Sharing on Pedagogy and Curriculum planning

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Agenda

1. Challenge for teaching NSS Chemistry
2. Planning for chemistry curriculum
3. Pedagogy of NSS chemistry
4. Resources for teaching chemistry

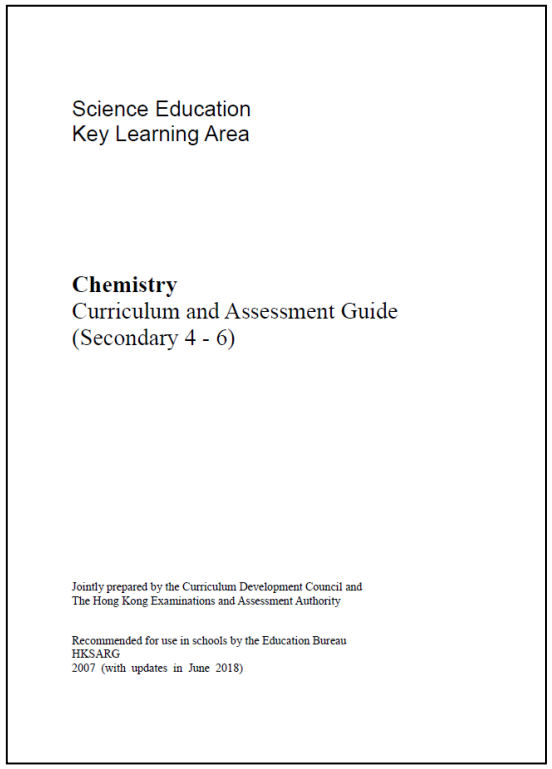
1.Challenge for teaching NSS Chem

- Learners' basic knowledge
- Cater for learners' diversity
- Motivate students to learn
- Lack of sufficient lesson time

NSS Chemistry - 3 years curriculum

- How to increase students motivation to learn in this 3 years with huge and difficult contents
- How to cater for different ability students

2. Planning for chemistry curriculum



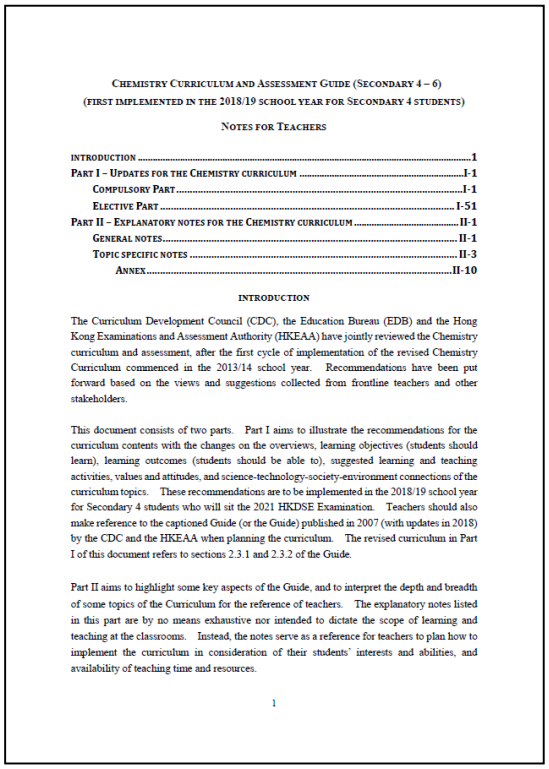
Science Education
Key Learning Area

Chemistry
Curriculum and Assessment Guide
(Secondary 4 - 6)

Jointly prepared by the Curriculum Development Council and
The Hong Kong Examinations and Assessment Authority

Recommended for use in schools by the Education Bureau
HKSARG
2007 (with updates in June 2018)

C and A guide



CHEMISTRY CURRICULUM AND ASSESSMENT GUIDE (SECONDARY 4 – 6)
(FIRST IMPLEMENTED IN THE 2018/19 SCHOOL YEAR FOR SECONDARY 4 STUDENTS)

NOTES FOR TEACHERS

INTRODUCTION 1
PART I – UPDATES FOR THE CHEMISTRY CURRICULUM I-1
COMPULSORY PART I-1
ELECTIVE PART I-51
PART II – EXPLANATORY NOTES FOR THE CHEMISTRY CURRICULUM II-1
GENERAL NOTES II-1
TOPIC SPECIFIC NOTES II-3
ANNEX II-10

INTRODUCTION

The Curriculum Development Council (CDC), the Education Bureau (EDB) and the Hong Kong Examinations and Assessment Authority (HKEAA) have jointly reviewed the Chemistry curriculum and assessment, after the first cycle of implementation of the revised Chemistry Curriculum commenced in the 2013/14 school year. Recommendations have been put forward based on the views and suggestions collected from frontline teachers and other stakeholders.

This document consists of two parts. Part I aims to illustrate the recommendations for the curriculum contents with the changes on the overviews, learning objectives (students should learn), learning outcomes (students should be able to), suggested learning and teaching activities, values and attitudes, and science-technology-society-environment connections of the curriculum topics. These recommendations are to be implemented in the 2018/19 school year for Secondary 4 students who will sit the 2021 HKDSE Examination. Teachers should also make reference to the captioned Guide (or the Guide) published in 2007 (with updates in 2018) by the CDC and the HKEAA when planning the curriculum. The revised curriculum in Part I of this document refers to sections 2.3.1 and 2.3.2 of the Guide.

Part II aims to highlight some key aspects of the Guide, and to interpret the depth and breadth of some topics of the Curriculum for the reference of teachers. The explanatory notes listed in this part are by no means exhaustive nor intended to dictate the scope of learning and teaching at the classrooms. Instead, the notes serve as a reference for teachers to plan how to implement the curriculum in consideration of their students' interests and abilities, and availability of teaching time and resources.

1

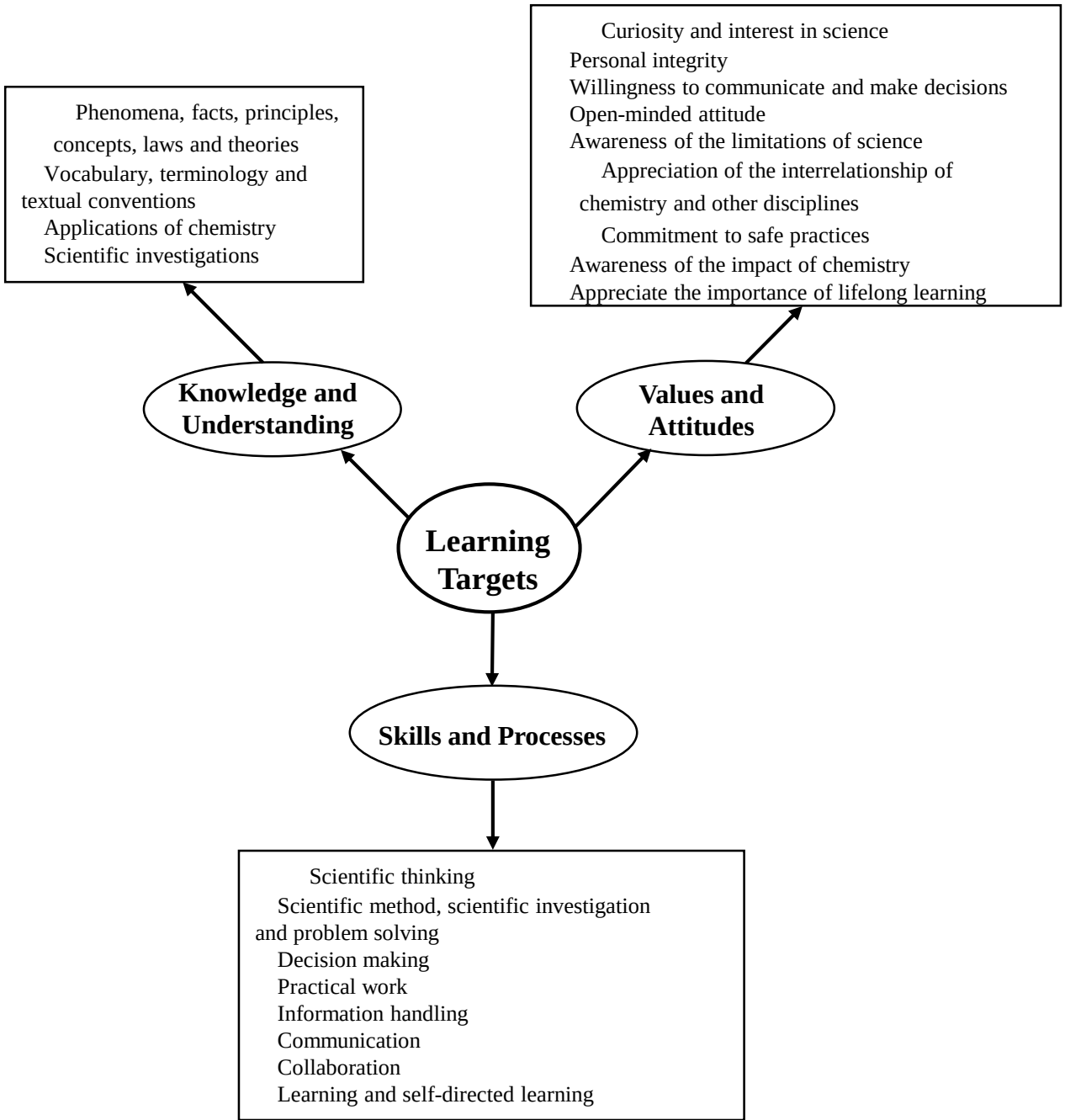
Supplementary notes

Chemistry Book Publisher

Relationship between S.1-3 Science and NSS chemistry

Science (S1-3)		Chemistry	
Unit		**Topic**	
2.1	The water cycle	I.	Planet earth
2.2	Dissolving		
2.3	Water purification		
2.4	Further treatment of drinking water		
5.3	Energy sources	V.	Fossil fuels and carbon compounds
6.1	Particle theory	II. VI.	Microscopic world I Microscopic world II
6.2	Particle model for the three states of matter		
6.3	Dissolving		
7.5	Balance of carbon dioxide and oxygen in Nature	I.	Planet earth
7.6	Air quality	XV.	Analytical chemistry
9.1	Common acids and alkalis	IV.	Acids and bases
9.2	Measuring pH for acids and alkalis		
9.3	Neutralisation		
9.4	Corrosive nature of acids		
9.5	Potential hazards related to the use of acids and alkalis		
13.1	Atoms and elements	II.	Microscopic world I
13.2	Periodic Table		
13.3	Mixtures and compounds	I.	Planet earth
13.4	Metals	III.	Metals
13.5	Materials of the modern world	V. XI. XIV.	Fossil fuels and carbon compounds Chemistry of carbon compounds Materials chemistry

Important learning targets of the curriculum



Proposed teaching sequence from C&A guide

Year	Sequence I	Sequence II	Sequence III
S4	Planet earth ⇩ Microscopic world I ⇩ Metals ⇩ Acids and bases ⇩ Fossil fuels and carbon compounds	Planet earth ⇩ Microscopic world I ⇩ Metals ⇩ Acids and bases ⇩ Chemical reactions and energy	Planet earth ⇩ Microscopic world I ⇩ Microscopic world II ⇩ Metals ⇩ Acids and bases
S5	⇩ Microscopic world II ⇩ Redox reactions, chemical cells and electrolysis ⇩ Chemical reactions and energy ⇩ Rate of reaction ⇩ Chemical equilibrium ⇩ Chemistry of carbon compounds ⇩ Patterns in the chemical world	⇩ Rate of reaction ⇩ Redox reactions, chemical cells and electrolysis ⇩ Microscopic world II ⇩ Fossil fuels and carbon compounds ⇩ Chemistry of carbon compounds ⇩ Chemical equilibrium ⇩ Patterns in the chemical world	⇩ Redox reactions, chemical cells and electrolysis ⇩ Fossil fuels and carbon compounds ⇩ Chemistry of carbon compounds ⇩ Chemical reactions and energy ⇩ Rate of reaction ⇩ Chemical equilibrium ⇩ Patterns in the chemical world

Planning of Chemistry Teaching sequences in HSS

S4

I. Planet earth

II. Microscopic World I

III. Metals

IV. Acids and bases

VII. Redox reactions, chemical cells and electrolysis

S5

VI. Microscopic world II

VIII. Chemical reactions and energy

IX. Rate of reaction

V. Fossil fuels and carbon compounds

XI. Chemistry of carbon compounds

XIII. Industrial chemistry

S6

X. Chemical equilibrium

XII. Patterns in the chemical world

XV. Analytical chemistry

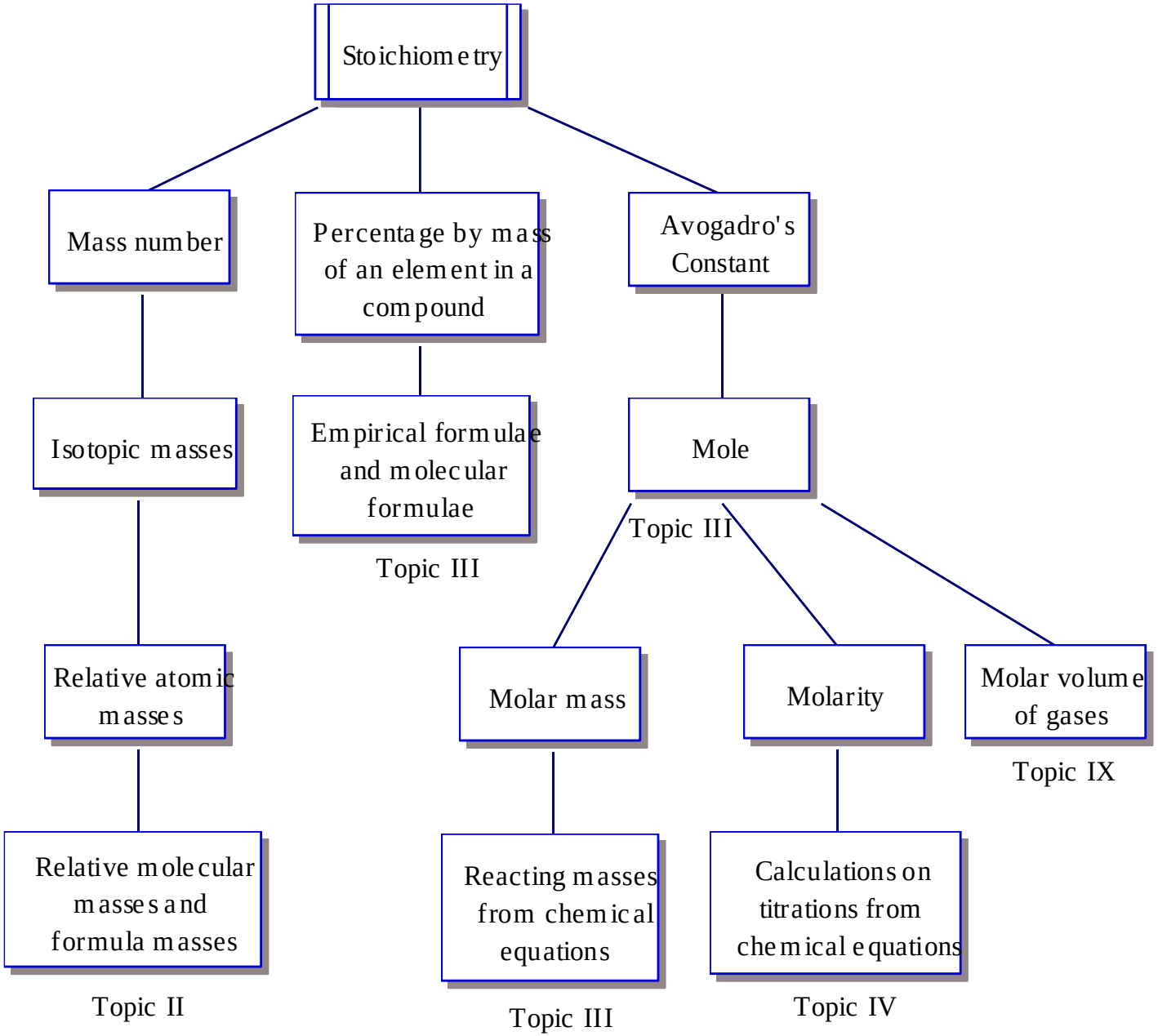
Point to note for planning

- Avoid learning too much abstract concepts in a short time (MWI and MWII)
- Teach basic chemistry concepts in S.4
- Spend more time on Compulsory part
- Learn in spiral way to improve learning efficiency

Basic Chemistry Topics

- II. Microscopic world I* (21 hours)
- III. Metals* (22 hours)
- IV. Acids and bases* (25 hours)
- VII. Redox reactions, chemical cells and electrolysis* (23 hours)

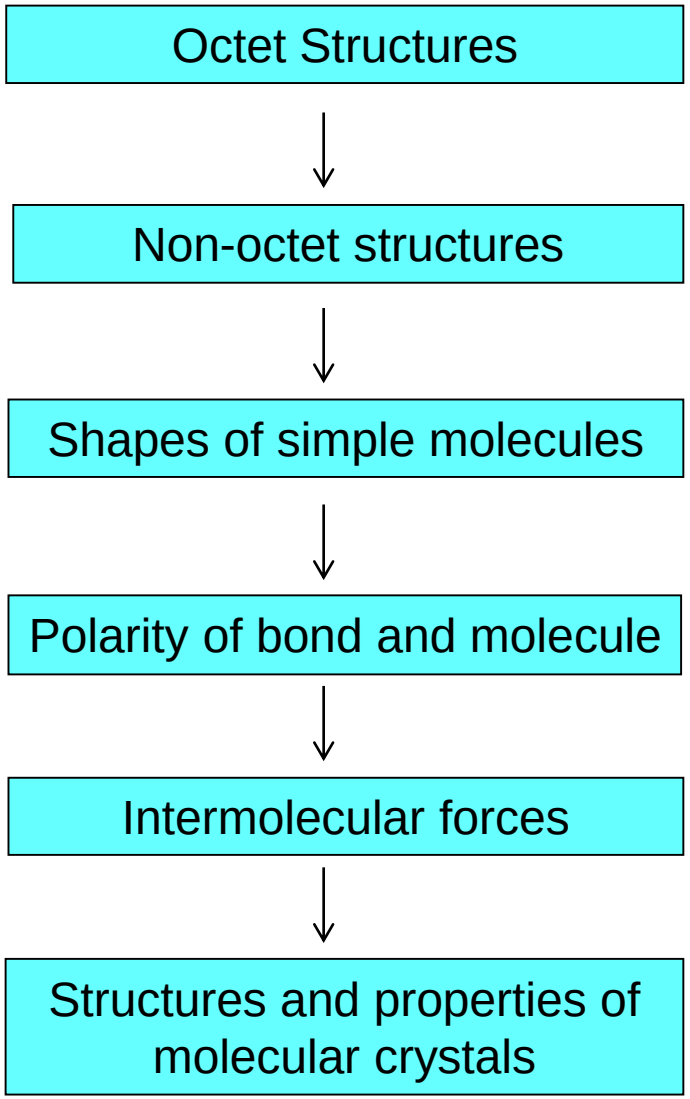
Spiral Learning of mole concepts in different topics



Microscopic World II

Students should learn	**Students should be able to**
a. Polarity of bond and molecule	•define the electronegativity of an atom •describe the general trends in the electronegativities of the main group elements down a group and across a period in the Periodic Table •explain how the sharing of electrons in covalent bonds leads to non-polar and polar bonds •explain the polar nature of molecules (such as HF, H_2O, NH_3 and $CHCl_3$) and the non-polar nature of molecules (such as CH_4 and BF_3) with reference to electronegativity, polarity of bonds and molecular shape
b. Intermolecular forces • van der Waals' forces • hydrogen bonding	•explain the existence of van der Waals' forces in non-polar and polar covalent substances •state the factors affecting the strength of van der Waals' forces between molecules •compare the strength of van der Waals' forces with that of covalent bonds •describe the formation of hydrogen bonding as exemplified by HF, H_2O and NH_3 •compare the strength of van der Waals' forces with that of hydrogen bonding •understand the effect of hydrogen bonding on properties of substances such as water and ethanol
c. Structure and properties of ice	•describe the structure of ice •state and explain the properties of ice in terms of its structure and bonding
d. Simple molecular substances with non-octet structures	•recognise the existence of covalent molecules with non-octet structures •draw the electron diagrams of some non-octet molecules such as BF_3, PCl_5 and SF_6
e. Shapes of simple molecules	•Predict and draw three-dimensional diagrams to represent shapes of (i) molecules with central atoms obeying octet rule; and (ii) molecules with central atoms not obeying octet rule and with no lone pair of electrons (such as BF_3, PCl_5 and SF_6)

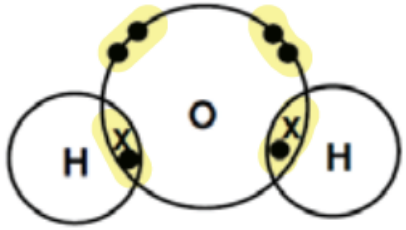
Modified teaching sequence with suitable learning and teaching activities



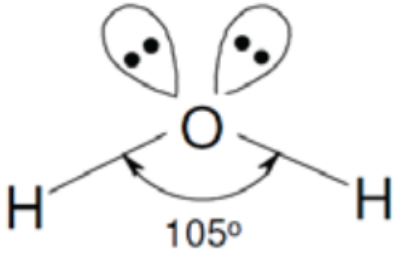
Recall to Microscopic World I

Related to Microscopic World I - Giant Covalent Structure

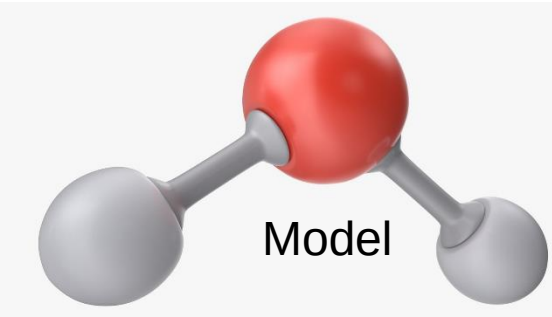
Shape of water molecule

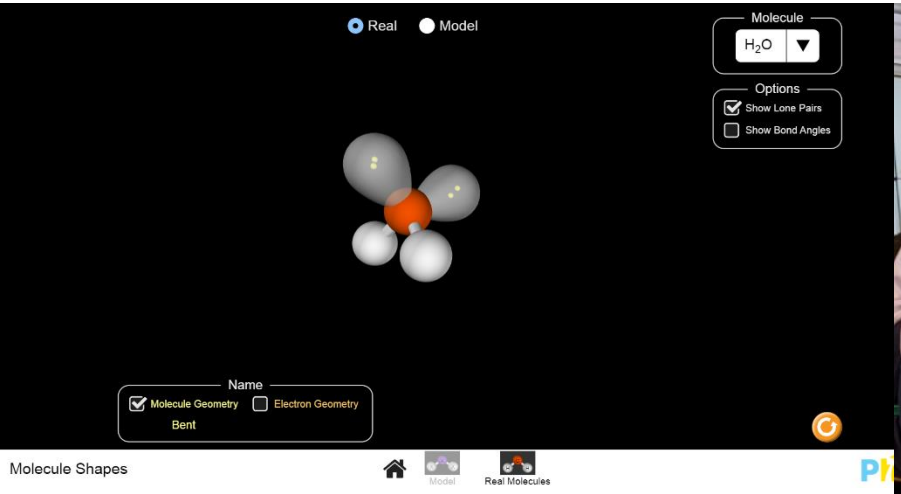


2BP +2LP ⇒ V-shaped



V-shaped

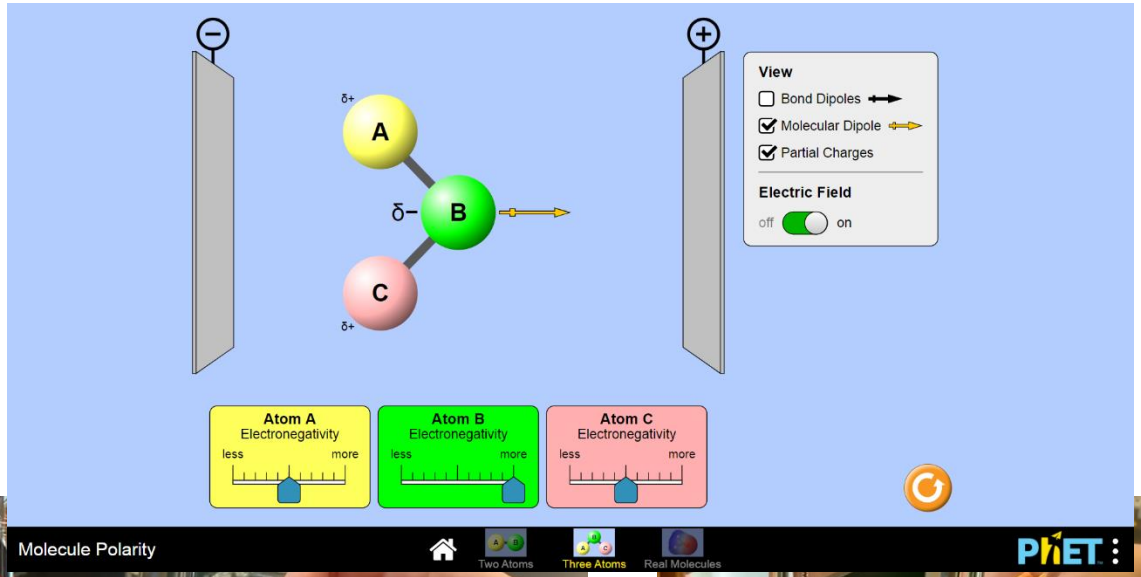




PhET molecule shapes simulation

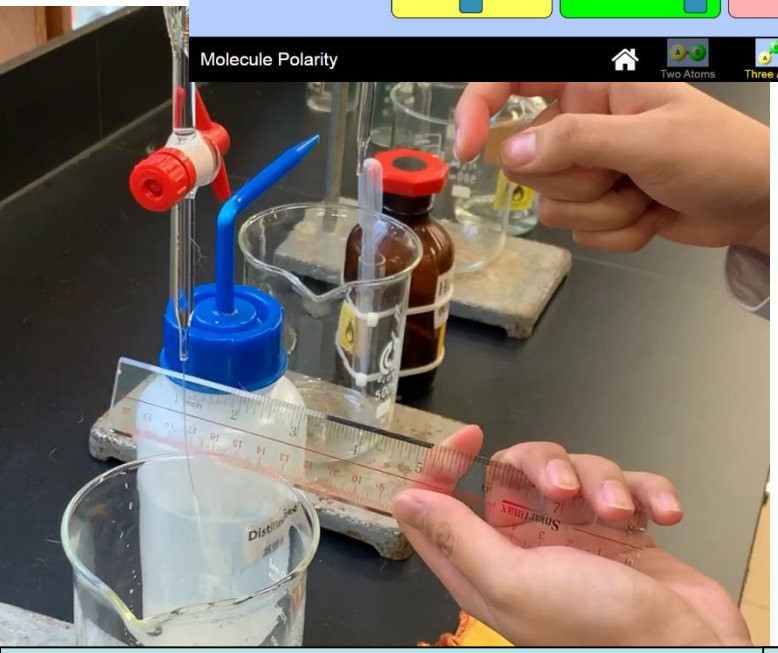
Use ipad PhET simulation on lesson

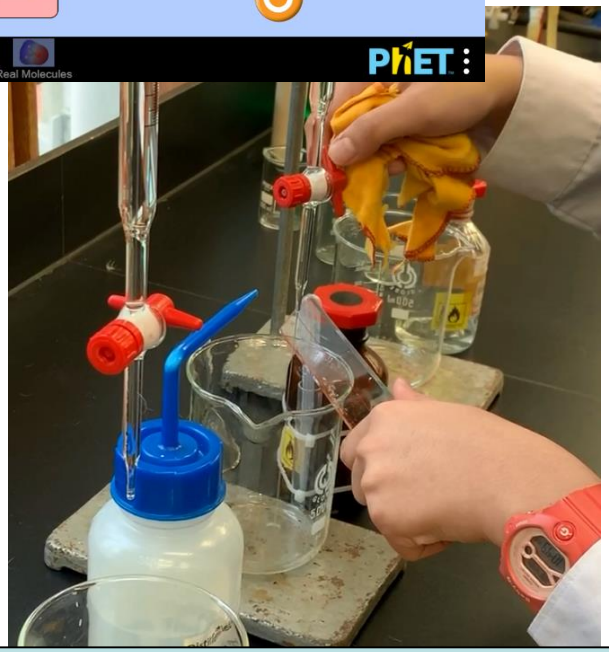
polarity of molecules



PhET sumulation
Molecular polarity

Experiment





Water – polar molecule deflected toward charged ruler	hexane – non-polar molecule not deflected toward charged ruler

3.Pedagogy in chemistry teaching

- Direct instructional teaching

  - Explain, demonstration

- Inquiry teaching
  - Experiments, Questions, Discussion

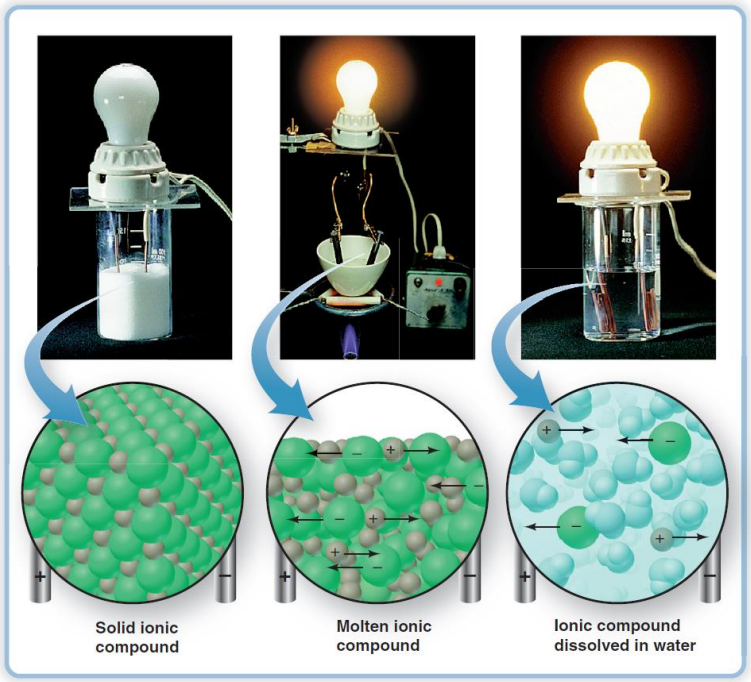
- Collaborative teaching
  - Experiments
  - Interactive activities
  - Collaborative projects

Enhancing Students learning

- Use more graphics and video to enhance students' understanding

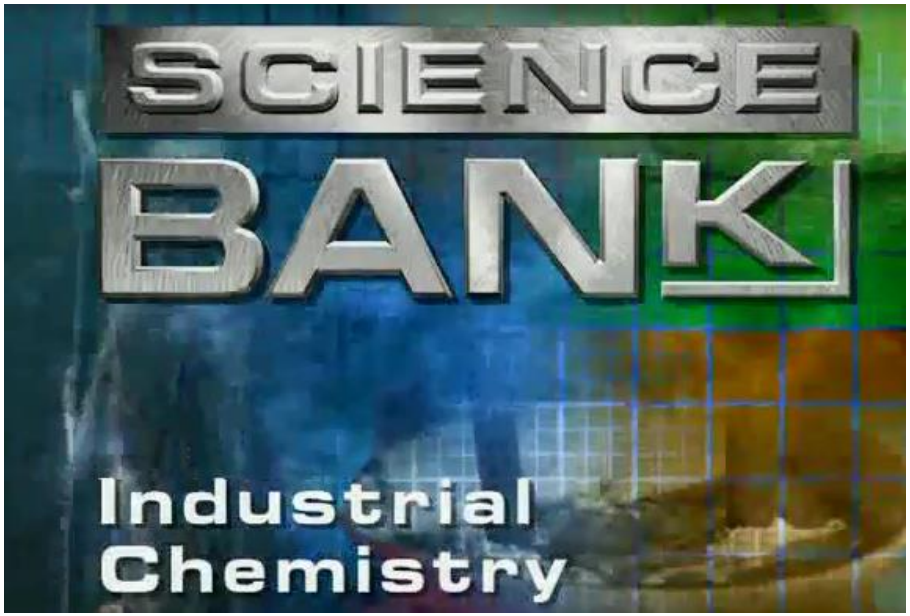
Macroscopic ⟺ Microscopic

Physical properties



Bonding
Structure of compound

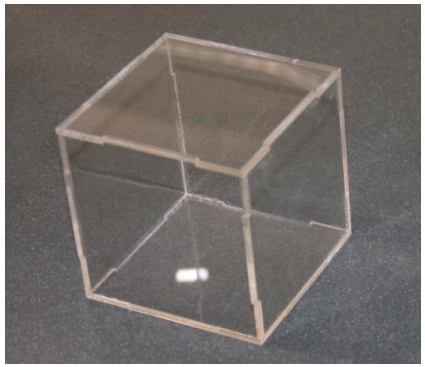
Use video to facilitate understanding Industrial Process



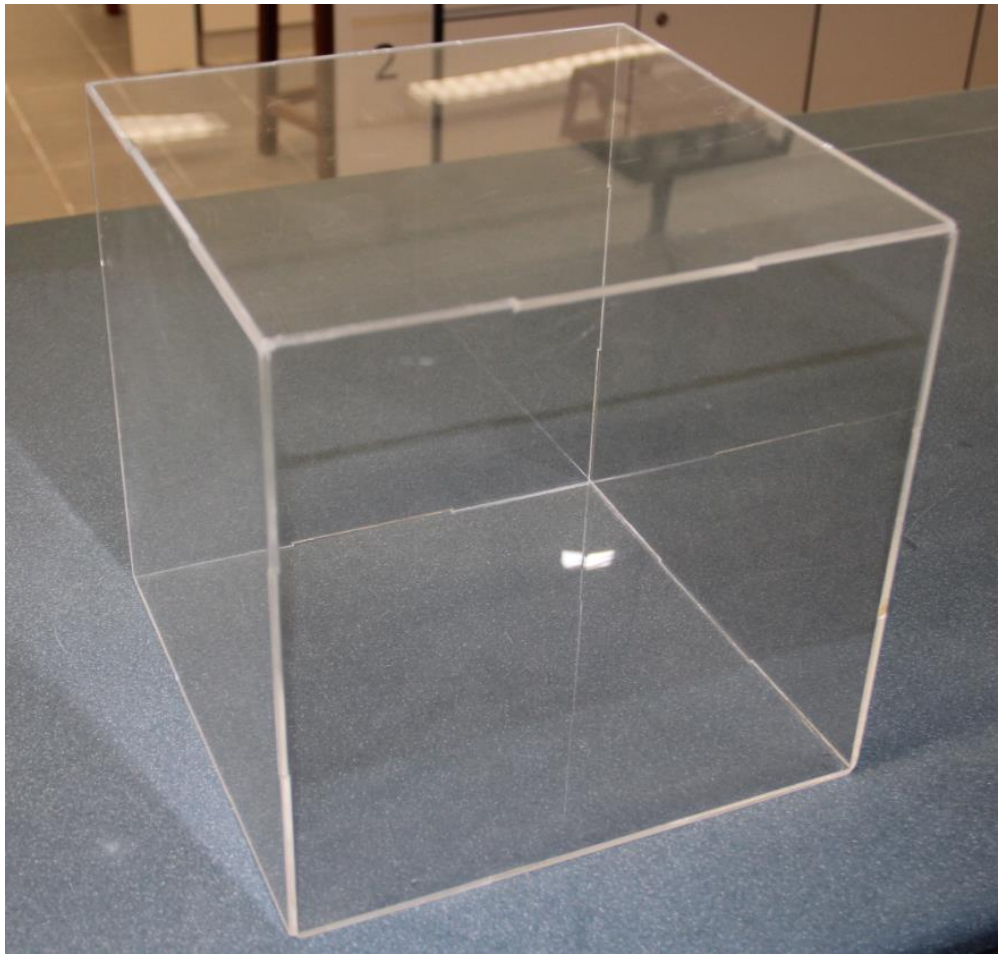
Chlor-alkali industries

Use of Teaching aids

Use models to visualize abstract concept



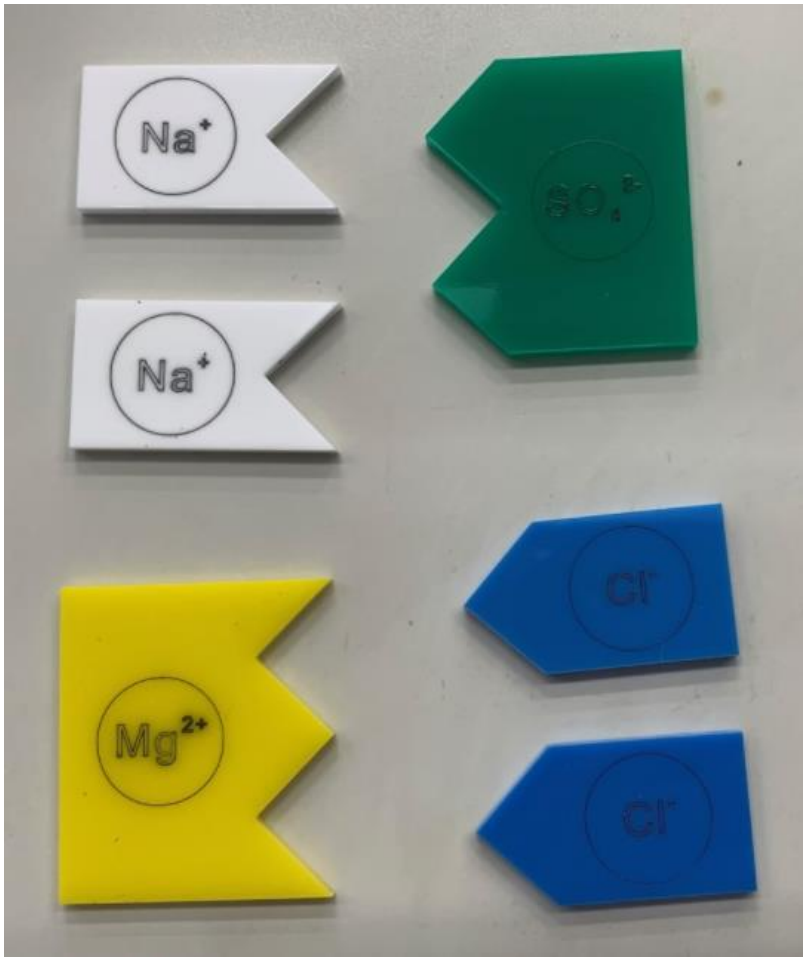
1dm^3 cube



Molar volume at 25°C
24dm^3 cube

Use models to visualize abstract concept

Ionic compound formula



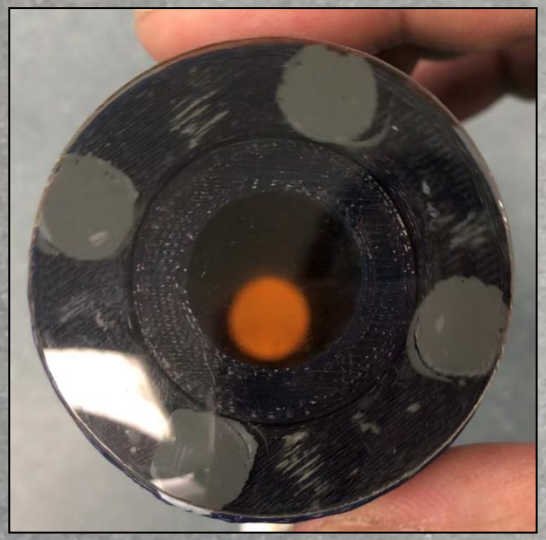
Na_2SO_4

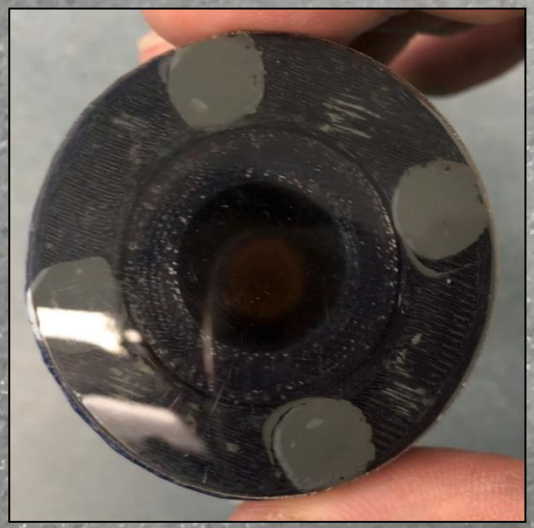
$MgCl_2$

Use models to increase students' understanding

Separation – DIY Filtration Principle Kit

DIY polarimeter

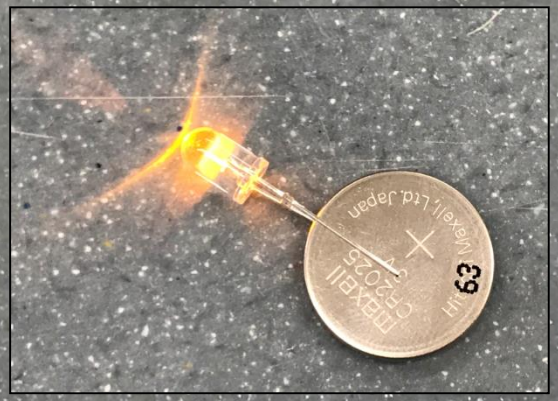




Turning analyzer to observe whether the compound can turn the plane of polarized light

DIY polarimeter

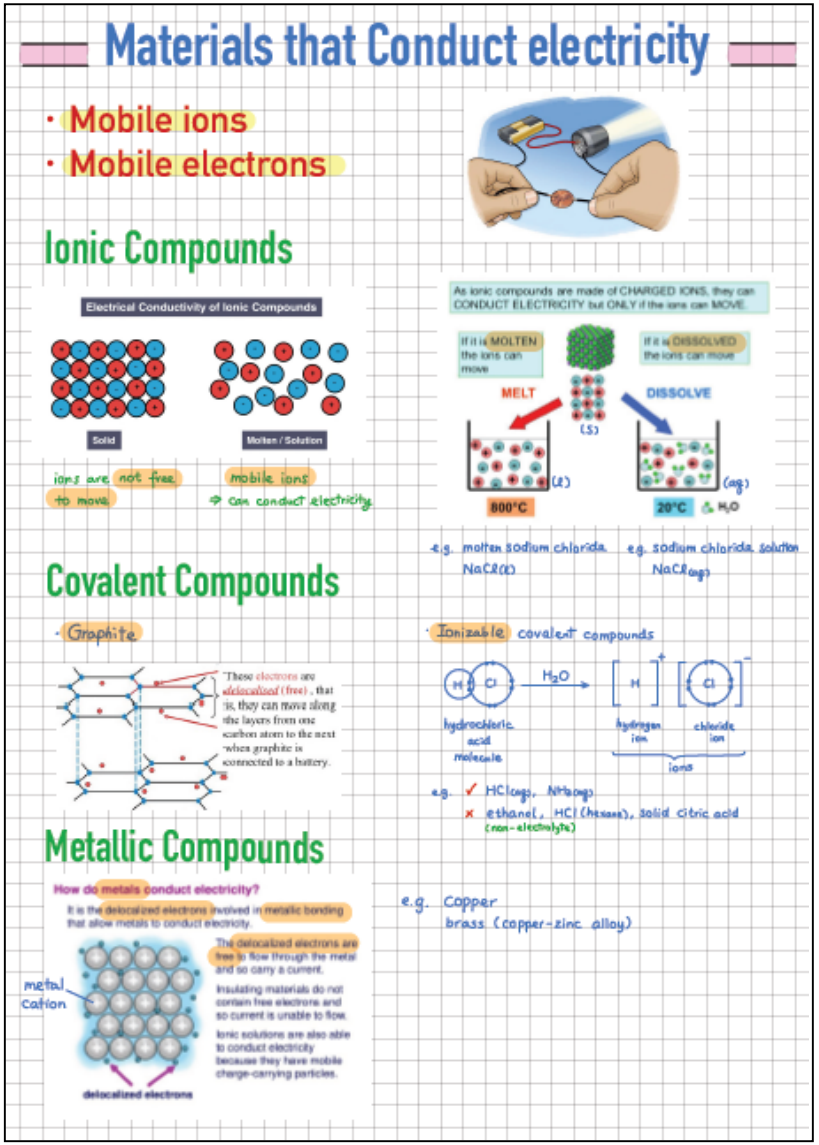
Sample tube

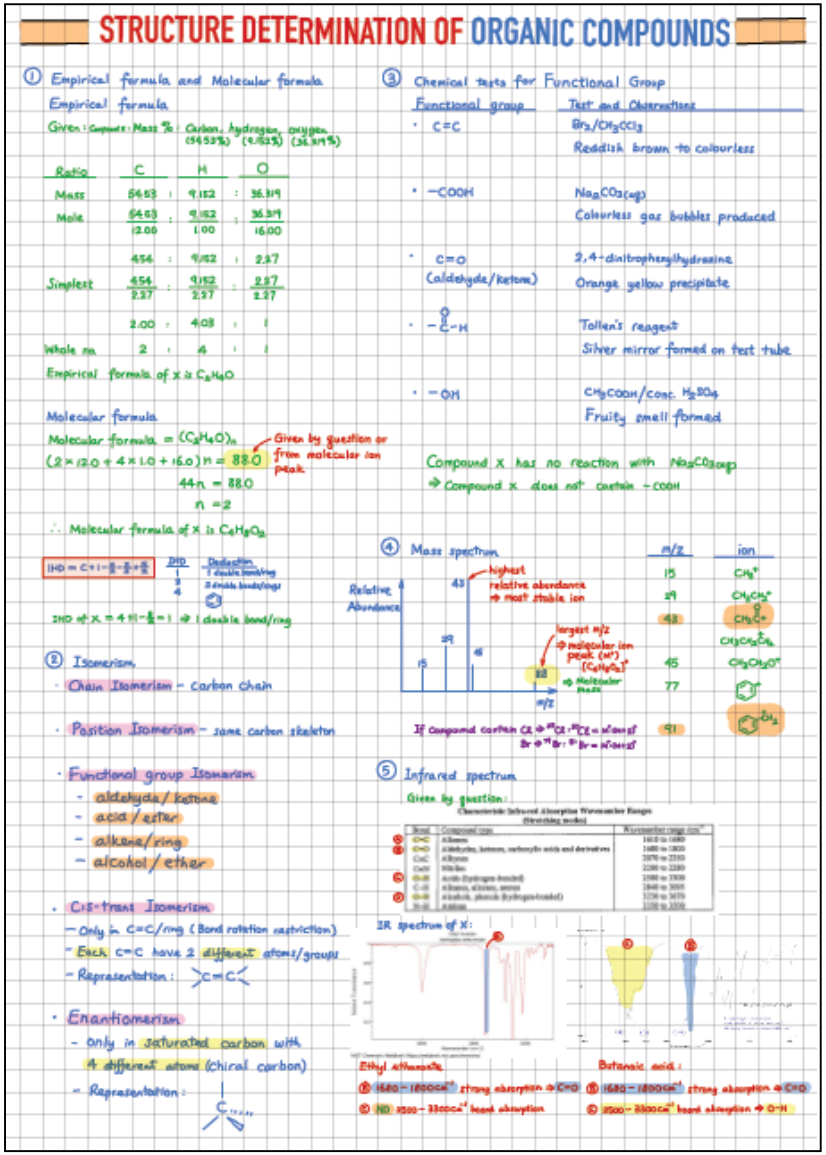


B. Cater for Learners' Diversity

- Make a summary at 5 minutes before the end of lessons
- test and exercises was given after short topics for consolidation of concepts
- help students how to tackle with past public examination paper
- Use chemistry knowledge to link with daily life examples and explain the chemical principle behind

Making Revision notes for students





Encourage student to write own notes for study

Classification of acid

Types

	Mineral Acid	Organic acid $R-\overset{O}{\overset{\|}{C}}-OH$
Introduce	Prepare from minerals	Composed by carbon, hydrogen, oxygen
Example	H_2SO_4, HCl, HNO_3 (oxidising)	CH_3COOH, $C_6H_8O_7$

☆ from living organism contain $-\overset{O}{\overset{\|}{C}}-OH$ (-COOH) $\xrightarrow{H_2O}$ $-\overset{O}{\overset{\|}{C}}-O^- + H^+$

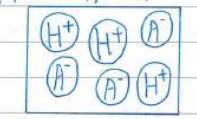
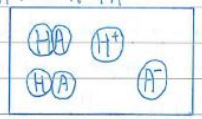
Physical state

	Gases	Liquids	Solid
Example	HCl	H_2SO_4, HNO_3, CH_3COOH	oxalic acid (spinach), citric acid, tartaric acid

Concentration acid

Concentration	Concentrated acid	Dilute acid
Molarity (M) [mol dm^{-3}]	> 2 mol dm^{-3}	≤ 2 mol dm^{-3}
Graphic representation	1 dm^3	1 dm^3

Strength of acid

	Strong acid	Weak acid
Soluble in water and ionization	Completely ionized in water	Partially ionized in water
Example	HCl, H_2SO_4, HNO_3	CH_3COOH, H_2CO_3
Graphical representation	$HA \xrightarrow{H_2O} H^+ + A^-$  Species in water · H^+ · A^-	$HA \rightleftharpoons H^+ + A^-$  Species in water · H^+ · A^- · HA (un-ionized molecule)

☆ All strong acid can completely ionized in dilute acid (≥2M)

☆ syngas = $CO + H_2$

natural gas = CH_4

produce methanol from syngas ?

$$CO(g) + 2H_2(g) \xrightarrow[200-300\,^\circ C,\ 50-100\,atm]{Al_2O_3} CH_3OH(g)$$

Advancement of methanol production technology - Explain.

Advancement ≅ good point

Direct conversion of methane to methanol with the use of a metal oxide catalyst at high temperature and atmosphere pressure. The conversion uses a catalytic reagent.

Why 'initial rate' is commonly used ? ☆☆

As the initial concentration of reactants are known.

What is 'initial rate' ?

The instantaneous rate at time = 0.

Teaching math in chemistry

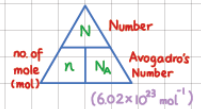
Mole calculations

Definition

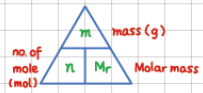
1 mol = Number of 12.00 g $^{12}_{6}C$ atoms = 6.02×10^{23}

Formula

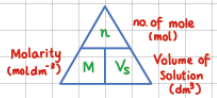
① Number



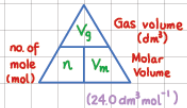
② mass



③ molarity



④ gas volume

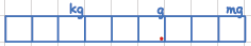


Unit conversion

① mass : g

kg → 10^3 g

mg → 10^{-3} g

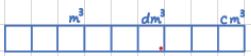


25 kg = 25×10^3 g = 25000 g

② volume : dm^3

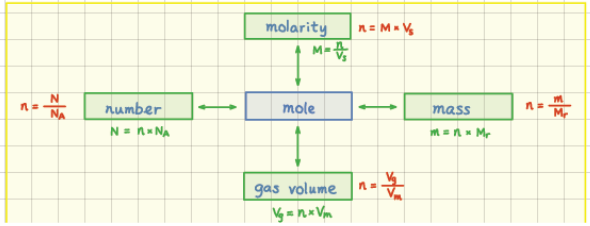
m^3 → 10^3 dm^3

cm^3 → 10^{-3} dm^3



25 cm^3 = 25×10^{-3} dm^3 = 0.025 dm^3

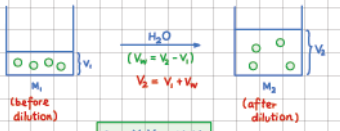
Calculations involving mole conversion



Applications of calculations involving mole conversion

1. Dilution

No. of mole of solute before dilution = no. of mole of solute after dilution



$n = M_1V_1 = M_2V_2$

$M_1V_1 = M_2(V_1 + V_w)$

$V_w = V_1\left(\frac{M_1}{M_2} - 1\right)$ or $V_w = V_1(D - 1)$ Dilution factor, $D = \frac{M_1}{M_2}$

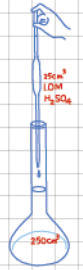
e.g. A 25.0 cm^3 of 1.0 M H_2SO_4 (M_1, V_1) was diluted to 250.0 cm^3 (V_2) in a volumetric flask.

Calculate the molarity of diluted H_2SO_4 in volumetric flask.

$n = M_1V_1 = M_2V_2$

$M_2 = \frac{M_1V_1}{V_2} = \frac{1.0\ mol\,dm^{-3} \times 25.0 \times 10^{-3}\ dm^3}{250.0 \times 10^{-3}\ dm^3}$

$= 0.10\ mol\,dm^{-3}$



2. Density

$$\text{Molarity, } M\ (mol\,dm^{-3}) = \frac{\text{density, } d\ (g\,cm^{-3}) \times \text{percent, } p\ (\quad\%) \times 1000}{\text{Molar mass, } M_r\ (g\,mol^{-1})}$$

rubbing alcohol (70% ethanol)

(70 cm^3 ethanol in 100 cm^3 solution)

Need :

1. Molar mass of ethanol = 46.0 $g\,mol^{-1}$
2. Density of ethanol = 0.85 $g\,cm^{-3}$
3. Percent in solution = 70% = 0.70

Assume volume of solution = 100 cm^3

Volume of ethanol in solution = 100 cm^3 × 0.7 = 70 cm^3

Mass of ethanol in solution = volume × density = 70 cm^3 × 0.85 $g\,cm^{-3}$ = 59.5 g

No. of mole of ethanol in solution = $\frac{\text{mass of ethanol}}{\text{molar mass of ethanol}} = \frac{59.5\ g}{46.0\ g\,mol^{-1}} = 1.29\ mol$

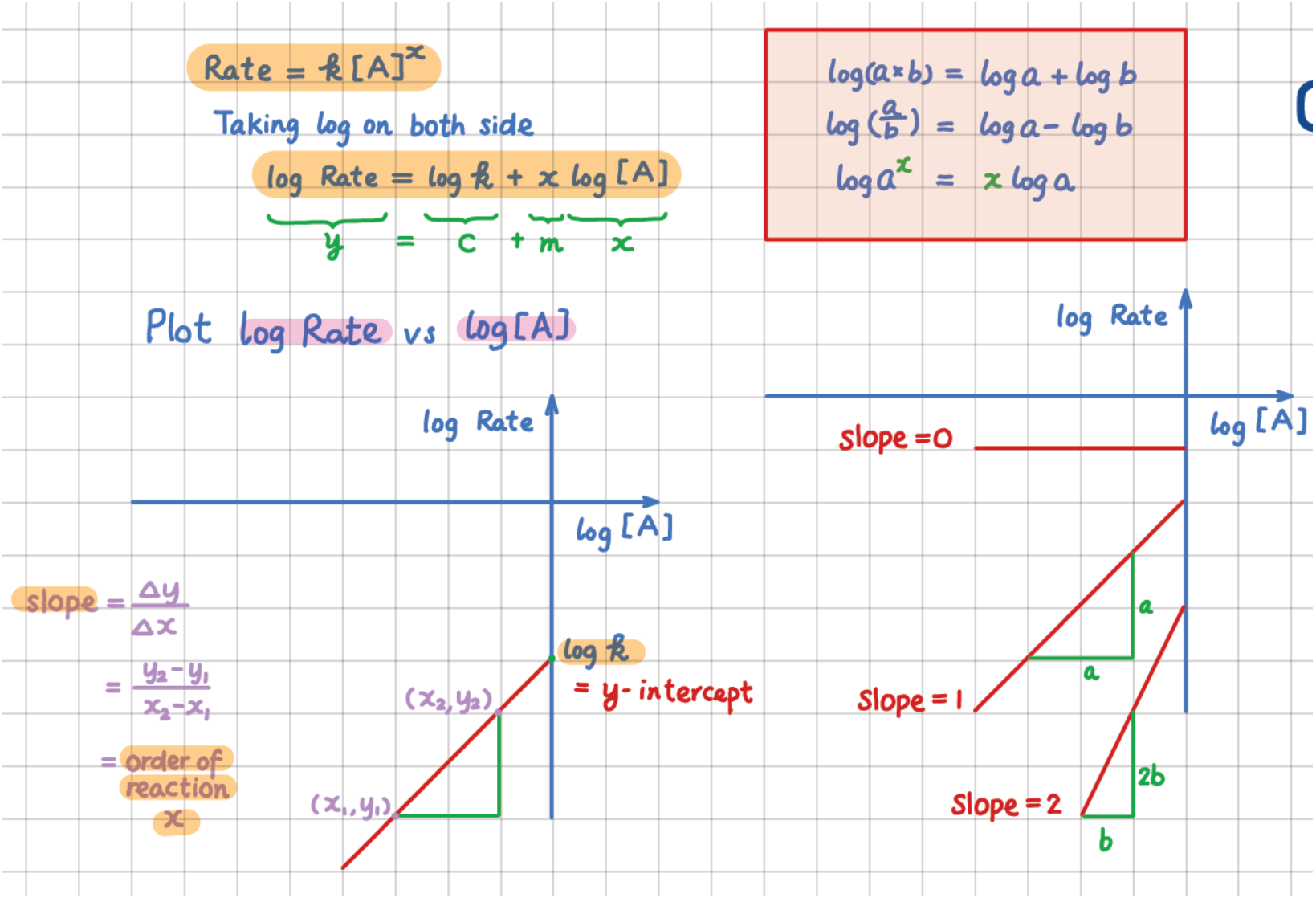
Molarity of ethanol in solution = $\frac{\text{no. of mole of ethanol}}{\text{volume of solution}} = \frac{1.29\ mol}{100 \times 10^{-3}\ dm^3} = 12.9\ mol\,dm^{-3}$

e.g. Calculate the concentration of the HCl in $mol\,dm^{-3}$ (2014-HKDSE-IBQ7)

$$\text{Molarity, } M\ (mol\,dm^{-3}) = \frac{\text{density, } d\ (g\,cm^{-3}) \times \text{percent, } p\ (\quad\%) \times 1000}{\text{Molar mass, } M_r\ (g\,mol^{-1})}$$

$$= \frac{1.18\ g\,cm^{-3} \times 0.36 \times 1000}{36.5\ g\,mol^{-1}} = 11.6\ mol\,dm^{-3}$$

Teaching graphing skills in chemistry



Use real life example to illustrate abstract ideas

Mole concept

$1\ \text{mol} = 6.02 \times 10^{23}$

$= 602000000000000000000000$

Mole concept

Coin exchange

Cost of each bag	$ 50
Cost of coin	$ 0.2
No. of coins	

No. of coins in each bag

1.Counting

No. of coins	

No. of coins in each bag

2.weighing

Mass of coins	500 g
Mass of each coin	2 g
No. of coins	

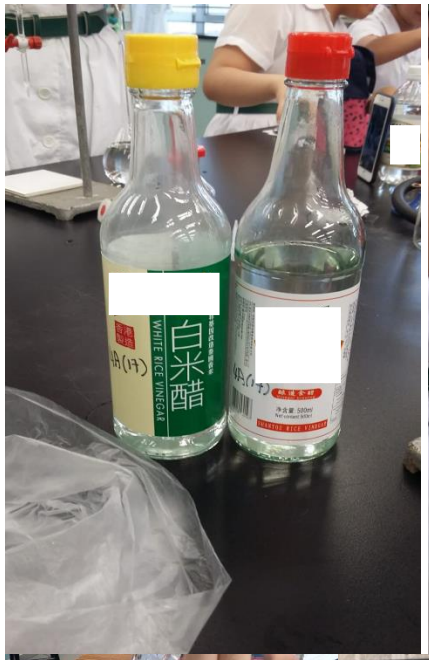
Project work :
Integration of the investigative study with household products

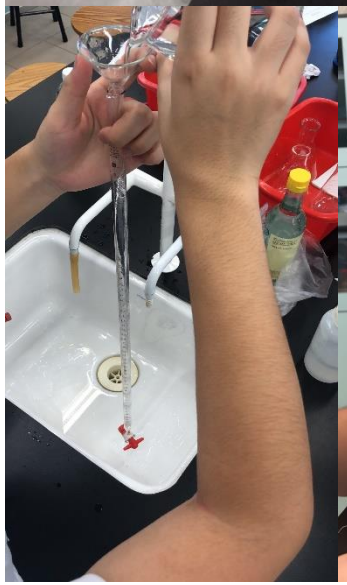
Hotung Secondary School

S.4 Chemistry Project

Determination of ethanoic acid in commercial vinegar

Member :



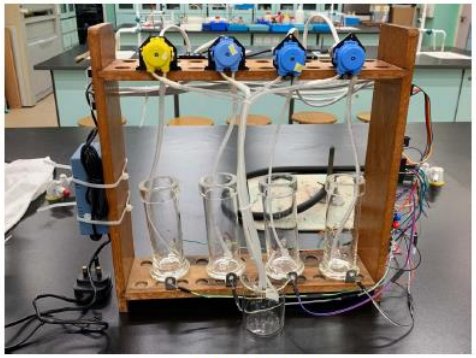


Science Talks and competition

第21屆香港青少年科技創新大賽
The 21st Hong Kong Youth Science & Technology Innovation Competition 2018 - 2019

混得出色

Solutions Mixing device



SSP0028

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Chemists Online Self-study Award Scheme

Chemists Online Self-study Award Scheme 2022

HKVU – COSAS

From Dec 2021

- I01: Drinking Water Treatment
- I02: Indoor Air Quality and Indoor Air Quality Certification Scheme
- I03: Air Quality Management Strategies for the Pearl River Delta Region
- I04: Water Uptake of Atmospheric Particles
- I05: Nuclear Plant Accident
- I06: Electrochemistry
- I07: The Importance of Water in Food Chemistry
- I08: Gastronomy
- I09: Colour Chemistry
- I10: Photodynamic Therapy
- I11: Synthetic Polymers in Modern Life
- I12: Metals in Biological Systems
- I13: Food Chemistry and Food Safety

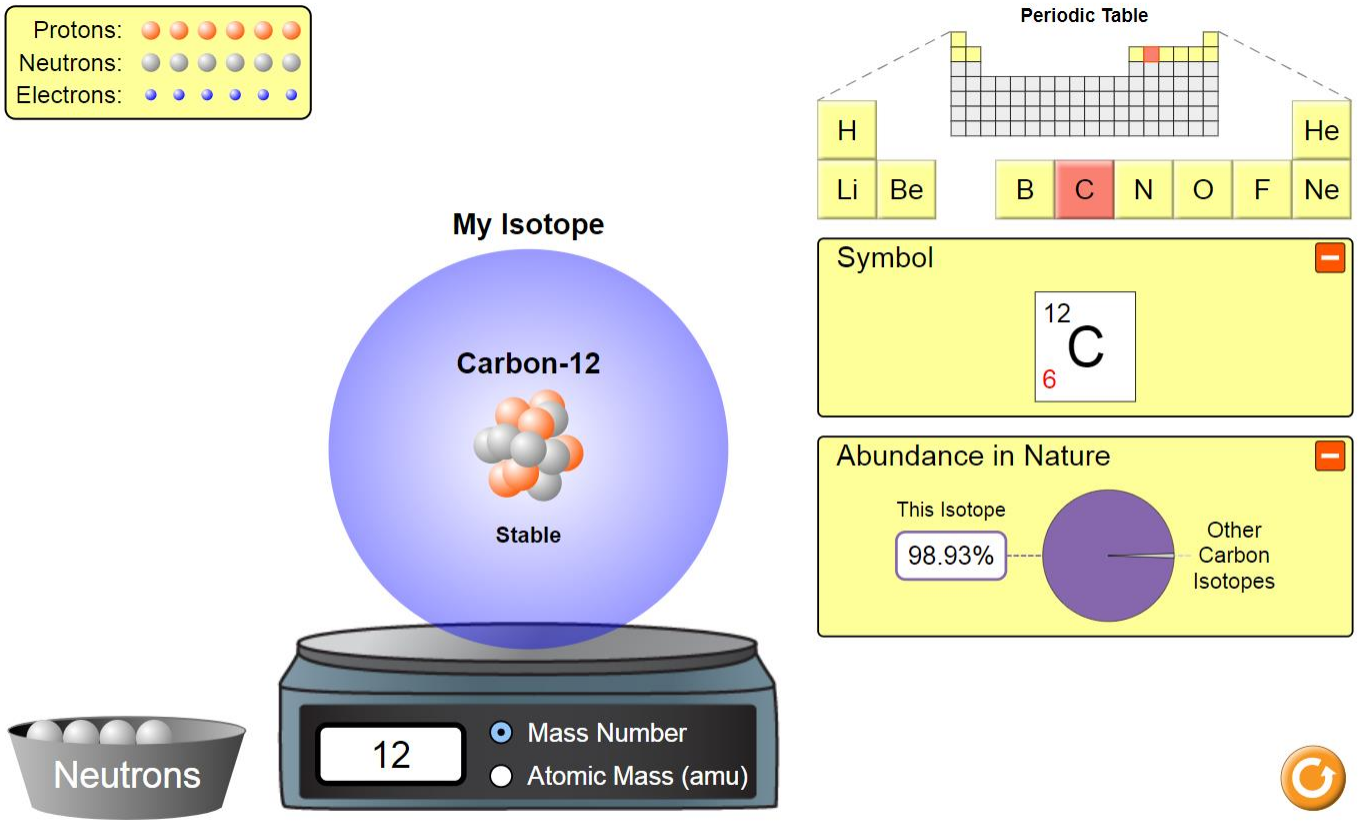
Chemists Online
Self-study Award Scheme

4. Resources for teaching chemistry

eLearning and eAssessment

- Interactive lesson to increase students' participation and motivation
- Increase the efficiency of learning
- Pre-lesson and post-lesson
- Learning Management System

Interactive PhET simulation

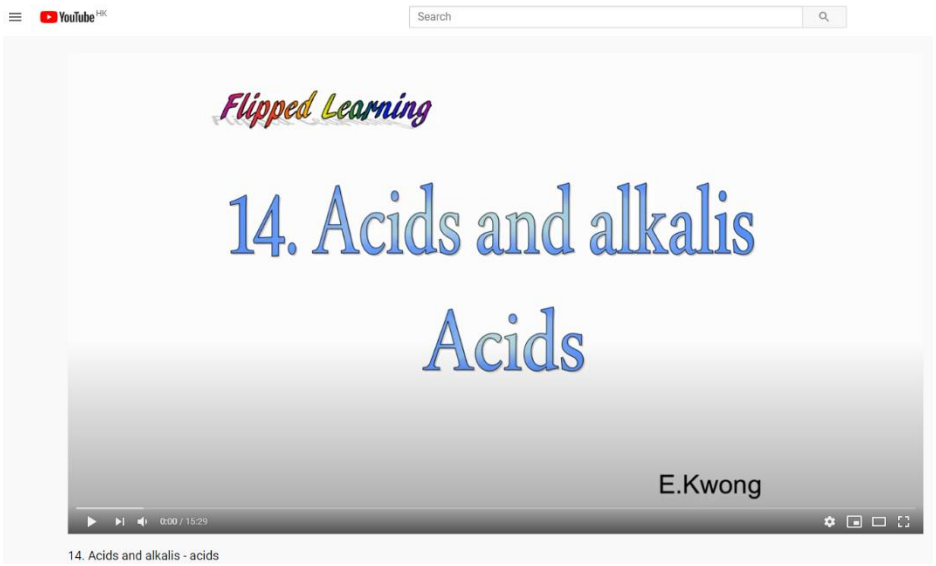


Use models to increase students' understanding

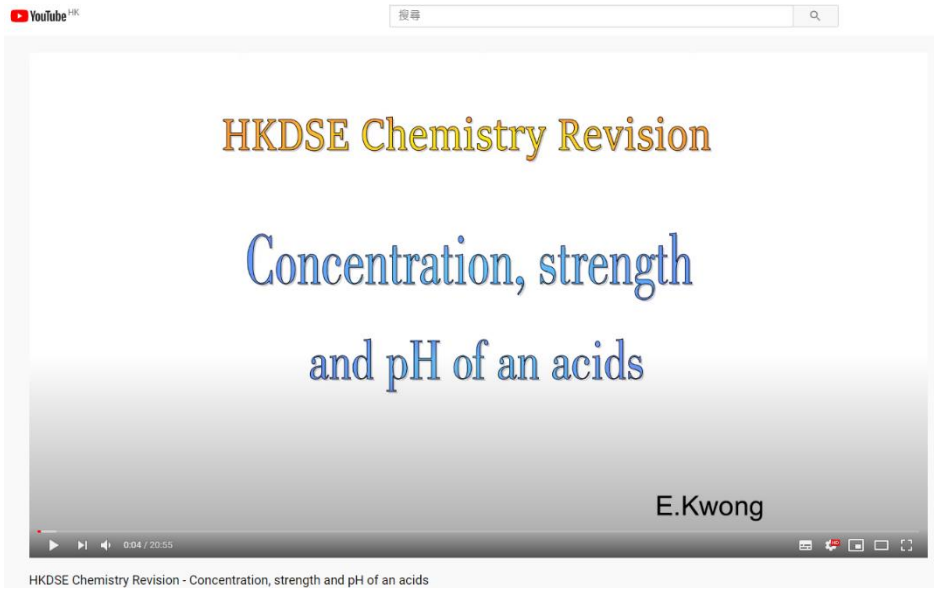
Water molecule (octet electronic structure)

Happy Atom

Prepare video clips for self learning Before and After Lesson



Pre-lesson self learning videos



Revison self learning videos

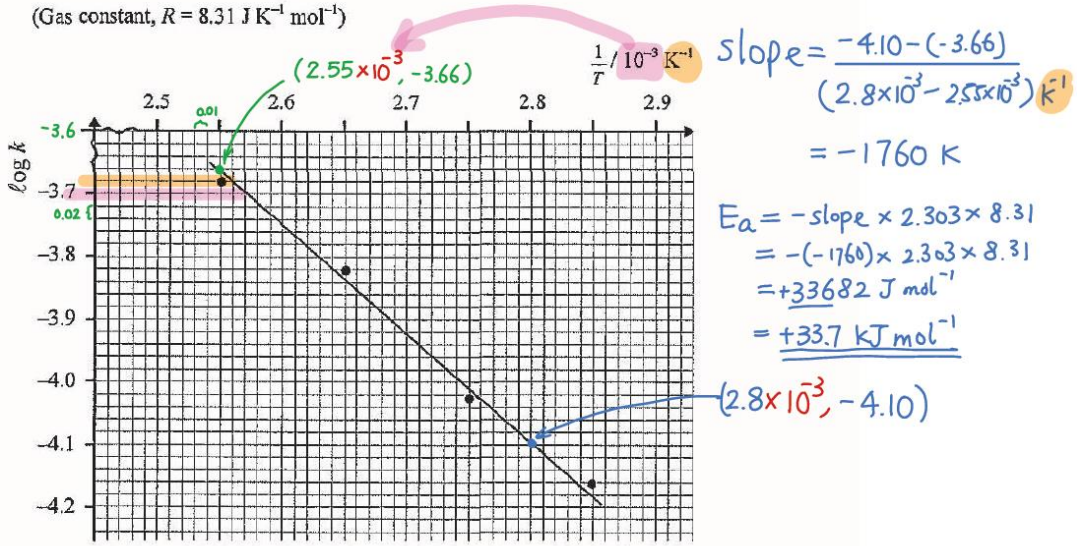
Discussion of Past exam paper

Online interactive live lessons

2013 HKDSE II 1b

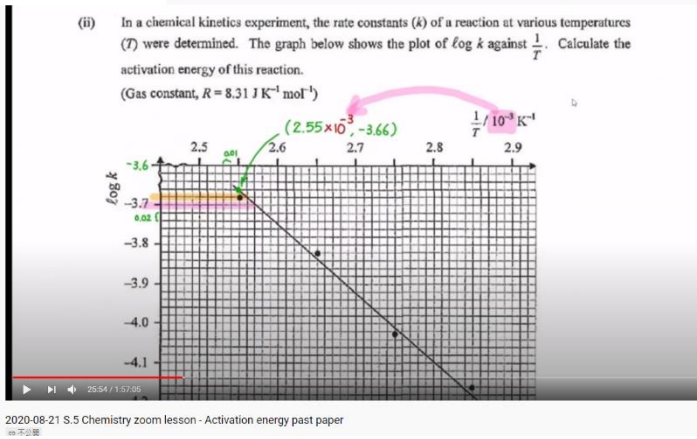
(ii) In a chemical kinetics experiment, the rate constants (k) of a reaction at various temperatures (T) were determined. The graph below shows the plot of $\ell\text{og } k$ against $\frac{1}{T}$. Calculate the activation energy of this reaction.

(Gas constant, $R = 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$)



(3 marks)

Lesson video for revision



Lesson handout

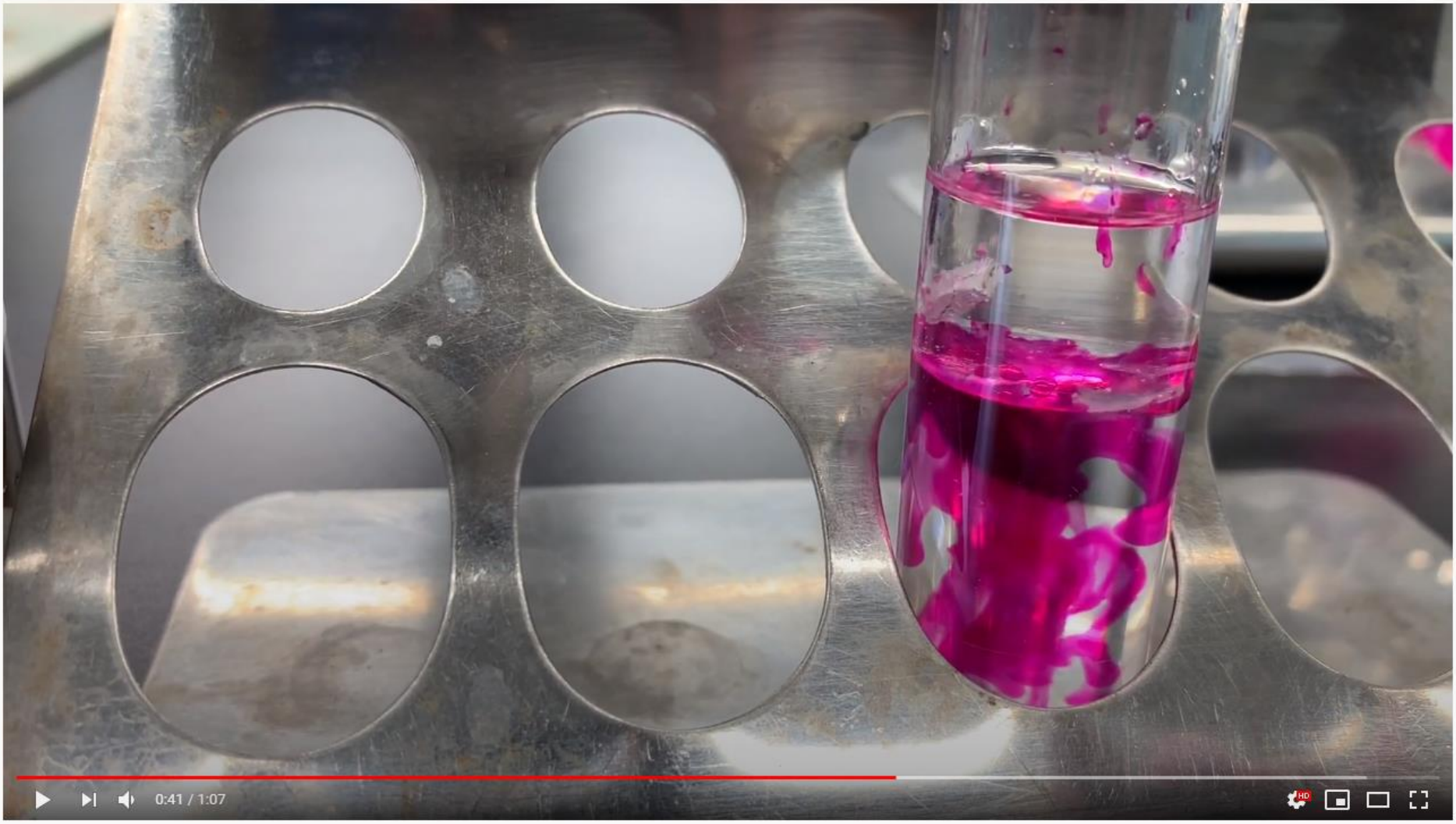
S5 Chemistry

Activation energy

Zoom lesson

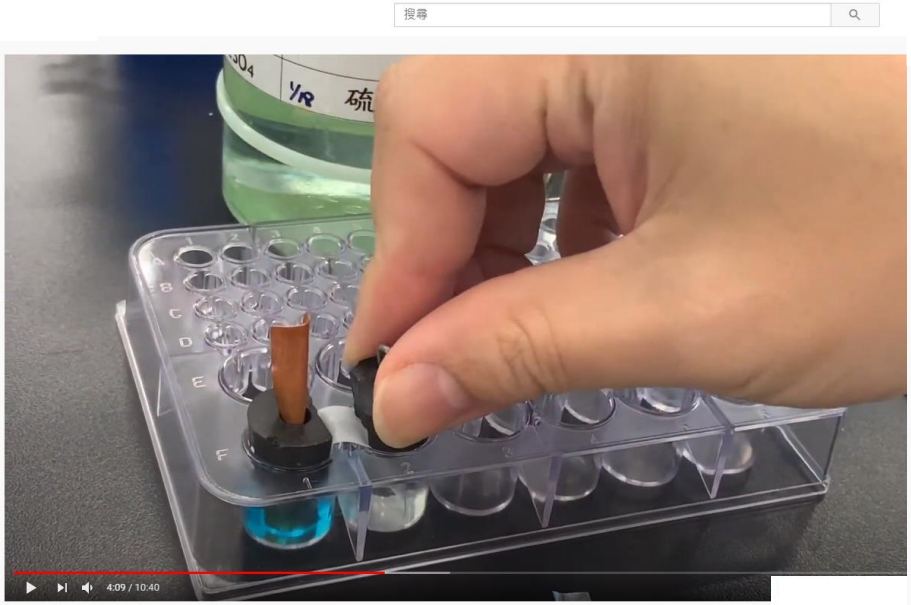
Experimental video

搜尋

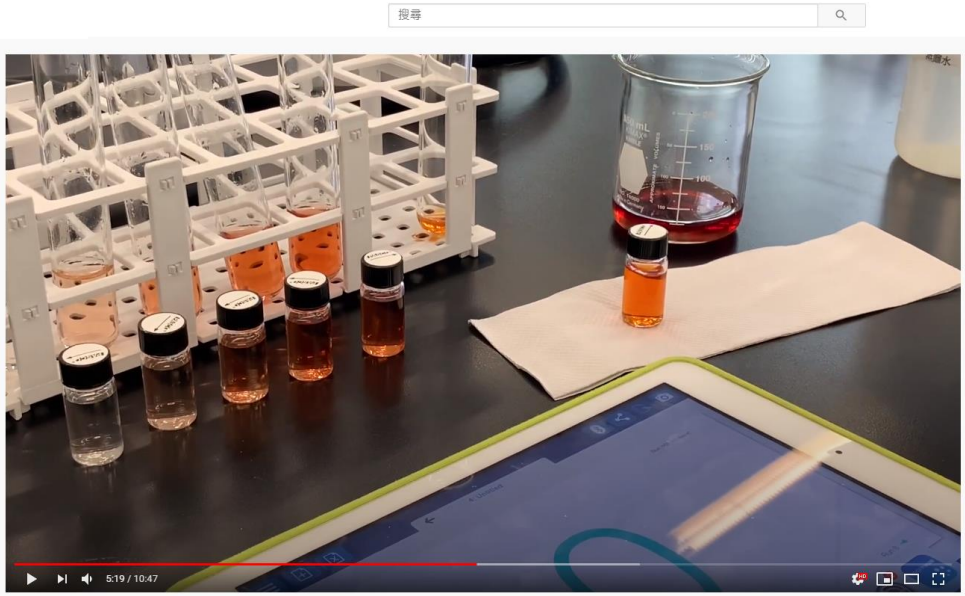


Jumping Sodium

SBA pre-lab experimental videos



SBA experiment - Redox reaction – to investigate the emf of electrochemical cells



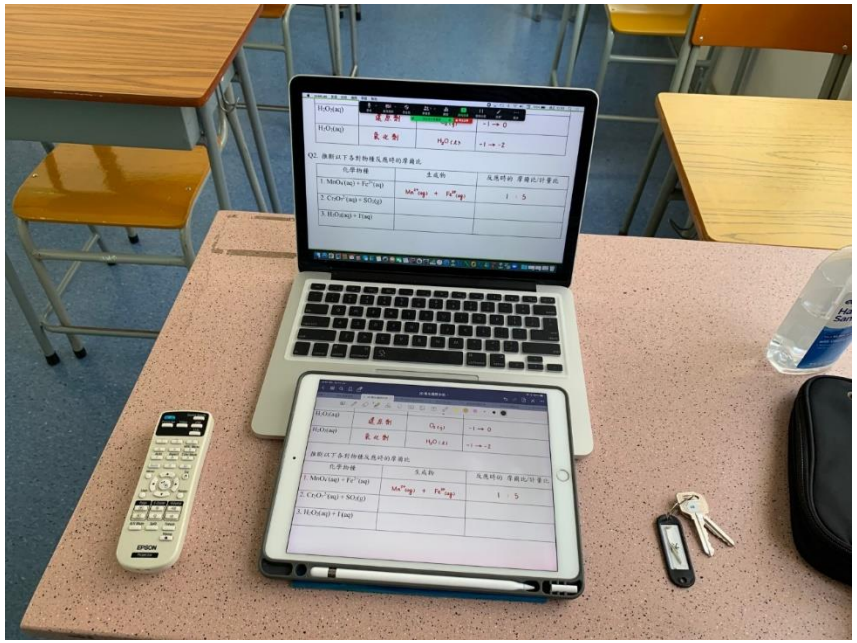
SBA Experiment - Determination of the equilibrium constant by colorimetric method

Video with pre-lab quiz to help students understand

SBA Experiment - Investigation the Order of Reaction between Hydrogen Peroxide and Iodide in Acid

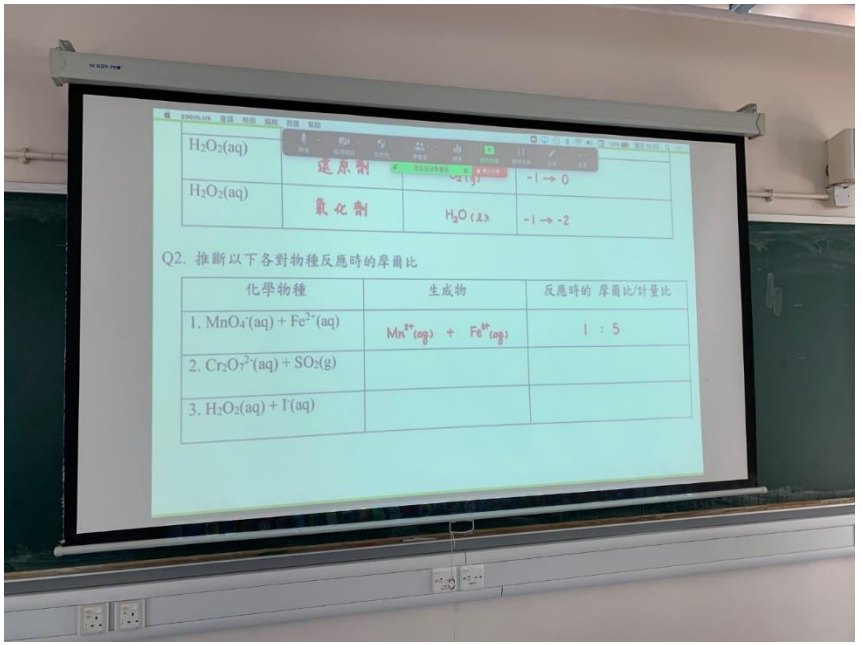
Face-to-face vs. online lessons

- For students do not able to attend face-to-face lessons



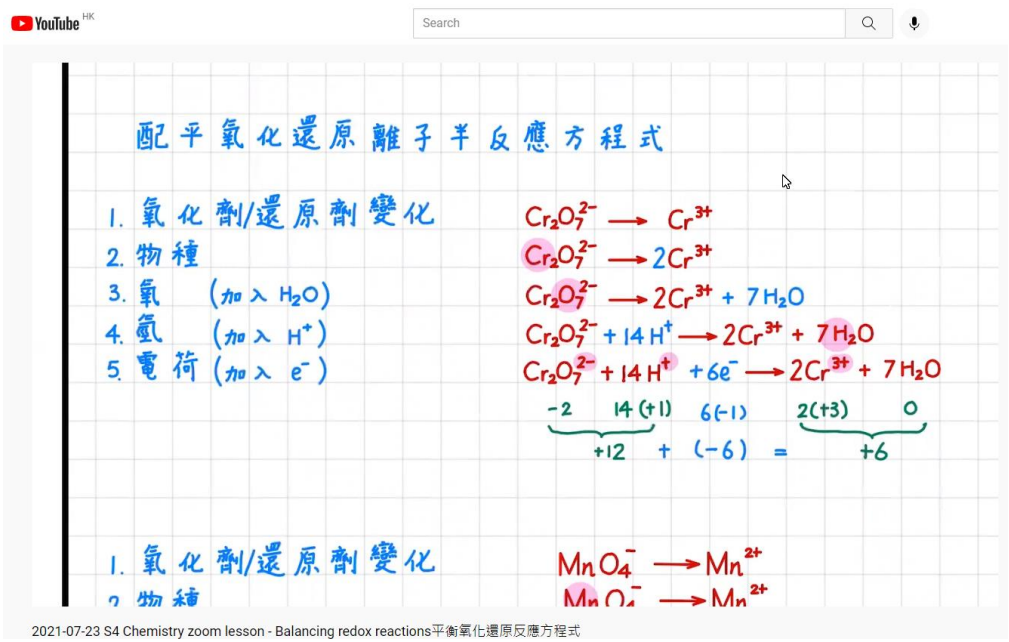
Share learning materials on Zoom

Online zoom lessons

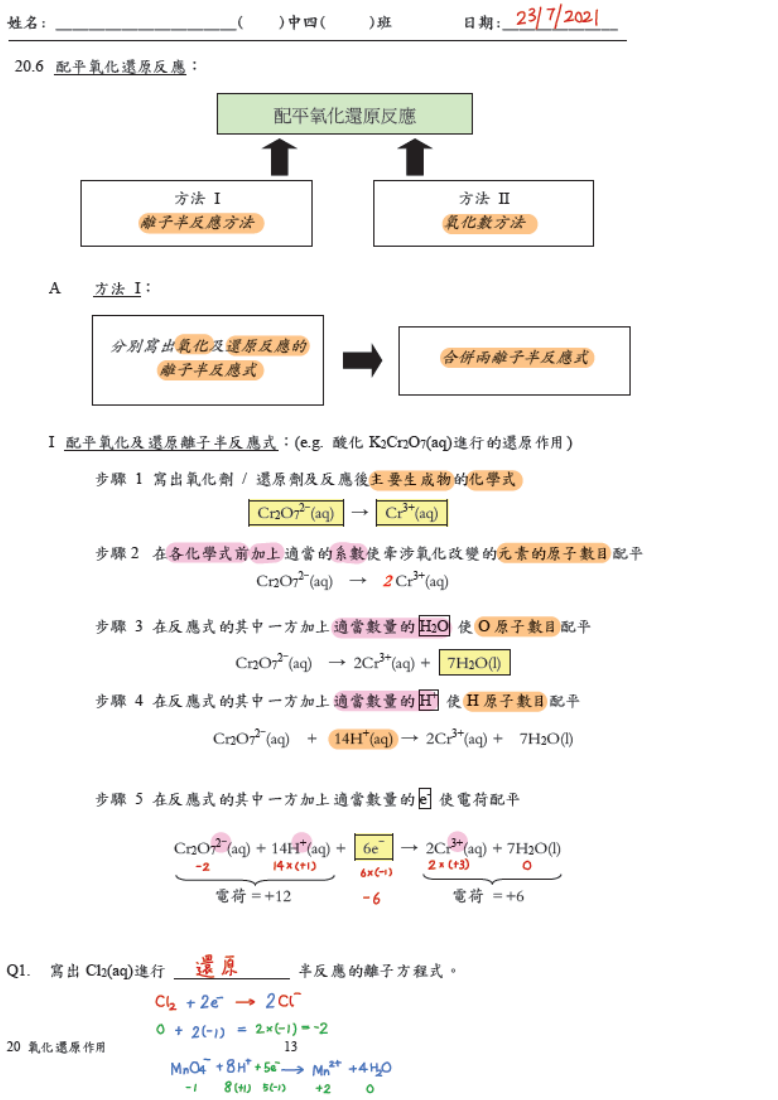


Project learning materials on screen

Face-to-face

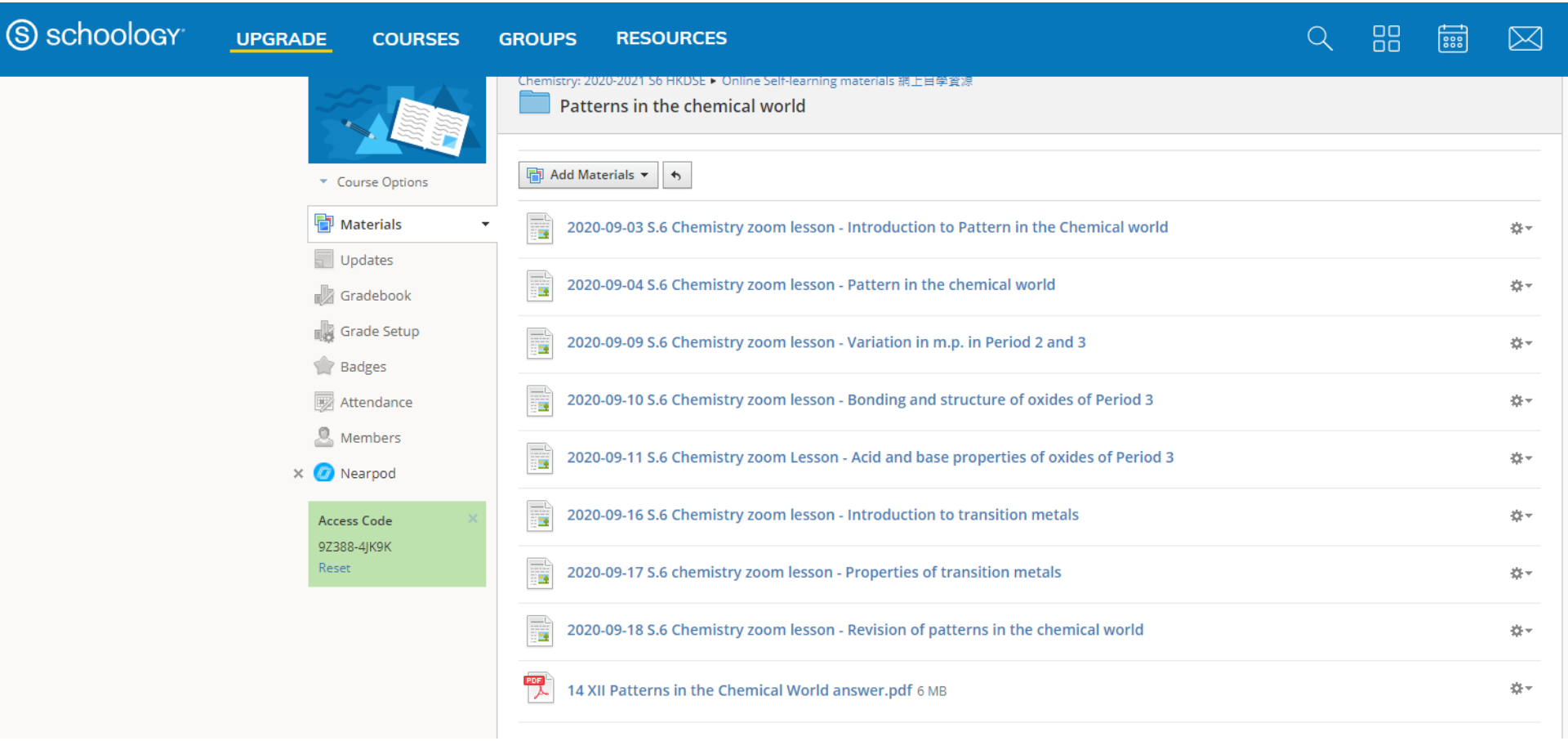


Recorded video shared on Youtube for revision or absent students



Teaching notes with answers

Learning Management System



Systematic way to organize teaching materials

Teaching notes/ self learning videos/ zoom lessons videos/ exercises/

Name: _____( ) S6( ) Date: 3/9/2020

XII Patterns in the Chemical World (化學世界中的規律)

Students should learn	Students should be able to
a. Periodic variation in physical properties of the elements from Li to Ar ● variation in the ① nature of bonding ● variations in ② melting point and ③ electrical conductivity	Li ··· Ne, Na ··· Ar } 2 periods ● describe the nature of bonding and structures of elements of Group I through Group 0 of the Periodic Table ● describe the periodic variations of melting point and electrical conductivity of the elements ● interpret the variations (graphical) in melting point and in electrical conductivity in terms of the bonding and structures of the elements, viz. the presence of metallic structures, covalent structures and molecular structures
b. ① Bonding, ② stoichiometric composition and ③ acid-base properties of the oxides of elements from Na to Cl (Period 3) Gp I → Gp VII	● describe the nature of bonding and stoichiometric composition of the oxides of elements from Na to Cl ● describe the variation in behaviour of the following oxides in water: Na_2O, MgO, Al_2O_3, SiO_2, P_4O_{10}, SO_2 and Cl_2O ● recognise the variations of acid-base properties of the oxides of elements from Na to Cl as exemplified by Na_2O, Al_2O_3 and SO_2
★ c. General properties of transition metals ● coloured ions ● variable oxidation states ● catalytic properties	● identify positions of the transition metals in the Periodic Table ● recognise that most aqueous ions of transition metals are coloured ● describe the colours of some transition metal ions such as Fe^{3+}(aq), Cr^{3+}(aq), Cu^{2+}(aq) ● describe that transition metals can exist in more than one oxidation states in their compounds, e.g. Fe^{2+} and Fe^{3+}; Mn^{2+}, MnO_2 and MnO_4^- ● describe that transition metals and their compounds can be used as catalysts e.g. iron in Haber process ● describe the importance of transition metals

S6 Chemistry

Patterns in the chemical world

2020-HKDSE IB

12. An experiment was performed to study the following reaction :

$KO_2CCH(OH)CH(OH)CO_2Na(aq) + 3H_2O_2(aq) \rightarrow HCO_2K(aq) + HCO_2Na(aq) + 2CO_2(g) + 4H_2O(l)$
(colourless)

When 10 cm^3 of 0.25 M $KO_2CCH(OH)CH(OH)CO_2Na(aq)$ and 3 cm^3 of 6% $H_2O_2(aq)$ were mixed at 60°C, it was found that only a few gas bubbles evolved. Then a small amount of pink $CoCl_2(aq)$ solution was added to the mixture. Gas bubbles formed vigorously and the mixture turned to green due to the formation of a cobalt(III) compound. When no more gas evolved, the green mixture turned back to pink.

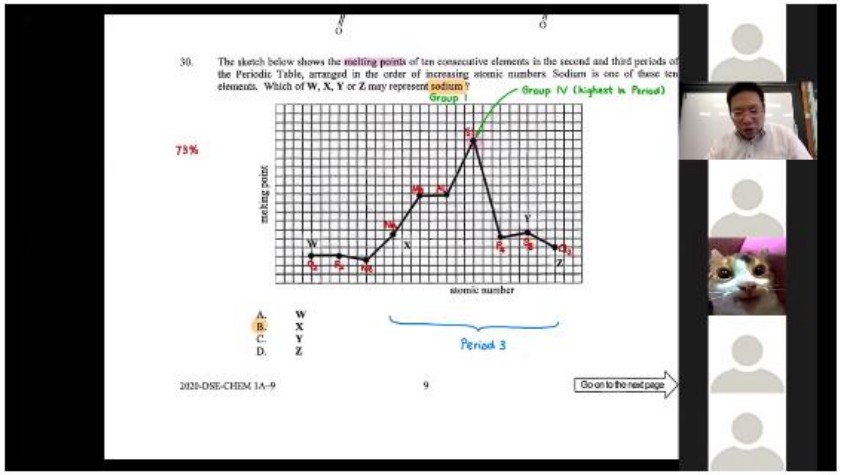
catalytic properties Coloured ion

There is a view saying that cobalt illustrates THREE characteristics of transition metals according to the observation of this experiment. Suggest reasons to support this view.

T.M. characteristic
① Variable oxidation state
Cobalt (II) and Cobalt (III)
$CoCl_2$ Co^{3+}
② Coloured ions
Co^{2+} – pink

2020-09-18 S.6 Chemistry zoom lesson - Revision of patterns in the chemical world

arks)



Online exercise submission and marking

6A12, [redacted]

Revision 2 ▾ Exercise33 5A14.pdf ▾

Grade w

Friday, April 10, 2020 at 1:36 pm

1 /2 202%

Name : _____(14)S5A Date : _____?

Hotung Secondary School
S5 Chemistry
Exercise 33

7/9

Topic : Fossil Fuel 2

1. Petrol is a commonly used motor car fuel. It can be obtained from petroleum by fractional distillation. (2014 - HKDSE - 9 marks)

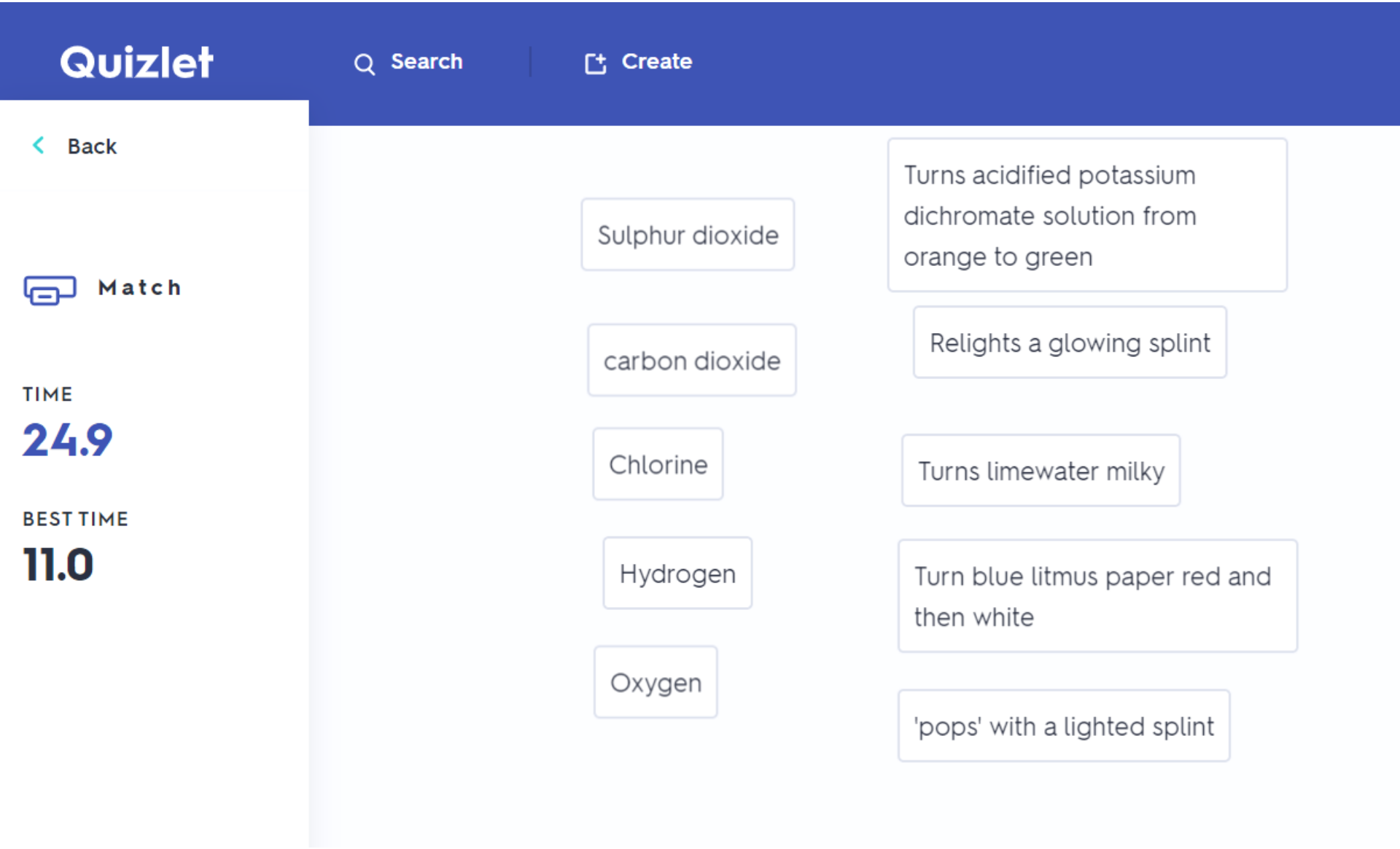
(a) (i) Explain, from molecular level, why petrol can be obtained from petroleum by fractional distillation.

✓ Fractional distillation can be used because the hydrocarbons have different boiling points. In general, a hydrocarbon with larger molecules has a higher boiling point. ✓

1
1

(ii) Other than directly obtaining petrol from fractional distillation of petroleum, suggest a way for producing extra petrol.

Self pack quiz - quizlet



Interactive quiz – Kahoot!

Kahoot!

Summary

- Setup a clear and achievable learning objectives for the students
- Plan diversify teaching and learning activities to increase learning efficiency
- Interactive between students and teacher
- Provides timely feedbacks to students
- Wisely use of different teaching and learning resources
- Cater for learners' diversity to make progress in different students