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OCR
Oxford Cambridge and RSA

AS LEVEL

Examiners' report

BIOLOGY A

H020

For first teaching in 2015

H020/02 Summer 2022 series

Version 1

Contents

Introduction

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

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

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.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 2 series overview

H020/02 assesses content from all four AS modules in a 70 mark written paper. To do well candidates need a good factual understanding of the topics and an array of practical and mathematical skills. Candidates who did well showed good examination technique, responding appropriately to command words and instructions. Candidates who did less well showed poor recall of facts and limited literacy and numeracy skills. Candidates performed best on questions requiring simple short statements of knowledge. Many candidates performed less well on tasks where careful selection and organisation of knowledge was required, such as the Level of Response 6 mark items and the 'compare' task in Question 2 (c).

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• recalled detailed subject knowledge accurately and applied it to novel contexts • read the question carefully and answered in terms of the command word and any specific instructions given • showed a good grasp of practical skills such as identifying variables, assessing the validity of a method, drawing a graph and designing a results table • used numeracy skills confidently including converting units and analysing graphical data.	• gave general answers that included some correct scientific knowledge but did not relate this appropriately to the context or the command word of the question • showed lack of familiarity with practical skills listed in the specification and with the principles of planning and measuring in investigations • did not always use the appropriate biological terminology • made no attempt to answer some questions • demonstrated poor mathematical and data handling skills.

OCR support

When preparing candidates to sit an examination this resource may be useful:

https://ocr.org.uk/Images/231995-the-ocr-guide-to-examinations.pdf Page 8 lists some common command words used in exam questions.

Question 1 (a)

1 The cells in beetroot contain a red pigment called betalain. The plasma membrane of the beetroot cell is impermeable to betalain.

A group of students set out to investigate how temperature affects the structure and permeability of the plasma membrane of beetroot cells. The method they used is shown below.

- Cut some pieces of beetroot.
- Place them in a flask containing 100 cm^3 of distilled water.
- Stand this flask in a water bath and increase the temperature at 10 °C intervals.
- Take a sample of water from the flask 5 minutes after each new temperature is reached.
- Measure the absorbance of the water samples taken using a blue filter in the colorimeter.

(a) A second group of students made improvements to this method. One of the improvements they made was to carry out two further trials at each temperature.

Suggest **two** further improvements they could have made **and** give a reason for the improvements you have suggested.

Improvement and reason 1

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Improvement and reason 2

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[4]

This question used the context of an experiment investigating varying temperature and measuring pigment loss from beetroot cells to assess how candidates could refine experimental design. Successful responses must identify the independent variable, plot results, relate experimental results to the fluid-mosaic theory of membrane structure and suggest how freezing affects cell membrane permeability.

In order to do well candidates needed to study the information given carefully. Less successful responses described general 'improvements' such as carrying out repeats and testing at smaller temperature intervals or over a greater range of temperatures. Strong responses focused on the faulty method described and picked up on generalities such as 'cut some pieces of beetroot' by asking questions about the size, shape and number of the pieces, so that they could suggest an improvement in line with the principles of experimental design (controlling extraneous variables) such as cutting the same number of pieces or same sized pieces. Similarly focusing on the error of heating the same pieces of beetroot through successive temperatures led to ideas for improvement such as having one flask and fresh beetroot pieces for each temperature tested. Candidates who suggested two sensible improvements to the method could not always explain the reasons why their suggestion was an improvement. Controlling the size and shape of the beetroot pieces was important in terms of the surface area over which betalain pigment could escape, and rinsing or drying the pieces was important in terms of removing excess pigment released by the cutting operation.

Misconception

Some candidates confused this experiment investigating the effect of temperature on membrane permeability with the osmosis practical that aims to find the water potential of plant material such as potato chips.

Question 1 (b)

(b) Name the independent variable in this investigation.

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

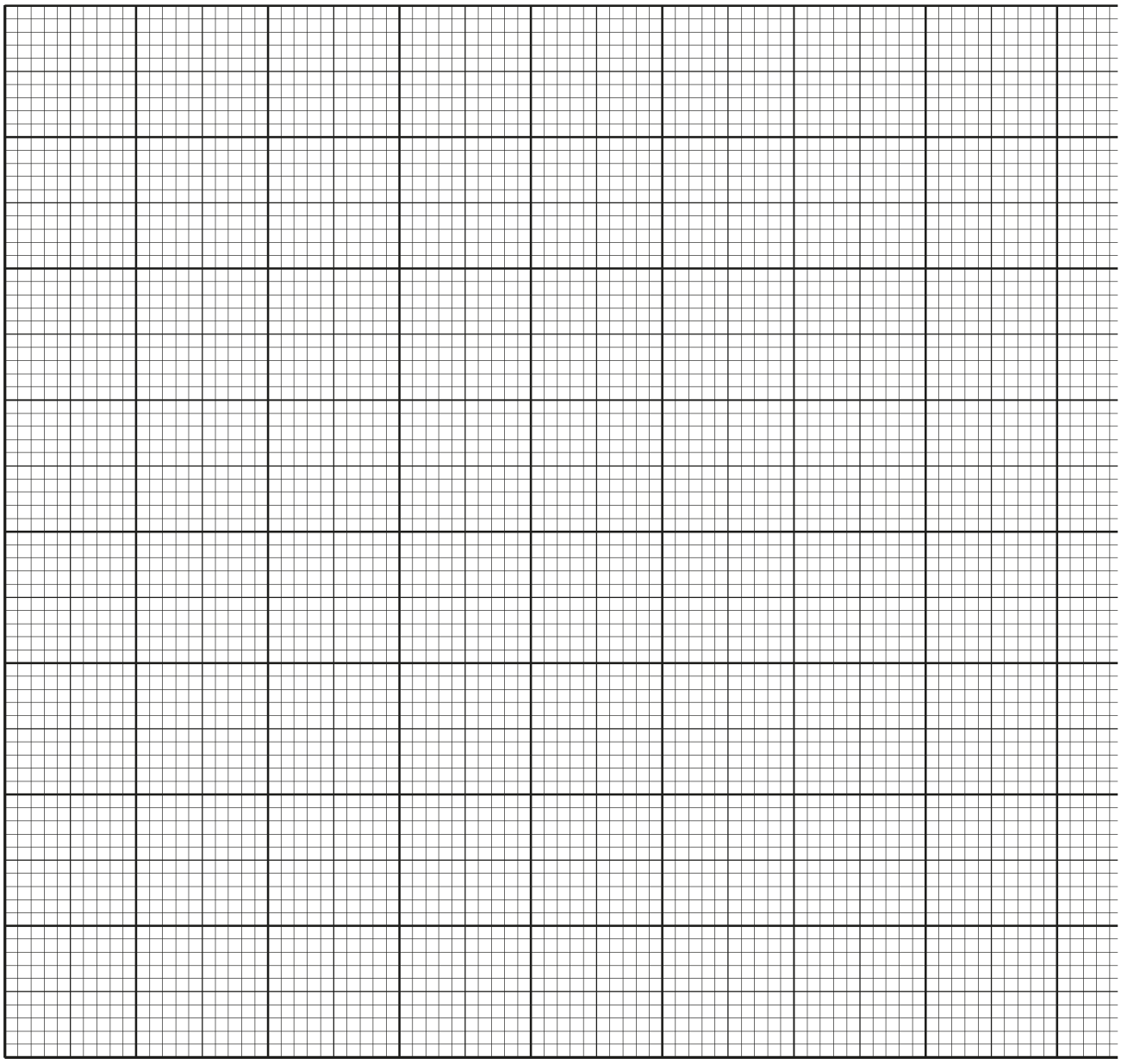
Most candidates named temperature as the independent variable.

Question 1 (c) (i)

(c) (i) The table shows the results obtained by the second group of students.

Temperature (°C)	Absorbance (%)			
	Trial 1	Trial 2	Trial 3	Mean
10	0	0	0	0.0
20	0	0	0	0.0
30	2	3	2	2.3
40	6	5	7	6.0
50	9	7	7	7.7
60	46	45	47	46.0
70	78	78	80	78.7

Plot a graph of the results from the table on the grid.



[3]

Graph skills varied, with most using the space appropriately and plotting temperature on the *x* axis and absorbance on the *y* axis, giving units for each axis and choosing a linear scale for each axis, but a proportion did not do some or all of these things. Most plotted the mean absorbance only but some obscured the mean data by also plotting the results from each trial. Candidates should be adequately equipped in the exam with a pencil for plotting data and a rubber for erasing mistakes so that the final answer is not marred by scribbled out lines or double lines.

OCR support

OCR provides tutorials, student tests and teacher answers on creating and interpreting graphs for M3.1 at **https://www.ocr.org.uk/subjects/science/maths-for-biology/graphs/**

This checklist for graphs is taken from the OCR support document 'Learner Checklist: Graphs, Tables and Drawings'. A link to this document can be found here: https://www.ocr.org.uk/qualifications/as-and-a-level/biology-a-h020-h420-from-2015/planning-and-teaching/

S	**S**ize of the graph: does the bit with actual plotted points in take up at least half the paper?	
P	**P**lotting: is every data point within half a little square of where it should be?	
L	**L**ine of best fit: if there's a trend in your data, is it indicated with a smooth curve or straight line?	
A	**A**xes right way round: the thing you changed (independent variable) along the bottom; the thing you measured (dependent variable) up the side.	
T	**T**itle: have you included a title that tells you what this graph shows?	
A	**A**xis labels: name of each variable with the right unit symbol.	

Question 1 (c) (ii)*

(ii)* Explain the results between 20 °C and 70 °C using your knowledge of the structure and properties of phospholipid molecules in the plasma membrane.

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

This was the first of two 6-mark levels of response questions on the paper. This style of question requires specific skills and candidates need guidance in how to assess what the question is asking for and how to structure their response. In this case a systematic approach to the data in the table was needed, covering the whole range of temperatures and dividing the range into sections with a common cause of permeability characteristics. Here there was the lowest temperature with zero permeability, the middle range of temperatures where progressive heating gave progressively more kinetic energy, membrane fluidity and pigment loss, and the highest temperatures where a more dramatic disruption and increase in permeability occurred. This disruption is a result of the phospholipids moving so that the bilayer arrangement breaks, which can be referred to as the bilayer melting. However, it is not correct to say that the phospholipid molecules themselves change state (melt). The question also asked for explanation in terms of both the **structure** and the **properties** of phospholipids, so both these aspects needed to be referred to in a Level 3 answer.

Exemplar 1

Between 20°C and 70°C, there is a major increase in the absorbance. This is because the increase in temperature caused the proteins in the phospholipid bilayer of the plasma membrane to denature. The ~~so~~ cytoskeleton below the ~~pl~~ plasma membrane will also denature. The higher the temperature the more proteins that will denature, ~~and so the permeability of the mem plasma membrane will increase. This allows~~ This will leave holes in the plasma membrane and so increase the permeability. This will allow betalain to cross the membrane and diffuse into the ~~distilled~~ water. When the ~~calito~~ colorimetry takes place, this red pigment [6]

Additional answer space if required.

will be absorbed by the blue filter, hence why the absorbance ~~fat~~ increases as the temperature increases.

This response shows a clear understanding of how membrane permeability affects pigment movement which is measured by the colorimeter as light absorbance. The candidate seeks to explain a general increase in absorbance over the whole temperature range and does not distinguish between the different temperature spans with different rates of permeability increase. Their explanation is all in terms of the effects of temperature increase on proteins. As the question asks for an explanation in terms of phospholipids, the protein references are irrelevant. This is a Level 1 response.

Question 1 (d)

(d) In a second experiment, students followed the same method but used pieces of beetroot that had been frozen for several days and then defrosted. They were surprised when their results differed from the students that had been given fresh beetroot.

Suggest how their results would **differ** from those given in the table **and** provide an explanation.

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

The command word 'suggest' provides a challenge for candidates to think creatively using their existing knowledge. A minority of candidates realised that the absorbance would be higher as more pigment would escape from the cells that had been frozen. Many candidates argued that freezing would make the membrane rigid and impermeable, preventing pigment loss, as they did not notice that the frozen beetroot was defrosted. Many candidates did not comment on the results (measured as absorbance in the colorimeter) as asked, but instead just commented on membrane permeability. Few candidates had the idea that when water freezes it both expands in volume, putting pressure on the cell surface membrane, and forms sharp ice crystals which can pierce the membrane.

Question 2 (a) (i)

2 (a) **Fig. 2.1** shows the larva of a European stag beetle, *Lucanus cervus*.

Fig. 2.1

These larvae can live for up to six years, feeding and growing in decaying wood. During this time, the cells in the larvae undergo mitosis to produce genetically identical cells.

Mitosis is part of the cell cycle. The cell cycle is shown in **Fig. 2.2**.

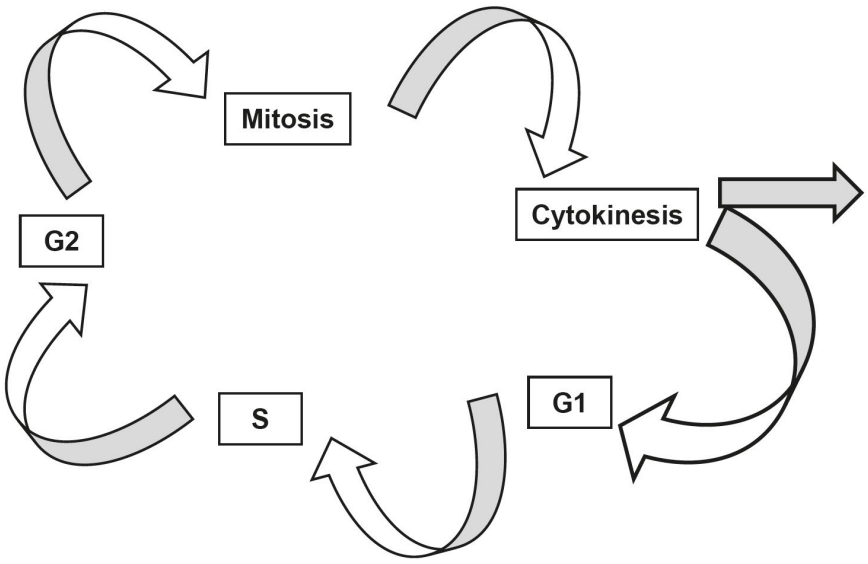


Fig. 2.2

(i) The size of the cell increases during stage **G2** in the cell cycle.

State **one** other process that takes place during stage **G2**.

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

Cell division and growth were explored in the context of the growth in a stag beetle larva.

Many candidates identified organelle synthesis and checking DNA for errors as processes that take place during G2 of the cell cycle. The commonest incorrect response was stating that DNA replicates at this point, despite the diagram showing the 'S' phase preceding G2.

Question 2 (a) (ii)

The length of a stag beetle larva was measured at yearly intervals and some of the data plotted onto the graph shown in **Fig. 2.3**.

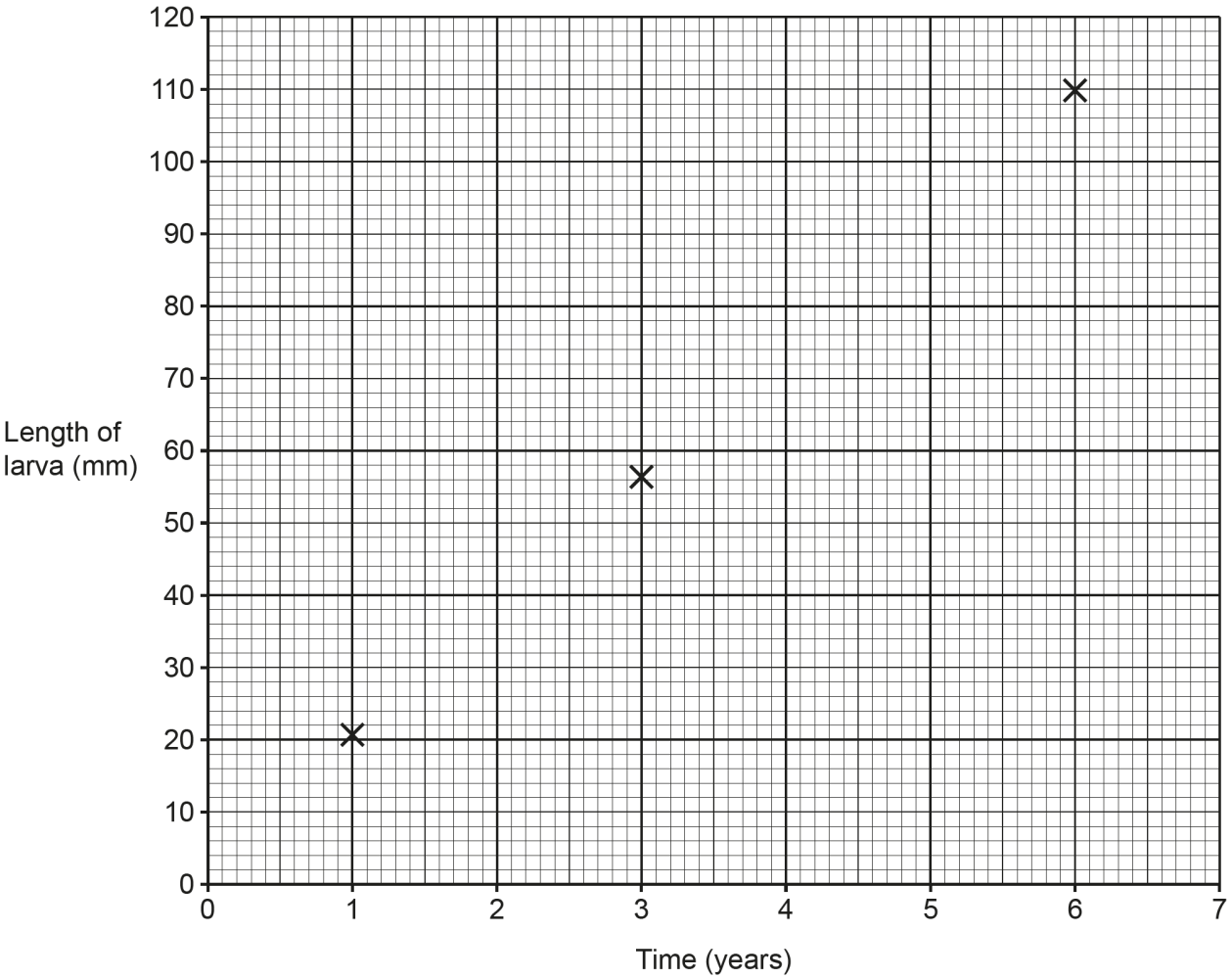


Fig. 2.3

(ii) Assuming that the growth of the larva follows a relationship of y = mx + c, use **Fig. 2.3** to determine the length of the larva at 0 years, when it emerges from the egg.

Length of larva = ... mm **[1]**

Some candidates calculated the slope of the relationship from two data points on the graph and used the equation to find 'c', but the easier method was to join the points on the graph and to read off the intercept at time 0 to find the length of the larva at year 0. Many candidates did not recognise that the equation simply means that the relationship is a straight line relationship, allowing one to join the points with a ruler to find the intercept.

Question 2 (a) (iii)

(iii) Calculate the growth rate of the larva.

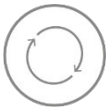
Growth rate = ...mm year^{-1} **[2]**

To calculate the growth rate of the larva candidates needed to find the gradient of the line using the formula:

$$\text{gradient} = \frac{\text{change in } y}{\text{change in } x}$$

The most common error was to forget that the line intercept was not 0, that is, when the larva hatched from the egg its size was not nothing (answers for part (i) between 2 and 4 mm were allowed). Therefore taking a single plotted point and dividing *y* by *x* overestimated the slope of the line. The commonest wrong answer of this type was 110/6 = 18.3.

Assessment for learning



This question could be used in teaching in conjunction with the Biology Mathematical Skills Handbook dealing with M3.5 on page 54.

Question 2 (b) (i)

(b) A group of students were investigating mitosis. They examined cells from onion root tip squashes that had been prepared using acetic orcein stain. Chromosomes appear a purple red colour when this stain is used.

Fig. 2.4 shows a light micrograph of one of these cells. A student stated that this cell was at metaphase.

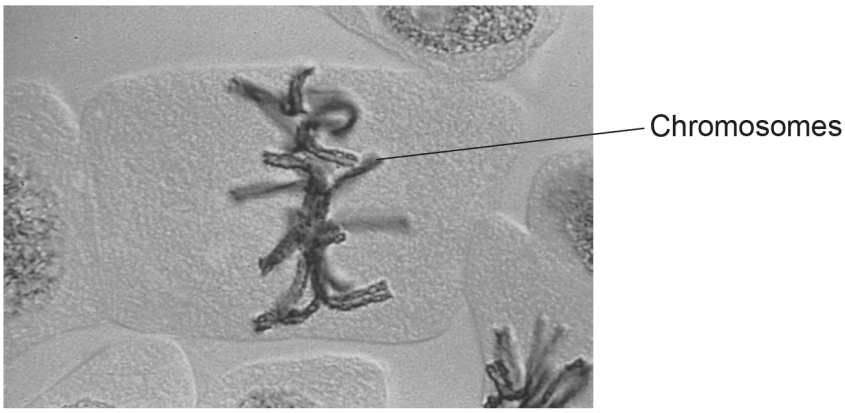


Fig. 2.4

(i) Describe how **Fig. 2.4** shows the importance of differential staining for observing cells undergoing mitosis.

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.....

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

Most candidates realised that staining made the chromosomes visible.

Question 2 (b) (ii)

(ii) Identify one piece of evidence that would have led the students to conclude that the cell in **Fig. 2.4** is at metaphase.

.....

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

Most candidates described the chromosomes lining up at the equator of the cell as showing metaphase.

Question 2 (b) (iii)

(iii) Three students were studying onion root tip squashes under the microscope. They recorded the number of cells at each stage of mitosis. A record of their observations is shown below.

Student 1:	Metaphase 1 cell
	Anaphase 3 cells
	Prophase 3 cells
Student 2:	Anaphase 4 cells
	Prophase 5 cells
	Telophase 1 cell
Student 3:	Telophase 3 cells
	Metaphase 5 cells
	Prophase 2 cells

In the space below draw an appropriate table to present the students' observations.

Include the headings for the columns. You are **not** required to enter any of the results into your table.

[2]

Very few candidates were able to design an appropriate table. Too frequently candidates were not providing informative column headings, not giving all the required information within the table itself, not enclosing the table in a box (or the box provided) and not showing the stages of mitosis in the correct order. Candidates should be encouraged to draw tables for their results from class practical experiments rather than relying on pre-printed worksheets to fill in the data. The table on page 4 of the exam paper could have been taken as a model for the task; in this example the dependent variable column was subdivided to show three trials in the same way that 'number of cells in each stage' results from three students needed to be plotted in Question 2 (b) (iii). The published mark scheme shows two ways of arranging the table, with the top version being a better match to the principle of putting the independent variable in the left-hand column. The principles of drawing a table are shown in the checklist below.

OCR support

This checklist for producing tables can be found in the 'Learner Checklist: Graphs, Tables and Drawings' here: https://www.ocr.org.uk/qualifications/as-and-a-level/biology-a-h020-h420-from-2015/planning-and-teaching/

1	All raw data in a single table with ruled lines and border.	
2	Independent variable (IV) in the first column; dependent variable (DV) in columns to the right (for quantitative observations) OR descriptive comments in columns to the right (for qualitative observations).	
3	Processed data (e.g. means, rates, standard deviations) in columns to the far right.	
4	No calculations in the table, only calculated values.	
5	Each column headed with informative description (for qualitative data) or physical quantity **and** correct units (for quantitative data); units separated from physical quantity using either brackets or a solidus (slash).	
6	No units in the body of the table, only in the column headings.	
7	Raw data recorded to a number of decimal places appropriate to the resolution of the measuring equipment.	
8	All raw data of the same type recorded to the same number of decimal places.	
9	Processed data recorded to up to one significant figure more than the raw data.	

Question 2 (c)

(c) Compare prophase in mitosis with prophase in meiosis.

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.....

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

Most candidates were able to recall features of prophase in mitosis and meiosis but not all candidates responded to the command word compare'.

Making a comparison

The command word 'compare' covers **similarities** and **differences**.

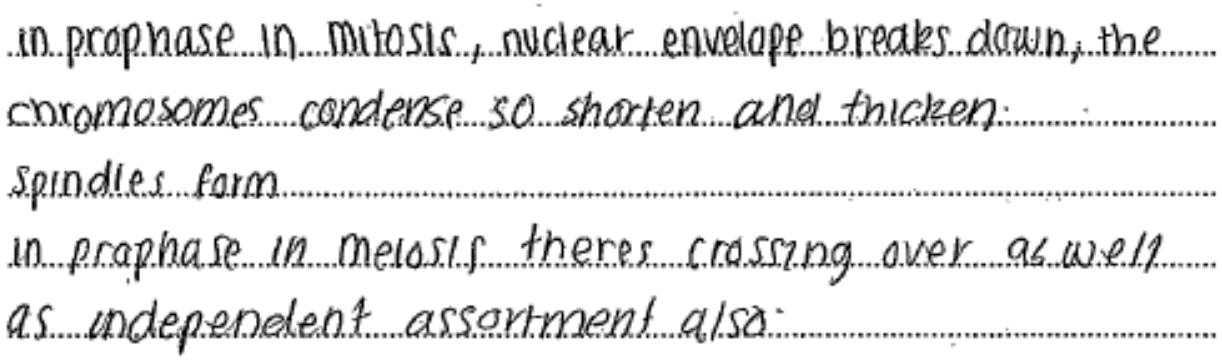
Comparing is a skill that involves **selecting** and **organising** factual knowledge.

Ideally similarities should be clearly stated in the format '**both** processes show….'

Differences should be paired, e.g. 'In meiosis … **does** happen but in mitosis … **does not** happen'.

In terms of knowledge, the most well-known facts were that chromosomes condense, the nuclear envelope breaks down and the centrioles move to the poles of the cell in both processes. The differences most often mentioned were the existence of two prophase stages in meiosis and mention of crossing-over in prophase 1 of meiosis. Some candidates missed out on marks by listing what happens in mitosis but not stating that the same also happens in meiosis (see exemplar 2). Some wasted valuable time in the examination by writing out two separate paragraphs with the same content for mitosis and then meiosis.

Exemplar 2



This response shows limited examination technique, with recalled facts not earning marks. The candidate did not draw a comparison by saying that the described events in mitosis also happen in meiosis. This response scored one mark but if the candidate had used the word both, or said for the first paragraph that 'the same happens in meiosis', they would have scored all 4 marks.

Question 3 (a) (i)

3 **(a)** Congenital lactose intolerance is where a person is born without the enzyme lactase needed to digest lactose in milk. The use of enzyme technology has allowed lactose free milk to be widely available in shops and supermarkets.

Fig. 3.1 shows a technique used to produce lactose free milk.

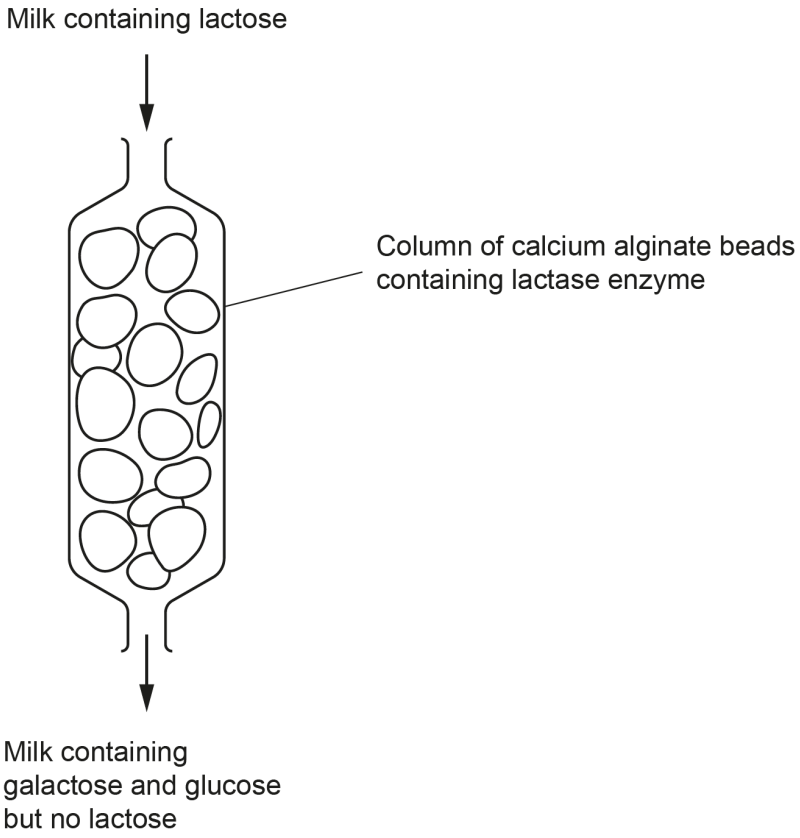


Fig. 3.1

(i) Name the type of bond broken by the enzyme lactase **and** describe what happens when this bond is broken.

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

This was fairly straightforward and many candidates named the glycosidic bond and referred to hydrolysis. Incorrect responses included peptide, disulphide and hydrogen bonds and the term condensation.

Question 3 (a) (ii)

(ii) A common symptom of lactose intolerance in adults is the creation of extra fluid in the large intestine.

Suggest why this occurs.

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

This high demand question was where marks were gained by the fewest candidates. It was rare for a candidate to think laterally and creatively and to link fluid build-up to water moving by osmosis. Lactose is soluble in water so exerts an osmotic effect. It may also be hydrolysed by bacteria in the large intestine producing more soluble monosaccharides.

Question 3 (b) (i)

(b) Research indicates that reducing dietary intake of saturated triglycerides and cholesterol can reduce potential risk of developing cardiovascular disease (CVD) in later life.

Fig. 3.2 shows the structure of a saturated triglyceride.

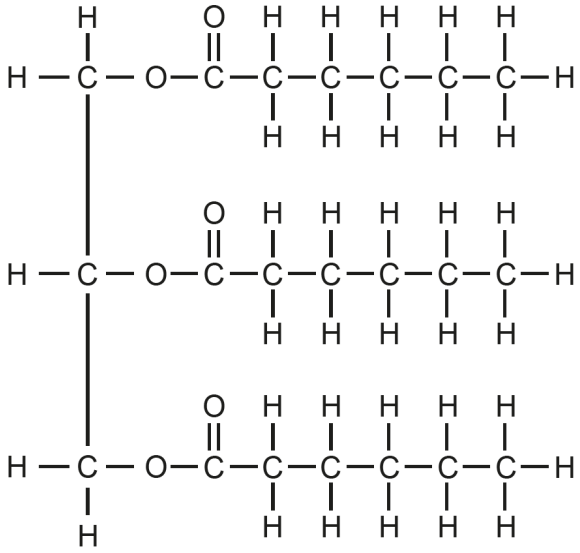

Fig. 3.2

(i) Describe how the structure of a polyunsaturated triglyceride molecule would **differ** from the molecule shown in **Fig. 3.2**.

.....

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

Many responses showed a clear understanding of saturated versus unsaturated but fewer than half picked up on the term polyunsaturated and said there would be **more than one** C=C double bond. References to a single kink or double bond were common.

Question 3 (b) (ii)

(ii) Hypercholesterolemia is a condition in which an individual has a high blood choleste level.

Studies were carried out in the USA over several decades, looking at the overall dea rates from cardiovascular disease (CVD) and the percentage of the population with hypercholesterolemia in different age groups.

Fig. 3.3 shows data from these studies.

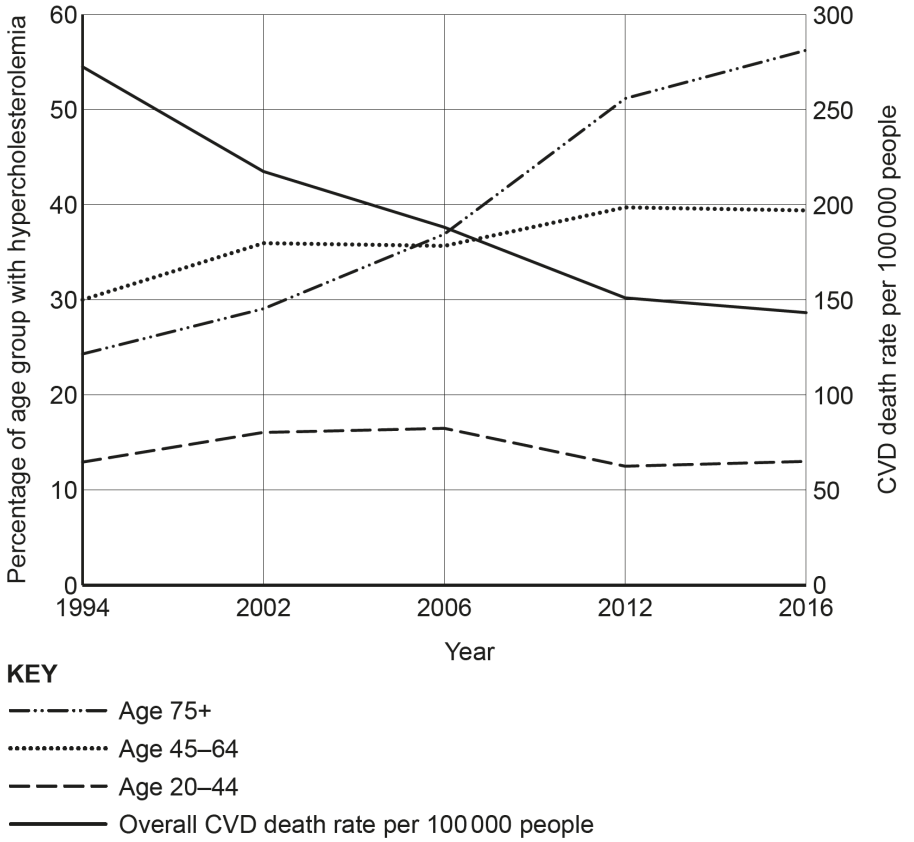

Fig. 3.3

A student looking at this data made the following statement:

'A fall in death rate from cardiovascular disease is due to a reduction in the percentage of people with hypercholesterolemia.'

With reference to the **20–44 age group** in **Fig. 3.3**, discuss whether the student's statement is correct.

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

Candidates found this data evaluation task very challenging. Errors included reading from the wrong line, quoting figures using the wrong scale, thinking the data showed death rates for the 22-44 age group specifically and not giving a time frame in years when describing trends. In order to develop this skill candidates need practice with this sort of complex analysis task. Key points for candidates to check before framing an answer to this type of question are listed below:

Analysing graph data to discuss whether two factors are causally linked

- On the graph, highlight or mark the lines of data that are relevant to the question. Here these were the long-dashed line for people aged 22-44 with hypercholesterolaemia, and the solid line for overall CVD death rate per 100 000 people.
- Check you are reading from the correct axis scales. The left-hand *y* axis scale was a scale from 0-60 for the percentage of people with hypercholesterolaemia, while the line for CVD death rate related to the right-hand *y* axis scale which ran from 0 to 300 per 100 000 people.
- 'Discuss whether the statement is correct'. Include sections of the data that support the statement (yes) but also sections of the data or other factors that do not support it (no).
- If for a section of the time frame both lines show the same trend, this shows they are correlated (yes) but correlation does not necessarily imply causation.

Question 3 (c)

(c) **Fig. 3.4** shows the changes in pressure in the left side of the heart and aorta during one cardiac cycle.

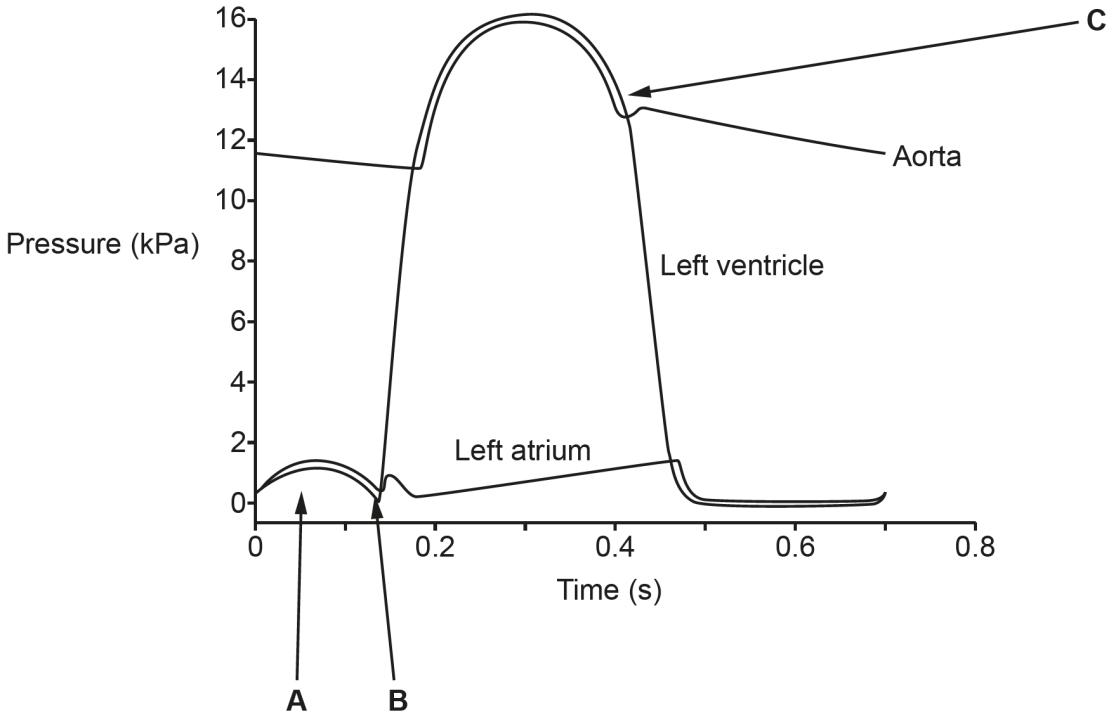

Fig. 3.4

A student described the events shown in **Fig. 3.4**.

'At **A**, the muscles in the wall of the atrium are contracting. This is caused by a wave of electrical excitation that starts at the atrio ventricular node (AVN).

At **B**, the muscles in the wall of the ventricle are contracting. The atrioventricular valve opens and the pressure in the aorta falls. The ventricular pressure rises above that of the aorta.

At **C**, the muscles in the walls of the ventricle are relaxing. The semilunar valve opens. The pressure in the ventricle drops.'

Identify **three** errors in the student's description and write the correction for each error.

Error and correction 1

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Error and correction 2

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Error and correction 3

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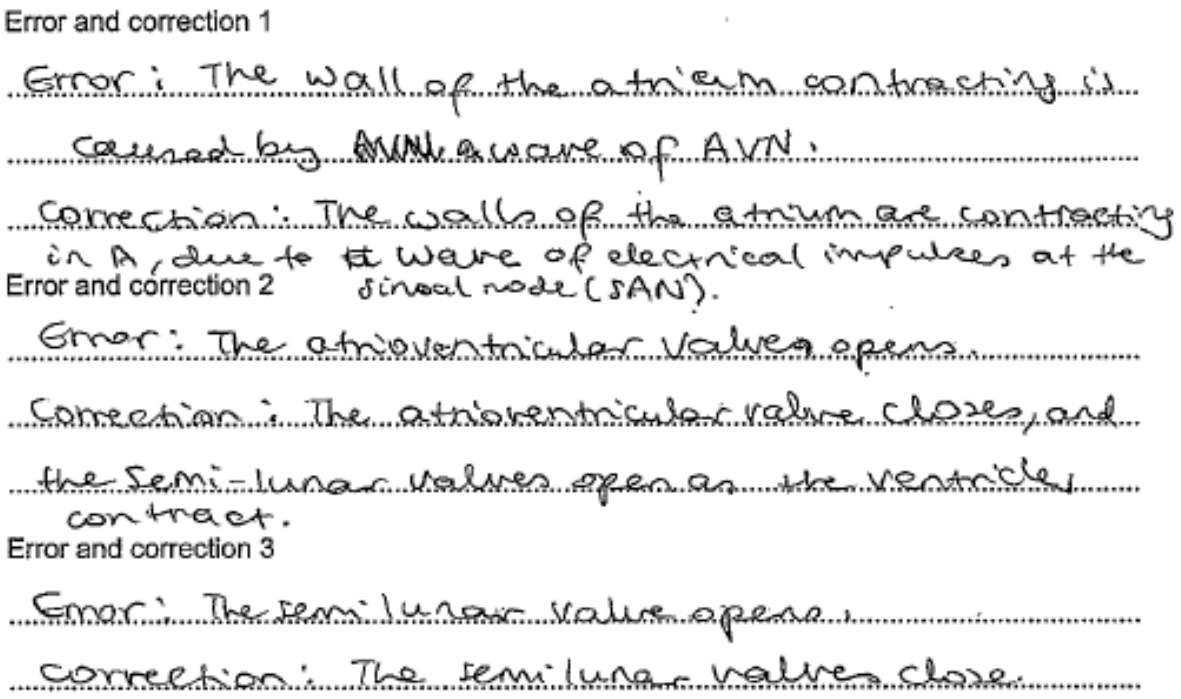
[3]

The candidates were asked to identify three errors in the text and to write the correction for each error. It is imperative that answers clearly and succinctly identify the error as an error **and** suggest the correction. Too many answers quoted extensive pieces of the original 'student description' without saying which part they considered to be wrong. For some answers it was unclear whether the description referred to an error or a correction. A systematic approach is needed for this type of question, as shown in exemplar 3.

Exemplar 3



This response clearly labels the error and the correction in each case and gains 3 marks. Some candidates save time by putting the error in quotation marks, which implies that this must be the error since it is lifted directly from the student description.

Question 4 (a) (i)

4 (a) **Fig. 4.1** shows a light micrograph of cells in the blood.

Cell **X** plays a role in the immune response.

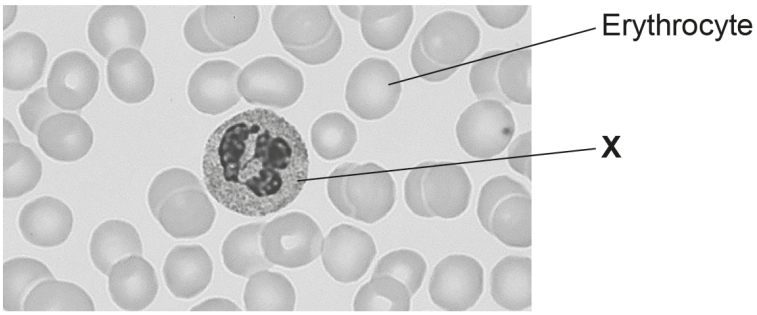


Fig. 4.1

(i) Name cell **X**.

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

Many candidates named the cell correctly as phagocyte or neutrophil. Macrophage was accepted although in humans, macrophages are larger than this cell (the diameter of which was calculated in part (ii)). The most frequently written incorrect response was the general term 'white blood cell'.

Question 4 (a) (ii)

(ii) The magnification of the microscope used to observe the cells in **Fig. 4.1** was ×950.

Calculate the diameter of cell **X** in **Fig. 4.1**.

Give your answer in micrometres.

Diameter = ... μm **[2]**

Candidates seemed well-prepared in terms of knowing the equation:

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

(although, not all could rearrange it). Many were given 1 mark for measuring the cell correctly and stating the length with units in their working and for dividing by the magnification, 950. Where many ran into problems was in converting their answer to micrometres and giving the answer to an appropriate number of significant figures (the same number as the original measurement or one more than that). Many answers were out by a factor of 10 because the candidate measured in centimetres and then multiplied by 1000 instead of 10 000 to convert to micrometres. A simple protocol for performing this calculation is shown below.

Checklist for calculating the diameter of a cell in a photomicrograph

- Measure in **millimetres**
- **Multiply by 1000** to convert this measurement to micrometres
- **Divide** by the magnification
- Round answer to **same** number of significant figures as the original measurement (or **one more**).

Question 4 (a) (iii)

(iii) Using **Fig. 4.1**, explain why blood is described as a tissue and not an organ.

.....

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

Only a minority of candidates explained that blood is made up of different cells but not different tissues. Although the different cell types were visible in the photomicrograph many candidates wrote that blood consisted of similar cells carrying out a similar function.

Question 4 (b) (i)

(b) Every winter a large proportion of the population are given a vaccine against the disease influenza.

(i) Identify the type of immunity given by an influenza vaccine.

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

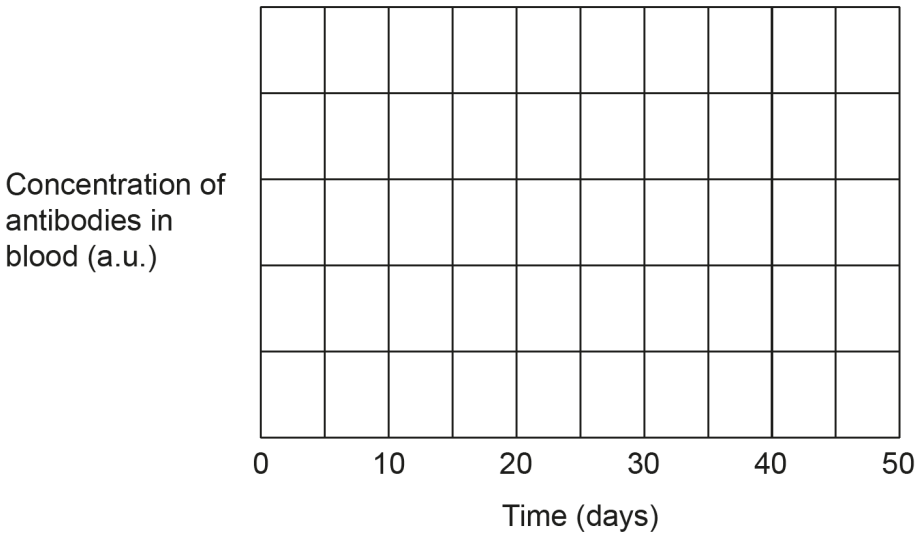
The type of immunity given by an influenza vaccine needed to be fully described as both artificial and active. The most frequently written incorrect response (apart from those who omitted one of the two descriptors) was 'herd immunity'.

Question 4 (b) (ii)

(ii) A patient was participating in influenza vaccination trials.

- On day 5 of the trial the patient was injected with antigens extracted from the influenza virus.
- On day 25 the patient was exposed to the influenza virus.
- The response of their immune system was monitored by regular blood tests to determine the quantity of antibodies in their blood.

Sketch a graph on the axes to show the possible primary **and** secondary immune response for this patient. Label **both** responses on your graph.



[2]

Candidates needed to read the question carefully and to proceed with care before drawing their curve. Successful responses were able to label the parts of the curve corresponding to the primary and secondary immune responses, make the secondary response steeper and higher than the primary (more rapid response and increased number of antibodies) and in particular they started to plot the primary response **after** the vaccine was given on day 5 and the secondary response **after** the second exposure on day 25. Less successful responses were not able to demonstrate this accuracy in their graphicacy skills.

Question 4 (b) (iii)

(iii) Outline the role of B memory cells in the secondary immune response.

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

Few candidates outlined the role of memory B cells correctly. Responses were often vague.

Misconception

"Memory cells remember the pathogen and produce antibodies."

Memory cells do not directly produce the antibodies that kill the pathogen. The selected memory cells divide and differentiate to form a clone of **plasma B cells** which then produce and release the antibodies.

Question 4 (c)

(c) Outline the roles of phagosomes and lysosomes in phagocytosis.

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

Some candidates had a good understanding of phagocytosis and used the terms phagocyte, phagosome, lysosome and phagolysosome correctly. A common error in less successful responses was confusing the cell (phagocyte) with the vesicle it forms after engulfing a pathogen (phagosome), so the incorrect phrase 'The phagosome engulfs the pathogen' appeared in some responses. Another common error was to refer to the enzymes in the lysosomes as 'lysozymes'.

Question 4 (d) (i)

(d) Most of the oxygen in blood is transported bound to haemoglobin.

Haemoglobin also plays an important role during the transportation of carbon dioxide by acting as a buffer and preventing a lowering of the pH in the erythrocytes.

(i) Explain how haemoglobin acts as a buffer.

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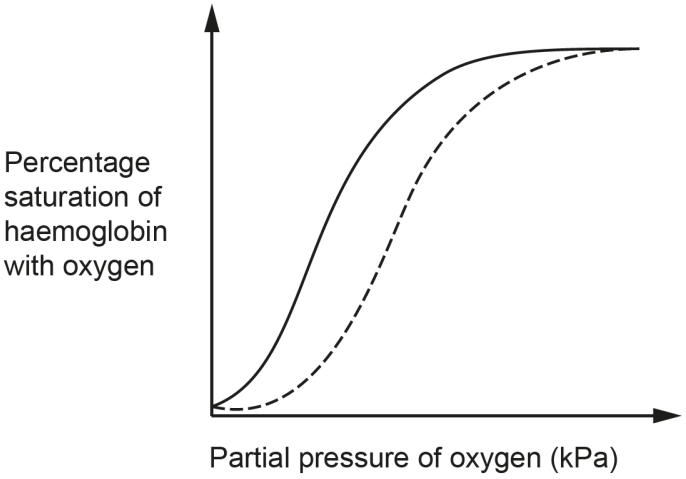
..... **[2]**

Many candidates appeared not to understand the term 'buffer'. Many referred to reactions that happen in the red blood cell but did not apply their knowledge to this question.

Question 4 (d) (ii)

(ii) **Fig. 4.2** shows the shape of oxygen dissociation curves for haemoglobin for a person at rest and during exercise.

The changes to the dissociation curve at different carbon dioxide concentrations is known as the Bohr effect.



KEY

——— At rest

– – – – During exercise

Fig. 4.2

With reference to **Fig. 4.2** explain why the Bohr effect is important during exercise.

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

Candidates in general showed a limited understanding of the Bohr shift shown on the graph. Some candidates' responses misquoting or mis-applying the axis labels and incorrectly concluding that the affinity of haemoglobin for oxygen increases during exercise, when the graph shows the opposite.

Question 5*

5* A teacher set up the apparatus shown in **Fig. 5.1** to demonstrate ventilation in mammals to a group of students.

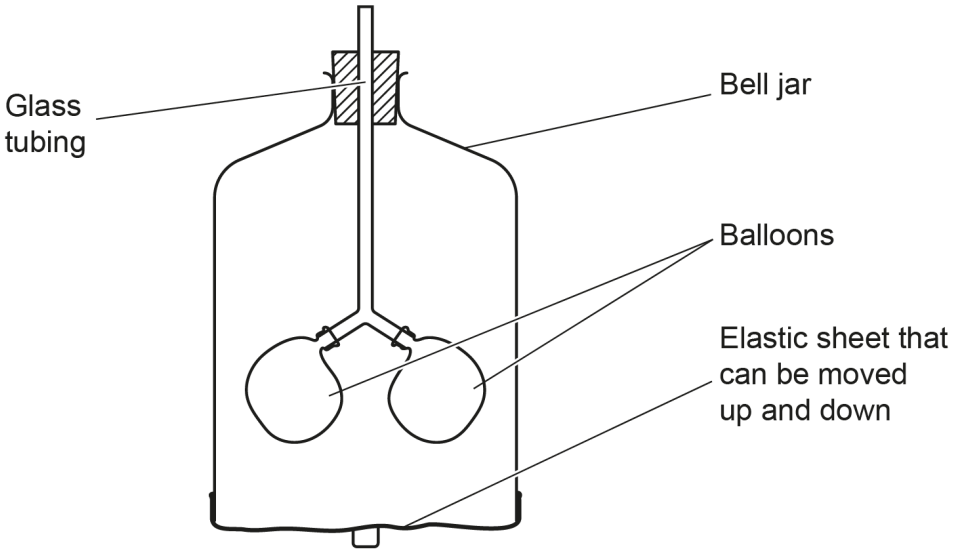

Fig. 5.1

Describe how the apparatus in **Fig. 5.1** can be used to model the changes that take place during inspiration in mammals.

In your answer comment on how appropriate the apparatus is in demonstrating inspiration.

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

Few candidates demonstrated confident familiarity with the use of the bell jar apparatus or the sequence of events that occurs during inspiration in a mammal. Level 1 responses drew some structural parallels between the two, such as the balloons representing the lungs and the elastic sheet representing the diaphragm. Descriptions of the inspiration process were often limited , with some candidates suggesting that air must be blown down the glass tubing to inflate the balloons. Many answers strayed from inspiration to expiration, and so responses contained some irrelevant material. Level 1 responses included statements about the elastic sheet being moved up and down without clearly describing the sequence of events that occurred in either scenario (a more accurate response would detail the sheet moving only down in inspiration). The strongest answers at Level 3 commented on differences as well as similarities, and correctly explained how increased volume in the jar or thorax decreases the pressure surrounding the balloons or lungs, causing atmospheric air at a higher pressure to be pushed into the balloons or lungs.

Question 6 (a) (i)

6 (a) **Fig. 6.1** shows a larva of the gum-leaf skeletoniser moth, *Uraba lugens*, found in Australia and New Zealand.

- The larva has an exoskeleton.
- The exoskeleton is the external skeleton that supports and protects the soft tissues and organs of the larva. It is shed periodically to allow the larva to grow.
- Each time it sheds its exoskeleton, the exoskeleton head remains attached to its body and these old exoskeleton heads stack up on top of each other.
- The larva is given the name mad hatterpillar because of this unusual adaptation.

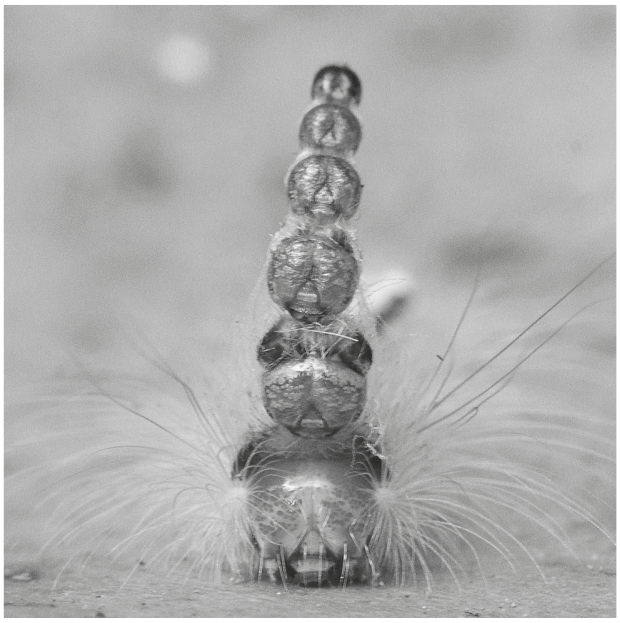

Fig. 6.1

(i) With reference to **Fig. 6.1**, suggest a purpose for the adaptation of attaching and stacking the old exoskeleton heads.

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

The photograph of a moth larva was a springboard for questions on adaptation, classification, natural selection in moths and convergent evolution in moles.

This was well done, with most candidates referring to protection or deterring predators.

Question 6 (a) (ii)

(ii) Name the genus of the gum-leaf skeletoniser moth.

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

Most candidates correctly identified the genus name.

Question 6 (a) (iii)

(iii) The table shows some taxonomic descriptions for the gum-leaf skeletoniser moth. They are **not** in the correct hierarchical sequence.

Complete the table to show the correct hierarchical sequence. Use the numbers 1 to 4. One row has been completed for you.

Taxonomic description	Hierarchical position
Phylum Arthropoda	
Order Lepidoptera	
Kingdom Animalia	1
Class Insecta	

[1]

Most candidates ordered the groups correctly in the taxonomic hierarchy.

Question 6 (b) (i)

(b) The peppered moth, *Biston betularia*, has two forms, a pale form and a dark form, both shown in **Fig. 6.2**.

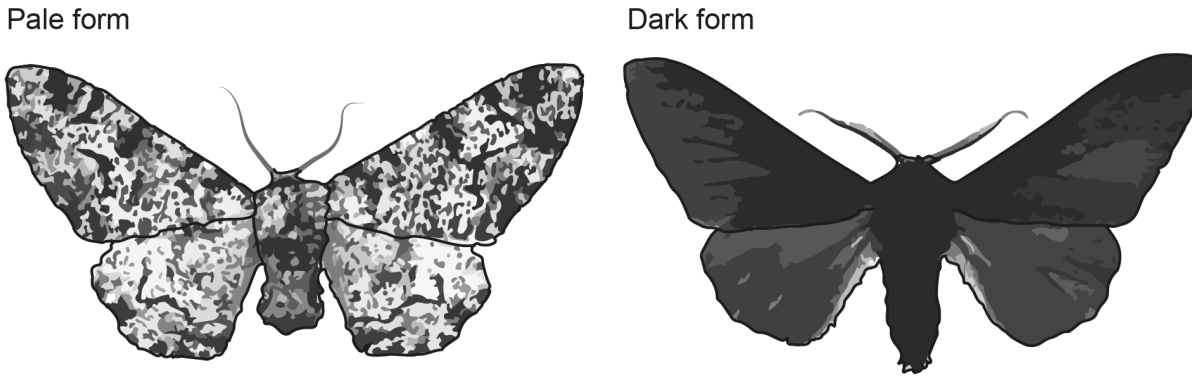

Fig. 6.2

Predators of the peppered moth include birds such as the robin and nuthatch. Peppered moths avoid these predators by flying at night and resting on tree trunks during the day. Many trees have light coloured lichens growing on them. However, many lichens are unable to tolerate high levels of air pollution. Without lichens the bark of trees appears darker.

The dark form of the peppered moth first appeared in Britain during the industrial revolution.

Various surveys have shown that the percentage of the dark form of the peppered moth population is higher in parts of England where there is a lot of heavy industry compared with more rural areas.

Explain how the process of natural selection has resulted in this distribution of the two forms of the peppered moth.

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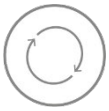
..... **[4]**

There were many less successful responses that reproduced sections of the introductory text without carefully extracting the key points about how natural selection operates to give the modern distribution of the two colour forms (phenotypes) of the peppered moth. When explaining how natural selection operates in any context, the points listed in the Assessment for learning box should be covered:

Assessment for learning



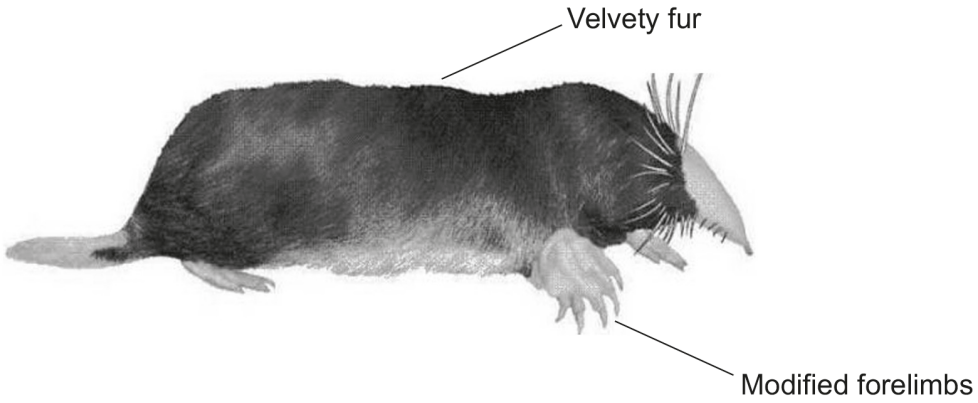
- explain that the different phenotypes arise due to **gene**tic variation, mutation in a **gene** or different alleles of a **gene**
- give **one** environmental context when selection operates, e.g. in polluted, urban or industrial areas, **or** conversely in unpolluted or rural areas for this example
- identify which phenotype is more likely to **survive** (has a selective advantage) in this context
- relate a higher chance of surviving to a higher chance of **reproducing** or passing on the advantageous allele in this context
- summarise how natural selection will affect the relative **frequency of the alleles** in the population, i.e. here the percentage frequency of the allele for the dark form increases at the expense of the allele for the pale form in an industrial or polluted location.

Question 6 (c)

(c) **Fig. 6.3** shows two types of mole and some information about each type.

Placental mole family *Talpidae*

Found in: North America, Asia and Europe
Habitat: Lives in burrows in soft soil
Food: Grubs and worms



Marsupial mole family *Notoryctidae*

Found in: Australia
Habitat: Lives in burrows in soft soil
Food: Grubs and worms

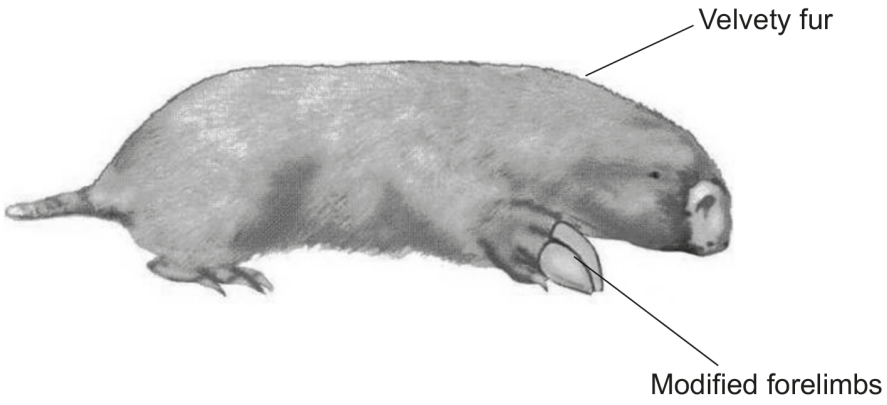


Fig. 6.3

Explain how **Fig. 6.3** supports the theory of convergent evolution.

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

To explain how Fig. 6.3 supported the theory of convergent evolution candidates needed first to understand and explain the two **principles** of convergent evolution, that (i) the organisms are not closely related but that (ii) they show similarities because they have evolved separately to adapt to the same type of environment or lifestyle. Each principle could be supported by information from Fig. 6.3. The 'not closely related' idea could be supported either by reference to the two mole species living in separate parts of the world or to them being in separate families. The 'adapt to the same environment' idea could be supported by describing a feature they share that is useful in their soil habitat, such as modified fore limbs or streamlined shape. Few candidates had a secure understanding of these principles and were able to back them up with evidence from Fig. 6.3. .

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