Swiss Cottage Secondary School
Preliminary Examination 2024
Secondary Four (O Level)
Chemistry 6092 (Mark Scheme) – Paper 1 & 2

Paper 1 (40 marks, [1] per qn)

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

Paper 2 Section A: 70 marks

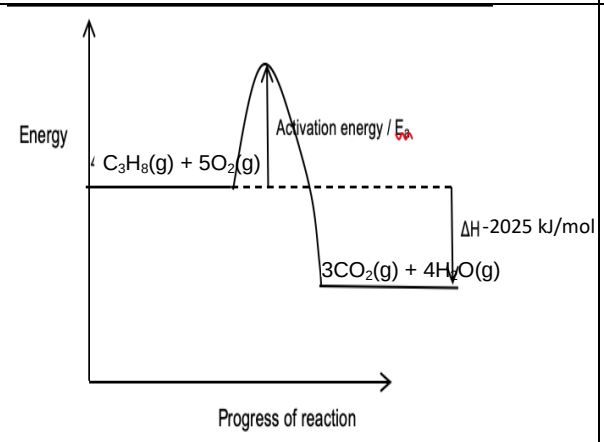
<table>
<tr><th colspan="2">Qn No.</th><th>Answer</th><th>marks</th><th>markers' comment</th></tr>
<tr><td>A1</td><td>(a)</td><td>zinc</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(b)</td><td>copper / hydrogen</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(c)</td><td>hydrogen / carbon</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(d)</td><td>argon</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(e)</td><td>fluorine</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(f)</td><td>silicon</td><td>[1]</td><td></td></tr>
<tr><td></td><td></td><td>Total</td><td>[6]</td><td></td></tr>
<tr><td>A2</td><td>(ai)</td><td>The atomic radii increase down the group due to the increase in the number of electron shells [1] to hold the electrons, thus resulting in a bigger atom.</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(aii)</td><td>The atomic radii increase while electronegativity decreases as it is harder for the nucleus to attract electrons to itself. [1]</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(aiii)</td><td>2.25 (accept value between 2.0 to 2.3).
It has a larger atomic radii compared to the elements above it in the group . Since the nucleus is further away from the valence shell, it is harder for the nucleus to attract electrons. [1]</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(bi)</td><td>Melting point and boiling point decreases down the group</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(bii)</td><td>As the atomic radii increases down the group, the negatively-charged valence electrons are further away from the positively-charged nucleus.
The electrostatic forces of attraction between valence electrons and the nucleus becomes weaker. [1]
Less energy is required to overcome the metallic bonding/forces of attraction [1] between the valence electrons and the nucleus.</td><td>[2]</td><td></td></tr>
<tr><td></td><td></td><td>Total</td><td>[6]</td><td></td></tr>
<tr><td>A3</td><td>(a)</td><td>It is because the acid contains oxygen and can dissociate/ionise in aqueous solution to form H^+ ions.</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(b)</td><td><table><tr><th>name of acid</th><th>oxidation state of chlorine</th></tr><tr><td>hypochlorous acid</td><td>+1</td></tr><tr><td>chlorous acid</td><td>+3</td></tr><tr><td>chloric acid</td><td>+5</td></tr><tr><td>perchloric acid</td><td>+7</td></tr></table></td><td>[2]</td><td></td></tr>
<tr><td></td><td></td><td>Every 2 correct answer [1m]</td><td></td><td></td></tr>
</table>

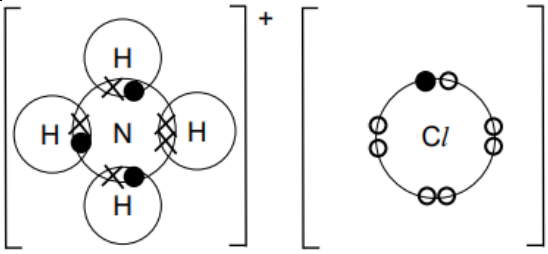
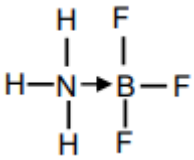
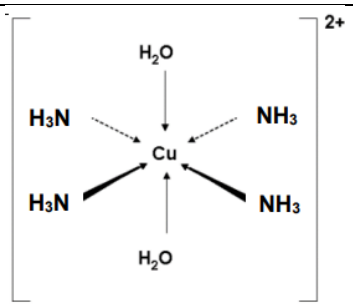
	(c)	As the oxidation state of chlorine increases, the strength of acid increases. [1] When oxidation state of chlorine increases **from +1 to +7**, the **reaction** between the acid and Mg **become more vigorous**. [1]	[2]	
	(d)	Hypochlorous acid / HC*l*O has the lowest electrical conductivity. It has the least vigorous reaction with magnesium and is therefore the weakest acid. This means that it must have the **lowest concentration of mobile ions** [1] to act as charge carriers.	[1]	
		Total	**[6]**	
A4	**(ai)**	Air is made up of a mixture of many gases, like oxygen and nitrogen. Hence • oxygen can react with hydrogen to form water if air is used during Haber process. • nitrogen reacts with oxygen to form oxides of nitrogen • air contains oxygen which oxidises iron catalyst to iron(II) oxide/iron(III) oxide • iron react with oxygen and water and rusting occurs. [choose any one point]	[1]	
	(aii)	No. of mole of H_2SO_4 $= \frac{10.5}{1000}$ X 0.150 = 0.001575 mol $\frac{No.of\ mole\ of\ NH_3}{No.of\ mole\ of\ H_2SO_4} = \frac{2}{1}$ No. of mole of $NH_3 = \frac{2}{1}$ X 0.001575 = 0.00315 mol Concentration of $NH_3 = \frac{0.00315}{0.002}$ = 0.1575 = 0.158 mol/dm^3 (to 3.s.f) [1]	[2] [1]	

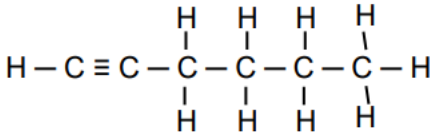
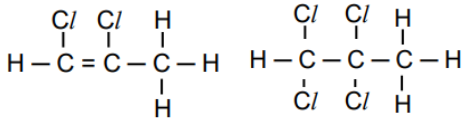
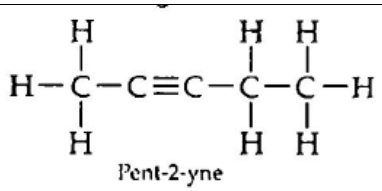
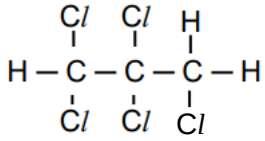
	(b)	Mr of NH_4NO_3 = 80 % N in NH_4NO_3 = 2(14) / 80 x 100% = 35.0% (to 3 s.f) Mr of $CO(NH_2)_2$ = 60 %N in $CO(NH_2)_2$ = 2(14) / 60 = 46.667 = 46.7% (3 s f) **[1] for both correct %N** Hence, urea would give more nitrogen per kg. [1]	[2]	
	(c)	1. Add excess calcium carbonate to nitric acid and stir. Filter the mixture to obtain a solution of calcium nitrate as the filtrate. 2. Add the calcium nitrate solution to aqueous sodium sulfate/ sulfuric acid/ any solution with sulfates. 3. Filter the mixture to obtain calcium sulfate as the residue. Wash the residue with distilled water and leave the residue to dry on filter paper. [1]: steps 1-2 [1]: step 3	[2]	
		Total	**[7]**	
A5	**(a)**	**A:** Iron / Fe [1] **B:** Iron(III) oxide / Fe_2O_3 [1] **C:** Iron(III) sulfate / $Fe_2(SO_4)_3$ [1] **D:** Ammonia / NH_3 [1]	[4]	
	(b)	Zn^{2+} and NH_4^+	[1]	
	(c)	$Zn^{2+} + 2OH^- \rightarrow Zn(OH)_2$ *{Note: Please follow instructions! State symbols are not required. Please do not include. If correct state symbols are given, no extra credit will be given. However, for incomplete or wrong state symbols, marks will be deducted.}*	[1]	
	(d)	Cl^- / chloride and I^- / iodide are not present in the filtrate.	[1]	
		Total	**[7]**	

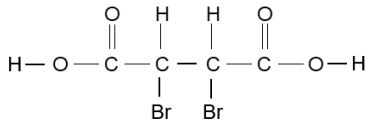
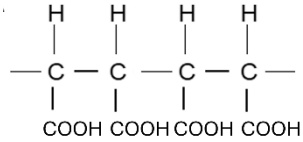
A6	**(a)**	$ZnCO_3 \rightarrow ZnO + CO_2$ No. of mole of zinc carbonate $= \frac{2.00}{125}$ = 0.016 mol $\frac{No.of\ mole\ of\ CO_2}{No.of\ mole\ of\ ZnCO_3} = \frac{1}{1}$ [1] No. of mole of $CO_2 = \frac{1}{1}$ X 0.016 = 0.016 mol Mass of CO_2 = 0.016 x 44 = 0.704g (to s.f.) Actual mass of CO_2 produced [1] = 2.00 – 1.35 = 0.65g % yield of CO_2 $= \frac{0.65g}{0.704g}$ X 100% = 92.330 = 92.3 % (3 s.f) [1]	[3]	
	(b)	It is because • different carbonates have different Mr values, hence the number of moles of carbonate present in the fixed mass of carbonate is also different. **OR** • different metals in the various carbonates have different Ar values, hence the number of moles of carbonate present in the fixed mass of carbonate is also different. **OR** • % of carbon in each compound is different, hence the number of moles of carbonate present in the fixed mass of carbonate is also different.	[1]	
	(c)	Observations: N**o visible change** occurs when hydrogen was passed over heated aluminium oxide. **Black solid t**urned **pink / red-brown** when hydrogen was passed over heated copper(II) oxide. [1] *{Note: water droplets/ colourless liquid is not acceptable in this case. See remarks on the right.}*	[2]	

		Explanations (method 1- displacement) Hydrogen is less reactive than aluminium, so hydrogen is not able to displace aluminium from aluminium oxide. Hydrogen is more reactive than copper, so hydrogen is able to displace copper from copper(II) oxide. [1] *{"to displace copper from copper(II) oxide" here means "to form the copper metal from copper(II) oxide"}* Explanations (method 2- reduction) Hydrogen is less reactive than aluminium, so hydrogen is not able to reduce aluminium oxide to aluminium. Hydrogen is more reactive than copper, so hydrogen is able to reduce copper(II) oxide to copper [1] *{"to reduce copper(II) oxide to copper" means "to convert copper(II) oxide [before] to copper [after]"}*		
		Total	**[6]**	
A7	**(a)**	Experiment 1: A1 Experiment 2: B1	[1]	
	(b)	Copper(II) ions (Cu^{2+}) gain electrons more readily than hydrogen ions (H^+), hence copper(II) ions are reduced to form copper solid. **OR** Copper(II) ions (Cu^{2+}) are preferentially discharged over hydrogen ions to form copper solid [1] $Cu^{2+} + 2e^- \rightarrow Cu$ [1]	[2]	
	(c)	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ *{Note: Please follow instructions! State symbols are not required. Please do not include. If correct state symbols are given, no extra credit will be given. However, for incomplete or wrong state symbols, marks will be deducted.}*	[1]	
	(d)	Colour of Universal Indicator in expt 1: <u>red</u> [1] pH of electrolyte in expt 1: pH <u>1</u> **OR** <u>2</u> [1] OH^- ions and Cu^{2+} ions are selectively discharged (while H^+ and SO_4^{2-} are not). This results in a higher concentration of H^+ ions than OH^- ions thus resulting in an acidic solution [1]	[3]	
		Total	**[7]**	

A8	**(a)**	B **most reactive** C D copper A **least reactive** [1]: first 2 [1]: next 3	[2]	
	(b)	Observation 1: Colour of solution will change from blue to colourless./fades to light blue [1] Observation 2: Red-brown solid/pink solid will be deposited. [1]	[2]	
	(c)	Voltage reading = 0.00 V / 0 V Ethanol exists as molecules and <u>does not have any mobile ions and mobile electrons</u> to act as charged carriers hence it cannot conduct electricity. [1]	[1]	
A9	**(a)**	$2H_2 + O_2 \rightarrow 2H_2O$ $\Delta H = -495$ kJ/ mol or $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ $\Delta H = -247.5$ kJ/ mol **correction equation [1] and ΔH [1]** **ecf is given to** ΔH based on the number of moles of hydrogen stated in the equation.	[2]	
	(bi)	**More energy is given off/released** in **bond forming** of **3 mol of CO_2 and 4 mol of H_2O** [1] than **energy is taken in/absorbed** to **break the bonds** in **1 mol of C_3H_8 and 5 mol of O_2**. [1]	[2]	
	(bii)		[2]	
		correct labels of reactants and products [1] correct exothermic graph, activation(upward arrow label) and energy change (downward arrow) labelled [1]		

	(c)	Piped gas: cleaner fuel as it only produces water as the only product / more convenient as the gas is on demand and you don't need to buy canisters / won't need to worry about the gas supply running out / takes up less space as don't have to install a bulky canister beneath the stove [1] Liquified petrol gas: generates more energy per mole of fuel as compared to piped gas/ more energy efficient [1]	[2]	
		Total	[8]	
A10	**(ai)**	 1m for each ions for each ion the number of valance shell must be completely filled.	[2]	
	(aii)	 Accept if brackets given with no charge.	[1]	
	(bi)	Light blue / blue precipitate formed. [1] Light blue precipitate dissolves in excess to form a dark blue solution. [1] Reject: Light blue/blue solution	[2]	
	(bii)	$[Cu(H_2O)_2(NH_3)_4]^{2+}$	[1]	
	(biii)	 **1m correct ligands with correct direction of arrows, 1m correct charge**	[2]	
	(ci)	$Fe(H_2O)_4(OH)_2$	[1]	
	(cii)	$Cu(H_2O)_4(OH)_2$ forms $[Cu(H_2O)_2(NH_3)_4]^{2+}$ which is soluble in excess aqueous ammonia while $Fe(H_2O)_4(OH)_2$ is insoluble.	[1]	

	(ciii)	When exposed to air/oxygen[1], green iron(II) hydroxide oxidises to form iron(III) hydroxide which is the red-brown precipitate. [1] Accept: iron(II) ions/iron/green precipitate oxidised	[2]	
		Total	[12]	
Section B				
B11	**(ai)**	Ethyne and propyne contain **only hydrogen and carbon atoms** [1] with **carbon-carbon triple bonds**. [1]	[2]	
	(aii)	C_nH_{2n-2} , where n = number of carbon atoms	[1]	
	(aiii)		[1]	
	(bi)	 [1] for each correct structure	[2]	
	(bii)	 Pent-2-yne correct structure, bonding between C – C and C – H must be accurate [1] addition Polymerisation [1]	[2]	
	(biii)	 correct structure [1] pentachloropropane [1]	[2]	
		Total	**[10]**	
B12	**(a)**	W: ethane / C_2H_6 [1] X: glucose / $C_6H_{12}O_6$ [1] Y: propyl ethanoate / $CH_3COOC_3H_7$ [1] Z: carbon dioxide / CO_2 [1]	[4]	

	(bi)	 The bromine solution will turn from **reddish-brown to colourless.** correct observation [1] and structural formula [1]	[2]	
	(bii)	Ester linkage	[1]	
	(ci)	 **reject if bonds are not correctly drawn**	[1]	
	(cii)	Substances that **cannot be decomposed** or **broken down by bacteria** or **natural biological processes** into **simpler substances**.	[1]	
	(ciii)	It will cause land pollution as plastic do not decompose hence burying plastic waste in land fills leads to an increase amount of built-up waste, or Water pollution, plastic thrown into the sea endanger marine animals. or Air pollution, plastics are mostly flammable, when plastics are incinerated, the produces air pollutants. Incineration of polymer produces carbon dioxide which is green house gases leads to global warming. Reject if students just state land pollution/water pollution/air pollution. (any one)	[1]	
		Total	**[10]**	