# 香港考試及評核局
# HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

## 2012年香港中學文憑
## HONG KONG DIPLOMA OF SECONDARY EDUCATION 2012

## CHEMISTRY PAPER 2

## MARKING SCHEME

本評卷參考乃香港考試及評核局專爲今年本科考試而編寫，供閱卷員參考之用。閱卷員在完成閱卷工作後，若將本評卷參考提供其任教會考班的本科同事參閱，本局不表反對，但須切記，在任何情況下均不得容許本評卷參考落入學生手中。學生若索閱或求取此等文件，閱卷員 / 教師應嚴詞拒絕，因學生極可能將評卷參考視爲標準答案，以致但知硬背死記，活剝生吞。這種落伍的學習態度，既不符現代教育原則，亦有違考試着重理解能力與運用技巧之旨。因此，本局籲請各閱卷員/教師通力合作，堅守上述原則。

This marking scheme has been prepared by the Hong Kong Examinations and Assessment Authority for markers' reference. The Authority has no objection to markers sharing it, after the completion of marking, with colleagues who are teaching the subject. However, under no circumstances should it be given to students because they are likely to regard it as a set of model answers. Markers/teachers should therefore firmly resist students' requests for access to this document. Our examinations emphasise the testing of understanding, the practical application of knowledge and the use of processing skills. Hence the use of model answers, or anything else which encourages rote memorisation, should be considered outmoded and pedagogically unsound. The Authority is counting on the co-operation of markers/teachers in this regard.

**INSTRUCTIONS TO MARKERS**

1. In order to maintain a uniform standard in marking, markers should adhere to the marking scheme agreed at the markers' meeting.

2. The marking scheme may not exhaust all possible answers for each question. Markers should exercise their professional discretion and judgment in accepting alternative answers that are not in the marking scheme but are correct and well reasoned.

3. The following symbols are used:

| | |
|---|---|
| / | A single slash indicates an acceptable alternative within an answer. |
| * | Step-mark (for questions involving calculations) |
| † | Correct spelling required |

4. In questions asking for a specified number of reasons or examples etc. and a candidate gives more than the required number, the extra answers should not be marked. For instance, in a question asking candidates to provide two examples, and if a candidate gives three answers, only the first two should be marked.

5. Award zero marks for answers which are contradictory.

6. Chemical equations should be balanced except those in reaction schemes for organic synthesis. For energetics, the chemical equations given should include the correct state symbols of the chemical species involved.

Marks

1. (a) (i) (1) finely divided iron / iron oxide / iron(II) oxide / iron(III) oxide / iron(II,III) oxide / $FeO$ / $Fe_2O_3$ / $Fe_3O_4$ / ~~$Fe_2O_4 \cdot nH_2O$~~ / 1

(2) It can increase / decrease / alter / change the rate of a reaction by providing an alternative pathway that requires lower / higher / different activation energy. 1+1
(Observation and explanation should match.)

(ii) Steam reforming of natural gas / methane / $CH_4$ 1

$CH_4(g) + H_2O(g) \rightleftharpoons 3H_2(g) + CO(g)$ OR (Accept irreversible sign) 1

$CO(g) + H_2O(g) \rightleftharpoons H_2(g) + CO_2(g)$ (Ignore state symbols, have to be balanced)

Accept "Natural gas", do not accept "methane", "steam reforming"

(iii) The higher temperature is used to speed up the reaction. 1

The lower pressure is dictated by limits of mechanical design / safety concerns. 1
(Lowering construction / maintenance costs of the plant / lower risk)
(Answers should be in PAIRs. Do not accept "cost" without additional information.
Correct reasons not pairing with temp/pressure, zero mark)

(iv) ● It takes a long time for the equilibrium (that the $NH_3(g)$ is of highest yield) to be attained. 1

● It can increase the total amount of $NH_3(g)$ produced per unit time. 1

(b) (i) Methanol is important because it is a 1-carbon compound and acts as a starting material to make organic compounds with larger carbon numbers / methanal / formaldehyde / ethanoic acid / acetic acid / ether (dimethyl ether, MTBE) / as a solvent. 1
(Do not accept methanol as fuel, to produce "vinegar", or it is used to produce hydrogen / ethene)
Mark first answer only.

(ii) $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$ (Accept irreversible sign) 1

Catalyst: Cu / ZnO / $Al_2O_3$ (Do not accept Pt / Pd / Ni …) } any two
Temperature: 200 – 300 °C (Require correct unit) } any two
Pressure: 50 – 100 atm (Require correct unit) } any two 2

Mark "equation" (1) and "conditions" (2) separately.
Strict requirements on conditions – pressure and temperature; lenient on catalyst

(iii) Direct conversion of methane to methanol with the use of a metal oxide catalyst at high temperature and atmospheric pressure. The conversion uses a catalytic reagent / high atom economy. OR 1+1

Oxidation of methane to methanol by microbial reactions. The oxidation has higher energy efficiency. OR (1+1)

Conversion of biomass to syngas/biogas for methanol production. The conversion uses renewable feed stocks. OR (1+1)

Carbon dioxide in flue gas can be converted to form methanol. The conversion helps to reduce the release of carbon dioxide to the atmosphere. OR (1+1)

Unconsumed hydrogen from chemical industries is allowed to react with carbon monoxide to form methanol. The conversion uses up the unconsumed raw materials (hydrogen). (1+1)

(c) (i) Initial rate is used because the initial concentrations of reactants are known. 1

(ii) • Compare experiments 2 & 3, $[H_2]$ remains the same but [NO] is halved, rate is decreased by a factor of 4. Therefore reaction order with respect to [NO] is two. 1

• Compare experiments 1 & 2, [NO] remains the same but $[H_2]$ is doubled, rate is also doubled. Therefore reaction order with respect to $[H_2]$ is one. 1

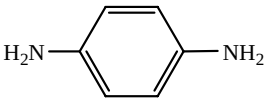
(Deduction must be shown. Accept other means to solve the problem, e.g. mathematical approach)

(iii) rate = $k[NO]^2[H_2]$ / $R = k[NO]^2[H_2]$ / $r= k[NO]^2[H_2]$ Do not accept other symbol for rate. Must be an equation. Do not accept "initial rate", expressions like "$k[NO]^2[H_2]$", "$= k[NO]^2[H_2]$". 1*

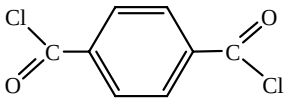
With data from experiment 1,
$1.20 \times 10^{-6} = k \times [2.50 \times 10^{-2}]^2 \times [5.00 \times 10^{-3}]$ 1
$\therefore$ $k = 0.384\ dm^6\ mol^{-2}\ s^{-1}$ OR $0.38\ dm^6\ mol^{-2}\ s^{-1}$

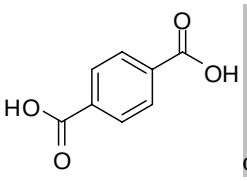
Marks

2. (a) (i) (1)




(Accept alternative means to express benzene ring like  ). 1




OR 


or anhydride 1

(2) condensation (†) polymerisation / polymerization 1

(ii) (1) $HOOC–(CH_2)_4—COOH$ 1

(2)
- The hydrogen peroxide used in Reaction (1) is less corrosive / hazardous when compared with the concentrated nitric acid used in Reaction (2). 1
- The by-product $H_2O$ produced in the Reaction (1) is less harmful / environmental friendly when compared with the by-product $N_2O$ produced in Reaction (2) (which is an air pollutant). 1
- A catalyst is used in Reaction (1) but not in Reaction (2). 1

(Must be in comparison style)

(3) Both reactions consume starting materials that possibly obtained from is a non-renewable resource / petroleum. 1

(iii)
- Kevlar is a much stronger material than nylon-6,6 because the benzene groups in the Kevlar molecules have a more rigid structure than chains in nylon molecules. 1
- Aromatic stacking / Intermolecular molecular interactions between the benzene groups of adjacent polymer molecules also contribute to the exceptionally high mechanical strength of Kevlar. 1

(b) (i) Name: vulcanisation / vulcanization (†) 1

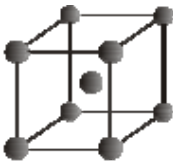
Purpose: To make the material strong / tough / high strength and elastic / flexible. (Do not accept "durable", "do not deform") 1 1

Principle: ( Sulphur reacts with some of the C=C bonds in the polymer chains, ) forming sulphur / disulphur / S-S cross-links between the polymer chains. (Accept sulphide bonds. Do not accept "cross links")

(ii) Bromination (addition of bromine) reaction occurs to the C=C bonds of the material. 1

(Accept "break carbon carbon double bond, do not accept "halogenations", "chlorination", "destroy structure".) 1

The brominated polymer have weaker intramolecular structure / weaker intermolecular attraction of the product leading to change in mechanical property.

(c) (i) (1)  OR  OR  1

(2) Number of atoms

$= 1 + 8 \times \frac{1}{8} = 2$ (Deduction process must be shown) 1

†: correct spelling

(ii) ● Carbon and chromium / nickel / manganese (Do not accept "coke") 1

● Size of carbon / chromium / nickel / manganese atom differs from that of iron atom, introducing carbon into iron makes iron become harder. 1

(Carbon atoms fill the spaces between iron atoms to makes iron harder) 1

● Introducing chromium / nickel / manganese into iron makes iron become corrosion resistant.

(Do not accept sacrificial protection)

Marks

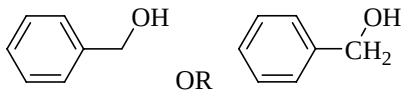
3. (a) (i) hydroxyl (group) / -OH / alcohol (Do not accept phenol) 1
aldehyde (group)/ -CHO / aldehyde 1

(ii) (1) Test for aldehyde (group) or ketone (group)/ carbonyl (group)/ aldehyde (group)and ketone (group)/ RCHO and RCOR' 1
(Accept "aldehyde", but do not accept "ketone")
(2) 2,4-dinitrophenylhydrazine reacts with aldehyde or ketone to give yellow, orange or red precipitate. (Do not accept "brown colour") 1

(iii) hydroxyl (group)/ -OH 1

(iv) m/z = 91 suggested the presence of $C_7H_7^+$ / $C_6H_5CH_2^+$ (ion). 1
(Must show plus sign) 1
m/z = 108 suggested the presence of $C_7H_8O^+$ / $C_7H_7OH^+$ / $C_6H_5CH_2OH^+$ (ion).
(Must show plus sign)

If there is no description of m/z, mark sequentially.

(v)  1

(b) (i) Combustion of materials containing chlorine / PVC. OR 1
Incineration of materials containing chlorine / PVC. OR
Emission from incinerators. OR
Burning / combustion of plastic waste. OR
Burning / combustion of waste.
(Do not accept "car exhaust")

(ii) Dioxin is carcinogenic / can cause cancer. 1

(iii) Gas chromatography-mass spectrometry / GC-MS / GC/MS / GC MS / GC,MS 1
It can measure more accurately the low level of dioxin than using gravimetric analysis or volumetric analysis. (Do not accept "faster …", "Dioxins – gaseous") 1

(c) (i) $AgNO_3(aq)$ and $NH_3(aq)$ / Accept "acidifed $AgNO_3(aq)$" (Mark only first TWO answers) 1+1

(ii) Step 1: Add excess $AgNO_3(aq)$ to the solution to form AgCl(s) and AgI(s). 1
Step 2: Filter the mixture, wash with deionised water and dry the residue. 1
Step 3: Determine / Weigh the total mass of AgCl(s) and AgI(s) collected. 1
Step 4: Wash the solid residue with excess ammonia solution to dissolve / remove AgCl(s), filter and dry the residue, and determine the mass of AgI(s) remains. 1

(iii) ● Subtracting the total mass of AgCl(s) and AgI(s) determined in Step 3 by the mass of AgI(s) determined in Step 4 to get the mass of AgCl(s). 1
● Number of mole of AgCl and AgI can be obtained by dividing their respective mass by the corresponding molar mass. Mole ratio of $Cl^-(aq)$ to $I^-(aq)$ can then be determined. 1