May 2019 subject reports

MYP Sciences

Comments from the chief examiner

Each of the four on-screen examinations offered in the MYP sciences subject group has a focus on a different area of science. This allows candidates to study the content that best suits their interests, while maintaining a clear focus on the common aims, objectives and criteria of the subject group. What has again surfaced from this session is that it is clear that whichever traditional subject discipline a candidate experiences prior to completing this assessment, candidates who are most successful are those who have been encouraged to inquire and be curious about the world around them.

Teachers sometimes observe that a certain area of the topic list has not been covered in an on-screen exam, or there is an over emphasis on one area. While the sciences on-screen examination will, over time, explore all areas listed in the guide, it has never been the intention to test the recall of all of the knowledge broadly listed in the topic list in each examination. Exploring a scientific mind-set, allowing candidates to demonstrate the application of the skills they have developed and encouraging them to show their understanding of a rapidly-changing scientific and technological society is at the core of these assessments.

Aside from these broad observations, these four reports touch on the following universal themes:

Candidates need to develop a thorough understanding of the command terms, so they are able to interpret them quickly and fluently. In this way they can follow the inherent guidance contained in these terms when structuring their responses. This is particularly important when questions contain a command term that appears in the upper bands of the sciences criteria. The thinking inherent in the command term *state* compared to the command term *discuss* is clearly different and the type of response expected is therefore also different.

Half of the on-screen examination is focused on the experimental skills assessed in the MYP classroom through criteria B and C. Classrooms where candidates have been encouraged to freely engage with the spirit of scientific inquiry, planning and carrying out candidate led investigations are best able to develop the skills that these assessments will test.

While these assessments are not intended to form part of a teacher's testing strategy, candidates who have been given the opportunity to familiarize themselves with the on-screen environment are best placed to demonstrate the skills they have developed. In future years, examiners will place a greater emphasis on the application of correct scientific notation. Whether this is subscript use for chemical notation or superscript use for unit powers, candidates familiar with the onscreen tools will be able to more quickly format correct responses.

Finally, candidates need to have the opportunity to explore the impact that science and scientific development has on the world. All MYP candidates need to have the opportunity to view this impact through the different factors listed in the guide. In this way they will be ready to explore the complex scenarios each on-screen examination visits and be prepared to examine them from a variety of perspectives.

Biology

Overall grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 18	19 - 36	37 - 49	50 - 57	58 - 66	67 - 74	75 - 100

General comments

The percent of candidates who completed the exam and the high percentage of candidates who completed each question indicates that the length of the exam was appropriate for the allotted time. The comments from the teachers also indicates that the material on the exam was appropriate for assessing candidate understanding. It would have been beneficial to have responses from more teachers.

Candidate responses indicated that the prompts and multimedia information was beneficial and used by the candidates. Candidate responses were well organized and more complete than past exams which indicates that candidates are being well prepared for the exam and that they are using information provided by the prompts and multimedia presentations to help them answer questions. It also appears that candidates are able to use tools such as the calculator and graphing software with little trouble.

The areas of the programme and examination which appeared difficult for the candidates

Natural selection appeared to be a difficult concept for candidates to explain. Many candidates stated that organisms changed their traits when their environment changed. Very few candidates understood that populations have variation and that a change in the environment may favour one variation over another.

Meiosis and fertilization were processes that candidates often reversed. Many candidates stated that daughter cells from meiosis were formed from sexual reproduction instead of leading to sexual reproduction. Candidates also described differences in the processes between mitosis and meiosis instead of differences in the cells produced by mitosis and meiosis.

Determining the increments for the axes of graphs was a challenge for candidates. Many placed exact numbers from the data table instead of evenly spacing increments. Some candidates placed numbers on the x axis that did not go in numerical order as they copied the numbers

directly from the data table. Candidates also struggled to space the increments based on the space available on the graph.

Many candidates were able to identify concepts, but candidates struggled to justify responses. Justifying and explaining were skills that appeared to be very difficult for candidates. Candidates could state what might happen but not why it would happen. Candidates could also identify variables but could not explain why certain variables should be controlled.

Many candidates failed to plan a method that allowed for five increments of the independent variable to be measured. Many candidates stated that duckweed should be grown in light or no light instead of five different light intensities or five different lengths of light exposure.

The areas of the programme and examination in which candidates appeared well prepared

Candidates had a very good understanding of the scientific process. Candidates were able to identify variables, design a method, and state a safety concern. Candidates structured their responses clearly and most methods were easy to follow.

Candidates were able to demonstrate basic facts such as the photosynthesis equation, the functions of mitosis, organelles of plant and animal cells, and the function of the mitochondria. Candidates appeared to have a wide understanding of most topics from the topic list and were well prepared to respond to basic questions about the topics.

Candidates were well prepared to evaluate the use of science to solve a problem. Regarding the use of genetically modified salmon to meet the demands of fish consumption, candidates were able to describe positive and negative impacts related to the environment, economy, and society. Candidates also structured the response to this question clearly so that it was easy to follow. Candidates were able to use information from the infographic and incorporate the information into their response.

Candidates also used scientific terminology appropriately. Terms related to extinction and connections between organisms in an ecosystem were two areas where candidates demonstrated an ability to use scientific terminology correctly.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Candidates were able to correctly arrange the categories used to describe living systems. Candidates were also able to identify organelles found in plants and animals but struggled to identify the organelles found in both plants and animals. Candidates also understood that the mitochondria help provide energy for the cell but struggled to describe how it performed this function.

Question 2

Candidates struggled to identify the characteristics of living organisms. Candidates were able to compare the outcomes of mitosis and meiosis. Candidates were able to state one cause of variation in a population but struggled to list to causes and also struggled to describe how the cause led to variation.

Question 3

Many candidates used the term “extinction” in their definition of extinction and mass extinction which was not accepted. Candidates were able to state events that could change population size but struggled to provide an outline of how it led to change in population size. Many candidates were able to state one trait that led to increased survival of mammals during a cooling period on Earth, but many struggled to list two traits. Most candidates stated that rabbits with a colour that provided camouflage avoided predation, but most candidates struggled to related this with increased reproduction and increase in the beneficial trait within the population.

Question 4

Candidates were able to correctly identify biotic organisms and abiotic objects and were also able to correctly organize the photosynthesis equation. Candidates were also able to identify variables and to distinguish between quantitative data and qualitative data. The mean was also calculated correctly by most candidates but few candidates used the correct number of digits in the final answer.

Question 5

Many candidates were able to design an investigation that included correctly stated variables, a hypothesis with a scientific explanation, correctly manipulated variables, and safety considerations. Most candidates developed an investigation with more than one trial but many did not clearly state that three trials should be conducted and that there should be five increments of the independent variable.

Question 6

Candidates were able to organize the steps of a scientific investigation and to state an improvement for that method. Candidates were also able to correctly design a graph and plot data points. Some candidates struggled with correctly spacing the increments of the variables on the axes. Some candidates used the values directly from the data table even when they were not in numerical order. Many candidates could describe trends from the graph, but many candidates struggled to explain why these trends occurred.

Questions 7

Candidates were able to identify variables and to correctly state a prediction with a scientific explanation. Candidates also recognized the weakness of not controlling variables in the method. Some candidates struggled to explain why uncontrolled variables could impact the results.

Question 8

Most candidates used the interactive graphic to identify increased fish consumption and an increasing human population as reasons for a decrease in wild fish populations. Many candidates were also able to describe how technology has been used to increase the amount of wild fish caught each year. Candidates were also very successful at describing how changes in one population of fish could lead to other changes in populations of organisms.

Question 9: Most students correctly stated that one advantage of genetically modified salmon was that salmon production could be increased. Most candidates struggled to suggest a disadvantage of genetically modified salmon. Most candidates referred to problems with fish farming in general but not genetically modified salmon specifically. Most candidates were able

to use the information provided in the infographics to discuss and evaluate how genetically modified fish raised in fish farms could solve the problem of decreasing fish populations. Candidates were able to describe positive and negative impacts on the environment, society, and the economy as well as describe where fish farms should be located. Candidates also developed a final appraisal.

Recommendations and guidance for the teaching of future candidates

It would be beneficial for candidates to practice creating graphs from data tables. It appeared candidates need practice determining appropriately spaced increments on the *x* and *y* axes of graphs. The increments should be in numerical order, evenly spaced, and appropriately spaced to show a pattern in the data.

Instruction focused on designing investigations should reinforce the use of three trials and five increments of the independent variable. Many candidates designed investigations with three trials but very few listed five increments of the independent variable. The importance of studying five increments is to gain a better understanding of trends that may be found during the investigation. The increments should also include an appropriate range of values. Enzyme activity, as an example, often rises to an optimum level and then decreases after the optimum value. If the range of increments was too small, the trend would appear to increase or decrease based on the factor.

It is also recommended that candidates continue to receive practice at extended writing. This helps candidates practice organizing their thoughts and can provide them more opportunities to practice explaining and justifying their ideas.

Chemistry

Overall grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 22	23 - 44	45 - 59	60 - 67	68 - 75	76 - 83	84 - 100

General comments

Feedback from teachers and candidates suggested that the assessment was accessible for all and that questions were of a suitable difficulty based on the topic list. The amount of feedback from teachers was limited and it was disappointing that so few teachers took the opportunity to provide valuable input into the overall assessment experience. The feedback provided by teachers provides valuable guidance in developing future assessment tasks and in the award of grade boundaries. It is hoped that in future more feedback is provided by teachers.

Overall there were fewer responses that candidates did not attempt. This suggests that candidates were more familiar with the format and expectations during this assessment.

The areas of the programme and examination which appeared difficult for the candidates

Candidates found the command term *justify* challenging and lacked the vocabulary and scientific understanding to show what they had been taught. For example, when comparing two methods for the production of bubbles, candidates found it difficult to explain and justify which method would produce the most reliable data.

Candidates also found it difficult to discuss advantages of Teflon coated pans compared to metal cooking pans and to determine the type of bonding present from diagrams. Candidates found it difficult to make inferences from the information provided, their wider MYP studies and the topic lists in the subject guide.

Candidates found it difficult to name and identify organic molecules even though this is an area of the topic list that has been identified as a weakness in previous assessments. Candidates also found it difficult to name and identify organic molecules using ball-and-stick models.

In the criterion D task which looked at recycling plastics and Green Chemistry, candidates found it difficult to extract and utilise information to answer a question based on the information given. Generally, candidates found using the command term *discuss* difficult and some candidates' scientific literacy was low.

The areas of the programme and examination in which candidates appeared well prepared

Candidates showed good scientific knowledge and understanding in the task concerning the periodic table and the behaviour of acidic substances.

Candidates had a good understanding of criterion B and were able to provide detailed investigative designs. Candidates had the ability to identify independent and dependent variables and produce a well-structured method that was easy to follow and that contained the relevant aspects for a laboratory investigation.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Candidates were able to identify elements from the periodic table but struggled to explain why groups such as the noble gases or lanthanide and actinides were not present in historical periodic tables. Candidates struggled to calculating proton and neutron number using differences between a known element and a new element created through a nuclear fusion reaction given the overall equation. Candidates struggled to identify the name of the element from the number of protons that the element contains.

Question 2

Candidates struggled to identify a simple Lewis structure using a dot and cross diagram. Candidates were able to use coefficients to balance an equation given the overall equation. Candidates were able to identify the group and period of elements but struggled to calculate the molar mass of a compound with a given molecular formula. Generally, candidates were

able to match organic structures with their names when provided but some candidates were unable to name the compounds even if they had correctly identified the class of the compound.

Question 3

Candidates' strength in this question was in the identification of physical properties of metals. Candidates struggled, however, to use diagrams to identify the types of bonding present in pans with and without Teflon coating and to infer what effect the coating may have had during cooking. Candidates were weak in explaining oxidation and determining the charge of an ion after a metal had been oxidised.

Question 4

Candidates' strength in this question was being able to identify variables. The weaknesses were in explaining a hypothesis and in relating increased temperature to an increase in molecular kinetic energy and hence an increased rate of diffusion of tea. Candidates also struggled to include units with data that was extracted from a given graph.

Question 5

Candidates' weakness in this question was in graphing. The requirement to produce evenly spaced scales and a suitable title including both the independent and dependent variable was also an identified weakness in this question. Candidates found it difficult to compare the two methods of producing bubbles and to justify which would produce the most reliable data.

Question 6

The design of the investigation was a strength of the candidates. Candidates were able to extract the required elements in order to clearly identify the various variables and write a suitable, stepwise method that would be easy to follow. Many candidates, however, did not include the measurement of the bubble as a control variable and so measurements would not have been reproducible.

Question 7

Candidates were able to describe the impact of plastics on the environment and the use of plastic to produce energy. However, candidates were not able to use the information provided to understand what Green Chemistry was and then use this information to discuss the recycling of plastics in relation to Green Chemistry. In answering the second part of question 7, candidates did not realise that the question was about glass so many answers were incorrectly based on plastic.

Question 8

Candidates' strength in this question was that they were able to compare and contrast the methods for removing copper ions using the information provided. A number of candidates, however, compared more than two methods even though the instruction was to compare two methods for the removal of toxic waste from water supplies.

Recommendations and guidance for the teaching of future candidates

Candidates should be exposed to a wide range of scientific concepts within the topic lists so that they are better able to address the questions that may be asked during the assessments.

Candidates need to understand the command terms and what is required for each command term.

Candidates need to be given the opportunity to evaluate and discuss various chemical topics so that they are able to provide a deeper understanding of the connections between the topic lists and the application of the science in the real world.

Candidates need to be able to work through unfamiliar situations and extract the relevant information required. In this assessment, the bubble blowing investigation provided two different methods with which to make the bubbles. Candidates should be able to evaluate the positive and negative aspects of two or more methods and choose accordingly which would be better for producing reliable data with a reason.

Physics

Overall grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 15	16 - 31	32 - 43	44 - 52	53 - 62	63 - 71	72 - 100

General comments

Candidate and teacher feedback shared following the assessment session was overwhelmingly positive. Teachers considered the assessment accessible and the level of difficulty appropriate to the candidates in their schools. Candidates also found that the on screen environment and the increasingly familiar experience of the on-screen assessment allowed them to show their experience of the skills developed in their MYP physics class. This feedback was supported by the session's team of examiners. It was clear from responses that candidates are increasingly familiar with the command terms and using these to help guide their responses. Better use of the various on-screen tools is being displayed across the range of responses. This is resulting in more candidates correctly presenting their responses using the equation editor, incorporating scientific notation and accurately displaying information in tabular form. Schools are therefore encouraged to continue to allow candidates to familiarize themselves with the on-screen environment before the assessment session. However, the development of these skills needs also to be encouraged throughout the five years of the programme through formative and summative assessments of all four criteria.

The areas of the programme and examination which appeared difficult for the candidates

Again this year, the questions candidates found most difficult were those requiring them to use the commend term explain. While these questions inevitably target those skills assessed through the 7-8 band of the sciences criteria, few such questions went unanswered. However, candidates found it challenging to offer explanations that incorporated the use of correct scientific terminology, with explanations often being superficial, relying on generalizations and incorrect terminology. Justifications of hypotheses and deeper understanding of why experimental procedures are followed also proved difficult. While a broad coverage of those skills assessed by criteria B and C was evident, this did not extend to a thorough awareness of the reasoning behind the choices of experimental design and structure. The impacts of science on the broad range of factors included in the guide were not evident, the political factor was poorly addressed by candidates in comparison to the environmental. While candidates were able to address the environmental impact of science with more fluency, again this year many candidates framed a response that focused on climate change and the enhanced greenhouse effect, which was not the focus of the question.

The areas of the programme and examination in which candidates appeared well prepared

Aside from the evidently growing familiarity with the on-screen environment, it was clear that candidates had developed a thorough understanding of the topic list including the fundamental ideas and concepts. These included applying these concepts to contexts that were undoubtedly unfamiliar to the majority of candidates. Teachers are encouraged to continue to expose candidates to contexts that are unfamiliar when designing formative and summative assessments so that in the eAssessment environment they can tackle these questions with confidence. Experimental design and structure also proved an area of strength for candidates who were able to respond to questions that dealt with the broad spectrum of criteria B and C. Understanding that scientific developments have an impact on the world was broadly shown to also be a strength, particularly when considering the impact on the environment.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

It was clear from the answers shared by candidates that this was a familiar area of the topic list. Most candidates were able to identify the means of heat transfer from the direction of travel, although some candidates mistakenly assumed that a convection current would begin with warm air travelling at right angles to the heat source. Identification of kelvin or celsius as the unit of temperature was straight forward for most candidates, although joules as the unit of heat energy proved more difficult. The final part of this question required an explanation of insulation; while almost all candidates attempted this part of the question, many answers lacked the degree of specificity required by the command term explain. Few candidates were able to explicitly link

the features named in the question with the mechanism of heat transfer they were designed to prevent and corresponding explanations were often superficial.

Question 2

The action of a photocopier was an unfamiliar context to explore the action of electrostatics for the majority of candidates. While most candidates were able to build a simple Bohr model of a helium atom using protons, neutrons and electrons, few were able to identify the force holding the electrons in orbit around the nucleus. From responses given by candidates it was evident that, as with heat transfer, this was an area of the topic list with which candidates were familiar. However, explanations offered were often simplistic and lacked the correct scientific terms required. In addition, many candidates were challenged by part d, which required the annotation of a diagram with force vector arrows.

Question 3

Given that again much of this question was set in a context that would be unfamiliar to candidates, it was pleasingly answered by most. The recall of information related to the areas of the solar system and forces on the topic list. The overwhelming majority of candidates were able to label bodies in the solar system and to identify the equations needed to solve the associated mathematical problems indicating that candidates were familiar with the concepts encountered. However, as with question two, many candidates found it challenging to correctly equate the magnitude of a force arrow to its length. Many weaker candidates, while able to identify the correct equation, were unable to rearrange it successfully to determine the correct numerical answer.

Question 4

This question allowed the candidates to demonstrate their understanding of experimental design and focused on the procedural elements of a physics experiment that would generate good quality data. Almost all candidates were able to use the graph to interpret simple data, but a significant proportion of candidates chose to give their units using incorrect or calculation notation. Only those who presented units correctly received marks in this question. Most candidates were able to identify the three different types of variable and were able to draw a simple prediction based upon the stimulus material. However, it was noticeable that many candidates did not attempt to offer a scientific explanation to accompany this predication based on the familiar concept of balanced forces. Most candidates were able to explain why it was necessary to choose equipment that allows for the control variables to be managed. However, few were able to explain why the range of data collected is of equal importance. Most candidates also stated a reasonable number of trials for the experiment, a common feature of classroom experimental procedure. However, few candidates were able to correctly explain the significance of multiple trials. Those candidates that attempted to justify their choice often incorrectly stated that repeated readings would improve the accuracy of their data.

Question 5

This question allowed candidates to show their understanding of the way data can be used to test a hypothesis and, as with question four, it was clear that the fundamental routines of

experimental procedure were familiar to most candidates. The majority of candidates were able to form a data table and to transfer data into a recognised format; this included correctly labelling table headings and the correct presentation of numerical information. Fewer candidates were able to work with a given formula and justify the need to transform data to test a given hypothesis. It is important that candidates are exposed in class to relationships that need to be manipulated and that they develop an understanding of the importance of linearization in physics. Again, as with question four, few candidates had more than a superficial understanding how to improve the reliability of data with many equating reliability with accuracy.

Question 6

The first part of question six allowed candidates to further display their understanding of data and relationships and to demonstrate their understanding of the ways experimental design can be improved. While most candidates were able to state the format of the graph that should be drawn to display continuous data, only the most able candidates were able to describe the features of this graph with many candidates mistaking a line of best fit for a straight line. Many candidates struggled to offer improvements to the experimental design and there was often a clear misunderstanding of the difference between improvements and extensions. Those candidates that did offer improvements often gave perfunctory justifications for these improvements, as with question five, showing only a superficial understanding of the underlaying reasons for the choices they routinely make in laboratory experiments.

Question 7

The first two parts of question seven required candidates to apply their understanding of ionising radiation to its application in medicine. Most candidates where able to apply their knowledge of half-life and give reasons why long exposure is undesirable. The final part of question seven required candidates to examine the impact that a range of devices might have on the production of radioisotopes in a country of their choice. It was evident that candidates were able to describe both advantages and disadvantages of their chosen device in very general terms, however few candidates were able to share answers that applied this to a specific country. Many candidates did not offer any local context and those that did often failed to make links that were country specific. Better responses showed candidates planning out their answers and structuring them in such a way as to offer clear delineation of their thinking.

Question 8

It was evident that most candidates were comfortable tackling the extended response question examining nuclear medicine. However, it was clear that many candidates were not fully engaged with the requirements of the question and, as such, did not frame their answers to look at the use of nuclear medicine rather looking at the nuclear industry in general. Schools should encourage candidates to read the question carefully and ensure their response focuses on the requirements of the assessment. Many candidates focused their answers on chemotherapy which, while receiving no marks, is an understandable conceptual error. It was also clear that candidates were more comfortable focusing their answer on the environmental implications rather than the political implications, which could reflect the emphasis schools place on the environment when looking at the factors associated with criterion D. It was worrying

how many candidates focused their response on the incorrect environmental impact of nuclear medicine as a producer of CO_2 and the way it contributes to the enhanced greenhouse effect.

Recommendations and guidance for the teaching of future candidates

Candidates with experience and understanding of the four Sciences criteria are able to best perform across the three tasks in the assessment and future classroom teaching which has a focus on the MYP objectives is to be strongly encouraged. When addressing assessments in the classroom, the following are recommended:

- Formative assessment tasks that allow candidates to develop explanations of studied phenomena are encouraged. The commend term explain is one that candidates are familiar with, but not one they are able to correctly address.
- Teachers need to spend time ensuring that candidates are taught the reasoning behind the experimental method, rather than simply following standard procedures. While repeated results will improve the reliability of data collected, it will not alter the accuracy. Such distinctions may be subtle; however, they are not beyond the comprehension of MYP5 candidates. Candidates therefore need to be explicitly taught these concepts.
- Candidates need to be exposed to all of the factors listed on page 10 of the guide on which science may have an impact. While the environment may often be an obvious choice for candidates to examine in science, the other factors carry equal importance and time needs to be spent unpacking these if candidates are to have the confidence to employ these ideas in the assessment.

Integrated Sciences

Overall grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 15	16 - 30	31 - 46	47 - 53	54 - 61	62 - 69	70 - 100

General comments

The Integrated Sciences on-screen examination was developed considering the four assessment objectives, key and related concepts, topic list and skills for the sciences. The global context was fairness and development with an exploration on rights, law, civil responsibility and public affairs.

Teachers commented that the structure of this exam was well developed and allowed candidates to demonstrate a wide range of knowledge and scientific skills. The questions were designed appropriately to the level of Year 5 MYP candidates and the difficulty level of the on-screen examination was about right. The use of scientific language was accessible to all candidates and clear instructions were provided in the exam. The comments also indicated

that there was a good coverage of the assessment objectives and the use of media was very rich, stimulating and appropriate for candidates.

Some teachers commented that the on-screen examination was biased towards biology rather than chemistry and physics.

The areas of the programme and examination which appeared difficult for the candidates

Some candidates appeared to have some difficulty outlining, describing, explaining and evaluating knowledge and understanding using correct scientific terminology.

Some candidates struggled with areas such as unit conversion, use of scientific notation and the correct use of decimal places. Candidates also struggled with discussing the validity of a method and formulating a hypothesis.

Although almost all candidates appreciated the importance for control variables, few of them were able to explain reasons why they were important during the experimental process.

Finally, most of the candidates were not able to identify the disadvantages of the different proposals applied to solve a problem in the extended response question.

The areas of the programme and examination in which candidates appeared well prepared

Again, and as in previous sessions, most candidates demonstrated a clear understanding of how to design a complete and safe method using the prompts provided. Candidates were able to select correct independent, dependent, control variables, identify appropriate equipment and for use in an investigation. Also, most candidates were able to write a complete method although sometimes with a lack of specific details.

To some extent, candidates appeared to be well prepared to answer extended responses using all the information and instructions given.

The strengths and weaknesses of the candidates in the treatment of individual questions

The following comments are made on individual questions.

Question 1

Candidates were able to state the products of a complete combustion reaction, select the correct energy type using a Sankey diagram and calculate the light energy output using the diagram. Candidates found it difficult to calculate the energy used by a light bulb which also involved unit conversion and standard form to give the final value.

Question 2

Candidates were able to select the trophic level in a pyramid of biomass diagram and to calculate the mass of zooplankton needed to make a meal using information from the pyramid

of biomass. Candidates found it difficult to outline possible impacts on the food chain due to the release of mercury compounds into a local river.

Question 3

Candidates appeared to struggle to provide physical properties of the substance contained in a thermometer and also found it difficult to explain why this substance expands with increasing temperature. Candidates were able to state the elements present in pentanol and could calculate the relative molecular mass of pentanol using information from the periodic table.

Question 4

Most candidates were able to calculate missing mean values and used the interactive tools to complete a table. Some candidates struggled to round a number to one decimal place. Candidates were able to formulate a research question for an investigation using the prompt provided. Also, candidates were able to identify the independent, dependent and control variables for this investigation. Nevertheless, candidates found difficult to suggest the importance of control variables in a scientific investigation.

Question 5

Most candidates appeared to struggle with the discussion of the validity of the candidate´s method. Some of them just mentioned some facts about the method although they were not able to state if the method was valid or invalid. Candidates also found difficult to justify how the method for data collection could be improved. Some candidates were able to evaluate whether the data supported the hypothesis given using information from the graph while other candidates did not use this information or did not use data to support their answer.

Question 6

Most candidates were able to use data provided to correctly calculate values and suggest and justify which fertilizer was better for a specific field and to improve profit.

Question 7

Most candidates did very well in this question and demonstrated a good understanding of how to plan an investigation using all the prompts provided. They were able to identify the independent, dependent and control variables, link equipment with the method and, in some cases, provide a complete description of the method. Nevertheless, some of the candidates struggled with the collection of sufficient data and stating a relevant safety precaution.

Question 8

Most candidates did not get complete marks for this question. They were required to suggest, outline or describe reasonable methods, comments and problems regarding the use and effect of pesticides on the environment.

Question 9

Candidates seem to be well prepared to answer extended responses. Many candidates demonstrated good critical thinking and communication skills. Candidates were familiar with discussing and evaluating the social and environmental implications of using science. Most candidates, however, were not able to identify the disadvantages of the two different proposals to reduce the number of mosquitos in order to prevent the spread of the Zika virus.

Recommendations and guidance for the teaching of future candidates

Teachers should focus on the use of the command terms and their specific meaning.

Candidates should continue working in designing and developing their own investigations following specific protocols.

Candidates should be able to write a complete method according to the information provided.

Candidates should be capable of identifying the dependent, independent and control variables using the information provided. Also, they should be able to identify relevant equipment and justifying the use of them within the method. It is also important to suggest safety considerations related to the experiment and avoid giving general safety issues.

Candidates should practice writing structured extended responses following the prompts given in the final task assessing criterion D.

Candidates also need to be aware of the importance of the correct use of scientific terminology.