

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.



PART I

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

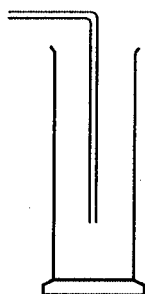
1. Barium (Ba) is an element in Group II of the Periodic Table. Its chemical properties are similar to those of calcium.

- (a) Describe the bonding in barium.

~~Barium cations are held together~~
 The bonding in barium is the strong electrostatic attraction force ~~between~~ between positively charged barium cations and a sea of electrons, which is called the metallic bond. (2 marks)

- (b) A gas with a pungent smell is formed when $\text{Ba}(\text{OH})_2(\text{s})$ is heated with $\text{NH}_4\text{Cl}(\text{s})$. State the reason why the gas **CANNOT** be collected by each of the following methods.

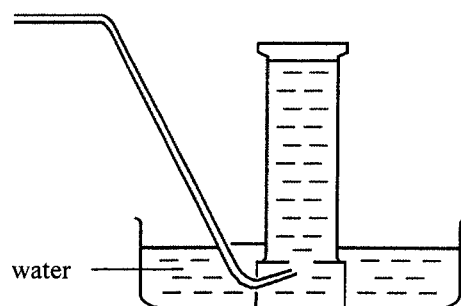
(i)



Reason: ammonia

The gas produced is ~~ten~~ less dense than air.

(ii)



Reason :

~~The~~ ammonia
 The gas produced is soluble in water.

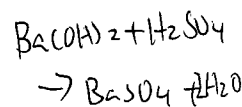
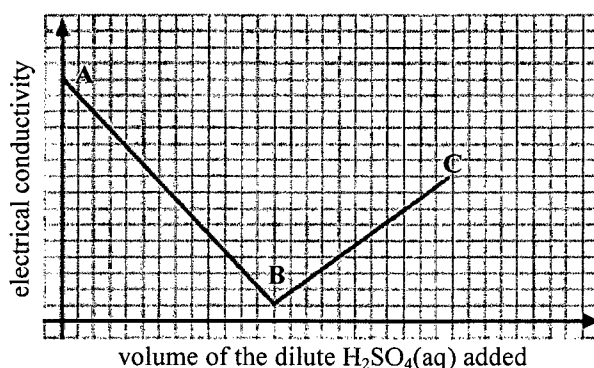
(2 marks)

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1. (c) An experiment was carried out to study the change in electrical conductivity of the mixture formed when a dilute $\text{H}_2\text{SO}_4(\text{aq})$ was added gradually to a fixed volume of a dilute $\text{Ba}(\text{OH})_2(\text{aq})$. The graph below shows the results of the experiment.



- (i) State the expected observation when dilute $\text{H}_2\text{SO}_4(\text{aq})$ is added to dilute $\text{Ba}(\text{OH})_2(\text{aq})$.

Φ An insoluble precipitate is formed.

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

- (1) From A to B

Initially, the electrical conductivity is ^{high} due to presence of $\text{Ba}^{2+}(\text{aq})$ and $\text{OH}^{-}(\text{aq})$ ions.
 $\uparrow$ mobile

As concentration of mobile ions decrease due to formation of precipitate, the electrical conductivity gradually decreases.

- (2) From B to C

At B, the electrical conductivity is the lowest which means all mobile $\text{Ba}^{2+}(\text{aq})$ and $\text{OH}^{-}(\text{aq})$ ions have been ~~reacted~~ reacted. Additional (3 marks) amount of $\text{H}_2\text{SO}_4(\text{aq})$ added will increase

the electrical conductivity due to mobile ions added.
 $\uparrow$ $\text{H}^{+}(\text{aq})$ and $\text{SO}_4^{2-}(\text{aq})$

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 Corrosion resistant.

Copper is less reactive than iron,

then it lose electrons less

readily than iron and

it will not easily ~~get~~ ^{rust} be corroded (2 marks)

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

lead is strong.

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

lead ions are toxic,
which can damage one's
nervous system. (2 marks)

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

Concentration =

$$\frac{1.0 \times 10^{-8}}{207.2}$$

$$= 5.31 \times 10^{-11} \text{ mol dm}^{-3}$$

(2 marks)

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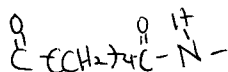
3. Answer the following questions.

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

propene contains >C=C< , whereas propane does not.

(1 mark)

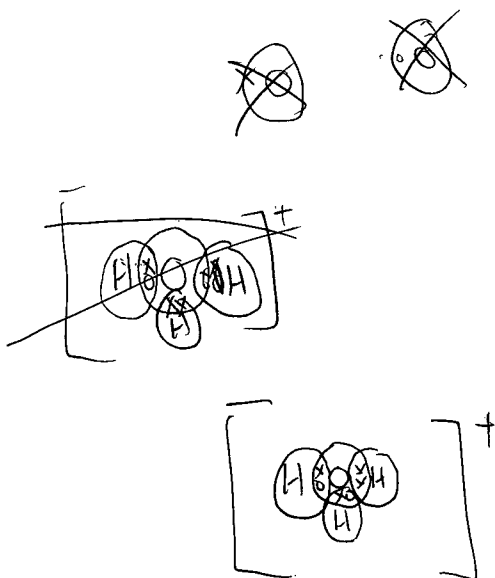
- (b) Explain why $\text{HO}_2\text{C}(\text{CH}_2)_4\text{CO}_2\text{H}$ can form a polymer with $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$, but $\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{H}$ cannot.



It is because there is only one carboxyl group in $\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{H}$ and it cannot continuously form amide linkage with $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$ but $\text{HO}_2\text{C}(\text{CH}_2)_4\text{CO}_2\text{H}$ has 2 carboxyl group.

(2 marks)

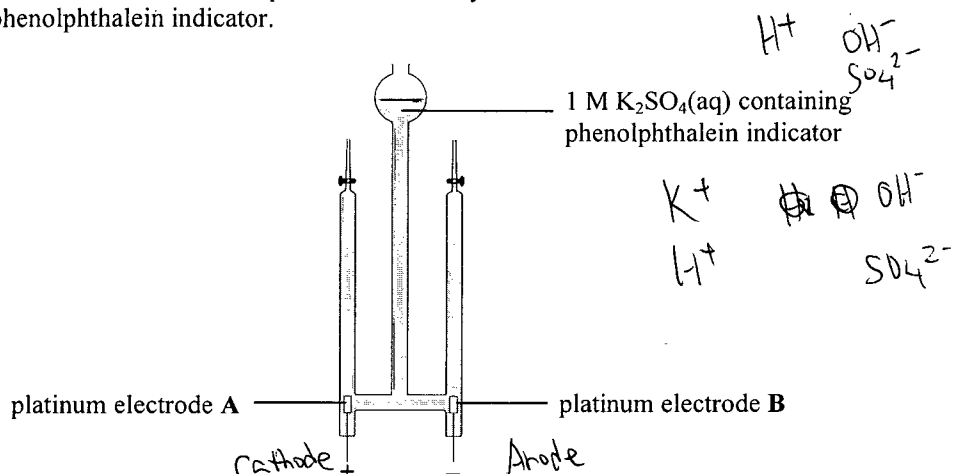
- (c) Describe the formation of dative covalent bond using H_3O^+ as example.



In H_3O^+ , the central oxygen atom acts as the donor atom, it do one of the covalent O-H's shared electrons all come from oxygen atom. ~~Hydrogen~~ Hydrogen atom acts as the acceptor atom.

(3 marks)

4. The diagram below shows a set-up for the electrolysis of a colourless solution of 1 M $\text{K}_2\text{SO}_4(\text{aq})$ containing phenolphthalein indicator.



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

(i) electrode A

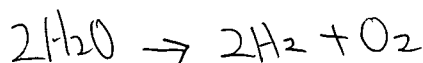
$\text{H}^+(\text{aq})$ ion is preferentially discharged to form hydrogen gas. $2\text{e}^- + 2\text{H}^+ \rightarrow \text{H}_2$ The solution around electrode A turns pink. Colorless gas bubbles evolve around electrode A

(ii) electrode B

$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ Colorless gas bubbles evolve

(3 marks)

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



(1 mark)

- (c) Explain whether there are any changes in the expected observation around the following electrodes during the electrolysis if the 1 M $\text{K}_2\text{SO}_4(\text{aq})$ is replaced with 1 M $\text{H}_2\text{SO}_4(\text{aq})$:

(i) electrode A

No

(ii) electrode B

No

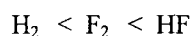
(3 marks)

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



H_2 , F_2 and HF molecules are all held together by weak van der Waals' forces.

As molecular size of F_2 is greater than H_2 , the van der Waals' forces between F_2 molecules stronger than that of H_2 molecules.

More energy is required to overcome the stronger intermolecular forces.

As fluorine is more electronegative than ~~H~~ hydrogen, $\text{H}-\text{F}$ in HF is polar. Then HF is polar. But F_2 and H_2 is non-polar.

Therefore, the van der Waals' forces

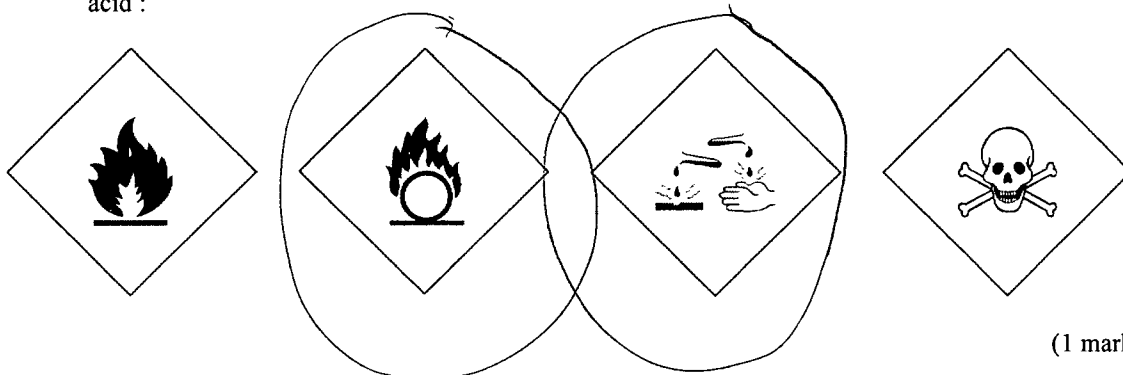
between HF molecules is the (3 marks)
strongest among them.

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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 $0.189 \text{ mol dm}^{-3} \text{ NaOH(aq)}$ 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) .

The reaction is too vigorous that
a large amount of heat will
be given out.

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

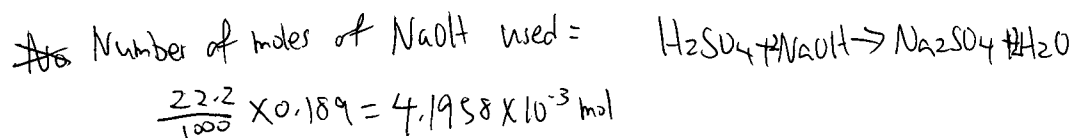
From red to yellow.

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



Mole ratio of NaOH : $\text{H}_2\text{SO}_4 = 2:1$

$\therefore$ number of moles of 25.00 cm^3 diluted H_2SO_4

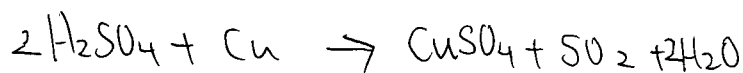
Sample is $2.0979 \times 10^{-3} \text{ mol}$

Number of moles of 1000.0 cm^3 ^{H_2SO_4} dilute sample =
 $2.0979 \times 10^{-3} \times \left(\frac{1000}{25}\right) = 0.083916 \text{ mol}$

Concentration of the ^{H_2SO_4} concentrated sample =
 $\frac{0.083916}{5/1000} = 16.8 \text{ M}$

(5 marks)

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

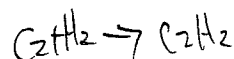


The solution turns blue.

Gas bubbles evolve.

(2 marks)

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 reaction between carbon and hydrogen is very slow.

(1 mark)

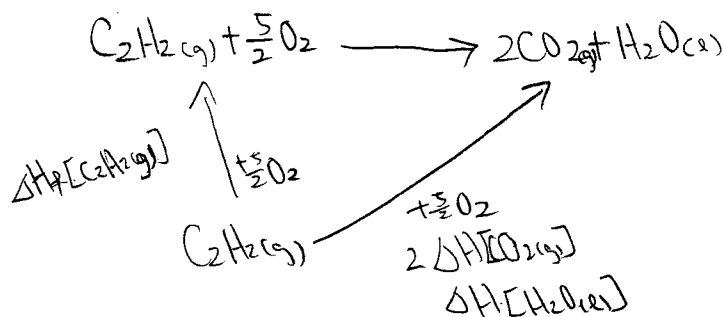
- (b) Hess's law can be used to find enthalpy changes which CANNOT be determined directly by experiment. State Hess's law.

Hess's law states that the total enthalpy change of a reaction is the same, regardless of the routes by which the reaction takes, provided that the initial and final conditions are the same.

(1 mark)

- (c) Based on the enthalpy changes of combustion ΔH_c of $C_2H_2(g)$, $C(\text{graphite})$ 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 ΔH_c° of $C_2H_2(g)$, $C(\text{graphite})$ and $H_2(g)$ are given below :

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

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

25°C , 1 atm,

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

$$\begin{aligned}
 \Delta H_f^\circ[C_2H_2(g)] &= 2\Delta H_f^\circ[CO_2(g)] + \Delta H_f^\circ[H_2O(l)] - \\
 &= 2\Delta H_c^\circ[C(\text{graphite})] + \Delta H_c^\circ[H_2(g)] - \Delta H_c^\circ[C_2H_2(g)] \\
 &= (-394) \times 2 + (-286) - (-1300) \\
 &= +226 \text{ kJ mol}^{-1}
 \end{aligned}$$

(5 marks)

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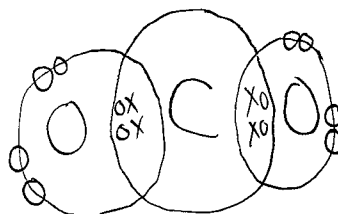
8. Combustion of petrol increases the concentration of carbon dioxide in the atmosphere, and may contribute to global warming. Combustion of petrol also emits poisonous air pollutants.

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



(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 :

Electric cars emit no greenhouse gases like CO_2 while driving.

AGAINST :

The supply of electricity to electric cars requires the burning of fossil fuels, which emit carbon dioxide

(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

(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).

Suspended particulate

(2 marks)

*9.

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



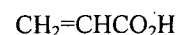
diol



ester



acid



C=C

Suggest chemical tests to distinguish the four liquids.

(5 marks)

To begin with, react ~~to~~ each of them with acidified potassium permanganate solution respectively. Only $\text{CH}_2=\text{CHCO}_2\text{H}$ can turn the solution from purple to colorless, while the others do not.

Afterwards, react the remaining three species with sodium carbonate solution respectively. Only $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ reacted to give colorless gas bubbles, whereas, the other two do not.

At last, react the last two liquids with acidified potassium dichromate solution respectively. Only $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$ can turn the solution from orange to green. But $\text{CH}_3\text{CO}_2\text{CH}_3$ has no ~~reaction~~ observable change upon reaction between the solution.

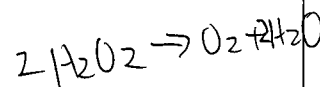
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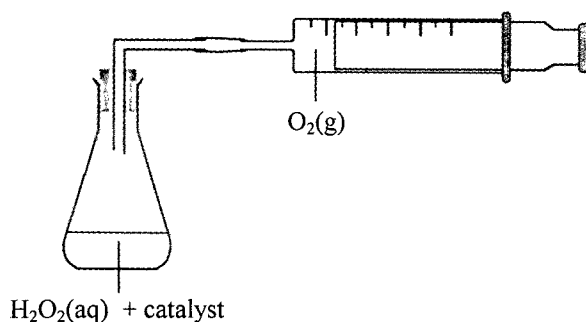
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PART II

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

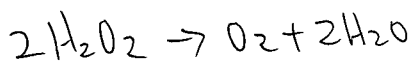


10. In an experiment performed under room conditions as shown below, 5.00 cm^3 of $\text{H}_2\text{O}_2(\text{aq})$ decomposed into $\text{O}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ in the presence of a catalyst. $\text{O}_2(\text{g})$ was continuously released from the start of the experiment 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 $\text{H}_2\text{O}_2(\text{aq})$, in mol dm^{-3} .
(Molar volume of gas at room conditions = 24 dm^3)

$$\text{Number of moles of } \text{O}_2(\text{g}) \text{ collected} = \frac{60 \div 1000}{24} = 2.5 \times 10^{-3} \text{ mol}$$



$$\text{Mole ratio of } \text{O}_2 = \text{H}_2\text{O}_2 = 1:2$$

$$\therefore \text{number of moles of } \text{H}_2\text{O}_2 \text{ is } 5 \times 10^{-3} \text{ mol}$$

$$\text{Initial concentration of } \text{H}_2\text{O}_2(\text{aq}) =$$

$$\frac{5 \times 10^{-3}}{5 \div 1000} = 1 \text{ M } / \text{mol dm}^{-3}$$

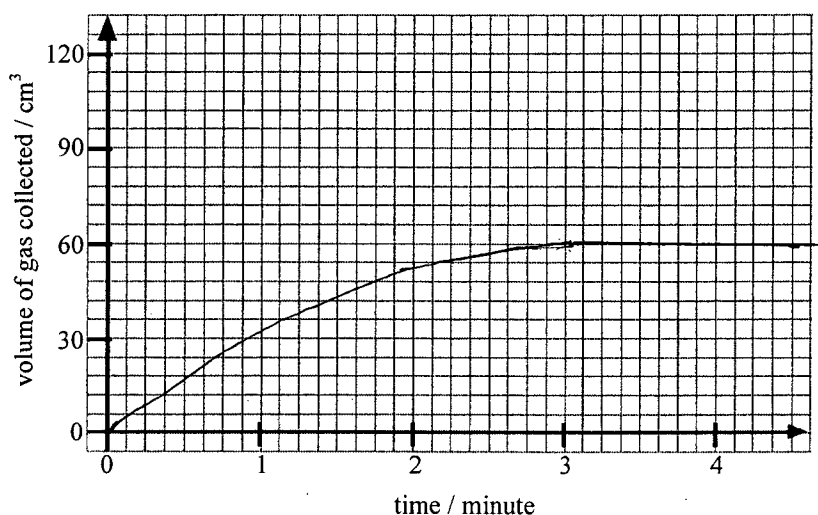
(2 marks)

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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 $\text{H}_2\text{O}_2(\text{aq})$ 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 total volume of gas obtained would still be 60 cm^3 as the number of moles of reactants remain the same

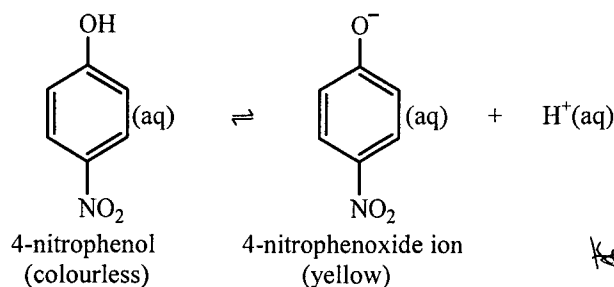
(1 mark)

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

Measure the change in the weight of the $\text{H}_2\text{O}_2(\text{aq})$ against time.

(1 mark)

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



$K_c > 0$

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

- (a) Write an expression for K_c .
(You may use **HA** to represent 4-nitrophenol and **A⁻** to represent 4-nitrophenoxide ion.)

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

(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.

Concentration (M)	HA	A ⁻	H ⁺
Initial	x	0	0
Change	$-10^{-2.4}$	$+10^{-2.4}$	$+10^{-2.4}$
Equilibrium	$x - 10^{-2.4}$	$10^{-2.4}$	$10^{-2.4}$

Ratio =

$$\frac{8 \times 10^{-5}}{10^{-2.4}} = \frac{(10^{-2.4})^2}{x - 10^{-2.4}}$$

$x = 198.11$

Ratio of concentration of 4-nitrophenol to the concentration of 4-nitrophenoxide ions =

$$2 \times 10^{-5} = 1$$

(2 marks)

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

The solution turns yellow
As NaOH removes $\text{H}^+(\text{aq})$,
the equilibrium position shifts
to the product side.

(2 marks)

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

Acts as an indicator.

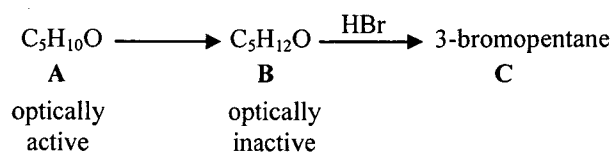
(1 mark)

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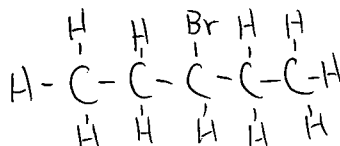
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12. Consider the following conversions :

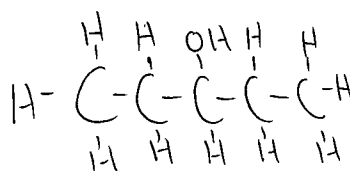


(a) Write the structural formula of C.



(1 mark)

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



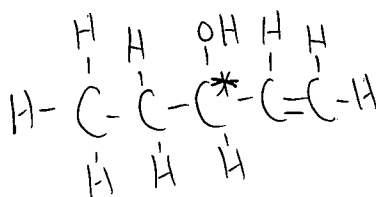
NO carbon atom
is chiral.
so B should be
this.

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

Substitution.

(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.

H₂ / Pt

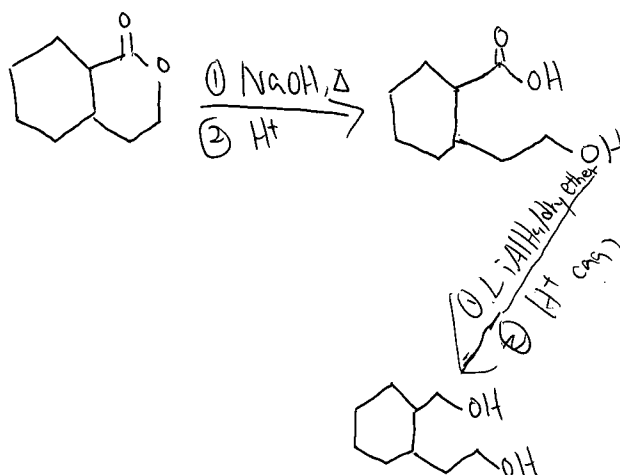
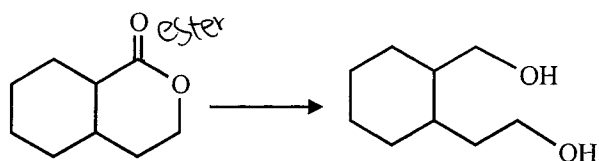
(3 marks)

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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.

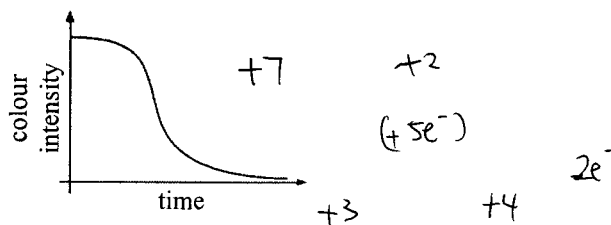


(3 marks)

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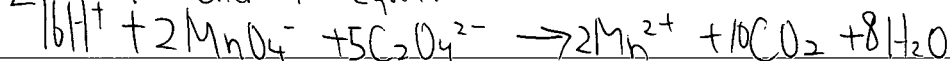
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- *14. At 60°C, $\text{MnO}_4^- (\text{aq})$ reacts with $\text{C}_2\text{O}_4^{2-} (\text{aq})$ in an acidic medium to give $\text{Mn}^{2+} (\text{aq})$, $\text{CO}_2 (\text{g})$ and $\text{H}_2\text{O} (\text{l})$. The graph below shows the variation 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)

The chemical equation should be



Firstly, In the middle of the reaction, the color intensity changes rapidly - This means one of the product, Mn^{2+} is a catalyst of the reaction, which will speed up the rate of reaction. Mn^{2+} 's catalytic property is one of the characteristics of transition metals.

Secondly, the oxidation of Mn in MnO_4^- and Mn^{2+} is +7 and +2 respectively. Variable oxidation states of transition metals in their compounds is one of their characteristics.

Finally, the solution turns from purple to colorless. This indicates the property of transition metals that their ions can be colored.

END OF SECTION B
END OF PAPER

Answers written in the margins will not be marked.

GROUP 族

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

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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

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(見下列)。
- (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.												
1	2	3	4	5	6	7	8	9	10	11	12	
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Level 5 Exemplar

Paper 2

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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總分 Total				

試題編號 Question No.

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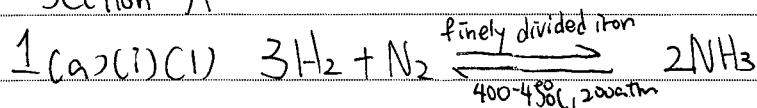
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每題另起新頁作答。

Start each question on a new page.

Section A

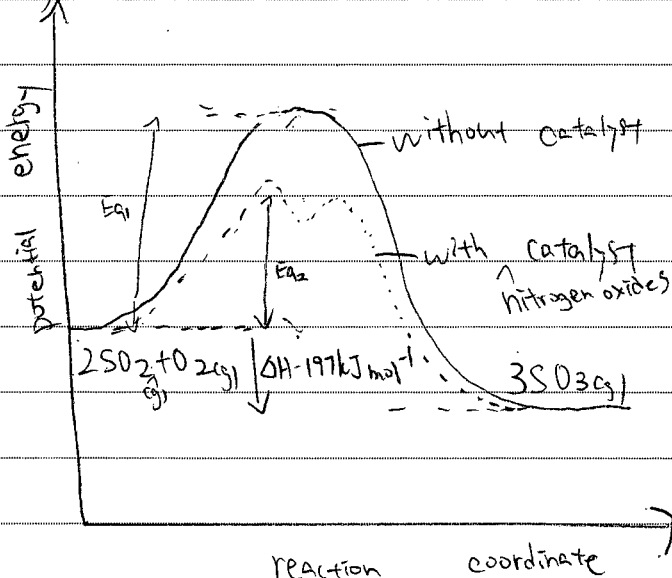


1(a)(i)(2) Ammonia obtained can be condensed into liquids, which in turn ~~can~~ be stored in a tank.

1(a)(ii) The order of reaction with respect to A(aq) is 0 as the rate of reaction is independent of the concentration of ~~A(aq)~~ A(aq) . Because the graph of $[\text{A(aq)}]$ against time gives a straight line.

1(a)(iii) Methanol is flammable, posing a threat of fire there.
 hazard

1(b)(i)



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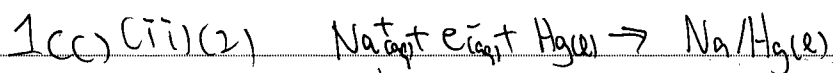
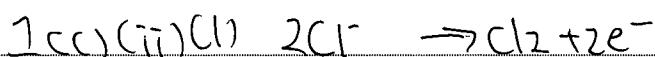
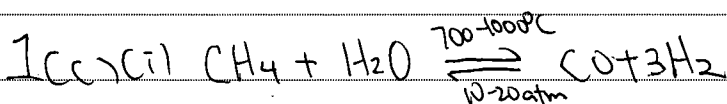
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1(b)(ii)(1) A small amount of impurity can poison a catalyst and destroys its catalytic effect.

1(b)(ii)(2)(I) Lowering the temperature of the reaction system will greatly lower the rate of reaction. Then the reaction will proceed very slowly.

1(b)(ii)(2)(II) The construction and maintenance cost of factory withstanding higher pressure of reaction system is high. This will increase the operation cost.

1(b)(ii)(3) O_2 . As O_2 is readily available in the atmosphere, no pollution will be produced. When O_2 is used in slight excess, it can shift the equilibrium position to the product side to increase the conversion percentage.



1(c)(ii)(3) The cathode, flowing mercury is toxic. If mercury leakage occurs, it damage greatly the marine life.

1(c)(iv)(1) The atom economy is 100%, There will be no waste of chemicals.

1(c)(iv)(2) The starting materials is $Cl_2(g)$, which requires the electrolysis of brine. The burning of fossil fuels to produce electricity involved will emit a lot of air pollutants.

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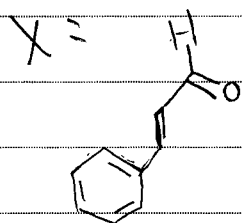
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Start each question on a new page.

3(a)(i) Carry out a flame test. Na^+ (aq) gives a golden yellow flame while K^+ (aq) gives a lilac flame.

3(a)(ii) SO_2 (g) turns a moist filter paper soaked with acidified potassium dichromate solution from orange to green.

3(a)(iii)



3(b)(i) From yellow to light purple

3(b)(ii)(1) $[(37.62) + (37.58) + (37.60)] \div 3 = 37.60 \text{ cm}^3$

3(b)(ii)(2) Number of moles of KMnO_4 (aq) used:

$$37.6 \div 1000 \times 0.0282 = 1.06032 \times 10^{-3} \text{ mol}$$

Mole ratio of $\text{MnO}_4^- = \text{Fe}^{2+} = 1:5$

$\therefore$ number of moles of Fe^{2+} in 25.00 cm^3 dilute solution = $5.3016 \times 10^{-3} \text{ mol}$

Number of moles of Fe^{2+} in $250 \text{ cm}^3 = 0.053016 \text{ mol}$

Number of moles of 0.875 g of $\text{HONH}_2 = \frac{0.875}{17+16+14+2} = 0.026515 \text{ mol}$

Mole ratio of HONH_2 (aq) : Fe^{3+} (aq) = $\frac{0.026515}{0.053016} = 1:2$

3(b)(ii)(3) +1. $\therefore$ Mole ratio of $\text{HONH}_2 = \text{Fe}^{3+} = 1:2$

* And $\text{Fe}^{3+} \rightarrow \text{Fe}^{2+} + e^-$

$\therefore$ the total number of e^- in the oxidation of HONH_2 should be 2.

The oxidation number of N = $-1 + 2 = +1$

3(b)(iii) ~~NO~~ N_2O

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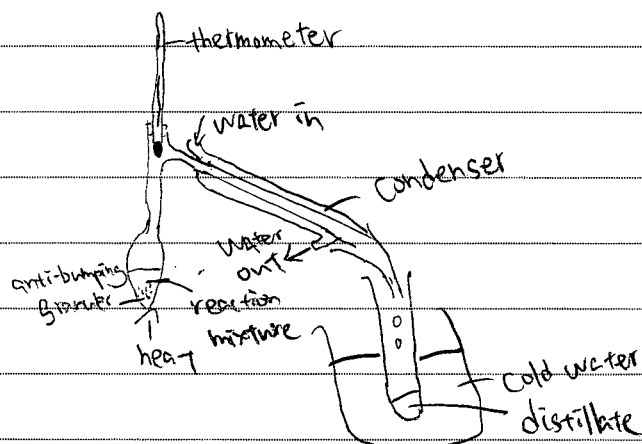
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Start each question on a new page.

3(c)(i) This prevents the loss of volatile reactants and products by evaporation.

3(c)(ii)(1)



3(c)(i)(3) Recrystallization

3(c)(ii) Artemisinin can react with $\text{NaHCO}_3(\text{aq})$, indicating it contains a carboxyl group. The absorption peak at round 1700 cm^{-1} corresponds to $\text{C}=\text{O}$ bond. Only γ contains both $-\text{COOH}$ and $\text{C}=\text{O}$ bond, therefore, γ would be a possible structure of artemisinin.

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