B

Level 5 Exemplar &
Comments
Paper 1B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2021

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

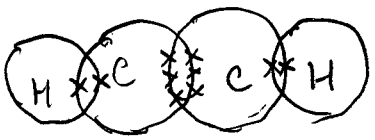
Answer **ALL** questions. Write your answers in the spaces provided.

1. Acetylene (C_2H_2) is a fuel. It can be obtained from calcium carbide (CaC_2) by two different reactions as represented by the equations shown below :

$$CaC_2 + \mathbf{A} \xrightarrow{2200\ ^\circ C} C_2H_2 + Ca \qquad \text{Reaction (I)}$$

$$CaC_2 + 2H_2O \xrightarrow{25\ ^\circ C} C_2H_2 + Ca(OH)_2 \qquad \text{Reaction (II)}$$

(a) Draw the electron diagram for a C_2H_2 molecule, showing ELECTRONS IN THE OUTERMOST SHELLS only.



(1 mark)

(b) Write a chemical equation for the complete combustion of acetylene.

$C_2H_2 + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(l)$

(1 mark)

(c) Refer to Reaction (I) :

(i) **A** is a gas at room conditions. Suggest what **A** would be.

Hydrogen gas.

(ii) Hence, explain why the reaction is dangerous.

Because hydrogen gas may explode at high temperature if mixed with air.

(2 marks)

(d) In Reaction (II), $Ca(OH)_2$ is formed. State one use of $Ca(OH)_2$ in daily life.

To detect high amount of CO_2 gas.

(1 mark)

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2. In the boxes **(a)** to **(g)** of the table below, fill in the information relating to the electrolysis of each electrolyte.

Electrolyte	Electrode	Observation at the electrode	Product at the electrode	Half equation OR Justification for the change occurred at the electrode
Molten $PbBr_2$	Graphite anode	**(a) Observation:** Reddish-brown gas release.		
	Graphite cathode			**(b) Half equation:** $Pb^{2+} + 2e^- \longrightarrow Pb_{(s)}$.
Very dilute $ZnCl_2$ solution	Platinum anode			**(c) Half equation:** $4OH^-_{(aq)} \longrightarrow H_2O_{(l)} + O_{2(g)} + 4e^-$
	Platinum cathode		**(d) Product:** Hydrogen gas.	
Concentrated $CuSO_4$ solution	Copper anode		**(e) Product:** Oxygen gas.	
	Copper cathode	**(f) Observation:** Reddish-brown solid deposit.		**(g) Justification:** Cu^{2+} ion have a lower position than H^+ ion in ECS. So Cu^{2+} ion will discharge first and form Cu(s).

(7 marks)

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3. Silicon occurs naturally in three isotopes with the abundance of each isotope shown in the table below :

Isotope	Abundance / %
^{28}Si	92.20
^{29}Si	x
^{30}Si	y

(a) What is meant by the term 'isotope' ?

It mean an element have same number of proton but different atom of an number in neutron.

(1 mark)

(b) Calculate x.
(Relative atomic mass : Si = 28.1)

$0.922 + \frac{x}{100} + \frac{y}{100} = 1$

$x + y = 7.8 \cdots (1)$

$28(0.922) + 29 \cdot \frac{x}{100} + 30 \cdot \frac{y}{100} = 28.1$

$0.29x + 0.3y = 2.284 \cdots (2)$

By solving (1), (2).

$x = 5.6, \quad y = 2.2$

$\therefore x = 5.6$

(2 marks)

(c) Silicon dioxide is an oxide of silicon.

(i) Explain why silicon dioxide has a high melting point.

Silicon dioxide have a giant covalent structure. Larger amount of energy is required to break millions of strong covalent bond between Si and O atom in order to melt it. Hence it has high melting point.

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3. (c) (ii) Under certain conditions, 1.0 g of SiO_2 is allowed to react with 1.0 g of Mg. The equation for the reaction is shown below :

$$SiO_2 + 2Mg \rightarrow 2MgO + Si$$

Calculate the theoretical mass of Si that can be formed.
(Relative atomic masses : O = 16.0, Mg = 24.3, Si = 28.1)

no. of mole of Mg = 0.0411

no. of mole of SiO_2 = 0.01664.

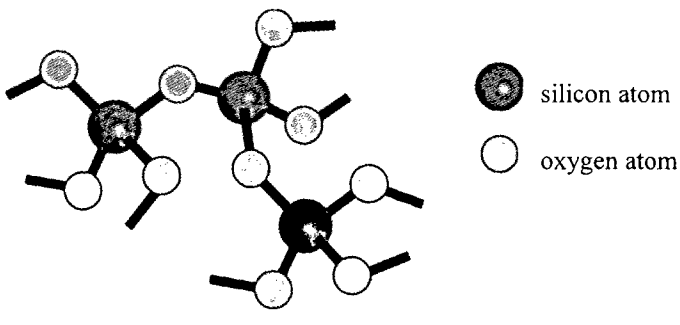
∴ SiO_2 is limiting reagent.

∴ Mass of Si can form = 0.01664 × 28.1

= 0.468 (g).

(4 marks)

(d) Part of the structure of a mineral containing silicon and oxygen only is shown in the diagram below :



What is this mineral ?

quaze.

(1 mark)

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4. The chemical equation for a possible cracking reaction of decane ($C_{10}H_{22}$) is shown below :

$C_{10}H_{22} \rightarrow C_4H_{10} + 2\mathbf{X}$ C_3H_6.

(a) State the systematic name of **X**.

propene.

(1 mark)

(b) Suggest a chemical test to show how **X** and butane can be distinguished.

Add brown bromine solution into both X and butane, X will decolourize bromine immediately but butane will not.

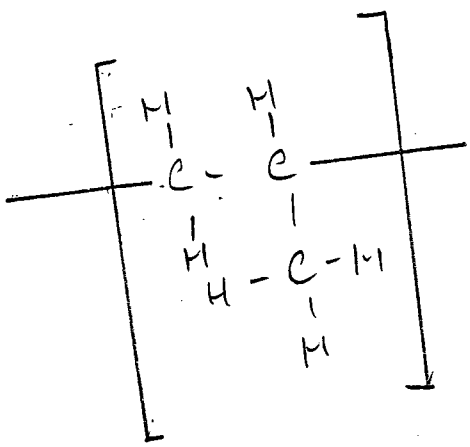
(2 marks)

(c) **X** can form a polymer **Z**.

(i) Suggest why **X** can form a polymer.

Because it is unsaturated with a C=C double bond.

(ii) Draw the repeating unit of **Z**.



(2 marks)

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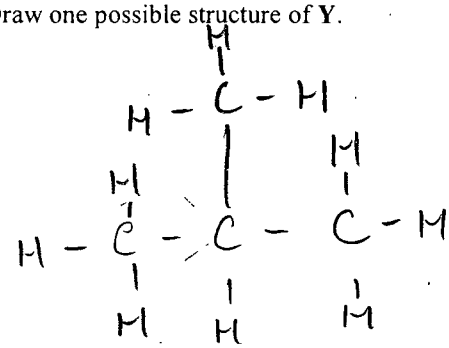
4. (d) Compound **Y** is a structural isomer of butane.

(i) Draw one possible structure of **Y**.



(ii) Which of decane, butane and **Y** would have the highest boiling point ? Explain your answer.

Butane.

As the structure of butane is more symmetrical, the intermolecular force between butane molecule is stronger than that of Y. Hence butane have a highest boiling point.

(3 marks)

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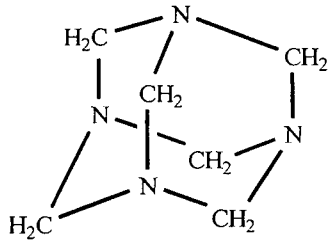
5. Hexamine ($C_6H_{12}N_4$) is the main component of a portable solid fuel. It is a solid under room conditions and its structure is shown below :



(a) Suggest why the combustion of hexamine is exothermic in terms of the breaking and forming of covalent bonds.

As the energy release during forming covalent bond in product is higher than the energy require to break the bond, it is exothermic. covalent. in the reactant.

(2 marks)

(b) It is given that :

Compound	Standard enthalpy change of formation / kJ mol^{-1}
$C_6H_{12}N_4(s)$	+123
$CO_2(g)$	–394
$H_2O(l)$	–286
$NO_2(g)$	+33

(i) Write a thermochemical equation for the standard enthalpy change of formation of hexamine.

$6C_{(s)} + 6H_{2(g)} + 2N_{2(g)} \longrightarrow C_6H_{12}N_{4(s)}$.

(ii) Hexamine combusts as shown by the equation below :

$$C_6H_{12}N_4(s) + 13O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l) + 4NO_2(g)$$

Calculate the standard enthalpy change of combustion of hexamine.

$\Delta H_c^{\ominus}[C_6H_{12}N_4] = -123 + 6(-394) + 6(-286) + 4(33)$.

$= -4071$ (kJ mol^{-1}).

(3 marks)

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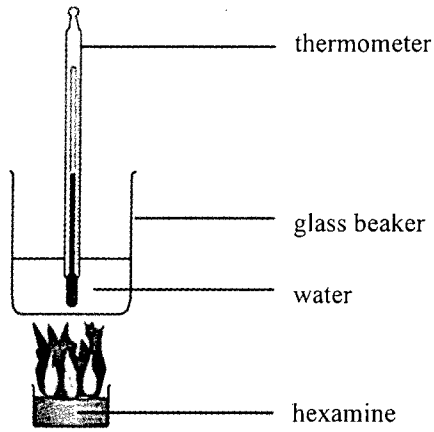
5. (c) The following diagram shows an experimental set-up for determining the enthalpy change of combustion of hexamine under certain experimental conditions.



The data obtained are shown below :

Mass of hexamine combusted :	2.40 g
Mass of water :	600.0 g
Initial temperature of water :	23.5 °C
Final temperature of water :	47.5 °C
Molar mass of hexamine :	140.0 g
Specific heat capacity of water :	4.20 J g^{-1} K^{-1}

Assuming that the heat capacity of the glass beaker is negligible, calculate the enthalpy change of combustion of hexamine under these experimental conditions.

Energy release = $600 \times 4.2 \times (47.5 - 23.5)$

$= 60480$ J.

$\Delta H_c^{\ominus} [C_6H_{12}N_4] = \dfrac{60480}{\frac{2.4}{140.}}$

$= -3528$ kJ mol^{-1}

(3 marks)

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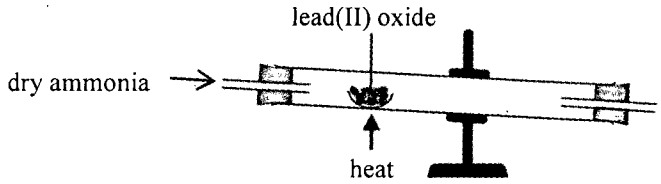
6. Lead can be obtained from lead(II) oxide using the experimental set-up shown below. Besides lead, nitrogen gas and steam are also formed.



(a) Suggest a reason for each of the following :

(i) The reaction tube is placed in a downward slanted position.

Ammonia is denser than air

(ii) The experiment is performed in a fume cupboard.

Ammonia is toxic.

(2 marks)

(b) Write a chemical equation for the reaction.

$2NH_{3(g)} + 4PbO_{(s)} \longrightarrow N_{2(g)} + 4Pb_{(s)} + 4H_2O_{(g)}$

(1 mark)

(c) Explain which of the reagents is a reducing agent in the reaction.

As oxydation number of N change from -3 to 0, it is reducing agent.

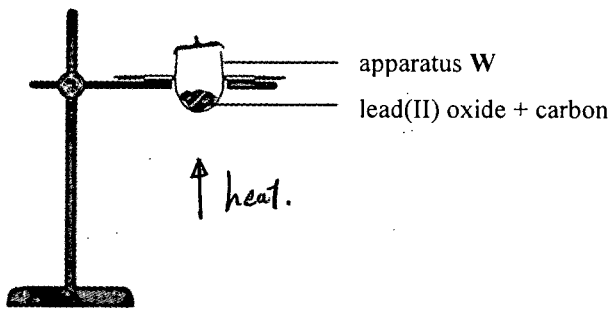
(1 mark)

(d) Lead can also be obtained from lead(II) oxide using carbon.

(i) Write a chemical equation for the reaction.

$2PbO_{(s)} + C_{(s)} \longrightarrow 2Pb_{(s)} + CO_{2(g)}$

(ii) The diagram below shows an incomplete set-up for performing the reaction :



(1) Add suitable drawing (with label) to the diagram for completing the set-up.

(2) Name apparatus **W**.

crucible.

(3 marks)

Answers written in the margins will not be marked.

7. The steps for determining the concentration of a sample of hydrochloric acid are listed below :

Step (1) : A 0.1038 M standard sodium carbonate solution was prepared by dissolving 2.750 g of anhydrous sodium carbonate solid in deionised water and made up to 250.0 cm^3.

Step (2) : 25.0 cm^3 of the standard solution obtained in Step (1) was transferred to a clean conical flask and then a few drops of methyl orange were added.

Step (3) : The sample of hydrochloric acid was put into a burette. The standard solution in the conical flask was titrated with the hydrochloric acid.

Step (2) and Step (3) were repeated for several times. The table below shows the results of the titrations :

	Trial	1	2	3	4
Final burette reading / cm^3	30.85	28.75	28.30	31.35	27.25
Initial burette reading / cm^3	2.00	1.50	1.00	3.00	0.00

(a) Describe the procedure in preparing the standard sodium carbonate solution in Step (1).

First, weight 2.75 g of anhydrous sodium carbonate by using electron balance accurately. Use small amount of distilled water to dissolve all Na_2CO_3 (s) and transfer all solution made to 250 cm^3 volumetric flask. Mix the solution by turning the flask upside down 10 times. (2 marks)

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

From yellow to orange. (1 mark)

(c) Calculate a reasonable average for the volume of the hydrochloric acid used in the titrations.

$$\text{Vol. of HCl used} = \frac{28.75 - 1.5 + 28.3 - 1 + 31.35}{3}$$

$$= 27.27\ cm^3.$$

(1 mark)

(d) Calculate the concentration of hydrochloric acid (in g dm^{-3}) in the sample.
(Relative atomic masses : H = 1.0, Cl = 35.5)

$2HCl + CO_3 \rightarrow CO_2 + H_2O$

$$\text{No. of mole of HCl reacted} = 0.1038 \times 0.025 \times 2$$

$$= 5.19 \times 10^{-3}\ mol.$$

$$\text{Concentration of HCl} = \frac{5.19 \times 10^{-3} \times 36.5}{0.02727}$$

$$= 6.95\ g\ dm^{-3}).$$

(3 marks)

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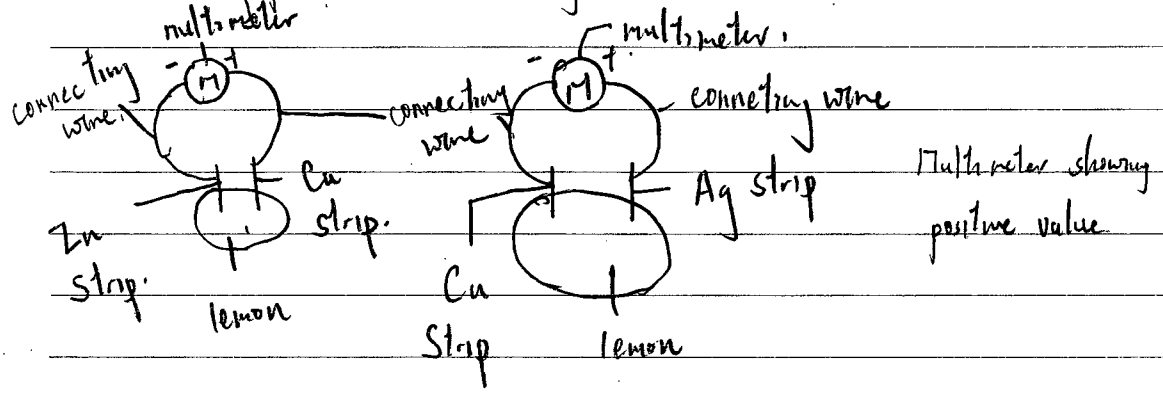
*8. You are provided with the following items :

lemon, multimeter, connecting wires, Zn strip, Cu strip, Ag strip

With the aid of a labelled diagram, suggest how you can perform an experiment to confirm (with explanation) the order of reducing power of metals as Zn > Cu > Ag. (6 marks)

The lemon can provide mobile ion to conduct electricity.

First, insert Zn strip and copper strip into the lemon. Use connecting wire to connect Zn strip to negative pole of multimeter and connect Cu strip to the positive pole. Measure the voltage across two strip. The voltage should be a positive value because Zn have a higher position in ECS than Cu. Repeat the experiment but replace Zn strip by Ag strip. Connect the Cu strip to negative terminal while Ag to positive terminal. Measure the voltage again and the voltage should be positive value because Cu have a higher position in ECS than Ag. As higher position in ECS mean stronger reducing power, the order of reducing power is Zn > Cu > Ag.



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PART II

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

9. An experiment was performed for a reversible reaction involving $CH_4(g)$, $H_2S(g)$, $H_2(g)$ and $CS_2(g)$ in a closed container of a fixed volume of 2.0 dm^3 at a constant temperature. The equation for the reaction is shown below :

$$CH_4(g) + 2H_2S(g) \rightleftharpoons 4H_2(g) + CS_2(g)$$

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

$$K_c = \frac{[CS_2(g)][H_2(g)]^4}{[CH_4(g)][H_2S(g)]^2}$$

(1 mark)

(b) The number of moles of each species at different times at that temperature are given in the table below :

	$CH_4(g)$	$H_2S(g)$	$H_2(g)$	$CS_2(g)$
Initial number of moles	0.04	0.08	0.08	0.04
Number of moles at equilibrium	0.055	0.11	0.02	0.025

(i) Fill in the number of moles at equilibrium for $CH_4(g)$ in the above table.

(ii) Calculate the equilibrium constant K_c for the reaction at that temperature.

$$K_c = \frac{\left(\frac{0.025}{2}\right)\left(\frac{0.02}{2}\right)^4}{\left(\frac{0.055}{2}\right)\left(\frac{0.11}{2}\right)^2}$$

$$= 1.50 \times 10^{-6}\ mol^2\ dm^{-6}$$

(iii) If the volume of the closed container changes to 3.0 dm^3 while all other experimental conditions remain unchanged, explain whether K_c would increase, decrease or remain unchanged.

Remain unchange as K_c only change if reaction temperature change.

(4 marks)

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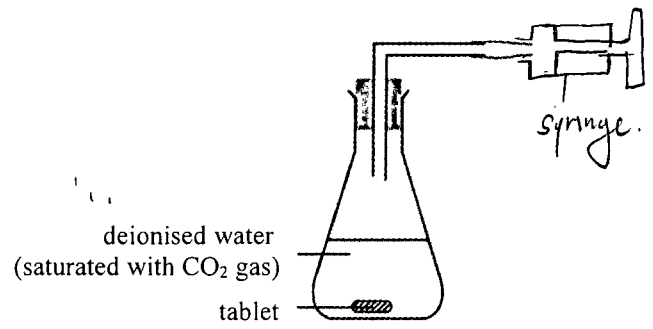
10. A tablet contains solid sodium hydrogencarbonate and solid citric acid (water soluble). An experiment was performed under room conditions to study the rate of formation of CO_2 gas when the tablet was placed in deionised water.

(a) The diagram below shows an incomplete set-up for the experiment :



(i) Explain why the deionised water used should be saturated with CO_2 gas before the start of the experiment.

Because CO_2 gas is slightly soluble in water and the experiment result may have error if water with normal deionized water is used.

(ii) Add suitable drawing (with label) to the above diagram to show how the volume of the CO_2 gas formed can be measured.

(2 marks)

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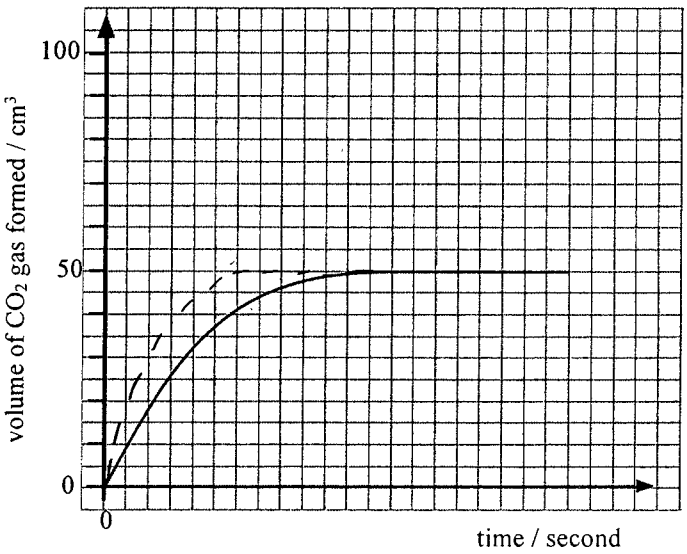
10. (b) (i) The graph below shows the variation of the volume of CO_2 gas formed with time for the experiment :



70 cm^3.

$H^+ + HCO_3^-$

Assuming that citric acid was in excess and no other substances reacted with sodium hydrogencarbonate, calculate the mass of sodium hydrogencarbonate in the tablet.
(Molar masses : sodium hydrogencarbonate = 84.0 g, citric acid = 192.0 g;
Molar volume of gas at room conditions = 24 dm^3)

No. of mole of $NaHCO_3 = \frac{70}{24000}$

$= 2.08 \times 10^{-3}$ mol.

Mass of $NaHCO_3 = 2.08 \times 10^{-3} \times 84$

$= 0.175$ g.

(ii) Sketch another curve (using **dotted line**) on the above graph to show the expected experimental result if the tablet is ground into a powder, with all other experimental conditions remaining unchanged.

(3 marks)

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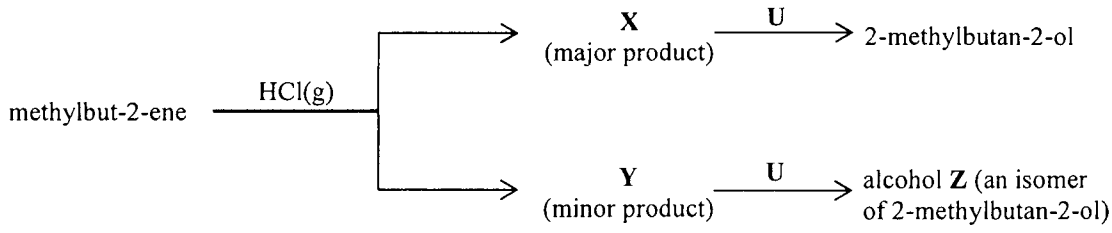
11. Methylbut-2-ene reacts with HCl(g) to give **X** as the major product as predicted from Markovnikov's rule. During the reaction, another product **Y** (minor product) can also be formed. Refer to the following organic conversions :

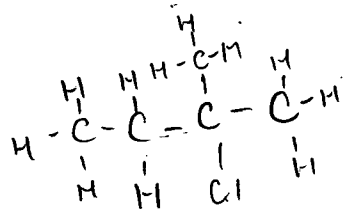


(a) State the Markovnikov's rule.

The main substituting atom A of from the reactant will ~~the~~ more likely to form bond with carbon in a carbon compound which have more similar group bond with.

(1 mark)

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



(1 mark)

(c) **X** reacts with **U** to give 2-methylbutan-2-ol. What is **U** ?

NaOH(aq).

(1 mark)

(d) (i) **Y** has one chiral centre. Draw a three-dimensional diagram for the structure of an enantiomer of **Y**.

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11. (d) (ii) **Y** is optically active. What is meant by the term 'optically active' ?

It mean it have enantiomers which can rotate polarized light in same magnetude but in different direction.

(2 marks)

(e) **Y** reacts with **U** to give alcohol **Z**. Suggest a chemical test to show how **Z** and 2-methylbutan-2-ol can be distinguished.

Z can turn orange acidified potassium dichromate solution green but 2-methylbutan-2-ol can not.

(2 marks)

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12. (a) Silicon dioxide is an acidic oxide. However, the pH of a mixture of silicon dioxide and distilled water is 7.

(i) Suggest why silicon dioxide is classified as an acidic oxide.

Because it can react with base solution but not with acidic solution.

(ii) Explain why the pH of the mixture is 7.

Because SiO_2 cannot dissolve in water.

(2 marks)

(b) Phosphorus(V) oxide is an acidic oxide. With the aid of a chemical equation, explain why the pH of a mixture of phosphorus(V) oxide and distilled water is smaller than 7.

$P_4O_{10(s)} + 6H_2O_{(l)} \longrightarrow 4H_3PO_{4(aq)}$

Because it can react with water, forming H_3PO_4 which can ionize in water, give out H^+ ion. So the pH value is smaller than 7.

(2 marks)

(c) Refer to the following reaction :

$$Cu_2O(s) + H_2SO_4(aq) \rightarrow Cu(s) + CuSO_4(aq) + H_2O(l)$$

State how this reaction can demonstrate that copper exhibits TWO characteristics of transition metals.

Cu have different oxydation state, it have oxidation number of +1 and +2. This shows transition metal can have different oxydation state.

$CuSO_4$ is blue in color. This shows transition metal ion can be colored.

(2 marks)

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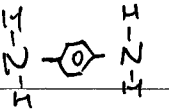
*13. Using nylon-6,6 as an example, illustrate the meaning of condensation polymerisation. Your answer should also include the structural feature of the monomers.

(5 marks)

Nylon have two monomers,  and $HOOC-(CH_2)_4-COOH$.
They both have two functional group, which can react with each other and form a longer chain. When react, a hydrogen from NH_2 group and OH from COOH group will react and form a water molecule. Hence the remain CO from COOH group and NH from NH_2 group will link together, forming an amide link. This process can repeat many time to form a long chain. Hence, condensation polymerisation mean the monomer reacts and will give out water molecule, also the product can form a long chain.

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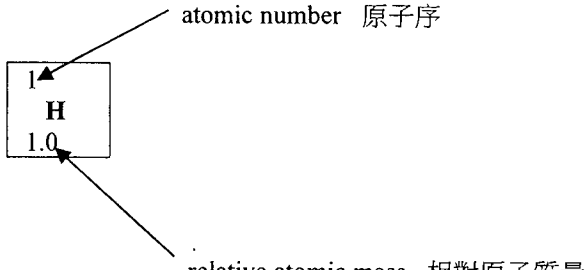
PERIODIC TABLE 周期表

GROUP 族



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

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

Level 5 Exemplar &
Comments
Paper 2

2021 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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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.

(a)(i) 49.2 kJ mol^{-1}.

(ii) $\log \frac{k_2}{k_1} = \frac{E_a}{2.3(8.31)(300)} - \frac{E_a}{2.3(8.31)(310)}$

$\frac{k_2}{k_1} = 10^{3.66\times10^{-4}}$

$k_2 = k_1 \times 10^{3.66\times10^{-4}}$.

∴ The rate constant is $k_1 \times 10^{3.66\times10^{-4}}$.

(iii)(1) The order of reaction with respect to B(g) is $\frac{3}{2}$.

(2) mol$^{-\frac{3}{2}}$ dm$^{\frac{9}{2}}$ s^{-1}.

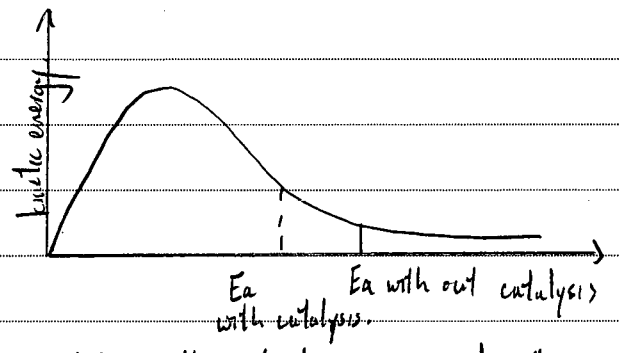
(b)(i) As side product will form if impurities like oxygen get in.

(ii) ~~To have a high yield of NH3~~. Reduce the cost of producing NH_3

(iii) Because NH_3 have a much higher boiling point than other gas. The temperature in condenser have temperature which only NH_3 can condense.

(iv)(1) Fine divided iron.

(2)



With catalysis, the activation energy for the reaction can be lower. Hence the no. of molecules that have kinetic energy equal or higher than new activation energy. So. no of effective collision per unit time increase and reaction rate increase.

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1.(c) (i) It is highly flammable.

(ii) Animal faeces

(iii) (1) From the graph, when temperature increase, the conversion ~~of~~ percentage increase. As high temperature favour endothermic reaction, forward reaction is endothermic.

(2). $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$.

From the graph, when pressure increase, the conversion percentage decrease. As no. of mole of gases at product side is higher than that of reactant side, equilibrium position shift to left. So pressure increase will result in conversion rate decrease.

(iv) $CO(g) + 2H_2(g) \rightarrow CH_3OH$.

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Start each question on a new page.

3 (a) Add excess NH_3 (aq) into both solution. The one will form white precipitate then redissolve is $ZnSO_4$ (aq) while form precipitate only is $Al_2(SO_4)_3$ (aq).

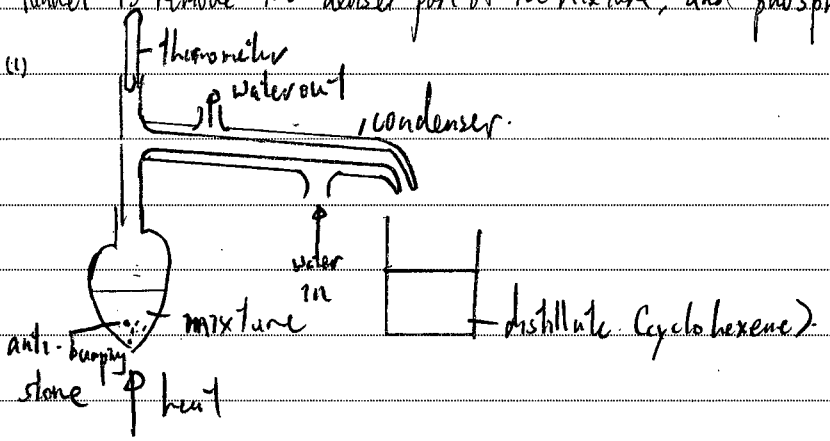
~~Add acidified potassium dichromate solution into both liquid and heat under reflux. The one will turn orange solution green is $(CH_3)_3COH$~~

(ii) Add sodium hydrogen carbonate solution into both liquid., the one will gave effervescence is CH_3COOH while no observable change is $(CH_3)_3COH$.

(iii) orange precipitate form.

(b) (i) First, add excess sodium hydrogen carbonate solution into the mixture, and shake. Use a separating funnel to remove the denser part of the mixture, and phosphoric acid is removed.

(ii) (1)



(2) The boiling point of distillate is exact 83°C, which match to the boiling point of cyclohexane and no other impurities.

The infrared spectrum should have a absorption peak at wave number 1610 cm^{-1} to 1680 cm^{-1} but not a board band at wave number of 3230 cm^{-1} to 3670 cm^{-1}.

absorption

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Start each question on a new page.

(c)(i) The molecular ion peak at 136, meaning the molecular mass of T is 136. A peak at m/z = 77 shows that T has a C_6H_5 structure. The peak at m/z = 105 shows a structure of C_7H_5O in its structure.

(c)(ii) Let there there are 100 g. of ester A.

mole ratio of C : H : O = 5.88 : 5.9 : 1.4875

= Abt 4 : 4 : 1.

∴ molecular formular = $(C_4H_4O)_n$.

∵ molecular ion at peak a m/z = 136

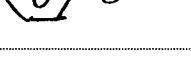
∴ molecular mass = 136

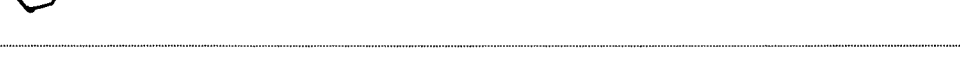
∴ $(12\times4+4+16)n = 136$

$n = 2$.

∴ molecular formula = $C_8H_8O_2$.

(c)(iii) At m/z = 105, a peak occur, it mean a 'ion' of $C_7H_5O^+$ occur. As it is a ester, it has a $\overset{O}{\overset{\|}{C}}-O$ structure.

∴ structure of ester A: 

(c)(iii) 

(c)(iv) No. of mole of $NaOH$ reacted with A = $0.05\times0.06 - 0.0204\times0.05$

$= 1.98\times10^{-3}$ mol.

∴ no. of mole of A = 1.98×10^{-3} mol.

Precentage by mass = $\frac{1.98\times10^{-3}\times136}{2.5}\times100\%$

= 9.79%.

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Comments

The candidate's answers show good understanding of the chemical concepts and principles in the curriculum (e.g. Paper 1 Qs. 1(c), 2(f) & (g), 3(a) & (c)(i), 4(b), 5(a), 7(b), 9(a) & (b)(iii), 10(a)(i), 12(b), 13; Paper 2 Qs. 1(a)(i) & (iii)(1) & (b)(iii) & (iv)(1) & (c)(ii), 3(a)).

The candidate demonstrates a very good ability to apply chemical concepts to solve problems on unfamiliar situations (e.g. Paper 1 Qs. 8, 11(b) & (e); Paper 2 Qs. 1(a)(iii)(2) & (c)(iii)(1) & (2), 3(b)(i) & (b)(ii)(2) & (c) (ii)).

He/she performs well on chemical calculations (e.g. Paper 1 Qs. 3(b), 5(b)(ii), 7(c) & (d), 9(b)(i) & (ii), 10(b)(i); Paper 2 Qs. 3(c)(i) & (c)(iii)(2)).

He/she effectively communicates ideas using appropriate scientific terminology, diagrams and chemical equations (e.g. Paper 1 Qs. 1(a), 2(b), 4(a) & (c)(ii), 6(d)(i), 8, 10(b)(ii), 11(b); Paper 2 Qs. 1(c)(iv), 3(b)(ii)(1) & (c)(iii)(1)).

He/she designs appropriate methods for carrying out scientific investigations (e.g. Paper 1 Q. 8).