Royal Society of Chemistry
Mastership in Chemical Analysis (MChemA)
Examiners’ report 2016

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Introduction
This is the annual report of the Examiners for the Mastership in Chemical Analysis for the year ending 31 December 2016. These general comments are intended for candidates and their counsellors, to help them understand the expectations of the examiners 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
Seven candidates sat the exam. One candidate did not demonstrate a suitable level of knowledge and understanding to pass and attained an overall mark of 38.5%. The other six candidates achieved a pass with marks ranging from 45.5 to 72%, demonstrating a range of knowledge and understanding. Questions 1, 3, 4 and 6 were the most popular with at least six out of the seven (if not all) candidates attempting these four questions. All questions were attempted by at least two candidates and the profile of marks demonstrated no single question was of too challenging a concern.

The range of marks pertinent to each candidate together with personal feedback was given to individuals in report form.

1. This question was divided into two sections. Section (a) to define and discuss the differences between five analytical pairs of terms and nomenclature, and (b) a statistical appraisal of two sets of data in terms of their significant difference at a given confidence interval. Both parts were attempted by all candidates and six of the seven achieved a first class score, demonstrating sound knowledge and understanding.

2. This question was divided into two parts with part (a) requiring the theory behind the spectroscopic emission technique of ICP-OES and part (b) a ‘practical’ application of data handling skills employing, among others, graphical techniques; the latter to test the analyst’s ability to both process and critically appraise the results from a partly flawed set of measurement data.

This was attempted by four out of the seven candidates. The marks ranged from 30 to 65%. This type of question was introduced some four years ago to allow candidates to demonstrate their practical data handling abilities given the raw data output from an instrumental technique commonly encountered in the PA laboratory. The use of linear range-response to calculate the original concentration of arsenic in a paint sample curiously
presented quite a challenge in terms of the third and fourth sections of this question. The theory section (a) was partly answered by three candidates and omitted by one.

3. All seven candidates attempted question 3 which was divided into three sections, focusing on quality assurance, quality control, and validation processes including CRMs. These were answered comprehensively by some and only in brief detail by others producing the broad range of marks, 35 to 80%. The section dealing with CRMs was not well covered by ~ four candidates.

4. This question was attempted by six out of the seven candidates and was divided into two sections. One asked for the function and operation of the individual parts (shown in block diagram) of a modern ICP-MS instrument to be described, while the other section asked for two other trace / ultra-trace elemental techniques of their choice to be discussed in terms of their advantages and disadvantages. Part (b) was omitted entirely by one candidate who also misinterpreted part (a), thereby providing a very low mark in this case (15%). The other marks ranged from 40 up to a very sound ~78%.

5. This question was attempted by three candidates and was introduced to allow the candidates to demonstrate their knowledge and understanding of biochemical techniques, as used within the public analysts laboratory these days. To some extent, the question was presented in an open format in two sections, requiring any two biochemical analytical techniques of their choice to be discussed (e.g. Immunoassay, Aptamer, ELISA, DNA and PCR techniques etc.) in terms of the techniques ability to identify and measure (1) a meat product contaminated with horse and (2) the possibility that the horse meat present may contain the veterinary drug “phenyl butazone”. Only one candidate provided sufficient details to gain any real marks but unfortunately did not complete the question resulting in a mark of 50%. The other candidates only briefly answered both sections with limited details; hence the lower marks score of 40 and ~23%.

6. This question was attempted by six candidates. However, in two cases these were brief final question answers in order to meet the expected five completed answers required (as stated in the rubric); hence the marks of 7.5 and 27.5%. The question asks candidates to describe the physico-chemical principles behind and applications of four out of the six presented analytical techniques. One candidate only presented ~three out of the requested four but still attained a mark of 55%. The marks of the other three ranged from ~43 to 78% demonstrating the range of detail included in their answers.

7. This question was divided into two equal sections, the first asking the candidates to describe with suitable details, the sample preparation steps for two out of five presented sample scenarios; the second section asked the candidate to describe and discuss one major technique of their choice used for the measurement of radionuclides in the environment. This question did not prove popular, with only two candidates attempting to provide any answer. In one case the relatively brief answer given was in addition to the other six answers they had presented to the five actually requested! This resulted in a mark of 30%. The other candidate did provide some details in both sections but this was their last question; hence the mark of 45%.

8. This question was again answered by only two candidates. This question asked for a discussion of the key practical steps involved, with details, in acquiring a measure of the
levels of “poly-aromatic hydrocarbons” in a ‘waste water’ from a treatment plant. Details to consider in the analytical steps included, taking suitably representative samples, their collection, storage and preparation, their extraction, PAH measurement, evaluation and required validation procedures. The integrity of the sample was also to be noted. Various relevant sections were provided by candidates, some sections in more depth than others but in one case were very well handled resulting in a mark of 85%. However, some expected critical information was not provided in the other case and as a result a mark of only 40% could be given for this answer.

Part B (11-12 October 2016 Burlington House)

Four candidates presented for both Part B papers. No candidate passed both papers. One candidate was successful in paper 1 and one candidate was successful in paper 2. One candidate presented for paper 2 and was successful.

Overall there seemed to be an absence of detailed information in some answers and a lack of knowledge regarding the sources of contaminants. Wrong information can result in the candidate being marked down.

Paper 1

1. The first part of this question related to the candidates understanding of five legislative terms. The second part related to the determination of artificial colours in food. The examiners expected the candidates to not only detail analysis of permitted colours but also of non-permitted colours such as Sudan dyes. The answer should also cover the problems associated with extracting colours from different food matrices.

2. This question related to arsenic in food. New legislation came into force 1 January 2016. It was expected that the candidates would have up to date knowledge of legislation. The first part of the question required knowledge of the current legislation and the sources that resulted in the contamination of food with arsenic (such as industrial emissions and ground water contamination in India). The second part of the question required the candidate to know how to analyse food for arsenic and its toxic species. The answer should include details of extracting inorganic arsenic and its determination (ICP-OES, Hydride generation –AA).

3. The first part of the question required knowledge of current legislation for composition and labelling of olive oil. The second part required knowledge of olive oil analysis. The analysis is laid down in legislation.

4. The first part of the question required knowledge of analysis of foods for polychlorinated biphenols and dioxins. Whilst this analysis is not undertaken in all
laboratories due to its specialist nature the examiners expect the candidate to have a good knowledge of the techniques involved. The second part of the question related to terms described in legislation.

5. This question required an outline of five analytical techniques. These techniques could be called classical and require little instrumentation. The answer to the question for sesame oil in tahini was generally over complicated with candidates focussing on the presence of an allergen when all that was required was a simple fat content. There seemed to be a lack of knowledge of the volatiles in the liqueur spirit and the errors involved in analysis by gas chromatography.

6. Outline the methods used in an official food control laboratory to determine the presence of five organisms. It would be expected that the candidate would have knowledge of the methods involved. Only one candidate answered this question.

7. This question concerned irradiation of food. It was expected that the candidate would identify the reasons for irradiation such as destruction of microorganisms/insects, enzyme inactivation and elimination of sprouting) and the methods used such as cobalt 60, x-rays and electrons. The answer should also cover the labelling and the restriction to authorised irradiation plants.

8. This question required knowledge of general contaminants in food. The answers for the different contaminants varied in quality. Aflatoxin and lead were reasonably well answered but the answers for histamine were poor with a lack of knowledge of its different sources (not just fish but also wine and cheese) and consequences of its ingestion.

Paper 2

1. Food Labelling has changed with the introduction of the Food Information Regulations. This question required the candidates to identify the aspects of the original legislation which have not be incorporated into the Food Information Regulations and how they are now controlled. This question was poorly answered indicating that the candidates were not conversant with the two pieces of legislation. It is important to know what has changed when new legislation is introduced.

2. This question concerned the primary authority agreement between food companies and local authorities. This question was answered better than the previous question.

3. Discuss the current legislation to fertilisers. Only one candidate attempted this question and gave a reasonably comprehensive answer.

4. This question required knowledge of official feeding stuff methods. This question was generally well answered. The candidates showed knowledge of the methods but the answers lacked some detailed information.

5. This question concerned the source of five contaminants in feeding stuffs and their effect on animals and the food chain. Whilst the candidates knew about the contaminants, again, there appeared to be a lack of knowledge about their sources.
6. The first part of this question required knowledge of three feed definitions. The second part required information regarding the labelling of these feed(s). This question, in most cases was reasonably well answered.

7. The question related to the methods available for water purification. Water purification is a reasonably well defined subject. This question was in general well answered.

8. This question concerned the validation of water methods to DWI requirements. This question was only answered by one candidate.

**Part C (7 September 2016 Reading University).**

Three candidates presented for part C. One candidate was sitting the paper for the first time. One candidate passed all three sections as required.

The candidates were presented with three certificate questions, three microscopy question and two interactive questions. One of the interactive questions required the candidate to contact a site manager before 10.00 am to obtain further information.

Part C requires good time management. It is to the candidate's advantage if they can practice working under time constraints prior to the examination.

**Section 1 Communication in the form of formal certificates.**

The examiners do not prescribe a particular approach to the production of a certificate. A candidate will adopt a reporting style with which they are comfortable. The only requirement is that the certificate is acceptable in a court of law. The certificate should state any relevant legislation, the result(s) of analysis and a positive statement of the offense or opinion.

Generally, the certificates were well answered with all three candidates passing.

1. This question required the interpretation of aflatoxin results in a marzipan. The candidates were given the results of analysis, recovery and uncertainty data and a list of ingredients and a quantitative declaration for the almond content of the marzipan. The candidate would be required to calculate the actual aflatoxin concentration in the almond part of the marzipan and apply the uncertainty of measurement. The Contaminants in Food Regulations should then be consulted to identify whether or not the aflatoxin was above the permitted level. An appropriate certificate should then be produced. The certificate also requires specific statements regarding recovery and uncertainty.

2. This related to a complete feeding stuff for chicken. The stated composition of the feeding stuff and the actual analytical results were provided. The candidate would need to assess the results of analysis against the given data using the permitted tolerances for each analyte provided in legislation. The uncertainty for lead and cadmium will need to be taken into account. The appropriate certificate should be produced identifying the correct legislation and avoiding the use the term “to the prejudice”.
The oil is high and the ash low. The cadmium is below the maximum limit and the lead is above at 12% moisture, but applying the uncertainty takes the lead under. With regard to the labelling the comment could be made that phosphorus and calcium need not be given in the statutory statement if present below 2 and 5% respectively. Lysine and methionine should be declared.

3. This related to the analysis of a cranberry sauce. The candidate was supplied with nutritional information and results of analysis. Cranberries naturally contain benzoic acid. The candidate is required to decide whether the level found by analysis was due to natural occurrence or whether additional benzoic acid had been added. If the carbohydrate by difference is calculated, then it can be seen to be higher than stated value. Reference must be made to the guidance on nutrition tolerances to decide whether or not the declaration is correct. In this case the carbohydrate level was outside the permitted tolerance. Certificate questions may contain more than one fault. The faults may come from the analysis and/or labelling.

**Section 2 Microscopy and identification.**

All three candidates passed the microscopy. The examiners would like to have seen more use of reference materials and reference books to confirm identities. Multiple slides should be produced (within reason) to ensure that minor components are not missed. Use of chemical tests as well as microscopy can assist. Good detailed and labelled diagrams score well. The candidate should also state what features they have not found and state what types of materials this eliminates. The marks against each question give an indication of complexity.

4. A foreign body in a vegetarian product. Only the foreign body was provided. The foreign body consisted of Quorn (mycoprotein). Whilst this was reasonably easy to identify there was lack of detail in the microscopy notes regarding features not found.

5. Herbal tea mix. This was a mixture of chamomile and lavender. Once again relatively easy to identify the components.

6. Spice mix from a restaurant owner for identification of its components. Mixture of cumin, coriander, ginger and chilli/paprika. The main difficulty with this sample is determining the presence of both cumin and coriander which have similar features. Use of standard materials could assist.

**Section 3 Problem solving – Interactives**

The candidate should approach the interactive exercises in a manner similar to dealing with a complaint sample. They can still score well without getting the right answer if they are on the right track and show a reasoned approach. Good descriptions, weights, recording seal numbers and planning are essential. The requests for information from the examiners during the exam does not eliminate the need for the candidate to thoroughly document their thought process. The examiners need to see how the candidates have drawn their conclusions.
7. A caravan site has been recently refurbished. The residents are complaining of an unusual taint in the water supply. The site manager will be on site until 10.00 am and then won’t be back until 12.00 pm. Please contact him for more details.

Contacting the site manager would have provided more information regarding the water supply. The site has recently changed from mains to a bore hole and has also been extensively re-plumbed. The site contains a mixture of static and mobile caravans. This question could provide a number of sources for the problems (contamination of the borehole, problems with the piping or microbial contamination). Appropriate questions and request for analysis would have narrowed the problem to microbial contamination. Infrequent use of some of the storage tanks due to the variable number of mobile caravans on the site resulted in *pseudomonas* contamination.

8. Complaint sample of chicken. Complainant stated that a chicken had an odd odour after cooking. Please investigate.

The odour could possibly be produced by a number of different ways. Deterioration of the chicken, uncleaned chicken (giblets present in bag, foreign material), the cooking process or contamination.

Appropriate questions and analysis requests would have eliminated the deterioration of the chicken and the presence of giblets as the source of the odour. A request as to the cooking process would have supplied the information that the chicken was cooked in a bag. This would lead to the candidate to consider the oven bag as the possible source of the odour.

Oven bags, also known as roasting bags, are typically made of food-grade polyester or nylon. They are generally BPA-free, phthalate-free.

Analysis of the sample would have shown the presence of cyclopentanone which would give the peppermint odour.

Additional unused oven bags were available on request which if analysed would have shown them to be the source of the cyclopentanone.