LEARNING, TEACHING & ASSESSMENT OF CHEMISTRY USING PRACTICAL ACTIVITIES

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Integrate SBA with Learning and Teaching

- From "Assessment of Learning" to "Assessment for Learning"
  - To enhance the validity of assessment by including assessment of students' practical skills and generic skills
  - To provide students quality feedbacks for fostering learning
- Connection between SBA tasks and learning objectives/outcomes
- Facilitating teachers to track students' learning progress and adjust teaching strategies

Activity 1

Do you think the practical activities in the following contexts can be conducted as SBA tasks?

2015 HKDSE Paper I Q5

Explain, with the aid of a chemical equation, why $NH_3(aq)$ is regarded as a weak alkali. Suggest how you would show that $NH_3(aq)$ is a weaker alkali than NaOH(aq) through an experiment.

(6 marks)

2016 HKDSE Paper I Q9

Three unlabeled reagent bottles each contains one of the white solids listed below:

$ZnSO_4$ $MgSO_4$ $MgSO_4 \cdot 7H_2O$

Outline how you would carry out tests to distinguish these three solids.

(6 marks)

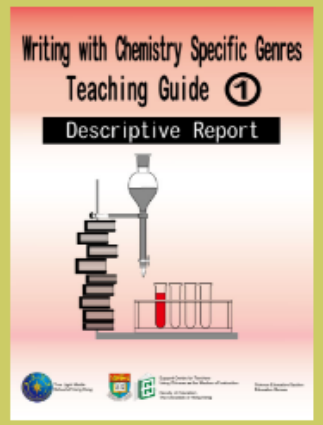
Writing with Chemistry Specific Genres

中文版 | Eng Version

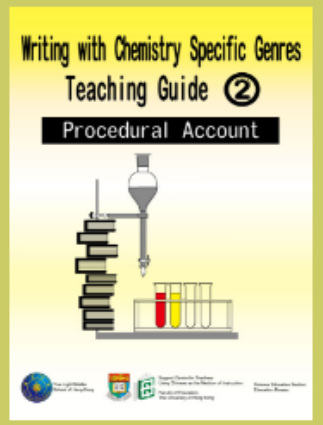
HOME | ACKNOWLEDGEMENTS | TEACHING GUIDE | ONLINE INTERACTIVE EXERCISE | WORKSHOP | REFERENCES | CONTACT US

Teaching Guide

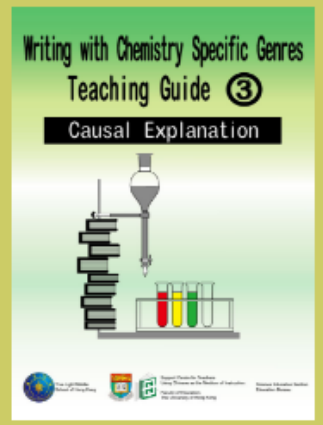
11 Jan 2012



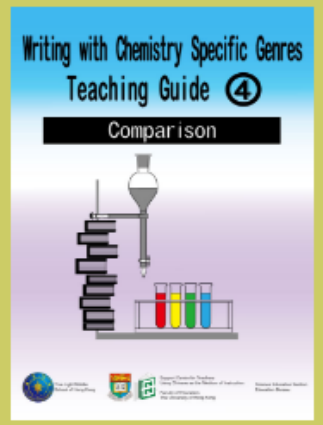
化學科專科語體教學指南 1 - 描述報告



化學科專科語體教學指南 2 - 程序記述



化學科專科語體教學指南 3 - 原因解說



化學科專科語體教學指南 4 - 比較語體

https://cd1.edb.hkedcity.net/cd/science/chemistry/resource/genre/

Example 1

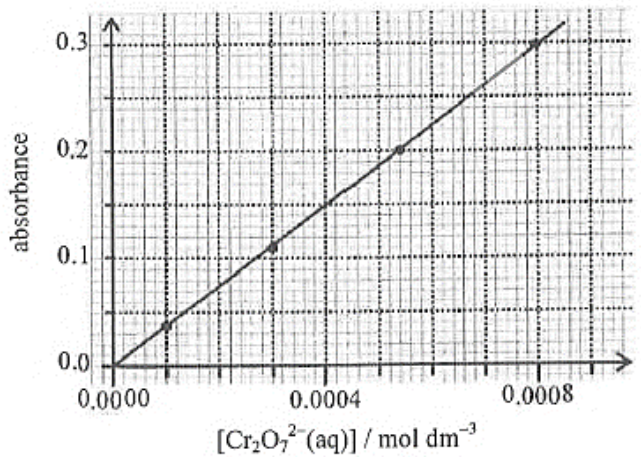
Topic XV Analytical Chemistry

Students should learn	Students should be able to
d. Instrumental analytical methods • **basic principles and applications of colorimetry**	• **understand the basic principles deployed in the instrumental analytical methods, viz. colorimetry, IR spectroscopy and mass spectrometry** • **construct a calibration curve by measuring absorbance of standard solutions** • **determine the concentration of a solution using a calibration curve**

2016 HKDSE Paper II Q3(b)

Topic XV(d) Instrumental analytical methods

3. (b) (ii) In colorimetry, various standard $Cr_2O_7^{2-}(aq)$ solutions were first prepared, and then the absorbance of these solutions were measured with a colorimeter installed with a blue filter. The calibration curve below shows the variation of absorbance with the concentration of $Cr_2O_7^{2-}(aq)$ ions.



(1) Suggest why a blue filter was used.

(2) With reference to the above calibration curve, state the relationship between absorbance and $[Cr_2O_7^{2-}(aq)]$.

(3) Sample **B** was diluted 100 times. The absorbance of the diluted solution was measured as 0.26 by the colorimeter. Based on the information given from the above calibration curve, calculate the concentration of $Na_2Cr_2O_7(aq)$ in **B**.

(4 marks)

(iii) Explain whether volumetric analysis or colorimetry is more appropriate in determining the concentration of a very dilute $Na_2Cr_2O_7(aq)$, such as around 10^{-4} mol dm^{-3}.

(1 mark)

The determination of copper in brass

Objective

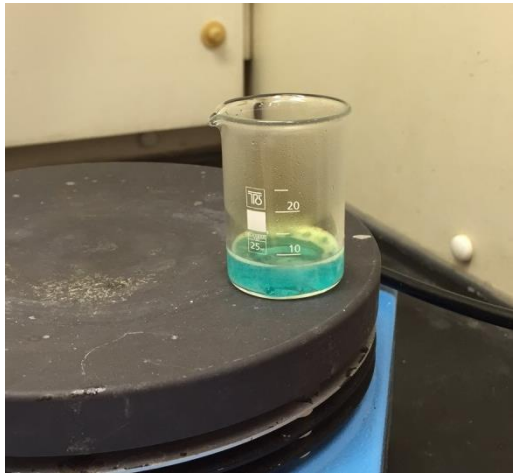
- To determine the amount of copper in a brass sample

Chemical reactions

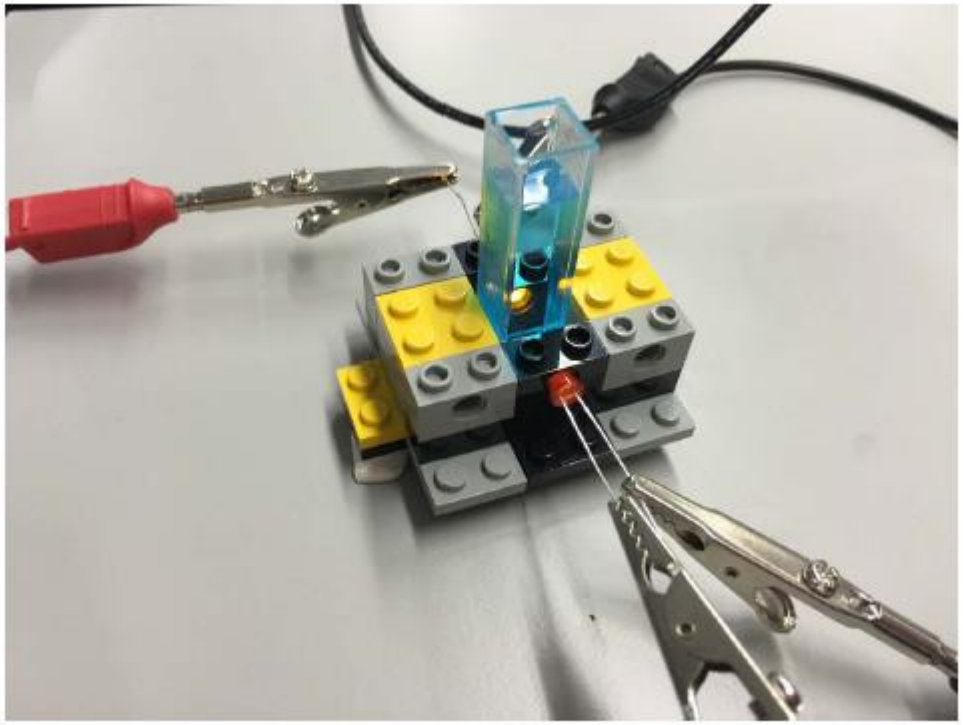
$3Zn + 2NO_3^- + 8H^+ \rightarrow 3Zn^{2+} + 2NO + 4H_2O$

$3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$

$2NO + O_2 \rightarrow 2NO_2$



The determination of copper in brass



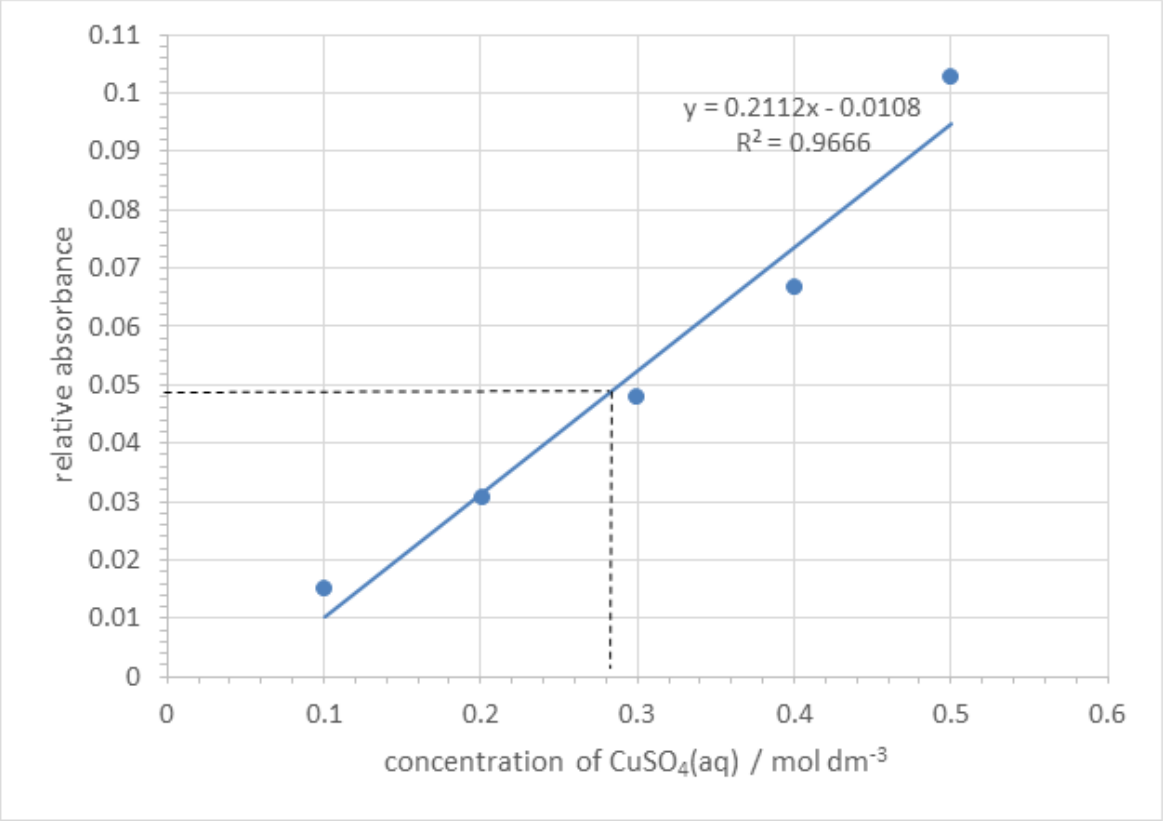
The determination of copper in brass

Relative absorbance = $\log_{10}(V_0 / V_s)$

where V_0 is the voltage reading with a cuvette containing deionized water
V_s is the voltage reading with a sample in the cuvette

	Deionised water	0.1 mol dm^{-3} $CuSO_4(aq)$	0.2 mol dm^{-3} $CuSO_4(aq)$	0.3 mol dm^{-3} $CuSO_4(aq)$	0.4 mol dm^{-3} $CuSO_4(aq)$	0.5 mol dm^{-3} $CuSO_4(aq)$	Sample solution
Voltage reading / V	0.822	0.794	0.766	0.736	0.705	0.649	0.735
Relative absorbance		$\log_{10}(0.822/0.794)$ = 0.0151	0.0306	0.0480	0.0667	0.103	0.0486

The determination of copper in brass



Conc. of sample $Cu^{2+}(aq)$ = 0.281 M

➔ Mass of Cu in brass solution = 0.178 g

➔ % by mass of Cu in brass sample = 59.3%

Example 2

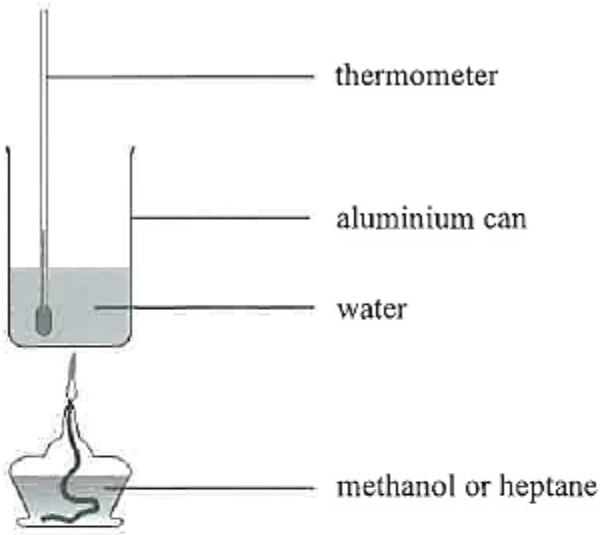
Topic VIII Chemical Reactions and Energy

Students should learn	Students should be able to
b. Standard enthalpy changes of reactions	• **explain and use the terms: enthalpy change of reaction and standard conditions, with particular reference to neutralisation, formation and combustion** • **carry out experimental determination of enthalpy changes using simple calorimetric method** • **calculate enthalpy changes from experimental results**

2018 HKDSE Paper IB Q6(b)

Topic VIII(b) Standard enthalpy changes of reactions

6. (b) Burning heptane (C_7H_{16}) releases energy. The enthalpy change of combustion of heptane was determined using the set-up shown below :



Step (I) : The aluminium can with a fixed mass of water was heated by burning methanol. The temperature of water increased by 18.5 °C after 1.58 g of methanol was burnt.

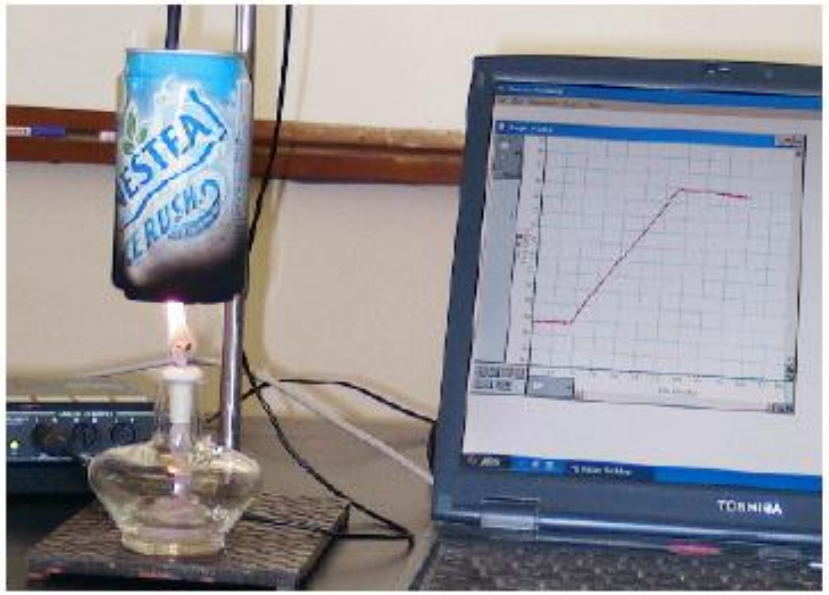
Step (II) : The aluminium can with the same mass of water in Step (I) was heated by burning heptane. The temperature of water increased by 25.8°C after 1.02 g of heptane was burnt.

(i) Given that, under the conditions of experiment, the enthalpy change of combustion of methanol is –715 kJ mol^{-1}, calculate the enthalpy change of combustion of heptane, in kJ mol^{-1}, under the same conditions.
(Relative molecular masses: methanol = 32.0, heptane = 100.0)

Determination of the Heat of Combustion of Alcohols

1. Calibration of the aluminum can with fixed amount of water

	1st run	2nd run	Unit
Molar mass of methanol, *Mr*	32		g mol $^{-1}$
Initial mass of alcohol lamp + methanol, m_1	172.10		g
Final mass of alcohol lamp + methanol, m_2	170.52		g
Mass of methanol burned, $m_1 - m_2$	1.58		g
Number of mole of methanol burned, $n = (m_1 - m_2) / Mr$	0.0494		mol
Initial temperature of aluminium can with 250 cm^3 of water	26.12		°C
Final temperature of aluminium can with 250 cm^3 of water	44.5		°C
Temperature change, ΔT	18.38		K
ΔH_c^{θ} [$CH_3OH(l)$]	-715 kJ mol $^{-1}$		
Heat released during the experiment, $\Delta H = \Delta H_c^{\theta}[CH_3OH(l)] \times$ no. of mole of methanol burned = -715 kJ mol $^{-1} \times n$	35.32		kJ
Heat capacity of aluminum can with 250 cm^3 of water, *c* (heat required for a rise in temperature of 1 K) $= \Delta H / \Delta T$	1.92		kJ K^{-1}
Average value of *c*			kJ K^{-1}



2. Heat of combustion of ethanol and propan-1-ol

	CH_3CH_2OH	$CH_3CH_2CH_2OH$
Molar mass, *Mr* / g mol^{-1}	46	60
Initial mass of alcohol lamp/g	163.83	164.78
Final mass of alcohol lamp/g	162.48	163.56
Mass of alcohol burned/g	1.35	1.22
Amount of alcohol burned, *n*/mol	0.0294	0.0203
Initial temperature/ °C	25.39	25.44
Final temperature/ °C	44.35	44.44
Temperature change, ΔT/K	18.96	19.00
$\Delta H_c^{\theta} = c \times \Delta T$ / n (kJ mol^{-1})	1238.20	1797.04

Example 3

Topic VIII Chemical Reactions and Energy

Students should learn	Students should be able to
b. Standard enthalpy changes of reactions	• **explain and use the terms: enthalpy change of reaction and standard conditions, with particular reference to neutralisation, formation and combustion** • **carry out experimental determination of enthalpy changes using simple calorimetric method** • **calculate enthalpy changes from experimental results**

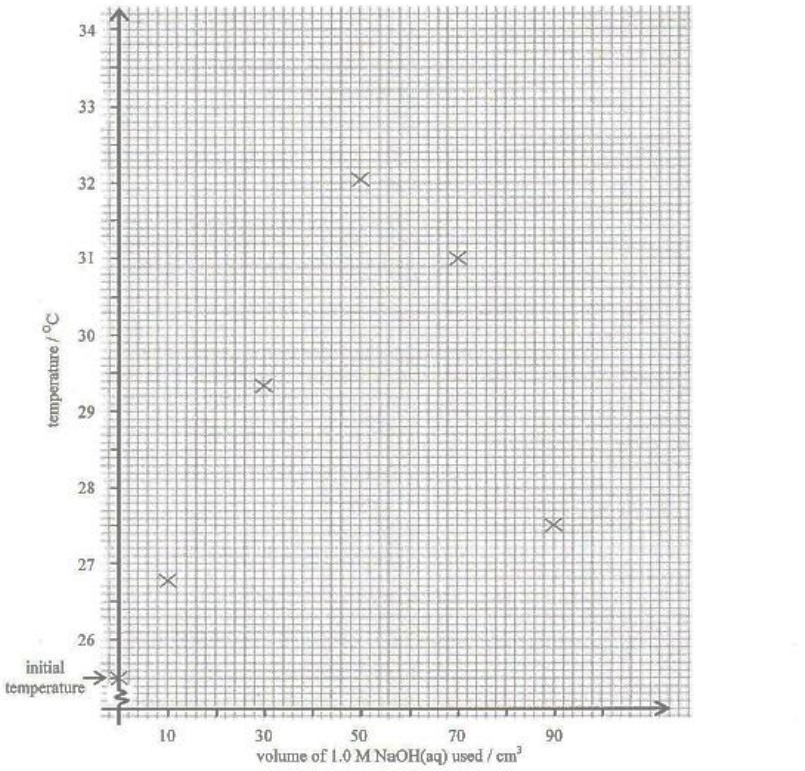
2019 HKDSE Paper IB Q8

Topic VIII(b) Standard enthalpy changes of reactions

8. Several trials of an experiment were performed for determining the enthalpy change of neutralisation for a reaction. For each trial, a total volume of 100.0 cm^3 of a solution was obtained from mixing specified volumes of a HCl(aq) and 1.0 M NaOH(aq) as shown below in an expanded polystyrene cup. The HCl(aq) and NaOH(aq) were kept at the same initial temperature before mixing.

Trial	1	2	3	4	5
Volume of the HCl(aq) used / cm^3	90	70	50	30	10
Volume of 1.0 M NaOH(aq) used / cm^3	10	30	50	70	90

For each trial, the mixture was stirred and its maximum temperature reached was recorded. A graph of the maximum temperature reached for each trial is shown below :



Determining the Stoichiometry of Reaction Between ClO^- and $S_2O_3^{2-}/OH^-$

Objective

To determine the stoichiometry of a chemical reaction

_____ClO^- + _____$S_2O_3^{2-}$ + _____OH^- → _____Cl^- +_____SO_4^{2-} +_____H_2O

Chemicals

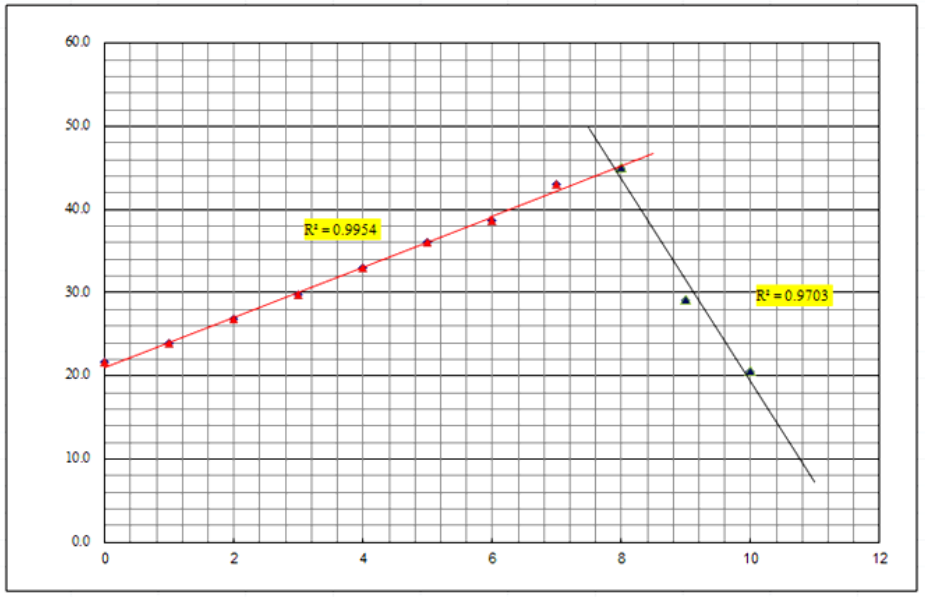
Solution **A**: 0.5 M sodium hypochlorite, 55 mL

Solution **B**: 0.5 M sodium thiosulphate in 0.2 M sodium hydroxide, 55 mL

Trial	1	2	3	4	5	6	7	8	9	10	11
Volume of solution A (mL)	10	9	8	7	6	5	4	3	2	1	0
Volume of solution B (mL)	0	1	2	3	4	5	6	7	8	9	10
Maximum Temp (℃)											

Sample data

Volume of Solution A (ClO-, cm3)	Max Temp (degree C)
10	20.6
9	29.1
8	45.0
7	43.1
6	38.6
5	36.0
4	33.0
3	29.8
2	26.9
1	23.9
0	21.7



For every 1 mole of $Na_2S_2O_3$ that reacts, 4 moles of NaClO are needed.

$4\ ClO^- + S_2O_3^{2-} + 2\ OH^- \rightarrow 4\ Cl^- + 2\ SO_4^{2-} + H_2O$

Activity 2

Consider the following practical activity, and complete the task in the following path:

https://forms.gle/1xNK5RXMvxPFHgoCA

Procedures:

1. Using a dropping pipette, put respectively nitrate solutions in the spotting tile, with reference to Figure 1.
2. Put a piece of each metal in each of the solutions, with reference to Figure 1.
3. Observe the change on the wells of the spotting tile.

Questions:

1) Write a chemical equation between zinc and copper nitrate solution.
2) Give the reactivity series in ascending order for the metals involved in the experiment.
3) Explain why there is no observable change when lead metal is added to magnesium nitrate solution.

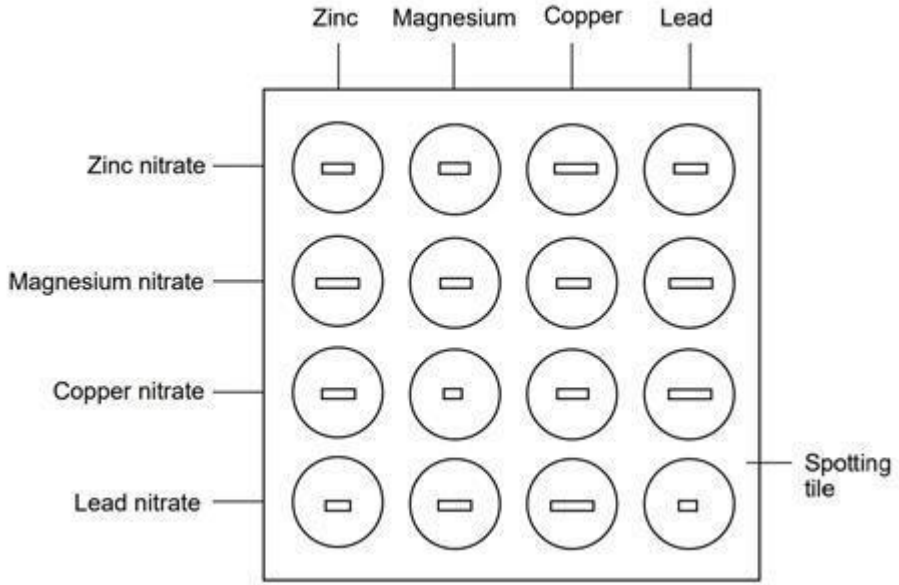
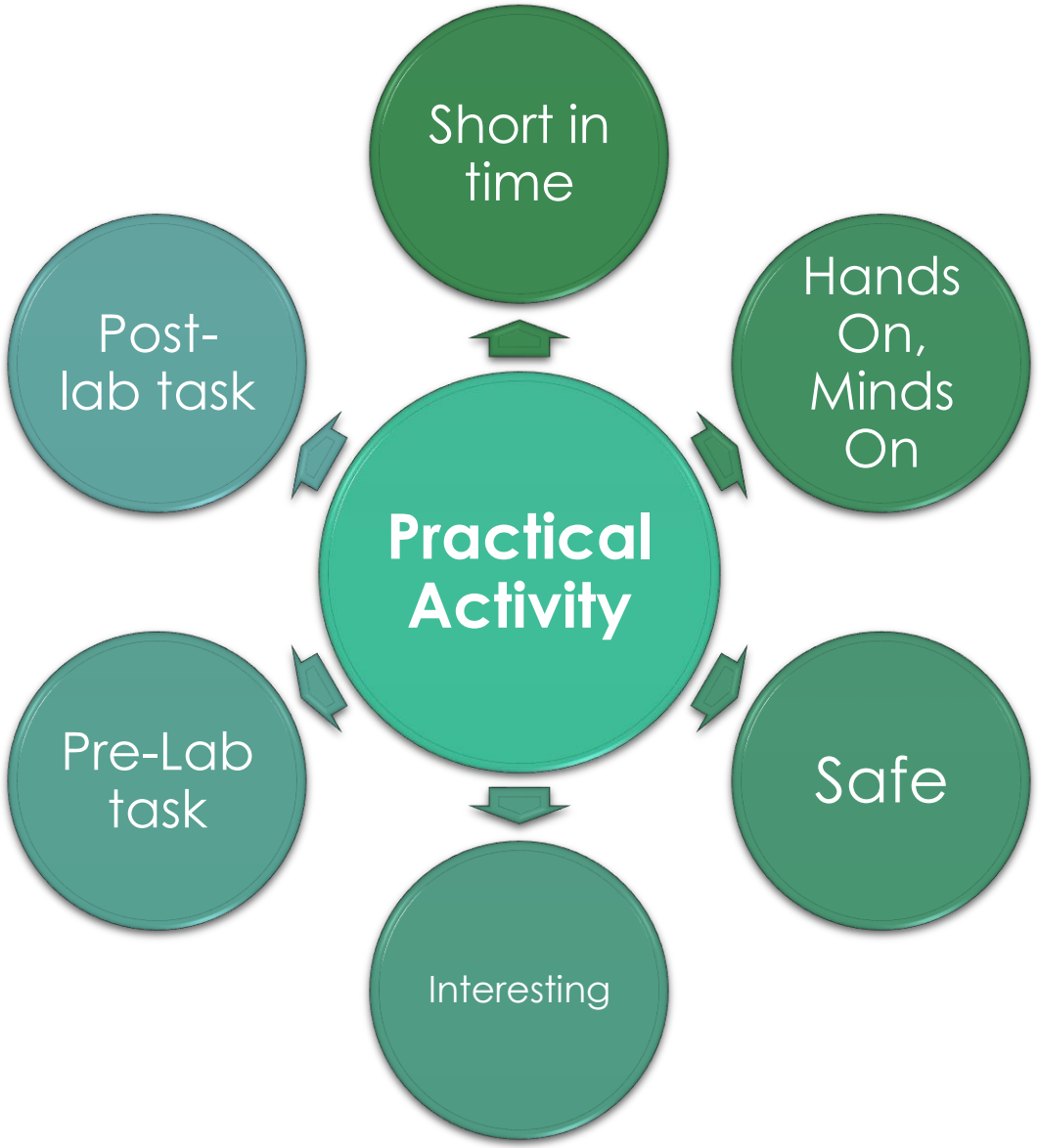


Figure 1

Resources for Learning, Teaching and Assessment of Chemistry

1. Chemistry Practical Activities – the Focuses
2. Chemical Demonstration
3. Micro-scale Chemistry Experiments
4. Use of technologies in Chemistry Experiments
5. Resources

1 Chemistry Practical Activities – the Focuses

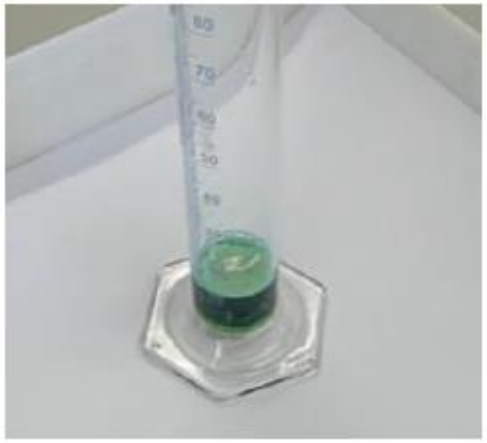


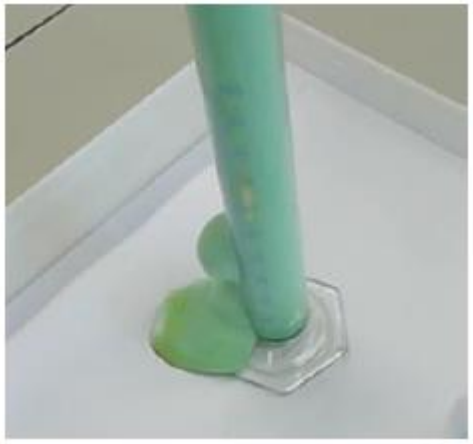
2 Chemical Demonstration

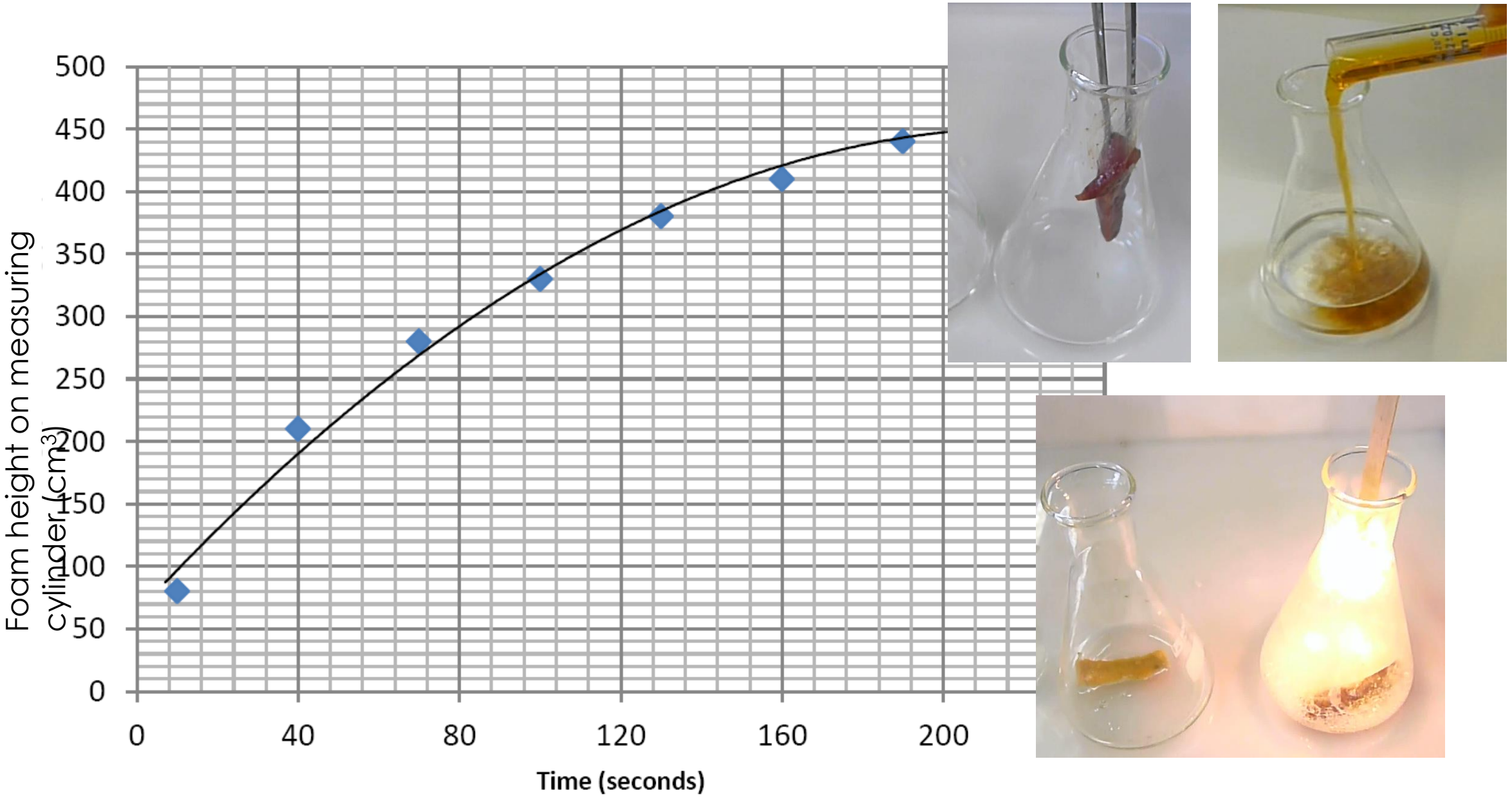
Example: “Elephant Toothpaste”

Chemical and apparatus

◦ 6% $H_2O_2(aq)$	50 cm^3
◦ $MnO_2(s)$ - Catalyst	0.5 g
◦ Soap	3 – 5 cm^3
◦ Spatula	x 1
◦ 10cm^3 measuring cylinder	x 1
◦ 50cm^3 measuring cylinder	x 1
◦ 500cm^3 measuring cylinder	x 1
◦ Timer	x 1
◦ Smartphone	x 1

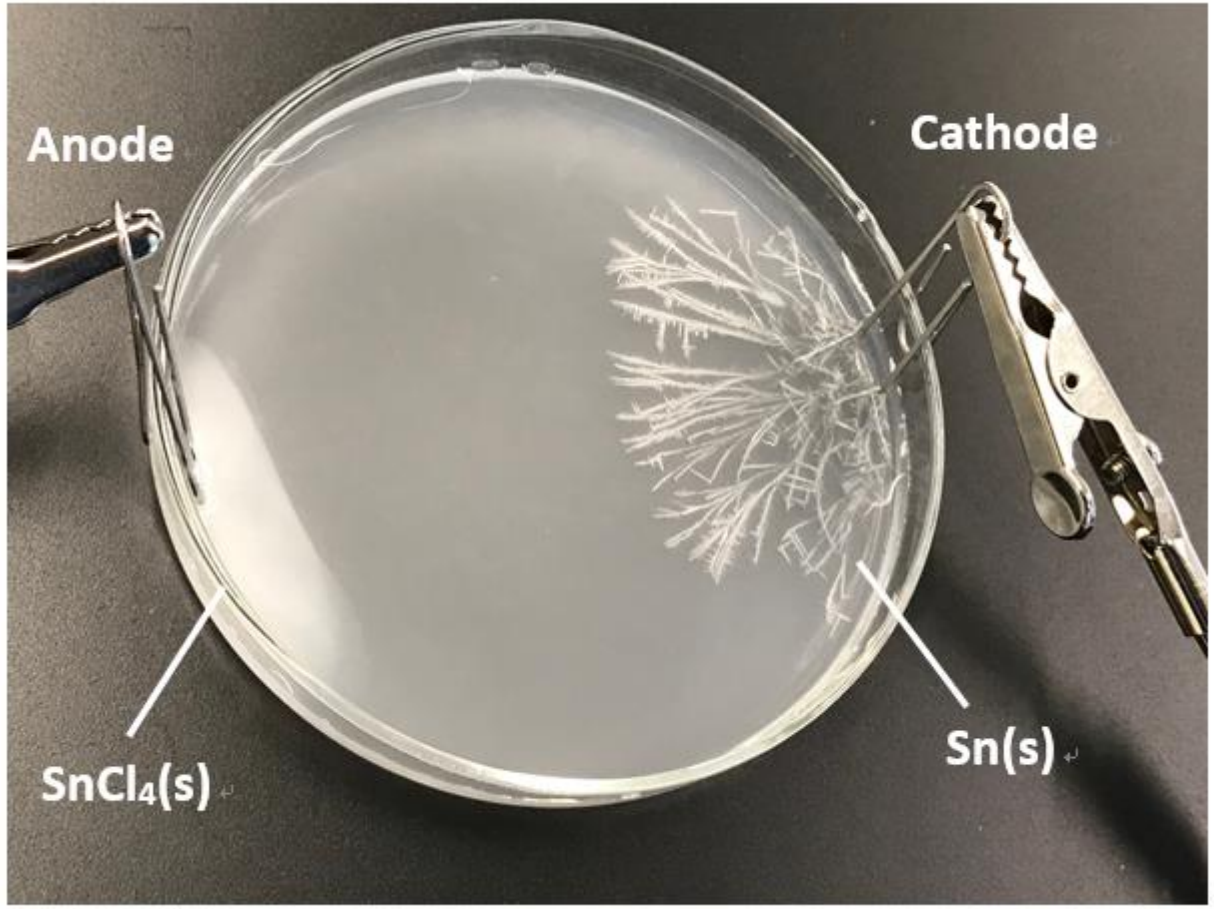


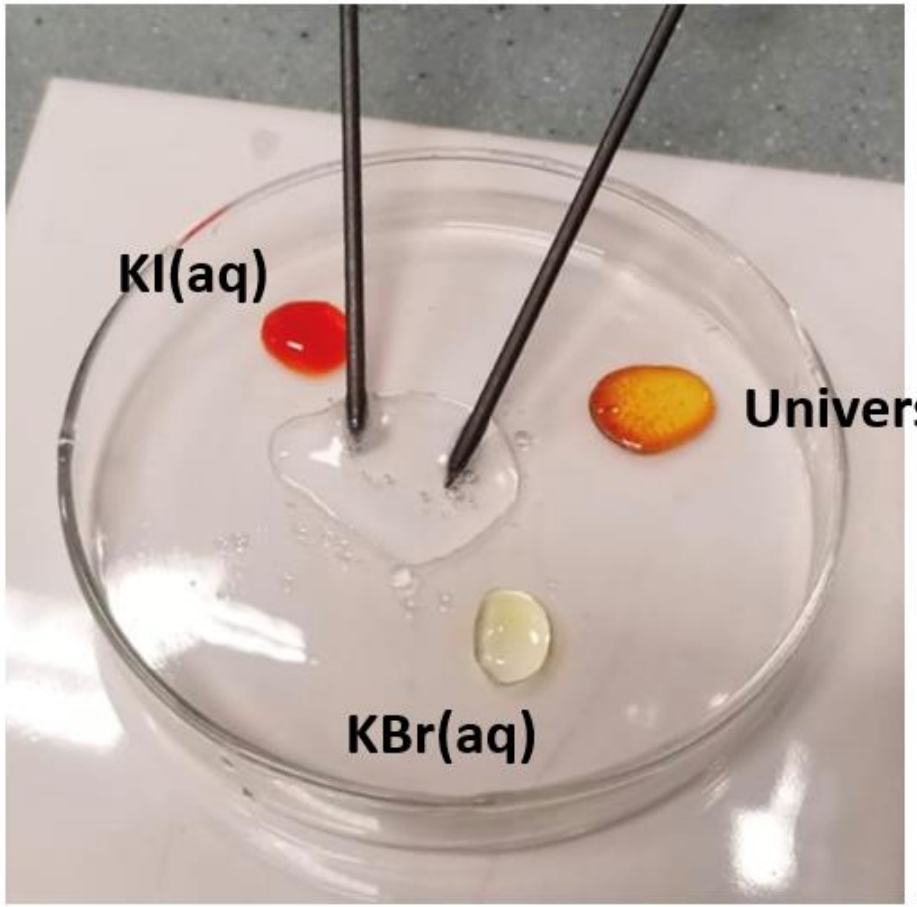



Foam height on measuring cylinder (cm3)
500
450
400
350
300
250
200
150
100
50
0
0
40
80
120
160
200
Time (seconds)

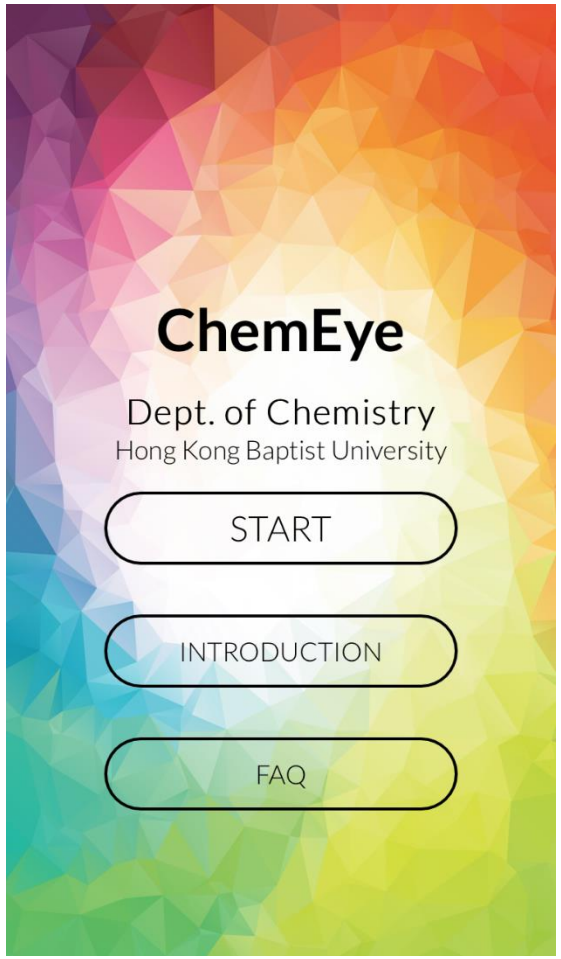
3 Micro-scale Chemistry Experiments

Example: “Electrolysis of tin(II) chloride solution and sodium chloride solution”





4 The use of technologies in Chemistry experiment
Example: The use of Smartphone and Mobile App in Chemistry Practical Activities



- **"ChemEye" by Hong Kong Baptist University, Chemistry Department**
- Curriculum link – Topic XV Analytical Chemistry
- To understand the basic principles and theory of colorimetry
- The use of smartphone and the mobile app allows practical activities to be performed inside and outside laboratory

iOS

Android

chemistry edb

2940 位訂閱者

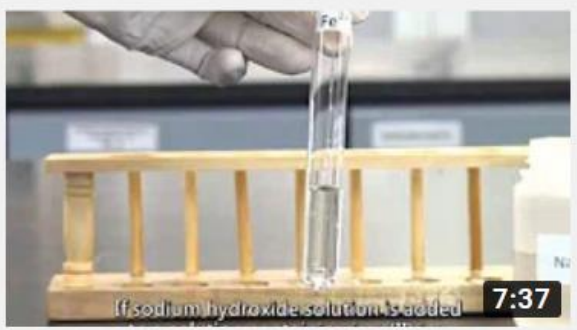
訂閱

首頁 影片 播放清單 社群 頻道 簡介

熱門上傳影片 ▶ 全部播放 英

Using Tollens' Reagent to Test for Aldehydes (Silver Mirror Test)

觀看次數：16萬次 • 5 年前



Qualitative Analysis of Cations

觀看次數：11萬次 • 5 年前

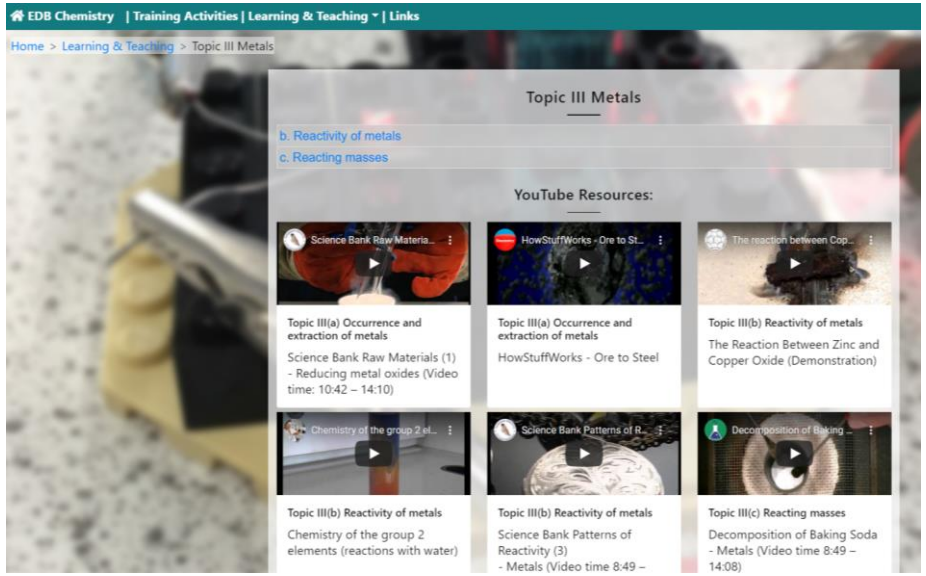
Qualitative Analysis of Anions

觀看次數：9.1萬次 • 5 年前

5 Teaching Resources - New Webpage

- Latest news and information of student activities
- Training programmes on Science / STEM education and Chemistry
- Learning and teaching resources (Sort topics)
  - Animations
  - Simulations
  - Practical activities

- Please bookmark this page and subscribe to get our update notifications !



https://cd1.edb.hkedcity.net/cd/science/chemistry/teacher_resources/index.html