

Exam Paper Format

The latest HKCE Chemistry Examination, starting from 2005, consists of two papers.

	Paper 1	Paper 2
Types of questions	Conventional questions	Multiple-choice questions
Duration	1 hour 45 minutes	1 hour
Percentage share of the total subject marks	64%	36%
Details of the papers	<p><u>Section A</u></p> <ul style="list-style-type: none">• 60% of paper mark• All questions are compulsory.• Consists of questions set on the Core part of the syllabus. <p><u>Section B</u></p> <ul style="list-style-type: none">• 40% of paper mark• All questions are compulsory.• Consists of questions set on the whole syllabus.	<p><u>Section A</u></p> <ul style="list-style-type: none">• 60% of paper mark• All questions are compulsory.• Consists of questions set on the Core part of the syllabus. <p><u>Section B</u></p> <ul style="list-style-type: none">• 40% of paper mark• All questions are compulsory.• Consists of questions set on the whole syllabus.

Comparison between NEW and OLD syllabuses

In the NEW Chemistry syllabus, some topics are newly added and some are removed or deleted. Moreover, the syllabus is divided into two parts: **core** and **extension**. Some difficult topics are grouped under the extension part and they will only be asked in Section B of both Papers 1 and 2.

(a) Topics added into the syllabus

Sections	Topics added
1 Planet Earth	<ul style="list-style-type: none">• The atmosphere• The ocean• Rocks and minerals
2 The Microscopic World	<ul style="list-style-type: none">• Similarities in chemical properties among elements in Group 0• Metallic bonding
3 Metals	<ul style="list-style-type: none">• Occurrence of metals in nature, in free state and in combined forms• Quantitative relationship of the reactants and products as revealed from a chemical equation• Mole• Percentage by mass of an element in a compound• Empirical formulae derived from experimental data• Reacting masses from chemical equation
4 Acids and Alkalis	<ul style="list-style-type: none">• Action on ammonium compounds to give ammonia gas• Rate of reaction
5 Chemical Cells and Electrolysis	<ul style="list-style-type: none">• Nitric acid of different concentrations as oxidizing agent to give NO and NO₂
6 Products from Important Processes	<ul style="list-style-type: none">• Properties of concentrated sulphuric acid• Preparation of sulphuric acid by 'action of acids on sulphites'
7 Fossil Fuels and Carbon Compounds	<ul style="list-style-type: none">• Alkene• Alkanols
8 Plastics and Detergents	<ul style="list-style-type: none">• Moulding methods in relation to their thermal properties• Equation for the production of soaps by relating fats or oil with alkali
9 Detection and Analysis	<ul style="list-style-type: none">• Separation of mixtures• Flame test and tests for chloride, bromide, iodide and sulphate ions.• Awareness of the uses of modern chemical instruments

9 Detection and Analysis

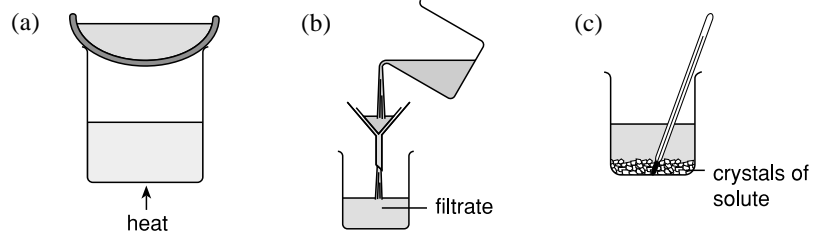


Detection and Analysis

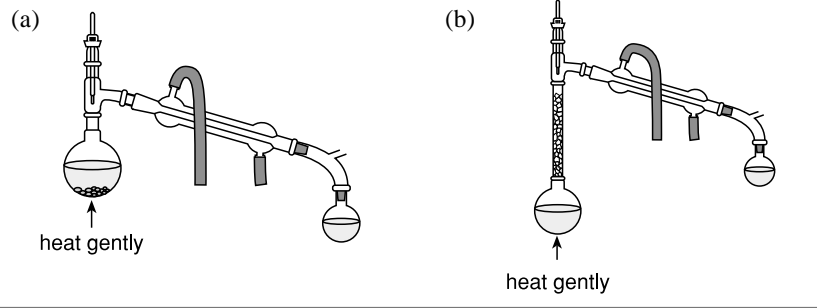
Separation of mixtures

Paper chromatography
 • Chromatography can be used to separate two or more solutes (solids) which are soluble in the same solvent.

Evaporation, filtration and crystallization
 • Evaporation (see (a)) is the method of separating soluble solids from a solution.
 • Filtration (see (b)) is the method of separating insoluble substances from a solution.
 • Crystallization (see (c)) is the method of separating a soluble salt from a solution.



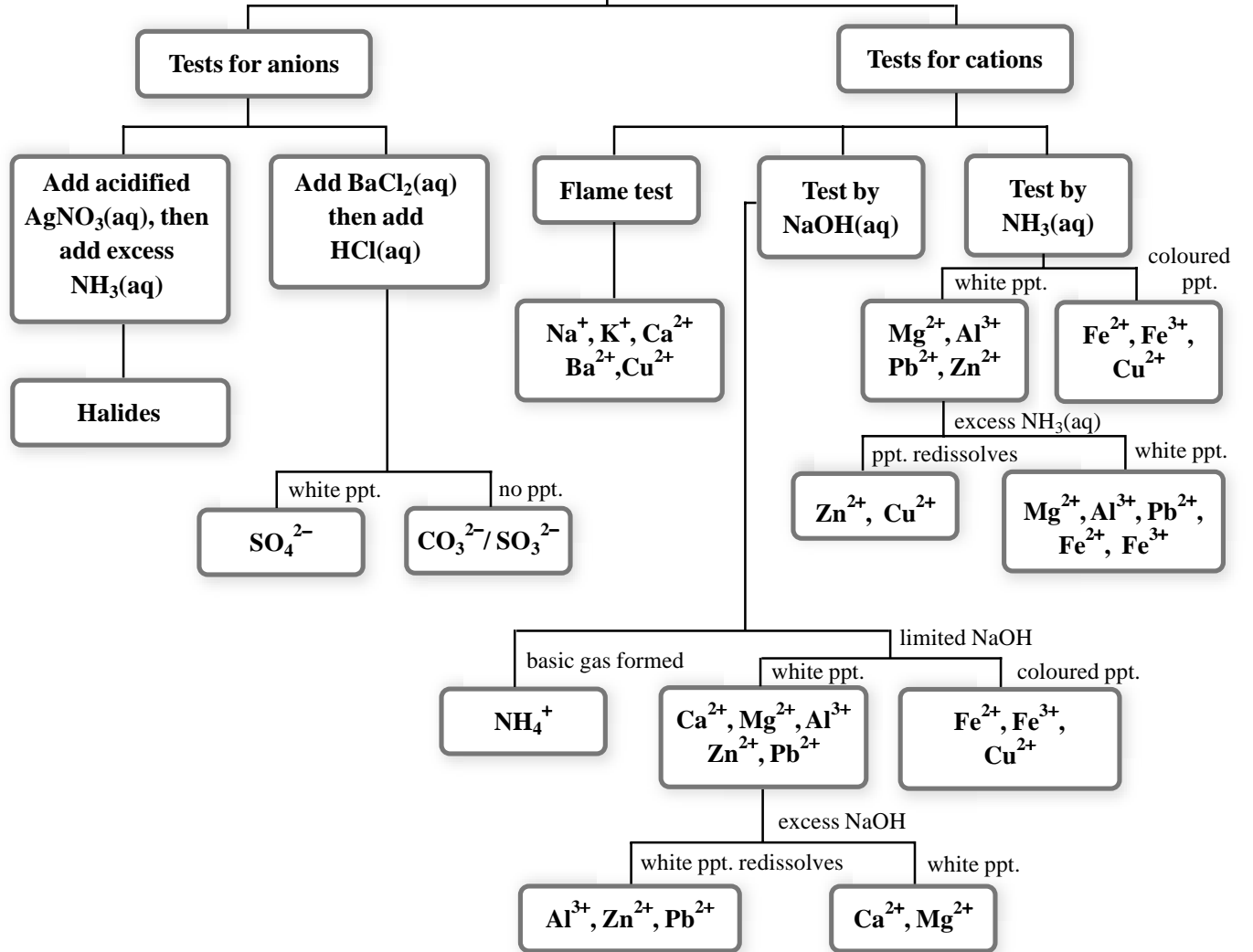
Simple distillation and fractional distillation
 • Simple distillation (see (a)) is used to separate a single liquid from one or more solids in a solution.
 • Fractional distillation (see (b)) is used to separate a mixture of miscible liquids.



Tests for gases or vapours
 Oxygen, hydrogen, carbon dioxide, sulphur dioxide, ammonia, chlorine, water and nitrogen

Test for substances

Tests for ions



7.4 Alkenes



Learning Focus

- Study the systematic naming of alkenes.
- Outline the physical and chemical properties of alkenes.
- Learn the uses of alkenes.

A. Introduction of alkenes

- Alkenes (烯烴) are unsaturated hydrocarbons (不飽和烴) with a C = C double bond.
- They form another homologous series with the general formula of C_nH_{2n} .
- They can be obtained from the cracking of petroleum.
- The following set-up is used for cracking medicinal paraffin:

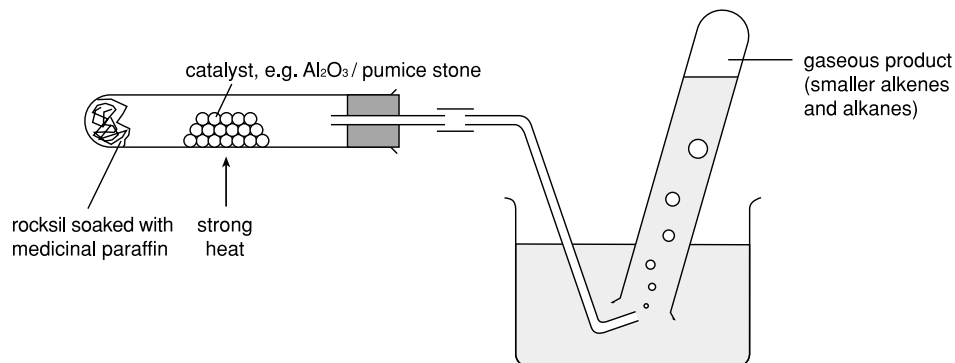
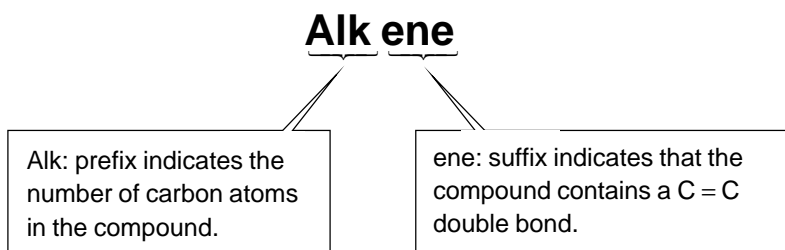


Figure 7.10

B. The naming of alkenes

(a) Straight chain alkenes

- The general formula of alkenes is C_nH_{2n} .
- The name of a straight chain alkene is composed of a prefix and a suffix.



C. The preparation of soap Extension

- By heating a mixture of animal fats or vegetable oils and concentrated sodium hydroxide solution, glycerol (甘油) and soap (肥皂) are formed.

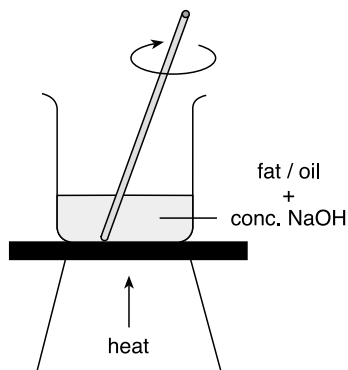
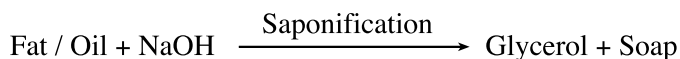


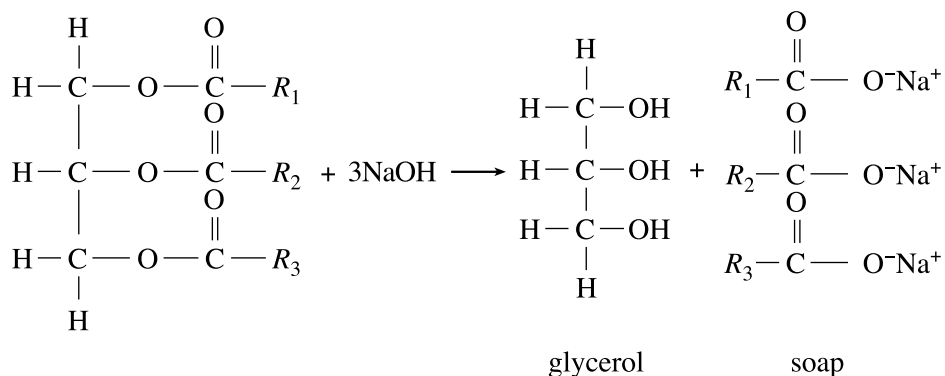
Figure 8.21



Reminder

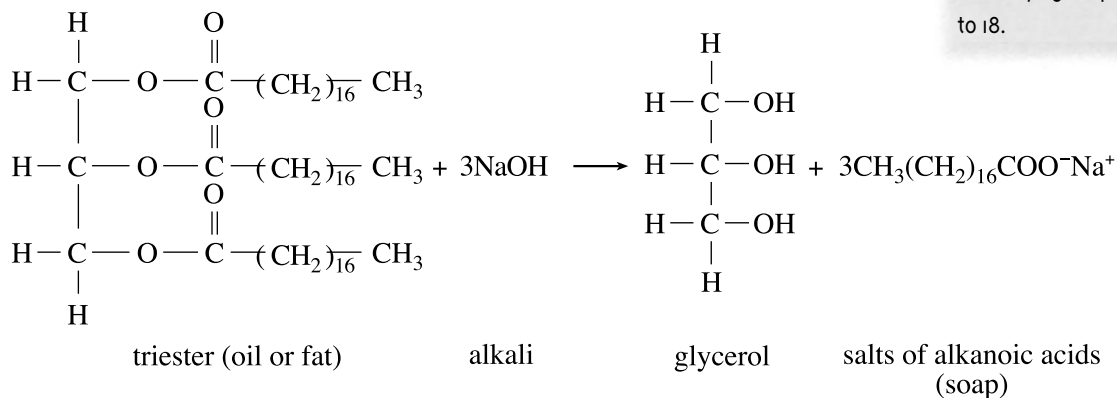
- Potassium hydroxide solution can be used instead of sodium hydroxide solution.
- Saponification (皂化作用) is a process which is used for making soap.

- The equation of the formation of triester (三酯) (oil or fat) is as follows:



All alkyl groups in triester or soap may or may NOT be equal, i.e. $R_1 = R_2 = R_3$ or $R_1 \neq R_2 \neq R_3$.

- For example, if $R_1 = R_2 = R_3 = (\text{CH}_2)_{16}\text{CH}_3$:



Reminder

- The best carbon range in the alkyl group is from 13 to 18.

Guided Example 1

Styrene was heated with kerosene at 150°C for 45 minutes as shown in the following figure. After cooling, the mixture was poured into about five times its own volume of methanol. A white solid formed under the surface of the methanol.

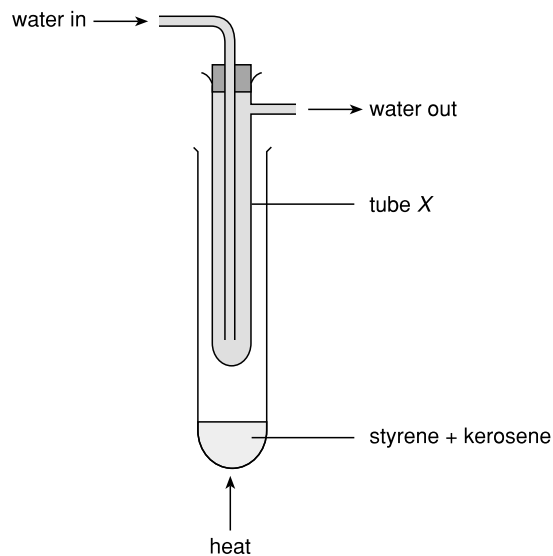


Figure 8.1

- (a) (i) The mixture was heated by using an electric heating mantle. Explain briefly.
 (ii) What was the function of tube X in the above set-up?
- (b) What was the function of kerosene in the experiment?
- (c) (i) Write the structural formula of styrene.
 (ii) Name the white solid.
 (iii) Write an equation for the formation of this white solid.
 (iv) Draw the structure for the repeating unit of the white solid.



Reminder

Students should know how to draw this experimental set-up, which may be set in the HKCEE.



Reminder

Most plastics are white solids.

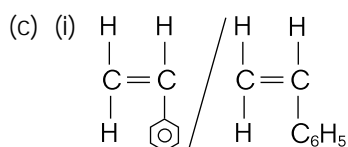


Reminder

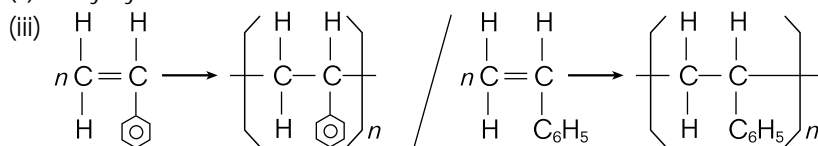
In part (a)(i), 'kerosene is inflammable' is also acceptable.

Suggested Answer

- (a) (i) This is because kerosene is **flammable**.
 (ii) Tube X is used as a **condenser / cold finger**.
- (b) Kerosene acts as a **catalyst** or **solvent** for the reaction.



(ii) Polystyrene



- A chemical plant usually occupies a large area of land, so the cost of land is a very important factor.
- Skillful workers should be available.

(2) Demand for products

- If there is a demand for the chemical products in nearby areas (e.g. Mainland China), the transportation costs will be reduced.

(3) Environmental impact

- Chemical plants usually release chemical wastes such as acid, toxic chemicals, etc. This leads to serious environmental pollution of different types.
- Hong Kong is an overcrowded city. Any serious leakage of pollutants or chemicals, or explosions, would be dangerous and disastrous for nearby residents.

Glossary

Avogadro's Law	亞佛加德羅定律	hydrochloric acid	氫氯酸
brine	濃鹽水	hypochlorite ion	次氯酸根離子
catalyst	催化劑	hypochlorous acid	次氯酸
chlorine	氯	mercury cell	汞電解池
chlorine bleach	氯漂白劑	molar volume	摩爾體積
chlorine water	氯水	oleum	發煙硫酸
Contact process	接觸法	sodium amalgam	鈉汞齊
dehydrating agent	脫水劑	sodium hypochlorite	次氯酸鈉
diaphragm cell	隔膜電池	sulphur dioxide	二氧化硫
drying agent	乾燥劑	sulphuric acid	硫酸
heptane	庚烷	sulphurous acid	亞硫酸
hydrated salt	水合鹽		

Important Formulae

Molar volume of any gas = $24 \text{ dm}^3 \text{ mol}^{-1}$

$$\begin{aligned} \text{Number of moles of a gas} &= \frac{\text{Volume of gas}}{\text{Molar volume}} \\ &= \frac{\text{Volume of gas (dm}^3\text{)}}{24 \text{ dm}^3 \text{ mol}^{-1}} \end{aligned}$$

Exam Question Analysis

Topics	Conventional Questions (Year)	Multiple-choice Questions (Year)
Chlorine and hypochlorite	93(5b), 95(8b), 97(8a), 98(9b), 02(9b), 04(9av), 07(3)	94(21), 96(30, 31), 97(21), 98(42), 00(47), 03(44), 04(18, 22, 36), 07(22, 37)
Sulphuric acid and sulphur dioxide	94(8b), 96(8biii), 97(6b), 98(8a), 99(9a), 00(8cii), 01(9c, d), 03(7ci), 04(7ci), 05(4), 06(3a)	93(25), 94(38), 95(13, 38), 96(37), 97(29, 36, 39, 45), 98(30, 32, 38), 99(24), 00(44, 45), 01(35), 02(30, 31, 38, 41), 03(22, 24, 39), 04(19, 32, 47), 05(15, 16, 17, 30, 47), 06(15, 20), 07(25)
Molar volume of gases	03(6aiv), 04(8aiv), 06(12)	96(11, 19, 32), 97(34), 98(46), 99(16), 00(48), 01(27), 02(16), 03(6), 04(3, 6, 21), 05(35), 06(41), 07(33)
Chemical plants	—	—

Demonstration

Paper I Conventional Questions

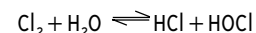
Section A

1. A student performed experiments on chlorine-containing substances and obtained the following results:

Experiment	Procedures	Results
I	Dilute hydrochloric acid was added to bleaching solution and heated.	A greenish-yellow gas X was evolved.
II	Gas X was passed into sodium hydroxide solution.	Gas X dissolved into the sodium hydroxide solution completely.
III	Gas X was bubbled into sodium bromide solution, then tetrachloromethane was added to the solution.	Two layers of liquids were obtained.
IV	Gas X was bubbled into iron(II) sulphate solution.	The iron(II) sulphate solution turned yellowish-brown.

Guidelines

Chlorine gas is acidic.



Thus, it can react with NaOH.

Guidelines

Iron(II) ions have reducing power:

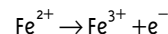


Table 6.11

Practice

Paper I Conventional Questions

Section A

1. For each of the following experiments, state an expected observation and write a chemical equation for the reaction involved.

- Chlorine gas is bubbled into a potassium bromide solution.
- Concentrated sulphuric acid was added dropwise to some sugar cube.
- Sulphur dioxide was bubbled into an acidified potassium dichromate solution.
- Dilute hydrochloric acid was added to chlorine bleach.

(8 marks)

2. The following set-up illustrate how to prepare the gas Y:

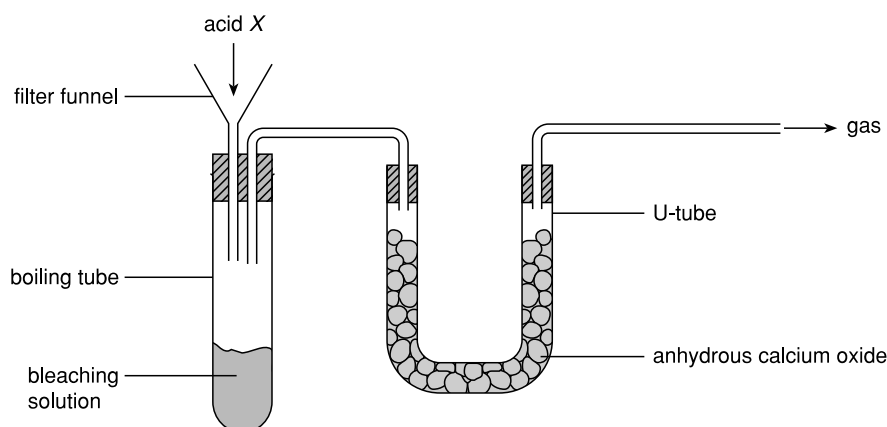


Figure 6.40

- Name the acid X used.
 - Write an equation for the reaction in boiling tube.
 - Explain whether this reaction is an example of a redox reaction.
- There are TWO mistakes in the above set-up.
 - What are they?
 - Suggest how each of the TWO mistakes could be corrected.
 - Draw a diagram to show how a jar of the gas Y can be collected.
- What would be observed if the gas Y is passed into test tubes containing aqueous solution of a reddish-purple vegetable dye? Write an equation for the reaction involved.

(11 marks)

Index

A

acid rain 酸雨	165
addition polymer 加成聚合物	211
addition polymerization 加成聚合作用	200, 211
addition reaction 加成反應	156
alcohol 酒精	174
alkaline manganese cell 鹼性錳電池	28
alkane 烷烴	140, 141
alkanoic acid 烷酸	140, 178
alkanol 烷醇	174
alkene 烯烴	140, 154
alkyl group 烷基	143
anion 陰離子	137, 283
anode 陽極	23
anodization 陽極電鍍	45
Avogadro's Law 亞佛加德羅定律	102

B

biodegradable 生物可降解的	236
biomass 生物量	174
block diagram 方塊圖	214
brine 濃鹽水	77

C

carbon monoxide 一氧化碳	162
catalyst 催化劑	90, 141
catalytic converter 催化轉化器	168
catalytic cracking 催化裂解作用	151
cathode 陰極	23
cation 陽離	136, 287
chemical cell 化學電池	16
chlorine 氯	76
chlorine bleach 氯漂白劑	76
chlorine water 氯水	79
chromatogram 色層譜	271
chromatography 色層分析法	270
coal 煤	134
combustion 燃燒	148

compression moulding 壓縮成型	226
condensation polymer 縮合聚合物	214
condensation polymerization 縮合聚合作用	210, 214
Contact process 接觸法	89
cracking 裂解作用	148
cross-link 交鍵	220
crude oil 原油	136
crystal 晶體	273
crystallization 結晶	270, 272

D

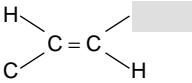

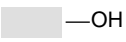
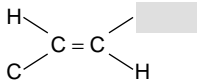
dehydrating agent 脫水劑	92
detergent 清潔劑	232
diaphragm cell 隔膜電池	77
diesel oil 柴油	159
dioic acid 二酸	218
diol 二醇	218
distillation 蒸餾	270
dry cell 乾電池	28
drying agent 乾燥劑	92
dye 染料	227

E

electrochemical series 電化次序	34
electrode 電極	16
electrolysis 電解	30
electrolyte 電解質	16
electroplating 電鍍	44
electrostatic precipitator 靜電沉積器	169
emission spectrometer 發射光譜儀	289
emulsifying action 乳化作用	232
emulsifying agent 乳化劑	235
endothermic reaction 吸熱反應	159
energy from biomass 生物量	173
ester 酯	140, 182
esterification 酯化作用	183
ethanol 乙醇	177

Question Commands

The following table lists the question command(s) which showing the requirements of answering questions:

Question commands	Examples
What / Which ... (Simple answer is usually required.)	<p>What gas evolves? Correct answer: Sulphur dioxide / SO₂</p> <p>What is the direction of electron flow in the external circuit? Correct answer: From left to right</p> <p>Which of the following compounds can be used to make an addition polymer?</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p>Correct answer: </p>
Suggest a formula ...	<p>The oxide of aluminium is insoluble in water, suggest the formula for this oxide. Correct answer: Al₂O₃ Incorrect answer: Aluminium oxide</p>
Name ... (Formula / Structure is NOT accepted.)	<p>Name an element which is a metalloid. Correct answer: Boron Incorrect answer: B</p>
Write the chemical equation ... (Although either chemical / ionic equation is accepted. The best answer should be a chemical equation.)	<p>Write a chemical equation for the reaction when adding dilute hydrochloric acid to zinc granules. Correct answer: Zn + 2HCl → ZnCl₂ + H₂ (chemical equation) Poor answer: Zn + 2H⁺ → Zn²⁺ + H₂ (ionic equation)</p>
Write the chemical equation ...	<p>Write a chemical equation for the reaction between sodium and water. State symbols should be given. Correct answer: 2Na(s) + 2H₂O(l) → 2NaOH(aq) + H₂(g) (Score 2 marks) Poor answer: 2Na + 2H₂O → 2NaOH + H₂ (Score 1 mark only) (Remarks: 1 mark for equation and 1 mark for state symbols)</p>
Write an ionic equation ...	<p>Write an ionic equation for the reaction when adding hydrochloric acid to sodium carbonate. Correct answer: 2H⁺ + CO₃²⁻ → H₂O + CO₂ Incorrect answer: 2HCl + Na₂CO₃ → H₂O + CO₂ + 2NaCl</p>