

UNIT I - THEORETICAL CHEMISTRY

Content

- Atomic structure
- Fundamental particles
- Electrons in shells, orbitals
- Ionisation energies, successive IE
- C12 scale & relative masses
- Mass spectrum
- Empirical formula
- Balancing equations
- The mole
- Stoichiometry calculations
- Types of bonding
- Balancing charges
- Ionic & covalent bonding
- Dative bond
- Shapes of molecules
- Orbital overlap
- Electronegativity
- Intermolecular forces
- Metallic bonding
- The kinetic theory
- The ideal gases equation
- Liquid state
- Lattice structures
- Alloys, ceramics

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- The subatomic particles' characteristics (mass, charge) and their location
- The shapes of s and p orbitals
- Definitions related to the C12 scale and relative masses
- How to represent a dative bond and hydrogen-bonding
- Uses of alloys and ceramics

Students to Understand

- How electrons are organised within orbitals
- The factors affecting the ionisation energies
- The principles behind mass spectrometry
- Why molecules have a certain shape using the VSEPR theory
- The concept of electronegativity

Students to be able to Do

- Calculate ionisation energies from the information found in the data booklet
- Perform stoichiometric calculations starting with balanced chemical equations
- Solve complex problem involving moles concepts
- Connect physical properties to a specific type of bonding

Cross curricular links

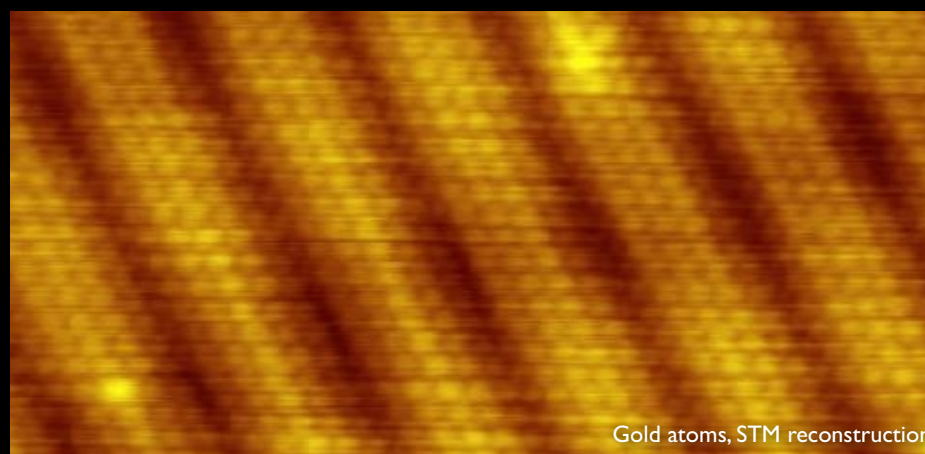
- Biology; the importance of weak bonds in biological processes
- Physics; the kinetic theory of matter
- Maths; using formulae

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



Gold atoms, STM reconstruction

Erwin Rossen / Public domain

Global citizenship, internationalism, local environment

- Highlight on the collaboration between scientists from different countries in order to establish theories and concepts
- The use of mass spectrometry amongst other analytical techniques at EPFL (possible field trip)

UNIT 2 - PHYSICAL CHEMISTRY

Content

- Enthalpy changes
- Exo / endothermic processes
- Standard enthalpy changes (formation & combustion)
- Direct & indirect determination of enthalpy changes
- Bond-making & bond-breaking
- Reaction rates
- Activation energy
- Boltzmann distribution
- Factors affecting rates
- Catalysts
- Reversible equilibrium
- LeChâtelier's principle
- Haber & Contact processes
- Equilibrium constant
- Brønsted-Lowry acids & bases
- Weak species
- Oxidation states
- Redox reactions, rusting
- Oxidising and reducing agents
- Electrolysis of brine
- Aluminium extraction
- Copper electrorefining

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- The shape of energy level diagrams with exothermic and endothermic reactions, including the intermediate state and the activation energy
- The shape of the Boltzmann distribution
- The conditions used in the Haber process and in the Contact process
- How to write an equilibrium constant for a given reaction
- The conditions required to perform electrolysis of brine, extraction of aluminium and electrorefining of copper

Students to Understand

- The effects of varying pressure, concentration, surface area, temperature and catalyst on the rate of a reaction
- The consequences the previously mentioned changes may have on the Boltzmann distribution
- How a dynamic equilibrium may be altered by changing concentrations, temperature or pressure
- The concept of a redox reaction and the behaviour of chemicals

Students to be able to Do

- Calculate enthalpy changes associated with formation and combustion of elements and compounds

Cross curricular links

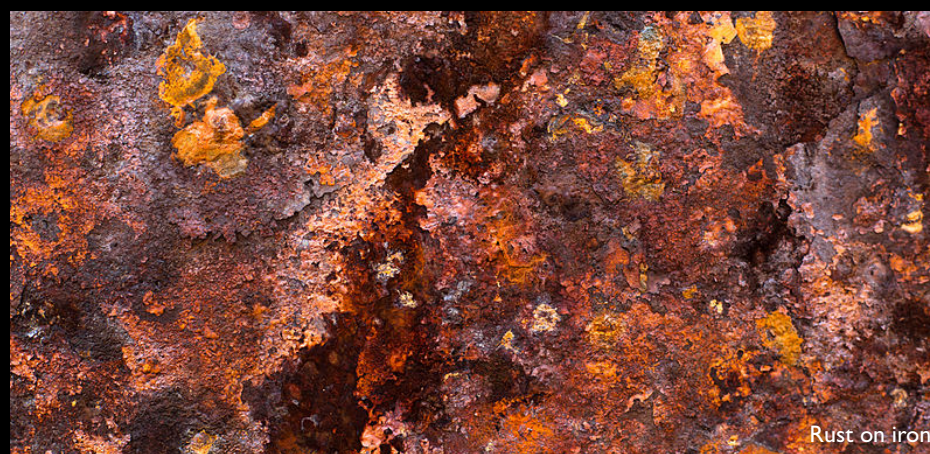
- Biology; the importance of enzymes, biological catalysts
- Physics; the kinetic theory of matter
- Maths; using formulae
- Economy; the cost of rust

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



Rust on iron

Laird Keiows / CC BY-SA 3.0

Global citizenship, internationalism, local environment

- Illustration of electrolysis process: aluminium production plant in Russia

UNIT 3 - ORGANIC CHEMISTRY I

Content

- Carbon compounds
- Types of formula
- Naming organic compounds
- Functional groups
- Isomerism (chain, positional, functional, geometrical, optical)
- Bond fission
- Percentage yield
- Alkanes
- Combustion, cracking, free radical substitution
- Alkenes
- Addition of steam, hydrogen chloride, bromine, hydrogen
- Addition polymerisation
- Oxidation of alkenes
- Addition polymerisation
- Halogenoalkanes
- Nucleophilic substitution
- Elimination reactions

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- Definitions of: hydrocarbon, functional group, homologous series, isomerism, cracking, free radical substitution, polymerisation
- The pathways connecting alkanes, alkenes, halogenoalkanes, alcohols, amines and cyanides in terms of reagents, catalysts and conditions

Students to Understand

- The reactions of alkenes (combustion, cracking, free radical substitution)
- The reactions of alkenes (addition, oxidation, polymerisation)
- The economical importance of alkenes and polymers
- The importance of anhydrous conditions in the hydrolysis of halogenoalkanes
- The consequences of altering the solvent when reacting a halogenoalkane with hydroxide ions

Students to be able to Do

- Identify functional groups and name organic chemicals when given a displayed or skeletal formula
- Recall the mechanism of the reactions of free radical substitution, addition, nucleophilic substitution and elimination

Cross curricular links

- Biology; biochemistry
- Economics; economical significance of the crude oil distillation and of its derived chemicals

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



The first 100% Brazilian oil platform, the P-51

Divulgação Petrobras / ABr / CC BY 3.0 BR

Global citizenship, internationalism, local environment

- Crude oil extraction: mention of the major petroleum exporting countries
- Images in the presentation are connected with different international locations for industrial processes of crude oil distillation or cracking
- Discussion about the uses of petroleum in Switzerland; connections with political issues
- Oil spills, environmental consequences

UNIT 4 - ORGANIC CHEMISTRY II

Content

- Alcohols
- Oxidation and substitution reactions
- Dehydration of alcohols
- Ester formation
- Characteristic test for alcohols
- Carbonyl compounds
- Reduction and oxidation
- Addition of hydrogen cyanide
- Characteristic tests for aldehydes and ketones

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- The pathways connecting alcohols, aldehydes, ketones, carboxylic acids, esters, amines and cyanides in terms of reagents, catalysts and conditions
- A reaction with cyanides is necessary in order to lengthen the carbon chain by one unit
- The characteristic tests for the aforementioned functional groups

Students to Understand

- The required setup when performing the oxidation of primary or secondary alcohols in order to reach a certain degree of oxidation
- The economical importance of the hydration of ethene

Students to be able to Do

- Identify functional groups and name organic chemicals when given a displayed or skeletal formula
- Recall the mechanism of the nucleophilic addition of hydrogen cyanide onto a carbonyl containing compound
- Connect with the previous unit

Cross curricular links

- Biology; biochemistry
- PSHE; consequences of alcohol consumption

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



Flaming cocktails

Nik Frey / CC BY 2.5

Global citizenship, internationalism, local environment

- Bioethanol and biofuels, the example of Brazil, advantages and drawbacks

UNIT 5 - INORGANIC CHEMISTRY

Content

- Chemical periodicity
- Trends in boiling points
- Trends in atomic radii
- Trends in first ionisation energies
- Period 3 elements: characteristics, oxides, chlorides
- Group II elements
- Calcium compounds
- Group VII elements
- Halogens as oxidising agents
- Halides as reducing agents
- Nitrogen & the Haber process
- Sulphur and the Contact process
- Pollutants in the atmosphere

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- The reasons why the periodic table is organised this way
- The trends in boiling points, atomic radii and first ionisation energies across a period or down a group
- The trends in reactivity of the elements in period 3, including the reactivity of their oxides and chlorides
- The uses of calcium compounds

Students to Understand

- How physical characteristics of a given elements may be deduced from its position in the periodic table
- How nitrogen and sulphur are obtained from nature
- How nitrogen and sulphur are used
- The redox properties of halogens and halides

Students to be able to Do

- Recall the characteristics of group II and group VII elements and compounds

Cross curricular links

- Biology; nitrogen cycle
- History & Geography; consequences of industrial processes developments on human activities

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



White Cliffs of Dover

Fanny / CC BY-SA 2.0

Global citizenship, internationalism, local environment

- Images in the presentation are connected to different local and international locations: White Cliffs of Dover; iron furnaces from Germany and China