

AS LEVEL

Examiners' report

BIOLOGY B ***(ADVANCING BIOLOGY)***

H022

For first teaching in 2015

H022/01 Summer 2018 series

Version 1

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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. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

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

Paper H022/01 series overview

AS Level Biology B (Advancing Biology) offers a context-based approach to learning with a range of topics assessed across two components, H022/01 and H022/02. For H022/01 candidates needed to demonstrate 'breadth' of learning across the whole AS specification and 20 multiple choice questions are included in the 70 marks. Both practical and mathematical skills are embedded in questions throughout the examination.

This examination appeared to be accessible to candidates across the ability range with no evidence to suggest that there were any time constraints.

Candidates who performed well on this paper were able to apply their knowledge to questions with novel context, use information provided in tables and diagrams to support their answers where required and complete calculations to include use of significant figures.

Candidates who performed less well appeared unable to use their subject knowledge when faced with novel context or could not provide detail in responses requiring explanation.

Overall, candidates demonstrated a wide range of ability with higher ability candidates applying their knowledge to new situations to gain higher level marking points and lower ability candidates displaying their ability to learn and recall facts.

Section A overview

This section of the examination consisted of 20 multiple choice questions covering a range of topics across the breadth of the AS Level Biology B specification. It is therefore important that candidates are fully prepared and undertake thorough revision of the whole AS specification for this examination. Only **AO1** and **AO2** were assessed in section **A**. Some questions involved recall, whilst others required the use of mathematical and/or analytical skills; some questions needed more time than others.

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

Candidates had been advised to spend no longer than 25 minutes on this section and the majority of candidates appeared to have managed their time effectively. It was pleasing to see that these questions were attempted by all candidates.

Question 1

1 Which of the options, **A** to **D**, is an **intracellular** biofluid?

- A** blood plasma
- B** cytoplasm
- C** tissue fluid
- D** serum

Your answer

[1]

Many candidates chose the correct option **A** for this question. Prefixes such as *inter-*, *extra-* and *intra-* are used throughout Biology and candidates should be familiar with their meaning.

Question 3

- 3 A student was using an eyepiece graticule and a stage micrometer to calculate the length of a human cheek epithelial cell.

The following calibration and measurements were recorded:

- magnification of eyepiece lens = $\times 10$
- magnification of objective lens = $\times 10$
- 20 eyepiece divisions = 25 micrometer divisions
- each micrometer division = $10\text{ }\mu\text{m}$
- length of epithelial cell observed = 6 eyepiece divisions.

Which of the rows, **A** to **D**, is correct?

	Total magnification	Length of one eyepiece division (μm)	Length of human cheek epithelial cell (μm)
A	20	12.5	75
B	100	50.0	300
C	100	12.5	75
D	20	50.0	300

Your answer

[1]

Candidates had to process information and choose appropriate values to perform simple calculations. Many candidates extracted the correct information and used it appropriately to obtain the correct response.

Question 5

- 5 The number of chromosomes in a developing fetus can be checked by producing a karyogram.

Which of the options, **A** to **D**, about the production of a karyogram is **not** correct?

- A** fetal cells can be extracted from the placenta
- B** fetal cells are stimulated to divide by meiosis
- C** a chemical is added to stop cell division in metaphase
- D** the chromosomes are stained and photographed

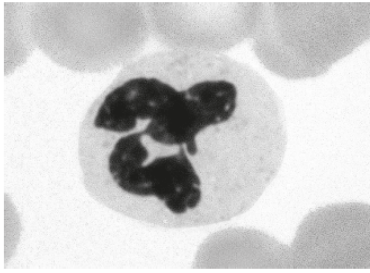
Your answer

[1]

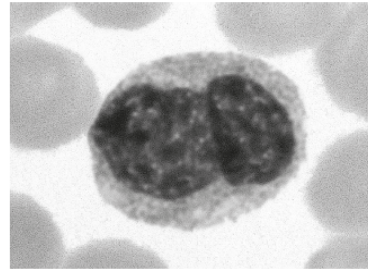
Many candidates were able to pick out the incorrect statement here, clearly demonstrating knowledge of cell division and karyograms.

Question 6

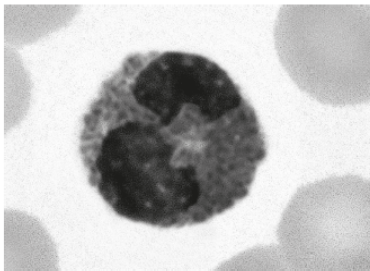
- 6 The photomicrographs show different types of leucocyte (white blood cell).



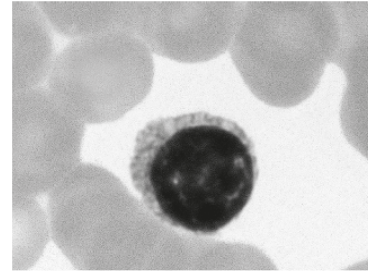
leucocyte A



leucocyte B



leucocyte C



leucocyte D

Which of the leucocytes, **A** to **D**, can differentiate into a plasma cell during the specific immune response?

Your answer

[1]

Whilst the recognition of leucocytes using images proved challenging for some candidates, higher ability candidates were able to correctly identify leucocyte D as the lymphocyte; distinguishing it from the other cells by the shape of the nucleus and the size of the cell.

Question 7

- 7 The rate of transpiration can be affected by changing certain environmental factors.

Which of the options, **A** to **D**, are changes that would result in an **increased** rate of transpiration?

- A** lower humidity and greater air movement
- B** lower humidity and less air movement
- C** higher humidity and greater air movement
- D** higher humidity and less air movement

Your answer ☐

[1]

There were many correct responses. Option C was the most commonly selected incorrect response demonstrating some confusion surrounding humidity and its effect on the rate of transpiration.

Question 8

- 8 A group of students investigated the effects of ethanol on the heart rate of the water flea, *Daphnia pulex*, and then analysed their results using a paired Student's *t*-test.

- Ten water fleas were used in the investigation.
- A value for *t* was calculated as 25.8.
- The critical value for a significance level of 5% is 2.23.

Which of the following statements, **A** to **D**, is correct?

- A** The number of degrees of freedom is 10 and the null hypothesis can be rejected.
- B** The number of degrees of freedom is 9 and the null hypothesis can be accepted.
- C** The number of degrees of freedom is 9 and the null hypothesis can be rejected.
- D** The number of degrees of freedom is 1 and the null hypothesis can be accepted.

Your answer ☐

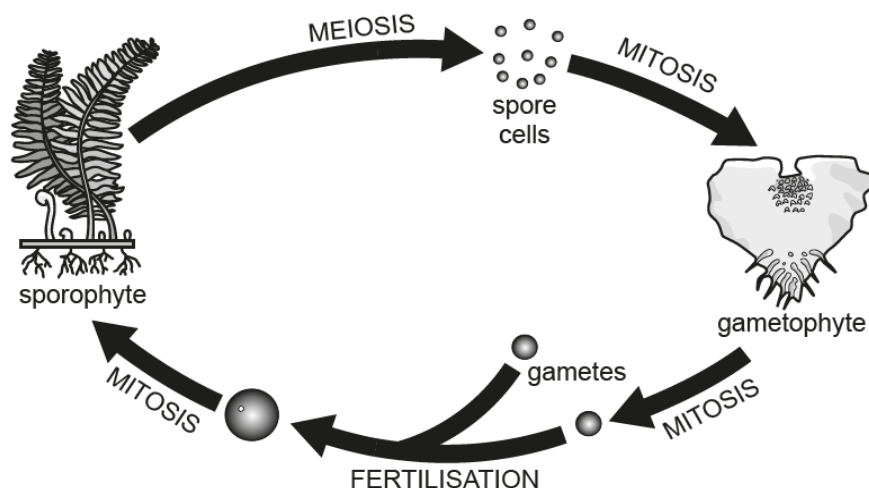
[1]

No calculations were required to obtain a response for this question. Higher ability candidates were able to analyse the information and choose the correct statement. Some candidates found this difficult.

Question 9

- 9 Plant life cycles show alternation of generations. The term alternation of generations is used to describe a process whereby mitosis and meiosis occur and the plant alternates between haploid and diploid forms during its life cycle.

Alternation of generations in the life cycle of a fern (*Polypodium* species) is shown in the diagram below.



Which of the rows, **A** to **D**, is correct?

	Sporophyte	Gametophyte	Spore cell	Gamete
A	diploid	haploid	haploid	haploid
B	haploid	diploid	haploid	haploid
C	diploid	haploid	diploid	diploid
D	diploid	diploid	haploid	haploid

Your answer

[1]

In this question candidates had to process both textual and diagrammatic information about the consequences of mitosis and meiosis in the novel context of plant life cycles. Many candidates who could apply their knowledge to the information provided in the diagram went on to choose A as the correct option.

Question 12

- 12** Phloem loading is the process whereby plants move sucrose from a source into phloem sieve tubes.

During phloem loading, sucrose must be transported across the cell surface membranes of companion cells.

Which of the statements, **A** to **D**, about the transport of sucrose across the cell surface membrane of a companion cell is correct?

- A** Hydrogen ions are used to pump sucrose molecules through a carrier protein down a concentration gradient.
- B** Hydrogen ions are used to pump sucrose molecules through a carrier protein against a concentration gradient.
- C** Hydrogen ions and sucrose molecules are co-transported through a carrier protein as hydrogen ions move against their concentration gradient.
- D** Hydrogen ions and sucrose molecules are co-transported through a carrier protein as hydrogen ions move down their concentration gradient.

Your answer

[1]

This question proved challenging for some, and required attention to detail in order to choose the most appropriate response

Question 14

- 14** The table shows the type of bond present in the different levels of structure for a protein molecule.

Which of the rows, **A** to **D**, is correct?

	Primary structure	Secondary structure	Tertiary structure
A	peptide	hydrogen	disulfide
B	hydrogen	peptide	ionic
C	peptide	disulfide	ionic
D	peptide	disulfide	hydrogen

Your answer

[1]

There were many correct responses to this question. However, this biochemistry-based question regarding level of protein structure proved challenging for some candidates.

Question 16

16 The table shows some of the properties of four types of blood vessel found in the human body.

Which of the blood vessels, **A** to **D**, is a vein?

Blood vessel	Lumen diameter (mm)	Wall thickness (μm)	Vascular blood pressure (mmHg)
A	0.02	1.0	50
B	0.008	0.5	20
C	5.0	500	5
D	4.0	1000	90

Your answer

[1]

This question provided a different way of looking at the properties of blood vessels and many candidates were able to pick out the information and choose the correct option.

Question 17

17 Carbapenems are a class of broad-spectrum antibiotics.

In recent years, there has been an increase in the number of carbapenem-resistant strains of bacteria.

Which of the statements, **A** to **D**, would contribute to an increase in the number of carbapenem-resistant strains of bacteria?

- A** some bacteria develop immunity to carbapenems
- B** increased use of carbapenems in animal feed to prevent infection
- C** increased use of carbapenems causes mutations in the bacteria
- D** some bacteria have plasmids containing genes for carbapenems

Your answer

[1]

Antibiotic resistance in bacteria is a commonly misunderstood concept and only higher ability candidates appeared able to pick out the correct option for this question.

Question 18

- 18** During her first antenatal appointment, a woman was advised that she needed to increase her current Dietary Reference Value (DRV) energy intake from 7800 KJ to 9200 KJ.

Which of the options, **A** to **D**, shows the correctly calculated percentage increase in DRV energy intake?

- A** 85%
- B** 118%
- C** 15%
- D** 18%

Your answer

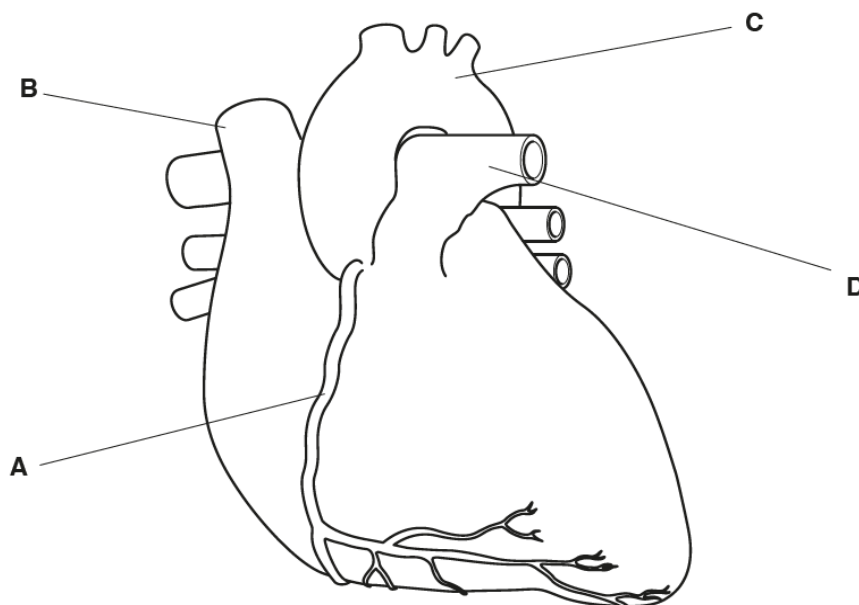
[1]

Candidates often struggle with such percentage calculations in section **B**, but this posed little problem for the majority of candidates who were able to perform the calculation and identify D as the correct option.

Question 19



19 The diagram shows the external structure of the mammalian heart.



Which of the blood vessels, **A** to **D**, carry oxygenated blood to the heart muscle?

Your answer ☐

[1]

Across the ability range there still appears to be some misconception of the fact that it **is** the coronary artery, i.e. option A, that supplies oxygenated blood to **heart muscle**. Some candidates opted for D, the pulmonary artery (a common misconception) that carries de-oxygenated blood to the lungs.

Question 20

20 Donated blood is processed into different products which can be used to treat patients with specific conditions.

Which of the patients, **A** to **D**, would be treated by using a transfusion of **platelets**?

- A** receiving regular blood transfusions
- B** has bone marrow failure
- C** has low concentration of clotting factors
- D** undergoing cardiac surgery

Your answer ☐

[1]

Some candidates confuse platelets (cell fragments) with clotting factors (proteins) and therefore C was the most commonly seen incorrect option.

Section B overview

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

Assessment objectives **AO1**, **AO2** and **AO3** were addressed throughout **Q21** to **Q25** with concepts from across the specification including species diversity, enzyme activity and the biochemistry of water.

Question 21(a)(i)

- 21** Certain geographical regions of the Earth have high species diversity including large numbers of species that are unique to these regions. Such species are called endemic species.

(a) (i) What is meant by the term species diversity?

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

A few excellent responses were seen where candidates had given both 'species evenness' and 'species richness' and were credited with two marks. The majority of candidates were able to gain one mark, usually for describing species richness as *the number of **species** that live in a particular location*.

Exemplar 1

	Geographical region	Original habitat (km ²)	Remaining habitat (km ²)	Number of endemic plant species
90%	Madagascar	594 150	59 038	9704
78%	New Zealand	270 500	59 400	1865

Table 21

Analyse the data in Table 21 and compare these geographical regions as potential biodiversity hotspots.

Madagascar has lost over 90% of its original habitat and has 3.2% of the Earth's plant species as endemic species. New Zealand has lost 78% of its original habitat and has 0.8% of the Earth's plant species as endemic species. This means that both regions could be identified as biodiversity hotspots but Madagascar may be more eligible as it has lost more of its habitat and has a higher proportion of Earth's plant species. [4]

This response identifies a high attaining response where information had been used to the full extent. Percentage calculations for loss of habitat and endemic species have been completed, enabling the candidate to make comparisons and confirm that both regions could be identified as potential biodiversity hotspots.

Question 21(b)

- (b) The rosy periwinkle, *Catharanthus roseus*, is one of the plant species found in Madagascar where it has evolved adaptations to survive in the hot and humid climate.

Describe the adaptations that plants such as *C. roseus* could have evolved to survive in a hot and humid climate?

.....

.....

.....

..... [2]

Many candidates focussed on hot climates without taking humidity into account. Therefore, many responses referred to adaptations for preventing water loss, such as leaves reduced to 'spines', which did not gain credit in this case. Candidates were credited with one mark for 'waxy leaves' because although it is an adaptation for preventing water loss, it could also be an adaptation to hot and humid climates by enabling water to run off the leaf surfaces.

Question 21(c)(i)

- (c) Researchers have discovered that the leaves of *C. roseus* contain chemicals that can disrupt mitosis in actively dividing cells.

- (i) Suggest a potential medicinal use for these chemicals.

..... [1]

Both parts (c)(i) and (c)(ii) were well answered by the majority of candidates.

Question 21(d)

- (d) Genetic diversity was investigated in coloured variants of *C. roseus*.

Genetic data from an analysis of 56 genes showed that 10 of these genes were monomorphic.

Calculate the proportion of polymorphic genes in this population of *C. roseus*.

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

Answer = [2]

Whilst the majority of candidates were able to perform the calculation, some did not then give their response to two significant figures as requested and so were only credited with one mark. Candidates were credited for expressing their response for proportion as either a decimal or a percentage.

Question 22(a)

- 22** An ectopic pregnancy occurs when a fertilised egg cell implants outside the uterus, often in a fallopian tube. Methotrexate is an enzyme inhibitor that has been used in the medical treatment of ectopic pregnancies.

Fig. 22 shows the enzyme reaction inhibited by methotrexate.

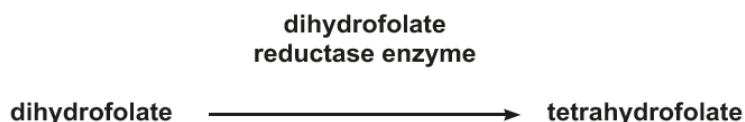


Fig. 22

- (a) The relative concentrations of dihydrofolate and methotrexate determine the rate of the reaction shown in Fig. 22, but the maximum rate of reaction can still be achieved even in the presence of methotrexate.
- (i) Explain how the maximum rate of the reaction can still be achieved despite the presence of methotrexate.

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.....

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.....

.....

.....

.....

..... [3]

AO2 was assessed in this part of the question. Many candidates were able to recognise the fact that methotrexate was most probably a competitive inhibitor and therefore would only bind temporarily to the active site. Mark points 3 and 4 were most often credited to higher ability candidates who could explain that maximum rate of reaction could still be achieved in the presence of a competitive inhibitor if the concentration of substrate was much higher than the concentration of inhibitor.

Exemplar 2

Competitive inhibitors temporarily bind to the active site via hydrogen bonds and therefore reduce the number of enzyme substrate complexes. However, if the substrate concentration (dihydrofolate) is increased it is more likely that an enzyme substrate complex will form as it's more likely the enzyme and substrate will collide with the correct orientation. Therefore, the maximum rate can still be achieved.

Handwritten notes: There are green checkmarks above 'Competitive' and 'active site'. There are red boxes around 'it' and 'will form'. A handwritten note 'therefore, it isn't a limiting factor' is written next to 'correct orientation'.

This response would have been improved by making it clear that substrate concentration should be increased relative to the inhibitor i.e. mark points 3 and 4 were comparative.

Question 22(a)(iii)

- (iii) Explain why methotrexate will eventually cause the death of the fertilised egg cell in an ectopic pregnancy.

.....

.....

.....

..... [2]

This part of the question assessed AO2. Candidates who were able to link information throughout this enzyme activity-based question about the inhibitor (methotrexate) and the need for the product (dihydrofolate) in synthesis of nucleotides were able to formulate good responses to this part of the question. Good responses showed understanding that nucleotides were a component of DNA required for protein synthesis and therefore the explanation why the inhibitor could lead to the death of the fertilised egg cell.

Question 23(a)

23 Water is an important biological molecule.

- (a) The table below shows some of the properties of water and their importance to living organisms.

Complete the table using the most appropriate term(s) or sentence(s).

Property of water	Importance to living organisms
.....	allows chemical reactions to take place inside cells
has a high latent heat of vaporisation	
.....	allows a continuous column of water to move through xylem vessels without breaking
has a high specific heat capacity	

[4]

This was generally well answered with candidates across the ability range being credited. Responses for the importance of a high latent heat of vaporisation often lacked detail and did not gain credit. Good detailed responses that gained credit stated how evaporation of water through sweating could cool the body down.

Question 23(b)(i)

(b) Water also plays an important role in the reactions involved in the formation and breakdown of macromolecules in the human body.

(ii) Name **both** products of reaction X.

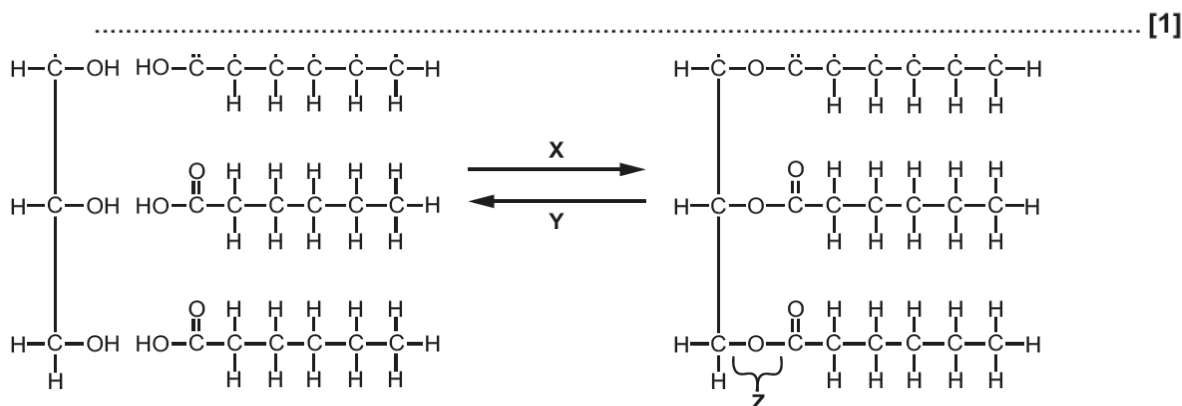


Fig. 23.1

(i) Name the types of reaction taking place at X and Y.

Reaction X

Reaction Y

[1]

Question 23(b)(ii)

(ii) Name **both** products of reaction X.

..... [1]

Question 23(b)(iii)

(iii) Name the bond labelled Z.

..... [1]

There were many good responses across the ability range for these biochemical questions in parts (b)(i), (ii) and (iii). In (b)(ii) some responses omitted water as a possible product and as both products were required for the response these did not gain credit.

Question 23(c)(i)

- (c) It is essential to the functioning of the human body to maintain the correct balance of water and dissolved nutrients.

Cyclospora cayetanensis and *Campylobacter jejuni* are microorganisms that cause diarrhoea in humans leading to excessive water loss.

Fig. 23.2 shows some of the data recorded for infections caused by these microorganisms in a human population during the year 2014.

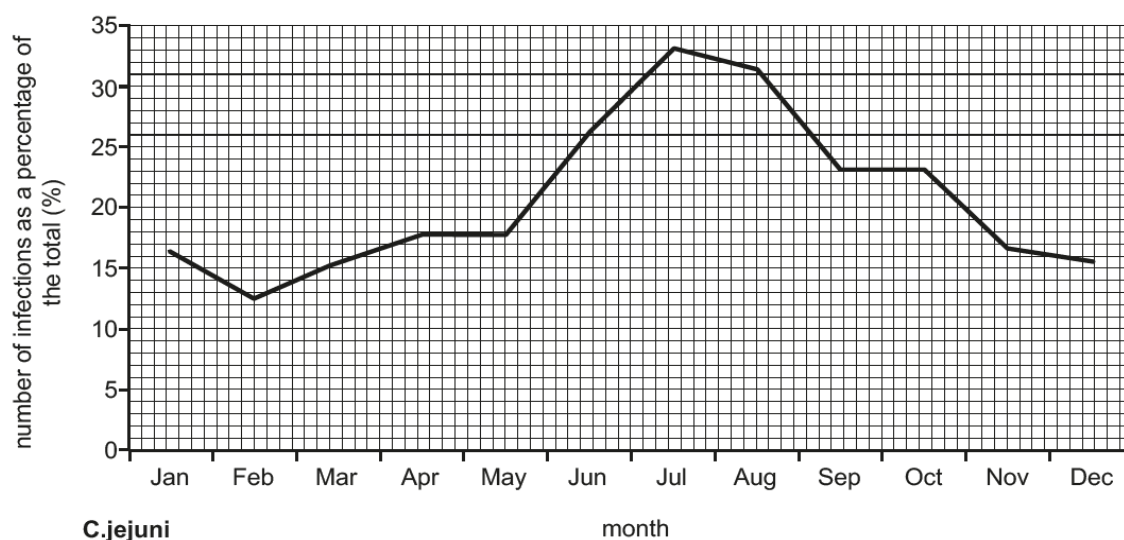
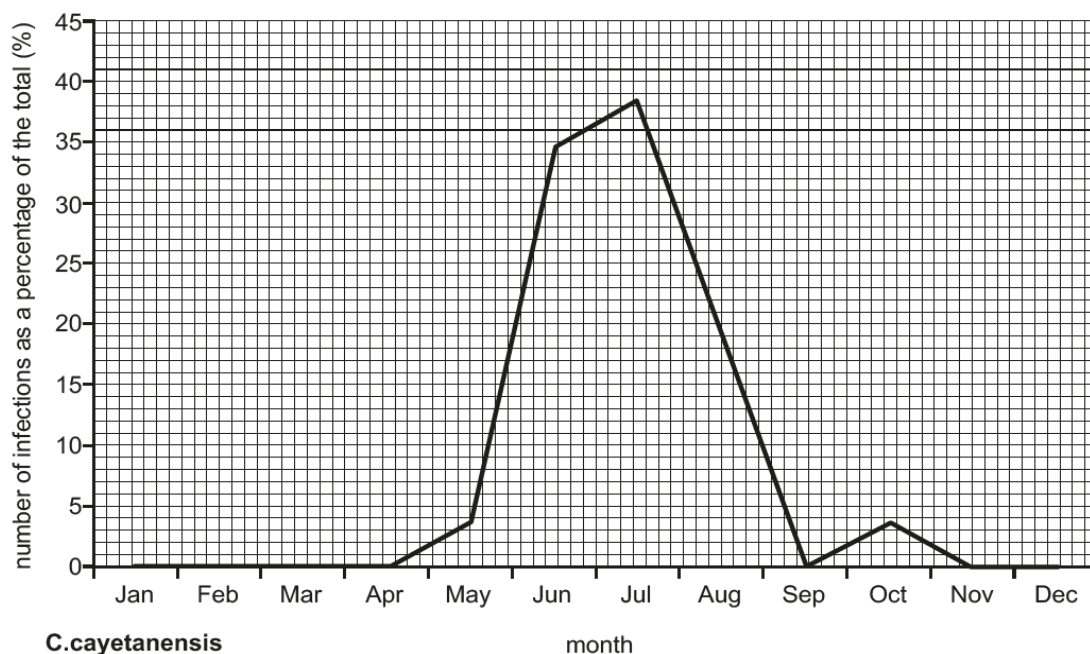


Fig. 23.2

- (i) Comment on the trends shown by the data in Fig. 23.2 for the infection caused by *C. jejuni*.

.....

.....

.....

..... [2]

Question 23(c)(ii)

- (ii) The data for the infection caused by *C.cayetanensis* suggests that an epidemic occurred between the months of May and August.

Comment on the validity of this suggestion.

.....

.....

.....

..... [2]

In parts (c)(i) and (c)(ii) candidates were required to use data provided in the form of graphs showing infections caused by two different bacteria. It is important that candidates refer to data when prompted to do so in the question stem. The majority of candidates gained credit for part (c)(i). There were fewer good responses to (c)(ii) and there were some responses which focussed on the term 'validity' with reference to how the data was collected, rather than on the validity of the suggestion that it was an epidemic.

A few candidates chose to describe the trends for *C.cayetanensis* in (c)(i) or used data for *C.jejuni* in (c)(ii) which could not be credited.

Question 23(d)(i)

(d) Fig. 23.3 is a transmission electron micrograph (TEM) of a *C.jejuni* bacterium.

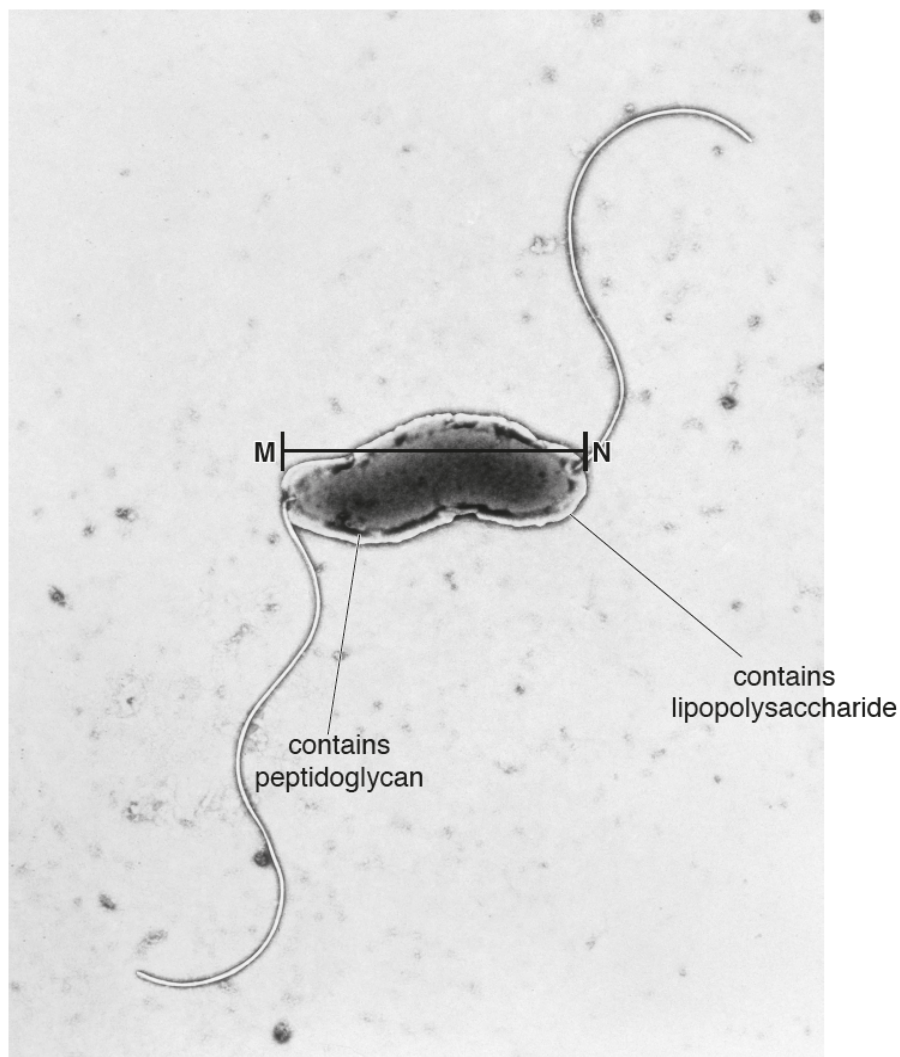


Fig. 23.3

- (i) The actual length of the bacterium shown in Fig. 23.3 between points **M** and **N** is $4\mu\text{m}$.

Calculate the magnification of the micrograph.

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

Answer = x [2]

Many candidates were credited with two marks for this calculation. Many others gained one mark for a correct calculation because they had not written their response to three significant figures. Most candidates were able to measure the line from M to N as between 42 and 43mm and demonstrated knowledge of the correct calculation for magnification. The challenge for some candidates was then to convert mm into μm , a mathematical skill required to achieve the correct response.

Question 23(d)(ii)

- (ii) Using the information in Fig. 23.3 comment on **and** explain the results that would be obtained following Gram staining of a culture of *C.jejuni*.

.....

.....

.....

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.....

..... [3]

Many candidates gained one mark for recognising *C.jejuni* as being Gram negative or would stain pink using the information in Fig.23.3. Higher ability candidates went on to give detailed explanations to support this comment. There were some unclear or confused responses where candidates could not remember the differences between Gram positive and Gram negative bacteria.

Exemplar 3

Gram-negative bacteria ^{organella} stains pink/red whereas Gram-positive bacteria/organella stain purple/blue. Peptidoglycan is Gram-positive so would stain purple. Lipopolysaccharide is Gram-negative so would stain pink.

This response could be improved by applying the information to *C.jejuni* rather than giving a general statement about both types of bacteria. There was also confusion about how the staining technique affected the cell wall and lipopolysaccharide layer surrounding the bacterium, so no marks could be credited.

Question 24(a)(i)

- 24** Different types of monitors are available for medical practitioners to measure the blood pressure of their patients.

These may include:

- digital upper arm monitor
- digital wrist monitor
- manual upper arm monitor

These blood pressure monitors all have inflatable cuffs.

- (a) (i)** Give **one** advantage of using a digital monitor for measuring blood pressure.

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

Examiners were looking for the idea that the digital monitor would be easier to read, so there would be less misinterpretation of data. There is no evidence that these monitors are more accurate, which was a common response. Candidates were not penalised for using the term 'accuracy', so could still gain credit if they had added credit-worthy information in their response.

Question 24(a)(ii)

- (ii)** Sources of error when taking blood pressure measurements using these monitors include improper technique and observer bias.

Suggest **two other** sources of error when using these monitors for measuring blood pressure.

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

AO3 was being assessed in this part of the question. The AVP (any valid point) mark enabled many candidates to achieve at least one mark for this part of the question. There were many good responses which included the idea that people may suffer from 'white coat syndrome' or be nervous about having their blood pressure monitored. There were some excellent responses from candidates who realised that all of the monitors used cuffs, which could introduce a source of error if it did not fit or inflate correctly.

Question 24(a)(iii)

(iii) Fig. 24 shows the variation in systolic pressure in different arteries.

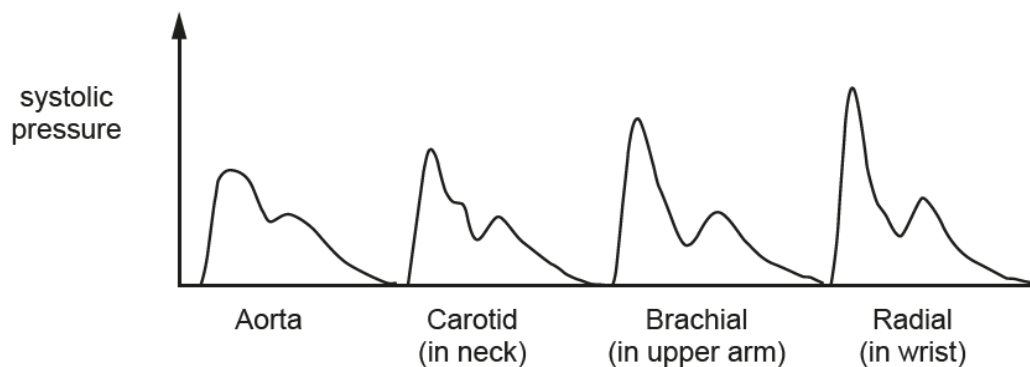


Fig. 24

Using the information in Fig. 24, comment on the suitability of using a digital wrist monitor for measuring blood pressure.

.....

.....

.....

.....

..... [2]

As this question asked candidates to comment on the suitability of the wrist monitor, candidates were credited for commenting on whether it was more suitable or less suitable for measuring blood pressure. Many candidates applied their knowledge of blood pressure measurements to the information in Fig. 24, suggesting that it was not suitable due to differences in systolic pressure readings between the wrist and the aorta.

Question 24(b)(i)

- (b) Hemorrhagic shock is a clinical syndrome resulting from decreased blood volume caused by blood loss. Hypotension may occur in hemorrhagic shock patients where blood loss is greater than 15% of the total blood volume.
- (i) Explain how the production of tissue fluid is affected in patients suffering from hemorrhagic shock syndrome.

.....

.....

.....

..... [2]

Many candidates deduced that less tissue fluid would be formed in patients suffering from haemorrhagic shock. Few responses gained credit for the second mark point as candidates had already been told that these patients would have hypotension (low blood pressure) so needed more detail.

Exemplar 4

The production of tissue fluid will be reduced ✓ in patients suffering from hemorrhagic shock syndrome, as their blood pressure is very low, and in order for tissue fluid to form there needs to be a high hydrostatic pressure at the arterial end of the capillary bed. ✓ [2]

This is an excellent response with the candidate applying knowledge of tissue fluid formation to the context of the question.

Question 24(b)(ii)

- (ii) In cases of severe blood loss, the body actively reabsorbs fluid from the tissues to restore blood volume.

Suggest how the composition of this restored blood would differ from that of the blood that has been lost.

.....

.....

.....

..... [2]

Many candidates gained credit for making the connection between restored blood and its likely similarity to tissue fluid and the suggestion that there would be fewer blood cells, to gain credit. In good responses candidates extended their suggestions to include information about the concentration of proteins and blood gases, thereby gaining both mark points.

Question 25(a)

25 Allergens, such as pollen, are non-pathogenic but can trigger an immune response. This is known as an allergic reaction.

- (a) Complete the passage below about an allergic reaction using the most appropriate words or phrases.

Exposure to an allergen triggers the production of IgE antibodies which bind to cells. The allergen molecules then bind to the variable region of the IgE antibodies causing a chemical called to be released from the cells by This chemical increases the permeability of resulting in the formation of excess tissue fluid that leads to swelling and irritation associated with an inflammatory response. [4]

This gap-fill style question was generally well answered with a spread of marks across the ability range. Many candidates correctly identified the chemical as *histamine* and that it would increase the permeability of *capillary walls*.

Question 25(b)

- (b) The symptoms of asthma can be triggered by allergens.

The table below shows information about two types of drug that are used in inhalers to treat the symptoms of asthma.

Complete the table by inserting a tick (✓) or a cross (✗) as appropriate for each drug.

Drug	Reduce inflammation of the bronchi	Widen the lumen of the bronchi	Can be used during an acute asthma attack
Corticosteroids			
Beta-agonists			

[2]

There were few correct responses for this question which was assessing AO1. Candidates that had learned this and could recall the information did gain both marks. It is important that candidates follow instructions for tick box style questions. Responses where ticks and crosses had been omitted or where a tick had been made to look like a cross (or vice-versa) could not be credited due to their ambiguity.

Copyright acknowledgements

Section A, Question 6

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Section B, Question 23b, Fig. 23.1

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Section B, Question 23d, Fig. 23.3

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Section B, Question 24. Fig. 24

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