

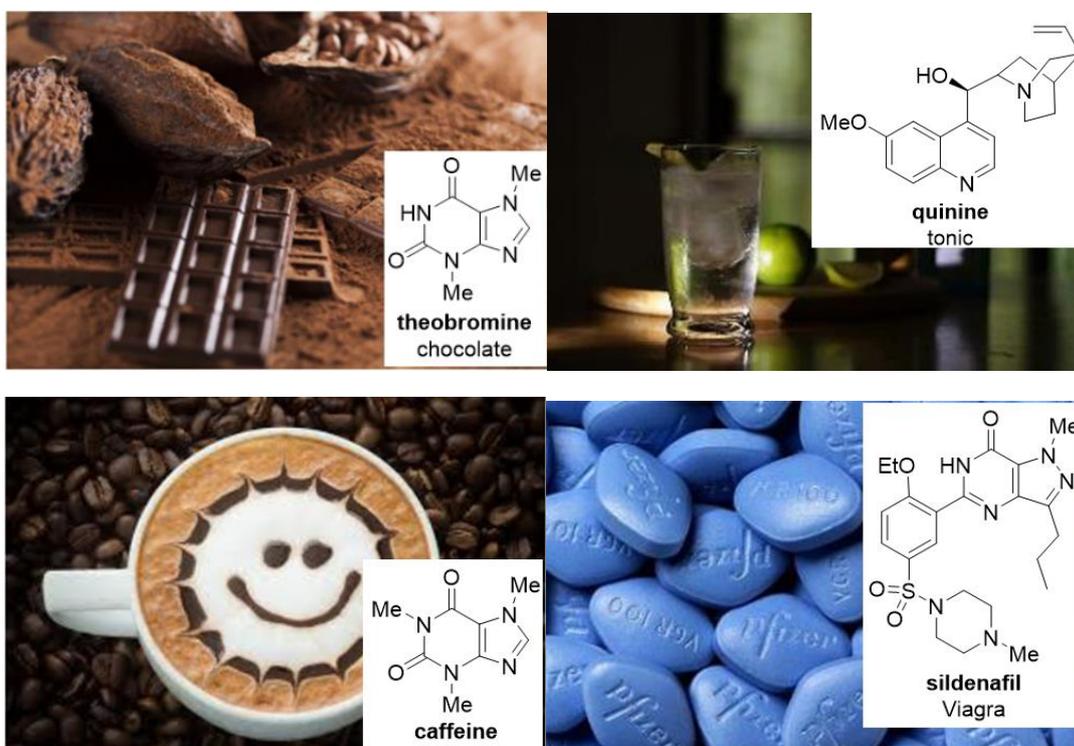
University of Nottingham

School of Chemistry

Synthesis and Spectroscopy

CHEM2010 (F12SAS)

Semester 1



Synthesis I (Aromatic and Heteroaromatic Chemistry)

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Spectroscopy

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## Introduction

These notes are intended to complement the lectures. They contain some, but **not all** of the material that you need. For example, you will need to annotate the notes by adding reaction mechanisms etc. Slide and lecture numbers are provided for easier navigation.

### Lectures

This year, lectures are in-person events again. Lecture recordings and supporting material (e.g. practice questions and solutions) will be provided on Moodle, but I strongly recommend you attend lectures and work through new material every week, so we can address questions or issues as early as possible and to avoid falling behind. This includes taking some time for independent study, where you work through the lecture material (e.g. by re-reading your notes, doing further reading in Clayden's Organic Chemistry on any topics that are unclear to you, and working through practise questions). A 10-credit course requires on average *100 hours of study* – including lectures, but also independent study!

### Tutorial timetable

Please check which tutorial group you are allocated to, and the timetable for that particular group. Your tutor should contact you with details of the tutorial, venue, etc.

## Preparation for Second Year

Not surprisingly, 2nd year chemistry is more advanced than 1st year, and many students find that it is a big step up. We will be building from foundations laid in 1st year, and therefore a modest amount of revision of these topics will mean that you start your 2nd year well prepared.

The following is a selection of material that you covered in 1st Year. There will not be time to go over all of this again in 2nd year lectures. ***Chemistry is NOT a modular subject where you can learn a topic just for the 1st year exams, and then forget it.***

To help your transition from 1st year, we start 2nd year Organic Chemistry with two topics that you are already very familiar with – spectroscopy and the chemistry of benzene. You should be familiar with all of the following topics without having to use your notes. Topics that are *particularly* relevant to the First Semester of CHEM2010 are highlighted in italics, and reference is made to the relevant 1st year lecture in Module CHEM1009 (F11ORG).

### General Organic Chemistry

- Identify and name functional groups (NJO lecture 2)
  - *e.g. alkenes, alkynes, halides, alcohols, amines, carboxylic acids, esters, amides, acid chlorides, nitriles.*
- Depict *mechanisms* and *resonance* forms using *curly arrows* (HWL lectures 1 & 3)
- Identify *nucleophilic* and *electrophilic* centres in molecules (HWL lectures 1 & 2), recognising polar bonds and inductive effects (NJO lecture 10)
  - use the  $\delta^+/\delta^-$  notation to help.
  - *explain substituent effects (resonance).*
- Understand and depict different mechanisms (HWL lectures 3-6) *including  $S_N1$  and  $S_N2$  substitutions, E2 eliminations*
- Carbonyl group chemistry
  - *nucleophilic addition to a C=O group* (RMD lectures 1 & 2)

- formation of imines/enamines from ketones plus amines (RMD lecture 4)
- keto-enol tautomerism (RMD lecture 5)
- acid chlorides as acylating agents, e.g. of amines to give amides (CJH lecture 6)

### **Benzene/Aromatic Chemistry**

You must be confident that you know and understand the following topics:

- the *electronic structure of benzene* (NJO lecture 9; HWL lecture 12)
- the concepts of delocalisation, conjugation and resonance (NJO lecture 9), electron-withdrawing and electron-donating groups, and how we depict these using “curly arrows”.

### **Spectroscopy (basics covered in CHEM 1011 (F11SEB))**

You must be confident that you know and understand the following topics:

- The EM spectrum, relationship between photon energy and frequency.
- Basic principles of absorption spectroscopy.
- UV – electronic transitions (seen in conjugated organic systems).
- IR – vibrational transitions (for organic functional group identification).
- NMR – nuclear spin (<sup>13</sup>C and <sup>1</sup>H – revealing chemical environment and connectivity)
- Chemical shift in NMR spectroscopy and significance in identifying organic structure.
- The significance structural significance of <sup>1</sup>H –<sup>1</sup>H coupling in NMR spectroscopy
- Interpretation of electron impact ionisation-mass spectrometry

### **Information for Synthesis I (Aromatic and Heteroaromatic Chemistry)**

#### **Resources**

The lecture course and tutorials contain all the information you require for the examination, however you may find the following resources useful:

#### **Textbook**

Clayden, *Organic Chemistry*, Oxford Uni. Press

Chapter numbers given on the lecture slides refer to edition 2, 2012.

#### **Online Resources**

Clayden, *Organic Chemistry*, Oxford Uni. Press (Ch. 7, 8, 21, 22, 29, 30)

<https://bibliu.com/app/#/view/books/9780192518545/epub/OEBPS/toc.html>

Interactive 3D animations visualising molecules, molecular orbitals and reactions:

<https://www.chemtube3d.com/>

Interactive 3D models of molecules: <https://qrchem.net/>

Interactive tool to practise mechanisms and curly arrows (RSC):

<http://www.rsc.org/learn-chemistry/resources/mechanism-inspector/investigations.html#/reaction/93/0>

Interactive tool to practise electron pushing and curly arrows (University of Ottawa):

<https://orgchem101.com/>

I hope you enjoy the course!

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