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2022-DSE
CHEM
PAPER 1B

B

Level 1 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.

* A 1 4 0 E 0 1 B *

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 $^{129}_{53}I$.

Isotopes.

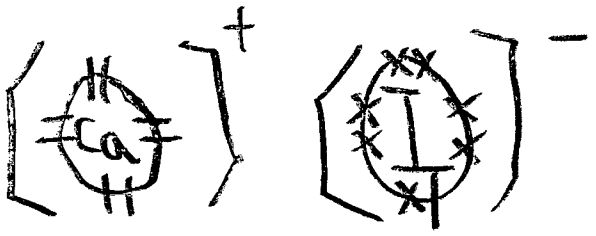
(1 mark)

(b) The electronic arrangement of an iodine atom is 2, 8, x, 18, y. What is 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 a giant ionic structure.

(1 mark)

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

hydrogen iodide have a higher melting point, it is because of the strong hydrogen bond.

(2 marks)

Answers written in the margins will not be marked.

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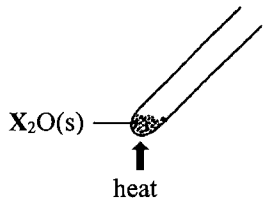
2. The diagram below shows an experimental set-up in which a metal oxide $X_2O(s)$ is decomposed upon strong heating. A silvery metal **X** and a colourless gas **Z** are formed.



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

O_2, 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)

$$\frac{3.028 - 2.819}{16 + 2X}$$

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

Zinc.

(3 marks)

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

(1 mark)

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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).

$NaHCO_3 + HCl \longrightarrow H_2O + CO_2 + NaCl$

(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)

percentage by mass :

$23.0 + 1 + 12 + 16 + 16 + 16$

$M = 84$ (mol)

(2 marks)

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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.

Phenolphthalein, colour change at the end point is colourless.

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

Use pH meter.

(3 marks)

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

It react faster.

(1 mark)

Answers written in the margins will not be marked.

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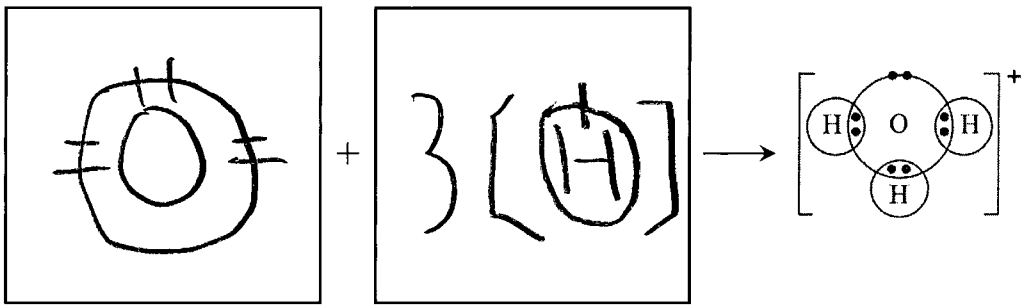
4. Consider the molecules H_2O, BF_3 and SF_6.

(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.

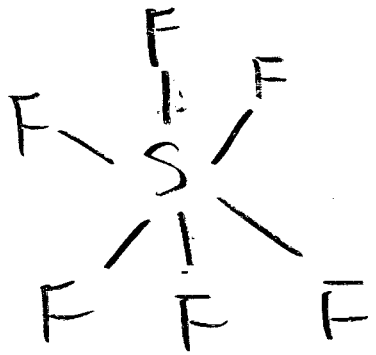
formation: $\frac{3}{2}H_2 + \frac{1}{2}O_2 \rightarrow H_3O^+$

(3 marks)

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

Yes, it is because B is group 3, outermost shell have 3 electron, whether F is group 7, so it is an octet structure. (1 mark)

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



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

SF_6 is V-shaped, so it is polar.

(2 marks)

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

$BF_3 < SF_6 < H_2O$

H_2O has a strong hydrogen bond, it is stronger than strong covalent bond of BF_3 and SF_6, so it has the highest boiling point. SF_6 molecular size is larger than BF_3, so SF_6 boiling point is higher than BF_3.

(3 marks)

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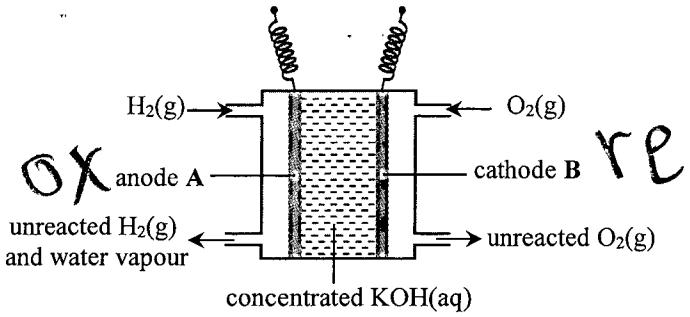
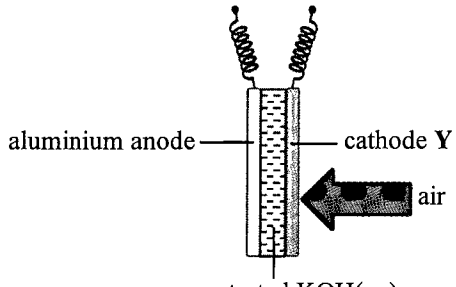
5. The following hydrogen-oxygen fuel cell and aluminium-air cell are primary cells. Their simplified structures are shown below :



hydrogen-oxygen fuel cell



aluminium-air cell

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

cell cannot be recharge. (1 mark)

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

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

$H_2 + O \rightarrow H_2O$

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

It is very high cost.

(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**.

$O_2 + 2H_2O \rightarrow 4OH^-$

(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.

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

When aluminium reacts with water and oxygen.

(3 marks)

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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. (1 mark)

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

UV light. (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.

It has one outermost shell electron, which is very easy to donate.

(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 :

$$Cl\bullet + CH_4 \rightarrow \boxed{CH_3\bullet} + \boxed{CHCl}$$

One of the steps in the termination stage :

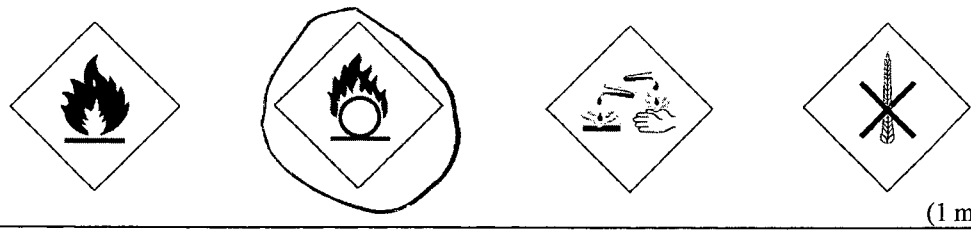
$$\boxed{CH_3\bullet} + \boxed{Cl\bullet} \rightarrow CH_3Cl$$

(3 marks)

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

Br is also can be used. (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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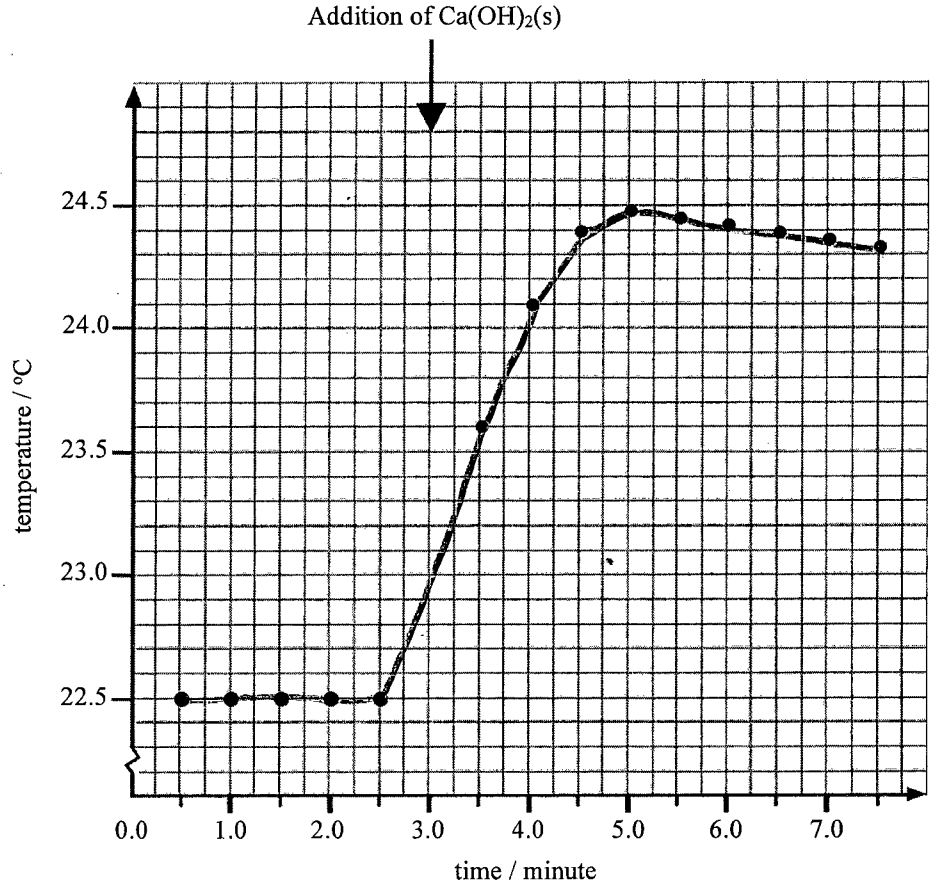
7. An experiment was performed to determine the enthalpy change of neutralisation between $Ca(OH)_2(s)$ and HCl(aq). 100.0 cm^3 of 1.0 M HCl(aq) was placed in an expanded polystyrene cup. The temperature of the contents in the cup was measured at half-minute intervals. Right at the third minute, 0.502 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).

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

(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 = 24.5 °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)

mole of $Ca(OH)_2$:

$$\frac{0.502}{40.1+16+16+1+1} = 6.774 \times 10^{-3}$$

enthalpy change :

$q_c = mc\Delta T$ $\quad 6.774 \times 10^{-3} \times 4.2 \times (24.5-22.5) \times 100 \div 1000$

$= 5.69 \times 10^{-3}$ (kJ/mol)

(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.

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

$+2HCl$ (-186.0×2) $\quad +2HCl$ (-58.6×2)

$CaCl_2 + H_2O$ $\quad CaCl_2 + 2H_2O$

$(-186.0 \times 2) + \Delta H = (-58.6 \times 2)$

$\Delta H = -117.2 + 372$

$\Delta H = +254.8$ kJ/mol

∴ the standard enthalpy change is +254.8 kJ/mol

(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)

Tin-plating and galvanising is also a physical protection to prevent rusting. It also have a impermeable layer that prevent water and oxygen react with iron, but galvanising is a scarifising protection, galvanising used a more reactive metal to protect iron. Tin-plating is only on a layer on iron surface.

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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.

$2.25 \times 10^{-2} = Qc \dfrac{(0.16)(0.16)}{(0.84)}$

$2.25 \times 10^{-2} = 0.03047619\,Qc$

$Qc = 0.738 \text{ (mol dm}^{-3}\text{)}$

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

decrease, it shift to the product of PCl_3 and Cl_2.

(4 marks)

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

Remain unchange, K_c is unchanged by temperature.

(2 marks)

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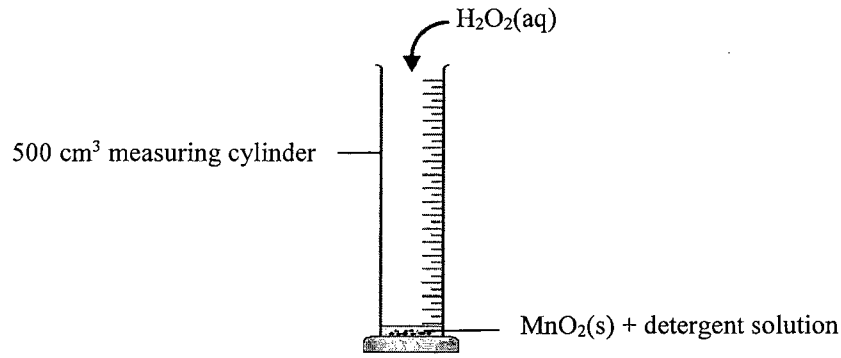
10. At room conditions, $H_2O_2(aq)$ would decompose into $O_2(g)$ and $H_2O(l)$ very slowly in the absence of $MnO_2(s)$. An experiment was performed as shown in the set-up below :



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 $H_2O_2(aq)$.

$H_2O_2 + MnO_2 \rightarrow MnOH + 2H_2O$

(1 mark)

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

It produce white pricipitate

(1 mark)

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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)

(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.

(2 marks)

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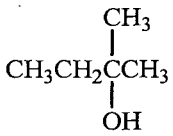
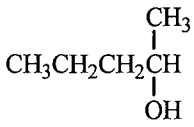
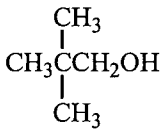
11. Compounds **P**, **Q** and **R** are structural isomers having the molecular formula of $C_5H_{12}O$. Their structures are shown below :



P



Q



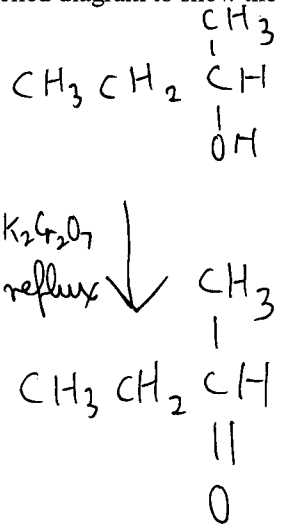
R

(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.

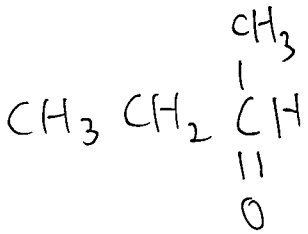
(i) Draw a labelled diagram to show the set-up for this reaction.



(ii) State the expected observation for this reaction.

It turns colour to silver mirror.

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



(4 marks)

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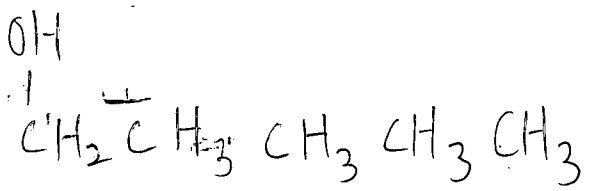
11. (c) **W** is an organic compound containing five carbon atoms. Under suitable conditions, **R** can be prepared from the reduction of **W**.

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

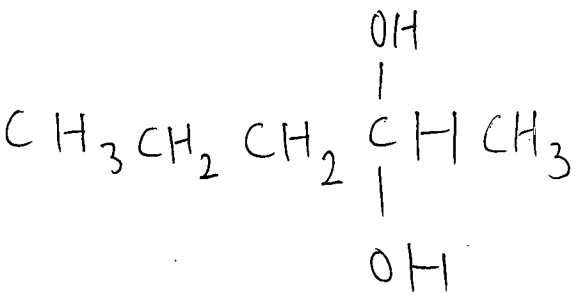


(ii) Suggest a reducing agent required for the reaction.

$NaBH_4 / H^+$ reflux

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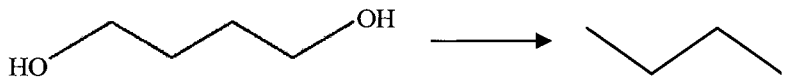
12. Outline a synthetic route, with NO MORE THAN THREE STEPS, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.



(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)

$Na_2O + 2HCl \longrightarrow 2NaCl + H_2O$

$MgO + 2HCl \longrightarrow MgCl_2 + H_2O$

$MgO + 2NaOH \longrightarrow Mg(OH)_2 + H_2O + Na_2O$

$Al_2O_3 + 2HCl \longrightarrow H_2O + Al_2O_2Cl$

$Cl_2O + 2NaOH \longrightarrow 2NaCl + H_2O + O_2$

Na_2O is acid properties

MgO is acid - base properties

Al_2O_3 is acid properties

Cl_2O is acid properties.

END OF SECTION B
END OF PAPER

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PERIODIC TABLE 周期表

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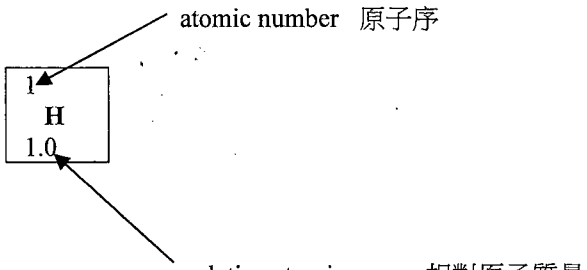

I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar**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

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

Level 1 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.	14 13

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	
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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.

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) 4t reduce CO gas to alleviate pollution.

1.(a)(i)(2) CO is toxic.

1. (a)(ii)(1). 3t converts the pollution gas to harmless.

1. (a) (ii)(2). 4t is because catalyst is denature after use

1. (iii). glass bottle

1. (b)(i) $+1$ $+1$ $_2O$

1.(b)(ii)(1) Br_2

1. (b) (ii)(2) $2Br^- \rightarrow Br_2 + 2e^-$

1. (iii) (1) $Na^+ + OH^- \rightarrow NaOH$

(iii) (2) The membrane electrolytic cell can separate NaCl and NaOH.

1. (iv) Mercury

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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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.

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

1.(c)(i) The started rate of the reaction.

1.(ii)

$\text{Rate} = k[-1.8]^1[1.8]^2$ — ①

$\text{Rate} = k'[-1.8]^1$ — ②

$\frac{①}{②} = \frac{-5.832k}{-1.8k'}$ $k' = 3.24$ //

1.(iii) $\text{Rate} = k[-1.8]^a$ — ①

$\text{Rate} = k[-1.9]^a$ — ②

$\frac{②}{①} = \frac{[-1.9]^a}{[-1.8]}$

1.(iv) $\ln = \frac{Ea}{2.3(8.31)} \times \frac{1}{25}$ — ①

$\ln 1.9 = \frac{Ea}{2.3(8.31)} \times \frac{1}{35}$ — ②

$Ea = 0.3759\ \text{JK}^{-1}\text{mol}^{-1}$

$Ea = 3.759 \times 10^{-4}\ \text{kJmol}^{-1}$ //

$\frac{①}{②} : \frac{1}{\ln 1.9} = \frac{\frac{Ea}{19.113 \times 25}}{\frac{Ea}{19.113 \times 35}}$

$\frac{1}{\ln 1.9} = \frac{Ea}{477.825} \times \frac{668.955}{Ea}$

$\frac{1}{\ln 1.9} = 1.4Ea$

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.

3(a)(i). Use lime water to test, only CO_2 can turn lime water milkly, SO_2 no change.

3(a). (ii) Use 2,4-dinitrithenelhydrazine, CH_3CH_2CHO no observable change, CH_3COCH_3 change colour from grey to siver mirror.

3(a)(iii) solid sodium hydroxide.

3(b).(i). $(3.04 - 1.40) \times \frac{(100-50)}{1000}$

$= 1.64 \times \frac{100}{1000}$

$= 0.082$ (mol)

3(b).(ii) 4A is water-insoluble that can be remove.

3(b)(iii) b condensation

3(b)(iv) 4A is because it remove the impurity 2, so the mass is smaller

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.

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

3(v)(i).

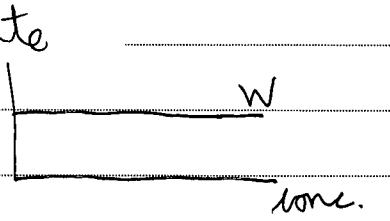
3(v)(ii) Z.

3(c)(i)(1). Fe^{2+} is pale yellow, so at start the colour is pale yellow, Fe^{2+} change to Fe^{3+} the pale yellow decolourized, Mn^{2+} is pale pink, so the colour change from yellow to pale pink.

3(c)(i)(2). $5 \times 3 - 5 \times 2$

$= 5$ //

3(c)(iii)(1)



(2) Reduction.

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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.

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Start each question on a new page.

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

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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.

B

Level 1 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 $^{129}_{53}I$.

they are isotpes

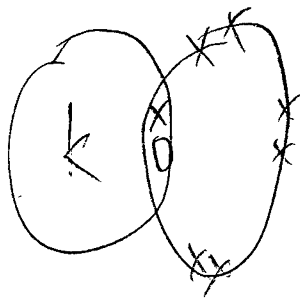
(1 mark)

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

because it have delocalized electron

(1 mark)

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

Ionic bonding have higher intermolecular force

the Van der Waals force between ... is strong

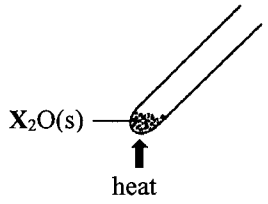
(2 marks)

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.

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.

carbon dioxide

It can turn limewater milky

(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)

3.028 - 2.819 = 0.209

$\frac{2.819}{2} = 1.4095$

$\frac{0.209}{1.409} = \frac{16}{x}$

$x \approx 107.9$

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

Ag

(3 marks)

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

the oxidation number of X have change

(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).

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

(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)

$1.0 + 23.0 + 12.0 + 16.0 \times 3$
$= 84$

$\frac{84}{152}$
$= 55.3\%$

(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.

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.

conical flask

from colorless to pale green

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

quenching method

(3 marks)

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

NaOH is too aggressive

$Mg(OH)_2$ react gently

(1 mark)

Answers written in the margins will not be marked.

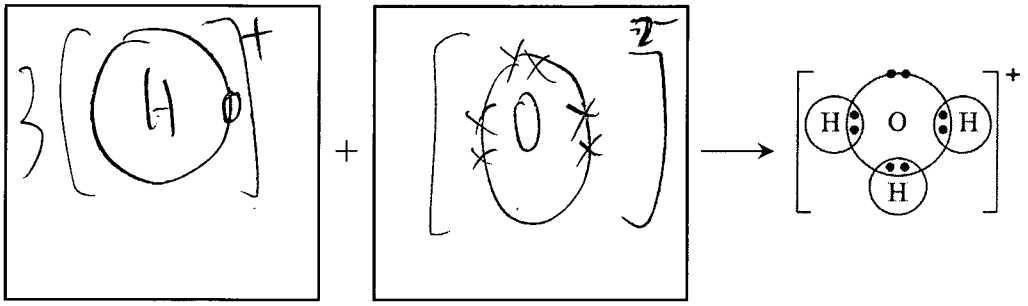
Answers written in the margins will not be marked.

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.

O has enough kinetic energy to break the bond between 3H, and H+ attract 3H form bond with it
have attraction energy

(3 marks)

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

Bonds share electron and they all get octet

(1 mark)

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

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.

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

It is colavent bond

(2 marks)

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

$BF_3 < SF_6 < H_2O$

BF3 is ionic bond, lare energy can beak it

SF6 is ~~covalent~~ Giant covalent structure, ~~~~ ~~~~ it intermolecular force need more energy to break.

H2O have the highest heat capacity among all things

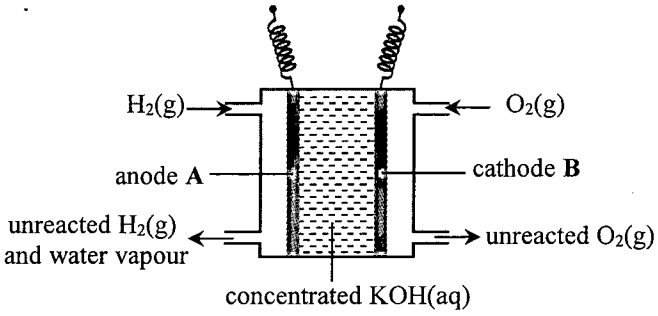
(3 marks)

Answers written in the margins will not be marked.

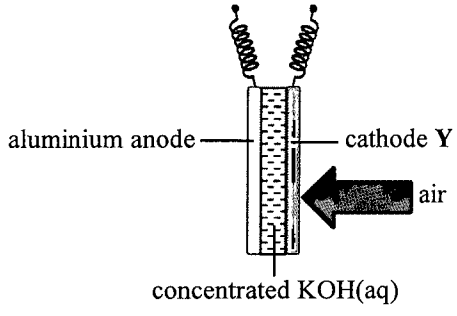
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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' ?

cannot recharge

(1 mark)

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

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

$H_2(g) + 2KOH(aq) \rightarrow$ [illegible] $+ H_2O(g) +$ [illegible]

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

[illegible] expensive

(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**.

$O_2(g) + 2H_2O(l) \rightarrow$ [illegible]

(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.

/

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

get aluminium [illegible] enough electrons to form aluminium

(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 :

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

(a) Name the type of reaction involved.

chanrul ~~reaction~~ reaction

(1 mark)

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

be careful

(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 ~~my~~ likes to pair with others

(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 :

$Cl\bullet + CH_4 \rightarrow$ [Cl^-] + [CH_4]

One of the steps in the termination stage :

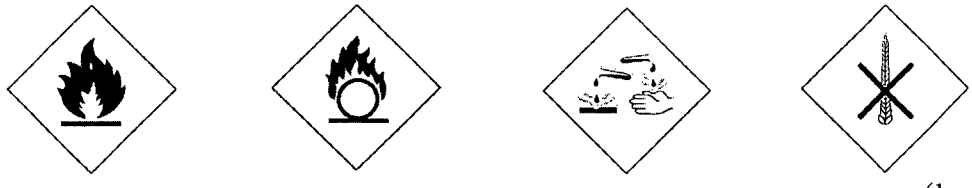
[H^+] + [e^-] $\rightarrow CH_3Cl$

(3 marks)

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

(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)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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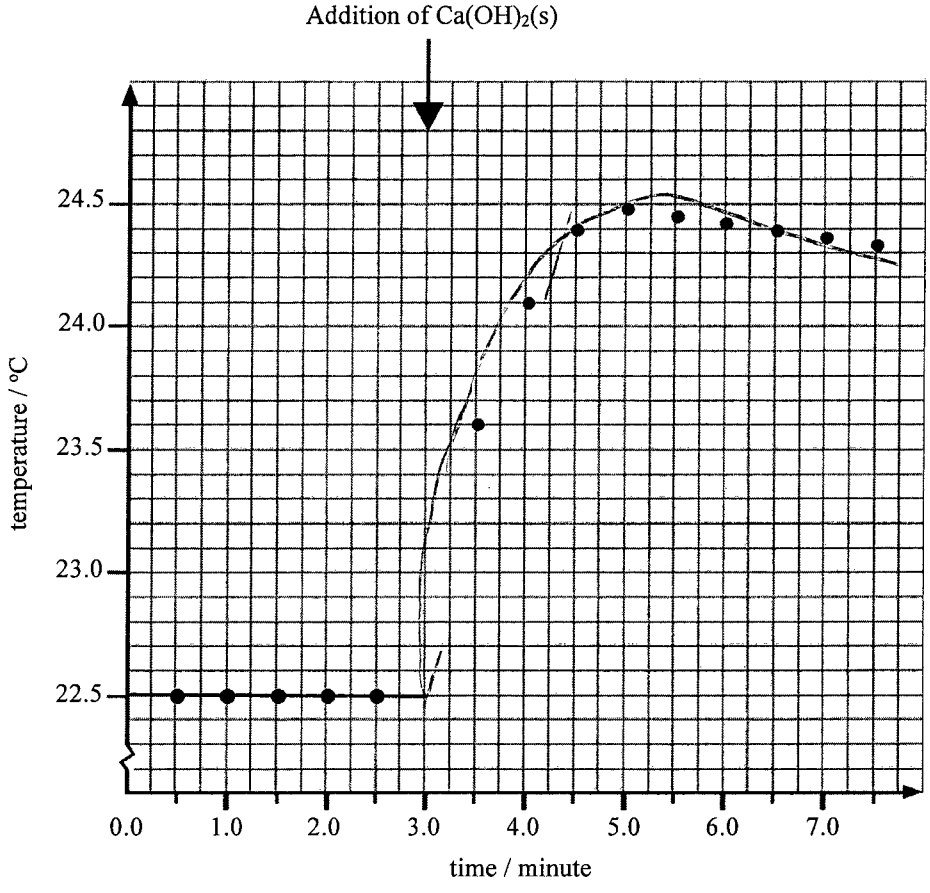
7. An experiment was performed to determine the enthalpy change of neutralisation between $Ca(OH)_2(s)$ and HCl(aq). 100.0 cm^3 of 1.0 M HCl(aq) was placed in an expanded polystyrene cup. The temperature of the contents in the cup was measured at half-minute intervals. Right at the third minute, 0.502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

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

(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 = 24.5 °C

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)

$(40.1 + 2\times(1+16.)) \times 0.502 + 2\times(1+35.5)\times 0.1 - 2\times 4.2$
$= 37.1982 + 7.3 - 8.4$
$= 36.0982$

$36.0982 \times (24.5 - 22.5)$
$= 72.1964$ kJ mol^{-1}

(5 marks)

(c) Standard enthalpy changes of neutralisation ΔH_n° for two reactions are given below :

	ΔH_n° / 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.

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

$-58.6 - 186.0$
$=$

(3 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

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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)

tin - plating is protect metal from contact the air, because oxygen in air would react with metal and rust. galvanising is use another metal with high reactive, as a sacrificing metal. it give electron to the protected metal and due to loss of electron. it will react with oxygen.

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}.

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

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.

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

decrease

(4 marks)

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

increase, because the reaction rate of higher

(2 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

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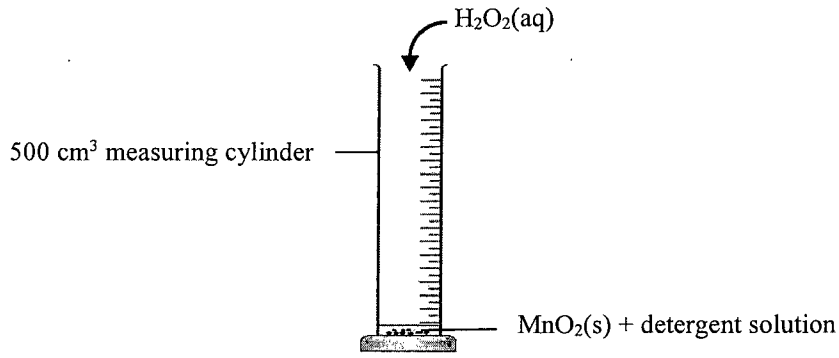
10. At room conditions, $H_2O_2(aq)$ would decompose into $O_2(g)$ and $H_2O(l)$ very slowly in the absence of $MnO_2(s)$. An experiment was performed as shown in the set-up below :



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 $H_2O_2(aq)$.

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

(1 mark)

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

(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)

(2 marks)

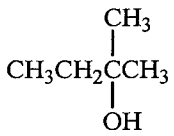
(d) In the experiment, the time taken for the foam to rise from the mark at 100 cm^3 to the mark at 200 cm^3 of the measuring cylinder was 18 seconds, while the time taken for the foam to rise from the mark at 200 cm^3 to the mark at 300 cm^3 was 63 seconds. Explain these results.

(2 marks)

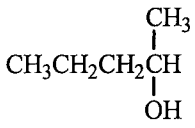
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

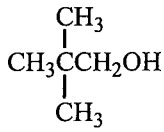
11. Compounds **P**, **Q** and **R** are structural isomers having the molecular formula of $C_5H_{12}O$. Their structures are shown below :



P



Q



R

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

(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.

(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.

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.

Potassium

(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)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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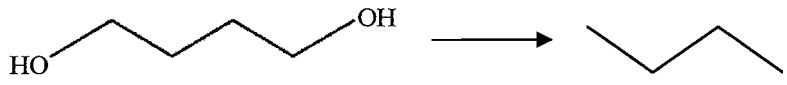
12. Outline a synthetic route, with NO MORE THAN THREE STEPS, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.



(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)

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
				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 1 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.

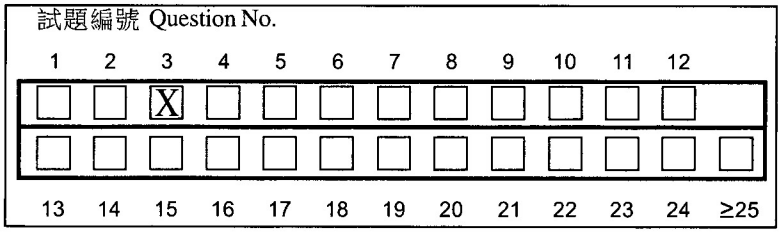
(2) Start each question (not part of a question) on a new page. Put 'X' in the corresponding question number box on each page to indicate the appropriate question number (see the example below), and write the question number(s) of the question(s) attempted in the space provided on Page 1.

(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.

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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.

a)i) (1) could make liquid gas

2) the concentration would affect to another chain

ii) cheap

(2) the catalyst bond is not strong and volatile

iii) glass bottle

b) i) ~~~~ ~~~~ ~~~~ ~~~~ hydrochloric acid

ii) 1) hydrogen

(2) ~~~~ ionize ~~~~ from brine

iii) 1)

(2) ~~~~ hydroxide attractive than chloride

iv) hexane

c) i) ~~the reaction rate just after the experiment~~

the ratio between concentration of $S_2O_3^{2-}(aq)$ and formation of S

ii) because ~~~~ all atomic values of hydrogen is 1

or $k' = k \times [H^+(aq)]^b$

試題編號 Question No.

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

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

3 i) CO_2 can turn lime water milky

ii)

iii) anhydrous sodium sulphate

iv) $\frac{80}{100} \times 3.04 = 1.52$ $1.52 > 1.40$

v) to prevent unaccurated data

vi) quenching method

vii) Z have take some mass of mixture of Y

viii)

Z) Y

c)

i) a) Mn^{2+} is orange, Fe is pink

(2) $34.1 + 54.9 + 16 \times 4 = 158$

ii) (1)

(2) use harber process

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Answers written in the margins will not be marked.

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