ANG MO KIO SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY FOUR EXPRESS
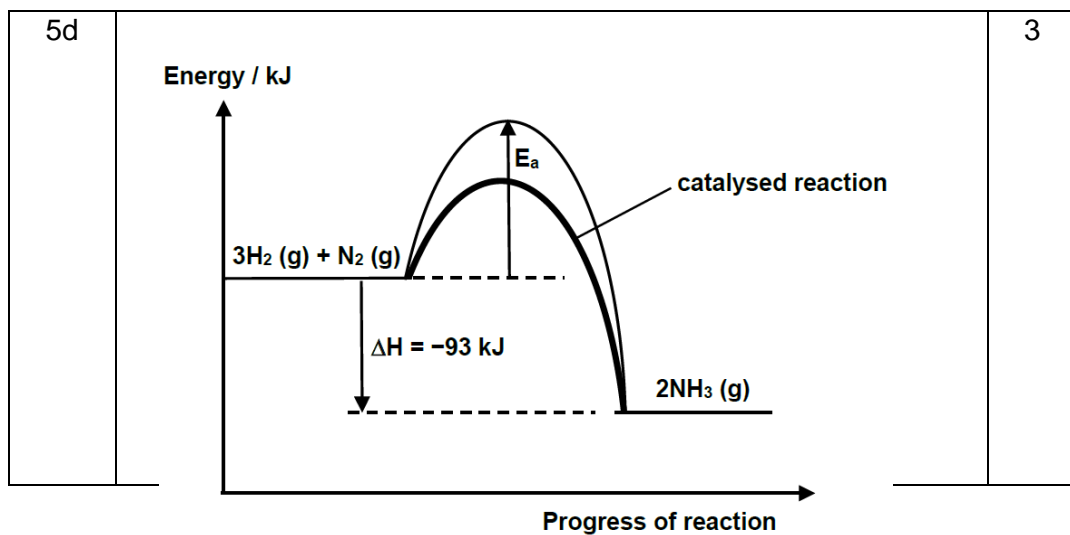**CHEMISTRY [6092]**

ANSWER SCHEME
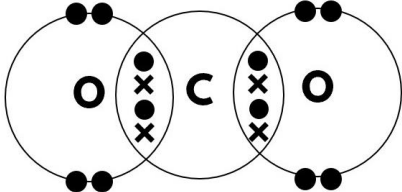
Paper 2
Section A: Compulsory Structured Questions [70 Marks]
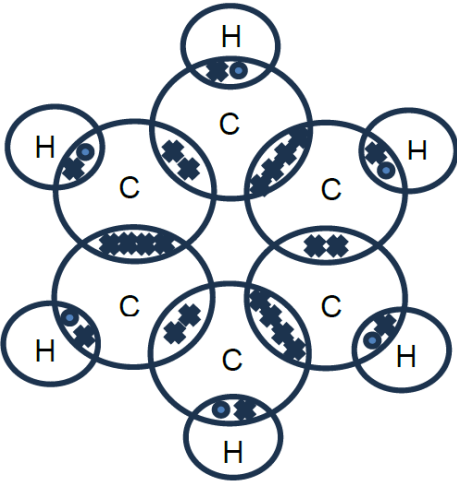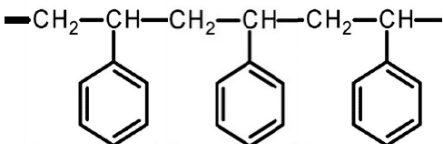
1a	Substance X.	1
	X is a noble gas as it exists as monatomic atoms. Atoms of noble gases have **completely filled outer shell** and **do not form bonds** with other atoms as it is stable.	1
1b	Substance Y.	1
	Each carbon atom in a molecule of carbon dioxide forms double covalent bond to each of the two oxygen atoms.	1
1c	W is a giant covalent structure/giant molecule with strong covalent bonds between the atoms in the giant molecule.	1
	Large amount of energy is needed to overcome these strong bonds.	1
1d	All the atoms in the four substances are non-metals / do not conduct electricity / (any appropriate answer)	1
	Total	**7**
2a	An amphoteric oxide reacts with both an acid and an alkali to form salt and water only.	1
2b	nitric acid	1
2c	Lead(II) sulfate is insoluble and will form a coating around lead(II) oxide.	1
	This prevent further reaction and will result in impure lead(II) sulfate salt formed.	1
	Total	**4**
3a	No of mole of MnO_4^- = 0.02 x 0.03 = 0.000600 mol	1
3b	2 moles of MnO_4^- reacts with 5 moles of SO_3^{2-} 0.000600 mol of MnO_4^- = (5 ÷ 2) x 0.000600	1
	= 0.00150mol of SO_3^{2-}	1
3c	The reducing agent is SO_3^{2-}.	1
	The oxidation state of Mn decreases from +7 in MnO_4^- to +2 in Mn^{2+}. Therefore, SO_3^{2-} has reduced MnO_4^-.	1

		Total	5
4a	calcium		1
4bi	7		1
4bii	4		1
4c			2

isotope	number of protons	number of neutrons	number of electrons
Fl−286	114	172	114
Fl−289	114	175	114

Each row correct = 1

4di	High melting and boiling points / conductor of electricity / malleable / ductile / (any appropriate physical properties of metals)	1
4dii	reacts with acid to form salt and water	1
	Total	**7**
5a	<u>Oxygen in air would react with the iron wool</u>. This would make the <u>iron lose its function as the catalyst</u> for the Haber Process.	1
5b	Total energy taken in to break bonds = 3(436) + 945 = 2253 kJ Total energy given out to make bonds = 6(391) = 2346 kJ Energy change for the reaction = 2253 − 2346 = −93 kJ	1 1
5c	Exothermic reaction. (must tally with their 5b ans)	1
	The total <u>energy taken in during bond breaking</u> is <u>lower than</u> the total <u>energy given out during bond making</u>. (base on whether they put it as endo or exo)	1

5d		3

5e	(answer in 5d)	1
	Total	9
6a	$2 H_2O_2 (l) \rightarrow 2 H_2O (l) + O_2 (g)$ (state symbols not required)	1
6b	To prevent chemical spray / splash	1
6c	Graph Y shows a <u>slightly lower mass obtained / greater mass loss</u> compared to Graph X.	1
	The actual mass loss in Graph X is less than theoretical mass loss in Graph Y is due to <u>a small amount of oxygen formed dissolving in the solution.</u>	1
6d	Heating the hydrogen peroxide solution / using smaller pieces of manganese(IV) oxide	1
6e	<u>Measure a fixed mass of manganese(IV) oxide</u> and add to a solution of hydrogen peroxide.	1
	When the mass loss reaches a constant reading, <u>filter</u> the mixture <u>to obtain manganese(IV) oxide</u> as the residue. <u>Dry</u> the residue.	1
	<u>Measure the mass of manganese(IV) oxide</u> remaining. <u>It is a catalyst if the mass remains the same</u>.	1
	Total	8
7a	To <u>remove any oxide layer</u> formed on the metal surface so as to <u>ensure better electrical conductivity</u>.	1
7b	X, W, Z, Cu, Y (first and last metals correct = 1; reactivity order correct = 1)	2
7c	The <u>further apart the metals are</u> positioned <u>in the reactivity series, the greater</u> the magnitude of <u>the voltage</u>.	1
7d	The voltmeter reading will be <u>zero for all the four metals</u>.	1
	Methylbenzene is a covalent compound and <u>does not conduct electricity as there are no mobile electrons or ions present</u>.	1
7ei	A pink/brown/reddish-brown solid is deposited.	1
	The solution turns from blue to colourless/lighter blue.	1

7eii	X (s) + Cu^{2+} (aq) $\rightarrow$ Cu (s) + X^{2+} (aq) (correct balanced equation = 1; correct state symbols = 1)	2
	Total	**10**
8a	Carbon monoxide is formed by <u>incomplete combustion of carbon-based fuels</u>.	1
8b	There is <u>zero percentage of carbon monoxide, oxides of nitrogen and unburnt hydrogen in the car exhaust gases of cars fitted with catalytic converters</u> compared with trace amounts of these gases in cars without catalytic converters.	1
	The use of a catalytic converter helps to <u>convert carbon monoxide and oxides of nitrogen into carbon dioxide and ~~carbon dioxide~~</u>.-nitrogen	1
	2 CO (g) + 2 NO (g) $\rightarrow$ 2 CO_2 (g) + N_2 (g) (state symbols not required)	
	<u>Unburnt hydrocarbons</u> are also <u>converted into carbon dioxide and water</u> in a catalytic converter. **(deduct ½ m if no equation is shown)**	1
8ci	carbon dioxide	1
8cii	change in rainfall patterns / heat waves / tropical storms / ocean warming and acidification / glacial retreat and melting of the polar ice caps	1
8di	During the day, trees take in carbon dioxide and give out oxygen during photosynthesis.	1
	This increases the percentage of oxygen and decreases the percentage of carbon dioxide in the day.	1
8dii		2
	(correct ratio of atoms and no. of electrons = 1; correct sharing of electrons = 1)	
	Total	**10**

9a	Styrene has a <u>simple molecular structure</u> / is a <u>simple molecule</u>.	1
	<u>Little amount of energy</u> is needed to <u>overcome the weak intermolecular attraction</u> between the molecules.	1
9b	(correct ratio of atoms and no. of electrons = 1; correct sharing of electrons = 1)	2
9c	<u>Enthalpy change is positive in value</u> / <u>heat taken in</u> during the reaction.	1
9d	The <u>boiling points</u> of styrene and ethylbenzene are <u>too close / similar</u>, with <u>only 9 °C in difference</u>.	1
9e	Addition polymerisation.	1
	<u>Carbon-carbon double bond on the side chain of styrene</u>.	1
9f	(correct addition polymerisation = 1; all three repeating units shown = 1)	2
	Total	**10**

Section B: Free Response Questions [10 Marks]

10a	electrode X: $2\,H^+\,(aq)\ +\ 2\,e^-\ \rightarrow\ H_2\,(g)$	1
	electrode Y: $2\,Cl^-\,(aq)\ \rightarrow\ Cl_2\,(g)\ +\ 2\,e^-$	1
10b	Colourless solution turns brown / a black solid is formed.	1

	$Cl_2 + 2 I^- \rightarrow I_2 + 2 Cl^-$ (state symbols not required; full equation accepted)	1
	Chlorine is <u>more reactive</u> than iodine. Chlorine will <u>displace iodine from potassium iodide</u>.	1
10c	Oxygen gas.	1
	Over time, the <u>concentration of chlorine ions will decrease</u>, and <u>hydroxide ions become</u> preferentially <u>discharged to form oxygen gas</u>.	1
10d	Student A is correct.	
	At the <u>anode</u>, <u>copper(II) ions are added to the electrolyte</u> when the copper electrode dissolves / reduces in size to form copper(II) ions. $Cu\ (s) \rightarrow Cu^{2+}\ (aq) + 2\ e^-$	1
	At the <u>cathode</u>, <u>copper(II) ions are removed from the electrolyte</u> as they are <u>preferentially discharged to form copper</u>. $Cu^{2+}\ (aq) + 2\ e^- \rightarrow Cu\ (s)$	1
	Therefore, the <u>concentration of copper(II) ions remains unchanged</u> in the electrolyte which remains blue in colour.	1
	Total	**10**
11ai	water	1
11aii	sweet smelling	1
11aiii	 (correct ester bond = 1; correct structural formula = 1)	2
11b		2

	(correct amide bond = 1; two repeating units shown = 1)		
11c	amide bond / linkage	1	
11d	unsaturated	1	
11e	Aqueous bromine becomes <u>decolourised / changes from reddish-brown to colourless</u>.	1	
	Bromine is added to compound X through <u>addition reaction as compound X is unsaturated</u>.	1	
	Total	10	