2019-DSE
CHEM
PAPER 1B

B

Level 5 Exemplar &
Comments
Paper 1B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2019

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. The table below shows some information of three atoms :

	Number of protons	Number of electrons	Number of neutrons
Protium	1	1	0
Deuterium	1	1	1
Oxygen	8	8	8

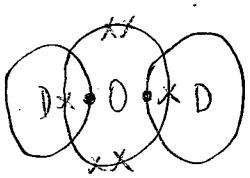
(a) Explain why protium and deuterium are isotopes.

They have the same number of proton which is 1 but different number of neutrons. (1 mark)

(b) Deuterium can be represented by D. It reacts with oxygen as shown in the equation below :

$$2D_2 + O_2 \rightarrow 2D_2O$$

Draw the electron diagram for a D_2O molecule, showing ELECTRONS IN THE OUTERMOST SHELLS only.



(1 mark)

(c) A small piece of sodium metal is placed into liquid D_2O at room conditions.

(i) State TWO expected observations.

A silver metal ball move quickly on the surface of water.
Colourless gas bubbles evolved.

(ii) Write the chemical equation for the reaction involved.

$2Na + 2D_2O \longrightarrow 2NaOD + D_2$

(3 marks)

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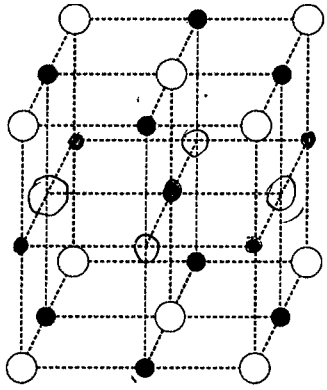
2. Sodium chloride crystal has a giant ionic structure.

(a) The diagram below shows a part of the structure of sodium chloride crystal with some ions missing.



● = Na^+
○ = Cl^-

Complete the diagram by using ● as Na^+ ion and ○ as Cl^- ion.

(1 mark)

(b) From an experiment, it was found that there are 4 Na^+ ions and 4 Cl^- ions in a cube of sodium chloride crystal of volume 1.80×10^{-22} cm^3.

(i) Express the total mass of 4 Na^+ ions and 4 Cl^- ions in terms of the Avogadro's constant L.
(Relative atomic masses : Na = 23.0, Cl = 35.5)

The total mass = $\frac{(23)(4)}{L} + \frac{(35.5)(4)}{L}$

$= \frac{234}{L}$ g //

(ii) Hence, calculate the Avogadro's constant L, given that 1.00 cm^3 of sodium chloride crystal weighs 2.17 g.

$2.17 \times (1.80 \times 10^{-22}) = \frac{234}{L}$

$L = 5.99 \times 10^{23}$ atoms/mol (corr. to 3 sig. fig.)

(3 marks)

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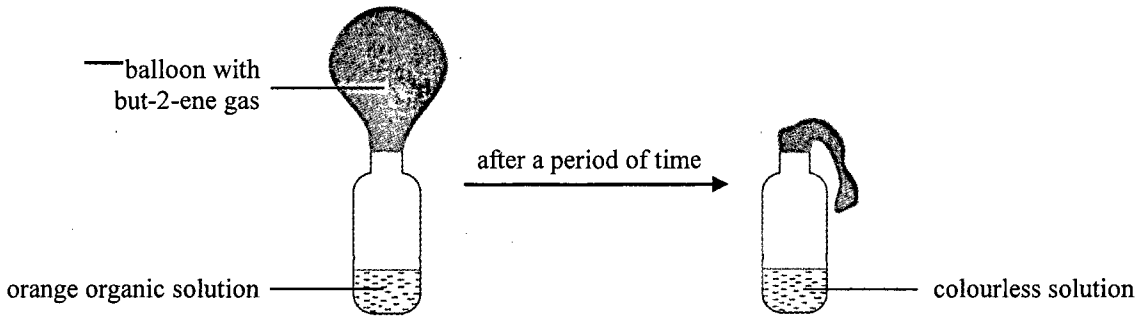
3. An experiment was carried out as shown below :



(a) (i) Suggest what the orange organic solution may be.

Br_2 solution dissolved in CCl_4

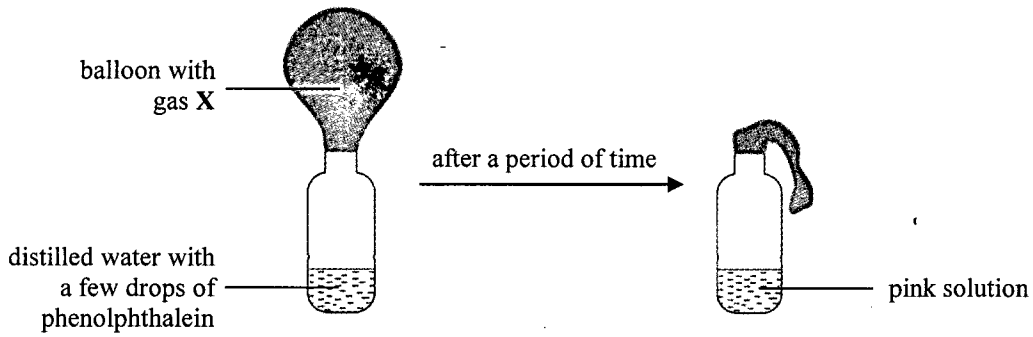
(ii) With the help of a chemical equation, explain the colour change in the solution.

$CH_3-CH=CH-CH_3 + Br_2 \longrightarrow CH_3-\underset{Br}{CH}-\underset{Br}{CH}-CH_3$

The colour change from orange to colourless as Br_2 (dissolved in CCl_4) is reacted into the but-2-ene.

(3 marks)

(b) Another experiment was carried out as shown below :



With the help of a chemical equation, suggest and explain what gas **X** may be.

$NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH_{4(aq)}^+ + OH_{(aq)}^-$

As the phenolphthalein changed from colourless to pink, it illustrate the solution is alkalone, as $NH_{3(g)}$ can dissolve in water to give out OH^- ions which turn the $[OH^-_{(aq)}]$ higher than $[H^+_{(aq)}]$ and turn the solution to alkalone. So it might be $NH_{3(g)}$

(3 marks)

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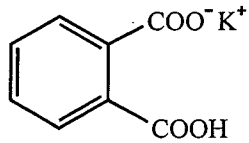
4. Solid potassium hydrogenphthalate can be used to prepare standard solutions. Its structure is shown below :



(a) You are provided with 1.12 g of solid potassium hydrogenphthalate.

(i) Describe briefly how a 250.0 cm^3 of standard solution containing 1.12 g of potassium hydrogenphthalate can be prepared in a laboratory.

Firstly, a 1.12 g of potassium hydrogenphthalate is added to a 250.0 cm^3 volumetric flask. Then, distilled water is added to the flask until the graduation mark is meeted.

(ii) Calculate the molarity of the standard solution obtained in (i).
(Formula mass : potassium hydrogenphthalate = 204.1)

No. of mole of ∴ potassium hydrogenphthalate in the solution: $\frac{1.12}{204.1} = 5.4875 \times 10^{-3}$ mole.

The molarity: $\frac{5.4875 \times 10^{-3}}{250/1000} = 0.0220\ M$ (corr. to 3 sig. fig.)

(4 marks)

(b) At room conditions, the pH of a 0.060 M of potassium hydrogenphthalate solution is 3.30. Based on this information and appropriate calculation, comment whether the –COOH group in potassium hydrogenphthalate is completely ionised.

If the -COOH group is completely ionised, the pH of the solution = $-\log[0.06]$
$= 1.22$ (corr. to 3 sig. fig.)

∴ As the pH value given which 3.30 is higher than 1.22, it illustrate the no. of mole of H^+ (aq) is less than completely ionised. So it don't.

(2 marks)

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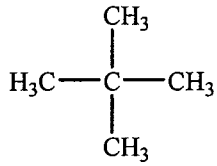
5. The structure of a compound is shown below :



Reacting with a reagent under certain conditions, it can give two compounds with the same molecular formula $C_5H_{10}Cl_2$ but different structures.

(a) Suggest what the reagent is.

Cl_2 (aq)

(1 mark)

(b) State the condition needed for the reaction to occur at room temperature.

Under sunlight

(1 mark)

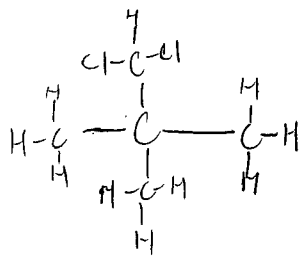
(c) Name the type of the reaction involved.

Substitution reaction

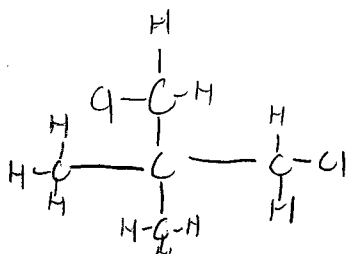
(1 mark)

(d) (i) Draw the structure of ONE of these two compounds and give its systematic name.

name : 1,1-dichloro-2,2-dimethylpropane



(ii) Draw the structure of the other compound.



(iii) These two compounds are isomers. State the type of isomerism exhibited by them.

Position isomer.

(4 marks)

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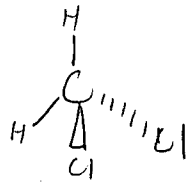
6. Consider CH_2Cl_2 and CCl_4 molecules :

(a) Draw the three-dimensional structure of a CH_2Cl_2 molecule.



(1 mark)

(b) (i) Explain why CH_2Cl_2 is a polar molecule but CCl_4 is not.

The electronegativity of Cl is much higher than that of C, the bonding between C and Cl are polar, however, in CCl_4, as it is in tetrahedral shape, the polarity between Cl and cancelled out each out. In CH_2Cl_2, it is in trigonal pyramidal shape so the polarity haven't cancelled out and create a polar molecule.

(ii) Explain why CCl_4 has a higher boiling point than CH_2Cl_2.

Although CH_2Cl_2 is polar but CCl_4 is not polar, the molecular size of CCl_4 is larger them that of CH_2Cl_2 the Van der Waal's force between CCl_4 molecules are therefore larger them that of CH_2Cl_2. As both of the in simple molecular structure, CCl_4 which have the stronger Van der Waal's force have a higher boiling point.

(3 marks)

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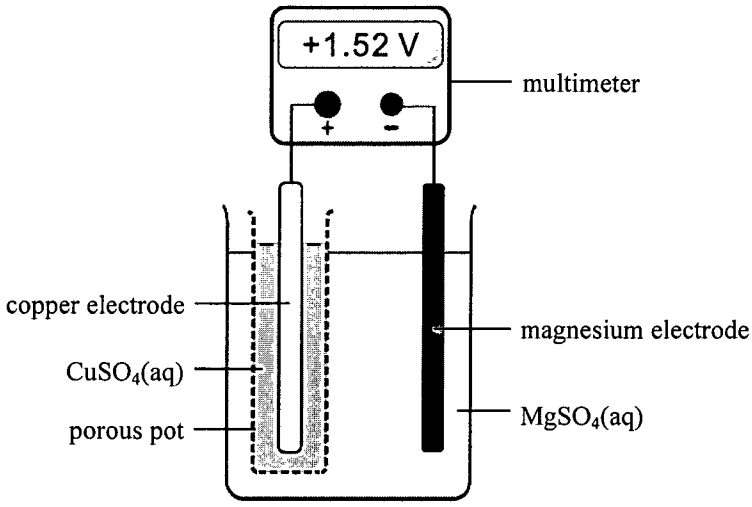
7. (a) Consider the chemical cell as shown below :



(i) What is the function of the porous pot ?

To allow the movement of $SO_4^{2-}(aq)$ and $Mg^{2+}(aq)$ and to prevent the direct interaction of Mg and $CuSO_4(aq)$

(ii) Deduce whether the electrons flow through the external circuit from the magnesium electrode to the copper electrode.

As Mg lose electrons more readily than Cu, electrons flow from Mg electrode to Cu electrode through external circuit.

(iii) Write the half equation for the change that occurs at the cathode.

$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$

(3 marks)

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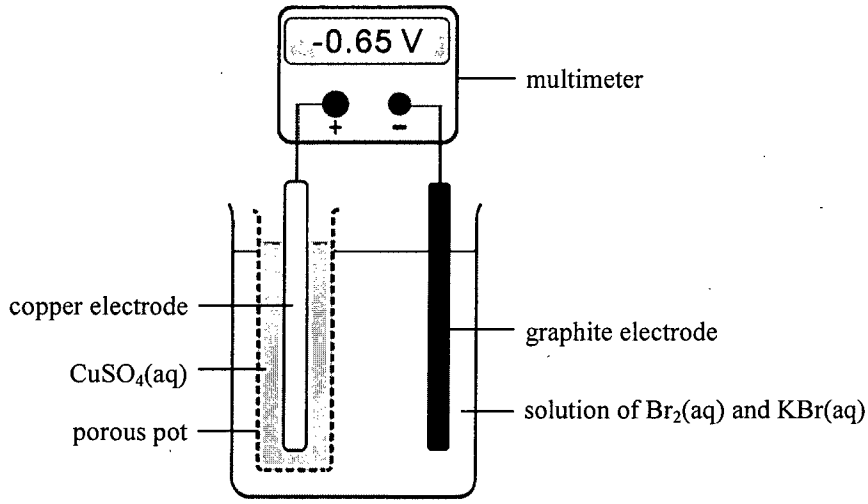
7. (b) Consider another chemical cell as shown below :



(i) Write the half equation for the change that occurs at the graphite electrode.

$Br_{2(aq)} + 2e^- \rightarrow 2Br^-_{(aq)}$

(ii) State the expected observation at the copper electrode.

The copper electrode decrease in size and mass.
And the blue colour in $CuSO_{4(aq)}$ become deeper.

(iii) Would the multimeter reading become more negative, less negative or remain unchanged if the solution of $Br_2(aq)$ and KBr(aq) is replaced by a solution of $I_2(aq)$ and KI(aq), while the other conditions remain unchanged ? Explain your answer.

Less negative, because $I_{2(aq)}$ is a weaker oxidizing agent compare to $Br_{2(aq)}$ and the readiness of losing electrons from Cu electrode decreased and the reading should (through external circuit) be also less negative.

(4 marks)

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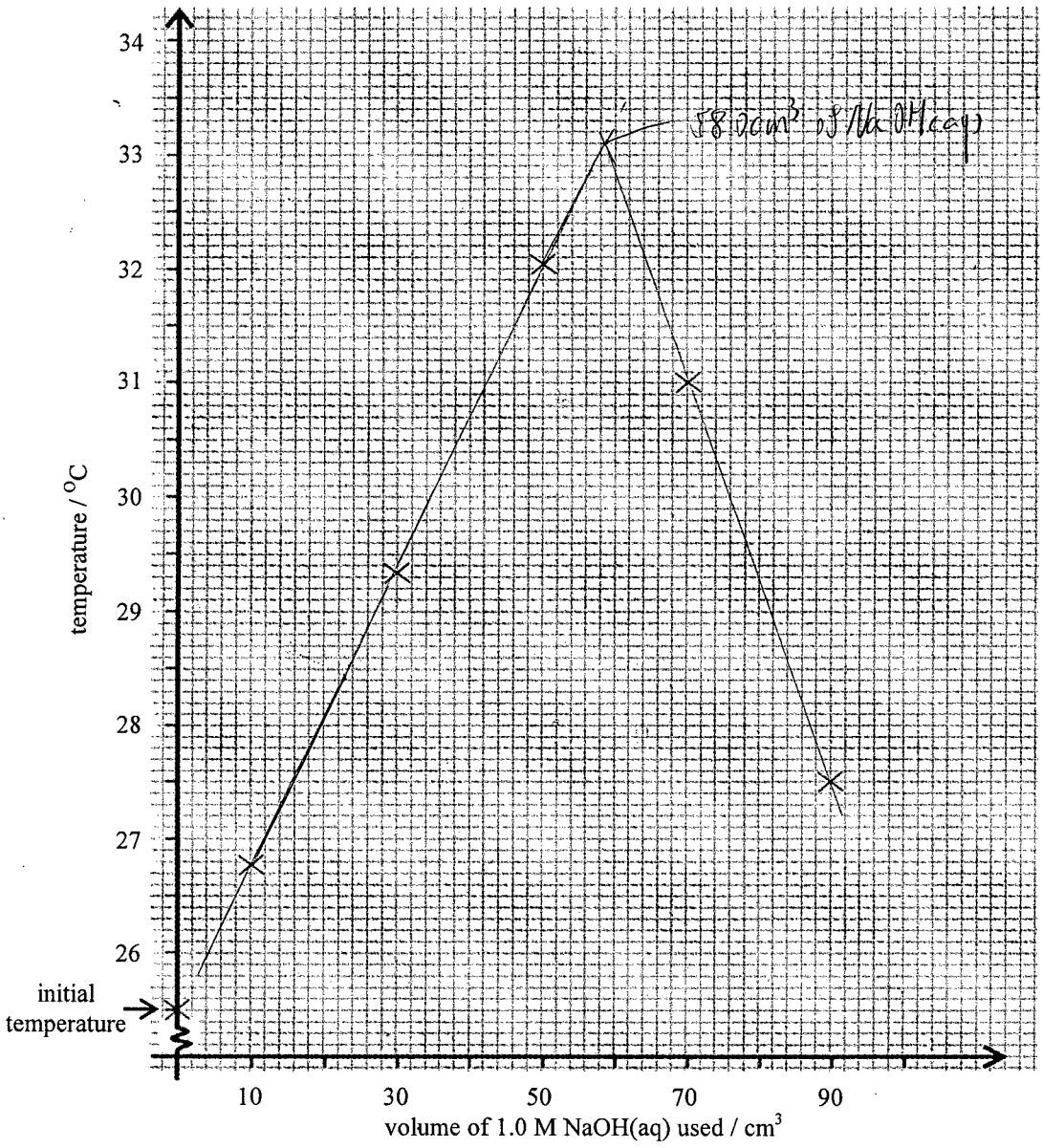
8. Several trials of an experiment were performed for determining the enthalpy change of neutralisation for a reaction. For each trial, a total volume of 100.0 cm^3 of a solution was obtained from mixing specified volumes of a HCl(aq) and 1.0 M NaOH(aq) as shown below in an expanded polystyrene cup. The HCl(aq) and NaOH(aq) were kept at the same initial temperature before mixing.

Trial	1	2	3	4	5
Volume of the HCl(aq) used / cm^3	90	70	50	30	10
Volume of 1.0 M NaOH(aq) used / cm^3	10	30	50	70	90

For each trial, the mixture was stirred and its maximum temperature reached was recorded. A graph of the maximum temperature reached for each trial is shown below :



(a) It is estimated from the graph that 58.0 cm^3 of NaOH(aq) (and 42.0 cm^3 of HCl(aq)) is required for obtaining the possible maximum temperature reached in this experiment. Show how this estimation can be done in the above graph.

(1 mark)

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8. (b) (i) Calculate the number of moles of NaOH(aq) reacted with HCl(aq) in (a). Hence, find the concentration of the HCl(aq).

The no. of mole of $NaOH_{(aq)}$ = $1 \times \frac{58}{1000}$ = 0.058 mole.

$NaOH + HCl \rightarrow NaCl + H_2O$.

$\therefore NaOH : HCl = 1:1$

The no. of mole of $HCl_{(aq)}$ used = 0.058 mole.

The concentration of $HCl_{(aq)}$ = $\frac{0.058}{42/1000}$

= 1.38 M

Corr. to 3 sig. fig.)

(ii) Given that the initial temperature of the mixture for each trial is 25.5°C, calculate the enthalpy change of neutralisation of the reaction, in kJ mol^{-1}.
(Density of the mixture = 1.00 g cm^{-3};
specific heat capacity of the mixture = 4.18 J g^{-1} K^{-1};
heat capacity of the expanded polystyrene cup : negligible)

The temperature increased = 33.1 - 25.5 = 7.6°C

$NaCl + HCl \rightarrow NaCl + H_2O$.

The energy released = $(\frac{100}{1000})(4.18)(-7.6)$

= -3.1768 KJ

The enthalpy change of the reaction

= $\frac{-3.1768}{0.058}$ = -54.8 KJ mol^{-1} (Corr. to 3 sig. fig.)

(4 marks)

(c) The one determined above is not the standard enthalpy change of neutralisation. What, then, is meant by the term 'standard enthalpy change of neutralisation' ?

It means the enthalpy change when 1 mole of water is formed by neutralisation of acid and base at standard condition which is 25°C, 1 atm.

(1 mark)

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9. Iron cans used to store food products are commonly coated with a thin layer of tin.

(a) The thin layer of tin prevents iron cans from corrosion.

(i) Briefly describe the principle for this kind of corrosion prevention.

To prevent iron contact from oxygen and water.

(ii) Explain whether these iron cans would corrode more readily once their surfaces are damaged by scratching.

As Tin is less reactive than iron, cans will lose electrons more rapidly once the surfaces are damaged by scratching.

(iii) Suggest why galvanisation is not suitable to prevent corrosion in iron cans that are used to store food products.

The Zinc plated on iron at galvanized iron is toxic.

(3 marks)

(b) There is an increasing trend for manufacturers to use cans made entirely of aluminium for storing food products.

(i) Explain why aluminium is more resistant to corrosion than iron, although it occupies a higher position than iron in the reactivity series.

There are a protective layer of Al_2O_3 which is impermeable to water or oxygen on the surface of aluminium.

(ii) Name the process that increases the corrosion resistance of aluminium cans.

Anodization.

(iii) Other than corrosion resistance, suggest one advantage of using aluminium to make cans.

It can be easier to dye on the surface of aluminium cans.

(3 marks)

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*10. You are provided with common laboratory apparatus and the following chemicals :

iron powder zinc powder aqueous ammonia distilled water

Describe how zinc sulphate crystals can be obtained from a solid sample of zinc sulphate containing copper(II) sulphate as impurity. (Not all chemicals must be used.)

(5 marks)

Firstly, add excess amount of distilled water to the solid sample to completely dissolve them. Then, add excess amount of Zn powder to the beaker containing the solution. Some reddish brown solid should be formed on the zinc powder. Repeat this process for several times until no reddish brown solid is formed on Zn powder. In addition, Filter all the precipitates through filtration. Moreover, boil the solution to make it saturated, Allow it to (and evaporate) cool down in room temperature, some crystal will be formed. Obtain the crystals by filtration. Wash the crystal with small amount of cold distilled water, and dry it with filter paper. The crystal is zinc sulphate crystals.

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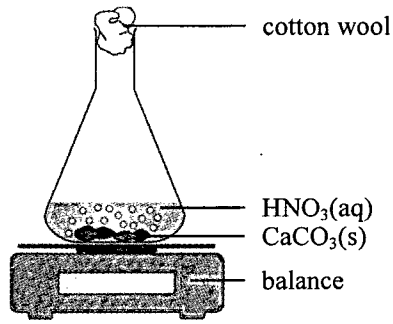
PART II

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

11. Two trials of an experiment were performed using the set-up below to study the reaction between nitric acid and calcium carbonate. A gas was formed in the reaction.



The chemicals used are listed in the table below while other experimental conditions were the same.

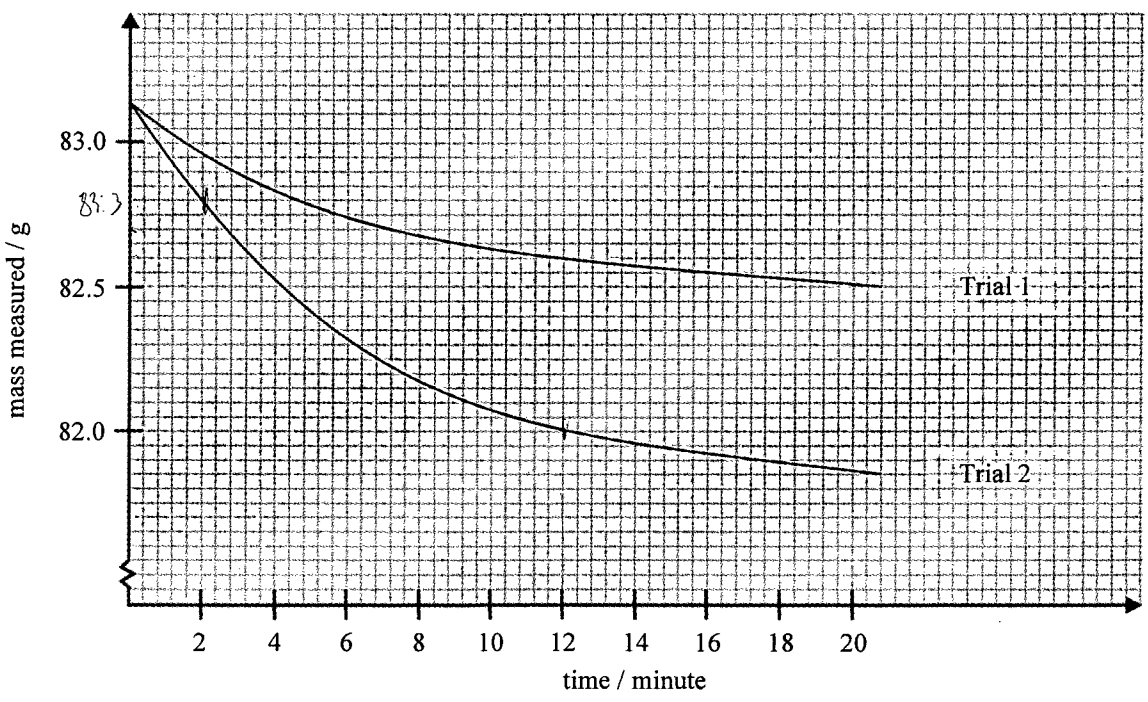
Trial	Mass of $CaCO_3(s)$ added / g	Volume of 3.0 M $HNO_3(aq)$ added / cm^3	Volume of $H_2O(l)$ added / cm^3
1	3.0	10.0	20.0
2	3.0	20.0	10.0

(a) Write the chemical equation for the reaction between nitric acid and calcium carbonate.

$2HNO_3 + CaCO_3 \longrightarrow CO_2 + Ca(NO_3)_2 + H_2O$

(1 mark)

(b) The graph below shows the variation of the mass measured with time for the two trials.



11. (b) (i) Calculate the average rate of formation of the gas from the 2nd minute to the 12th minute for Trial 2.

The average rate: $\frac{83.3 - 82}{12 - 2} = 0.13\ g\ min^{-1}$

(ii) Explain ONE difference in the shape of the curves for Trial 1 and Trial 2.

The shape of curve for Trial 1 is flatter than that of trial 2.

It is because the concentration and also number of mole of HNO_3 (aq) in trial is lower than that of trial 2. As the concentration is lower, the reaction rate is also lower hence the curve of trial 1 is more flatten.

(4 marks)

(c) Suggest how the effect of surface area of solid reactant on the rate of reaction can be studied using the above set-up.

We can using (same mass of) $CaCO_3$ granule and $CaCO_3$ powder independently added to the above set-up and compare the (result) in same volume of 3M HNO_3 (aq) added.

(1 mark)

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12. Consider an equilibrium mixture of the following chemical reaction :

$$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons Fe(SCN)^{2+}(aq)$$
yellow colourless deep red

(a) Write an expression for the equilibrium constant K_c for the reaction.

$$K_c = \frac{[Fe(SCN)^{2+}_{(aq)}]_{eqm.}}{[Fe^{3+}_{(aq)}]_{eqm.}[SCN^-_{(aq)}]_{eqm.}}$$

(1 mark)

(b) At a certain temperature, the equilibrium constant K_c for the reaction is 1.08×10^3 dm^3 mol^{-1}. The equilibrium mixture is prepared by mixing 20.0 cm^3 of 0.030 M $Fe(NO_3)_3$(aq) with 10.0 cm^3 of 0.030 M KSCN(aq) in an acidic medium. Calculate the concentration of $Fe(SCN)^{2+}$(aq) in the equilibrium mixture at that temperature.

The concentration of $Fe(NO_3)_{3(aq)}$: $0.03 \times \frac{20}{1000} \div \frac{30}{1000}$
$= 0.02M$.

the concentration of $KSCN_{(aq)}$: $0.03 \times \frac{10}{1000} \div \frac{30}{1000}$
$= 0.01M$

$$1.08 \times 10^3 = \frac{[Fe(SCN)^{2+}_{(aq)}]_{eqm}}{[0.02][0.01]}$$

$$[Fe(SCN)^{2+}_{(aq)}]_{eqm.} = 0.216M$$

(3 marks)

(c) It is known that the equilibrium constant K_c increases when temperature increases. Suggest and explain whether the enthalpy change of the reaction is positive, negative or zero.

The enthalpy change of the reaction should be positive.

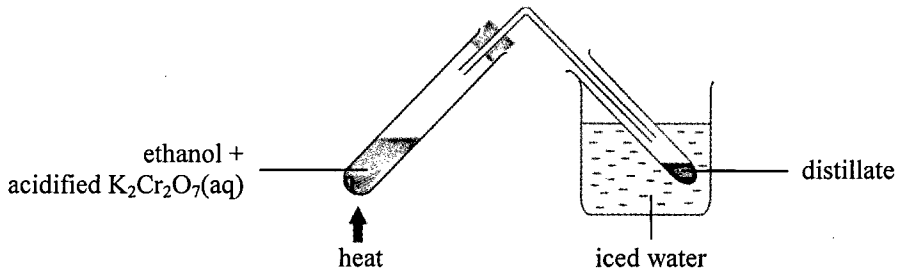
(1 mark)

(d) When a little amount of Na_2SO_3(s) is added to the equilibrium mixture, the colour of the mixture becomes paler. Explain this observation.

When $Na_2SO_{3(s)}$ is added, it dissolve to provide $SO_3^{2-}{}_{(aq)}$ which reduce the $Fe^{3+}_{(aq)}$ to $Fe^{2+}_{(aq)}$. As the concentration of $Fe^{3+}_{(aq)}$ decreased. The equilibrium position shifted to the reactant side and ; therefore (solution) the concentration of deepred $Fe(SCN)^{2+}_{(aq)}$ decreased and paler.

(2 marks)

13. (a) It was intended to prepare ethanoic acid from ethanol by the following set-up. However, the distillate collected mainly contained another organic product **X** but not ethanoic acid.



(i) What is **X** ?

ethanal

(ii) Explain why the distillate collected mainly contained **X** but not ethanoic acid.

The boiling point of X is much lower than that of ethanoic acid so when the ethanol turned into ethanal, it evaporate and condensed as distillate. (2 marks)

(b) Ethanoic acid can be converted to an unsubstituted amide.

(i) Give the systematic name of this amide.

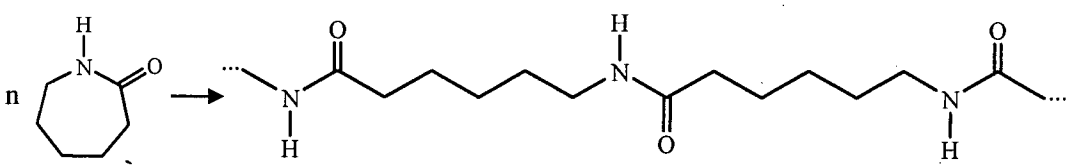
Ethanamide.

(ii) Suggest what reagent and condition are needed for this conversion.

$PCl_{3(aq)}$ and $NH_{3(aq)}$, heat under reflux.

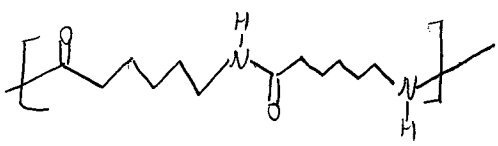
(2 marks)

(c) The following shows the formation of a polymer from an amide :



a portion of the polymer formed

(i) Draw the repeating unit of the polymer formed.



(ii) There is a view which suggests that the above polymerisation does not involve condensation. Give a reason to support this view.

The have no H_2O formed from the polymerization

(2 marks)

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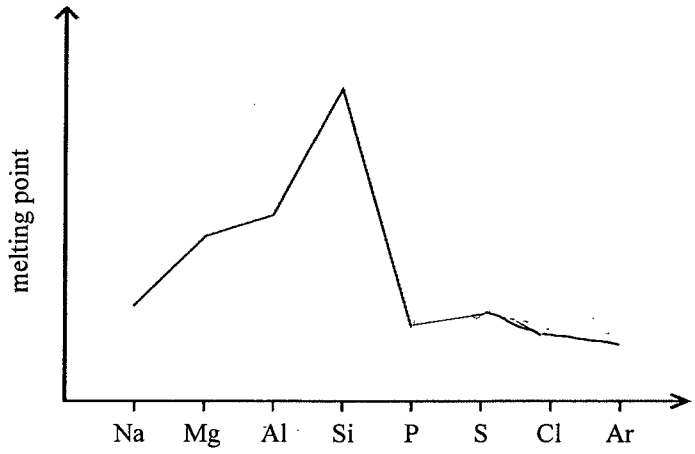
14. The following graph shows an incomplete sketch of the variation in melting points of the elements in the third period of the Periodic Table.



(a) Complete the sketch on the graph above.

(1 mark)

(b) Explain why the melting point of Mg is higher than that of Na.

Both of them are in giant metallic structure and held by metallic bond.
As there are more delocalized electrons in Mg than that of Na, the metallic bond in Mg is stronger than that of Na.

(1 mark)

(c) Explain why the melting point of Si is higher than that of P.

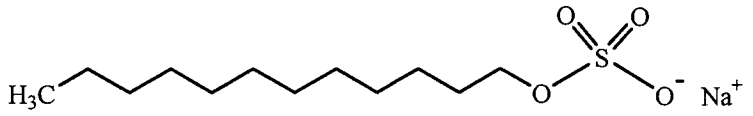
Si is in giant covalent structure but P just having a simple molecular structure. It is much harder to break the extensively strong covalent bond among Si compare to break the Van der Waal's force among weak P molecules.

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

*15. With reference to the structure of sodium lauryl sulphate (SLS) below, explain why it has cleansing properties.



(5 marks)

First of all, it have a long hydrocarbon chain and a ionic head. For the hydrocarbon chain, it can dissolve in oil droplets as oil droplets are also hydrophobic like the hydrocarbon chain. When the hydrocarbon chain is dissolved in those greases and oil, the oil droplets formed from emulsion will carry negative charge as the ionic head of the SLS carry negative charge. The oil droplets therefore repel each other and can not join up into a oil layer again, and water can better bring them away and clean it.

On the other hand, when it dissolved in greases or oil, the greases or oil will bring negative charge which allow polar water molecules to cleft them out from the surface easier.

Hence, we can see SLS can acts as emulsifying agent and help the greases to be cleft off, which improve the cleaning action of water.

END OF SECTION B
END OF PAPER

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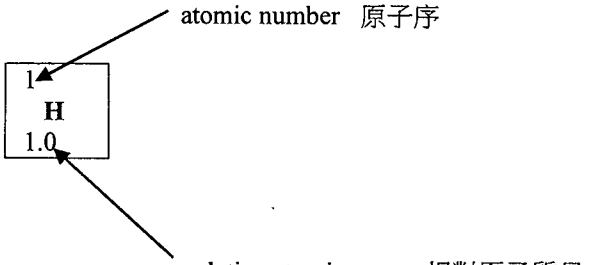
Answers written in the margins will not be marked.

PERIODIC TABLE 周期表

GROUP 族



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)

2019 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)，並在第一頁之適當位置填寫作答的試題編號。

(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.

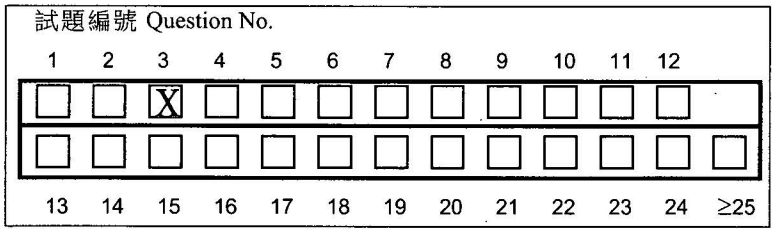
(2) Start each question (not part of a question) on a new page. Put 'X' in the corresponding question number box on each page to indicate the appropriate question number (see the example below), and write the question number(s) of the question(s) attempted in the space provided on Page 1.

(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



Level 5 Exemplar & Comments
Paper 2

由考生填寫 To be filled in by the candidate	
試題編號 Question No.	Q1
	Q3

試題編號 Question No.

1	2	3	4	5	6	7	8	9	10	11	12
X											

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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.

1ai, NH_3 produced from Haber process can be used to produce fertilizer which help with the growth of crops.

ii)(1) $CH_{4(g)} + H_2O_{(g)} \overset{NiO}{\rightleftharpoons} CO_{(g)} + 3H_{2(g)}$

(2) Syngas is the feedstock of methanol and the obtain of syngas become greener can be considered as the process of methanol production become greener.

iii, Rate $= k[A_{(aq)}]^x[B_{(aq)}]^y$

From trial 2 and 3, $[0.0836]^x[0.404]^y = 1.04\times10^{-4}$ ... ①

$[0.0418]^x[0.404]^y = 0.52\times10^{-4}$ ... ②

① ÷ ②,

$$\left(\frac{0.0836}{0.0418}\right)^x = \frac{1.04\times10^{-4}}{0.52\times10^{-4}}$$

$2^x = 2$

$x = 1$

∴ The reaction is first order with respect to A.

From trial 1 & 2, $0.26\times10^{-4} = (0.0836)(0.202)^y$ ... ①

$1.04\times10^{-4} = (0.0836)(0.404)^y$ ... ②

② ÷ ①,

$$\left(\frac{0.404}{0.202}\right)^y = \frac{1.04\times10^{-4}}{0.26\times10^{-4}}$$

$2^y = 4$ ∴ The reaction is second order with respect to B.

$y = 2$

寫於邊界以外的答案，將不予評閱。
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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.

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b.i. (Chlorine is supplied) At Anode side, $Cl^-_{(aq)}$ ions are preferentially discharged due to concentration effect. $2Cl^-_{(aq)} \longrightarrow Cl_{2(g)} + 2e^-$. The oxidized from -1 to 0 at $Cl_{2(g)}$. The chlorine gas formed is collected seperately. At Cathode side, $H^+_{(aq)}$ ions are preferentially discharged as it have a strong oxidizing power than $Na^+_{(aq)}$ ions. $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$. The $H^+_{(aq)}$ ions reduced to $H_{2(g)}$ and collected seperately. As ions are discharged in the cells, ions are moving to balance the charge. However, the Membrane in the middle of anode and cathode just allow the cations to cross, Therefore only $Na^+_{(aq)}$ moved from the anode side to the cathode size. As $H^+_{(aq)}$ is preferentially discharged, $OH^-_{(aq)}$ is remain in the cathode size and it formed NaOH solution with the moved in $Na^+_{(aq)}$ ions.

b.ii. $Cl_2 + 2NaOH \longrightarrow NaCl + NaOCl + H_2O$

b.iii. The aton economy of (I) : $\frac{32}{74.5+17\times2} \times 100\% = 29.5\%$

(II) : $\frac{32}{34+17\times2} \times 100\% = 47.1\%$

As the atom economy of Reaction II is higher, reaction II is greener.

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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.

i. Carbon dioxide.

ii. The combustion of C in air is exothermic, as it more deeper, C combust more to give out more heat to the environment.

iii. A higher operation pressure may increase the construction and maintainence cost of the plant. Moreover, as the product of the reaction contain gas, increase in pressure might shift the equilibrium position to left and lower the yield of the reaction.

iv. $\log k_1 = \frac{-160}{2.3R}\left(\frac{1}{1500}\right) + \log A \cdots ①$ Let k_1 and k_2 be the rate constant of the reaction at 1500k and 1200k respectively.

$\log k_2 = \frac{-160}{2.3R}\left(\frac{1}{1200}\right) + \log A \cdots ②$

① - ②,

$$\log \frac{k_1}{k_2} = \frac{-160}{2.3R}\left(\frac{1}{1500} - \frac{1}{1200}\right)$$

$$\log \frac{k_1}{k_2} = 1.395 \times 10^{-3}$$

$$\frac{k_1}{k_2} = 1 \quad (\text{corr. to 3 sig. fig.})$$

$$\therefore k_1 : k_2 = 1 : 1$$

v. The decomposition of $CaCO_3(s)$ is endothermic, as zone B have the highest temperature, the reaction there have the highest yield as the equilibrium shifted to right. Moreover, a high temperature also provide higher rate.

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

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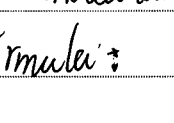
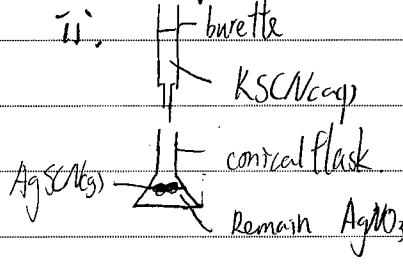
Answers written in the margins will not be marked.

3ai. A absorption peak at around 2150 cm^{-1} illustrate the presence of C≡C group. As its molecular mass = 40,
The possible structural formula: 

aii. The are immiscible to water and aqueous layer.

aiii. Add them into Tollens' reagent. Only the one added with A show a silver mirror, while the one added with B have no observable change.

bi. To remove any precipitates formed by $Ag^+_{(aq)}$ and anions that not $Cl^-_{(aq)}$ like $CO_3^{2-}{}_{(aq)}$.

ii. 

iii. The no. of mole of KSCN(aq) used = $0.1 \times \frac{9.42}{1000}$

$= 9.42 \times 10^{-4}$ mole

∵ KSCN : $AgNO_3$ = 1 : 1

∴ The no. of mole of excess $AgNO_3 = 9.42 \times 10^{-4}$ mol

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13	14	15	16	17	18	19	20	21	22	23	24	≥25

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

(iii) No. of mole of $AgNO_3$ (aq) reacted with Cl^- = $1 \times \frac{25}{1000} - 9.4 \times 10^{-4}$
= 1.558×10^{-3} mole.

∴ NaCl : $AgNO_3$ = 1 : 1
and Na^+ : Cl^- = 1 : 1
∴ No. of mole of Na = 1.558×10^{-3} mol

The % by mass of sodium in the sample: $\frac{23 \times 1.558 \times 10^{-3}}{2} \times 100\%$
= 1.79%.

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(i) (1) There are different solubility of different substances in a mixture to the mobile phase, which is a developing solvent, and the stationary phase. They move faster or slower with the mobile phase.

(2) Using column chromatography with the same solvent in as eluting solvent, then we can seperate it. (developing) (TLC)

(ii) From the peak of m/z = 91, it should be a fragment ion of $C_6H_5CH_2^+$. There are a difference of 49 between m/z = 140 and m/z = 91, it would be a $ClCH_2^+$ as fragment. Therefore, the structure of the compound:

(iii) (1) Dioxin is carcinogenic.

(2) Modern instrumentation give a more accurate measurement and also more sensitive to the dioxins.

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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(a), 3(b), 7(a), 8(c), 9(a), 11(b)(ii) & (c), 12(d); Paper 2 Qs 1(a)(i) & (ii)(1) & (iii) & (b)(ii) & (iii), 3(a)(ii) & (iii) & (b)(i) & (ii) & (c)(i) & (iii)).

He/she demonstrates very good abilities of applying chemical concepts on unfamiliar situations for solving the problems (e.g. Paper 1 Qs. 4(b), 7(b)(iii); Paper 2 Qs 1(c)(ii) & (iii) & (v), 3(a)(i) & (c)(ii)).

The candidate performs well on chemical calculations (e.g. Paper 1 Qs. 2(b)(i) & (ii), 4(a)(ii), 8(b)(i) & (ii); Paper 2 Q. 3(b)(iii)).

He/she can effectively communicate ideas using scientific terminology, appropriate diagrams and chemical equations (e.g. Paper 1 Qs. 1(b) & (c)(ii), 5(d)(i) & (ii), 6(a), 8(b)(i), 9(b), 10, 11(a), 14(b); Paper 2 Q. 1(b)(i)).

He/she can design appropriate method for carrying out scientific investigations (e.g. Paper 1 Q. 10).