

A LEVEL

Examiners' report

BIOLOGY B **(ADVANCING BIOLOGY)**

H422

For first teaching in 2015

H422/01 Summer 2019 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 1 series overview

Paper 1 is worth 110 marks and is split into two sections. Section A is multiple choice and is worth 30 marks and section B comprises short structured questions involving aspects of problem solving, calculations and questions based on practical. Like last year, this examination was felt to be an appropriate level of difficulty although there were more candidates who gave no response to certain questions. In general candidates answered questions in detail although they did not always refer to the information, diagrams or make use of data from graphs to support their answers.

Note

From this series students have been provided with a fixed number of answer lines and an additional answer space. The additional answer space will be clearly labelled as additional, and is only to be used when required. Teachers are encouraged to keep reminding students about the importance of conciseness in their answers. Please follow this link to our SIU

(<https://www.ocr.org.uk/administration/support-and-tools/siu/alevel-science-538595/>)

Section A overview

This section of the paper consisted of 30 multiple choice questions covering a range of topics across all modules of the Biology B specification. In general candidates seemed to find most of the questions accessible and performed well in this section, particularly on questions requiring recall of knowledge. However, there were more candidates that left some multiple choice items blank. Candidates should be encouraged to respond to all items since there is no penalty for an incorrect answer.

Candidates should be aware that answers to multiple choice questions should be clearly written and if answers are changed and the intended response is unclear, the mark is not credited. In such cases one letter should be crossed out and the new answer written clearly.

The section below gives feedback on those multiple choice questions which caused the greatest difficulty to candidates.

Question 15

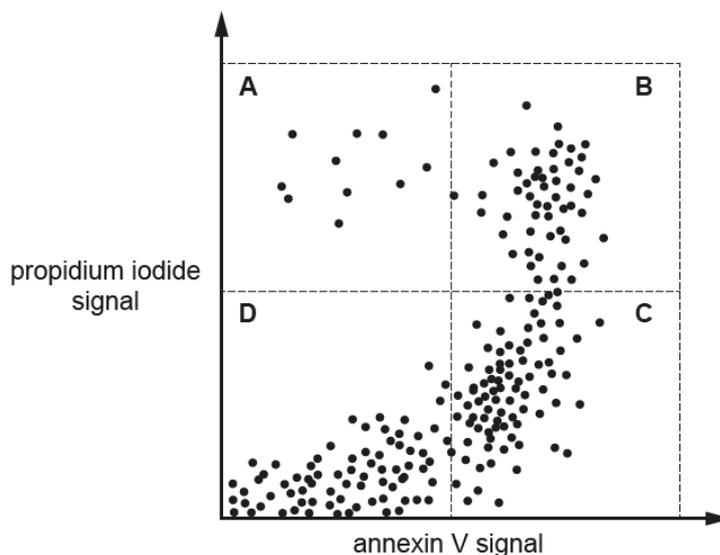
15 Cells undergoing apoptosis can be distinguished from living cells by staining with two reagents:

- annexin V, which binds to phosphatidylserine
- propidium iodide, which binds to DNA.

After staining, a flow cytometer is used to measure the fluorescent signal from each cell.

Neither reagent can diffuse across biological membranes.

The graph below shows the result of a flow cytometry experiment in a population of cells using annexin V and propidium iodide. Four regions are labelled **A** to **D**.



Which of the regions from the graph, **A** to **D**, identifies cells in **late** apoptosis?

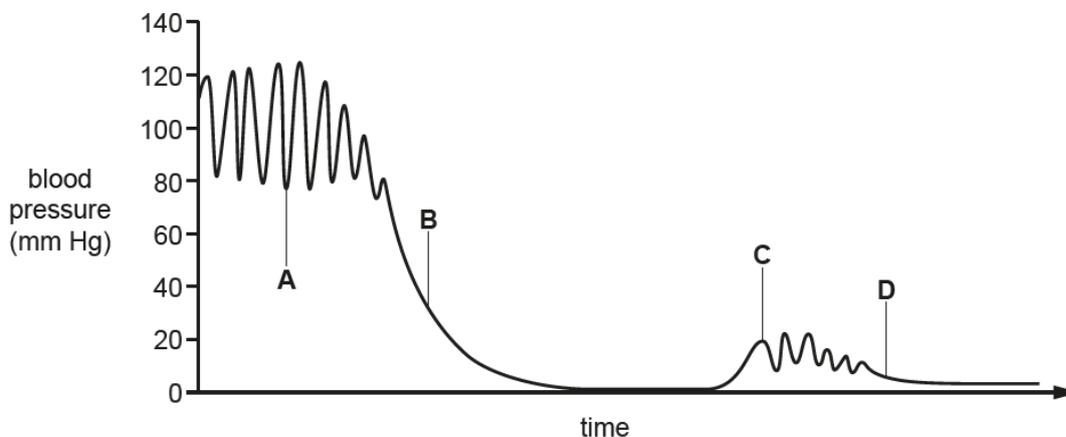
Your answer

[1]

This proved to be the most challenging question of the multiple choice items. Both DNA and phosphatidylserine are normally found within cells and because neither reagent can normally diffuse across the membrane they would not be stained and picked up in flow cytometry. In late apoptosis the cell fragments, so that annexin can access phosphatidylserine and propidium iodide will be able to stain the DNA. Thus, there would be high signals from both reagents as demonstrated by section B. Most candidates either opted for A or C.

Question 19

19 The graph below shows the normal variation in blood pressure across different regions of the human circulatory system. Four regions are labelled **A** to **D**.



Which of the regions on the graph, **A** to **D**, is the region in which blood becomes oxygenated?

Your answer

[1]

Few candidates were able to interpret this graph correctly and possibly did not realise that it included both the pulmonary and systemic circulation. Those who answered correctly (option D) were able to recognise the two periods of variable pressure as blood leaving the main arteries of the heart. The smaller pressure in the pulmonary artery (option C) is immediately followed by the pulmonary capillaries where blood gets oxygenated.

Question 21

21 Heart rate is affected by the sympathetic and parasympathetic nervous systems.

Which of the options, **A** to **D**, is an event that stimulates the accelerator nerve?

- A decrease in blood pH
- B increase in blood pressure
- C release of adrenaline into the blood
- D release of glucose into the blood

Your answer

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[1]

The most common incorrect distractor here was option C. Candidates were aware that adrenaline would increase the heart rate but adrenalin does not act on the accelerator nerve. High ability students were able to identify that a decrease in blood pH would trigger chemoreceptors which would cause the sympathetic region of the medulla oblongata to generate impulses along the accelerator nerve. So the correct answer was option A.

Question 28

28 Brain atrophy is the loss of brain tissue as a result of neuronal cell death.

A study was conducted to investigate a possible relationship between brain atrophy and levels of β -amyloid in fifty patients with Alzheimer's disease.

Paired measurements of brain volume and β -amyloid were taken from each patient using an imaging technique.

Which of the statistical tests, **A** to **D**, is appropriate to analyse the correlation of the data obtained?

- A chi squared (χ^2) test
- B paired Student's *t*-test
- C Spearman's rank
- D unpaired Student's *t*-test

Your answer

[1]

Like last year, several candidates were unclear about which statistical test to apply. Here we have a clear case of an investigation into a relationship between two variables - looking for a correlation. In this case the Spearman's rank is the appropriate test. Some candidates were clearly distracted by mention of the paired measurements, but it is worth remembering that *t* tests are for comparing mean values, not relationships between variables; and in the case of paired *t* tests, two sets of measurements are taken one before and one after the investigation.

	OCR support	Maths for Biology website offers support to candidates in statistical tests: https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/ You can also use the 'Mathematical skills statistics' booklet: https://www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc
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Question 29

29 Alzheimer's disease is associated with several pathological changes in the brain.

Which of the options, **A** to **D**, is observed in the brain of an individual with Alzheimer's disease?

- A β -amyloid protein in synaptic vesicles
- B β -amyloid protein in the nuclei of neurones
- C neurofibrillary tangles in the cytoplasm of neurones
- D Tau protein around neurones

Your answer

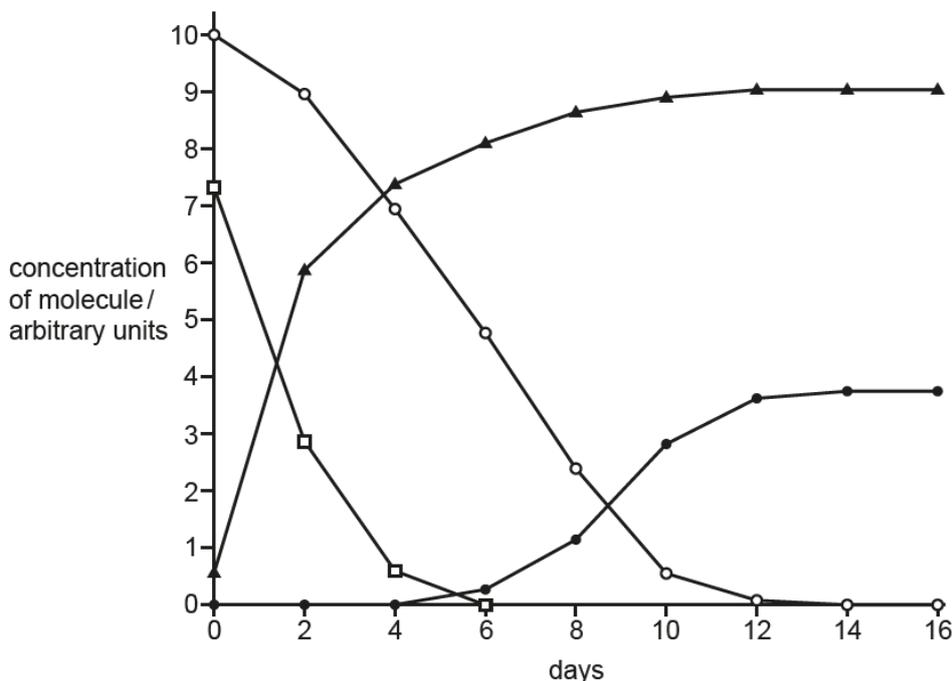
[1]

A few candidates were able to identify that the correct answer was C. However, some candidates were often incorrectly drawn to option D in this question.

	Misconception	Tau proteins are abundant in neurones, but they only become harmful when they become defective forming neurofibrillary tangles.
---	----------------------	---

Question 30

30 The graph below shows the concentration of several molecules over time in the medium of a cell culture.



- Key**
- oxygen
 - ▲ carbon dioxide
 - glucose
 - product X

Which of the following statements is/are correct?

- 1 The culture comprises mammalian cells, **not** yeast cells.
 - 2 The graph shows evidence of aerobic and anaerobic respiration.
 - 3 Product X is generated in the cell cytoplasm.
- A** 1, 2 and 3 are correct
B only 1 and 2 are correct
C only 2 and 3 are correct
D only 1 is correct

Your answer

[1]

Most candidates recognised that both aerobic and anaerobic respiration were taking place, since very few candidates selected option D. Product X is produced only when oxygen levels are practically zero and thus must be a product of anaerobic respiration which takes place in the cytoplasm. Carbon dioxide is not produced as a product of anaerobic respiration in mammals and it is shown here as still increasing, thus option C is correct.

Section B overview

This section included questions on a range of topics. Many of the questions were highly structured with varying levels of demand within a topic area. This gave candidates the opportunity to pick up marks on subsections even when the topic area was highly challenging for them. Some questions were set in familiar contexts and candidates performed better on these questions. In questions involving the interpretation of data candidates need to be more accurate when reading from graphs both when quoting data to support an answer or using figures in calculations. They need to check carefully that they are using the correct units.

<i>Topics where most candidates were successful</i>	<i>Topics where fewer candidates were successful</i>
<ul style="list-style-type: none"> • Q 36aii The regulation of blood glucose by negative feedback • Q 33ai and ii Calculation and plotting of standard deviations • Q 31eiii Showing understanding of the evolution of antibiotic resistance • Q 32b Mechanism of stomatal closure. 	<ul style="list-style-type: none"> • Q 35a -c Genetic engineering and the principles of RNA interference • Q 34a-c Measurement of VO₂ max including understanding of partial pressure and the oxygen dissociation of haemoglobin • Q33b Interpreting data on changes in mass of potato • Q33b Calculation of field of view.

Candidates should be encouraged to make handwriting legible and be advised not to continue their answer outside of the lines provided, using long arrows to direct the examiner to different parts of the page. Candidates should always use the extra spaces at the back of the paper if their answer is longer than the space given.

Question 31 (a) (i)

31 The human immunodeficiency virus (HIV) is spread through direct contact with body fluids.

Untreated HIV infection causes progressive destruction of the immune system. This leads to acquired immunodeficiency syndrome (AIDS).

The graph in Fig. 31.1 summarises yearly epidemiological data relating to HIV infection and AIDS in the USA between 1981 and 2008.

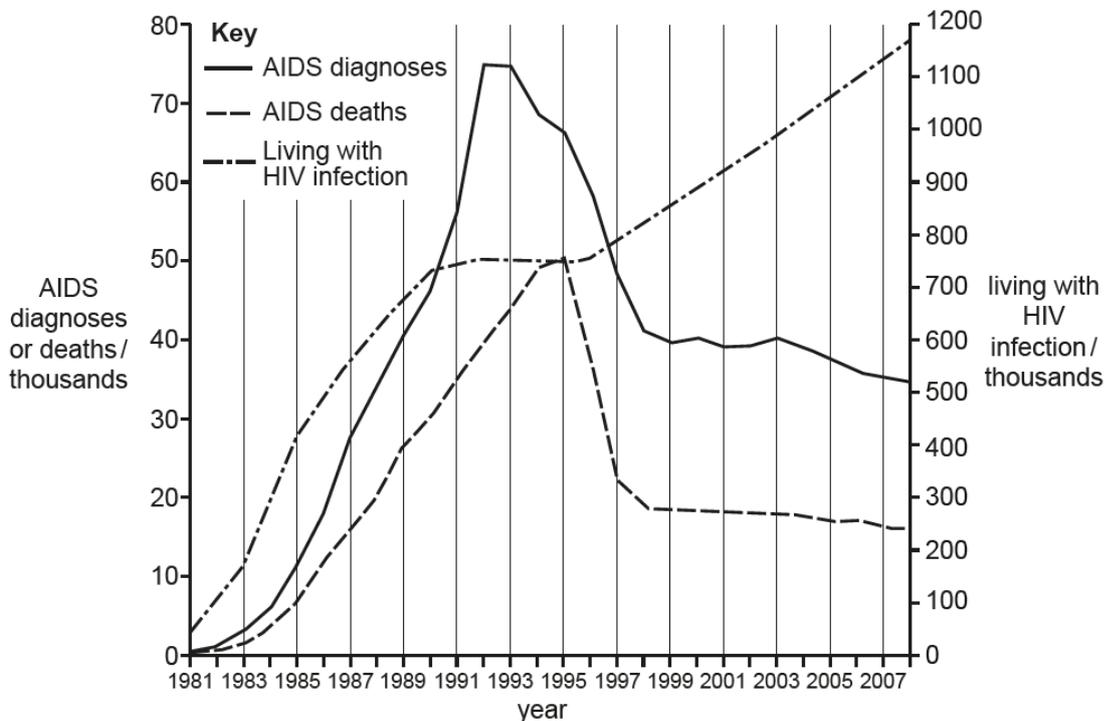


Fig. 31.1

(a) (i) The population of the USA in 1993 was 260 million.

Estimate the mortality rate of AIDS in the USA in 1993.

mortality rate = deaths per 100 000 population [2]

Candidates who didn't score full marks either made an error in reading the data from the graph or they did not realise that the question asked for mortality rate in deaths per 100,000 of the population. A horizontal line at the intersect of 1993 and AIDS deaths gives a value of 43 or 44 thousand. Many candidates were careless with the reading of the data or gave their answer in deaths per million.

Question 31 (a) (ii)

- (ii) Patients with HIV/AIDS are managed with highly active antiretroviral therapy (HAART), which was introduced in 1996.

Discuss the effectiveness of HAART as a treatment for patients with HIV/AIDS. Use the data in Fig. 31.1 to support your answer.

.....

.....

.....

.....

.....

.....

..... [4]

This question clearly states the HAART was introduced in 1996 and answers that gave information relating to different dates did not gain credit. Unintended errors such as writing 1966 instead of 1996 were common. Candidates also frequently quoted figures in deaths per thousand rather than deaths in thousands. The most commonly awarded correct answer was the increase in the number of people living with HIV after HAART was introduced. Many candidates did not pick up on the idea that the AIDS deaths were decreasing before 1996 which may have been due to the decline in diagnoses.

Exemplar 1

data in Fig. 31.1 to support your answer.

* in 1996

It proved effective ~~as~~ because after 1996, number of people living with HIV increased from ~~700,000~~ 750,000* to 1,175,000 in 2007. This showed treatment was effective as people living longer. As a result number of deaths due to AIDS also decreased. However deaths were decreasing before treatment was introduced. Also AIDS diagnoses also decreased. However HAART may not be as effective as thought.

A good answer which achieved 3 marks. If the decrease in deaths from AIDS had been described in more detail, this would have been awarded full marks.

Question 31 (b)

(b) HIV testing can prevent the spread of infection. In the UK, HIV testing must be carried out with consent from the patient. The results must be treated in a confidential manner.

Suggest **two** other ethical or social concerns associated with receiving an HIV positive test result.

1.....

.....

2.....

.....

[2]

In this question candidates should be referring to specifically social or ethical concerns about a positive test. Any form of discrimination that might occur would be credited as would the idea of the responsibility of the patient/health carers to inform others who might be at risk. Candidates did however need to develop their answers e.g. discrimination alone would not be credited but discrimination from insurance companies would.

Question 31 (c)

- (c) Vaccines against HIV are currently being developed:
- to protect individuals from contracting HIV
 - to boost the immune response in HIV-positive individuals.

Explain why it is difficult to produce an effective vaccine for HIV.

.....

.....

.....

.....

.....

..... [3]

While this question is asking about the issues of vaccine development such as high mutation rates and antigen variability; several candidates restricted their answer to the idea that HIV reproduces within body cells making it inaccessible.

Question 31 (d) (ii)

(ii) Fig. 31.2 shows CD4 cell levels over time in patients immunised with 7.5 μg or 30 μg Tat protein.

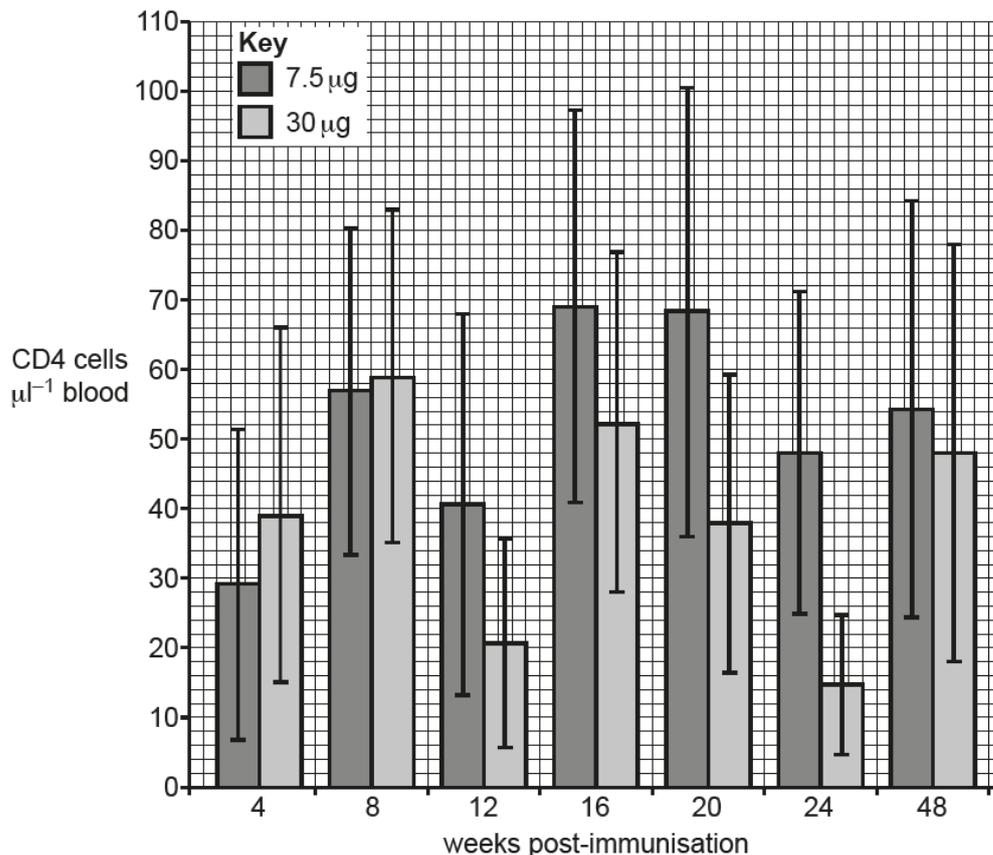


Fig. 31.2

Suggest **two** reasons why the effectiveness of the vaccine can **not** be determined from the data in Fig. 31.2.

- 1
-
- 2
-

[2]

Several candidates stated that the error bars overlapped which was too vague, given that overlapping error bars often occurred between the two doses (although there was no overlap at 24 weeks), but not always between weeks e.g. 30mg at 8 weeks and 30mg at 24 weeks. The key point about the data is the fluctuations (so large error bars/standard deviations was acceptable) and lack of overall trend.

Question 31 (e) (i)

(e) AIDS is an advanced stage of HIV infection that is defined by the occurrence of opportunistic infections, such as tuberculosis (TB) and hepatitis B and C. TB is the most common opportunistic infection in patients with HIV.

(i) In the UK, TB is a notifiable disease.

State **two** possible consequences of the reporting of a notifiable disease.

1

.....

2

.....

[2]

This question was generally well answered although some candidates suggested consequences which would not be practical and thus were not credited. For example, isolation of affected individuals would be accepted but it would be impractical to isolate a human population.

Question 31 (e) (iii)

(iii) Multi-drug resistance is a major challenge in the treatment of patients with TB.

Outline how a population of *M. tuberculosis* may become resistant to antibiotics.

.....

.....

.....

.....

.....

..... [3]

Most candidates scored at least one mark on this question, most commonly for identifying that a mutation may give rise to resistance. A few candidates mistakenly suggested that the use of antibiotics **caused** mutations to arise rather than identifying the antibiotics as the selection pressure that causes the population to evolve.

	OCR support	<p>OCR's delivery guide on controlling communicable disease offers support in the development of antibiotic resistance:</p> <p>https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-b-advancing-biology-h022-h422-from-2015/delivery-guide/module-bb03-module-3-cell-division-development-and-disease-control/delivery-guide-bbdg017-controlling-communicable-disease-323</p>
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Question 32 (a) (i)

32 Abscisic acid (ABA) is a plant hormone that plays a role in many physiological processes.

(a) (i) Most ABA is produced in root hair cells and is carried in xylem tissue to the leaves.

ABA is transported to the xylem tissue via the apoplast pathway. Describe this pathway.

.....

.....

.....

..... [2]

Many candidates referred only to the movement between cell walls but for both marks the route to the xylem is needed (through the cytoplasm at the Casparian strip).

Question 32 (a) (ii)

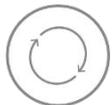
(ii) Some ABA is produced in leaves and is transported to the rest of the plant in phloem tissue.

The photomicrograph in Fig. 32.1, **on the insert**, is a transverse section through a stem.

State which letter, **R** to **U**, in Fig. 32.1, represents phloem tissue.

..... [1]

Many candidates opted for the letter S, which is showing the xylem vessel, rather than R.

	<p>AfL</p>	<p>It is better to use actual photomicrograph when identifying the tissues in a stem, rather than using representations of the stem which sometimes might be misleading.</p>
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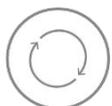
Question 32 (a) (iii)

(iii) Describe and explain **three** ways in which phloem tissue is adapted for the transport of sugars and other small molecules.

- 1
-
- 2
-
- 3
-

[3]

Candidates were sometimes not specific in their answers and referred to phloem tissue in general rather than the type of cells. For example, it needs to be stated that it is the companion cells and not the sieve tubes that have lots of mitochondria.

	AfL	Candidates need to be aware that phloem tissue comprises with both sieve tubes and companion cells.
--	------------	---

Question 32 (b)

(b) ABA is known to promote the closure of stomata.

Binding of ABA to receptors on the surface of guard cells results in the removal of ions.

Explain how a loss of ions in guard cells causes the stomata to close.

-
-
-
-
-

[2]

When discussing movement by osmosis in relation to water potential candidates need to be very clear to explain which regions contain the highest water potential and in which direction water moves.

Exemplar 2

Loss of potassium^{ions} in the guard cells lowers the water potential. Water no longer diffuses by osmosis down its water potential gradient. Guard cells become flaccid. Stomata close (because they rely on the turgidity of guard cells to be open). [2]

Turn over

The candidate has stated that a loss of ions lowers the water potential. In this context it would lower the water potential of the tissue it is moving into but raise the water potential of the guard cells. This would cause water to move out of the guard cells. The lack of clarity has restricted the mark to 1.

Question 32 (c)

(c) An experiment was conducted to investigate the effect of soil water potential on the production of ABA in leaves and the resistance to air flow through stomata.

The following parameters were measured daily in a maize plant:

- water potential of soil
- resistance to air flow through stomata
- ABA concentration in leaves.

Before the experiment, the plant was well-watered. The plant was not watered again until day 6 of the experiment.

The results are shown in Fig. 32.2.

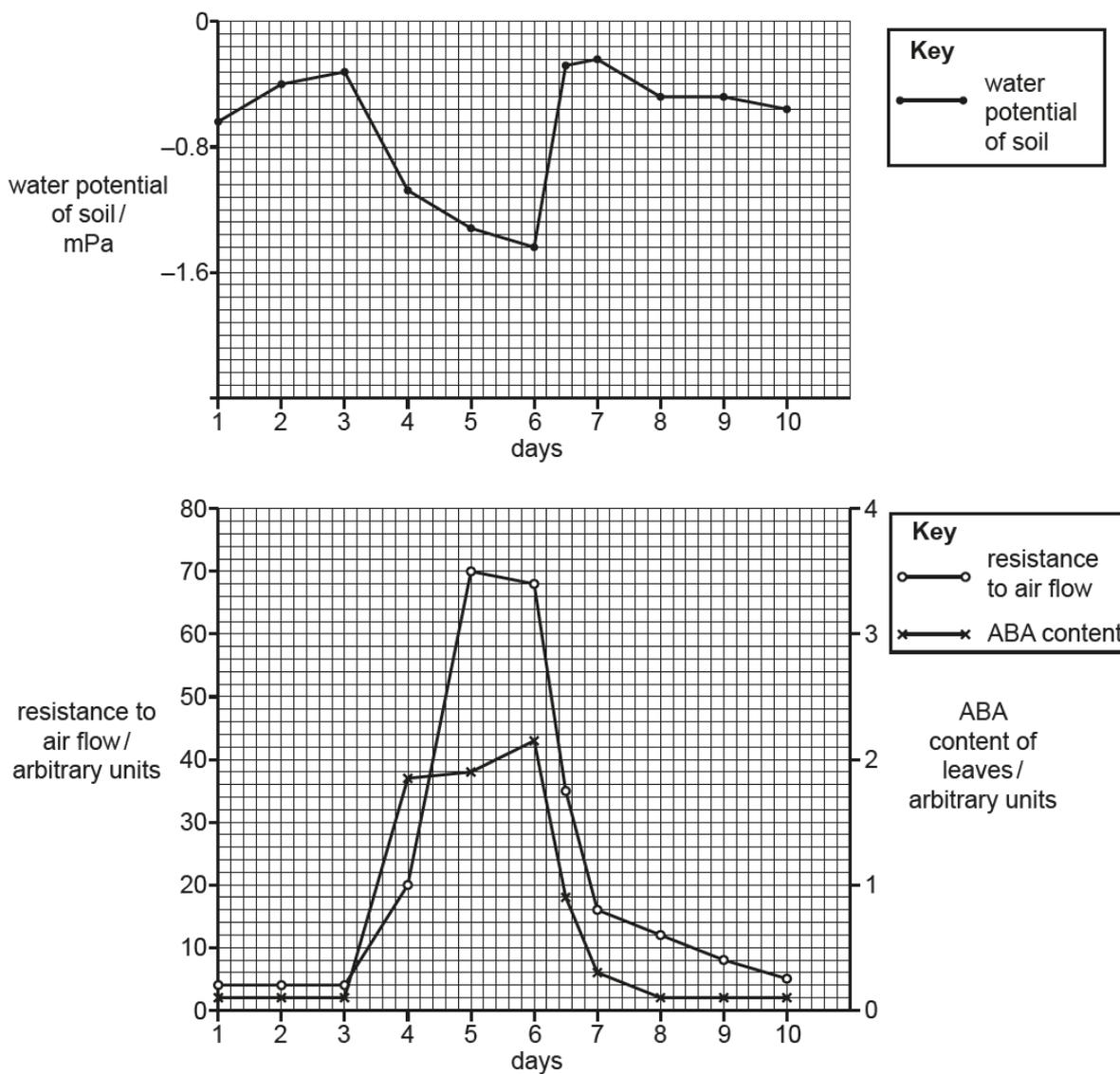


Fig. 32.2

The investigator made the following claim:

The data show that dry soil conditions promote the synthesis of ABA in maize plants, causing stomata to close.

Discuss the validity of this claim using **only** the data shown in Fig. 32.2.

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

The question asked about **dry** soil and the **synthesis** of ABA. Thus, candidates who only referred to the ABA levels decreasing when the soil was watered were not given credit. The principle here is that there is a correlation between soil drying and ABA increasing (and resistance to air flow) but a correlation between variables does not necessarily mean there is causation.

Question 33 (a) (iii)

(iii) With reference to the data in Table 33, explain how the sucrose concentration of the solution determines the final mass of potato.

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

Most candidates did not read this question carefully and did not appreciate that the potato slices in pure water/low sucrose concentrations were gaining mass (starting mass was 2.5g). This classic practical exercise allows the precise water potential of the cells to be obtained by determining the sucrose concentration at which there is no change in mass. Very few candidates referred to specific values when explaining the data.

Exemplar 3

As the sucrose concentration increases the mean final mass of potato decreases, with the mean mass being 2.80 g in 0.0 mol dm^{-3} sucrose to being 2.22 g in 1.0 mol dm^{-3} . This is because there is a lower water potential outside the potato cells, compared to inside resulting in water to move out of the cell by osmosis down a water potential gradient. As water leaves the potato, the mass will decrease, so the lower the water the potential due to the sucrose concentration the more water is lost and the more the mass decreases. [3]

This script was typical of many that gained just one mark for understanding that the change in mass of the potato was due to osmosis. To obtain more than this reference needed to be made to specific data points where the potato was gaining mass and where it was losing mass, along with an explanation as to why this was the case.

Question 33 (b)

- (b) Osmosis can also be investigated on a single-cell scale with microscopy by measuring cell size.

Fig. 33 shows the view down a microscope fitted with a stage micrometer.

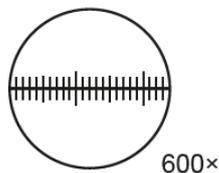


Fig. 33

Calculate the **area** of the field of view of the microscope set up as shown in Fig. 33.

Give your answer to the nearest whole number.

area = μm^2 [2]

Some candidates did not calculate the actual diameter, and hence the radius, of the field of view although many did state the equation ($A=l/M$). Some calculated the actual radius but were not able to convert these to micrometres. Others did not know the formula for calculating the surface area of a circle.

	OCR support	Maths for Biology website offers support to candidates in use of units and formulae that learners need to recall https://www.ocr.org.uk/subjects/biology/maths-for-biology/arithmatic-and-numerical-computation/
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Question 34 (a) (i)

34 VO_2 max is an indicator of cardiovascular fitness and a predictor of mortality risk.

- (a) (i) Describe what is meant by the term VO_2 max.

.....
 [1]

Many candidates gave vague definitions of VO_2 max such as the maximum amount of oxygen used.

	AfL	It is important that candidates realise that measurements of VO_2 max must be made per unit of time. It can therefore be described as the maximum rate of oxygen use OR the volume of oxygen taken up per minute/hour .
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	<p>OCR support</p>	<p>Topic exploration packs on oxygen dissociation curves can be downloaded from the following website:</p> <p>https://www.ocr.org.uk/Images/304428-oxygen-dissociation-curves.doc</p>
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Question 34 (c) (ii)

(ii) Air temperature changes at higher altitudes.

Suggest why air temperature can affect VO_2 max.

.....

..... [1]

Most candidates mentioned ideas around temperature affecting the kinetic energy of molecules. Only a few candidates identified that high temperatures would affect the binding of oxygen to the haemoglobin.

Question 34 (d)

(d) Excess post-exercise oxygen consumption (EPOC) is required for the regeneration of ATP and the replenishment of muscle glycogen stores.

Give **two** other reasons why excess oxygen is required after exercise.

1.....

.....

2.....

..... [2]

In general, this question was well answered. Some candidates lost marks through lack of detail. For example, to aid the breakdown of lactic acid was insufficient whereas to convert lactate to pyruvate would be credited.

Question 35 (a)

35 CRISPR is an adaptive system in bacteria that protects against invading viruses by destroying viral DNA upon entry into cells.

CRISPR is an acronym for **clustered regularly interspaced short palindromic repeats**.

(a) Define the term palindrome in the context of DNA.

.....

..... [1]

Only a few candidates were able to answer this question, as it proved to be challenging. Many simply stated that it is a sequence of nucleotide bases that reads the same forwards as backwards. In the context of DNA however candidates need to refer to the two strands of DNA and be clear that the bases are in opposite direction on each strand. Sometimes a diagram was useful in this answer.

Question 35 (b) (i)

(b) The actions of CRISPR are mediated by an enzyme-RNA complex. The enzyme, Cas9, is attached to a guide RNA molecule, as shown in Fig. 35.

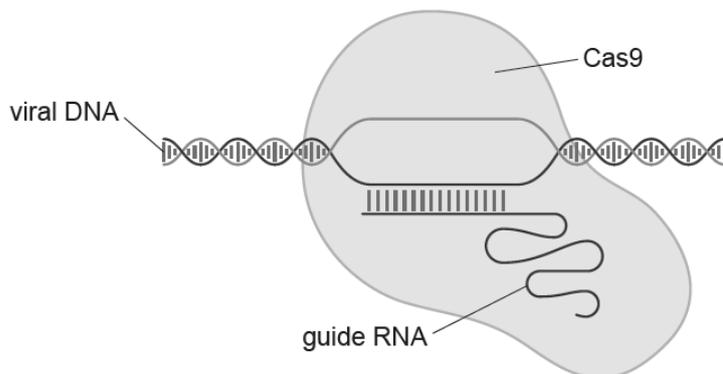


Fig. 35

The guide RNA molecule is complementary to the viral DNA molecule. Upon binding of the guide RNA to viral DNA, Cas9 cuts straight through both strands of the DNA at a precise position. The gene encoded by the DNA is inactivated. This prevents the virus from replicating inside the bacterial cell.

(i) Cas9 is an endonuclease enzyme because it cuts within a nucleotide sequence.

Name another type of bacterial endonuclease enzyme.

..... [1]

Question 35 (b) (ii)

(ii) State **one** similarity and **one** difference between Cas9 and the type of enzyme in (b)(i).

similarity

.....

difference.....

.....

[2]

A lot of candidates didn't score any marks in this question. This was mainly because they missed out the statement in the question to Q35 (b)(i) which stated that all endonucleases cut within a nucleotide sequence. Candidates should have used this to help them answer Q35 (b)(ii).

Exemplar 4

similarity They both cut DNA strands, inactivating a
 gene

 difference..... restriction enzymes produce sticky ends via
 a staggered cut.

[2]

In Exemplar 4 the first point did not give enough detail about the nature of the cut and the differences were not credited because the candidate did not compare both enzymes and only described what the restriction enzyme did.

Question 35 (c)

- (c) CRISPR has been adapted into a laboratory tool for genetic modification in eukaryotic cells. Using purified Cas9 protein and artificially-synthesised guide RNA molecules, scientists can target genes of interest.

In eukaryotic cells, DNA breaks induced by Cas9 are repaired by the cell's own (imperfect) DNA repair mechanisms. This leads to the generation of mutations at the site of the DNA break, and the gene function is lost.

RNA interference (RNAi) is another laboratory tool that scientists can use to target genes of interest.

Using the information provided, and your knowledge of RNAi, discuss the advantages **and** disadvantages of CRISPR and RNAi for the study of gene function.

CRISPR

.....

.....

.....

.....

RNAi

.....

.....

.....

[4]

A lot of candidates scored no marks for this question, with a very small number gaining more than two marks. It was clear that many candidates did not understand the basic premise that both techniques targeted gene expression. Candidates need to appreciate that RNAi destroys mRNA but that multiple strands of mRNA are produced so that the gene is not permanently switched off whereas with CRISPR (they are told) the gene function is lost, and this would be permanent.

	<p>OCR support</p>	<p>RNA interference case study is available on the delivery Guide for OCR AS/A Level Biology B (Advancing Biology) Gene technologies (5.1.3)</p> <p>https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-b-advancing-biology-h022-h422-from-2015/delivery-guide/module-bb05-module-5-genetics-control-and-homeostasis/delivery-guide-bbdg029-gene-technologies-513</p>
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Exemplar 5

CRISPR... • can make edits in DNA directly, so is a one time solution to stop gene expression

• mutations at site of DNA break could be unpredictable + harmful - could cause cancer.

RNAi... • Process would have to be repeated as only cuts mRNA, and transcription causes more mRNA to be synthesised

• No risk of cancer

In Exemplar 5. It is clear from the first two lines that the candidate understands that genes are permanently 'switched off' if the DNA is cut whereas RNAi cuts mRNA and more can be transcribed from the undamaged DNA.

Question 35 (d)

(d) Using the most appropriate word(s), complete the sentences below about the production of mature mRNA.

A molecule of pre-mRNA contains sequences that code for amino acids, known as, and sequences that are non-coding, known as

The process of removes non-coding regions and joins coding regions to produce a molecule of mature mRNA. In this way, a gene may code for several different proteins.

[3]

Extrons was a common incorrect answer.

Question 36 (a) (i)

36 The photomicrograph in Fig. 36, **on the insert**, shows a section of pancreatic tissue.

An endocrine structure is labelled X.

(a) (i) Identify structure X.

..... [1]

Many candidates did not recognise the Islets of Langerhans, although the question stated that this was a section of pancreatic tissue.

Question 36 (a) (ii)

(ii)* In a healthy individual, the concentration of blood glucose is maintained at around 80 to 90 mg per 100 cm³.

Discuss the mechanisms that control blood glucose concentration.

Your answer should include **named** cell types and biochemical pathways.

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

This question was answered well by many candidates. Most candidates correctly identified the hormones and cell types as well as some biochemical pathways. For full marks candidates needed to refer to the mechanism of control i.e. deviations from the set point being detected, hormones released which produce effects to reverse the change in a negative feedback pathway.

Exemplar 6

The mechanism of negative feedback is used to control blood glucose concentration, where the level of glucose is maintained around a set point (80 to 90 mg per 100 ml³). When glucose concentration becomes too high, beta cells in the Islet of Langerhans secrete insulin, resulting in the conversion of glucose to glycogen in liver and muscle cells. This process is called glycogenesis, and results in a decrease in blood glucose concentration to the set point.

When blood glucose concentration gets too low, alpha cells produce glucagon. This causes the liver cells to convert glycogen into glucose in the process of glycogenolysis. Amino acids and lipids are also converted into glucose by the process of gluconeogenesis. This increases the blood glucose concentration back up to the set point. [6]

Exemplar 6 illustrates a script awarded full marks.

Exemplar 7

In the islets of Langerhans, it consists of α and β cells. β cells secrete insulin. So when glucose conc. is high, α cells stop secreting glucagon, and β cells secrete insulin. Insulin causes ^{increased} uptake of glucose in cells, also causes glycogenesis to occur where liver + muscle cells convert glucose to glycogen. Lipogenesis occurs where adipose cells convert glucose to fatty acids/lipids. If glucose concentration is too low, α cells secrete glucagon and β cells stop secreting insulin. This causes glycogen to be broken down to glucose in liver + muscle cells called glycogenolysis. Also causes adipose tissue to convert fatty acids into glucose, gluconeogenesis. Uptake of glucose by cells is decreased. [6]

Insulin causes an increase in glucose transporter protein on cell surface membrane of cells. Glucagon prevents transcription of glucose transporter proteins.

Exemplar 7 is a good answer that accurately describes the hormones and their effects but without any detail of how the system is controlled by negative feedback.

Question 36 (b) (i)

(b) Impaired regulation of blood glucose concentration is a feature of diabetes.

Scientists are investigating new treatments for diabetes using mouse models. Diabetes can be induced in healthy mice by administering a compound called streptozotocin (STZ) and feeding the mice with a normal or high-fat diet.

STZ is toxic to pancreatic islet cells.

(i) Two strategies for inducing diabetes in healthy mice are described below. For each strategy, suggest which **type** of diabetes would be induced **and** provide an explanation.

High dose of STZ and a normal diet.

.....
.....

Low dose of STZ and a high-fat diet.

.....
.....

[2]

Several elements are needed for each correct answer here. Firstly correct reference to the type i.e. Type 1 or 2. Secondly a link between the treatment and the effect. So, for type 1 diabetes a high dose of STZ would destroy the pancreatic/beta cells so no insulin would be produced. For type 2 diabetes, a high fat diet would make the (target) cells less responsive to insulin.

Question 36 (b) (ii)

(ii) Both strategies are carried out over a period of five weeks. After this time, the mice are tested for diabetes.

Name **one** test that can be used to confirm that the mice are diabetic.

..... [1]

The glycosylated haemoglobin test is not appropriate for diagnosis of diabetes in mice.

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Question 30

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Question 31 (a) (i)

Adapted from L Torian, M Chen, P Rhodes, I Hall, 'HIV Surveillance --- United States, 1981--2008', pp689-693, Morbidity and Mortality Weekly Report (MMWR), Vol. 60.21, 3 June 2011.

Question 31 (d) (ii)

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