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前言

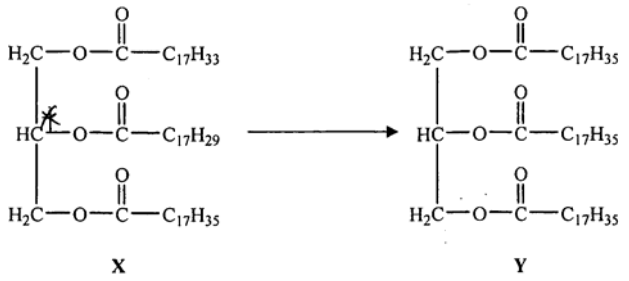
第一屆香港中學文憑考試的成績已於本年 7 月 20 日發布。爲讓教師、學生以及公眾人士進一步了解中學文憑考試考生的水平，本局選取個別考生的答卷，輯錄爲本套示例，以助說明各級考生的表現。

本科設有三卷，本套示例取材於其中的傳統筆試答卷，以便於說明各等級考生的典型表現。卷一甲部爲多項選擇題、卷三爲校本評核，由於考生多項選擇題的答案難以說明不同等級的表現及考生的校本評核課業樣本只屬有關評核的一部分，因此未有選用這些卷別作爲示例。

參閱這套示例時，讀者亦宜同時參考本年試卷及評卷參考，以了解試題及評分要求。有關文件會刊於本年 10 月至 11 月間出版的《2012 年香港中學文憑考試--考試報告及試題專輯》內。

卷一第五級示例及評語

14. 下圖顯示一個油分子 **X** 轉化成一個脂肪分子 **Y**。



X **Y**

(a) (i) 已知在 **X** 和 **Y** 兩者中的所有烷基均爲直鏈，在上圖使用 '*' 來標示手性碳(一個或多個)。

(ii) 根據 (i)，解釋在上面的轉化中是否涉及旋光性的變化。

(a) (ii) 當一油脂分子被轉化後 Y分子缺手性碳. 故其立體旋光性由能無的變化.

(2 分)

*(b) **Y** 的加鹼水解的其中一個產物具清潔性質。解釋這產物的清潔性質。

(4 分)

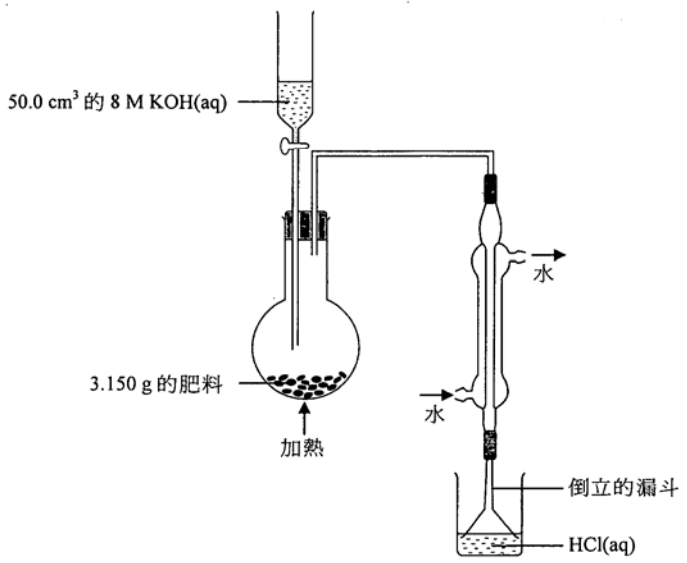
當Y進行加重金屬鹽後. 生成一個皂性清潔劑。皂性清潔劑具有一親水的-COO⁻亞原部和疏水的碳氫連尾部。當把皂性清潔劑加入至含有油份的污水. 清潔劑尾部會与油份結合. 而親水性的COO⁻亞原部則向外. 由於親水性亞原部互相排斥. 污水中会形成無數的油份滴. 最化形成白色泡沫.

評語

考生對化學課程所涵蓋的事實、概念及原理有廣泛的認識和透徹的理解，並能應用化學概念於各種不熟悉的情境中。 答案顯示考生能從分子結構上判斷其旋光性的性質，並能指出脂肪分子經鹼水解後衍生產物的結構特徵，並以此來闡釋其清潔性質。 考生能準確地運用科學辭彙，以簡潔和有條理的方式，有效地表達其意念。

卷一第四級示例及評語

7. 一肥料只含有硝酸銨 (NH_4NO_3) 和氯化鉀 (KCl)。進行一實驗以測定在這肥料中 NH_4NO_3 的質量百分率，所用的裝置如下所示：



把 KOH(aq) 慢慢加進肥料並把所生成的混合物溫和地加熱。由 NH_4NO_3 與 KOH 反應所釋出的氨首先在冷凝器冷卻，然後經過一倒立的漏斗通入含 0.0485 mol 的 HCl 的溶液內。最後把這溶液配成 100.00 cm^3，並標示爲「S」。

(a) 寫出 NH_4NO_3 與 KOH 反應的離子方程式。

$NH_4^+{}_{(aq)} + OH^-{}_{(aq)} \longrightarrow NH_3{}_{(g)} + H_2O_{(l)}$

(1 分)

(b) 提出其中一個所用的化合物的潛在危險。

KOH 为强碱，为强腐蚀性

(1 分)

(c) 已知氨非常溶於水，寫出使用一個倒立的漏斗的好處。

確保大部份氨均溶於 HCl的溶液中，
減少氨的流失

(1 分)

7. (d) 把 25.00 cm^3 的「S」轉移到一錐形瓶，然後以 0.100M NaOH(aq) 進行滴定，用甲基橙爲指示劑，需用 41.00 cm^3 的該 NaOH(aq) 來達到終點。

(i) 寫出應用來轉移 25.00 cm^3 的「S」的儀器名稱。

移液管

(ii) 寫出在滴定終點的顏色變化。

由紅轉为黄

(iii) 計算在這肥料中 NH_4NO_3 的質量百分率。
(NH_4NO_3 的摩爾質量 = 80.0 g)

NaOH 的使用 mol = $\left(\frac{41.00}{1000}\right)(0.100)$

= 4.1×10^{-3} mol

$NaOH + HCl \rightarrow NaCl + H_2O$

由反应式可見 25 cm^3 HCl 的 mol = NaCl 的 mol

= 4.1×10^{-3} mol

100 cm^3 HCl 的 mol = 0.0164 mol

∴ 5 NH_3 反应的 HCl mol = 0.0485 − 0.0164

= 0.0321 mol

∴ NH_4NO_3 的 g = (0.0321)(80)

= 2.568 g

∴ 肥料中 NH_4NO_3 的质量百分率

= $\frac{2.568}{3.150} \times 100\%$

= 81.5 %

(5 分)

(e) 建議一測試以顯示該肥料中存有一個含鉀的化合物。

利用焰色試驗，会有紫色的火焰。

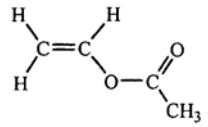
(1 分)

評語

考生的答案展現其對化學分析所涵蓋的概念及原理有足夠的認識和理解。答案顯示考生能分析及處理容量分析的數據，並能提出測試化合物中含鉀離子的方法。

卷一第三級示例及評語

2. 聚(乙酸乙烯酯) 是一個聚合物。它的單體是乙酸乙烯酯，其結構如下所示：



(a) 乙烯是用來製造乙酸乙烯酯的原料。乙烯可從較高分子質量的碳氫化合物經一個重要的工業過程產得。

(i) 寫出這工業過程的名稱。

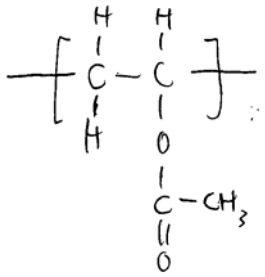
裂解作用。

(ii) 解釋爲什麼這過程是重要的。

可產生烯從而製造不同塑料。

(2 分)

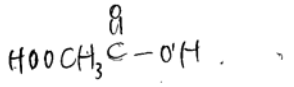
(b) 繪畫聚(乙酸乙烯酯)的結構。



(1 分)

(c) 乙酸乙酯是一個有機溶劑。

(i) 繪畫乙酸乙酯的結構。



(ii) 建議一個化學測試，顯示如何分辨乙酸乙烯酯和乙酸乙酯。

分別加入溶於有機溶劑的溴溶液中，如果溶液由橙色變成無色，即那是乙酸乙烯酯，另外的就是乙酸乙酯。

(3 分)

評語

考生的答案展現其對烯烴化學的認識。考生能提出測試烯烴的合適方法，及烯在工業上的應用。

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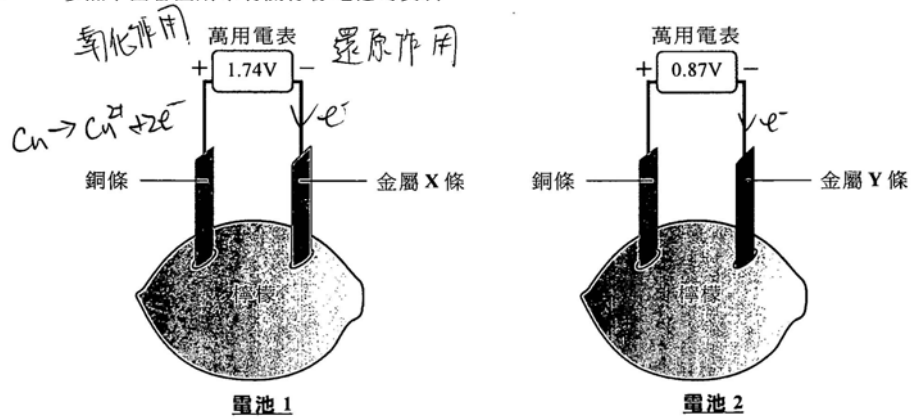
卷一第二級示例及評語

3. 參照下面各圖所示有關檸檬電池的資料：



(a) 電池中的檸檬有什麼功用？

檸檬的汁液含可流動的離子，它可用作电解质之用。 (1 分)

(b) 完成下表，把金屬 X、金屬 Y 和銅按還原能力遞增的次序排列。

還原能力遞增 →		
銅	金屬 Y	金屬 X

(1 分)

(c) 參照**電池 1**，寫出在以下地方發生變化的半反應式：

(i) 金屬 X 條 (X 是一個第 II 族金屬)，及

$2H^+ + 2e^- \rightarrow H_2$

(ii) 銅條。

$Cu \rightarrow Cu^{2+} + 2e^-$

(2 分)

(d) 參照**電池 2**，如果以銀條取代銅條，那金屬 Y 條會否是正電極？解釋你的答案。

不是。較銅不活潑的金屬有汞，銀，金，但汞在室温下是液体，故Y不是汞，因此Y有机会是銀和金，若Y是銀，沒有化学反应，若Y是金，Y仍是負电極。 (1 分)

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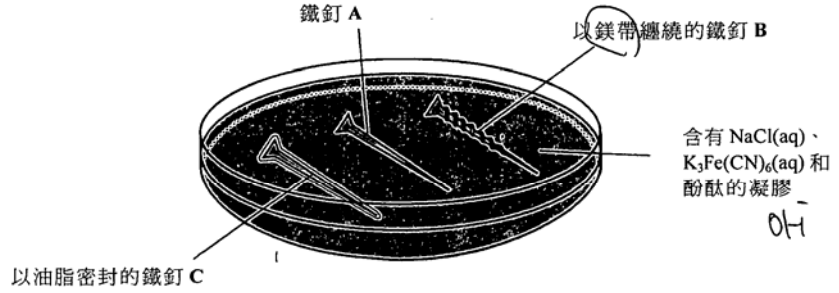
評語

考生對電化學的概念及原理有基礎的認識和理解，能指出檸檬在檸檬電池中的功用；並且能從各組電池的電壓來推斷金屬的還原能力。

卷一第一級示例及評語

9. 下圖顯示一個探究影響鐵生銹的因素的實驗裝置。



(a) 如果上面裝置中的某鐵釘生銹，會有什麼觀察？

鐵釘B最初是 粉紅色，
被鎂帶 纏繞部份變色。 (1 分)

(b) 提出在上面裝置的鐵釘中，何者在實驗中**不會**生銹。解釋你的答案。

以油脂密封的鐵釘C，因為油脂阻止空
氣(氧)和(水)入。生銹必須氧和水同時存在
進行反應
不會發生。

(3 分)

評語

考生能記憶化學課程中較淺易的事實及原理。答案顯示考生能指出氧和水須同時存在，鐵釘才會生銹；然而，考生未能正確掌握鎂帶的特殊功能，並誤以爲被鎂帶纏繞的鐵釘會生銹。

卷二第五級示例及評語(第一題)

1.(a) (i) (1) 金鈺

(2) (2) 催化劑能夠為反應提供另一活化能較低的途徑，加速反應達至化學平衡的速率

使有更多的反應物分子含有足以進行反應的能量

(ii) 透過水-煤氣重整作用的逆反應提取氫

$CO + H_2O \rightleftharpoons CO_2 + H_2$

(iii) 工業上選擇的操作條件為 500°C 和 200 atm。~~然而~~ 選擇500°C的原因是由於高溫有助反應更快達致平衡。雖然哈柏法為放熱反應，低溫有助增加產率。但高溫能使反應平衡時減少。

而壓強選擇 200atm 而非 1000°C，是因為能抵受高壓的喉管造價高昂，不符合成本效益。

(iv) 因為當產率達20%時，反應已達平衡，故需要移除 $NH_3(g)$ 以~~讓更多的反應物~~使平衡往右移。使 N_2 和 H_2 繼續參與反應。

(b) (i) 甲醇是眾多工業產品的原材料，如乙酸、~~屯~~等。

(ii) 合成氣為 CO 和 H_2 的混合物

$CO + 2H_2 \rightleftharpoons CH_3OH$ ($Cu/ZnO/Al_2O_3$)

~~850°C 10 atm~~

300°C, 200 atm

(b)(iii) 氫氣進行以合成氨過程生成甲醇的反應上，工業上以 $Cu/ZnO/Al_2O_3$ 催化劑作為當時使用的 Cu/ZnO。這催化劑使得反應所需的溫度和壓減少，能夠以更溫和的條件進行反應，故是一種改進。

(c) (i) 因為反應速率會隨時間變化，需有一標準作指標。

(ii) 當 NO 的濃度不變，而 H_2 的濃度增加一倍時，反應的初速提升 1 倍。

故 $H_2(g)$ 的反應級數為 1。

當 $H_2(g)$ 初始濃度不變，而 $NO(g)$ 濃度由 1.25×10^{-2} 增加 $mol\,dm^{-3}$ 一倍至 $2.50\times10^{-2}\,mol\,dm^{-3}$，$N_2$ 的初速上升四倍。

故 $NO(g)$ 的反應級數為 2。

(iii) 速率 $= K[NO(g)]^2[H_2(g)]$

當初速為 $1.20\times10^{-6}\,mol\,dm^{-3}\,s^{-1}$，[NO(g)] 為 K 為

$1.20\times10^{-6}\,mol\,dm^{-3}\,s^{-1} = K\left(2.50\times10^{-2}\,mol\,dm^{-3}\right)^2\left(5\times10^{-3}\,mol\,dm^{-3}\right)$

$1.20\times10^{-6}\,mol\,dm^{-3}\,s^{-1} = K\left(3.125\times10^{-6}\,mol^3\,dm^{-9}\right)$

$K = \frac{1.20\times10^{-6}\,mol\,dm^{-3}\,s^{-1}}{3.125\times10^{-6}\,mol^3\,dm^{-9}}$

$K = 0.384\,mol^{-2}\,dm^6\,s^{-1}$

∴ 速率方程為 速率 $= 0.384\,mol^{-2}\,dm^6\,s^{-1}[NO(g)]^2[H_2(g)]$

評語

考生的答案展現其對工業化學課程所涵蓋的概念及原理有廣泛的認識和透徹的理解。考生不但能指出催化劑對化學反應的影響及其原理，並能闡釋製造氨氣的工業過程所選用的操作條件。考生能處理和分析所提供的數據，從而推論化學反應的速率方程式。

卷二第四級示例及評語(第三題)

3a(i) ~~使用2,4-二硝基苯肼是用來測試~~

3ai X可能有的兩個官能基

$-OH$ 及 $-\overset{O}{\overset{\|}{C}}-H$

3a(ii)(1) 使用2,4-二硝基苯肼是用來測試化合物有否含有羰基

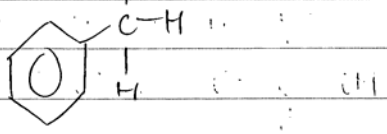
(2) X得出陽性結果是溶液會生成橙色沉澱物

3a(iii) 可能存在X的官能基是 $-OH$

3a(iv) 在 m/z = 108處，該化学物種是 C_7H_7OH

在 m/z = 91處，該化学物種是 $C_7H_7^+$ 離子

v) X的可能結构：



3b(i) 二噁英的來源是焚燒塑膠所產生的氣体

(ii) 因二噁英是對人体有害的氣体，必須量度其水平以確保空氣對人体的害處在低的位置

(iii) 二噁英不溶於水也難成固体。

3c(i) $AgNO_3(aq)$ 及 $NH_3(aq)$

c(ii) 把 $AgNO_3(aq)$ 加入該溶液，便有沉澱物生成，其後再加入 $NH_3(aq)$，溶液內仍有沉澱物。而該沉澱物為 $AgI(s)$

把 $AgI(s)$ 加入乾燥四号皿，剩餘溶液則以蒸發获取固体物。

c(iii) 從 $AgI(s)$ 的質量計算它的摩尔数

評語

考生的答案展現其對分析化學課程所涵蓋的概念及原理有充分的認識和理解。考生能綜合及評鑑各個測試結果，推論某有機化合物樣本的可能結構。考生能應用化學概念於不熟悉的情境中，雖描述不詳盡，但能建議使用硝酸銀來沉澱氯離子和碘離子，作重量分析。

卷二第三級示例及評語(第一題)

ai (1) 所用的催化劑是鉄粉

(2) 催化劑能提供一條較低能量的活化能反应途徑給反应物，令較多粒子能進行有效碰撞，不能同時加快正向和逆向的反应速率。

aii) ~~利用石油中的短鏈化合物和天然氣進行~~ 电解稀鹽水能獲取氫

$2e^- + 2H_2O \longrightarrow H_2 \uparrow 2OH^-$

aiii) 這是因為在500°C較高溫中，能夠加快正向速率和逆向速率，令反应在較短時間內達致平衡，而在200 atm方面，工業無法把氣壓維持在1000 atm，因1000 atm在工業上已是很高壓，工業無法把1000 atm下工作，而且太高壓會令逆向速率減慢，無法達致平衡。

aiv) 因为這样可以避免氨再經逆向而分解回氮和氫，而且避免有任何氨流失的情況出現。

bi) 因为甲醇能生產出不同的副產物。

bii) $CH_4 + H_2O \xrightarrow{Pt} CH_6O$

biii) 不再使用天然地合成，因为採用科技能確保甲醇的產率和生成更多的副產物

(i) 因为初速为最準確的反应時間，而且反应物濃度亦沒有任何改变下，而得出的初速，結果。

(ii) ~~速率方程：初速 = k[NO][H_2]~~

~~實驗1：$1.20\times10^{-6} = k[2.50\times10^{-2}][5.00\times10^{-3}]$ —①~~

~~實驗2：~~ NO的反应級數应为2，而 H_2 的反应級數亦是1，因为在實驗1與實驗2所得的 H_2 初速與濃度剛好是 2=2，所以 H_2 的反应級數是1。
而NO在濃度在實驗3和實驗2中和初速之比是2=4
∴ NO反应級數为2。

(iii) 速率方程式：$Rate = k[NO]^2[H_2]^1$

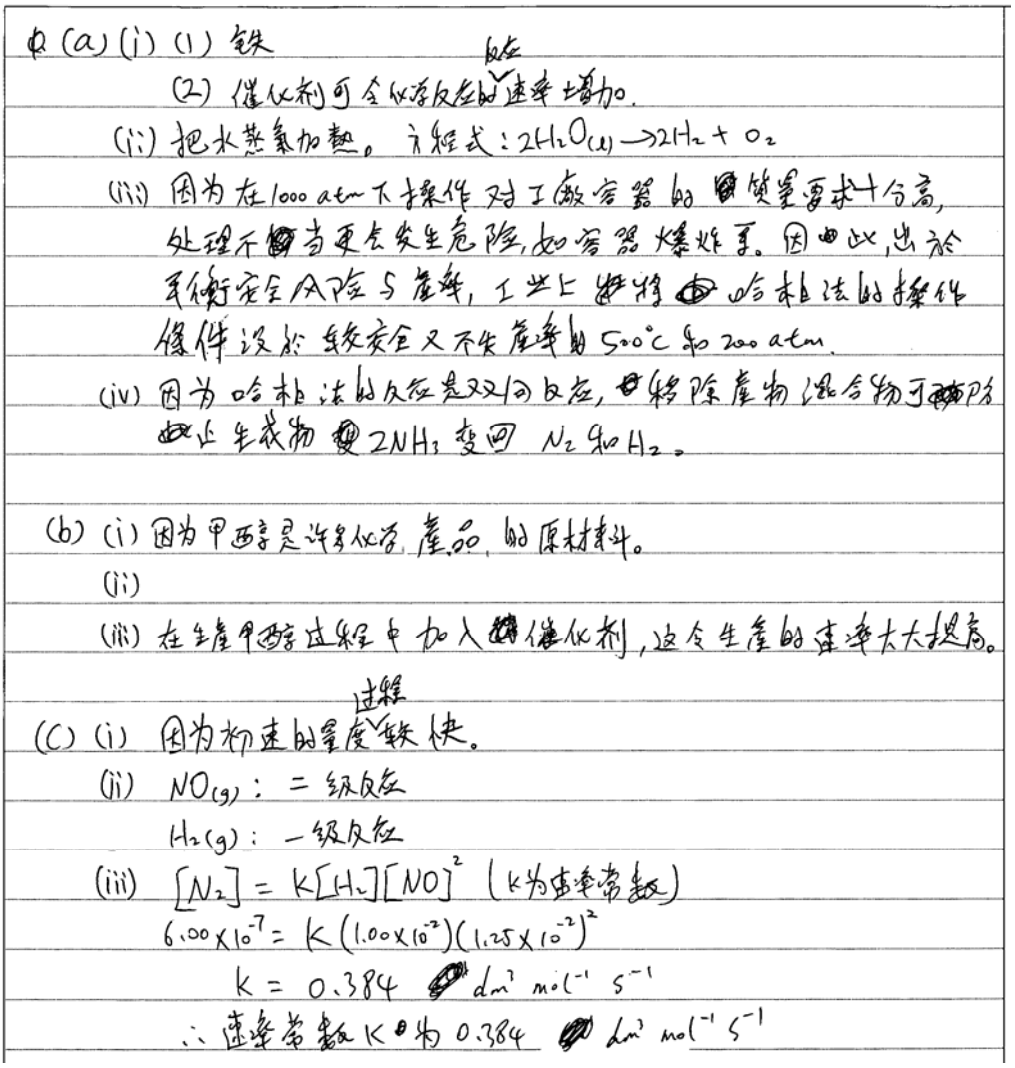
代實驗1結果入方程，

$$Rate = k[NO]^2[H_2]^1$$
$$1.20\times10^{-6} = k[2.50\times10^{-2}]^2[5.00\times10^{-3}]$$
$$k = 0.384\ (mol\ dm^{-3})^{-2}\ s^{-1}.$$

評語

考生的答案展現其對工業化學課程所涵蓋的概念及原理有足夠的認識和理解。考生能指出催化劑對化學反應的影響及其原理，並能處理和分析所提供的數據，從而推論化學反應的速率方程式。

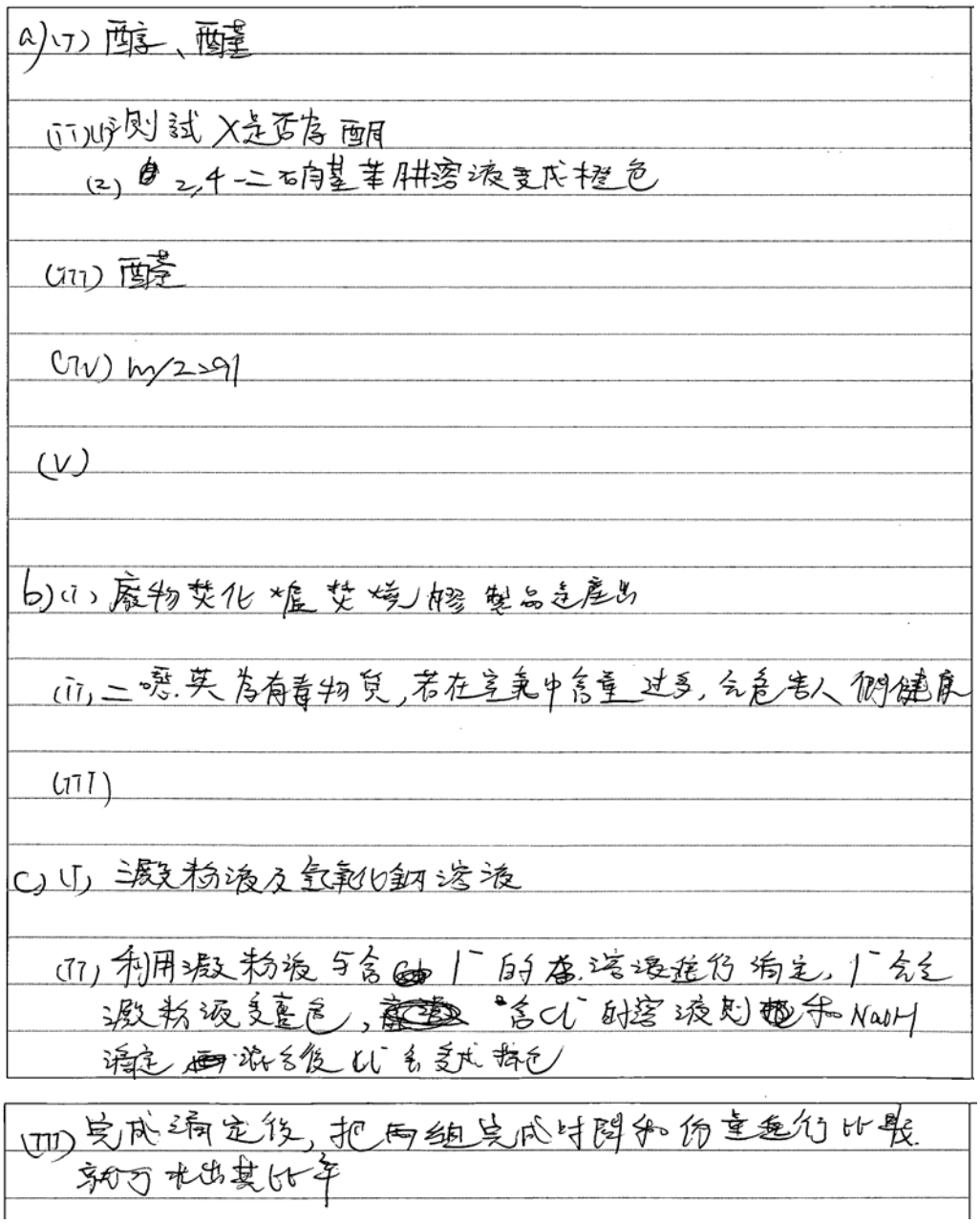
卷二第二級示例及評語(第一題)



評語

考生的答案展現其對工業化學課程所涵蓋的概念有基礎的認識和理解。考生只能指出催化劑對化學反應的影響，但未有提及其原理。考生能利用所提供的數據，寫出化學反應的速率方程式，但沒有留意速率方程式的正確形式，及速率常數的正確單位。

卷二第一級示例及評語(第三題)



評語

考生的答案展示其只能記憶分析化學課程中淺易的事實及原理。考生能處理以直接方式表達的簡單資料，如參照測試結果，只能提出化學物可能有的官能基，以及提出空氣中的二噁英的一個來源。

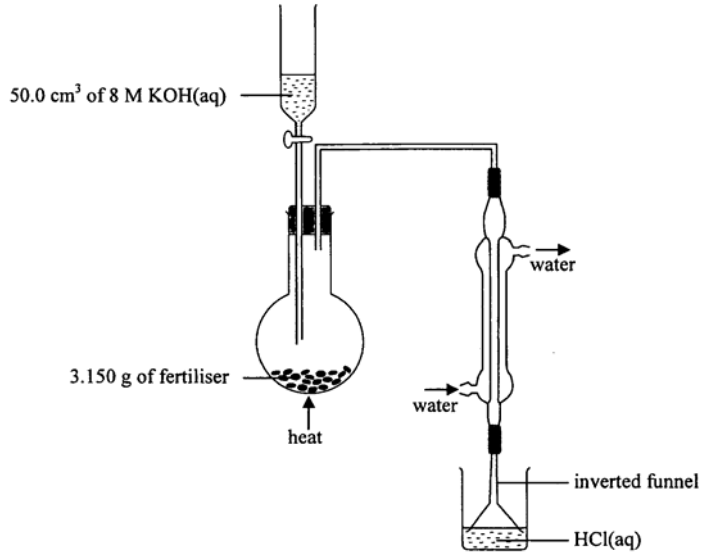
INTRODUCTION

The results of the first HKDSE Examination were released on 20 July 2012. To enhance the understanding of the standards of the HKDSE Examination, authentic samples of candidates' scripts are selected to form this set of exemplars to illustrate the performance standards at different levels.

There are 3 papers in this subject. This set of exemplars is selected from candidates' scripts of the written conventional papers to illustrate the typical performance standards at different levels. Paper 1 Section A comprises Multiple-choice (MC) questions while Paper 3 is the School-based Assessment. As candidates' MC responses cannot illustrate well the performance standards and their SBA work only represents part of the assessment, exemplars have not been selected from these papers.

It is advisable to read this set of exemplars together with the question papers and the marking schemes in order to understand the requirements of the questions and the marking criteria. The question papers and the marking schemes will be published in the *Examination Report and Question Papers* for 2012 HKDSE which will be available for sale in October / November this year.

7. A fertiliser only contains ammonium nitrate (NH_4NO_3) and potassium chloride (KCl). An experiment was performed to determine the percentage by mass of NH_4NO_3 in this fertiliser. The set-up used is shown below :



The KOH(aq) was added slowly to the fertiliser and the mixture formed was heated gently. The ammonia liberated from the reaction between NH_4NO_3 and KOH was first cooled in a condenser, and then passed through an inverted funnel to a solution containing 0.0485 mol of HCl. The solution was finally made up to 100.00 cm^3 and labelled 'S'.

(a) Write an ionic equation for the reaction between NH_4NO_3 and KOH.

$NH_4^+(aq) + OH^-(aq) \rightarrow NH_3(g) + H_2O(l)$

(1 mark)

(b) Suggest the potential hazard of one of the chemicals used.

KOH is corrosive in concentrated ~~soln~~ condition.

(1 mark)

(c) Given that ammonia is very soluble in water, state the advantage of using an inverted funnel.

Inverted funnel can prevent sucking back of the ~~sol~~ solution when NH_3 is dissolved into the solution.

(1 mark)

7. (d) 25.00 cm^3 of 'S' was transferred to a conical flask, and then titrated with 0.100M NaOH(aq) using methyl orange as an indicator. 41.00 cm^3 of the NaOH(aq) was required to reach the end point.

(i) Name the apparatus that should be used to transfer 25.00 cm^3 of 'S'.

Pipette

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

red to yellow

(iii) Calculate the percentage by mass of NH_4NO_3 in this fertiliser.
(Molar mass of NH_4NO_3 = 80.0 g)

Let M be the molarity of HCl in S

$HCl + NaOH \rightarrow NaCl + H_2O$

$\frac{\text{no. of mole of HCl}}{\text{no. of mole of NaOH}} = \frac{1}{1}$

$\frac{0.025\ M}{0.041\ (0.1)} = 1$

$M = 0.164\ M$

no. of mole of HCl in S = $0.164 \times 0.1 = 0.0164$ (mol)

$HCl + NH_3 \rightarrow NH_4Cl$

no. of mole of HCl reacted with NH_3 = 0.0485 − 0.0164 = 0.0321 (mol)

no. of mole of NH_3 reacted with HCl = 0.0321 (mol)

= no. of mole of NH_3 liberated = no. of mole of NH_4NO_3 in the fertilizer

% by mass = $\frac{0.0321 \times 80}{3.15} \times 100\% = 81.5\%$ (5 marks)

(e) Suggest a test to show the presence of a potassium-containing compound in the fertiliser.

Perform a flame test on the fertilizer, if a lilac flame is observed, the K-containing compound really contain K. (1 mark)

Comments

The candidate's response shows an extensive knowledge and clear understanding of chemical reactions involved in the analysis. He/she makes use of the data provided to deduce the percentage by mass of ammonium nitrate in the sample. He/she also demonstrates his/her knowledge of laboratory safety.

5. In order to prepare 50 dm^3 of 0.1 M $CuSO_4$(aq), an inexperienced electroplating worker added the required exact amount of $CuSO_4 \cdot 5H_2O$(s) to water in a plastic container. He then stirred the mixture with an iron rod until the $CuSO_4 \cdot 5H_2O$(s) dissolved completely. Finally, he sent a sample of the solution to the Quality Control Laboratory for analysis, but found that the concentration of $CuSO_4$(aq) was lower than 0.1 M.

(a) With the aid of a chemical equation, explain why the concentration of the $CuSO_4$(aq) prepared was lower than 0.1 M.

He used an iron rod to stir the $CuSO_4 \cdot 5H_2O$(s) until dissolved completely. During the stirring process, Cu^{2+} ions are displaced out by Fe and form $FeSO_4$. Fe is a stronger reducing than Cu. $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ (2 marks)

(b) The worker used the prepared $CuSO_4$(aq) to coat a layer of copper on a metallic object by electrolysis. He used an unreasonably high voltage, and found that some bubbles were formed on the object and the copper layer easily flaked off.

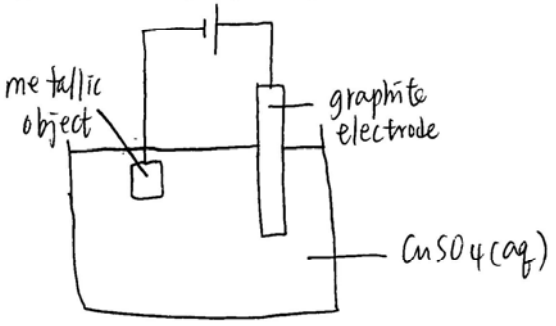
(i) Explain why copper can be coated on the metallic object by electrolysis.

Cu^{2+} ions in $CuSO_4$(aq) are reduced to Cu(s) by receiving electrons on the cathode. A Cu layer can therefore be formed on the metallic object.
$Cu^{2+} + 2e^- \rightarrow Cu$

(ii) Suggest what the bubbles were, and explain why the copper layer easily flaked off.

The bubbles were hydrogen gas. Since the hydrogen gas bubbles were formed on the object, the Cu layer cannot firmly attach to the object surface so it flaked off easily. (3 marks)

(c) Draw a labelled diagram of the experimental set-up used in a laboratory for coating a layer of copper on a metallic object by electrolysis.



(3 marks)

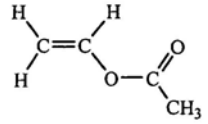
.

Comments

The candidate's response shows a sound knowledge and clear understanding of concepts and principles in redox reactions. He/she is able to account for the unexpected low concentration of $CuSO_4$(aq) in terms of displacement reaction. The candidate shows an ability to apply the relevant concepts in electroplating. He/she points out that the metallic object should be connected to the negative terminal of the power supply in the electrolytic cell. He/she also extrapolates the concept to an unfamiliar situation whereby an unreasonably high voltage leading to the formation of gas bubbles on the metal surface would reduce the efficiency and quality of plating.

Paper 1 Level 3 exemplar and comments

2. Poly(ethenyl ethanoate) is a polymer. Its monomer is ethenyl ethanoate with the structure shown below :



(a) Ethene is the raw material used in making ethenyl ethanoate. Ethene can be produced from hydrocarbons of higher molecular mass by an important industrial process.

(i) Name this industrial process.

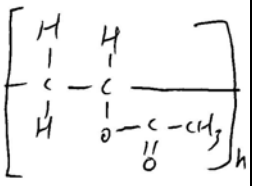
cracking

(ii) Explain why this process is important.

It can provide useful raw material to specific uses for development.

(2 marks)

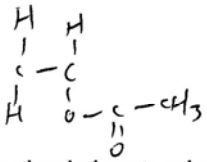
(b) Draw the structure of poly(ethenyl ethanoate).



(1 mark)

(c) Ethyl ethanoate is an organic solvent.

(i) Draw the structure of ethyl ethanoate.



(ii) Suggest a chemical test to show how to distinguish between ethenyl ethanoate and ethyl ethanoate.

Add bromine solution in organic solvent into them. ethenyl ethanoate can turn the bromine from brown to colourless while ethyl ethanoate cannot.

(3 marks)

.

Comments

The candidate's response shows an adequate knowledge and understanding of facts and principles in alkene chemistry. He/she proposes an appropriate method to distinguish a compound with a carbon-carbon double bond from one without such a bond. The candidate is also able to draw the structure of a polymer in the correct format.

Paper 1 Level 2 exemplar and comments

1. Neon occurs naturally in three isotopes with the abundance of each isotope shown in the table below :

Isotope	Abundance (%)
^{20}Ne	90.48
^{21}Ne	0.27
^{22}Ne	9.25

(a) What is meant by the term 'isotope' ?

Isotope means the same atom which has same number of protons but different number of neutrons.

(1 mark)

(b) Calculate the relative atomic mass of neon.

Relative atom mass of neon :

$20 \times 90.48\% + 21 \times 0.27\% + 22 \times 9.25\%$

$= 20.1877$

$\simeq 20.2$ //

(2 marks)

(c) Give one daily application of neon.

Use in the advertising light.

(1 mark)

(d) Explain why the boiling point of neon is lower than that of oxygen.

~~Neon is inert as it is in stable octet structure while Oxygen is not inert as~~

Neon is in monoatomic structure while Oxygen is in diatomic structure. Van der Waals' force is formed between oxygen atoms. Therefore, boiling point of neon is lower than that of oxygen.

(2 marks)

Comments

The candidate's response shows a basic knowledge and understanding of the concepts and principles in the microscopic world. He/she is able to deduce the relative atomic mass of an element from the given relative abundances of its isotopes. The candidate communicates ideas using correct scientific terminology such as 'monoatomic' and 'diatomic'. However, errors are evident such as his/her stating 'van der Waals' force is formed between oxygen atoms'.

.

Paper 1 Level 1 exemplar and comments

1. Neon occurs naturally in three isotopes with the abundance of each isotope shown in the table below :

Isotope	Abundance (%)
^{20}Ne	90.48
^{21}Ne	0.27
^{22}Ne	9.25

(a) What is meant by the term 'isotope' ?

Isotope means the same atom contain the same number of protons, but different number of neutrons.

(1 mark)

(b) Calculate the relative atomic mass of neon.

The relative atomic mass of neon $= \frac{90.48 \times 20 + 0.27 \times 21 + 9.25 \times 22}{100}$

$= 20.2$ (cor. to 3 s.f.)

(2 marks)

(c) Give one daily application of neon.

Clothing.

(1 mark)

(d) Explain why the boiling point of neon is lower than that of oxygen.

It is because neon have the ionic bond, while oxygen contain colvant bond. Thus ~~the~~ more heat is required to break the bond between oxygen than neon, so the boiling point of neon is lower. (2 marks)

.

Comments

The candidate's response shows an elementary knowledge of the deduction of relative atomic mass of an element from the given relative abundances of its isotopes. However, the candidate fails to account for the difference in boiling points of neon and oxygen. The candidate appears to misunderstand the structure and property of neon.

(a)(i)(1) Finely divided iron.

(2) It increases the rate of reaction by providing an alternative pathway with lower activation energy for the reaction to proceed.

(ii) It can be obtained by steam-methane reforming.

$$CH_4 + H_2O \xrightarrow[Ni]{850^\circ C,\ 10\text{ atm}} CO + 3H_2$$

(iii) Although a low temperature favours the production of NH_3, the rate of reaction is very slow at low temperature, thus a moderate temperature 500°C is used.
Although a high pressure also favours the production of NH_3, the cost of building a container to withstand and maintain such high pressure is very high, therefore a moderate pressure 200atm is used.

(iv) As the NH_3 is removed from the reaction, the concentration of NH_3 decreases, thus the equilibrium position will shift to the right (product side), this can increase the yield of NH_3.

(b)(i) It can be made into other important materials such as DME, MTBE, formaldehyde and acetic acid.

(ii)

$$CO + 2H_2 \xrightarrow[Cu/ZnO/Al_2O_3]{250^\circ C,\ 50\text{-}100\text{ atm}} CH_3OH$$

(iii) The production of methanol uses $Cu/ZnO/Al_2O_3$ now, as it uses other catalyst before. The use of catalyst $Cu/ZnO/Al_2O_3$

.

is an advancement as it can increase the rate of reaction and a more moderate condition can be used.

(c)(i) Because 'initial rate' is usually the fastest instantenous rate in the reaction, thus it is more convenient when studying the kinetics of a reaction.

(ii) Consider trial 2 and 3, the initial rate increases by four times when the concentration of NO(g) doubles, thus the order of reaction with respect to NO(g) is two.

Consider trial 1 and 2, the initial rate doubles when the concentration of $H_2(g)$ doubles, thus the order of reaction with respect to $H_2(g)$ is one.

(iii) Rate $= k[NO(g)]^2[H_2(g)]$

When Rate $= 1.20\times10^{-6}$ mol dm^{-3} s^{-1}, $[NO(g)] = 2.50\times10^{-2}$ mol dm^{-3} and $[H_2(g)] = 5.00\times10^{-3}$ mol dm^{-3},

$1.20\times10^{-6} = k(2.50\times10^{-2})^2(5.00\times10^{-3})$

$k = 0.384$ $\quad \frac{\text{mol dm}^{-3}\text{ s}^{-1}}{(\text{mol}^3\text{ dm}^{-9})}$

$\therefore$ Rate $= 0.384[H_2(g)][NO(g)]^2$

and the rate constant is 0.384 mol^{-2} dm^6 s^{-1}

Comments

The candidate's response demonstrates comprehensive knowledge and understanding of facts, concepts and principles in the Industrial Chemistry curriculum. The candidate can analyse and critically evaluate the conditions employed in the industrial production of ammonia. The candidate is able to handle and analyse the experimental data provided to deduce the rate equation for the reaction.

Paper 2 Level 4 exemplar and comments (Question 3)

3 (a) (i) X may have –CHO group and –OH group

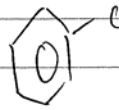
(ii) (1) To test the compound X whether or not have –CHO group.

(2) There will be some red participates.

(iii) –OH group

(iv) at m/z = 91 , $[C_7H_7]^+$

at m/z = 108 , $[C_6H_5CH_2OH]^+$.

(v) 

(b) (i) The gas emissed from the factories.

(ii) To control the air pollution level or to know whether it is dangerous to stay in the street.

.

(iii) paper chromatography because it is easy and cheap to work out.

(c) (i) ~~$AgNO_3$~~ $AgNO_{3(aq)}$, $NH_{3(aq)}$

(ii) Firstly, add excess $Ag^+_{(aq)}$ into the solution to form $AgCl_{(s)}$ & $AgI_{(s)}$ which is insoluble.

Secondly, filter the solution to get $AgCl_{(s)}$ & $AgI_{(s)}$.

Then, add these solid into excess standard $NH_{3(aq)}$ to let $AgCl_{(s)}$ dissolve in excess $NH_{3(aq)}$.

Filter the solution to seperate $AgI_{(s)}$ and the remaining solution.

Lastly, we can weight the $AgI_{(s)}$ to calculate the moles of $I^-_{(aq)}$, we can use back titration to calculate the mole of Cl^-

(iii) $HI_{(aq)} + Ag^+_{(aq)} \rightarrow AgI_{(s)} + H^+$

Since the moles of HI = moles of AgI, we can know the mole of $I^-_{(aq)}$ in the solution, by weighting the $AgI_{(s)}$

$Ag^+ + 4NH_3 \rightarrow [Ag(NH_3)_4]^+$

$HCl + Ag^+ \rightarrow AgCl + H^+$

We can use back titration the titration the remaining NH_3 (aq) to know that the moles use to dissolve $AgCl_{(s)}$, so we can calculate the moles of $Ag^+_{(aq)}$ which is same to the mole of $HCl_{(aq)}$. Therefore, we can calculate the moles of $Cl^-_{(aq)}$.

Compare the mole of $Cl^-_{(aq)}$ & $I^-_{(aq)}$, we can find the mole ratio of $Cl^-_{(aq)}$ to $I^-_{(aq)}$.

Comments

The candidate's response demonstrates sound knowledge and understanding of facts, concepts and principles in the Analytical Chemistry curriculum. The candidate can analyse, synthesise and evaluate information provided to deduce the possible structure of a compound. He/she shows an ability to interpret a mass spectrum. The candidate also possesses adequate knowledge of the chemical reactions involved in analytical work.

1ai(1) iron

1ai(2) the catalyst can provide an alter pathway of the reaction with a lower activation energy, so that more particles per unit volume can undergo collision to increase the effective collision which can fasten the reaction

1aii hydrogen can be obtained from metal reacts with dilute hydrochloric acid.

$Fe + 2HCl \rightarrow FeCl_2 + H_2$

1aiii the operation conditions which has a higher temperature is to make the reaction faster to attain equilibrium, it can shorten the time of reaction, increase the rate of reaction which can undergo more reaction ~~frequency~~ in the time. With lower pressure, it can lower the cost of making high pressure, so it is cheaper.

1iv If we do that, the ~~product will be~~ quantity of the product will be smaller, the equilibrium position will shift to right which can increase the product quantity by increasing the forward reaction rate.

1bi methanol can reaction with carboxyl acid to form ester which has a high demand in chemical industry.

1bii

1bii The advancement of the production of methanol under ~~reactions~~ industrial process is more advance because the percentage yield is much higher.

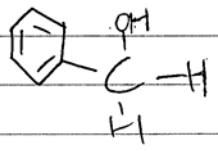
1ci It is because initial rate is more accurate.

1cii Consider Trial ① and ②, when the initial concentration of $NO_{(g)}$ is kept constant, the initial concentration of $H_{2(g)}$ doubled, the initial rate of $N_{2(g)}$ doubled - ∴ the order of reaction of $H_{2(g)}$ is 1.
Consider Trial ③ and ②, when the initial concentration of $H_{2(g)}$ is kept constant, the initial concentration of $NO_{(g)}$ is doubled when the initial rate of $N_{2(g)}$ is 4 times than before - ∴ the order of reaction of $NO_{(g)}$ is 2.

1ciii Rate = $k[NO_{(g)}]^2[H_{2(g)}]$ — ④
Sub Trial ① into ④
$1.2 \times 10^{-6} = k(2.5 \times 10^{-2})^2(5 \times 10^{-3})$
$k = 0.384\ mol^{-2}\ dm^6\ s^{-1}$ #

Comments

The candidate's response demonstrates adequate knowledge and understanding of facts, concepts and principles in the Industrial Chemistry curriculum. The candidate is able to explain the effect of a catalyst on a chemical reaction. He/she accounts for the operation conditions set in the industrial production process of ammonia. The candidate is able to make use of the experimental data provided to deduce the rate equation for the reaction.

ai) Ketone, ~~aldehydes~~.
aii) To test whether there are aldehydes in the compound
aiii) 2,4-dinitrophenylhydrazine will turn colourless
aiii) Ketone
aiv) m/z = 91 may be a ring form while m/z 108 may be
av) 
bi) ~~exertion from cattle~~ large vehicles
bii) It ~~is~~ will lead to death of human if the dioxins level is high
biii) It is more accurate and convinence for carrying out the analysis.
ci) Silver nitrate ~~solution~~ and ~~ammonia~~ solution
cii) ~~Mixing HCl(aq) with AgNO3(aq) and wait until a salt AgCl(s) is formed. Mixing HI(aq) with AgNO3(aq) and formed AgI(s). After that, mix AgCl(s)~~

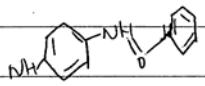
cii) Mix the solution with silver nitrate solution and ~~distur u~~ stir it until solid is formed. Then, carry out filteration is too until the solid is dry. After that, ~~mix~~ ~~put~~ put the solid into NH_3 solution. The remaining solid is $AgI_{(s)}$
ciii) Weight the solid which mixing with AgCl and AgI first. After carrying out the ~~exp~~ step which AgCl dissolve in NH_3 solution, weight the remain $AgI_{(s)}$.

Comments

The candidate's response demonstrates basic knowledge and understanding of facts and principles in the Analytical Chemistry curriculum. The candidate is able to handle and interpret data provided to deduce the possible structure of the unknown. He/she proposes the use of precipitation reactions in gravimetric analysis although he/she is not able to present his/her ideas in a systematic way.

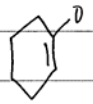
Paper 2 Level 1 exemplar and comments (Question 2)

2a) (i) (1)



(2). addition reaction

(ii) (1)



(2) the cost of Reaction (1) is cheaper than Reaction (2)
the size of ~~Reaction~~ catalyse is large
Reaction (1) use nature

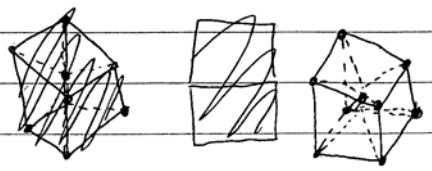
(3). cannot be reused.

(iii) kevlar is better than nylon 6,6, kevlar has giant covalent ~~sta~~ structure, is is greater than nylon 6,6.

2b (i) Two-stage of process,
C=C bond

(ii) phenomenon is form from Br_2 and the structure of natural rubber
the structure of natural rubber of ~~C=C~~ CH_3 that with change to ~~C=C~~ CBr_2

c (i) (1)



~~8~~ (2). 9

(ii) ~~Bec~~ Because stainless steel form from body-centred cubic ~~structure~~ structure, It is hard, so it is suitable for ~~mark~~ making knives.

Comments

The candidate's response demonstrates the recall of elementary facts in the Materials Chemistry curriculum. The candidate is able to draw a unit cell of iron correctly but he/she fails to deduce the number of iron atoms in the unit cell.

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