HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2019

# CHEMISTRY PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)

This paper must be answered in English

## GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 45 minutes.

2. Section A consists of multiple-choice questions in this question paper, while Section B contains conventional questions printed separately in Question-Answer Book **B**.

3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book for Section B will be collected separately at the end of the examination.**

4. A Periodic Table is printed on page 20 of Question-Answer Book **B**. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

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## INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.

2. When told to open this book, you should check that all the questions are there. Look for the words **'END OF SECTION A'** after the last question.

3. All questions carry equal marks.

4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.

5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.



Not to be taken away before the end of the examination session

**This section consists of two parts. There are 24 questions in PART I and 12 questions in PART II.**

**Choose the best answer for each question.**

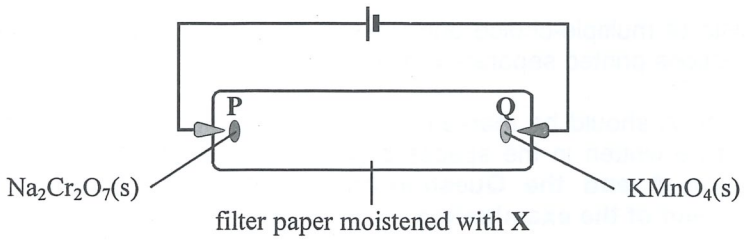
**Candidates may refer to the Periodic Table printed on page 20 of Question-Answer Book B.**

**PART I**

1. Which of the following pairs of atomic numbers corresponds to elements with similar chemical properties ?

   A. 4, 14
   B. 8, 18
   C. 9, 35
   D. 19, 38

2. The set-up of an experiment is shown below :




   What can be observed after the circuit is closed for a period of time ?

   A. If **X** is dilute $H_2SO_4$, a purple patch migrates towards **P**.
   B. If **X** is dilute $H_2SO_4$, an orange patch migrates towards **Q**.
   C. If **X** is ethanol, a purple patch migrates towards **P**.
   D. If **X** is ethanol, an orange patch migrates towards **Q**.

3. Which of the following processes does NOT involve oxidation and reduction ?

   A. red wine turning sour
   B. removing rust using white vinegar
   C. combusting natural gas in a power station
   D. removing nitrogen oxides in the catalytic converter of a car

4. 25.00 $cm^3$ of 0.051 M $C_4H_4O_4(aq)$ can completely neutralise 22.18 $cm^3$ of 0.115 M KOH(aq). What is the basicity of the acid $C_4H_4O_4$ ?

   A. 1
   B. 2
   C. 3
   D. 4

5. 25.00 $cm^3$ of 0.50 M lead(II) nitrate solution is mixed with 50.00 $cm^3$ of 1.00 M sodium chloride solution. Insoluble lead(II) chloride is formed during mixing. What is the concentration of $Cl^-(aq)$ in the mixture ?

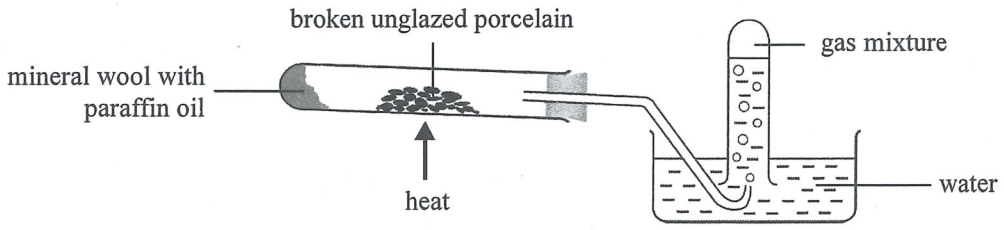
   A. 0.33 M
   B. 0.50 M
   C. 0.75 M
   D. 1.50 M

6. 2.53 g of $NaHCO_3(s)$ was heated until no further changes and 1.59 g of a solid remained. Which of the following equations matches with the experimental result ?

(Relative atomic masses : H = 1.0, C = 12.0, O = 16.0, Na = 23.0)

A. $NaHCO_3(s) \rightarrow NaOH(s) + CO_2(g)$
B. $2NaHCO_3(s) \rightarrow Na_2O_2(s) + 2CO_2(g) + H_2(g)$
C. $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$
D. $2NaHCO_3(s) \rightarrow Na_2O(s) + H_2O(g) + 2CO_2(g)$

7. The set-up of an experiment is shown below :




Which of the following statements is INCORRECT ?

A. The broken unglazed porcelain acts as a catalyst.
B. Fractional distillation is performed in the set-up.
C. The gas mixture turns acidified potassium permanganate solution from purple to colourless.
D. When no more gas can be collected, the delivery tube should be taken out of the water before removing the heat source.

8. 39.2 g of an oxide of rubidium (Rb) contains 28.5 g of rubidium. What is the empirical formula of this oxide ?

(Relative atomic masses : O = 16.0, Rb = 85.5)

A. RbO
B. $RbO_2$
C. $Rb_2O$
D. $Rb_2O_2$

9. It is given that :

Standard enthalpy change of formation of water = –286 kJ $mol^{-1}$
Standard enthalpy change of combustion of propane = –2222 kJ $mol^{-1}$
Standard enthalpy change of formation of carbon dioxide = –394 kJ $mol^{-1}$

What is the standard enthalpy change of formation of propane ?

A. –52 kJ $mol^{-1}$
B. +52 kJ $mol^{-1}$
C. –104 kJ $mol^{-1}$
D. +104 kJ $mol^{-1}$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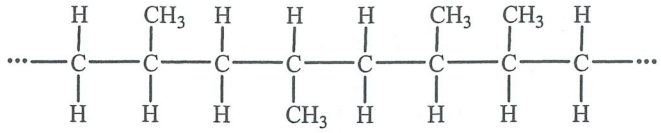
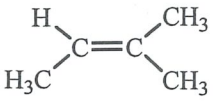
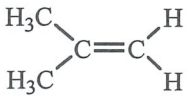
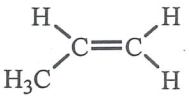
10. A part of the structure of a polymer is shown below :

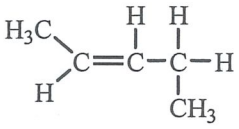


Which of the following can be a monomer of this polymer ?

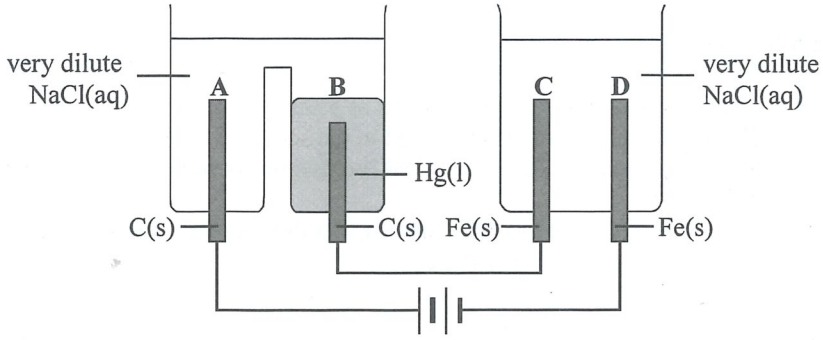
A. 

B. 

C. 

D. 

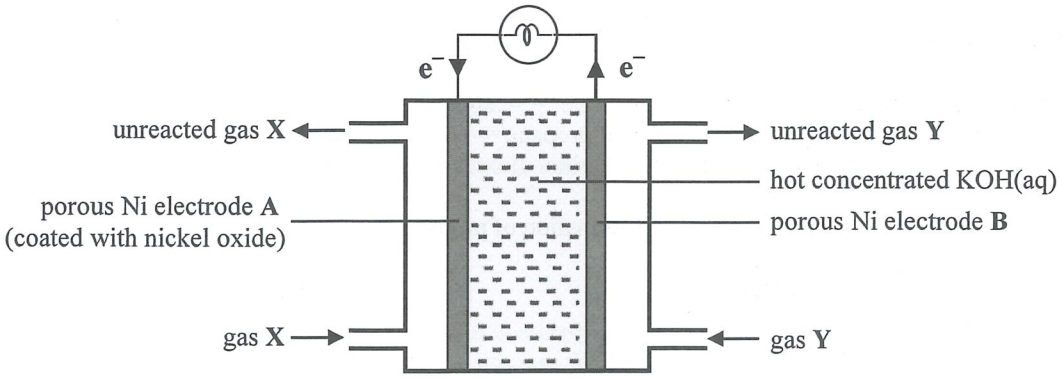
11. Consider the following electrolytic cells :




What would happen during electrolysis ?

A. Oxygen forms around **A**.
B. Chlorine forms around **B**.
C. Hydrogen forms around **C**.
D. Iron(II) ions form around **D**.

12. Which of the following statements concerning the fuel cell below that can form water is INCORRECT ?




A. It is a primary cell.
B. Ni also acts as a catalyst.
C. **X** can be obtained from fractional distillation of liquid air.
D. The equation for the change at electrode **B** is : $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

13. Which of the following combinations is correct ?

| | Molecule | Molecular shape |
|---|---|---|
| A. | $OF_2$ | linear |
| B. | $CS_2$ | V shaped |
| C. | $NCl_3$ | trigonal planar |
| D. | $PF_3$ | trigonal pyramidal |

14. Consider the following reaction :

$(NH_4)_2Cr_2O_7(s) \rightarrow Cr_2O_3(s) + N_2(g) + 4H_2O(g)$

Which of the following statements is / are correct ?

(1) The oxidation number of chromium decreases.
(2) Only covalent bonds are broken and formed.
(3) Green solid turns to orange solid.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

15. Which of the following methods can slow down the corrosion of an iron-made object ?

(1) Connect it to a piece of lead.
(2) Plate a layer of copper coating completely onto its surface.
(3) Connect it to the cathode of a chemical cell.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

16. Which of the following chemicals can be used to distinguish concentrated hydrochloric acid from concentrated nitric acid ?

(1) sodium carbonate solid
(2) silver nitrate solution
(3) copper metal

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

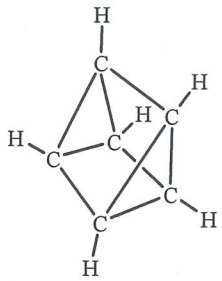

Go on to the next page

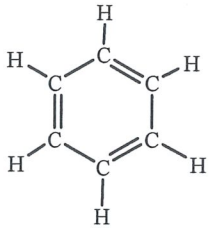
17. Which of the following metal oxides can be reduced to a metal when heated with carbon using a Bunsen burner ?

(1) lead(II) oxide
(2) magnesium oxide
(3) copper(II) oxide

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

18. Consider the following two compounds :





Which of the following statements is / are correct ?

(1) They are both soluble in water.
(2) They have the same empirical formula.
(3) They are in the same homologous series.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

19. In which of the following reactions does the underlined chemical act as a reducing agent ?

(1) $\underline{2C_4H_{10}} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
(2) $\underline{Ba(NO_3)_2} + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$
(3) $\underline{Zn(OH)_2} + 2NaOH \rightarrow Na_2Zn(OH)_4$

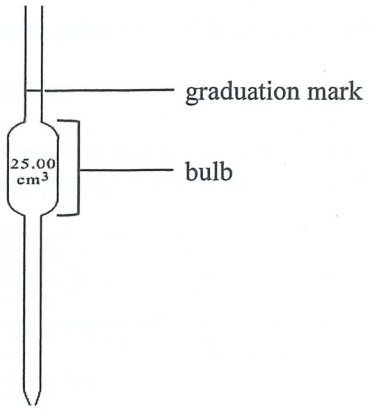
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

20. Aqueous calcium hydroxide can be used to

(1) neutralise acidic substances in soil.
(2) distinguish carbon dioxide from carbon monoxide.
(3) remove sulphur dioxide from a polluted air sample.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

21. The diagram below shows a common glass apparatus :




Which of the following statements concerning the transfer of an acid using this apparatus are INCORRECT ?

(1) The bulb should be firmly held in the hand when being filled with acid.
(2) Exactly 20.00 $cm^3$ of acid can be transferred using this apparatus.
(3) The apparatus should first be rinsed by distilled water, then immediately followed by the transfer of acid.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

22. Which of the following are exothermic ?

(1) thermal decomposition of mercury(II) oxide solid
(2) dilution of concentrated sulphuric acid with water
(3) reaction of magnesium ribbon with dilute hydrochloric acid

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

23. Which of the following statements concerning ethanol are correct ?

(1) It is flammable.
(2) It is soluble in water.
(3) It is more volatile than water.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

24. Consider the following statements and choose the best answer :

| **1st statement** | **2nd statement** |
|---|---|
| Mercury has good electrical conductivity at room temperature. | Mercury has delocalised electrons. |

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.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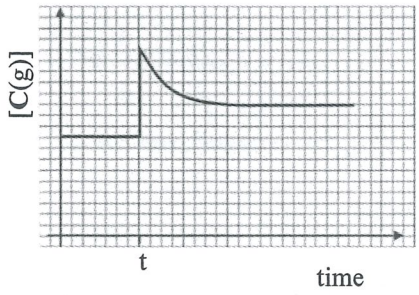
**PART II**

25. Consider the following equilibrium system in a closed container of fixed volume :

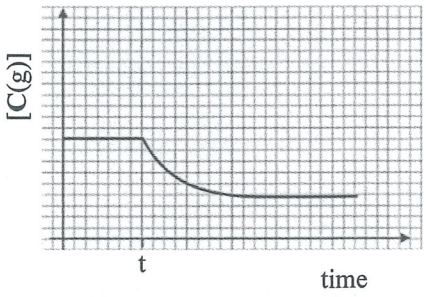
$\mathbf{A}(g) + \mathbf{B}(g) \rightleftharpoons 2\mathbf{C}(g)$

A small amount of **B**(g) is added at time t and finally a new equilibrium is attained at the same temperature. Which of the following graphs can represent the variation of [**C**(g)] with time ?

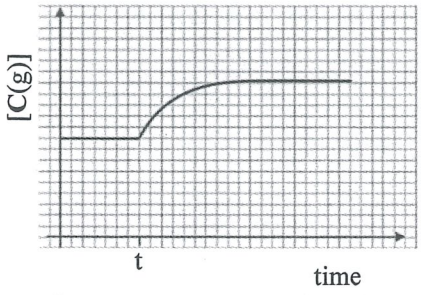
A.



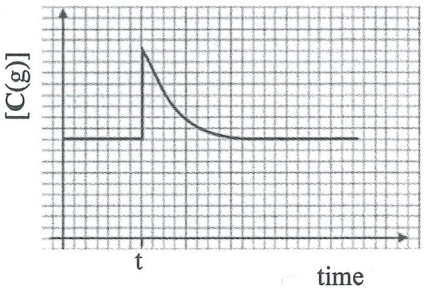

B.




C.




D.




26. Consider the following two reactions at a certain temperature :

Reaction (1) : $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ Equilibrium constant $Kc = 0.8$
Reaction (2) : $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$ Equilibrium constant $Kc = \mathbf{X}$

What is **X** ?

A. 0.8
B. 1.25
C. 0.8 $mol^{-1}dm^3$
D. 1.25 $mol^{-1}dm^3$

27. The decomposition of HI(g) into $H_2(g)$ and $I_2(g)$ is reversible. In a closed container of 3.0 $dm^3$ keeping at a fixed temperature, an equilibrium mixture contains 0.10 mol of HI(g), 0.60 mol of $H_2(g)$ and 0.60 mol of $I_2(g)$. What is the equilibrium constant *Kc* for the decomposition at this temperature ?

A. 0.4
B. 3.6
C. 9.0
D. 36.0

28. Consider the following reaction :

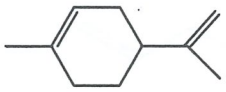
$2NaOH(aq) + N_2O_4(g) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$

What is the minimum volume of 0.5 M NaOH(aq) needed to completely react with 480 $cm^3$ of $N_2O_4(g)$ at room conditions ?

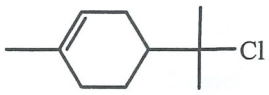
(Molar volume of gas at room conditions = 24 $dm^3$)

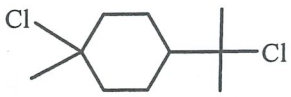
A. 8 $cm^3$
B. 12.5 $cm^3$
C. 40 $cm^3$
D. 80 $cm^3$

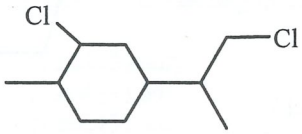
29. The structure of limonene is shown below :

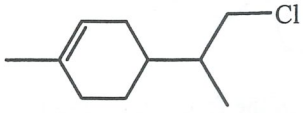


It reacts with excess HCl(g) to give **Z** as the major product. Which of the following is **Z** ?

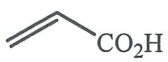
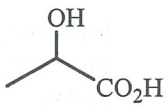
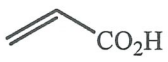
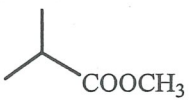
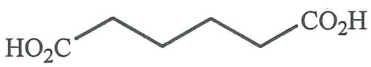
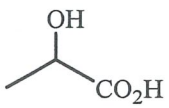
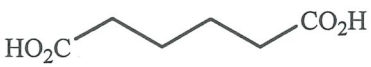
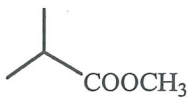
A. 


B. 


C. 


D. 


30. Choose one combination from below in which **X** can make an addition polymer; while **Y** can make a condensation polymer.

| | **X** | **Y** |
|---|---|---|
| A. |   |   |
| B. |   |   |
| C. |   |   |
| D. |   |   |



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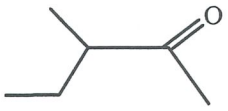
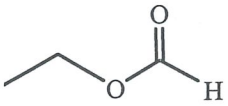
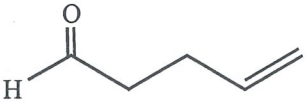
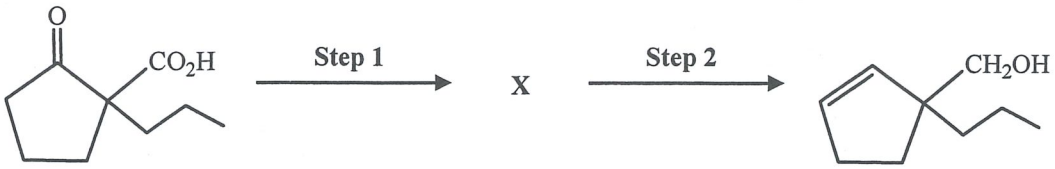
31. Which of the following combinations is correct ?

| | Structure | Systematic name |
|---|---|---|
| A. |  | 3-ethylbutanone |
| B. |  | pentane-1,5-diamide |
| C. |  | ethyl methanoate |
| D. |  | pent-1-enal |

32. Consider the following conversion of organic compounds :




Which of the following combinations of steps is correct ?

| | Step 1 | Step 2 |
|---|---|---|
| A. | $LiAlH_4$, dry ether; then $H^+(aq)$ | NaOH(aq), heat |
| B. | $NaBH_4$, ethanol; then $H^+(aq)$ | NaOH(aq), heat |
| C. | $LiAlH_4$, dry ether; then $H^+(aq)$ | concentrated $H_2SO_4(l)$, heat |
| D. | $NaBH_4$, ethanol; then $H^+(aq)$ | concentrated $H_2SO_4(l)$, heat |

33. Which of the following does NOT exhibit a characteristic of iron as a transition metal ?

A. Iron corrodes readily.
B. Iron can be used as a catalyst.
C. Iron can form two chlorides.
D. Iron(II) sulphate solution is green.

34. Consider the following reaction :

$$2H_2O_2(aq) \xrightarrow{MnO_2(s)} 2H_2O(l) + O_2(g)$$

Which of the following statements is / are correct if the concentration of $H_2O_2(aq)$ changes from 2 M to 1 M, while the other conditions remain unchanged ?

(1) The consumption of $MnO_2(s)$ will decrease.
(2) The rate of formation of $O_2(g)$ will decrease.
(3) The volume of $O_2(g)$ formed will decrease.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

35. Consider the following reaction :

$$5NaBr(aq) + NaBrO_3(aq) + 6HCl(aq) \rightarrow 3Br_2(aq) + 6NaCl(aq) + 3H_2O(l)$$
(colourless)

Which of the following can be measured in order to follow the progress of the reaction ?

(1) pH of the reacting mixture
(2) pressure of the reaction system
(3) colour intensity of the reacting mixture

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

36. Consider the following statements and choose the best answer :

| **1st statement** | **2nd statement** |
|---|---|
| $CH_2$=CHCH($CH_3$)$C_2H_5$ can exhibit optical activity. | $CH_2$=CHCH($CH_3$)$C_2H_5$ has one chiral centre. |

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.

**END OF SECTION A**

2019-DSE
CHEM
PAPER 1B

**B**

Please stick the barcode label here.

| Candidate Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2019

# CHEMISTRY PAPER 1

## SECTION B : Question-Answer Book B

This paper must be answered in English

### INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) This section consists of TWO parts, Parts I and II.

(4) Answer ALL questions in both Parts I and II. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.

(6) Supplementary answer sheets will be provided on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this Question-Answer Book.

(7) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.





*A140E01B*

## PART I

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

1. The table below shows some information of three atoms :

| | Number of protons | Number of electrons | Number of neutrons |
|---|---|---|---|
| Protium | 1 | 1 | 0 |
| Deuterium | 1 | 1 | 1 |
| Oxygen | 8 | 8 | 8 |

(a) Explain why protium and deuterium are isotopes.

(1 mark)

(b) Deuterium can be represented by D. It reacts with oxygen as shown in the equation below :

$$2D_2 + O_2 \rightarrow 2D_2O$$

Draw the electron diagram for a $D_2O$ molecule, showing ELECTRONS IN THE OUTERMOST SHELLS only.

(1 mark)

(c) A small piece of sodium metal is placed into liquid $D_2O$ at room conditions.

(i) State TWO expected observations.

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

(3 marks)



Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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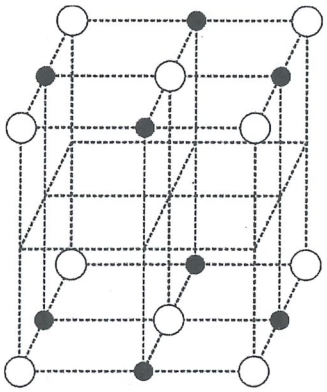
2. Sodium chloride crystal has a giant ionic structure.

(a) The diagram below shows a part of the structure of sodium chloride crystal with some ions missing.



● = $Na^+$
○ = $Cl^-$

Complete the diagram by using ● as $Na^+$ ion and ○ as $Cl^-$ ion.

(1 mark)

(b) From an experiment, it was found that there are 4 $Na^+$ ions and 4 $Cl^-$ ions in a cube of sodium chloride crystal of volume $1.80 \times 10^{-22}$ $cm^3$.

(i) Express the total mass of 4 $Na^+$ ions and 4 $Cl^-$ ions in terms of the Avogadro's constant L.
(Relative atomic masses : Na = 23.0, Cl = 35.5)

(ii) Hence, calculate the Avogadro's constant L, given that 1.00 $cm^3$ of sodium chloride crystal weighs 2.17 g.

(3 marks)



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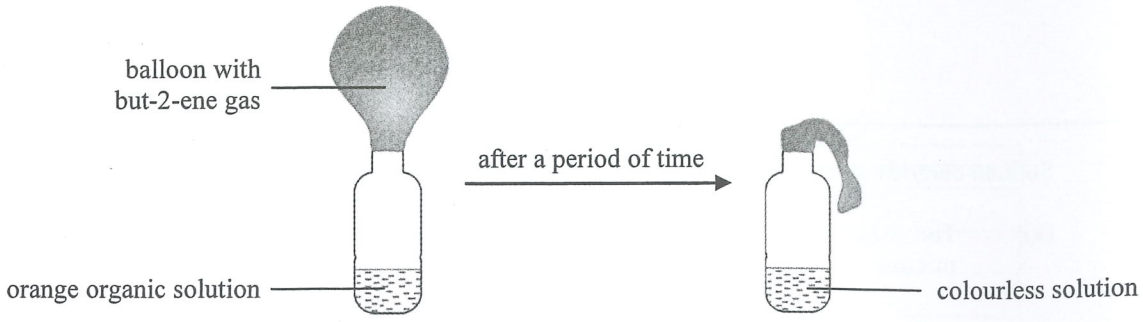
3. An experiment was carried out as shown below :

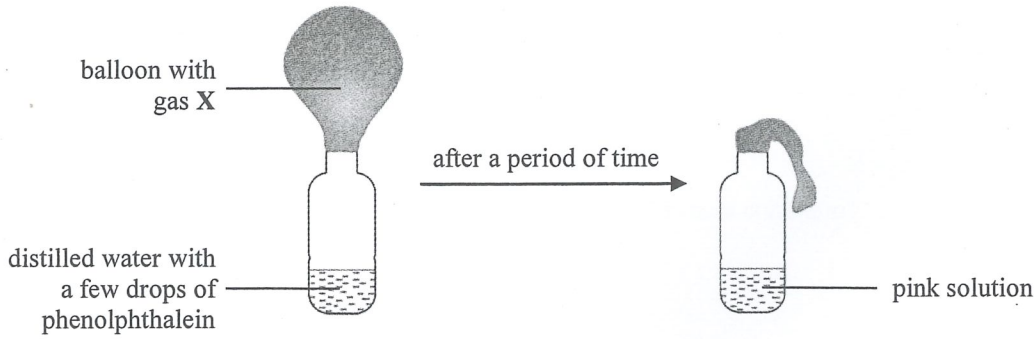



(a) (i) Suggest what the orange organic solution may be.

(ii) With the help of a chemical equation, explain the colour change in the solution.

(3 marks)

(b) Another experiment was carried out as shown below :




With the help of a chemical equation, suggest and explain what gas **X** may be.

(3 marks)



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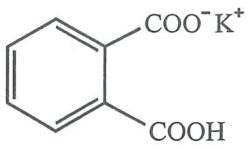
4. Solid potassium hydrogenphthalate can be used to prepare standard solutions. Its structure is shown below :




(a) You are provided with 1.12 g of solid potassium hydrogenphthalate.

(i) Describe briefly how a 250.0 $cm^3$ of standard solution containing 1.12 g of potassium hydrogenphthalate can be prepared in a laboratory.

(ii) Calculate the molarity of the standard solution obtained in (i).
(Formula mass : potassium hydrogenphthalate = 204.1)

(4 marks)

(b) At room conditions, the pH of a 0.060 M of potassium hydrogenphthalate solution is 3.30. Based on this information and appropriate calculation, comment whether the –COOH group in potassium hydrogenphthalate is completely ionised.

(2 marks)



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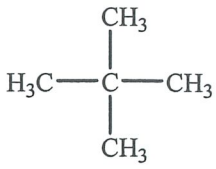
5. The structure of a compound is shown below :



Reacting with a reagent under certain conditions, it can give two compounds with the same molecular formula $C_5H_{10}Cl_2$ but different structures.

(a) Suggest what the reagent is.

(1 mark)

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

(1 mark)

(c) Name the type of the reaction involved.

(1 mark)

(d) (i) Draw the structure of ONE of these two compounds and give its systematic name.

(ii) Draw the structure of the other compound.

(iii) These two compounds are isomers. State the type of isomerism exhibited by them.

(4 marks)



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6. Consider $CH_2Cl_2$ and $CCl_4$ molecules :

(a) Draw the three-dimensional structure of a $CH_2Cl_2$ molecule.

(1 mark)

(b) (i) Explain why $CH_2Cl_2$ is a polar molecule but $CCl_4$ is not.

(ii) Explain why $CCl_4$ has a higher boiling point than $CH_2Cl_2$.

(3 marks)



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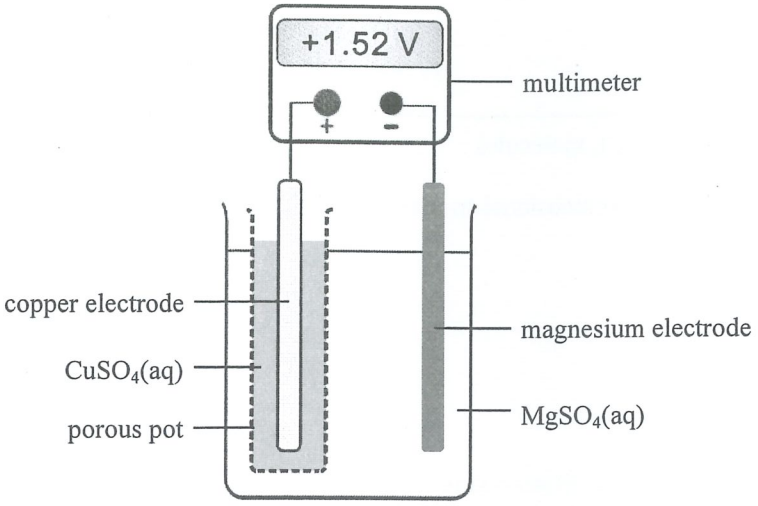
7. (a) Consider the chemical cell as shown below :




(i) What is the function of the porous pot ?

(ii) Deduce whether the electrons flow through the external circuit from the magnesium electrode to the copper electrode.

(iii) Write the half equation for the change that occurs at the cathode.

(3 marks)



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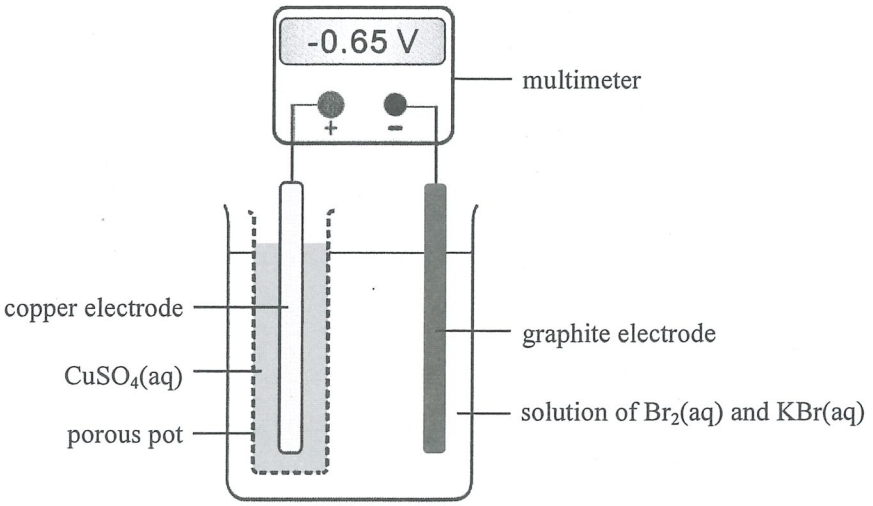
7. (b) Consider another chemical cell as shown below :




(i) Write the half equation for the change that occurs at the graphite electrode.

(ii) State the expected observation at the copper electrode.

(iii) Would the multimeter reading become more negative, less negative or remain unchanged if the solution of $Br_2(aq)$ and KBr(aq) is replaced by a solution of $I_2(aq)$ and KI(aq), while the other conditions remain unchanged ? Explain your answer.

(4 marks)



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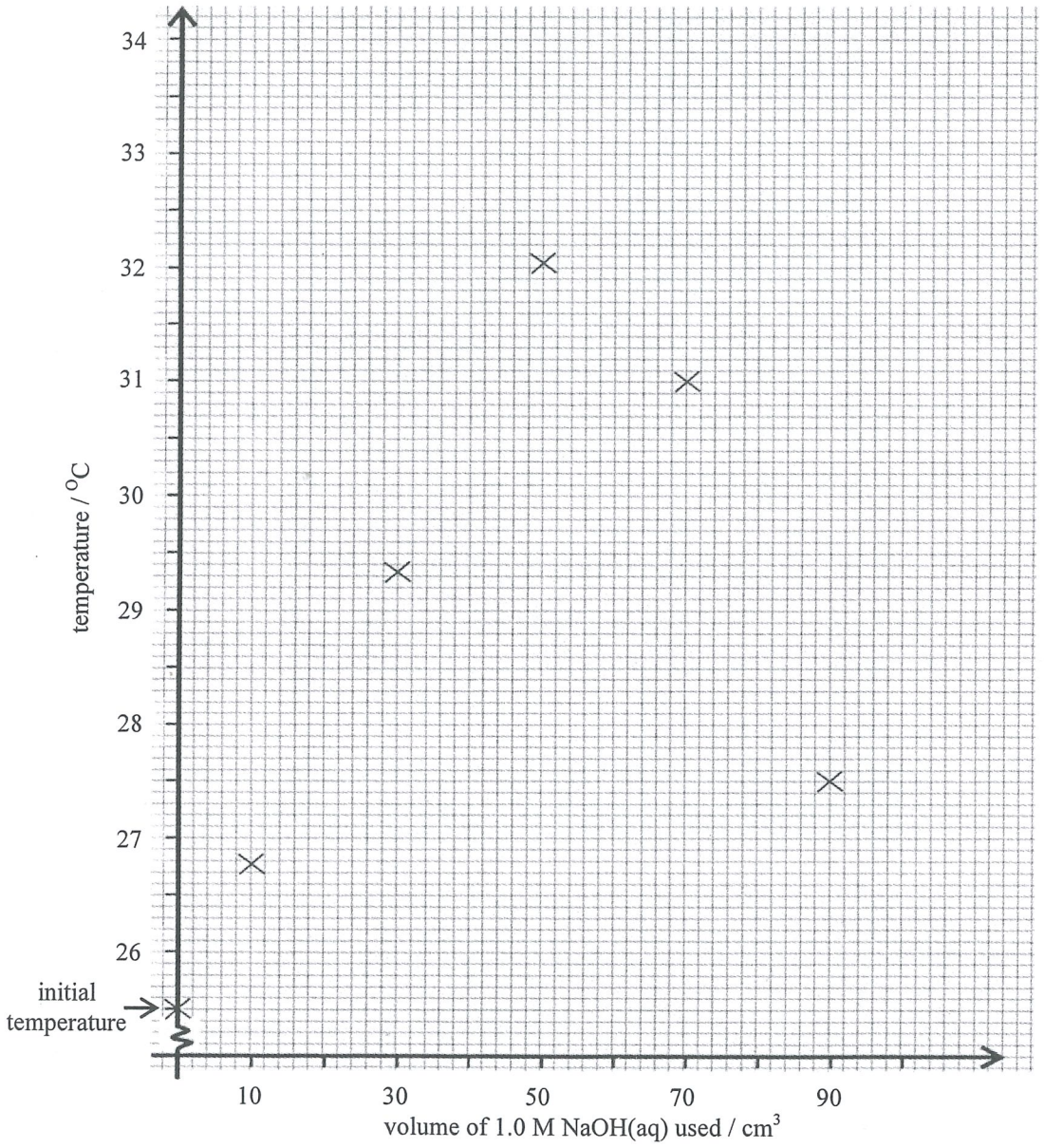
8. Several trials of an experiment were performed for determining the enthalpy change of neutralisation for a reaction. For each trial, a total volume of 100.0 $cm^3$ of a solution was obtained from mixing specified volumes of a HCl(aq) and 1.0 M NaOH(aq) as shown below in an expanded polystyrene cup. The HCl(aq) and NaOH(aq) were kept at the same initial temperature before mixing.

| Trial | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Volume of the HCl(aq) used / $cm^3$ | 90 | 70 | 50 | 30 | 10 |
| Volume of 1.0 M NaOH(aq) used / $cm^3$ | 10 | 30 | 50 | 70 | 90 |

For each trial, the mixture was stirred and its maximum temperature reached was recorded. A graph of the maximum temperature reached for each trial is shown below :




(a) It is estimated from the graph that 58.0 $cm^3$ of NaOH(aq) (and 42.0 $cm^3$ of HCl(aq)) is required for obtaining the possible maximum temperature reached in this experiment. Show how this estimation can be done in the above graph.

(1 mark)



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Answers written in the margins will not be marked.

8. (b) (i) Calculate the number of moles of NaOH(aq) reacted with HCl(aq) in (a). Hence, find the concentration of the HCl(aq).

(ii) Given that the initial temperature of the mixture for each trial is 25.5°C, calculate the enthalpy change of neutralisation of the reaction, in kJ $mol^{-1}$.
(Density of the mixture = 1.00 g $cm^{-3}$;
specific heat capacity of the mixture = 4.18 J $g^{-1}$ $K^{-1}$;
heat capacity of the expanded polystyrene cup : negligible)

(4 marks)

(c) The one determined above is not the standard enthalpy change of neutralisation. What, then, is meant by the term 'standard enthalpy change of neutralisation' ?

(1 mark)



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9. Iron cans used to store food products are commonly coated with a thin layer of tin.

(a) The thin layer of tin prevents iron cans from corrosion.

(i) Briefly describe the principle for this kind of corrosion prevention.

(ii) Explain whether these iron cans would corrode more readily once their surfaces are damaged by scratching.

(iii) Suggest why galvanisation is not suitable to prevent corrosion in iron cans that are used to store food products.

(3 marks)

(b) There is an increasing trend for manufacturers to use cans made entirely of aluminium for storing food products.

(i) Explain why aluminium is more resistant to corrosion than iron, although it occupies a higher position than iron in the reactivity series.

(ii) Name the process that increases the corrosion resistance of aluminium cans.

(iii) Other than corrosion resistance, suggest one advantage of using aluminium to make cans.

(3 marks)



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Answers written in the margins will not be marked.

*10. You are provided with common laboratory apparatus and the following chemicals :

iron powder zinc powder aqueous ammonia distilled water

Describe how zinc sulphate crystals can be obtained from a solid sample of zinc sulphate containing copper(II) sulphate as impurity. (Not all chemicals must be used.)

(5 marks)



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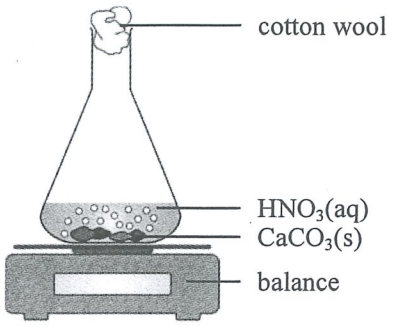
## PART II

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

11. Two trials of an experiment were performed using the set-up below to study the reaction between nitric acid and calcium carbonate. A gas was formed in the reaction.



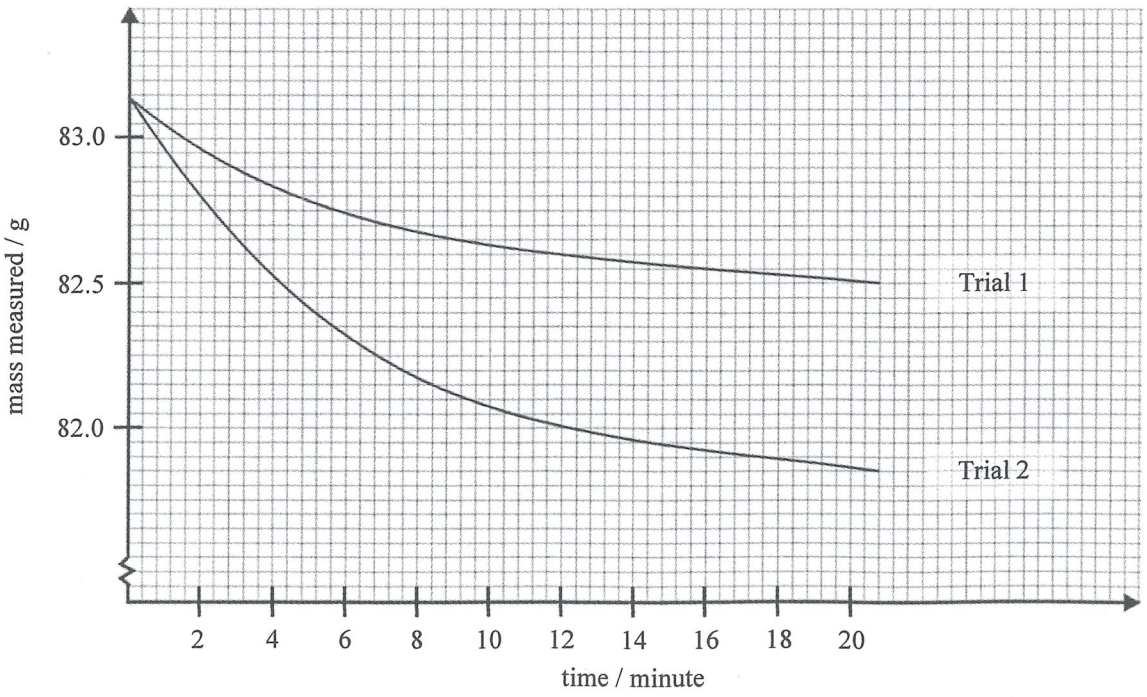

The chemicals used are listed in the table below while other experimental conditions were the same.

| Trial | Mass of $CaCO_3(s)$ added / g | Volume of 3.0 M $HNO_3(aq)$ added / $cm^3$ | Volume of $H_2O(l)$ added / $cm^3$ |
|---|---|---|---|
| 1 | 3.0 | 10.0 | 20.0 |
| 2 | 3.0 | 20.0 | 10.0 |

(a) Write the chemical equation for the reaction between nitric acid and calcium carbonate.

(1 mark)

(b) The graph below shows the variation of the mass measured with time for the two trials.



11. (b) (i) Calculate the average rate of formation of the gas from the 2nd minute to the 12th minute for Trial 2.

(ii) Explain ONE difference in the shape of the curves for Trial 1 and Trial 2.

(4 marks)

(c) Suggest how the effect of surface area of solid reactant on the rate of reaction can be studied using the above set-up.

(1 mark)



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12. Consider an equilibrium mixture of the following chemical reaction :

$$\underset{\text{yellow}}{Fe^{3+}(aq)} + \underset{\text{colourless}}{SCN^-(aq)} \rightleftharpoons \underset{\text{deep red}}{Fe(SCN)^{2+}(aq)}$$

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

(1 mark)

(b) At a certain temperature, the equilibrium constant $K_c$ for the reaction is $1.08 \times 10^3$ $dm^3$ $mol^{-1}$. The equilibrium mixture is prepared by mixing 20.0 $cm^3$ of 0.030 M $Fe(NO_3)_3(aq)$ with 10.0 $cm^3$ of 0.030 M KSCN(aq) in an acidic medium. Calculate the concentration of $Fe(SCN)^{2+}(aq)$ in the equilibrium mixture at that temperature.

(3 marks)

(c) It is known that the equilibrium constant $K_c$ increases when temperature increases. Suggest and explain whether the enthalpy change of the reaction is positive, negative or zero.

(1 mark)

(d) When a little amount of $Na_2SO_3(s)$ is added to the equilibrium mixture, the colour of the mixture becomes paler. Explain this observation.

(2 marks)



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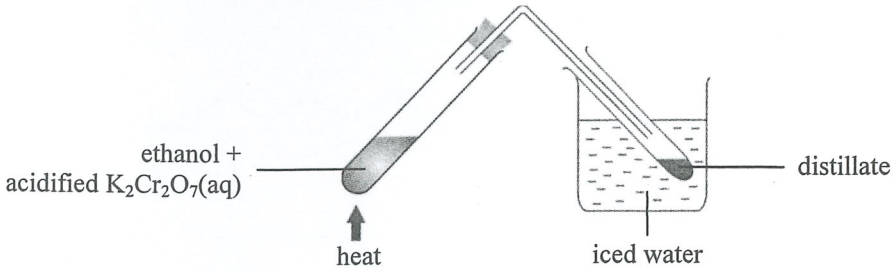
13. (a) It was intended to prepare ethanoic acid from ethanol by the following set-up. However, the distillate collected mainly contained another organic product **X** but not ethanoic acid.




(i) What is **X** ?

(ii) Explain why the distillate collected mainly contained **X** but not ethanoic acid.

(2 marks)

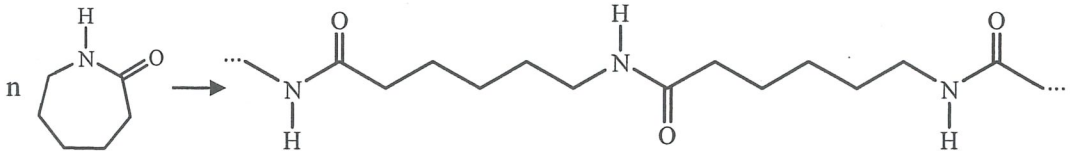
(b) Ethanoic acid can be converted to an unsubstituted amide.

(i) Give the systematic name of this amide.

(ii) Suggest what reagent and condition are needed for this conversion.

(2 marks)

(c) The following shows the formation of a polymer from an amide :



a portion of the polymer formed

(i) Draw the repeating unit of the polymer formed.

(ii) There is a view which suggests that the above polymerisation does not involve condensation. Give a reason to support this view.

(2 marks)



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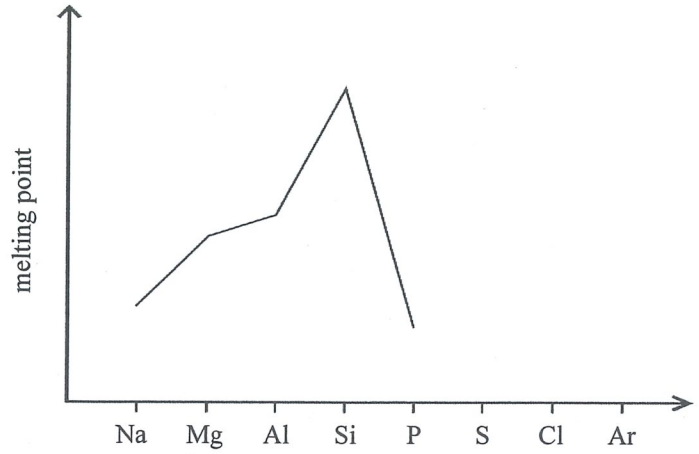
14. The following graph shows an incomplete sketch of the variation in melting points of the elements in the third period of the Periodic Table.




(a) Complete the sketch on the graph above.

(1 mark)

(b) Explain why the melting point of Mg is higher than that of Na.

(1 mark)

(c) Explain why the melting point of Si is higher than that of P.

(2 marks)



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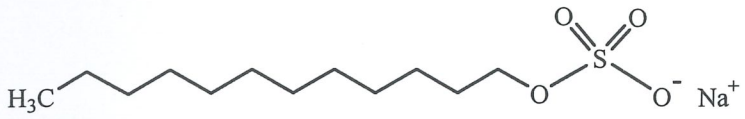
*15. With reference to the structure of sodium lauryl sulphate (SLS) below, explain why it has cleansing properties.




(5 marks)

**END OF SECTION B**
**END OF PAPER**



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# PERIODIC TABLE 周期表

**GROUP 族**

atomic number 原子序

1 **H** 1.0

relative atomic mass 相對原子質量

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

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