



Higher National Unit specification

General information for centres

Unit title: Chemical Engineering: Applied Physical Chemistry

Unit code: F3X9 34

Unit purpose: This Unit will provide candidates with underpinning knowledge and problem solving skills in applied physical chemistry.

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

- 1 Apply the laws of thermodynamics to systems involving chemical and physical change.
- 2 Apply the principles of chemical kinetics to rates and mechanisms.
- 3 Apply the principles of gas-solid adsorption to heterogeneously catalysed reactions.

Credit points and level: 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. It is recommended that candidates have some prior skills in mathematics and chemistry at SCQF level 6, or equivalent.

Core Skills: There are opportunities to develop the Core Skill of *Numeracy* and the component Critical Thinking of the Core Skill of *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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.

Assessment: The assessment for Outcomes 1, 2, and 3 will either be assessed individually at the end of each Outcome or as a single holistic assessment. Questions set should reflect a representative sample from the content in the Knowledge and/or Skills and Evidence Requirements. Assessment should be conducted under supervised conditions.

Higher National Unit specification: statement of standards

Unit title: Chemical Engineering: Applied Physical Chemistry

Unit code: F3X9 34

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

Apply the laws of thermodynamics to systems involving chemical and physical change

Knowledge and/or Skills

- ◆ First law of thermodynamics
- ◆ Definitions of thermodynamic functions
- ◆ Hess's Law
- ◆ Kirchoff's Law
- ◆ Equilibrium constant

Evidence Requirements

Evidence for this Outcome will be provided on a sample basis with candidates being required to provide evidence for four of the five Knowledge and/or Skills items. Assessment must be carried out under supervised conditions.

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ apply the first law of thermodynamics
- ◆ define thermodynamic functions: definitions must include enthalpy, entropy, internal energy, free energy
- ◆ demonstrate correct calculations selecting the appropriate thermodynamic equation to solve problems relating to Hess's Law, Kirchoff's Law and calculations involving the equilibrium constant

Where calculations are performed the candidate must:

- ◆ apply appropriate formulae.
- ◆ apply the principles of the calculation.
- ◆ show all working through a calculation.
- ◆ provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Higher National Unit specification: statement of standards (cont)

Unit title: Chemical Engineering: Applied Physical Chemistry

Assessment Guidelines

Outcome 1 could be combined with Outcomes 2 and 3 to form a single holistic assessment, or may be assessed individually. The assessment could be composed of an appropriate balance of short answer, restricted response and structured questions.

Outcome 2

Apply the principles of chemical kinetics to rates and mechanisms

Knowledge and/or Skills

- ◆ Calculations using kinetic data
- ◆ Batch reactors
- ◆ Flow reactors
- ◆ Static and Flow techniques for determining rate of reaction
- ◆ Kinetics in industrial processes Maxwell Boltzmann distribution, activation energies, catalysis

Evidence Requirements

Evidence for this Outcome will be provided on a sample basis with candidates being required to provide evidence for three of the five Knowledge and/or Skills items. Assessment must be carried out under supervised conditions.

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ solve calculations using kinetic data. Calculations should include reaction rate, rate equation and rate determining step
- ◆ explain the differences between batch and flow reactors
- ◆ explain Maxwell Boltzmann distribution, activation energies
- ◆ describe Homogenous and heterogenous reactions, and the differences between them
- ◆ describe static and flow techniques for determining rates of reaction
- ◆ apply the principles of chemical kinetics to rate and mechanisms

Where calculations are performed the candidate must:

- ◆ apply appropriate formulae.
- ◆ apply the principles of the calculation.
- ◆ show all working through a calculation.
- ◆ provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Assessment Guidelines

Outcome 2 could be combined with Outcomes 1 and 3 to form a single holistic assessment, or may be assessed individually. The assessment could be composed of an appropriate balance of short answer, restricted response and structured questions.

Higher National Unit specification: statement of standards (cont)

Unit title: Chemical Engineering: Applied Physical Chemistry

Outcome 3

Apply the principles of gas-solid adsorption to heterogeneously catalysed reactions

Knowledge and/or Skills

- ◆ Isotherms
- ◆ Adsorption
- ◆ Calculations using adsorption data
- ◆ Factors affecting heterogeneous catalysis

Evidence Requirements

Evidence for this Outcome will be provided on a sample basis with candidates required to provide evidence for three of the four Knowledge and/or Skills items. Assessment must be carried out under supervised conditions.

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ describe isotherms and factors affecting adsorption, at least three factors affecting adsorption should be given
- ◆ apply the principles of gas-solid adsorption to perform at least one calculation, using adsorption data
- ◆ explain the factors affecting heterogeneous catalysis, at least three factors affecting heterogeneous catalysis should be given

Where calculations are performed the candidate must:

- ◆ apply appropriate formulae.
- ◆ apply the principles of the calculation.
- ◆ show all working through a calculation.
- ◆ provide reasonable answers to the questions asked. The answer should derive from the application of the formulae and correct application of the principles of the calculation.

Assessment Guidelines

The assessment for Outcome 3 could be combined with that for Outcomes 1 and 2 to form a single holistic assessment or it may be assessed individually. The assessment could be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be carried out under supervised conditions.

Administrative Information

Unit code: F3X9 34

Unit title: Chemical Engineering: Applied Physical Chemistry

Superclass category: RD

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Higher National Unit specification: support notes

Unit title: Chemical Engineering: Applied Physical Chemistry

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 designed as part of the HNC Chemical Engineering and HNC/HND in Chemical Process Technology and will provide candidates with the underpinning knowledge and problem solving skills associated with Applied Physical Chemistry.

Topics/areas covered in the Unit are as follows:

Outcome 1

- ◆ First Law of Thermodynamics
- ◆ Relations between U, H, q, w. Molar heat capacities
- ◆ State functions
- ◆ Hess's Law
- ◆ Kirchhoff equation
- ◆ Reversible and irreversible systems
- ◆ Entropy and the Second Law of Thermodynamics
- ◆ G and S Equilibrium. Application to an industrial process

Outcome 2

- ◆ Homogeneous and heterogeneous reactions
- ◆ Reaction rate, rate equation, rate determining step
- ◆ Collision theory mechanism, reaction order
- ◆ Static and flow methods for determining rates
- ◆ Maxwell Boltzmann distribution, activation energy, catalysis
- ◆ Batch and continuous reactors
- ◆ Plug flow
- ◆ Isothermal and adiabatic reactions
- ◆ Application to industrial processes, eg Haber Process

Outcome 3

- ◆ Adsorption, adsorbant, adsorbate
- ◆ chemical and physical adsorption
- ◆ Adsorption isotherms
- ◆ Langmuir isotherm
- ◆ Degree of cover
- ◆ Surface areas
- ◆ Heterogeneous catalysis
- ◆ Application to industrial processes

Higher National Unit specification: support notes (cont)

Unit title: Chemical Engineering: Applied Physical Chemistry

Guidance on the delivery and assessment of this Unit

This Unit is part of the HNC/HND Chemical Process Technology and HNC Chemical Engineering. The Unit requires the candidate to be familiar with the underpinning knowledge and problem solving skills associated with Applied Physical Chemistry.

Independent study should be encouraged by the use of candidate-centred learning material although it is envisaged that candidates will require a significant amount of planned instruction.

The assessment for Outcomes 1, 2, and 3 will be assessed either individually at the end of each Outcome or as a single, holistic, end of Unit assessment.

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.

A note on the Evidence Requirements

The Evidence Requirements state that candidates must 'provide reasonable answers' derived 'from the application of the formulae and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where candidates' final answer may be inaccurate.

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skill of *Numeracy* and the component Critical Thinking of the Core Skill of *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Throughout this Unit candidates are required to perform calculations, manage formulae and equations, all of which provide the opportunity to develop the Core Skill of *Numeracy* at SCQF level 6. In Outcome 2 candidates will also be required to interpret and plot graphs which again will aid development of *Numeracy* skills.

The presentation of problems in assessments which candidates require to interpret and work through will also develop the Critical Thinking component of *Problem Solving*, at SCQF level 6.

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.

Higher National Unit specification: support notes (cont)

Unit title: Chemical Engineering: Applied Physical Chemistry

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: Chemical Engineering: Applied Physical Chemistry

Whilst this Unit may be studied on a standalone basis, it has been designed as a single-credit HN Unit at SCQF level 7 intended for candidates undertaking an HNC/HND Chemical Process Technology or HNC Chemical Engineering. It is designed to provide you with an knowledge of some of the main concepts of the theory and practice of *Applied Physical Chemistry*. This will be useful you to you in further studies in Chemical Process Technology or Chemical Engineering, as many of the principles studied here will be of relevance.

On completion of this Unit you should be able to:

- 1 Apply the laws of thermodynamics to systems involving chemical and physical change.
- 2 Apply the principles of chemical kinetics to rates and mechanisms.
- 3 Apply the principles of gas-solid adsorption to heterogeneously catalysed reactions.

This Unit requires a number of calculations to be carried out, and whilst tutor support may be available, it is strongly recommended that you have prior skills in mathematics and chemistry at SCQF level 6 or equivalent before commencement. Should this be of concern, you should discuss it with your tutor.

Outcomes 1, 2, and 3 will either be assessed individually by Outcome, or as a single, holistic, end of Unit assessment. Your tutor will advise you as to how this will be conducted in your centre. The questions will be conducted on a sample basis which means that you will be expected to revise all subjects, even though all subjects may not be covered in the assessment.

Throughout the Unit you will also have the opportunity to develop Core Skills in *Numeracy*, and *Problem Solving* at SCQF level 6. You will perform calculations, manage formulae and equations that may develop the Core Skill of *Numeracy* at SCQF level 6. You will also be required to interpret and plot graphs, which again provides the opportunity to develop the Core Skill of *Numeracy* at SCQF level 6.

The presentation of problems throughout the delivery and assessment of the course will require you to interpret situations, apply the learned principles and develop appropriate solutions, thus providing the opportunity to develop the component Critical Thinking of the Core Skill of *Problem Solving*.