Paper 2

Marks

1\. (a) (i) 'Activation energy' refers to the minimum energy possessed by the colliding reactant particles in order that a reaction can occur. 1

(ii)
- Yeast provides enzyme / catalyst. 1
- At high temperature, the enzyme (yeast) is denatured / destroyed so that it cannot function as a catalyst. 1

(iii) It is to solve the problems of inadequate or shrinking supply of vitamin C. 1

(iv) Any two: chlorine, hydrogen, sodium hydroxide 1

(b) (i) 'Initial rate' is the instantaneous rate at the start of a reaction. 1

(ii)
- Follow the colour intensity of the solution / by colorimetry. 1
- The solution changes from colourless to brown. 1

(iii)
- The initial rate is directly proportional to $[BrO_3^-(aq)]$. 1
- Therefore, the order of reaction with respect to $BrO_3^-(aq) = 1$ 1

(iv) (1) Rate = $k[BrO_3^-][I^-][H^+]^y$ 2

$$\frac{\text{initial rate 1}}{\text{initial rate 2}} = \frac{(0.17)(0.15)}{(0.17)(0.30)}\left(\frac{0.10}{0.20}\right)^y = \frac{2.30\times10^{-3}}{1.84\times10^{-2}}$$

$y = 2$

The reaction is second order with respect to $H^+(aq)$.

(2) Rate of consumption of BrO_3^- = 1/3 × rate of formation of I_2 1

Based on Trial 1, initial rate of consumption of $BrO_3^-(aq)$

$= 2.30 \times 10^{-3} \times 1/3$

$= 7.67 \times 10^{-4}$ mol dm^{-3} s^{-1}

(c) (i) The ammonia produced by the Haber process can be used to manufacture fertilisers / explosives, etc. 1

(ii) Natural gas remains the more convenient / cheap way to provide hydrogen as feedstock for the production of ammonia in the Haber process. 1

(iii) Provide a larger surface area that makes the catalyst more effective. 1

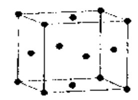
(iv)
- equilibrium position / yield 1
- reaction rate 1

(v) Any unreacted reactants are reused / recycled so that they can react again. / Removing ammonia from the product mixture so as to shift the equilibrium position to the product side. 1

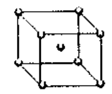
(vi) As the demand for mining the natural nitrate to produce fertilisers drops drastically, the mining work was no longer profitable / mining work might be closed / it could lead to a high unemployment rate. 1

Marks

2\. (a) (i) (1) 1



(2) 1



(ii) Any two: 2
- With a fairly rigid molecular backbone containing double bonds defining the long axis of the molecule
- many liquid-crystalline materials have benzene rings
- rod-like or disc-like molecules
- polar groups

(iii) Thermoplastics: polyvinyl chloride, polystyrene 1

Thermosetting plastics: urea-methanal

(b) (i) (1) Both of them have giant structures. 1

(2) Silicates are natural materials, while ceramics are synthetic materials. 1

(ii) (1) $Si_2O_5^{2-}$ 1

(2)
- Talc: Sheet structure in which the sheets are held together by van der Waals' forces. 1
- Quartz: Si and O atoms joined by a giant network / strong covalent bonds. 1
- A small amount of energy can make the sheets slip over one another in talc, while a large amount of energy is needed to break the giant network in quartz. 1

(iii) High hardness 1

(c) (i) Blow moulding 1

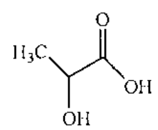
(ii)
- low density polyethene (LDPE) and high density polyethene (HDPE) 1
- As the bottle for cough syrup is hard, HDPE is more suitable. HDPE molecules have a linear structure that pack more closely. 1

  OR

  As the bottle for cough syrup is soft, LDPE is more suitable. LDPE molecules are highly branched that cannot pack closely.

(iii)
- The polar PET molecules are held together by much stronger polar-polar interactions. 1
- The non-polar PE (HDPE) molecules are held together by van der Waal's forces. 1

(iv) (1) 1



(2) PLA is made from renewable resources, while PE and PET are made from non-renewable petroleum products. 1

OR

PLA is biodegradable, while PE and PET are non-biodegradable.

(3) PLA is made from agricultural products. Massive production of PLA may affect the supply of food. 1

Marks

3. (a) (i) (1) • Place HCl(g) near NH_3(conc). 1
• Dense white fume is observed. 1

(2) • Add 2,4-dinitrophenylhydrazine. 1
• Yellow/ orange/ red precipitate is formed. 1

(ii) anhydrous magnesium sulphate 1

(b) (i) To ensure the reaction go to completion. 1

(ii) (1) No more gas is given out. / All solids are dissolved. 1

(2) Brown precipitate formed. 1

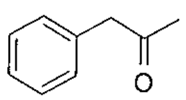
(iii) No. of mole of CaC_2O_4 formed in step 6: 3
2.374 / 128.1 = 0.01853
Mass of $CaCO_3$ in the limestone sample:
0.01853 x 100.1 = 1.855 g
Percentage of $CaCO_3$ by mass in the limestone sample:
1.855 g / 2.025 g = 91.60 (%)

(iv) Gravimetric analysis 1

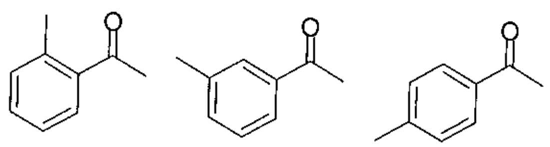
(c) (i) • Dissolve the sample in pentane and shake the solution with $NaHCO_3$(aq) in a separating funnel. 1
• Collect the organic layer and carry out fractional distillation. 1

(ii) • The spectrum does not show strong absorption at about 3230-3670 cm^{-1}, ruling out the presence of a hydroxyl group (the possibility of being an alcohol) 1
The absence of absorption at 2070-2250 cm^{-1} ruled out the presence of C≡C group.
The absence of absorption at 1610 - 1680 cm^{-1} ruled out the presence of C=C group.
• The spectrum has a strong absorption at 1730 cm^{-1}, which corresponds to C=O stretching. The compound may contain an aldehyde group or a ketone group. 1
• The negative result in Tollens' test ruled out the presence of aldehyde group in the compound. The compound may contain a ketone group. 1

(iii) m/z = 43: $[CH_3CO]^+$ 1
m/z = 134: $[C_7H_7COCH_3]^+$ 1

(iv)  1

Other possible structures:



Candidates' Performance

Paper 1

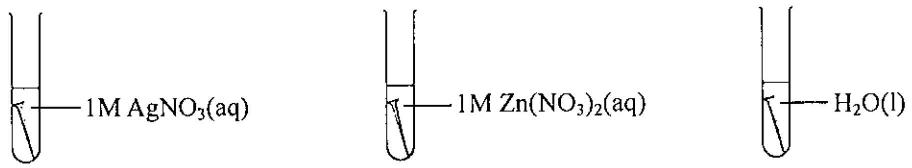
Paper 1 consisted of two sections, Section A (multiple-choice questions) and Section B (conventional questions). Sections A and B each comprised two parts, Part I and Part II. Part I contained questions set mainly on Topics I to VIII of the curriculum, while Part II mainly on Topics IX to XII. All questions in both sections were compulsory.

Section A (multiple-choice questions)

This section consists of 36 multiple-choice questions. The mean score was 23. Candidates' performance was generally good. Some misconceptions of candidates were revealed from their performance in the following items.

1. For Q.3, nearly half of the candidates wrongly chose option B. It shows that they did not realise that iron corrodes faster in the presence of mobile ions (in the case of **Y**) than that just placed in water (in the case of **Z**). It should be noted that corrosion of iron, being a redox reaction, can be facilitated by mobile ions.

Q.3 The diagram below shows three iron nails of the same size and shape each immersed in a liquid.



X **Y** **Z**

Which of the following arrangements represents the ascending order of rate of corrosion of the iron nails ?

A.*	**Z < Y < X**	(19%)
B.	**Y < Z < X**	(46%)
C.	**Z < X < Y**	(20%)
D.	**X < Z < Y**	(15%)

2. For Q.7, it should be noted that electrical conductivity of an aqueous solution mainly depends on the concentration of mobile ions in the solution. Candidates not choosing the key B might indicate that they did not realise that $BaSO_4$ is insoluble and the ions in it are not free to move in water.

Q.7 Which of the following pairs of aqueous solutions, upon mixing, would have the lowest electrical conductivity ?

A.	20.0 cm^3 of 0.1 M HNO_3	and 20.0 cm^3 of 0.1 M KOH	(7%)
B.*	20.0 cm^3 of 0.1 M H_2SO_4	and 20.0 cm^3 of 0.1 M $Ba(OH)_2$	(32%)
C.	20.0 cm^3 of 0.1 M CH_3COOH	and 20.0 cm^3 of 0.1 M NH_3	(32%)
D.	20.0 cm^3 of 0.1 M HCl	and 20.0 cm^3 of 0.1 M $C_6H_{12}O_6$(glucose)	(29%)