B

Level 5 Exemplar &
Comments
Paper 1B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2017

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. Barium (Ba) is an element in Group II of the Periodic Table. Its chemical properties are similar to those of calcium.

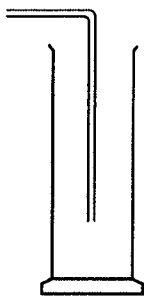
(a) Describe the bonding in barium.

Barium has giant metallic structure with metallic bonds between atoms due to the attraction of electrons with protons of other atoms.

(2 marks)

(b) A gas with a pungent smell is formed when $Ba(OH)_2(s)$ is heated with $NH_4Cl(s)$. State the reason why the gas CANNOT be collected by each of the following methods.

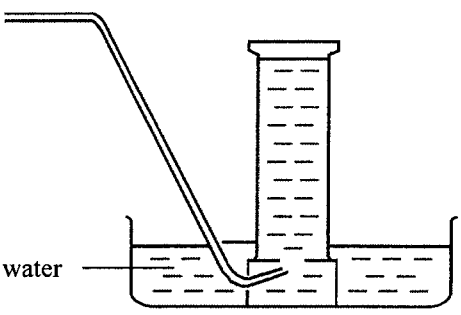
(i)



Reason :

The gas formed is less dense than air, the gas will escape upwards if this method is used.

(ii)



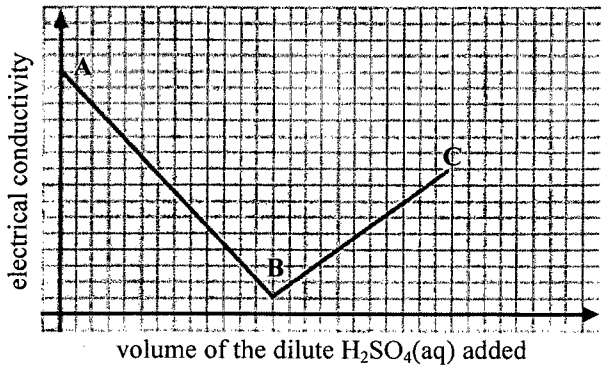
Reason :

The gas is soluble in water, using this method will dissolve the gas in water and cannot collect the gas in gas jar.

(2 marks)

Answers written in the margins will not be marked.

1. (c) An experiment was carried out to study the change in electrical conductivity of the mixture formed when a dilute $H_2SO_4(aq)$ was added gradually to a fixed volume of a dilute $Ba(OH)_2(aq)$. The graph below shows the results of the experiment.



(i) State the expected observation when dilute $H_2SO_4(aq)$ is added to dilute $Ba(OH)_2(aq)$.

White precipitate forms

(ii) Explain the change of electrical conductivity in the following stages :

(1) From **A** to **B**

H_2SO_4 reacts with $Ba(OH)_2$ to form $BaSO_4(s)$ which is not a good electrical conductor. As reaction proceeds, number of mobile ions that can conduct electricity decreases in the solution resulting in decrease in electrical conductivity.

(2) From **B** to **C**

As all $Ba(OH)_2$ has used up, the addition of H_2SO_4 supplies mobile ions to the solution without formation of non-conducting $BaSO_4(s)$. Thus, electrical conductivity increases. (3 marks)

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2. Water pipes used to carry drinking water are commonly made of copper instead of iron. Although lead-containing solder can be used to join these water pipes, such use is prohibited.

(a) Suggest one chemical property of copper that makes it more suitable than iron for making water pipes. Explain your answer.

Copper is less reactive than iron which does not react with cold water in water pipes.

This ensures that the water pipes would not corrode.

(2 marks)

(b) (i) Suggest one reason of adding lead to soldering materials.

Lead provides sacrificial protection in soldering materials to supply electrons more readily than iron to prevent rusting of iron.

(ii) Explain why lead-containing solder is prohibited in joining these water pipes.

Lead is toxic, if leaked into the water pipes, drinking water is contaminated.

(2 marks)

(c) A city stipulates that the concentration of lead ions in drinking water should not exceed 1.0×10^{-8} g cm^{-3}. Express this concentration in mol dm^{-3}.
(Relative atomic mass : Pb = 207.2)

$$\text{Concentration} = \frac{1.0 \times 10^{-8} \text{ g cm}^{-3}}{207.2 \text{ g mol}^{-1}}$$

$$= 4.826 \times 10^{-11} \text{ mol cm}^{-3}$$

$$= 4.8 \times 10^{-8} \text{ mol dm}^{-3}$$

(2 marks)

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3. Answer the following questions.

(a) Explain why propene can form a polymer, but propane cannot.

Propene contains C-C double bond, it is an unsaturated hydrocarbon that can form addition polymer but propane is saturated without C=C.

(1 mark)

(b) Explain why $HO_2C(CH_2)_4CO_2H$ can form a polymer with $H_2N(CH_2)_6NH_2$, but $CH_3(CH_2)_4CO_2H$ cannot.

$HO_2C(CH_2)_4CO_2H$ contains carboxyl group at both ends and $H_2N(CH_2)_6NH_2$ contains amine group at both ends. They can form condensation polymer with lost of small molecules.

However, $CH_3(CH_2)_4CO_2H$ has only one carboxyl group, it cannot form bonds with $H_2N(CH_2)_6NH_2$ continuously, thus cannot form polymer with it.

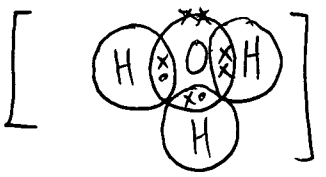
(2 marks)

(c) Describe the formation of dative covalent bond using H_3O^+ as example.

There is a H^+ ion without electron and H_2O molecules with two lone pairs of electrons in O atom.

The O atom provides both electrons in bonding with H^+ and form a dative covalent bond. $\left[H\text{-}\underset{H}{O}\rightarrow H\right]^+$

H_3O^+ is then formed with O atom sharing one electrons with two H atoms and providing both two electrons bonding with the other H atom.



(3 marks)

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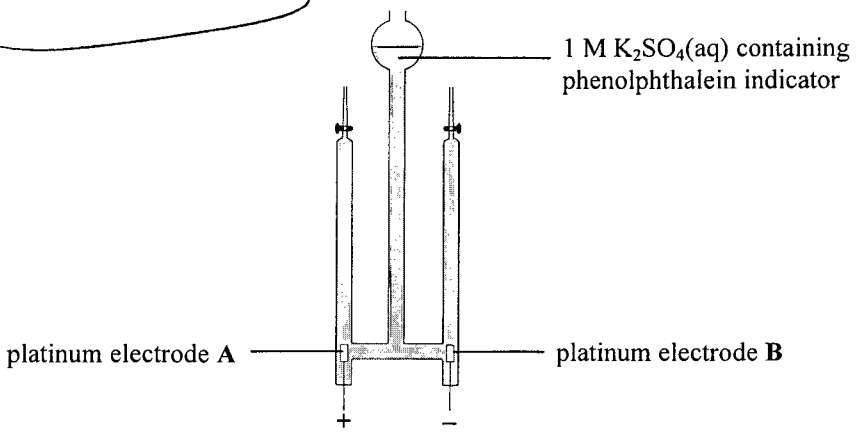
4. The diagram below shows a set-up for the electrolysis of a colourless solution of 1 M K_2SO_4(aq) containing phenolphthalein indicator.



(a) State, with explanation, the expected observation around the following electrodes during the electrolysis :

(i) electrode **A**

Colourless gas bubbles evolve. At A, both SO_4^{2-} and OH^- are attracted, OH^- is higher in E.C.S. than SO_4^{2-}, thus is preferentially discharged to form oxygen gas. ~~The remaining H^+ ion turns the colour of solution from pink to colourless.~~

(ii) electrode **B**

Colourless gas bubbles evolve. At B, both K^+ and H^+ are attracted, H^+ is lower in E.C.S. than K^+, thus is preferentially discharged to hydrogen gas. ~~The remaining OH^- ion turns the colour from colourless to pink.~~ (3 marks)

(b) Write the equation of the overall reaction in the electrolysis.

$$4H^+_{(aq)} + 4OH^-_{(aq)} \longrightarrow 2H_2(g) + O_2(g) + 2H_2O(l)$$

(1 mark)

(c) Explain whether there are any changes in the expected observation around the following electrodes during the electrolysis if the 1 M K_2SO_4(aq) is replaced with 1 M H_2SO_4(aq) :

(i) electrode **A**

No changes in observation, OH^- is still preferentially discharged to form oxygen gas since OH^- is higher in E.C.S. than SO_4^{2-}.

(ii) electrode **B**

Colourless gas bubbles evolve more vigorously. There are more aqueous H^+ ions in 1M H_2SO_4(aq) than in 1M K_2SO_4(aq), H^+ is discharged to form hydrogen gas at faster rate. (3 marks)

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5. Explain the following increasing order of the boiling points of three substances :

$H_2 < F_2 < HF$

All three substances have simple molecular structure with van der Waals' forces among molecules.

HF is polar with polar H-F bond, resulting in its highest boiling point among the three as more energy is needed to separate the stronger attraction forces.

F_2 and H_2 are both non-polar but F_2 has a greater molecular size thus greater van der Waals' force between molecules than H_2. Boiling point of F_2 thus is greater than H_2

∴ Boiling point of $H_2 < F_2 < HF$

(3 marks)

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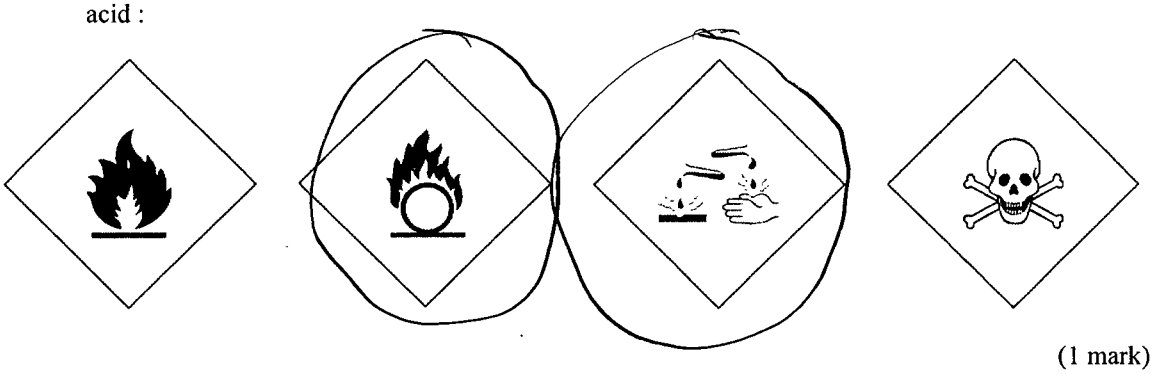
6. Concentrated sulphuric acid is a reagent commonly found in laboratories.

(a) Circle TWO hazard warning labels that should be displayed on a bottle of concentrated sulphuric acid :



(1 mark)

(b) In order to determine the concentration of a sample of concentrated sulphuric acid, 5.00 cm^3 of the sample was diluted to 1000.0 cm^3 with deionised water. Portions of 25.00 cm^3 of the diluted sample were titrated with 0.189 mol dm^{-3} NaOH(aq) using methyl orange as an indicator. An average of 22.20 cm^3 of NaOH(aq) was used to reach the end point.

(i) Explain why concentrated sulphuric acid should NOT be titrated directly with NaOH(aq).

This is to reduce chemicals used (NaOH(aq)) as a large amount of NaOH(aq) would be needed to titrate with conc. sulphuric acid, consuming more chemicals and producing more chemical waste.

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

From red to orange

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

6. (b) (iii) Calculate the concentration of the sample of concentrated sulphuric acid, in mol dm^{-3}.

No. of moles of NaOH used $= 0.189 \times \frac{22.2}{1000} = 4.1958 \times 10^{-3}$ mol

$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

No. of moles of $H_2SO_4 = \frac{1}{2} \times 4.1958 \times 10^{-3} = 2.0979 \times 10^{-3}$ mol

Conc. of H_2SO_4 sample $= 2.0979 \times 10^{-3} \times \frac{1000}{25} \div \left(\frac{5}{1000}\right)$

$= 16.78$ mol dm^{-3}

(5 marks)

(c) With the help of a chemical equation, state the observation when hot concentrated sulphuric acid reacts with copper.

$2H_2SO_4(l) + Cu(s) \longrightarrow SO_2(g) + 2H_2O(l) + CuSO_4(aq)$

Reddish brown copper dissolves to form a blue solution with gas bubbles with pungent smell evolve.

(2 marks)

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7. Ethyne is a gaseous hydrocarbon with molecular formula C_2H_2.

(a) Suggest why the enthalpy change of formation of $C_2H_2(g)$ CANNOT be determined directly by experiment.

The formation of $C_2H_2(g)$ from its constituent elements is an extremely slow process.

(1 mark)

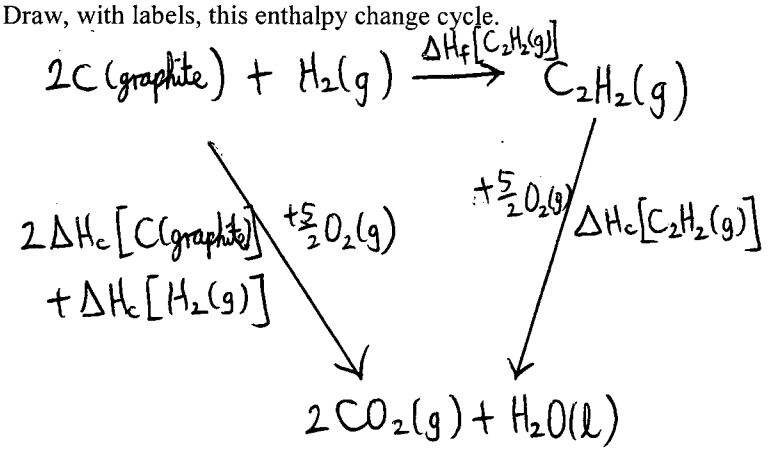
(b) Hess's law can be used to find enthalpy changes which CANNOT be determined directly by experiment. State Hess's law.

Hess's law states that ethalpy changes of a reaction can be found by reactions occuring with different steps and linking to the reactants and products.

(1 mark)

(c) Based on the enthalpy changes of combustion ΔH_c of $C_2H_2(g)$, C(graphite) and $H_2(g)$ to construct an enthalpy change cycle and applying Hess's law can give the enthalpy change of formation of $C_2H_2(g)$.

(i) Draw, with labels, this enthalpy change cycle.



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7. (c) (ii) The standard enthalpy changes of combustion $\Delta H_c^\ominus$ of $C_2H_2(g)$, C(graphite) and $H_2(g)$ are given below :

	$\Delta H_c^\ominus$ / kJ mol^{-1}
$C_2H_2(g)$	–1300
C(graphite)	–394
$H_2(g)$	–286

(1) State the standard conditions for 'standard enthalpy change'.

At room temperature (25°C) and atmospheric pressure (1 atm)

(2) Calculate the standard enthalpy change of formation of $C_2H_2(g)$.

$\Delta H_f^\circ[C_2H_2(g)] + \Delta H_c^\circ[C_2H_2(g)] = 2\Delta H_c^\circ[C(\text{graphite})] + \Delta H_c^\circ[H_2(g)]$

$\Delta H_f^\circ[C_2H_2(g)] - 1300 = 2(-394) - 286$

$\Delta H_f^\circ[C_2H_2(g)] = 226\ \text{kJ mol}^{-1}$

(5 marks)

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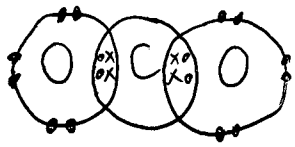
8. Combustion of petrol increases the concentration of carbon dioxide in the atmosphere, and may contribute to global warming. Combustion of petrol also emits poisonous air pollutants.

(a) Write a chemical equation for the complete combustion of octane (C_8H_{18}), a component in petrol.

$$C_8H_{18} + \frac{25}{2}O_2 \longrightarrow 8CO_2 + 9H_2O$$

(1 mark)

(b) Draw the electron diagram for a molecule of carbon dioxide, showing *electrons in the outermost shells* only.



(1 mark)

(c) Give one reason FOR and one reason AGAINST the following statement :

'Switching from using petrol-driven cars to using electric cars can help alleviate global warming.'

FOR : It can reduce combustion of petrol, thus reduce CO_2 formed which contribute to global warming.

AGAINST : The electricity provided for electric cars is mainly generated from combustion of coal in power station. The combustion of coal generates more CO_2 which contribute to global warming.

(2 marks)

(d) Carbon monoxide is one of the poisonous air pollutants emitted from the combustion of petrol. Under what condition would carbon monoxide be formed during the combustion of petrol ?

Incomplete combustion of petrol occurs at insufficient supply of oxygen.

(1 mark)

(e) (i) Name a device that can be installed in petrol-driven cars so as to reduce the emission of carbon monoxide.

Catalytic converter

(ii) Suggest one air pollutant in car exhaust which cannot be removed by the device in (i).

Sulphur dioxide

(2 marks)

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*9. Four unlabelled reagent bottles each contains one of the colourless liquids listed below :

$HOCH_2CH_2CH_2OH$ $CH_3CO_2CH_3$ $CH_3CH_2CO_2H$ $CH_2=CHCO_2H$

Suggest chemical tests to distinguish the four liquids.

(5 marks)

Test the liquids with acidified potassium dichromate solution respectively, only $HOCH_2CH_2CH_2OH$ has the colour changes from orange to green, other three liquids have no observable change.
Test the remaining three liquids with Br_2 in 1,1,1-trichloroethane, only $CH_2=CHCO_2H$ turns from red-orange to colourless, other two liquids have no observable change.
Test the two remaining liquids with sodium hydroxide solution, only $CH_3CH_2CO_2H$ has colourless gas bubbles evolve, the other liquid shows no observable change.
The remaining liquid is $CH_3CO_2CH_3$.

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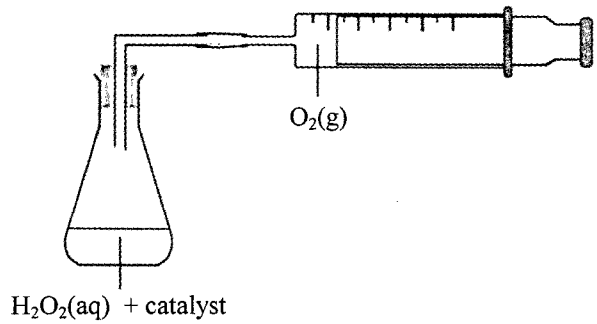
PART II

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

10. In an experiment performed under room conditions as shown below, 5.00 cm^3 of $H_2O_2(aq)$ decomposed into $O_2(g)$ and $H_2O(l)$ in the presence of a catalyst. $O_2(g)$ was continuously released from the start of the experiment until the third minute when a total of 60 cm^3 of gas was collected. After that, no more gas was collected.



(a) Calculate the initial concentration of the $H_2O_2(aq)$, in mol dm^{-3}.
(Molar volume of gas at room conditions = 24 dm^3)

$H_2O_2(aq) \rightleftharpoons H_2O(l) + \frac{1}{2}O_2(g)$

No. of mole of oxygen in equilibrium $= \frac{\frac{60}{1000}}{24}$

$= 2.5 \times 10^{-3}$ mol

~~$H_2O_2(aq) \rightleftharpoons H_2O(l) + \frac{1}{2}O_2(g)$~~

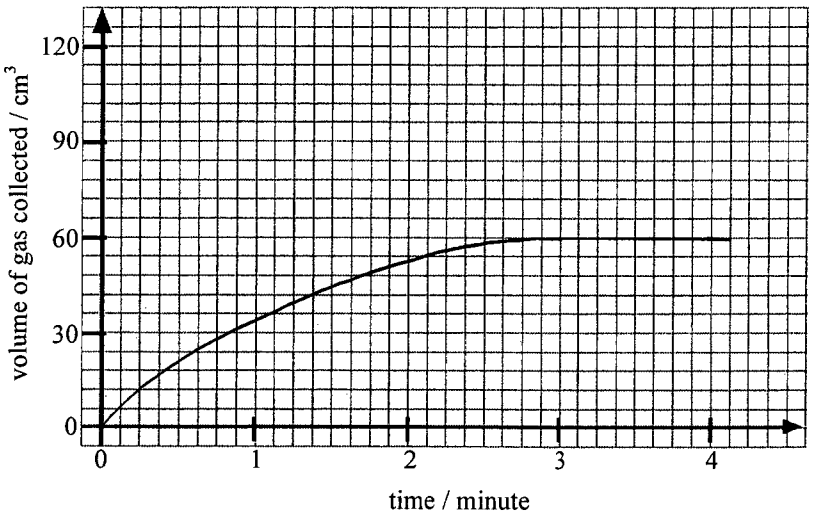
I	x	0	0
C	-5	+5	+2.5
E	x-5	5	2.5

(2 marks)

Initial conc. of $H_2O_2(aq) = \frac{2.5 \times 10^{-3} \times 2}{\frac{5}{1000}}$

$= 1$ mol dm^{-3}

10. (b) In the graph below, sketch the variation of the volume of gas collected with time in the first 4 minutes.



(2 marks)

(c) The experiment is repeated using a $H_2O_2(aq)$ at a higher temperature but other conditions remain unchanged. Explain whether the total volume of gas obtained would still be 60 cm^3. (The volume of gas is measured at room conditions.)

The reaction is exothermic, at higher temperature, the equilibrium shifts to the left, total volume of gas decrease and is lower than $60 cm^3$.

(1 mark)

(d) Suggest another method that can be used to follow the progress of this reaction.

Measure the mass of the H_2O_2 solution using electronic balance as reaction proceeds.

(1 mark)

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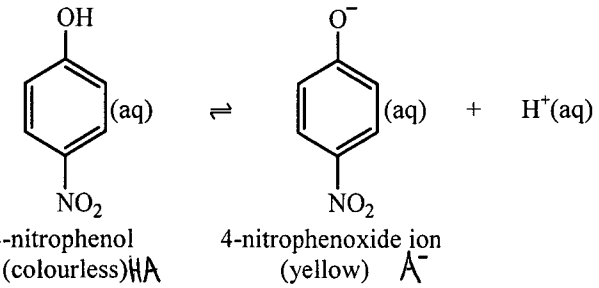
11. The equation below shows the ionisation of 4-nitrophenol in water :



4-nitrophenol (colourless) HA — 4-nitrophenoxide ion (yellow) A^-

At 25°C, the equilibrium constant K_c for the ionisation is 8.0×10^{-8} mol dm^{-3}.

(a) Write an expression for K_c.
(You may use **HA** to represent 4-nitrophenol and $\mathbf{A}^-$ to represent 4-nitrophenoxide ion.)

$$K_c = \frac{[A^-(aq)]_{eqm}[H^+(aq)]_{eqm}}{[HA(aq)]_{eqm}}$$

(1 mark)

(b) When the above ionisation attains equilibrium at 25°C, the pH of an aqueous solution of 4-nitrophenol is 2.4. Calculate the ratio of the concentration of 4-nitrophenol to the concentration of 4-nitrophenoxide ions in this solution.

$$-\log[H^+(aq)] = 2.4$$

$$[H^+(aq)] = 3.98107 \times 10^{-3} \text{ mol dm}^{-3}$$

$$K_c = \frac{[A^-(aq)]_{eqm}[H^+(aq)]_{eqm}}{[HA(aq)]_{eqm}}$$

$$[HA(aq)] : [A^-(aq)] = \frac{3.98107 \times 10^{-3}}{8 \times 10^{-8}} = 48763 : 1$$

(2 marks)

(c) Suggest if there is any colour change when NaOH(aq) is added gradually into the solution in (b). Explain your answer.

Yes, the yellow colour becomes more intense.
As NaOH(aq) is added, $H^+(aq)$ is consumed.
The equilibrium shifts to the right, more yellow A^- ions are produced.

(2 marks)

(d) Suggest one possible use of 4-nitrophenol in acid-base titration experiments.

As an indicator to detect end point.

(1 mark)

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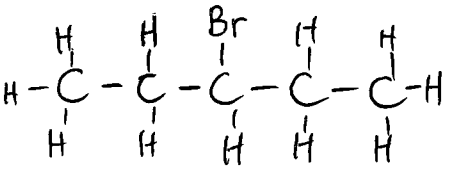
12. Consider the following conversions :

$$\underset{\textbf{A}}{C_5H_{10}O} \longrightarrow \underset{\textbf{B}}{C_5H_{12}O} \xrightarrow{HBr} \underset{\textbf{C}}{\text{3-bromopentane}}$$

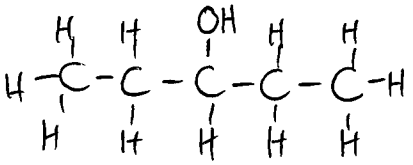
optically active — optically inactive

(a) Write the structural formula of **C**.



(1 mark)

(b) (i) Deduce the structural formula of **B**.

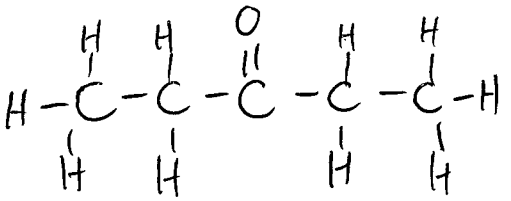


(ii) Name the type of reaction for the conversion of **B** to **C**.

halogenation

(3 marks)

(c) (i) Deduce the structural formula of **A**. Label on this structural formula all chiral centre(s), if any, by using '*'.



(ii) State the reagent(s) required for the conversion of **A** to **B**.

1. $LiAlH_4$, dry ether
2. $H^+(aq)$

(3 marks)

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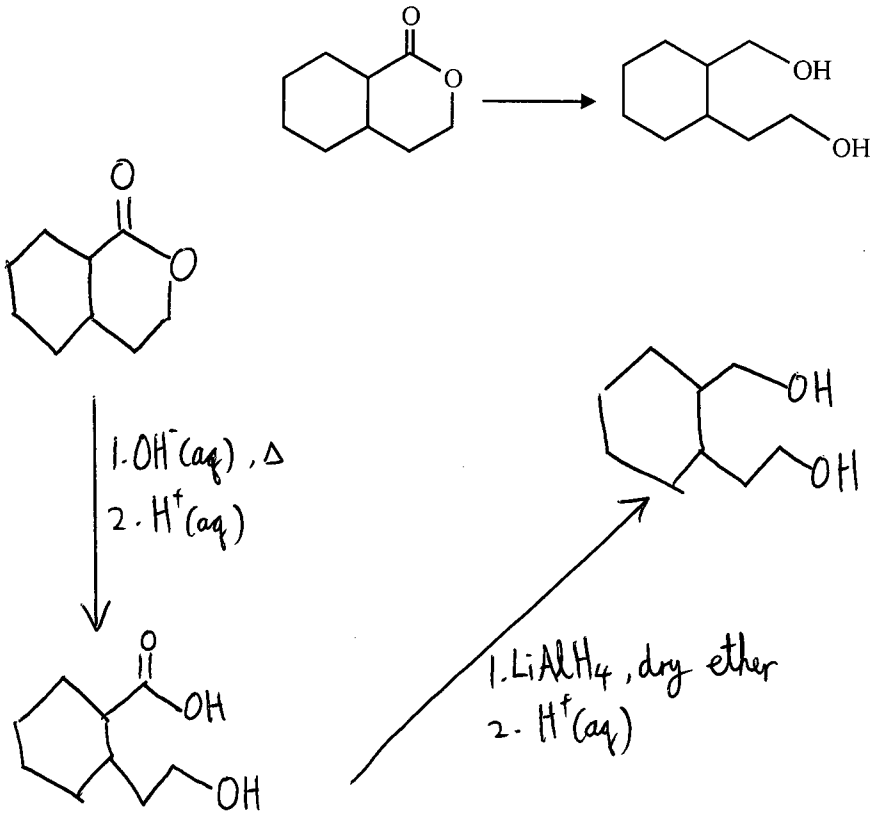
13. Outline a synthetic route, with *no more than three steps*, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and the structure of the organic product.



(3 marks)

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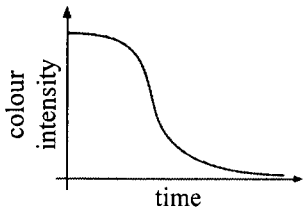
*14. At 60°C, $MnO_4^-(aq)$ reacts with $C_2O_4^{2-}(aq)$ in an acidic medium to give $Mn^{2+}(aq)$, $CO_2(g)$ and $H_2O(l)$. The graph below shows the variation of the colour intensity of the reaction mixture with time.



Based on the information above, write the chemical equation for the reaction and illustrate THREE characteristics of transition metals exhibited by manganese.

(6 marks)

$16H^+_{(aq)} + 2MnO_{4(aq)}^- + 5C_2O_{4(aq)}^{2-} \longrightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 10CO_2(g)$

Transition metals have coloured ions, for example, $Mn^{2+}(aq)$ is colorless but $MnO_4^-(aq)$ is purple, reflected by the decrease in colour intensity over time in the graph.

Transition metals can serve as catalyst, $Mn^{2+}(aq)$ serves as the autocatalyst in this reaction and the colour intensity drops significantly as $Mn^{2+}(aq)$ accumulates.

Transition metals have variable oxidation states. The oxidation number of Mn in $MnO_4^-(aq)$ is +7 while in Mn^{2+} is +2.

END OF SECTION B
END OF PAPER

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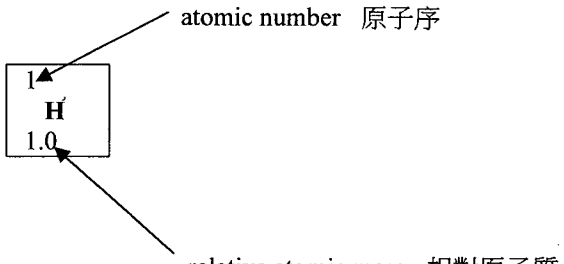
PERIODIC TABLE 周期表

GROUP 族



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)

2017 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

Level 5 Exemplar & Comments
Paper 2

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.

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

試題編號 Question No.	各頁積分 Marks	積分 Marks	積分 Marks
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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.

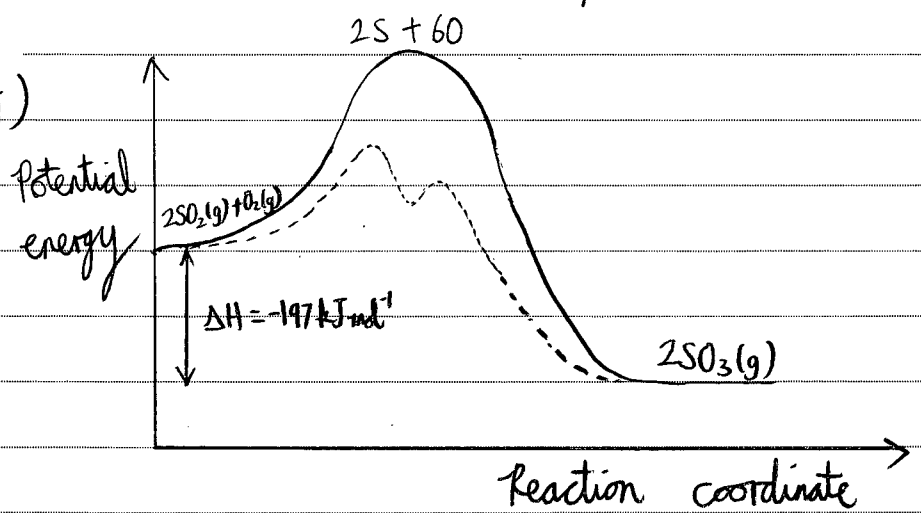
1a(i) (1) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

1a(i)(2) Use fractional distillation and separate liquified ammonia.

1a(ii) The order of reaction w.r.t. A(aq) is zero.
The concentration of A(aq) decreases at linear relationship with time, showing that change in concentration of A(aq) does not affect rate of reaction.

1a(iii) Methanol is flammable which can cause serious fire accident in a chemical plant.

1b(i)



1b(ii)(1) This is to prevent impurities from binding to the active site of catalyst and reducing its catalytic property

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1b(ii)(2)(I) The reaction of converting $SO_2(g)$ to $SO_3(g)$ would be too slow.

1b(ii)(2)(II) The cost of increasing the pressure for a slight increase in percentage of conversion is too high.

1b(ii)(3) $O_2(g)$ would be in slight excess. This can allow $O_2(g)$, which is abundant in air to shift the equilibrium to the right.

1c(i) $CH_4(g) + H_2O(l) \rightleftharpoons 3H_2(g) + CO(g)$

1c(ii)(1) $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

1c(ii)(2) $e^- + Hg^+(aq) \xrightarrow{+Na} Hg/Na(l)$

1c(ii)(3) Mercury is toxic. If leakage occurs, it impose serious impact to the environment.

1c(iii) Rate $= k[CO(g)][Cl_2(g)]$, let rate be a, $[CO(g)]$ be b

$a = k(b)^x[Cl_2(g)]$ —①

$2.83a = k(2b)^x[Cl_2(g)]$ —②

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$\frac{(2)}{(1)}$: $\frac{2^x}{1^x} = 2.83$

$x = 1.5$

∴ Order of reaction w.r.t. $CO(g)$ is 1.5

1c(iv) (1) No solvent is used, thus less chemical waste is produced.

1c(iv) (2) No catalyst is used thus more energy is needed for the reaction to take place. ~~the coat~~

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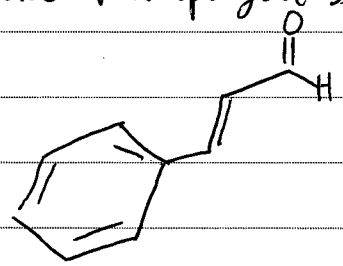
Start each question on a new page.

3a(i) Use flame test, sodium ions burn with golden yellow flame while potassium ions burn with lilac flame.

3a(ii) Dissolve the gas in water and add NaOH(aq), gas bubbles evolve with pungent smell indicates sulphur dioxide gas.

3a(iii)



3b(i) From purple to colourless

3b(ii)(1) Average volume of $KMnO_4(aq)$

$$= \frac{37.62 + 37.58 + 37.60}{3}$$

$$= 37.60\ cm^3$$

3b(ii)(2) No. of moles of $KMnO_4$ used $= 0.0282 \times \frac{37.6}{1000}$

$$= 1.06032 \times 10^{-3}\ mol$$

No. of moles of $Fe^{2+}(aq) = 5 \times 1.06032 \times 10^{-3}$

$$= 5.3016 \times 10^{-3}\ mol$$

No. of moles of $Fe^{2+}(aq)$ in step (1) $= 5.3016 \times 10^{-3} \times \frac{250}{25}$

$$= 0.053016\ mol$$

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No. of moles of $HONH_2$ = $\frac{0.875}{1+16+14+2}$

= 0.026515 mol

∵ All Fe^{2+} is converted from Fe^{3+}

∴ No. of moles of Fe^{3+} = 0.053016 mol

Mole ratio of $HONH_2(aq) : Fe^{3+}(aq)$ = 0.026515 : 0.053016

= 1 : 2

3b(ii)(3) Oxidation number of N in the oxide

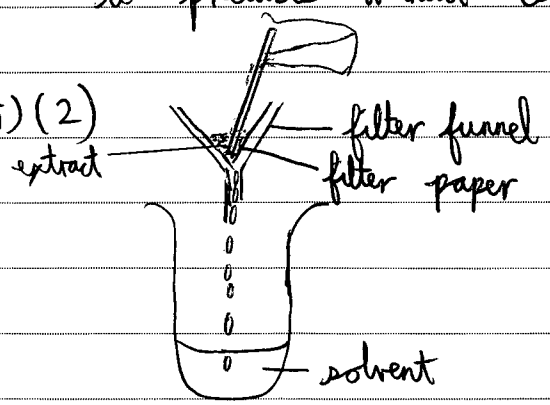
= −1 + 2

= +1

3b(iii) Empirical formula of the oxide is N_2O

3c(i)(1) This method ensures that all reactants can convert to products without escape of reactants.

3c(i)(2)



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3c(i)(3) ~~Pour 1,1,1-trichloroethane into the mixture in a separating funnel and shake thoroughly. Wait until two immiscible layer are formed. The aqueous layer is obtained without organic impurities.~~

3c(i)(3) Use fractional distillation and collect S with sharp boiling point obtained from data book.

3c(ii) The strong absorption peak at around 1700cm^{-1} indicates that the compound contains C=O bond.
The compound is either W or Y.
Artemisinin cannot react with $NaHCO_3$, this indicates that it does not contain carboxyl group.
The compound is W.

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Comments

The candidate's answers show good understanding of the chemical concepts and principles in the curriculum (e.g. Paper 1 Qs. 1(b) & (c), 3(a) & (b) & (c), 4(a) & (c), 6(b)(i), 10(b), 11(c) and 14; Paper 2 Qs. 1(a)(i)(1) & (iii), (b)(ii)(1) & (2), (c)(i) & (ii)(1) & (3) and 3(a)(i) & (iii)).

He/she demonstrates very good abilities of applying chemical concepts on unfamiliar situations for solving the problems (e.g. Paper 1 Qs. 2(a), 4(c) and 13; Paper 2 Qs. 1(a)(ii), (c)(iv)(1) and 3(b)(ii) & (iii)).

The candidate performs well on chemical calculations (e.g. Paper 1 Qs. 2(c), 6(b)(iii), 10(a) and 11(b); Paper 2 Qs. 1(c)(iii) & (iv)(1) and 3(b)(ii)(2) & (3)).

He/she can effectively communicate ideas using scientific terminology, appropriate diagrams and chemical equations (e.g. Paper 1 Qs. 3(c), 4(a), 7(c)(i), 9, 11(a), 12(a), 13 and 14; Paper 2 Qs. 1(b)(i) and Q.3(c)(ii)).

He/she can design appropriate method for carrying out scientific investigations (e.g. Paper 1 Q. 9).