



## Higher National Unit specification

### General information

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

**Unit code:** H935 35

**Superclass:** RD

**Publication date:** May 2015

**Source:** Scottish Qualifications Authority

**Version:** 02

### Unit purpose

This Unit is designed to provide learners with the underpinning knowledge, problem solving skills and practical techniques associated with key concepts of phase equilibria and surface chemistry.

### Outcomes

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

- 1 Describe and apply the principles and laws associated with phase equilibria, phase diagrams, colligative properties, and adsorption isotherms.
- 2 Perform laboratory techniques and correctly analyse, interpret and present the results correctly and accurately.

### 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

Entry to this Unit is at the discretion of the centre, but it is preferable for learners to be able to demonstrate a knowledge of physical chemistry at SCQF level 7. Where the Unit is delivered as part of an HN Science Group Award, it is anticipated that learners will have completed level 7 Units in H92X 34 *Fundamental Chemistry: Theory and Laboratory Skills* and H936 34 *Physical Chemistry: Theory and Laboratory Skills* prior to commencing this Unit.

## Higher National Unit Specification: General information (cont)

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

### Core Skills

Achievement of this Unit gives automatic certification of the following:

Complete Core Skill	Numeracy at SCQF level 6
Core Skill component	Critical Thinking at SCQF level 6

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

### 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.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

### 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](http://www.sqa.org.uk/assessmentarrangements).

## Higher National Unit specification: Statement of standards

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

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 and apply the principles and laws associated with phase equilibria, phase diagrams, colligative properties, and adsorption isotherms.

#### Knowledge and/or Skills

- ◆ Colligative properties
- ◆ Phase behaviour of two component systems
- ◆ Adsorption isotherms and surface chemistry

### Outcome 2

Perform laboratory techniques and correctly analyse, interpret and present the results correctly and accurately.

#### Knowledge and/or Skills

- ◆ Follow instructions to perform a range of chemical experiments
- ◆ Work in a safe manner regarding current health and safety regulations
- ◆ Achieve consistent and accurate results
- ◆ Report the results clearly and concisely
- ◆ Data analysis and interpretation
- ◆ Evaluate errors implicit in the experiment

## Higher National Unit specification: Statement of standards (cont)

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

### Evidence Requirements for this Unit

#### Outcome 1

Outcome 1 will be assessed using a closed-book end of Unit assessment under supervised conditions. Learners can only have access to the *SQA Databook for HN Chemistry* or a suitable alternative when sitting the assessment.

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

- ◆ Describe nature of colligative properties.
- ◆ Perform calculations on application of Raoult's law to colligative properties.
- ◆ Construct phase diagrams using cooling curve data.
- ◆ Interpret phase diagrams for two component condensed systems, applying phase rule and tie-line principle.
- ◆ Explain and apply concepts of surface chemistry with respect to models for adsorption isotherms.
- ◆ Describe aspects of adsorption isotherms in industrial and commercial applications.

#### Outcome 2

Evidence for this Outcome will be provided by the learners:

- ◆ Performing practical activities in line with instructions and health and safety regulations.
- ◆ Analysing and interpreting experimental data.
- ◆ Submitting a full and complete laboratory report.
- ◆ Reporting results and evaluating errors implicit in the experiment.

The minimum requirement is that the learner satisfactorily completes one assessed practical and one laboratory report. A checklist should be used to record learner performance in the practical activities.

The analysis of experimental data will necessitate graphical and/or mathematical data manipulation of a standard appropriate to HN study at level 8.

The laboratory report should be clear and concise, with correctly stated aims, full experimental method detail, all raw data and correctly presented and interpreted calculations. Any graphs required should be presented in the appropriate format in terms of scaling, units, best fit, title, etc. A checklist should be used to ensure standards are met.



## Higher National Unit Support Notes

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF Level 8)

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 HND Applied Chemical Sciences. The aim is to give learners the underpinning theoretical, data analysis and practical chemical skills to facilitate them to function as effective technicians or to progress to more advanced study.

#### Outcome 1

Raoult's law. Lowering of vapour pressure of a liquid by a non-volatile solute. Elevation of boiling point and depression of freezing point for solutions. Molality. Osmosis, semi-permeable membranes. Osmotic pressure of solutions. Calculations for each colligative property. Effects of association and dissociation.

Construction of phase diagrams using cooling curve data. Interpretation of phase diagrams for two component condensed systems by applying phase rule and tie-line principle. Phase diagram for system forming a eutectic.

Gas adsorption processes. Adsorption isotherms. Langmuir and BET models and their derivation from kinetic and thermodynamic considerations. Variations of surface coverage with temperature and pressure, enthalpies of adsorption, Clausius-Clapeyron. Applications of isotherms, eg pressure-swing adsorption, catalytic applications, chromatography.

#### Outcome 2

Learners will encounter a range of practical activities which support and develop the theory from Outcome 1. Suitable practical activities might include:

- ◆ Freezing point depression by weak and strong electrolytes.
- ◆ Adsorption isotherm for N<sub>2</sub> on charcoal.
- ◆ Enthalpies of vaporisation by application of Clausius equation.
- ◆ Construction of triangular phase diagram for ternary liquid system.
- ◆ Effects of varying operating conditions on gas chromatographs.
- ◆ Study of vapour-liquid equilibrium for acetone-cyclohexane system by GC analyses of vapour.

## Higher National Unit Support Notes (cont)

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

### Guidance on approaches to delivery of this Unit

This Unit is likely to form part of a Group Award, which is designed both to prepare learners for employment in science related posts and to offer the possibility of articulation into more advanced study. The emphasis therefore should be on ensuring learners comprehend the important aspects and applications of phase and surface chemistry and are able to correctly analyse and interpret experimental data.

Independent study should be encouraged by using learner-centered, resource-based methodologies. It is envisaged that ICT based approaches will feature in the delivery of the Unit.

### 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.

The assessment of Outcome 1 could be by a holistic test worth 50 marks, with equal weighting on each section. All Knowledge and Skills will be assessed, however, the questions set in the assessment could cover a representative sample of the topics covered, and it is envisaged they will entail a mixture of short answer and structured questions. The allocation of marks per question should be weighted on the basis of the level of response and the amount of effort required. The pass mark for the overall assessment will be 60%.

In Outcome 2, learners will be assessed on their ability to perform laboratory work to a required standard, to correctly analyse and interpret data, and to present their findings in suitable and sufficient laboratory reports. It is envisaged that the analysis of experimental data will necessitate graphical and/or mathematical data manipulation of a standard appropriate to HN study at level 8.

While it is recommended that learners should perform a range of practical activities, only one is required for assessment purposes. The practical should support the theory delivered in Outcome 1, but is not restricted to any particular area.

The laboratory report should be clear and concise, with correctly stated aims, full experimental method detail, all raw data and correctly presented and interpreted calculations. Any graphs required should be presented in the appropriate format in terms of scaling, Units, best fit, title etc.

A laboratory diary or pro forma will be kept and learners should be introduced to Standard Operating Procedures (SOPs). Laboratory reports should be in an appropriate format. Health and safety, in regard to risk and Control of Substances Hazardous to Health (COSHH) assessments should be emphasised at all times.

Should a learner fail to carry out an experiment to the required standard, a further attempt at an alternative experiment should be offered. Where a laboratory report does not meet the required standard, a learner should be given the opportunity to resubmit following remediation. While the completion of one practical is required for assessment purposes, it is envisaged that learners will participate in several experiments during the course of the Unit.

## Higher National Unit Support Notes (cont)

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

An exemplar instrument of assessment with marking guidelines has been produced to indicate the national standard of achievement at SCQF level 8.

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.

### 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](http://www.sqa.org.uk/e-assessment).

### Opportunities for developing Core and other essential skills.

This Unit has the Core Skill of *Numeracy* embedded in it. This means that when learners achieve this Unit, their Core Skills profile will also be updated to show that they have achieved *Numeracy* at SCQF level 6.

This Unit has the *Critical Thinking* component of *Problem Solving* embedded in it. This means that when learners achieve the Unit, their Core Skills profile will also be updated to show they have achieved *Critical Thinking* at SCQF level 6.

## History of changes to Unit

Version	Description of change	Date
02	Core Skills Component Critical Thinking at SCQF level 6 embedded.	28/07/2015
02	Core Skill Numeracy at SCQF level 6 embedded.	28/07/2015

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## General information for learners

### Unit title: Phase Equilibrium and Surface Chemistry (SCQF level 8)

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 SCQF level 8 Unit, intended to be delivered as part of an HND Science qualification. It is designed to give you essential skills and knowledge in phase equilibrium and surface chemistry, and to understand the commercial applications.

On completion of this Unit you should be able to:

- 1 Describe and apply the principles and laws associated with phase equilibria, phase diagrams, colligative properties, and adsorption isotherms.
- 2 Perform laboratory techniques and correctly analyse, interpret and present the results correctly and accurately.

#### Outcome 1

Describe nature of colligative properties: Lowering of vapour pressure of a liquid by a non-volatile solute, elevation of boiling points and depression of freezing points, osmotic pressure and semi-permeable membranes. Effects of association and dissociation on colligative properties. Perform calculations on application of Raoult's law to colligative properties.

Construction of phase diagrams using cooling curve data. Interpretation of phase diagrams for two component condensed systems by applying phase rule and tie-line principle. Phase diagram for system forming a eutectic.

Gas adsorption processes. Adsorption isotherms. Langmuir and BET models and their derivation from kinetic and thermodynamic considerations. Variations of surface coverage with temperature and pressure, enthalpies of adsorption, Clausius-Clapeyron equation. Applications of isotherms in commercial and industrial settings, eg pressure-swing adsorption, catalytic applications, chromatography.

Explain and apply concepts of surface chemistry with respect to models for adsorption isotherms. Explain aspects of industrial and commercial applications of adsorption isotherms.

Outcome 1 will be assessed by a single end of Unit closed-book test covering a selection of topics from each of the four sections above.

## General information for learners (cont)

**Unit title:** Phase Equilibrium and Surface Chemistry (SCQF level 8)

### Outcome 2

In this Outcome you will carry out a range of practical activities which will support the theory from Outcome 1. Although it is likely that a range of practicals will be covered, only one will be formally assessed. For assessment purposes you will be required to perform laboratory work to a set standard, in line with health and safety rules and regulations, to correctly analyse and interpret data, and to present your findings in a suitable and sufficient laboratory report. The laboratory report should be clear and concise, with correctly stated aims, full experimental method detail, all raw data and correctly presented and interpreted calculations. Any graphs required should be presented in the appropriate format in terms of scaling, units, best fit, title, etc.

This Unit has the Core Skill of *Numeracy* and the Core Skill component of *Critical Thinking* at SCQF level 6 embedded in it.