Higher National Unit specification

General information

Unit title: Instrumental Techniques 2 (SCQF level 8)

Unit code: H931 35

Superclass: RA

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Version: 01

Unit purpose

This Unit is designed to introduce learners to a range of options available in instrument design and control, which can be used to optimise analytical results.

Outcomes

On successful completion of the Unit the learner will be able to:

1 Describe the main factors within an instrument, which can be altered to optimise the analytical results.
2 Perform experiments using a range of advanced analytical techniques.
3 Develop methods to obtain optimum results from a range of analytical instruments.

Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 SCQF credit points at SCQF level 8)

Recommended entry to the Unit

Access to this Unit will be at the discretion of the centre however it would be an advantage if the learner had prior experience of working in a science laboratory. In particular it would be beneficial to have completed the HN Unit H930 35 *Instrumental Techniques 1* or equivalent.

Higher National Unit Specification: General information (cont)

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Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

Higher National Unit specification: Statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe the main factors within an instrument, which can be altered to optimise the analytical results.

Knowledge and/or Skills

- Main components which can be changed to suit different analyses
- Range of options available to alter the reaction conditions during an analysis
- Implications of changing the reaction conditions and linking this to the likely experimental result

Outcome 2

Perform experiments using a range of advanced analytical techniques.

Knowledge and/or Skills

- Calibrate the instrument
- Work in a safe manner in line with current health and safety practices
- Achieve accurate results
- Report the results clearly and concisely
- Evaluate the results in terms of their reliability and analytical significance

Outcome 3

Develop methods to obtain optimum results from a range of analytical instruments.

Knowledge and/or Skills

- Prepare analytical instruments for a range of experiments
- Critically discuss the analytical results
- Alter the analytical method in a way which improves the results

Higher National Unit specification: Statement of standards (cont)

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Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can:

Outcome 1

The learner should discuss two modern analytical instruments, outlining all the aspects of instrument and experimental design. In particular identifying which components are common to all instruments and those where the analyst may have a choice depending on the work to be carried out. The case studies ideally should also encourage the learner to detail the various aspects of experimental design, which can be changed by the analyst to improve results.

Outcome 2

Evidence for this Outcome will be provided by the learner performing two practical assignments from the range suggested in the Support Notes. These assignments will allow Outcomes 2 and 3 to be assessed. Emphasis should be on the learner's performance in completing the laboratory work, their ability to produce satisfactory laboratory reports but particularly on their ability to discuss the results in terms of their analytical significance.

Outcome 3

The evidence for this Outcome will be gathered using the experimental exercises designed to assess Outcome 2. The learner will be asked to describe the main factors, which they can change to alter the analytical results. They will be expected to alter at least one feature of the analytical process and run the experiment under the new conditions, reporting on the results of their changes.

Higher National Unit Support Notes

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Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit is intended to be part of the HND Applied Sciences, HND Applied Biological Sciences and HND Chemical Sciences Group Awards. It should also be suitable for inclusion in other Science HNC/HND awards. The aim is to give learners the underpinning theoretical and practical knowledge of a range of instrumental techniques to allow them to contribute effectively in an analytical laboratory. They should be able to develop new analytical methods as well as troubleshoot when the analytical results are not what were expected.

Outcome 1

Learners should be introduced to a range of more advanced instrumental techniques. It is expected that the recent advances in the design of spectrometers and chromatography instruments will form the main focus of this Unit. For example if HPLC is a chosen technique learners should be introduced to the difference between single stage and multistage pumps. This would then lead to a discussion on isocratic and gradient elution experiments and the advantages to be gained. In GC this discussion could focus on isothermal and temperature gradient experiments. In addition learners could be introduced to the more advanced detectors now available such as Diode array or the combined techniques of GC-MS and more recently LC-MS.

There are a wide range of techniques which could be discussed, some of which have been mentioned above. It would be important to concentrate on techniques appropriate to the HNC/HND discipline being studied. Emphasis should be placed on highlighting the factors under the control of the technician in the laboratory and how changing these can alter the analytical results. In chromatography this would almost certainly require discussion on the range of columns available and the various injection systems as well as the possible detectors which could be installed.

Typical techniques, which could be included in this Unit, would be GC temperature programming, GC-MS, HPLC- gradient elution, LC-MS, NMR spectroscopy, 1D and 2D electrophoresis, PCR, Blotting techniques etc. Learners should become familiar with the types of analyses performed on the various instruments, the overall design and the mode of operation of the main components.

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Outcome 2 and 3

Given the vocational nature of the HN awards these Outcomes are crucial to the Unit. Learners should be given every opportunity to gain experience in programming and operating a wide range of instruments. Wherever possible, learners should set the instruments from the beginning, switching them on, calibrating them, programming in the method and obtaining the required results. It is essential that learners be allowed to alter instrument or experimental parameters and monitor the effect on the analysis. The more hands-on experience the learners can be given the better. If it is possible they should be allowed to take part in some routine maintenance activity, eg changing the column of a chromatography instrument, or the lamp of an Atomic Absorption Spectrometer.

On completing the Unit learners should feel confident that they could move into a laboratory position and be able to contribute to experimental design, method development and troubleshooting.

As stated above the range of practical exercises carried out should reflect the HN award being undertaken. Typical techniques are listed above. This should not be seen as an exhaustive list and lecturers should feel free to vary the techniques as appropriate. The emphasis should be on instrumentation and optimising the analytical results. It would not be appropriate to introduce practical work which did not use some kind of instrumental technique.

Guidance on approaches to delivery of this Unit

This Unit is likely to form part of a Group Award, which is primarily designed to prepare learners for employment in a science related post. The emphasis should be on encouraging the learners to become familiar with a wide range of analytical techniques and applications. They should become aware of the range of options available within each particular technique, which could be used to alter the analytical results. They should be able to alter instrument or experimental conditions to obtain the most appropriate analytical results. In addition they should produce results to the required degree of accuracy.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Outcome 1 will be assessed using a case study, which requires the learner to describe the range of options available to the analyst both in terms of alternative components and instrument programming, which could be used to improve the experimental design.

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Learners will be encouraged to access various sources of information before submitting their answers. Two analytical instruments should be discussed in some detail, with learners concentrating on the key components, which can be chosen or set by the analyst to obtain optimum results. The report should be approximately 2,000 words in length and a pass would require learners to demonstrate that they understand the operation of the instruments they discuss. They should also show that they understand the ways in which they can influence the results of an experiment depending on how the instrument is set up.

In Outcomes 2 and 3 learners will complete a series of practical exercises, two of which will be assessed. It is recommended that the practical exercises take the form of mini projects running over two or three laboratory sessions. The exercises will be designed to allow the learner to decide on certain experimental conditions and hence develop a method for the analyses. A combination of observation checklist and a written laboratory report should be used to assess the work.

Those practicals selected for assessment purposes should allow the learner to critically analyse the experimental results. This should allow the learner to suggest changes to the instrument conditions, which will achieve better analytical results. It is suggested that a checklist be used to assess performance in the laboratory. This checklist should recognise the need for accuracy in analytical work. A laboratory report should also be produced to assess the learner's ability to plan, analyse and discuss analytical work. Should a learner fail to complete two assignments, they should be given the opportunity to attend further laboratory sessions. Ideally learners will be participating in several experiments, with only two required for assessment purposes. If a report is not of the required standard, remediation should be offered and a re-submission accepted.

Laboratory reports should be clear and concise, with all results and calculations reported. Learners should discuss the results in terms of their accuracy and reliability, taking into account inherent experimental errors. They should highlight the work they have done to optimise the analytical results, commenting on both successes and failures.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**.

Higher National Unit Support Notes (cont)

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Opportunities for developing Core and other essential skills

There may be opportunities to gather evidence towards Core Skills of *Problem Solving, Numeracy* and *Information and Communication Technology (ICT)* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

History of changes to Unit

Version	Description of change	Date

General information for learners

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This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This is a 1 credit Unit at SQCF level 8, intended to be delivered as part of an HNC/HND science qualification. It is likely to be delivered in the second year of an HND programme. It is designed to give you the basic knowledge and practical skills you will need to undertake a role as a higher-grade technician in a wide range of science based industries. The emphasis will be on introducing you to the range of modern instruments used in laboratories.

On completion of this Unit you should be able to

1 Describe the main factors within an instrument, which can be altered to optimise the analytical results.
2 Perform experiments using a range of advanced analytical techniques.
3 Develop methods to obtain optimum results from a range of analytical instruments.

Outcomes 1

You will be introduced to a range of advanced analytical techniques. The actual instruments discussed will depend on the nature of your course, but will include a selection from GLC, HPLC, electrophoresis systems and possibly a range of spectroscopy techniques. You will discuss the recent advances in instrument design and the ways in which this has improved the analytical results.

You will be expected to become familiar with the range of analytical techniques, especially the main aspects of the instruments which can be altered to change the analytical results. You will be expected to use this knowledge to decide on the most appropriate changes to the method to solve analytical problems.

Outcomes 2 and 3

In this Outcome you will be expected to set up and operate a range of analytical instruments. You will carry out several practical exercises covering a range of analytical techniques. The emphasis will be on your ability to understand the nature of the analytical work being undertaken and to appreciate when the results are accurate and reliable. You will be expected to suggest changes to the methods which will improve on the instrument performance. In this Unit the practical exercises are likely to take place over a few laboratory sessions, which will allow you to review results and decide on improvements to the experimental conditions. You will be expected to keep accurate records of all your work and to report this accurately and concisely.