2015-DSE
CHEM
PAPER 1B

B

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HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2015

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.

* A 1 4 0 E 0 1 B *

PART I

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

1. Argon and chlorine are elements in the same period of the Periodic Table.

(a) Draw the electron diagram for a molecule of argon, showing *electrons in all shells.*

(1 mark)

(b) What is the type of intermolecular force in chlorine gas ?

(1 mark)

(c) Complete the table below by stating the natural source and the method of extraction from the source for each element.

Element	Natural source	Method of extraction
Argon		
Chlorine		

(4 marks)

Answers written in the margins will not be marked.

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2. For each of the following experiments, state the expected observation, and write the chemical equation(s) for the reaction(s) involved.

(a) passing carbon dioxide gas into limewater until in excess

(3 marks)

(b) adding sodium sulphite solution to acidified potassium dichromate solution until in excess

(2 marks)

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3. Aluminium and iron are commonly used construction materials.

(a) Suggest why iron was used earlier than aluminium in history.

(1 mark)

(b) A compound contains iron and oxygen only. In an experiment for determining the empirical formula of this compound, 2.31 g of the compound was heated with carbon monoxide. Upon complete reaction, carbon dioxide and 1.67 g of iron were formed.

(i) Calculate the empirical formula of this compound.

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

(iii) As carbon monoxide is poisonous, suggest one necessary safety precaution in carrying out the experiment.

(4 marks)

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3. (c) Explain why a galvanised iron object does not easily rust even if the zinc layer is broken.

(2 marks)

(d) Explain why anodisation can prevent aluminium objects from corrosion.

(2 marks)

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4. Lead-acid accumulator is a secondary cell containing sulphuric acid. It is commonly used in starting up motor vehicle engines.

(a) What is meant by the term 'secondary cell' ?

(1 mark)

(b) Suggest why a lead-acid accumulator is suitable for starting up motor vehicle engines.

(1 mark)

(c) State one environmental impact that would be imposed from the disposal of lead-acid accumulators.

(1 mark)

(d) A student diluted a sample of concentrated sulphuric acid for making a lead-acid accumulator.

(i) Describe how concentrated sulphuric acid can be diluted in a laboratory. State a safety precaution needed during the dilution process.

(ii) 5.00 cm^3 of the solution in the lead-acid accumulator made contains 2.48 g of sulphuric acid. Calculate the molarity of the sulphuric acid in the solution.
(Molar mass of sulphuric acid = 98.1 g)

(5 marks)

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*5. Explain, with the aid of a chemical equation, why $NH_3(aq)$ is regarded as a weak alkali. Suggest how you would show that $NH_3(aq)$ is a weaker alkali than NaOH(aq) through an experiment.

(6 marks)

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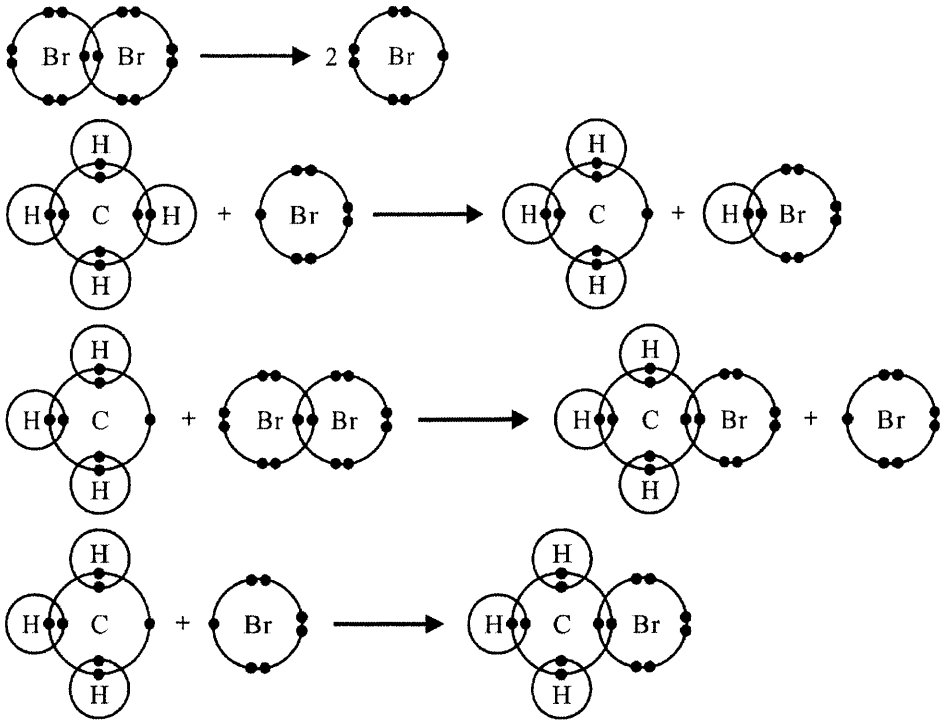
6. The steps involved in the reaction of methane with bromine forming CH_3Br can be shown by the following diagram. Only electrons in the outermost shells are shown.



(a) Name the type of the reaction for the formation of CH_3Br from methane and bromine.

(1 mark)

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

(1 mark)

(c) State the expected observation for the reaction.

(1 mark)

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6. (d) With reference to its electronic structure, explain why the species  has a high reactivity.

(1 mark)

(e) The reaction of methane with bromine can also form other single-carbon-containing organic compounds.

(i) Suggest one such compound.

(ii) Suggest a condition so that the reaction of methane with bromine can form more CH_3Br but less other organic compounds.

(2 marks)

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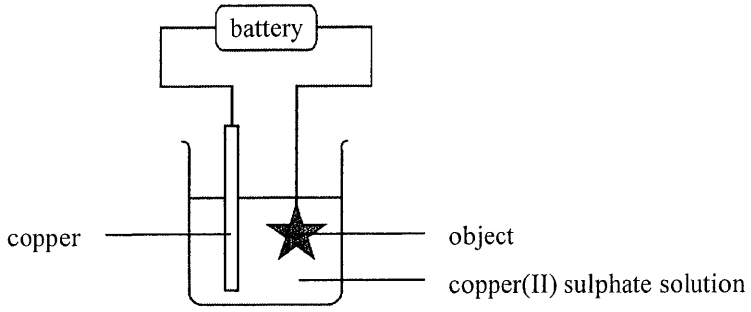
7. Refer to the set-up for electroplating an object shown in the diagram below.



(a) Explain why oily dirts on the object should be removed before electroplating.

(1 mark)

(b) Copper(II) sulphate is an electrolyte. What is meant by the term 'electrolyte' ?

(1 mark)

(c) List ALL the ions existing in the solution.

(1 mark)

(d) Explain why copper(II) ions are preferentially discharged during the electroplating process.

(1 mark)

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7. (e) Write the half equation of the change that occurs at the anode.

(1 mark)

(f) State the observable change, if any, in the solution during the electroplating process.

(1 mark)

(g) It is known that 2.28×10^{22} electrons have passed through the external circuit during the electroplating process. Calculate the mass of copper that would theoretically be plated on the object.
(Relative atomic mass: Cu = 63.5; Avogadro's constant = 6.02×10^{23} mol^{-1})

(2 marks)

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8. Natural gas is an important energy source for electricity generation. It contains mainly methane (CH_4).

(a) Write the general formula of the molecules in the homologous series that methane belongs to.

(1 mark)

(b) The combustion of methane is an exothermic reaction. Its chemical equation is shown below :

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

(i) Complete the table below by stating all the covalent bond(s) that are broken and formed during the combustion of methane.

Covalent bond(s) broken	
Covalent bond(s) formed	

(ii) Suggest why the combustion is exothermic in terms of the breaking and forming of covalent bonds.

(iii) Calculate the standard enthalpy change of combustion of methane.
(Standard enthalpy changes of formation :
$CH_4(g) = -74.8$ kJ mol^{-1}; $CO_2(g) = -393.5$ kJ mol^{-1}; $H_2O(l) = -285.9$ kJ mol^{-1})

(5 marks)

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8. (c) Some regions tend to generate electricity more by natural gas but less by coal. Give TWO reasons from environmental protection consideration.

(2 marks)

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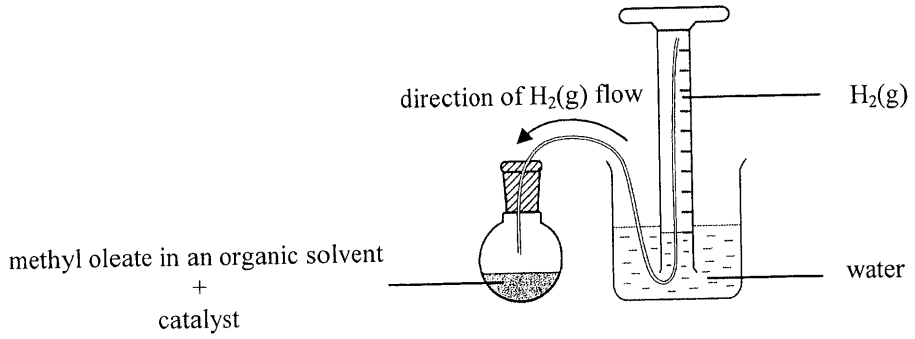
PART II

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

9. Consider the reaction below :

$$\underset{\text{methyl oleate}}{CH_3(CH_2)_7CH{=}CH(CH_2)_7CO_2CH_3(l)} + H_2(g) \xrightarrow{\text{catalyst}} CH_3(CH_2)_7CH_2CH_2(CH_2)_7CO_2CH_3(l)$$

At room temperature and pressure, a micro-scale experiment was performed using the set-up shown below in which 0.080 g of methyl oleate in an organic solvent was allowed to react with excess $H_2(g)$. The $H_2(g)$ flowed from the inverted measuring cylinder to the reacting flask through the tubing.



(a) State one advantage of conducting this reaction in a micro-scale experiment.

(1 mark)

(b) Explain why the right end of the tubing was placed at the uppermost position of the inverted measuring cylinder.

(1 mark)

(c) State an expected observation in the inverted measuring cylinder during the reaction.

(1 mark)

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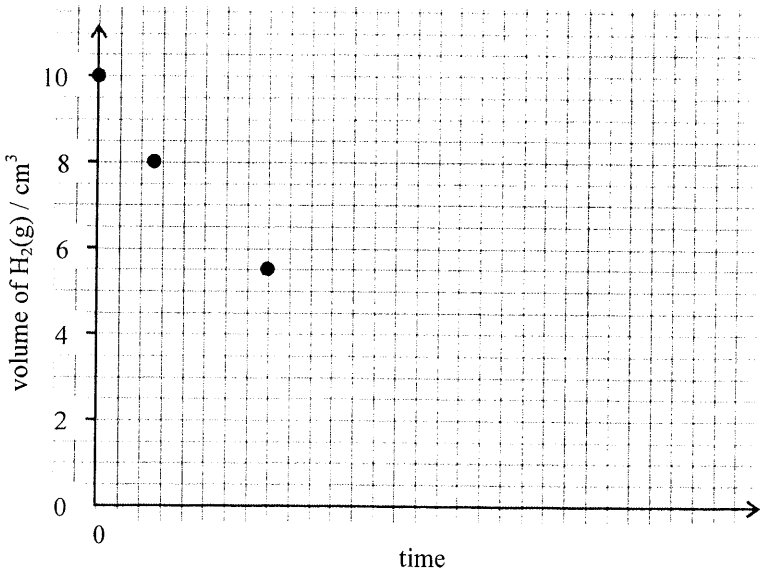
9. (d) Calculate the theoretical volume of $H_2(g)$ needed for the reaction to complete at room temperature and pressure.
(Molar volume of gas at room temperature and pressure = 24 dm^3;
Relative molecular mass: methyl oleate = 296.0)

(3 marks)

(e) (i) Sketch, in the graph below, the variation of the volume of $H_2(g)$ in the measuring cylinder with time from start until the completion of the reaction. You should label this sketch as 'A'. (The measuring cylinder initially contained 10.0 cm^3 of $H_2(g)$. The first few points have been given in the graph to facilitate the sketch.)



(ii) In the same graph above, give another sketch as required in (i) but only using 0.040 g of methyl oleate for the reaction while the other conditions remain unchanged. You should label this sketch as 'B'.

(2 marks)

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10. (a) For each of the oxides below, draw its electron diagram (*showing electrons in the outermost shells only*), and state its behaviour in water.

(i) Na_2O

(ii) Cl_2O

(4 marks)

(b) Using iron as an example, illustrate TWO characteristics of transition metals.

(2 marks)

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11. Refer to the following chemical equation :

$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq) \qquad \Delta H > 0$

Under fixed conditions, $[H_2O(l)]$ is considered as a constant. In consideration of the definition of K_c, $[H^+(aq)][OH^-(aq)]$ would also be a constant.

(a) The pH of an aqueous solution is defined as $-\log[H^+(aq)]$. The pH of water equals 7.0 at 298 K. Find, at this temperature, the :

(i) $[H^+(aq)]$

(ii) $[H^+(aq)][OH^-(aq)]$

(3 marks)

(b) $[H_2O(l)]$ equals 55.6 mol dm^{-3} at 298 K. Suggest why $[H_2O(l)]$ is considered as a constant with reference to the values of $[H^+(aq)]$ and $[OH^-(aq)]$.

(1 mark)

(c) Explain whether the pH of water at 328 K would be less than 7.0, equal to 7.0, or greater than 7.0.

(2 marks)

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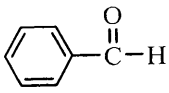
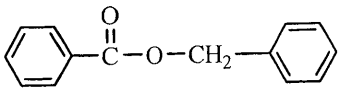
12. You are provided with  , inorganic reagents and organic solvents.

Outline a synthetic route, *with no more than three steps,* to obtain the following compound :



For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.

(3 marks)

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*13. Using $C_2H_5CH(OH)CH_3$ as an example, write a paragraph to illustrate 'enantiomerism'. Suitable diagram(s) should be included in your answer.

(5 marks)

END OF SECTION B

END OF PAPER

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PERIODIC TABLE 周期表

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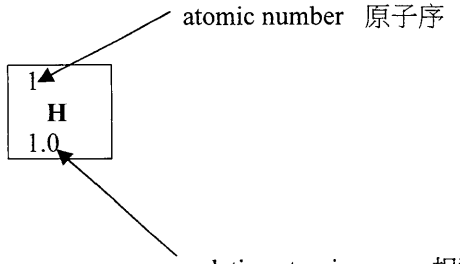

I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar**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