GCE EXAMINERS' REPORTS

BIOLOGY
GCE
AS/Advanced

SUMMER 2023

Introduction

Our Principal examiners' reports offer valuable feedback on the recent assessment series. They are written by our Principal Examiners and Principal Moderators after the completion of marking and moderation, and detail how candidates have performed.

This report offers an overall summary of candidates' performance, including the assessment objectives/skills/topics/themes being tested, and highlights the characteristics of successful performance and where performance could be improved. It goes on to look in detail at each question/section of each unit, pinpointing aspects that proved challenging to some candidates and suggesting some reasons as to why that might be.[i]

The information found in this report can provide invaluable insight for practitioners to support their teaching and learning activity. We would also encourage practitioners to share this document – in its entirety or in part – with their learners to help with exam preparation, to understand how to avoid pitfalls and to add to their revision toolbox.

Further support

Document	Description	Link
Professional Learning / CPD	WJEC offers an extensive annual programme of online and face-to-face Professional Learning events. Access interactive feedback, review example candidate responses, gain practical ideas for the classroom and put questions to our dedicated team by registering for one of our events here.	https://www.wjec.co.uk/home/professional-learning/
Past papers	Access the bank of past papers for this qualification, including the most recent assessments. Please note that we do not make past papers available on the public website until 6 months after the examination.	www.wjecservices.co.uk or on the WJEC subject page
Grade boundary information	Grade boundaries are the minimum number of marks needed to achieve each grade. For unitised specifications grade boundaries are expressed on a Uniform Mark Scale (UMS). UMS grade boundaries remain the same every year as the range of UMS mark percentages allocated to a particular grade does not change. UMS grade boundaries are published at overall subject and unit level. For linear specifications, a single grade is awarded for the overall subject, rather than for each unit that contributes towards the overall grade. Grade boundaries are published on results day.	For unitised specifications click here: Results, Grade Boundaries and PRS (wjec.co.uk)

Exam Results Analysis	WJEC provides information to examination centres via the WJEC secure website. This is restricted to centre staff only. Access is granted to centre staff by the Examinations Officer at the centre.	www.wjecservices.co.uk
Classroom Resources	Access our extensive range of FREE classroom resources, including blended learning materials, exam walk-throughs and knowledge organisers to support teaching and learning.	https://resources.wjec.co.uk/
Bank of Professional Learning materials	Access our bank of Professional Learning materials from previous events from our secure website and additional pre-recorded materials available in the public domain.	www.wjecservices.co.uk or on the WJEC subject page.
Become an examiner with WJEC.	We are always looking to recruit new examiners or moderators. These opportunities can provide you with invaluable insight into the assessment process, enhance your skill set, increase your understanding of your subject and inform your teaching.	Become an Examiner | WJEC

Subject Officer's Executive Summary

2023 has seen a return to assessment of the full specification. Advanced notice of the main topics covered in the examinations was issued to candidates.

It was pleasing that most units had an increased mean compared to 2022, showing an improvement in the standards. More able candidates in all units demonstrated a sound ability to process, analyse and interpret data and information and were able to express themselves well using appropriate scientific terminology. However, a significant number of candidates were not able to recall the terminology required for AO1 questions.

It is still evident that centres and candidates have been impacted by events during COVID and that this is still being reflected in their practical skills. It was noted that many candidates lost marks due to poor communication skills. This may be related to the lack of examination experience of this cohort.

The overall performance in unit 1 showed an improvement in candidates' knowledge and understanding of the content of the specification. This included knowledge of enzymes, cell division and nucleic acids. Questions testing practical skills were also answered better than in 2022. Far fewer questions were left un-attempted than in previous years. However, some issues remain in the recall of basic facts. This was quite polarised between the more and less able candidates.

In Unit 2, while there was some improvement in the recall of basic facts associated with the content of the specification, overall, candidates performed less well on Unit 2 compared with Unit 1. This has historically been the case but the return to teaching the full content of the specification this year may have further impacted teaching.
Questions testing microscope work were also found to be challenging with only a minority gaining full marks on the calibration question.

Overall performance in unit 3 remained similar between 2022 and 2023 and the mean in 2023 is still higher than in 2019. Many examples of excellent answers were seen. However, significant issues remain in terms of the quality of written communication. In terms of maths skills, generally these were good, but candidates should take care to express their answer in the way requested in the question.
Performance on unit 4 improved in 2023. The option topics were reinstated and performance on these was also good with improved means. The issues here were similar to above in terms of quality of written communication, understanding of the demand of questions, the conversion of units and calculations involving the use of scale bars.

The mean for Unit 5, the practical examination decreased slightly this year, even though the rigour of the assessment was deemed to be similar to previous. This may still be because of missed practical experience over the past few years. Less able candidates struggled to draw conclusions or be able to evaluate and explain steps in the method. In the practical analysis paper, most were able to carry out the T test correctly but again microscopy skills proved troublesome.

Areas for improvement	Classroom resources	Brief description of resource
Recall of scientific terminology	Knowledge organisers	A collection of sample knowledge organisers to support the learning of A level Biology.
Improving AO1 skills	Improving AO1 skills resource	Series of questions for every topic designed to help candidate revision.
Practical skills	Experiments on film	Videos of every specified practical and questions to strengthen practical skills.
Microscopy skills	Improving microscopy skills resource	Worksheets containing worked calculations of calibrations, magnifications, and actual size. Also contains a range of questions for students.
Correct responses to different command words and using information given in the stem of the question	Online exam review	Annotated sample candidate responses which can be used to show good practice
Knowledge and understanding of plant transport	Adaptations for transport in plants - Blended Learning	This blended learning resource contains interactive self-study content covering Unit 2 - Adaptations for transport in plants.

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UNIT 1: BASIC BIOCHEMISTRY AND CELL ORGANISATION

Overview of the Unit

Unit 1 tests knowledge and understanding of the core concepts in Biology. Knowledge and understanding is tested as well the ability of the students to apply that learning and connect the topics within the unit.
The practical work related to this unit is also tested alongside the theory. Improvement in knowledge, understanding and particularly practical work compared to the previous year was apparent. The better candidates scored highly throughout the paper, although there were a range of standards seen and there were a significant number of candidates who had not learned the basic facts. There were very few questions which were not attempted.

Comments on individual questions/sections

Q.1 Responses to this question were polarised into those that had learned protein structure and those who had not. A significant proportion of candidates could not recall the definitions of levels of protein structure. When explaining the effects of lysozyme on bacterial cells, many candidates described water moving out of the cells instead of into the cells. Describing and explaining the pH graph for lysozyme was done well by many, although some candidates refer to “before” or “after” optimum pH rather than using the values shown in the graph.

Q.2 Recognition of what happens to chromosomes in mitosis and meiosis, was well answered, although in part (ii) some candidates lost marks for referring to the number of daughter cells rather than differences in chromosomes. Calculating the distance between centromeres was done well by many candidates, although fewer candidates could relate what was happening in each line on the graph to what was happening in a cell undergoing mitosis. Most candidates recognised cells in metaphase and anaphase from the micrograph image, but fewer candidates were able to use the scale bar to calculate magnification. In suggesting where in a plant cells would be undergoing mitosis, many candidates were able to state regions of growth, but few managed to refer specifically to root or shoot tips or meristems.

Q.3 Candidates were generally able to identify oxygen and glucose and their mode of transport into the cell from the graph. Most answers explaining the shape of the lines in relation to transport were able to state what the graph showed, but few candidates correctly linked the properties of oxygen and glucose to their mode of transport. When asked about why mature red blood cells cannot make haemoglobin, only the more able candidates linked organelles which were absent to a stage in protein synthesis or post translational modification. More candidates were able to relate a lack of mitochondria to a lack of ATP for active transport.

Q.4 Most candidates were able to identify the glycosidic bond and the similarities and differences between amylose and amylopectin. Fewer candidates were able to define hydrolysis specifically, some got it confused with condensation. Few candidates were able to describe the role of the three enzymes required for complete digestion of starch. The names of the enzymes were not needed, but answers did not generally use the information in the images to help them answer the question. Very few candidates were able to relate the higher amylopectin content to increased rate of starch hydrolysis using the images. Many candidates identified iodine as the test reagent for starch, but fewer answers stated a negative result.

Q.5 Knowledge of the structure of DNA was demonstrated by most candidates who were able to identify which bases were present in DNA and understand complimentary base pairings. Most candidates were unable to explain the reason for the slight difference in the percentage of the complimentary base pairs. Most candidates were unable to state fully what is meant by complimentary base pairing, this was consistent with the previous year. The answers to the last part of the question were varied but most could explain that three bases code for one amino acid and the need for this code to be a triplet code. Few candidates went on to explain how so many proteins could be produced and the basis for this.

Q.6 The first part of this question was answered well by most candidates, they were able to plot the graph and calculate solute potential using the formula. Some candidates also were able to recall the term incipient plasmolysis, demonstrating the application of specified practical work. When suggesting improvements, most candidates suggested repeat readings, but few candidates realised that improving accuracy of determining solute potential required closer readings around the concentration that was believed to result in incipient plasmolysis.

Q.7 The best answers to this question treated DNA, mRNA, tRNA and rRNA separately, identifying their function in protein synthesis. Some candidates included where they carry out their role alongside the description, others included this in a separate paragraph. Explaining the role of ATP required a description of what was happening in the diagram and was less well answered by the majority of candidates. Some candidates gave accounts of protein synthesis despite it being stated as not required. The best answers were concise and demonstrated a clear knowledge of the function of the nucleic acids in protein synthesis.

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UNIT 2: BIODIVERSITY AND PHYSIOLOGY OF BODY SYSTEMS

Overview of the Unit

Generally, candidates performed better at answering recall questions. Many struggled with accurately interpreting the information provided in the questions, leading to incorrect answers and incomplete explanations. Additionally, the poor quality of written communication further compounded their difficulties in effectively conveying their understanding. Furthermore, candidates often failed to apply their existing knowledge to new contexts or make connections between concepts, resulting in incomplete responses.

Comments on individual questions/sections

Q.1 This question provided a range of marks. The better candidates made use of the information provided and scored highly. However, most of the candidates showed a lack of awareness/understanding of field work techniques.

In part (b) most candidates stated that using more than 11 quadrats wouldn't increase the number of species recorded, but very few appreciated that this would increase the time taken to collect the data. Very few candidates noticed that using less than 11 quadrats would mean that the sample wouldn't be representative of the heathland.

In part (c) (ii) approximately half of the candidates did not use the information provided in the table and made references to the woodland not being sampled or that the whole area had not been recorded. Most candidates gained full marks for the calculation of diversity, although some lost a mark for not giving their answer to two decimal places (as had been given for the unfenced area). However, only about half of the candidates drew the correct conclusion about the effect of grazing on biodiversity. Either they had not read the information carefully and thought that their calculation was for the grazed area, or they had assumed that grazing will always be detrimental to biodiversity.

In part (d) the very best candidates assimilated all the information and correctly referred to the grazers causing a decrease in the presence of the taller species listed in table 1.4, and that this would reduce the competition for light etc. for the shorter species. Many candidates gained a mark for making a sensible suggestion about pollen/seed dispersal.

Q.2 Traditionally, candidates struggle to answer questions about tissue fluid, and this year was no exception. In part (a), many candidates didn't use the information provided and failed to appreciate that the higher hydrostatic pressure was on the right of the diagram. Therefore, many candidates wrongly identified X as an arteriole and not a venule and didn't gain the mark for the direction of blood flow; most candidates correctly identified the lymph vessel.

Part (b) proved to be the most challenging question on the paper. Very few candidates were able to correctly interpret the graph of hydrostatic pressure and osmotic pressure. Many candidates recognised that increase in friction would reduce the hydrostatic pressure, but very few candidates referred to the loss of fluid from the capillary; when they did some stated a loss of *tissue fluid* or *blood* from the capillaries, both of which are incorrect. A small minority of candidates recognised that the constant osmotic pressure was being caused by the large plasma proteins, and that these are too large to leave the capillary. Although many candidates realised that the role of the lymph capillaries is to remove excess tissue fluid, very few candidates referred to the graph, as instructed, to explain why excess tissue fluid would be formed.

In part (c) many candidates failed to look at the image and simply relied on the information they could recall. When candidates did refer to the image, they made incorrect references to the smooth muscle cells reducing friction or bringing about elastic recoil. Only the better candidates gain two marks on this question. Very few candidates correctly calculated the percentage increase in blood flow. Many candidates suggested that the increased blood flow to the skin supplied more oxygen to the muscles or made references to sweat production. Where candidates did refer to heat loss, they did not appreciate that heat is constantly being lost from the skin and that an increase in blood flow or result in *more* heat being lost.

Q.3 In part (a) many candidates correctly identified the guard cell but few correctly identified the epidermal cell, with many calling it an epithelium. There were many excellent descriptions of stomatal opening and the majority also recognised that closing stomata would reduce water loss. Unfortunately, some candidates thought that closing the stomata would *prevent* water loss which is incorrect.

In part (b) the quality of written communication let some candidates down using the repeated word of *amount* when describing variables that needed to be controlled. Other candidates did not look carefully enough at the information provided and stated that the concentration of carbon dioxide needed to be controlled. Most candidates were able to draw a conclusion from the investigation with just a few candidates simply describing the results. The explanations provided a range of marks, with the better candidates gaining all three. Many candidates appreciated that at higher carbon dioxide concentrations fewer stomata would be needed to obtain sufficient carbon dioxide for photosynthesis, however only the best candidates related this to the rate of diffusion.

In part (e), most candidates were able to draw one conclusion, but very few made both conclusions about the carbon dioxide concentrations in the Mesozoic period.

Q.4 Part (a) was poorly answered as most candidates did not use the image provided. Quality of written communication was also an issue with many candidates simply saying that *they* had a lower surface area and not actually referring to the alveoli. Candidates also didn't appreciate that it is the fact that there are *many* alveoli which causes a larger surface area and that it is the *wall* of the alveoli which is thin which reduces the length of the diffusion pathway. Many candidates recognised the emphysema leads to a reduction in the surface area of the alveoli but did not relate this to the rate of diffusion of oxygen into the blood. Unfortunately, many candidates saw the reference to oxygen saturation of haemoglobin in the stem of the question and made incorrect references to haemoglobin affinity for oxygen.

Quality of written communication was also very poor in part (b) with many candidates describing the process of inspiration a level barely beyond GCSE, or they simply described the path air takes through the respiratory system. Those candidates that had learned their biology got full marks.

In part (c) most candidates recognised that the forced vital capacity or residual volume was different with the person with emphysema, but very few recognised but the forced expiration takes longer. Most candidates attempted to explain the differences. However, they simply stated the information provided but did not link it to their knowledge of ventilation. For example, they did not relate the loss of elastic tissue to less recoil, or the increased mucus production to the narrowing of the bronchioles.

Q.5 In part (a) very few candidates understood that heterotrophic organisms must consume complex organic molecules, with many simply stating that they eat other organisms, or they are unable to produce their own food. Many candidates gained all three marks for describing the process of saprotrophic nutrition.

In part (b) only more able candidates recognised both organisms were holozoic, with many candidates simply saying that they were heterotrophic which was stated in the stem of the question. Many candidates were able to explain one difference between the mode of nutrition of the two organisms, but very few identified two differences.

Part (c) also proved very challenging for many candidates. Many were able to use the image to show that 100 stage micrometre units was equivalent to 38 eyepiece graticule units, but then simply divided the two to gain an answer of 2.63. Again only more able candidates were able to use the information provided to realise that each stage micrometre division was 10 µm in length. Many candidates did not appreciate the length of 1 eyepiece unit varies at different magnifications and therefore it is important that the amoeba was viewed at the same magnification as the calibration had taken place. As a result, many thought they had to divide their answer by the magnification to obtain the correct answer.

Q.6 Most candidates picked up at least one mark for part (a) but only the more able could correctly identify the phloem from the image. Most candidates also knew the difference between apoplast and symplast pathways and correctly described these. Unfortunately, a minority failed to refer to the plasmodesmata when describing the symplast pathway.

It was clear from parts (c) and (d) that only more able candidates understood the role of the endodermis in generating root pressure, and the effect that cyanide would have on this. Approximately 20% did not attempt part (c) and 10% did not attempt part (d). Most candidates correctly referred to the Casparian strip blocking the apoplast pathway, but only the minority then went on to give good explanations of the role of the endodermis in the active transport of ions into the xylem and the generation of a water potential gradient. Most candidates recognised that cyanide was a respiratory inhibitor but were unable to explain the role of ATP in the formation of root pressure. Less able candidates made references to the active transport of water, or cyanide lowering the water potential of the soil.

Q.7 The full range of marks was awarded in question 7 demonstrating that all candidates have some knowledge of the dentition of different organisms. Unfortunately, the quality of written communication meant that many of the responses confined students to the lower and middle bands. Many candidates simply described their role of the teeth, failing to describe their *adaptations*. A very common misconception is that the wolf's canines are sharp; these teeth are large and pointed to pierce flesh. Some candidates also confused the role of canines and incisors in the grey wolf, with others simply making generic statements that carnivores have long sharp teeth to kill prey. The majority of candidates correctly identified that the black bear had an omnivorous diet, and generally described the adaptations of its dentition, better than the deer or the wolf.

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UNIT 3: ENERGY, HOMEOSTASIS AND THE ENVIRONMENT

Overview of the Unit

- The paper assessed the required breadth of topics including synoptic material from units 1,2 and 4.
- Attempt rates were over 97% for all questions except 3(c) which targeted AO3, and 2(c) which contained synoptic material from unit 2.
- Accessibility was generally improved compared to last year, with facility factors (FF), ranging between 40%and 70% for most items. Part 2(a) was relatively inaccessible with a FF of 24%. Parts 1(a) (FF, 76.2%) and 4(c) (FF, 82%) appeared to lack challenge though both were included as context setters for subsequent items.
- Performance on the items requiring mathematical skills was mixed, substituting into formulae was generally accomplished well, but errors occurred in failing to convert to appropriate units, not using standard form or the correct number of significant figures when required. There was also confusion over use of tangents of curves in graphs to calculate rate.
- Poor written communication was an issue, especially when asked to describe patterns and trends or to make comparisons. There was also some failure to answer the question asked and instead answering “Write everything you know about …”

Comments on individual questions/sections

Q.1 Part (a) was a straightforward recall question. It was well answered by most candidates, but some responses lacked precision stating mitochondria instead of matrix of mitochondria.

Parts (b) and (c) required candidate to apply knowledge to an unconventional diagram. These were also well answered with some errors in naming the enzyme and type of reaction, and some lack of clarity in descriptions and explanations in part (c)(ii) II.

Q.2 Part (a) required candidates to compare patterns in two graphs in order to describe the relationship between an absorption spectrum and an action spectrum and to formulate a conclusion to explain the relationship. This turned out to be the most difficult question on the paper. Lack of clarity was the main issue with the comparison, weak responses made no reference to wavelength using terms like ‘when’ or ‘where’ instead. The weakest responses wrote about the spectra as if they were two continuous variables on the same graph, e.g., “As the absorption spectrum increases the action spectrum increases.” The best responses make it clear that similarities occur at the same wavelengths. The issue with the conclusion was writing descriptions of the spectra without linking them, basically writing observations not conclusions.

Part (b) required candidates to extract information from two graphs and make a comparison. Weaker responses referred to one pigment only leaving the examiner to make the comparison. Although benefit of doubt can be given if comparative adjectives, e.g., longer are used, candidates should be encouraged to write something about both objects when making comparisons.

Part (c) targeted AO3 and required candidates to formulate a hypothesis. The best responses made a clear link between the ability of chlorophyll c to absorb blue light and the ability of blue light to penetrate to the depths at which diatoms were found. Weakest responses lacked clarity or contained inaccuracies, e.g., "the pigments cannot penetrate deep enough.'

Part (d) had the second lowest attempt rate on the paper which might have been because the content was synoptic with Unit 2. Those that attempted it generally got both marks. The most common error was to name the domain as 'Plants'.

Parts (e) (i) and (i) targeted mathematical skills. Both parts were simple arithmetic, but the most common error seen in part (i) was not including energy lost to 'E' and in part (ii) it was not converting values into a common unit, as well as not giving the answer in standard form.

Q.3 Part (a) was a straightforward recall question to set the context for the rest of the question.

In Part (b) candidates were expected to apply their knowledge to interpret information provided in unfamiliar diagrammatic form. Most were able to distinguish the chloroplast from the mitochondria in part (b)(i) but completing table 3.3 in part (b)(ii) was more challenging. The best responses correctly name both membranes and all four compartments, the worst responses named random parts of the cell including cell wall, vacuole and cytoplasm. In Part (b)(iii), candidates were fortunate that writing everything they knew about chemiosmosis gained them most of the marks.

However, part (c) targeted AO3 and required critical analysis of the results of an unfamiliar experiment so a regurgitated account of chemiosmosis would not do. The best responses were able to recognise that changing the pH created a proton gradient, the weakest responses wrote about protons being pumped out of or into the isolated membrane.

Q.4 Part (a) was meant to be a context setter for the rest of the question but it proved more challenging than expected. All possible permutations of the four terms were seen, many candidates confused immigration with emigration and the weakest responses equated birth rate + death rate with immigration + emigration.

Maths skills were tested in part (b)(i) and most candidates were able to substitute the correct values into the equation and calculate the correct number of frogs. The best responses rounded the answer to a whole number of frogs. Part (b)(ii) targeted AO3 and candidates' ability to criticise experimental design. Poor quality written communication was an issue in this part with lack of clarity in the weakest responses.

Part (c) targeted AO2, with candidates expected to apply knowledge of bacteriology to an unfamiliar situation and most candidates did so.

Part (d)(i) tested mathematical skills, the best responses accurately found the gradient of the tangent to the curve at day 10 which had been provided and gave the answer to two significant figures. Some calculated the gradient correctly but showed no understanding of what is meant by two significant figures by giving an answer to two decimal places. Weaker responses ignored the tangent provided and attempted to calculate the gradient of the curve over the first 10 days.

Parts (d)(i) , (e)(i) and (e)(ii) targeted AO3 with candidates being expected to evaluate evidence, make a conclusion and criticise experimental design.

Q.5 Part (a) targeted AO1 to test knowledge of the functions of parts of the kidney nephron. However, there was an element of practical skill with marks being lost because of sloppy labelling. The best responses labelled to the standard expected on practical examinations using straight lines clearly drawn with a ruler and touching the structure being labelled. Weaker responses contained roughly drawn arrows pointing in the general direction of the structures, marks were not awarded for inaccurate labelling.

Part (b) targeted AO3 and practical skills, and caused some difficulty. Candidates were expected to interpret experimental results. In part (b)(i) most responses correctly explained the decline in chloride ion concentration along the proximal convoluted tubule. However, many did not refer to reabsorption of water to explain the increase in concentration of urea. Part (b)(ii) was less well answered. The best responses gave a clear interpretation of the experimental making clear links between oligomycin inhibiting ATP production and the role of ATP in active transport of sodium ions. Some responses were 'everything I know about glucose-sodium co-transport '. The poorest responses just described the results with no interpretation, e.g., 'when oligomycin was present the glucose concentration increased.'

In both sections of Part (c) quality of written communication was an issue. The best responses used the information provided in the question and gave clear explanations. The weakest responses made inaccurate statement about sodium ion movements and in some cases were impossible to make sense of.

Q.6 Part (a) targeted AO2, candidates were expected to apply knowledge of carbon fixation and release to a slightly unconventional diagram of the carbon cycle.

Parts (b) and (c) were essentially AO1 questions testing knowledge of planetary boundaries. The best responses showed obvious preparation for this topic, the poorest contained vague references to climate change and global warming.

Q.7 In the first part candidates were expected to compare an unfamiliar sensory pathway with a familiar reflex arc. The indicative content for this part of the question expects comparisons to be made. Weaker responses to this part gave separate lists of features with no comparison made. In the second and third parts candidates were expected to USE knowledge of generation of action potentials and synaptic transmission TO SUGGEST how the local anaesthetics work. Numerous responses were seen where candidates had written everything they knew about action potentials and/or synapses, often including irrelevant detail, such responses were awarded limited credit for indicative content if there was little attempt to explain how it applied to the anaesthetics' modes of action.

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UNIT 4: VARIATION, INHERITANCE AND OPTIONS

Overview of the Unit

Unit 4 assesses sexual reproduction in humans and plants; inheritance; variation and evolution; and the application of reproduction and genetics. This includes microscopy and practical skills such as the plant dissection and animal reproduction histology. There are a number of opportunities for the testing of mathematical skills, especially within the practical sections of this unit including the microscope work. The use of ratios, fractions and percentages; using significant figures; understanding simple probability; selecting and using a statistical test can all be assessed. There are many opportunities for learners to be assessed in their ability to communicate information and ideas using appropriate terminology, theories, models and ideas to develop scientific explanations. The understanding of genetics allows learners to be assessed on knowing that scientific knowledge and understanding develops over time and the study of genetic disorders allows the assessment of the consideration of the applications and implications of science and evaluation of their associated benefits and risks.
The paper this year was a slight improvement on last year, overall, reflecting the return to normalised teaching and learning. Almost all attempts were well above 95% with the exception of 1ciii (FF=30.3), 3b (FF=16.4) and 3c (FF=26.6).

Comments on individual questions/sections

Q.1 Part (a) was intended to be a gentle start to the paper, but there was a distinct lack of simple recall which was disappointing.

Part (b) was entirely based on microscopy and calculation of the real length of a spermatozoon. Although many gained full marks, there is a worrying inability to look at numbers and units and think about what they actually mean; there was more than one 32m spermatozoon and many more which were 3.2m and 32mm.

All of part (c) was recall and a lot of candidates had not revised this work. Part (c)(iii) was very poorly answered, with a distinct lack of the correct response of endosperm and its function.

Part (d) required candidates to apply their knowledge of the placenta to a photograph and identify which features were visible; the obvious ones being the umbilical cord and the many arteries/veins. Too many candidates trotted out all that they know about the placenta and did not actually answer the question asked.

Q.2 Parts (a) and (b) were testing practical work and this was answered well by many, whilst others wanted gloves and a lab-coat as essential to carrying out the work, rather than a blade, forceps and a hand lens. The weakest answer in (b) was C, which large numbers of candidates labelled as leaves.

Part (c) should have been simple, since they had just done the spermatozoon length calculation using the scale bar, but the scale bar was completely ignored in both pollen photographs, so many thought that E was larger than F, when in fact, F is almost twice the size of E. This, of course led to candidates tying themselves in knots because they got the wind and insect the wrong way round. However, credit was given for candidates knowing the features of wind and insect pollinated plant pollen, even though they had got them the wrong way round.

Q.3 Part (a) was a straightforward co-dominance genetics question, which many candidates flew through and there were many who achieved full marks for both sections. The biggest problem for those who struggled with it, is that although they got the correct parental genotype, they did not know how to work out or present the gametes. The easiest way is to put circles around them or space them out really clearly. A list of letters – usually R R G A and R W G A is exactly the same as the parental genotype and does not represent the contents of all the possible gametes. Many turned this into a monohybrid cross or somehow guessed at a ratio.

Part (b) led to whole essays on germination, leaf structure or just a brief mention of ratios (often 9:3:3:1, even though they had correctly got the 2:2:1:1:1:1 ratio in part (a). The answer just needed a brief reference to germination and leaf structure, to clue them into realising that something stopped the plants growing after germination i.e. white leaves, so no chlorophyll, no photosynthesis. This leads to the plant dying when food stores run out. This was the weakest question of the paper and was an application of knowledge question.

Asexual reproduction using cuttings posed a problem for many in part (c), despite being told that sexual reproduction involves meiosis in the stem of the question. Many correctly identified asexual reproduction was occurring, but then gave an explanation that ‘if all the gametes came via meiosis from a single plant then they would all be genetically identical’; clearly there is much confusion over sexual and asexual reproduction and the roles of meiosis and mitosis.

Q.4 Parts (a) and (b) were well done by most candidates; they made two sensible conclusions, identified the modes, gave a correct hypothesis (some forgot the significant difference in mean shell length), correctly calculated the degrees of freedom and came to the correct conclusion. Some chose the wrong probability column, usually 0.005.

Part (c) was generally well answered on the density-dependent factors, but not the independent factor. Given that the difference between the two populations was that they were on exposed or sheltered rocky shores, the only answer was some reference to waves.

Q.5 Part (a) was another recall question, which was surprisingly poorly answered.
Part (b) was well answered by many, with reference to geographical isolation and genetic drift/lack of gene flow.
Questions (c) and (d) were often well answered, although there was a lack of correct terminology i.e. selection pressure/selective advantage/selecting for….
Part (e) was generally well answered, although a surprising number wanted to clone tusk-less elephants from the DNA of elephants with tusks, or use the DNA to make artificial ivory.

Q.6 Many candidates gave reasonable accounts of gene therapy techniques and the HGP, but knew little to nothing of DMD, which brought them down to middle band marks. For top band, candidates must cover all sections of the essay to a good standard. There were some very good essays produced by candidates; a pleasure to read. This essay was largely AO1, recall.

Option A

Q.7 Section (a) was well answered by most although few were able to explain how antibiotic resistance was passed on in (iii). Some candidates were using the term 'immune' which was not accepted.
In (b)(i) candidates' definitions of pandemic were better than their definitions of endemic and epidemic.
In (c)(ii), many candidates did not use the 'at 2 years old' part of the stem and therefore had one mark for the correct calculation using the wrong year. Most other parts of this section were answered well.

Option B

Q.8 In (a)(i) candidates lost marks for just stating 'antagonistic muscles' or not naming the muscles. Most candidates were able to identify the effort, load and fulcrum in (ii), however their understanding of the third order lever was not as good.

Candidates were able to complete the calculation well in (b)(i). In (ii) many candidates were able to describe the lower rate of fatigue for females, but were not able to explain the lack of validity.

Many candidates struggled to label the components of the sarcomere in (c)(i). Label lines were not always obviously pointing to a structure.
Lots of candidates were just describing the sliding filament theory in (ii), rather than linking their answer to the question and explaining why less calcium could lead to fatigue

Many candidates struggled to identify the region of the vertebra in (d)(i), but when they did, they explained their answer well
Candidates struggled to express the right direction in (ii), lots using terms such as 'outwards'.
Part(iii) was very well answered, candidates often listed all three alternatives on the mark scheme

Option C

Q.9 Part (a)(i) was quite poorly answered with candidates missing the idea of ranking, and tending to describe an alpha male.
Candidates did not fully elaborate on their answers enough in (ii) and did not link the decreased aggression with feeding/mating.
On the whole (iv) was well answered, with candidates able to identify the pathway in the nervous system and the effect on the heart/breathing rate. There was some confusion with noradrenaline/adrenaline release.

Candidates were able to carry out the calculation well in (b)(i). Part (ii) was less well answered, although some candidates were able to link the higher testosterone to being stronger/more likely to mate.

At times the language used in (c)(i) lost the candidates marks as they struggled to define the term accurately. However, candidates clearly understood and were able to describe the male handicap model in (ii).

Some candidates gained the learning mark in (d)(i), but very few linked their answer to storage of memory and just stated 'learning and memory', which was not enough to gain credit. In part (ii), many candidates were able to describe the positive correlation and the neuroplasticity, however few gained the third marking point for linking the memory storage to the posterior hippocampus.

BIOLOGY

General Certificate of Education

Summer 2023

Advanced Subsidiary/Advanced

UNIT 5 PRACTICAL EXAMINATION

Overview of the Unit

Unit 5 is assessed through two papers both of which assess all three assessment objectives and a range of mathematical skills in practical contexts:

- *a Practical Task which assesses candidates' ability to follow a method to collect data, to present that data and then answer questions relating to the method and / or thedata collected. The context for the practical task can be taken from any part of the specification*
- *a Practical Analysis Task which assesses candidates' practical skills in analysing data provided, explaining observations and in reaching conclusions. This includes the application of mathematical skills. They may also be required to prepare a risk assessment* for the method provided and to evaluate a method or conclusions.

In 2023, the Practical Task involved the use of a simple respirometer. Candidates were required to enter their results into a table following instructions provided in the method. They were also required to calculate means and volumes and provide correct units. Candidates were asked to present their results in a graph and then answer questions on the method used to collect the data.

The Practical Analysis Task included questions that assessed candidates' understanding of experimental design, the use of statistics to analyse data and reach conclusions and microscopy.

Overall, the paper performed well.
Candidates' practical skills were stronger than in 2022, reflecting a return to normality following disruption due to COVID. The mean for the Practical Task was 14.3 with a facility factor of 71.4. These figures are comparable if not slightly higher than in previous series.

On the Practical Analysis task, item level data suggest that the data analysis question was more challenging in 2023 than in the past: the facility factor and corresponding mean were lower, although the standard deviation was as in 2022. The mean for the microscopy question was higher than in 2022 although the running mean for this question over this specification has remained constant in 2023. The facility factors for both questions on this paper were the same, suggesting an equivalent challenge.

Comments on individual questions/sections

PRACTICAL TASK

Question 1

Table
The majority of candidates were able to state the correct units and follow the instructions given as to the format of the data recorded, eg., the required number of decimal places. However, many students did not follow the instructions to record results to the nearest millimetre or to calculate volumes to one decimal place. The main concern is that many candidates cannot round answers correctly and do not record all answers to the same number of decimal places.

Graph
The standard of graphs drawn was much improved compared to 2022 with no major issues.

Questions
Most candidates gave reasonable answers to the questions asked regarding the method. Candidates did, however, lose marks where they just stated the equation for aerobic respiration and did not explain what the equation shows regarding the volumes of oxygen and carbon dioxide involved and then relating this to the role of sodium hydroxide. There is still some confusion about accuracy and reliability – these are not interchangeable terms.

PRACTICAL ANALYSIS TASK

Question 1

Q.1 **(a)** Candidates were expected to interpret the phrase 'chemical formula' as in the form $C_xH_yO_z$. Miscounting the number of atoms of a given element, the use of brackets or a mixture of numbers before and after element symbols prevented some candidates being awarded credit.

(b) **(ii) and (ii)** As they did at GCSE, candidates are expected to understand that a hazard is an object with its specific potential problem, whereas the risk describes the action in the method where this potential problem arises. The risk should therefore contain a 'when' clause to explain in which part of the process the danger might be met. Many candidates did not adequately distinguish between hazard and risk and some included terms such as 'hurt', 'harm' or 'injury', which lack specificity.

(iii) Despite the stem of the question stating that vitamin C is a reducing agent, many candidates did not correctly identify which molecules were being oxidised and which were being reduced. Many understood that the vitamin C is oxidised by methylene blue and that as oxygen is also an oxidising agent, less methylene blue is required to fully oxidised vitamin C in its presence. Many candidates were unable to express these concepts adequately and so did not gain credit, suggesting more practice is needed in writing extended answers with clarity and accuracy. Precision with language is essential, so 'air' rather than 'oxygen' as an oxidising agent did not gain credit.

Q.1 **(c)** Most candidates can add, count and divide, however some did not use the mean in column 1 to determine that one decimal place was appropriate for the answer.

(d) **(i)** A small number of candidates showed a good understanding of the meaning of p. Many alluded to the use of p=0.05 being standard in experiments such as this, but, while this is true, it does not reflect the meaning of p. Candidates are expected to understand that the t test allows the null hypothesis to be accepted if the difference between the means exceeds a given value, expressed as the critical value of t at a certain probability. Accepting a null hypothesis at p=0.05 suggests that the means and standard deviation obtained will be seen in $\geqslant$5% of cases, or that in $\leqslant$5% of cases, the difference between them is due to chance. It should be noted that it is the difference between the data sets, not the raw data, that is due to chance. Candidates are reminded that a null hypothesis is 'accepted' or 'rejected'; it is not 'right' or 'wrong', 'true' or 'false'.

(ii) Most candidates could explain how the number of degrees of freedom was calculated.

(e) **(i)** Most candidates were able to state an appropriate null hypothesis, correctly including the words 'significant' and 'mean'.

(ii) Most candidates understood the three separate concepts required to interpret the t test in answer to this question. They correctly compared t values leading them to reject the null hypothesis. It is important to use the correct terminology: it is the 'difference between the means' that is significant, not the 'evidence'. In verbalising what this implies, candidates should make a value judgment i.e. 100g peas have more vitamin C than 100g cabbage, rather than just quoting numbers.

(f) **(i)** Candidates should decide the relevant number of decimal places in the answer by using other data in the table. All data in this table are given to 2dp so the median for peas should be also.

(ii) Many candidates suggested using a mean rather than a median, but the crucial factor here is that a t test should not be used on so few samples: 15 of each is appropriate, 4 is not.

(g) Many candidates answered in terms of environmental hazards from excess fertiliser use, such as eutrophication, whereas the reasons behind relative fertiliser requirements for these two crops relate to nitrogen fixation in legume root nodules. Thus, references to *Azobacter, Nitrosomonas, Nitrobacter* and *Pseudomonas* were not relevant. Few candidates described the formation of nitrogen-containing ions or compounds in legumes. The formation of these compounds in the soil was not relevant to the answer.

Question 2

Q.2 **(a)** **(i)** To be completely unambiguous, label lines on diagrams should be drawn using a sharp pencil and a ruler, ending within the structure they are labelling, not touching its edge or ending nearby.

(ii) Of the few candidates who were able to correctly label both X and Y, many were unable to spell dura mater or meninges.

(b) **(i) and (ii)** Calibrating a microscope and using the calibration to make measurements are standard practical exercises and are included in the WJEC lab book and in student texts. Some candidates seemed unfamiliar with the equipment needed for this activity. Most candidates were able to substitute into the given equation, but many were unable to cross multiply, to solve for the unknown.

(c) **(i)** A common source of inaccuracy in diagrams was drawing neurones in the areas of the image that were white, rather than entirely within the nervous tissue. Some candidates placed the cell body of the sensory neurone high on the dorsal root, as it is usually represented in textbook drawings. The label on the right-hand side of the diagram indicated the position of the dorsal root ganglion, but this information was often not used and so the cell body was not drawn in the correct position.

(ii) Most candidates understood that the synapse is smaller than the limit of resolution of the light microscope but expressed it in various ways. ‘Low’ and ‘high’ resolution or magnification are appropriate terms, but ‘power’ or ‘strength’ of a microscope are not technical descriptions. In addition, compound microscopes do not ‘zoom’.

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[i] ***Please note that 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.***