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B

Level 4 Exemplar 1
Paper 1B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2022

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. Iodine is a halogen. It can form potassium iodide and hydrogen iodide.

(a) Name the relationship between $^{127}_{53}I$ and $^{129}_{53}I$.

They are isotopes.

(1 mark)

(b) The electronic arrangement of an iodine atom is 2, 8, x, 18, y. What is x ?

x=18

(1 mark)

(c) Draw the electron diagram for potassium iodide, showing ELECTRONS IN THE OUTERMOST SHELLS only.

(1 mark)

(d) Suggest why an aqueous solution of hydrogen iodide can conduct electricity.

There are mobile ions.

(1 mark)

(e) In terms of bonding and structure, explain whether potassium iodide or hydrogen iodide would have a higher melting point.

potassium iodide is a giant ionic structure with strong ionic bond while hydrogen iodide is a simple molecular structure with weak Van der Waal's force. As a result, potassium iodide have a higher melting point.

(2 marks)

Answers written in the margins will not be marked.

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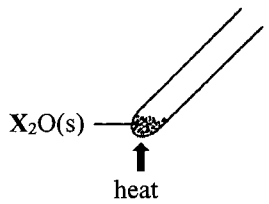
2. The diagram below shows an experimental set-up in which a metal oxide $X_2O(s)$ is decomposed upon strong heating. A silvery metal **X** and a colourless gas **Z** are formed.



(a) State what **Z** is and suggest a test for it.

Z is oxygen. Oxygen can relight glowing splint.

(2 marks)

(b) When 3.028 g of $X_2O(s)$ is completely decomposed, 2.819 g of metal **X** can be obtained.

(i) Calculate the relative atomic mass of **X**.
(Relative atomic mass : O = 16.0)

Let the relative atomic mass of X be q.

The mass of oxygen:
$3.028 - 2.819$
$= 0.209\,g$

$$\frac{2.819}{y} = 2\left(\frac{0.209}{16}\right)$$
$$y = 107.9$$

(ii) Suggest what **X** is.

X is silver.

(3 marks)

(c) Explain whether the decomposition of $X_2O(s)$ is a redox reaction.

Yes. It is because the oxidation number of oxygen increase from -2 to 0.

(1 mark)

Answers written in the margins will not be marked.

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3. Antacid is a drug for neutralising stomach acid. A sample of an antacid contains $NaHCO_3(s)$ and other soluble inert substances. 1.52 g of the antacid sample was completely dissolved in deionised water to give a weakly alkaline solution. The solution was then titrated with 0.644 M HCl(aq) using a suitable indicator. 25.20 cm^3 of the HCl(aq) was required to reach the end point.

(a) Write the chemical equation for the reaction between $NaHCO_3(s)$ and HCl(aq).

$NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$

(1 mark)

(b) Calculate the percentage by mass of $NaHCO_3(s)$ in the antacid sample.
(Relative atomic masses : H = 1.0, C = 12.0, O = 16.0, Na = 23.0)

The number of mol of HCl : $0.644 \times \left(\frac{25.2}{1000}\right)$
$= 0.0162$ mol

As $NaHCO_3$: HCl is 1 : 1

The number of mol of $NaHCO_3$ is 0.0162 mol

The percentage by mass :

$$\frac{(0.0162)(23+1+12+[6\times])}{1.52} \times 100\%$$

$= 89.7\%$

(2 marks)

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Answers written in the margins will not be marked.

3. (c) The pH of the solution at the end point of the titration was found to be between 3 and 4.

(i) Suggest a suitable indicator for this titration and state the colour change at the end point.

methyl orange . From red to yellow .

(ii) Suggest an instrument to measure the pH of the solution accurately.

PH meter .

(3 marks)

(d) State one advantage of taking antacids containing $Mg(OH)_2(s)$ over those containing $NaHCO_3(s)$.

No carbon dioxide will be produced in our stomach .

(1 mark)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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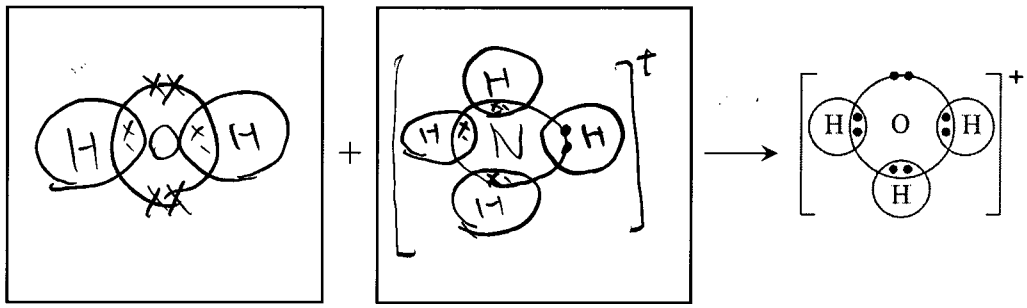
4. Consider the molecules H_2O, BF_3 and SF_6.

(a) H_2O molecules can form H_3O^+ ions.

(i) In each of the following boxes, draw the electron diagram (showing ELECTRONS IN THE OUTERMOST SHELLS only) for a suitable chemical species to show the formation of a H_3O^+ ion.



(ii) Describe the formation of dative covalent bond using H_3O^+ as an example.

As oxygen molecule is already obtained the octet structure, the hydrogen ion form dative bond with H_2O using the lone pair of the oxygen to obtain the octet structure.

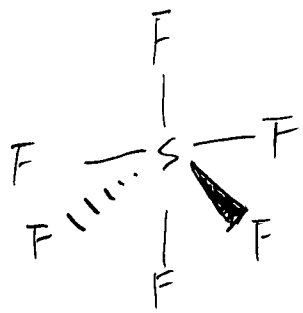
(3 marks)

(b) Explain whether the boron atom in a BF_3 molecule has an octet structure.

No. It does not. The boron atom only have six electrons in the outermost shell in a BF_3 molecule.

(1 mark)

(c) (i) Draw the three-dimensional structure of a SF_6 molecule.



Answers written in the margins will not be marked.

4. (c) (ii) Explain whether SF_6 is a polar molecule.

It is not a polar molecule. Although S-F bond is polar, the polar bond of SF_6 cancel each other. As a result, SF_6 is a non-polar molecule.

(2 marks)

(d) Explain the following increasing order of the boiling points of the three compounds :

$BF_3 < SF_6 < H_2O$

All of them are simple molecular structure. However, H_2O is held together mainly with hydrogen bond, while the other two do not have hydrogen bond. As a result, H_2O has the highest boiling points. As SF_6 has a larger molecular size than BF_3, the intermolecular force of SF_6 is stronger than BF_3. Therefore, SF_6 has a higher boiling point than BF_3.

(3 marks)

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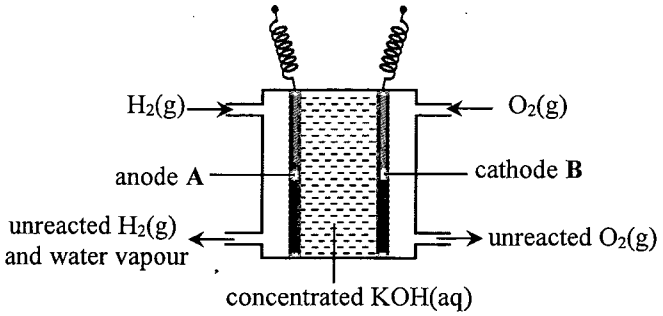
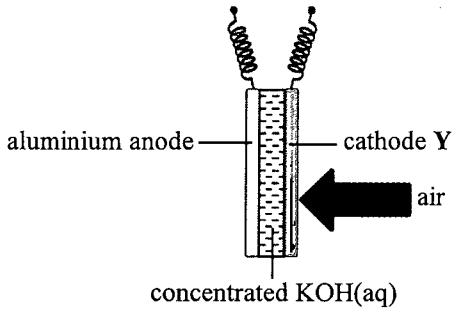
5. The following hydrogen-oxygen fuel cell and aluminium-air cell are primary cells. Their simplified structures are shown below :



hydrogen-oxygen fuel cell



aluminium-air cell

(a) What is meant by the term 'primary cell' ?

They are cell that cannot be recharged.

(1 mark)

(b) For the above hydrogen-oxygen fuel cell,

(i) write the half equation for the change that occurs at anode **A**.

$2H_2(g) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e^-$

(ii) suggest one disadvantage of using this hydrogen-oxygen fuel cell.

It is expensive as the cost of obtaining pure oxygen and hydrogen is high.

(2 marks)

(c) In the above aluminium-air cell, oxygen in air reacts with water to form hydroxide ions at cathode **Y**.

(i) Write the half equation for the change that occurs at cathode **Y**.

$4e^- + O_2(g) + 2H_2O(l) \rightarrow 4OH^-(aq)$

(ii) The half equation for the change that occurs at the aluminium anode is as follows :

$$Al(s) + 3OH^-(aq) \rightarrow Al(OH)_3(s) + 3e^-$$

Write the chemical equation for the overall reaction in the aluminium-air cell.

$4Al(s) + 3O_2(g) + 6H_2O(l) \rightarrow 4Al(OH)_3(s)$

(iii) Suggest how aluminium can be obtained from aluminium oxide.

By electrolysis of molten aluminium oxide.

(3 marks)

Answers written in the margins will not be marked.

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6. Consider the following chemical equation for the formation of CH_3Cl from methane and chlorine :

$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g)$$

(a) Name the type of reaction involved.

Substitution reaction.

(1 mark)

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

Under sunlight.

(1 mark)

(c) The reaction involves three stages: initiation, propagation and termination. In the initiation stage, chlorine free radicals (Cl•) are formed from chlorine molecules.

(i) With reference to the electronic structure, explain why a chlorine free radical (Cl•) is a reactive chemical species.

It does not obtain the octet structure.

(ii) Complete the chemical equations below by filling in a suitable chemical species in each of the following boxes :

One of the steps in the propagation stage :

$Cl\bullet + CH_4 \rightarrow$ [$H_3C\cdot$] + [$H\text{-}Cl$]

One of the steps in the termination stage :

[$H_3C\cdot$] + [$Cl\cdot$] $\rightarrow CH_3Cl$

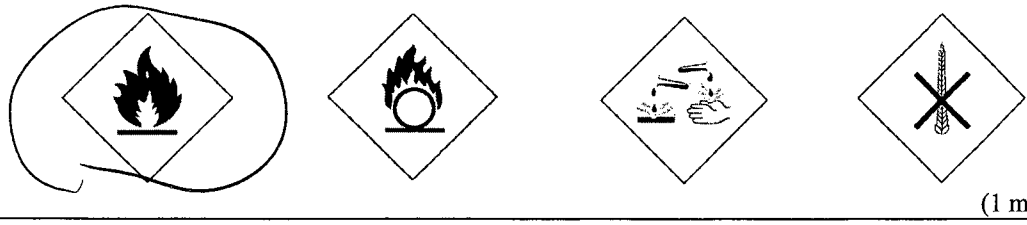
(3 marks)

(d) Explain why CH_3Cl is not the only organic product formed in the reaction between methane and chlorine.

As the chlorine can continue to react with CH_3Cl which forms a chain reaction to produce product of CH_2Cl_2, $CHCl_3$ and CCl_4.

(1 mark)

(e) From the hazard warning labels shown below, circle a label that should be displayed on a gas cylinder containing methane.



(1 mark)

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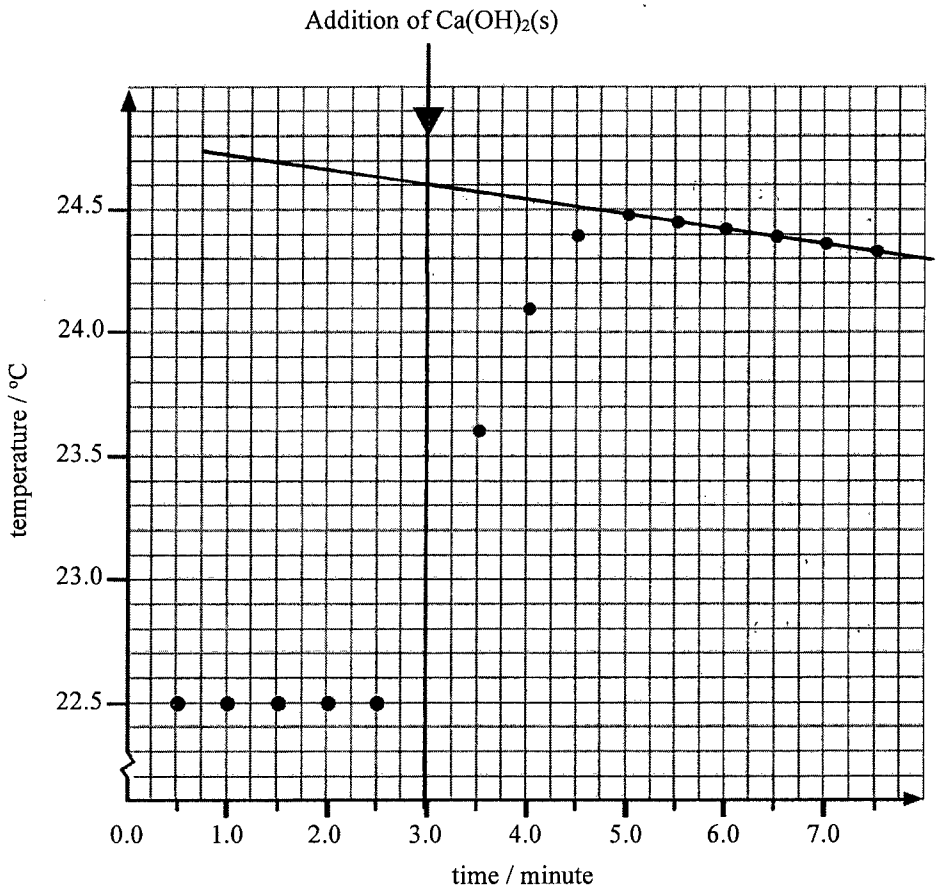
7. An experiment was performed to determine the enthalpy change of neutralisation between $Ca(OH)_2(s)$ and HCl(aq). 100.0 cm^3 of 1.0 M HCl(aq) was placed in an expanded polystyrene cup. The temperature of the contents in the cup was measured at half-minute intervals. Right at the third minute, 0.502 g of $Ca(OH)_2(s)$ was added to the cup with thorough stirring. The recordings of temperature are shown in the graph below :



(a) Write a chemical equation for the reaction between $Ca(OH)_2(s)$ and HCl(aq).

$Ca(OH)_2(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$

(1 mark)

(b) (i) By SKETCHING on the graph above, estimate the greatest temperature rise of the contents in the cup.

The greatest temperature rise = 2.1 °C

Answers written in the margins will not be marked.

7. (b) (ii) It is given that the enthalpy change of neutralisation is the enthalpy change when solutions of an acid and an alkali react together to produce one mole of water.

In the experiment, HCl(aq) is in excess. Calculate the enthalpy change of neutralisation between $Ca(OH)_2(s)$ and HCl(aq), in kJ mol^{-1}, under the experimental conditions.

(Volume of the reaction mixture = 100.0 cm^3;
density of the reaction mixture = 1.00 g cm^{-3};
specific heat capacity of the reaction mixture = 4.2 J g^{-1} K^{-1};
heat capacity of the expanded polystyrene cup : negligible)
(Relative atomic masses : H = 1.0, O = 16.0, Cl = 35.5, Ca = 40.1)

$mc\Delta T = 100(1)(4.2)(2.1)$
$= 882\ J$

As mol of $Ca(OH)_2 : H_2O$ is 1 : 2

∴ The enthalpy change :

$$\frac{882}{\left(\frac{0.502}{40.1+17\times2}\right)\div 2}$$

$= -26\ kJ\ mol^{-1}$

(5 marks)

(c) Standard enthalpy changes of neutralisation $\Delta H_n^\ominus$ for two reactions are given below :

	$\Delta H_n^\ominus$ / kJ mol^{-1}
Reaction between $Ca(OH)_2(s)$ and HCl(aq)	−58.6
Reaction between CaO(s) and HCl(aq)	−186.0

Calculate the standard enthalpy change of the following reaction.

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$

Let the reaction between $Ca(OH)_2(s)$ and HCl(aq) be $\Delta H_n^\ominus(1)$ and the reaction between CaO(s) and HCl(aq) be $\Delta H_n^\ominus(2)$

$\Delta H_n^\ominus = \Delta H_n^\ominus(2) - \Delta H_n^\ominus(1)$
$= -186.0 - (-58.6)$
$= -127.4\ kJ\ mol^{-1}$

(3 marks)

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*8. Describe and explain the similarities and differences between the chemical principles involved in tin-plating and galvanising in the rusting prevention of iron-made objects.

(6 marks)

To start off, the similarities of tin-plating an galvanising is that both of them have a layer of metal surround the iron-made objects to prevent iron in touch with oxygen and water. As they are impermeable to water and oxygen, iron cannot rust as iron cannot lose electron, to form Fe^{2+} ion.

However, there are some differences between tin-plating and galvanising. When the surface of tin-plated iron-made objects is scratched, iron will rust faster as iron is more reactive than tin. However, even if the surface of galvanized iron-made objects is scratched, iron will not rust as zinc is more reactive than iron. As a result, zinc will corrode first.

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Answers written in the margins will not be marked.

PART II

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

9. At a certain temperature, the equilibrium constant K_c for the following reaction is 2.25×10^{-2} mol dm^{-3}.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g) \qquad \Delta H > 0$$

In an experiment, 0.84 mol of $PCl_5(g)$, 0.16 mol of $PCl_3(g)$ and 0.16 mol of $Cl_2(g)$ were initially introduced in a closed container of a fixed volume of 4.0 dm^3, and the system was allowed to attain equilibrium at that temperature.

(a) (i) Calculate the reaction quotient Q_c for the system under the initial conditions.

$$Q_c = \frac{[Cl_2][PCl_3]}{[PCl_5]}$$

$$= \frac{\frac{0.16 \times 0.16}{4^2}}{\frac{0.84}{4}}$$

$$= 7.619 \times 10^{-3} \text{ mol dm}^{-3}$$

(ii) Explain whether the concentration of $PCl_5(g)$ would increase or decrease just after the reaction started.

The concentration of PCl_5 would decrease as there are more molecules in left hand side. The equilibrium will shift to the right.

(4 marks)

(b) Explain whether K_c would increase, decrease or remain unchanged if the temperature of the equilibrium mixture is increased.

If the temperature increased, K_c would increase as increase of temperature favours endothermic reaction.

(2 marks)

Answers written in the margins will not be marked.

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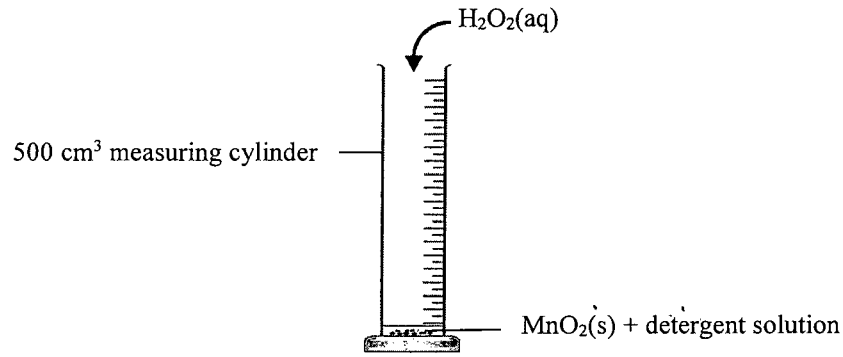
10. At room conditions, $H_2O_2(aq)$ would decompose into $O_2(g)$ and $H_2O(l)$ very slowly in the absence of $MnO_2(s)$. An experiment was performed as shown in the set-up below :



When 10.0 cm^3 of 3.00 M $H_2O_2(aq)$ was mixed with a small amount of $MnO_2(s)$ and detergent solution at room conditions, $O_2(g)$ started to be released rapidly and foam was produced. The $MnO_2(s)$ remained chemically unchanged at the end of the reaction.

(a) Write a chemical equation for the decomposition of $H_2O_2(aq)$.

$2\,H_2O_2(aq) \longrightarrow 2\,H_2O(l) + O_2(g)$

(1 mark)

(b) Explain how manganese illustrates a characteristic of transition metals according to the results of this experiment.

It is used as a catalyst in this reaction.

(1 mark)

Answers written in the margins will not be marked.

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10. (c) Upon completion of the reaction, all the $H_2O_2(aq)$ was used up. Calculate the theoretical volume of $O_2(g)$ released at room conditions.
(Molar volume of gas at room conditions = 24 dm^3)

The mol of $H_2O_2(aq)$: $\frac{10}{1000} \times 3 = 0.03$ mol

The mol of $O_2(g)$: $\frac{0.03}{2} = 0.015$ mol

The theoretical volume:

24×0.015

$= 0.36 dm^3$

(2 marks)

(d) In the experiment, the time taken for the foam to rise from the mark at 100 cm^3 to the mark at 200 cm^3 of the measuring cylinder was 18 seconds, while the time taken for the foam to rise from the mark at 200 cm^3 to the mark at 300 cm^3 was 63 seconds. Explain these results.

At the beginning of the reaction, the reaction rate is high because the concentrate of $H_2O_2(aq)$ is high. The When the reaction proceeds, the concentration of $H_2O_2(aq)$ starts to decrease and the reaction rate decreases.

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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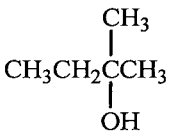
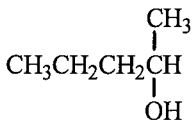
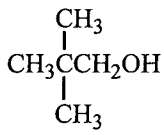
11. Compounds **P**, **Q** and **R** are structural isomers having the molecular formula of $C_5H_{12}O$. Their structures are shown below :



P



Q



R

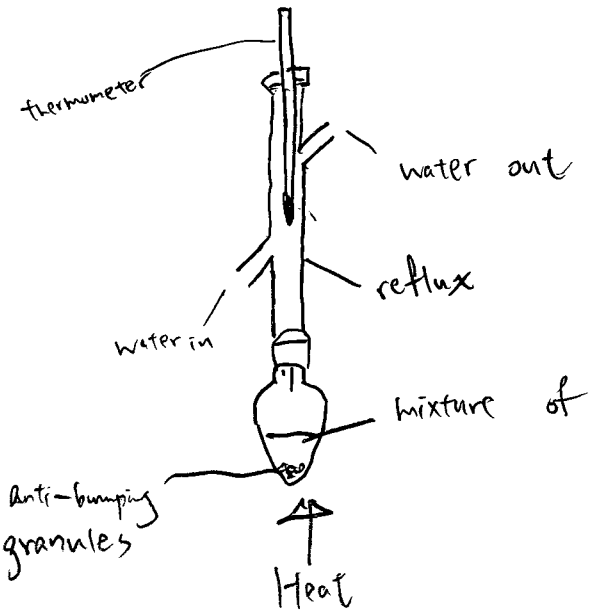
(a) Give the systematic name of **P**.

2-methylbutan-2-ol

(1 mark)

(b) Heating **Q** with acidified $K_2Cr_2O_7(aq)$ under reflux will give an organic product.

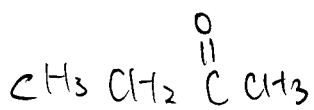
(i) Draw a labelled diagram to show the set-up for this reaction.



(ii) State the expected observation for this reaction.

The solution turns from orange colour to green colour

(iii) Write the structural formula of the organic product.



(4 marks)

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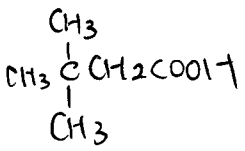
Answers written in the margins will not be marked.

11. (c) **W** is an organic compound containing five carbon atoms. Under suitable conditions, **R** can be prepared from the reduction of **W**.

(i) Suggest the structural formula of **W**.

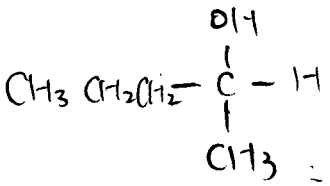


(ii) Suggest a reducing agent required for the reaction.

$LiAlH_4$

(2 marks)

(d) Compound **S** is an optically active secondary alcohol. It is also a structural isomer of compounds **P**, **Q** and **R**. Write the structural formula of **S**.



(1 mark)

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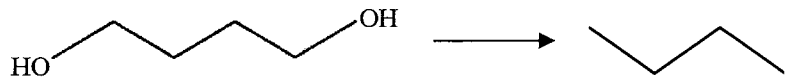
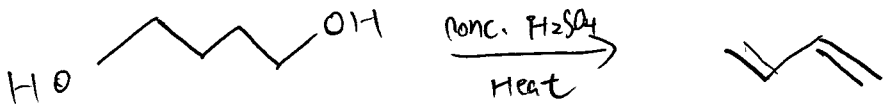
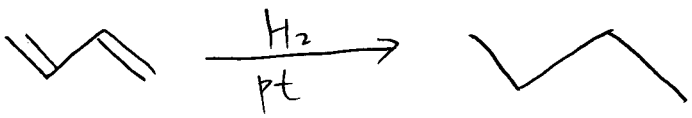
12. Outline a synthetic route, with NO MORE THAN THREE STEPS, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.







(3 marks)

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*13. Describe the acid-base properties of the products formed (if any) when the following oxides are added to water separately. Chemical equations are NOT required.

Na_2O MgO Al_2O_3 Cl_2O

(5 marks)

To commence with, Al_2O_3 is amphoteric. It can dissolve in water to act as acid and base. It can neutralize both acid and base.

Na_2O and MgO are both alkaline oxide. They can dissolve in water to form base which can neutralize acid.

Lastly, Cl_2O is acidic oxide which can dissolve in water to form acid which can neutralize base.

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

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)

Level 4 Exemplar 1
Paper 2

2022 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

由考生填寫 To be filled in by the candidate	
試題編號 Question No.	1
	3

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

試題編號 Question No.

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試題編號 Question No.

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X											

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.

1a i. (1) there are no side products. The atom economy is high.

(2) Carbon monoxide is used as reactants. The leak of toxic carbon monoxide has adverse impact on the environment.

ii. (1) Allow selective molecules / ions pass through.

(2) Some of the catalyst may denature.

iii. glass bottle

b (i) water

(ii) (1) chlorine gas

(2) The chloride ions in brine is preferentially discharged to form chlorine gas.

(iii) (1) $2H^+(aq) + 2e^- \rightarrow H_2(g)$

(2) As hydrogen ions and chloride ions keep to discharge and escape. The concentration of Na^+ and OH^- ions keep to increase. As Cl^- ions are discharged. It does not contain sodium chloride.

(iv) bleach.

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

(c. i. The instantaneous rate at time = 0s.

II. It is because the concentration of $H^+(aq)$ does not affect the rate of the reaction as the order of $[H^+(aq)]$ is zero.

III. The slope of the graph = k :

$k = \frac{-1.5-(-1.1)}{-2.24-(-1.84)} = 1$

when rate $= 10^{-1.5}$, $[S_2O_3^{2-}(aq)] = 10^{-2.24}$

when rate $= 10^{-1.1}$, $[S_2O_3^{2-}(aq)] = 10^{-1.84}$

$\therefore \frac{10^{-1.5}}{10^{-1.1}} = \frac{10^{-2.24}}{10^{-1.84}}$

∴ rate is directly proportional to $[S_2O_3^{2-}(aq)]$, the order of $S_2O_3^{2-}(aq)$ is 1

IV. $\log k_2 - \log k_1 = -\frac{Ea}{2.3RT_2} + \frac{Ea}{2.3RT_1}$

$\log 1.9 = \frac{Ea}{(2.3)(8.31)(25+273)} - \frac{Ea}{(2.3)(8.31)(35+273)}$

$Ea = 48.9\ kJ\,mol^{-1}$

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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.

3a i. Pass both gases into limewater. Only $CO_2(g)$ can turn limewater milky.

ii. $CH_3CH_2CHO(l)$ peaks at m/z 29 which is the mass spectra of CHO^+. While $CH_3COCH_3(l)$ peaks at m/z 28 which is the mass spectra of CO^+.

iii. anhydrous sodium sulphate.

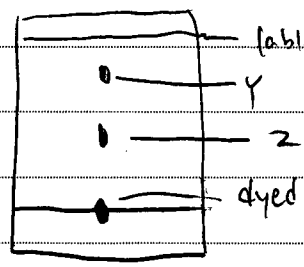
3b.(i) The maximum weight of Y(s) that can dissolve in $100cm^3$ of deionised water at 80°C : $\frac{3.04}{2} = 1.52g$.

As only 1.40g is used in step(1), all of Y should have dissolved.

iii. Crystallization.

iv. Some of the Y evaporate during crystallization.

v. (1).



(2.) The first-collected fraction is Y, because Y moves faster in the solution than 2.

3b(ii). To make sure all of the impurities are removed.

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.

3C i. (1) At first, the solution contains $MnO_4^-(aq)$ which is purple and $Fe^{2+}(aq)$ which is green. Their colour mixed together to form pale yellow. After the reaction, the pale pink $Mn^{2+}(aq)$ and yellow $Fe^{3+}(aq)$ forms pale pink colour.

(2) The number of mol of used $KMnO_4(aq)$: $\left(\frac{32.35}{1000}\right)(0.0041)$

$= 1.326 \times 10^{-4}$ mol

The number of mol of Fe^{2+} :

$1.326 \times 10^{-4} \times 5$

$= 6.632 \times 10^{-4}$ mol

The concentration of Fe^{2+} ions in solution 5 :

$$\frac{6.632 \times 10^{-4}}{\frac{25}{1000}}$$

$= 0.0265$ mol dm^{-3}

ii. (1)

(2)

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

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

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B

Level 4 Exemplar 2
Paper 1B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2022

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. Iodine is a halogen. It can form potassium iodide and hydrogen iodide.

(a) Name the relationship between $^{127}_{53}I$ and $^{129}_{53}I$.

Isotops

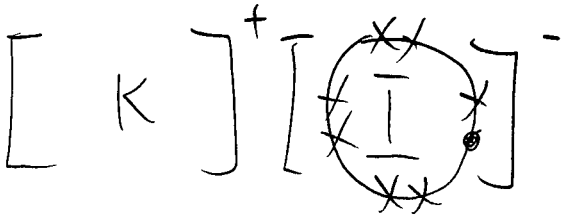
(1 mark)

(b) The electronic arrangement of an iodine atom is 2, 8, x, 18, y. What is x ?

$x = 18$

(1 mark)

(c) Draw the electron diagram for potassium iodide, showing ELECTRONS IN THE OUTERMOST SHELLS only.



(1 mark)

(d) Suggest why an aqueous solution of hydrogen iodide can conduct electricity.

It is because there are mobile ion in the solution for conduct electricity.

(1 mark)

(e) In terms of bonding and structure, explain whether potassium iodide or hydrogen iodide would have a higher melting point.

Potassium iodide will have a higher melting point, Because it is giant ionic structure with strong ionic bond among its molecule. While hydrogen iodide is simple molecular structure with weak van der waals force. Only a little heat could break its bond.

(2 marks)

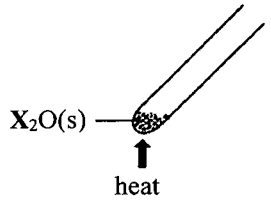
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

~~N_2O~~

2. The diagram below shows an experimental set-up in which a metal oxide $X_2O(s)$ is decomposed upon strong heating. A silvery metal **X** and a colourless gas **Z** are formed.



(a) State what **Z** is and suggest a test for it.

Z is oxygen, use glowing splint to test. If the glowing splint relight, it is oxygen(Z). (2 marks)

(b) When 3.028 g of $X_2O(s)$ is completely decomposed, 2.819 g of metal **X** can be obtained.

(i) Calculate the relative atomic mass of **X**.
(Relative atomic mass : O = 16.0)

$2X_2O(s) \rightarrow 4X(s) + O_2(g)$

$\left(\frac{3.028}{16+2X}\right)\times 2 = \frac{2.819}{X}$

$\frac{6.056}{16+2X} = \frac{2.819}{X}$

$5.638X$

$6.056X = 45.104 + 11.276X$

$X = 107.9$

(ii) Suggest what **X** is.

Silver

(3 marks)

(c) Explain whether the decomposition of $X_2O(s)$ is a redox reaction.

It is a redox reaction.

The oxidation number of silver turn from +1 to 0. It is reduced.

(1 mark)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Go on to the next page

3. Antacid is a drug for neutralising stomach acid. A sample of an antacid contains $NaHCO_3(s)$ and other soluble inert substances. 1.52 g of the antacid sample was completely dissolved in deionised water to give a weakly alkaline solution. The solution was then titrated with 0.644 M HCl(aq) using a suitable indicator. 25.20 cm^3 of the HCl(aq) was required to reach the end point.

(a) Write the chemical equation for the reaction between $NaHCO_3(s)$ and HCl(aq).

$NaHCO_{3(s)} + HCl_{(aq)} \rightarrow H_2O_{(l)} + CO_{2(g)} + NaCl_{(aq)}$

(1 mark)

(b) Calculate the percentage by mass of $NaHCO_3(s)$ in the antacid sample.
(Relative atomic masses : H = 1.0, C = 12.0, O = 16.0, Na = 23.0)

Number of mole of HCl used

$= 0.644 \times 0.0252\ dm^3 = 0.0162288$ mol

Number of mole of $NaHCO_{3(s)}$ used

$= 0.0162288$ mol.

From equation, mole ratio of HCl and $NaHCO_3$ is 1 : 1.

Mass of $NaHCO_3 = 1.3632$ g

percentage by mass $= \frac{1.3632}{1.52\text{g}} \times 100\%$

$= 89.68\%$

$= 89.7\%$

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

red -> orange -> y

3. (c) The pH of the solution at the end point of the titration was found to be between 3 and 4.

(i) Suggest a suitable indicator for this titration and state the colour change at the end point.

methyl orange.

The color turn from yellow to orange

(ii) Suggest an instrument to measure the pH of the solution accurately.

pH meter

(3 marks)

(d) State one advantage of taking antacids containing $Mg(OH)_2(s)$ over those containing $NaHCO_3(s)$.

$Mg(OH)_2$ is a stronger base than $NaHCO_3$. It can react with acid faster than $NaHCO_3$ (s)

(1 mark)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

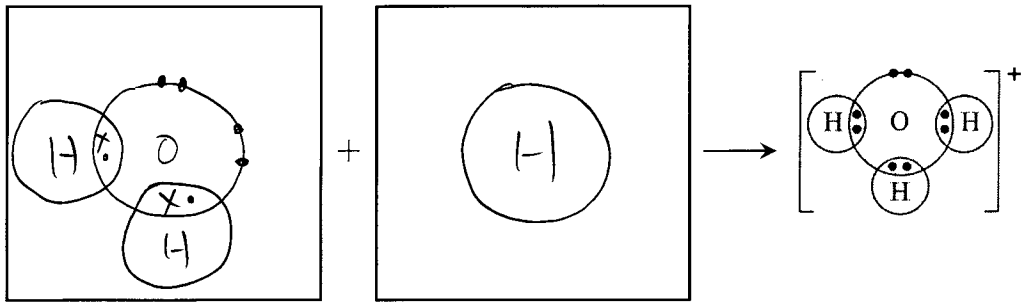
Answers written in the margins will not be marked.

Go on to the next page

4. Consider the molecules H_2O, BF_3 and SF_6.

(a) H_2O molecules can form H_3O^+ ions.

(i) In each of the following boxes, draw the electron diagram (showing ELECTRONS IN THE OUTERMOST SHELLS only) for a suitable chemical species to show the formation of a H_3O^+ ion.



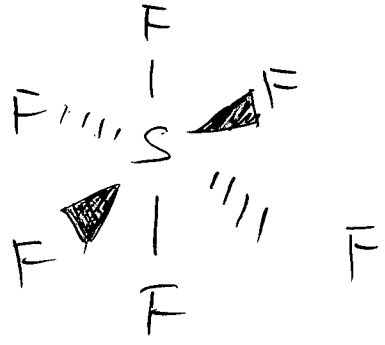
(ii) Describe the formation of dative covalent bond using H_3O^+ as an example.

H_2O contain 1 lone pair to act as electron donor while H^+ do not contain electron to act as a electron acceptor. H_2O share 2 electron to H^+ ion. Patie covalent bond formed. (3 marks)

(b) Explain whether the boron atom in a BF_3 molecule has an octet structure.

No. It do not has an octet structure, It form 3 covalent bond with flourine atom. It only contain 6 outermost shell electron. (1 mark)

(c) (i) Draw the three-dimensional structure of a SF_6 molecule.



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4. (c) (ii) Explain whether SF_6 is a polar molecule.

It is a polar molecule.
It contain 6 S-F bond which could cancel out the polarity each other. It is also symmetrical.
It have trigonal bipyramidal shape. (2 marks)

(d) Explain the following increasing order of the boiling points of the three compounds :

$BF_3 < SF_6 < H_2O$

H_2O have a highest boiling point because it can forme strong hydrogen bond between highly electronegativities atom (N/F/O). However SF_6 only formed weak van der Waals' force among its molecule, SF_6 have higher boiling point than BF_3 because it have a larger molecular size. The van der Waals' force among SF_6 molecule is stronger than that of BF_3 (3 marks)

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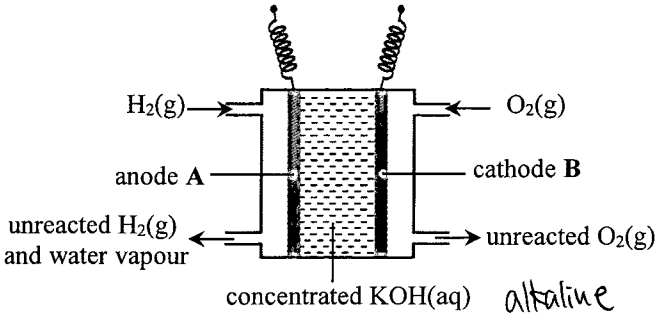
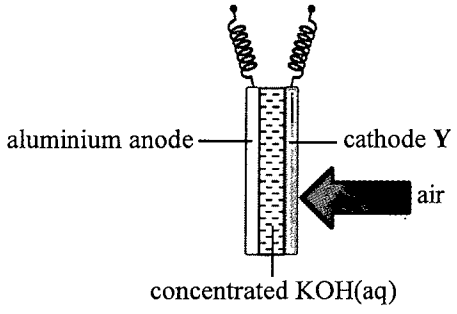
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

5. The following hydrogen-oxygen fuel cell and aluminium-air cell are primary cells. Their simplified structures are shown below :



hydrogen-oxygen fuel cell



aluminium-air cell

(a) What is meant by the term 'primary cell' ?

The cells that could not be recharged. (1 mark)

(b) For the above hydrogen-oxygen fuel cell,

(i) write the half equation for the change that occurs at anode **A**.

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

(ii) suggest one disadvantage of using this hydrogen-oxygen fuel cell.

It is too expensive to store H_2 and O_2 gas.

(2 marks)

(c) In the above aluminium-air cell, oxygen in air reacts with water to form hydroxide ions at cathode **Y**.

(i) Write the half equation for the change that occurs at cathode **Y**.

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

(ii) The half equation for the change that occurs at the aluminium anode is as follows :

$$Al(s) + 3OH^-(aq) \rightarrow Al(OH)_3(s) + 3e^-$$

Write the chemical equation for the overall reaction in the aluminium-air cell.

$3O_{2(g)} + 6H_2O_{(l)} + Al_{(s)} \rightarrow Al(OH)_3 + 9OH^-_{(aq)}$

(iii) Suggest how aluminium can be obtained from aluminium oxide.

electrolysis of aluminium liquefied

(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

6. Consider the following chemical equation for the formation of CH_3Cl from methane and chlorine :

~~substitution~~

$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g)$$

(a) Name the type of reaction involved.

Substitution

(1 mark)

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

Al_2O_3 should be used as catalyst.

(1 mark)

(c) The reaction involves three stages: initiation, propagation and termination. In the initiation stage, chlorine free radicals ($Cl\bullet$) are formed from chlorine molecules.

(i) With reference to the electronic structure, explain why a chlorine free radical ($Cl\bullet$) is a reactive chemical species.

Because

(ii) Complete the chemical equations below by filling in a suitable chemical species in each of the following boxes :

One of the steps in the propagation stage :

$Cl\bullet + CH_4 \rightarrow$ [$CH_3\bullet$] + [Cl]

One of the steps in the termination stage :

[$Cl\bullet$] + [$CH_3\bullet$] $\rightarrow CH_3Cl$

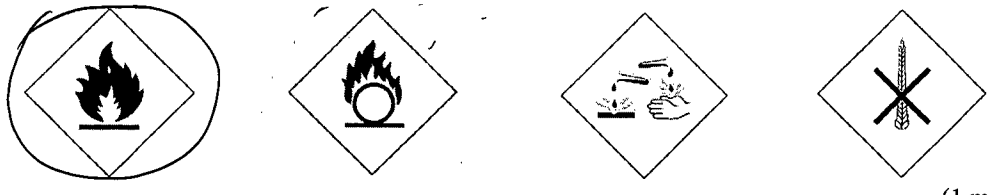
(3 marks)

(d) Explain why CH_3Cl is not the only organic product formed in the reaction between methane and chlorine.

Because the reaction could form different organic product

(1 mark)

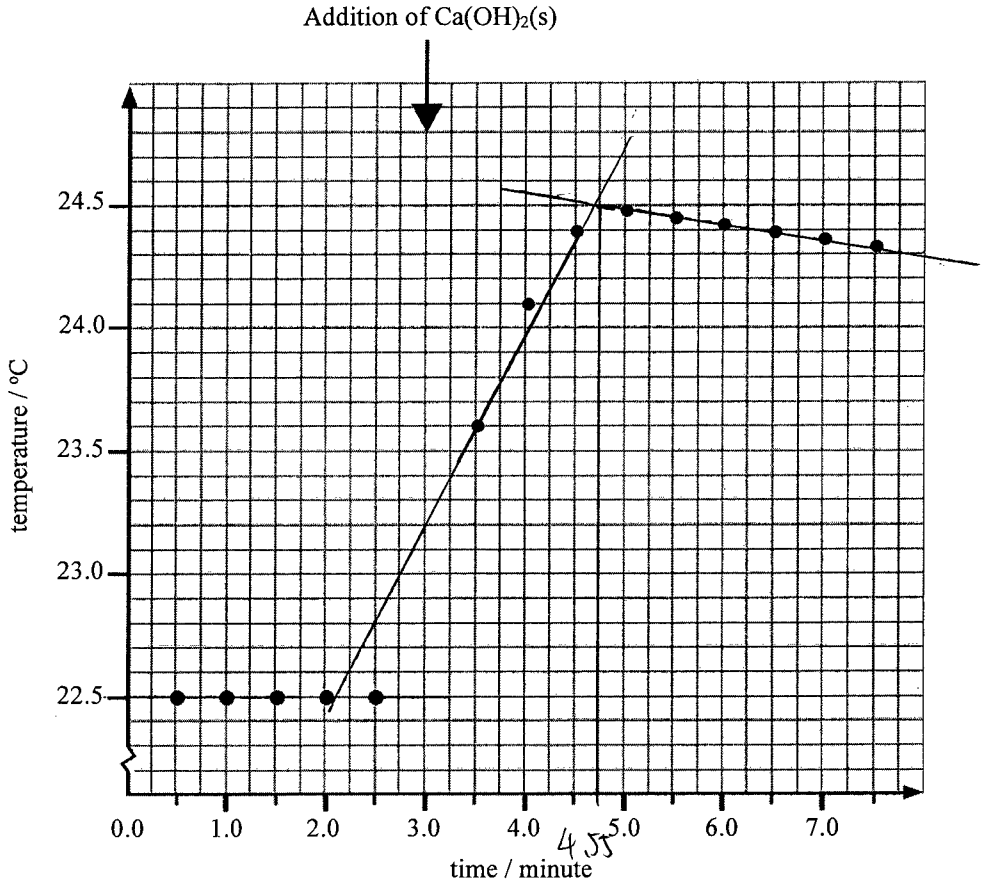
(e) From the hazard warning labels shown below, circle a label that should be displayed on a gas cylinder containing methane.



(1 mark)

Go on to the next page

7. An experiment was performed to determine the enthalpy change of neutralisation between $Ca(OH)_2(s)$ and HCl(aq). 100.0 cm^3 of 1.0 M HCl(aq) was placed in an expanded polystyrene cup. The temperature of the contents in the cup was measured at half-minute intervals. Right at the third minute, 0.502 g of $Ca(OH)_2(s)$ was added to the cup with thorough stirring. The recordings of temperature are shown in the graph below :



(a) Write a chemical equation for the reaction between $Ca(OH)_2(s)$ and HCl(aq).

$Ca(OH)_2(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$

(1 mark)

(b) (i) By SKETCHING on the graph above, estimate the greatest temperature rise of the contents in the cup.

The greatest temperature rise = 2 °C

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

7. (b) (ii) It is given that the enthalpy change of neutralisation is the enthalpy change when solutions of an acid and an alkali react together to produce one mole of water.

In the experiment, HCl(aq) is in excess. Calculate the enthalpy change of neutralisation between $Ca(OH)_2(s)$ and HCl(aq), in kJ mol^{-1}, under the experimental conditions.

(Volume of the reaction mixture = 100.0 cm^3;
density of the reaction mixture = 1.00 $g\ cm^{-3}$;
specific heat capacity of the reaction mixture = 4.2 $J\ g^{-1} K^{-1}$;
heat capacity of the expanded polystyrene cup : negligible)
(Relative atomic masses: H = 1.0, O = 16.0, Cl = 35.5, Ca = 40.1)

Number of mole of $Ca(OH)_2 = 6.774 \times 10^{-3}$ mol

Number of mole of water formed
= 0.0135 mol

Heat released: $4.2\ J\ g^{-1} K^{-1} \times 2 \times 100$
= 840 J
= 0.84 kJ

enthalpy change $= -\frac{0.84\ kJ}{0.0135\ mol} = -62.2\ kJ\ mol^{-1}$

(5 marks)

(c) Standard enthalpy changes of neutralisation $\Delta H_n^\ominus$ for two reactions are given below :

	$\Delta H_n^\ominus$ / kJ mol^{-1}
Reaction between $Ca(OH)_2(s)$ and HCl(aq)	−58.6
Reaction between CaO(s) and HCl(aq)	−186.0

Calculate the standard enthalpy change of the following reaction.

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$

① $-58.6\ kJ\ mol^{-1}$ $Ca(OH)_2(s) + HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$

② $-186\ kJ\ mol^{-1}$ $CaO(s) + 2HCl(aq) \rightarrow H_2O(l) + CaCl_2(aq)$

standard enthalpy change = ② + −①
= 58.6 + (−186)
= −127.4 kJ mol^{-1}

(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Go on to the next page

*8. Describe and explain the similarities and differences between the chemical principles involved in tin-plating and galvanising in the rusting prevention of iron-made objects.

(6 marks)

In similarities.

Tin-plating and galvanising are both covered the surface of iron to prevent iron to contact with water and air.

Besides, Tin and Zinc are corrosion resistant so they are not easy to corrode.

In differences.

Tin is less reactive than iron. Thus, if the surface of Tin-plating is broken, the rate of rusting will be increased. However, Zinc is more reactive than iron. If the surface of galvanising is broken, zinc will provide sacrificial protection to iron.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

PART II

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

9. At a certain temperature, the equilibrium constant K_c for the following reaction is 2.25×10^{-2} mol dm^{-3}.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g) \qquad \Delta H > 0$$ endothermic

In an experiment, 0.84 mol of $PCl_5(g)$, 0.16 mol of $PCl_3(g)$ and 0.16 mol of $Cl_2(g)$ were initially introduced in a closed container of a fixed volume of 4.0 dm^3, and the system was allowed to attain equilibrium at that temperature.

(a) (i) Calculate the reaction quotient Q_c for the system under the initial conditions.

$$Q_c = \frac{\left(\frac{0.16}{4}\right)\left(\frac{0.16}{4}\right)}{\frac{0.84}{4}}$$

$$Q_c = 7.6190 \times 10^{-3}$$

$$Q_c = 7.62 \times 10^{-3} \text{ mol dm}^{-3}$$

(ii) Explain whether the concentration of $PCl_5(g)$ would increase or decrease just after the reaction started.

The concentration of $PCl_5(g)$ will decrease. Because $Q_c > K_c$, the reaction will shift to left. (4 marks)

(b) Explain whether K_c would increase, decrease or remain unchanged if the temperature of the equilibrium mixture is increased.

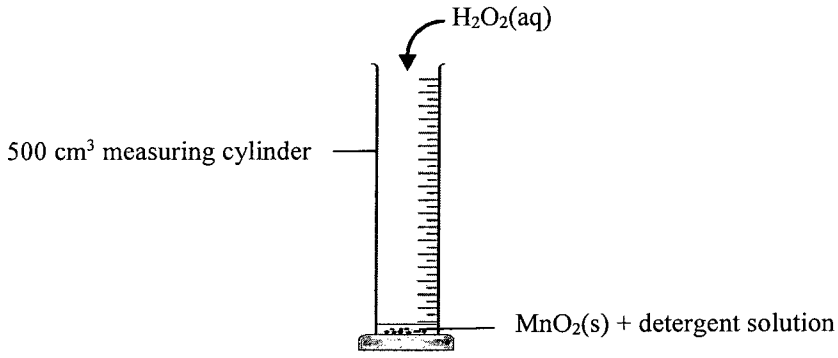
K_c will increase if the temperature increased. Because the reaction is endothermic reaction, increasing the temperature could help the reaction shift to right. (2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Go on to the next page

10. At room conditions, $H_2O_2(aq)$ would decompose into $O_2(g)$ and $H_2O(l)$ very slowly in the absence of $MnO_2(s)$. An experiment was performed as shown in the set-up below :



When 10.0 cm^3 of 3.00 M $H_2O_2(aq)$ was mixed with a small amount of $MnO_2(s)$ and detergent solution at room conditions, $O_2(g)$ started to be released rapidly and foam was produced. The $MnO_2(s)$ remained chemically unchanged at the end of the reaction.

(a) Write a chemical equation for the decomposition of $H_2O_2(aq)$.

$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

(1 mark)

(b) Explain how manganese illustrates a characteristic of transition metals according to the results of this experiment.

It contain variety of oxidation state.
Because in the result of the experiment, it turns back into $MnO_2(s)$.

(1 mark)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

10. (c) Upon completion of the reaction, all the $H_2O_2(aq)$ was used up. Calculate the theoretical volume of $O_2(g)$ released at room conditions.
(Molar volume of gas at room conditions = 24 dm^3) mol^{-1}

Number of mole of H_2O_2 (aq)
= 0.01 x 3 M = 0.03 mol & O_2

From the equation, the mole ratio of H_2O_2 V
= 2 : 1

Number of mole of O_2
= 0.015

Theoretical volume of O_2
= 0.015 mol x 24 dm^3 mol^{-1}
= 0.36 dm^3 = 360 cm^3 (2 marks)

(d) In the experiment, the time taken for the foam to rise from the mark at 100 cm^3 to the mark at 200 cm^3 of the measuring cylinder was 18 seconds, while the time taken for the foam to rise from the mark at 200 cm^3 to the mark at 300 cm^3 was 63 seconds. Explain these results.

The foam rise faster at first because the temperature is high and near the reactant.

The foam rise slower from 200 cm^3 to 300 cm^3 because it was condensed by the air and more slowly.

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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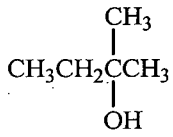
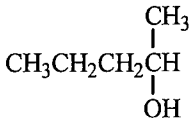
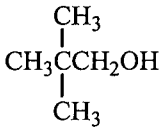
11. Compounds **P**, **Q** and **R** are structural isomers having the molecular formula of $C_5H_{12}O$. Their structures are shown below :



P



Q



R

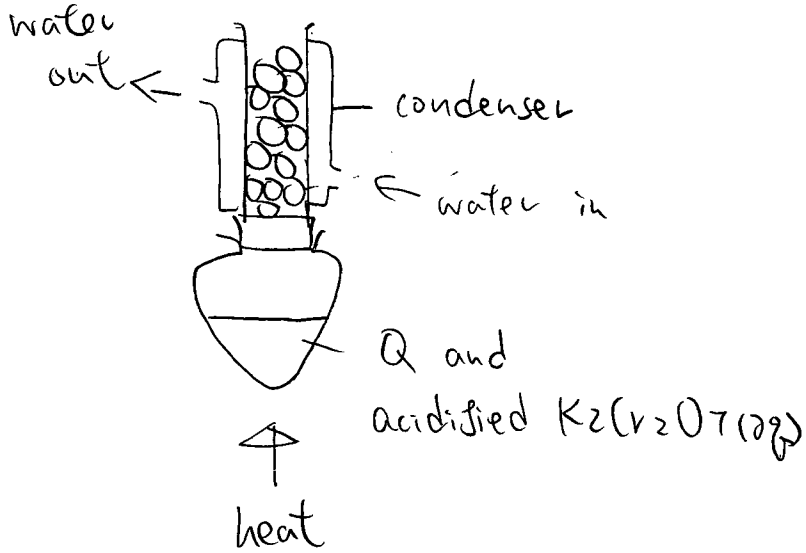
(a) Give the systematic name of **P**.

2-methylbutan-2-ol

(1 mark)

(b) Heating **Q** with acidified $K_2Cr_2O_7(aq)$ under reflux will give an organic product.

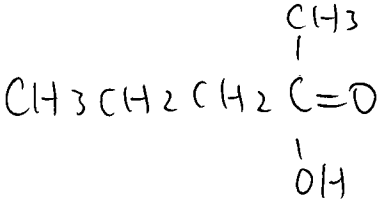
(i) Draw a labelled diagram to show the set-up for this reaction.



(ii) State the expected observation for this reaction.

The solution turn from orange to green.

(iii) Write the structural formula of the organic product.



(4 marks)

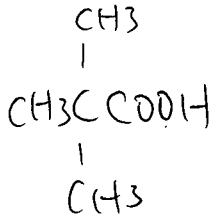
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

11. (c) **W** is an organic compound containing five carbon atoms. Under suitable conditions, **R** can be prepared from the reduction of **W**.

(i) Suggest the structural formula of **W**.



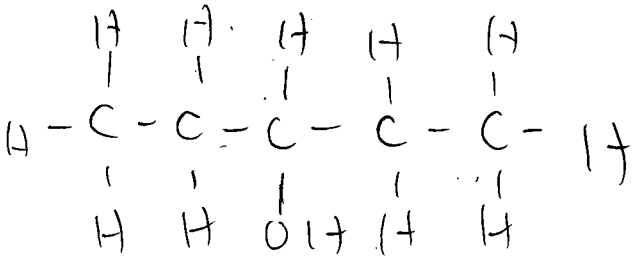
(ii) Suggest a reducing agent required for the reaction.

① $LiAlH_4$, dry ether

② H^+

(2 marks)

(d) Compound **S** is an optically active secondary alcohol. It is also a structural isomer of compounds **P**, **Q** and **R**. Write the structural formula of **S**.



(1 mark)

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Answers written in the margins will not be marked.

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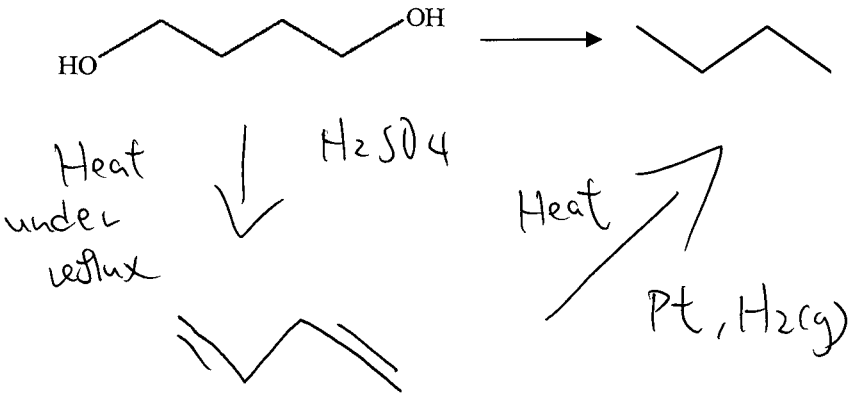
12. Outline a synthetic route, with NO MORE THAN THREE STEPS, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.



(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

*13. Describe the acid-base properties of the products formed (if any) when the following oxides are added to water separately. Chemical equations are NOT required.

Na_2O MgO Al_2O_3 Cl_2O

(5 marks)

Na_2O and MgO have base properties which is alkaline. They are alkaline oxides.

When $Na_2O(s)$ dissolved in water, NaOH will be produced and provide alkaline.

When MgO react with water, $Mg(OH)_2$ will be produced and provide alkaline.

Al_2O_3 is amphoteric oxide will could both react with acid and alkali. When it dissolve in water, $[Al(OH)_4]^-$ will be produced.

Cl_2O is acidic oxide, when it react with water, HOCl will be produced which is acidic.

END OF SECTION B
END OF PAPER

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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
																	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)

Level 4 Exemplar 2
Paper 2

2022 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

由考生填寫 To be filled in by the candidate	
試題編號 Question No.	1
	3

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

試題編號 Question No.

1	2	3	4	5	6	7	8	9	10	11	12	
☐	☐	X	☐	☐	☐	☐	☐	☐	☐	☐	☐	
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13	14	15	16	17	18	19	20	21	22	23	24	≥25

試題編號 Question No.

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

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.

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

1 a) i) 1) CH_3COOH is the only product. which do not contain side product.

2) CO is used which will make people choking and harmful to human.

ii) 1) to prevent the impurities to pioson the catalyst

2) catalyst has been piosoned so it could not work.

iii) glass bottle.

b) i) Water

ii) 1) A is chlorine gas

2) Cl^- ion in brine is a reduction agent which oxidized and lose electron. $Cl_{2(g)}$ is formed. Concentration on Cl^- ion in brine is high, thus it is preferencially discharged.

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

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

試題編號 Question No.

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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.

(b iii) 1) $2e^- + 2H^+_{(aq)} \rightarrow H_{2(g)}$ (differentially permeable)

2) It is a membrane on the cell which only allow Na^+ ion to pass through. Therefore, Cl^- ion cannot pass through the membrane. Only NaOH solution is formed

iv) $Cl_2O_{(s)}$

(c i) initial rate is the started time against the started volume in the first time, when $t=0$.

ii) Because the reaction is not depens on $[H^+_{(aq)}]$ but $[S_2O_3^{2-}]$. thus, only $[S_2O_3^{2-}]$ will affected the rate. $[H^+_{(aq)}]$ is with respect to zero.

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

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

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

試題編號 Question No.

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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) $k(\log 1.84)^a = -\log 1.1$

$k(-\log 2.24)^a = -\log 1.5$

the order with respect to I

iv) $\log \frac{k_1}{k_2} = -\frac{E_a}{2.3(8.31)}\left(\frac{1}{k_1} - \frac{1}{k_2}\right)$

$\log \frac{1}{1.9} = -\frac{E_a}{2.3(8.31)}\left(\frac{1}{k_1} - \frac{1}{k_2}\right)$

$E_a = 466.18$

$E_a = 466\ kJ\ mol^{-1}$

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

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

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.

3a) i) Using $\wedge_{\text{acidified}}$ $KMnO_4$ (aq) to test.
Only SO_2 will be reduced into SO_4^{2-} and turn the color from purple to colorless.

ii) CH_3CH_2CHO will give m/z = [29] and show [$CH_3CH_2^+$] ion but CH_3COCH_3 would only show m/z = 43, [CH_3CO^+] ion.

iii) anhydrous sodium sulphate

b) i)

ii) Make sure the left charcoal was removed.

iii) crystalization

iv) Some of the Y may dissolved in the water when it was washing. Not all Y are formed crystal.

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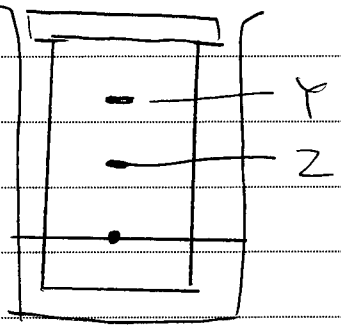
v) 1)



2) The first collected fraction is Y

3c i) 1) Pale yellow is Fe^{2+},
when there are end point, the
small amount of MnO_4^- turn
the solution into pale pink.

2) Number of mole of $KMnO_4$
= 0.03235 dm^3 x 0.0041 M
= 1.32635×10^{-4} mol

From the equation, the mole ratio is
1 : 5

Number of mole of Fe^{2+}
= 6.63175×10^{-4} mol

Concentration of Fe^{2+}
= 0.026527 mol dm^{-3}

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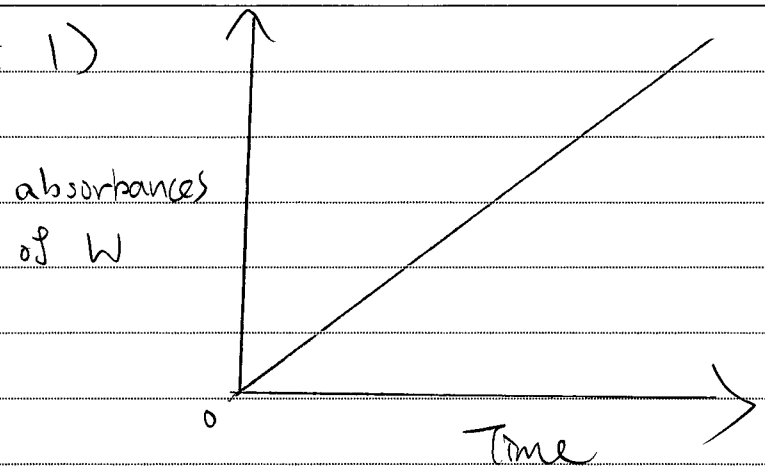
3 c ii 1)



2)

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