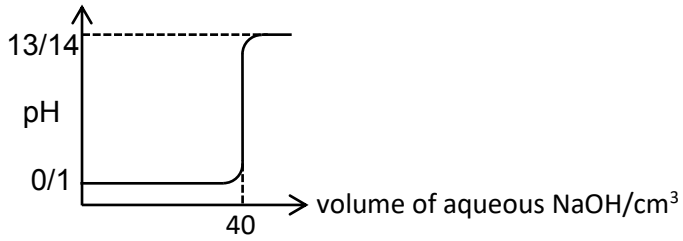
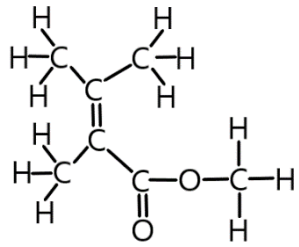
Victoria School
2022 Secondary 4 Chemistry Prelim Answer Scheme + Markers' Report

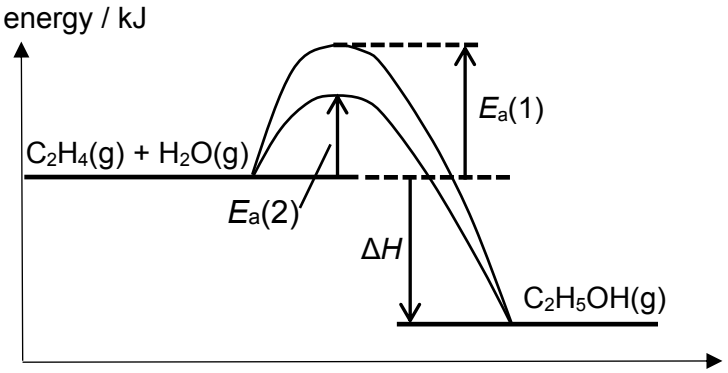
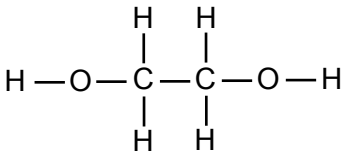
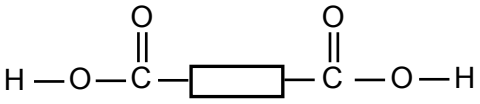
Paper 1

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

Paper 2 Section A

Qn	Suggested answers	Mark
A1a	CO_2	1
A1b	K	1
A1c	Ni	1
A1d	$Ca(OH)_2$	1
A1e	K/Ni and Cl_2	1
A1f	SO_2	1
A2ai	They dissolve/ionise/dissociate in water to produce H^+/hydrogen ions.	1
A2aii	Add a 2 cm magnesium strip into 25.0 cm^3 of 1 mol/dm^3 of both acids. Measure the time taken for the strips to totally react away, T will take a shorter time / Measure volume of gas produced in 5 min, T will produce a larger volume / Measure time taken to collect 10 cm^3 of gas, T will take a shorter time REJECT: collect total volume of gas as both will be equal if Mg is limiting. Max 1m: qualitatively determine that T produces a faster speed of reaction (more vigorous effervescence for T)	1 1
A2aiii	Brown solution will turn colourless / decolourise.	1
A2bi	$H^+ + OH^- \rightarrow H_2O$	1
A2bii	pH 9.2 Accept range from 9.0 to 9.4	1

Qn	Suggested answers	Mark
A2biii	 1m - both correct pHs 1m - 40 cm^3 Reject: pH 2 for strong acid	2
A2ci	T reacts with calcium carbonate to form an <u>insoluble layer</u> of calcium sulfate that coats on the carbonate, <u>preventing further reaction</u>.	1
A2cii	amount of calcium carbonate = $\frac{1}{100}$ = 0.0100 mol amount of acid used = 1.2 x 0.050 = 0.0600 mol since $2H^+ \equiv Ca$, calcium carbonate is the limiting agent. since $Ca \equiv CO_2$, volume of CO_2 = 0.0100 x 24 = 0.240 dm^3	1 1 1
A2d	 1m – ester linkage 1m – displayed formula (only if ester linkage present)	2
A3ai	Glutamic acid, sodium hydroxide and monosodium glutamate are all <u>soluble</u> in water (to form colourless solution).	1
A3aii	112 dm^3 of sodium hydroxide solution. (must state but no mark) Glutamic acid is dibasic/2 mol of sodium hydroxide reacts with 1 mol of glutamic acid (to form a disubstituted salt) (11.20 cm^3 will react with 25.0 cm^3 aqueous sodium hydroxide to form a monosubstituted salt.)	1 1
A3bi	copper(II) oxide/copper(II) hydroxide	1
A3bii	Excess copper(II) carbonate can be removed by <u>filtration</u> but not glutamic acid.	1
A4a	Total energy absorbed for bond breaking = 610 + 4(414) + 2(463) = 3192 kJ Total energy released from bond forming = 346 + 5(414) + 358 + 463 = 3237 kJ Total energy change = 3192 – 3237 = -45.0 kJ	1 1 1

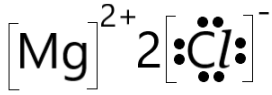
Qn	Suggested answers	Mark
A4b	 1m – $E_a(1)$ and curve 1m – $E_a(2)$ and curve 1m – energy level and product with state symbol 1m – ΔH	4
A5ai	 	1 1
A5aii	Catalyst / enzyme	1
A5bi	Butanal C_3H_7CHO	1 1
A5bii	$C_nH_{2n+1}CHO$ / $C_{n-1}H2_{n-1}CHO$	1
A5biii	Presence of oxygen in the organic compound. Length of carbon chain/number of carbon atoms. ACCEPT percentage by mass of carbon	1 1
A5ci	Oxidation	1
A5cii	Waxworms can remove <u>non-biodegradable</u> plastic from the environment, <u>reducing pollution</u>.	1
A6a	Pigment B has an <u>additional component/ring/circle</u> compared to A. Pigment B is a <u>mixture</u> while A is <u>pure</u>.	1 1
A6bi	Ethanol/solvent BOD organic solvent REJECT oil	1

Qn	Suggested answers	Mark
A6bii	Only a small sample is required.	1
A6ci	Phosphoric acid. Experiment 2 uses a higher number of moles of phosphoric acid to produce a higher amount of moles of product. Only the increasing the amount of limiting reactant will affect the amount of product formed.	 1 1
A6cii	A higher concentration of particles increases the number of moles of H^+ ions/particles per unit volume. This results in a higher frequency of effective collisions between reacting particles, resulting in shorter time taken for the reaction to complete.	1 1

Paper 2 Section B

Qn	Suggested answers	Mark
B7a	largest mass of Mn from pyrolusite = 0.09 x $\frac{55}{87}$ x 1 = 0.0569 tonne smallest mass of Mn from hausmannite = 0.08 x $\frac{165}{229}$ x 1 = 0.0576 tonne	1 1 1
B7b	Mn_3O_4 + CO $\rightarrow$ 3MnO + CO_2	1
B7c	Silica in ores chemically combines with manganese(II) oxide and prevents it from being reduced. Roasting manganese ores with limestone to remove silica will produce more slag which tends to dissolve manganese and lower the yield of the metal. Silica can be reduced to silicon and enter the molten metal.	1 1 1
B7d	Calcium carbonate in limestone thermally decompose to form calcium oxide which then react with silica to form slag.	1
B7e	Aqueous ammonia is a weak alkali and will not precipitate out manganese(II) hydroxide.	1
B7fi	The concentration of manganese(II) ions will decrease resulting in the concentration of hydrogen ions being relatively higher and hence preferentially discharged/reduced.	1
B7fii	Hydrogen ions are discharged/reduced at cathode to form hydrogen gas which is trapped in between the metal flakes.	1
B7g	Use as a catalyst / added into iron to increase strength	1
B8a	The zinc case oxidises to form zinc ions and electrons/ zinc loses electrons At carbon rod, the hydrogen ions react with manganese(IV) oxide and electrons to form manganese(III) oxide and water.	1 1

Qn	Suggested answers	Mark
	The flow of electrons from zinc to carbon rod creates the electricity.	1
B8b	Cathode (must state but no mark). Reduction occurred at carbon rod.	1
B8c	Zinc case is used up and contents in the cell leaks out. Ammonia gas produced from the dissociation of ammonium ions leaks out.	1 1
B8di	Iron is less reactive than zinc	1
B8dii	Iron case will rust (in the presence of oxygen and water).	1
EITHER B9a	Similarities: Both contain carbon atoms / have covalent bonds / contain unbonded electrons / have three-dimensional structures (Note: carbon nanotubes do not have five-membered rings) Differences: Fullerene has simple molecular structure while carbon nanotube has macromolecular structure / Atoms are arranged like a sphere/soccer ball in fullerene but in a tube in carbon nanotube / Fullerene has both five-membered and six-membered rings but carbon nanotube has only six-membered rings Carbon atom has four outer electrons. However, only three electrons are involved in (covalent) bonding leaving one electron unbonded. This (unbonded) electrons can be delocalised across/down the nanotube /are mobile to conduct electricity. In fullerenes, electrons cannot jump from molecule to molecule, hence they cannot conduct electricity.	1 1 1 1 1
B9bi	Fullerenes have simple molecular structure with weak intermolecular forces of attraction. Hence, little energy is required to overcome these forces.	1 1
B9bii	More than 600 °C	1
B9c	The oxidation state of C increases from 0 in C to +4 in CO_2. This is oxidation. The oxidation state of Cl decreases from +1 in NaClO to -1 in NaCl. This is reduction. Since both oxidation and reduction occurred simultaneously, this is a redox reaction.	1 1
OR B9ai	White precipitate is formed when aqueous ammonia is added dissolves in excess aqueous ammonia, showing that zinc ions are present.	1
B9aii	Aluminium and lead(II) have the same results when tested with aqueous sodium hydroxide and aqueous ammonia.	1

Qn	Suggested answers	Mark
	Add aqueous sodium chloride/dilute hydrochloric acid, a white precipitate will be formed if lead(II) ions are present **OR** Add aqueous sodium iodide, a yellow precipitate will be formed if lead(II) ions are present.	1
B9b	No, as the ammonia was already present in that test and would be released when the tube is heated. There is no nitrates present as no ammonia was produced when the mixture was heated with aqueous sodium hydroxide and aluminium foil.	1 1
B9ci	 	2 2
B9cii	The colourless solution will turn brown.	1