

TABLE OF CONTENTS

Level 5

Exemplar 1 Paper 1B

Exemplar 1 Paper 2

Exemplar 2 Paper 1B

Exemplar 2 Paper 2

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2023

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.



PART I

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

1. Both calcium (Ca) and strontium (Sr) are elements in Group II of the Periodic Table.

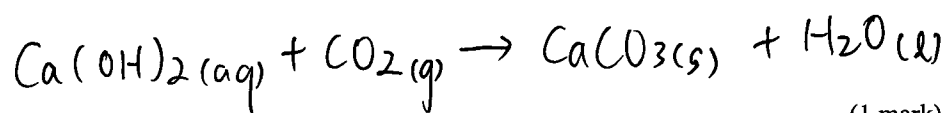
- (a) What is the name of Group II?

Alkaline earth metals

(1 mark)

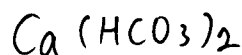
- (b) Limewater is a saturated solution of calcium hydroxide.

- (i) Carbon dioxide gas is passed into limewater until the solution turns milky. Write the chemical equation for the reaction involved.



(1 mark)

- (ii) When excess carbon dioxide gas is passed into the milky solution in (b)(i), a colourless solution is formed. What is the product of this reaction?



(1 mark)

- (c) The table below shows the abundance of each isotope in a sample of strontium:

Isotope	^{84}Sr	^{86}Sr	^{87}Sr	^{88}Sr
Abundance (%)	0.56	9.86	7.02	82.56

Calculate the relative atomic mass of strontium in the sample.

$$\begin{aligned} &\text{Relative atomic mass of Sr} \\ &= 84 \times 0.56\% + 86 \times 9.86\% + 87 \times 7.02\% + 88 \times 82.56\% \\ &= 87.7 \end{aligned}$$

(2 marks)

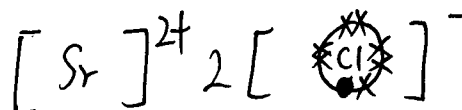
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

1. (d) Strontium reacts with chlorine to form strontium chloride.

- (i) Draw the electron diagram for strontium chloride, showing ELECTRONS IN THE OUTERMOST SHELLS only.



(1 mark)

- (ii) Complete the following sentences :

(1) The bonding in solid strontium is the electrostatic attraction between positive Sr^{2+} ions and 'sea' of delocalised electrons.

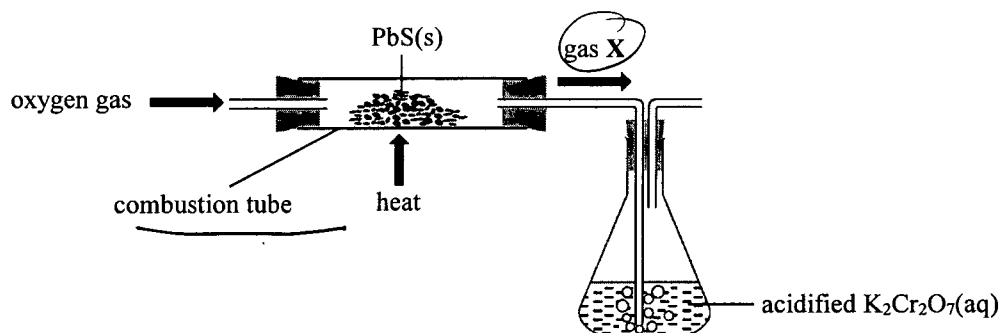
(2) The type of structure in solid strontium chloride is giant ionic structure. (2 marks)

- (iii) State and explain the difference between the electrical conductivity of solid strontium and that of solid strontium chloride.

Sr(s) is in giant metallic structure.
Strong metallic bond exist between Sr^{2+} ions and the 'sea' of delocalised electrons.
 $\text{SrCl}_2\text{(s)}$ is in giant ionic structure.
Strong ionic bond exist between Sr^{2+} and Cl^{-} ions.
However, Sr^{2+} and Cl^{-} ion in $\text{SrCl}_2\text{(s)}$ isn't mobile.
 Sr(s) has delocalised electrons.
Thus Sr(s) can conduct electricity but $\text{SrCl}_2\text{(s)}$ can't conduct electricity. (2 marks)

2. The extraction of lead metal from lead(II) sulphide (PbS) involves two stages.

Stage I: PbS(s) and oxygen gas are strongly heated using the experimental set-up shown below. Lead(II) oxide and a gas X are formed in the combustion tube. Gas X is passed into acidified K₂Cr₂O₇(aq).



- (a) Suggest a method to obtain oxygen from air.

Fractional distillation

(1 mark)

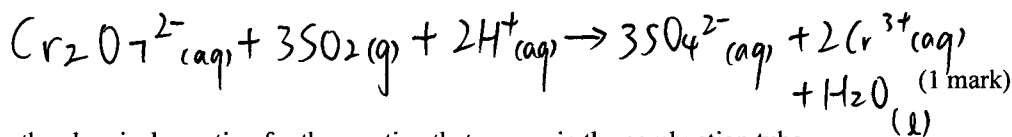
- (b) Gas X turns acidified K₂Cr₂O₇(aq) from orange to green.

- (i) What is gas X?

SO₂

(1 mark)

- (ii) Write an ionic equation for the reaction between gas X and acidified K₂Cr₂O₇(aq).



- (c) Write the chemical equation for the reaction that occurs in the combustion tube.



(1 mark)

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

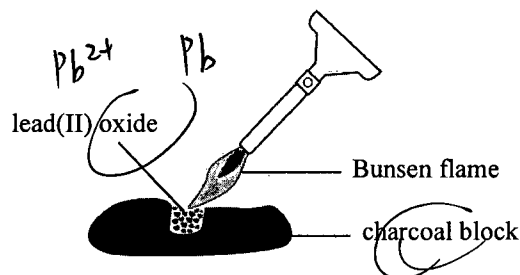
Fume cupboard.
SO₂(g) is an acidic gas.
It may cause breathing problems if he breathed in lungs. (1 mark)

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.

2. **Stage II :** The lead(II) oxide formed in the combustion tube is separated and placed on a charcoal block. The oxide is then strongly heated as shown below.



- (e) (i) A ~~solid product~~ is formed from the reaction in Stage II. Describe the appearance of the solid product.

The solid is shiny and grey.

(1 mark)

- (ii) In terms of oxidation number, explain whether the reaction in Stage II is a redox reaction.

Pb is reduced in the reaction.

(1 mark)

Thus, it is a redox reaction.

Because Pb decreases its oxidation number ^{of +2} in PbO to the oxidation number of 0 in Pb

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

3. The following table shows the results of some experiments carried out on three metals A, B and C.

Experiment \ Metal	A	B	C
Reaction with water	no observable change	no observable change	reacts <u>vigorously</u>
Reaction with dilute hydrochloric acid	a colourless gas Y evolves moderately	no observable change	(This experiment is dangerous and should NOT be carried out.)
Strong heating in air	a white solid is obtained after cooling	no observable change	burns with a lilac flame

- (a) According to the above experimental results, arrange these three metals in descending order of reactivity.

C, A, B

(1 mark)

- (b) Suggest a test for gas Y.

Use a burning splint.
A 'pop' sound will be heard.

(1 mark)

- (c) (i) State an expected observation when metal C reacts vigorously with water.

Metal C dissolves in water.
to give colorless gas bubbles

(1 mark)

- (ii) Explain why it is dangerous to carry out the reaction of metal C with dilute hydrochloric acid.

The reaction is highly exothermic,
causing HCl(aq) to boil and even
splash out from the container
and may hurt people and corrode clothing.

(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.

3. (d) Using the following items ONLY, outline the experimental procedure and state an expected observation to confirm the relative reactivities of metal A and metal B.

a strip of metal A, a strip of metal B, $A(NO_3)_2(aq)$, $BNO_3(aq)$, test tubes

Add the strip of metal A to a test tube of $BNO_3(aq)$.
Add the strip of metal B to a test tube of $A(NO_3)_2(aq)$.

Metal A will displace B in $BNO_3(aq)$,
forming B(s) and $A(NO_3)_2(aq)$.

Putting metal B into $A(NO_3)_2(aq)$
has no observable change.

(2 marks)

4. Tartronic acid ($C_3H_4O_5$) is an organic acid found in cucumbers.

(a) 24.62 cm³ of 0.207 M NaOH(aq) can completely neutralise 25.00 cm³ of 0.102 M tartronic acid.

(i) Calculate the basicity of tartronic acid.

$$\begin{aligned} &\text{no. of moles of NaOH(aq)} \\ &= \frac{24.62}{1000} \times 0.207 \end{aligned}$$

$$= 5.1 \times 10^{-3}$$

no. of moles of tartronic acid

$$= \frac{25}{1000} \times 0.102$$

$$= 2.55 \times 10^{-3}$$

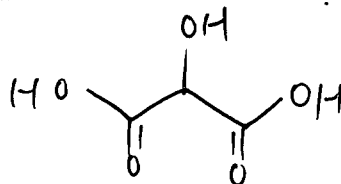
$$2.55 \times 10^{-3} : 5.1 \times 10^{-3} = 1 : 2$$

Thus tartronic acid has basicity of 2.

Since 1 mole of that acid can neutralize
2 mole of NaOH(aq).

(2 marks)

(ii) A molecule of tartronic acid contains a hydroxyl group. Write the structural formula of tartronic acid.



(1 mark)

(b) Under certain conditions, the pH of 0.102 M tartronic acid is 1.87. By calculation, show that tartronic acid is NOT completely ionised in water.

theoretical pH of 0.102 M tartronic acid

$$= -\log [0.102 \times 2]$$

$$= 0.69 < 1.87.$$

Actual pH is lower than theoretical pH.

Thus tartronic acid is not completely ionised in water.

(2 marks)

Answers written in the margins will not be marked.

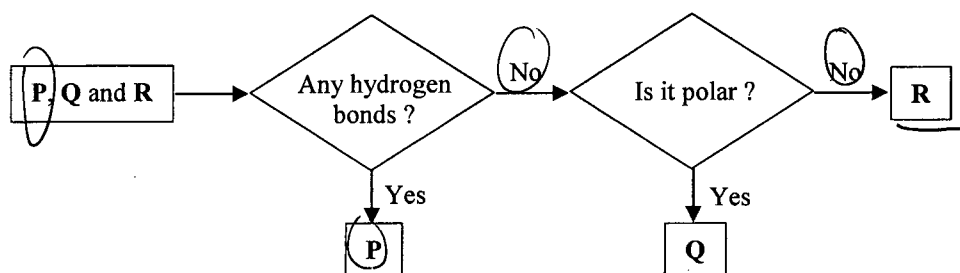
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

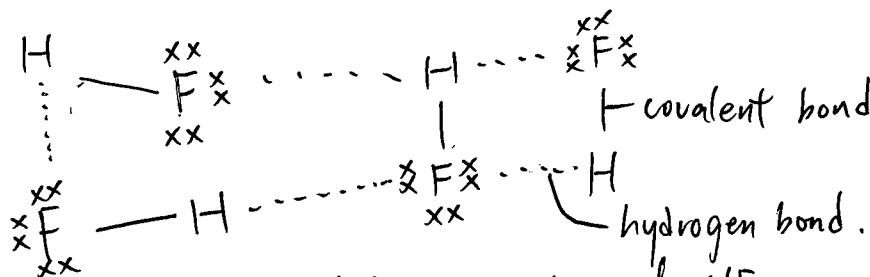
5. P, Q and R, each represents one of the following compounds :



The following flowchart can be used to identify P, Q and R.



- (a) With the aid of a diagram, describe and explain the formation of hydrogen bonding between P molecules.

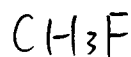


Hydrogen bond exist between H atom of HF and the highly electronegative atom F. F is highly electronegative.

- Thus, strong intermolecular attraction force exist between delta positive H atoms and electronegative F atoms.

(3 marks)

- (b) (i) What is Q?



(1 mark)

- (ii) Explain, from molecular level, why Q is polar.

C-H bond polarities of CH_3F can't cancel out the C-F bond polarities in CH_3F . Thus Q is polar.

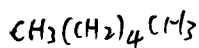
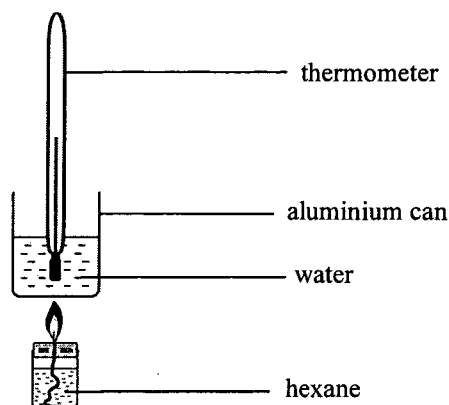
(1 mark)

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.

6. Hexane (C_6H_{14}) is a liquid fuel. Under certain experimental conditions, the enthalpy change of combustion of hexane was determined using the following set-up. The combustion of 0.120 g of hexane increased the temperature of 100.0 g of water by 13.4 °C.



- (a) Calculate the enthalpy change of combustion of hexane, in $kJ\ mol^{-1}$, under these experimental conditions.

(Assume that the heat capacity of the aluminium can is negligible and the specific heat capacity of water is $4.20\ J\ g^{-1}\ K^{-1}$.)

(Relative atomic masses : $H = 1.0$, $C = 12.0$)

$$\begin{aligned} \Delta H_c [\text{hexane (l)}] &= \frac{-13.4 \times 4.2 \times 100}{\frac{0.12}{12 \times 6 + 1 \times 14}} \times \frac{1}{1000} \\ &= -4033.4\ kJ\ mol^{-1} \end{aligned}$$

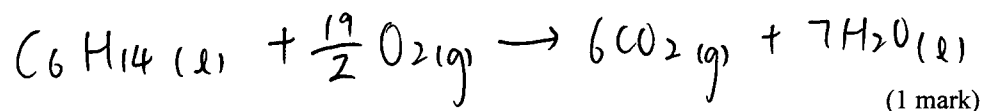
(2 marks)

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.

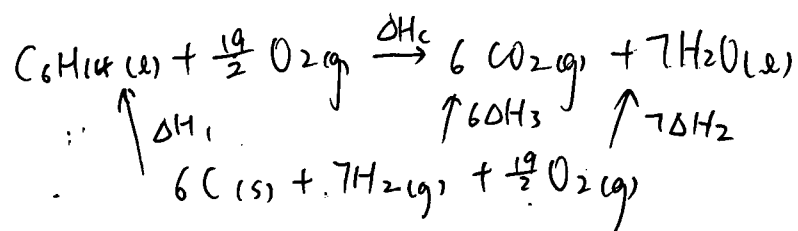
6. (b) (i) Write the chemical equation for the complete combustion of hexane, showing all state symbols.



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

$$\text{C}_6\text{H}_{14}(\text{l}) = -167.2 \text{ kJ mol}^{-1}, \text{H}_2\text{O}(\text{l}) = -285.9 \text{ kJ mol}^{-1}, \text{CO}_2(\text{g}) = -393.5 \text{ kJ mol}^{-1}$$

Calculate the standard enthalpy change of combustion of hexane.



$$\Delta H_c^\ominus [\text{hexane}(\text{l})]$$

$$= 6(-393.5) + 7(-285.9) - (-167.2)$$

$$= -4195.1 \text{ kJ mol}^{-1}$$

(2 marks)

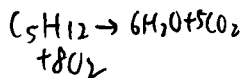
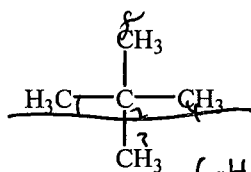
- (c) Besides heat loss, suggest one reason why the answers obtained from (a) and (b)(ii) are different.

Incomplete combustion of hexane.

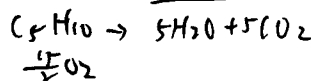
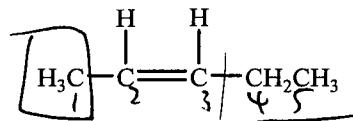
(1 mark)

7. X and Y are hydrocarbons. Their structural formulae are shown below :

X:



Y:



- (a) Write the systematic name of X.

dimethylpropane

(1 mark)

- (b) Suggest one difference between the burning characteristics of X and Y.

Complete combustion of Y need less oxygen than that of X

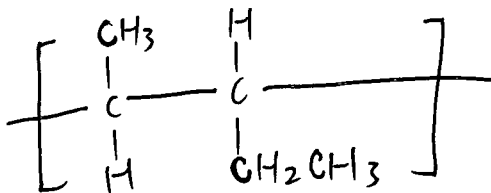
(1 mark)

- (c) Besides burning, suggest a chemical test to distinguish between X and Y.

Add KMnO_4 aq. in acidified medium.
Y turns solution from purple to colourless.
X has no observable change.

(2 marks)

- (d) Y can form a polymer. Draw the repeating unit of this polymer.



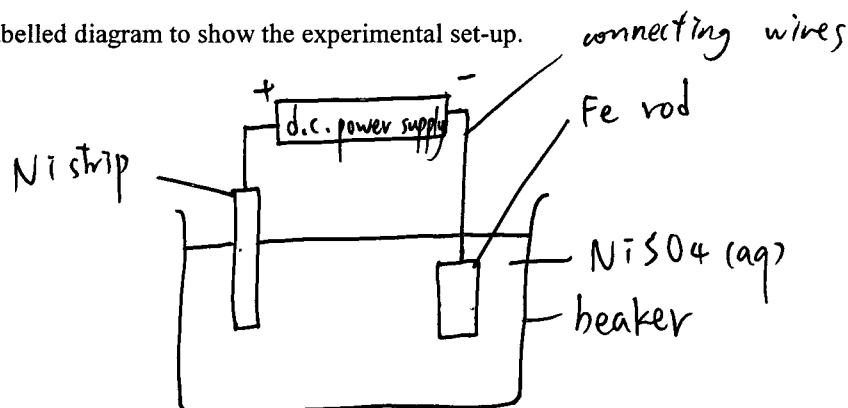
(1 mark)

Answers written in the margins will not be marked.

8. Using the following items ONLY, design an experiment to electroplate nickel (Ni) on an iron rod.

d.c. power supply, a nickel strip, an iron rod, nickel(II) sulphate solution, connecting wires, a beaker

(a) Draw a labelled diagram to show the experimental set-up.

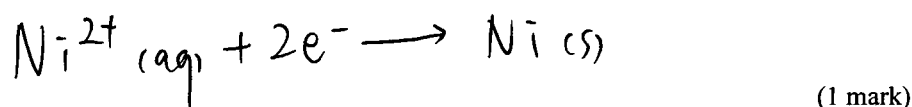


(2 marks)

(b) State one function of nickel(II) sulphate solution in this experiment.

Being electrolyte.
Conduct electricity and be decomposed to form Ni(s), (1 mark)

(c) Write the half equation for the formation of nickel on the iron rod.



(d) Ni(s) is a stronger reducing agent than $\text{OH}^{-}(\text{aq})$ ions and $\text{SO}_4^{2-}(\text{aq})$ ions. Nickel(II) sulphate solution is green in colour. Would there be any expected observable change in the solution in this experiment? Explain your answer.

No.
In the experiment, Ni^{2+} is continuously preferentially discharged to form Ni(s) on Fe rod.
Ni strip is also continuously preferentially discharged to form Ni^{2+} ions.
Thus concentration of Ni^{2+} keeps unchanged and have (2 marks)

(e) State one purpose of electroplating nickel on iron objects. No observable change.

Prevent rusting.

(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.

*9.

Outline the steps in preparing magnesium sulphate crystals from solid magnesium carbonate and dilute sulphuric acid. You do NOT need to mention the apparatus involved.

(5 marks)

Add excess $\text{MgCO}_3(\text{s})$ into dilute $\text{H}_2\text{SO}_4(\text{aq})$.

Filter to collect the resulting $\text{MgSO}_4(\text{aq})$.

Heat $\text{MgSO}_4(\text{aq})$ to be saturated.

Wait for cooling down and crystallization.

Wash the MgSO_4 crystals with small amount of cold distilled water.

Dry MgSO_4 crystals with filter paper.

MgSO_4 crystals is prepared.

Answers written in the margins will not be marked.

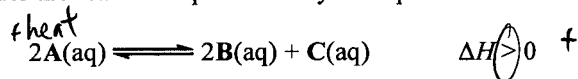
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

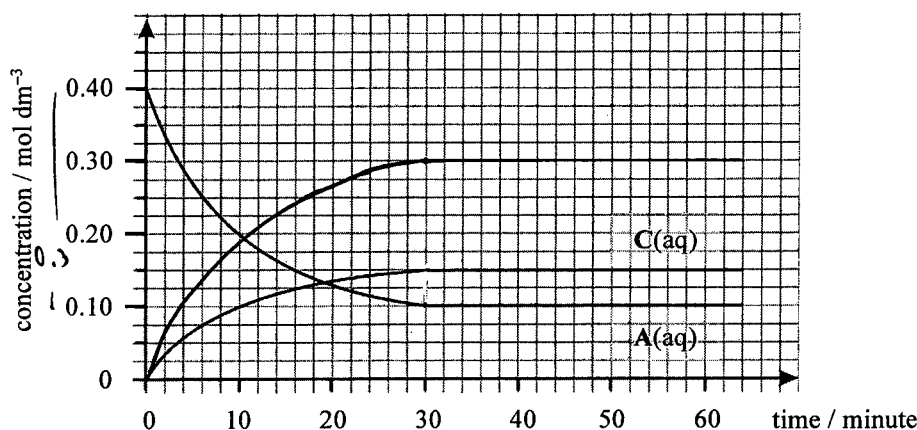
PART II

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

10. Consider the reaction represented by the equation below :



In an experiment, a certain volume of 0.40 mol dm^{-3} A(aq) was initially placed in a container, and this system was allowed to attain chemical equilibrium at constant temperature T_1 . The following graph shows the variation of the concentrations of A(aq) and C(aq) with time.



- (a) According to the above graph, give one reason to support the following statement :

‘The system just attained chemical equilibrium at the 30th minute.’

concentration of C(aq) and A(aq) on graph
remains unchanged after 30th minute.
net the

(1 mark)

- (b) Draw a curve on the graph to show the variation of the concentration of B(aq) with time. (1 mark)

- (c) Calculate the equilibrium constant K_c for the reaction at temperature T_1 .

$$K_c = \frac{[\text{B(aq)}]^2 [\text{C(aq)}]}{[\text{A(aq)}]^2}$$

$$= \frac{(0.3)^2 (0.15)}{(0.1)^2}$$

$$= 1.35 \text{ mol dm}^3$$

(2 marks)

- (d) When the temperature of the equilibrium mixture changed from T_1 to T_2 , a new chemical equilibrium was attained. The concentration of A(aq) was found to be 0.14 mol dm^{-3} in the new chemical equilibrium. Deduce whether T_1 or T_2 is the higher temperature.

Concentration of A increased from 0.1 M to 0.14 M in T_2 .
Thus, equilibrium position shift to left to reduce change.
Since the reaction is endothermic ΔT_2 is lower temperature than T_1 .
Thus, T_1 is the higher temperature.

(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.

11. Compounds X and Y are *cis-trans* isomers with the same molecular formula C₄H₈.

(a) X is polar but Y is non-polar.

(i) Give the systematic name of X.

cis-but-2-ene

(1 mark)

(ii) Write the structural formula of Y.



(1 mark)

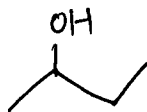
(b) A mixture of X and Y can be formed from the dehydration of an optically active alcohol Z.

(i) Suggest a reagent and a reaction condition needed for this reaction.

*Al₂O₃ (s);
Heating.*

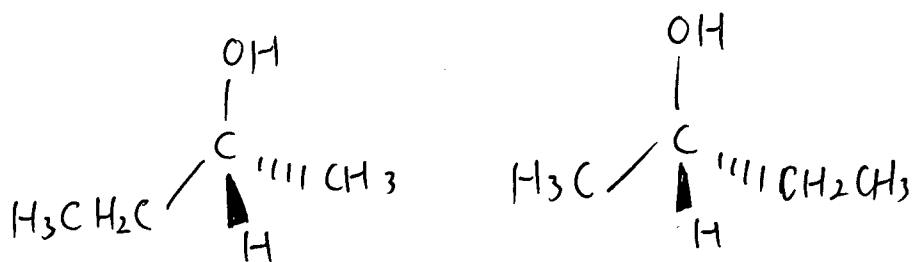
(1 mark)

(ii) Write the structural formula of Z.



(1 mark)

(iii) Draw the three-dimensional diagrams for the structures of the pair of enantiomers of Z.



(2 marks)

(iv) Describe the difference in the optical activity between the pair of enantiomers of Z.

*The pair of enantiomers of Z rotates
the plane polarization of plane-polarized light
in opposite directions.*

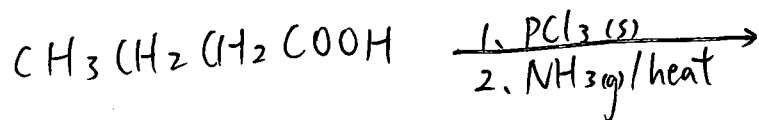
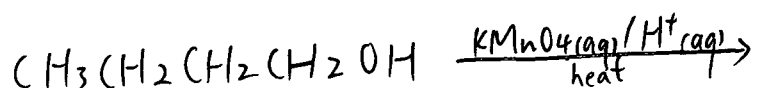
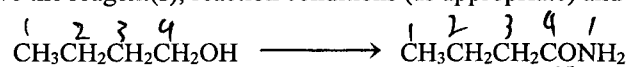
(1 mark)

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.

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)

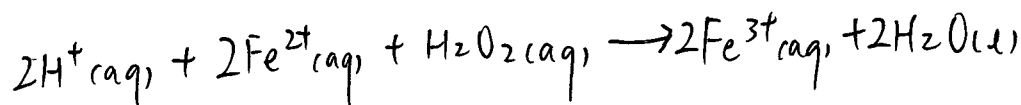
13. (a) In terms of bonding and structure, account for the difference in the melting points of the following oxides.

	SiO ₂	P ₄ O ₁₀	SO ₂
Melting point (°C)	1710	340	-72

SiO₂ is in giant covalent structure.
 P₄O₁₀ and SO₂ is in simple molecular structure.
 Strong covalent bond exist between Si and O atoms.
 Only weak van der Waals' forces exist between P₄O₁₀ molecules and SO₂ molecules.
 Thus SiO₂ has higher melting point than P₄O₁₀ and SO₂.
 P₄O₁₀ has much larger molecular size than SO₂.
 Thus P₄O₁₀ has strong van der Waals' force between P₄O₁₀ molecules.
 Thus P₄O₁₀ has higher melting point than SO₂ (3 marks)

- (b) Fe²⁺(aq) reacts with H₂O₂(aq) in an acidic medium to form Fe³⁺(aq) and H₂O(l).

- (i) Write the chemical equation for the reaction.



(1 mark)

- (ii) State how this reaction can demonstrate that iron exhibits TWO characteristics of transition metals.

Transition metal has variable oxidation states
 such as +2 in Fe²⁺ and +3 in Fe³⁺

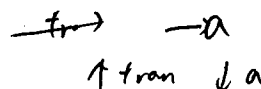
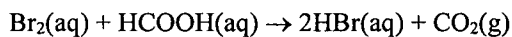
Transition metal has coloured ions
 such as pale green Fe²⁺ and yellowish brown Fe³⁺.

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

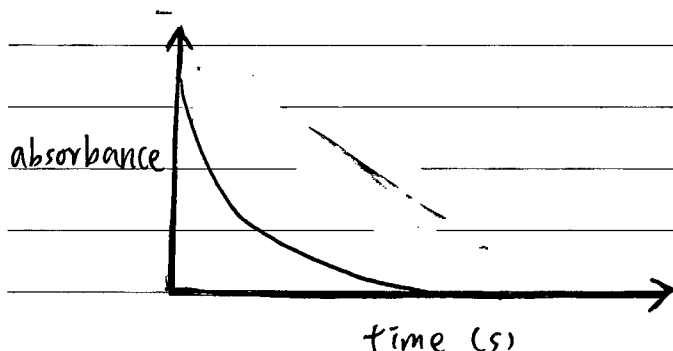
*14. Consider the following reaction :



Describe and explain how to follow the progress of the above reaction by measuring the colour intensity of the reaction mixture. Experimental details are NOT required. Sketch a labelled graph to show the expected results and explain the shape of the graph.

(6 marks)

Use a colorimeter to
measure the color intensity of reaction mixture.



On the reactant side, $\text{Br}_2(\text{aq})$ is brown in color.
The remaining HCOOH , HBr and CO_2 are all colorless.
The reaction is irreversible.

Thus, after time, concentration of $\text{Br}_2(\text{aq})$ decreases.
The reaction mixture has lower color intensity and
light absorbance.

After complete reaction after time, the light
absorbance drops to 0 since no more Br_2 is present.
The reaction mixture remains colourless product.

Moreover, since reactant $\text{Br}_2(\text{aq})$ and $\text{HCOOH}(\text{aq})$'s
concentration decreases by time.

Chance of effective collision lowers.

The rate of reaction lowers from time to time

Thus, the graph shows a curve

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.

Answers written in the margins will not be marked.

PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序

																0
																2
																He
																4.0

2023 DSE (D)

香港考試及評核局
HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

香港中學文憑考試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

答題簿 ANSWER BOOK

考生須知

- (一) 宣布開考後，考生須首先在第 1 頁之適當位置填寫考生編號，並在第 1 及 3 頁之適當位置貼上電腦條碼。
- (二) 每題(非指分題)必須另起新頁作答，並須在每一頁的相應試題編號方格填畫「X」號，以表示選答的題號(見下例)，並在第一頁之適當位置填寫作答的試題編號。
- (三) 紙張兩面均應使用，並應每行書寫。不可在各頁邊界以外位置書寫。寫於邊界以外的答案，將不予評閱。
- (四) 如有需要，可要求派發方格紙及補充答題紙。每一紙張均須填寫考生編號、填畫試題編號方格、貼上電腦條碼，並用繩縛於簿內。
- (五) 試場主任宣布停筆後，考生不會獲得額外時間貼上電腦條碼及填畫試題編號方格。

INSTRUCTIONS

- (1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1 and 3.
- (2) Start each question (not part of a question) on a new page. Put 'X' in the corresponding question number box on each page to indicate the appropriate question number (see the example below), and write the question number(s) of the question(s) attempted in the space provided on Page 1.
- (3) Write on both sides using each line. Do not write in the margins. Answers written in the margins will not be marked.
- (4) Graph paper and supplementary answer sheets will be supplied on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this book.
- (5) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

例 Example:

試題編號 Question No. = 3

試題編號 Question No.																								
1	2	3	4	5	6	7	8	9	10	11	12													
☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
13	14	15	16	17	18	19	20	21	22	23	24	≥25												

Level 5 Exemplar 1
Paper 2

由考生填寫 To be filled in by the candidate	
試題編號 Question No.	A1
	C3

試題編號 Question No.

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

☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

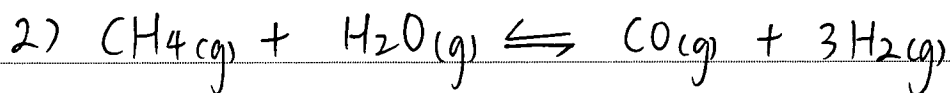
13 14 15 16 17 18 19 20 21 22 23 24 ≥25

每題另起新頁作答。

Start each question on a new page.

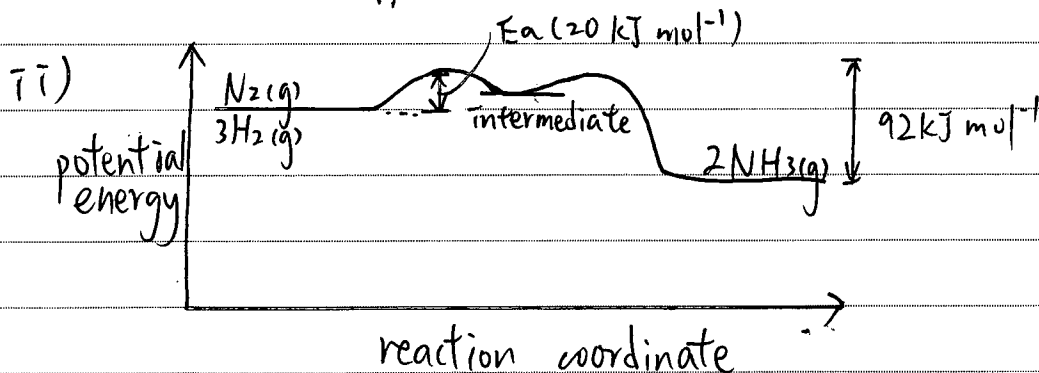
- (a) i) 1) To reach the market demand of people being healthy by synthesising enough vitamic C in industry
People eat not enough fruits and vegetables nowadays.
2) Reactant Cl_2 is toxic, in the process.
None of the

ii) 1) Natural gas



iii) Cl_2 gas.
 H_2 gas.

- (b) i) minimum amount of energy needed to happen a reaction.



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.

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

☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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) Activation energy

$$= + (92 + 20)$$

$$= 112 \text{ kJ mol}^{-1}$$

iv) 450°C ;

High temperature increases rate of reaction.

However, the reaction is exothermic.

Thus, low temperature favours forward reaction, equilibrium position shifts to right and increase yield.

Thus, 450°C is used.

250 atm ;

4 gaseous molecules exist on reactant side while

2 gaseous molecules exist on product side.

In high pressure, equilibrium position shift to right.

The yield is increased.

However, construction cost is high.

Thus, 250 atm is used.

v) No, More Fe catalyst can't increase NH_3 yield.

Fe catalyst only provide an alternative reaction pathway of lower activation energy, increasing rate, but not yield of the reaction.

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.

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

☒ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

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.

(c) i) 1) Crush the palladium into smaller pieces.

2) Y is a catalyst.

It remains chemically unchanged in the end of reaction.

3) Many by-products ^{such as H₂O} are produced in ^{in a single step} the synthesis of forming H₂O₂ from H₂(g) and O₂(g).

ii) 1) rate = $k [H_2O_2(aq)] [I^-(aq)]^x [H^+(aq)]^y$ _____ (1)

Substitute trial 1 into (1)

$$2.8 \times 10^{-6} = k (0.001) (0.1)^x (0.1)^y$$
 _____ (2)

Substitute trial 3 into (1)

$$2.8 \times 10^{-5} = k (0.002) (0.5)^x (0.1)^y$$
 _____ (3)

$$\frac{(2)}{(3)} : 0.1 = 0.5 \left(\frac{0.1}{0.5}\right)^x$$

$$x = 1$$

Thus, order of reaction with respect to $I^-(aq)$ is 1.

Substitute trial 2 into (1)

$$5.6 \times 10^{-6} = k (0.002) (0.1) (0.001)^y$$
 _____ (4)

$$\frac{(4)}{(2)} : 2 = 2 (0.01)^y$$

$$y = 0$$

Thus, order of reaction with respect to $H^+(aq)$ is 0.

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.

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

☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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.

(c) (i) 2) $\text{rate} = k [\text{H}_2\text{O}_2(\text{aq})] [\text{I}^-(\text{aq})]$
 $2.8 \times 10^{-6} = k (0.001) (0.1)$
 $k = 0.028 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$ //

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。

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.

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

☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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) Put $\text{Ca}(\text{NO}_3)_2(\text{s})$ and $\text{Mg}(\text{NO}_3)_2(\text{s})$ into the flame.
 $\text{Ca}(\text{NO}_3)_2(\text{s})$ turns flame to brick red.
 $\text{Mg}(\text{NO}_3)_2(\text{s})$ gives bright white light.

ii) $\text{NaOH}(\text{s})$ absorbs water in air.
 Its concentration may be affected by the present water in $\text{NaOH}(\text{s})$.

iii) Pour the mixture of hexanoic acid and hexan-1-ol and $\text{NaHCO}_3(\text{aq})$ into a separating funnel.
 Shake the separating funnel gently.
 Release pressure in funnel from time to time.
 Repeat the above 2 step till no more gases evolve.
 Allow the layers to settle.
 Collect the organic oily layer.
 Use anhydrous $\text{CaCl}_2(\text{s})$ to dry the liquid.
 Filter to collect the hexan-1-ol.
 Hexan-1-ol is obtained.

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.

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

☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

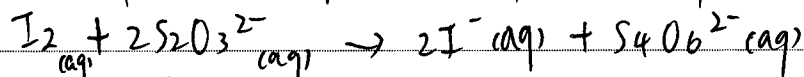
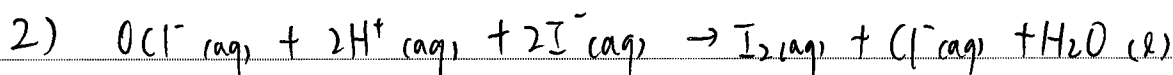
13 14 15 16 17 18 19 20 21 22 23 24 ≥25

每題另起新頁作答。

Start each question on a new page.

(b)i) 250 cm³ volumetric flask

ii) 1) From dark blue to pale yellow



mole ratio of $\text{OCl}^- : \text{I}^- : \text{I}_2 : \text{S}_2\text{O}_3^{2-}$

$$= 1 : 2 : 1 : 2$$

Thus mole ratio of $\text{OCl}^- : \text{S}_2\text{O}_3^{2-} = 1 : 2$

number of moles of OCl^- in diluted bleach

$$= \text{number of moles of } \text{S}_2\text{O}_3^{2-} \times \frac{1}{2}$$

$$= \frac{21.02}{1000} \times 0.0512 \times \frac{1}{2}$$

$$= 5.38112 \times 10^{-4}$$

number of moles of OCl^- in bleach

$$= 5.38112 \times 10^{-4} \times \frac{250}{25}$$

$$= 5.38112 \times 10^{-3}$$

Actual concentration

$$= 5.38112 \times 10^{-3} \times (23 + 16 + 35.5) \div \frac{25}{1000}$$

$$= 16.0 \text{ g dm}^{-3}$$

Minimum concentration to be lied

$$3) = 16 - 16 \times 5\% = 15.2 \text{ g dm}^{-3} < 15.5 \text{ g dm}^{-3}$$

Thus, the bleach fulfills quality control standards.

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.

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

☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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) Collect ^a more accurate titrate value.

(c) 7) 1) Peak at $m/z = 86$ deduce the relative molecular mass of A.

$$n(12 + 1 \times 2) + 16 = 86$$

$$n = 5$$

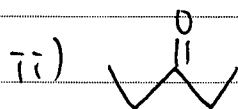
Thus A is $C_5H_{10}O$.

2) Peak at $m/z = 71$ corresponds to the $CH_3COCH_2CH_2^+$ ion. Thus A has $CH_3COCH_2CH_2-$ group.

Difference between peak at $m/z = 71$ and $m/z = 86$ is 15, corresponding to CH_3^+ ion.

Thus A has CH_3- group.

Thus A is



iii) Add Tollen's reagent.

C forms silver mirror while

B has no observable change.

iv) C is an alkanal and D is a primary alcohol.

Thus only C shows an absorption peak within $1680-1800\text{ cm}^{-1}$.

Only B shows an absorption peak

within $3230-3670\text{ cm}^{-1}$, corresponding to O-H bond

corresponding to C=O bond

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.

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2023

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.



PART I

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

1. Both calcium (Ca) and strontium (Sr) are elements in Group II of the Periodic Table.

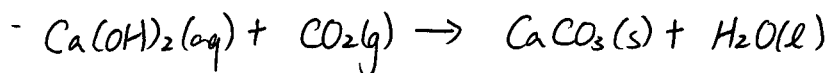
(a) What is the name of Group II?

Alkaline metal

(1 mark)

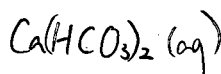
(b) Limewater is a saturated solution of calcium hydroxide.

(i) Carbon dioxide gas is passed into limewater until the solution turns milky. Write the chemical equation for the reaction involved.



(1 mark)

(ii) When excess carbon dioxide gas is passed into the milky solution in (b)(i), a colourless solution is formed. What is the product of this reaction?



(1 mark)

(c) The table below shows the abundance of each isotope in a sample of strontium:

Isotope	⁸⁴ Sr	⁸⁶ Sr	⁸⁷ Sr	⁸⁸ Sr
Abundance (%)	0.56	9.86	7.02	82.56

Calculate the relative atomic mass of strontium in the sample.

$$\begin{aligned} &\text{The relative atomic mass:} \\ &= 84 \times 0.56\% + 86 \times 9.86\% + 87 \times 7.02\% + 88 \times 82.56\% \\ &= 87.7 \end{aligned}$$

(2 marks)

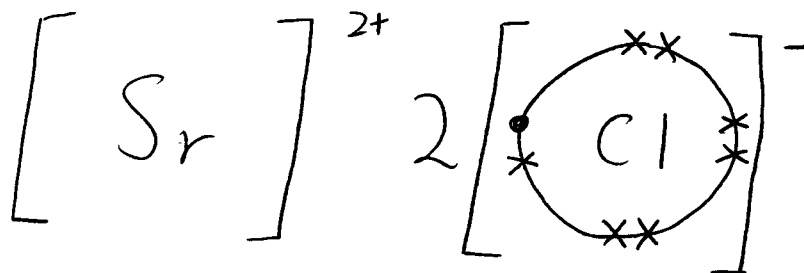
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

1. (d) Strontium reacts with chlorine to form strontium chloride.

(i) Draw the electron diagram for strontium chloride, showing ELECTRONS IN THE OUTERMOST SHELLS only.



(1 mark)

(ii) Complete the following sentences :

(1) The bonding in solid strontium is the electrostatic attraction between

the lattice of cation and delocalized electrons
metal the surrounding

(2) The type of structure in solid strontium chloride is giant metallic
structure.

(2 marks)

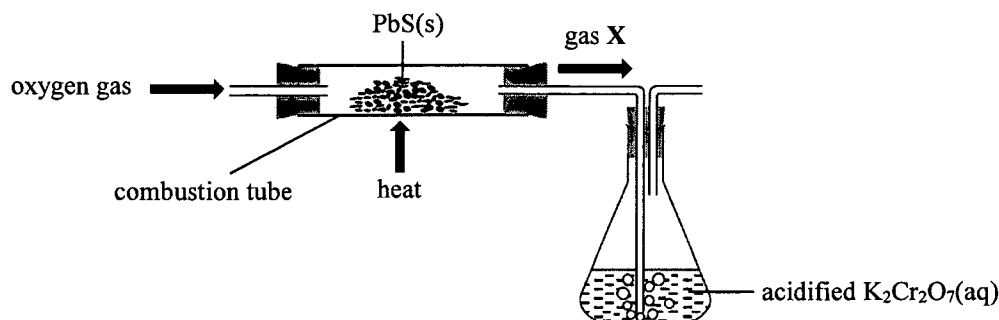
(iii) State and explain the difference between the electrical conductivity of solid strontium and that of solid strontium chloride.

Solid strontium conducts electricity while solid strontium chloride doesn't. Because solid strontium has delocalized electrons while solid strontium chloride doesn't have delocalized electrons or mobile ions.

(2 marks)

2. The extraction of lead metal from lead(II) sulphide (PbS) involves two stages.

Stage I: PbS(s) and oxygen gas are strongly heated using the experimental set-up shown below. Lead(II) oxide and a gas X are formed in the combustion tube. Gas X is passed into acidified K₂Cr₂O₇(aq).



- (a) Suggest a method to obtain oxygen from air.

Fractional distillation of liquid air

(1 mark)

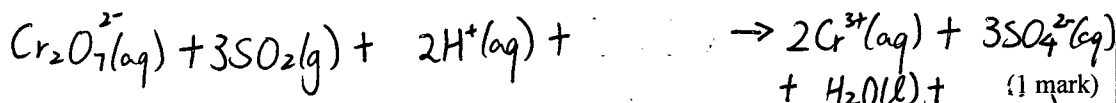
- (b) Gas X turns acidified K₂Cr₂O₇(aq) from orange to green.

- (i) What is gas X?

SO₂(g)

(1 mark)

- (ii) Write an ionic equation for the reaction between gas X and acidified K₂Cr₂O₇(aq).



(1 mark)

✓(c)

- Write the chemical equation for the reaction that occurs in the combustion tube.



(1 mark)

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

Inside the fume cupboard as irritant SO₂(g) is produced

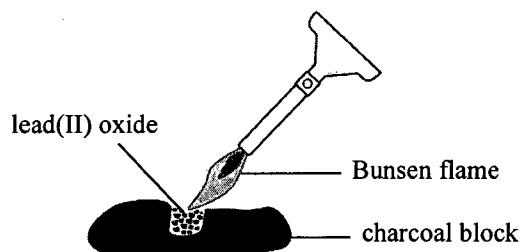
(1 mark)

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.

2. **Stage II :** The lead(II) oxide formed in the combustion tube is separated and placed on a charcoal block. The oxide is then strongly heated as shown below.



- (e) (i) A solid product is formed from the reaction in Stage II. Describe the appearance of the solid product.

It has a shiny surface

(1 mark)

- (ii) In terms of oxidation number, explain whether the reaction in Stage II is a redox reaction.

Yes, the oxidation number of Lead decreased from +2 to 0

(1 mark)

3. The following table shows the results of some experiments carried out on three metals A, B and C.

Experiment \ Metal	A	B	C
Reaction with water	no observable change	no observable change	reacts vigorously K
Reaction with dilute hydrochloric acid	a colourless gas Y evolves moderately	no observable change	(This experiment is dangerous and should NOT be carried out.)
Strong heating in air	a white solid is obtained after cooling	no observable change	burns with a lilac flame

- (a) According to the above experimental results, arrange these three metals in descending order of reactivity.

$C > A > B$

(1 mark)

- (b) Suggest a test for gas Y.

A pop sound test using a burning splint

(1 mark)

- (c) (i) State an expected observation when metal C reacts vigorously with water.

The metal slides on the surface of water and melts

(1 mark)

- (ii) Explain why it is dangerous to carry out the reaction of metal C with dilute hydrochloric acid.

is so exothermic that it'll cause an explosion
The reaction

(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.

$A > B$

3. (d) Using the following items ONLY, outline the experimental procedure and state an expected observation to confirm the relative reactivities of metal A and metal B.

a strip of metal A, a strip of metal B, $A(NO_3)_2(aq)$, $BNO_3(aq)$, test tubes

First, pour $BNO_3(aq)$ into the test tube and add a strip of metal A into the solution. The metal A will slowly dissolve and precipitates are formed.

(2 marks)

Answers written in the margins will not be marked.

4. Tartronic acid ($C_3H_4O_5$) is an organic acid found in cucumbers.

(a) 24.62 cm³ of 0.207 M NaOH(aq) can completely neutralise 25.00 cm³ of 0.102 M tartronic acid.

(i) Calculate the basicity of tartronic acid.

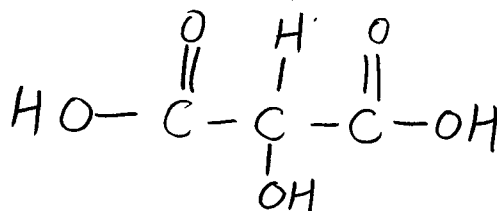
$$\text{The no. of moles of NaOH(aq)} = 0.207 \times \frac{24.62}{1000} = 5.096 \times 10^{-3} \text{ moles}$$

$$\text{The no. of moles of tartronic acid} = 0.102 \times \frac{25.00}{1000} = 2.55 \times 10^{-3} \text{ moles}$$

$$\therefore \text{The basicity} = \frac{5.096 \times 10^{-3}}{2.55 \times 10^{-3}} = 1.998 \approx 2$$

(2 marks)

(ii) A molecule of tartronic acid ^{-OH} contains a hydroxyl group. Write the structural formula of tartronic acid.



(1 mark)

(b) Under certain conditions, the pH of 0.102 M tartronic acid is 1.87. By calculation, show that tartronic acid is NOT completely ionised in water.

$$[H^+(aq)] = 10^{-1.87} = 0.0135 M, \text{ Concentration of acid} = 0.102 M$$

$\therefore 0.102 M$ is much more larger than $0.0135 M$
 $\therefore$ It's not completely ionised
The concentration of acid is much higher than hydrogen ions

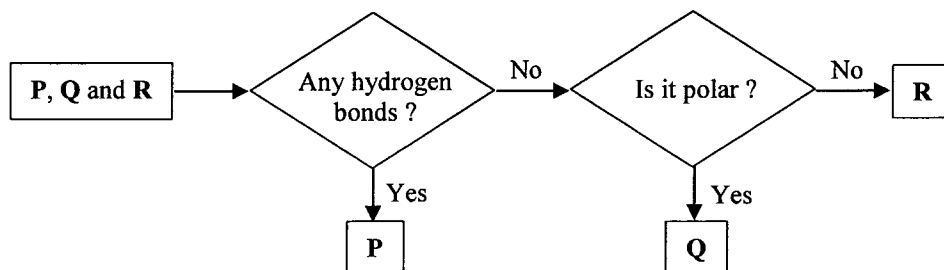
(2 marks)

Answers written in the margins will not be marked.

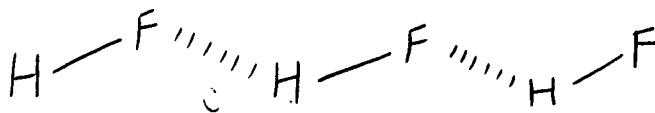
5. P, Q and R, each represents one of the following compounds :



The following flowchart can be used to identify P, Q and R.

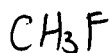


- (a) With the aid of a diagram, describe and explain the formation of hydrogen bonding between P molecules.



As fluorine atom is much more electronegative than hydrogen atom, the outermost shell electrons of H_{atom} is pulled towards F atom and F atom becomes negative while H atom is positive. The F atom and H atom of different molecule attracts each other due to the electrostatic attraction and hydrogen bond is formed between lone pair of F atom and hydrogen atom. In average, each H-F^{atom} the molecules are bonded by 2 hydrogen bond. (3 marks)

- (b) (i) What is Q?



(1 mark)

- (ii) Explain, from molecular level, why Q is polar.

The polar C-F and C-H bonds can't cancel out each other.

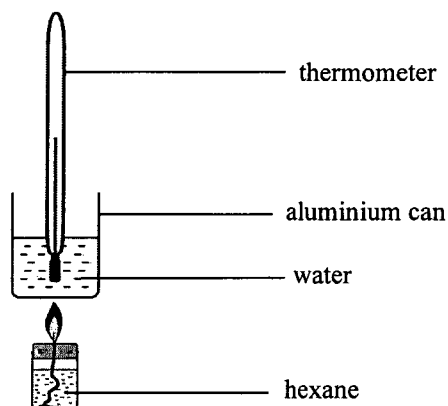
(1 mark)

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.

6. Hexane (C_6H_{14}) is a liquid fuel. Under certain experimental conditions, the enthalpy change of combustion of hexane was determined using the following set-up. The combustion of 0.120 g of hexane increased the temperature of 100.0 g of water by 13.4 °C.



- (a) Calculate the enthalpy change of combustion of hexane, in kJ mol^{-1} , under these experimental conditions.
 (Assume that the heat capacity of the aluminium can is negligible and the specific heat capacity of water is $4.20 \text{ J g}^{-1} \text{ K}^{-1}$.)
 (Relative atomic masses : $H = 1.0$, $C = 12.0$)

$$\begin{aligned} \text{The enthalpy change} &= -(100)(4.2)(13.4) \div \left(\frac{0.120}{12 \times 6 + 14}\right) \\ &= -4030000 \text{ J mol}^{-1} \\ &= -4030 \text{ kJ mol}^{-1} \end{aligned}$$

(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.

6. (b) (i) Write the chemical equation for the complete combustion of hexane, showing all state symbols.

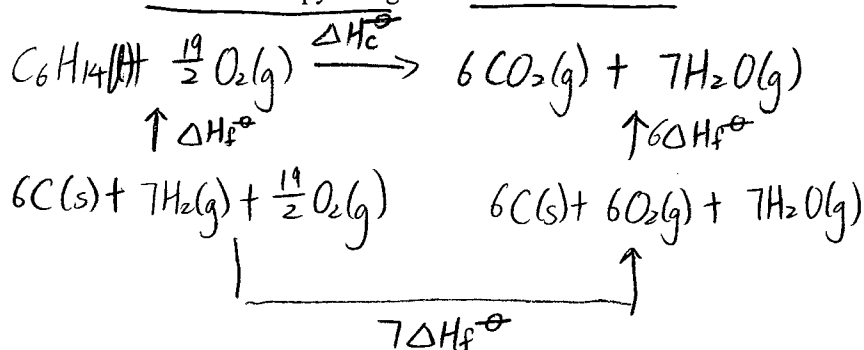


(1 mark)

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

$$\text{C}_6\text{H}_{14}(\text{l}) = -167.2 \text{ kJ mol}^{-1}, \text{H}_2\text{O}(\text{l}) = -285.9 \text{ kJ mol}^{-1}, \text{CO}_2(\text{g}) = -393.5 \text{ kJ mol}^{-1}$$

Calculate the standard enthalpy change of combustion of hexane.



$$\begin{aligned} \Delta H_c^\ominus [\text{C}_6\text{H}_{14}] &= +6(-393.5) + 7(-285.9) - (-167.2) \\ &= -4195.1 \text{ kJ mol}^{-1} \end{aligned}$$

(2 marks)

- (c) Besides heat loss, suggest one reason why the answers obtained from (a) and (b)(ii) are different.

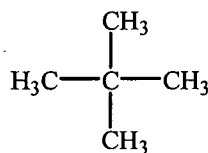
The experiment conducted in (a) is not under room temperature and 1 atm (standard conditions)

(1 mark)

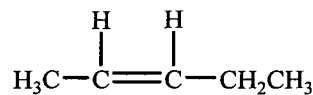
Answers written in the margins will not be marked.

7. X and Y are hydrocarbons. Their structural formulae are shown below :

X :



Y :



- (a) Write the systematic name of X.

2,2-dimethylpropane

(1 mark)

- (b) Suggest one difference between the burning characteristics of X and Y.

Y will produce a more sooty flame than X

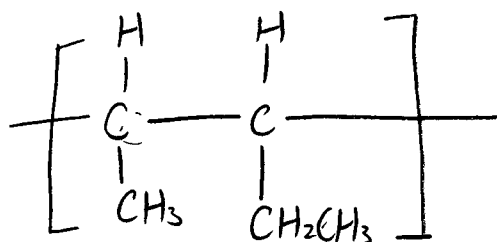
(1 mark)

- (c) Besides burning, suggest a chemical test to distinguish between X and Y.

Add acidified $\text{KMnO}_4(\text{aq})$ into X and Y respectively.
Only Y can decolourize purple $\text{KMnO}_4(\text{aq})$ while X can't.

(2 marks)

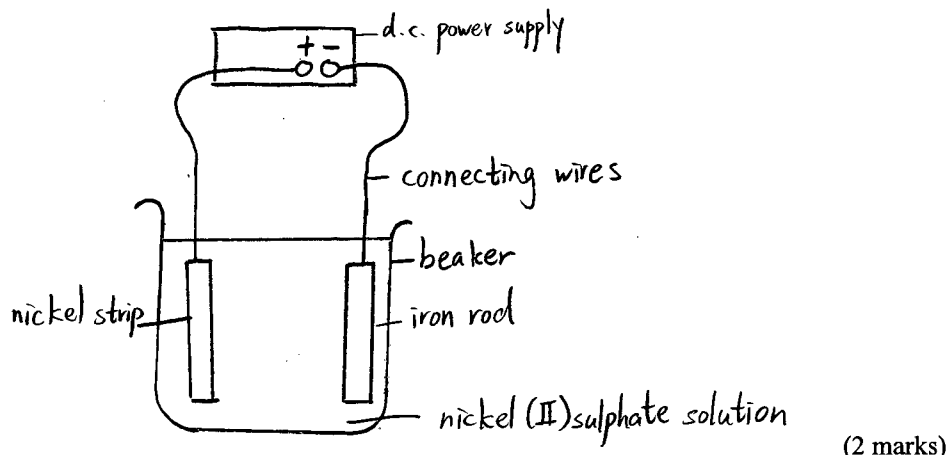
- (d) Y can form a polymer. Draw the repeating unit of this polymer.



(1 mark)

8. Using the following items ONLY, design an experiment to electroplate nickel (Ni) on an iron rod.
d.c. power supply, a nickel strip, an iron rod, nickel(II) sulphate solution, connecting wires, a beaker

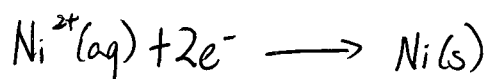
(a) Draw a labelled diagram to show the experimental set-up.



(b) State one function of nickel(II) sulphate solution in this experiment.

To provide mobile ions for conducting electricity and completes the circuit.

(c) Write the half equation for the formation of nickel on the iron rod.



(d) Ni(s) is a stronger ^(any) reducing agent than $\text{OH}^{-}(\text{aq})$ ions and $\text{SO}_4^{2-}(\text{aq})$ ions. Nickel(II) sulphate solution is green in colour. Would there be any expected observable change in the solution in this experiment? Explain your answer.

There won't be any observable change. As Ni(s) is a stronger reducing agent and is the anode in the experiment, it is above $\text{OH}^{-}(\text{aq})$ and $\text{SO}_4^{2-}(\text{aq})$ in the electrochemical series and is preferentially discharged and oxidized to $\text{Ni}^{2+}(\text{aq})$ which replenish the $\text{Ni}^{2+}(\text{aq})$ reduced and discharged at the cathode. ^{1 can}

(e) State one purpose of electroplating nickel on iron objects.

To prevent iron underneath the nickel from rusting as iron can't contact with air and water anymore.

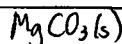
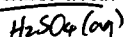
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

*9.

Outline the steps in preparing magnesium sulphate crystals from solid magnesium carbonate and dilute sulphuric acid. You do NOT need to mention the apparatus involved.



(5 marks)

First, add excess solid $\text{MgCO}_3(\text{s})$ into $\text{H}_2\text{SO}_4(\text{aq})$ until no colourless gas bubbles are given out. Second, filter the mixture and collect the $\text{MgSO}_4(\text{aq})$ filtrate. Third, heat the filtrate until it is saturated and cool it in room temperature. Then, filter the mixture and collect the crystals. Lastly, wash the surface of the crystals with a small amount of distilled water and dry it with a filter paper.

Answers written in the margins will not be marked.

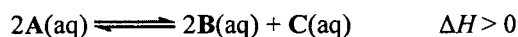
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

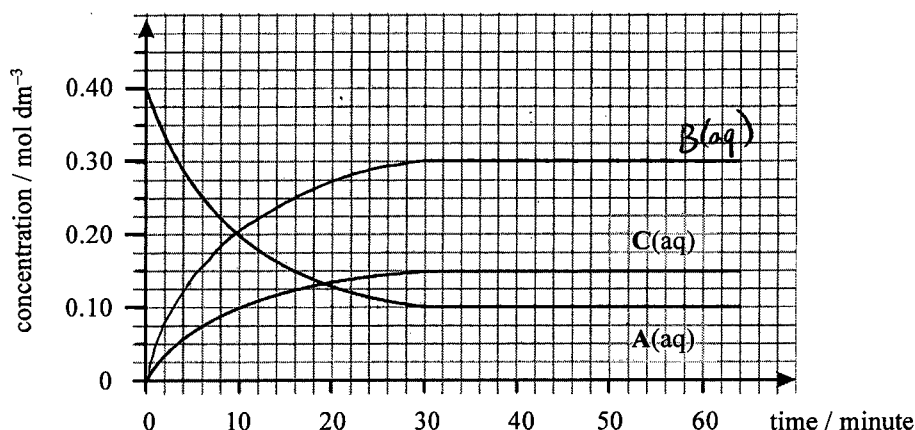
PART II

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

10. Consider the reaction represented by the equation below :



In an experiment, a certain volume of $0.40 \text{ mol dm}^{-3} \text{ A}(\text{aq})$ was initially placed in a container, and this system was allowed to attain chemical equilibrium at constant temperature T_1 . The following graph shows the variation of the concentrations of $\text{A}(\text{aq})$ and $\text{C}(\text{aq})$ with time.



- (a) According to the above graph, give one reason to support the following statement :

‘The system just attained chemical equilibrium at the 30th minute.’

The concentration of C(aq) and A(aq) remains unchanged after the 30th minute.

(1 mark)

- (b) Draw a curve on the graph to show the variation of the concentration of B(aq) with time. (1 mark)

- (c) Calculate the equilibrium constant K_c for the reaction at temperature T_1 .

$$K_c = \frac{[\text{B}(\text{aq})]^2 [\text{C}(\text{aq})]}{[\text{A}(\text{aq})]^2}$$

$$= \frac{(0.3)^2 (0.15)}{0.1^2} = 1.35 \text{ mol}^{-1} \text{ dm}^3$$

(2 marks)

- (d) When the temperature of the equilibrium mixture changed from T_1 to T_2 , a new chemical equilibrium was attained. The concentration of A(aq) was found to be 0.14 mol dm^{-3} in the new chemical equilibrium. Deduce whether T_1 or T_2 is the higher temperature.

As $[\text{A}(\text{aq})]$ rises, it shows that the equilibrium position is shifted to the left. As the forward reaction is endothermic, the new temperature should be lower. So T_1 is the higher temperature.

(2 marks)

Answers written in the margins will not be marked.

11. Compounds X and Y are cis-trans isomers with the same molecular formula C₄H₈.

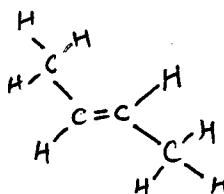
(a) X is polar but Y is non-polar.

(i) Give the systematic name of X.

Butene

(1 mark)

(ii) Write the structural formula of Y.



(1 mark)

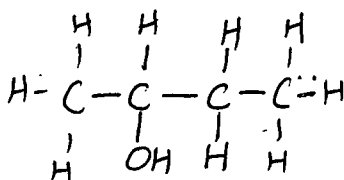
(b) A mixture of X and Y can be formed from the dehydration of an optically active alcohol Z.

(i) Suggest a reagent and a reaction condition needed for this reaction.

concentrated H₂SO₄ (l), heated under reflux

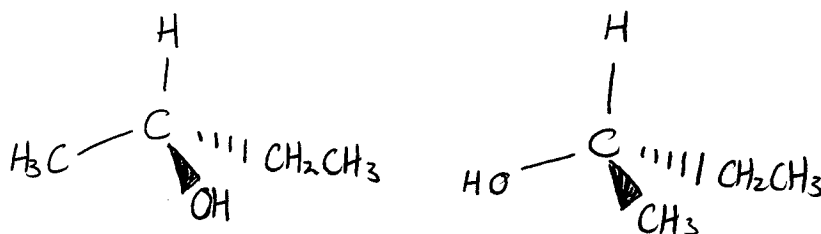
(1 mark)

(ii) Write the structural formula of Z.



(1 mark)

(iii) Draw the three-dimensional diagrams for the structures of the pair of enantiomers of Z.



(2 marks)

(iv) Describe the difference in the optical activity between the pair of enantiomers of Z.

They rotate a plane of polarized light in opposite directions

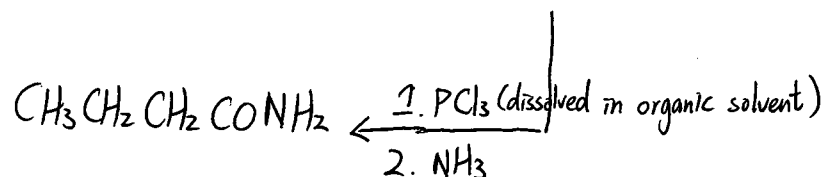
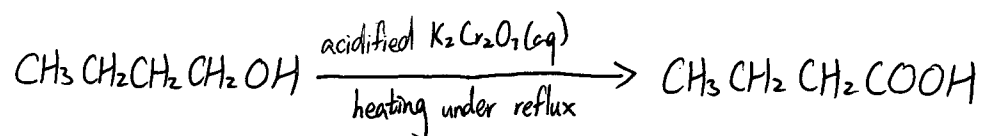
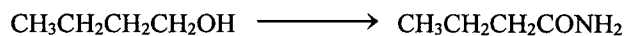
(1 mark)

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.

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.

13. (a) In terms of bonding and structure, account for the difference in the melting points of the following oxides.

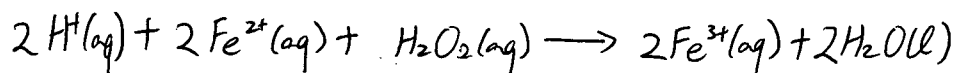
	SiO ₂	P ₄ O ₁₀	SO ₂
Melting point (°C)	1710	340	-72

SiO₂ has a giant covalent structure and its atoms are bonded by ^{strong} covalent bond. P₄O₁₀ and SO₂ has a simple molecular structures and their molecules are held by weak van der Waal's force. As covalent bond is stronger than van der Waal's force, SiO₂ has the highest melting point. And as P₄O₁₀ has a much larger molecular size than SO₂, it has a stronger van der Waal's force than SO₂, thus P₄O₁₀ has a higher melting point than SO₂.

(3 marks)

- (b) Fe²⁺(aq) reacts with H₂O₂(aq) in an acidic medium to form Fe³⁺(aq) and H₂O(l).

- (i) Write the chemical equation for the reaction.



(1 mark)

- (ii) State how this reaction can demonstrate that iron exhibits TWO characteristics of transition metals.

First, iron consist of varies oxydation states (Fe²⁺ and Fe³⁺).
Second, ions of iron is coloured.

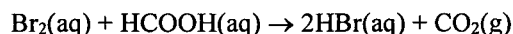
(2 marks)

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.

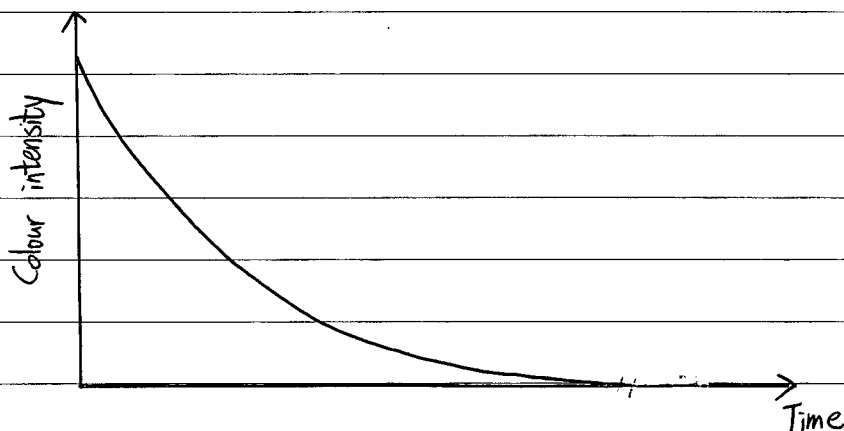
*14. Consider the following reaction :



Describe and explain how to follow the progress of the above reaction by measuring the colour intensity of the reaction mixture. Experimental details are NOT required. Sketch a labelled graph to show the expected results and explain the shape of the graph.

(6 marks)

As ^{only} $\text{Br}_2(\text{aq})$ has is coloured, when the experiment proceeds, $\text{Br}_2(\text{aq})$ is consumed and its brown colour fades and eventually becomes colourless. Therefore, by measuring the colour intensity, the decrease in concentration of $\text{Br}_2(\text{aq})$ can be recorded so the progress of the reaction can be followed



As the initial concentration of the reactants is the highest among the whole process of reaction, it will have the highest reaction rate. However, as the reactants are consumed, the concentration of reaction decreases, which means that the rate of collision between $\text{Br}_2(\text{aq})$ and $\text{HCOOH}(\text{aq})$ molecules decreases, and the rate of effective collision also decreases. So the rate of reaction continue to decrease as the reaction goes on, until all the $\text{Br}_2(\text{aq})$ is used up and the colour intensity remain unchange as the reaction stops. Therefore, the graph shows a curve.

END OF SECTION B
END OF PAPER

Answers written in the margins will not be marked.

PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序

1	2	0
H 1.0	He 4.0	
3	4	10
Li 6.9	Be 9.0	Ne 20.2
11	12	18
Na 23.0	Mg 24.3	Ar 40.0
19	20	36
K 39.1	Ca 40.1	Kr 83.8
37	38	54
Rb 85.5	Sr 87.6	Xe 131.3
55	56	86
Cs 132.9	Ba 137.3	Rn (222)
87	88	
Fr (223)	Ra (226)	
89	90	
Ac (227)		
103	104	
Lr (260)		
101	102	
No (259)		
100	101	
Fm (257)		
99	100	
Es (252)		
98	99	
Cf (251)		
97	98	
Bk (247)		
96	97	
Cm (247)		
95	96	
Am (243)		
94	95	
Pu (244)		
93	94	
Np (237)		
92	93	
U 238.0		
91	92	
Pa (231)		
90	91	
Th 232.0		
89	90	
Ac (227)		
88	89	
Ra (226)		
87	88	
Fr (223)		
86	87	
Rn (222)		
85	86	
At (210)		
84	85	
Po (209)		
83	84	
Bi 209.0		
82	83	
Pb 207.2		
81	82	
Tl 204.4		
80	81	
Hg 200.6		
79	80	
Au 197.0		
78	79	
Pt 195.1		
77	78	
Ir 192.2		
76	77	
Os 190.2		
75	76	
Re 186.2		
74	75	
W 183.9		
73	74	
Ta 180.9		
72	73	
Hf 178.5		
71	72	
Lu 175.0		
70	71	
Yb 173.0		
69	70	
Tm 168.9		
68	69	
Er 167.3		
67	68	
Ho 164.9		
66	67	
Dy 162.5		
65	66	
Tb 158.9		
64	65	
Gd 157.3		
63	64	
Eu 152.0		
62	63	
Sm 150.4		
61	62	
Pm (145)		
60	61	
Nd 144.2		
59	60	
Pr 140.9		
58	59	
Ce 140.1		

relative atomic mass 相對原子質量

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

*

**

香港考試及評核局
HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

香港中學文憑考試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

答題簿 ANSWER BOOK

考生須知

- (一) 宣布開考後，考生須首先在第 1 頁之適當位置填寫考生編號，並在第 1 及 3 頁之適當位置貼上電腦條碼。
- (二) 每題(非指分題)必須另起新頁作答，並須在每一頁的相應試題編號方格填畫「X」號，以表示選答的題號(見下列)，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															
☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
13	14	15	16	17	18	19	20	21	22	23	24	≥25														

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

試題編號 Question No.

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

☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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

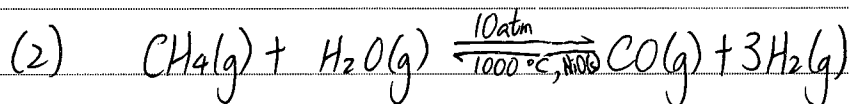
每題另起新頁作答。

Start each question on a new page.

lai) (1) Human body can't synthesis vitamin C by itself and extration of vitamin C from fruits will be too expensive. Synthesise vitamin C in industry is the cheapest way to obtain a huge amount of vitamin C in a short period of time as it's required in large amount.

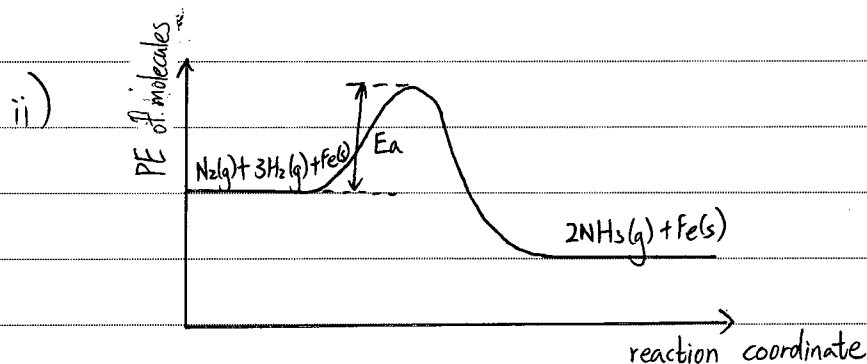
(2) It consist^s the use of corrosive concentrated $H_2SO_4(l)$ in the process of reaction.

ii) (1) From cracking of heavy oil followed by fractional distillation of the product



iii) Chlorine gas and $NaOH(aq)$

bi) The kinetic energy required for starting the reaction when colliding with other reactant molecules so in the molecule that effective collisions occurs.



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.

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

☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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) $E_a = 20 + 92 = 112 \text{ kJ mol}^{-1}$

iv) Under 200 atm and 400 °C. The temperature needs to be high to increase the rate of reaction so that the reaction is efficient. But the temperature can't be set too high as it will shift the equilibrium position of the reaction to the left and decrease the yield.

For the pressure, as the number of moles on the reactant side is larger than the product side, the pressure needs to be high so as to shift the equilibrium position to the right and increase the yield. However, if the pressure is too high, the cost of building and maintaining the equipment used in reaction will also be too high.

v) It's wrong as catalyst only lowers the activation energy and more catalyst can't further increase the yield.

ci) (1) Make the shape of the metal to be board and thin to increase its surface area contacting with the reactants

(2) Y is a catalyst and it will be chemically unchanged at the end of the reaction.

(3) Pd metal may catalyst the reactant in Step (2) to undergo other reactions that is not preferred

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.

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

☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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.

ii)(1) Let x and y be the order of reaction with respect to $I^-(aq)$ and $H^+(aq)$ respectively

$$2.8 \times 10^{-6} = k(0.001)(0.1)^x(0.1)^y \quad \text{--- (1)}$$

$$5.6 \times 10^{-6} = k(0.002)(0.1)^x(0.001)^y \quad \text{--- (2)}$$

$$\textcircled{2}/\textcircled{1}, \quad \frac{5.6 \times 10^{-6}}{2.8 \times 10^{-6}} = \frac{(0.002)(0.001)^y}{(0.001)(0.1)^y}$$

$$y = 0$$

~~Sub $y=0$ into (1), $2.8 \times 10^{-6} = k(0.001)(0.1)^x(0.1)^0$~~

$$2.8 \times 10^{-5} = k(0.002)(0.5)^x(0.1)^0 \quad \text{--- (3)}$$

$$\textcircled{3}/\textcircled{2}, \quad \frac{2.8 \times 10^{-5}}{5.6 \times 10^{-6}} = \frac{(0.002)(0.5)^x}{(0.002)(0.1)^x}$$

$$x = 1$$

$\therefore$ The order of reaction with respect to $I^-(aq)$ is 1

The order of reaction with respect to $H^+(aq)$ is 0

(2) The rate constant is k

$$2.8 \times 10^{-6} = k(0.001)^1(0.1)^1(0.1)^0$$

$$k = 0.028$$

$\therefore$ Rate constant is $0.028 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$

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。

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.

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

☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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.

3ai) Perform a flame test. $\text{Ca}(\text{NO}_3)_2(\text{s})$ will give out a brick-red flame while $\text{Mg}(\text{NO}_3)_2(\text{s})$ will give out a bright white flame.

ii) It absorbs moisture in air

iii) Add $\text{NaHCO}_3(\text{aq})$ (excess $\text{NaHCO}_3(\text{aq})$ dissolved in organic solvent) into the solution until no colourless gas bubbles are produced. Pour the mixture into separating funnel and invert and released pressure inside for a few times. Discard the upper layer and collect it as it's hexan-1-ol.

bi) A 250.0cm^3 volumetric flask

ii)(1) From dark blue to colourless

$$\begin{aligned} (2) \text{ The amount of } \text{I}_2(\text{aq}) \text{ produced} &= 0.0512 \times \frac{21.02}{1000} \div 2 = 5.381 \times 10^{-4} \text{ moles} \\ \text{The concentration of NaOCl} &= 5.381 \times 10^{-4} \times (16 + 35.5) \times \left(\frac{250}{25}\right) \div \left(\frac{25}{1000}\right) \\ &= 11.08 \text{ g dm}^{-3} \end{aligned}$$

(3) The lowest concentration that the standard allows = $15.5 \times (1-5\%)$
 $= 14.73 \text{ g dm}^{-3}$

$$\therefore 11.08 < 14.73$$

$\therefore$ It doesn't fullfills the standards

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.

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

☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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) To reduce the inaccuracy due to errors made by human

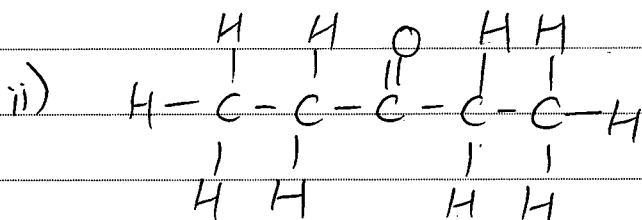
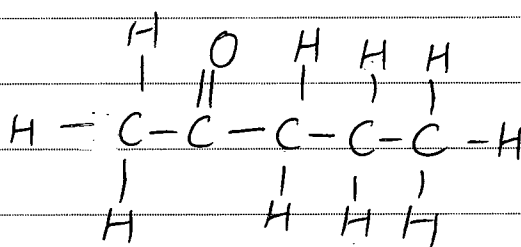
ci) (1) The molecular mass of A is 86

$$12n + (1)(2n) + 16 = 86$$

$$n = 5$$

∴ The molecular formula of A is $C_5H_{10}O$

(2) As the peak at $m/z = 43$ is due to the presence of $\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\text{C}^+=\text{O} \\ | \\ \text{H} \end{array}$ ion



iii) Add Tollen's reagent to B and C respectively, only C can give a silver mirror but not B

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.

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

☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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.

iv) There's a broad absorption peak at 3230cm^{-1} to 3670cm^{-1} in D while it's absent in C.

There's a absorption peak at 1680cm^{-1} to 1800cm^{-1} in C while it's absent in D.

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

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.