

Higher National Unit Specification

General information for centres

Unit title: Applied Biochemical Techniques

Unit code: DG6Y 34

Unit purpose: This Unit is designed to provide candidates with a practical introduction to, and understanding of, the common techniques used in biochemical laboratories.

On completion of the Unit the candidate should be able to:

1. Describe the use of isotopes in biochemical analysis.
2. Explain the use of and apply chromatography as a biochemical tool.
3. Explain the use of and apply electrophoresis as a biochemical tool.
4. Perform an enzyme assay and explain its use in biochemical analysis.

Credit value: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this unit will be at the discretion of the centre, however it is recommended that candidates should have experience of studying chemistry at HNC level. Although differing programmes of study will be sufficient to prepare candidates for this unit, it is recommended that they should have completed the HN Unit 'Fundamental Chemistry'.

Core skills: There may be opportunities to gather evidence towards core skills in numeracy, communication and problem solving at Higher within this Unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: This Unit is included in the framework of the group awards, HNC Applied Sciences and HND Biotechnology. It is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Assessment: Each outcome in this Unit requires that candidates are assessed on practical ability as well as knowledge and understanding.

General information for centres

In assessing underlying theory an integrated approach should be utilised. A holistic end-of-unit test is advised with evidence for the knowledge and skills in this unit being provided on a sample basis. At least 9 of the 17 total knowledge and/or skills items for the unit must be covered by this single test, with the specified (minimum) number of items from an individual outcome being assessed on each occasion. This assessment should be based on case studies and/or problem-solving activities and last approximately 90 minutes. The assessment should be presented in a supervised, closed-book situation.

In addition, candidates must complete a supervised practical task for each outcome. These practical activities covering all four outcomes can be assessed on an outcome-by-outcome basis or may be integrated into a project. In either case a laboratory report (s) must be produced to demonstrate that the candidate has undertaken this practical work.

Candidates must meet the level of performance specified in the evidence requirements for all four outcomes to achieve the unit.

Higher National Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

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. Candidates 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 use of isotopes in biochemical analysis

Knowledge and/or skills

- ◆ Stable and radio isotopes
- ◆ Decay of radio-isotopes
- ◆ Analytical techniques involving isotopes
- ◆ Safety considerations

Evidence requirements

Where an item is sampled, a candidate's response will be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ define stable isotopes and radio-isotopes
- ◆ explain radio-active decay and calculate half-lives in this context
- ◆ describe different applications involving isotopes
- ◆ describe safe handling, storage and disposal of isotopes.

For this outcome at least two of the four knowledge and skills items listed above must be assessed on each occasion.

Evidence should be gathered using a test under closed-book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

In addition, candidates must have the opportunity to carry out the following practical activity:

- ◆ handling and disposal of a simulated radioactive spillage.

A lab report should be produced to record the candidate's ability to analyse, plan and carry out the task .

Higher National Unit specification: statement of standards (cont)

Unit title: Applied Biochemical Techniques

Assessment guidelines

Assessment of this outcome is by a holistic end-of-unit test based on problem-solving activities and/or case study materials, and by completion of practical work. The test should be completed in approximately 90 minutes and must be taken under supervised, closed-book conditions.

Practical work should require the candidate to actively participate in the planning and management of the activity as well as identifying and obtaining resources and carrying out the practical task. The practical activity should last no more than 20 minutes.

Outcome 2

Explain the use of and apply chromatography as a biochemical tool

Knowledge and/or skills

- ◆ General principles of chromatography
- ◆ Gel filtration
- ◆ Ion exchange
- ◆ Affinity
- ◆ High Performance Liquid Chromatography (HPLC)
- ◆ Gas Chromatography (GC)

Evidence requirements

Where an item is sampled, a candidate's response will be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ demonstrate an understanding of the concept of separation between a mobile and a stationary phase
- ◆ demonstrate an understanding of the concept of separation based on size
- ◆ demonstrate an understanding of the concept of separation based on charge
- ◆ demonstrate an understanding of the concept of separation based on affinity for a specific ligand
- ◆ demonstrate an understanding of the concepts of high performance liquid chromatography
- ◆ demonstrate an understanding of the concept of chromatography where the mobile phase is in the gaseous state.

For this outcome at least three of the six knowledge and/or skills items listed above must be assessed on each occasion.

Evidence should be gathered using a written test under closed-book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

Higher National Unit specification: statement of standards (cont)

Unit title: Applied Biochemical Techniques

In addition, candidates must have the opportunity to carry out one of the following practical activities:

- ◆ separation of a mixture of molecules by HPLC
- ◆ separation of a mixture of molecules by standard column chromatography.

A lab report should be produced to record the candidate's ability to carry out the task and to interpret the results obtained.

Assessment guidelines

Assessment of this outcome is by a holistic end-of-unit test based on problem-solving activities and/or case study materials, and by completion of practical work. The test should be completed in approximately 90 minutes and must be taken under supervised, closed-book conditions.

Practical work should require the candidate to actively participate in the planning and management of the experiment as well as identifying and obtaining resources and carrying out the practical activity. The practical activity should last no more than 60 minutes and could be integrated with Outcome 3 of the unit 'Instrumental Techniques: Theory and Practice 1'.

Outcome 3

Explain the use of and apply electrophoresis as a biochemical tool

Knowledge and/or skills

- ◆ The principles of electrical attraction
- ◆ The concept of gel matrices
- ◆ Techniques used in visualisation and identification of molecules from a gel
- ◆ Types of electrophoresis

Evidence requirements

Where an item is sampled, a candidate's response will be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ demonstrate an understanding of the concept of polarity and of the influence of pH on attraction
- ◆ demonstrate an understanding of the ability of a gel to separate molecules based on size and shape
- ◆ demonstrate an understanding of protein and nucleic acid stains/dyes and of coupled antibodies
- ◆ demonstrate knowledge of a range of biochemical applications of electrophoresis.

Higher National Unit specification: statement of standards (cont)

Unit title: Applied Biochemical Techniques

For this outcome at least two of the four knowledge and/or skills items listed above must be assessed on each occasion.

Evidence should be gathered using a test under closed-book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

In addition, candidates must have the opportunity to carry out the following practical activity:

- ◆ separation of a mixture of differently sized proteins or nucleic acid fragments by electrophoresis

A lab report should be produced to record the candidate's ability to carry out the task and to interpret the results obtained.

Assessment guidelines

Assessment of this outcome is by a holistic end-of-unit test based on problem-solving activities and/or case study materials, and by completion of practical work. The written test should be completed in approximately 90 minutes and must be taken under supervised, closed-book conditions.

Practical work should require the candidate to actively participate in the planning and management of the experiment as well as identifying and obtaining resources and carrying out the practical activity. The setting up of this activity should last no more than 60 minutes (gels can be left to run out-with class time).

Outcome 4

Perform an enzyme assay and explain its use in biochemical analysis

Knowledge and/or skills

- ◆ The basic principles of kinetics
- ◆ The design of controls
- ◆ The effect of inhibitors

Evidence requirements

Where an item is sampled, a candidate's response will be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- describe kinetics in terms of reaction rates, saturation, affinity and limiting factors
- explain the need for appropriate controls
- describe the mechanism of action of competitive and non-competitive inhibitors

Higher National Unit specification: statement of standards (cont)

Unit title: Applied Biochemical Techniques

For this outcome at least two of the three knowledge and skills items listed above must be assessed on each occasion.

Evidence should be gathered using a test under closed-book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

In addition, candidates must have the opportunity to carry out the following practical activity:

- visible/UV spectrophotometry, and the application of Beer-Lamberts Law, to follow enzyme reactions directly or through coupled reactions.

A lab report should be produced to record the candidate's ability to carry out the task and to interpret the results obtained.

Assessment guidelines

Assessment of this outcome is by a holistic end-of-unit test based on problem-solving activities and/or case study materials, and by completion of practical work. The test should be completed in approximately 90 minutes and must be taken under supervised, closed-book conditions.

Practical work should require the candidate to actively participate in the planning and management of the experiment as well as identifying and obtaining resources and carrying out the practical activity. This practical activity should last no more than 60 minutes.

An ideal opportunity exists in this outcome to engage candidates in data-handling/problem solving activities. This could be through the production and use of Lineweaver-Burke plots to allow the determination of K_m and V_{max} in the presence and absence of inhibitors.

Administrative Information

Unit code: DG6Y 34

Unit title: Applied Biochemical Techniques

Superclass category: RH

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History of changes:

Version	Description of change	Date
02	Amendment to Outcome 3 Guidance Requirements	November 2007

Source: SQA

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Higher National Unit specification: support notes

Unit title: Applied Biochemical Techniques

This part of the Unit specification is offered as guidance. The support notes 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 primarily intended to provide the candidate with underpinning knowledge relevant to common techniques utilised in biochemical laboratories. In this environment it is essential that scientists can understand and manipulate the techniques which they utilise. Hence, the unit focuses on the application of techniques via practical experience, safety considerations and data handling/problem solving activities. The essential underpinning knowledge and skills gained here will be invaluable during employment or further study.

Outcome 1 focuses on the use of isotopes in biochemical analysis. Candidates should become familiar with the following features:

- ◆ Stable and radioisotopes: definitions and examples of isotopes.
- ◆ Applications: radioimmunoassay; autoradiography; phospho-imaging; nuclear magnetic resonance; mass spectrometry.
- ◆ Decay: alpha, beta, gamma; half-lives; calculations of $t_{1/2}$.
- ◆ Safety: storage; exposure levels; biological effects of radiation; shielding; disposal.

Outcome 2 focuses on providing candidates with practical skills in chromatography. The knowledge and/or skills which should be covered are:

- ◆ Gel filtration: pore size; calibration; elution.
- ◆ Ion exchange: anion and cation exchangers; salt gradients.
- ◆ Affinity: coupling; resolving power; elution.
- ◆ HPLC: pressure; resolution; mobile and stationary phases.
- ◆ GC: sample preparation; phases; resolution; sample detection.

The assessed practical for this outcome could take one of the following formats:

- ◆ Separation of organic molecules, such as parabens, by hydrophobic HPLC column.
- ◆ Separation of a mixture of dyes or proteins by gel filtration column.

Higher National Unit specification: support notes (cont)

Unit title: Applied Biochemical Techniques

Outcome 3 focuses on providing candidates with practical skills in electrophoresis. The knowledge and/or skills which should be covered are:

- ◆ Electrical: attraction: polarity; effect of pH; role of buffers.
- ◆ Gel matrices: pore size; agarose; acrylamide; safety aspects.
- ◆ Visualisation and identification: coomassie blue; silver stains; ethidium bromide; enzyme-linked antibodies; autoradiography; safety aspects.
- ◆ Types: flat-bed; vertical; denaturing; non-denaturing; isoelectric; DNA sequencing; safety aspects.

Outcome 4 candidates are asked to perform an enzyme assay and to explain the underlying principles. The knowledge and/or skills which should be covered are:

- ◆ Kinetics: V_{max} and K_m determinations could be utilised to illustrate the concepts of enzyme saturation and enzyme affinity respectively.
- ◆ Controls: the requirement for and design of appropriate controls.
- ◆ Inhibitors: changes in V_{max} and K_m could be used to differentiate between mechanisms of competitive and non-competitive inhibition only.

Guidance on the delivery and assessment of this Unit

This unit forms part of the group awards, HNC Applied Sciences and HND Biotechnology, which is primarily designed to prepare candidates for employment in a biological science related post. The unit requires the candidate to be able to utilise various instruments and techniques and hence it is expected to be delivered subsequent to units in chemistry and biochemistry in the first year of a full-time HNC Applied Sciences or HND Biotechnology programme. Where possible during the delivery, links should be drawn with other relevant areas of the course eg Quality and Health & Safety systems in Science Industries.

The use of candidate-centred, resource-based methodologies should be as extensive as possible to promote independent study.

Assessment of the underlying theory in Outcomes 1-4 is by production of appropriate evidence. It is recommended that this evidence should be generated by a holistic extended case study or problem-solving activity. The practical element of each Outcome should be assessed by a laboratory report. Evidence of performance can be recorded by means of a checklist.

Where evidence of the practical elements is found to be unsatisfactory, candidates may be questioned in order to identify particular problems with specific area(s). Support tutorials may prove to be useful in facilitating a solution to these problems. During remediation only the inadequate section or sections require to be re-assessed.

Higher National Unit specification: support notes (cont)

Unit title: Applied Biochemical Techniques

In delivery of this unit an ideal opportunity exists to engage students in problem-solving activities. For example:

- ◆ plotting a graph of radioisotope decay could be used to determine half-life in Outcome 1.
- ◆ Lineweaver-Burke plots could be utilised to determine V_{max} and K_m (+/- inhibitors) in Outcome 4.

Open learning

If this unit is delivered by open or distance learning methods, additional planning resources may be required for candidate support, assessment and quality assurance, particularly given the practical element of each outcome.

A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes.

For further information and advice, please see *Assessment and Quality Assurance for Open and Distance Learning* (SQA, February 2001 – publication code A1030).

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).

General information for candidates

Unit title: Applied Biochemical Techniques

This is a 1 credit HN unit at SCQF level 7 intended for candidates undertaking a biological science related qualification. It is designed to provide you with an introduction to some of the commonest techniques utilised in biochemical laboratories. Emphasis is placed on you being provided with the opportunity to gain hands-on experience of these techniques.

On completion of this unit you should be able to:

1. Describe the use of isotopes in biochemical analysis.
2. Explain the use of, and apply chromatography as a biochemical tool.
3. Explain the use of, and apply electrophoresis as a biochemical tool.
4. Perform an enzyme assay and explain its use in biochemical analysis.

The four outcomes which make up the unit are described below;

Outcome 1

You will be introduced to the concept of stable and radioisotopes. The lectures/tutorials for this outcome will focus on particular aspects such as how these isotopes are utilised in various biochemical techniques. You will also learn how radioisotopes decay and how to handle these isotopes so as to protect yourself and others from exposure.

Outcome 2

In this outcome you will be introduced to the concept of chromatography. Lectures/tutorials will focus on some of the main types of chromatography and the basic principles behind each category. You will learn about different matrices, elution methods and detection methods. Here you should be asked to separate components of a mixture either by HPLC or by standard column chromatography.

Outcome 3

This outcome focuses on the use of electrophoresis as a biochemical tool. The concept of separating out a mixture of molecules by this technique will be introduced and you will be required to carry out this technique in practice.

Outcome 4

In this outcome you will be asked to perform a basic enzyme assay and to display understanding of the principles behind it. In lectures/tutorials you will learn about such principles, namely; limiting factors, need for controls and effects of inhibitors.

Your knowledge of the topics covered in this unit will be assessed by a holistic end-of-unit assessment where, in order to pass, you will have to obtain at least 60% of the marks available. Additionally, you will be required to produce evidence of having applied the techniques described in outcomes 1-4. To pass in this unit you must achieve a satisfactory level of performance in all assessments.