KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL
SECONDARY FOUR EXPRESS
CHEMISTRY
PRELIMINARY EXAMINATION 2024
Answer Scheme

Paper 1 – Multiple Choice Questions (40 marks)

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A	**B**	**B**	**D**	**B**	**B**	**C**	**A**	**D**	**D**

Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	**B**	**A**	**A**	**C**	**A**	**B**	**D**	**C**	**C**

Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
B	**D**	**D**	**B**	**C**	**A**	**C**	**A**	**C**	**C**

Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
A	**A**	**C**	**B**	**C**	**C**	**B**	**C**	**C**	**B**

KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL
SECONARY FOUR EXPRESS CHEMISTRY 6092
PRELIMINARY EXAMINATION 2024

MARK SCHEME

Section A (70 marks)

<table>
<tr><td>1</td><td>a</td><td>Ar</td><td>[1]</td></tr>
<tr><td></td><td>b</td><td>Ca, Ar</td><td>[1]</td></tr>
<tr><td></td><td>c</td><td>C, At</td><td>[1]</td></tr>
<tr><td></td><td>d</td><td>Na</td><td>[1]</td></tr>
<tr><td></td><td>e</td><td>Cu, Zn</td><td>[1]</td></tr>
<tr><td></td><td>f</td><td>C, Pt</td><td>[1]</td></tr>
<tr><td></td><td></td><td>Note: Penalise if incomplete or extra answers are given. Penalise one mark overall if names were given instead of symbols.

Marker’s comment: Majority of the students missed out on giving complete answers. Common mistakes for (e) make up of brass is carbon and iron and (f) electrodes is copper and zinc.</td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>2</td><td></td><td><table>
<tr><th>Mixture</th><th>separation technique</th></tr>
<tr><td>ammonium chloride + sodium chloride</td><td>Sublimation [1]</td></tr>
<tr><td>water + lead(II) sulfate</td><td>Filtration [1]</td></tr>
<tr><td>methanol + glucose solution</td><td>(fractional/simple) distillation [1]</td></tr>
</table>1m each</td><td>[3]</td></tr>
<tr><td></td><td></td><td>Marker’s comment: Common mistake is to give preparation methods instead of separation techniques. For lead(II) sulfate, evaporation to dryness was rejected as question asked for the most appropriate technique.</td><td></td></tr>
<tr><td colspan="4"></td></tr>
</table>

3	**a**	Thermometer, Conical flask, Measuring cylinder All correct 2m, 2 correct 1m. Penalise for spelling once throughout the paper.	[2]
	b	No of mol of Mg = 2 / 24 = 0.083333 No of mol of HNO_3 = 100 / 1000 x 1.5 = 0.150 Mole ratio of Mg : HNO_3 is 1 : 2 For 0.15 mol of HNO_3 used, ½ x 0.15 = 0.075 mol of Mg is needed. As there's 0.0833 mol of Mg, it is in excess. OR For 0.0833 mol of Mg used, 2 x 0.0833 = 0.167 mol of HNO_3 is needed. Since there is only 0.15 mol of HNO_3, it is the limiting reactant and Mg is in excess.	[1] [1] [1]
		Marker's comment: (a) students incorrectly identify gas jar, missing out that the apparatus has markings. (b) poorer response was the inability to do the link/explain clearly why Mg is in excess. Some calculations were given in fractions and was unclear which value was greater/smaller.	
4	**a**	A_r of Cu = (69.15/100 x 63) + (30.85/100 x 65) = 63.617 = 64 (nearest whole number)	[1] [1]
	bi	$AgNO_3$: White precipitate forms. NH_3: Light blue / Blue precipitate forms, soluble in excess to give a dark blue solution. Penalize once overall if short-form (ppt) was given.	[1] [1] [1]
	bii	Precipitation	[1]
	biii	Element | Cu | F | K	[3]

% in 100g	21.5	38.7	39.8	
Ar	64	19	39	
No. of mol	0.33594	2.0368	1.0205	
Mol ratio	0.33594 / 0.33594 = 1	2.0368 / 0.33594 = 6.06	1.0205 / 0.33594 = 3.04	
Simplest ratio	1	6	3	

Empirical formula: **CuF_6K_3**

1m – Indication of the conversion from % to mass, 1m – workings, 1m – empirical formula (accept any combination of the formula)

Markers' comment:

(a) poorer response did not follow instructions to give answers to nearest whole number.

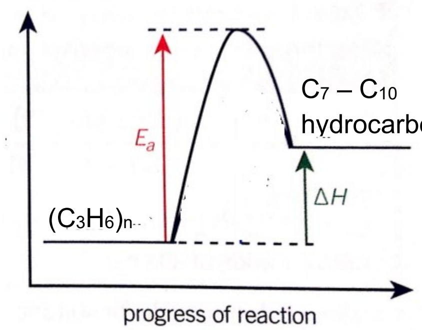
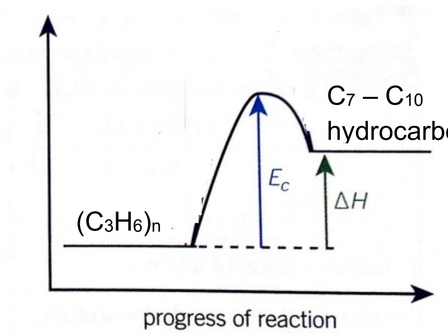
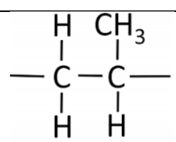
(b)(i) majority was not able to give complete answers for the observation. Misconception of ppt turning into solution.

(b)(ii) most common mistake was "metal displacement". Students did not understand the reaction.

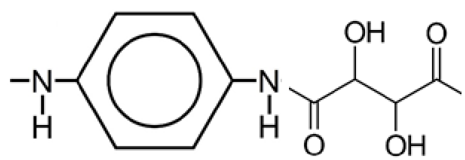
(b)(iii) common mistake was not converting % to mass and not showing calculations.

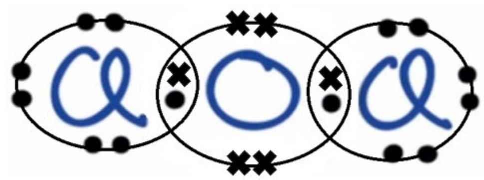
5	**a**	Set-up A: Anticlockwise Set-up B: Clockwise	[1]
	bi	Zinc electrode in set–up **A** increased in size, whereas the zinc electrode in set–up **B** decreased in size. In set-up A, Zn^{2+} ions are discharged / gained 2e- / reduced to formed Zn metal which causes the electrode to increase in size. In set-up B, Zinc is more reactive than copper and loses electrons to form Zn^{2+} ions causing the electrode to decrease in size. Set-up A: Zn^{2+} (aq) + 2e → Zn (s) Set-up B: Zn (s) → Zn^{2+} (aq) + 2e	[1] [1] [1] [1] [1]
	bii	The copper electrode in **A will decrease** in size whereas the copper electrode in **B will increase** in size.	[1] [1]

		The blue aqueous $CuSO_4$ colour will intensify in **A** whereas the blue aqueous $CuSO_4$ colour will fade in **B**.	
	c	Zn (s) / ZnO (s) / $ZnCO_3$ (s) CuO(s) / $CuCO_3$ (s) Penalize once for missing state symbols.	[1] [1]
		Markers' comment: (b)(i) students did not read the question carefully that both setup changes in size. Half-equations were missing state-symbols. Explanations were missing the key concept (more reactive metal has a higher tendency to lose electrons) of simple cell. (b)(ii) Students gave only one differences or incomplete comparisons. (c) common mistake was giving salts as answers and students thinking that copper can be used, forgetting that it is an unreactive metal.	
6	**a**	Ammonia particles are far apart and disorderly. They move about rapidly in all direction.	[1]
	b	As the number of bonds between nitrogen atoms increases from single to triple bond, the bond energy increases from 160 kJ/mol to 941 kJ/mol. This is due to a stronger attraction between the nitrogen atoms due to more electrons shared between them, require more energy to break the bonds. Note: Vice versa accepted.	[1] [1]
	ci	Total energy absorbed = 941 + 3(436) = 2249 kJ Total energy released = 2 x 3(391) = 2346 kJ Overall enthalpy change = 2249 – 2346 = –97 kJ	[1] [1] [1]
	cii	+97kJ	[1]
		Markers' comment: (a) incomplete answers. Commonly missing out the idea of "disorderly" or "rapid movement"	

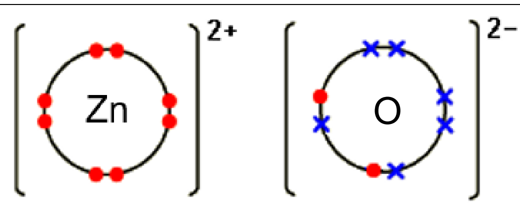
		(b) misconception that bond were “overcome” when it is broken or that intermolecular forces of attraction were incorrectly discussed showing poor understanding of question. (c)(i) incorrect use of data. N-N data used instead of N≡N Poor statements given and incorrect calculation of the number of bonds. (ii) missing signs and incorrect units given. 2 moles of ammonia decomposes hence it isn’t kJ/mol.	
7	**a**	 reaction without catalyst  reaction with catalyst 1m – same reactant and product height, labelled 1m – correct Ea / Ec 1m – same △H (endothermic)	[3]
	bi	 Empirical formula: CH_2	[1] [1]
	bii	$2CH_2 + 3O_2 \rightarrow 2CO_2 + 2H_2O$	[1]
	biii	No. of mol of poly(propene) = 5000 / (12+2) = 357.14 Mole ratio of CO_2 : Poly(propene) = 2 : 2 ∴ No. of mol of CO_2 = 357.14 Vol of CO_2 = 357.14 x 24	[1]

		= 8571.42 = 8570 dm^3 (to 3 s.f.)	[1]
	c	Advantage: Poly(propene) is durable / does not rust unlike iron. Disadvantage: Poly(propene) is non-biodegradable and would contribute to waste, pollution problems.	[1] [1]
8	**ai**	Butanedioic acid, $HOOC(CH_2)_2COOH$ OR $HOOCCH_2CH_2COOH$	[1]
	aii	$HOOC(CH_2)_nCOOH$ OR $(CH_2)_n(COOH)_2$	[1]
	b	Disagree with the claim. It is unable to undergo condensation polymerization on its own as it only has carboxyl functional group. OR does not contain hydroxyl or amine group.	[1]
	ci	The term weak acid means the acid undergoes only partial dissociation in water to form H+ ions. Circle the 2 acidic hydrogen of carboxy functional group.	[1] [1]
	cii	Physical property: pH < 7, turns moist blue litmus paper red, turns green Universal Indicator orange/yellow. (any one) Chemical property: Reacts with metal to produce salt and hydrogen, reacts with metal carbonate to produce salt, water and carbon dioxide, undergoes redox reaction with potassium manganate (VII). (any one)	[1] [1]
	ciii	Tartaric acid contain 2 carboxyl groups (per molecule) whereas butanoic acid contains only 1 carboxyl group (per molecule). Tartaric acid contains 2 types of functional groups (per molecule), hydroxyl and carboxyl whereas butanoic acid contains only 1 type of function group (per molecule), carboxyl. Tartaric acid contains a hydroxyl functional group (per molecule), whereas butanoic acid does not.	[2]

		Tartaric acid contains 4 functional groups (per molecule), whereas butanoic acid contains only 1 functional group. Any 2 of the above.	
	civ		[1]
9	**a**	Experiment 4. Comparing Expt 3 and 4, with the <u>same concentration of ClO_2 and OH^-</u>, the initial rate of reaction was <u>lower for expt 4, 0.00552 mol/dm^{3}s</u> as compared to <u>expt 3, 0.01104 mol/dm^{3}s</u>.	[1] [1]
	bi	The rate of the reaction increases by <u>4 times (2^2)</u> when the concentration of ClO_2 <u>doubles</u>. From experiment 1 and 3, the rate of reaction <u>increases from 0.00276 mol/dm^3 s to 0.01104 mol/dm^3 s</u> when the concentration <u>increases from 0.02 mol/dm^3 to 0.04 mol/dm^3</u>. (OR expt 2 and 5 with evidence)	[1] [1]
	bii	Second order reaction Reject: 2 order, order 2, 2nd order.	[1]
	c	0.000230 mol/dm^3 s Penalise for wrong or missing units.	[1]
	d	Increasing concentration increases the <u>number of particles per unit volume</u>. This increases the frequency of collisions between reacting particles. As a results, the <u>frequency of effective collisions increases</u> and the <u>rate of reaction increases</u>.	[1] [1]

	e	 1m for correct bonding electrons, 1m for correct valence electrons for all	[2]

Section B (10 marks)

10	**a**	Giant ionic lattice structure	[1]
	b	Zinc sulfide has strong electrostatic forces of attraction between the oppositely charged Zn^{2+} and S^{2-} ions but diamond has strong covalent bonds between the C atoms. More energy is needed to break the strong covalent bonds in diamond than to overcome the strong electrostatic forces of attraction in zinc sulfide hence melting point of diamond is higher than zinc sulfide.	[1] [1]
	c	 1m for each ion.	[2]
	d	C is oxidised as it gains oxygen to form CO, O_2 is reduced as it decreases in oxidation state from 0 (in O_2) to -2 (in CO). Hence it is a redox reaction. OR ZnO is reduced as it loses oxygen to form Zn. CO is oxidised as it gains oxygen to form CO_2. Hence it is a redox reaction. Accept all explanations of redox.	[1] [1] [1] [1]
	e	Environment: SO_2 forms acid rain when dissolved in clouds/rainwater which corrodes limestone building/metal structures when it falls. (Accept marine life impact) Human: CO reacts irreversibly with haemoglobin in blood to form carboxyhaemoglobin which reduces the ability to transport O_2 which causes breathing difficulties and even death.	[1] [1]
	f	Cool to room temperature and collect the solid formed / sieve out the solid.	[1]

11	**a**	Silicon carbide has a giant molecular structure. A lot of energy is needed to break the strong covalent bonds between silicon and carbon atoms. Hence its melting point is very high and makes it resistant to melting. 1m – Structure, 1m – energy + mp, 1m – breaking of strong covalent bonds	[3]
	bi	Platinum, Rhodium and Palladium Note: all must be stated.	[1]
	bii	Catalyst provides an alternative pathway with a lower activation energy which helps increase the frequency of effective collisions.	[1]
	ci	$2CO + \mathbf{O_2} \rightarrow 2CO_2$ OR 2**NO** + 2CO → N2 + 2CO2 OR $2C_8H_{18} + 25\mathbf{O_2} \rightarrow 16CO_2 + 18H_2O$ Accept any C_nH_{2n+2} molecules within $5 \leq n \leq 25$	[1]
	cii	OA highlighted above. Allow ecf	[1]
	di	…**8**.. NH_3 + …**6**.. NO_2 → …**7**.. N_2 + …**12**.. H_2O	[1]
	dii	In step 2, nitrogen monoxide produced is reused in step 1 to react with the ozone again in a continuous cycle. Thus, there is no net loss of nitrogen monoxide molecules.	[1] [1]