Course Report 2016

Subject	Chemistry
Level	National 5

The statistics used in this report have been compiled before the completion of any Post Results Services.

This report provides information on the performance of candidates which it is hoped will be useful to teachers, lecturers and assessors in their preparation of candidates for future assessment. It is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

Section 1: Comments on the Assessment

Component 1: question paper

The distribution of marks across the different sections and the skills, knowledge and understanding to be assessed is detailed in the Course Assessment Specification. The 2016 National 5 Chemistry question paper followed closely the distribution of marks used in the Specimen Paper.

For teachers used to preparing candidates for the Standard Grade assessment, it is worth remembering that there are significant differences in the assessments for the two courses. The National 5 Chemistry paper places far greater emphasis on assessing a candidate's ability to explain underlying chemistry, scientific inquiry skills and analytical thinking skills. Consequently, there are a greater total number of marks assigned to questions requiring extended answers. The National 5 Course places significant emphasis on the development of numeracy and literacy skills.

In considering the marking of candidates' papers it should be remembered that, unlike in the examination of the Standard Grade course, half-marks are not used.

Component 2: assignment

This assignment requires learners to apply skills, knowledge and understanding to investigate a relevant topic in chemistry and its effect on the environment and/or society. The topic should draw on one or more of the key areas of the National 5 Chemistry course.

The distribution of marks across the different sections and the skills, knowledge and understanding to be assessed is detailed in the Chemistry Assignment General Assessment Information document.

The majority of the marks are awarded for applying scientific inquiry and analytical thinking skills. The other marks will be awarded for applying knowledge and understanding related to the topic chosen.

Section 2: Comments on candidate performance

Component 1: question paper

The overall impression of the question paper from feedback received from markers and centres was that the National 5 Chemistry paper was at a level appropriate to National 5. Feedback from markers and centres confirmed that the time allocated to the examination allowed all candidates to answer all questions. The full range of marks was accessed by candidates and the question paper provided good differentiation.

Centres appear to have taken care in preparing candidates for many of the different types of question to be found in the examination. However, candidates appear not to be prepared for the open-ended questions, some types of calculation and the recall of basic chemical terms.

Component 2: assignment

The full range of marks was accessed by candidates, and the assignment provided good differentiation. Overall, candidate performance has improved from that of 2015.

A range of topics were submitted by candidates, including hydrogels, fuels and radioisotopes. Due to the level of understanding of chemistry involved in hydrogels, this investigation proved difficult for candidates to achieve full marks in section 7.

The investigation on fuels (alcohols) which relates the number of carbon atoms to the quantity of energy produced proved to be, on the whole, an assignment where candidates could score very high marks. Candidates who used two or more of their own practical activities/experiments only as sources of data and/or information were unable to access the full range of marks. The investigation on radioisotopes also proved to be, on the whole, an assignment where candidates could score high marks.

Many centres had prepared their candidates well and it was evident that an increased number of candidates had clearly followed the 'Instructions to Candidates'.

It appeared that some centres had provided candidates with resources packs. While this is acceptable, centres should ensure good practice by providing candidates with a wide selection of material covering several topics, possibly including ‘red herrings’, rather than limiting the resources provided to two or three pieces of data and/or information related to the chosen topic. Even if using a resource pack, candidates should have the opportunity to select appropriate data from a range of materials. The experience for candidates should replicate, as far as possible, being able to access websites, textbooks or journals, so they have to select which sources they wish to use and extract the appropriate data from the sources, rather than the teacher/lecturer having pre-selected only the relevant table of data, graph, etc from the website, data booklet, journal, etc. Centres should not direct candidates as to which data/information within the pack that they should be choosing.

Areas in which candidates performed well

Component 1: question paper

Section 1

Question 2:	Most candidates could identify the time taken for magnesium to react with acid under specific conditions.
Question 4:	Most candidates could identify copper as the element that does not contain covalent bonds.
Question 5:	Most candidates could identify monatomic as the structure that is never found in compounds.
Question 6:	Most candidates could identify the properties of an ionic substance.

Question 10: Most candidates could identify the compound that belongs to the same homologous series as a compound with molecular formula C_3H_8.

Question 11: Most candidates could identify the name of a branched alkene from its structural formula as 2,3-dimethylpent-1-ene.

Question 14: Most candidates could use information on flash point to identify the correct statement.

Question 15: Most candidates could identify nickel as a metal that can be obtained from its ore by heating with carbon monoxide.

Question 17: Most candidates could identify the most suitable type of radioisotope for a smoke detector as an alpha-emitter with a long half-life.

Section 2

Question 1(a)(i): Most candidates could state the relative mass of a proton as 1 and the charge on a neutron as zero charge/neutral.

Question 1(a)(ii): Most candidates could state that an electron is found outside the nucleus and the charge is negative / one negative.

Question 1(c)(ii): Most candidates could state that Haber is the name of the industrial process used to manufacture ammonia.

Question 2(a): Most candidates could draw a section of polystyrene using the structure of the monomer given in the question.

Question 3(a): Most candidates could state that exothermic is the term used to describe all chemical reactions that release heat energy.

Question 3(b)(i): Most candidates could calculate the average rate of reaction.

Question 3(b)(iii): Most candidates could state that using powder rather than lumps would increase the rate of reaction.

Question 3(c)(i): Most candidates could identify aluminium nitrate as the salt.

Question 4(a)(i): Most candidates could identify kyanite and andalusite as the two forms of the mineral which exist at 400 °C.

Question 4(b): Most candidates could calculate the percentage mass of silicon in Al_2SiO_5 as 17·3%.

Question 5(a): Most candidates could suggest a reason why gold was used in the first coins minted.

Question 5(b): Most candidates could calculate the number of neutrons present in an isotope of gold.

Question 5(c)(ii): Most candidates could, after reading a passage, state that gold was a catalyst in the chemical reaction.

Question 5(d): Most candidates could identify that an acid contained more hydrogen ions than hydroxide ions.

Question 9(a): Most candidates could explain that method A would give a more accurate result.

Question 9(b)(i): Most candidates could write a statement linking the amount of energy released to the position of the functional group in an alcohol molecule.

Question 9(b)(ii): Most candidates could use data provided to predict the amount of energy released, in kJ, when 1 mole of hexan-2-ol is burned.

Question 10(b)(i): Most candidates could indicate the path and direction of electron flow from zinc to copper through the connecting wires.

Question 10(b)(ii): Most candidates could name the piece of apparatus in the cell as an ion / salt bridge.

Question 11(d)(i): Most candidates were able to use problem solving information to name ethene as the alkene which would be used to produce a specific epoxide.

Question 12(a): Most candidates could name the functional group in a structural formula as hydroxyl.

Question 12(c): Most candidates could calculate 15 cm^3 as the average volume of oxalic acid required to neutralise the sodium hydroxide solution.

Question 12(d): Most candidates could calculate the number of moles of oxalic acid contained in 1·8 g of oxalic acid as 0·02.

Component 2: assignment

Section 1: Most candidates could write an aim for their investigation.

Section 2(a): Most candidates could describe an application of chemistry and provide a characteristic and/or feature of their chosen application.

Section 2(b) Most candidates could provide a relationship between the application and its effect on society and/or the environment.

Section 3: Most candidates could explain their choice of sources.

Section 4: Most candidates could include relevant data in their report.

Section 5(b): Most candidates could present their data and/or information in appropriate formats.

Section 8(a): Most candidates could provide an appropriate title.

Section 8(b): Most candidates could provide at least two references.

Section 8(c): Most candidates provided a report that was clear and concise.

Areas which candidates found demanding

Component 1: question paper

Section 1

Question 3: Some candidates had difficulty identifying the change in a group 1 atom when it reacts to become X^+.

Question 7: Some candidates had difficulty identifying the name of the compound with the formula Ag_2O as silver(I) oxide. A common incorrect answer was silver(II) oxide.

Question 13: Some candidates had difficulty identifying the structure of an ester. A common incorrect answer was the structure for a carboxylic acid.

Question 16: Most candidates had difficulty identifying that polyesters are always made from monomers with two functional groups per molecule. A

common incorrect answer was that polyesters are made from unsaturated monomers.

Question 18: Some candidates had difficulty identifying the particle formed when an atom of thorium 234 (atomic number 90) emits a β particle. A common incorrect answer was Actinium with an atomic number of 89.

Question 19: Some candidates had difficulty using data on half life to calculate how many years had passed since wood for a fire was cut. A common incorrect answer was option A which was a 1/4 of the half life given in the question.

Section 2

Question 3(c)(ii): Many candidates had difficulty using mole ratio from a balanced equation to calculate volume of gas produced. A common wrong answer was to multiply 0·01 moles by 24 litres.

Question 5(c)(i): Some candidates had difficulty writing an equation, using symbols and formulae, for the reaction between carbon monoxide and oxygen to produce carbon dioxide. Incorrect answers included oxygen written as monatomic and an equal sign in place of an arrow. A very common incorrect answer was the inclusion of the symbol for gold in the equation.

Question 6(a)(ii): Some candidates had difficulty identifying that an ammonium compound contained nitrogen. A common incorrect answer was in relation to solubility.

Question 6(b): Many candidates were unable to balance an equation. A common incorrect answer was

$$H_3PO_4 + 3NH_4OH \longrightarrow (NH_4)_3PO_4 + 2H_2O$$

Question 7: Some candidates had difficulty using their knowledge of chemistry to comment on the chemistry of strontium. Many candidates just stated information from the data book which showed limited understanding.

Question 8(a): Some candidates had difficulty drawing the full structural formula for $CH_2C(CH_3)CHCH_2$. Many candidates did not include double bonds in the appropriate positions.

Question 8(b): Some candidates had difficulty completing the diagram to show the apparatus required to collect the essential oils. Common incorrect answers included diagrams without a water bath and/or the delivery tube / test tube closed off.

Question 8(c)(ii): Many candidates were unable to write the molecular formula for the product formed when $C_{10}H_{16}$ reacts with bromine solution. A common incorrect answer was $C_{10}H_{16}Br_2$ rather than $C_{10}H_{16}Br_4$.

Question 10(a): Many candidates had difficulty stating that electrolyte is the term used to describe an ionic compound which is used to complete an electric circuit. A common wrong answer was ion / salt bridge.

Question10(c)(ii): Some candidates had difficulty writing a redox equation for an overall reaction using two half ion equations. A common incorrect answer was the inclusion of electrons in the redox equation.

Question 11(b): Some candidates had difficulty suggesting a general formula for ethers. A common incorrect answer was $C_nH_{2n+2} + O$ rather than $C_nH_{2n}+2O$.

Question 11(d)(ii): Many candidates had difficulty using problem solving information to draw a structural formula for an epoxide with the chemical formula C_3H_6O. A common incorrect answer had four atoms in a ring rather than three atoms one of which is oxygen.

Question 13: Some candidates had difficulty using their knowledge of chemistry to describe how the concentration of carbon dioxide gas could be determined in two brands of carbonated water. Many candidates only stated the test for carbon dioxide which demonstrated a limited understanding.

Component 2: assignment

Section 5(a): Some candidates had difficulty processing their data and/or information from at least two sources accurately. Many candidates who attempted to summarise their data and/or information stated a conclusion or trend rather than producing a summary. Some candidates are not using graph paper when drawing graphs or charts, and this makes it very difficult to access these marks. In many instances candidates are rounding their calculated values incorrectly.

Section 5(c) Some candidates had difficulty providing all appropriate units, headings and labels for their processed data.

Section 5(d) Some candidates had difficulty comparing their data and/or information. Many candidates provided a conclusion related to each source rather than comparing the information provided by their sources. Many candidates choose data and/or information which could not be compared and made no statement to specify this.

Section 6: Some candidates had difficulty stating a valid conclusion which related to their aim and did not provide information in their report to support their conclusion. Many candidates stated a conclusion which was too vague and did not cover all aspects of their aim. If a candidate specifies in their aim they are going to calculate a value, this value must be stated in their conclusion.

Section 7: Some candidates had difficulty explaining the underlying chemistry related to their chosen topic. Some candidates chose topics which were at National 4 level or outwith the key areas of the National 5 course. Some candidates' reports contained underlying chemistry but it was clear that the candidate did not have an understanding of the chemistry involved.

Section 3: Advice for the preparation of future candidates

Component 1: question paper

Candidates should continue to make every effort to learn basic ‘routines’ for the different types of calculation.

In all calculations worth more than 1 mark, candidates should be aware that credit will be given for the correct demonstration of chemical concepts or for intermediate results in a

multiple-step calculation. They should be encouraged to show their working clearly to maximise their chances of obtaining partial marks.

Candidates should be reminded that page 3 of the data booklet contains relationships which can be used for National 5 calculations.

Candidates should be advised that if a unit is provided in a question it is not necessary to state the unit with their answer. However, if the candidate does provide a unit it must be correct, otherwise the candidate will only have access to partial marks.

Centres should advise candidates to consider calculations using mole ratio other than 1:1, 1:2 or 2:1.

Candidates should be encouraged to learn basic types of chemical reaction such as oxidation and addition.

Candidates should be advised that when asked to write a molecular / general formula, numbers should be subscript. A large number of candidates lost marks for incorrect positioning of numbers within a formula. Centres are advised to emphasise to candidates the correct format for writing formulae throughout the course.

Candidates should be advised that when writing a general formula, the symbols can be in any order but they should not be separated by a + sign.

Candidates should be advised to learn how to write formulae including that for diatomic elements, and that in an equation all the products must be written on the right hand side of the arrow. Candidates should also be advised that the symbol for a catalyst should not be written in an equation.

Candidates should be advised to rote-learn the name of functional groups in organic compounds as well as being able to name / identify them from structural formulae. Candidates should be advised that if the question asks for the name of the functional group, the formula will not be accepted if this is shown within the question. In question 12 (a), OH in place of the word ‘hydroxyl’ is awarded zero marks, as this is shown in the structure given in the question.

Candidates should be advised that if asked for a chemical test, the test and the result must be given.

Centres should stress to candidates that additional information given with a correct answer may negate the correct answer. For example, in question 10 (a) the incorrect term ‘ion bridge’ given with the correct term ‘electrolyte’ would be awarded zero marks.

Centres should stress to candidates that when a two-mark question asks for an explanation, it is necessary to demonstrate a deeper understanding of the concept to achieve the full mark allocation.

Centres are advised that candidates could be asked to calculate any of the values in $E_h = cm\Delta T$. This also includes the value of c for a solution other than water.

Centres are advised that candidates should have an understanding of factors affecting reaction rate and that candidates should be able to identify an ester from the oate ending in the name and from the COO group.

Candidates should be advised to draw the arrow showing the direction of electron flow in a cell on the connecting wire and not the space between the wire and ion bridge.

Centres are advised to check the SQA website for updates to National 5 Chemistry and access exemplar material on the Understanding Standards website.

Component 2: assignment

Centres are advised to provide candidates with the 'Instructions to Candidates', which is available on the SQA secure website, and to encourage candidates to follow the structure outlined in this guide. Centres should also share the marking instructions with candidates, before and during the research stage. However, the marking instructions should not be given to candidates during the communication stage of the assignment, and centres should not mark and comment on a draft report provided by the candidate. Centres are advised to access the material on assignments in the Understanding Standards website to allow staff and candidates to prepare sufficiently for this component.

Centres should encourage candidates to choose topics that lend themselves to the types of data processing and presenting being assessed, and advise against researching topics for which little or no data can be accessed. Centres should also consider taking an approach where candidates can include and compare their own experimental data with literature research, rather than simply pure literature research.

Centres should encourage candidates to choose topics that focus on the chemistry from the key areas of the National 5 course rather than on socio-economic issues. Candidates should be discouraged from investigating how an aspect of chemistry affects society or the environment, advantages and disadvantages or the uses of a chemical. An example of this is to investigate ethanol as a drink and how it affects society. Aims such as ‘investigate the use of alcohols as fuels / alcohols as alternative fuels / efficiency of alcohols as fuels’ do not allow candidates to easily access the marks in sections 3, 4 and 6. This also applies to the use of electrochemical cells.

Centres should advise candidates that data and/or information submitted from their Outcome 1 report will be marked as raw data. Any calculations or processed data carried out as part of the O1 cannot access any presenting or processing marks as part of the assignment.

Centres should advise candidates that they have to produce a scientific report that must include appropriate data and/or information, and which demonstrates the skills being assessed in the assignment; and not to produce essays on their chosen topic. Candidates may feel that they have produced a very good essay but if it does not demonstrate the skills being assessed it will not score highly.

Centres should advise candidates that if they include more than one practical activity/experiment carried out by the candidate/class, this will only count as one source of raw data/information.

Candidates should be advised that the raw data and/or information **must** be included in their report and this should be directly related to the aim of their assignment. Many candidates provided raw data / information that had a tenuous link to the theme of their assignment, but did not relate specifically to their aim. An example of this would be an assignment with the aim 'to investigate the relationship between the number of carbons in an alcohol and the quantity of energy' containing raw data/information on the use of fossil fuels or the quantity of energy released by burning fossil fuels. Another example would be including information related to the types of battery in an assignment with the aim to investigate the effect of different metals on the voltage produced in a cell.

Candidates should be advised to clearly link their raw data to the source of this data either in the body of the report or in the referencing section.

Candidates should be advised that although the terms 'relevant', 'reliable' or 'perspective' do not need to be included in justifying their selection of sources, their explanation must convey this information. In justifying their choice of a source in terms of relevance, they must explain why the source is relevant. Statements such as 'it is relevant to my topic or to my aim' do not explain why the information in the source is relevant. Candidates should also be advised that stating a website is reliable 'because it has .org in its address' is insufficient to access the mark.

Candidates should be advised that 90% of calculations, including rounding and units, must be correct to access the mark for accuracy. To access the presenting mark, at least one full calculation must be shown in a logical and coherent manner.

Candidates should be advised that graph paper, rather than square or lined paper, should be used for drawing graphs to access the mark for accuracy.

Candidates should be advised that if a general trend is given as a summary, the accuracy mark cannot be accessed.

Candidates should be advised that if raw data/information is **not** included in their report, the marks for accuracy and labelling cannot be accessed.

Candidates should be advised that to access the mark for labelling, all graphs, tables, charts or diagrams used in presenting the processed data must have appropriate units, labels and headings included. They should also be advised that if their presentation of the processed data does not include a graph, table, chart or diagram the labelling mark **cannot** be accessed.

Centres should advise candidates that if the data and or/information cannot be compared, the candidate must make a statement to this effect, explaining why it cannot be compared. Centres should also consider advising candidates on making an appropriate choice of sources. It is better for candidates to choose sources that allow comparison rather than disparate sources, where the candidates then have to explain why the data cannot be compared.

Candidates should be advised that their conclusion must relate to **all** aspects of their aim and **must** be supported by data and/or information in their report. Candidates should also be

advised to avoid multiple aims and choose an aim which is concise and which can be concluded from their research.

Centres should advise candidates that an appropriate title (section 8a) is awarded 1 mark. The mark for the title and the mark for the aim are separate marks, and a candidate who does not provide an appropriate title cannot access this mark through their aim. Titles such as ‘National 5 Assignment’ or ‘N5 Chemistry’ are not appropriate titles.

To access the mark for referencing in section 8(b), the format must allow retrieval by a third party — eg www.bbc.co.uk is not acceptable.

To access this mark two references must be given, to include:

- Websites — a full URL
- Textbooks — title, author, page number and either ISBN number or version / edition number. This is also necessary for the SQA data booklet.
- Journals — title, author, volume and page number
- Experiment / practical activity — title and aim

Centres are advised that the communication stage of the assignment should be written up by the candidates under controlled conditions. A candidate's report must **not** be scrutinised by staff, and no feedback or redrafting is permitted. The assignments should be kept secure until submitted to SQA. Centres are advised that once an assignment has been completed and submitted by the candidate, staff and candidate must not have further access to it.

Centres are also reminded that the communication phase is not a timed assessment and may be completed over a period of time. Where centres are taking the approach that candidates complete the reports over a number of periods, the teacher/lecturer should retain the reports between periods so that the candidates cannot work on them outwith the controlled conditions. If this approach is taken, staff must **not** read the reports and must **not** provide feedback to candidates during the next period.

Grade Boundary and Statistical information:

Statistical information: update on Courses

Number of resulted entries in 2015	16659

Number of resulted entries in 2016	17046

Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark -				
A	34.1%	34.1%	5811	72
B	23.3%	57.3%	3964	61
C	18.7%	76.1%	3196	51
D	7.4%	83.5%	1263	46
No award	16.5%	-	2812	-

General commentary on grade boundaries

- While SQA aims to set examinations and create marking instructions which will allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and a well prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary), it is very challenging to get the standard on target every year, in every subject at every level.

- Each year, SQA therefore holds a grade boundary meeting for each subject at each level where it brings together all the information available (statistical and judgemental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the management team at SQA.

- The grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- Where standards are comparable to previous years, similar grade boundaries are maintained.

- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set in centres. If SQA has already altered a boundary in a particular year in, say, Higher Chemistry, this does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related, as they do not contain identical questions.

- SQA's main aim is to be fair to candidates across all subjects and all levels and maintain comparable standards across the years, even as arrangements evolve and change.