2018-DSE
CHEM
PAPER 1B

B

Level 5 Exemplar &
Comments
Paper 1B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2018

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.

A140E01B

PART I

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

1. Lithium occurs naturally in two isotopes, ^{6}Li and ^{7}Li. It can form lithium nitride (Li_3N) when burnt in air.

(a) (i) Calculate the percentage abundance of ^{6}Li in nature.
(Relative atomic mass: Li = 6.9)

Let x% be the percentage abundance of ^{6}Li in nature

∴ The percentage abundance of ^{7}Li in nature is $(100-x)$%.

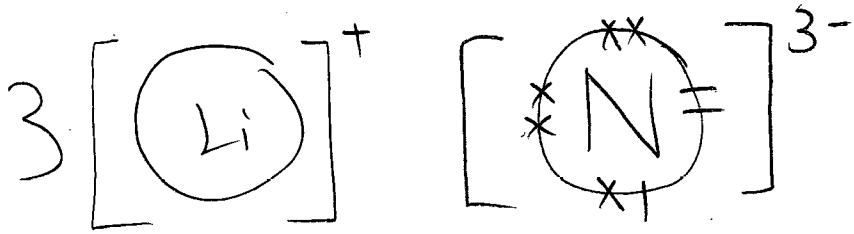
$$6.9 = 6 \times (x\%) + 7 \times (100-x)\%$$

$$6.9 = \frac{6x}{100} + 7 - \frac{7x}{100}$$

$$x = 10$$

∴ The percentage abundance of ^{6}Li in nature is 10%

(ii) Draw the electron diagram for lithium nitride, *showing electrons in the outermost shells only.*



(3 marks)

Answers written in the margins will not be marked.

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1. (b) In an experiment, 1.25 g of lithium nitride is formed when a piece of lithium is burnt in air.

(i) Write a chemical equation for the reaction involved.

$6Li + N_2 \rightarrow 2Li_3N$

(ii) Calculate the mass of lithium that reacted with nitrogen.
(Relative atomic masses: Li = 6.9, N = 14.0)

The mass of lithium that reacted with nitrogen

$= 1.25 \times \frac{6.9 \times 3}{6.9 \times 3 + 14}$

$= 0.746$ g

(3 marks)

(c) Name another compound which will also be formed when lithium is burnt in air.

Lithium oxide

(1 mark)

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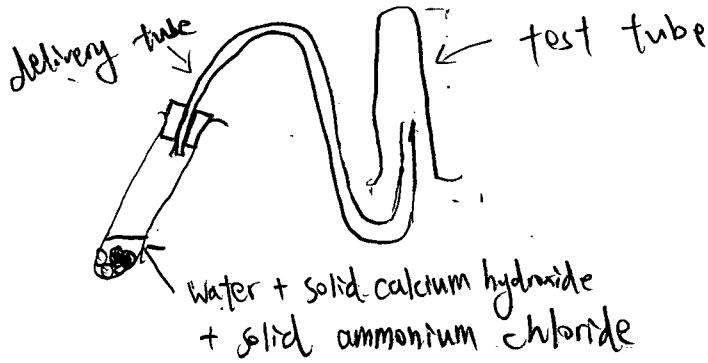
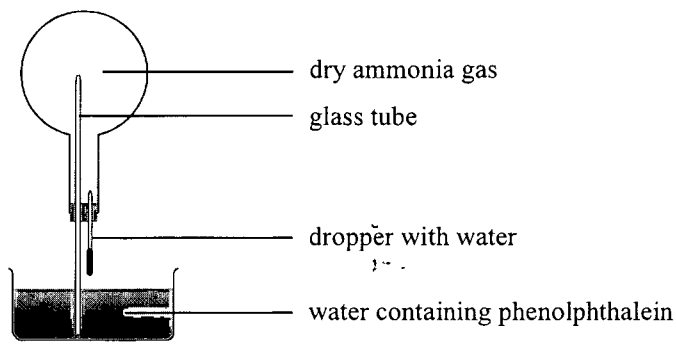
2. This question involves the preparation of ammonia gas and the investigation of the properties of ammonia gas in a laboratory.

(a) Solid calcium hydroxide reacts with solid ammonium chloride to form ammonia gas. Draw a labelled diagram to show the set-up involved and how ammonia gas is collected.



(2 marks)

(b) An experiment was performed to investigate the properties of ammonia gas with the set-up shown below :



The round-bottomed flask was initially full of dry ammonia gas. Several drops of water were injected into the flask from the dropper. The water containing phenolphthalein was then automatically sucked into the flask through the glass tube.

(i) Briefly explain why the water containing phenolphthalein was sucked into the flask.

It is used to dissolve ammonia gas in water in order to ionize it.

(ii) State, with explanation, an observation related to phenolphthalein in the flask.

The phenolphthalein turns from colourless to pink as ammonia solution is alkaline

(4 marks)

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3. (a) Explain whether $BaCl_2$ or OCl_2 would have a higher melting point.

$BaCl_2$ has a giant ionic structure
OCl_2 has a simple molecular structure.
OCl_2 molecules are only held together by weak van der Waal's forces.
Ba atoms and Cl atoms in $BaCl_2$ are held together by strong ionic bond.
More energy is required to break the ionic bond. Thus, $BaCl_2$ has a higher melting point

(2 marks)

(b) Explain the following decreasing order of the boiling points of three substances :

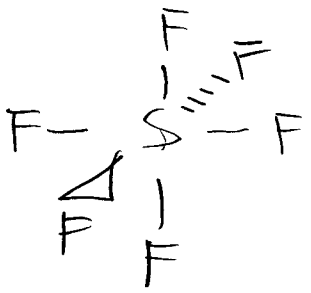
$NH_3 > PH_3 > CH_4$

All of the three substances has simple molecular structure. The molecules are held together by van der Waal's forces

Firstly, CH_4 is non polar due to its symmetrical arrangement. NH_3 and PH_3 is polar due to its asymmetrical arrangement.
The van der Waal's forces between NH_3 molecules and PH_3 molecules is greater and they have higher boiling point.
Secondly, there is hydrogen bonds between NH_3 molecules due to the great electronegativity difference between N and H atom. Hydrogen bond does not exist in PH_3. Thus, NH_3 has a higher boiling point than PH_3

(3 marks)

(c) Draw a three-dimensional diagram to represent the molecular shape of SF_6.



(1 mark)

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4. Petroleum is an important source of hydrocarbons.

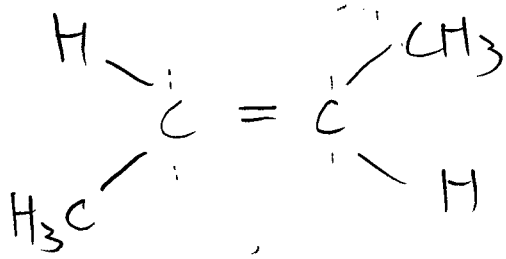
(a) Describe the origin of petroleum.

Petroleum is formed form the dead remains of marine organisms million years ago under water under the higher pressure and high temperature.

(2 marks)

(b) **D**, **E** and **F** are isomeric alkenes containing four carbon atoms. **D** and **E** are *cis-trans* isomers.

(i) Draw the structure of **E** (*trans*-isomer).



(ii) State the systematic name of one possible structure of **F**.

but-1-ene

(2 marks)

(c) Ethene and ethane are hydrocarbons.

(i) Suggest how ethene can be converted to ethane.

Ethene can be converted to ethane by hydrogenation under 150 - 200°C and the presence of Pt catalyst

(ii) Suggest a chemical test to distinguish between ethane and ethene.

Adding bromine dissolved in 1,1,1-trichloromethane into ethane and ethene in the absence of light

Only the solution of ethene turns from brown to colourless

(3 marks)

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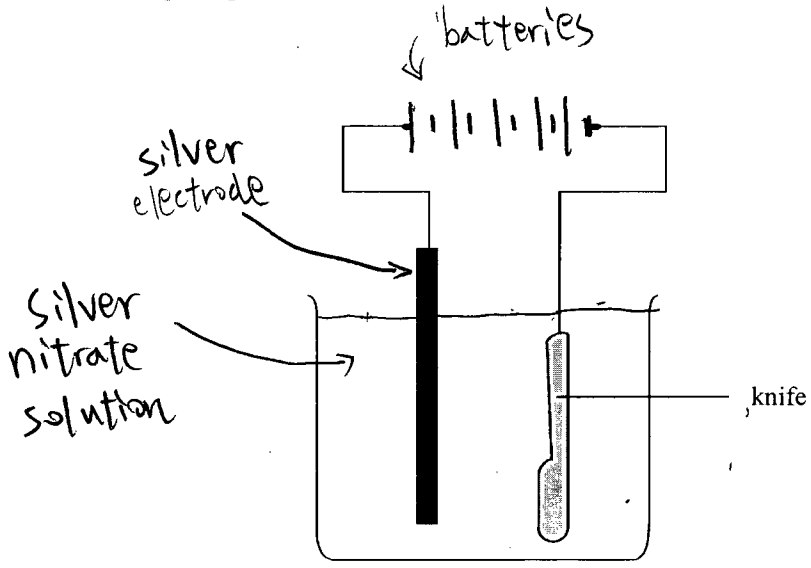
5. Electroplating and rust prevention are common applications of electrochemistry.

(a) The diagram below shows an incomplete set-up. Add suitable drawings and labels to the diagram for electroplating of silver onto the knife.



(2 marks)

(b) Suggest a method, besides painting or electroplating, that can prevent underground iron-made pipelines from rusting. Explain your answer.

Sacrificial protection
Prevent the pipelines from rusting by linking a zinc block with it. Zinc is more reactive than iron. It loses electrons more readily than iron. Thus, Zinc loses electrons instead of iron and prevent the pipelines from rusting

(2 marks)

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6. Energy exists in various forms.

(a) Glucose ($C_6H_{12}O_6$) is one important energy source for living things.

(i) Write a chemical equation for the conversion of carbon dioxide gas and liquid water to solid glucose and oxygen gas.

$6\,CO_2(g) + 6H_2O(l) \longrightarrow C_6H_{12}O_6(s) + 6O_2(g)$

(ii) The following standard enthalpy changes of formation are given :

$CO_2(g) = -394\ kJ\ mol^{-1}$, $H_2O(l) = -286\ kJ\ mol^{-1}$, $C_6H_{12}O_6(s) = -1274\ kJ\ mol^{-1}$

Calculate the standard enthalpy change of the conversion in (i) above.

$6\,CO_2(g) + 6H_2O(l) \xrightarrow{\Delta H^\theta} C_6H_{12}O_6(s) + 6O_2(g)$

$6\Delta H_f^\theta[CO_2(g)] + 6\Delta H_f^\theta[H_2O(l)]$ ↑ $6C(s) + 9O_2(g) + 6H_2(g)$ ↗ $\Delta H_f^\theta[C_6H_{12}O_6(s)]$

$\Delta H^\theta = \Delta H_f^\theta[C_6H_{12}O_6(s)] - 6(\Delta H_f^\theta[CO_2(g)] + \Delta H_f^\theta[H_2O(l)])$

$= -1274 - 6(-394 - 286)$

$= +2806\ kJ\ mol^{-1}$

(iii) Green plants can convert carbon dioxide and water to glucose and oxygen. State the transformation of energy in this conversion.

Heat energy to chemical energy

(4 marks)

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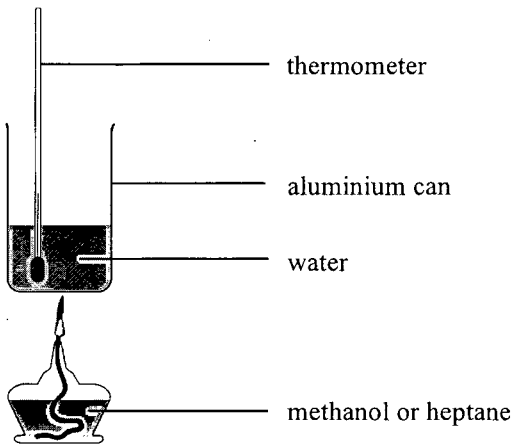
6. (b) Burning heptane (C_7H_{16}) releases energy. The enthalpy change of combustion of heptane was determined using the set-up shown below :



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)

Energy released by burning methanol in Step (I)
$= \frac{1.58}{32} \times -715$
$= -35.30$ kJ
Heat capacity of the water
$= \frac{-35.30}{18.5}$
$= -1.91$ kJ °C^{-1}
Enthalpy change of combustion of heptane
$= -1.91 \times 25.8 \div (1.02 \div 100)$
$= -4830$ kJ mol^{-1} (corr. to 3 sig. fig.)

(ii) Besides heat loss, suggest another source of error in the experiment.

The heat capacities of apparatus are not taken into account

(4 marks)

7. An experiment was performed to determine the number of water of crystallisation, **n**, in a sample of hydrated sodium tetraborate ($Na_2B_4O_7 \cdot nH_2O$). 0.452 g of the sample was dissolved completely in about 50 cm^3 of deionised water in an apparatus **X**. The solution obtained was alkaline and was immediately titrated in **X** with 0.125 M HCl(aq) using methyl orange as an indicator. It required 18.98 cm^3 of the acid to reach the end point.

(a) Name **X**.

Conical flask

(1 mark)

(b) State the colour change at the end point of the titration.

yellow to orange

(1 mark)

(c) It is known that in the reaction during the titration, the mole ratio of $B_4O_7^{2-}(aq)$ to $H^+(aq)$ is 1 : 2. Calculate the number of water of crystallisation, **n**.
(Relative atomic masses: H = 1.0, B = 10.8, O = 16.0, Na = 23.0)

No. of moles of HCl (aq) used

$= 0.125 \times \frac{18.98}{1000}$

$= 2.373 \times 10^{-3}$ mol

By mole ratio, $B_4O_7^{2-}(aq) : H^+(aq) = 1 : 2$

∴ mass of $Na_2B_4O_7$ (aq) in the sample

$= 2.373 \times 10^{-3} \div 2 \times (23 \times 2 + 10.8 \times 4 + 7 \times 16)$

$= 0.2387$ g

	$Na_xB_4O_7$	H_2O
Mass (g)	0.2387	0.452 − 0.2387 = 0.2133
No. of moles (mol)	$0.2387 \div (23 \times 2 + 10.8 \times 4 + 7 \times 16)$ $= 1.186 \times 10^{-3}$	$\frac{0.2133}{18}$ $= 0.0119$
Mole ratio	$\frac{1.186 \times 10^{-3}}{1.186 \times 10^{-3}}$ $= 1$	$\frac{0.0119}{1.186 \times 10^{-3}}$ ≈ 10

∴ empirical formula $= Na_2B_4O_7 \cdot 10H_2O$

∴ $n = 10$

(3 marks)

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7. (d) It is known that hydrated sodium tetraborate can be used to prepare standard solutions.

(i) What is meant by the term 'standard solutions' ?

Standard solutions are solutions that having known concentration.

(ii) Suggest one use of standard solutions.

Titration in volumetric analysis

(2 marks)

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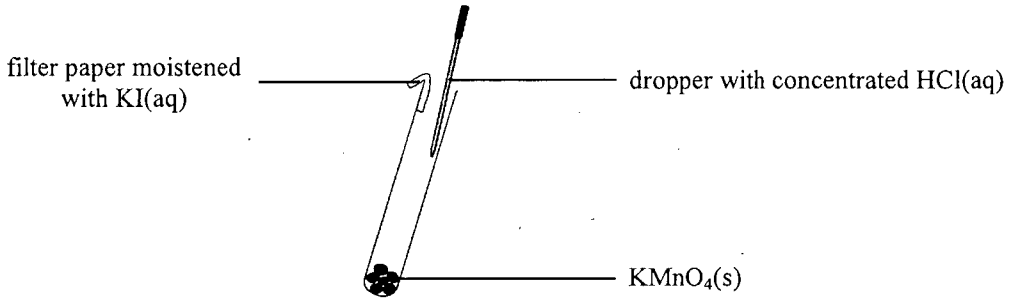
8. Refer to the experimental set-up as shown below.



(a) HCl is a strong acid. What is meant by the term 'strong acid' ?

Strong acid is acid which ionize completely in water

(1 mark)

(b) When concentrated HCl(aq) is dropped into $KMnO_4(s)$, a yellowish green gas is formed.

(i) What is the yellowish green gas ?

Chlorine

(ii) Explain whether the reaction forming the yellowish green gas is a redox reaction.

The reaction is a redox reaction.
$Cl^-(aq)$ is oxidized to $Cl_2(g)$.
At the same time, $MnO_4^-(aq)$ is reduced to $Mn^{2+}(aq)$.

(2 marks)

(c) With the aid of an ionic equation, state the expected observation when the yellowish green gas reaches the filter paper.

$2I^- + Cl_2 \longrightarrow 2Cl^- + I_2$

The colourless filter paper turns brown because colourless iodide ion is oxidized to brown iodide solution by chlorine gas

(2 marks)

(d) In consideration of laboratory safety, explain where the experiment should be performed.

As iodine solution and chlorine gas is toxic, the experiment should be performed inside fume cupboard

(1 mark)

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*9. Tetrafluoroethene undergoes polymerisation to form a polymer called 'Teflon'. Using this example, describe this type of polymerisation.

(5 marks)

Tetrafluoroethene molecules first polymerise to repeating units of Teflon.
Then, the repeating units join together without elimination of small molecules to form the Teflon polymer chains.
Eventually, the chains are held together by van der Waal's forces to form polymer Teflon.
This type of polymerisation is the addition polymerisation. Addition polymerisation is are reaction joing the monomer of polymer together repeatly without elimination of any small molecules

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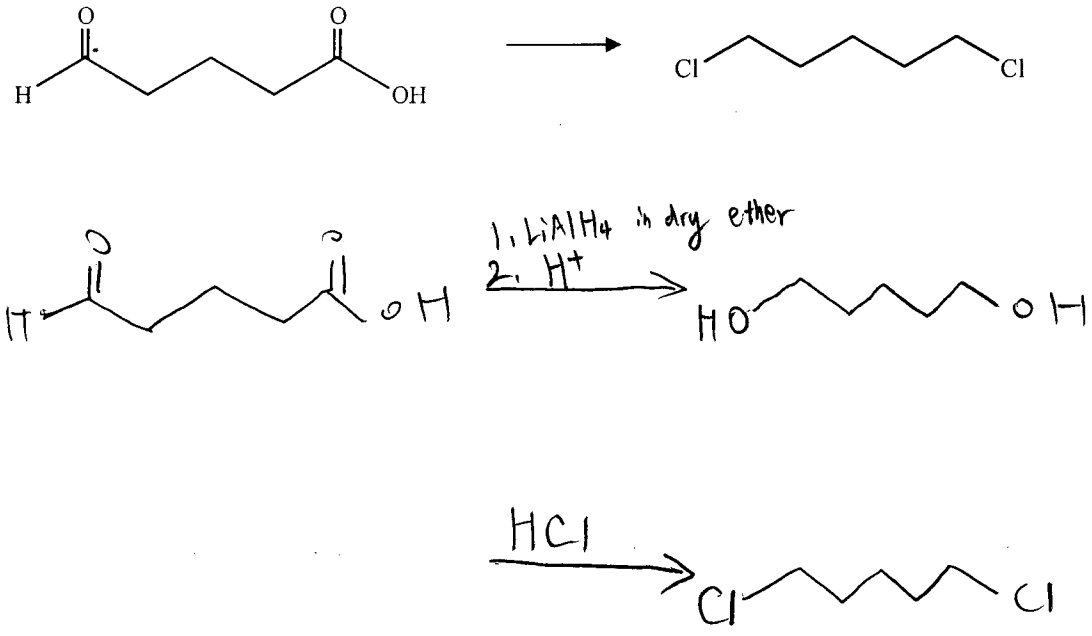
PART II

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

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



(3 marks)

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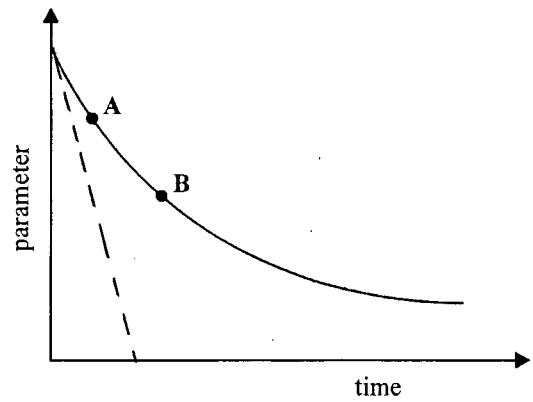
11. Consider the following reaction :

$$Br_2(aq) + HCO_2H(aq) \rightarrow 2HBr(aq) + CO_2(g)$$

In an experiment to study the rate of consumption of $Br_2(aq)$, equal volumes of 0.01 M $Br_2(aq)$ and 1.0 M $HCO_2H(aq)$ were mixed. The progress of the reaction was followed by measuring a certain parameter of the reaction system using a colorimeter. The graph below shows the results from the start of the reaction.



(a) Assume that the rate of change of the parameter with time can represent the rate of reaction.

(i) According to the shape of the curve above, suggest what the parameter should be.

absorbance

(ii) The initial rate of the reaction can be determined by a suitable sketch on the above graph. Draw the suitable sketch on the above graph, and describe how the initial rate of the reaction can be obtained from the sketch.

First, draw a tangent of the graph at $t=0$
Second, determin the slope of the tangent
The slope is the initial rate of the reaction

(iii) According to the graph above, the rate of reaction at **A** is higher than that at **B**. Explain this at molecular level.

From A to B, the number of moles of $Br_2(aq)$ and $HCO_2H(aq)$ are decreasing due to the progressing of reaction. Thus, the concentration of both solution decreases. It is more difficult for the molecules possesses enough kinetic energy collide together at right orientation. Thus, no. of effective collisions decrease and rate of reaction decrease

(5 marks)

(b) Suggest another method that can follow the progress of the reaction.

Measuring the change in gas pressure of the system

(1 mark)

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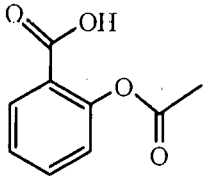
12. Aspirin is a pain-killer. Its structure is shown below :

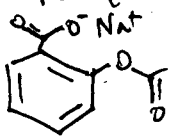


(a) State one medical application of aspirin other than pain-killing.

anti-inflammatory

(1 mark)

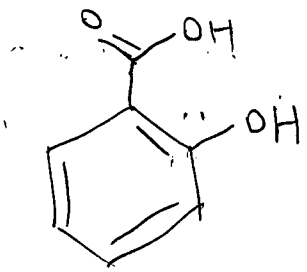
(b) Explain why a suspension of aspirin and water can become clear when sodium hydrogencarbonate powder is added.

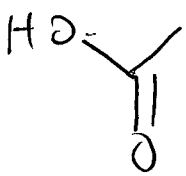
When sodium hydrogencarbonate powder is added, aspirine react with it to form an ionic product  , water and carbon dioxide which are all soluble in water.

(2 marks)

(c) Heating aspirin with excess dilute aqueous acid under reflux will give two organic products.

(i) Draw the structures of these two organic products.





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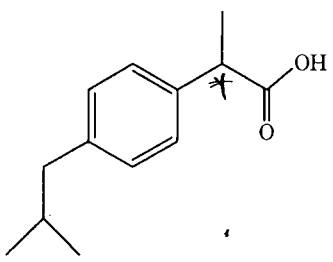
12. (c) (ii) Explain why the conversion of aspirin to these two organic products can hardly reach 100% even though the mixture of aspirin and dilute acid is heated under reflux for a long time.

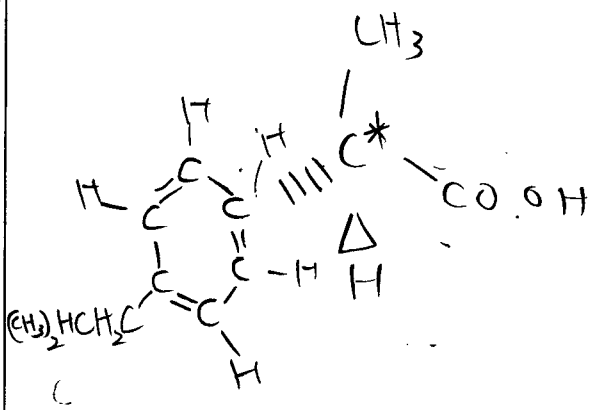
Acid hydrolysis of ester is reversible. The reaction never go to complete as it is reversible.

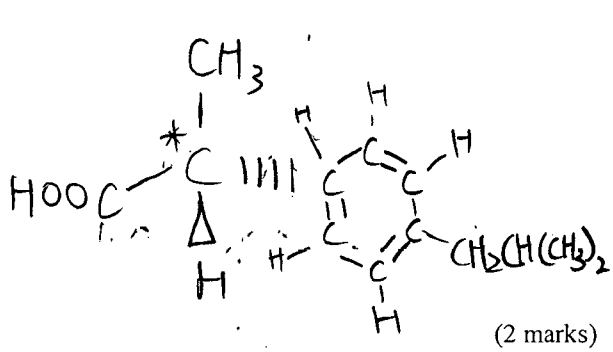
(3 marks)

(d) Ibuprofen is also a pain-killer. Its structure is shown below :



There exists enantiomerism in ibuprofen. Draw the three-dimensional structures for the pair of enantiomers.





(2 marks)

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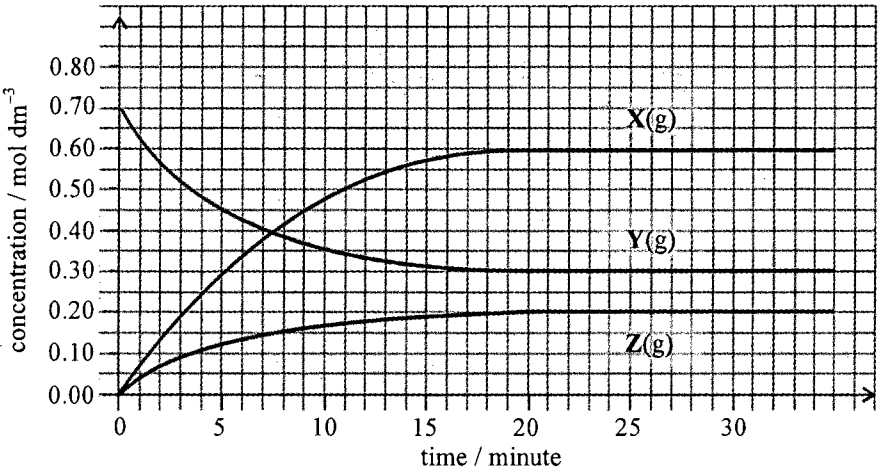
13. An experiment was performed for a reversible reaction involving **X**(g), **Y**(g) and **Z**(g) in a closed container of 2.0 dm^3 at a constant temperature. The graph below shows the relevant experimental data.



(a) According to the graph, how do you know that the reaction is reversible ?

None of X, Y, Z is consumed completely after the reaction obtains an equilibrium at t = 25 minute

(1 mark)

(b) Calculate the equilibrium constant K_c for the reaction at the temperature of the experiment.

From the graph, Y was the reactant of forward reaction, X and Z is the product of forward reaction

The mole ratio of X : Z = 0.6 : 0.2
= 3 : 1

mole ratio of Z : Y = 0.2 : (0.7 − 0.3)
= 1 : 2

$\therefore K_c = \dfrac{(0.6)^3 \times 0.2}{0.3^2} = 0.48\ mol^{-2}dm^6$

(3 marks)

(c) Comment on the following statement :

'The rate of the forward reaction is zero at the 25th minute after the start of the reaction.'

The reaction obtain an equilibrium state at t = 25
The forward and backward reaction at equilibrium state will not become zero according to the definition.
∴ The comment is incorrect

(1 mark)

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*14. Using Na_2O, Al_2O_3 and SO_2 as examples, illustrate the acid-base behaviour of the oxides of the third period elements with the aid of relevant reactions.

(6 marks)

Na_2O can react with water and acid but cannot react with alkali. It shows alkaline property.

∴ Na_2O is an alkaline salt

$Na_2O + H_2O \rightarrow 2NaOH$

$Na_2O + 2H^+ \rightarrow 2Na^+ + H_2O$

Al_2O_3 can react with acid and alkali

It shows both acidic and alkaline properties.

∴ Al_2O_3 is an atmospheric salt.

$3H_2O + Al_2O_3 + 2OH^- \rightarrow 2[Al(OH)_4]^-$

$Al_2O_3 + 6H^+ \rightarrow 2Al^{3+} + 3H_2O$

SO_2 can react with alkali and water but cannot react with acid. It shows acidic property.

∴ SO_2 is an acidic salt

$SO_2 + H_2O \rightarrow H_2SO_3$

$SO_2 + 2OH^- \rightarrow SO_3^{2-} + H_2O$

END OF SECTION B
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PERIODIC TABLE 周期表

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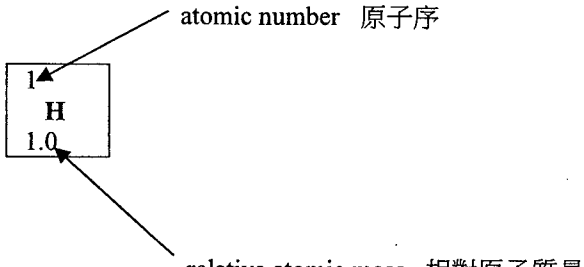

I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 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)

2018 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

Level 5 Exemplar & Comments
Paper 2

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.

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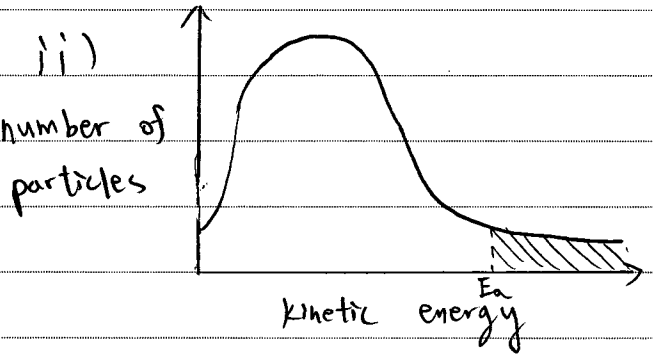
每題另起新頁作答。
Start each question on a new page.

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

ai) 1. $2Cl^- \rightarrow Cl_2 + 2e^-$

2. $2H^+ + 2e^- \rightarrow H_2$

ii)



iii) glucose

bi) 1) copper

2) Both of the reactants are gases. The distance between gas molecules are large. It is difficult for the gas molecules possessed enough kinetic energy collide with other gas molecules with enough high speed and at right orientation. Thus, the frequency of effective collision is low in the absence of catalyst. Reaction then proceed slowly

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

3) The number of moles of gas at the product side of forward reaction is smaller than than at the reactant side. When gas pressure increases, the equilibrium position shifts to right to encounter the change. Thus, the yield of CH_3OH can be increased.

100 atm is used to increase the product yield.

b ii) 1) CO(g) which is toxic is used in reaction (I) while no toxic chemical is used in reaction (II). Thus, reaction (II) is greener

2) Reaction (II) can convert $CO_2(g)$ to methanol. It can be used to reduce the number of moles of $CO_2(g)$ which is greenhouse gas in atmosphere. As a result, the problem of global warming can be alleviated and less serious

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b)ii) CH_3OH + $\longrightarrow$ CH_3COOH

(c) i) The reaction order with respect to N_2O_5 does not change with temperature as the slope of graph is equal to its reaction order. The kinetic energy of molecules does not affect the reaction order of chemicals.

ii) Order of reaction with respect to $N_2O_5(g)$
= slope of l_1
$= [(-1.4)-(-3.4)] \div [0-(-2)]$
$= 1$

iii) From l_2, $\log r_0 = m \log [N_2O_5(g)]_0 + \log k$
$\log r_0 = \log [N_2O_5(g)]_0 + \log k$
sub $(-2, -4)$
$-4 = -2 + \log k$
$\log k = -2$
$k = \frac{1}{100}$
∴ the rate constant for reaction at 345K
$= \frac{1}{100}\ s^{-1}$

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

(v) $\log k = \log A - \frac{E_a}{2.3(R)} \times \frac{1}{T}$

From l_1, sub $(-2, -3.4)$

$\log r_0 = \log [N_2O_5(g)]_0 + \log k$

$-3.4 = -2 + \log k$

$\log k = -1.4$

$\therefore \log k$ at $360K = -1.4$

From (iii), $\log k$ at $345k = -2$

$$\begin{cases} -1.4 = \log A - \frac{E_a}{2.3 \times 8.31} \times \frac{1}{360} \rightarrow ① \\ -2 = \log A - \frac{E_a}{2.3 \times 8.31} \times \frac{1}{345} \rightarrow ② \end{cases}$$

① − ②,

$-1.4 + 2 = \log A - \frac{E_a}{2.3 \times 8.31} \times \frac{1}{360} - \log A + \frac{E_a}{2.3 \times 8.31} \times \frac{1}{345}$

$E_a = 94953\ J\ mol^{-1}$

$\therefore$ activation energy of the reaction is $94953\ J\ mol^{-1}$

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Start each question on a new page.

3ai) The compound may contains calcium ion

ii) Adding bromine water which dissolved in 1,1,1-trichloromethane into both solution. Only K_2SO_3 (aq) can turn the solution from brown to colourless.

iii) Rf value of a substance is the ratio of distance travelled in a developing solvent by the substance to the distance travelled in the developing solvent by the testing sample

bi) Firstly pour the sample solution into a 250 cm^3 volumetric flask.
Secondly wash the container with deionised water again and pour the remains into the volumetric flask.
Thirdly, add deionised water into the volumetric flask until the meniscus reached the graduation mark.
Then, stopper the flask
Lastly, invert the flask several times.

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

ii) $ClO_3^- + 6I^- + 6H^+ \longrightarrow 3I_2 + Cl^- + 3H_2O$

iii) From dark blue to colourless

iv) No. of moles of $Na_2S_2O_3$ used

$= \frac{27.88}{1000} \times 0.112$

$= 3.12256 \times 10^{-3}$ mol

~~No. of moles of KI used~~

~~$= \frac{10}{1000} \times 1$~~

~~$= 0.01$ mol~~

By mole ratio of b(iv), $S_2O_3^{2-} : I_2 = 2:1$

∴ no. of moles of iodine solution formed

$= 3.12256 \times 10^{-3} \div 2$

$= 1.56128 \times 10^{-3}$ mol

By molar ratio of b(ii), $I_2 : ClO_3^- = 3:1$

percentage by mass of $NaClO_3$ in the sample

$= \frac{1.56128 \times 10^{-3} \div 3 \times \frac{250}{10} \times (23 + 16 \times 3 + 35.5)}{1.63} \times 100\%$

$= 85.0\%$

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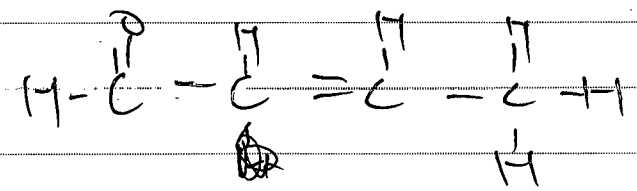
(i) The boiling point of X and Y is too close.

(ii) 1) The strong absorption peak between 1680 and 1800 cm^{-1} shows the presence of C=O bond in X. Aldehyde may be present in X

2) Peak at m/z = 43 corresponds to fragment ion CH_3CO^+ or $CH_3CH_2^+$
Peak at m/z = 55 corresponds to fragment ion $CH_3CHCH_2^+$

3)



(iii) Y may be ketone butanone as only give positive result to 2,4-dinitrophenylhydrazine test and negative in Tollens' test

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Comments

The candidate's answers show good understanding of the chemical concepts and principles in the curriculum (e.g. Paper 1 Qs. 2(b)(ii), 3(b), 4(a) & (c), 7(d)(i), 8(a), 11(a), 12(b) & (c)(ii), 14; Paper 2 Qs. 1(a)(i) & (iii) & (b)(i)(1) & (3), 3(a) & (b)(ii) & (iii) & (c)(i) & (ii)(1)).

He/she demonstrates very good abilities of applying chemical concepts to unfamiliar situations for solving the problems (e.g. Paper 1 Qs. 5(b), 8(c), 10, 11(a)(iii); Paper 2 Qs. 1(b)(ii) & (c)(i), 3(c)(iii)).

He/she performs well on chemical calculations (e.g. Paper 1 Qs. 1(a)(i) & (b)(ii), 6(a)(ii) & (b)(i), 7(c); Paper 2 Qs. 1(c)(ii) & (iii) & (iv), 3(b)(iv)).

He/she can effectively communicate ideas using scientific terminology, appropriate diagrams and chemical equations (e.g. Paper 1 Qs. 3(c), 4(b)(i) & (ii), 5(b), 8(c), 9, 12(c)(i), 14; Paper 2 Q. 3(b)(i)).

He/she can design appropriate method for carrying out scientific investigations (e.g. Paper 1 Q. 5(a)).