2019-DSE
CHEM
PAPER 1B

B

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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.

* A 1 4 0 E 0 1 B *

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)

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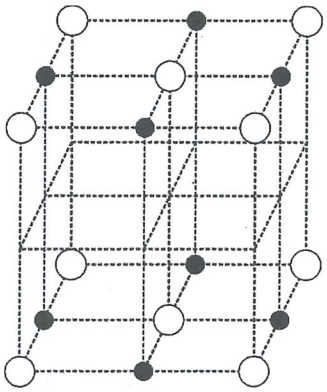
2. Sodium chloride crystal has a giant ionic structure.

(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 1.80×10^{-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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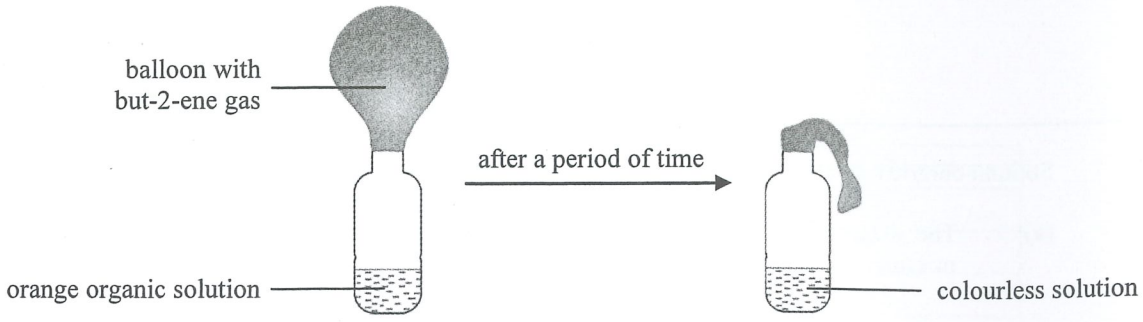
3. An experiment was carried out as shown below :

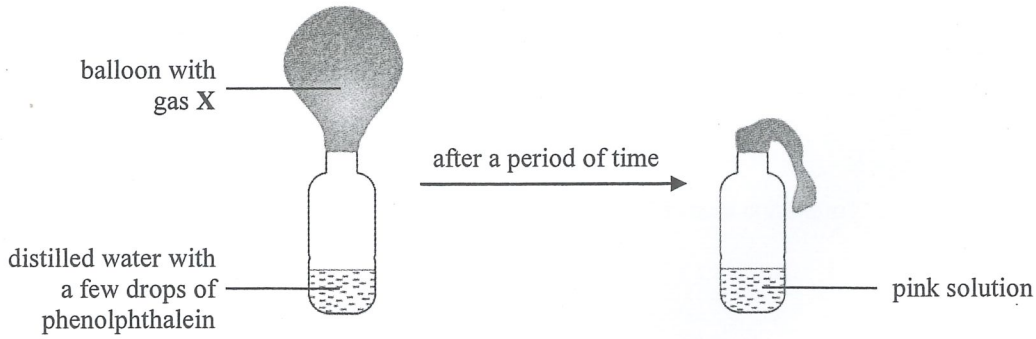


(a) (i) Suggest what the orange organic solution may be.

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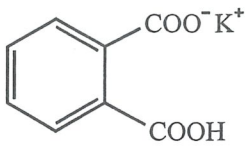
4. Solid potassium hydrogenphthalate can be used to prepare standard solutions. Its structure is shown below :



(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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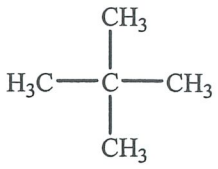
5. The structure of a compound is shown below :



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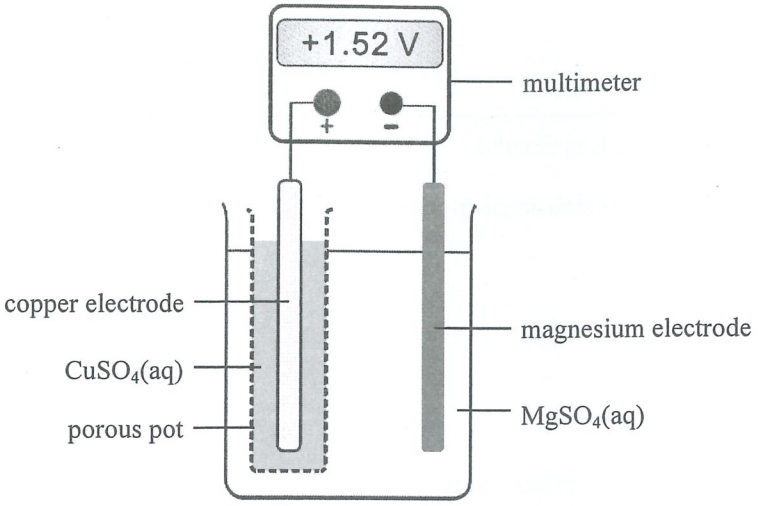
7. (a) Consider the chemical cell as shown below :



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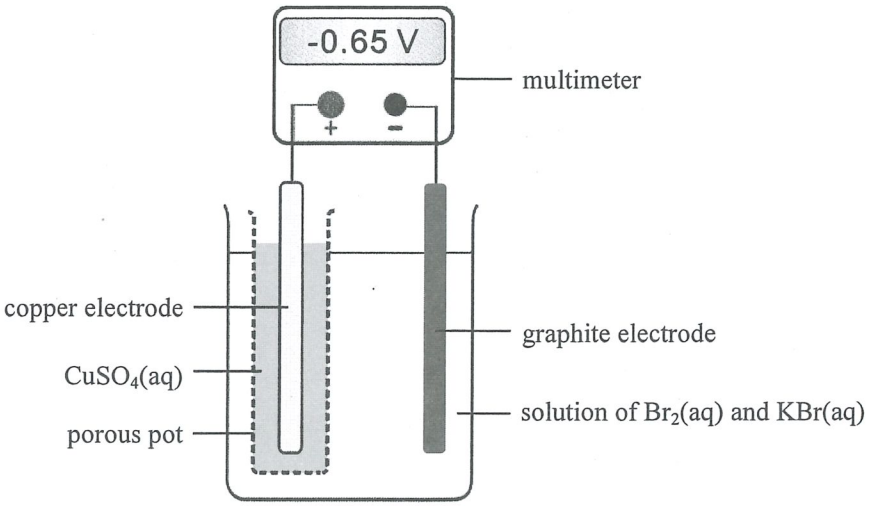
7. (b) Consider another chemical cell as shown below :



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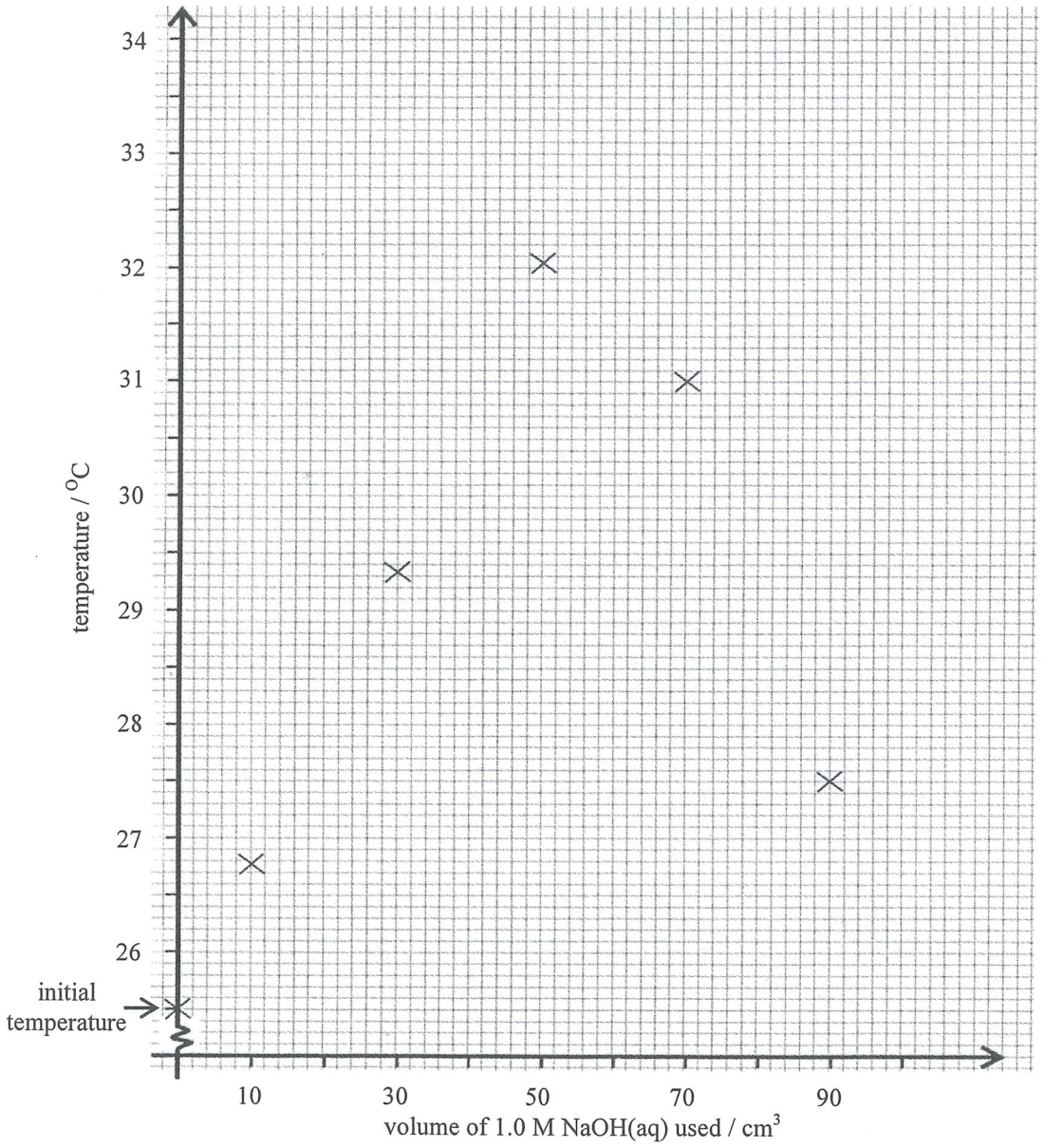
8. Several trials of an experiment were performed for determining the enthalpy change of neutralisation for a reaction. For each trial, a total volume of 100.0 cm^3 of a solution was obtained from mixing specified volumes of a HCl(aq) and 1.0 M NaOH(aq) as shown below in an expanded polystyrene cup.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

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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*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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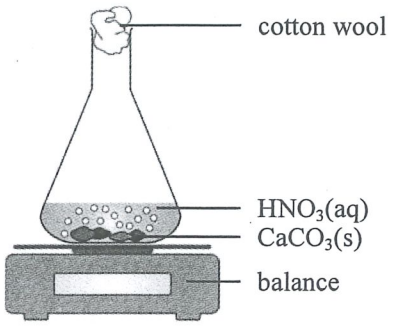
PART II

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.



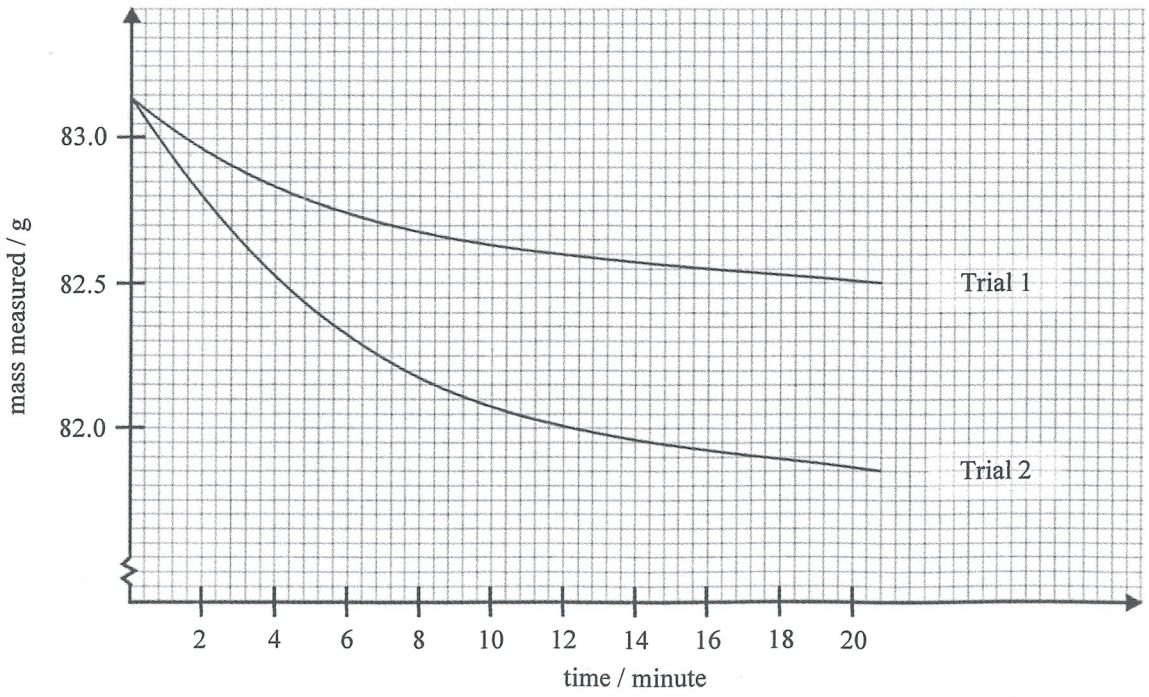
The chemicals used are listed in the table below while other experimental conditions were the same.

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.



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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 1.08×10^3 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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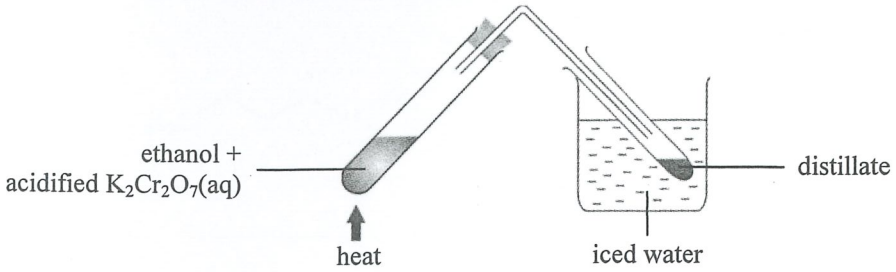
13. (a) It was intended to prepare ethanoic acid from ethanol by the following set-up. However, the distillate collected mainly contained another organic product **X** but not ethanoic acid.



(i) What is **X** ?

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

(2 marks)

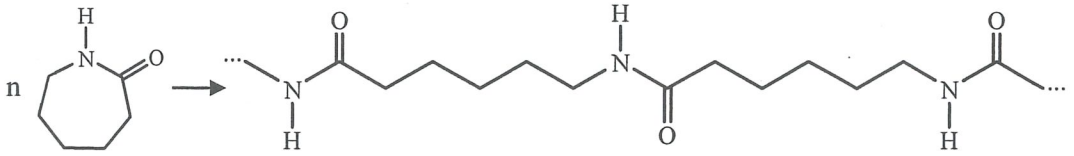
(b) Ethanoic acid can be converted to an unsubstituted amide.

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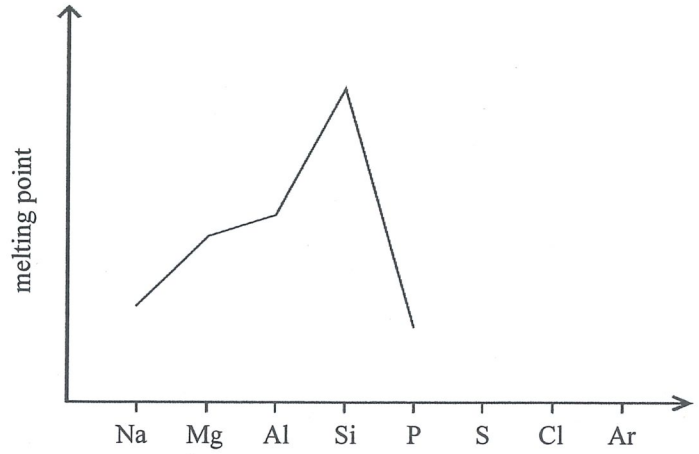
14. The following graph shows an incomplete sketch of the variation in melting points of the elements in the third period of the Periodic Table.



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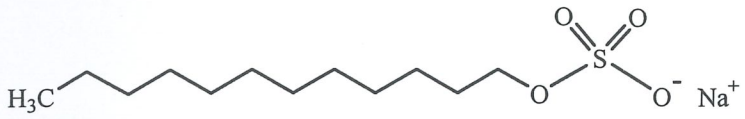
*15. With reference to the structure of sodium lauryl sulphate (SLS) below, explain why it has cleansing properties.



(5 marks)

END OF SECTION B
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PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序

relative atomic mass 相對原子質量

I	II											III	IV	V	VI	VII	0
																	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)