2014-DSE
CHEM
PAPER 1B

B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2014

CHEMISTRY PAPER 1

SECTION B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) This section consists of TWO parts, Parts I and II.

(4) Answer ALL questions in both Parts I and II. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.

(6) Supplementary answer sheets will be provided on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this Question-Answer Book.

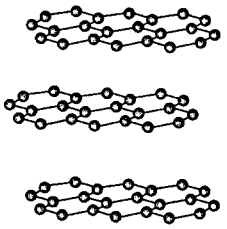
(7) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

* A 1 4 0 E 0 1 B *

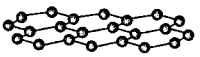
PART I

Answer **ALL** questions. Write your answers in the spaces provided.

1. Graphite is a form of carbon and has a layer structure. Graphene is an individual single layer of graphite. Their structures are shown below:



graphite



graphene

(a) Thin sheets of graphene can be easily peeled off from graphite using adhesive tape.

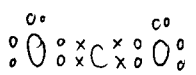
(i) Explain why graphene can be easily peeled off.

As there is only weak van der Waals' force between layers of graphene in graphite.

(ii) Explain whether graphene can conduct electricity.

It can conduct electricity as a Carbon atom is bonded to other three carbon atom, same as the structure of a single layer of graphite. Each carbon atom has one delocalized electron (unbonded) to conduct electricity.

(iii) Draw the electron diagram for a molecule of the compound formed by complete combustion of graphene, showing *electrons in the outermost shells* only.



(3 marks)

(b) Based on the fact that graphene can be easily peeled off from graphite, a student concluded that graphite should have a low melting point due to its layer structure. Explain whether you agree with this conclusion.

I don't agree. Graphite has a giant covalent structure. Carbon atoms in the same layer are joined by strong covalent bond. Melting requires the breaking of all these strong covalent bonds. Thus, the melting point of graphite is not low.

(1 mark)

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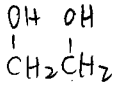
1. (c) Fullerene (such as C_{60}) is another form of carbon. Briefly describe the structure of C_{60}, and suggest why it is soluble in some organic solvents.

C_{60} has a simple molecular structure. There is only weak van der Waals' force between C_{60} molecules. As some organic solvents contains non-polar molecules, the intermolecular force is also weak van der Waals' force. Since the force between C_{60} molecules and solvent molecule are comparable, weak van der Waals' force can be formed between C_{60} molecules, with similar strength as forces between their own molecules and solvent molecules and they can mix well.

(3 marks)

2. Draw the structure of ethane–1,2–diol, and suggest whether it is soluble in water.



It is soluble in water. The -OH group in ethane-1,2-diol allows it to form hydrogen bond between molecules. As there is also hydrogen bond between water molecules, the comparable force allows them to form hydrogen bond with each other ($CH_2(OH)CH_2OH$ and H_2O) and mix well.

(3 marks)

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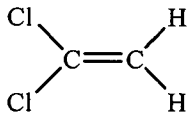
3. Both polyethene (PE) and 'Saran' can be used to make food wrap, but 'Saran' is more suitable than PE in making food wrap for use in microwave ovens.

(a) The monomer of PE is ethene. Suggest a chemical test to show that ethene is an unsaturated compound.

Add acidified potassium permanganate to ethene. The purple colour of the solution decolorizes. Only unsaturated compound has positive results in the reaction.

(2 marks)

(b) 'Saran' can be formed from the polymerisation of the compound shown below:



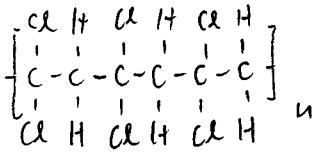
(i) State the systematic name of this compound.

1,1-dichloroethene

(ii) Name the type of polymerisation involved in forming 'Saran'.

Addition polymerisation

(iii) Draw the structure of 'Saran', showing at least THREE repeating units.



(3 marks)

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3. (c) In terms of intermolecular force, explain why 'Saran' is more suitable than PE in making food wrap for use in microwave ovens.

Saran has two polar C-Cl bonds which arrange to result in a net dipole moment of the molecule. While polythene has no net dipole moment, the van der Waals' force between polar Saran molecules is stronger than that between PE molecules. Thus the melting point of Saran is higher than PE and can be heated to a higher temperature in microwave oven.

(2 marks)

(d) When incinerated, why would food wrap made from 'Saran' cause more serious pollution problem than food wrap made from PE ?

Saran is a chlorine-containing compound while PE does not contain any Cl. When Saran is incinerated, toxic Cl_2 and HCl will be emitted, causing air pollution. But no such poisonous gas is emitted from PE incineration due to the lack of Cl.

(1 mark)

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*4. With reference to the methods of obtaining copper, magnesium and silver from their oxides, deduce the order of reactivity of these three metals.

(5 marks)

Silver oxide can be decomposed by heating and silver metal is formed. It shows that silver oxide is thermally unstable and silver forms unstable compound with oxygen. But copper and magnesium oxide cannot be decomposed by heating as they form more stable compound with oxygen. Thus, silver has the lowest reactivity as it has the lowest tendency to lose electron to react with oxygen (weaker reducing agent)

While copper oxide can be reduced by carbon to form copper metal. However, magnesium oxide cannot be decomposed by this way as well. It can only be decomposed by electrolysis of its molten compound, which can also be used to decompose copper oxide. Thus, it shows that it is more difficult to extract metal from magnesium compound than copper. Magnesium forms more stable compound with oxygen (stronger reducing agent), which is difficult to be reduced.

So the reactivity of the metals:

Ag < Cu < Mg

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5. Concentrated acids are common reagents found in laboratories.

(a) State a safety measure in handling concentrated acids in laboratories.

Wear safety spectacles to prevent spilling of corrosive acid to attack eyes.

(1 mark)

(b) Comment on the following statement:

'All concentrated acids are strong acids.'

It is not correct. The strength (strong or weak) of acid depends on the extent of its molecules to ionize to form H^+ (aq) in water, not merely its concentration.

(1 mark)

(c) Explain how concentrated sulphuric acid, concentrated nitric acid and concentrated ethanoic acid can be distinguished by using copper granules.

By adding Cu granules to each acid respectively, only concentrated sulphuric acid and nitric acid give observable result. For concentrated H_2SO_4, colourless gas (SO_2) will evolve when Cu is added. For concentrated HNO_3, brown gas in air (NO_2) is evolved. The two concentrated acids are strong oxidizing agent and they undergo redox reaction with Cu. But for concentrated ethanoic acid, it is not oxidizing and cannot react with Cu which is not reactive (weak reducing agent).

(3 marks)

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6. Petrol is a commonly used motor car fuel. It can be obtained from petroleum by fractional distillation.

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

Petroleum is a mixture of hydrocarbon. Different hydrocarbon have different boiling points. Some with lower molecular mass (like petrol) condense at lower temperature while larger ones condense at higher temperature after heating and cooling. Thus separate fraction can be obtained at different temperature.

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

Cracking.

(iii) Octane (C_8H_{18}) is a component of petrol. Using octane as an example, state the meaning of the term 'standard enthalpy change of combustion' with the aid of a chemical equation.

$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

Standard enthalpy change of combustion is the enthalpy change when 1 mole of substance (C_8H_{18} in this case) combusts completely (to form CO_2 and H_2O in this case) under standard condition.

(5 marks)

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6. (b) Motor cars powered by petrol emit air pollutants such as nitrogen monoxide and carbon monoxide. Installing a certain device in motor cars can convert these two oxides to less harmful substances.

(i) Name this device.

Catalytic converter.

(ii) The equation for the reaction involved in the conversion is shown below:

$$2CO(g) + 2NO(g) \rightarrow 2CO_2(g) + N_2(g)$$

The standard enthalpy changes of formation of NO(g), CO(g) and CO_2(g) are as follows:

Compound	$\Delta H_f^\ominus$ / kJ mol^{-1}
NO(g)	+90.3
CO(g)	−110.5
CO_2(g)	−394.0

Calculate the standard enthalpy change of the above reaction.

$2\times\Delta H_f^\circ[NO_{(g)}] + 2\times\Delta H_f^\circ[CO_{(g)}]$

$2CO_{(g)} + 2NO_{(g)} \longrightarrow$

$2\times\Delta H_f^\circ[CO_{2(g)}]$ ↘ ↙ ΔH°

$2CO_2 + N_{2(g)}$

From the energy cycle,

$$2\times\Delta H_f^\circ[CO_{2(g)}] = 2\times\Delta H_f^\circ[NO_{(g)}] + 2\times\Delta H_f^\circ[CO_{(g)}] + \Delta H^\circ$$

$$\Delta H^\circ = 2\times(-394.0) - 2\times(-110.5) - 2\times(+90.3)$$

$$= -747.6 \text{ kJ mol}^{-1}$$

(4 marks)

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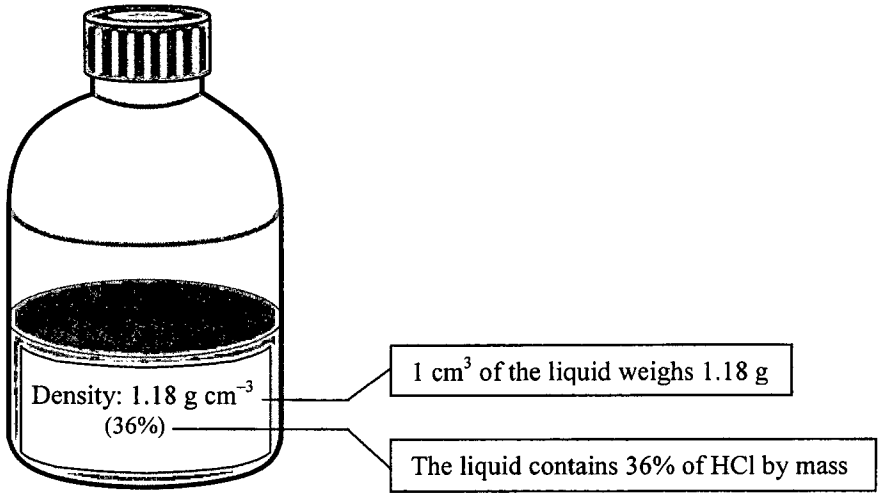
7. A bottle of concentrated hydrochloric acid HCl(aq) is shown below:



(a) According to the information on the label, calculate the concentration of the concentrated hydrochloric acid in mol dm^{-3}.

Mass of HCl in 1 dm^3 = $1.18 \times 1000 \times 36\%$
= 424.8 g

Number of mole of HCl in 1 dm^3
= $\frac{424.8}{1+35.5}$ = 11.6

∴ Concentration of HCl = 11.6 mol dm^{-3}

(2 marks)

(b) To find out the concentration of the concentrated acid, a laboratory technician first drew from the bottle a sample of 10.00 cm^3 of the concentrated acid and diluted it to 100.0 cm^3 in a volumetric flask. The diluted acid sample was then used to titrate a standard sodium carbonate solution placed in a conical flask using methyl orange as an indicator. 10.00 cm^3 of 1.06 mol dm^{-3} sodium carbonate solution required 20.30 cm^3 of the diluted acid sample to reach the end point.

(i) Briefly describe the procedure in preparing a standard sodium carbonate solution.

First, weigh the mass of $Na_2CO_3(s)$ to be added in the solution. Then, dissolve $Na_2CO_3(s)$ in a beaker of water. Pour the solution to a ($100\ cm^3$) volumetric flask. Add distilled water to the flask until the water level reaches the graduation mark. The concentration is known by $\frac{(\text{mass}/\text{molar mass})}{\text{volume of volumetric flask}}$.

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7. (b) (ii) Using the titration result, calculate the concentration, in mol dm^{-3}, of the concentrated hydrochloric acid in the bottle.

$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$

Number of mole of Na_2CO_3 (aq)

$= \frac{10}{1000} \times 1.06$

$= 0.0106$

$\because$ 2 mole of acid reacts with 1 mole Na_2CO_3 (aq)

Concentration of dilute acid

$= \frac{0.0106 \times 2}{(\frac{20.3}{1000})}$

$= 1.04$ mol dm^{-3}

Concentration of concentrated acid

$= 1.04 \times \frac{100}{10}$

$= 10.4$ mol dm^{-3}

(5 marks)

(c) Suggest a possible reason why the concentration of the concentrated hydrochloric acid in the bottle obtained from (b)(ii) would be smaller than that obtained from (a) above.

As other substances in the acid sample may undergo reaction with Na_2CO_3 (aq).

(1 mark)

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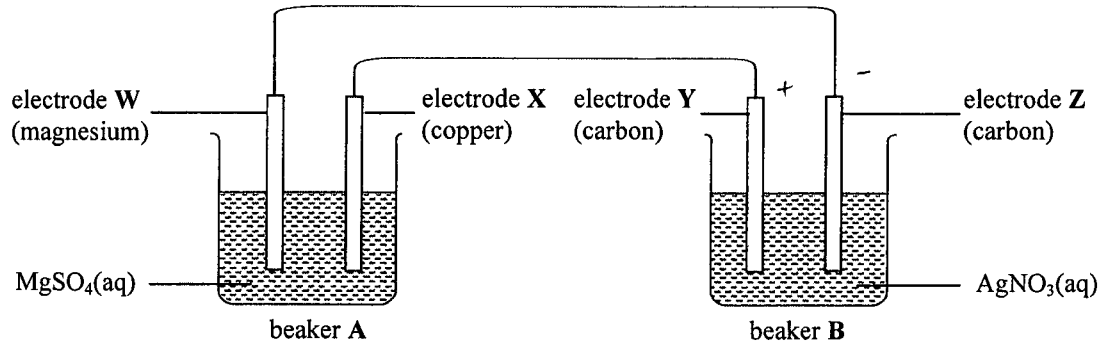
8. The diagram below shows a set-up in which electrons are flowing through the electric wires. Moreover, one of the electrodes in beaker **A** is forming ions.



(a) State an expected observation at each of the following electrodes:

(i) electrode **W**

Mg dissolves to form colourless solution.

(ii) electrode **X**

Silvery metal (Mg) deposits on it.

(2 marks)

(b) Write the half equation for the expected change at each of the following electrodes:

(i) electrode **Y**

$4OH^-_{(aq)} \rightarrow O_{2(g)} + 2H_2O_{(l)} + 4e^-$

(ii) electrode **Z**

$e^- + Ag^+_{(aq)} \rightarrow Ag_{(s)}$

(2 marks)

(c) Complete the following table by filling in 'anode' or 'cathode' to describe the electrodes.

	electrode **W**	electrode **Z**
anode / cathode	anode	cathode

(1 mark)

(d) Predict, with reason, what would happen if the $MgSO_4(aq)$ in beaker **A** is replaced by ethanol.

No current flows in the wire.
As ethanol is a non-electrolyte which cannot conduct electricity.

(1 mark)

Answers written in the margins will not be marked.

9. Consider each of the experiments below and answer the questions that follow.

(a) Dilute sodium hydroxide solution is added to copper(II) sulphate solution.

(i) State the expected observation.

Blue precipitate is formed.
gelatinous

(ii) Write the chemical equation for the reaction that occurs.

$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$

(2 marks)

(b) Acidified potassium permanganate solution is added to sodium sulphite solution.

(i) State the expected colour change.

It changes from purple to colourless.

(ii) For the reaction leading to the colour change,

(1) state the name of the type of reaction; and

Reduction

(2) write the ionic equation for the reaction.

$5e^- + MnO_4^-(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 4H_2O(l)$

(3 marks)

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PART II

Answer **ALL** questions. Write your answers in the spaces provided.

*10. You are provided with common laboratory apparatus, calcium carbonate and 1M hydrochloric acid. Outline how you would perform a fair comparison in studying the effect of different concentrations of acid on the rate of production of carbon dioxide from the following reaction:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

(5 marks)

Add 10 cm^3 of 1M HCl to 1g calcium carbonate. Measure the volume of $CO_2(g)$ produced by gas syringe in 30 second interval. Plot the graph of volume of $CO_2(g)$ produced against time. Find the initial rate of $CO_2(g)$ production by drawing a tangent at time = 0 s. Repeat the experiment with different acid concentration by the following combination (2 cm^3 water + 8 cm^3 HCl, 4 cm^3 water + 6 cm^3 HCl, 6 cm^3 water, 4 4 cm^3 HCl, 8 cm^3 water + 2 cm^3 HCl). Other variables like mass of $CaCO_3$, temperature should be kept constat. Obtain the initial rate of $CO_2(g)$ production of different acid concentration. Plot a graph with rate against concentration. It is predicted that the higher the acid concentration, the higher the rate of CO_2 production.

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11. Vanadium is a transition metal, its chemical symbol is V. The formulae and the colours of three aqueous vanadium-containing ions are shown below:

Formula	$VO^{2+}(aq)$	$V^{3+}(aq)$	$V^{2+}(aq)$
Colour	blue	green	violet

(a) Based on the given information, suggest TWO properties of vanadium to characterise it as a transition metal.

It has variable oxidation states (+4, +3, +2).
It forms coloured ions (blue, green, violet).

(1 mark)

(b) Vanadium also forms the ion $VO_2^+(aq)$. In the presence of acid, 1.0 mol of $VO_2^+(aq)$ ions and 1.0 mol of $SO_2(g)$ react completely to form $SO_4^{2-}(aq)$ ions and one of the above aqueous vanadium-containing ions.

(i) By considering the amount of electrons transferred, deduce the final colour of the solution obtained.

As $SO_2(g)$ gains two electrons to $SO_4^{2-}(aq)$, VO_2^+ should lose two electrons as 1 mole VO_2^+ reacts with 1 mole $SO_2(g)$. $V^{3+}(aq)$ will be formed and the colour of solution is green

(ii) Write a chemical equation for the reaction in (i).

$VO_2^+(aq) + SO_2(g) \rightarrow V^{3+}(aq) + SO_4^{2-}(aq)$

(3 marks)

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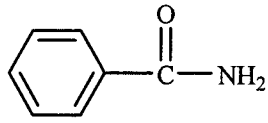
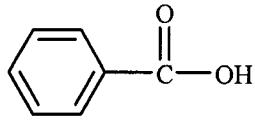
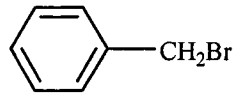
12. Benzamide, benzoic acid and benzyl bromide are commonly used organic compounds. Their structures are shown below:



benzamide



benzoic acid



benzyl bromide

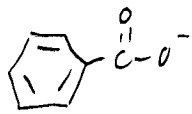
(a) In an experiment, benzoic acid is prepared from benzamide in two steps:

Step 1: Benzamide is added to excess 1M NaOH(aq) and the mixture is heated gently. An organic compound **X** is formed.
Step 2: The resulting mixture is then treated with reagent **Y** until no more solid benzoic acid is given out.

(i) Name the type of reaction involved in Step 1.

Hydrolysis

(ii) Draw the structure of **X**.



(iii) Suggest what **Y** would be.

Dilute acid

(iv) Suggest why **X** is more soluble than benzoic acid in water.

As it is ionic in nature.
It is mobile in water.

(v) Describe briefly how a dry benzoic acid sample can be obtained after Step 2.

Placing the sample in a
desiccator with anhydrous $CaCl_2$

(5 marks)

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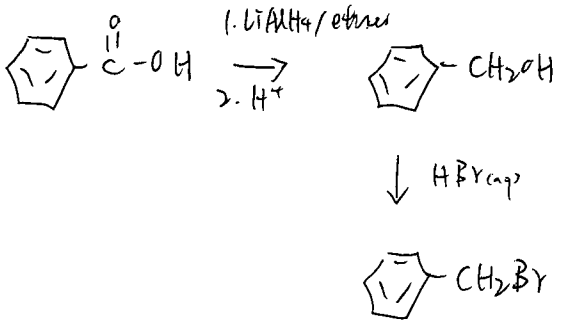
12. (b) Outline a synthetic route, *with no more than three steps*, to accomplish the conversion of benzoic acid to benzyl bromide. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.



(3 marks)

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13. Consider the reaction represented by the equation below:

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$

(a) In an experiment, 1.02 mol of NO(g) and 1.29 mol of $O_2(g)$ are mixed in a 50.0 dm^3 closed container maintained at 980 K. When equilibrium is attained, 61.0% of NO(g) is consumed.

(i) Calculate the equilibrium constant K_c for the above reaction under the experimental conditions.

$$K_c = \frac{[NO_{2(g)}]^2}{[NO_{(g)}]^2[O_{2(g)}]}$$

	NO(g)	$O_2(g)$	$NO_2(g)$
Initial Concentration	$\frac{1.02}{50} = 0.0204$	$\frac{1.29}{50} = 0.0258$	0
Equilibrium Concentration	$0.0204 \times (1-61\%)$		

(ii) Discuss whether K_c would change if additional NO(g) is introduced into the above equilibrium mixture.

Kc does not change as the temperature is constant.

(4 marks)

(b) The values of K_c (in appropriate unit) for this reaction at different temperatures are shown below:

Temperature / K	600	700	800	900
K_c	6.88×10^6	2.97×10^5	2.89×10^3	4.68×10^2

Based on the above data, deduce whether the forward reaction is exothermic or endothermic.

When the temperature increase, Kc decreases. That means the equilibrium position shifts to the left. Therefore, the forward reaction is exothermic.

(1 mark)

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14. Butter contains a small amount of the triglyceride of butanoic acid.

(a) Draw the structure of the triglyceride of butanoic acid.

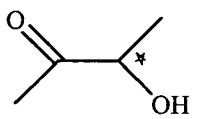
$CH_2OO\,CH\,CH_2CH_2CH_3$
$CH_2OO\,CH\,CH_2CH_2CH_3$
$CH_2OO\,CH\,CH_2CH_2CH_3$

(1 mark)

(b) An organic acid **Q** is an isomer of butanoic acid. State the systematic name of **Q**.

(1 mark)

(c) The structure of **Z**, another isomer of butanoic acid, is shown below:



Z

(i) Using '*', label ALL chiral centre(s) in the above structure of **Z**.

(ii) Suggest a chemical test to show how to distinguish between **Q** and **Z**.

(3 marks)

(d) Margarine, a butter substitute, can be made from vegetable oils. What chemical reaction is involved in the production of margarine from vegetable oils ?

Hydrogenation

(1 mark)

END OF SECTION B

END OF PAPER

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PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序

relative atomic mass 相對原子質量

I	II											III	IV	V	VI	VII	0
				1 **H** 1.0													2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)													

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
**	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

2014 DSE (D)

香 港 考 試 及 評 核 局
HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

香 港 中 學 文 憑 考 試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

答 題 簿
ANSWER BOOK

考生須知

(一) 宣布開考後，考生須首先在第 1 頁之適當位置填寫考生編號，並在第 1 及 3 頁之適當位置貼上電腦條碼。
(二) 每題(非指分題)必須另起新頁作答，並須在每一頁的相應試題編號方格填畫「X」號，以表示選答的題號(見下例)。
(三) 紙張兩面均應使用，並應每行書寫。不可在各頁邊界以外位置書寫。寫於邊界以外的答案，將不予評閱。
(四) 如有需要，可要求派發方格紙及補充答題紙。每一紙張均須填寫考生編號、填畫試題編號方格、貼上電腦條碼，並用繩縛於**簿內**。
(五) 試場主任宣布停筆後，考生不會獲得額外時間貼上電腦條碼及填畫試題編號方格。

INSTRUCTIONS

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1 and 3.
(2) Start each question (not part of a question) on a new page. Put 'X' in the corresponding question number box on each page to indicate the appropriate question number (see the example below).
(3) Write on both sides using each line. Do not write in the margins. Answers written in the margins will not be marked.
(4) Graph paper and supplementary answer sheets will be supplied on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this book.
(5) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

例 Example:
試題編號 Question No. = 3

試題編號 Question No.

1	2	3	4	5	6	7	8	9	10	11	12
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13	14	15	16	17	18	19	20	21	22	23	24	≥25
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由考生填寫 To be filled in by the candidate	由閱卷員填寫 Marker's Use Only	由試卷主席填寫 Examiner's Use Only
	閱卷員編號 Marker No.	試卷主席編號 Examiner No.

試題編號 Question No.	各頁積分 Marks	積分 Marks	積分 Marks
1	+ + =		
3	+ + =		
	+ + =		
	+ + =		
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	+ + =		
	總分 Total		

由核分員填寫 Checker's Use Only	
核分員編號 Checker No.	
總分 Total	

試題編號 Question No.

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每題另起新頁作答。
Start each question on a new page.

(a) i Activation energy is the energy required to overcome the energy barrier for the reaction to start.

ii Yeast contains the enzyme to catalyze fermentation. When the temperature is too high, the enzyme in the yeast will be denature and loses its catalytic function.

iii The amount of vitamin C in fruit is too small to meet humans' needs. Moreover, the generation time of fruit to produce vitamin C is long. So industrial process is used to synthesize large amount of vitamin C quickly.

iv Chlorine and sodium hydroxide.

(b) i It is the reaction rate at the start of the reaction (time = 0 second), when the reaction has not gone too far.

ii Colorimetry is applied. As brown $I_2(aq)$ produced is the only coloured species in the reaction mixture, its colour intensity represents its concentration. By measuring the light absorbance of reaction mixture at different time using colorimeter intensity of mixture and $I_2(aq)$ concentration can be followed.

寫於邊界以外的答案，將不予評閱。
Answers written in the margins will not be marked.

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iii The graph is linear and can be extended to pass through origin. Thus, the reaction rate is directly proportional to the concentration of $BrO_3^-(aq)$. The reaction is first order with respect to $[BrO_3^-(aq)]$.

iv (1) By trial 1 and 2, when the concentration of $I^-(aq)$ and $H^+(aq)$ is doubled, the rate of $I_2(aq)$ is 8 times of the original. As the reaction is 1st order with respect to $I^-(aq)$, the rate doubles (×2) when concentration double. Thus, the rate is 4 times of original when $H^+(aq)$ Concentration double so as to make the rate 8 times as original when both concentration is doubled (×2×4) So the reaction is second order with respect to $H^+(aq)$.

(2) Rate $= k[BrO_3^-]^n[I^-(aq)][H^+(aq)]^2$ (let n be the reaction order with respect to $[BrO_3^-(aq)]$)

$2.3\times10^{-3} = k[BrO_3^-]^n(0.15)(0.10)^2$

$k[BrO_3^-]^n = 1.53\ M^{-2}s^{-1}$

∴ The initial rate of reaction with respect to $BrO_3^-(aq)$ is $1.53\ M^{-2}s^{-1}$

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每題另起新頁作答。
Start each question on a new page.

c) i It produces ammonia which is widely used in manufacturing other useful products like fertilizers.

ii Natural gas contains methane. By steam reforming, hydrogen, which is one of the reactant of Haber process, is produced from methane.

iii It can increase the surface area of catalyst to speed up reaction by providing larger adsorption surface for collision with reactants.

iv The shifting of equilibrium position and rate of reaction is considered.

v Remove the product (ammonia) rapidly from the reactor.

vi They have high agricultural products yield.

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每題另起新頁作答。
Start each question on a new page.

3 a) i (1) Mix the gas with ammonia. Ammonium chloride which is a dense white fume formed shows $HCl_{(g)}$'s presence.

(2) By adding Brady's reagent to the sample. Red / orange / yellow precipitate formed shows the presence of $-\overset{O}{\overset{\|}{C}}-$.

ii Anhydrous magnesium sulphate.

b) i To speed up the reaction.

ii (1) As the reaction between $CaCO_3$ and $HCl_{(aq)}$ gives carbon dioxide, when no more gas bubbles are produced, the reaction is completed.

(2) Reddish brown gelatinous precipitate is formed.

iii Number of mole of $Ca^{2+}_{(aq)}$ in the sample
= Number of mole of CaC_2O_4
$= \frac{2.374}{40.1+12\times2+16\times4}$
$= 0.0185$

Mass of $CaCO_3$
$= 0.0185 \times (40.1+12+16\times3)$
$= 1.86\ g$

Percentage by mass
$= \frac{1.86}{2.075} \times 100\%$
$= 91.6\%$

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每題另起新頁作答。
Start each question on a new page.

iv Gravimetric analysis

3 c) i Add $NaHCO_3$ (aq) to the sample. It will react with the acid to form aqueous solution. By adding pentane, only other organic compound (except acid) can dissolve in it. Pour the mixture in Separating funnel. The aqueous (lower denser) layer can run out of the funnel when the tap is opened. The remaining mixture contain pure T.

ii (I)(II) From the IR spectrum, absorption peak at 1700 cm^{-1} shows the presence of C=O group. As it is not an ester and ketone (negative result in Tollen's reagent and contains only C, H and O), it is an alkanal with aldehyde group.

iii Chemical species at m/z = 43:
$CH_3CH_2CH_2^+$

Chemical species at m/z = 91,
$CH_3CH_2CH_2CH_2CHO^+$

iv

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