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

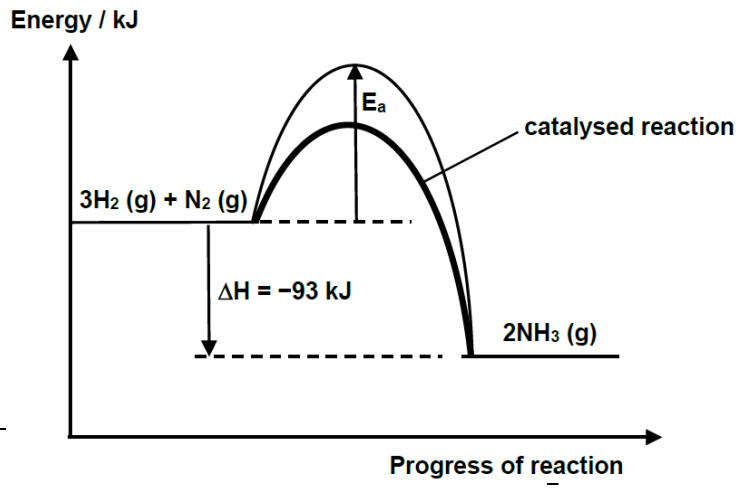
ANSWER SCHEME

Paper 2
Section A: Compulsory Structured Questions [70 Marks]

1a	Substance X. 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 1
1b	Substance Y. Each carbon atom in a molecule of carbon dioxide forms double covalent bond to each of the two oxygen atoms.	1 1
1c	W is a giant covalent structure/giant molecule with strong covalent bonds between the atoms in the giant molecule. Large amount of energy is needed to overcome these strong bonds.	1 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. This prevent further reaction and will result in impure lead(II) sulfate salt formed.	1 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 = 0.00150mol of SO_3^{2-}	 1 1
3c	The reducing agent is SO_3^{2-}. 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 1

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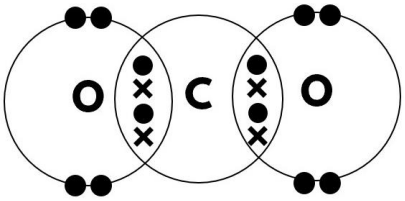
	Total	**5**
4a	calcium	1
4bi	7	1
4bii	4	1
4c	<table><tr><th>isotope</th><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr><tr><td>Fl−286</td><td>**114**</td><td>**172**</td><td>**114**</td></tr><tr><td>Fl−289</td><td>**114**</td><td>**175**</td><td>**114**</td></tr></table> Each row correct = 1	2
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	Oxygen in air would react with the iron wool. This would make the iron lose its function as the catalyst 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) The total energy taken in during bond breaking is lower than the total energy given out during bond making. (base on whether they put it as endo or exo)	1 1

5d		3

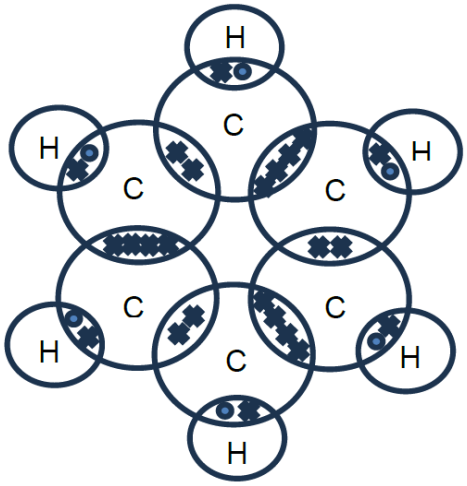
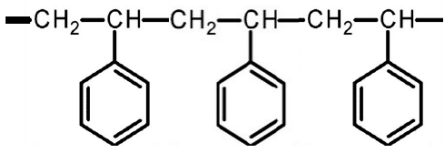
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5e	(answer in 5d)	1
	Total	9
6a	$2\ H_2O_2\ (l) \rightarrow 2\ H_2O\ (l) + O_2\ (g)$ (state symbols not required)	1
6b	To prevent chemical spray / splash	1
6c	Graph Y shows a slightly lower mass obtained / greater mass loss compared to Graph X. The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

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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. The use of a catalytic converter helps to <u>convert carbon monoxide and oxides of nitrogen into carbon dioxide and ~~carbon dioxide.~~</u> nitrogen $2\ CO\ (g) + 2\ NO\ (g) \rightarrow 2\ CO_2\ (g) + N_2\ (g)$ (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 1 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. This increases the percentage of oxygen and decreases the percentage of carbon dioxide in the day.	1 1
8dii	 (correct ratio of atoms and no. of electrons = 1; correct sharing of electrons = 1)	2
	Total	**10**

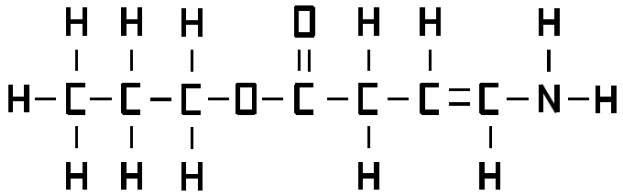
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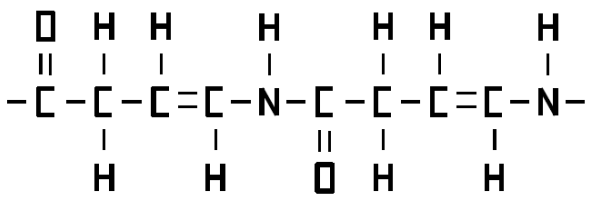
9a	Styrene has a <u>simple molecular structure</u> / is a <u>simple molecule</u>. <u>Little amount of energy</u> is needed to <u>overcome the weak intermolecular attraction</u> between the molecules.	1 1
9b	 (correct ratio of atoms and no. of electrons = 1; correct sharing of electrons = 1)	2
9c	<u>Enthalpy 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. <u>Carbon-carbon double bond on the side chain of styrene</u>.	1 1
9f	 (correct addition polymerisation = 1; all three repeating units shown = 1)	2
	Total	**10**

<u>Section B: Free Response Questions [10 Marks]</u>

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

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	$Cl_2 + 2 I^- \rightarrow I_2 + 2 Cl^-$ (state symbols not required; full equation accepted) Chlorine is <u>more reactive</u> than iodine. Chlorine will <u>displace iodine from potassium iodide</u>.	1 1
10c	Oxygen gas. 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 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. $Cu\ (s) \rightarrow Cu^{2+}\ (aq) + 2\ e^-$ 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>. $Cu^{2+}\ (aq) + 2\ e^- \rightarrow Cu\ (s)$ Therefore, the <u>concentration of copper(II) ions remains unchanged</u> in the electrolyte which remains blue in colour.	 1 1 1
	Total	**10**
11ai	water	1
11aii	sweet smelling	1
11aiii	 (correct ester bond = 1; correct structural formula = 1)	2

11b		2

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	(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>. Bromine is added to compound X through <u>addition reaction as compound X is unsaturated</u>.	1 1
	Total	10

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