National Qualifications

Chemistry
Project-report
General assessment information

This pack contains general assessment information for centres preparing candidates for the project-report Component of Advanced Higher Chemistry Course assessment.

It must be read in conjunction with the specific assessment task for this component of Course assessment which may only be downloaded from SQA's designated secure website by authorised personnel.

This edition: September 2018 (version 2.0)

Contents

Introduction

This is the general assessment information for Advanced Higher Chemistry project–report.

This project–report is worth 30 marks out of a total of 130 marks available for this Course. The Course will be graded A–D.

Marks for all Course Components are added up to give a total Course assessment mark which is then used as the basis for grading decisions.

This is one of two Components of Course assessment. The other Component is a question paper.

This document describes the general requirements for the assessment of the project–report Component of this Course. It gives general information and instructions for assessors.

It must be read in conjunction with the assessment task for this Component of Course assessment.

Equality and inclusion

This Course assessment has been designed to ensure that there are no unnecessary barriers to assessment. Assessments have been designed to promote equal opportunities while maintaining the integrity of the qualification.

For guidance on assessment arrangements for disabled candidates and/or those with additional support needs, please follow the link to the Assessment Arrangements web page: www.sqa.org.uk/sqa/14977.html

Guidance on inclusive approaches to delivery and assessment in this Course is provided in the *Course/Unit Support Notes*.

What this assessment covers

This project–report is worth 30 marks out of a total of 130 marks available for this Course.

The assessment will assess the skills, knowledge and understanding specified for the project–report in the *Course Assessment Specification*. These are:

- extending and applying knowledge of chemistry to new situations, interpreting and analysing information to solve complex problems
- planning and designing chemical experiments/investigations, using reference material and including risk assessments, to test a hypothesis or to illustrate particular effects
- recording systematic detailed observations and collecting data
- selecting information from a variety of sources and presenting detailed information appropriately, in a variety of forms
- processing and analysing chemical information/data (using calculations, significant figures and units, where appropriate)
- making reasoned predictions and generalisations from a range of evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- critically evaluating experimental procedures by identifying sources of uncertainty, suggesting and implementing improvements
- drawing on knowledge and understanding of chemistry to make accurate statements, describe complex information, provide detailed explanations and integrate knowledge
- communicating chemical findings/information fully and effectively
- analysing and evaluating scientific publications and media reports

Assessment

Purpose

The purpose of this assessment is to generate evidence for the Added Value of this Course by means of a project–report.

Assessment overview

Assessment should take place when the candidates are ready to be assessed.

In this assessment the candidate will carry out an in-depth investigation of a chemistry topic. The topic will be chosen by the candidate, who will individually investigate/research the underlying chemistry of the topic. The candidate must discuss the selection of possible topics with their assessor to ensure that time is not wasted on researching topics that are unsuitable. The topic does not need to be a complex one with multiple aims. It is possible to achieve 30 marks from a straightforward project, well worked through.

This is an open-ended task which may involve a significant part of the work being carried out without supervision.

The project–report offers challenge by requiring skills, knowledge and understanding to be applied in a context that is one or more of the following:

- unfamiliar
- familiar but investigated in greater depth
- integrating a number of familiar contexts

Prior to starting this assessment candidates should have started a chemistry investigation. This would normally be as part of their *Researching Chemistry* Unit. In that Unit, candidates are required to plan and carry out a chemistry investigation. They should keep a record of their work as this will form the basis of their project–report. This record should include details of their research, experiments and recorded data. Typically this may include a series of related experiments using at least two different techniques.

The project–report submitted to SQA must have a logical structure and must be clear, concise and easy to read.

The project–report should be between 2500 and 4500 words in length excluding the title page, contents page, tables, graphs, diagrams, calculations, references, acknowledgements and any appendices. The word count should be submitted with the project–report. If the word count exceeds the maximum by 10%, a penalty of 3 marks will be applied. It should be written in the past tense and the impersonal voice should be used.

Detailed advice on the content of the project report is given in the *Advanced Higher Chemistry Project Assessment Task*.

Assessment conditions

Assessors must exercise their professional responsibility in ensuring that evidence submitted by a candidate is the candidate's own work.

This assessment will be carried out over a period of time. Candidates should start at an appropriate point in the Course. This will normally be after they have started work on the Units in the Course.

Evidence which meets the requirements of this Component of Course assessment will be between 2500 and 4500 words. The word count should be submitted with the project–report. If the word count exceeds the maximum by 10%, a penalty of 3 marks will be applied.

There are no restrictions on the resources to which candidates may have access.

Candidates must undertake the assessment, whatever the nature, independently. However, reasonable assistance may be provided prior to the formal assessment process taking place. The term 'reasonable assistance' is used to try to balance the need for support with the need to avoid giving too much assistance.

Coursework in Advanced Higher may involve candidates undertaking a larger amount of autonomous work without close supervision than they have previously undertaken. Assessors may provide guidance and support as part of the normal teaching and learning process. However, assessors should not adopt a directive role or provide specific advice on how to re-phrase, improve responses or provide model answers.

Assessor comments on the selection of a topic are appropriate before the candidate starts the task.

The requirements of the project–report should be made clear to candidates at the outset.

The project–report will be conducted under some supervision and control. This means that although candidates may complete part of the work outwith the learning and teaching setting, assessors should put in place processes for monitoring progress and ensuring that the work is the candidate's own and that plagiarism has not taken place.

Assessors should put in place mechanisms to authenticate candidate evidence. For example:

- regular checkpoint/progress meetings with candidates
- short spot-check personal interviews
- checklists which record activity/progress
- photographs

Evidence to be gathered

The following candidate evidence is required for this assessment:

- a project report

The project report will be submitted to SQA, within a given timeframe, for marking. The same project–report cannot be submitted for more than one subject.

General Marking Instructions

In line with SQA's normal practice, the following general Marking Instructions are addressed to the marker. They will also be helpful for those preparing candidates for Course assessment.

Evidence will be submitted to SQA for external marking.

All marking will be quality assured by SQA.

General Marking Principles for Advanced Higher Chemistry project report

This information is provided to help you understand the general principles you must apply when marking candidate responses to this project-report. These principles must be read in conjunction with the Detailed Marking Instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the Detailed Marking Instructions for this assessment.

(b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

Overview of Marking Instructions

Assessment category and criteria	Marks
Abstract ♦ a brief abstract (summary) stating the overall aim(s) and finding(s) of the investigation	**1** **(1)**
Introduction ♦ account of underlying chemistry relevant to aims ♦ chemical terms/ideas are used accurately ♦ chemical ideas explained clearly ♦ underlying principles behind techniques used	**4** **(4)**
Procedures ♦ appropriate to aim(s) ♦ procedures clearly described in sufficient detail to allow the investigation to be repeated ♦ procedures are at an appropriate level for Advanced Higher complexity, two or more techniques/modification(s) ♦ controls and duplication used appropriately ♦ accuracy of measurements ♦ risk assessment	**1** **2** **2** **1** **1** **2** **(9)**
Results **Quantitative** ♦ relevant to aim(s) of the investigation ♦ raw data recorded and within limits of accuracy of measurement ♦ raw and processed results are presented in a clear and concise manner with appropriate use of tables, graphs, diagrams and calculations ♦ observations are detailed and suitably recorded **or** **Qualitative** ♦ relevant to aim(s) of the investigation ♦ raw and processed results are presented in a clear and concise manner using appropriate format ♦ observations are detailed and suitably recorded	**1** **1** **3** **1** **(6)** **1** **2** **3** **(6)**
Discussion (conclusion(s) and evaluation) ♦ conclusion(s) is/are valid and relate to aim(s) of the investigation ♦ evaluation of procedures and results includes comment as appropriate on: — accuracy of measurement — adequacy of replication/sampling — adequacy of controls — sources of uncertainties in relation to measurements — solutions to problems and modifications to procedures ♦ evaluation of results includes as appropriate: — analysis and interpretation of results — account of uncertainties described and consideration of uncertainties on outcome ♦ overall quality of the investigation	**1** **3** **3** **1** **(8)**

Presentation ♦ appropriate structure, including informative title, contents page and page numbers ♦ references cited in the text and references listed in standard form, acknowledgements, where appropriate	**1** **1** **(2)**
Total marks	**30**

Detailed Marking Instructions for the project report

These Detailed Marking Instructions provide the basis on which the General Marking Principles should be applied. The following table shows how the 30 marks are allocated to each of the categories against which the evidence will be assessed.
The project report should be between 2500 and 4500 words in length. The word count should be submitted with the project report. If the word count exceeds the maximum by 10%, a penalty of 3 marks will be applied.

	Category	Expected response	Max mark	Additional guidance
1	Abstract	A brief abstract (summary) stating the overall aim(s) and finding(s)/ conclusion(s) of the project	1	**1 mark** is awarded for a brief abstract (summary) which must immediately follow the contents page. The 'abstract' must contain a clear statement of the main aim(s) and overall finding(s)/conclusion(s) of the project and must be placed before the underlying chemistry. The overall findings must be consistent with the conclusion(s) given in the 'discussion' and/or results and must relate to the aim(s). If the aim of the project is to determine the actual quantity of a substance then the main findings must include the values obtained. For example, if the aim is to determine the mass of vitamin C in a fruit juice, then the values must be stated in the abstract. However if the aim is to compare the quantities of vitamin C in two different fruit juices then actual values need not be given here. It would be enough to say that 'type X contains more vitamin C than type Y'. A table/list of all values would also constitute a comparison. An incorrect conclusion, correctly summarised, would still be awarded the mark.

	Category	Expected response	Max mark	Additional guidance
				Extra findings not related to an aim need not be given. However, if they are stated, then they must also be consistent with the conclusions given in the 'discussion' and/or results.
2	Introduction	An account of underlying chemistry relevant to aim(s). Chemical terms/ideas are used accurately and explained clearly. Underlying principles behind techniques used are given	**4**	Underlying chemistry may be found anywhere in the project report but the marks are awarded in this section. This section is marked holistically and is an opportunity to give marks for the 'quality' of the underlying chemistry **relevant** to the aim of the project. Markers will have to use professional judgement and comments from markers on the flyleaf would be helpful. It should be fairly easy for candidates to get 1 mark but progressively more difficult to get 2, 3 or 4 marks. For example, **1 mark** may be awarded for a limited account of the chemistry involved. The student has made one or two accurate statements which are **relevant** to the project, showing that at least a little of the chemistry is understood. **2 marks** may be awarded for a better than limited account. **3 marks** may be awarded for a reasonably good account of the chemistry involved. **4 marks** may be awarded for a good account of the underlying chemistry involved in the project. This account might include statements of the principles involved, relationships and equations, and the application of these. Background theory of the techniques used would also be expected. The account does not need to be what might be

	Category	Expected response	Max mark	Additional guidance
				termed an 'excellent' one or a 'complete' one. **Zero marks** may be awarded here. Historical and other information may be included but the marks are only awarded for chemistry. Terms must be used accurately and ideas must be clearly explained. Ignore minor errors but not if these are fundamental to the chemistry behind the project. Candidates should use their own words wherever possible. Diagrams and complicated structural formulae copied and pasted from an internet source are acceptable.
3	Procedures	(a) Appropriate to aim(s) (**1**)	**9**	**1 mark** is awarded if the procedures would allow the aim(s) to be achieved. If there is no stated aim(s), this mark may still be awarded if the aim(s) is obvious from elsewhere in the project report.
		(b) Procedure(s) are clearly described in sufficient detail to allow the project to be repeated and are written in the past tense and impersonal voice (**2**)		**2 marks** are awarded if all procedures are described well enough for another competent Advanced Higher Chemistry candidate to be able to repeat the procedure(s) from the description. Ignore the omission of a small number of minor details. Procedures must be in the past tense and impersonal voice. Allow the use of the incorrect tense on one occasion.

	Category	Expected response	Max mark	Additional guidance
				Bulleted/numbered points are only acceptable if statements are in sentences and are meaningful and coherent, ie they must make sense if numbers or bullet points were to be removed, but must not be a list of instructions. **1 mark** is awarded if any one procedure is described well enough for another competent Advanced Higher Chemistry candidate to be able to repeat it from the description. Award **zero marks** if none of the procedures have been described well enough for another competent Advanced Higher Chemistry candidate to be able to repeat the procedure from the description. Candidates may include labelled diagrams or photographs of assembled apparatus. Concentration of solutions, volumes, masses, temperature used etc, should be included. The candidate may have included this information with the 'results' but the marks are awarded here.
		(c) Procedures are at an appropriate level of complexity for Advanced Higher (**1**) Two or more techniques or a modification		**1 mark** is awarded for treatment of the topic at Advanced Higher level, ie the complexity of the design of the experiments. **1 mark** is awarded for two or more techniques or a modification to procedures in the light of experience or a control experiment or an appropriate standardisation.

	Category	Expected response	Max mark	Additional guidance
		or a control experiment or standardisation of solutions (**1**)		Some examples of the use of two techniques include heating under reflux followed by a back titration, or extracting a substance followed by recrystallisation. Two different types of titration are acceptable, for example, acid-base and redox. Where a second technique has been carried out there must be evidence that it has been done by the candidate. This should be obvious from the description of the procedure given in the project report. Acceptable modifications would involve changes to the original procedure in light of experience. For example, dilution of solutions to get better titration values or changing the solvent in a chromatography experiment if the first one hasn't been effective. If a modification is carried out, the original results before the modification must be given where practicable. It will not count as a modification if the procedure was carried out wrongly to begin with and the modification involved carrying out the procedure the way it should have been done. It is not appropriate for a candidate just to give a blanket statement that a modification has been carried out. A control experiment is an experiment used to validate a technique. For example, in determining the vitamin C content of orange juice, a solution of known vitamin C

	Category	Expected response	Max mark	Additional guidance
				concentration could be used to check the accuracy of the technique. There must be evidence that the candidate has carried out the control experiment. Standardisation of any solution where the accuracy of the concentration is crucial in an analysis. There must be evidence that the candidate has carried out the standardisation and used the results.
		(d) Duplication (**1**)		**1 mark** is awarded for procedures being carried out in duplicate where appropriate. There must be evidence given in the results. If titrations are being carried out to determine a quantity of substance in an actual product, for example the mass of vitamin C in fruit juice, and the candidate starts with two samples from the same fruit juice, then this should be accepted as duplication. It is not necessary to duplicate a multi-step synthesis, however, to access this mark, further analytical techniques need to be duplicated. It is not necessary to duplicate the procedure used to produce a calibration graph or a control or a standardisation. Neither is it necessary to duplicate any spectroscopic techniques.

	Category	Expected response	Max mark	Additional guidance
		(e) Accuracy of measurements (**1**)		**1 mark** is awarded for the correct choice and use of apparatus in all procedures to make measurements of **appropriate accuracy**. For masses, this could either be evident from the procedure or from the values quoted. The values may be in the 'procedures' or elsewhere in the report. The mark would not be awarded for using measuring cylinders for dilutions when standard flasks would be more appropriate. It may be possible to award this mark by looking at a list of apparatus given by the candidate. This mark is not normally awarded if titre values are less than 5·0 cm^3. Titre values less than 5·0 cm^3 can be ignored if a modification is made to increase the values above 5·0 cm^3.
		(f) Risk assessment (**2**)		**2 marks** are awarded for: identifying all the major hazard(s) associated with the chemicals and for detailing precautions that should be taken to minimise the risk associated with each identified hazard, for example when a fume cupboard should be used. The hazards identified must be appropriate to the actual concentrations/masses etc used. OR

	Category	Expected response	Max mark	Additional guidance
				Where no significant hazards are associated with the chemicals then the candidate must state this is the case and that no additional precautions were necessary. **1 mark** may be awarded for correctly: identifying all the major hazard(s) associated with the chemicals OR stating that there are no major hazards associated with the chemicals OR detailing all the appropriate precautions that should be taken with the hazards identified OR stating that no additional precautions need be taken with the chemicals OR identifying a major hazard associated with a chemical and for detailing appropriate precautions that should be taken to minimise the risk associated with this identified hazard, for example when a fume cupboard should be used It is taken for granted that candidates will follow general safety rules, such as wearing safety glasses/goggles.

	Category	Expected response	Max mark	Additional guidance
4	Results Quantitative		**6**	Your decision to mark this category as quantitative or qualitative should be made to benefit the candidate with respect to the number of marks awarded.
		Relevant to the procedure(s) (**1**)		**1 mark** should be awarded for results being relevant to the procedure(s).
		Raw data recorded and within limits of accuracy of measurement (**1**)		**1 mark** is awarded for raw data given for all techniques or procedures. For titrations, initial and final burette readings must be given. Interfacing data in the form of graphs are acceptable as raw data but not if it is unclear what the graph (or spectrum) is showing. These graphs, spectra, etc must be labelled clearly and correctly. When weighing by difference or heating to constant mass, all balance readings must be recorded. The number of decimal points quoted in the results should be appropriate to the apparatus used. For example, burette readings should be to one decimal place, except for an initial reading of 0. Accept chromatograms, photographs, diagrams and statements of results as raw data.

	Category	Expected response	Max mark	Additional guidance
		Raw and processed results are presented in a clear and concise manner with appropriate use of tables, graphs, charts and calculations (**3**)		**1 mark** is awarded for the correct number of significant figures in the final results. Allow one fewer or two more significant figures than the raw data. The number of significant figures or decimal places in final results should be consistent when produced from the same set of raw data. **1 mark** is awarded for the correct final values to calculations including appropriate units, which are used to form a conclusion. This mark may not be awarded if non-concordant titre values are used or duplicate values are not processed correctly. All concordant titre values must be averaged although a concordant rough value may be omitted. **1 mark** is awarded for any operation from tables, graphs or charts done correctly. If a graph is crucial to the final result, for example, a calibration graph, it must be correct for this mark to be awarded. Graphs can be hand-drawn or computer-generated and should be line of best fit where appropriate. If a value is to be taken manually from a graph then it should be of appropriate size and scale with suitable grid lines. Headings, labels and units in tables and graphs must be correct.
		Observations are detailed and suitably recorded (**1**)		**1 mark** is awarded for at least one appropriate observation recorded in the 'procedures' or 'results' or 'discussion' section. For example, descriptions of indicator colour changes, shapes and colours of crystals, precipitates forming, gases forming etc. If one or more different

	Category	Expected response	Max mark	Additional guidance
				titrations were done then at least one colour change must be given for this mark to be awarded.
	Results Qualitative	Relevant to the procedure(s) (**1**)	**6**	**1 mark** should be awarded for the results being relevant to the procedure(s) and readings (raw data) being recorded. Accept chromatograms, photographs, diagrams and statements of results as raw data.
		Raw and processed results are presented in a clear and concise manner using appropriate format (**2**)		**1 mark** is awarded for presentation of raw data. For example, initial and final masses and other relevant measurements should be recorded with appropriate units and in an appropriate format including lab report. Chromatograms, photographs, spectra, diagrams and melting points are also acceptable as raw data. It is almost inevitable that there will be some quantities given and these should be recorded within appropriate limits of accuracy. Some of these may appear in 'procedures' or 'evaluation', but the mark is awarded here. **1 mark** is awarded for processing of results. For example, interpretation of spectra and chemical tests or calculating a percentage yield.

	Category	Expected response	Max mark	Additional guidance
				Some of these may appear in 'procedures' or 'discussion', but the mark is awarded here.
		Observations are detailed and suitably recorded (**3**)		**3 marks** are awarded for three appropriate observations. For example, descriptions of indicator colour changes, shapes and colours of crystals, precipitates forming, gases forming etc. However, where a crucial observation has been omitted then a maximum of **2 marks** can be awarded in this section.
5	Discussion	**Conclusion** (a) Conclusion(s) are valid and relate to aim(s) of the project (**1**)	**8**	**1 mark** is awarded for valid conclusion(s). If conclusion(s) are written after each experiment, they must also be given in this section. All aims given in the 'abstract/summary' must be covered in the 'conclusion' and must be valid for the experimental results obtained. If a mistake is made in processing results, making the results invalid then use follow through. Extra conclusions that do not relate to the original aim(s) must be valid from the results.
		Evaluation		This section is marked holistically and is an opportunity to give marks for the 'quality' of the evaluation. Markers will have to use professional judgement and comments from markers on the flyleaf would be helpful. It should be fairly easy for candidates to get 1 mark but progressively more difficult to get 2, or 3 marks in each section.

	Category	Expected response	Max mark	Additional guidance
				The evaluation is an overview by the student of what he/she has done in the project. It is a review of the **positives** as well as the negatives. Sources of error, possible improvements, accuracy/precision of equipment and of measured values should be discussed. The effect of these on the final results should be considered.
		(b) Evaluation of procedures (**3**) Includes comment as appropriate on: ♦ accuracy of measurement ♦ adequacy of repetition ♦ adequacy of controls ♦ sources of uncertainties in relation to measurements ♦ solutions to problems and modifications to procedures		This is an opportunity for the candidate to review and evaluate the procedures used in a positive way as well as suggesting modifications which might have given better results. Look for sources of uncertainties in relation to individual pieces of apparatus/how problems were dealt with/modifications to procedures/controls or sample size/explanations of 'magic numbers'. Not everything has to be covered but the main sources of error should be covered. The candidate may not have done the procedure correctly but has shown that he/she realises this. If the candidate has included a numerical treatment of errors then **1 mark** may be awarded for correct uncertainty values in apparatus/techniques and a second mark awarded for correctly combining the uncertainties.
		(c) Evaluation of results (**3**)		Look for a meaningful/valid analysis and interpretation of the results.

	Category	Expected response	Max mark	Additional guidance
		Includes as appropriate: ♦ analysis and interpretation of results ♦ account of uncertainties described and consideration of uncertainties on outcome		Comparisons to literature and manufacturer values. Discussion of differences between the calculated values and the control. Comments on the reproducibility of the results based on duplicates. Candidate has considered the effects of uncertainties in apparatus and techniques in procedures and considers the effect on the result.
		(d) Overall quality of the project (**1**)		This is a final quality mark for the standard of the project and not just the 'discussion' part of the project report. This is for a project report well worked through or a more complex treatment of a topic.
6	Presentation	(a) A clear report with an appropriate structure, including informative title, contents page and page numbers (**1**)	**2**	The project report structure should be easy to follow. A title and contents page are essential — the contents page must show correct page numbers and the pages throughout the project report must be numbered. Occasional missing page numbers (for example on graphs) should not be penalised. A report with a word count in excess of 4950 words (excluding title page, contents page, tables, graphs,

	Category	Expected response	Max mark	Additional guidance
				diagrams, calculations, algebraic justifications, references, acknowledgements and appendices) should be referred using the appropriate exception.
		(b) References cited in the text and references listed in standard form using either Vancouver, Harvard or Royal Society of Chemistry referencing styles, acknowledgements where appropriate (**1**)		At least **three** references must be cited correctly in the main body of the project report and the same ones also listed correctly at the end of the project report. Any additional references cited or listed incorrectly should be ignored. References may include books, journals/periodicals and websites. Internet sources must be referenced by as many of the following as possible: author (year), article title, website title, URL, date of access. Book sources must be referenced by as many of the following as possible: author(s) or editor(s) names, title of book, edition number (if other than the first publication), place of publication, publisher's name, year of publication, page numbers. Referencing **must** use one of Vancouver, Harvard or Royal Society of Chemistry styles. Any websites referenced must have the date visited. A blanket statement of the date visited is not acceptable.

	Category	Expected response	Max mark	Additional guidance
				Note that it must not be the same book/website referred to on two or three occasions even if the reference is to different page numbers.
		Total marks	**30**	

Administrative information

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History of changes

Version	Description of change	Date
1.1	Detailed marking instructions updated to further clarify marking instructions.	September 2016
2.0	Marking instructions have been updated for clarity.	September 2018

Security and confidentiality

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