1ai)
450K (1)
It can sustain a higher reaction rate of the reaction than 0K. Although the yield is lowed, it is compromised. (1)

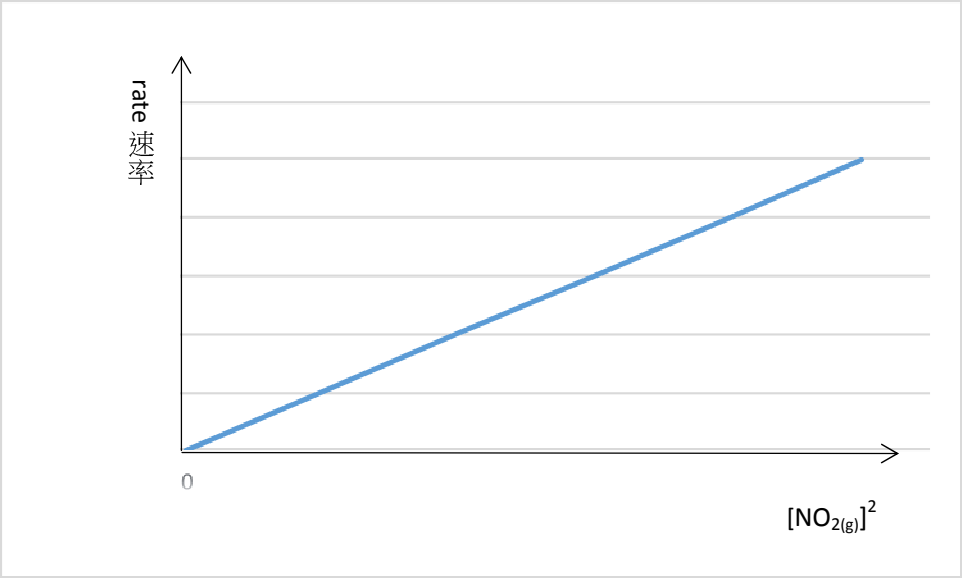
450K (1)
這可以比起 0K 維持較高的反應速率。雖然其產率比較低，不過平衡了速率後的條件(1)

1aii)
200atm (1)
It can increase the yield of reaction without cause too larger cost on the instruments.(1) / As for the forward reaction there are more gaseous products produced comparing with the backward reaction, it can increase the yield of the reaction.
200 atm (1)
這可增加反應的產率而並不會增加太多的成本 (1)/ 因為正向反應比逆向反應能產生更多的氣體產物，這能增加反應的產率。(1)

1bi)
The components in rate equation shows in the rate determining step. (1)
There are 2 NO for the reaction which is the same as the first step. (1)
在速率方程存在的物質應出現在速率斷定步驟。 (1)
有 2 NO 出現在反應中，並與第一個步驟相同。(1)

1bii)
Colorimetry (1)
By measuring the color intensity change during the reaction, as NO_2 is brown in color. (1)
比色法 (1)
因 NO_2 是棕色的，所以可量度顏色的深度在反應中的改變。(1)

1biii)



Correct x-y asix (1)
Correct curve(1)--- only for the correct x-y asix(1)
正確 X-Y 軸(1)
正確曲線(1) --- 只給予正 X-Y 軸

Actually, if candidate sketch out the $[NO_{2(g)}]$ against rate with a straight line can also gain one mark.

如考生畫出速率同 $[NO_{2(g)}]$ 關係圖都可得一分,但必須是直斜線.

1biv(1))
For the reaction mixture of the first batch:
CO_2 is in excess.
The heat released = 1mol x0.55x 226 $kJmol^{-1}$
= 124.3kJ

By E = mcΔT
The final temperature of the reaction mixture of the first batch = 124300J / (38$Jmol^{-1}K^{-1}$ x 4mol) + (50+273)K
= 1140K
The final temperature of the reaction mixture of the second batch = $(T_1 + T_2)/2$ = 719.4K

1biv(2))
To calculate the rate constant of the first batch:
Rate = $k[NO_2]^2$
$\frac{0.55}{20} \div 60 = k[1/20]^2$

k= 0.18333$mol^{-1}dm^3\ s^{-1}$

For the rate constant of the second batch:

$$\log\left(\frac{k2}{k1}\right) = -\frac{Ea}{2.3R}\left(\frac{1}{T2} - \frac{1}{T1}\right)$$

$$\ln\left(\frac{k2}{k1}\right) = -\frac{Ea}{R}\left(\frac{1}{T2} - \frac{1}{T1}\right)$$

By substitute k1 = 0.183333
R= 8.31
T_2 =719.4K
T_1 = 298K

$K_2 = 0.1833x\ e^{Ea}$ or $0.1833x\ 10^{Ea}$ $mol^{-1}dm^3\ s^{-1}$

考生如沒有寫出正確單位,即使答案對也沒有分.

1biv(1))
在第一批次的反應:
CO_2 是過量的
釋出的熱 = 1mol x0.55x 226 $kJmol^{-1}$
= 124.3kJ

根據 E = mcΔT
第一批次的反應混合物的最終溫度 = 124300J / (38$Jmol^{-1}K^{-1}$ x 4mol) + (50+273)K
= 1140K

第二批次的反應混合物的最終溫度 = $(T_1 + T_2)/2$ = 1041.4K

1biv(2))
計算第一批次反應的速率常數
速率 = $k[NO_2]^2$
$\frac{0.55}{20} \div 60 = k[1/20]^2$
k= 0.18333 $mol^{-1}dm^3\ s^{-1}$

計算第二批次反應的速率常數

$$\log\left(\frac{k2}{k1}\right) = -\frac{Ea}{2.3R}\left(\frac{1}{T2} - \frac{1}{T1}\right)$$

$$\ln\left(\frac{k2}{k1}\right) = -\frac{Ea}{R}\left(\frac{1}{T2} - \frac{1}{T1}\right)$$

代入 k1 = 0.183333
R= 8.31
T_2 = 1041.4K
T_1 = 298K

$K_2 = 0.1833x\ e^{Ea}$ or $0.1833x\ 10^{Ea}\ mol^{-1}dm^3\ s^{-1}$

(c)(i)

Methanol is used as a raw material in the production of chemicals(1) such as ethanoic acid (1)

甲醇可作為製作不同化合物的原材料。(1) 例如乙酸。(1)

Accept other reasonable answers.

接受其他合理答案。

(c)(ii)

$$H_2(g) + CO(g) \underset{\text{300 °C}}{\overset{\text{copper and zinc oxide catalyst}}{\rightleftharpoons}} CH_3OH(g)$$

50 – 100 atmospheres

$$H_2(g) + CO(g) \underset{\text{300 °C}}{\overset{\text{銅和氧化鋅的催化劑}}{\rightleftharpoons}} CH_3OH(g)$$

50 – 100 大氣壓力

Correct equation (1)

Correct condition (1)

正確方程式(1)

正確條件(1)

(c)(iii)(1)

Hydrogen is explosive which is not favor in storage comparing with methanol. (1)

氫氣是爆炸性的，相比甲醇不利於儲存。 (1)

(c)(iii)(2)

Methanol has a lower percentage by mass of carbon which burns with less sooty flame comparing with ethanol. (1)

甲醇有較低的碳的質量百分比，燃燒時會產生更少的黑煙。(1)

Accept other reasonable answers.

No mark for answer without comparison.

接受其他合理答案。

沒有比較不給分。

2(a)(1)
It has a larger surface area. (1)
它有更大的表面面積。 (1)

2(a)(2)
The microorganism can decompose it. (1) As a result the surface area of the plastic products increased, which increase the rate of decomposition. (1)
微生物可以將其分解。(1) 最後該塑膠產品的表面面積增加，會增加分解的速率。(1)

2(a)(3)
Their molecules are often shaped like rods or disks. (1)
These molecules have an uneven distribution of electrons. (1)
它們的分子形狀大多呈棒狀和碟狀。(1)
它們的電子是不平均分佈的。(1)

2(b)
Not soluble in water. (1)
Although it can form hydrogen bond with water, it has a long chain hydrocarbons so it is more assemble to an organic compound. (1)
不溶於水。(1)
雖然它可以與水生成氫鍵，但它有長的碳氫鏈, 所以這會與有機化合物更相似。(1)

2(d)(ii)
When added to a polymer, the molecules of the plasticizer get in-between the polymer chains (1)and allow the chains to slide past one another more easily.(1)
當加進聚合物後,
塑化劑的分子會存在於聚合物鏈之間(1)並容許鏈與鏈能夠有相對的滑動(1)

2(d)(iii)
The molecule has a ester bond (1)which can be broken by strong acids or bases. (1)As a result, the function of plasticizer may be vanished.
該分子有酯鍵(1)，這鍵能夠被強酸或強鹼破壞。(1)因此塑化劑的功能可能會被破壞。

2ci)The unit cell is the simplest arrangement of atoms (or ions) which when repeated will reproduce the whole structure. (1)
晶胞是晶體中最小的單位, 把晶胞重複並置，就可構成整個結構。(1)

2cii)cubic close-packed structure. (1)
立方緊密裝填結構。 (1)

2ciii) the diagonal of the cube = r(M)+ 2r(M) + r(M) = 4r(M)
the length of a unit cell = $4r(M)/2^{0.5}$
$= 4 \times 1.40 \times 10^{-10} \times 2^{0.5}$ m
$= 7.91 \times 10^{-10}$ m (1)

the volume of a cube = $(7.91 \times 10^{-10})^3$ m^3
number of atoms = 4 (1)
mass of individual atom = $63.55/6.02 \times 10^{23}$ g
mass of unit cell = $4 \times 63.55 \times 6.02\ 10^{23}$g
density =$[(4 \times 63.55)/6.02 \times 10^{23}]/ (7.91 \times 10^{-10})^3$
= 5338.2 kg m^{-3} (1)

該立方的對角線長度 = r(M)+ 2r(M) + r(M) = 4r(M)
晶胞的長度 = 4r(M)/$2^{0.5}$
= 4 ×1.40 x 10^{-10} x $2^{0.5}$ m
= 7.91 × 10^{-10} m (1)

立方的體積 = $(7.91 \times 10^{-10})^3$ m^3
原子的數目 = 4 (1)
一粒原子的重量 = 63.55/6.02x10^{23} g
晶胞的質量= 4 ×63.55x 6.02 10^{23}g
密度 = [(4 x 63.55)/6.02x10^{23}]/ $(7.91 \times 10^{-10})^3$
= 5338.2 kg m^{-3} (1)

2civ)In a pure metal, all the atoms are of the same size. The layers of atoms can slide past one another easily when a force is applied. In an alloy, atoms of a different size are added. This distorts the regular structure of the pure metal. The layers of atoms in the alloy are difficult to slide past one another when a force is applied. (2)
在純金屬中，所有的原子都有相同的體積。當施加力時，原子層能夠輕易進行相對滑動。在合金中有不同體積的原子。這將改變純金屬規則的結構。於是施力時難以令到原子層進行相對滑動。 (2)

3a(i)
Adding $Na_2CO_{3(aq)}$ to the solution separately, only for the sample with Ca^{2+} ,there are white precipitate formed.
分別地加入 $Na_2CO_{3(aq)}$至 2 個樣本，只有含有 Ca^{2+} 的樣本會有白色沉澱物生成。
Accept other reasonable answers.
接受其他合理答案。

3a(ii)

As the Ag^+ can form white precipitate with CO_3^{2-}, after acidified it, H^+ can react with CO_3^{2-} which can avoid such things happen.
因為 Ag^+能夠與 CO_3^{2-}生成一個白色沉澱物，酸化後，H^+能與 CO_3^{2-} 反應，以避免此事發生。
Accept other reasonable answers.
接受其他合理答案。

3b ⅰ)
For methanol, there is no reaction. 若為甲醇, 並沒有反應。
$C_6H_6N_4O_4 + HCOH \rightarrow H_2O + C_7H_6N_4O_4$

3bii)
1. Suction filtration/ filtration (1)
2. Wash the solid with small amount of cold distillated water (1)
3. Dry it by filter paper and place it into desiccator until the weight doesn't change. (1)
1. 吸濾法 (1)
2. 使用少量冷凍的蒸餾水清洗該固體 (1)
3. 使用濾紙將其弄乾並將固體放置在乾燥皿內，直至其重量不再有變化 (1)

3biii)

No of mole of compound X reacted = (0.965x10)/(86)= 0.1122mol

As 1 mole of compound X will form 1 mole of orange precipitate

No of mole of orange precipitate formed = 0.1122mol

The relative molecular mass of the substance = 50.07/0.1122

= 446.2 (1)

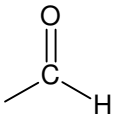
The relative molecular mass of $C_6H_6N_4O_4$ = 198

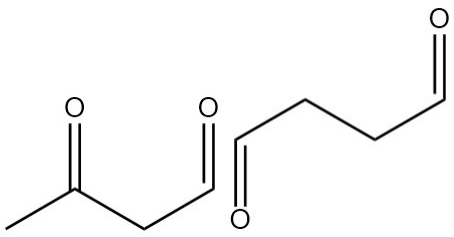
Let n be the no of C=O in compound X.

Hence,

198n +86 - 18n = 446.2

n = 2 (1)

Also, the compound X has a positive result with Tollen's reagent, it suggests that compound X has  as function group. (1)



(1)

3biii)

已反應的化合物 X 的數目 = (0.965x10)/(86)= 0.1122mol

因 1 摩爾的化合物 X 會生成 1 摩爾的橙色沉澱物

橙色沉澱物的生成量 = 0.1122mol

該物質的相對原子質量為 = 50.07/0.1122

= 446.2(1)

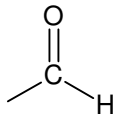
$C_6H_6N_4O_4$ 的相對分子質量 = 198

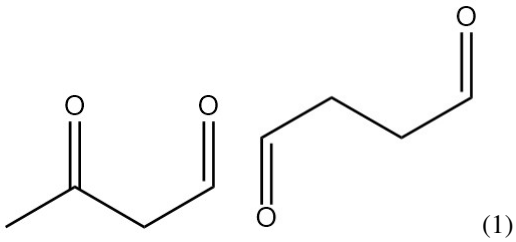
設 n 為化合物 X 內含的 C=O 總數

因此

198n +86 - 18n = 446.2

n = 2(1)

另外，化合物 X 與托倫斯試劑的反應中會呈陽性反應。這顯示化合物 X 應有  作為官能基。(1)



(1)

3(c)(i)

Check the thin layer Chromatography(1)
Simultaneously place reactants, reaction mixture in the same thin layer and under the same solvent system.(1)
If the reaction is completed, the spot of the reactants would disappear(1)
可以檢查薄層色層法(1)
同時將反應物、混合物置於同一薄層板(1)
如果反應完成，反應物並不會出現在反應混合物內。(1)

Accept other reasonable answers.
接受其他合理答案。

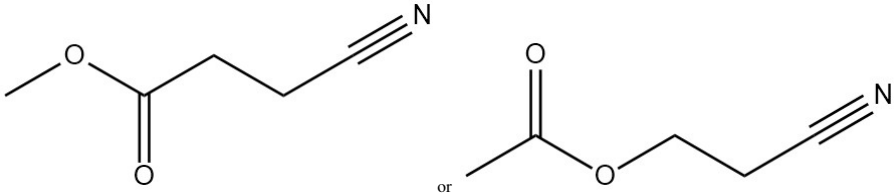
3(c)(ii)

Column Chromatography (1)
柱色層法 (1)

3(c)(iii)

1. A strong absorption at around 1700cm^{-1}
2. A medium absorption at around 2240cm^{-1}

By mass spectrum, it suggest that the compound with the relative molecular mass = 113
The maximum possible number of carbon in this compound is 9; C_9H_5
a strong absorption at around 1700cm^{-1} suggest C=O presence.
After combining info (2)
The maximum possible number of carbon in this compound is 8; C_8H_1O
As it is not possible to have C_8H_1O,
maximum possible number of carbon in this compound is 7; $C_7H_{13}O$
In this compound C cannot form 4 bonds, and a medium absorption at around 2240cm^{-1} suggest the presence of C≡N
maximum possible number of carbon in this compound is ; $C_6H_{11}ON$
Under the presence of C=O, C≡N the compound cannot have so much H atom. But there are not other absorption peak observed. So, the most possible is C-O presence .
The possible molecular formula is $C_5H_7O_2N$
The difference between 113 and 98 is 15, so it is probable that a methyl radical is lost from the molecular ion, producing the peak at m/z = 98
The difference between 113 and 73 is 40, so it is probable that a CH_2CN radical is lost from the molecular ion, producing the peak at m/z = 73
The peak at m/z = 54 suggests the presence of $CH_2CH_2CN^+$.



Correctly state the implication of IR Peak (1)x2

State the correct meaning of m/z=113 (1)

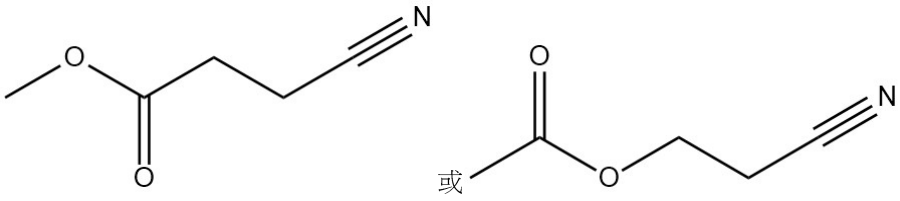
State the correct molecular formula (1)

Correct structure (1)

3(c)(iii)

根據質譜，可以得知相對分子質量為 113
該化合物最大可行的碳數目為 9; C_9H_5
在 1700cm^{-1} 有一個強吸收峰建議 C=O 的存在
將這些資訊結合，
該化合物最大可行的碳數目為 8; C_8H_1O
因為 C_8H_1O 不是一個合理的分子式
該化合物最大可行的碳數目為 7; $C_7H_{13}O$
$C_7H_{13}O$ 亦不是一個合理的分子式，因為 C 不能滿足 4 個鍵的情況。
再加上在 2240cm^{-1} 有個吸收峰建議 C≡N 的存在
該化合物最大可行的碳數目為 6; $C_6H_{11}ON$
在 C=O 以及 C≡N 的存在下，該化合物不能擁有 11 個 H。不過並沒有其他吸收峰。
所以 C-O 是可能存在鍵。
所以可行的分子式為 $C_5H_7O_2N$

113 與 98 之差為 15 因此分子離子生成導致在 m/z = 98 處的峰的離子時,很可能是失去了甲基自由基。
113 與 73 之差為 40 因此分子離子生成導致在 m/z = 73 處的峰的離子時,很可能是失去了 CH_2CN 自由基。
在 m/z=54 的峰很可能來自 $CH_2CH_2CN^+$



正確指出 IR 峰代表甚麼 (1)X2

正確指出 m/z = 113 的意思 (1)

正確的化學式 (1)

正確的結構 (1)