

Marking Scheme

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Paper 1

SECTION A

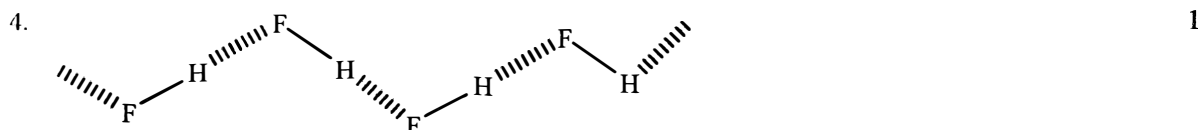
Question No.	Key	Question No.	Key
Part I		Part II	
1.	D (71%)	25.	A (69%)
2.	D (54%)	26.	D (88%)
3.	A (78%)	27.	A (60%)
4.	C (71%)	28.	D (47%)
5.	C (82%)	29.	D (79%)
6.	B (74%)	30.	A (71%)
7.	A (56%)	31.	A (81%)
8.	C (94%)	32.	A (66%)
9.	D (81%)	33.	B (65%)
10.	C (88%)	34.	D (58%)
11.	B (61%)	35.	C (60%)
12.	A (84%)	36.	C (62%)
13.	B (60%)		
14.	B (83%)		
15.	D (63%)		
16.	B (64%)		
17.	B (50%)		
18.	C (77%)		
19.	D (59%)		
20.	A (71%)		
21.	A (69%)		
22.	C (84%)		
23.	C (49%)		
24.	B (61%)		

Note: Figures in brackets indicate the percentages of candidates choosing the correct answers

SECTION B

Part I

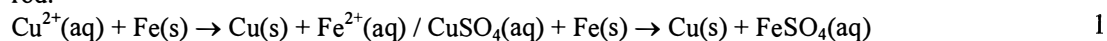
	<u>Marks</u>
1. (a) Atoms with the same number of protons but different numbers of neutrons / Atoms with the same atomic number but different mass numbers	1
(b) $20 \times 0.9048 + 21 \times 0.0027 + 22 \times 0.0925$ = 20.19	1 1
(c) Gas for filling luminous advertisement tubes / neon tubes / neon signs / neon lights	1
(d) Neon is monoatomic whereas oxygen is diatomic. O_2 molecule has larger molecular size than Ne molecule. Thus stronger van der Waals' forces / stronger intermolecular forces among O_2 molecules.	1 1
2. (a) (i) Cracking / Catalytic cracking / Thermal cracking	1
(ii) This process can produce small molecules from large hydrocarbons to meet the industrial demand.	1
(b)	1
(c) (i)	1
(ii) Bromine test – ethenyl ethanoate can decolourise orange bromine solution immediately while ethyl ethanoate cannot. / Acidified potassium permanganate solution test – ethenyl ethanoate can decolourise purple acidified potassium permanganate solution while ethyl ethanoate cannot.	2
3. (a) Provide H^+ / ions / electrolyte for the chemical cell.	1
(b) Copper, Metal Y, Metal X	1
(c) (i) $X \rightarrow X^{2+} + 2e^-$	1
(ii) $2H^+ + 2e^- \rightarrow H_2$	1
(d) No, the metal Y strip would be the negative electrode. It is because silver is lower than copper in the electrochemical series, so silver should be lower than Y in the electrochemical series.	1



Fluorine / F is a highly electronegative element. 1

The H-F covalent bond is very polar. / The HF molecule is highly polarised. 1

5. (a) Displacement reaction occurs when the iron rod is dipped into the copper(II) sulphate solution. / Some copper(II) ions are reduced to copper metal and deposited onto the surface of the iron rod. 1

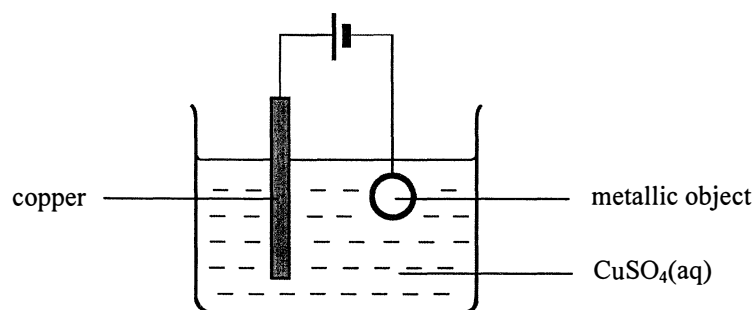


- (b) (i) Copper is lower than hydrogen in the electrochemical series. / Cu^{2+} is discharged preferentially than H^+ when a current is applied. 1

- (ii) Hydrogen gas / H_2 1

The hydrogen gas bubbles hinder the deposition of copper on the surface of the metallic object, hence causing the copper metal deposited easily flaked off. 1

(c)



3

6. • Dissolve solid lead(II) nitrate in water. 1
- Then mix with excess sulphuric acid / K_2SO_4 / Na_2SO_4 solution. 1
- Filter the mixture to obtain the solid residue (PbSO_4), wash it with deionised water and then dry in oven. 1
- Communication Mark 1

	Marks
7. (a) $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$	1
(b) KOH is very corrosive. / NH_4NO_3 is explosive. / HCl is corrosive.	1
(c) Prevent sucking back as $\text{NH}_3(\text{g})$ is very soluble.	1
(d) (i) pipette	1
(ii) Changes from red to orange.	1
(iii) Number of moles of HCl(aq) remained in the beaker : $= 0.100 \times 0.04100 \times (100.00 \div 25.00) = 0.0164$ Number of moles of $\text{NH}_3(\text{g})$ produced $= 0.0485 - 0.0164 = 0.0321$ Percentage by mass of NH_4NO_3 in the fertiliser $= (0.0321 \times 80) / 3.150 \times 100\% = 81.5\%$	3
(e) Flame test – gives a lilac flame.	1
8. (a) CO_2 gas produced makes the bread rise / spongy.	1
(b) $2\text{KHCO}_3 \rightarrow \text{K}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$	1
(c) (i) $q = 27.5 \times 4.3 \times (25.8 - 20.2) = 662.2 \text{ J}$ $\Delta H = +662.2 \times 10^{-3} \div (3.39 / 100.1) = +19.6 \text{ kJ mol}^{-1}$	2
(ii) $\Delta H = 19.6 - (-49.1 \times \frac{1}{2})$ $= +44.15 \text{ kJ mol}^{-1}$	2
(d) (i) $\Delta H = \frac{1}{2} (-1146 - 394 - 286 - (-959 \times 2)) = +46 \text{ kJ mol}^{-1}$	1
(ii) Not performing the experiment in standard conditions. / Heat transfer with the surroundings. / The heat capacity of the container was neglected.	1
9. (a) Blue colouration would be observed near the iron nail which rusts.	1
(b) Both iron nail B and iron nail C would not rust. For iron nail B, as Mg is higher than iron in the metal reactivity series, the magnesium ribbon protects the iron nail from rusting by sacrificial protection. For iron nail C, as it is sealed with grease and cannot contact with water and air (oxygen), so rusting cannot occur.	3

10. (Any three)

3

- Install catalytic converters in car.
- Use unleaded petrol.
- Replace diesel with LPG for vehicles. / Use LPG for vehicles/mini-bus/bus/taxi.
- Install scrubbers in power plant.
- Using Ultra Low Sulphur Diesel.
- Use electrostatic precipitator.

Part II11. (a) Initial rate = $60/4 = 15 \text{ cm}^3/\text{min}$

1

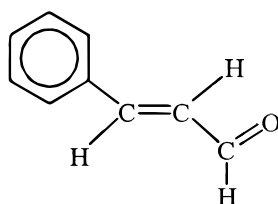
(b) HCl is a monobasic acid, while H_2SO_4 is a dibasic acid. Initial rate increases if H_2SO_4 is used.
/ Initial rate increases as the concentration of H^+ increases when using 2.0 M H_2SO_4 .

1

(c) No. of mol of Zn = $2/65.4 = 0.0306 \text{ mol}$
Volume of H_2 formed = 0.0306×24000
= 734 cm^3

3

12. (a)



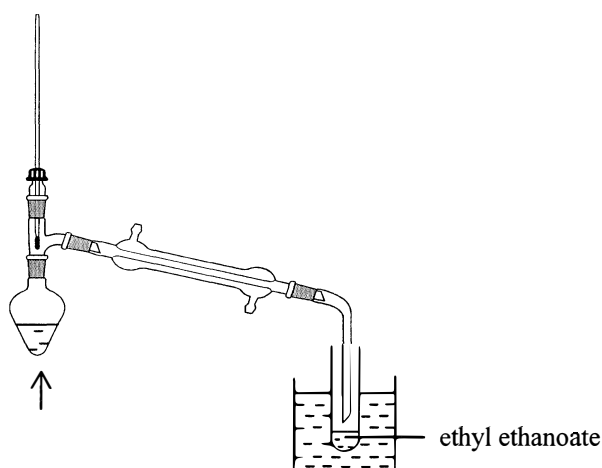
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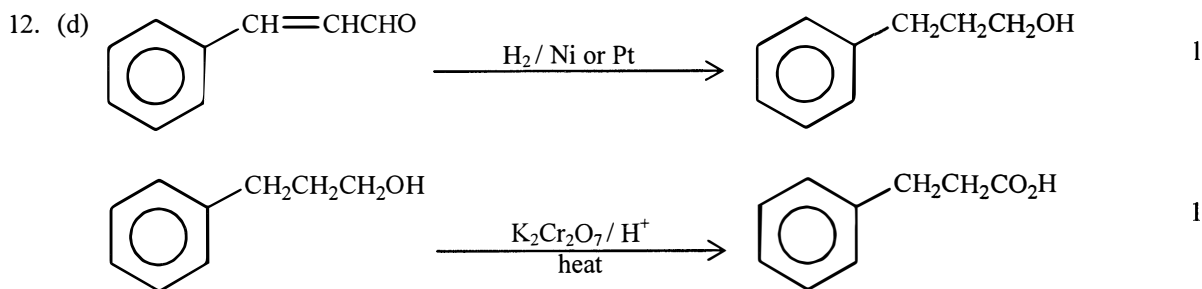
(b) Cinnamaldehyde is a non-polar compound which can dissolve in a relatively non-polar organic solvent like ethyl ethanoate. However, water is a polar solvent. / Both cinnamaldehyde and ethyl ethanoate are relatively non-polar compounds. Their molecules can be attracted by weak intermolecular forces.

1

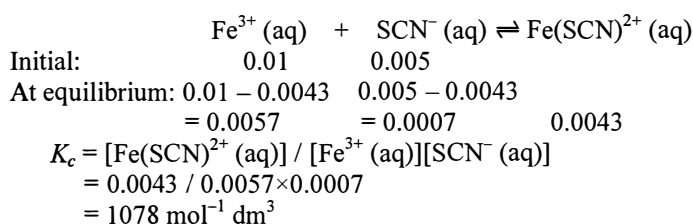
(c)

2

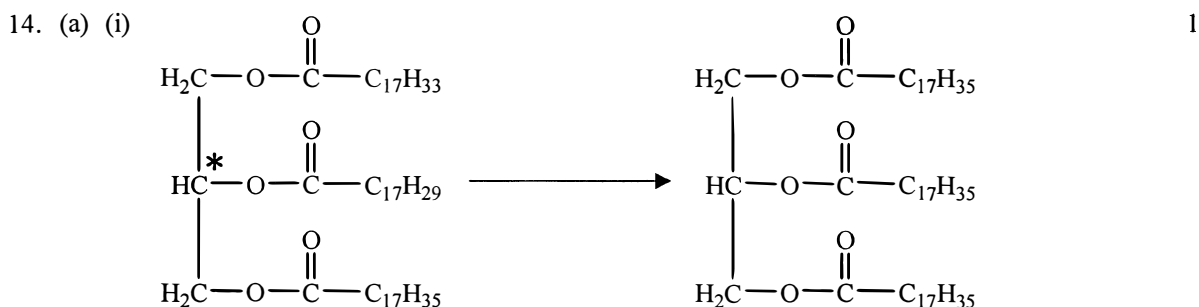




13. (a) Initial $[\text{Fe}^{3+}(\text{aq})]$ after mixing $= 0.010 \times 2 \times 1/2 = 0.01 \text{ M}$
 Initial $[\text{SCN}^{-}(\text{aq})]$ after mixing $= 0.010 \times 1/2 = 0.005 \text{ M}$ 3



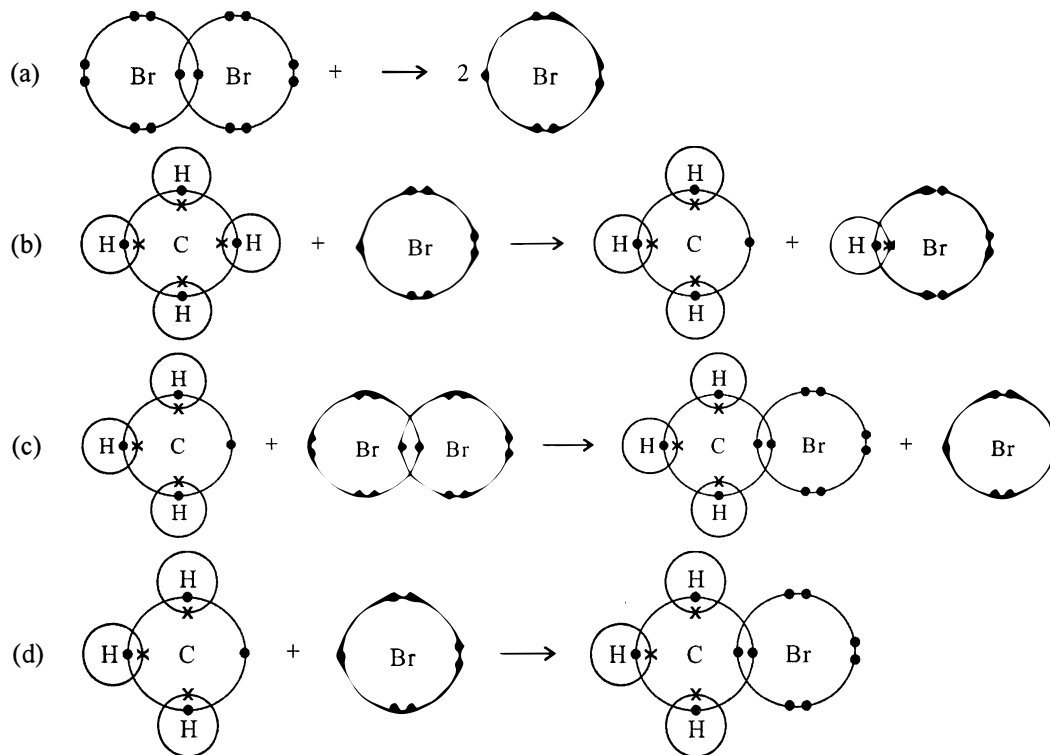
- (b) The equilibrium position will shift to the left hand / reactant side. 1



- (ii) Yes. X has one chiral carbon and hence optically active, while Y does not have chiral carbons and hence optically inactive. Thus, there is a change in optical activity for the conversion. 1

- (b)
- The $\text{C}_{17}\text{H}_{35}\text{COO}^{-}$ ion has an ionic head (COO^{-}) and a hydrocarbon tail ($\text{C}_{17}\text{H}_{35}$). 1
 - The hydrocarbon tail dissolves in grease droplets / is hydrophobic, while the ionic head dissolves in water / is hydrophilic. 1
 - The ionic heads of the grease droplets repel from each other and the dirt inside these droplets are then removed. 1
 - Communication Mark 1

15.



(a), (b), (c) OR (a), (b), (d)

1+1+1

16. (a) Na_2O , MgO , Al_2O_3

1

(b) SiO_2 has a giant covalent structure, and the Si and O atoms are linked by strong covalent bonds.

1

Other covalent oxides are discrete molecules attracted by weak van der Waals' forces / weak intermolecular forces / weak dipolar interactions.

1

(c) $\text{Al}_2\text{O}_3 + 2\text{OH}^- + 3\text{H}_2\text{O} \rightarrow 2\text{Al}(\text{OH})_4^-$ / $\text{Al}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 2\text{NaAl}(\text{OH})_4$

1

Paper 2

Marks

1. (a) (i) (1) finely divided iron / iron oxide 1
 - (2) It can increase / decrease the rate of a reaction by providing an alternative pathway that requires lower / higher activation energy. 2
- (ii) Steam reforming of natural gas 1

$\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons 3\text{H}_2(\text{g}) + \text{CO}(\text{g})$ OR 1

$\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{CO}_2(\text{g})$
- (iii) The higher temperature is used to speed up the reaction. 1

Not very high pressure is applied in consideration of mechanical design and safety concerns. 1
- (iv) • It takes a long time to reach equilibrium that the $\text{NH}_3(\text{g})$ is of highest yield to be attained. 1
 - It can increase the total amount of $\text{NH}_3(\text{g})$ produced per unit time. 1
- (b) (i) Methanol is important because it is a 1-carbon compound and acts as a starting material to make organic compounds with larger carbon numbers. 1
- (ii) $\text{CO}(\text{g}) + 2\text{H}_2(\text{g}) \rightleftharpoons \text{CH}_3\text{OH}(\text{g})$ 1

Catalyst: $\text{Cu} / \text{ZnO} / \text{Al}_2\text{O}_3$ } any two 2

Temperature: $200 - 300^\circ\text{C}$

Pressure: $50 - 100 \text{ atm}$
- (iii) Direct conversion of methane to methanol with the use of a metal oxide catalyst at high temperature and atmospheric pressure. The conversion uses a catalytic reagent. OR 2

Oxidation of methane to methanol by microbial reactions. The oxidation has higher energy efficiency. OR

Conversion of biomass to syngas/biogas for methanol production. The conversion uses renewable feed stocks. OR

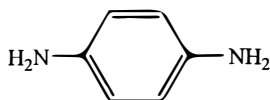
Carbon dioxide in flue gas can be converted to form methanol. The conversion helps to reduce the release of carbon dioxide to the atmosphere.
- (c) (i) Initial rate is used because the initial concentrations of reactants are known. 1
- (ii) • Compare experiments 2 & 3, $[\text{H}_2]$ remains the same but $[\text{NO}]$ is halved, rate is decreased by a factor of 4. Therefore reaction order with respect to $[\text{NO}]$ is two. 1
 - Compare experiments 1 & 2, $[\text{NO}]$ remains the same but $[\text{H}_2]$ is doubled, rate is also doubled. Therefore reaction order with respect to $[\text{H}_2]$ is one. 1
- (iii) $\text{rate} = k[\text{NO}]^2[\text{H}_2]$ 1

With data from experiment 1,

$1.20 \times 10^{-6} = k \times [2.50 \times 10^{-2}]^2 \times [5.00 \times 10^{-3}]$

$\therefore k = 0.384 \text{ dm}^6 \text{ mol}^{-2} \text{ s}^{-1}$ 1

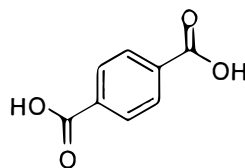
2. (a) (i) (1)



1



OR



1

(2) condensation polymerisation

1

(ii) (1) $\text{HOOC}-(\text{CH}_2)_4-\text{COOH}$

1

- (2) • The hydrogen peroxide used in Reaction (1) is less corrosive / hazardous when compared with the concentrated nitric acid used in Reaction (2).
 • The by-product H_2O produced in the Reaction (1) is less harmful / environmental friendly when compared with the by-product N_2O produced in Reaction (2).
 • A catalyst is used in Reaction (1) but not in Reaction (2).

1

1

1

(3) Both reactions consume starting materials that possibly obtained from a non-renewable resource.

1

- (iii) • Kevlar is a much stronger material than nylon-6,6 because the benzene groups in the Kevlar molecules have a more rigid structure.
 • Aromatic stacking interactions between the benzene groups of adjacent polymer molecules also contribute to the exceptionally high mechanical strength of Kevlar.

1

1

(b) (i) Name: vulcanisation

1

Purpose: To make the material strong and elastic

1

Principle: Sulphur reacts with some of the $\text{C}=\text{C}$ bonds in the polymer chains, forming S-S cross-links between the polymer chains.

1

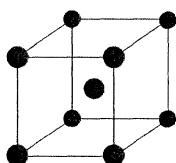
(ii) Bromination reaction occurs to the $\text{C}=\text{C}$ bonds of the material.

1

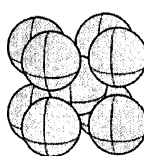
The brominated polymer have weaker intramolecular structure of the product leading to change in mechanical property.

1

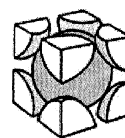
(c) (i) (1)



OR



OR



1

(2) Number of atoms

$$= 1 + 8 \times \frac{1}{8} = 2$$

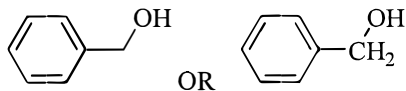
1

- (ii) • Carbon and chromium / nickel / manganese
 • Size of carbon atom differs from that of iron atom, introducing carbon into iron makes iron become harder.
 • Introducing chromium into iron makes iron become corrosion resistant.

1

1

1

- | | |
|---|---|
| 3. (a) (i) hydroxyl group | 1 |
| aldehyde group | 1 |
| (ii) (1) Test for aldehyde group or ketone group | 1 |
| (2) 2,4-dinitrophenylhydrazine reacts with aldehyde or ketone to give yellow or red precipitate. | 1 |
| (iii) hydroxyl group | 1 |
| (iv) $m/z = 91$ suggested the presence of $C_7H_7^+$ ion. | 1 |
| $m/z = 108$ suggested the presence of $C_7H_8O^+$ ion. | 1 |
| (v)  | 1 |
| (b) (i) Combustion of materials containing chlorine | 1 |
| (ii) Dioxin is carcinogenic / can cause cancer. | 1 |
| (iii) Gas chromatography-mass spectrometry | 1 |
| It can measure more accurately the low level of dioxin than using gravimetric analysis or volumetric analysis. | 1 |
| (c) (i) $AgNO_3(aq)$ and $NH_3(aq)$ | 2 |
| (ii) Step 1: Add excess $AgNO_3(aq)$ to the solution to form $AgCl(s)$ and $AgI(s)$. | 1 |
| Step 2: Filter the mixture, wash with deionised water and dry the residue. | 1 |
| Step 3: Determine the total mass of $AgCl(s)$ and $AgI(s)$ collected. | 1 |
| Step 4: Wash the solid residue with excess ammonia solution to dissolve $AgCl(s)$, filter and dry the residue, and determine the mass of $AgI(s)$ remains. | 1 |
| (iii) • Subtracting the total mass of $AgCl(s)$ and $AgI(s)$ determined in Step 3 by the mass of $AgI(s)$ determined in Step 4 to get the mass of $AgCl(s)$. | 1 |
| • Number of mole of $AgCl$ and AgI can be obtained by dividing their respective mass by the corresponding molar mass. Mole ratio of $Cl^-(aq)$ to $I^-(aq)$ can then be determined. | 1 |