1. A	2. A	3. B(E) C	4. C	5. B	6. C	7. C	8. D	9. B	10. D
11. B	12. A	13. B	14. A	15. C	16. B	17. B	18. B	19. C	20. C
21. B	22. C	23. B	24. A	25. A	26. A	27. B	28. A	29. D	30. D
31. B	32. C	33. B	34. D	35. C	36. A				

問題	選擇 A	選擇 B	選擇 C	選擇 D	漏空	正確答案
1	76%	9%	0%	16%	0%	A
2	9%	29%	44%	19%	0%	A
~~*3~~	~~0%~~	~~89%~~	~~7%~~	~~4%~~	~~0%~~	**中文卷及 12/2 後考的考生:C 除上以外:B**
4	7%	9%	77%	7%	0%	C
5	9%	79%	13%	0%	0%	B
6	19%	4%	64%	13%	0%	C
7	10%	9%	74%	7%	0%	C
8	6%	6%	33%	56%	0%	D
9	26%	41%	10%	21%	1%	B
10	13%	17%	19%	51%	0%	D
11	36%	16%	21%	27%	0%	B
12	46%	31%	9%	14%	0%	A
13	3%	91%	3%	1%	1%	B
14	71%	3%	19%	4%	3%	A
15	24%	3%	66%	4%	3%	C
16	7%	63%	20%	10%	0%	B
17	24%	39%	21%	16%	0%	B
18	4%	79%	1%	16%	0%	B
19	6%	13%	74%	6%	1%	C
20	17%	6%	74%	3%	0%	C
21	26%	46%	19%	10%	0%	B
22	7%	14%	43%	33%	3%	C
23	6%	66%	26%	1%	0%	B
24	93%	4%	1%	1%	0%	A
25	49%	14%	17%	17%	3%	A
26	79%	4%	14%	3%	0%	A
~~*27~~	~~10%~~	~~3%~~	~~1%~~	~~86%~~	~~0%~~	**中文卷為:B 英文卷為 D**
28	64%	4%	13%	16%	3%	A
29	14%	34%	40%	11%	0%	D
30	4%	31%	7%	56%	1%	D
31	51%	34%	11%	3%	0%	B
32	11%	1%	61%	24%	1%	C
33	26%	39%	21%	14%	0%	B
34	11%	17%	11%	57%	3%	D
35	17%	31%	31%	20%	0%	C
36	80%	4%	9%	7%	0%	A

考試等級與試卷分數對照參巧		
等級	試卷分數	考生比率
Lv. 5**	>66%	1%
Lv. 5*	58%-66%	10%
Lv. 5	50%-58%	14%
Lv. 4	40%-50%	19%
Lv. 3	30%-40%	15%
Lv. 2	20%-30%	15%
Lv. 1	<20%	26%

Max: 68% (109.5 分)

Mean: 38% (61.05 分)

SD: 23.78 分

Detailed explanation of MC

1. A

Information from the question:

1. X is an ionic compound
2. Charge ratio of cation and anion = 1:1

For option I,

NaCl exist as

Na^+ Cl^-

For option II,

MgS exist as

Mg^{2+} S^{2-}

The elements in option III would not form an ionic compound.

從題目中得知的資訊:

1. X 是一個離子化合物
2. 陽離子和陰離之的電荷比例為 1:1

在選擇 1,

NaCl 以 Na^+ Cl^-的形式存在。

在選擇 2,

MgS 以 Mg^{2+} S^{2-} 的形式存在。

2. A

For option A, the same amount doesn't ensure the same surface area.

For option B, pH=-log[H^+], given that the concentration of H^+ is high enough, the pH can be a negative value.

For option C, very dilute strong acid is not corrosive.

For option D, Acid is defined as compound with H atom and the H atom can be ionized in water. Without water, acid cannot ionize H^+ to perform the acidic properties.

在選項 A, 需要留意相同的數量並不保證當中的表面面積相同。

在選項 B, pH=-log[H^+], 所以只有 H^+的濃度足夠高, pH 值是可以是負數的。

在選項 C, 非常稀的強酸是不帶腐蝕性的。

在選項 D, 酸的定義是一化合物同時含有氫原子且其氫原子能在水的電離。沒有水，酸不能電離出 H^+ 以展現其酸的性質。

3. C

The empirical formula is a chemical formula showing the simplest integer ratio of atoms of each element present in a substance.

The correct answer should be found by finding the empirical formula first.

實驗式是化學式的一種，它顯示物質中各種元素原子之間的最簡單整數比例。

要找出正確的答案應首先找出實驗式。

4. C

What is the criteria of the solution used in salt bridge?

1. No reaction with the electrolyte
2. No formation of insoluble compound with the electrolyte
3. conduct electricity
   導電

AgBr(s) is insoluble in water.

鹽橋的溶液需符合甚麼條件?

1. 與電解質沒有反應
2. 與電解質不會生成不溶物質
3. 導電

AgBr(s) 是不溶於水的。

5. B

Actually the 4 options cannot be used to surely confirm the two compound are in the same homologous series. Amount the 4 options, B is the most probable option. As the homologous series having the same functional group.

Functional group determine the chemcial properties of the organic compound.

For option A, empirical formula can be the same in different homologous series. For example, ketone and aldehyde.

For option C, molecular formula can be the same in different homologous series. For example, ketone and aldehyde.

For option D, number of carbon presence in the compound affects the boiling point.

4 個選項中實際上不能用作完全確定 2 種化合物為同系列。因當中 B 是最切合的答案。因為同系列擁有相同的官能基。官能基主導該有機化合物的化學性質。

於選擇 A, 在不同的同系列其實驗式都可以是相同的。例如酮和醛。

於選擇 C, 在不同的同系列其分子式都可以是相同的。例如酮和醛。

於選擇 D, 分子的沸點受到化合物存在的碳的數目影響。

6. C

To consider a preparation of a salt, we have to consider:

1. The feasibility of the reaction
2. The safety of the reaction
3. Purification of the product

The reaction of option A is explosive.

The reaction of option B cannot produce salt that can be separated.

By titration method, the condition in option C can be used to prepare salt.

No reaction for option D.

在製備一鹽時，需要考慮：

1. 反應的可行性
2. 反應的安全性
3. 產物的純化

在選項 A 的方法是爆炸性的。

在選項 B 是不能製備可被純化的鹽。

用滴定方法可以使用選項 C 的組合製備該鹽。

在選項 D 的組合是沒有反應的。

7. C

the oxidation number of H^+ is not changed.
Oxidation number of Metal Pb = 0
Oxidation number of Pb in $PbSO_4$ = +2
Oxidation number of Pb in PbO_2 = +4
An oxidising agent can oxidize other substance in a reaction. The oxidizing agent undergo reduction itself.
在 H^+中的氧化數沒有改變。
金屬 Pb 的氧化數 = 0
在 $PbSO_4$ 的 Pb 的氧化數= +2
在 PbO_2 的 Pb 的氧化數= +4
氧化劑在反應中氧化其他物質。氧化劑自身進行還原。

8. D

For option I, it increases the rate of Fe losing e^- which is not cathodic protection.
For cathodic protection, the battery provides electrons to iron, preventing the formation of Fe^{2+} ions, and hence inhibiting the rusting process.
Zinc can serve as a sacrificial protection.
Connect the iron object to a more reactive metal (e.g. Mg or Zn).
The more reactive metal corrodes instead of iron, because it loses electrons more readily.

就選項 I, 這會加快 Fe 失去電子的速率。並不是陰極保護。
電池向鐵提供電子，阻止 Fe^{2+}離子形成，從而抑制生銹蝕發生。
鋅能夠作為犧牲性保護。
把鐵製物件與一較活潑的金屬(e.g. Mg 或 Zn)連接。
較活潑的金屬會先腐蝕，而鐵則不會，因為該金屬較鐵容易失去電子。

9. B

For the electrolysis of concentrated potassium nitrate solution,
H^+ will be preferentially discharged in cathode.
$2e^- + 2H^+ \text{--> } H_2$
OH^- would be preferentially discharged in anode.
$4OH^- \rightarrow O_2 + H_2O + 4e^-$
Overall reaction: $4H^+ + 4OH^- \rightarrow 2H_2 + O_2 + H_2O$
The ratio of H_2 and O_2 produced is 2:1

在電解濃硝酸鉀中,
H^+會於陰極優先放電。
$2e^- + 2H^+ \text{--> } H_2$
OH^- 會於陽極優先放電。
$4OH^- \rightarrow O_2 + H_2O + 4e^-$
總反應：$4H^+ + 4OH^- \rightarrow 2H_2 + O_2 + H_2O$
H_2 和 O_2 is 反應比例為 2:1

10. D

Electrolysis can be used to extract different type of metal. So it can be used to be distinguish the metal.
When the metals are placed in the water, it has a fairly high chance that both of them are having or are not having reaction with water.
When the metals are place in the acid, it has a fairly high chance that both of them are having or are not having reaction with acid
Comparing with other answer, if one of the metal has a higher reactivity, it can displace the other metal's nitrate solution. (with an except for a pair of 2 very reactive metal which can react with water vigorously without carrying out displacement reaction.)

電解能夠提取不同類型的金屬。所以不能分辨
放置於水中時，有比較大的機會出現 2 者沒有反應或 2 者都有反應。
放置於酸中時，有比較大的機會出現 2 者沒有反應或 2 者都有反應。
相對其他答案，若其中一個金屬能夠於另一金屬的硝酸鹽溶液中進行置換反應，必定能夠分辨其活潑性。(除非該種金屬的活潑性都能與水進行劇烈的反應因而沒有進行置換反應。)

11. C

In this question, several concepts should be reviewed.

1. The solubility of a salt.
2. The limiting reagent
3. The calculation of concentration

For the reaction equation:

$Pb(NO_3)_{2(aq)} + 2NaCl_{(aq)} \rightarrow PbCl_{2(s)} + 2NaNO_{3(aq)}$

For ionic equation:

$Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2(s)}$

The number of mole of Pb^{2+} provided by $Pb(NO_3)_{2(aq)}$ = Volume(in dm^3) x molarity x number of Pb^{2+} per formula unit

= 100/1000 x0.05 x 1

= 0.005 mol

The number of mole of Cl^- provided by $NaCl_{(aq)}$ = Volume(in dm^3) x molarity x number of Cl^- per formula unit

= 100/1000 x0.05 x 1

= 0.005 mol

From the ionic equation, 0.005 mole of Pb^{2+} has to reaction with 0.01mol of Cl^-, so, Cl^- is a limiting reactant.

The number of mole $PbCl_2$ = $\frac{\text{number of mole of Cl}-}{2}$

= 0.005/2

= 0.0025mol

Total ion removed from the solution = (The number of mole $PbCl_2$) X (Number of ions in a formula unit which is 3)

= 0.0025x3

= 0.0075 mol

Remaining ions in the solution = total ion originally mixed - Total ion removed from the solution

$= \frac{100}{1000} x\ 0.05x\ 3 + \frac{100}{1000}\ x\ 0.05\ x\ 2 - 0.0075$

= 0.0175mol

Concentration of the ions in the solution = $\frac{\text{Remaining ions in the solution}}{\text{total volume of the final solution}}$

$= \frac{0.0175}{\frac{100+100}{1000}}$

= 0.0875M

在這題目中，需要處理數種概念。

1. 鹽的溶解度
2. 限量反應物
3. 濃度的計算

反應方程式:

$Pb(NO_3)_{2(aq)} + 2NaCl_{(aq)} \rightarrow PbCl_{2(s)} + 2NaNO_{3(aq)}$

離子方程式:

$Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2(s)}$

由 $Pb(NO_3)_{2(aq)}$提供的 Pb^{2+}的摩爾數 = 體積(以 dm^3 為單位) x 摩爾濃度 x 每一式量的 Pb^{2+} 的數目

= 100/1000 x0.05 x 1

= 0.005 mol

由 $NaCl_{(aq)}$提供的 Cl^-的摩爾數 = 體積(以 dm^3 為單位) x 摩爾濃度 x 每一式量的 Cl^- 的數目

= 100/1000 x0.05 x 1

= 0.005 mol

由離子方程式得知，0.005 mole 的 Pb^{2+} 可與 0.01mol 的 Cl^-反應, 所以 Cl^-是限量反應物

$PbCl_2$ 的摩爾數= $\frac{Cl^-\text{的摩爾數}}{2}$

= 0.005/2

= 0.0025mol

從溶液中移除的總離子數 = ($PbCl_2$ 的摩爾數) X (在式量的離子數目總數(3))

= 0.0025x3

= 0.0075 mol

在溶液餘下的離子 = 最初混合的離子總數 - 從溶液中移除的總離子數

$= \frac{100}{1000} x\ 0.05x\ 3 + \frac{100}{1000}\ x\ 0.05\ x\ 2 - 0.0075$

= 0.0175mol

在溶液的離子的濃度 = $\frac{\text{在溶液餘下的離子}}{\text{溶液最反的體積}}$

$= \frac{0.0175}{\frac{100+100}{1000}}$

= 0.0875M

12. A

To form a hydrogen, there are two conditions

1. F/O/N provides lone pair electron
2. H bond with F/O/N through covalent bond

NH_3BCl_3 cannot fulfill both conditions

生成氫鍵需要符合 2 個條件：

1. F/O/N 提供孤電子對
2. H 與 F/O/N 以共價鍵直接鍵合

NH_3BCl_3 並不符合該條件。

13. B

Fractional distillation of liquefied air used for producing nitrogen, oxygen and argon.

The member in group VII has color.

Burning with “pop” sound is the characteristic of hydrogen gas.

分餾液化空氣用於生產氮，氧，氬

第 VII 族的成員都是有顏色的

燃燒時有「卜」聲的是氫氣

14. A

This is a redox reaction. (by calculation of oxidation number)

We can construct the full equation by 2 half equations.

$H_2O + HNO_2 \rightarrow NO_3^- + 3H^+ + 2e^-$

$6e^- + 14H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O$

$3HNO_2 + 5H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 3NO_3^- + 4H_2O$

這是氧化還原反應。（根據氧化數的計算）

我們可以藉 2 條半反應式建構總反應式。

$H_2O + HNO_2 \rightarrow NO_3^- + 3H^+ + 2e^-$

$6e^- + 14H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O$

$3HNO_2 + 5H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 3NO_3^- + 4H_2O$

15. C

TWO general trends of electronegativity：

1. Electronegativity INCREASES across a period (from left to right).
2. Electronegativity DECREASES down a group (from top to bottom).

The degree of polarity depends on the different of electronegativity between two atoms.

電負性兩個基本趨勢：

1. 沿週期左至右，電負性遞增。
2. 沿族上至下，電負性遞減。

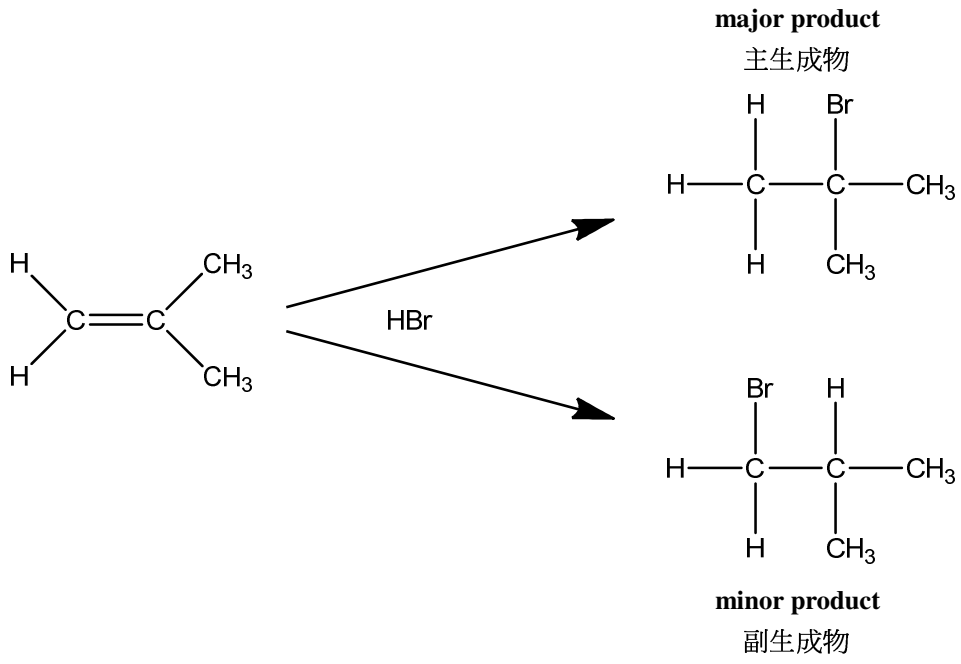
極性的大小受到 2 個原子的電負性差距影響。

16. B

Markovnikov's rule

馬科尼科夫規則

- In the addition of alkene and HX, the H atom will mainly attach to the C atom of the C=C bond with larger number of H atoms.
  在烯與 HX 的加成反應中，H 原子主要附加於 C=C 鍵中已帶有較多 H 原子的 C 原子上。



當中 2 種生成物都存在。

17. B

The double bond in benzene have different chemical properties between the double bond between alkenes.

在苯環中的雙鍵與烯擁有的化學性質不同

(A):

$2C_6H_{10} + 17O_2 \rightarrow 12CO_2 + 10H_2O$

(B):

$2C_6H_6 + 15O_2 \rightarrow 12CO_2 + 6H_2O$

18. B

Only $SO_{2(g)}$ and $NO_{2(g)}$ can be produced by burning fossil fuel.

只有 $SO_{2(g)}$ 和 $NO_{2(g)}$可透過燃燒化石燃料產生並導致酸雨。

19. C

For option A, the oxidation number of Cl changes from +7 to +5 which is a reduction.
For option B, the oxidation number of N changes from 0 to -3 which is a reduction.
For option C, the oxidation number of N changes from +1 to +2 which is an oxidation.
For option D, the oxidation number of S changes from +6 to +4 which is a reduction.
在選擇 A，Cl 的氧化數由+7 轉為+5，這是還原作用。
在選擇 B，N 的氧化數由 0 轉為-3，這是還原作用。
在選擇 C，N 的氧化數由+1 轉為+2，這是氧化作用。
在選擇 D，S 的氧化數由+6 轉為+4，這是還原作用。

20. C

Concentrated $HNO_3(aq)$ can react with non-reactive metals (e.g. Cu / Ag) and form nitrogen dioxide ($NO_2(g)$, a brown colour, toxic gas).

$$Cu(s) + 4HNO_3(aq) \xrightarrow{\text{Conc.}} Cu(NO_3)_2(aq) + 2H_2O(l) + \underbrace{2NO_2(g)}_{\text{nitrogen dioxide (brown)}}$$

Concentrated $H_2SO_4(l)$ is a strong oxidizing agent, while dilute $H_2SO_4(aq)$ has no oxidizing power.

$$Cu(s) + H_2SO_4(l) \xrightarrow{\text{Conc.}} CuSO_4(aq) + 2H_2O(l) + \underbrace{SO_2(g)}_{\text{sulphur dioxide}}$$

Copper can react with concentrated nitrate acid and concentrated sulphuric acid.
Copper (II) is blue in color instead of Copper metal.
$2Cu + O_2 \text{ --> } 2CuO$
Sacrificial protection:
Connect the iron object to a more reactive metal 犧牲性保護需將鐵連接到更活潑的金屬。

濃 $HNO_3(aq)$可與低活性的金屬(e.g. Cu / Ag)反應，生成二氧化氮($NO_2(g)$，一種棕色、有毒的氣體)。

$$Cu(s) + 4HNO_3(aq) \xrightarrow{\text{濃}} Cu(NO_3)_2(aq) + 2H_2O(l) + \underbrace{2NO_2(g)}_{\text{二氧化氮 (棕色)}}$$

$$Cu(s) + H_2SO_4(l) \xrightarrow[\text{加熱}]{\text{濃}} CuSO_4(aq) + 2H_2O(l) + \underbrace{SO_2(g)}_{\text{二氧化硫}}$$

濃 $H_2SO_4(l)$是一種強氧化劑，但稀 $H_2SO_4(aq)$則不具有氧化能力。
銅能夠與濃硝酸和濃硫酸反應。
銅(II)離子才呈現藍色而非銅金屬。
$2Cu + O_2 \text{ --> } 2CuO$

21. B

Properties 性質	**Explanation** 解釋
Soft and black solid 軟和黑的固體	C_{60} sublimates at 600 ^oC, while graphite sublimates at > 4000 ^oC. C_{60} 於 600 ^oC 昇華，石墨於> 4000 ^oC 昇華。
Relatively low melting point 相對較低的熔點	C_{60} has a simple molecular structure. There are only weak van der Waal's force between C_{60} molecules. C_{60} 具有簡單分子結構。 C_{60} 分子間只帶有微弱的范德華力。
Soluble in non-polar solvent 可溶於非極性溶劑	C_{60} is soluble in many organic solvents (which are non-polar). e.g. C_{60} is soluble in benzene / methyl benzene and form a purple solution. 可溶於許多不同的有機溶劑中(有機溶劑為非極性)。 e.g. C_{60} 可溶於苯/甲基苯中，形成紫色溶液。 C_{60} has no any polar bond and it is a symmetrical molecule. Hence, it is a non-polar compound. C_{60} 不含任何極性鍵，且是一對稱分子，因此它是一非極性化合物。 The van der Waal's force between C_{60} molecules are of comparable strength as those in molecules of non-polar solvents. C_{60} 分子間的范德華力的強度與非極性溶劑分子間的引力相若。
Electrical insulator 絕緣體	There are no mobile ions or delocalized electrons between C_{60} molecules. C_{60} 分子間沒有游動離子或離域電子。 However, C_{60} will be electrical conductive in the following situations： 但是，在以下情況可令 C_{60} 變得導電： 1. Connecting C_{60} molecules with each other through polymerization. 透過聚合作用，把 C_{60} 分子互相連結在一起。 2. Converting C_{60} molecules into carbon nanotubes. 把 C_{60} 分子轉化成碳納米管 3. C_{60} molecule are doped with metal ions (e.g. K^+) into its structure. 把金屬離子(e.g. K^+)摻雜到 C_{60} 的分子結構中。

22. C

For option A:

Anode Cu--> $Cu^{2+} + 2e^-$

Cathode $e^- + Ag$ --> Ag

For option B:

Anode: Cu --> $Cu^{2+} + 2e^-$

Cathode: $Cu^{2+} + 2e^-$ -->Cu

For option C:

Anode: $4OH^-$ --> $O_2 + 2H_2O + 4e^-$

Cathode: $2e^- + 2H^+$ --> H_2

For option D:

Anode: Cu--> $Cu^{2+} + 2e^-$

Cathode: $e^- + Na^+$ --> Na

In option C, both anode and cathode produce gaseous product.

選擇 A:

陽極: Cu--> $Cu^{2+} + 2e^-$

陰極: $e^- + Ag$ --> Ag

選擇 B:

陽極: Cu --> $Cu^{2+} + 2e^-$

陰極: $Cu^{2+} + 2e^-$ -->Cu

選擇 C:

陽極: $4OH^-$ --> $O_2 + 2H_2O + 4e^-$

陰極: $2e^- + 2H^+$ --> H_2

選擇 D:

陽極: Cu--> $Cu^{2+} + 2e^-$

陰極: $e^- + Na^+$ --> Na

在選擇 C，陽極和陰極都會產生氣體產物。

23. B

Graphite has giant covalent structure, during melting a lot of energy is needed to break down the strong covalent bond between atoms. Hence, it has a high melting point.

Weak van der Waals' force exist between layers of carbon atoms.

→ Layers can slip over each other without breaking.

→ Graphite is soft and slippery.

→ Graphite can be used as lubricants.

石墨擁有巨型共價結構，熔解時需要很多破壞原子之間強大的共價鍵。所以石墨有高的溶點。

碳原子層之間只帶有微弱的范德華力。

→ 碳原子層可互相滑動，而不會被破壞。

→ 石墨是柔軟和滑的。

→ 石墨可作為潤滑劑。

24. A

Rusting can be prevented by attaching a layer which isolate oxygen and water from iron.

Tin-plating

Widely used for protecting food cans made of iron because Sn^{2+} ion is non-toxic.

However, once the tin layer has been scratched to expose the iron underneath, rusting is speeded up.

Because tin (Sn) is a less reactive metal then iron (Fe), iron loses electrons more readily when attaching to tin.

在鐵的表面加上一隔可絕氧和水的物質，以防止生銹發生。

鍍錫

常用於保護鐵製的食物罐頭，因為 Sn^{2+}離子是無毒的。

但是，如果錫層被刮損並露出底下的鐵，生銹過程會加快。

因為錫(Sn)較鐵(Fe)活潑，當鐵與錫接觸時，鐵會較易失去電子。

25. A

Related concept of option A:

Across a period from left to right, the atomic radius decrease (e.g. Li > Be > B > C).
Because the number of protons increase, while the number of electron shells remain unchanged, which increase the effective nuclear charge of the atom.
The attraction between the nucleus and outermost electrons increase.
Outermost electrons are thus closer to the nucleus.

Down the group, the atomic radius gradually increase (e.g. Rb > K > Na > Li).

As down the group, each successive element has one more filled inner shell than the previous element in the same group.

More electron shells increase the shielding effect, which reduce the effective nuclear charge , and therefore lower the attraction between the nucleus and outermost electrons.

Outermost electrons are thus farther away from the nucleus.

Related concept of option B:

For elements of period 2 and 3,

Melting point steadily increase from Group I to Group III.
Group I to III elements are metals (except baron, which is a semi-metal with giant covalent structure).
In the giant metallic structure, there are strong metallic bonds formed between metal ions and delocalized electrons.
From Group I to III, since the number of outermost shell electrons of elements increase,
the electrons involved on the metallic bond increase as well.
Moreover, the charge of metal ions also increase, the strength of metallic bond is thus increase from Group I to III.

The melting point is maximum at Group IV.

Both C and Si have the highest melting point in their own period.
Both C and Si form giant covalent structure in which atom form strong covalent bonds with other atoms.
Large amount of energy is required to break the covalent bonds.

Melting point decrease sharply at group V.
Both nitrogen and phosphorus have simple molecular structure, their molecules are held by weak van der Waals' forces.

Melting points show slightly variation but low for Group V to VII.
They are usually diatomic molecules, so that the molecules are also attracted by weak van der Waals' forces.
Sulphur has a crown shaped S_8 molecular structure, while phosphorus (white) has a tetrahedral P_4 structure.
Since the strength of van der Waals'forces are consistent with the molecular size, the melting point order in period 3： $S_8 > P_4 > Cl_2 > Ar$.

Related concept of option C:

The reactivity of group I elements increase down the group.
The reactivity of group II elements increase down the group.
The reactivity of group VII elements decrease down the group.

Related concept of option D:

Electronegativity increases across a period
From left to right：
The number of protons increases, but the number of electron shells remains unchanged.
The effective nuclear charge increases.
The bond pair electrons are attracted toward the nucleus more strongly.
∴Higher electronegativity.
Electronegativity decreases down a group
From top to bottom
The number of electron shells increase, so that the atomic radius increase.
The distance between bond pair electrons and the nucleus increase.
The effective nuclear charge decreases.
the bond pair electrons are attracted toward the nucleus less strongly.
∴lower electronegativity.

選擇 A 相關概念:

沿週期左至右，原子半徑減少 (e.g. Li > Be > B > C)。
由於質子數目上升，而電子層的數目則不變，導致原子的有效核電荷增加。
原子核與最外層電子間的吸引力上升。
最外層電子與原子核的距離減少。

沿族而下，原子半徑遞增 (e.g. Rb > K > Na > Li)。
沿族而下，每個元素均較同族前一個成員多一個已填入電子的內層。
電子層增加導致屏蔽效應增加，令有效核電荷減少，使原子核與最外層電子間的吸引力下降。
最外層電子與原子核的距離增加。

選擇 B 相關概念:

對於第 2 和 3 週期元素，
熔點由第 I 族至第 III 族穩定上升。
第 I 族至 III 族元素為金屬(除了硼是具有巨型共價結構的半金屬)。
在巨型金屬結構中，金屬離子與離域電子間帶強大的金屬鍵。
由第 I 族至 III 族，最外層電子數目增加，能夠參與金屬鍵的電子數目也因此增加。此外，由於金屬離子的電荷上升，金屬鍵的強度會由第 I 族至 III 族增加。

第 IV 族的熔點為全週期中最高。

C 和 Si 的熔點在它們週期中是最高的。
C 和 Si 均形成巨型共價結構，原子之間帶強大的共價鍵。
破壞共價鍵需要大量能量。

第 V 族的熔點急劇下降。
氮和磷均屬簡單分子結構，它們的分子間只帶微弱的范德華力。

第 V 至 VII 族的熔點很低，但呈輕微變化。
它們通常是雙原子分子，它們的分子間均帶微弱范德華力。
硫具有皇冠形的 S_8 分子結構，磷(白磷)則具有正四面體形的 P_4 分子結構。
由於范德華力的強度會隨分子的體積增加，因此第 3 週期元素的熔點： $S_8 > P_4 > Cl_2 > Ar$。

選擇 C 相關概念:

沿族上而下，第 I 族元素的活潑性遞增。
沿族上而下，第 II 族元素的活潑性遞增。
沿族上而下，第 VII 族元素的活潑性遞減。

選擇 D 相關概念:

電負性沿週期左至右遞增
由左至右：
質子數目上升，但電子層數目則維持不變。
有效核電荷上升。
鍵合電子對會被較強的引力吸向原子核。
∴ 電負性增加。

電負性沿族上至下遞減
由上至下：
電子層數目上升，因此原子半徑增大。
鍵合電子對與原子核之間的距離增加。
有效核電荷下降。
鍵合電子對會被較弱的引力吸向原子核。
電負性減少。

26. A

In option A, two molecules are not Superimposable.
在選項 A, 2 個分子並不能重疊。

27. D for English paper, C 為中文卷答案

Catalyst can increase the rate of the reaction but not the yield of the reaction.

The effect of surface area on reaction rate

For solid reactant, a finer particles means a higher surface area to volume ratio. A larger surface area would lead to more collisions per unit mass of the solid reactant and higher reaction rate.

The effect of temperature change on reaction rate

For all reactions (either exothermic or endothermic)：

1. When Temperature ↑ , kinetic energy of reactant particles ↑ ,
2. Total number of particles with kinetic energy ≧ Ea ↑,
3. number of effective collisions ↑ , rate ↑

催化劑可以增反應的速率，但不能增加其產率。

表面面積對反應速率的影響

對於固體反應物，當固體粒子越細小，其總表面面積越大。
反應物的表面面積越大，撞擊的次數亦會越多，因此反應速率會上升。

改變溫度對反應速率的影響

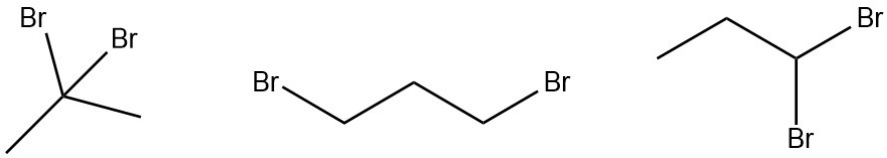
對於任何反應 (無論放熱或吸熱)：

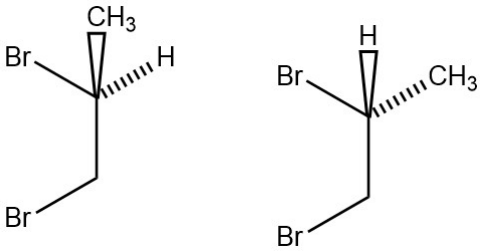
1. 當溫度↑，反應物粒子的動能↑，
2. 擁有動能 ≧ Ea 的粒子總數目↑，
3. 有效碰撞的次數↑，速率↑

28. A

Common oxides 常見氧化物	$Na_2O(s)$	$MgO(s)$	$Al_2O_3(s)$	$SiO_2(s)$	$P_4O_{10}(s)$	$SO_2(g)$	$Cl_2O(g)$
Acid-base properties 酸鹼性質	basic 鹼性		amphoteric 兩性	acidic 酸性			
Reaction with H_2O 與 **H_2O** 的反應	vigorously 劇烈反應 $Na_2O + H_2O \rightarrow 2NaOH(aq)$	slowly 緩慢反應 $MgO + H_2O \rightarrow Mg(OH)_2(s)$	-	-	vigorously 劇烈反應 $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4(aq)$	$SO_2 + H2O \rightarrow H_2SO_3(aq)$	$Cl_2O + H_2O \rightarrow 2HOCl(aq)$

29. D





30. D

For a reaction that can be measured by weight difference, it has to show a significant change in weight.
H_2 is too light to be sensed. The accurate of the experimental result is not high.
若要以重量差來監測一個反應，這反應需要有一個明顯的重量改變。H_2 的重量會太過輕，令到實驗的結果不明顯。

31. B

As $C_{(s)}$ is in solid state, it would not be included in the Kc expression.
因為 $C_{(s)}$ 在固態，它並不會包括在 Kc 的表達式。

So, $Kc = \frac{[D]eqm}{[A]eqm[B]eqm}$

$$Kc = \frac{[1/25]eqm}{[1/25]eqm[2/25]eqm}$$

Kc = 12.5 $mol^{-1}dm^3$

32. C

In the description, we can understand it as the $D_{(g)}$ (product) is removed. So the equilibrium position will shift to the right. However, the increment of $D_{(g)}$ cannot cover the removal of the $D_{(g)}$.
在描述中，我們可以知道 $D_{(g)}$(產物) 被移除。所以平衡位置會移到右方。不過，$D_{(g)}$ 的增加不能抵消 $D_{(g)}$ 的移除。

33. B

In the new condition, all the reactants and products will be in aqueous state. So, the new Kc expression will be

$$Kc = \frac{[c]eqm[D]eqm}{[A]eqm[B]eqm}$$

$$Qc = \frac{[c][D]}{[A][B]}$$

Qc = 1
Qc<Kc, So, the reaction will be shifted to the product side. As a result, the concentration of B will be lower.
在新條件下，所有的反應物和產生都在水溶液狀態。所以，新的 Kc 表達式為:

$$Kc = \frac{[C]_{eqm}[D]_{eqm}}{[A]_{eqm}[B]_{eqm}}$$

$$Qc = \frac{[C][D]}{[A][B]}$$

Qc = 1
Qc<Kc, 反應會轉移至產物方。因此，B 的濃度會減低。

34. D
This compound can form hydrogen bond with water.
After the reaction with $LiAlH_4$/dry ether, following by H^+, some optical isomers present.
It is polar as the polar bonds cannot be cancelled out each other.
The carboxylic acid can react with NH_3

該化合物能與水生成氫鍵。
在與 $LiAlH_4$/乾醚, 隨後加入 H^+ 的反應中會產生數個旋光異構體。
這是帶極性的，因為這性極性鍵不會互相抵消。
羧酸能與 NH_3 反應。

35. C
Total bonds are broken in the reaction:
2 H-H bonds
1 O=O bond
Total bonds are formed in the reaction:
4 H-O bonds
For bond breaking, energy has to be gained.
For bond breaking, energy is released.
So, the enthalpy change is 2x+y-4z
在反應中拆開的鍵:
2 H-H 鍵
1 O=O 鍵
在反應中總共生成的鍵:
4 H-O 鍵
在拆鍵的過程中，需要能量。
在生成鍵的過程中，會釋出能量。
所以，焓變為 2x+y-4z

36. A
When the concentration decease, the rate of effective collision decrease. Hence, the rate of reaction decreased.
當濃度下降時，有效碰撞會減少，因此反應速率下降。

1(a) (Simple) distillation(1)
(簡單)蒸餾法 (1)

1(b) The set-up cannot separate methanol and ethanol(1)
as methanol and ethanol has similar boiling point(1)
該裝置不能用作分離甲醇與乙醇(1)
因為甲醇和乙醇有相近的沸點(1)

2(a) Let the relative atomic mass of element X be y.

$$\frac{y}{y+2}\times 100\% = 88.9\% \quad (1)$$

$$y = 16$$

Hence, element X should be oxygen.(1)
設元素 X 的相對原子質量為 y。

$$\frac{y}{y+2}\times 100\% = 88.9\% \quad (1)$$

$$y = 16$$

因此元素 X 應該氧。(1)

2(b) H_2Y (1)

2(c) The statement is wrong.(1)
As XH_2 can form hydrogen bond between the molecules, while there are weak Van Der Waals force between the compound in (b).More energy is needed to break down the hydrogen bond than Van Der Waals force.(1)
這陳述是錯誤的。(1)
因為 XH_2 能夠生成分子之間的氫鍵, 不過在(b)的化合物只有弱的范德華力。比起破壞范德華力更多能量需要用以破壞氫鍵。(1)

3(a) Direct heating of paraffin causes the evaporation of paraffin very fast/faster than the rate of cracking(1)
the paraffin leave the test tube without carrying out cracking.(1)
直接加熱石蠟油會令石蠟油的蒸發速率快於進行裂解的速率(1)
沒有進行裂解的石蠟油會直接離開試管。(1)

3(b) The gas can be not able to react with water/insoluble in water.(any one)(1)
Structural characteristics: don't consist of: H atom which bond with F,O,N atom/ F, O, N with lone pair electron.(any one) (1)
該氣體不能與水反應/不溶於水。 (任何一項)(1)
結構特徵: 不擁有:與 F,O,N 原子直接鍵合的 H 原子/有弧電子對的 F,O,N 原子。 (任何一項)(1)

3(c) Provide extra small hydrogencarbons as fuel to meet the need.(1)
Provide alkene to be the raw material of plastics.(1)
提供額外的細少碳氫化合物用作燃料，以滿足其需求。 (1)
提供烯烴以作為塑膠的原材料。 (1)

4(a) A known concentration solution is called standard solution. (1)
標準溶液為該溶液的濃度是已知的。(1)

4(b) As an indicator for the titration. (1)
作為滴定法的指示劑。 (1)

4(c) $2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e^-$ (1)

4(d) from brown to dark blue.(1)
由棕色轉成藍黑色。(1)

4(e) $I_{2(aq)} + 2S_2O_3^{2-}{}_{(aq)} \rightarrow S_4O_6^{2-} + 2I^-_{(aq)}$

Number of mole of $S_2O_3^{2-}$ reacted $= \frac{17.9}{1000} \times 1$

$= 0.0179$ mol

Number of mole of I_2 reacted $= \frac{0.0179}{2}$

$= 8.95 \times 10^{-3}$ mol

Mass of I_2 in sample $= 8.95 \times 10^{-3} \times 126.9 \times 2$

$= 2.27151$ g

Percentage by mass $= \frac{2.27151}{2.73} \times 100\%$

$= 83.2\%$ (corr. to. 3.sig. fig.)

$I_{2(aq)} + 2S_2O_3^{2-}{}_{(aq)} \rightarrow S_4O_6^{2-} + 2I^-_{(aq)}$

已反應的 $S_2O_3^{2-}$的摩爾數 $= \frac{17.9}{1000} \times 1$

$= 0.0179$ mol

已反應的 I_2 的摩爾數 $= \frac{0.0179}{2}$

$= 8.95 \times 10^{-3}$ mol

I_2 在樣本的質量 $= 8.95 \times 10^{-3} \times 126.9 \times 2$

$= 2.27151$ g

質量百分比 $= \frac{2.27151}{2.73} \times 100\%$

$= 83.2\%$ (corr. to. 3.sig. fig.)

5(a) Percentage difference:

$$\frac{(35.5\times2+12\times2+2)-(12\times2+4)}{(12\times2+4)}\times100\%$$

= 246%

百分差異:

$$\frac{(35.5\times2+12\times2+2)-(12\times2+4)}{(12\times2+4)}\times100\%$$

= 246%

5(b) Polyermer (i), the C-Cl bond in that is more reactive(1) than inert C-H bond.(1)
聚合物(i), C-Cl 鍵比較活潑，比起惰性的 C-H 更易進行反應。

*6. Add 3 substances to the water, sodium burns with a golden yellow flame. So, sodium is the most reactive metal.
Add the remaining 2 substances to the hydrochloric acid, only magnesium give out colorless gas bubbles and dissolve. Don't put the sodium into the hydrochloric acid, as it is explosive.
Reactivity: Na>Ca>Cu. Avoid adding hydrochloric acid before identified the sodium.
effective communication.(1)
加入 3 個物質到水中，鈉會燃燒生成金黃色火焰。(1)
將其餘物質置於氫氯酸，只有鎂能夠產出無色氣體。(1)
反應性: Na>Ca>Cu. 避免加入鈉至氫氯酸，因為這是爆炸性的。(1)
有效傳意。(1)

如考生寫出把 **Na, Ca** 及 **Cu** 分別放入 **HCl ,**會直接被扣 **2** 分,因為 **Na** 加入 **HCl** 會爆炸,非常危險**.**

7(a) $Cu^{2+}_{(aq)} + 2OH^-_{(aq)}$ --> $Cu(OH)_{2(s)}$

Blue precipitate formed.

$Cu(OH)_{2(s)} + NH_{3(aq)}$ -->$[Cu(NH_3)_2]^{2+}_{(aq)} + OH^-_{(aq)}$

Under excess $NH_{3(aq)}$ the blue precipitate dissolved. A deep blue solution formed.

$Cu^{2+}_{(aq)} + 2OH^-_{(aq)}$ --> $Cu(OH)_{2(s)}$

藍色沉澱物生成。

$Cu(OH)_{2(s)} + NH_{3(aq)}$ -->$[Cu(NH_3)_2]^{2+}_{(aq)} + OH^-_{(aq)}$

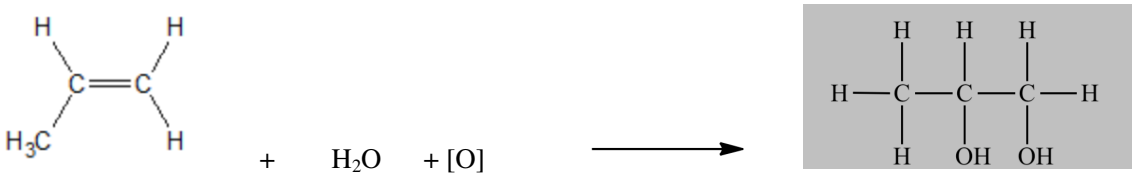
在過量的 $NH_{3(aq)}$下，藍色沉澱物溶解。深藍色的溶液會生成。

7(b) It will change from purple to colorless.

oxidizing agent ($KMnO_4$)

[O] 氧化劑 $KMnO_4$

氧化劑($KMnO_4$ 這會由紫色轉成無色。



8(a) The enthalpy change when ONE mole of a substance is burnt completely in oxygen under standard condition.

標準狀態下，一摩爾的物質在氧氣中完全燃燒時的焓變。

8(b) $C_3H_8O_{(l)} + 9/2O_{2(g)}$ --> $3CO_{2(g)} + 4H_2O_{(l)}$

No mark for the answer without physical state.

沒有物理狀態沒有分數。

8(c) $\Delta H^{\ominus}$ = $\Sigma\Delta H^{\ominus}_f$ [product] -$\Sigma\Delta H^{\ominus}_f$ [reactant] (1)

Let the standard enthalpy change of formation of propan-1-ol be y.

-2021 = (-393.5 x 3) + (-285.8 x 4)- y (1)

y = -302.7kJmol^{-1} (1)

$\Delta H^{\ominus}$ = $\Sigma\Delta H^{\ominus}_f$ [產物] -$\Sigma\Delta H^{\ominus}_f$ [生成物](1)

設丙-1-醇標準生成焓變為 y.

-2021 = (-393.5 x 3) + (-285.8 x 4)- y (1)

y = -302.7kJmol^{-1} (1)

8(d) No(1), As the reaction would not occur under standard conditions.／Side reactions occur. (1)
不(1), 因為這個反應並不會在標準狀態進行。／會有副反應的進行。(1)

第一分需要解釋正確才給分。

9(a) $Zn \rightarrow Zn^{2+} + 2e^-$
$Cu \rightarrow Cu^{2+} + 2e^-$

9(b) The purification cannot be done.(1) As the Ag^+ in the electrolyte will be preferentially discharged rather than Cu^{2+}, there is $Ag_{(s)}$ coating on the surface of the cathode.(1)
純化不能完成（１）因為在電解的 Ag^+ 會比 Cu^{2+} 優先放電，會有 $Ag_{(s)}$ 在陰極的表面生成。(1)

9(c) Cu^{2+} in the solution is blue in color. (1)
The concentration of it is directly proportional to the color intensity.(1)
在溶液中的 Cu^{2+} 是藍色的(1)
濃度與顏色深度是成正比的。

9(d) The concentration decreased = 1M-0.45M = 0.55M
Number of mole of Cu formed in cathode when Zn is discharge in anode
= 0.55x1
= 0.55mol (1)
Number of mole of Zn discharged = 0.55mol
Mass of Zinc = 35.97g
Assume there is only zinc and copper in the impure copper
Percentage by mass of copper = 40-35.97/40 x100%
= 10% (1)
下降的濃度= 1M-0.45M = 0.55M
當鋅在陽極放電時在陰極生成的銅
= 0.55x1
= 0.55mol (1)
放電的 Zn 的摩爾數 = 0.55mol
鋅的質量 = 35.97g
假設不純銅中只有鋅和銅
銅的質量百分比
= 40-35.97/40 x100%
= 10% (1)

9(e) Cannot。The Ca reacts with water to form $Ca(OH)_2$ which release OH^- to the solution. The OH^- combine with Zn^{2+} to form an insoluble $Zn(OH)_2$. So, Zn^{2+} cannot discharge in cathode.(2)
不能。鈣會與水的反應生成會釋出 OH^-至溶液的 $Ca(OH)_2$。OH^-會與 Zn^{2+} 結合生成不溶的 $Zn(OH)_2$，所以 Zn^{2+}不能在陰極放電。(2)

PART II

*10

1.A known amounts of $CH_3COOC_2H_5$(l) and NaOH(aq) are mixed. The time is recorded (t = 0).(1)
2.A fixed volume (e.g. 10 cm^3) of the reaction mixture is withdrawn by a pipette at regular time intervals (e.g. every 5 minutes), (1)
3.and is transferred to a conical flask containing some ice water.(1)
4.This solution is then titrated against standard HCl(aq) using phenolphthalein as indicator.(1)
5.The amount of NaOH(aq) remained in the reaction mixture at each time intervals can be determined by the titration results and plot a graph to find the rate of reaction. (1)
effective communication(1)
把已知體積的 $CH_3COOC_2H_5$(l)和 NaOH(aq)混合，並記錄時間(t = 0)。(1)
每隔一固定時間(e.g. 每 5 分鐘)，用移液管抽取一固定體積(e.g. 10 cm^3)的反應混合物(1)
並將其轉移到一載有冰水的錐形瓶中。(1)
利用標準 HCl(aq)滴定這溶液，並用酚酞作指示劑。(1)
根據滴定結果，可計算出各時間間距中，NaOH(aq)在反應混合物中的殘餘量。並繪出相應的圖以找出其反應速率(1)
有效傳意(1)

11(a) $K_c = [H^+][A^-]/[HA]$ (1)

11(b)

	HA	H^+	A^-
Initial concentration	(1/0.1)M	0 M	0 M
Change in concentration	-x	+x	+x
Final concentration	10-x	x	x

$K_c = [H^+][A^-]/[HA]$

$2.00x10^{-10} = x^2/(10-x)$

$x = 4.47x10^{-5}$M or $x = -4.47x10^{-5}$M(rejected) (1)

Hence the concentration of H^+ is $4.47x10^{-}$M

$pH = -\log[H^+]$

pH=4.35 (1)

	HA	H^+	A^-
初始的濃度	(1/0.1)M	0 M	0 M
濃度的改變	-x	+x	+x
最終的濃度	10-x	x	x

$K_c = [H^+][A^-]/[HA]$

$2.00x10^{-10} = x^2/(10-x)$

$x = 4.47x10^{-5}$M or $x = -4.47x10^{-5}$M(rejected) (1)

因此 H^+ 的濃度為 $4.47x10^{-}$M

$pH = -\log[H^+]$

pH=4.35 (1)

11ci

酚酞的摩爾數 = (1 x 1.277) /318.32 - $4.01x10^{-3}$mol (1)

反應的比例為 1:1

因些, NaOH 所需的摩爾數 = $4.01x10^{-3}$ mol (1)

ii

With high molar mass.(1)When the molar mass of the indicator lower, more alkaline in needed to neutralize it.(1)

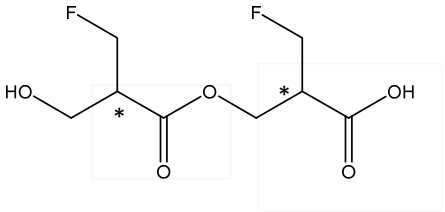
要有高的摩爾質量。(1)當指示劑的摩爾質量降低，更多的鹼需要用於中和它。(1)

12ai

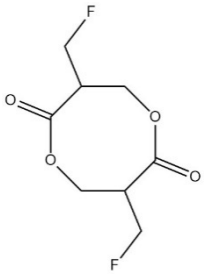
Heat/H_2SO_4(1)condensation/esterification/condensation polymerisation. (1)

加熱/H_2SO_4(1)縮合作用/酯化作用/縮合聚合作用(1)

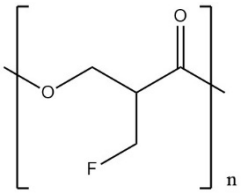
12aii.



or



Or



With the corresponding answer with 12ai.

與 12ai 的答案對應。

12bi

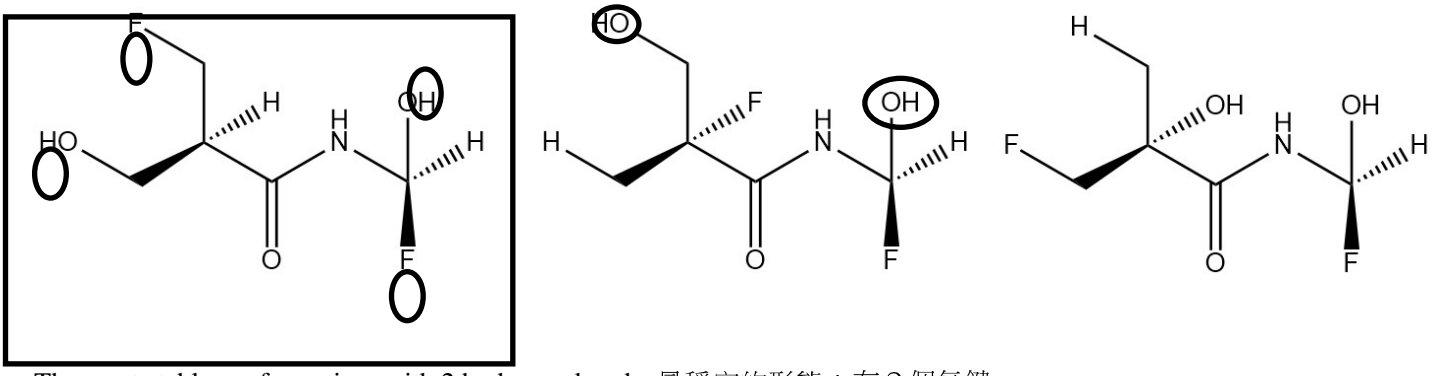
As the two products are enantiomer which has the same physically property except optical property. (1)

因為 2 個產物為對映異構當中除子旋光性質外所有物理性質相同。 (1)

12bii

For one of the optical isomer A_1 it can form a compound with B as the following conformations.

其中一個旋光異構體 A_1 能與 B 生成一化合物並有下列形態。



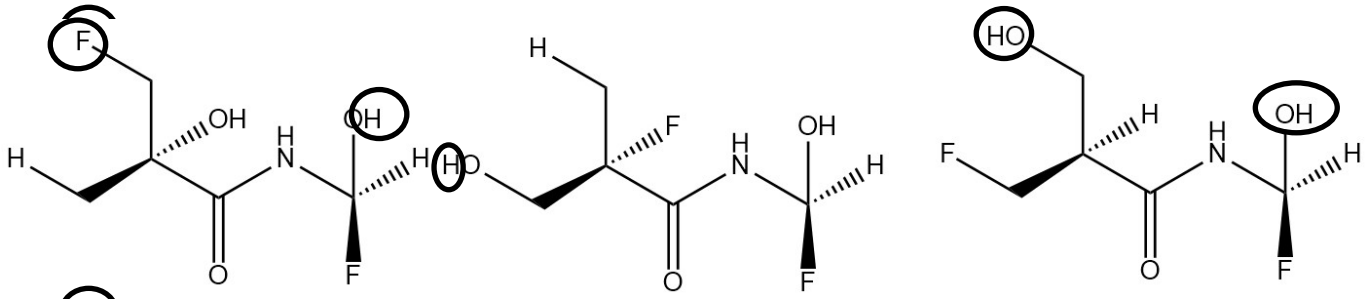
The most stable conformation: with 2 hydrogen bonds 最穩定的形態：有 2 個氫鍵

The compound stays as the most stable conformation. (the one with more intramolecular hydrogen as more energy is needed to rotate the bond).

化合物會以最穩定的形態存在。(擁有最多分子內的氫鍵的形態會最穩定，因為要轉換形態需要更多的能量。

For one of the optical isomer A_2 it can form a compound with B as the following conformations.

其中一個旋光異構體 A_2 能與 B 生成一化合物並有下列形態。



The ○ show the possible intramolecular hydrogen bond form by the molecules in different conformation.

The compound stays as the more stable conformation. (the one more intramolecular hydrogen as more energy is needed to rotate the bond).

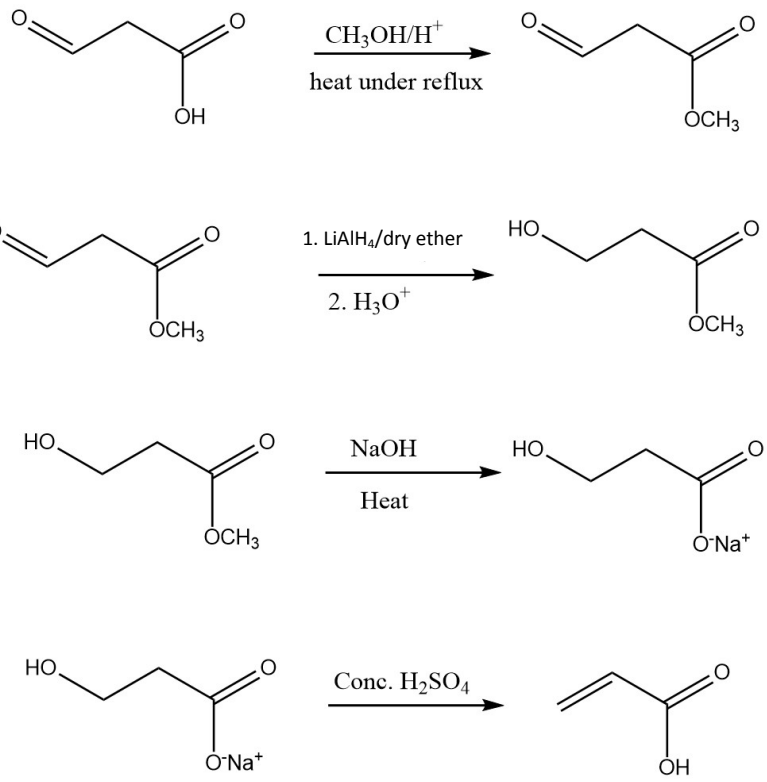
○顯示出在不同形態可能生成分子內氫鍵的原子。化合物會以最穩定的形態存在。(擁有最多分子內的氫鍵的形態會最穩定，因為要轉換形態需要更多的能量。在這化合物最穩定的形態只能生成一組分子內的氫鍵。

The more intramolecular hydrogen bond, the less intermolecular hydrogen bond. As a result, there are boiling point different between two compounds which can be separated.

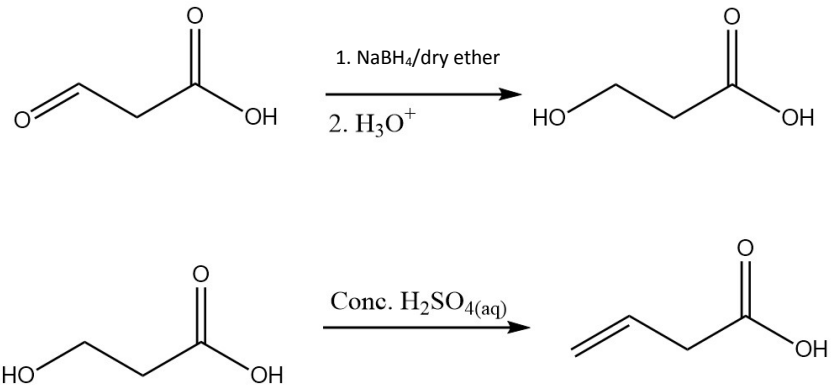
愈多的分子內氫鍵，更少的分子內氫鍵生成。因此，沸點會有所差異，因而可以用作分離這 2 個化合物。

13.

(4)



Or



(4)

Heat under reflux: 回流加熱

Dry ether:乾醚

Conc.: 濃

14(a) Fe^{2+} acts as a catalyst (1)
Fe^{2+} 作為催化劑 (1)

14(b) Fe^{2+} has different oxidation state. (1)
Fe^{2+} 有不同的氧化劑

14(c) As the reaction progress, the product would not affect the reaction itself.(1)
When the concentration decease, the rate of effective collision decrease. Hence, the rate of reaction decreased. (1)
當反應進行時，產物並不會影響該反應。
當濃度下降時， 有效碰撞會減少，因此反應速率下降。

14(d) During the reaction, OH^- formed . Fe^{2+} and OH^- form an insoluble $Fe(OH)_2$. (1)As a result, the Fe^{2+} is removed. When the catalyst removed, the rate of reaction decreased. (1)
在反應過程中， OH^-生成。Fe^{2+} 與 OH^- 生成不溶的 $Fe(OH)_2$. (1) 因此，Fe^{2+} 被移除。當催化劑被移除後，反應速率因而下降。