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 1 & COMBINED SCIENCE (CHEMISTRY)
SECTION B

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。

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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.

7. In the question paper, questions which assess candidates' communication skills are marked with an asterisk (*). For these questions, the mark for effective communication (1 mark per question) will be awarded if candidates can produce reasonable answers using complete sentences which are easily understandable.

Part I

Marks

1. (a) <u>Atoms</u> with the <u>same number of protons but different numbers of neutrons.</u> / <u>Atoms</u> with the <u>same atomic number but different mass numbers.</u> (Accept giving the answer with a specific example. E.g. All neon atoms have 10 protons, but they can have 10, 11 or 12 neutrons. NOT Accept ions, elements and molecules) — 1

   (b) $20 \times 0.9048 + 21 \times 0.0027 + 22 \times 0.0925$ — 1
   $= 20.19$ / 20.2 / 20.188 / 20.1877 — 1

   (c) Gas for filling luminous advertisement tubes / neon tubes / neon signs / neon lights (NOT Accept fluorescent tubes) — 1

   (d) <u>Neon is monoatomic whereas oxygen is diatomic.</u> O_2 molecule has larger molecular size than Ne molecule. (NOT Accept larger molecular mass) — 1
   Thus stronger van der Waals' force / stronger intermolecular force among O_2 molecules. (NOT Accept VDW force) — 1

2. (a) (i) <u>Cracking</u> (†) / Catalytic <u>cracking</u> (†) / Thermal <u>cracking</u> (†) — 1

   (ii) This process can produce small molecules (alkenes / ethene / petrol / hydrocarbons) of lower molecular masses from large hydrocarbons to meet the industrial demand / to make useful materials / to make useful fuels) / — 1
   This process can produce <u>more</u> small molecules (alkenes / ethene / petrol / hydrocarbons of lower molecular masses) from large hydrocarbons.
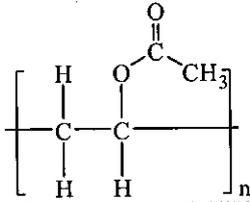
   (b) — 1
   - CH₃ and OC(=O)CH₃ can be written in the condensed form
   - The brackets and "n" SHOULD NOT be omitted
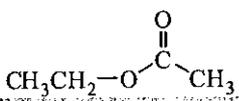
   (c) (i) — 1
   $CH_3CH_2-O-\overset{\overset{O}{\|}}{C}-CH_3$
   - The ester group should not be written in the condensed form. $CH_3COOCH_2CH_3$ is NOT acceptable
   - The bond angle of the ester group NOT necessary be drawn as 120°

   (ii) <u>Bromine test</u> – ethenyl ethanoate can <u>decolourise orange / brown / yellow</u> bromine (Br_2 solution immediately while <u>ethyl ethanoate cannot.</u> (NOT Accept Br). (Require to mention the reaction of Br_2 with ethenyl ethanoate is much faster than ethyl ethanoate) / — 1+1
   <u>Treating with acidified potassium permanganate solution</u> - ethenyl ethanoate can decolourise <u>purple</u> acidified potassium permanganate solution while <u>ethyl ethanoate cannot.</u> (Also accept treating with potassium permanganage solution (without acidification) with the correct descriptions of observations – change from purple to brown (ppt)).

†: correct spelling

Marks

3. (a) Provide H^+ / ions / electrolyte for the chemical cell.　　　1

   (b) Copper, Metal **Y**, Metal **X** / Cu, Y, X　　　1

   (c) (i) $X \rightarrow X^{2+} + 2e^-$　　　1

      (ii) $2 H^+ + 2e^- \rightarrow H_2$　　　1

   (d) <u>No</u>, the metal **Y** strip would be the negative electrode. It is because silver is lower than copper　　1
   in the electrochemical series / silver is less reactive than copper. So silver should be lower than
   Y in the electrochemical series / less reactive than **Y**.
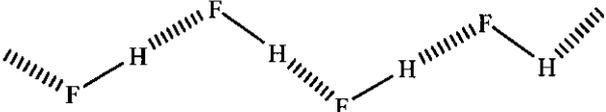
4.　　　1

- The drawing should show at least TWO HF molecules.
- Should show complete HF molecules.
- Should indicate the hydrogen bonds by dashed lines.
- Each H atom can only form one hydrogen bond.
- F-H-F angle not necessary be drawn as 180° in the drawing.

Fluorine / F is a <u>highly</u> /very electronegative element.　　　1
The <u>H-F</u> covalent <u>bond</u> is <u>very</u> /highly polar / The H-F molecule is highly polarized.　　1

(For CS:
(a) (gas) syringe (†)　　　1
(b) Initial rate = 60/4 = 15 cm³/min (0.25 cm³/s) (Accept 14.8 – 15.2)　　1
(c) Initial rate is not the same as the average rate because the slope of the curve is not a constant /　　1
   the slope of the curve is decreasing / the slope of the curve and the slope of the tangent are
   different. (Accept comparison of rates calculated from the curve and tangent shown in the
   graph.)

5. (a) <u>Displacement reaction</u> occurred when the iron rod is dipped into the copper(II) sulphate　　1
   solution. / Some copper(II) ions (Cu^{2+}) are reduced and deposited onto the surface of the iron
   rod as copper metal.
   $Cu^{2+}(aq) + Fe(s) \rightarrow Cu(s) + Fe^{2+}(aq)$ / $CuSO_4(aq) + Fe(s) \rightarrow Cu(s) + FeSO_4(aq)$ (Not accept　　1
   $CuSO_4·5H_2O$; physical states are not required.)

   (b) (i) Copper is <u>lower than hydrogen in the electrochemical series</u> / Cu^{2+} is <u>discharged</u>　　1
      <u>preferentially than H^+</u> when a current is applied.

      (ii) Hydrogen gas / H_2　　　1
      The hydrogen gas bubbles <u>hinder the deposition of copper</u> on the surface of the metallic　　1
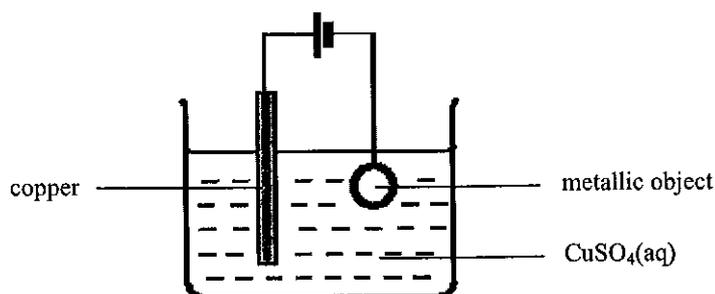   object, hence causing the copper metal deposited easily flaked off.

†: correct spelling

5. (c)

copper ——— metallic object

CuSO$_4$(aq)

3

Correct overall diagram – 1 mark
Correct labels (copper, object (accept omitting the object), CuSO$_4$(aq)/Cu^{2+}(aq)) - 1 mark
Correct direction of the battery / power supply – 1 mark
● Label not accept CuSO$_4$.5H$_2$O

6. ● Dissolve solid <u>lead(II) nitrate</u> in <u>water</u>,　　　　　　　　　　　　　　　　　　1

● Then mix with (excess) sulphuric acid / K$_2$SO$_4$ / Na$_2$SO$_4$ solution. (Also accept other examples of soluble sulphates) (Remark: if the candidate considered PbSO$_4$ as soluble salt, 0 mark for this part)　　　1

● <u>Filter</u> the mixture to obtain the residue (PbSO$_4$), <u>wash</u> it with deionised water and then <u>dry</u> in oven.　　　1

● Communication Mark
[Chemical knowledge = 0 or 1 no communication mark]
[Chemical knowledge = 2 or 3 for easily understandable complete sentences communication mark = 1, otherwise = 0)　　　1

7. (a) $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$ (Neglect physical state)   1
   (NOT Accept: $NH_4NO_3 + OH^- \rightarrow NH_3 + NO_3^- + H_2O$)

   (b) The KOH is (very) corrosive. / NH_4NO_3 is explosive / NH_4NO_3 is flammable / HCl is   1
   corrosive.
   (Should specify the chemical; NOT Accept harmful / toxic / poisonous; NOT Accept HCl
   fume is corrosive as dilute HCl is involved.)

   (c) Prevent sucking back as $NH_3(g)$ is very soluble. (Accept prevent HCl sucking upwards or   1
   similar descriptions) / Increase the surface area for dissolving $NH_3(g)$

   (d) (i) pipette (†)   1

       (ii) Changes from red to orange. (NOT Accept red to yellow)   1

       (iii) Number of moles of HCl(aq) remained in the beaker :
            = 0.100 x 0.04100 x (100.00 ÷ 25.00) = **0.0164**   1*
           Number of moles of $NH_3(g)$ produced
            = 0.0485 – 0.0164 = 0.0321   1*
           Percentage by mass of NH_4NO_3 in the fertiliser
            = (0.0321 x 80) / 3.150 x 100% = 81.5% 81.5   1
            (Accept 81.52% / 82.5% / 82.54%)

   (e) Flame test – gives a lilac / purple / light purple flame. (Not Accept deep purple and violet)   1

8. (a) CO_2 gas produced makes the bread rise / spongy / soft.   1

   (b) $2 KHCO_3 \rightarrow K_2CO_3 + H_2O + CO_2$ / $KHCO_3 \rightarrow ½K_2CO_3 + ½H_2O + ½CO_2$ 1

   (c) (i) q = 27.5 x 4.3 x (25.8 – 20.2) = 662.2 J   1*
           ΔH = +662.2 x 10^{-3} ÷ (3.39 / 100.1) = +19.6 kJ mol^{-1} / +19.55 kJ mol^{-1} / +19.5 kJ mol^{-1} 1
           (the unit must be correct)

       (ii) ΔH = 19.6 – (–49.1x½) / ½((+19.6x2) – (–49.1))   1*
           = +44.15 kJ mol^{-1} (Accept +44.1 to +44.2 kJ mol^{-1}) (the unit must be correct)   1

   (d) (i) ΔH = ½ (–1146 – 394 – 286 – (–959x2)) = +46 kJ mol^{-1} (the unit must be correct)   1

       (ii) Not performing the experiment in standard conditions. / Heat transfer with the   1
   surroundings. / The heat capacity of the container was neglected.

(Remark for 8(c)(i), 8(c)(ii) and 8(d)(i))
1. If the candidate omitted the "+" sign for the positive numbers, and the numerical answers are correct,
deduct 1 mark only.)
2. If the units given in 8(c)(i), 8(c)(ii) and 8(d)(i) are wrong, but they are the same, deduct 1 mark only. If
those incorrect units are not the same in each questions, marks are deducted individually)

* step mark
†: correct spelling

Marks

9. (a) Blue [Blue and pink] colouration would be observed near the iron nail which rusts. [Accept green to blue / yellow to blue]　　1

(b) Both iron nail B and iron nail C would not rust.　　1

For iron nail B, as Mg is higher than iron in the metal reactivity series (with further explanation such as: the magnesium ribbon loses electrons more readily and will become Mg^{2+} / Mg corrodes more readily). /　　1

For iron nail B, the magnesium ribbon protects the iron nail from rusting by sacrificial protection.　　1

For iron nail C, as it is sealed with grease, the iron cannot contact with water and [or] air (oxygen), so rusting cannot occur.

- Give two correct explanations without referring to the corresponding iron nails → 1 mark

10. (Any three)　　3

- Install catalytic converters in car
- Use unleaded petrol
- Replace diesel with LPG for vehicles / Use LPG for vehicles/mini-bus/bus/taxi
- Install scrubbers in power plant
- Using Ultra Low Sulphur Diesel / Use low sulphur coal in power plant / use low sulphur fuels
- Use electrostatic precipitator
- Remove dust by mechanical filtering

[NOT accept use less fossil fuels / use alternative fuels]

Part II

Marks

11. (a) Initial rate = 60/4 = 15 cm³/min (0.25 cm³/s) (Accept 14.8 – 15.2)　　1

    (b) HCl is a monobasic acid, while H_2SO_4 is a dibasic acid. Initial rate increases if H_2SO_4 is used.　　1
    / Initial rate increases as the concentration of H^+ increases in 2.0 M H_2SO_4.
    Therefore, the frequency of effective collisions increases.

    (c) No. of mol of Zn = 2/65.4 = 0.031 mol　　1*
    Vol of H_2 formed = 0.031 × 24000　　1*
    　　　　　　　　= 734 cm³ / 0.734 dm³ (Accept 730-744 cm³ / 0.73-0.74 dm³)　　1
    　　　　　　　(the unit must be correct)

12. (a)

    ● The bond angles of the alkene should be about 120°. The bonds drawn in 90° are not accepted　　1

    (b) Cinnamaldehyde is a non-polar compound which can dissolve in a relatively non-polar organic　　1
    solvent like ethyl ethanoate. However, water is a polar solvent. /
    Both cinnamaldehyde and ethyl ethanoate are relatively non-polar compounds. Their
    molecules are attracted by weak intermolecular forces. / weak dipole-dipole interactions / van
   der Waals' forces/

    (c)　　2

    ethyl ethanoate (†)
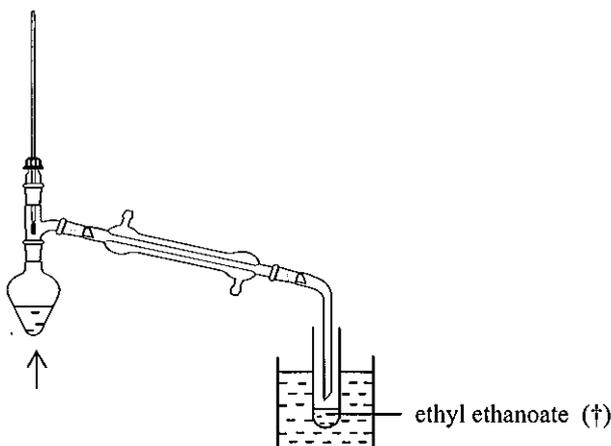
    ● 1 mark is given to the drawing of the correct setup
    ● No mark will be given to the drawing if
    　■ The thermometer or the condenser is missing
    　■ The setup is a closed system
    　■ The top of the distillation head is open to air
    　■ A fractional column is included in the drawing
    ● 1 mark is given to the correct labeling and spelling of the distillate (ethyl ethanoate)
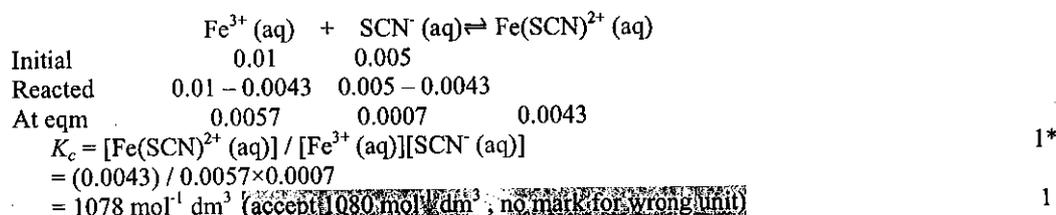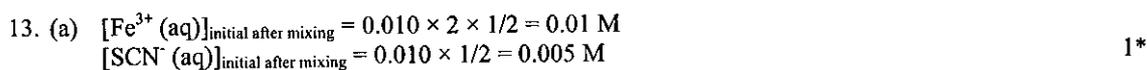
*: step mark
†: correct spelling

Marks

12. (d)

$C_6H_5-CH=CHCHO \xrightarrow{\text{H}_2/\text{Ni or Pt}} C_6H_5-CH_2CH_2CH_2OH$

1
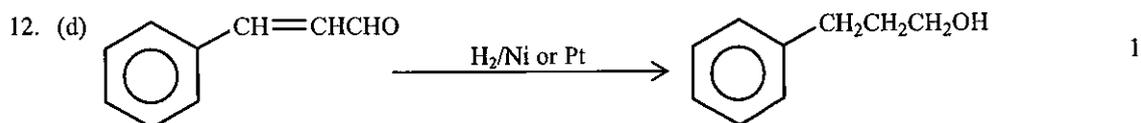
[Accept the aldehyde group (CHO) is NOT reduced by H₂/catalyst to give CH₂OH]

$C_6H_5-CH_2CH_2CH_2OH \xrightarrow[\text{heat}]{\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+} C_6H_5-CH_2CH_2CO_2H$

1
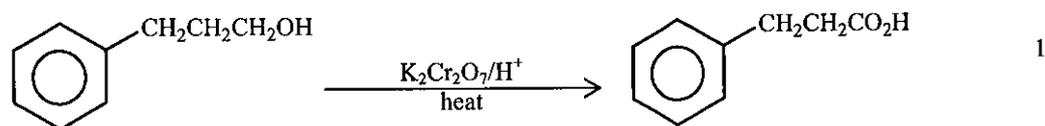
(Accept other correct answers.)
- If the candidate gave more than three steps, only the first three steps will be marked.
- If a reaction/an intermediate is incorrect, it will not affect the marking of the subsequent steps as long as the chemistry of the subsequent steps is correct.

13. (a) $[Fe^{3+} (aq)]_{\text{initial after mixing}} = 0.010 \times 2 \times 1/2 = 0.01$ M
$[SCN^- (aq)]_{\text{initial after mixing}} = 0.010 \times 1/2 = 0.005$ M

1*

	Fe^{3+} (aq)	+	SCN^- (aq) $\rightleftharpoons$	$Fe(SCN)^{2+}$ (aq)
Initial	0.01		0.005	
Reacted	0.01 − 0.0043		0.005 − 0.0043	
At eqm	0.0057		0.0007	0.0043

$K_c = [Fe(SCN)^{2+} (aq)] / [Fe^{3+} (aq)][SCN^- (aq)]$

1*

$= (0.0043) / 0.0057 \times 0.0007$

$= 1078$ mol^{-1} dm^3 (accept 1080 mol^{-1} dm^3, no mark for wrong unit)

1

- For the 2nd step mark:
Correct expression for K_c : 1 mark
No expression is written, the numbers in "(0.0043) / 0.0057×0.0007" is correct : 1/2 mark
No expression, the numbers in "(0.0043) / 0.0057×0.0007" is incorrect : 0 mark

(b) The equilibrium position will shift to the left hand side / reactant side.

1

14. (a) (i)

1
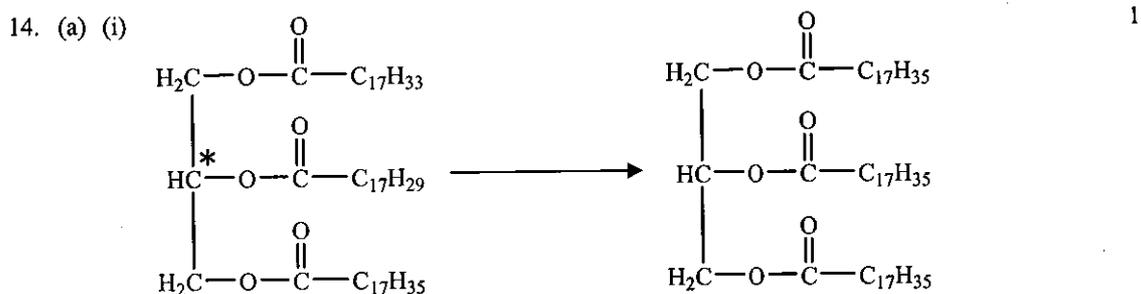
(ii) Yes. X has one chiral carbon and hence optically active, while Y does not has chiral carbons and hence optically inactive. Thus, there is a change in optical activity for the conversion.

1

*: step mark

Marks

14. (b) The $C_{17}H_{35}COO^-$ ion has an <u>ionic</u> head (COO^-) and a <u>hydrocarbon</u> tail ($C_{17}H_{35}$). 　1

The hydrocarbon tail dissolves in grease droplets / is hydrophobic while the ionic head dissolves in water / is hydrophilic. 　1

The <u>ionic heads of the grease droplets repel</u> from each other and the dirts inside these droplets are then removed. 　1

Communication Mark 　1
[Chemical knowledge = 0 or 1: no communication mark]
[Chemical knowledge = 2 or 3: for easily understandable complete sentences, communication mark = 1, otherwise = 0]

15.

(a)

(b)

(c)

(d)

(a), (b), (c)　　OR 　1+1+1
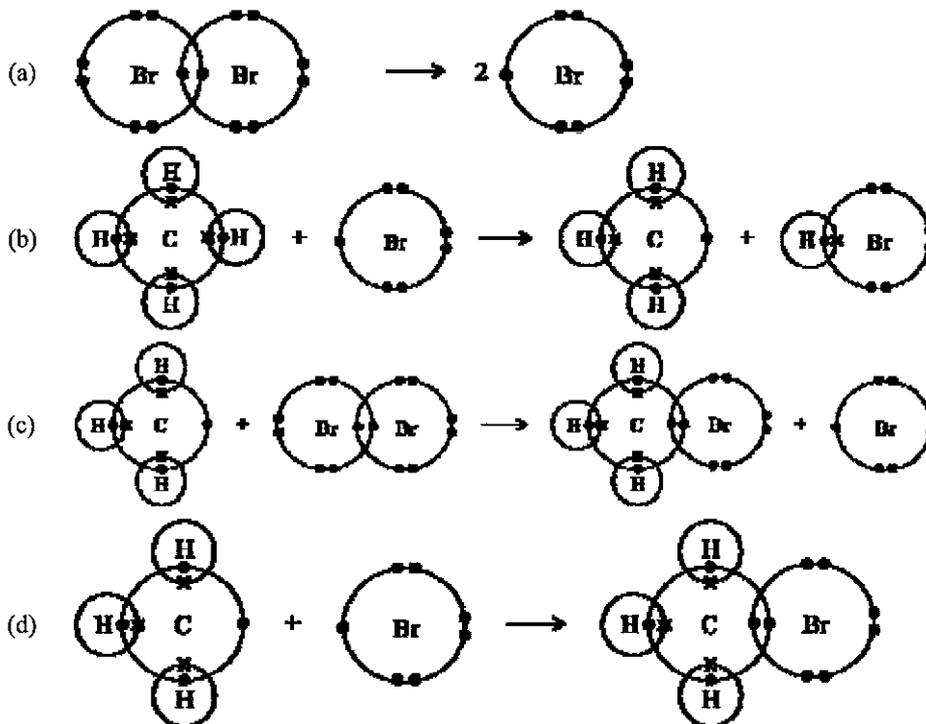
(a), (b), (d) 　(1+1+1)

● No marks are given if the numbers of electrons in the outermost shells are wrong.
● If more than three equations are written, marks are given to the correct ones (Max = 3)
● If the candidate used the wrong halogen atoms (F, Cl, I) in the drawing, deduct 1 mark

16. (a) Na_2O, MgO, Al_2O_3 　1
[Order is not important, 0 mark if more/less than these 3 oxides are listed.]

(b) SiO_2 has a <u>giant covalent structure</u>, and the Si and O atoms are linked by <u>strong covalent bonds</u>. (Not accept strong covalent structure / giant covalent bonds) 　1

Other covalent oxides are discrete molecules attracted by weak van der Waals' forces / weak intermolecular forces / weak dipolar interactions. (NOT accept VDW forces) 　1

(c) $Al_2O_3 + 2\,OH^- + 3\,H_2O \rightarrow 2\,Al(OH)_4^-$ 　1
or $Al_2O_3 + 2\,NaOH + 3\,H_2O \rightarrow 2\,NaAl(OH)_4$

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Marks

1. (a) (i) (1) finely divided iron / iron oxide (iron(II) oxide / iron(III) oxide / iron(II,III) oxide / FeO / Fe₂O₃ / Fe₃O₄·nH₂O)   **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. (Observation and explanation should match)   **1+1**

(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" in 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. (Do not accept methanol as fuel, to produce "vinegar", or it is used to produce hydrogen / ethene)
Mark first answer only)   **1**

(ii) $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$ (Accept irreversible sign)   **1**
Catalyst: Cu / ZnO / Al₂O₃ [Do not accept Pt / Pd / Ni]   ⎫
Temperature: 200 – 300 °C (Require correct unit)   ⎬ any two **2**
Pressure: 50 – 100 atm (Require correct unit)   ⎭
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, [H₂] 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 [H₂] is doubled, rate is also doubled. Therefore reaction order with respect to [H₂] is one.   **1**
(Deduction must be shown. Accept other means to solve the problem, e.g. mathematical approach)

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

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
∴ k = 0.384 dm^6 mol^{-2} s^{-1} OR 0.38 dm^6 mol^{-2} s^{-1}
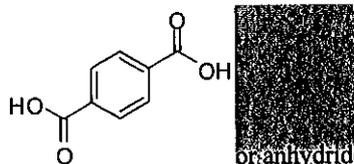
Marks

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$_2$O produced in the Reaction (1) is less harmful / environmental friendly when compared with the by-product N$_2$O 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
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")   1

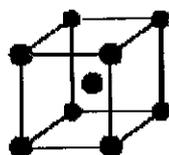(ii) Bromination (addition of bromine) reaction occurs to the C=C bonds of the material.   1
(Accept "break carbon carbon double bond; do not accept "halogenations", "chlorination", "destroy structure".)
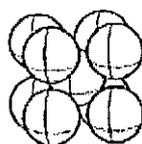The brominated polymer have weaker intramolecular structure / weaker intermolecular attraction of the product leading to change in mechanical property.   1
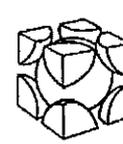
(c) (i) (1)

   OR   OR   1

(2) Number of atoms
$= 1 + 8 \times \dfrac{1}{8} = 2$ (Deduction process must be shown)   1

†: correct spelling

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

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

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

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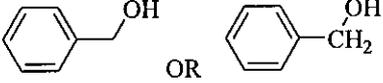
(b) (i) Combustion of materials containing chlorine / PVC　OR　　1
Incineration of materials containing chlorine / PVC　OR
Emission from incinerators　OR
Burning / combustion of plastic waste　OR
Burning / combustion of waste
(Do not accept "car exhaust")

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

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

(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　　1
AgCl(s), filter and dry the residue, and determine the mass of AgI(s) remains.

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