2018-DSE
CHEM
PAPER 1B

B

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HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2018

Candidate Number

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.

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PART I

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

1. Lithium occurs naturally in two isotopes, ^{6}Li and ^{7}Li. It can form lithium nitride (Li_3N) when burnt in air.

(a) (i) Calculate the percentage abundance of ^{6}Li in nature.
(Relative atomic mass: Li = 6.9)

(ii) Draw the electron diagram for lithium nitride, *showing electrons in the outermost shells only*.

(3 marks)

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1. (b) In an experiment, 1.25 g of lithium nitride is formed when a piece of lithium is burnt in air.

(i) Write a chemical equation for the reaction involved.

(ii) Calculate the mass of lithium that reacted with nitrogen.
(Relative atomic masses: Li = 6.9, N = 14.0)

(3 marks)

(c) Name another compound which will also be formed when lithium is burnt in air.

(1 mark)

Answers written in the margins will not be marked.

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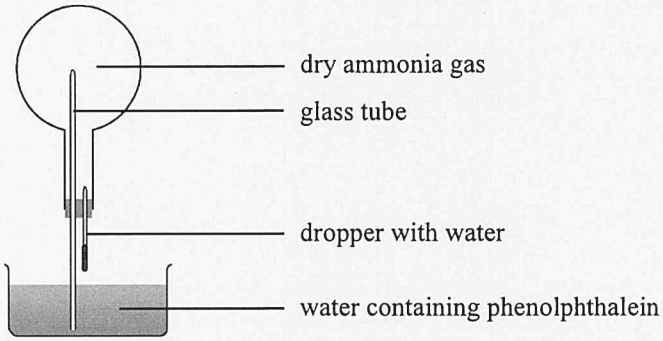
2. This question involves the preparation of ammonia gas and the investigation of the properties of ammonia gas in a laboratory.

(a) Solid calcium hydroxide reacts with solid ammonium chloride to form ammonia gas. Draw a labelled diagram to show the set-up involved and how ammonia gas is collected.

(2 marks)

(b) An experiment was performed to investigate the properties of ammonia gas with the set-up shown below :



The round-bottomed flask was initially full of dry ammonia gas. Several drops of water were injected into the flask from the dropper. The water containing phenolphthalein was then automatically sucked into the flask through the glass tube.

(i) Briefly explain why the water containing phenolphthalein was sucked into the flask.

(ii) State, with explanation, an observation related to phenolphthalein in the flask.

(4 marks)

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3. (a) Explain whether $BaCl_2$ or OCl_2 would have a higher melting point.

(2 marks)

(b) Explain the following decreasing order of the boiling points of three substances :

$NH_3 > PH_3 > CH_4$

(3 marks)

(c) Draw a three-dimensional diagram to represent the molecular shape of SF_6.

(1 mark)

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4. Petroleum is an important source of hydrocarbons.

(a) Describe the origin of petroleum.

(2 marks)

(b) **D**, **E** and **F** are isomeric alkenes containing four carbon atoms. **D** and **E** are *cis-trans* isomers.

(i) Draw the structure of **E** (*trans*-isomer).

(ii) State the systematic name of one possible structure of **F**.

(2 marks)

(c) Ethene and ethane are hydrocarbons.

(i) Suggest how ethene can be converted to ethane.

(ii) Suggest a chemical test to distinguish between ethane and ethene.

(3 marks)

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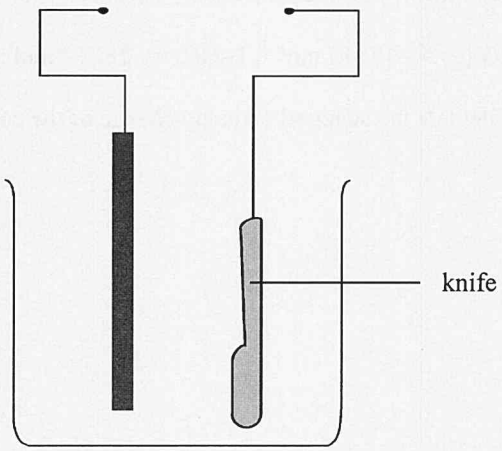
5. Electroplating and rust prevention are common applications of electrochemistry.

(a) The diagram below shows an incomplete set-up. Add suitable drawings and labels to the diagram for electroplating of silver onto the knife.



(2 marks)

(b) Suggest a method, besides painting or electroplating, that can prevent underground iron-made pipelines from rusting. Explain your answer.

(2 marks)

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6. Energy exists in various forms.

(a) Glucose ($C_6H_{12}O_6$) is one important energy source for living things.

(i) Write a chemical equation for the conversion of carbon dioxide gas and liquid water to solid glucose and oxygen gas.

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

$CO_2(g) = -394$ kJ mol^{-1}, $H_2O(l) = -286$ kJ mol^{-1}, $C_6H_{12}O_6(s) = -1274$ kJ mol^{-1}

Calculate the standard enthalpy change of the conversion in (i) above.

(iii) Green plants can convert carbon dioxide and water to glucose and oxygen. State the transformation of energy in this conversion.

(4 marks)

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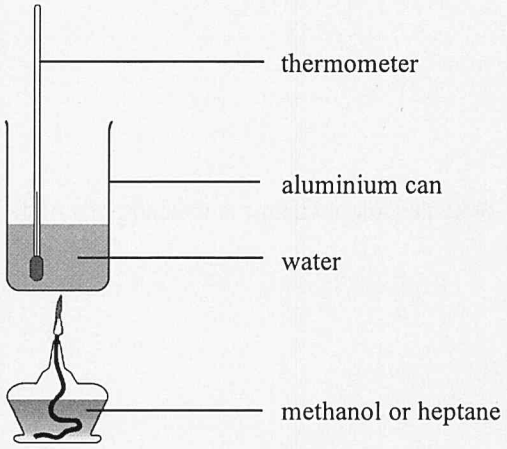
6. (b) Burning heptane (C_7H_{16}) releases energy. The enthalpy change of combustion of heptane was determined using the set-up shown below :



Step (I) : The aluminium can with a fixed mass of water was heated by burning methanol. The temperature of water increased by 18.5 °C after 1.58 g of methanol was burnt.

Step (II) : The aluminium can with the same mass of water in Step (I) was heated by burning heptane. The temperature of water increased by 25.8°C after 1.02 g of heptane was burnt.

(i) Given that, under the conditions of experiment, the enthalpy change of combustion of methanol is –715 kJ mol^{-1}, calculate the enthalpy change of combustion of heptane, in kJ mol^{-1}, under the same conditions.
(Relative molecular masses: methanol = 32.0, heptane = 100.0)

(ii) Besides heat loss, suggest another source of error in the experiment.

(4 marks)

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7. An experiment was performed to determine the number of water of crystallisation, **n**, in a sample of hydrated sodium tetraborate ($Na_2B_4O_7 \cdot nH_2O$). 0.452 g of the sample was dissolved completely in about 50 cm^3 of deionised water in an apparatus **X**. The solution obtained was alkaline and was immediately titrated in **X** with 0.125 M HCl(aq) using methyl orange as an indicator. It required 18.98 cm^3 of the acid to reach the end point.

(a) Name **X**.

(1 mark)

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

(1 mark)

(c) It is known that in the reaction during the titration, the mole ratio of $B_4O_7^{2-}(aq)$ to $H^+(aq)$ is 1 : 2. Calculate the number of water of crystallisation, **n**.
(Relative atomic masses: H = 1.0, B = 10.8, O = 16.0, Na = 23.0)

(3 marks)

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7. (d) It is known that hydrated sodium tetraborate can be used to prepare standard solutions.

(i) What is meant by the term 'standard solutions' ?

(ii) Suggest one use of standard solutions.

(2 marks)

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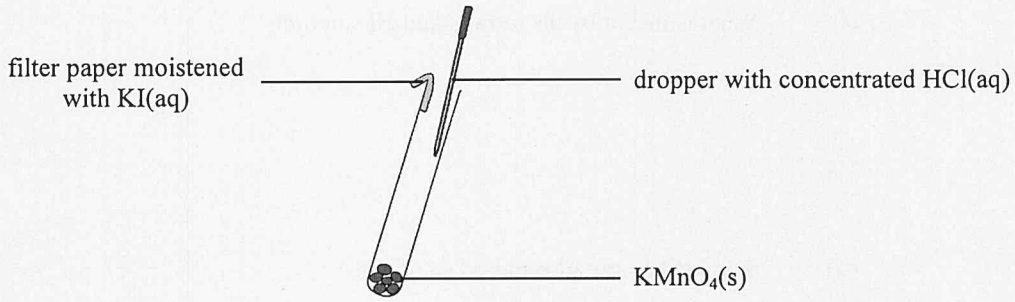
8. Refer to the experimental set-up as shown below.



(a) HCl is a strong acid. What is meant by the term 'strong acid' ?

(1 mark)

(b) When concentrated HCl(aq) is dropped into $KMnO_4(s)$, a yellowish green gas is formed.

(i) What is the yellowish green gas ?

(ii) Explain whether the reaction forming the yellowish green gas is a redox reaction.

(2 marks)

(c) With the aid of an ionic equation, state the expected observation when the yellowish green gas reaches the filter paper.

(2 marks)

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

(1 mark)

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*9. Tetrafluoroethene undergoes polymerisation to form a polymer called 'Teflon'. Using this example, describe this type of polymerisation.

(5 marks)

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PART II

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

10. 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)

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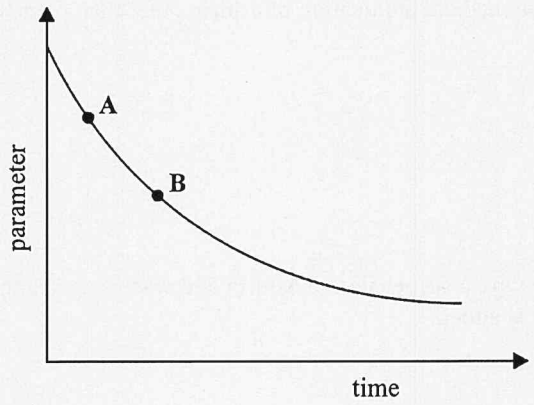
11. Consider the following reaction :

$$Br_2(aq) + HCO_2H(aq) \rightarrow 2HBr(aq) + CO_2(g)$$

In an experiment to study the rate of consumption of $Br_2(aq)$, equal volumes of 0.01 M $Br_2(aq)$ and 1.0 M $HCO_2H(aq)$ were mixed. The progress of the reaction was followed by measuring a certain parameter of the reaction system using a colorimeter. The graph below shows the results from the start of the reaction.



(a) Assume that the rate of change of the parameter with time can represent the rate of reaction.

(i) According to the shape of the curve above, suggest what the parameter should be.

(ii) The initial rate of the reaction can be determined by a suitable sketch on the above graph. Draw the suitable sketch on the above graph, and describe how the initial rate of the reaction can be obtained from the sketch.

(iii) According to the graph above, the rate of reaction at **A** is higher than that at **B**. Explain this at molecular level.

(5 marks)

(b) Suggest another method that can follow the progress of the reaction.

(1 mark)

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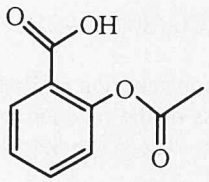
12. Aspirin is a pain-killer. Its structure is shown below :



(a) State one medical application of aspirin other than pain-killing.

(1 mark)

(b) Explain why a suspension of aspirin and water can become clear when sodium hydrogencarbonate powder is added.

(2 marks)

(c) Heating aspirin with excess dilute aqueous acid under reflux will give two organic products.

(i) Draw the structures of these two organic products.

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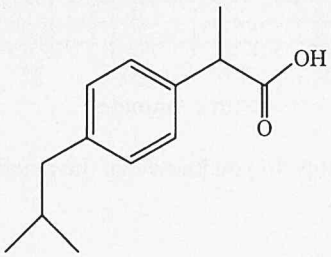
12. (c) (ii) Explain why the conversion of aspirin to these two organic products can hardly reach 100% even though the mixture of aspirin and dilute acid is heated under reflux for a long time.

(3 marks)

(d) Ibuprofen is also a pain-killer. Its structure is shown below :



There exists enantiomerism in ibuprofen. Draw the three-dimensional structures for the pair of enantiomers.

(2 marks)

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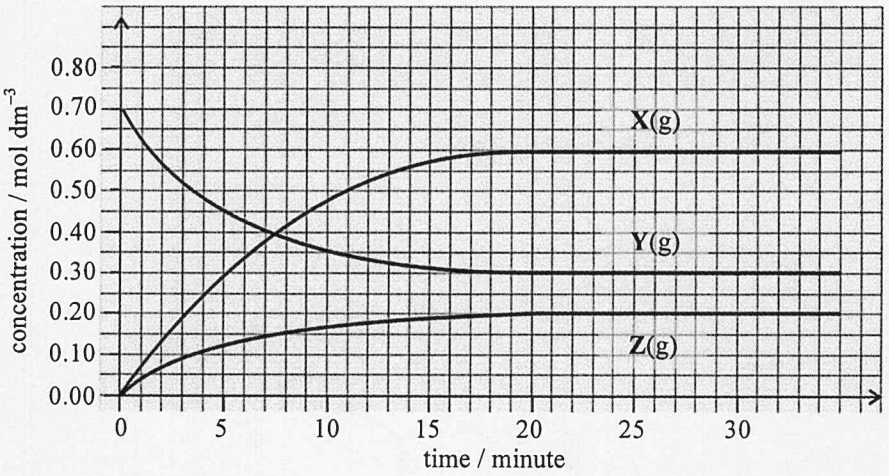
13. An experiment was performed for a reversible reaction involving **X**(g), **Y**(g) and **Z**(g) in a closed container of 2.0 dm^3 at a constant temperature. The graph below shows the relevant experimental data.



(a) According to the graph, how do you know that the reaction is reversible ?

(1 mark)

(b) Calculate the equilibrium constant K_c for the reaction at the temperature of the experiment.

(3 marks)

(c) Comment on the following statement :

'*The rate of the forward reaction is zero at the 25th minute after the start of the reaction.*'

(1 mark)

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*14. Using Na_2O, Al_2O_3 and SO_2 as examples, illustrate the acid-base behaviour of the oxides of the third period elements with the aid of relevant reactions.

(6 marks)

END OF SECTION B
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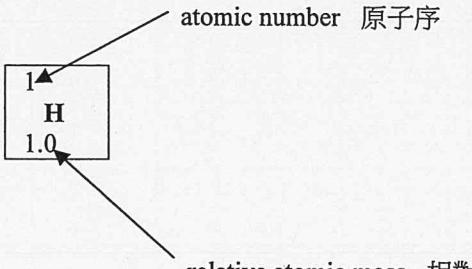

I	II										III	IV	V	VI	VII	0
																2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0										5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3										13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
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)