

GCE



**Chief Examiner's and
Principal Moderator's Report
Life and Health
Sciences**

Summer Series 2019

Foreword

This booklet outlines the performance of candidates in all aspects of this specification for the Summer 2019 series.

CCEA hopes that the Chief Examiner's and/or Principal Moderator's report(s) will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This booklet forms part of the suite of support materials for the specification. Further materials are available from the specification's section on our website at www.ccea.org.uk.

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GCE LIFE AND HEALTH SCIENCES (SINGLE AWARD AND DOUBLE AWARD)

Principal Moderator's Report

Introduction

In the 2019 cohort of candidates taking AS level Life and Health Sciences the samples provided for moderation across the internally assessed units indicated that teachers for the most part had:

- Provided their candidates with suitable and appropriate learning opportunities and activities to present portfolios of evidence which would demonstrate the achievement of all Learning Outcomes and allow them to access all mark bands in the Assessment Objectives for the subject specification.
- Applied the assessment objective mark criteria correctly and awarded marks commensurate with the quality of the candidate response.
- Improved their use of essential teacher annotation.

Candidates continue to access marks in the higher mark bands in the Learning Outcomes and Assessment Objectives which require them to:

- List materials and equipment, draw diagrams and present results tables etc.
- Demonstrate safe and skilful practical techniques.
- Make observations with appropriate precision.
- Devise, refine and select appropriate techniques in their introductions for Unit 1 and identify and use appropriate activities and techniques in their investigations in Units 4 and 6.
- Select and handle their own and others data in an appropriate way whether that be tables and graphs in Units 1, 4 and 6 or in factsheets and summary observations and reports or work logs in Units 4 and 6.
- State trends and patterns.
- Irrespective of working with periodic times and pendulum lengths (Unit 1) or the bioassay and quantitative analysis (Unit 6) be able to handle and translate data from one form to another.
- Write clearly, coherently and fluently using a high level of scientific terminology and specialist terms.

Nevertheless in the more challenging assessment objectives of Assessment Objective 2 and Assessment Objective 3 candidates continue to find it more difficult to access the higher mark bands:

- Recording methodically; across the AS internally assessed units, precision and methodical recording was not consistent.
- Apply skills, knowledge and understanding of processes; techniques and equipment to a range of contexts; this application should be evidenced across all three AS units in report and investigation introductions, hypotheses, suggested outcomes and indeed the assessment of risks and the detail of how data might be handled e.g. in graphs etc. This was not always present to allow for higher mark bands.

- Whilst risk assessments were always present across the internally assessed units frequently there was a lack of detail and the generic nature of some risks showed little application to the particular report, investigation or piece of research.
- Researching, using primary and secondary sources, and analysing and presenting findings from the research undertaken; once again this did stretch candidates across the units.
- Interpret, explain, analyse, evaluate, draw conclusions from their own and others investigative and experimental activities making reasoned arguments; this is where candidates found it most difficult to access the higher mark bands Introductions, report findings, conclusions, refinements and evaluations across Units 1, 4 and 6 is where candidates are still experiencing difficulty. There has been a marginal improvement in drawing conclusions.

Teachers and assessors hoping to optimise the achievement of their students should take note of the following outcomes of the moderation process across the internally assessed units of this specification.

- The subject specification indicates that centres must use the Candidate Mark Records. This does not happen in a small but significant number of centres.
- Where Candidate Mark Records had been correctly used by centres this was to the advantage of the candidate allowing the centre to identify where marks had been awarded in the portfolio and why they had been awarded. Thus, making clear the mark and mark band. It is preferred that teacher marking and annotation is conducted in red pen.
- The setting of appropriate and suitable pupil objectives and activities by the teacher is key to providing candidates with the opportunity to access the full mark range.
- Candidates must appropriately reference all the materials they use in their work, including any online resources, using the Harvard referencing system where appropriate.

In conclusion candidates continue to find the following category of marks accessible; organising and presenting information, making precise observations, devising and refining experimental and investigative activities, selecting appropriate techniques, describing trends and patterns from data in tabular or graphical forms and translating data from one form to another. On the other hand candidate responses to the following category of marks are much less accessible; methodical recording, applying skills, knowledge and understanding of processes, techniques and equipment to a range of contexts, carrying out detailed risk assessments, researching using primary and secondary sources, and interpreting, explaining, analysing, evaluating and drawing conclusions from their own and others investigative and experimental work. Centres continues to achieve differentiation across the units as is evidenced by the mark range.

It is important to note that support is available to address any of the issues raised in this report by way of the Centre Report TAC6, Agreement Trials and Portfolio Clinics and the most up-to-date information and support material on the CCEA website.

The following Unit-specific comments have been provided by the relevant Assistant Principal Moderators, incorporating feed-back provided by the moderators in their various teams. The comments are intended to direct centres towards best-practice in the generation of candidate portfolio evidence.

Assessment Unit AS 1 Experimental Techniques

Portfolio Requirements

In the 2019 cohort the majority of centres met the requirement to use the updated CCEA Portfolio Checklist and Candidate Mark Record for this unit whilst others also use the candidate response proforma to structure their evidence. The majority of reports had been produced according to the requested format and this year essential teacher annotation was present and impactful.

Learning Outcomes and Assessment Objectives

On the whole with few exceptions, centres had completed 12 reports matching each of the Learning Outcomes 1.1.1 through to 1.3.4. Consequently, it was clear from the presentation of the portfolios that the requirement for all learning outcomes to be evidenced had been met. Once again a small but significant number of centres are not using the learning outcome codes posing some difficulties when matching the report to the teacher awarded mark.

Candidates were generally able to: *organise and present information, make observations with appropriate precision, devise and refine experimental and investigative activities, selecting appropriate techniques, translate data presented as prose, diagrams, drawings, tables or graphs successfully from one form to another and write succinctly, clearly and coherently using specialist terms with appropriate referencing*; as was evidenced in the report introductions, materials and apparatus lists, procedures, risk assessments and results. In these assessment objectives, as was evidenced in the materials and apparatus and procedure sections of their reports for each Learning Outcome candidates were able to access the full mark range. Candidates were not able to access the full mark range in the following areas; methodical recording, applying skills, knowledge and understanding of processes, techniques and equipment to a range of contexts, carrying out risk assessments, researching and using primary and secondary sources, and Interpreting, explaining, analysing, evaluating and drawing conclusions from their own and others investigative and experimental activities making reasoned arguments.

Candidates continue to be unable to reach the top band because they are unable to:

- In their introductions state a prediction/hypothesis or expectation of results in anyway referenced/linked to the centre-defined objective or include relevant scientific reasoning.
- Provide detailed risk assessments with detailed outcomes and plans to minimise or eliminate the hazard.
- In their Results section include all units graph axes and tables.
- In their Conclusions state their findings and evaluate the method in terms of limitations and errors. Suggest refinements or improvements for future investigation and refer with confidence to the terms accuracy, precision, and repeatability/reliability.

Once again a significant number of candidates scored within the lowest mark band for their conclusions across the Learning Outcomes.

Assessment and Award of Marks

Before referring in general to this area it is important that we remind centres of the importance and the need for properly conducted and controlled internal standardisation of a centres assessment and award of marks where more than one teacher is delivering the

specification. If this process is not properly conducted within the centre the inconsistent marking which may result could have an extremely detrimental effect on the marks submitted. This important issue notwithstanding the majority of the teacher assessment and award of marks was appropriate and within tolerance matching the assessment objective mark criteria for this unit. Centres had successfully used the updated Portfolio Checklist/Candidate Mark Record. The use of these documents ensured that teachers and candidates could easily evidence the presence of all the Learning Outcomes associated with this unit and indicate where and in which band marks had been awarded. Teachers were slightly lenient in their marking of introductions across the Learning Outcomes where no reference or links had been made to the investigation objective and the expected findings.

Assessment Unit AS 2 Human Body Systems

This paper provided candidates with a range of abilities the opportunity to achieve marks in each of the seven questions provided.

In general candidates performed well on the paper. The standard of answering was as expected, with a full range of response levels. There was a good range of questions to allow D/E grade candidates to respond but equally some demanding questions to allow discrimination between B/A/A* candidates (e.g. Question 3(c), Question 4(c)(ii) and Question 7(b)(iii)).

However, it is also clear that, as in summer 2018, a loss of marks was due to the inability to recall factual information. For example, many candidates were unable to recall the normal heart rate (Question 4 (a)(i)), or information on the correct usage of the peak flow meter (Question 6(a)).

Candidates of all abilities achieved the majority of marks for Questions 1, 3 and 5. In addition, most candidates successfully gained marks from the mathematical content of the paper; in particular, Question 1(a), Question 3(a), Question 5(b). Candidates of all ability found Question 7 challenging. Where applicable, candidates also achieved marks for Quality of Written Communication.

- Q1 (a) (i)** In general this was answered well – most candidates were able to calculate 27.1 or 27% for two marks.
- (ii)** Most gained two marks here. Some did not compare and just stated ‘has 30g of fat’ etc.
- (iii)** Most identified that the healthy pasta had a higher sugar content. Some, incorrectly, responded that there was ‘less energy’.
- (iv)** Somewhat worryingly, often students who answered ‘less energy’ in Part (iii), answered that this could result in weight loss/anorexia. However, most students answered correctly citing tooth decay, diabetes (the most common answer) and obesity.
- (b) (i)** Well answered and compared. Many described the difference in sugar, Vitamin B and C. References to fibre were much less common, with a small number of students indicating incorrectly that lower fibre in the banana was a positive nutritional benefit.
- (ii)** Many candidates showed confusion between the body functions of Vitamins B, C and Vitamin D. The most common function cited for Vitamin B was to release energy from food.
- (iii)** Better answered than Part (ii). The most common response was to prevent scurvy. Some incorrectly referred to maintaining a healthy immune system.

- Q2**
- (a)**
 - (i)** It was extremely disappointing to note several candidates who did not provide a definition for homeostasis.
 - (ii)** Most candidates achieved 1 or 2 marks here. The majority of candidates could not cite three correct functions of ions. The most common correct response was regulating the amount of water in the blood. Others correctly described the role of ions in maintaining blood pH.
 - (b)**
 - (i)** The majority of candidates correctly answered hormone.
 - (ii)** The majority of candidates could describe aldosterone decreasing but failed to link this to negative feedback. Relatively few candidates responded with negative feedback, which proved to be a discriminating marking point.
 - (iii)** Most were able identify less salt in diet as a cause of hyponatraemia. Others then incorrectly linked the development of this condition to not drinking enough water. Few candidates achieved both marks here.
 - (c)** This was generally well answered, with most gaining two or three marks. The most common answers were, hypertension, CHD or strokes. A significant number of candidates incorrectly referred to cholesterol or obesity.
- Q3**
- (a)**
 - (i) (ii)** Many candidates were able to complete the table and gain all three marks here. Those that did not used the same food twice – most commonly liver. Also, marks were lost if, for example, the number of eggs were not given.
 - (b)** This was generally well answered, and most candidates gained at least one mark.
 - (c)**
 - (i)** This was a discriminating question. Many vague answers were provided, for example, needed for growth of the baby.
 - (ii)** Most candidates got Vitamin D supplements and eat more food containing Vitamin D. Worryingly, some listed foods containing Vitamin B or C, even though a table with Vitamin D – containing foods was provided earlier in the question.
- Q4**
- (a)**
 - (i)** Most candidates gained the mark here, however, many bizarre answers were provided, for example, heart rates starting at ten.
 - (ii)** Most candidates answered thick muscle correctly.
 - (b)**
 - (i)** This was generally very poorly answered. Many candidates failed to recognise that one beat was 0.9 which penalised for the second mark. This was a highly discriminating question showing that most candidates did not have a thorough enough understanding of the cardiac cycle.
 - (ii)** This was generally well answered.
 - (c)** Lumen was a relatively common answer, although some (surprisingly) wrote the blood vessel which was provided in the question stem.
 - (ii)** A discriminating question. Most could describe a larger lumen but failed to link to less friction or resistance. More linked to the observation that more blood could pass through the vessel.
- Q5**
- (a)** It was very surprising and disappointing how many candidates did not gain this mark. Many responded incorrectly by saying two units every day.
 - (b)** This was generally well done. The vast majority of candidates gained 5–6 marks here. Some did not use an appropriate scale and it made it difficult to plot correctly, the most common of which was the use of intervals of three

(rather than 5/10) which resulted in using half boxes as plots and, ultimately, the loss of marks.

- (c) Most could complete the addition aspect of the question and thus gained the first marking point. Many candidates did not know how to work out the difference, and so did not gain the second mark. This was very surprising as not a difficult skill, particularly at this level.
 - (d) A number of candidates merely gave a written summary of the data with no evaluation or analysis at all and gained no marks. Candidates should be encouraged to read the command terms more carefully. Of those who did provide an evaluation of the data the most common observations were the decreasing alcohol consumption with age and the fact that young adults had the highest consumption over 14 units and adults had the highest consumption up to 14 units. Where applicable, QWC was good and the mark was awarded.
- Q6**
- (a) Again, very surprisingly, this was extremely poorly answered. The vast majority of candidates only gained either 1 or 2 marks. The most common mark was awarded for to exhale as forcefully as you can. Only a handful of candidates responded that it was held horizontally, set to zero or that repeat measurements were taken.
 - (b) Many could gain the first marking point but not figure out the second for the reduction. Again, quite a basic mathematical skill which many students cannot complete and which needs to be addressed.
 - (ii) Many candidates identified that the women needed treatment for asthma, only a small number clearly identified that it is unethical to fail to treat. Many students responded with an answer which referred incorrectly to the role of a control group.
 - (c) Again, as in Question 5(d), some candidates merely gave a summary of the data with no evaluation or analysis at all and gained no mark or only 1–2 marks. However, most candidates achieved 3–4 marks, and were able to identify that, while both drugs were successful, drug A worked faster and was more effective than drug B.
- Q7**
- (a)
 - (i) This was generally well answered.
 - (ii) This was not answered well by most candidates. A small number described that a small amount of ATP can be produced.
 - (b)
 - (i) Some candidates identified anaerobic conditions, with others describing strenuous exercise. Marks were not awarded for 'exercise'.
 - (ii) Many candidates read off the first figure incorrectly. However, the majority achieved 1 or 2 marks
 - (iii) (iv) Were both very poorly answered. The responses of the vast majority of candidates demonstrated a lack of understanding of the process of respiration. Many incorrectly described the effect on the cardiovascular system.

Assessment Unit AS 3 Aspects of Physical Chemistry in Industrial Processes

This examination paper gave candidates of all abilities the opportunity to gain marks. There was a wide range of total marks, but it was clear that teachers are now preparing candidates well and are more confident in the delivery of the content and detail required for this unit. Students must make sure that they learn definitions of key terms more carefully and when carrying out calculations lay out their working in a clear manner so that if applicable part credit can be given for a correct calculation, if the final answer is incorrect.

- Q1** This question was based mostly on the kinetics section of the specification. It was well answered by the majority of candidates and proved to be a good introductory question to the paper. In Question 1(a) candidates defined heterogeneous catalysis well, but the most common error was to reference 'same physical state as the reactants **and** products' in their answer and so did not gain credit. Question 1(b) was answered well overall, but candidates must take care when drawing the shape of the Maxwell-Boltzmann distribution curve. Question 1(c) asked for two definitions, these were well known. Question 1(d) was the most challenging part of the question with candidates not recognising that they had to reference the graph in order to access maximum marks. In Question 1(e) some candidates did not fully state the disadvantage of high pressure; simply stating that it is more expensive is not worthy of credit at this level.
- Q2** This question was based on the energetics section of the specification. It proved to be challenging for a few candidates. In Part (a) candidates were asked the meaning of the term average bond enthalpy, it was clear that this definition had not been learned in its entirety. Part (b) was a differentiating question, the vast majority of candidates attempted the calculation and gained some of the marks. In Part (c)(ii) standard conditions were generally well known, some candidates did not include units and so did not gain marks. In Part (c)(ii) the most common error made by students was to state the law of conservation of energy rather than Hess's law. As expected only the more able candidates were able to gain full marks in Part (iii) and Part (iv).
- Q3** This question was based on the calorimeter. The calculation proved to be challenging for a number of candidates. In Part (a) candidates on the whole gained this mark. In Parts (b) and (c) there was a varying degree of success with the calculations required, candidates performed better than in previous years, this was most likely due to the scaffolding provided in the question which gave candidates more confidence in attempting the calculation.
- Q4** This question was based on volumetric analysis. Surprisingly in Part (a)(ii) a large number of candidates did not read the value on the burette correctly. On the whole Parts (b)(i) and (ii) were well answered. As anticipated, there was a range of marks for the QWC question in Part (iii); candidates were asked to describe how a standard solution would be prepared. There were some excellent answers, but many candidates described the method for a titration rather than the method for preparing the standard solution. The indicator in Part (iv) was well known, but on occasions candidates got the colour change in the reverse order. Unexpectedly many candidates failed to calculate the titre values for the table in Part (v); the most common error was not giving the volume to the correct number of decimal places. The most common mistake in calculating the mean titre for Part (vi) was to include the rough titre value. Parts (vii) and (viii) as anticipated were discriminatory questions, only the most able candidates gained these marks.

Q5 This question was based on the Contact process. Parts (a)(i) and (iii) were well answered but Part (a)(ii) in which candidates were asked to describe catalytic poisoning proved challenging for some candidates, it is important that in such an answer the key term ‘active sites’ is used. Parts (b) and (c) which examined the area of processes and costs in industry was well answered, but it is important that reasons are well explained in order to gain marks, a vague answer such as ‘cheaper’ is not enough to gain credit at this level, there must be a qualifying statement. Part (d) involved candidates analysing information to draw conclusions it was pleasing to see that this was a skill the candidates had gained whilst studying for this unit.

Assessment Unit AS 4 Brain Science

The moderated work showed that candidates and their teachers seem to have a good understanding of the breadth and depth needed to meet the submission requirements for this unit on Brain Science. The work showed a good range of marks within and across centres, with candidates evidencing learning outcomes in various novel ways. The unit continues to be content heavy especially in the Assessment Objective 1 (AO1) resulting in submissions which are lengthy.

Portfolio Requirements

The Submission Criteria as listed in the specification for this unit, does not allow all learning outcomes to be addressed, however, the use of the Candidate Mark Records has guided candidates and their teachers to ensure all learning outcomes are met. Most centres used the standard laboratory report proforma to ensure they met all the requirements, to access the top mark band, in their investigative work. The headings in the proforma must all be evident in all investigations to award the higher mark bands for both AO3(i) and AO3(ii) tasks.

Learning Outcomes and Assessment Objectives

Most candidates evidenced all the learning outcomes required in this unit. Where there was no evidence of a learning outcome teachers had awarded ‘0’ marks as appropriate. Most centres addressed the Section 4.5 (Research methods) by incorporating the learning objectives into their investigations and these were clearly annotated by the teacher. It is important to note that those learning outcomes (in Section 4.5) that do not naturally fall into the investigations should be addressed separately, most candidates did this in a separate report at the end of the portfolio. The majority of candidates had carried out extensive research using a variety of sources, which were Harvard referenced as appropriate (in-text and bibliography) – a small number of candidates, provided no indication of sources used which must be addressed.

Assessment and Award of Marks

The use of the Candidate Mark Record assisted teachers in the application of the mark criteria. Most centres seem to have grasped the detail required to achieve in the various mark bands in all learning outcomes and across all assessment objectives. Where marking was lenient it was primarily in the investigations, particularly in the awarding of Mark Band 4 to investigations where there was no evidence that the candidates could draw conclusions based on their findings or evaluate the method/s they had used. These are difficult skills and candidates need to be given opportunities to develop these skills in class.

Overall, it is evident that centres and candidates have worked diligently to generate evidence to address the large number of learning outcomes in this unit. Centres have presented work in a variety of ways to evidence the different learning outcomes. The majority of assessors

seem to have a good grasp of the standard and have used the mark criteria, Candidate Mark Records and excellent annotation to justify marks awarded.

Assessment Unit AS 5 Material Science

Quite a large range of ability was demonstrated by the candidature in this unit. Some individuals were well prepared; others much less so. Some candidates demonstrated a wide range of skills in certain areas yet were unable to answer some relatively straightforward questions in other sections.

Some candidates, in a small minority of centres, used an additional booklet to add a few extra words to individual questions, some requiring as few as three extra words. Candidates should be advised that if there is a real need for extra space, such as where the answer to a question is to be rewritten, or the answer is to be expanded, an extra answer booklet should of course be used. However, if only a few extra words are to be added, these should be written in the spaces provided, or in the space just below.

- Q1 (a)** One might expect the first question in a paper to be answered well by most candidates, yet some were unable to recall that the word 'force' is required in the answer to a question on tensile strength.
- (b)** Quite a few candidates correctly identified the material X or Y in each part of the question but were unable to give a correct explanation for their choice.
- Q2 (a)** The graph was completed well by most candidates, although a few were unable to provide a uniform scale along the x-axis. A considerable number could not convert correctly from millimetres to metres in calculating the gradient, resulting in frequent errors involving powers of ten.
- (b) (c)** A large number of candidates did not appear to realise that marks are available for correctly writing a formula in the form of an equation. Note that rise/run is not an equation.
- (d)** Many candidates appeared to struggle with the calculation of the Young Modulus. Errors involving powers of ten were very common.
- Q3 (a)** This question generated a large variety of answers, illustrating that while many candidates had learned the structure, uses and properties of carbon nanotubes, yet others failed to earn some easy marks.
- (b) (c) (d)** These question parts were generally well answered.
- Q4** This question was well answered by most candidates.
- Q5 (a)** While it is clear that most students understood the Bohr model of the atom, a disappointing number did not answer the question fully. Detail of all three of each of the names, locations and charges were required for three relatively easy marks.
- (b)** Many candidates failed to recognise that Part (i) required the 'microscopic structure' while Part (ii) required the 'property' for each material. A large number of candidates answered Part (ii) in the space for Part (i)
- Q6 (a) (b)** While most candidates could explain what they understood by an 'alloy' many failed to give the constituent materials for those alloys in the table and a large number could not give examples of their common use.
- (c)** A disappointingly large number of candidates failed to note the powers of ten when comparing the values of coefficient of thermal expansion.
- (d)** Most candidates gained credit in this question.

- Q7 (a)** This question was well answered by many. However, some candidates were unable to give the names of the three main types of biomaterial or explain their behaviour.
- (b)** Quite a few candidates incorrectly thought that touch screens on mobile phones were photochromatic.
- Q8** Some candidates were unable to calculate simple percentages or to rearrange simple equations, which is most disappointing at this level. However, the question was answered well by some, including a few candidates who had scored less well in other questions.

Assessment Unit AS 6 Medicine, Drugs and Clinical Trials

The work produced by candidates was mostly of a high standard, demonstrating a clear understanding of the learning outcomes in this unit. Centres have submitted a wide range of marks across this unit providing evidence that differentiation between candidates is taking place.

Portfolio Requirements

It was clear that centres had a better understanding of the portfolio requirements than in previous submissions; portfolios were well organised and coherent. Some centres need still to be reminded that it is compulsory to use the Candidate Mark Records provided on the CCEA website, otherwise moderators cannot identify the marks that have been awarded.

It was pleasing to note that most centres had acted upon the advice provided last year, on how to address the research element of the two practical investigations. The vast majority of centres provided at least two researched techniques that could be used and evaluated both of these, providing justification as to why one was chosen over the other.

Learning Outcomes and Assessment Objectives

More so than in previous years, it was evident that the vast majority of centres had a clear understanding of the learning outcomes and interpreted them correctly. However, in a very small number of cases, centres had misinterpreted a small number of the learning outcomes in the specification. Any misinterpretations have been clearly identified on TAC6 reports and should be addressed by centres in future submissions.

It is important to remember that all learning outcomes within the specification for this unit must be covered and evidenced in the portfolio, where sections are missing candidates cannot be awarded any marks. In particular, please note that for Learning Outcome 6.4.7, teachers should annotate the work of candidates to indicate where they have completed the practical investigations autonomously, skilfully and safely.

Assessment and Award of Marks

Most centres effectively used the Candidate Mark Record from the CCEA website; this made the moderation process very straightforward and allowed moderators to quickly determine what marks had been allocated to the various learning outcomes within the specification. In a small number of instances, centres are still having difficulty in awarding the most appropriate mark band to candidate's work mostly in relation to AO3 learning outcomes. It is important to refer to the marking grids which are available within the SAMs to guide your awarding of the mark bands. Comments made on the TAC6 report to centres in relation to inappropriate awarding of mark bands should be acted upon for future submissions. Annotation provided by centres was appropriate and indicated the mark band and learning outcomes assessed.

Principal Moderator's Report

Introduction

In the 2019 cohort of candidates taking A2 level Life and Health Sciences the samples provided for moderation across the internally assessed units indicated that teachers for the most part had:

- With few exceptions provided their candidates with suitable and appropriate opportunities and activities which allowed them to present portfolios of evidence which demonstrated the achievement of all Learning Outcomes and access to all mark bands in the Assessment Objectives for the subject specification.
- Assessed candidate response appropriately and awarded marks commensurate with the quality of the candidate response.
- Achieved centre differentiation as was indicated in the quality of the candidate response and the range of marks observed.
- Made essential annotations within portfolios.
- For the most part achieved internal standardisation.

Candidates could successfully:

- Make lists of materials and equipment, draw diagrams, present results tables, assemble and produce literature reviews, keep laboratory books and work logs, produce databases etc. across Units 1, 6, 7, 8, 9 and 10.
- Work independently, safely and skilfully in the carrying out of the work indicated in the methods/procedures of the written reports, experimental investigations and laboratory book trials of all the internally assessed units.
- Collect data and record observations throughout the portfolio units whether for reviews, scientific investigations or Laboratory Book trials in Unit 1 Scientific Method, Investigation, Analysis and Evaluation or for investigations and Laboratory Book entries in Microbiology or Oral Health and Dentistry or case studies and databases in Enabling Technology.
- Select appropriate techniques and identify and use appropriate activities in their investigations across the A2 portfolio units and identify and adapt refinements in respect of their work.
- Competently select and handle their own and others data in an appropriate way whether that be tables and graphs or in factsheets, summary observations and reports or work logs. Once again this year the interpretation of this information in the higher mark bands was in some instances not indicated.
- State trends and patterns.
- Whether reviewing literature and the data arising (Unit 1) or using various pieces of monitoring information from their own database (Unit 10) handle, use and change data from one form to another.
- Make responses across the units which were clear, coherent and fluent and in many instances demonstrate a high level of scientific terminology and specialist terms with few exceptions.

Consequently satisfying mark criteria in the Assessment Objectives which allowed access to the higher mark bands in these aspects of the portfolio.

However, candidates continue to find the more challenging assessment objectives of AO2 and AO3 difficult to handle.

- Once again whether candidates were justifying an area of research from their literature review in Unit 1 or putting forward a hypothesis in Unit 6, application of knowledge, process, equipment and technique should be evidenced across all the A2 units. This was not always present to allow for higher mark bands. i.e. apply skills, knowledge and understanding of processes, techniques and equipment to a range of contexts.
- Present across the internally assessed units but frequently lacking in detail and of a generic nature were risk assessments. There has nevertheless been a marginal improvement in this area with candidates identifying physical and chemical risks in greater detail.
- Candidates continue to find it difficult across the units whether it was a written report a fact sheet or a review essay to write clear analytical statements of findings in their introductions or conclusions. This is where candidates found it most difficult to access the higher mark bands.

Teachers and assessors who will obviously wish to optimise the achievement of their students should take note of the following outcomes of moderation across the internally assessed units of this specification.

- The setting of appropriate and suitable pupil objectives and activities by the teacher is key to providing candidates with the opportunity to access the full mark range.
- Candidates are unable to research, extract salient information, justify decisions, write scientifically and technically, conduct statistical analysis and evaluation unless they have first been taught how to do so.
- Teachers have increased their use of essential annotation but should ensure that this continues. It is preferred that teacher marking and annotation is conducted in red pen.
- Ensuring that standard formats from the specification are used across the units as all units aim to develop and assess the same skills via different specification content.
- Candidates must appropriately reference all the materials they use in their work, including any online resources, using the Harvard referencing system where appropriate.

In summary candidate responses to: organising and presenting information; making precise observations; devising and refining experimental and investigative activities; selecting appropriate techniques; describing trends and patterns from data in tabular or graphical forms and translating data in a variety of forms from one form to another; resulted in candidates providing portfolio evidence throughout their essays, fact sheets, case studies, databases, investigation reports and other pupil activity responses in their introductions, equipment lists, labelled diagrams, procedures, tables, graphs, statistical analysis etc. which allowed candidates to access the higher mark bands. Whereas candidate responses to: methodical recording, applying skills, knowledge and understanding of processes, techniques and equipment for a range of contexts, carrying out risk assessments, researching and using primary and secondary sources, and interpreting, explaining, analysing, evaluating and drawing conclusions from their own and others investigative and experimental activities, elicited candidate responses in portfolio evidence by way of introductions, literature review and investigative findings, and laboratory, working log and written report conclusions and evaluations which were not in the higher mark bands.

It is important to note that support is available in addressing all of the issues addressed in this report by way of TAC6 reports to centres, Agreement Trials and Portfolio Clinics. The most up-to-date information and support material can be found on the CCEA website.

The following unit-specific comments have been provided by the relevant Assistant Principal Moderators, incorporating feed-back provided by the moderators in their various teams. These comments are intended to direct centres towards best-practice in the generation of candidate evidence.

Assessment Unit A2 1 Scientific Method, Investigation, Analysis and Evaluation

Portfolio Requirements

The majority of centres met the requirements to use the CCEA Portfolio Checklist and Candidate Mark Record for the unit. Most centres evidenced the three compulsory components for this unit; literature review, laboratory book and written report. However, it is important to draw attention to the following issues:

In some cases:

- The essay was still not a review of the literature in the area of study.
- Harvard referencing was not conducted correctly in text or in the bibliography.
- There is a need for clearer scheduling from draft plan to project plan.
- Appendices should be included.

Learning Outcomes and Assessment Objectives

Throughout the moderation process it was clear that the vast majority of centres used the Portfolio Checklist and Candidate Mark Record to evidence each of the learning outcomes in the specification; this allowed moderators to easily identify the format for each learning outcome.

In a small number of centres, the learning outcomes were not all evidenced and could not be easily located as there was no Portfolio Checklist used.

Within most of the work moderated this year, all of the tasks set by the centres provided candidates with the opportunity to access the full mark range in all assessment objectives and their related mark criteria. However, annotation on independent, safe and skilful use of practical equipment by candidates is not always present; this should be annotated on each candidate's work to ensure it is clear that the candidate has fulfilled these criteria in the execution of their method.

Some centres are still awarding candidates higher mark bands throughout the unit, despite the following issues:

- Limited suggestions for improvement or refinement of technique and methodology.
- References not being cited in text or listed in alphabetical order in the bibliography/reference list (Harvard referencing is required).
- Limited refinements identified for the trials being conducted.

It would also be good practice for candidates to use statistical analysis in the written report to analyse results obtained.

Assessment and Award of Marks

Across centres the majority of the teacher assessment and award of marks was appropriate with teachers matching the mark criteria and band in line with the quality of the candidate response. The use of the Portfolio Checklist and Candidate Mark Records allowed learning outcomes to be evidenced easily, along with an indication of which mark band has been awarded.

It was evident that on the whole centres and candidates had worked diligently to meet the submission requirements of this unit.

Chief Examiner's Report

Assessment Unit A2 2 Organic Chemistry

Candidates produced a wide range of responses with some issues regarding nomenclature still remaining. Names of types of reactions and definitions were poorly answered but structural formulae and skeletal formula were well attempted. Practical details of the purification of aspirin were not well known. Candidates responded well to analysis questions on mass spectrometry and infra-red spectroscopy.

- Q1** In Part (a)(i) most candidates gave a correct response to the colour change observed with bromine water and ethene with a range of colours being accepted. Clear was incorrect for colourless and the colours the wrong way around was not credited. Errors with commas and dashes were evident in 1,2-dibromoethane in Part (a)(ii) with each error being penalised. Steam was the expected answer for Part (a)(iii) but many gave water which was not accepted. In Part (b)(i) many scored well for the arrows in the first stage of the mechanism but lost marks if it was not clear that the arrows went from one of the bonds of the C=C bond to the H atom and from the bond of the H—Br to the Br atom. The term carbocation was only seen from a few candidates in Part (b)(ii). The curly arrow in Part (b)(iii) had to leave the lone pair of electrons and go to the carbon with the positive charge and most often the arrow did not clearly leave the lone pair. In Part (b)(iv) many gained the mark for bromoethane and the name of the mechanism in Part (b)(v). The balanced symbol equation was well attempted in Part (b)(vi). Part (c) was the most poorly answered part of Question 1 with a mark being gained by a few candidates for the names in Part (i) and the type of reaction in Part (ii) but only a few candidates obtained marks for the equation in Part (iii) with many using F1 for fluorine and forming fluoromethane rather than tetrafluoromethane. In Part (c)(i) many different spellings of the fluoro substituent but candidates will be expected to spell this correctly in future examinations.
- Q2** The structure of pentan-2-ol was well answered in Part (a)(i) as were the classification of the alcohols but the names produced a mixed response with commas being used in place of the first dashes in C and D. A reasonable number of candidates knew that B was oxidised to form a ketone in Part (a)(ii) and there were many good attempts at another primary alcohol apart from those given in the table in Part (a)(iii). Errors here included pentan-3-ol which had the correct molecular formulae but was obviously not a primary alcohol. In Part (b)(i) very few candidates correctly identified dehydration or elimination as the type of reaction. The name of the organic product in Part (b)(ii) was reasonably well answered with pentene being a common incorrect answer. The catalyst used for the dehydration reaction in Part (b)(iii) was not well known with nickel being a common incorrect answer. The dehydration equation in Part (b)(iv) was not well answered with some candidates omitting the water or the CH₃ group being removed to give but-1-ene rather than 2-methylbut-1-ene.
- Q3** In Part (a)(i) many knew fractional distillation and cracking, but they did not put the answers in the correct place. Reforming was not well known. In Part (a)(ii) candidates lost marks for an incorrect description of the C=C such as simply 'double bond' or 'carbon double bond'. The definition of hydrocarbon in Part (a)(iii) was well known with some losing marks for including incorrect terms such as 'an element containing only carbon and hydrogen' or 'a substance containing carbon and hydrogen molecules'. The saturated hydrocarbons in Part (b)(i) were well identified but a small number did give the unsaturated ones. In Part (b)(ii) the skeletal formula of hex-2-ene was well answered and the cis-trans isomers in Part (b)(iii) were well drawn and identified. The groups attached were occasionally wrong and candidates lost marks

if the wrong alkene was used. In Part (b)(iv) nickel was well known as was hexane with 'nickle' being a common spelling error, which was not penalised on this occasion. The branched chain isomer of pentane in Part (b)(v) was well known but some '1-methyl' type errors were evident. The balanced symbol equation for the complete combustion of pentane in Part (a)(vi) was well answered but some used the incorrect formula of the hydrocarbon. In Part (c)(i) many struggled to give a correct definition of empirical formula and molecular formula losing marks for incomplete or confusing definitions. Many correctly obtained C_2H_5 and C_4H_{10} in Part (c)(ii) and Part (iii) but those who did not obtained some marks for the calculations in Part (ii). Most who obtained C_4H_{10} in Part (iii) correctly identified alkanes and gave the general formula in Part (c)(iv).

- Q4** In Part (a) the definition of the term polymer produced a variety of responses, but many scored well. The structure of the monomer of chloroethene in Part (b)(i) was not well answered despite the poly(chloroethene) name being given in the question. The type of polymerisation in Part (b)(ii) produced the incorrect 'additional' more often than the correct answer. Disposal of waste in Part (b)(iii) was well answered with most understanding that disposal meant landfill or incineration as opposed to other waste management strategies. In Part (c), many candidates did not know condensation as the type of polymerisation, but some could explain based on the information given why it was called nylon-6,6. The reverse of condensation was most often called hydration as opposed to hydrolysis. Hydrolysis was the only acceptable answer.
- Q5** In Part (a), many candidates gained most of the marks for the description of fermentation. In Part (b)(i) few gained the mark for the molecular formula of aspirin but were able to work out a relative formula mass from their given formula. The calculation was reasonably well answered in Parts (iii), (iv) and (v) but candidates should be reminded not to round answers to one significant figure and should follow the instructions when asked for an answer to one decimal place in Part (b)(v). Candidates did not understand that the ethanoic acid was in excess in Part (b)(vi) with side reactions being a common incorrect answer. Part (c) was not well answered by many candidates despite some of this appearing in a previous paper. Candidates should be familiar with the purification of aspirin including the techniques and apparatus used. The idea of a minimum volume of hot solvent was not clearly understood in Part (c)(i) and few could draw the apparatus in Part (c)(ii) with any success. In Part (c)(iii) some marks were gained for "faster", but most did not explain it was also drier. In Part (c)(iv) higher and lower were common answers and this was not credited when given together in this way. A few gained a mark for understanding there was a range.
- Q6** In Part (a)(i) many candidates knew the oxidising agent and the colour change but may have lost a mark for the missing "acidified" or some knew the colour change but not the oxidising agent used. The IUPAC names were reasonably well known in Part (a)(ii) ethanoic acid being the best answered. Aldehyde and ketone nomenclature is expected. The skeletal formula of D was well drawn in Part (a)(iii). Candidates were guided into the mass spectrum in Part (b) and answered it well based on the relative formula mass of ethanol. In Part (c) many were able to correctly identify F as the substance producing the peak by identifying the bonds present.

Assessment Unit A2 3 Medical Physics

The A2 3 unit was quite well received by most students with the majority able to access and answer many parts of the paper. The strongest answered questions were Question 4 and Question 6 which included calculations of which candidates seemed to be better prepared. The weakest answered questions were still the definitions and descriptions, with even the very strongest candidates performing poorly.

- Q1** In Part (a) the question began with a straightforward short description of the purpose of a radioactive tracer. This gentle introduction was poorly completed, with most students giving a use of a tracer or wrongly suggesting it is used to treat cancer. Part (ii) was a long response question outlining the benefits and risks of using a radioactive tracer. A short list of pointers was provided to base the discussion on. Those students who organised their discussion around these points were very successful and outlined most of the indicative content without much repetition. Others, however, were very repetitive and although they wrote a lot, didn't cover much of the content. There were limited marks available for those students who failed to choose the correct type of radiation - gamma.
- Q2** The explanation as to why a patient was to receive minimal exposure to radiation was well known and well answered. Part (b) however was not well known to the candidates, with many failing to pick up any marks. Quite a few candidates attempted to provide definitions of both physical and biological half-life but appeared to have little understanding of either. The calculation in Part (ii) was synoptic and a similar type of calculation should have been encountered in the AS1 experiment of finding the focal length of a lens. Students really struggled with this equation and the numbers in standard form. Calculator skills were weak also. The data was provided to two significant figures and so any answers calculated should also have been quoted to this significance.
- (b) (ii)** Was very challenging, with many pupils unable to identify the correct radioisotope and therefore forfeiting all marks for the question.
- Q3** The core body temperature and temperatures above and below which the body can no longer survive were well known. The table in Part (b)(i) was less well answered with a large number of candidates failing to read and understand the question. The limitations of each type of thermometer for measuring body temperature were less well known with dropping, breaking and batteries running out appearing as common incorrect responses. Part (ii) was very well answered.
- Q4** Part (a)(i) was straightforward for most students scoring 4 or 5 marks. Quite a few learned off the mark scheme for last year's similar question and discussed exercising, which was unnecessary. Part (ii) was very well answered. Part (b) was very well answered by most candidates including the limitations of an ECG in diagnosing genetic disorders.
- Q5** The properties of x-rays in Part (a)(i) was well answered by many candidates, however the production of x-rays was less well known. Errors in understanding were centered around failing to understand that high speed electrons were required to be rapidly decelerated to produce x-rays. Most candidates were aware that a vacuum was required, the anode required cooling and shielding was necessary. In Part (b), many candidates could not recall that x-ray pictures were shadow images, however, most candidates knew that conventional x-ray images produced 2D images and CT scans produced 3D images. A significant number of candidates failed to state a difference and instead just suggested CT scans produced 3D images without mentioning conventional x-ray images. This also happened in Part (ii) where again students only

discussed CT scans and did not discuss conventional x-rays at all. Part (iii) was well answered.

- Q6** Part (a)(i) was a straightforward definition which was very poorly recalled. The calculation in Part (ii) was attempted by most candidates and produced a large variety of responses. Some students were unaware that activity was measured per second and so did not convert the minutes to seconds. Others didn't average, quite a few did not give their answer correct to three significant figures as required or rounded incorrectly and lost credit for this mark. Most students were aware of background radiation but did not read the question thoroughly and gave examples instead of a definition... again. Most students knew to subtract background reading from activity reading to find the actual activity. If students did not attempt Part (ii) then they could not get any credit for Part (iv). The calculations for Part (b) were both much better attempted than last year and students gained most of the available marks. Errors included not changing the 77.3 days and 100 days into seconds and not being able to use the calculator correctly.
- Q7** Part (a)(i) and Part (ii) provided two further places where students were asked for definitions on descriptions but instead provided examples and achieved no credit. The frequency range in Part (b)(i) and the reason used were well known. Candidates were also familiar with the reason why the frequency range was unsuitable for deep structures and why coupling agents are used. Part (c) was not as well known, with a significant number of students being unaware of what the letters MRI mean. The type of EM radiation most frequently, and incorrectly quoted was 'magnetic'. Most students knew that the strong magnetic fields created in the MRI posed problems, however, they didn't mention the field was strong and assumed that every metallic object was pulled into the machine. The answer to Part (iv) was well known.
- Q8** Part (a) was difficult for students as they did not appear to have as much practice in finding density from the specific acoustic impedance equation and so tended to multiply terms instead of dividing. There were also 10n errors changing the 1.5 to 1500 and using the calculator. Part (b) was better, with most students able to correctly identify the correct equation, substitute numbers and provide an answer. A few students forgot to square their answer at the end. Part (ii) was poorly answered. Both materials were required to be correct before credit could be given for the explanation. A significant number of students misread Part (iii) and discussed reflections rather than absorption of sound producing heat. Part (c) was another comparison type question. This was quite well answered with students usually providing detail on both A and B scans. Again, the default answer appeared to be actual uses rather than visual output. Part (iii) was an application of A scan where the depth of an organ was to be calculated using $\text{distance} = \text{speed} \times \text{time}$, remembering that the sound was reflected. Students did not show enough working out in many cases and so lost partial credit for their work.

Assessment Unit A2 4 Sound and Light

The A2 4 unit was quite well received by many students with the majority able to access and answer many parts of the paper. The strongest answered questions were Question 1, and Question 8 including the calculations of which candidates seemed to be better prepared. The weakest answered questions were still those with definitions and descriptions, with even the very strongest candidates performing poorly.

- Q1** In Part (a), the question began with a straightforward short definition of transverse and longitudinal waves. A significant number of candidates used the word move instead of vibrate when discussing particle motion and received zero credit. Part (ii) tested students' knowledge of the order of EM waves. This was well done by many. The calculation in Part (iii) was well done, however, it is to be noted that pupils must use the correct symbols in this equation, $v = f\lambda$, and that use of other symbols for λ will not be considered for partial credit. A significant number of candidates still struggle with power of 10 errors and require more practice with these numbers. Parts (b) (i) and (ii) were straightforward with most candidates scoring well. The frequency calculation in Part (iii) was also well done, however not all students quoted their answer to three significant figures as requested. Labelling the time axis in Part (iv) was very difficult even for the strongest candidates, with some who understood what they were doing recording the times in s and not ms. The wave sketch was very well done by most candidates.
- Q2** Parts (a)(i), (ii) and (iii) required students to draw the apparatus and discuss how the wavelength of the wave could be measured from the apparatus. The question provided a challenge for candidates with a significant number appearing unprepared. Those who were familiar with the apparatus could draw the apparatus, but often forgot to thoroughly label their sketch. The description of achieving the standing wave patterns and measuring λ were weak throughout. Part (b) proved even more challenging with many candidates unable to sketch the standing wave pattern. The majority could label nodes and antinodes and very few could complete the challenging calculation.
- Q3** It was disappointing that not all candidates could recall the labels for the eye. Part (b) was a Quality of Written Communication question on parts of the ear. These were the ear parts not asked on last years' paper and therefore was not as well recalled as expected. Students should note that where possible all parts of the specification will be covered by the exam paper therefore their study would need to be more detailed and thorough.
- Q4** Part (a)(i) usually scored one mark but not two. The definition of 1pWm^{-2} was partly completed in that students understood that it referred to amount of energy in joules, but did not all know that pico is 10^{-12} and this is the energy per second per m^2 . The intensity level for the threshold of hearing was well known and the calculations for Part (d) and (e) were much better attempted than last year. It should be noted that in a 'show' type question, full working out is required. The final step in Part (e) was not well known, however, quite a few of the strongest candidates achieved full credit.
- Q5** The definition of critical angle, like other definitions throughout the paper, was not well recalled. The comparison of single and multimode fibres was well attempted by most, however, candidates often repeated themselves due to not ordering their work. In a comparison question a statement on each feature is required for both quantities being compared. Failure to do this was often the cause of lost marks. The diagrams in Part (c) were GCSE type questions and should have been better attempted. In all ray diagrams like these a normal is required to be drawn.

- Q6** Part (a) was straightforward and usually well recalled. The descriptions in Part (b) were vague and not detailed which often lost candidates' marks. In reflection type questions, students are required to discuss the equipment sending the waves, what the waves are reflecting from and where they are reflected to. The Doppler effect was quite well known. Many students understood that there was a change in frequency of the waves when the storm was moving but rarely mentioned that the size of the frequency change indicated a faster moving object.
- Q7** Part (a) was a similar question to last years' paper only this time in continuous prose. Candidates were confident in answering this question and accessed most marks. The graph question in Part (b) achieved partial credit. Most candidates could fill in the box on the x axis, however some struggled with the labelling of the phons value. Interpreting the loudness curve in Part (ii) was well done.
- Q8** The calculation of the power of the lens in Part (a) was very well done. The most frequent error was a rounding error, where students rounded 6.66666 reoccurring incorrectly as 6.66 rather than 6.67 and did not receive full credit. The calculation in Part (ii) was also well done with errors only creeping in due to inconsistencies with cm and m. Some candidates however require more practice with their calculators or strategies to assist them with these types of calculations. Part (b) was well done. The term long sighted was required for Part (i). Some candidates used the term hypermetropia which also gained full credit but was more difficult to recall successfully. The definition in Part (ii) was very well recalled along with a suitable value for normal near point. The description in Part (iii) was weak and in many cases only scored one or two marks. Most students did not mention that the ciliary muscles are used to effect the change in lens width. Part (c) was very well recalled by most students.

Assessment Unit A2 5 Genetics, Stem Cell Research and Cloning

The paper generated a wide range of marks and was successful in discriminating among candidates of different abilities. The paper enabled candidates to show the breadth and depth of their knowledge across the unit content. Candidate responses ranged from poor to excellent, with the vast majority of candidates attempting all questions. Some questions including Question 8 and Question 9(c) proved to be more challenging than others.

- Q1** This question was answered very well by the candidates. Many scored full marks demonstrating sound knowledge on the structure of DNA, RNA and base pairing rules.
- Q2** This question on DNA replication and theories of replication was a little more challenging, however, most candidates scored all 3 marks in Part (a). Part (b)(i) proved to be more challenging as some candidates failed to recall the theories to describe the process of DNA replication. Most however recalled semi-conservative replication and successfully recognised that this was part of the answer to Part (b)(ii).
- Q3** Knowledge of stem cells were tested in this question. In general, this question was answered poorly, which is very surprising and disappointing since a main topic in this unit is stem cell research. Very few candidates gained full marks. For Part (a)(i) some candidates were able to give key features of stem cells, but many failed to describe that they can replicate to form new cells. Those that gained full marks also described differentiation into specialised cells. Most candidates could describe a difference between embryonic and adult stem cells for Part (a)(ii). It is pleasing to see the terms totipotent and pluripotent used by some candidates. Question 3(b) required candidates to use their knowledge of stem cells in relation to diabetes. Some candidates were able to suggest pancreatic cells with others suggesting β -cells in Islets of Langerhans which was very pleasing. Others were confused and incorrectly gave insulin as their answer. Most candidates made a good attempt answering Part (b)(ii) to give a reasonable suggestion of the benefit of these cells to a person with diabetes.
- Q4** This question required analysis of a DNA fingerprint in relation to cystic fibrosis. It is clear from Part (a)(i) that candidates do not fully understand the effect of cystic fibrosis on the respiratory system. Most gained one mark for Part (a)(ii) describing how the process of gel electrophoresis produced the DNA fingerprint, again it is clear that candidates do not fully understand the process of gel electrophoresis. For Part (a)(iii) most candidates noted that Ian was a carrier and Denise was not. However, too few failed to recognise that there would be no chance of Ian and Denise having a child with cystic fibrosis, many stating incorrectly that there would be a chance of having a child with cystic fibrosis. Part (b)(i) was answered well however in Part (ii) very few candidates provided a mark worthy answer, the most common incorrect response 'might be recessive' indicating a clear lack of understanding.
- Q5** Most candidates gained 3–5 marks in Part (a) illustrating a good understanding of the genetic engineering of insulin. Most gave restriction endonuclease as Enzyme A in Part (i) a small minority incorrectly identified Enzyme B as DNA polymerase instead of Ligase.

Part (b) assessed candidate's Quality of Written Communication; which was generally excellent. Most candidates gained 4–6 marks with a significant number gaining the full 8 marks available. This question proved to be discriminating as the most common loss of marks occurred from incorrect reading of the question. This resulted in candidates including information on comparisons between non-diabetic and diabetic blood glucose concentrations in the upper section and then omitting these in the

lower section. It is also surprising how many candidates did not explain the role of insulin reducing blood glucose concentration between one and two hours after eating a meal. Many were able to give data to compare differences between a non-diabetic and diabetic which shows good analysis skills.

- Q6** This question assessed epistasis gene interaction. Most described the term 'gene' correctly gaining at least one mark for Part (a)(i). The Punnett square in Part (b)(i) was answered very well with many candidates gaining full marks. A very small number of candidates failed to work out the gametes. Surprisingly some who completed Part (b)(i) correctly did not give the correct number of each type of phenotype for Part (ii). Showing a lack of understanding of the process of epistasis and application of this interaction to the genotypes obtained in Part (b)(i).
- Q7** In general this question was not answered well. Few candidates gained full marks for Part (a)(i), common errors included, not plotting temperature on the x axis, omitting units from the axis label and failing to join point to point with a straight line. A small number of candidates drew a bar graph. A significant number of candidates did not answer Part (a)(ii) or (iii) correctly. This was disappointing and shows a lack of analysis skills. Most suggested reasonable control variables for Part (iv). Part (v) proved to be one of the most discriminating questions. Only those of the highest ability gained two marks here. Many could describe smaller temperature intervals, giving examples of these but failed to state between which temperatures these smaller intervals should be investigated. Question Part (b) is familiar to candidates with most achieving both marks.
- Q8** This question examined candidate's knowledge of gene therapy. This question was answered very poorly demonstrating a clear lack of knowledge and understanding of the process of gene therapy. No candidate gained full marks, however candidates scored across question Parts (a), (b) and (c). Part (a) and Part (b) were recall questions, describing what is meant by the term 'gene therapy' and differences between somatic cell therapy and germ line cell therapy for Part (b). Part (c) surprisingly was answered better by candidates.
- Q9** In general this question was attempted reasonably well by many candidates. Part (a) was answered very well with the vast majority of candidates correctly calculating the number of amino acids for Part (ii). A very small number incorrectly multiplied the number of bases by three instead of dividing by three. Most did not gain full marks for Part (iii) with the majority of candidates scoring one mark here. Many completed Part (b)(i) correctly, calculating the chi square value, using data presented in a table. A small minority of candidates completed the table correctly but failed to calculate the chi-square value correctly. Clearly, candidates can carry out the operation of a chi-square test, but some do not understand how to interpret the results of this test. Many identified the degrees of freedom correctly for Part (ii) with fewer giving the correct range of probabilities for Part (iii). Part (iv) was more poorly answered as candidates failed to link the outcome of this statistical analysis to the results obtained. Part (c) proved to be very discriminating. Some gained one mark for Part (i) comparing the incidence of sickle cell as highest in areas where malaria does not occur. Only those with the highest ability gained a mark in Part (ii). Too many candidates linked this incorrectly to better health care in Southern Africa, failing to give a reasonable suggestion such as no mosquitoes or no advantage of carrying the sickle cell gene. This question part proved to be very discriminating.

Assessment Unit A2 6 Microbiology

The moderated work showed that candidates and their teachers seem to have a good understanding of the breadth and depth needed to meet the submission requirements for this unit on Microbiology. The work showed a range of marks within and across centres.

Portfolio Requirements

The submission criteria requests candidates write up their investigations in accordance with the standard laboratory report guidelines, a proforma for this can be found in the SAMs. Candidates are required to Harvard reference, whilst some candidates did this very well this is an area that still requires development in some centres in future submissions. The lab book took various forms in different centres. Candidates should be aware that this is a working document and does not need to be neatly presented for them to access the full range of marks. This is a good way to evidence those practical learning outcomes that do not form part of their investigative work.

Learning Outcomes and Assessment Objectives

The majority of candidates in all centres evidenced all the learning outcomes required in this unit and had carried out extensive research using a variety of sources, which were referenced in the bibliography – a small number of candidates, however, provided no indication of sources used which must be addressed.

Assessment and Award of Marks

The Candidate Mark Record was amended for the 2019 series and allowed assessors to award marks for each of the practical investigations separately which seems to have aided the allocation of marks. Most centres seem to have grasped the detail required to achieve at each mark band in all AOs. Some leniency is seen in the marking of AO3(i) which requires candidates to interpret results in a rigorous way and to draw conclusions based on their findings. On occasion, conclusions were brief and lacked the scientific language/detail needed to award the higher mark bands. The evaluations were also lacking the detail required for Mark Band 4. Evaluations should be reflective of the method they have detailed in their planning and should suggest refinements in order to award Mark Band 4. Overall, it was evident that centres and candidates had worked diligently to generate evidence for this unit. Assessors had accurately assessed candidate evidence using the mark criteria and new Candidate Mark Record, and had provided detailed annotation to justify the marks awarded.

Assessment Unit A2 7 Oral Health & Dentistry

The moderated work indicates that candidates successfully evidenced the majority of Learning Outcomes as required by the specification to the requisite breadth and depth. Whilst a small number of centres submitted work for this unit, that which was submitted was of a very high standard indicating that centres have a good understanding of specification requirements.

Portfolio Requirements

Submission criteria requires that candidates write the reports of their investigations in accordance with standard laboratory guidelines, a proforma for which can be found in the SAMs. Candidates are required to reference all information and sources using the Harvard referencing system. Whilst some candidates met this requirement well, it is an area that very much needs development in future submissions.

Learning outcomes and Assessment Objectives

Candidates successfully described the structure and function of the mouth and its associated components as given in the specification. Similarly, the five basic tastes and what each taste may indicate was evidenced well by a very large majority of candidates. Several candidates described the location of each of the three pairs of salivary glands but did not describe their structure. Whilst several candidates did not make comparisons between the three pairs of glands, those who did, provided detailed comparisons on the basis of and nature of secretions produced, shape and location. The importance of the salivary glands in digestion, maintaining dental health and oral lubrication was evidenced well by most candidates. The majority of candidates described the chemical composition of teeth (including enamel, dentin, cementum and pulp) successfully and in detail.

There was considerable overlap and repetition of the evidence provided for Learning Objectives 13.2.1, 13.2.2 and 13.2.3. Most candidates provided a detailed account of ingestion, physical digestion and mastication. The passage of food via the upper gastrointestinal tract to the stomach was discussed in sufficient detail to a lesser extent by candidates. The role and function of teeth was well evidenced by the majority of candidates. The majority of candidates successfully investigated the role of the salivary glands in chemical and microbiotic digestion with the majority of candidates practically investigating the action of both amylase and lipase as per specification requirements. Most candidates provided a written account of the role of haptocorrin in protecting Vitamin B12 from damage by stomach acid and the reduction of inorganic nitrate (obtained from the diet) by oral bacteria to nitrite. Some candidates, however, investigated the latter practically. The majority of candidates successfully described the development, treatment and prevention of dental caries and periodontal disease. The impact of dental disease and tooth loss on general health was generally well answered by all candidates.

The comparison and contrasting of the dental antibiotics was generally evidenced to a good standard by most candidates with some candidates providing a comprehensive comparison on the basis of conditions treated, dosage, side effects, antibiotic classification, cost and provided detailed comparisons based on each of the above. The antimicrobial properties of a range of toothpastes and mouthwashes were investigated practically, however, some centres failed to investigate the antimicrobial properties of both toothpastes and mouthwashes which is a requirement of the specification. The majority of centres successfully investigated how acid erosion of teeth can be accelerated by bulimia or gastro-oesophageal reflux disease.

Most candidates evidenced the practical aspects of the investigation to a good standard, however, the following points are worthy of note:

- Experimental aims, hypotheses and predictions were often confused and lacked clarity. Several candidates stated a hypothesis but actually gave a prediction.
- At times there was a lack of consistency in Risk Assessment format. Risk Assessments should identify the risk, effect of the risk on the individual, measures taken to prevent the risk and action to be taken in the event of the risk being realised. Where appropriate, volumes and concentrations of reagents used should be identified.
- Photographs or diagrams support experimental apparatus lists. Diagrams should consist of assembled apparatus as opposed to individual items.
- Experimental methods should be written in the third person, past tense.
- To achieve the higher mark bands, candidates are required to analyse and interpret scientific information/evidence in a rigorous way with conclusions and evaluations leading to refinements. Spelling, punctuation and grammar, form and style of writing and use of scientific terminology are always of an excellent standard. All sources are referenced using the Harvard referencing system. Marking by some centres in this area was lenient. Whilst conclusions were generally stated, analysis and interpretation of data was not always evident.
- Evaluations did not always evaluate the materials, method used or results obtained. Refinements/ recommendations were not always to the depth required for the marks awarded.

Assessment and Award of Marks

Most centres appear to recognise and understand the level of detail required to award each of the mark bands for each learning outcome. Some leniency was observed in the awarding of A03(ii) marks which requires that candidates analyse and interpret scientific information/evidence in a rigorous way with conclusions and evaluations leading to refinements and in which spelling, punctuation and grammar, form and style of writing and use of scientific terminology are always of an excellent standard. In addition, all sources are referenced using the Harvard referencing system. Whilst conclusions were drawn, analysis and interpretation of experimental data were not always evidenced. Evaluations generally did not reflect a valid critique of the materials and methods used. Relatively few candidates successfully evaluated the experimental method or evaluated the accuracy and reliability of the results obtained. Refinements, though suggested, were not always valid or appropriate to the investigation conducted. In general the awarding of A03(ii) marks is an area that requires improvement.

Overall, it is evident that candidates invested considerable effort in evidencing the learning outcomes identified in the specification. Candidates work was largely assessed accurately at centre level using the marking criteria specified with detailed annotation justifying marks awarded or lost provided.

Assessment Unit A2 8 Histology and Pathology

Portfolio Requirements

Submission criteria requires that candidates write the reports of their investigations in accordance with standard laboratory guidelines, a proforma for which can be found in the SAMs. Candidates are required to reference all information and sources using the Harvard referencing system. Whilst some candidates met this requirement well, it is an area that very much needs development in future submissions.

Learning Outcomes and Assessment Objectives

Several candidates gave a detailed account of each of the stages involved in specimen processing supported by documentation used in hospitals in Northern Ireland. The majority of candidates discussed the relevance of the Data Protection Act 1998 to specimen processing.

Core legislation relating to the maintenance of health and safety across all pathology departments was identified and discussed by the majority of candidates. Several candidates, however, described the safety symbols and risk assessments used by pathology departments without actually referring to the legislation which governs or requires their use. Candidates should ensure that the legislation which ensures that pathology departments operate in a manner that prevents health and safety risks being realized are identified and described. Most candidates successfully described the role of each of the four pathology departments and the types of specimens used.

Some candidates gave a detailed discussion of the importance of health and safety principles in relation to the tests/activities identified, however, evidence provided for this learning outcome was non-specific and discussed in broader terms. Candidates should discuss health and safety pertaining specifically to each of the tests given in the specification for each pathology department.

In describing the work undertaken by a pathology department (Haematology or Histopathology) in identifying cells, candidates should identify the features or characteristics of a cell which lead to its identification. Analytical processes which lead to identification of cells, including staining techniques used should also be included. Whilst labelled diagrams/photos greatly support the description of cells, they do not fully describe those distinguishing characteristics which lead to cell identification.

The majority of candidates gave a detailed account of the roles and responsibilities of those working within the various pathology departments which does not fully evidence the learning outcome. Candidates should discuss the core skills and competencies required by personnel to fulfill their role and where possible, this should be department specific.

Whilst the majority of candidates described all of the tests given in the specification, this is an area which requires improvement. To access higher mark bands for Learning Outcome 14.2.2, candidates should aim to identify why a test is being conducted; how the test is carried out including a description of the materials and/or apparatus used and the scientific theory underpinning the test. Expected/normal results should also be discussed. For Learning Outcome 14.2.3, candidates should discuss how results of testing that are outside of the normal range are used to diagnose disease in patients and also how these results support subsequent treatments used.

The majority of candidates successfully completed chromatographic analysis. The specification requires that Thin Layer Chromatography (TLC) is completed, however, several centres completed paper chromatography but discussed TLC in their introduction. An investigation employing TLC should be undertaken for future submissions for this unit.

Most candidates access the higher mark bands for A03(i) however marking of A03(ii) was lenient. To access the higher mark bands candidates are required to analyse and interpret scientific information/evidence in a rigorous way with conclusions and evaluations leading to refinements. The majority of candidates drew accurate and valid conclusions based on analysis and interpretation of experimental data. Evaluation of the investigation (materials, method and results) and identification of valid refinements are areas that require improvement. Candidates should aim to evaluate the method used in terms of the sources of errors it actually presented during the investigation.

Results can be evaluated in terms of their accuracy and reliability. Suggested refinements/recommendations must be valid and relate directly to the investigation undertaken. The majority of candidates successfully described the nature and types of tests undertaken to diagnose blood-related disorders including Leukaemia, however, several candidates did not link the diagnosis to the results of testing obtained. Candidates should aim to discuss how the results of testing suggest the existence of blood-related disorders.

The majority of candidates successfully explained cross-matching and its purpose. A few candidates gave a detailed account of the cross-matching process which should be included to access the higher mark bands for this Learning Outcome.

The preparation of blood smears was evidenced to a very high standard by the majority of candidates. Candidates largely described the types of diseases that are infectious with few candidates giving a detailed account of how hospitals actually monitor infectious diseases and their role in this process. To access higher mark bands, candidates should aim to identify the types and sources of data obtained by microbiology departments and the data analysis undertaken in monitoring infectious diseases. How and to whom this information is communicated should also be discussed.

The majority of candidates successfully explained what antibiotic assays and cross-infection surveys are and their purpose. Candidates should outline how each of these processes are undertaken in order to secure the higher mark bands. The specific role of the Microbiology Department in monitoring antibiotic resistance and how this process is undertaken should also be described.

The majority of candidates described the Gram's staining, dilution plate and ELISA techniques to a very high standard.

The majority of candidates described the types of biopsies obtained and how assays undertaken inform the diagnosis of disease or the establishment of the cause of death in the case of deceased individuals.

Whilst the majority of candidates described the preparation of tissue samples for microscope slides in detail and to a high standard, several candidates failed to evidence how atheroma and emphysema could be recognised from slides.

Assessment and Award of Marks

Most centres appear to recognise and understand the level of detail required to award each of the mark bands for each learning outcome. It is important, however, that centres ascertain whether the learning outcomes have actually been successfully evidenced by candidates. Some leniency was observed in the awarding of A03(ii) marks at times which requires that candidates analyse and interpret scientific information/evidence in a rigorous way with conclusions and evaluations leading to refinements. The majority of candidates drew accurate and valid conclusions based on analysis and interpretation of experimental data. Evaluation of the investigation (materials, method and results) and identification of valid refinements are areas that require improvement. Candidates should aim to evaluate the method used in terms of the sources of errors it actually presented during the investigation. Results can be evaluated in terms of their accuracy and reliability.

Suggested refinements/recommendations must be valid and relate directly to the investigation undertaken.

Overall, it is evident that candidates invested considerable effort in evidencing the learning outcomes identified in the specification. Candidates work was largely assessed accurately at centre level using the marking criteria specified with detailed annotation justifying marks awarded or lost provided.

Assessment Unit A2 9 Analytical Chemistry Techniques

Portfolio Requirements

This is an optional A2 unit which was selected by a large number of centres. Overall, the work submitted by centres was of a very high standard; indicating a clear understanding and interpretation of the specification. All centres correctly used the Candidate Mark Record to evidence the learning outcomes and the corresponding mark band. Across most centres it was also evident that they had adhered to the pro-forma in the SAMs for writing up practical investigations; this allowed candidates to access the higher mark bands more easily. It would be of benefit to centres who have not used this pro-forma to access it for future submissions. It is a requirement that candidates use the Harvard referencing system to reference any sources used throughout their portfolio; this is still an issue across many centres and should be addressed.

Learning Outcomes and Assessment Objectives

Overall, an excellent standard of work was submitted by centres, evidencing all learning outcomes within the specification. There are still misinterpretations occurring with evaluation of each practical investigation; candidates are required to evaluate methodology and technique as well as assess the accuracy and reliability of their results.

The investigation on qualitative analysis requires candidates to perform each of the techniques listed within the specification and write these up as practicals. These techniques should then be used to devise an investigation to identify an unknown compound which is provided by the teacher. The candidate is then required to derive a conclusion from this investigation. It was evident that in a number of centres LO 15.5.6 was being missed out or not completed fully.

Centres are reminded that annotation on independent, safe and skilful use of practical equipment by candidates, where appropriate, is a requirement, this should be annotated on each candidate's work to ensure it is clear that the candidate has fulfilled these criteria in the execution of their method.

Assessment and Award of Marks

All centres correctly used the Candidate Mark Record which is available on the CCEA website. Annotation was appropriate across most centres, indicating the presence of the learning outcome and the mark band awarded. Awarding of mark bands was much more commensurate with the level of the candidate response during this series. There are still a few minor issues, where centres are allocating Mark Band 4 to evaluations that are not comprehensive enough. Teachers should remind themselves of the criteria for each mark band across the different assessment objectives before marking a candidate's response. This information can be found in the SAMs for Life and Health Sciences.

Assessment Unit A2 10 Enabling Technology

Portfolio Requirements

In the 2019 cohort all candidate portfolios sampled evidenced the compulsory components i.e. a case study and database for patient monitoring. However, it is important to also draw to the attention of centres that it is difficult in this unit to guide candidates to ensure that their portfolios are not simply a huge compilation of internet cut and paste exercises. This can be assisted and in many instances irradiated from portfolios by:

- Providing very clearly structured pupil activities which require the candidates to present their evidence of each learning outcome in particular and varied ways.
- Candidates ensuring that they keep a learning log or diary style evidence format for particular learning outcomes.

Nevertheless, there was a high quality and standard of portfolio evidence and excellent organisation and presentation of the portfolios sampled in this series in most centres.

Learning Outcomes

Portfolios tended to evidence learning outcomes as presented in the specification in the form of factsheets or written reports whereas learning outcomes were assessed in the Case Study and in the Patient Monitoring Database as would have been expected. In virtually all centres the evidence presented for the programme/regime of exercise/fitness put in place for patients being monitored was clear and evident which was not the case in the previous series. Finally where the evidence of a learning outcome was the record of a discussion of the pros and cons of sharing and safeguarding patient data, the evidence allowed candidates to access the higher mark bands. Candidates throughout this unit had carried out extensive research using a variety of sources, which were referenced in the bibliographies. But extreme care must be taken to ensure once again that portfolios do not become a plethora of copy and paste exercises as this can lead to plagiarism concerns.

Assessment and Award of Marks

The majority of the teacher assessment and award of marks was appropriate with teachers matching the assessment objective mark criteria and band in line with the nature of the quality of the candidate response. Centres had successfully used the updated Portfolio Checklist/Candidate Mark Record. The use of these documents ensured that teachers and candidates could easily evidence the presence of all the Learning Outcomes associated with this unit and indicate where and in which band marks had been awarded. There was evidence of differentiation in the range of marks presented.

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