CH165-15 Chemical Change

24/25

Department
Chemistry
Level
Undergraduate Level 1
Module leader
Julie Macpherson
Credit value
15
Module duration
5 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module is a self-contained and integrated introduction to chemical change:

The rate (kinetics) and energetics (thermodynamics) of chemical reactions are of central importance in all aspects of chemistry. By considering the energetics of a system it tells us if a process can happen, whilst the kinetics tell us how quickly. Many industrial processes rely on a thorough understanding of chemical change. This module will introduce the student to the fundamentals of chemical change at a level suitable for a Year 1 student. Case studies will be drawn from all branches of chemistry to illustrate the concepts developed, both in the lectures and in associated support teaching, and how understanding these concepts are important to the real world. This module will provide links to the modules in Year 1 and also help set the scene for topics covered in Year 2 and beyond.

Module web page

Module aims

The module aims to build up knowledge and confidence in the student in being able to understand the different forms of energy which are important in describing chemical systems (solutions, liquids, gases and solids), and how the energetics can control system behaviour. Reaction rates and the parameters which control a rate of reaction will also be considered. Consideration will also

be given to how to measure the energetics and rate of a reaction in the laboratory, with the aim that students can make informed suggestions as to how best measure a range of different chemical change processes and also how to analyse data provided.

Students at the end of the module will be able to understand the link between the feasibility of a reaction and how quickly it will reach a desired outcome.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The course will be broken down into 3 main topic areas, with 10 lectures devoted to each topic and 6 lectures delivered each week.

Introduction to course: Introduction to the inter-relationship between the energetics and rate of a chemical reaction via a simple reaction co-ordinate pathway

Energetics: Introduction to energy and units, how to make experimental measurements, first law of thermodynamics and conservation of energy (introduction to U, q and w). Ideal gas laws, kinetic theory of gases, enthalpy and heat capacity, spontaneity and entropy, liquid gas equilibrium and vapour pressure, phase diagrams and liquid mixtures, colligative properties, chemical reactions, extent of a reaction, equilibrium constant and link to thermodynamic parameters

Rates: Introduction to timescales of chemical reactions, difference between a rate constant and equilibrium constant, how to measure rates of reactions, case studies to illustrate what is meant by different reaction orders. How to calculate rate constants and half-life once a reaction order is known. Unit discussion, concept of pseudo order reactions, extracting kinetics from experimental data, complex reactions, steady-state approximation, importance of temperature, introduction to catalysis and enzyme kinetics, chain reactions

Solution Properties and Electrochemistry: Water and thermochemistry of ions in water, solution equilibria, pH, pKa, pKb, ideal and real solutions, partial molar quantities, activity versus concentration, thermodynamics and reaction kinetics of solution reactions, movement of ions and molecules in solution, transport controlled reactions. Redox systems, oxidation numbers, equilibria chemical reactions and link to electrode potential, thermodynamics of electrochemical processes, Nernst equation, introduction to biological redox systems, galvanic versus electrolytic systems (thermodynamic versus kinetic).

Learning outcomes

By the end of the module, students should be able to:

- Gain an understanding of the inter-relationship between a reaction co-ordinate, energy distance profile, the energetic feasibility of a reaction and the rate of a reaction
- Appreciate how to measure a thermodynamic quantity or the rate of reaction.
- Gain confidence in making quantitative calculations related to chemical change reactions with an appreciation for appropriate magnitudes and correct use of units
- Understand how to work with gases, liquids and solutions in the context of chemical change

- Understand why and how chemical change matters in the real world (examples drawn from across chemistry and industry)
- Appreciate the difference between an equilibrium constant and a rate constant when describing a chemical change process
- Understand the energetics behind electrochemical systems and importance in the real world
- Appreciate fundamental solution properties such as pH, activity

Indicative reading list

- Atkin’s Physical Chemistry
- Chemistry Student Guides on Thermodynamics and Kinetics should be released within the next 12 – 24 months which will help with the course
- Chemical Structure and Reactivity – Keeler / Wothers
- Electrode Potentials (Compton and Sanders)

Subject specific skills

Numeracy
Problem solving
Critical thinking
Time management and organization

Transferable skills

Numeracy
Problem solving
Critical thinking
Time management and organization

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	3 sessions of 1 hour (2%)
Practical classes	3 sessions of 1 hour (2%)
Other activity	4 hours (3%)
Private study	110 hours (73%)
Total	150 hours

Private study description

N/A

Other activity description

Revision workshops

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B1

Assessment component	Weighting	Study time	Eligible for self-certification
Written examination	100%		No

- Answerbook Pink (12 page)
- Students may use a calculator
- Graph paper
- Periodic Tables

Reassessment component is the same

Feedback on assessment

Cohort level examination feedback will be provided after the June examination period

Past exam papers for CH165

Availability

Courses

This module is Core for:

- UCHA-4 Undergraduate Chemistry (with Intercalated Year) Variants
  - Year 1 of F101 Chemistry (with Intercalated Year)
  - Year 1 of F122 Chemistry with Medicinal Chemistry (with Intercalated Year)
- UCHA-3 Undergraduate Chemistry 3 Year Variants
  - Year 1 of F100 Chemistry
  - Year 1 of F121 Chemistry with Medicinal Chemistry
- UCHA-F110 Undergraduate Master of Chemistry (with Industrial Placement)
  - Year 1 of F100 Chemistry
  - Year 1 of F110 MChem Chemistry (with Industrial Placement)
  - Year 1 of F112 MChem Chemistry with Medicinal Chemistry with Industrial Placement
- Year 1 of UCHA-F107 Undergraduate Master of Chemistry (with Intercalated Year)
- UCHA-F109 Undergraduate Master of Chemistry (with International Placement)
  - Year 1 of F109 MChem Chemistry (with International Placement)
  - Year 1 of F111 MChem Chemistry with Medicinal Chemistry (with International Placement)
- UCHA-4M Undergraduate Master of Chemistry Variants
  - Year 1 of F100 Chemistry
  - Year 1 of F105 Chemistry
  - Year 1 of F110 MChem Chemistry (with Industrial Placement)
  - Year 1 of F109 MChem Chemistry (with International Placement)
  - Year 1 of F125 MChem Chemistry with Medicinal Chemistry
- Year 1 of UCHA-F127 Undergraduate Master of Chemistry with Medicinal Chemistry(with Intercalated Year)