SQA Advanced Unit Specification

General information for centres

Unit title: Phase Equilibrium and Surface Chemistry

Unit code: HV9E 48

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

On completion of the Unit the candidate 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.

Credit points and level: 1 SQA Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**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 National 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit is at the discretion of the centre, but it is preferable for candidates to be able to demonstrate a knowledge of Physical Chemistry at SCQF level 7. Where the Unit is delivered as part of an SQA Advanced science Group Award, it is anticipated that candidates will have completed level 7 Units in Fundamental Chemistry: Theory and Practice (HV4H 47) and Fundamental concepts of Physical Chemistry (HV98 47) prior to commencing this Unit.

Core Skills: There may be opportunities to gather evidence towards Core Skills in this Unit, in particular Problem Solving and Communication at SCQF level 6, 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: Outcome 1 will be assessed using a closed-book end-of-Unit assessment and a score of 60% will be required for a pass. The questions should reflect a representative sample from the content detailed in the support notes.

Outcome 2 should be assessed by practical activities. Candidates should be assessed on their practical ability, adherence to health and safety rules and regulations, their analysis of data, and on the quality of their laboratory reports.

Unit specification: statement of standards

Unit title: Phase Equilibrium and Surface Chemistry

Unit code: HV9E 48

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 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

Evidence requirements

Candidates 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

Evidence should be gathered using a holistic closed-book assessment under supervised conditions. The pass mark for the overall assessment will be 60%.

Candidates should have access to the SQA Databook for Higher/Advanced Higher Chemistry or a suitable alternative when sitting the assessment.

Assessment guidelines

All knowledge and skills will be assessed, however, the questions set in the assessment could cover a representative sample of the topics covered in the support notes, 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 assessment could be worth a total of 50 marks, with equal weighting in each section.

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

Evidence requirements

Evidence for this Outcome will be provided by the candidates:

- 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 candidate satisfactorily completes one assessed practical and one laboratory report. A checklist should be used to record candidate performance in the practical activities.

The analysis of experimental data will necessitate graphical and/or mathematical data manipulation of a standard appropriate to SQA Advanced 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.

Assessment guidelines

While it is recommended that candidates 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.

Administrative information

Unit code: HV9E 48

Unit title: Phase Equilibrium and Surface Chemistry

Superclass category: RD

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

Unit specification: support notes

Unit title: Phase Equilibrium and Surface 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 intended to be part of the SQA Advanced Diploma provision in Chemistry and Applied Sciences. The aim is to give candidates 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

Candidates 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_2 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

Guidance on the delivery and assessment of this Unit

This Unit is likely to form part of a Group Award, which is designed both to prepare candidates for employment in science related posts and to offer the possibility of articulation into more advanced study. The emphasis therefore should be on ensuring students 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 candidate-centred, resource based methodologies. It is envisaged that ICT based approaches will feature in the delivery of the Unit.

The assessment of Outcome 1 could be by a holistic test worth 50 marks**,** with equal weighting on each section. 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, candidates 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 SQA Advanced 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 laboratory diary or proforma 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 COSHH assessments should be emphasised at all times.

Should a candidate 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 candidate should be given the opportunity to resubmit following remediation. While the completion of one practical is required for assessment purposes, it is envisaged that candidates will participate in several experiments during the course of the Unit.

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.

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

For further information and guidance, please see Assessment and Quality Assurance of Open and Distance Learning (SQA, February 2001, publication code A1030).

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.

General information for candidates

Unit title: Phase Equilibrium and Surface Chemistry

This is a one credit SCQF level 8 Unit, intended to be delivered as part of an SQA Advanced Diploma 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.

The main components of the Unit are described in more detail below:

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 Raoults 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.

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.