even at 100% intensity and concluded that a mixture of respiratory substrates would be used.

Question 21 (a)

21

(a) Most digestive enzymes are extracellular.

Complete the sentences about the synthesis and secretion of a typical digestive enzyme using the most appropriate terms.

The polypeptide chain is assembled at ribosomes on the ..... .

After this, the protein is transported to the ..... where

further processing occurs. The final protein is packaged into .....

for transport to the plasma membrane where the protein is released by exocytosis.

[3]

There were many excellent responses for this question showing that candidates were clear about the roles of organelles in protein secretion.

Question 21 (b) (i)

(b) Hydrogen peroxide is a highly reactive chemical.

Catalase is an intracellular enzyme that catalyses the breakdown of hydrogen peroxide.

(i) Explain why it is important that catalase is able to break down hydrogen peroxide very quickly.

.....

.....

.....

.....

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

Most candidates understood that hydrogen peroxide is toxic or would damage cells or their components to gain one mark. However, only good responses offered further detail about the importance of the breakdown.

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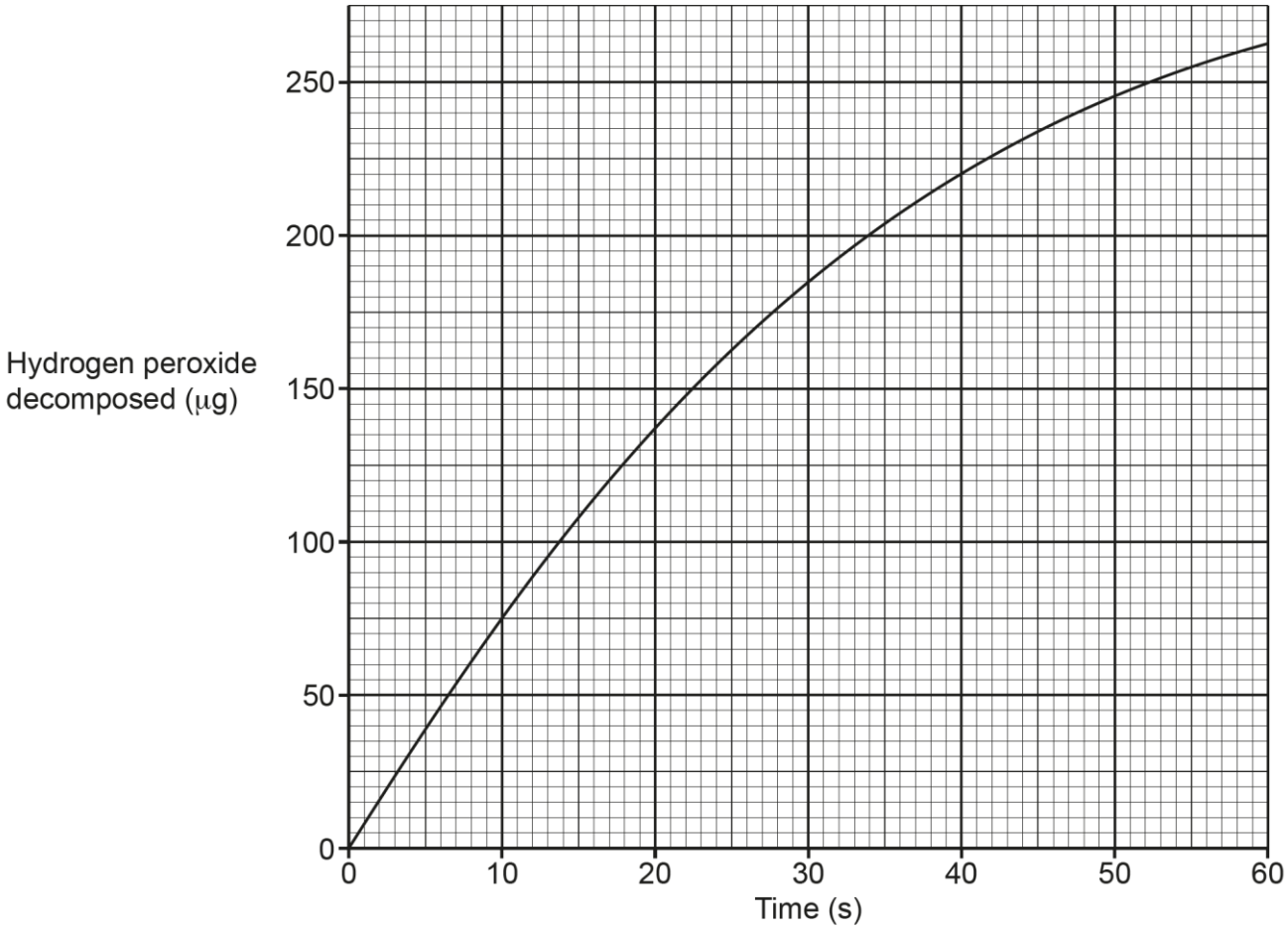
Question 21 (b) (ii)

(ii) **Fig. 21.1** is a graph of decomposition of hydrogen peroxide against time for catalase.

Fig. 21.1



Calculate the rate of the enzyme catalysed reaction **at 30 s**.

Rate = ... Units = ... **[3]**

Candidates who scored well on this question drew an appropriate tangent to the curve, and a range of answers were accepted to account for the variation in possible gradients. However, some candidates made the error of not calculating the rate using a tangent and, instead, took the readings of x and y and divided them or simply read off the value at 30 seconds. The mark for correct units was given regardless of the method used.

Assessment for learning

Calculating rate from curves on graphs using tangents is a mathematical skill included in this specification. Many candidates were just reading the value for hydrogen peroxide at 30s, so practice in use of tangents is to be encouraged.

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OCR support

Maths skills handbook can be found to support candidates preparing for assessment.

There is also extra support on maths skills in the 'Maths for Biology' resources.

Question 21 (c) (i)

(c) Male infertility is associated with low motility (ability to move) of sperm cells.

(i) Superoxide dismutase (SOD) is an enzyme that is often located together with catalase in cells.

Superoxide ions are produced in mitochondria and are highly reactive. Superoxide ions cause damage to many biological molecules, including DNA and lipids.

SOD converts superoxide ions into hydrogen peroxide and oxygen.

Explain why sperm cells might have high concentrations of hydrogen peroxide.

.....

.....

.....

.....

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

Many candidates understood that sperm cells would have many mitochondria to gain credit. However, only high achieving candidates gained further mark points by referring to the possibility of high concentrations of SOD or the presence of inactive catalase.

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Question 21 (c) (ii)

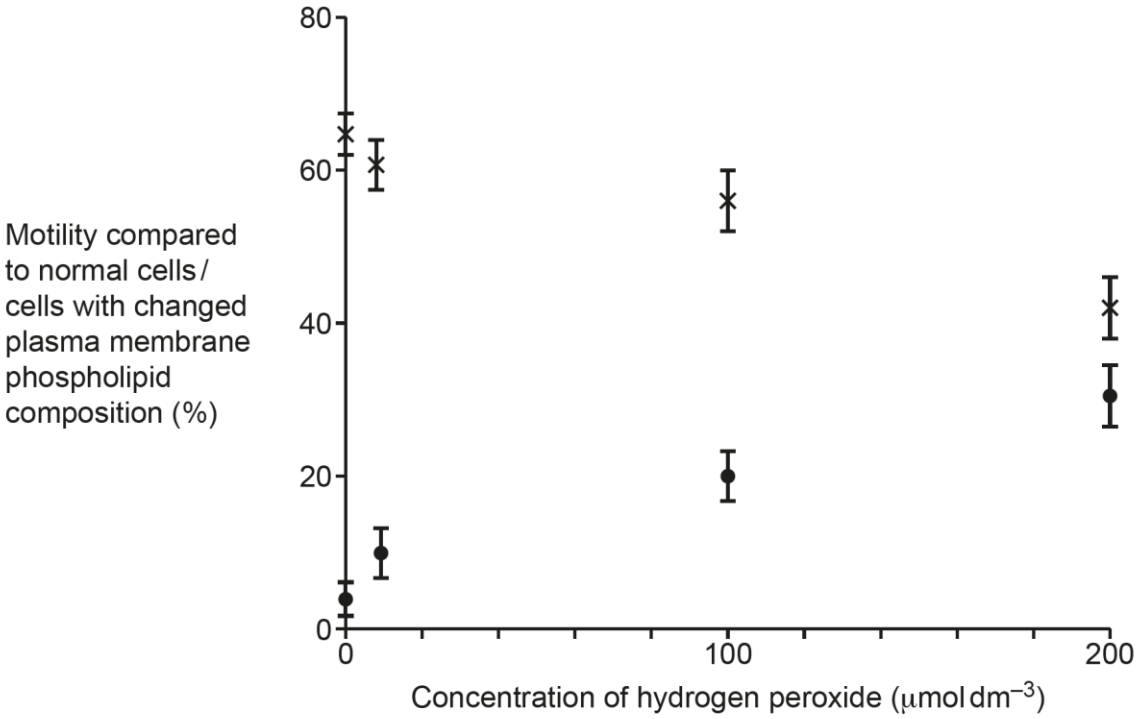
(ii) Scientists investigate the effect of hydrogen peroxide on sperm cells. This is the method that they use:

- incubate sperm cells with different concentrations of hydrogen peroxide for two hours
- measure the motility of the cells compared with normal sperm cells
- measure the percentage of cells that have changes in the composition of phospholipids in the plasma membrane.

They use sperm samples from 10 different men attending a fertility clinic and calculate mean values.

Their results are shown in **Fig. 21.2**.

Fig. 21.2



Key:

× = motility

● = cells with changed plasma membrane

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The scientists conclude that hydrogen peroxide causes changes in the plasma membrane of sperm cells that reduces their motility.

Evaluate this conclusion.

.....

.....

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.....

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

Candidates appear to be more familiar with the command word "evaluate" and there were many who structured their response with supporting points followed by points against the conclusion, along with comments on the methodology of the investigation.

Assessment for learning

Candidates should be encouraged to read graphs carefully noting the named variables on the x and y axes.

Question 21 (c) (iii)

(iii) Suggest how hydrogen peroxide could affect the plasma membrane.

.....

.....

.....

.....

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

Most candidates achieved at least one mark for this question part. There were a number of alternative phrases allowed and candidates should be encouraged to refer to the phospholipid bilayer when answering questions on this topic, rather than the more general term 'membrane'.

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Question 22 (a)

22 A student investigates the effect of ethanol on the membranes of beetroot cells at 25 °C.

They place equal masses of beetroot in tubes containing different concentrations of ethanol.

They then use a colorimeter to measure the concentration of purple pigment that leaked out of the cells.

The student replicates the experiment five times at each ethanol concentration and plots a graph of absorption in arbitrary units (A.U.) against concentration of ethanol.

(a) The student controls the mass of beetroot in this investigation.

Identify **two** other variables that the student should control in this investigation.

1 .....

2 .....

[2]

Most candidates could identify at least one variable for this investigation. Although some restated e.g. temperature which was ignored as it had been mentioned in the stem of the question.

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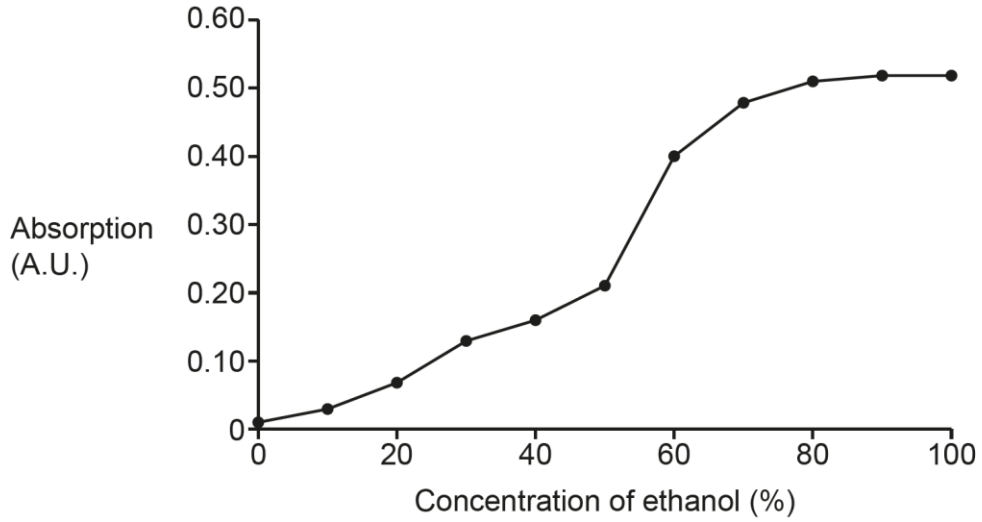
Question 22 (b) (i)

(b) The student's graph is shown below.



(i) Explain the shape of the graph.

.....

.....

.....

.....

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

Many candidates did not spot the command term in this question and went on to provide a description rather than an explanation. Good responses offered an explanation for both the rise of the curve and the plateau.

Question 22 (b) (ii)

(ii) The student repeats the experiment at a temperature of 30 °C.

Sketch the graph you expect the student to obtain.

Answer on the graph. **[2]**

Most candidates drew a graph to the left of the original for one mark, but many then extended their graphs beyond the maximum value of the original so were not given the second mark. There were a number of 'no responses' suggesting that some candidates missed this question at the end of the question paper.

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