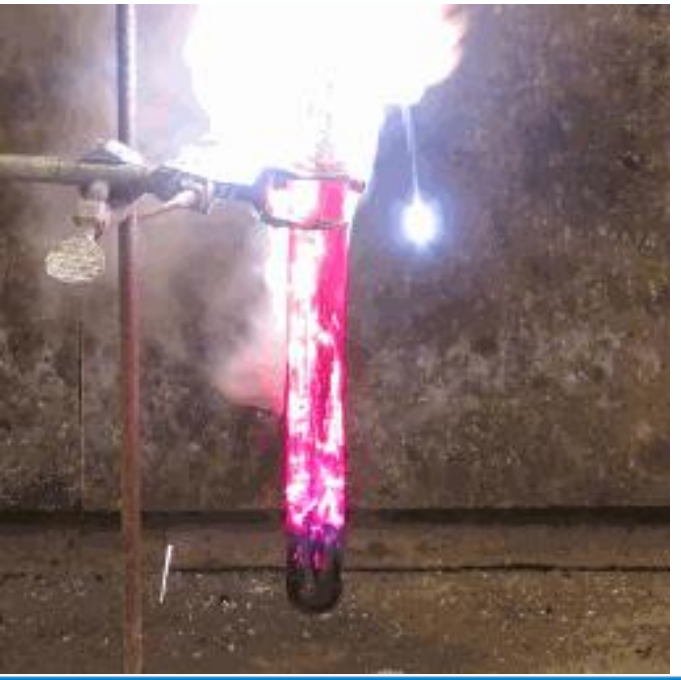
AP/IB Sciences In MCPS

IB Chemistry SL/HL

Mr. Chris Knocke (B-CC HS)



May 8th
Wootton High School

About Me:

- Finished first year teaching Standard Level this year (Exam on May 22/23)
- Worked with MCPS to confirm alignment of both levels to NGSS
- Proposed the offering of Higher Level at B-CC for the first time

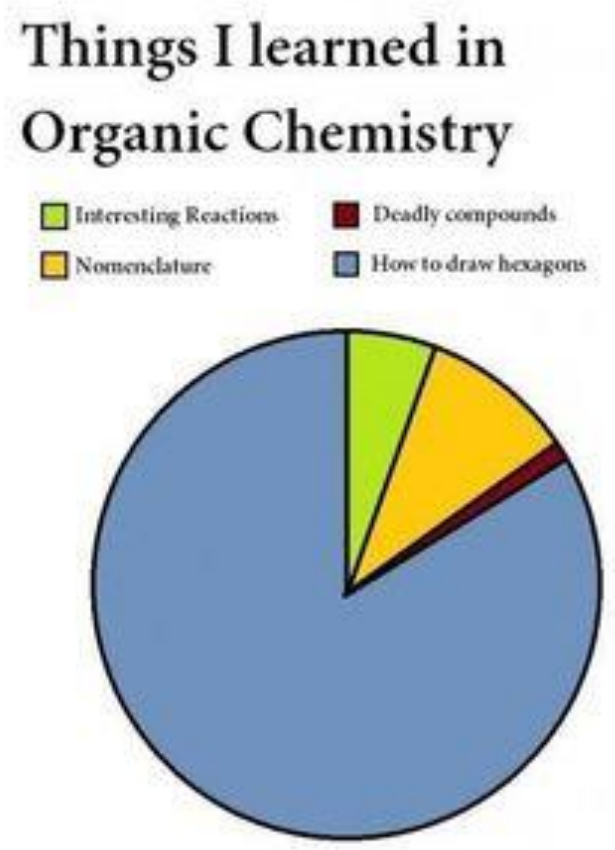
Learning Engagements:

- Overview of the IB Chemistry course
- Examine the pacing of the content in the course
- Laboratory and Scientific Practices IB Chemistry
- Internal Assessments (IA) and External Assessments (Papers 1, 2, & 3)

Overview of the IB Chemistry course

- SL - Standard Level - Equivalent to:
  - 1-2 semesters of General Chemistry
  - & Some Organic

- HL - Higher Level - Equivalent to:
  - 2 semesters of General Chemistry
  - 1 semester of Organic



Standard Level vs. Higher Level

The philosophy of the IB DP is that students should engage with a range of subjects while being able to explore specific areas of personal interest in greater depth.

- SL courses ensure students are exposed to a range of disciplines that they might otherwise opt out of, and
- HL courses allow students to spend more time with subjects they are more interested in by exploring options in addition to the SL core curriculum.
- In this sense, all DP courses, regardless of whether they are SL or HL, are integral to the programme

Standard Level vs. Higher Level

- SL and HL courses consist of the same educational aims, core syllabus and curriculum and assessment models.
- HL courses typically also include a range of additional elements designed to allow students to explore areas of interest within the subject in more depth. In this sense, SL courses are not watered down versions of their HL counterparts. The assessment criteria are equally demanding for both levels, and SL exams are marked and standardized with the same rigour as all IB coursework

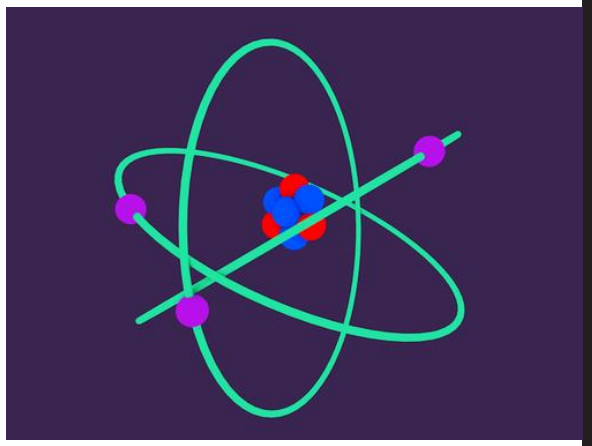
11 Core Topics - SL & HL levels

1: Stoichiometric Relationship (Chemical Reactions)

- Intro to nature of matter and chemical change
- The Mole Concept
- Reacting Masses and Volumes

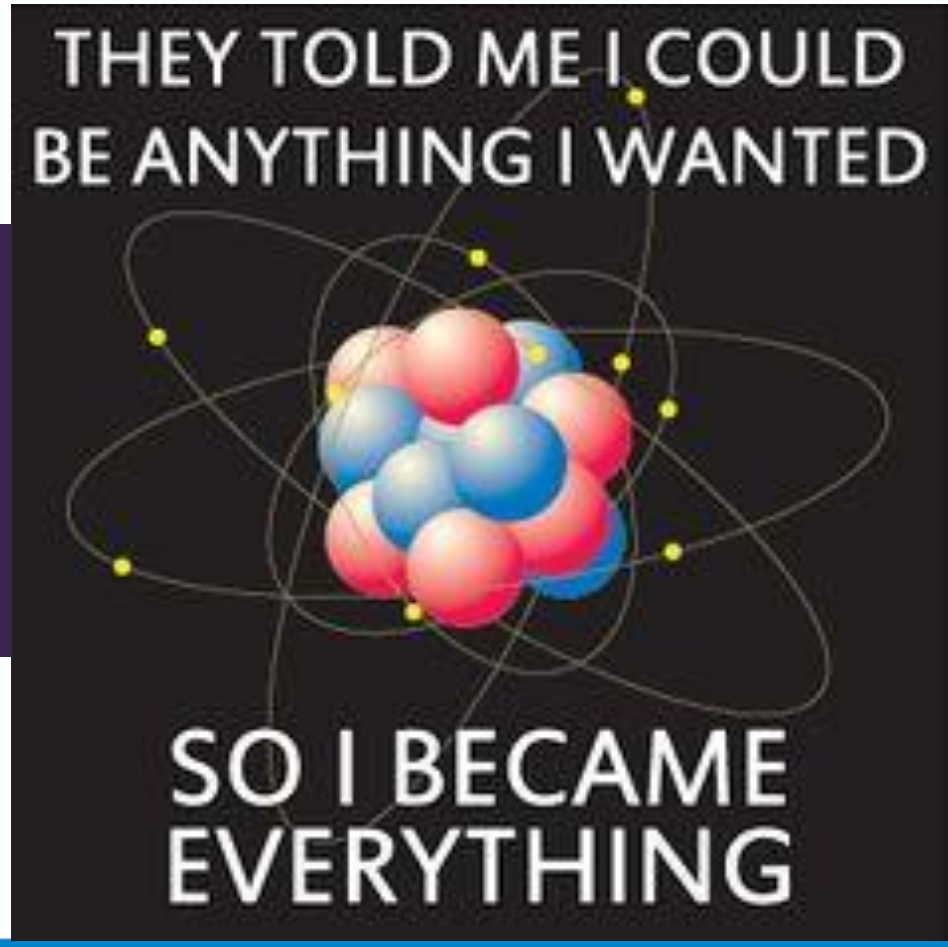
2: Atomic Structure

- The Nuclear Atom
- Electron Configurations
- (HL) Electrons in Atoms



3: Periodicity

- The Periodic Table
- Periodic Trends
- (HL) First Row D-Block Elements
- (HL) Coloured Complexes



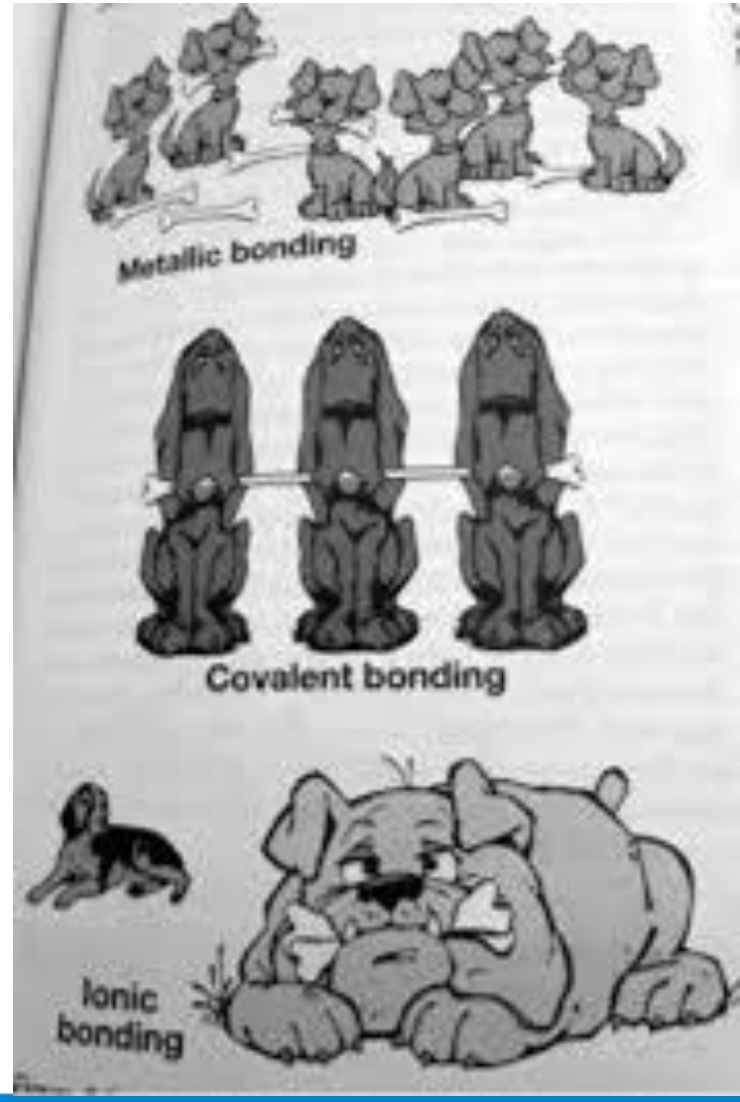
11 Core Topics - SL & HL

4: Chemical Bonding and Structure

- Ionic Bonding and Structure
- Covalent Bonding and structures
- Intermolecular Forces
- Metallic Bonding
- (HL) Further Aspects of covalent bonding
- (HL) Hybridization

5. Energetics/Thermochemistry

- Measuring Energy Changes
- Hess' Law
- Bond Enthalpy
- (HL) Energy Cycles
- (HL) Entropy and Spontaneity



11 Core Topics - SL & HL

6. Chemical Kinetics

- Collision Theory and Reaction Rates
- (HL) Rate Expressions and Mechanisms
- (HL)Activation Energy

7. Chemical Equilibrium

- Equilibrium
- (HL) The Equilibrium Law

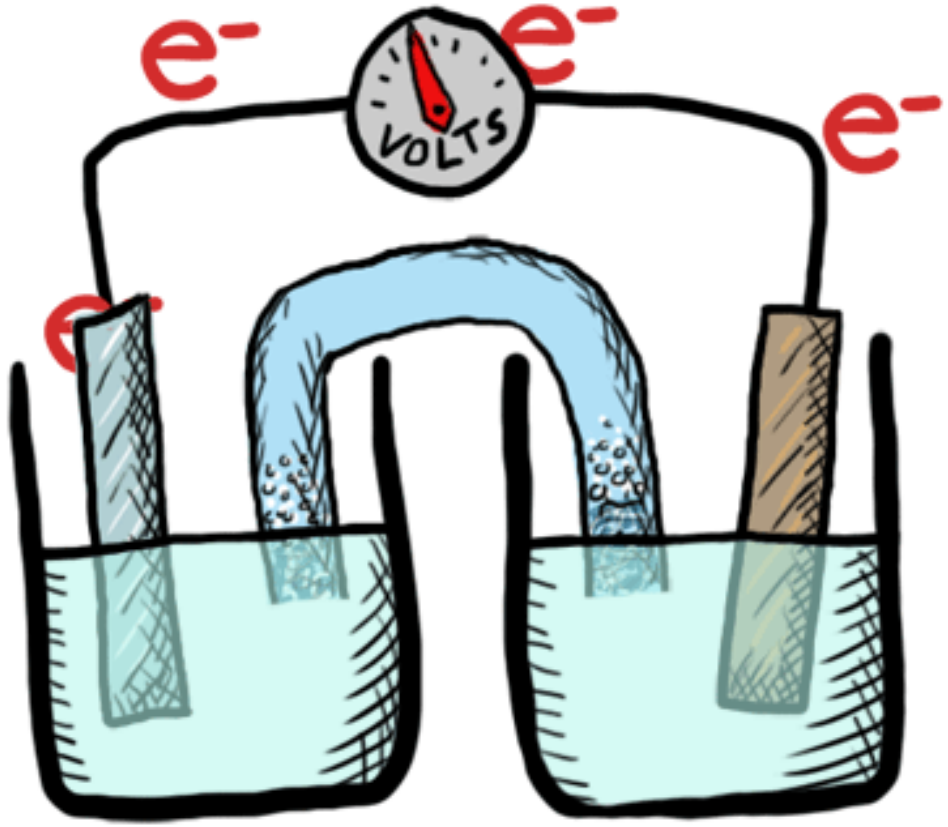
11 Core Topics - SL & HL

8: Acids and Bases

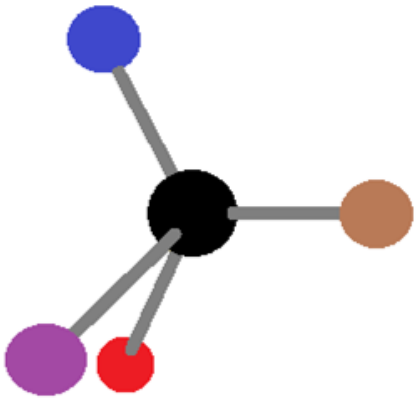
- Acid Base Theory and Properties
- pH Scale
- Strong/Weak Acids
- Acid Deposition
- (HL) Lewis Acids
- (HL) Acid Base Calculations
- (HL) Titration Curves

9: Redox Processes

- Oxidation and Reduction
- Electrochemical Cells
- (AHL) Electrochemical Cell Calculations



11 Core Topics - SL & HL



10: Organic Chemistry

- Fundamentals of Organic Chemistry
- Functional Group Chemistry
- (HL) Types of Organic Reactions
- (HL) Synthetic Routes
- (HL) Stereoisomerism

11: Measurement and Data Processing

- Uncertainties and errors in data and results
- Graphical Techniques
- Spectroscopic identification of organic compounds
- (HL) Further spectroscopy

Options (Each Class chooses 1, Students may self-study)

A: Materials Science (Interesting, Relevant field of Chemistry/Engineering)

- Metals, Catalysts, Liquid Crystals, Polymers, Nanotechnology, Plastics,
- (HL) Superconductors, Condensation Polymer, and Heavy Metals

B: Biochemistry (Good for students also in IB Biology)

- Proteins, Enzymes, Lipids, Carbohydrates, Vitamins, Environment
- (HL) Further Proteins/Enzymes, Nucleic Acids, Pigments, Stereochemistry

C: Energy (Good for students also in IB Physics)

- Energy Sources, Fossil Fuels, Nuclear Fusion/Fission, Global Warming
- (HL) Rechargeable Batteries & Fuel Cells, Further Nuclear, Solar Cells

D: Medicinal Chemistry (High interest topic)

- Pharmaceuticals, Aspirin, Penicillin, Opiates, Antacids, Antivirals, Environment
- (HL) Taxol (Chriality), Nuclear Medicine, Drug Detection/Analysis

Pacing of the content in the course

1 Year Standard Level example:

- **Semester 1**
  - Chemistry Basics (Atoms, Periodic Table, Bonding, Reactions)
  - Redox Chemistry
  - Organic Chemistry
- **Semester 2**
  - Thermochemistry
  - Kinetics & Equilibrium
  - Acids
  - Option

Pacing of the content in the course

2 year Standard or Higher Level example:

- **Semester 1**
  - Chemistry Basics (Atoms, Periodic Table, Bonding, Reactions)
  - Energy
- **Semester 2**
  - Kinetics
  - Equilibrium
  - Acids
- **Semester 3**
  - Redox Processes
  - Organic Chemistry
- **Semester 4**
  - Option & Review

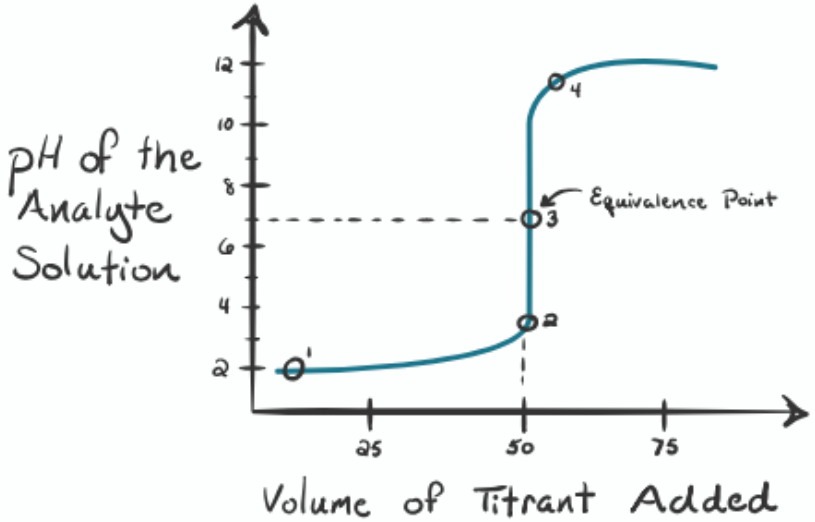
Overview of Labs

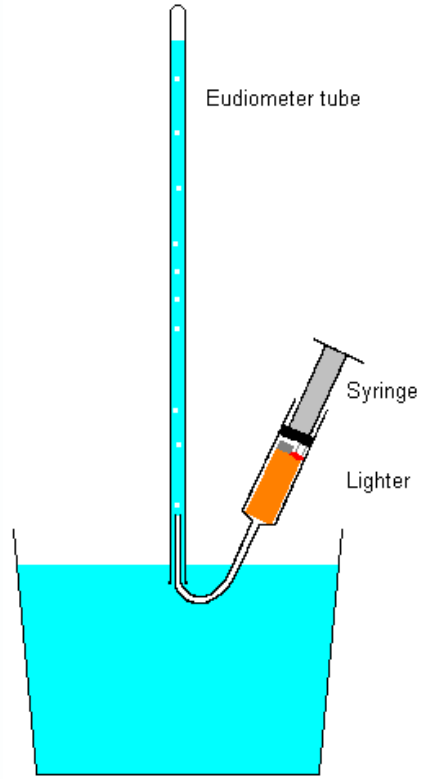
- 9 "required" lab skills built into the course
  - Labs are modeled to be like mini-Internal Investigations
  - Helps students improve their scientific communication and data processing skills
- Teachers may substitute similar activities

Lab Overview

Topic 1: Stoichiometric Relationships

1. Empirical Formula from Mass Change
2. Molar Mass of Gasses
3. Acid-Base Titrations (Also Topic 8)

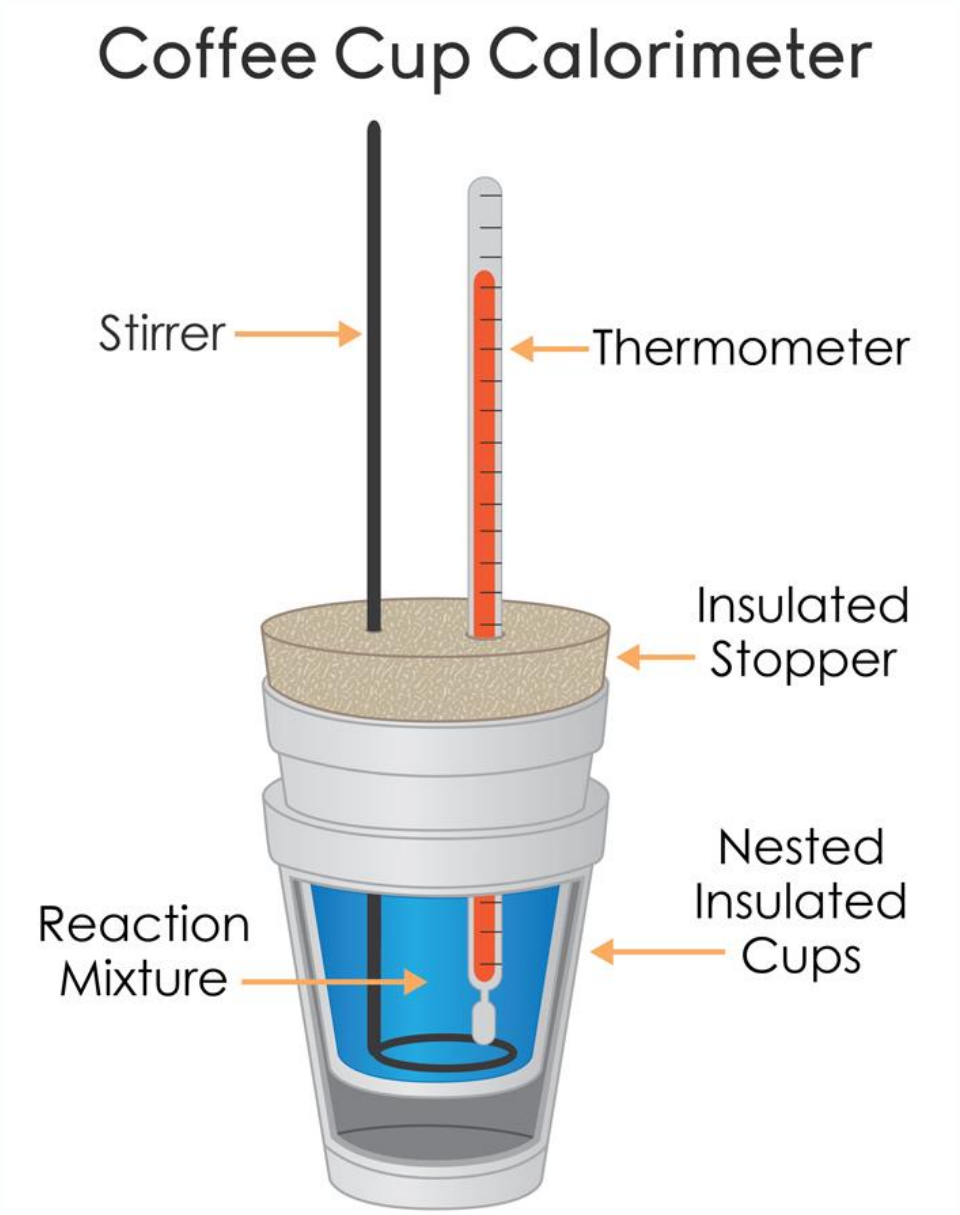




Lab Overview

Topic 5: Thermochemistry

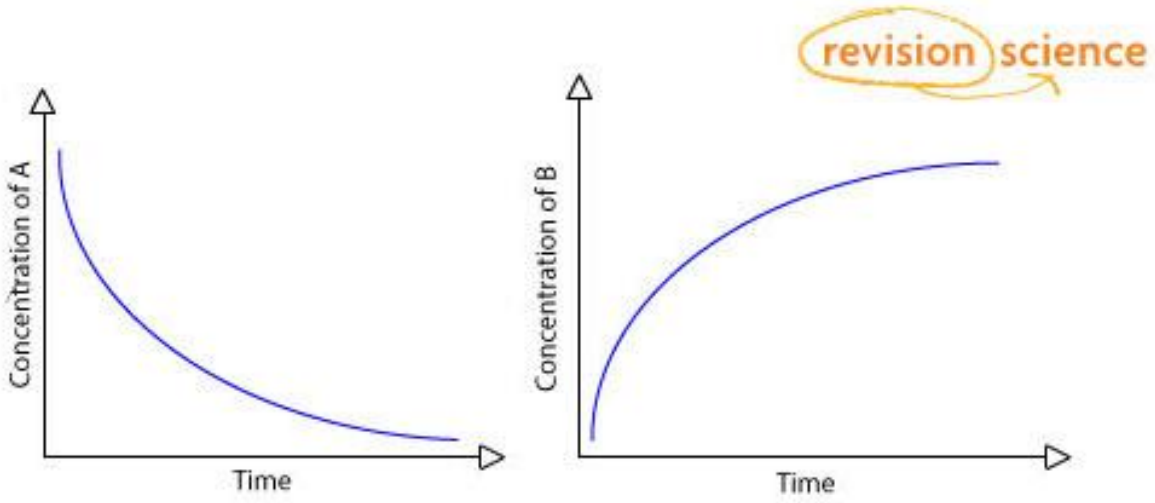
1. Determine Enthalpy from Calorimeter

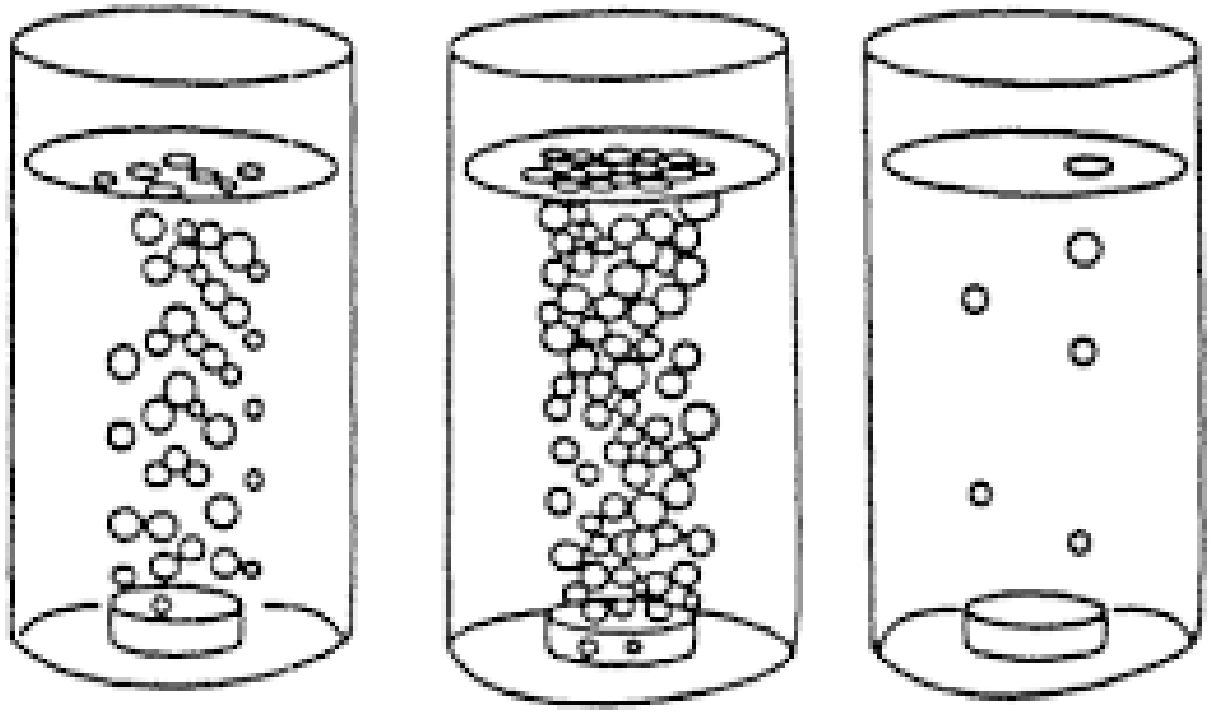


Lab Overview

Topic 6: Kinetics

1. Reaction Rates

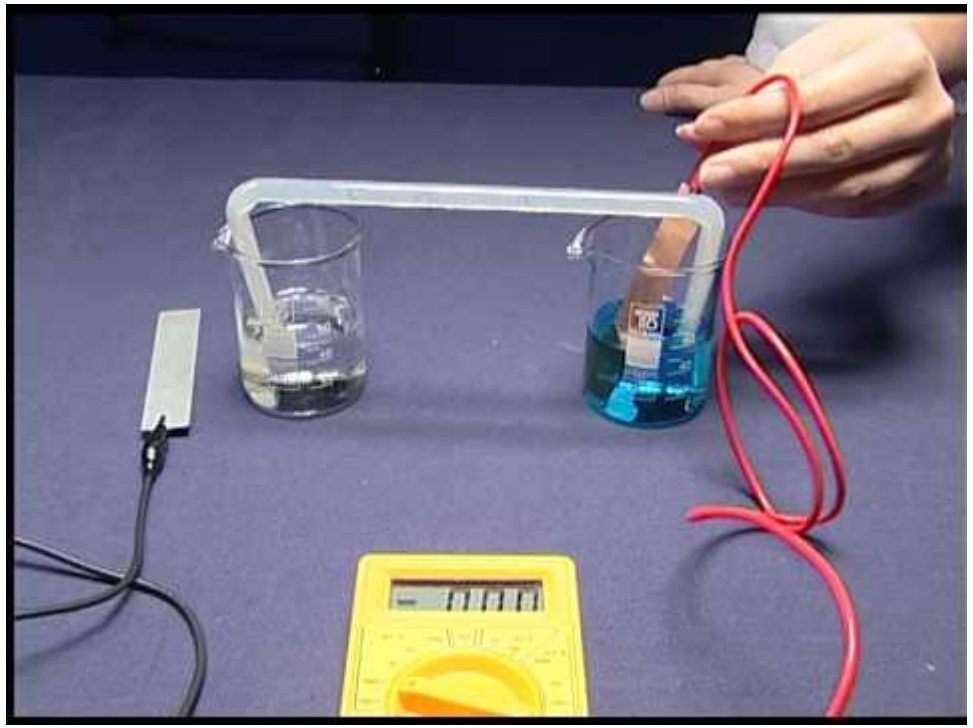


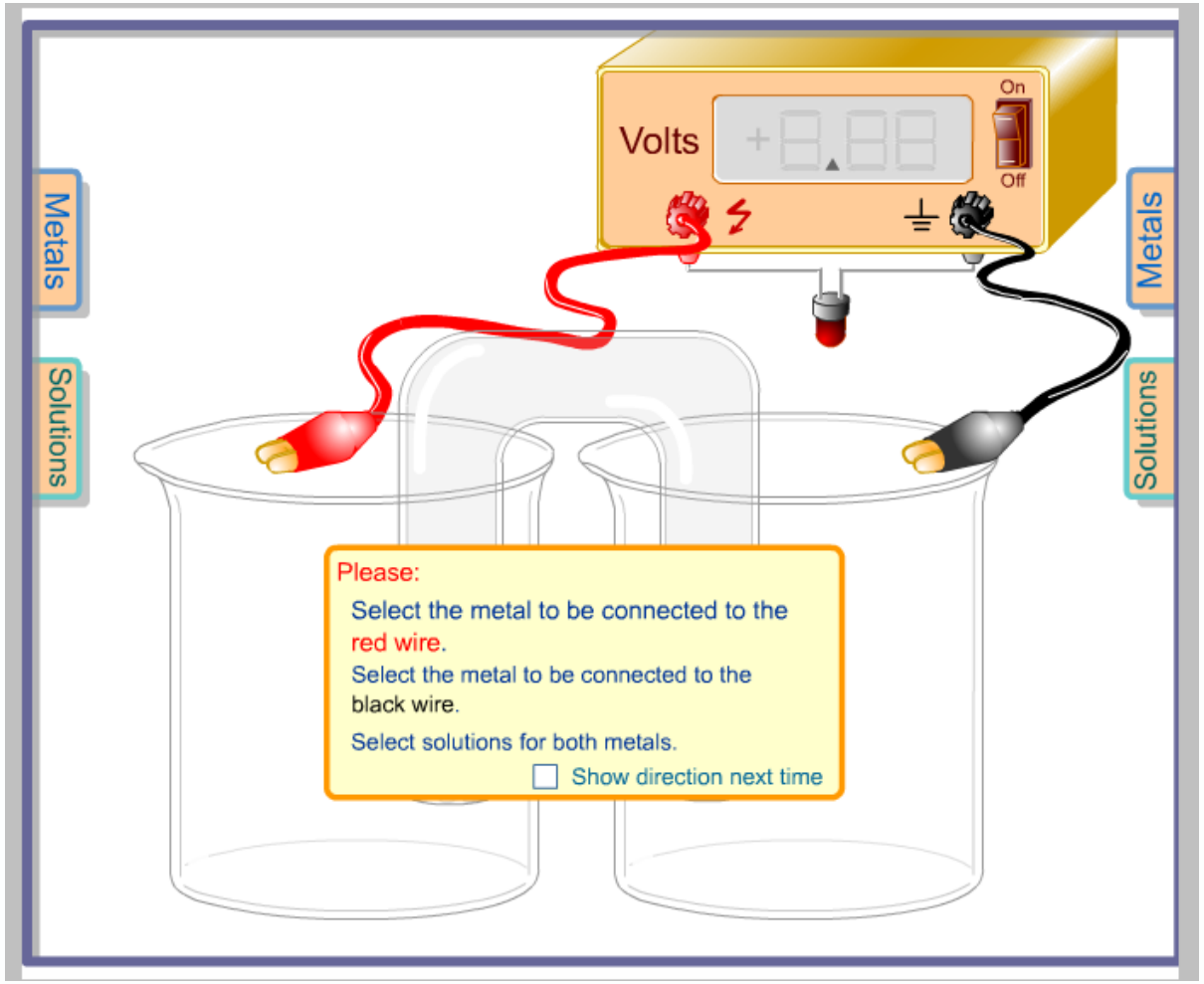


Lab Overview

Topic 9: Redox

1. Voltaic Cells

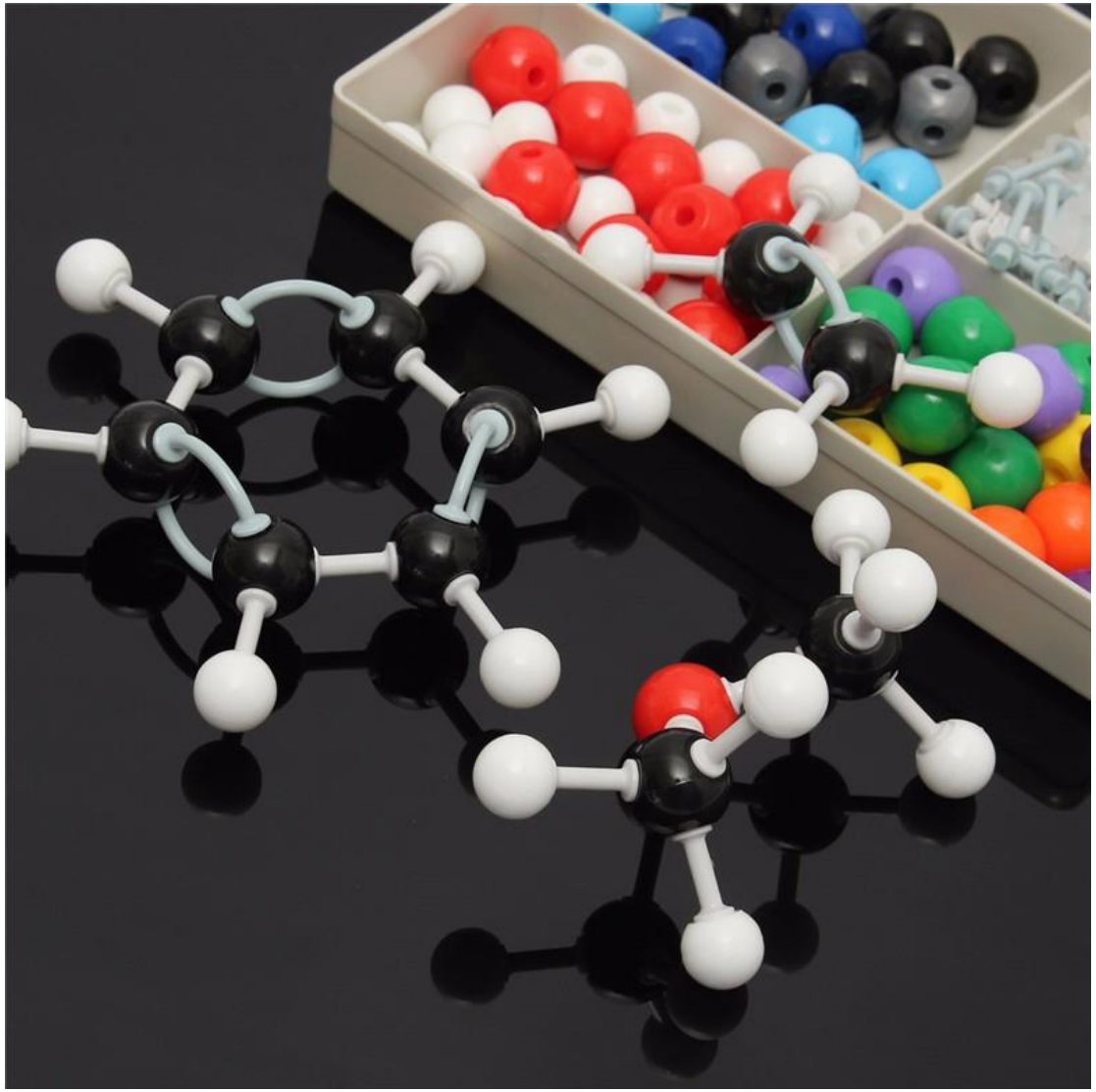




Lab Overview

Topic 10: Organic Chemistry

1.3-D Modeling



Internal and External Assessments

1. Group 4 Project - Interdisciplinary Problem Based Project done with other Group 4 Science students (Bio, Physics, SEHS)

1. Internal Assessment (Worth 20% of final grade)
   a. An Independent Investigation performed by the students. A formal Lab report is written up and marked by teacher. The marking is moderated by IB

Sample G4P

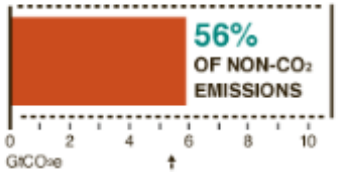
SUSTAINABLE EATING

Keeping an Eco-Friendly Diet

Background

- Every year, each American consumes nearly 1 ton of food all throughout the year.
- In order to obtain this food, it must be grown and unfortunately, a lot of energy (often non-sustainable) is needed to grow and produce food at the rapid rate necessary for the demands of the nation.
- Agriculture makes up 30% of the world's greenhouse gas emissions.
- 1 calorie of animal protein needs 11 times more fossil energy than 1 calorie of plant protein.
- A study in the UK recently showed that food systems account for 18-20% of UK annual greenhouse gas emissions (GHGEs).
- As climate change grows as a global issue, solutions must be found in order to reduce the effects, while at the same time recommendations for improving food choices to reduce GHGEs must be balanced against dietary requirements for health.

Agriculture is the largest contributor of non-CO_2 GHGs.



Impact of Food Production on the Environment

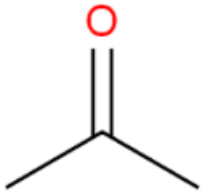
- Natural habitats and ecosystems are also destroyed in the process of clearing more land for agricultural purposes. This is turn, causes a decline in wildlife species populations.
- Deforestation leads to the removal of major carbon sinks that remove greenhouse gases from the atmosphere.
- As foods are grown, artificial herbicides and pesticides are used, which can be toxic to organisms in surrounding areas and pollute the atmosphere.
- Farming is also responsible for the release of methane (a major greenhouse gas) from the production of livestock animals. Livestock animals also require large amounts of water and other plant-based resources.
- The transportation of the food itself is also extremely unsustainable, using large amounts of fossil fuels.

Sample IA

How Changing Acetone Measurement Affects the Ability of Acetone to Absorb Orange Light

Introduction

The inspiration for this lab came from the fascination I experienced while learning about alcohol oxidation reactions in class combined with my appreciation for the science I learn in school being applied to everyday life. After researching, I realized that an everyday application of the oxidation reactions I have learned about in class are breathalyzer tests. Once I realized I was interested in mimicking a breathalyzer test reaction, I had to find a question. After further investigation I discovered that many people with diabetes, who have high levels of acetone in their breath, read wrongfully positive on a breathalyzer test [4]. This information puzzled me, as I know that all people have some amount of acetone in their breath naturally, and I wondered how much more acetone hypoglycemia could possibly produce in the mouths of diabetics.



[1]

Background Information

Standard Oxidation

Propanone, typically called acetone, is a ketone, meaning that it is a simple organic molecule with a carbonyl group [3]. Under normal circumstances, acetone is unable to undergo oxidation reactions because it is not an alcohol, as its oxygen atom is double bonded to the central carbon. In a standard oxidation reaction, the alcohol, either primary or secondary, is catalyzed with acidified dichromate, an orange acidic solution, and undergoes a redox reaction in which the alcohol acts as the reducing agent and oxidizes, causing the solution to transition from

Internal and External Assessments

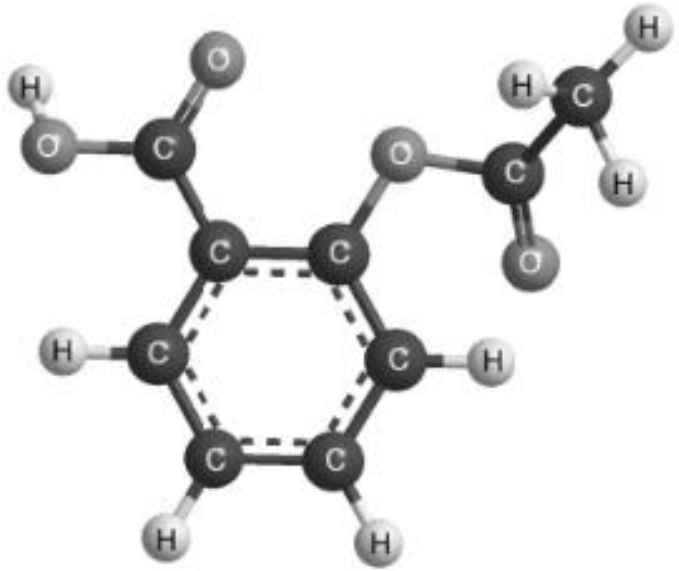
1. Paper 1 (External - worth 20% of final grade)
    a. Multiple Choice Examination on Core 11 topics
    b. 30 Q for SL - 45 mins -- 40 Q HL -60 mins

1. Paper 2 (External - worth 36 [HL] - 40%[SL] of final grade)
    i. Short and Extended Response Questions on Core 11 Topics -
    ii. SL - 75 mins -- HL - 135 mins

1. Paper 3 (External - worth 20[SL] - 24%[HL] of final grade)
    a. Short and Extended Response Questions on:
        i. Data/Lab Practical Based questions - All students must answer
        ii. Option Topics - Students pick one option and answer questions related to that option

Sample Paper 1

25. What are the functional groups in the aspirin molecule?



I. Ether
II. Carboxyl
III. Ester

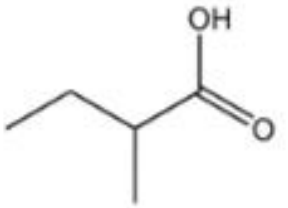
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

26. What is the name of the compound with this molecular structure applying IUPAC rules?



A. 1-methylpropanoic acid

B. 2-methylpropanoic acid

C. 2-methylbutanoic acid

D. 3-methylbutanoic acid

Sample Paper 2

(ii) Explain why an aluminium-titanium alloy is harder than pure aluminium. [2]

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(ii) A chloride of titanium, $TiCl_4$, melts at 248 K. Suggest why the melting point is so much lower than that of KCl. [1]

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(f) $TiCl_4$ reacts with water and the resulting titanium(IV) oxide can be used as a smoke screen.

(i) Formulate an equation for this reaction. [2]

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(Question 2 continued)

(ii) Suggest **one** disadvantage of using this smoke in an enclosed space.

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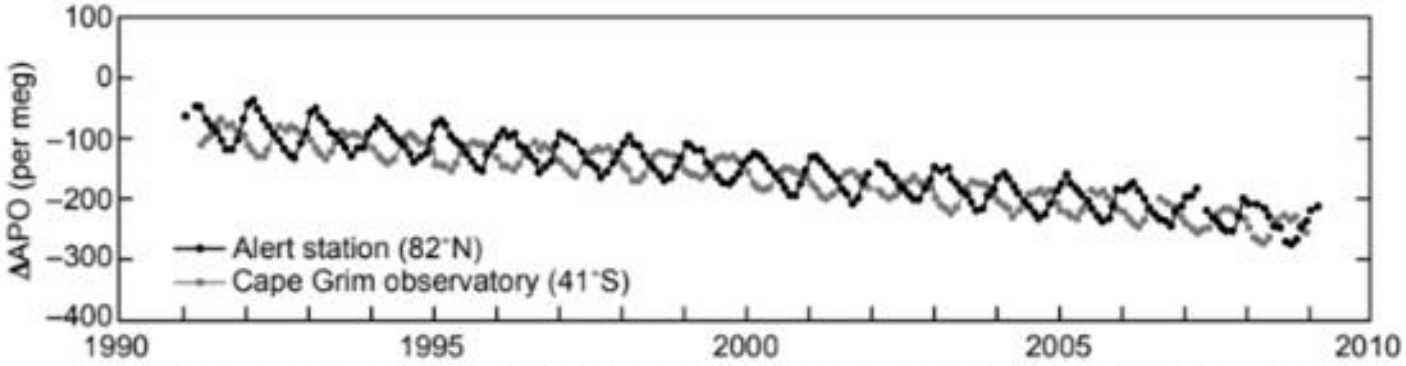
Sample Paper 3 - Section A

(Question 1 continued)

(c) Climate induced changes in the ocean can be studied using measurements such as the Atmospheric Potential Oxygen (APO). Trends in APO concentration from two stations, one in each hemisphere, are shown below.



Trends in atmospheric potential oxygen (APO) based on monthly averages between 1990 and 2010.

[Source: www.ioos.noaa.gov]

(i) The equilibrium expression for O_2 exchange between the atmosphere and ocean is $O_2(g) \rightleftharpoons O_2(aq)$. Identify **one** factor which shifts the equilibrium to the right. [1]

.....

.....

(ii) Factors such as photosynthesis and respiration are excluded so that APO is influenced by oceanic changes only. Suggest why the seasonal cycles from Alert station and Cape Grim observatory are different. [2]

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Sample Paper 3 - Section B

16. The structures of morphine, diamorphine and codeine are given in section 37 of the data booklet.

(a) Explain why diamorphine passes more readily than morphine through the blood-brain barrier. [2]

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(b) Suggest a reagent used to prepare diamorphine from morphine. [1]

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(c) Suggest **one** reason why codeine is available without prescription in some countries whilst morphine is administered under strict medical supervision. [1]

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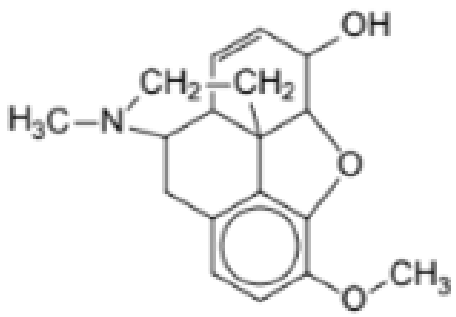
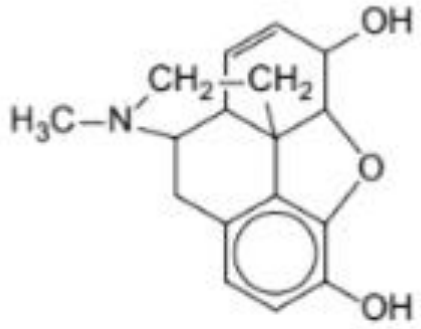
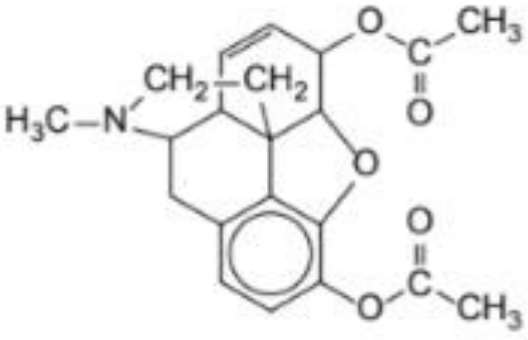


codeine



morphine



diamorphine (heroin)

Credit Equivalency - Local Schools

Most Schools offer credit for a 6 or 7 on the HIGHER LEVEL Examination
Some offer credit for the standard level exam

UMCP

Chemistry	Chemistry	Standard (SL)	5	CHEM131 *and* CHEM132	3 1	DSNL
			6, 7	CHEM131 *and* CHEM132 *and* CHEM271	3 1 2	DSNL None
		Higher (HL)	5	CHEM131 *and* CHEM132	3 1	DSNL
			6, 7	CHEM131 *and* CHEM132 *and* CHEM271	3 1 2	DSNL None

UMBC

Chemistry	Higher	6,7	4	CHEM 101

Towson SL

Chemistry	CHEM 131	Core 7	3

HL

Chemistry	CHEM 131	Core 7	4
	CHEM 132	Core 8	4

Final Thoughts

The skills and processes approach to IB Chemistry is excellent preparation for:

- College courses, particularly STEM courses,
- The MISA,
- Any course or career that requires effective communication and analytic skills. (an IB Learner)

Questions?

Index Card:

please include your contact info

Online form:

Type the link in your browser or scan the QR code

bit.ly/SciNight19

For more information on enrolling your student in this course, please contact the Counselor and/or the Science Department Resource Teacher at your high school.