Yuan Ching Secondary School
Preliminary Examination 2024
Secondary Four Express

Chemistry (Revised)
6092 Paper 1
Answer Key

1	D
2	D
3	C
4	C
5	C
6	C
7	A
8	D
9	D
10	D
11	C
12	A
13	C
14	C
15	D
16	D
17	C
18	B
19	B
20	B

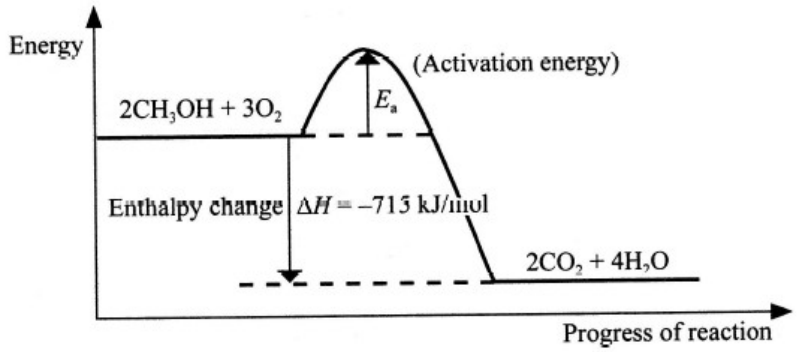
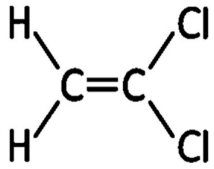
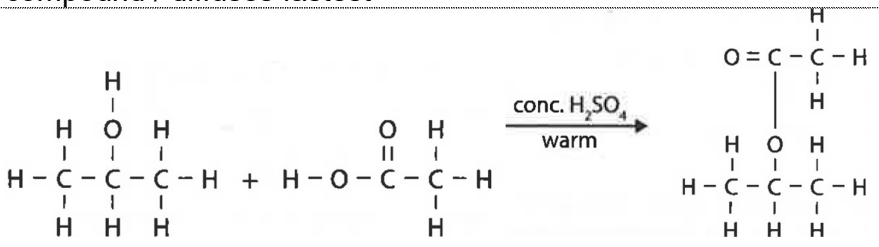
21	A
22	D
23	B
24	C
25	A
26	B
27	A
28	D
29	D
30	A
31	C
32	D
33	D
34	C
35	C
36	D
37	A
38	D
39	D
40	D

Chemistry (Revised)
6092 Paper 2
Marking Scheme

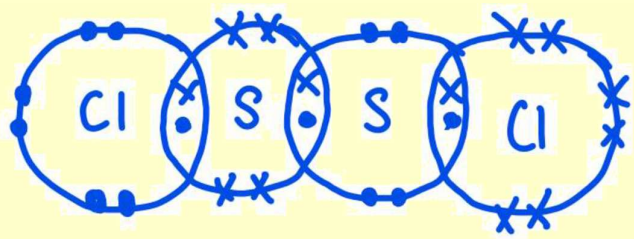
Section A (70 marks)			
S/No.		**Answers**	**Marks**
1	**(a)**	C	1
	(b)	A	1
	(c)	B	1
	(d)	D	1
2	**(a)**	Methane, it has the **smallest / lowest relative molecular mass** than the rest of the gases	1
	(b)	Temperature affects the kinetic energy of the particles. At **higher temperatures, particles move faster** and further apart (ORA) Keeping the temperature at a constant ensures that particles have the **same average kinetic energy**.	1 1
	(c)	132s	1
	(d)	Ammonia is **soluble in water**. Hence it will back into the way of the graduated cylinder.	1
3	**(a)**	**Y** is the **weak** acid **Reference** to Universal indicator colour **to pH** (i.e orange indicator a higher pH than red) **Reference** to **rate** of gas produced in 10s (i.e. rate of reaction is slower as it produces less hydrogen in 10s compared to X) **ALLOW**: infer lower concentration of hydrogen ions is lower in acid Y as compared to acid X. [1m only] **MUST** quote data ("*use information from table*")	1 1 1
	(b)	no. of mol of NaOH produced = 221000 x 0.100 = **0.0022 mol** by mol ratio, H_2A : NaOH 1 : 2 **0.011**: 0.0022 Concentration of tartaric acid = 0.0011 / 0.025 = **0.044 mol/ dm^3**	1 1 1

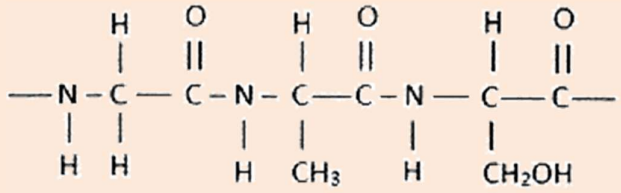
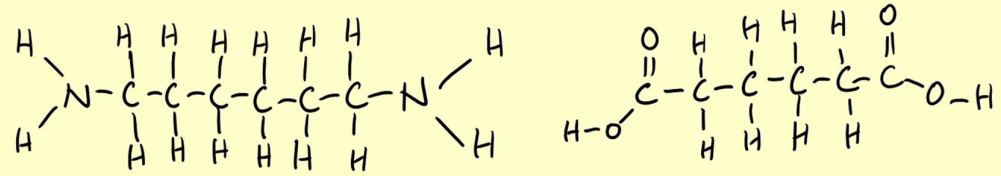
4	**(a)**	<table><tr><th>halogen</th><th>Colour and state at room temperature and pressure</th></tr><tr><td>chlorine</td><td>Yellow-green **gas**</td></tr><tr><td>bromine</td><td>Red-brown **liquid**</td></tr><tr><td>iodine</td><td>Purple-grey **solid**</td></tr></table> [1m] correct **states** [1m] correct colours [MAX 1m]: 2 correct states & colours	2
	(b)(i)	Chlorine is **more reactive than** bromine in Group 17, **chlorine displaces bromide** from aqueous sodium bromide solution, causing aqueous bromine to form which is brown in colour.	1
	(b)(ii)	When a jet of iodine gas is aimed at a filter paper soaked in a solution of sodium bromide. There is **no displacement reaction** as iodine is less reactive than bromine. Filter **paper turns brown** slowly as **iodine** gas **dissolved in the aqueous solution** to give a brown solution When a jet of bromine gas is aimed at a filter paper soaked in a solution of sodium iodide. Filter paper turns brown as **iodine is less reactive than bromine hence bromine displaces iodine from sodium iodide**, causing aqueous iodine to form which is brown in colour. [1m]: brown colour for iodine in aq. state in <u>both</u> cases [1m]: explain no displacement reaction for iodine gas with bromide salt [1m]: displacement reaction takes place for bromine gas with iodide salt	3
	(c)	Chlorine **has a strong tendency to gain electrons from other elements** to form a negatively charge ion. This causes itself to be reduced and hence an oxidising agent. **ALLOW**: reverse argument	1
5	**(a)**	<table><tr><th>experiment</th><th>concentration of acid / mol/dm^3</th><th>volume of acid / cm^3</th><th>particle size of metal (small or large)</th></tr><tr><td>**d**</td><td>0.25</td><td>**<u>20</u>**</td><td>**<u>large</u>**</td></tr></table>	1

	(b)	Graph **a is steeper than graph d** hence speed of reaction in a is faster than in d. In d, **particle size is bigger, hence there is less surface area to volume ratio.** Hence **frequency of effective collision between reacting particles decreases**, resulting in slower reaction. **ALLOW**: reverse explanation as well	1 1 1
	(c)	Experiment B	1
	(d)	No. of moles of HCl used = $0.20 \times \frac{30}{1000} = 0.006$ Mole ratio of HCl : M = 2 : 1 = 0.006 : 0.003 OR Volume of H_2 produced = $72cm^3$ No. of moles of H_2 = $\frac{72}{1000 \times 24} = 0.003$ [1] Mole ratio of H_2 : M = 1 : 1 = 0.003 : 0.003 [1] Ar of Metal M = $\frac{0.195}{0.003} = 65$ Therefore, metal M is Zinc. [1]	3
6	**(a)(i)**	Hydrogen, H_2 = 256 ÷ 2 = 128 kJ/ g 1 g of hydrogen **releases 128 kJ of energy** Methanol = 715 ÷ 32 = 22.3 kJ / g 1 g of methanol **releases 22.3 kJ of energy**	1 1
	(a)(ii)	1. From the calculated results, 1 g of hydrogen produces/releases more energy (128kJ) than 1 g of methanol (22.3kJ). 2. From the melting and boiling point, hydrogen is a gas while methanol is a liquid at room temperature. Hence, for the same volume of fuel used, there are more particles per unit volume when burning ethanol than hydrogen. 3. Also being a fuel gas, hydrogen is highly flammable and difficult to store. Pressurised cylinder is needed to contain liquefied hydrogen while methanol is much easier to handle and store.	1 1 1

	(b)	 [1m] enthalpy change, single arrow down with -715kJ/mol; [1m] activation energy, single arrow up from reactants. [1m] shape of profile diagram as exothermic **REJECT**: [-1m] no labels of axes and/or methanol, oxygen and products of this reaction	3
7	**(a)**	It is described as substitution reaction because the **hydrogen atoms in methane** is **replaced by halogen atoms**. It is photochemical because it requires (ultraviolet) **light** to initiate the reaction.	1 1
	(b)		1
	(c)	The C*l*O particle produced in step 1 reacts with an oxygen atom in step 2 to produce another C*l* atom. This C*l* atom is then able to start step 1 again. This is a chain reaction.	1 1
	(d)	Ozone **absorbs out excessive ultraviolet radiation** that could lead to **increased incidence of skin cancer**.	1
8	**(a)(i)**	It is an ester (contains structure contains ester linkage), and esters are generally sweet-smelling **ALLOW**: has the lost relative molecular mass, it is the most volatile compound / diffuses fastest	1
	(a)(ii)	 [1m] for correct structure from acid [1m] for correct structure from alcohol **REJECT** [-1m] not displayed formula	2

	(b)(i)	Y has a smaller molecular mass than Z and should be more volatile than Z. OR Y has a smaller molecular mass than Z hence it diffuses faster than Z. OR Y is an alcohol as it contains the hydroxyl group hence it is volatile.	1
	(b)(ii)	**Heat** each compound with **acidified potassium manganate(VII).** Y will turn acidified potassium manganate(VII) **from purple to colourless**, but Z will not.	1 1
9	**(a)(i)**	Electronegativity **decreases down Group** 2 elements. As the **atomic size increases, the attraction between the nucleus and valence electrons is weaker**, making the atom less likely to attract electrons.	1 1
	(a)(ii)	Any value between 0.82 to 0.98 (actual 0.93)	1
	(b)	Helium, neon and argon have **completely filled valence electron shells** and they are **unable to form bonds with other elements**. **ALLOW**: these elements are noble gases and noble gases are unreactive [1m MAX]	1 1
	(c)	Σ of Al_2O_3 = 3.44 – 1.61 = **1.83** Σ value of Al_2O_3 does not support. Al_2O_3 is an **ionic compound but its Σ is less than 2.0.** **REJECT** Σ value of $AlCl_3$ supports the bonding in $AlCl_3$.	1 1
	(d)	<u>Student 1</u> No. For example, Σ value (H-F) / bond energy of H-F = 1.78/562 = 0.00317 and Σ value (H-Cl) / bond energy of H-Cl = 0.96/431 = 0.00223 **correct set of working to prove (i.e. Σ value (H-F) / bond energy) [1];** **do not give the same constant value**. [1] **ACCEPT**: Other examples with single covalent bonds. <u>Student 2</u> No. From table 9.1, there is **only one Σ value** for CO bond and **it cannot be used to predict the bond strengths** of C-O, C=O or C≡O (cannot tell the difference between the type of bonds in CO and hence the strengths). OR From table 9.1, **Σ value for CO bond is zero**, but the bond energy is 432 kJ/mol which is about the same bond energy as HF bond but it's Σ value is higher at 1.78	2 1

	(e)(i)	Nitrogen is **more electronegative** than hydrogen and the **bonding electrons should be closer to the nucleus of the nitrogen.** OR Dot-and-cross diagram does not show that **nitrogen atom having a higher tendency to attract the bonding pair of electrons to itself** in the chemical bond.	1
	(e)(ii)		1
10	**(a)**	The electrodes and copper wires have **free moving electrons** [1m]; to conduct electricity whereas the electrolyte has **free moving ions** to conduct electricity. [1m]	2
	(b)	$Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$ Or $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$ **ACCEPT**: If no state symbols are written. **REJECT**: If state symbols are written incorrectly.	1
	(c)(i)	$Ag^+(aq) + e^- \rightarrow Ag(s)$ Reject: If no or wrong state symbols are written.	1
	(c)(ii)	The **pH** of the electrolyte **decreases**. OH^- is **selectively discharged at graphite electrode 2** and resulting in a **lower OH^- concentration** or concentration of OH^- becomes lower than concentration of H^+.	1 1
	(d)	Oxide ions are **discharged to give oxygen** gas at graphite electrode **2**. After a long period of time, the **oxygen gas produced reacts / oxidises graphite electrode 2** to become carbon dioxide gas. **ACCEPT** equations written for the reactions at the electrode At graphite electrode 2: $2O^{2-}(l) \rightarrow O_2(g) + 2e-$ and $C(s) + O_2(g) \rightarrow CO_2(g)$	1 1

Section B (10 marks)			
S/No.		**Answers**	**Marks**
11	**(a)(i)**	 [1m]: 2 proper amide linkages [1m]: consist of 1 glycine, 1 alanine and 1 serine	2
	(a)(ii)	Condensation polymerisation; Polymer formed contains amide linkages / amino acids monomers have functional groups. **ALLOW**: loss of water	1 1
	(a)(iii)	Mr of repeat unit = **215**; Number of repeat units = 6000 000 / 215; Number of amino acids = 2790/7 × 3 = 8372.1 ≈ **8372** **ALLOW**: ecf **ALLOW**: 8373	1 (allow ecf) 1
	(b)(i)		2 1m for each monomer
	(b)(ii)	Depolymerisation is a process in which the polymers / condensation polymers are broken down into their monomers [1m]; Water and the presence of an acid catalyst are required. [1m]	2

12	**(a)**	Aluminium is the **most reactive** followed by carbon then silicon. **Silicon dioxide can be reduced by carbon** to form silicon and carbon monoxide, carbon is more reactive than silicon. But, **aluminium oxide remains in the silicon as it cannot be reduced by carbon.** This shows that aluminium is more reactive than carbon. [1m] - *clearly stated an order of reactivity* [1m] - *explain their answer in terms of reduction*	2
	(b)	✓1 = structure ✓2 = (FOA) between (particles) ✓3 = mp; energy required to overcome (FOA) ✓4 = explain density using states or particles per unit vol ✓5 = conductivity Suggested answer: **Carbon monoxide** - has a simple molecular structure - Small amount of energy is needed to overcome the weak intermolecular forces between simple CO molecules. - Hence, it has low melting and boiling points and exist at gas at room temperature. - There are no free mobile electrons in the structure, hence it does not conduct electricity in any states - small number of molecules packed per unit volume / particles are far apart **Silicon dioxide** - Has a giant molecular structure - Large amount of energy is needed to overcome the network of strong covalent bonds between silicon and carbon atoms - Hence, it has a high melting and boiling points and exist at solid at room temperature. - There are no free mobile electrons in the structure, hence it does not conduct electricity in any states - Large number of atoms packed per unit volume / particles are closely packed **Aluminium oxide** - Has a giant ionic lattice structure - Large amount of energy is needed to overcome the strong electrostatic forces of attraction between oppositely charged ions - Hence, it has a high melting and boiling points and exist at solid at room temperature.	5

		- In solid state, oppositely charged ions are held in fixed position but in molten state, aluminium and oxide ions are free and mobile, hence it allows current to pass through the structure. - Large number of ions packed per unit volume / particles are closely packed	
	(c)	Mass of 2.8 mol of Al = 2.8 × 27 = 75.6 g [1m] Mass of Si and other elements present in the alloy = 100 g - 75.6 g = 24.4 g % by mass of Si and other elements present in the alloy $= \frac{24.4}{100} \times 100$ = 24.4% [1m] With reference to the table, hence for the following alloy: X: % by mass silicon = 24.4% – 7% = **17.4%;** but %by mass silicon is <16% which is smaller than 17.4% Y: % by mass silicon = 24.4% – 8% = 16.4%; similarly %by mass silicon is between 16% - 19% Ans: Alloy **Y** [1m – with proving] **ALLOW**: other methods of proving	3