

Royal Society of Chemistry
Mastership in Chemical Analysis (MChemA)
Assessors' Report 2022

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Introduction

This is the annual report of the Assessors for the Mastership in Chemical Analysis for the year ending 31st December 2022. These comments are intended for candidates and their counsellors only, to help them to understand the expectations of the assessors and to aid their preparations for the MChemA.

The MChemA Regulations, Syllabus and Guidance Notes can be found on the RSC website at <http://rsc.li/mchema>.

Part A

Two candidates took the Part A examination in April 2022.

Previously we had met on-line for a discussion on how to tackle examination questions, mark breakdown (and its importance), and a 'live' session on answering the previous examination paper.

Both students performed well achieving marks of 77% and 74%. Interestingly they both attempted the same 5 out of 8 questions, and mainly (on four of the questions) scored very similar marks. This selection of specific examination questions probably reflected their background and expertise. The questions attempted were as follows:

Question 1: A statistics-based question, around a scenario of an antibiotic in whey powder, that had mainly numerical answers with some limited discussion. (19/20) and (17/20).

Question 2: A calculation question involving determine of the pesticide concentration in a rain-run off sample. The degree of difficulty within the question was understanding how to deal with a concentration factor. Another part within the question was descriptive on outlining how solvent evaporation is done (for organic compounds), and finally a purely numerical exercise on calculating a concentration when given a $Y = mx + c$ calculation. (17/20) and (8/20).

Question 3: An initial descriptive question about HPLC, some definitions, and followed by a theory type calculation. (15/20) and (20/20).

Question 4: An initial descriptive question on an ICP, sample introduction and then parts on ICP-MS including the interface and MS issues. (13/20) and (15/20).

Question 5: An initial descriptive question on AAS, sample introduction issues in a flame and a comparison of detectors for MS and AES. (13/20) and (14/20).

Both avoided questions on:

Question 6: X-ray fluorescence

Question 7: Electrochemistry

Question 8: Food Microbiology / bacteria

Part B

The two Part B exams were held virtually on the 12th and 13th October 2022. This was the first year of the Part B in the new format of an open book exam. From 2023, this exam is scheduled to be held in April every year.

The format for the papers has changed from answering five questions in three hours to answering four questions in four hours. This equates to one hour per question rather than 36 minutes per question previously. The change has been made firstly, to allow the questions to be broader in scope and more in-depth, to reflect the open-book approach, and secondly, to allow the candidate some time to research and formulate their answer.

Two candidates sat both papers. One candidate sat Part B in 2020 and in 2021 but had not passed. The other candidate was sitting Part B for the first time.

General observations from the invigilators of the exam were that the candidates appeared to spend very little time reading the paper and a lot of time writing. It was apparent from the answers given to some of the questions that the questions had not been read properly. Candidates are advised to read the whole paper over very carefully before beginning to write, as marks can only be awarded for material which answers the specific questions set.

Having said that, neither candidate gave answers to the questions that were particularly in-depth, despite the amount of time given. It was clear from the candidates' answers which subjects they had a good knowledge of and which they had only been able to research on the day. The open-book format enabled the assessors to get a good understanding of the abilities, experience, knowledge, thought processes and problem-solving skills of the candidates, in a way that a memory-based closed-book exam could not.

Feedback from both candidates following the new-style exam revealed that the questions were thought to be more relevant to the reality of working as a public analyst and were more wide-ranging in the breadth of knowledge required to answer, taking a more holistic approach to sampling, analysis and assessment. This approach requires candidates to have a broader view of the context and framework within which public analysts operate. It requires candidates to take a step back from the individual methods of analysis and pieces of legislation and look at the bigger picture. One candidate observed that a different approach to preparing for the exam is needed,

compared with the previous Part B, with wider reading and awareness around subjects required and less focus on learning test methods off by heart and practising calculations.

Detailed comments on the papers:

Paper 1

Candidates were required to answer any four of the six questions set. All questions were attempted.

Question 1

The first two parts of this question asked for explanations of how to handle and test formal and informal samples of fresh poultry. Answers should have included the official drip test method for the formal sample. Added water, added proteins, phosphates, TVN/B, peroxide value, micro, antibacterial products were all tests that could be applied to informal samples.

The third part of the question was about assessing minced meats of different animal species to ensure their compliance with all relevant compositional and safety legal requirements. Answers should have included reference to testing for different species, e.g. pork, beef, chicken, lamb, turkey etc., fat content (lean, extra lean etc.), collagen/protein ratio, additives, microbiological safety and treatment/recommendations based on results.

Both candidates attempted this question. They both had mixed success, answering some parts well, but missing other parts out altogether.

Question 2

This question was about the sampling of wheat from bulk for mycotoxin testing, the approach to be taken, advice given to the sampling officer and the sample preparation and testing required and how the results should be assessed.

Regulations EC 1882/2006 specifies limit for contaminants in food. For wheat there are limits for DON, ZON, Aflatoxins, Ochratoxin A, Cadmium.

For T2 & HT2 Commission Recommendation lays down indicative levels for wheat as well as specifying the sampling and analysis requirements and for monitoring the trends in cereal products before limits are set in legislation.

EC 401/2006 lays down the methods of sampling and analysis for the official control of the levels of mycotoxins in foodstuffs.

The answer should include a summary of the limits that would apply and a discussion of the sampling that could be undertaken by the officer.

It is expected that a suitable method/methods could be described - LC method/ELISA and the performance criteria that would be required, e.g. LOQ, LOD and what comments, caveats would go on the report.

One candidate attempted this question.

Question 3

This question was about honey. Candidates were asked to evaluate and discuss the analytical techniques available to test the authenticity of label claims relating to floral and geographic origin and describe which honeys on sale in supermarkets and farm shops should be sampled, and what tests should be carried out on them. They were then asked how they would interpret the results of analysis and advise the local authority to act on the results.

One candidate attempted this question.

Question 4

This question was about QUID. Candidates were asked to explain the principles of QUID and how food businesses should apply it to their products. They were asked to describe how to establish the quantity of the following ingredients in foods:

- a. Steak in a cooked steak and kidney pie
- b. Raisins and sultanas in a breakfast muesli
- c. Tomato in tomato ketchup
- d. Egg in mayonnaise

Candidates were asked to explain when a QUID declaration is not required and were given four ingredients lists and asked to choose the ingredients which should have a QUID declaration and why.

Although most of the information asked for is readily available, an understanding of and familiarity with the use of QUID in real-life examples would help candidates enormously with the specific examples given. The candidate who attempted this question answered the general principles part well, but did not appear to be familiar with how to apply the principles in practice. Candidates should look at lots of different food labels from a range of manufacturers and retailers to familiarise themselves with the correct and appropriate use of QUID.

Question 5

This question was about labelling and candidates were presented with two images of food label artwork to assess for legal compliance.

Both labels contained multiple issues, not all obvious non-compliances, in some cases questionable use of reserved descriptions, warnings and claims, which were expected to be identified and discussed.

One candidate attempted this question but only identified a few of the issues expected to be raised.

This type of question did not appear in the previous Part B exams and candidates may not have been prepared for it. However, at this stage, candidates are expected to have carried out multiple label assessments in the preparation of their portfolio of evidence and should be fairly proficient at them. Candidates are advised to practise assessing as many different types of food labels as possible, particularly those where complex information is presented and nutrition and health claims are made and feedback on these assessments should be sought from and discussed with counsellors.

Question 6

This question was about sweeteners and candidates were asked to discuss the testing of a sample of sugar-reduced sweets containing the ingredients aspartame, maltitol, polydextrose, sugar and flavourings to determine the nutrition information for the product label, the level of sweeteners in the product and whether they comply with legal requirements, and how the product should be named and labelled.

Candidates were expected to identify and discuss the different types of sweeteners in the product, i.e. bulk and intense sweeteners and discuss the different methods of analysis for each and the overall nutritional analysis, e.g. the need to do a different AOAC fibre method, HPLC methods for maltitol and aspartame.

The discussion should then have moved onto the required label warnings – aspartame warning, laxative effects warning, and the requirement for the name of food to include ‘contains sugars and sweeteners’.

Although one candidate attempted this question, they did not get very far with it.

Paper 2

Candidates were required to answer two questions from four in section 1 (Food), and two questions from two in section 2 (Agriculture).

Two of the four questions in Section 1 were not attempted (Questions 3 and 4).

Food

Question 1

This question was in two parts. The first was about acrylamide and its occurrence in food and the measures in place to control it. Candidates were asked to consider the role of Food Business Operators and Local Authority enforcement officers in this control and their views on how this would work in practice. Answers were expected to include discussion of Regulation EU 2017/2158, benchmark levels only for certain product types, mitigation measures that may be put in place, discussion of how this can be enforced - sampling that may be carried out by LA Officers, follow-up action. Also discussion of the guidelines for local authorities on the implementation of EU 2017/2158 and how practical some of the measures are.

The second part of the question was about food contact materials and candidates were asked to describe the legislative framework in place for ensuring the safety of food contact materials and how new food contact materials could be assessed as safe to use, bearing in mind increasing consumer demand for sustainable packaging. Answers were expected to include the framework directive and regulations for different FCMs,

Both candidates attempted this question and the first part on acrylamide was well-answered. Marks were lost in dealing with the second part, with candidates seemingly having less of an understanding of how this area works.

Question 2

This question was on the microbiology of ready-to-eat foods. Five scenarios were given and candidates were asked to state the microbiological examination that would be carried out to determine whether the sample in each complies with the relevant legislation and/or guidelines, including reference to the statutory method (s) and the criteria that would have to be satisfied for compliance purposes.

This question was very straightforward and answers were to be found in The Guidelines for Assessing the Microbiological Safety of Ready to Eat Foods Placed on the Market.

Both candidates attempted this question and both identified the guidelines, though one candidate interpreted them better than the other and gave the correct answers, whilst the other candidate's answers were only partially correct. Familiarity and regular use of the guidelines would help candidates to answer this question well.

Question 3

This was a microbiology question and concerned assisting a public official with investigating a local outbreak of *Listeria monocytogenes* in smoked salmon, including the sampling, testing and interpretation of results.

This question requires a broader knowledge of food poisoning outbreaks and investigation than just knowing about the testing required and may be beyond the level of experience of candidates. However, public analysts could be called upon to provide this type of assistance and should be able to research the subject and devise a sampling strategy.

Neither candidate attempted this question.

Question 4

This was a food policy question, asking candidates to debate the advantages and disadvantages of the change in food composition and labelling legislation from traditional 'recipe' law to 'informative labelling'.

This question requires candidates to consider the broader context in which food legislation is made and consider the history of how it has arrived at its present state. Candidates are expected to argue both sides of the debate and present and provide evidence for their personal views on the subject. This type of question is generally unpopular with candidates and often not answered well where it is attempted. However, with a bit of practice of presenting and arguing a case in writing, this question could be an excellent way of gaining marks.

Neither candidate attempted this question.

Agriculture

Question 5

Candidates were asked to produce a sampling protocol for a Trading Standards officer to use to take official samples of animal feed, ensuring all elements were captured to ensure a robust process resulting in successful enforcement action, should this be required.

Both candidates attempted this question. Neither actually produced the protocol requested, both making notes on what should be included. These notes included some, but not all of the required elements.

Question 6

This question was about a liquid fertiliser found, by analysis, to be deficient in nitrogen compared with the amount declared on the statutory statement. Candidates were asked to discuss the possible causes of the low nitrogen result, focussing on the way liquid fertilisers are manufactured, stored and used, how the sample for analysis should be taken and the relative merits of the official methods for the detection of nitrogen in fertilisers when applied to this product.

The question was based on a real-life case and the reason for the apparent nitrogen deficiency was never properly elucidated, despite extensive investigations into the manufacture, storage and testing of samples over a period of several years. Answers were expected to focus on the nature of liquid fertilisers compared with solid fertilisers and their likely homogeneity, i.e. they are often suspensions and not true liquids, therefore if not homogenised properly, not all of the nitrogen will be present in the aliquot sampled.

A discussion of the analytical method to be used depending on the form that nitrogen is present in, e.g. nitrates, ammonium salts, cyanamide, urea was also expected.

Portfolio of Evidence

Two first-part portfolios of evidence were submitted to the assessors for assessment in 2022. As per the new requirements, the submissions were reviewed by the assessors and feedback was given to the candidates in interviews held in November, with guidance on completion of the portfolio for second submission prior to Part C being provided.

Both candidates appeared to have understood and followed the new portfolio requirements for the most part and had identified gaps in their knowledge with plans to address these gaps. Both candidates were encouraged to provide as much detailed narrative as possible in all parts of the portfolio. They were also encouraged to develop the complexity of the certificates and label assessment reports and to include examples of grey areas, where the interpretation of the results or label claims is not clear-cut. One candidate was advised to obtain more detailed narrative on their experience from their counsellor.

An example submission was also received from a candidate just starting their portfolio, with a short practical and problem-solving section and a small number of certificates and labels. The approach to the portfolio was considered to be very good, with clear, detailed narrative. Feedback and general advice was fed back to the candidate.

Part C

The Part C exam was held in laboratories at Glasgow Scientific Services on Wednesday 7th September 2022. One candidate took part, in their first attempt.

The candidate was required to write three certificates of analysis based on results provided (a vacuum-packed honey roast smoked salmon with microbiology results, a milk chocolate with test results for calculating cocoa and milk solids and a pet food tested for analytical constituents), examine and report on three microscopy specimens and complete two interactive exercises within an eight-hour period.

The candidate made a start on the first interactive exercise involving the illness of residents at a care home after a birthday party at the beginning of the day. They took a systematic approach to the investigation, asking about symptoms of illness and time of onset. The candidate then chose to focus on the sandwiches consumed at the party as the most likely cause of the illness, rather than the other items consumed, testing for pathogens and concluding the correct cause of the illness as *Listeria* in the smoked salmon and cream cheese sandwiches.

The Candidate gained good marks in this question due to the approach taken, however, assumptions were made that may not have paid off. Candidates should be careful about going down a particular route at the expense of missing out other significant factors.

The second interactive involved a sample of bacon alleged to be of poor quality, with no other information available initially. Although various questions were asked about the nature of the complaint and whether a reference material was available, the answers supplied initially led the candidate to focus on potential contamination of the sample. Some compositional tests were requested, but the candidate did not ask for a meat content or salt analysis which would have enabled them to determine that the bacon contained a high level of added water. Information about the bacon shrinking away in the pan and having a white residue appear on the surface did not appear to suggest to the candidate that the added water content may be the cause of the consumer complaint. Although they did not identify the issue, their systematic approach to problem-solving enabled them to gain marks for the question.

The candidate did not allow themselves very much time to work on the microscopy specimens and was only able to answer two of the three questions. The two questions that were answered were satisfactory, the candidate providing clear, labelled drawings and rationale for the identifications made. As the candidate must pass each part of the exam to pass overall, this is a risky strategy and candidates are advised to devote sufficient time to each section of the exam.

The certificates of analysis were completed well for the most part. A couple of errors were made, but it was clear from the accompanying notes that the candidate had the correct intentions before writing the certificate. This demonstrates the importance of making good notes as marks may not be given otherwise for a final certificate drafted with errors.

The candidate completed all of the questions bar one on the paper and passed each of the three sections, enabling them to pass the entire paper.