Cambridge Assessment International Education

Example Responses – Paper 4

Cambridge IGCSE™ / IGCSE (9–1) Biology 0610 / 0970

For examination from 2023

Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9-1) Biology 0610 / 0970.

This booklet contains responses to all questions from June 2023 Paper 41, which have been written by a Cambridge examiner. Responses are accompanied by a brief commentary highlighting common errors and misconceptions where they are relevant.

The question papers and mark schemes are available to download from the School Support Hub

0610 / 0970 June 2023 Question Paper 41

0610 / 0970 June 2023 Mark Scheme 41

Past exam resources and other teaching and learning resources are available from the School Support Hub

Question 1

1 **(a)** Fig. 1.1 is a diagram of the digestive system.

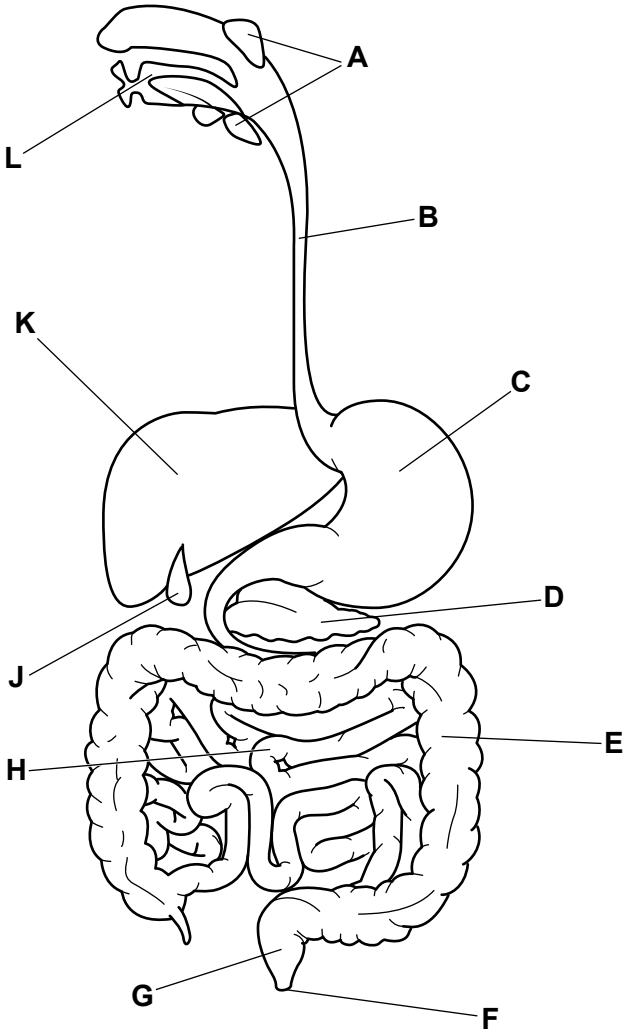

Fig. 1.1

Each letter may be used once, more than once or not at all.

State the letter of the part shown in Fig. 1.1:

that produces bile ...K...

that produces gastric juice ...C...

that produces urea ...K...

where maltose is digested ...H...

where trypsin acts. ...H...

[5]

Examiner comment

- Some candidates did not realise they were able to use the same letter more than once, as there were some organs that had more than one role. Bile and urea are produced by the same organ (the liver). Maltose is digested in the small intestine and this is also where trypsin acts.
- Some candidates misinterpreted the instructions and provided the names of the organs, instead of the letter identifying the organs on the figure provided. The skill required was not only to identify the organ but to be able to give its location in diagrams.

(b) A student investigated the effect of bile on the digestion of fat in milk.

They set up three different test-tubes:

- test-tube **A** contained milk and bile
- test-tube **B** contained milk and lipase
- test-tube **C** contained milk, lipase and bile.

They used an indicator that is pink in alkaline solutions and colourless in acidic solutions. They added the same volume of indicator to each test-tube.

The student observed and recorded the colour of the contents of each test-tube at 0 minutes, 20 minutes and 40 minutes.

Table 1.1 shows the results of the investigation.

Table 1.1

test-tube	indicator colour observed		
	0 minutes	20 minutes	40 minutes
A	pink	pink	pink
B	pink	pink	colourless
C	pink	colourless	colourless

(i) Explain the results for test-tubes **B** and **C** in Table 1.1.

Test-tubes B and C contain lipase which breaks down the fats in milk into fatty acids and glycerol. The fatty acids are acidic causing a colour change. Test-tube C contains bile which emulsifies the fats, creating a larger surface area for lipase to act. This causes a faster breakdown of fats in test-tube C than test-tube B.

[4]

Examiner comment

- Lipase was not always linked with the digestion of fat in milk, some candidates incorrectly described the digestion of milk by lipase.
- Bile physically digests fat droplets. Some candidates described bile as breaking down fat into smaller molecules, which is chemical digestion.

(ii) Explain the purpose of test-tube **A** in Table 1.1.

Test-tube A is a control and allows us to compare with test-tubes B and C. It shows that bile does not chemically digest fats and that only lipase is responsible for fat digestion.

[2]

Examiner comment

- Test-tube A was often incorrectly referred to as a control variable.
- Candidates found it difficult to explain the purpose of tube A, often giving vague responses such as ‘to check the effect of lipase’, with no reference to the necessity of lipase for fat digestion.

(c) The action of lipase is affected by temperature.

Fig. 1.2 shows the axes for a graph of the effect of temperature on the activity of lipase.

Complete the graph by:

- drawing a line to show the expected effect of temperature on the activity of lipase
- adding a label line and a label to show the point at which all the lipase has been denatured.

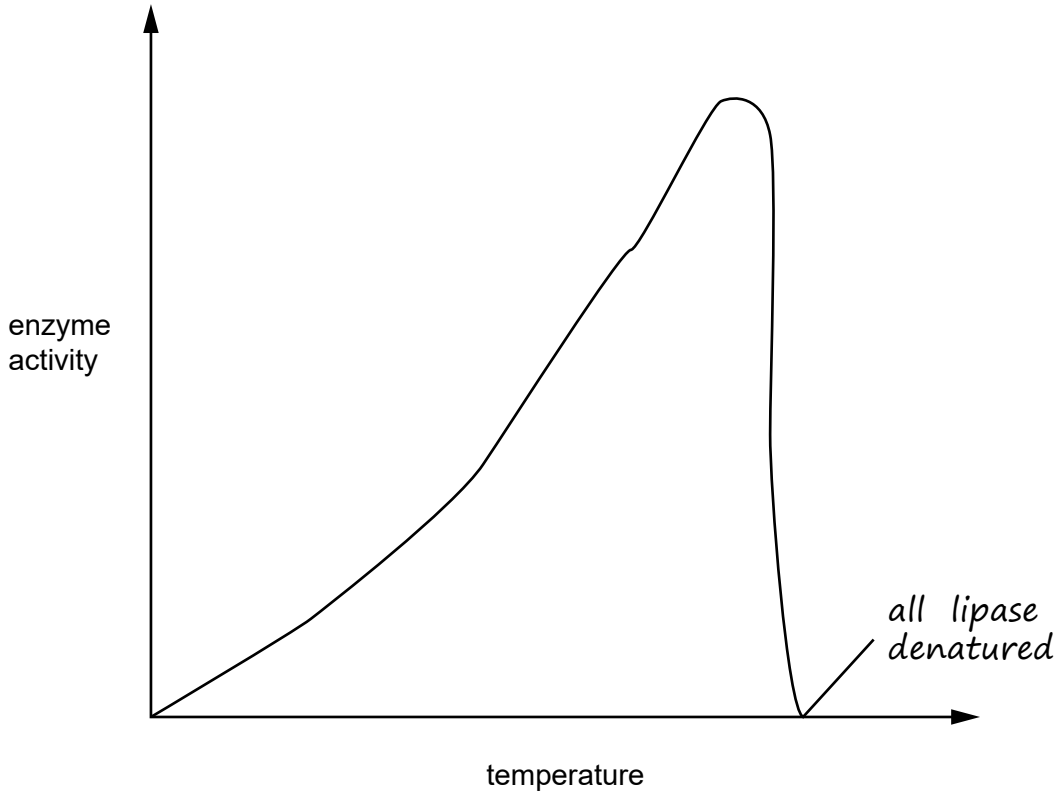

Fig. 1.2

[2]

Examiner comment

- A line shown increasing and then levelling off was often drawn rather than increasing and then decreasing.
- The line should have decreased at a greater rate than it increased. Many candidates drew a bell-shaped curve with no difference in the rate of increase and decrease.
- There was a lack of precision seen in labelling the point of denaturation. Labels to the peak of the curve were seen as well as labels just above the point of zero enzyme activity.

(d) Explain why lipase cannot be used to catalyse the breakdown of proteins.

Lipase is enzyme-specific and will only break down a fat substrate. The shape of the active site of lipase is not complementary to protein, so protein cannot bind to lipase and an enzyme-substrate complex cannot be formed.

[3]

Examiner comment

Many candidates described the lipase as not being complementary to a protein substrate. However, very few specifically described a lack of complementary **shape**.

Question 2

2 **(a)** A student investigated osmosis in potato plant cells.

He immersed cubes of potato tissue in water and different concentrations of sucrose solution for 30 minutes.

The masses of the potato cubes were measured before and after immersion.

The percentage changes in mass were calculated.

Table 2.1 shows the results.

Table 2.1

concentration of sucrose solution / mol dm^{-3}	mass of potato cube before immersion / g	mass of potato cube after immersion / g	percentage change in mass
0.00	1.32	1.50	13.64
0.20	1.34	1.49	11.19
0.40	1.30	1.34	3.08
0.60	1.33	1.29	–3.01
0.80	1.22	1.12	–8.20
1.00	1.28	1.11	

(i) Using the information in Table 2.1, calculate the percentage change in mass at 1.00 mol dm^{-3}.

Give your answer to **two** decimal places.

Space for working.

$1.11 - 1.28 = -0.17$

$\left(\frac{-0.17}{1.28}\right) \times 100 = -13.28125$

.....-13.28..... %

[3]

Examiner comment

- It was common for candidates to divide -0.17 by 1.11 instead of 1.28, giving a value of -15.45 %.
- Some candidates forgot to include a '-' symbol before their numerical value to indicate the change in mass was negative.

(ii) Using the information in Table 2.1, explain the difference in the results between the 0.6 mol dm^{-3} and the 0.8 mol dm^{-3} sucrose solutions.

Use the term water potential in your answer.

The potato cube in 0.8 mol dm^{-3} solution loses a greater percentage of mass than the cube in the 0.6 mol dm^{-3} solution. This is because the water potential of the 0.8 mol dm^{-3} solution is lower than the 0.6 mol dm^{-3} solution causing a steeper water potential gradient between the potato and the solution. More water in the 0.8 mol dm^{-3} solution leaves the potato cube from high water potential to low water potential than in the 0.6 mol dm^{-3} solution causing a greater decrease in mass.

[5]

Examiner comment

- It was common for candidates to refer to relative concentrations of the potato and the sucrose solution, rather than explaining in terms of water potential.
- Many candidates described the differences in water potential between the potato cube and one concentration of sucrose solution in excessive detail, rather than explaining the reasons for the difference in change of mass between the potato cubes immersed in 0.6 mol dm^{-3} solution and the 0.8 mol dm^{-3} solution.

(iii) Describe the expected appearance of a cell from a potato cube that has been immersed in distilled water for 30 minutes.

the cell would appear more swollen and turgid because the vacuole increases in size causing the cell contents to press on the cell wall

[2]

Examiner comment

- Some candidates described the effect of immersion on the potato instead of the potato cells.
- Some candidates incorrectly described the predicted appearance of potato cells if they had been immersed in 0.8 mol dm^{-3} sucrose solution instead of distilled water. This led to incorrect descriptions such as cells being flaccid or plasmolysed.

(b) Describe how the process of active transport differs from the process of osmosis.

active transport uses energy to transport ions against a concentration gradient and involves protein carriers

[3]

Examiner comment

The question asked for how active transport is different from osmosis. Candidates only needed to describe these differences, however many gave the features of active transport as well as the different features of osmosis. This was unnecessary, but was not detrimental to the candidates that did this.

(c) State the type of plant cells that use active transport to absorb mineral ions from the environment.

root hair cells [1]

Examiner comment

- 'Root cells' unqualified was not an acceptable response.
- Some candidates gave other incorrect plant cells such as xylem and phloem.

(d) Explain the effect of a lack of magnesium ions on the colour of plant leaves.

the leaves would appear a yellow colour as magnesium is required for synthesis of chlorophyll, the green pigment

[2]

[Total: 16]

Examiner comment

A common error was the statement that magnesium ions were used to synthesise chloroplasts.

Question 3

3 **(a)** Fig. 3.1 is a photomicrograph of some cells lining the trachea.

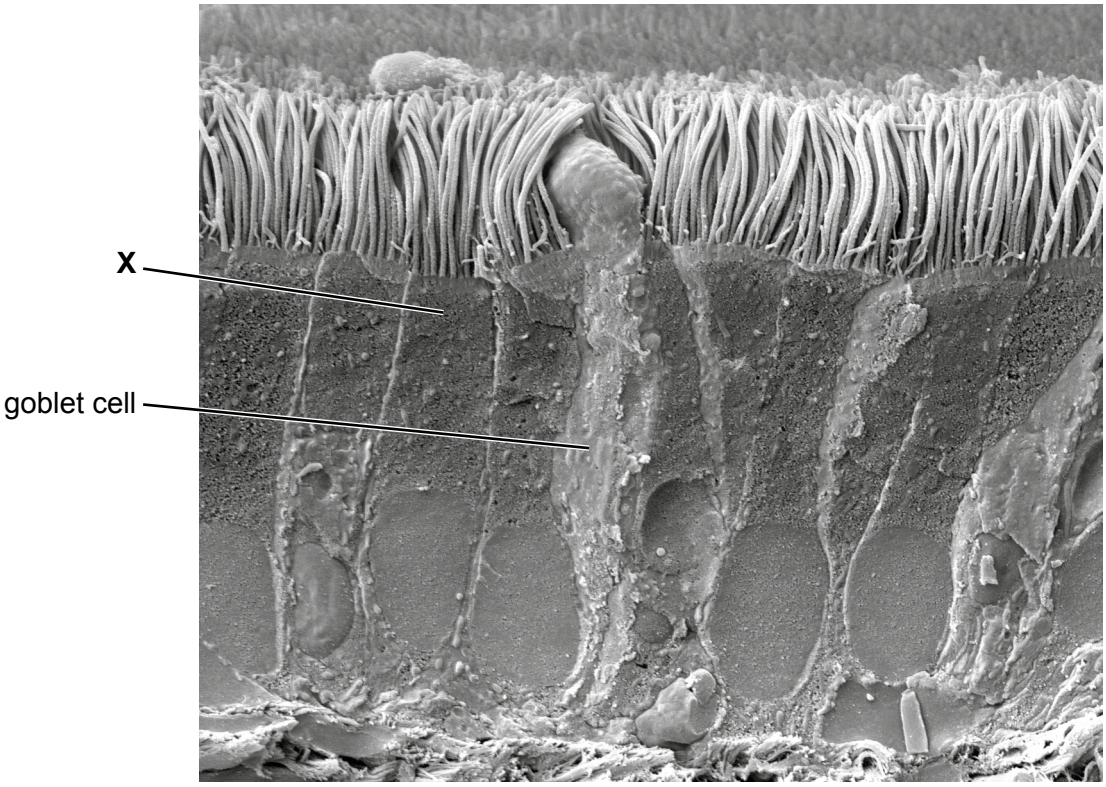

Fig. 3.1

(i) Describe the role of goblet cells.

goblet cells secrete mucus to trap pathogens

[2]

Examiner comment

- A common misconception was to identify the cells as mucus-secreting cells in the digestive system.
- If the cells were misidentified as located in the digestive system, the role of mucus was described as the lubrication of food rather than the correct role of trapping pathogens.

(ii) Explain how the cell labelled **X** in Fig. 3.1 is adapted for its function.

The cells are ciliated. The cilia move mucus out of the respiratory system.

[2]

Examiner comment

- The ciliated cells were sometimes misidentified as having microvilli for absorption.
- The cilia were often incorrectly described as 'hairs'.

(iii) State the name of **one other** part of the body where the type of cell labelled **X** in Fig. 3.1 is found.

bronchioles [1]

Examiner comment

Common incorrect answers identified the location of ciliated cells in the digestive system, for example in the small intestine, stomach, or oesophagus.

(b) Table 3.1 contains some features of the breathing system.

Complete Table 3.1 to show the actions of each feature of the breathing system that occur to cause inspiration.

Table 3.1

feature of the breathing system	action that causes inspiration
diaphragm	contracts and flattens
external intercostal muscles	contract
pressure in the thorax	decreases
ribs	move upwards and outwards
volume of the thorax	increases

[5]

Examiner comment

- Where candidates gave the wrong answers, this was generally in their description of the action of the external intercostal muscles and the ribs during inspiration.
- Candidates often described the external intercostal muscles as relaxing, rather than contracting during inspiration.
- Candidates often described the ribs as expanding, rather than moving upwards and outwards during inspiration.

(c) State the name of the gas that is excreted by the breathing system.

carbon dioxide ..... [1]

(d) Good ventilation is one feature of gas exchange surfaces.

State **two other** features.

1 large surface area .....

2 has a good blood supply .....

[2]

Examiner comment

Instead of the walls of the gas exchange surface being described as ‘thin’, candidates sometimes described a thin cell wall or a thin cell membrane, which was not acceptable.

(e) State the name of the gas exchange surface in humans.

alveoli ..... [1]

Question 4

4 **(a)** Fig. 4.1 shows the effect of light intensity on the rate of photosynthesis at different temperatures and concentrations of carbon dioxide.

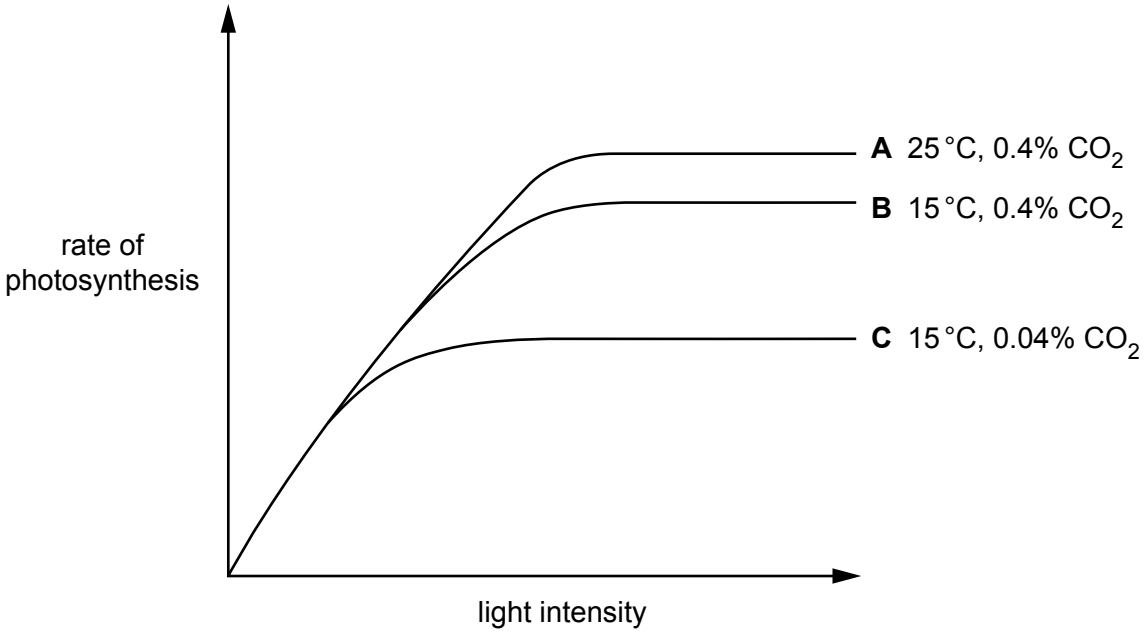

Fig. 4.1

Describe **and** explain the reasons for the shape of lines **B** and **C** in Fig. 4.1.

Initially at low light intensities, as light intensity increases the rate of photosynthesis increases at the same rate for B and C because light intensity is the limiting factor and provides the energy needed for photosynthesis. Lines B and C then level off and become constant when light intensity is no longer a limiting factor. This happens at a lower light intensity in C because light intensity becomes limiting at a higher intensity in B due to B having a higher carbon dioxide concentration available than C. Carbon dioxide is a raw material needed for photosynthesis. Carbon dioxide is a limiting factor in C at lower light intensities than B. In B temperature is limiting at high light intensities.

[6]

Examiner comment

- A common misconception was for candidates to describe the rate of photosynthesis as stopping, rather than becoming constant when the line on the graph levels off and becomes horizontal.
- The command in this question was 'describe and explain'. Few candidates gave a detailed description of the lines on the graph as instructed and just provided explanations.
- Some candidates misinterpreted the graph and needed to read the axes labels carefully to understand what the graph showed them. Some candidates thought that temperature increased as light intensity increased. The graph shows the effect of increasing light intensity on the rate of photosynthesis at only two different temperatures, in this case 15 °C for line B and C and 25 °C for line A.
- The question only required descriptions and explanations for line B and C, but some candidates also attempted to describe and explain the shape of line A. Candidates who did this were not penalised, but it unnecessary.
- Not all the candidates used the term 'limiting factor', which was the key idea required for this question.

(b) $C_6H_{12}O_6$ is one of the products of photosynthesis.

State the chemical formula of the **other** product.

O_2 ..... [1]

Examiner comment

- Several candidates included the full equation for photosynthesis, rather than just the gaseous product.
- The question asked for the chemical formula of the gaseous product of photosynthesis, but a few candidates gave the name in its place.

(c) Outline how the carbohydrates made during photosynthesis are used in plants.

The glucose produced can be used in respiration to provide energy. Glucose can also be stored as starch or converted to sucrose, which is used for translocation. Carbohydrates are also used in fruits and nectar to attract pollinators. Other uses include conversion to cellulose to build cell walls, lignin for cells walls and synthesis of amino acids.

..... [4]

Examiner comment

Some candidates misread this question, with candidates providing a description of how glucose is made in plants rather than the uses of carbohydrates made in plants.

Question 5

5 **(a)** Fig. 5.1 shows the stages involved in protein synthesis.

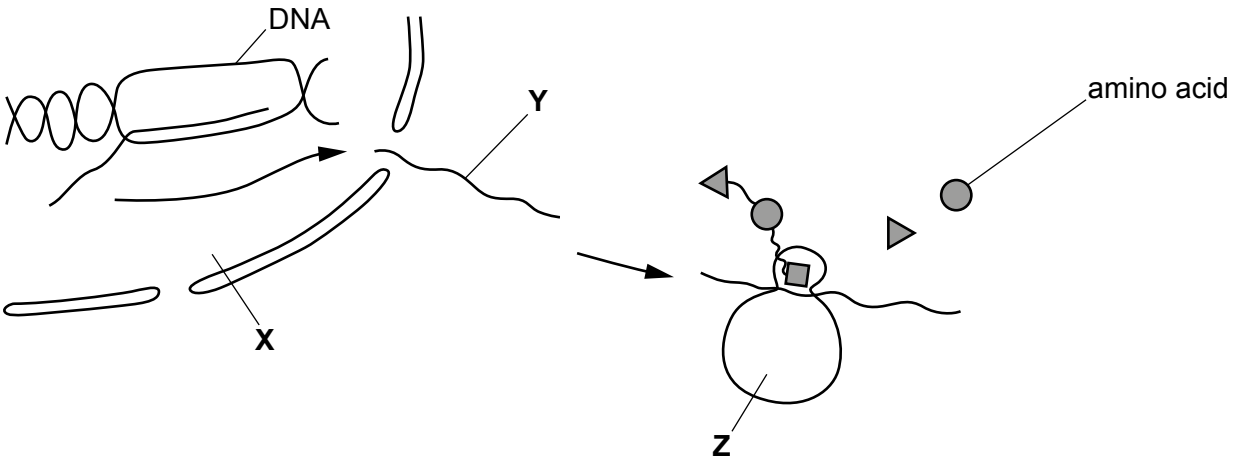

Fig. 5.1

(i) State the names of the parts labelled **X**, **Y** and **Z** in Fig. 5.1.

X nucleus

Y mRNA

Z ribosome

[3]

Examiner comment

- Candidates sometimes misidentified the nucleus (X) as cytoplasm.
- Candidates sometimes misidentified Ribosomes (Z) as enzymes.

(ii) State what determines the sequence of the amino acids in the protein that is produced.

the order of bases in mRNA determines the sequence of amino acids

[1]

Examiner comment

Many candidates gave vague answers and simply stated ‘genes’ or ‘DNA’ rather than the sequence of bases in a gene / DNA / mRNA.

(iii) Explain why the sequence of amino acids is important in the production of receptor molecules for neurotransmitters.

The sequence of amino acids determines the shape of the receptor molecule. The shape of the receptor molecule needs to be complementary to the neurotransmitter to allow the receptor molecule and neurotransmitter to bind.

..... [2]

Examiner comment

- Some candidates made reference to 'receptor cells' rather than 'receptor molecules'.
- Only a few candidates seemed to understand the link between the order of amino acids, the influence they have on the shape of the receptor molecule and subsequent bonding of the neurotransmitter.

(b) Explain why body cells can have different specialised functions even though they contain the same genes.

cells can have specialised functions because not all the genes in a cell are expressed, in order that cells only produce the proteins they need

..... [2]

Examiner comment

- Many candidates described the role of stems cells, which did not answer the question.
- This was a challenging question and only a few candidates made the link between gene expression and protein synthesis.

(c) Allele frequency in a population can be changed by natural selection and artificial selection.

State the meaning of the term allele.

an allele is an alternative form of a gene

..... [1]

(d) Describe how artificial selection differs from natural selection.

Artificial selection is when humans choose specific features often for economic reasons in organisms and reproduce these individuals. Changes happen much faster than in natural selection. Artificial selection is not caused by environmental pressures and results in decreased genetic variation and evolution.

[3]

Examiner comment

- Many candidates gave vague responses simply stating that artificial selection is 'done by humans', instead of a description of how humans choose the desired features in organisms and then use these individuals to breed.
- Some candidates incorrectly described artificial selection as the choosing of genes through genetic modification.

(e) Mutation causes formation of new alleles which increases genetic variation.

State **two other** sources of genetic variation in populations.

1 meiosis

2 random mating

[2]

[Total: 14]

Examiner comment

- Some candidates misread this challenging question, and gave examples of variation instead.
- Some candidates gave the causes of mutation such as radiation.

Question 6

6 **(a)** A scientist monitored the changes in the pH in muscles before, during and after two minutes of vigorous exercise.

The changes in pH are caused by the production of lactic acid.

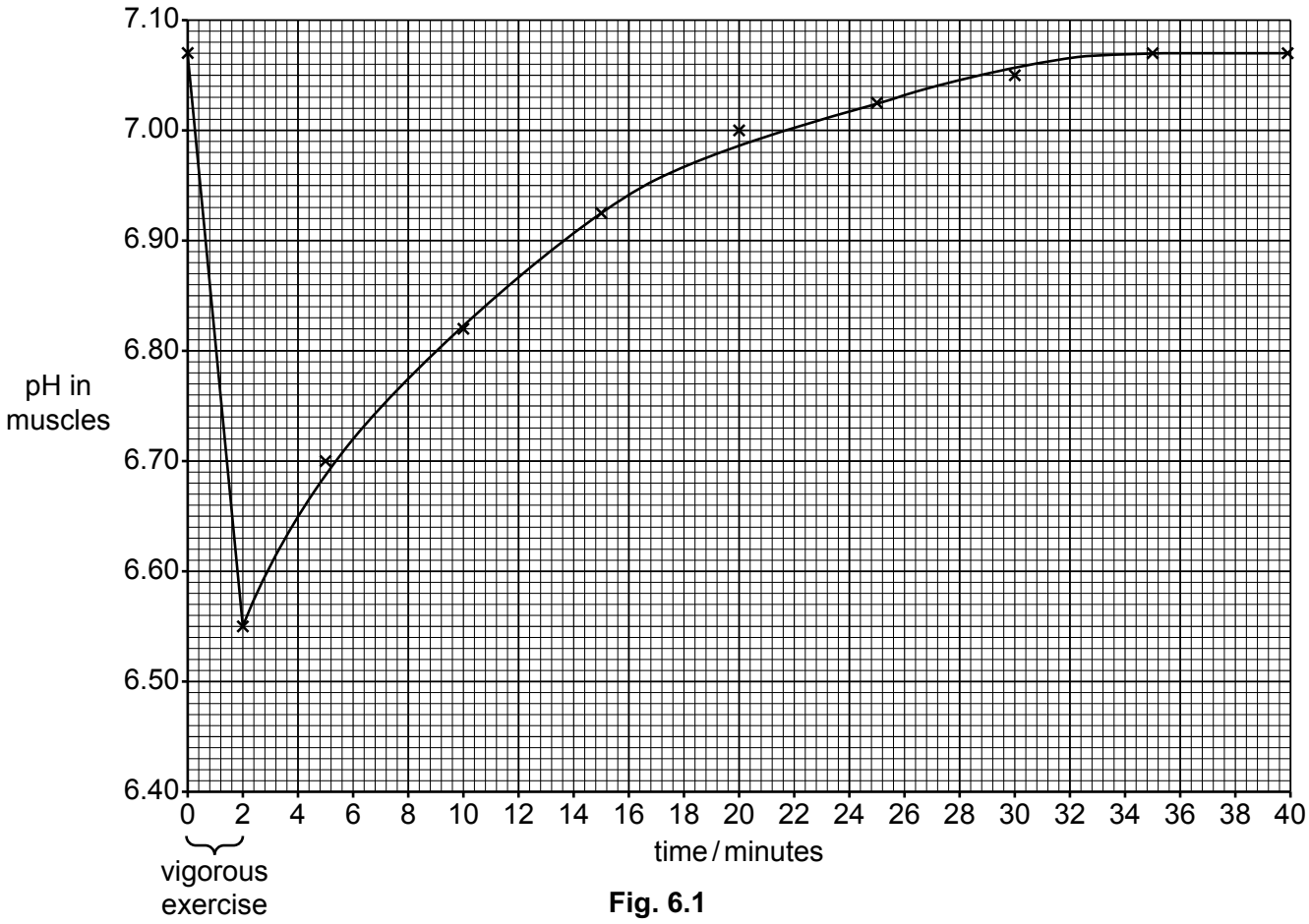

Fig. 6.1

Complete the sentences to describe **and** explain the results in Fig. 6.1.

The pH decreases from .....7.07..... to .....6.55..... during vigorous exercise.

There is not enough .....oxygen..... supplied to the muscles.

The body respires anaerobically. The lactic acid produced builds up in the muscles causing an .....oxygen..... debt.

It takes .....31..... minutes for the muscle pH to return to its initial level after exercise.

The pH value increases after vigorous exercise has ended, as lactic acid is transported in the .....blood..... to the .....liver..... .

During this time the breathing rate and .....heart..... rate remain high.

[6]

Examiner comment

- Some candidates read the graph inaccurately and gave a pH value of 7.7 given instead of 7.07.
- Inaccurate reading of the graph also led many candidates to give 34-35 minutes for the muscle pH to return to its initial value, rather than 31 minutes.
- Some candidates stated that a lack of energy supplied to the muscles led to anaerobic respiration, rather than a lack of oxygen.

(b) Yeast can respire anaerobically.

(i) Complete the balanced chemical equation for anaerobic respiration in yeast.

$C_6H_{12}O_6$ → $2C_2H_5OH + 2CO_2$ [2]

Examiner comment

- Many candidates struggled to write the formula for ethanol correctly.
- Some candidates struggled to balance the equation successfully.
- Some candidates added oxygen to the equation and gave the balanced formula for aerobic respiration. The question specifically asked for the formula of **anaerobic** respiration in yeast.

(ii) Yeast belongs to the kingdom fungus.

State **one** cell component that is present in yeast cells but is absent in animal cells.

cell wall [1]

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