CHUA CHU KANG SECONDARY SCHOOL

Secondary 4E
Chemistry
Preliminary Examination 2024

Mark Scheme

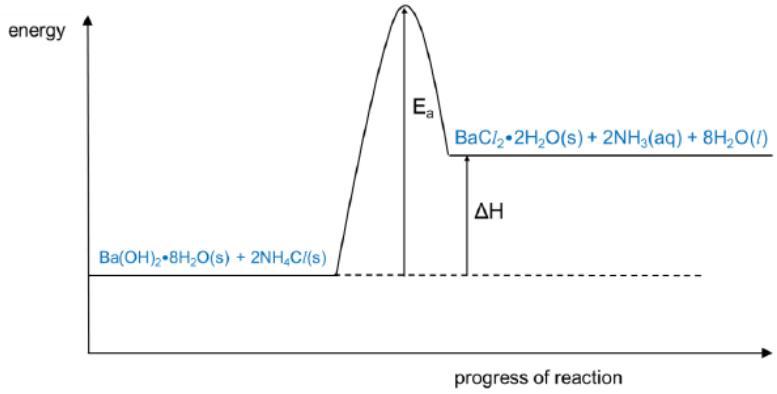
Paper 1 (40 marks)

1	**B**	**11**	**D**	**21**	**A**	**31**	**D**
2	**D**	**12**	**D**	**22**	**C**	**32**	**A**
3	**B**	**13**	**D**	**23**	**D**	**33**	**C**
4	**A**	**14**	**B**	**24**	**C**	**34**	**A**
5	**B**	**15**	**A**	**25**	**C**	**35**	**D**
6	**B**	**16**	**C**	**26**	**D**	**36**	**D**
7	**B**	**17**	**A**	**27**	**A**	**37**	**D**
8	**C**	**18**	**B**	**28**	**B**	**38**	**A**
9	**B**	**19**	**C**	**29**	**C**	**39**	**B**
10	**C**	**20**	**A**	**30**	**C**	**40**	**C**

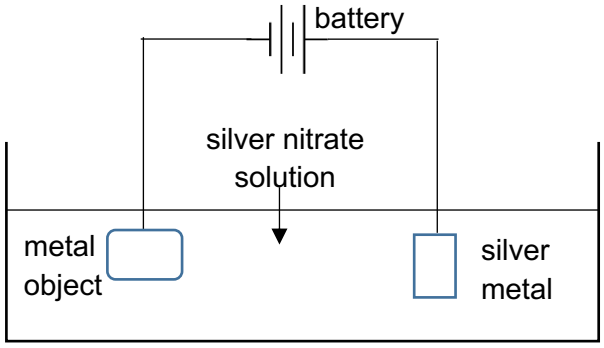
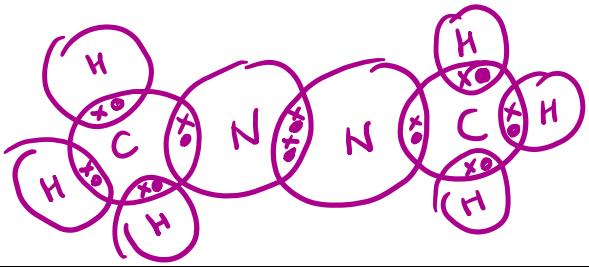
A – 9, B – 10 , C – 11 , D – 10

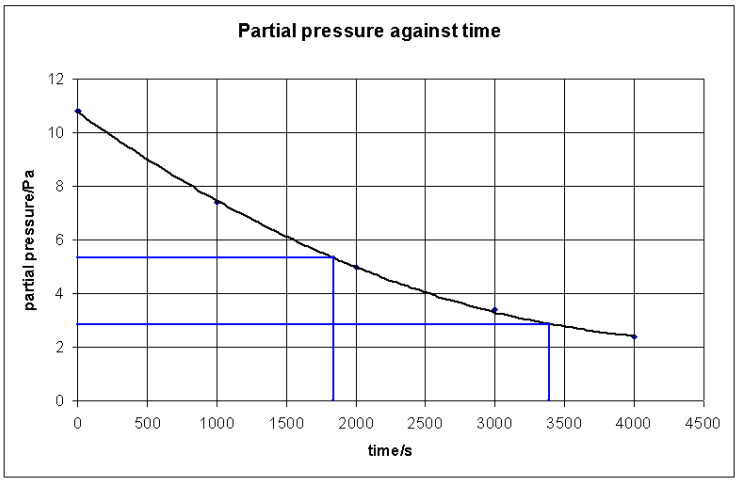
Paper 2 Section A (70 marks)

<table>
<tr><td>1(a)</td><td>Potassium carbonate</td><td>1</td></tr>
<tr><td>1(b)</td><td>Potassium iodide</td><td>1</td></tr>
<tr><td>1(c)</td><td>Ammonium chloride</td><td>1</td></tr>
<tr><td>1(d)</td><td>Potassium iodide</td><td>1</td></tr>
<tr><td>1(e)</td><td>Lead(II) fluoride, sodium chloride, ammonium chloride</td><td>1</td></tr>
<tr><td>1(f)</td><td>Barium sulfate, lead(II) fluoride</td><td>1</td></tr>
<tr><td colspan="3">Total: 6</td></tr>
<tr><td>2(a)</td><td>
<table>
<tr><td>Element</td><td>K</td><td>Cu</td><td>Cl</td><td></td></tr>
<tr><td>Mass</td><td>31.5</td><td>25.6</td><td>100-31.5-25.6 = 42.9;</td><td></td></tr>
<tr><td>Ar</td><td>39</td><td>64</td><td>35.5</td><td></td></tr>
<tr><td>Mol</td><td>31.5/39 = 0.80769</td><td>25.6/64 = 0.4</td><td>42.9/35.5 = 1.2084;</td><td></td></tr>
<tr><td>;implest ratio</td><td>0.80769/0.4 = 2.0192 = 2</td><td>0.4/0.4 = 1</td><td>1.2084/0.4 = 3.02 = 3</td><td></td></tr>
</table>
Empirical formula is $\underline{K_2CuCl_3}$
</td><td>1
1
1</td></tr>
<tr><td>2(bi)</td><td>Protons: 29;
Neutrons: 37;
Electrons: 27;</td><td>1</td></tr>
<tr><td rowspan="2">2(bii)</td><td>Add aqueous sodium hydroxide / add aqueous ammonia</td><td>1</td></tr>
<tr><td>Blue ppt insoluble in excess / blue ppt soluble in excess to form a dark blue solution</td><td>1</td></tr>
</table>

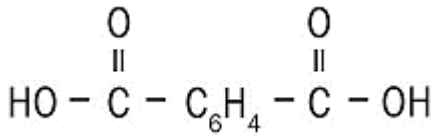
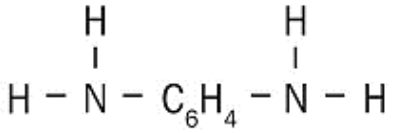
		Total: 6
3(a)	Calcium oxide is an <u>ionic compound</u> with <u>giant ionic lattice structure</u>.	1
	At high temperatures, <u>sufficient/large amount of energy</u> is provided to	1
	to <u>overcome strong electrostatic force of attraction between oppositely charged ions</u>	1
3(b)	$CaO(s) + 3C(S) \rightarrow CaC_2(s) + CO(g)$ 1m balanced chemical equation 1m state symbols	2
3(c)	Number of moles of CO present = 2400 / 24000 = 0.1 mol	1
	Mole ratio, CaO/CO = 1/1 Number of moles of CO = 0.1 mol	1
	Mass of CaO = 0.1 x 56 = 5.6g Percentage purity = 5.6 / 8 X 100% = 70%	1
		Total: 8
4(a)	Reaction is <u>endothermic/takes in heat</u> from the surroundings/water.	1
	Causing water to freeze/cool to below 0 °C OR temperature of water to decrease below melting/freezing point (of 0 °C).	1
4(b)	 Single-head arrow ΔH – 1m Single-head arrow Ea – 1m Correct energy levels + reactants and products (accept names or formula, no need state symbols) – 1m	3
		Total: 5
5(a)	No. of moles of MgO: 1 / 40 = 0.025mol No of moles of HCl = [25/1000] x 0.1 = 0.0025 mol MgO: HCl 1: 2 Therefore, HCl is the LR	1
	No of moles of $MgCl_2$= 0.0025/2 = 0.00125 mol	1
	Mass of $MgCl_2$ = 0.00125 x [24 + 2(35.5)]= 0.119g	1

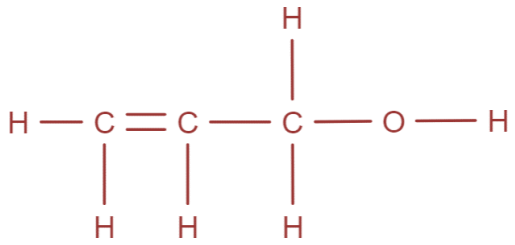
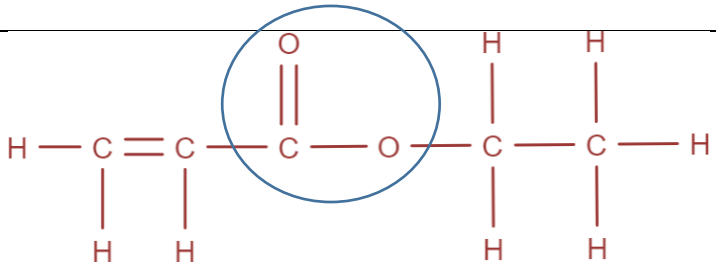
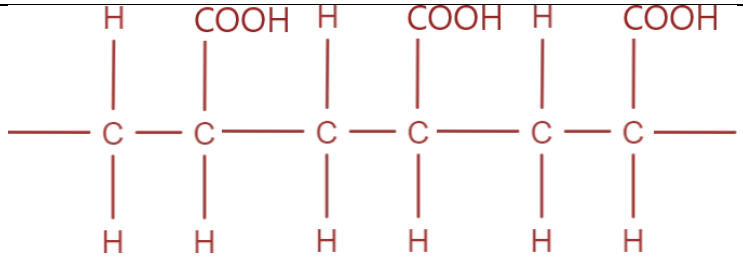
5(b)	A: Before adding, pH= 1 thus presence of strong acid As MgO is added, pH increases gradually as H^+ ions is removed by OH^-/ HCl reacting with MgO B: At pH=4, the reaction is complete/neutralisation C: pH remains at 7 as excess MgO is insoluble in water/ no increase in concentration of OH^- ions 6pts – 4m 4-5pts – 3m 2-3 pts – 2m 1pt – 1m	4
		Total:7
6(a)(i)	The high temperature of the engine causes the nitrogen and oxygen in air to react and form nitrogen oxides.	1
	Incomplete combustion of fuels	1
6(a)(ii)	Eye/ lung irritation, causes breathing difficulties	1
	Prevents transport of oxygen to the body, leading to breathing difficulties/death	1
6(b)	Carbon dioxide, a greenhouse gas, is being released excessively when catalytic converters are used, causing global warming.	1
	melting of polar ice causes rising sea levels causing floods worldwide OR extreme weather events such as increase/decrease rainfall in some areas, causing disruption of food crops leading to possible famine.	1
		Total: 6
7(a)(i)	3	1
7(a)(ii)	Disagree, acid solutions speed up rusting OR metal will react with citric acid.	1
7(b)	No, Citric acid is a weak acid that dissociates partially to form lower concentration of hydrogen ions.	1
	While sulfuric acid is a strong dibasic acid that dissociates fully to form higher concentration of hydrogen ions, thus will remove rust faster.	1
7(c)	No, because calcium carbonate is also an insoluble solid.	1
	Calcium citrate formed cannot be separated from the unreacted calcium carbonate.	1
		Total: 6
8(a)(i)	The relative molecular mass/ molar mass of each metal carbonate is different.	1
	Hence, the same mass of carbonate will produce different number of moles of carbon dioxide, result in different mass of carbon dioxide which escapes and thus varying decrease in mass.	1

8(b)	2.00g	1
	Potassium is a highly reactive metal, thus potassium carbonate is <u>very thermally stable</u> and hence <u>does not decompose</u> upon heating.	1 1
8(c)	copper	1
		Total: 6
9(a)	H^+, OH^- , CH_3COO^- 1-2 ions – 1m 3 ions- 2m	2
9(b)(i)	Fe (s) → Fe^{2+} (aq) + $2e^-$	1
9(b)(ii)	Change the iron to a more reactive metal (zinc, magnesium) / Change the copper to a less reactive metal (silver, gold)	1
9(c)(i)		1
9(c)(ii)	Positive electrode: becomes smaller/loses mass Negative electrode: increases in size Electrolyte: remains colourless/ no change in concentration 3pts – 2m 1-2 pts – 1m	
10(c)	1. <u>Silver anode oxidises to form silver ions which goes into the solution</u>. The anode loses mass. 2. <u>Silver ions are selectively discharged over hydrogen ions because they receive ions more readily</u>. The cathode gains mass. 3. The <u>concentration of the electrolyte remains the same</u> as the silver ions that are selectively discharged at the cathode is <u>replenished</u> by the silver ions produced at the anode.	1 1 1
		[Total: 10]
10(a)(i)		2

10(a)(ii)	Diazomethane is a covalent compound, <u>all the electrons are involved</u> <u>in sharing</u> between the atoms/ <u>exist as neutral molecules</u> and there are <u>no free mobile charged particles</u>.	1 1
10(b)(i)	 All points plotted correctly. [1] Smooth curve starting from origin [1]	
10(b)(ii)	When partial pressure is 5.4 Pa, half-life is 1800s, When partial pressure is 2.7 Pa, half-life is 1700 – 1900 s half-life is constant (1800s) , this is a first-order reaction	 1 1
10(b)(iii)	When initial pressure is increased, the <u>number of particles per unit volume increases.</u> The collisions between the particles of gaseous diazomethane become more frequent. As a result, the <u>frequency of effective collisions</u> <u>increases</u> and the <u>rate of reaction increases</u>.	1 1
		Total: 10

Section B (2C1, 10 marks)

11(a)(i)		1
		1
11(a)(ii)	Mr of 1 repeat unit = 14(12) + 2(16) + 2(14) + 10(1) = 238	1
	Min no. of repeating units = 12000/238 = 50.42 = 51 Max no. of repeating units = 20000/238 = 84.03 = 84	1
11(b)	Advantage : more durable / stronger / waterproof	1
	Disadvantage : non-biodegradable, hence accumulate in landfills	1
11(c)(i)	propene	1
11(c)(ii)	• Polymer M is formed from <u>unsaturated monomers</u> with carbon-to-carbon double bonds but Kevlar is formed from <u>monomers with two reactive functional groups in each molecule</u> i.e diamines and dicarboxylic acids. • Polymer M is formed by <u>without the removal of a small molecule</u> hence only one product, the polymer is formed but Kevlar is formed with the <u>removal of small molecules</u> such as H_2O. • Formation of Polymer M occurs at <u>high temperature and pressure and in the presence of a catalyst</u> while formation of Kevlar can <u>take place at room conditions.</u> 1 point – 1m	3
		Total: 10
12(a)(i)	Since ethanol made from glucose comes from crops like sugarcane, And as sugarcane can be grown and replaced in a short period of time. Therefore ethanol made from glucose is considered a renewable resource.	1
12(a)(ii)	Bioethanol is <u>made from plants</u> (corn, sugarcane, potato) that <u>take in carbon dioxide for photosynthesis</u>. This offsets <u>the carbon dioxide given out during combustion of bioethanol.</u> <u>Therefore the net carbon dioxide output is lower than burning crude oil</u>	1 1
12(b)(i)	oxidation	1

12(b)(ii)		1
12(b)(iii)	<u>Addition of bromine</u> takes place. reddish-brown solution turns colourless / decolourises.	1 1
12(b)(iv)		2
12(b)(v)		1
		Total: 10