

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY  
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2016

**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.

©香港考試及評核局 保留版權  
Hong Kong Examinations and Assessment Authority  
All Rights Reserved 2016



# PART I

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

1. Refer to the following information of phosphorus (P) and chlorine (Cl).

|                      | P    | Cl   |
|----------------------|------|------|
| Atomic number        | 15   | 17   |
| Relative atomic mass | 31.0 | 35.5 |

- (a) State the electronic arrangement of a phosphorus atom.

2, 8, 5

(1 mark)

- (b) All chlorine atoms have the same atomic number. Explain why some chlorine atoms have different mass numbers.

It is because it is the isotopes of chlorine atoms, which has the same number of protons but different number of neutrons, so it has different mass number.

(1 mark)

- (c) A compound of phosphorus and chlorine has a relative molecular mass smaller than 250. It contains 22.6% of phosphorus by mass.

- (i) Deduce the molecular formula of the compound.

Let the compound is 100g.

|                     |                             |                             |
|---------------------|-----------------------------|-----------------------------|
|                     | P                           | Cl                          |
| Mass                | 22.6g                       | 100 - 22.6 = 77.4g          |
| mole ratio          | $\frac{22.6}{31.0} = 0.729$ | $\frac{77.4}{35.5} = 2.180$ |
| simplest mole ratio | $\frac{0.729}{0.729} = 1$   | $\frac{2.180}{0.729} = 3$   |
| ∴ empirical formula | PCl <sub>3</sub>            |                             |

Let the molecular formula be (PCl<sub>3</sub>)<sub>n</sub>

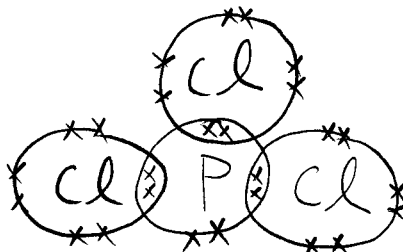
$$n(31 + 35.5 \times 3) < 250$$

$$n < 1.82$$

∴ n = 1

∴ The molecular formula is PCl<sub>3</sub>

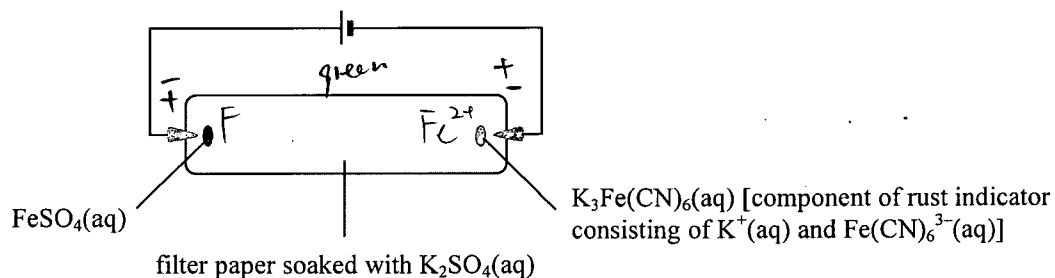
- (ii) Draw the electron diagram for the compound, showing electrons in the outermost shells only.



(3 marks)

Answers written in the margins will not be marked.

2. The set-up of an experiment for studying the movement of ions is shown below.



- (a) Explain why the filter paper is soaked with  $K_2SO_4(aq)$  instead of water.

Increase the electrical conductivity of the filter paper

(1 mark)

- (b) State the colour of  $FeSO_4(aq)$ .

Green

(1 mark)

- (c) Explain what would be observed around the middle of the filter paper when the circuit is closed for a period of time.

The green colour of  $Fe^{2+}$  will mix with pale yellow colour of  $Fe(CN)_6^{3-}$  to give yellowish green colour in the middle.

(2 marks)

- (d) The experiment is repeated, but the two poles of the cell have been reversed at the very beginning. Explain what would be observed around the middle of the filter paper when the circuit is closed for a period of time.

No observable change

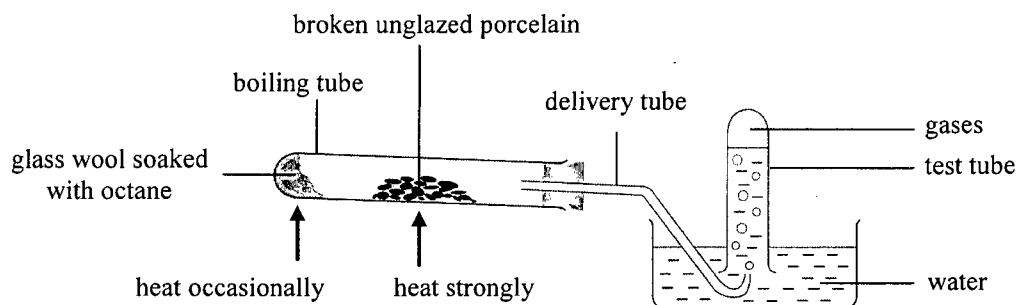
(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

3. The diagram below shows an experimental set-up in which the glass wool soaked with octane is heated occasionally and the broken unglazed porcelain is heated strongly. Some gases are collected in the test tube over water.



- (a) Name the type of reaction that occurs in the boiling tube. Suggest one importance of this type of reaction in industry.

Cracking, It produces extra petrol for meeting the demand.

(2 marks)

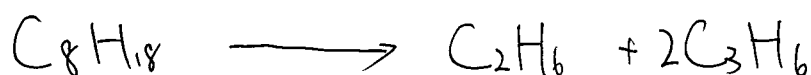
- (b) Explain why, instead of a large piece of unglazed porcelain, broken unglazed porcelain is used in this experiment.

It can increase the rate of reaction by providing a large contact surface area.

(1 mark)

- (c) Suppose that during the experiment, octane changes to ethane gas and propene gas only and they can be collected in the test tube.

- (i) Write the balanced equation for the reaction of changing octane to ethane and propene.



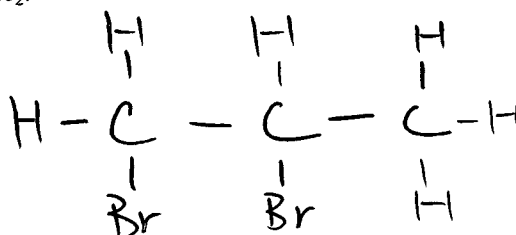
Answers written in the margins will not be marked.

3. (c) (ii) The gases collected in the test tube are shaken thoroughly with a few drops of  $\text{Br}_2$  (in  $\text{CH}_2\text{Cl}_2$ ) solution.

(1) State the expected observation.

The colour of the solution change from orange to colourless rapidly.

(2) Draw the structure of the product formed from the reaction between propene and  $\text{Br}_2$ .



(3 marks)

- (d) When no more gas can be collected, what should be done to end the experiment for safety consideration? Explain your answer.

Remove the delivery tube from the water first, in order to sucking back of water, it may crack the test tube

(2 marks)

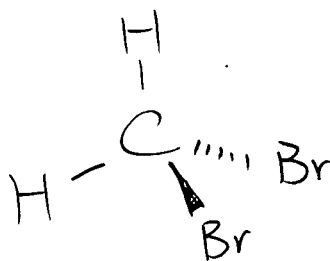
4. Consider the molecules  $\text{CO}_2$ ,  $\text{CS}_2$  and  $\text{CH}_2\text{Br}_2$ .

(a) For each of the following molecules, draw its three-dimensional structure.

(i)  $\text{CS}_2$



(ii)  $\text{CH}_2\text{Br}_2$



(2 marks)

(b) Identify, with explanation, the polar bond(s) in  $\text{CH}_2\text{Br}_2$ .

$\text{C}-\text{H}$  bonds and  $\text{C}-\text{Br}$  bonds in  $\text{CH}_2\text{Br}_2$  is polar, since the electronegativity of Br is higher than carbon and carbon is higher than hydrogen. So Br tends to attract the electron in the  $\text{C}-\text{Br}$  bond, while carbon also has this behaviour. So  $\text{C}-\text{H}$  bonds and  $\text{C}-\text{Br}$  bonds are polar.

(2 marks)

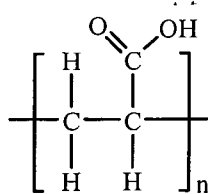
(c) Suggest why, under room temperature and pressure,  $\text{CO}_2$  is a gas but  $\text{CS}_2$  is a liquid.

The van der Waals' force of  $\text{CS}_2$  is stronger than  $\text{CO}_2$ . Although they have the same simple molecular structure. The mass of  $\text{CS}_2$  is larger than  $\text{CO}_2$ , so van der Waals' force of  $\text{CS}_2$  is stronger.

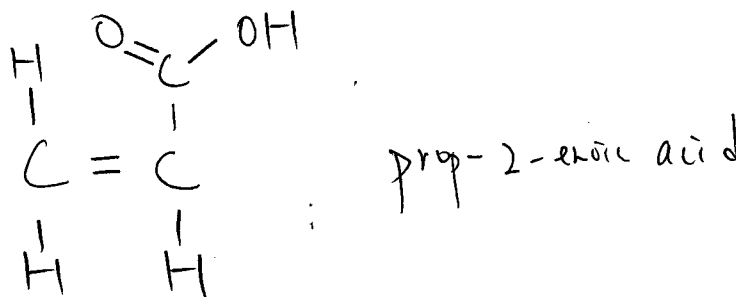
(2 marks)

Answers written in the margins will not be marked.

5. Polymer **B** shown below can be used as water absorbing material in diapers. It can be formed from the polymerisation of compound **A**.

polymer **B**

- (a) Draw the structure of compound **A** and state its systematic name.



(2 marks)

- (b) State the type of polymerisation for the formation of **B** from **A**.

Addition polymerisation

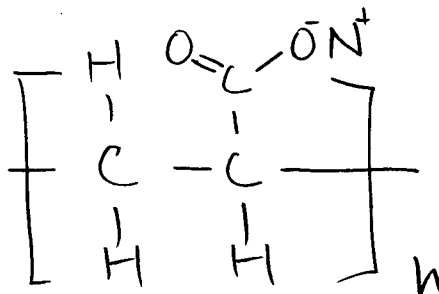
(1 mark)

- (c) Suggest why the relative molecular mass of **B** is expressed using a range of values instead of a single fixed value.

It is because the length of polymer **B** is not constant, so it has a range of values.

(1 mark)

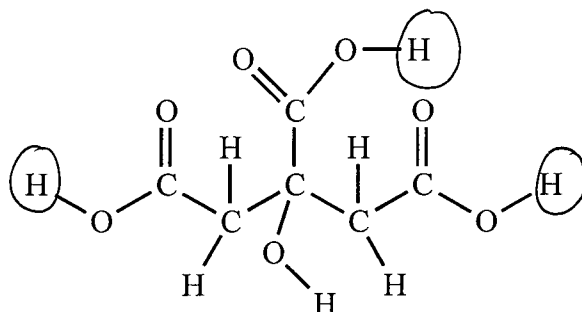
- (d) It is known that the reaction of polymer **B** with NaOH(aq) forms polymer **C** which can absorb water better. Draw the structure of **C**.



(1 mark)

6. Citric acid is a tribasic acid found in lemon. It is a white solid and soluble in water.

- (a) In the structure of citric acid shown below, circle ALL ionisable hydrogen atom(s) making it a tribasic acid.



(1 mark)

- (b) A solid sample contained citric acid and other soluble inert substances. 1.65 g of the sample was dissolved in deionised water and diluted to 250.0 cm<sup>3</sup> in apparatus X. After that, 25.00 cm<sup>3</sup> of the diluted solution was withdrawn and titrated with 0.123 M NaOH(aq) using phenolphthalein as an indicator. 18.45 cm<sup>3</sup> of the NaOH(aq) was required to reach the end point. (Molar mass of citric acid = 192.0 g)

- (i) What is apparatus X?

volumetric flask

- (ii) Calculate the percentage by mass of citric acid in the solid sample.

$$\text{No. of mole NaOH(aq) used} = \frac{18.45}{1000} \times 0.123 = 2.26935 \times 10^{-3}$$

$$\text{No. of mole of citric acid reacted} = \frac{2.26935 \times 10^{-3}}{3} = 7.5645 \times 10^{-4}$$

$$\begin{aligned} \text{No. of mole of citric acid in the original} &= 7.5645 \times 10^{-4} \times \frac{250}{25} \\ &= 7.5645 \times 10^{-3} \end{aligned}$$

$$\begin{aligned} \text{The actual mass of citric acid} &= 7.5645 \times 10^{-3} \times 192 \\ &= 1.452384 \\ &= 1.45 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{The percentage by mass} &= \frac{1.45}{1.65} \times 100\% \\ &= 87.9\% \end{aligned}$$

(4 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

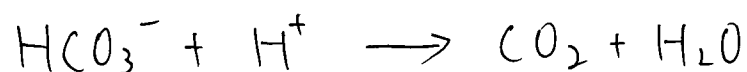
Answers written in the margins will not be marked.

6. (c) A few drops of lemon juice are added to sodium hydrogencarbonate powder.

(i) State the expected observation.

Effervescence occur

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



(2 marks)

7. The enthalpy change of formation of  $\text{MgCO}_3(\text{s})$  can be obtained using an indirect method. Firstly, the enthalpy change for the reaction of  $\text{MgCO}_3(\text{s})$  with  $\text{H}_2\text{SO}_4(\text{aq})$ , and that of  $\text{Mg}(\text{s})$  with  $\text{H}_2\text{SO}_4(\text{aq})$  are respectively determined experimentally. After that, the enthalpy change of formation of  $\text{MgCO}_3(\text{s})$  can be obtained through calculation with given enthalpy changes of formation of  $\text{CO}_2(\text{g})$  and  $\text{H}_2\text{O}(\text{l})$ .

- (a) According to definition, under which condition could the 'heat change' of a reaction be regarded as the 'enthalpy change'?

The reaction is occur at the sealed container, in which the system of the reaction, is disconnected to the surroundings.

(1 mark)

- (b) Explain why, instead of a direct method, an indirect method is used to obtain the enthalpy change of formation of  $\text{MgCO}_3(\text{s})$ .

Since the formation of  $\text{MgCO}_3$  is highly exothermic. Use indirect method is for safety concern.

(1 mark)

- (c) In order to determine experimentally the enthalpy change for the reaction of  $\text{MgCO}_3(\text{s})$  with  $\text{H}_2\text{SO}_4(\text{aq})$ , an accurate mass of  $\text{MgCO}_3(\text{s})$  was firstly allowed to react with excess  $\text{H}_2\text{SO}_4(\text{aq})$  in a polystyrene foam cup. The maximum rise in temperature of the mixture was then found. After calculation, the enthalpy change for the reaction can be obtained.

- (i) Suggest one possible error for the above experimental procedure.

There is heat lost to the surroundings.

- (ii) Explain whether the enthalpy change for the reaction of  $\text{CaCO}_3(\text{s})$  with  $\text{H}_2\text{SO}_4(\text{aq})$  can be obtained using a similar experimental procedure.

So, since  $\text{CaCO}_3(\text{s})$  react with  $\text{H}_2\text{SO}_4(\text{aq})$  form insoluble precipitate, the reaction will stop immediately which will hinder the reaction

(2 marks)

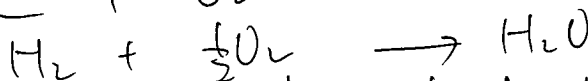
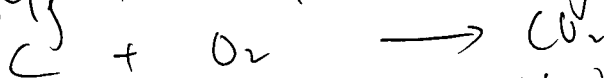
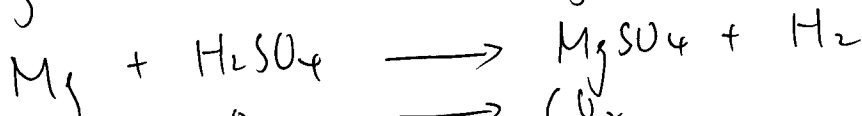
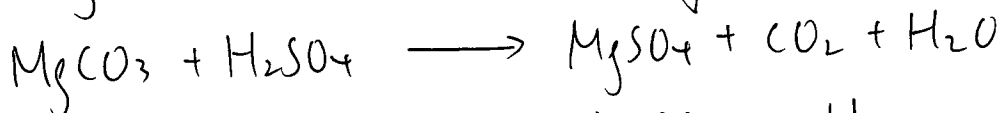
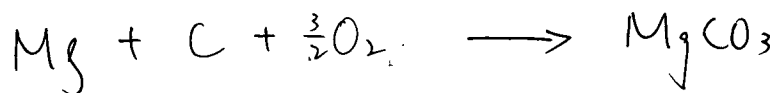
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

7. (d) Using the information given below, calculate the standard enthalpy change of formation of  $\text{MgCO}_3(\text{s})$ .

|                                                                                                                |                              |
|----------------------------------------------------------------------------------------------------------------|------------------------------|
| Standard enthalpy change for the reaction of $\text{MgCO}_3(\text{s})$ with $\text{H}_2\text{SO}_4(\text{aq})$ | $= -50 \text{ kJ mol}^{-1}$  |
| Standard enthalpy change for the reaction of $\text{Mg}(\text{s})$ with $\text{H}_2\text{SO}_4(\text{aq})$     | $= -467 \text{ kJ mol}^{-1}$ |
| Standard enthalpy change of formation of $\text{CO}_2(\text{g})$                                               | $= -394 \text{ kJ mol}^{-1}$ |
| Standard enthalpy change of formation of $\text{H}_2\text{O}(\text{l})$                                        | $= -286 \text{ kJ mol}^{-1}$ |



The standard enthalpy change of formation

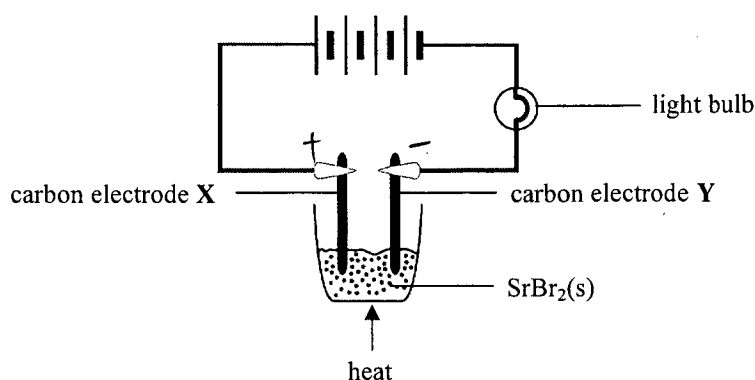
$$\begin{aligned} \text{of } \text{MgCO}_3(\text{s}) &= (-467) + (50) + (-394) + (-286) \\ &= -1097 \text{ kJ mol}^{-1} \end{aligned}$$

(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

8. Consider the experimental set-up shown below :

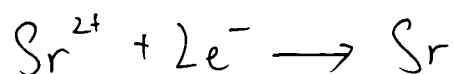


- (a) In the above experiment, the bulb lights up when the  $\text{SrBr}_2(\text{s})$  becomes molten.  
(Atomic number of Sr = 38)

- (i) State the observation at carbon electrode X.

A brown colour is observed near electrode X

- (ii) Write a half equation for the change that occurs at carbon electrode Y.



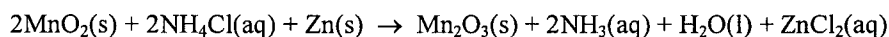
(2 marks)

- (b) Explain why the experiment should be performed in a fume cupboard.

It is because bromine evolved is toxic

(1 mark)

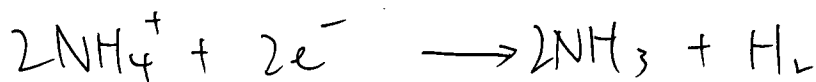
- (c) Zinc-carbon cells are used in the above experiment. The equation below shows the reaction that occurs in the zinc-carbon cells when the bulb lights up.



- (i) Deduce, in terms of change in oxidation number, the oxidising agent in a zinc-carbon cell.

The oxidising agent is  $\text{MnO}_2$ , the oxidation number of Mn change from +4 to +3, which reduction occur.

- (ii) Write a half equation for the change that occurs at the cathode in a zinc-carbon cell.



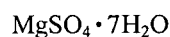
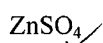
(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

\*9. Three unlabelled reagent bottles each contains one of the white solids listed below :



Outline how you would carry out tests to distinguish these three solids.

(6 marks)

Add the three solid into water to become aqueous solution.

(Add aluminium metal to the <sup>other two</sup> solution, a grey metal is deposit in the solution, indicate it is  $\text{ZnSO}_4$ , since Al displace  $\text{Zn}^{2+}$  ion to Zn.)

Observed the other two solution, the solution which does not have precipitate, it indicates it is  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ . Since  $\text{MgSO}_4$  and  $\text{ZnSO}_4$  will dissolve in water. Then, →

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. In an experiment, 2.0 mol of  $\text{SO}_2(\text{g})$  and 2.0 mol of  $\text{O}_2(\text{g})$  are allowed to react in a closed container maintained at 950 K. The chemical equation for the reaction is shown below:



When the reaction attains dynamic equilibrium, 1.8 mol of  $\text{SO}_3(\text{g})$  is obtained.

- (a) What is meant by the term 'dynamic equilibrium'?

It means <sup>in</sup> the reversible reaction, the forward and backward reaction is keep happening, and the rate is the same.

(1 mark)

- (b) At 950 K, the equilibrium constant  $K_c$  for the above reaction is  $878 \text{ dm}^3 \text{ mol}^{-1}$ . Calculate the volume of the container.

Let the volume be  $V$

$$K_c = \frac{[\text{SO}_3]_{\text{eqn}}^2}{[\text{SO}_2]_{\text{eqn}}^2 [\text{O}_2]_{\text{eqn}}}$$

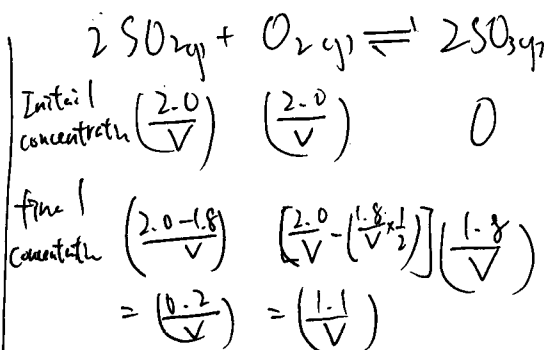
$$878 = \frac{\left(\frac{1.8}{V}\right)^2}{\left(\frac{0.2}{V}\right)^2 \left(\frac{1.1}{V}\right)}$$

$$878 = \frac{\frac{3.24}{V^2}}{\frac{0.044}{V^3}}$$

$$878 = \frac{3.24}{V^2} \times \frac{V^3}{0.044}$$

$$878 = \frac{3.24V^3}{0.044V^2}$$

$$V = 11.9 \text{ dm}^3$$



(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

10. (c) If the above equilibrium mixture is subjected to each of the following changes, will the number of moles of  $\text{SO}_3(\text{g})$  obtained increase, decrease or remain unchanged? Explain your answer in each case.

(i) increasing the temperature

It will decrease, since the reaction is exothermic, increase temperature favours endothermic reaction, the equilibrium position shift to left, so it decrease.

(ii) adding a suitable catalyst

It will remain unchanged, since a catalyst will just make the equilibrium constant faster reached, by alter the forward and backward reaction - in the same extent. It will not affect the mole of  $\text{SO}_3(\text{g})$  obtained

(2 marks)

11. Under certain conditions, a pink compound **X** reacts with  $\text{NaOH(aq)}$  to give a colourless product. Three trials of an experiment were conducted to study the kinetics of the reaction. Firstly, three  $\text{NaOH(aq)}$  solutions were prepared by mixing different volumes of  $2.0 \text{ M NaOH(aq)}$  and  $\text{H}_2\text{O(l)}$  at  $25^\circ\text{C}$ . After that, one drop of **X** was added to each of them and the time needed for the pink colour to disappear was recorded. The relevant data is shown below :

|         | Volume of<br>$2.0 \text{ M NaOH(aq)}$ used / $\text{cm}^3$ | Volume of<br>$\text{H}_2\text{O(l)}$ used / $\text{cm}^3$ | Time needed for the<br>pink colour to disappear / s |
|---------|------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|
| Trial 1 | 5.0                                                        | 0                                                         | 61                                                  |
| Trial 2 | 4.0                                                        | 1.0                                                       | 76                                                  |
| Trial 3 | 3.0                                                        | 2.0                                                       | 101                                                 |

- (a) Why is it necessary to make the total volume of the reaction mixtures the same for the trials ?

The experiment will be fair, and the reaction will just depends on the volume of  $\text{NaOH}$  added.

(1 mark)

- (b) Given that at  $25^\circ\text{C}$ ,  $[\text{H}^+(\text{aq})][\text{OH}^-(\text{aq})] = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ , calculate the pH of the  $\text{NaOH(aq)}$  solution prepared in Trial 2.

The concentration of  $\text{NaOH}$  in trial 2  
 $= 2 \times \frac{4}{5} = 1.6$

$$\text{By } \text{pH} = -\log[\text{H}^+]$$

The concentration of  $\text{H}^+$  is also 1.6  
 so  $\text{pH} = -\log[1.6]$   
 $= -0.20$

(3 marks)

- (c) Based on the information provided, deduce one factor which affects the rate of this reaction.

The concentration of  $\text{NaOH}$

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

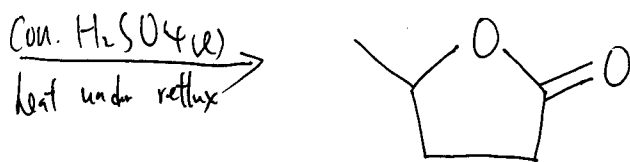
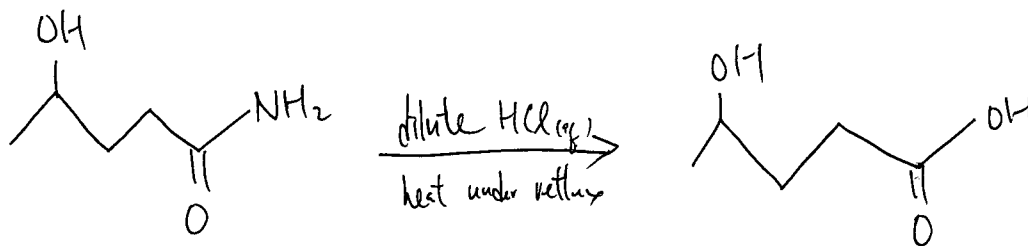
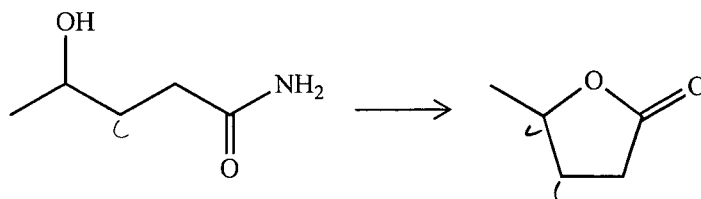
Answers written in the margins will not be marked.

11. (d) Detection of colour change using naked eye is not accurate enough. Suggest an instrumental method that can be used to more accurately detect the colour change.

Colorimetry

(1 mark)

12. Outline a synthetic route, with *no more than three steps*, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.



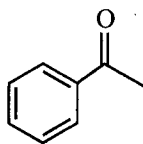
(3 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

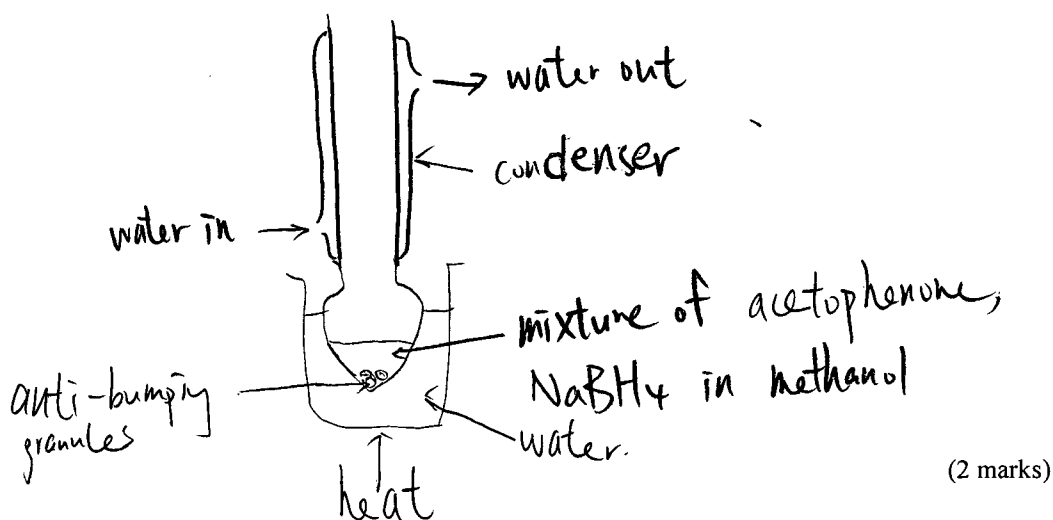
Answers written in the margins will not be marked.

13. The structure of acetophenone is shown below :



Heating a mixture of acetophenone and  $\text{NaBH}_4$  in methanol solvent under reflux can give two isomeric compounds **P** and **Q**. **P** and **Q** have the same melting point and same solubility in methanol.

- (a) Draw a labelled diagram of the set-up for heating the mixture under reflux.



- (b) Suggest another reagent that can also react with acetophenone in a suitable solvent to give **P** and **Q**.

Lithium aluminium hydride,  $\text{LiAlH}_4$  in dry ether

(1 mark)

- (c) What kind of isomers are **P** and **Q**?

Enantiomers

(1 mark)

- (d) State one different physical property between **P** and **Q**.

Optical property, which rotated the plane of polarisation of a beam of plane polarised light in opposite direction.

(1 mark)

- (e) Suggest a chemical test to show how acetophenone and **P** can be distinguished.

Add acidified potassium dichromate solution, **P** can turn the solution from orange to green, while colour of acetophenone does not.

(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. Arrange sodium, aluminium, silicon and sulphur in decreasing order of electrical conductivity at room conditions, and explain your answer in terms of bonding and structure.

(5 marks)

Aluminium > sodium > Sulphur > silicon

Silicon has the lowest electrical conductivity since it does not have any mobile ion or delocalised electrons in the giant covalent structure of silicon.

Sulphur has a simple molecular ~~the~~ structure, it can become slightly mobile, so its conductivity is lower than metal, sodium and aluminium. Aluminium and sodium both have giant metallic structure. The 'sea' of delocalised electrons provide these two with high electrical conductivity. However, each Al can produce 3 electrons, while Na only produces 1 electron in the structure, so aluminium has more electrons in the structure. Its electrical conductivity is highest.

END OF SECTION B

END OF PAPER

Answers written in the margins will not be marked.

## 2016-DSE-CHEM 1B-20

**GROUP 族**

atomic number 原子序

|    |             |    |             |                             |             |    |             |       |             |     |             |     |             |     |             |     |             |     |             |     |             |     |             |     |             |     |              |     |              |     |              |     |              |     |              |     |              |     |              |     |              |
|----|-------------|----|-------------|-----------------------------|-------------|----|-------------|-------|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|--------------|-----|--------------|-----|--------------|-----|--------------|-----|--------------|-----|--------------|-----|--------------|-----|--------------|
| I  |             | II |             | relative atomic mass 相對原子質量 |             |    |             |       |             |     |             |     |             |     |             |     |             |     |             |     |             |     |             |     |             |     |              |     |              |     |              |     |              |     |              |     |              |     |              |     |              |
| 3  | Li<br>6.9   | 4  | Be<br>9.0   | 21                          | Sc<br>45.0  | 22 | Ti<br>47.9  | 23    | V<br>50.9   | 24  | Cr<br>52.0  | 25  | Mn<br>54.9  | 26  | Fe<br>55.8  | 27  | Co<br>58.9  | 28  | Ni<br>58.7  | 29  | Cu<br>63.5  | 30  | Zn<br>65.4  | 31  | Ga<br>69.7  | 32  | Ge<br>72.6   | 33  | As<br>74.9   | 34  | Se<br>79.0   | 35  | Br<br>79.9   | 36  | Kr<br>83.8   |     |              |     |              |     |              |
| 11 | Na<br>23.0  | 12 | Mg<br>24.3  | 39                          | Y<br>88.9   | 40 | Zr<br>91.2  | 41    | Nb<br>92.9  | 42  | Mo<br>95.9  | 43  | Tc<br>(98)  | 44  | Ru<br>101.1 | 45  | Rh<br>102.9 | 46  | Pd<br>106.4 | 47  | Ag<br>107.9 | 48  | Cd<br>112.4 | 49  | In<br>114.8 | 50  | Sn<br>118.7  | 51  | Sb<br>121.8  | 52  | Te<br>127.6  | 53  | I<br>126.9   | 54  | Xe<br>131.3  |     |              |     |              |     |              |
| 19 | K<br>39.1   | 20 | Ca<br>40.1  | 37                          | Rb<br>85.5  | 38 | Sr<br>87.6  | 73    | Ta<br>180.9 | 74  | W<br>183.9  | 75  | Re<br>186.2 | 76  | Os<br>190.2 | 77  | Ir<br>192.2 | 78  | Pt<br>195.1 | 79  | Au<br>197.0 | 80  | Hg<br>200.6 | 81  | Tl<br>204.4 | 82  | Pb<br>207.2  | 83  | Bi<br>209.0  | 84  | Po<br>(209)  | 85  | At<br>(210)  | 86  | Rn<br>(222)  |     |              |     |              |     |              |
| 55 | Cs<br>132.9 | 56 | Ba<br>137.3 | 87                          | Fr<br>(223) | 88 | Ra<br>(226) | 89 ** | Ac<br>(227) | 104 | Rf<br>(261) | 105 | Db<br>(262) | 106 | Sg<br>(266) | 107 | Bh<br>(264) | 108 | Hs<br>(265) | 109 | Mt<br>(268) | 110 | Ds<br>(271) | 111 | Rg<br>(272) | 112 | Uue<br>(285) | 113 | Uub<br>(286) | 114 | Uut<br>(289) | 115 | Uuq<br>(291) | 116 | Uur<br>(293) | 117 | Uus<br>(294) | 118 | Uuh<br>(295) | 119 | Uuo<br>(296) |

\*

\*\*

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

## 2016 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)。
- (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).
- (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                       |                          |                          |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |                          |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13                       | 14                       | 15                                  | 16                       | 17                       | 18                       | 19                       | 20                       | 21                       | 22                       | 23                       | 24                       | ≥25                      |                          |

## Level 5 Exemplar & Comments

### Paper 2

|                                           |                             |                                |
|-------------------------------------------|-----------------------------|--------------------------------|
| 由考生填寫<br>To be filled in by the candidate | 由閱卷員填寫<br>Marker's Use Only | 由試卷主席填寫<br>Examiner's Use Only |
|                                           | 閱卷員編號<br>Marker No.         | 試卷主席編號<br>Examiner No.         |

[illegible]

試題編號 Question No.

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

|                                     |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

|                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

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.

ai) The equilibrium position will shift to right when 2 mole of reactant and 1 mole of product. The reaction rate will be faster if it is set at a high temperature.

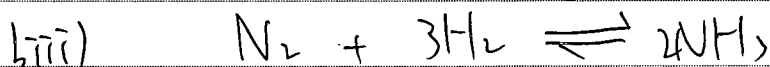
aii) The total number of molecules

1. aiii) Carbon monoxide, Hydrogen.

2. aiii) methanol

bi) Fractional distillation of liquid air.

bii) ~~In order to~~ Since the Haber process is highly exothermic, install a heat exchanger can help exchange to hot and reuse it.

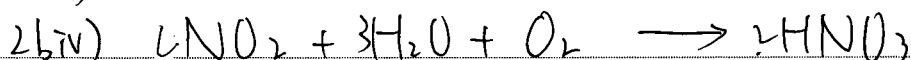
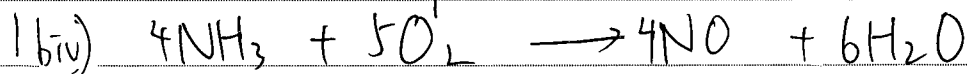


$$\text{no of mole of N}_2 = \frac{420000}{(14 \times 2)} = 15000$$

$$\text{no of mole of H}_2 = \frac{160000}{2} = 80000$$

1 mole of  $\text{N}_2$  required 3 moles of  $\text{H}_2$ ,  $\text{H}_2$  is in excess.

$$\therefore \text{Mass of ammonia produced} = 15000 \times 2 \times (14 + 3) \times 15\% = 76500 \text{ g.}$$



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.

本頁積分 Page total

|  |
|--|
|  |
|--|

試題編號 Question No.

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

|                                     |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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.

1ci) Consider trial 1 and 3, the concentration of  $C_{12}H_{22}O_{11}$  is keeping constant, the concentration of  $HCl(aq)$  increase 3 times, the reaction rate increase 3 times. So, the reaction order of  $HCl$  is 1

$$\frac{\text{Rate 1}}{\text{Rate 2}} = \frac{k(0.01)^x \left(\frac{0.1}{0.2}\right)^y}{k(0.02)^x \left(\frac{0.1}{0.2}\right)^y} = \frac{6.0 \times 10^{-7}}{2.4 \times 10^{-6}}$$

$$\left(\frac{0.01}{0.02}\right)^x = \frac{1}{2}$$

$$x = 1$$

∴ The reaction order of  $C_{12}H_{22}O_{11}$  is 1

Let the equation of rate be  $\text{rate} = k[C_{12}H_{22}O_{11}]^x [HCl(aq)]^y$

2ci)  $\text{Rate} = k[C_{12}H_{22}O_{11}]^x [HCl(aq)]^y$

3ci)  $6.0 \times 10^{-7} = k(0.01)(0.1)$

$$k = 6 \times 10^{-4} \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$$

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.

本頁積分 Page total

|  |
|--|
|  |
|--|

試題編號 Question No.

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

|                                     |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

13 14 15 16 17 18 19 20 21 22 23 24  $\geq 25$

每題另起新頁作答。

Start each question on a new page.

(ii) As a catalyst

(iii) The atom economy is 100%, less waste is produced.

less hazardous reactant is used in the reaction of starch.

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.

本頁積分 Page total

試題編號 Question No.

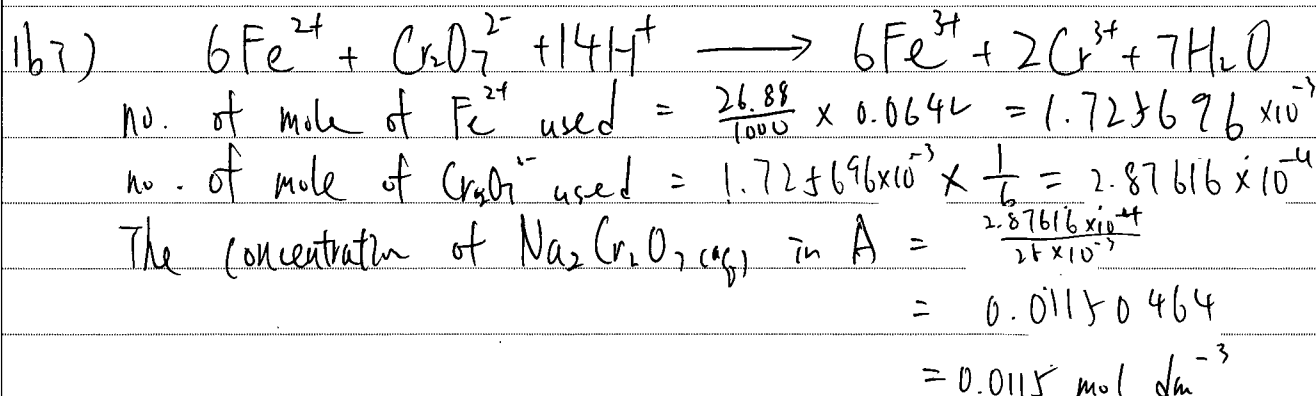
|                          |                          |                                     |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1                        | 2                        | 3                                   | 4                        | 5                        | 6                        | 7                        | 8                        | 9                        | 10                       | 11                       | 12                       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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.

ai) It absorb  $\text{CO}_2$  in the air, which is hygroscopic.

aii) Add dilute hydrochloric acid into the solution, a yellowish green gas is evolved, which is chlorine.

aiii) The similarity is both of them show a broad absorption peak at  $2500\text{cm}^{-1}$  to  $3300\text{cm}^{-1}$ , since both of them contain hydroxyl group. The difference is in the infra-red spectra of chitin, it will show a absorption peak at  $1680\text{cm}^{-1}$  to  $1800\text{cm}^{-1}$  since chitin contain  $-\text{C}=\text{O}$  group, while cellulose does not.



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

本頁積分 Page total

試題編號 Question No.

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

|                          |                          |                                     |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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

每題另起新頁作答。

Start each question on a new page.

寫於邊界以外的答案，將不予評閱。

Answers written in the margins will not be marked.

1 bii) In order to select a suitable light which will absorbed by  $\text{Cr}_2\text{O}_7^{2-}$  (aq) solution.

2 bii) They are directly proportional, concentration of  $\text{Cr}_2\text{O}_7^{2-}$  increase, the absorbance increase.

3 bii) By the graph, the concentration at 0.26 absorbance is  $0.0007 \text{ mol dm}^{-3}$

The concentration of  $\text{Na}_2\text{Cr}_2\text{O}_7$  (aq) in B  
 $= 0.0007 \times 100$   
 $= 0.07 \text{ mol dm}^{-3}$

3 biii) Colorimetry will be better, since the rate of <sup>reaction</sup> of very dilute  $\text{Na}_2\text{Cr}_2\text{O}_7$  will be very slow, <sup>it is hard to do reaction.</sup> but colorimetry will be accurate.

c i) In the mass spectra of Y, the  $m/z$  peak of 45 will <sup>significantly</sup> observed since the stripping of the  $\text{COOH}^+$  ion from the compound Y. And in the spectrum of X, the  $m/z$  peak of 28 will observed <sup>significantly</sup> since the stripping of  $\text{C}=\text{O}^+$  of X.

1 c ii) Add solution of X and Y in dichloromethane to the separating funnel. Then add dilute  $\text{Na}_2\text{CO}_3$  (aq) into the funnel. Stopper the funnel and shake gently. Also, open the stopper to release the pressure at a regular of time. Discard the lower layer. Then add dilute  $\text{H}_2\text{SO}_4$  (aq) into the funnel to regenerate solid Y. Use filtration.

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.

本頁積分 Page total

|  |
|--|
|  |
|--|

試題編號 Question No.

|                          |                          |                                     |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1                        | 2                        | 3                                   | 4                        | 5                        | 6                        | 7                        | 8                        | 9                        | 10                       | 11                       | 12                       |                          |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| 13                       | 14                       | 15                                  | 16                       | 17                       | 18                       | 19                       | 20                       | 21                       | 22                       | 23                       | 24                       | ≥25                      |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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

to filtrate the solution and obtain solid Y. Wash with a little water and dry with filter paper.

2C(ii) Compare the melting point of solid Y with an authentic sample, since pure compound will give the same <sup>sharp</sup> melting point, but if it is not pure, there will be a wide range of melting point.

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.

本頁積分 Page total



| 試題編號 Question No.        |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |     |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----|
| 1                        | 2                        | 3                        | 4                        | 5                        | 6                        | 7                        | 8                        | 9                        | 10                       | 11                       | 12                       |     |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |     |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |     |
| 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.

本頁積分 Page total

### Comments

The candidate's answers show good understanding of the chemical concepts and principles in the curriculum (e.g. Paper 1 Qs. 1(b), 2(a), 3(b), 4(b), 10(c)(i), 13(d); Paper 2 Qs. 1(a)(ii), 1(a)(iii), 1(b)(i), 1(c)(ii), 3(a)(ii), 3(c)(ii)(2)). He/she demonstrates very good abilities of applying chemical concepts on unfamiliar situations for solving the problems (e.g. Paper 1 Qs. 8(a)(i), 12; Paper 2 Qs. 1(b)(iv)(1), 3(b)(ii)(2)). The candidate performs well on chemical calculations (e.g. Paper 1 Qs. 1(c)(i), 6(b)(ii), 7(d), 10(b); Paper 2 Qs. 1(c)(i), 3(b)(i)(2), 3(b)(ii)(3)). He/she can effectively communicate ideas using scientific terminology, appropriate diagrams and chemical equations (e.g. Paper 1 Qs. 1(c)(ii), 3(c)(i), 6(b)(i), 7(d), 12, 13(a); Paper 2 Q. 1(c)(iii)). He/she can design appropriate method for carrying out scientific investigations (e.g. Paper 1 Qs. 13(a), 13(e); Paper 2 Q. 3(c)(ii)(1)).