GCE EXAMINERS' REPORTS

GCE
BIOLOGY
AS/Advanced

SUMMER 2022

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BIOLOGY

General Certificate of Education

Summer 2022

Advanced Subsidiary/Advanced

UNIT 1: BASIC BIOCHEMISTRY AND CELL ORGANISATION

General Comments

The scripts demonstrated a range of standards, the better candidates scoring very highly. There were a significant number of candidates, however, who failed to demonstrate sound knowledge and understanding of fundamental biochemistry and cell organisation. Application of this vital knowledge was not applied in many cases and understanding of specified practical work was poorly applied in a significant proportion of candidates' responses.

Comments on individual questions/sections

Q.1 Despite the fact that this was supposed to be a straightforward question on cells, using knowledge and some calculations, it was poorly answered. A significant proportion of candidates failed to link the structure of alveolar tissue to its function. Although they described an adaptation, many failed to link it to gas exchange. The majority of candidates failed to identify the basement membrane in the image, but the definition of a tissue was answered better. When explaining why some cells appeared not to have a nucleus, many candidates suggested that the cells did not have one, rather than it being due to where the section was taken through the cell. Very few candidates knew the difference between stratified and simple epithelial tissue, but more candidates could suggest that the cells of the bladder were able to change shape to accommodate a larger volume of urine. The calculation was answered better, although in the final part of the question there was confusion in how to lay out the calculation.

Q.2 This question was answered better than the previous one. It mostly required subject knowledge of the structure and function of phospholipids and triglycerides. Many candidates correctly identified the saturated and unsaturated fatty acids, However, when describing the differences in terms of single and double bonds marks were lost for failing to mention carbon atoms. Most candidates correctly identified membrane 2 as being more permeable to small molecules, although some failed to articulate why. Although many candidates correctly described differences in the structure of triglycerides and phospholipids, a significant proportion failed to identify the function of triglycerides in cells, referring instead to buoyancy and thermal insulation rather than as an energy store. The majority of candidates could state the effect on human health of saturated vs unsaturated fatty acids.

Q.3 The first part of this question was well answered, the majority of candidates correctly linking the stages of the Meselson-Stahl experiment with the graphs. Fewer candidates scored full marks on the section where they had to sketch the graph for the third division, however, many scored one or two marks for identifying the number of peaks and their relative positions. A minority of candidates located the correct position of DNA polymerase on the replication fork. Although many candidates could describe the role of DNA helicase, they struggled to explain how the experiment showed a semi conservative mechanism. In the final section where candidates were asked to suggest the importance of the proof-reading role of DNA polymerase, few candidates were able to construct a well sequenced explanation of the consequences of DNA replicated with an incorrect base sequence.

Q.4 This question required candidates to use their practical skills relating to the effect of temperature and different substances on the permeability of cell membranes. They also were required to explain the shape of a temperature vs membrane permeability graph. Most candidates identified 80 ^{o}C as producing the most reliable results, but few could use the idea of a ruptured membrane to explain why. The graph was generally well plotted, although a number of the lines did not gain credit, especially those that extrapolated below 10 ^{o}C. Some candidates stated that the prediction was not entirely correct, but they failed to relate it to the shape of the graph. Poor explanations of the shape of the graph failed to link the phospholipids to kinetic energy and the effect of increasing temperature on membrane protein structure. The answers to part b were mixed, with part (ii) being answered better than part (i). Candidates were unable, generally, to link the effect of acid on proteins in the membrane and ethanol on phospholipids. They did better on the explanation of osmosis resulting in the beetroot in water increasing in size, only gaining full marks if they mentioned that water entered the cells rather than the beetroot. Using technical terms correctly was crucial here.

Q. 5 This question needed application of knowledge about transport in and out of cells, cell structure, biochemistry of carbohydrates and the properties of immobilised enzymes. This question was, surprisingly, the best answered on the paper. Many candidates correctly identified exocytosis and could identify mitochondria and their function in the milk producing cell. However, very few candidates were able to look at the image and link membrane creation and removal to exocytosis and endocytosis respectively. In part b, although candidates made a good attempt at drawing the monosaccharides, fewer answers placed water correctly as a reactant. Nonetheless, hydrolysis was correctly identified and glucose and galactose were correctly identified in many cases. Part c proved more of a challenge as the candidates had to compare and explain the relative activities of free and immobilised lactase. Many candidates failed to explain the differences using technical language relating to enzyme-substrate complexes and successful collisions. Most candidates failed to understand that Benedict's reagent would give the same result on heating with the reactants and the products of the reaction so could not be used to monitor progress of the reaction.

Q.6 This question was about globular and fibrous proteins and their structure and synthesis in the cell. The example proteins were fibrinogen and fibrin. Most students correctly identified the highest level of protein structure as quaternary from the diagram showing its formation in the cell. There was a reasonable attempt by many candidates at explaining how the rough endoplasmic reticulum and Golgi body are involved in the production of fibrinogen, However, few candidates used the image which they were directed to in the stem of the question and so failed to really apply their knowledge in the context of the question. In part b they were required to link the soluble globular fibrinogen in solution in plasma to a conversion to an insoluble fibrous protein. Candidates who gained marks on this part of the question generally gained the marks for a description of the formation of a blood clot. In part c, some candidates correctly identified the peptide bond, but few were able to articulate why the arg-gly bond would be hydrolysed, but the gly-arg bond would not be in terms of the active site of thrombin. In part d, there were some good descriptions of competitive inhibition, but few candidates gained full marks as they failed to link the role of hirudin in helping the leech to feed effectively. Many candidates suggested a medical use for hirudin as an anticoagulant, although some confused this with the use of leeches to clean wounds and promote healing.

Q.7 This question was about the cell cycle and required an understanding of the importance of control of the cell cycle. This question was not well-answered and many answers were incomplete and focused on the first and last sections only. Few candidates identified more than three events in interphase that need to be completed before mitosis occurs. The first section was generally the best answered. In the second section of indicative content there was confusion between cells needing replacing in damaged or growing tissues and tissues having a high mitotic index, many candidates referred to cells having a high mitotic index, which is incorrect. Many candidates chose muscle cells being made, although this was credited, it would have been better to refer to skin cells, cells lining the gut or bone marrow stem cells, needing replacement. References to cell repair were also given incorrectly when tissue repair was the correct description. In the third part of indicative content candidates were required to explain the effects of abnormally high concentrations of cyclin B. Few candidates expressed this well. The marks for this section were disappointingly low and, in part, reflects an inability to articulate ideas as well as poor application of knowledge regarding the importance of control of cell division.

Summary of key points

To improve of their performance, I would encourage candidates to:

- Identify which parts of their knowledge are required to answer the question. Use the correct biological terminology when answering the question.
- Highlight or underline the command words in the question, “describe, state, explain” and especially “compare” where they must make a comparative statement.
- For calculations, lay out the formula clearly and set out the calculation in such a way that the examiner can see the process. Think about whether the answer makes sense and do not lose marks unnecessarily for the wrong number of significant figures, decimal places or failing to use standard form correctly.
- Make sure that they can explain the outcomes of practicals in detail and relate outcomes to the biological principles they demonstrate. Be prepared to see the practical in a different context.

BIOLOGY

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UNIT 2: BIODIVERSITY AND PHYSIOLOGY OF BODY SYSTEMS

General Comments

This paper provided comprehensive coverage of the topic areas within this unit. There was a range of questions, assessing both theoretical knowledge and practical skills. Only a very small minority of candidates failed to attempt to answer the questions, demonstrating that the paper was accessible to all. Many of the candidates found the practical questions very challenging and consequently gained few marks. The quality of written communication was also an issue for many candidates.

Comments on individual questions/sections

Q.1 (a) Many candidates struggled to interpret this image as it is more common to see a longitudinal section of the heart. However, the dissection of the mammalian heart is a required practical and if candidates had followed the method outlined in the lab book, they would have first-hand experience of this transverse section.

(b) The majority of candidates were able to interpret the graph of the cardiac cycle. The most common loss of mark was for incorrectly calculating the heart rate.

(c) Most candidates gained a mark for correctly rearranging the equation; however, many were unable to convert their volume from dm^3 to cm^3.

(d) This image should be familiar to candidates as it is also from a required practical.
Unfortunately, many labelled it as part of the gut wall. Very few candidates showed an understanding that the tunica media has a high proportion of elastic fibres, which stretch and recoil to force blood through the aorta during diastole.

Q.2 (a) This was generally well answered. A common loss of marks was due to candidates referring to *Planaria*, when the question was asking about *Lumbricus* i.e. they had not answered the question.

(b) This question produced a full range of marks with the best candidates demonstrating a good understanding of dissociation curves. Many candidates recognised the difference in metabolic rates between the two worms but did not link this to their oxygen requirements. Unfortunately, many lost marks for referring to the worm's affinity for oxygen and not their haemoglobin. Lack of precise biological terminology also resulted in marks lost.

Q.3 This proved to be the most challenging question on the paper. The rationale behind the question was to look at the effects of bile salts and lipase in lipid digestion – bile salts mechanically breaking down the lipids and lipase chemically digesting the lipids. The method for the practical investigation provided was a modification of the method provided in the teacher's guidance notes and student's lab book.

(a) Many candidates recognised that enzymes were involved in chemical digestion, but few candidates gained the mark for mechanical digestion.

(b) Most candidates thought that bile salts were synthesised in the gall bladder, not the liver. However, the majority understood the role of HCO_3^- in the small intestine.

(c) Very few candidates gained any marks here. They failed to recognise that at the start of the investigation the pH needed to be above 10 so that the indicator would be pink, allowing a colour change to be observed.

Although many recognised that adding different volumes of distilled water would ensure that the total volume of solution in the test tubes would be constant, they didn't link this to maintaining the concentration of the tubes contents; most importantly the lipid (substrate) concentration.

(d) Many candidates were able to explain the role of bile salts in the investigation but failed to explain the role of lipase in bringing about the colour change. Only the better candidates referred to both.

Again, it was only the best candidates that understood that test tube C was set up to show that bile salts on their own are unable to hydrolyse lipids.

Many candidates recognised that the endpoint of the reaction was subjective, with the majority suggesting colorimetry as an improvement. Although colorimetry would not produce accurate data in this investigation, students were given credit for recognising that it would produce quantitative data.

Q.4 (a) The majority of candidates correctly calculated the percentage of endemic species, but the majority thought that the difference was due to the difference in climate between the UK and Hawaii.

(b) This proved to be the easiest question on the paper with most candidates gaining full marks.

(c) Many candidates correctly interpreted the information provide and were able to construct the phylogenetic tree and provide a clear explanation of the methodology provided in the stem of the question.

(d) In the first part of the question, very few candidates gained this relatively easy mark. Many lost the mark for not stating the birds would be unable to interbree

In the second part of the question many explained that natural selection had led to the variety of beak shapes due to the diet of each species. Only the better candidates referred to adaptive radiation or divergent evolution.

Q.5 This question also proved to be very challenging for the candidates.

(a) In the first part of the question many students gained 2 marks, but it was only the better candidates that recognised that the lignin prevents the collapse of the xylem vessels during transpiration.

Being able to calculate the actual size (and magnification) of a specimen from an image is an essential skill in A-level biology. Unfortunately, many candidates could not convert between mm and µm and therefore lost a mark. For the second calculation, many candidates were able to rearrange the equation, but did not realise that they needed to convert their units from µm to mm.

(b) Only the very best candidates gained full marks. Most candidates described aspects of both transpiration and translocation. However, they failed to recognise that the observations were due to pressure gradients between the vessels and the atmosphere. Cohesion-tension generates negative pressure inside the xylem vessels and mass flow is the result of hydrostatic pressure gradients inside the sieve tubes.

(c) The first part of this question was simple recall, unfortunately very few candidates gained the mark.

The second part of the question was generally well answered, and many candidates gained most of the marks. Common errors included candidates referring to $^{14}CO_2$ being transported in the phloem.

Many candidates gave vague answers in the third part of the question. They failed to recognise that the young leaves were above, and the roots were below, the leaves supplied with $^{14}CO_2$. Only the better candidates referred to bidirectional flow.

In the final part of the question most candidates failed to recognise the phloem tissue in the vascular bundle, with their arrows pointing to the xylem vessels of the surrounding sclerenchyma tissue.

Q.6. Most candidates demonstrated a good knowledge of the adaptations of *Taenia solium*. Unfortunately, few had a good knowledge about *Pediculus capitus*, and many failed to address the first part of the question. As a result, only the best candidates gave ‘top band’ responses. The quality of written communication was an issue for many candidates with their responses lacking precise biological terminology. A common error was candidates referring to *Taenia* being a hermaphrodite, which therefore allows it to reproduce asexually.

Summary of key points

A minimum of 15% of marks available on each paper assesses practical skills. Candidates need to ensure that to be fully prepared for the exams they need to review their practical work as part of their revision.

A minimum of 10% of marks available on each paper assesses maths skills. Candidates must make sure that they are confident in their ability to convert between different units, such as mm to µm.

Candidates need to ensure that they read the stem of the question carefully. Many candidates demonstrated an understanding of the biology, but lost marks as they did not answer the question being asked.

When answering the QER question, candidates must ensure that they address all three parts of the question. They may find it helpful to use sub-headings to help structure their answer.

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UNIT 3: ENERGY, HOMEOSTASIS AND THE ENVIRONMENT

General Comments

The paper assessed the required breadth of topics including synoptic material from unit 4 and the Assessment Objectives (AOs) with the required weightings. The paper was adjusted to remove content that was synoptic with units 1 and 2. Attempt rates were over 95% for all questions except 4(b) and 4(c) and for these two were over 90%. Facility factors (FF), expressed as the mean mark as the percentage of the maximum mark, ranged between 40%and 60%for most items. Performance on some of the items requiring mathematical skills was poorer than expected and marks were lost because of poor written communication.

Comments on individual questions/sections

Q.1 Parts (a)(i) and (ii) targeted mathematical and practical skills.

In part a(i) candidates were expected to obtain the correct starting concentration of bacteria from the graph (2000), correctly calculate the dilution factor (X10) and multiply the two values. Responses were seen with errors at each stage, some that were unable to obtain the correct value from the graph, some that incorrectly calculated the dilution factor and some that incorrectly multiplied the two together. Part (a) (ii**)** was a simpler calculation involving reading values from the graph and simple subtraction. Many more correct answers were seen for this part.

There was a lack of accuracy in some responses to part (b)(iii), with some describing diluting a sample then suggesting counting bacteria without plating them on agar, referring to putting samples “in a Petri dish”, or counting cells through a microscope.

Parts (c)(i) and (ii) were highly accessible items, even so there were a significant number of inaccurate responses to part (c)(i), with some answering “round or circular” despite the question asking for a three-dimensional shapeand. Some candidates did not refer to the lipopolysaccharide layer in part (c)(ii) despite it being mentioned in the question.

Parts (d)(i) and d(i) targeted AO3 and many responses gained full marks, showing candidates’ ability to take information from different parts of the question to formulate conclusions.

Q.2 In part (a)(i) the most common error was to give a vague reference to low numbers to describe endangered, and marks were lost because of poor written communication. A minority of responses were awarded 2 marks for part (a)(ii), with some responses attempting to answer the question in term of intraspecific or interspecific competition.

Responses to part (b)(i) were almost all correct, though a small number referred to reafforestation or coppicing. Part (b)(ii) was less well answered with responses failing to use technical terms despite an instruction to do so in the question. Marks were also lost due to poor quality of written communication.

Part (c), which was synoptic with unit 4, was less accessible. In part (c)(i), only the best responses recognised that the Hardy Weinberg principle would not apply because the fragments were small and went on to link that with genetic drift. In part (c)(ii), most responses placed the fragments in the correct order of decreasing risk and linked that to the distance from the main forest, relatively few referred to the consequences for gene flow. In both parts (c)(i) and (ii), some responses referred to the fragments as islands surrounded by sea and although they were not penalised, provided they included the required marking points, it does indicate that there is an issue with candidates not reading the questions carefully.

Part (d) on the whole was not well answered. Part (d)(i) was simple mathematics involving areas of rectangles and percentages, but relatively few responses contained a correct calculation of the area influenced by edge effects and even fewer contained a subsequent correct percentage calculation. Some responses included a correct calculation of the percentage NOT influenced by edge effects but very few of those went on to subtract that value from 100%. In part (d)(ii) most responses included a correct description of the trend but there was some confusion about the term ‘abiotic’ in part (d)(ii).

Q.3 Part (a) was simple mathematics involving substitution into a formula, this proved to be the easiest question on the paper.

Part (b) targeted AO2, AO3 and practical skills and was more challenging. Part (b)(i) involved substituting values into the formula for a straight line. There were many responses which included the wrong value for x, some that had the correct value for x but incorrectly calculated y, and a few with rounding errors. Most responses had a correct answer for part (b)(ii), but very few responses referred to limiting factors in part (b)(iii). Candidates were expected to understand, from the data in the table, that the graph would have shown a plateau, it was clear that many did not.

Q.4 Part (a) was a straightforward AO1 question about hormonal control of osmoregulation. There was some confusion in part (a)(i), with some responses referring to concentration of blood as the source of the impulses. Parts (a)(ii) and (iii) were correctly answered in most responses. Precision was the issue in part (a)(iv), with some responses referring to kidneys, the nephron, or the wrong part of the nephron.

Part (b) was also an AO1 question, this one about the action of ADH on its target cells. The best responses seen gave clear and accurate descriptions of the role of aquaporins, movement of water by osmosis and the consequences on volume and concentration of urine. The poorest responses gave a description of how changes in concentration of the blood brought about the release of ADH.

Part (c) targeted AO2, its relatively high level of demand was due to the requirement of the candidates to apply knowledge from one part of the specification to an unfamiliar situation in a different part of the specification, responses were seen in which verbatim accounts of synaptic transmission were given.

Part (d) targeted AO3 and candidates were expected to predict the effects of water retention. This was the least well answered question on the paper. Few responses were seen in which a dilution of body fluids was predicted and even fewer which correctly described osmotic consequences for cells.

Q.5 Part (a) targeted AO1 and tested knowledge of the light-dependent and light-independent reactions of photosynthesis. The relatively poor responses by many candidates showed a possible lack of preparedness in these topics. The best responses named both ATP and reduced NADP as the products of the light-dependent reactions and gave a specific use for each in the light-dependent reactions. The poorest responses gave a vague statement such as 'the products of the light-dependent reactions are used in the light-independent reactions' which was essentially given to them in the question. There were some responses which gave NAD instead of NADP.

Part (b) targeted AO2 and AO3 and practical skills. In part (b)(i) most responses identified B as the correct sequence, however some responses included reference to the Calvin cycle pathways rather than using the results of the experiments. Part (b)(ii) was less well answered. The best responses gave a clear interpretation of the experimental results and suggested a suitable nitrogen containing compound. The poorest responses just described the results with no interpretation, e.g., 'X was not present in experiment 2 when there was no nitrate' and did not give a suitable nitrogen containing compound.

Part (c) was less accessible than expected. Precision was an issue with part (c)(i). The best responses gave 'the stroma of chloroplasts', many responses just gave 'chloroplast', some incorrectly gave 'mitochondria', and some gave impossible answers e.g., 'the cytoplasm of chloroplasts.' Part (c)(ii) required candidates to calculate the size of an object shown in a photograph using a scale bar. Questions of this type regularly appear on A level biology papers, so it was disappointing to see many responses in which an incorrect formula was used, especially where the length X-X on the photograph was simply multiplied by the length of the scale bar. Also, there was a great deal of confusion about converting between units which was added to in some cases where measurements had been taken in centimetres.

Part (d)(i) appeared to have been readily accessible. Most responses included reference to increased uptake of CO_2 by plants with carboxysomes but in some responses there was lack of clarity as to how farmers would benefit. Part (d)(ii) was more demanding and fewer responses obtained full marks. Some responses neglected to refer to the carbon cycle and described GM crops escaping and competing with wild plants.

Q.6 Part (a) was a straightforward AO1 question about respiration and was a good discriminator. There were numerous responses that did not refer to ATP production or energy provision. The most common error was to refer to muscle contraction as a specific cell activity even though 'all organisms' was specified in the question.

Parts (b)(II) and (III) targeted AO2 and candidates were expected to use information from Image 6.1 to determine the answers. This proved to be more difficult than expected, a range of different answers were seen with errors most common in part (b)(II).

Part (c) was an AO1 question about the nature of chemical reactions in respiration. The question was less accessible than expected. In part (c)(i) many responses were seen which gave a vague reference to oxygen availability without distinguishing between acetyl CoA and lactate. In part (c)(ii) there were plenty of responses indicating knowledge that the reactions were redox reactions but confusion about which was being oxidised and which reduced, as well as lack of clarity about the role of the coenzyme.

Part (d) targeted AO3, and candidates were expected to extract information about the nature and names of scientific processes from Image 6.1 as well as making predictions based on the information. Almost all responses correctly gave 'glycerol' as the answer to part (d)(i). There was a range of answers seen for part d(ii) and the most common errors were to make no reference to the terms synthesis and condensation which were given in Image 6.1.

Q.7 There was a large variation in the amount of content in responses; varying from a few lines to the three sides provided.

The question targeted AO2 and AO3 as well as testing quality of extended response (QER) and it proved to be a good discriminator. Many responses contained quite detailed accounts of the processes involved in eutrophication but too often no reference was made to the information provided in the images. Similarly, there were plenty of responses which described the results of the experiment shown in image 7.3 without making reference to the low nitrate medium. There were also many responses which gave general accounts of any possible impact of humans on the environment. The best responses linked their accounts of the environmental impact of agricultural practice to features visible in the images; they gave a clear interpretation of the experiment with explicit reference to the low nitrate medium and made a clear link to the presence and relevance of root nodules. They also made suggestions on how environmental impact would be lessened which were clearly linked to the first two sections.

Summary of key points

Quality of written communication continues to be an issue. Although there is a Quality of Extended Response (QER) question which explicitly assesses quality of written communication, candidates need to address this in other questions too. What a candidate writes must make sense; examiners cannot award marks for answers which do not make sense. Clarity is also important, candidates must not rely on examiners knowing what is meant by a vague response, examiners are simply not allowed to fill in anything omitted from a candidate's response. Candidates should be encouraged to re-read each response to make sure it makes sense and is clear.

Relying too much on recall is another recurring issue. The number of marks for AO1 is limited on this style of paper, there are many more marks for AO2 where candidates are required to apply knowledge to information provided in the question. In was evident in this examination that some candidates had read the question briefly, identified the topic and given a recall answer for that topic. Candidates should be trained to read questions in detail and use as much of the information provided in rubric, tables, graphs, and images as possible when they write their answers.

Where mathematical skills are being tested and especially when the question asks for workings to be shown, candidates are most successful if they present their calculations in a well ordered and fully labelled sequence, always including appropriate units. Candidates should avoid writing a jumble of unrelated and unlabelled numbers and they should only use the equals symbol if the components either side are actually equal. Care needs to be taken with the rounding of numbers, if the question does not specify the number of decimal places required candidates should round to the same number of decimal places as other numbers provided in the question.

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UNIT 4: VARIATION AND INHERITANCE

General Comments

General Comments

Most questions had been attempted by candidates and there were some superb responses showing clear knowledge and understanding of biological principles. However, there were many responses showing confusion, lack of knowledge and understanding, incorrect terminology and poor explanations.
The application of knowledge questions tended to be weaker. Candidates are not able to apply their biology knowledge to real situations or using the information they are given. Handwriting in many cases was very difficult to read.

Comments on individual questions/sections

Q.1 (a) Generally well done. The main incorrect answer to (i) was implantation.

Part (ii) was straight recall, but far too many started with the mechanics of getting sperm into the reproductive tract. This wasted time instead of getting on with what they were asked for, which was fertilisation.

(b) The answer here was in the diagrams- cilia waving to move any correctly named stage along the fallopian tube from ovary to uterus. This was often poorly answered, again frequently because of poor terminology.

(c) This section was poorly done. Candidates needed to apply the information given in the table. Better candidates worked out in (i) that both sheep and horses would lamb/foal in the spring. This would mean that the weather is warmer and there is more grass for the ewe/mare (thus more milk available for the lamb/foal). Few could explain why ovulation occurs towards the end of possible mating time, even though they had needlessly explained, in detail, in (a)(ii) about sperm taking time to swim all the way to the secondary oocyte, surviving for a number of days and being in place prior to ovulation.

Q.2 (a) If candidates had used the information they were given, this question was very accessible. The graph showed that there was no hCG prior to pregnancy and that hCG levels rose very rapidly if there is a pregnancy. This means it is easy to detect and there are reduced chances of false positives. This was all that was needed, not long explanations of why the other two hormones were not suitable.

(b) This was surprisingly poorly done, bearing in mind that most candidates should have known the importance of the control line showing that the test has worked correctly.

(c) Largely well done.

(d) One of the poorest scoring questions on the paper. All that was required here was the two sides to the effect of a mutation, i.e. 'some mutations mean that hCG protein may not change shape and so have no effect on pregnancy, whereas big shape changes in the hCG protein mean it will not be recognised and so the pregnancy may fail.

(e) This was straight recall; they had either learnt it or not. A common error here was to state that the uterus stretches to accommodate the growing foetus. It is not a balloon, but a muscle. It grows.

Q.3 (a) The maths was largely well done in part(i). Common errors were confusion over p and p^2. This led to mistakes in the calculation and subsequently incorrect answers.

In part (ii), candidates were told that the malaria parasite cannot survive in cells with the Tt mutant haemoglobin. This inferred therefore that it was possible for them to become infected with the parasite. Too many responses stated that Tt individuals would not get infected. They do get infected, but something about the haemoglobin means that the parasite is disadvantaged – candidates needed to offer a sensible suggestion of what that might be and why it conferred a resistance to malaria.

(b) The first two parts were general well done, but (iii) was not. Yet again the answers were in the diagram. Correct responses referred to; a need to know where genes are and their sequence, the base sequence of the normal or replacement gene and the base sequence for the RNA guide (the latter two being in the diagram given).

Q.4 (a) Well done by most, although there were a significant number who misread the graph and mixed up the colours/banding.

(b) The majority sailed through the Chi squared, with the only problem being not rounding up to 39.45 (39.44) or only giving the figure to one decimal place (39.5). Candidates should be looking at the Chi-squared table opposite to confirm that if the table is two decimal places, then their answer should be too. Although the null hypothesis was given in the text, that the snails were equally distributed, a significant number of candidates tried to calculate some other figures for the expected column, presumably trying to make a genetic ratio of some sort.

(c) This was marked using the value from the candidates calculation, so the logic had to be correct for their Chi squared value. Although (b) may have been incorrect, most were able to correctly apply their knowledge. This was the best answered question on the paper.

Q.5 (a) This was another recall question, which if they had learnt it, routinely scored full marks. Poor terminology lost marks here, candidates should have been referring to gametes/nuclei, polar nucleus/ei (not polar bodies) and endosperm/triploid nuclei.

Part (ii) led on directly from (i), this was missed by many candidates. If there is no embryo, there is no point in carbohydrates/proteins/lipids being synthesised and stored in a sterile seed. Evolution has ensured that does not happen. Double fertilisation means no zygote=no endosperm (kernels in this case); candidates need to understand this.

(b) This was one of the lowest scoring questions on the paper. This question was about seed dispersal, but very many candidates gave answers referring to pollination. Candidates were told in the text that they are seeds, so as such they would not have anthers, feathery stigmas etc. The photos and their labels, i.e. feathery parachutes on seeds, should have given the clue to wind dispersal and hooks to attach to fur would indicate animal dispersal. It was very disheartening to see so many A level biology students with no clue about seed dispersal.

(c) Those candidates who looked at the text and photos identified both variables correctly, although there were many incorrect responses with all kinds of variables. Conclusions were generally good, but relied on candidate's knowledge of germination, which was straight recall.

Q.6 The information given should have made candidates aware that this was an application of knowledge question. In this case there was text, photographs and a map. There was a distinct reluctance to use these resources in candidate's responses and yet most of the marks could have been gained from reading the text correctly, looking at the photographs and interpreting the graph. There were few really strong essays which was very surprising, given that this is a highly topical subject and that biologists should know the diverse effects of rising global temperatures on ecosystems.

There were three parts to the answers, but candidates spent very little effort with the last section and thus dropped overall credit for the essay. There is a vast difference between viable and fertile and candidates are totally confusing the two terms. Hybrids can be totally viable; mules, zebronkeys, tigons, ligers etc, may live long (and useful in the case of mules) lives, but they are not fertile because they cannot produce functional gametes.

Summary of key points

- It is important that candidates are trained to use the given material more effectively to answer questions. Ensure they do not neglect going back to the stem of the question/text/graphs/tables/photographs. The answers will, in part, be in that information.
- Encourage the use of correct biological terminology for all areas of the specification; incorrect/unscientific terminology is not acceptable.
- Please impress upon candidates not to fold their script in half. Frequently the information they need is right opposite the question; it is no use folded round the back.

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UNIT 5: PRACTICAL EXAM: EXPERIMENTAL TASK

General Comments

Unit 5 is assessed through two papers – an experimental task and a practical analysis task. Some general comments are given below together with a separate report is provided on each paper.

Both of the papers for Unit 5 should be sent to examiners in the same envelope with both papers for each candidate together. Exam papers should be in the same order as the names on the Attendance Sheet. In many cases this year, papers from the Experimental Task were sent separately to the papers for the Practical Analysis and in quite a number of cases, the papers were in random order. This increases the chance of scripts not being matched up or indeed, getting lost.

During the experimental task official graph paper should be provided if a candidate needs to redraw their graph. However, some centres provided loose-leaf graph paper and candidates used this graph paper rather than the graph paper in the examination booklet. On both papers, additional space is given at the back of the exam paper for candidates to continue their answers as necessary. Extra booklets should only be provided if a candidate fills the additional space on the examination paper.

The process of devising tasks for the practical examination involves extensive testing by the Principal Examiner, the Reviser for the paper, members of the Qualification Paper Evaluation Committee (QPEC) and other centres. The aim, as always, is to produce experiments that will enable candidates to collect all required results in 45 to 60 minutes at most.

However, as we know, biological investigations can be affected by many factors, for example, age of the enzymes, temperature of the laboratory, make of reagents. To allow for these factors, centres are required to trial the experimental method supplied to centres one week before Test 1. This enables them to identify issues that they face and to adjust concentrations / methods as required to enable candidates to collect their results in at most 1 hour. Centres also need to collect a set of results to be submitted with the exam papers.

If candidates experience problems in getting a practical to work, teachers should provide them with the centre's unformatted results at least 1 hour before the end of the exam. If a centre experiences problems getting the practical to work, WJEC will provide advice and suggestions as to what teachers / technicians can do to get the practical to work. In the event of a centre being unable to collect their own results, WJEC will provide a set of unformatted results that can be provided to candidates if they are struggling to complete the practical in the first hour of the examination. If results are provided to a candidate this should be recorded on the exam paper.

However, even if candidates are provided with results, it is important that they attempt the practical so that teachers can award the mark(s) available for observation of practical skills.

It is also important that the teachers in charge of a group of candidates do provide unformatted results as soon as they realise that a candidate is struggling. It is evident from the comments received from teachers that some students were not provided with results early enough in the practical examination.

Comments on individual questions/sections

(a) Table

The rubric of the question asked students to record the times, in seconds (to the nearest 10 seconds) for the iodine to not change colour for each extract. Depending on whether a candidate sat Test 1 or Test 2, the extract referred to days of germination or temperature of germination.

Headings:
Many students just stated extract with no reference to the independent variable. For the dependent variable, many stated time for a colour change or just stated time. The headings in a table of results must be informative and state the independent and dependent variables.

Units:
Days was often included in the heading for the IV which was acceptable. Candidates were informed to record time in seconds and this should have been stated in the column heading. Some candidates gave the unit as time… to the nearest 10 seconds. This was also acceptable as they were told to record times to the nearest 10 seconds.

Note: some candidates persist in including a separate column for the mean which does not come under the heading for the DV. In this case both the heading and unit must be repeated in the heading for the mean column.

Data:
Most students followed the instructions and did record all times to the nearest 10 seconds. Some students, however, recorded time to the nearest second or even 100^{th} of a second.

Mean:
If times are recorded to the nearest 10 seconds, means should be calculated to the same level of precision. Where means were calculated to the nearest second or to 1dp this was accepted. Rounding, however, was an issue and many candidates lost marks here.

(b) Graph

Use of grid: No major problems here; the vast majority made very good use of the plotting area available. Some lost marks by starting the y axis at 0 rather than another value which would have enable them to double the scale on the y axis and gain this mark.

Axis labels: Error carried forward was applied extensively to both x and y axis labels. However, many lost this mark as they did not include **mean** in their y axis label.

Axis units: Again, error carried forward was applied for both axes.

Scales: Most candidates included numbers at the origins of the axes. However, many candidates chose scales on the y axis that made it difficult to plot their results (eg., 0, 30, 60…) and a large number did not give a linear scale on the y axis.

Plotting: Most data points were correctly plotted. Some errors were made where difficult scales were used. Candidates should be reminded of the need to use a sharp pencil and that there is a tolerance of only ½ a small square on each plot.

Despite being told that Range bars are **not** required, many continued to include them. In some cases this made it difficult to use a suitable scale on the y axis.

Line: Common practice in Biology is to connect the **centre** of each plot to the next with no extrapolation. However, suitable curves of best fit and indeed straight lines of best fit were accepted. Again, sharp pencils are essential, whatever line is drawn. Many lines missed the centres of plots or were not accepted due to the thickness of the pencil used. Rulers were not used in many cases and lines of best fit, often did not match the data plotted.

(c) (i) Linking the IV and DV

Marks were lost here by many candidates because their conclusions did not match their data. For example, if the time taken for the iodine to not change colour reached the lowest value at 8 days of germination and then increased at 10 days, this needs to reflected in their answer.

(ii) Control

Most students identified that seeds vary in size and that each seed can therefore contain more or less amylase. What was less commonly recognised is that this is a confounding variable so changes in the time taken for the iodine to not change colour would not definitely be due to number of days or temperature of germination.

(iii) Subjectivity

This question was well answered, even if candidates expressed their answers in many ways. Many, however, left themselves down by being imprecise by repeating the rubric in the question stem, eg., different colour perception could affect the reproducibility.

(iv) Times

Recording times to the nearest 10 seconds does not enable the calculation of accurate times. Many students overcomplicated their answers to this question.

(v) Seedlings

Candidates were told that seedlings produce leaves. At this point in Year 13 they should know that starch reserves are mobilised and digested in germinating seeds to provide the carbohydrate needed for respiration. Many did not, however, make the link to leaves enabling the seedling to carry out photosynthesis, hence the reduced amylase activity.

Summary of key points

Overall, despite difficulties faced by some centres and the impact on practical work due to COVID, most candidates performed well on this paper.

- However, more errors were evident in construction of tables and in drawing graphs than in previous practical examinations.
- Candidates need to read and understand the rubric of a question before attempting to answer that question.
- Candidates should also be reminded to be clear when communicating their answers – the use of words such as it, they, those should be discouraged.
- Teachers are reminded that practical skills are tested on each theory paper (a minimum of 15% of the marks). Therefore, even when there are difficulties in carrying out practical work, candidates do need to be taught these skills.

BIOLOGY

General Certificate of Education

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Advanced Subsidiary/Advanced

UNIT 5: PRACTICAL EXAM: PRACTICAL ANALYSIS TASK

General Comments

Some excellent answers were seen in the Practical Analysis Task. For question B1, concerning a field work investigation, performance data show that attainment was very similar to that of 2019. The mean scores and facility factor were equivalent, although the spread of results was slightly greater. Data for question B2, on microscopy, show a lower mean and facility factor, while the spread of results was equivalent to previous years. Taken together, these data may reflect the lack of opportunities for microscope work over the two years of this course.

Comments on individual questions/sections

Q.1 (a) (i) Candidates understood the premise of this question, but some should remember to answer the question directly; it was unnecessary to described the fate of digestion products.

(ii) Most candidates recognised that three rodents were eaten but some did not clearly state that one animal requires both halves of a jaw bone. The volume of fur was irrelevant.

(b) (i) As part of the Risk Assessment, candidates should state the context in which the activity is carried out.

(ii) The study concerned the contents of the pellets, not their distribution, which the stem of the questions had already shown to be non-random. Many did not appreciate that random co-ordinates for placing a quadrat were, consequently, irrelevant.

There was an indication that random sampling using quadrats was not well understood by candidates who described the area of the quadrat in relation to whole woodland area.

Many observed that a 0.25m^2 quadrat was unlikely to fit over a tree, which was true but not relevant.

In addition, there was misuse of the word ‘even’ when ‘random’ was meant in describing owl pellet distribution.

(c) (i) Most candidates suggested the reason for using a χ^2 test was to allow a comparison between observed and expected data or described data as being categorical. Some did not realise that this test does not compare means.

It should be noted that the name of the test can be hand-written as 'chi^2', 'chi squared' or 'χ^2'. Many write x^2 instead, which is incorrect but was not penalised.

(ii) A surprising number of candidates did not seem to realise that the χ^2 test can be used in situations other than testing for Mendelian inheritance. Answers were, consequently, inappropriately modelled on the terminology used in genetics problems.

- Some candidates described χ^2 as being 'to the right' of the critical value, even though no table of critical values was given.
- As this question uses a statistical test, difference must be described as 'significant'.
- If an answer is designed to discuss the effect of chance, 'deviation due to chance' must state what the deviation is from i.e. expected values.
- In writing about deviation from expected values, some candidates wrote about 'variation'. In a biological context, 'variation' refers to different readings within a data set, not between data sets.
- A null hypothesis is either accepted or rejected. It is not right or wrong, true or false, proved or disproved.

(iii) In explaining the meaning of n, candidates that cited 'the number of phenotypes' were incorrectly applying the terminology used for testing for Mendelian inheritance. Some incorrectly cited the number of rodents of each species.

(d) (i) Candidates are advised to be very careful with the use of pronouns. If a candidate writes 'it is living', it must be very clear what 'it' refers to.

(ii) Many correctly described a change in the physical environment or in owl behaviour throughout the year that might affect the number of owl pellets collected. Very few recognised that rodent behaviour might also be a factor. Some cited owl migration or hibernation, neither of which tawny owls do, but as a general comment on animal behaviour, this was not penalised.

Candidates' own experience of weather should have made them realise that controlling for the time of day does not guarantee identical temperature, humidity, rainfall etc. Consequently, suggestions concerning animal behaviour were more appropriate.

(iii) This question illustrates the importance of reading the question very carefully. Many interpreted it in terms of owl or tree population size, rather than the number of owl pellets collected, showing they had not read the label on the graph's y axis carefully enough. Similarly, the trend over time was asked, not the relative numbers within each of the two years for which data was presented.

A value judgement is required in describing the trend i.e. more or fewer pellets collected, rather than merely quoting data.

The role of human influence was rarely appreciated.

Q.2 (a) The correct use of the terms ‘magnification’ and ‘resolution’ appeared to be centre- dependent. It should be noted that light microscopes do not ‘zoom’.

(b) (i) Many candidates did not understand how to use the scale in Image 2.2 and wrongly invoked the objective magnification for the image, dividing 60,000 µm by 40.

Some gave large answers e.g. in the mm or cm range, indicating the need to sense-check the answer of any calculation.

(ii) Many got the ratio upside-down and some did not reduce the ratio to x:1, despite this being indicated in the answer line.

(iii) Many referenced stages of mitosis or meiosis in their answer, apparently not noticing the appearance of a vacuole occupying most of the cell in the diagram.
There is no need to repeat the wording of a question so reference to roots growing was unnecessary.

(c) As stressed in Examiners’ Reports over many years, a label line should be drawn using a ruler, as a single line, not an arrow. The line should end precisely within the structure being labelled, not just touching its edge or floating nearby.

Circling a structure is not adequate as too much in addition to the structure in question is encompassed by the circle.

A frequent error in questions requiring the labelling of two structures is that labels are reversed.

(i) This required the recognition of the centromere as a constriction. Candidates were not penalised for labelling the secondary constriction seen in two of the chromosomes.

(ii) A single line ending within a chromatid was expected although if a single chromatid was bracketed at its end, the candidate was not penalised. Where a bracket was along the long axis of the chromosome, it was not clear if a single chromatid or the whole chromosome was indicated.

(d) The provision of acceptable answers appeared to be centre-dependent and it was clear that over the past two years some centres had not been able to provide their students with enough experience or understanding of light microscopy.

(i) Staining ‘so you can see them’ is self-evident from the question and some understanding of light absorption or contrast was required here.

(ii) Iodine was a very common answer, indicating a lack of practical experience. The colours of photomicrographs provided routinely in text books are unlikely to be the yellow-brown of iodine and the WJEC lab book stipulates methylene blue for this exercise.

(iii) Few understood that the x40 objective has a very small depth of focus, hence the need for a very flat specimen, though some suggested an understanding and worded their answer to include the concept of focusing the entire specimen at one time.

'Squished' is not a scientific term used to describe making a root tip preparation.

Summary of key points

- This Data Analysis Task required candidates to analyse the information presented to them in the context of their practical experience. It relies little on recall and repetition of learned information. Candidates are advised to approach this task, therefore, in expectation of interpreting and evaluating what is actually on the paper, rather than what they can remember.
- Candidates' use of language sometimes compromises the quality of their answers. Many would benefit from reading widely throughout the course, to enhance their literary style and their ability to write clearly. For example, the use of the pronoun 'it' is often used ungrammatically, making it unclear what the candidate is referring to. It is best to avoid colloquialisms, and to use scientific terminology. Candidates might also watch relevant videos and listen to relevant podcasts to enhance their understanding of the significance of biology and means of expression.
- Examination questions should be answered directly without repeating the question and with only information that the question has asked for. While repeating the question may be part of the thinking process, a better examination technique is to think before writing, to use the time and space available most efficiently.
- As always, the space allotted to each answer is a guide to the extent of the expected answer. If significantly more space is used, candidates should question whether they have understood what is being asked.
- Many candidates perform well in questions requiring calculations. There is plenty of space in the answer booklet where rough work may be done, so that the space for the answer should have only a logical sequence of mathematical statements. Examiners should not have to have to hunt for aspects of the correct answer in order to award credit.

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk