Victoria School
2023 Chemistry O Levels / 6092
Suggested Answer Key

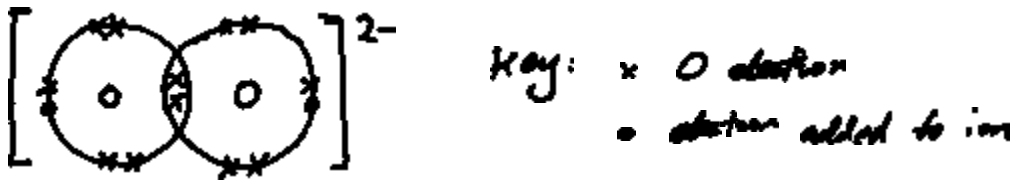
PAPER 1

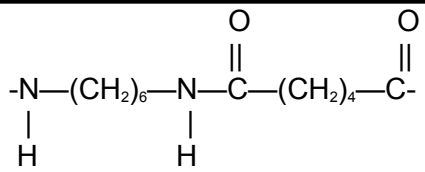
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	A	D	B	A	D	B	D	C	B	A	B	D	C	C	A	C	B	A	C
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
D	A	C	D	B	D	B	D	C	C	D	A	C	B	D	B	C	A	B	A

PAPER 2 (SECTION A)

Question		Answer	Mark
A1	**a**	Y: 2, Li^+ Z: VI, Se^{2-}	2 2
	b	F^-. Since number of protons = number of electrons and the mass number is given by total number of neutrons + total number protons. Thus, the mass number of X (i.e. 10+9 = 19) is the same as the relative atomic mass shown on the Periodic Table.	1 1
	c	Helium	
	d	No observable change Bromine is less reactive than fluorine, thus bromine unable to displace fluorine from its salt solution. [reject if fluoride is used in place of fluorine]	1 1

A2	**a**	Negative electrode: silver Positive electrode: oxygen gas	1 1
	b	When passing through platinum electrodes (metal): there are mobile electrons, hence platinum remains chemically unchanged. When passing through the solution (ionic compound): mobile ions in the solution act as mobile charge carriers. (Thus, at the cathode (negative electrode), Ag^+ is selectively discharged to form silver metal. While at the anode (positive electrode), OH^- is selectively discharged to form oxygen gas / The electrolyte decomposes.)	1 1
	c	compound: nitric acid/HNO_3 [Reject: H^+ ions] explanation: Since Ag^+ and OH^- were selectively discharged, only H^+ and NO_3^- ions are left remaining in the solution.	1 1
	di	Hydrogen gas	
	dii	**All** the Ag^+ has been preferentially discharged at the start of the electrolysis (gain electrons more readily) and leaving behind only H^+ ions in the solution. Hence, H^+ions are discharged and hydrogen gas is formed. Reject: silver ions less reactive than hydrogen ions.	
A3	**ai**	$4CuFeS_2 + 11\ O_2 \rightarrow 4Cu + 2Fe_2O_3 + 8SO_2$ 1m for correct reactants and products 1m for balanced equation	2
	aii	Mass of Cu in 1 tonne of chalcopyrite = = 347.8 kg = 348 kg Mass of Cu in tonnes = 0.348 tonnes (3sf)	1 for working 1
	bi	Acid: silicon dioxide Base: iron(III) oxide	 1
	~~**bii**~~	~~Basic compound used in the extraction of iron is calcium oxide which is obtained from the thermal decomposition of calcium carbonate, whereas the basic compound used in the extraction of copper is iron(III) oxide.~~ ~~The molten slag formed in the extraction of iron is calcium silicate, instead of iron silicate.~~ [not in syllabus]	1 1
	c	CO_2 and H_2O [1m each] Reject: hydrogen gas Explanation: $4CuO + CH_4 \rightarrow 4Cu + CO_2 + 2H_2O$	2

A4	**a**	The ratio of atoms of metal to atoms of oxygen decreases [1] from 2 :1 in Li_2O to Na_2O, to 1 : 1 ratio in Na_2O_2 and K_2O_2, to 1 : 2 ratio in KO_2 [1].	2
	b	 1 m for bonded electrons and correct charge 1 m for 'extra' electron added to each ion	2
	ci	O_2^-	1
	cii	One of the oxygen atoms in the superoxide ion does not have a fully filled valence electron shell	1
	di	Group 1 metal hydroxides dissociate in water to form OH^- so the solution turns blue. Hydrogen peroxide is a bleach, which is a substance that removes colour/bleaches, so the solution turns colourless. Oxygen is produced (from decomposition of hydrogen peroxide), so bubbles are formed.	2m for 3 points
	dii	$2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2$ 1m for correct reactants and products 1m for balanced equation	2
A5	**a**	Photosynthesis	1
	b	A	1
	c	Process B. (Must state but no marks)	

		Process B consists of a reversible arrow, / reaction can proceed forward or backward./ CO_2 (g) dissolves in water to form CO_2 (aq) and reversibly to form gaseous CO_2 again.	1
	d	Carbon dioxide gas dissolves in water to form aqueous carbon dioxide. Dissolved carbon dioxide vapourises into the atmosphere to form carbon dioxide gas.	1
	e	<table><tr><th></th><th>exothermic</th><th>endothermic</th></tr><tr><td>**A**</td><td></td><td>√</td></tr><tr><td>**C**</td><td>√</td><td></td></tr><tr><td>**D**</td><td>√</td><td></td></tr></table>	1
	f	The amount of dissolved carbon dioxide liberated as gaseous carbon dioxide through Process B is also the same amount taken in from the atmosphere by phytoplankton through process A which is photosynthesis (carbon cycle) . Hence, there is no net change in the concentration of dissolved and liberated carbon dioxide gas. [1]	1 1
A6	**a**		1
	b	Similarity: Both monomers should contain a dicarboxylic acid. Difference: monomer 1 is a diamine whereas one of the monomers used to make the polymers in Fig 6.2 is a diol.	1 1
	ci	A macromolecule is a very large molecule that is made up of many small molecules.	1
	cii	In condensation polymerisation, the monomers with carboxyl, hydroxyl and amine group combine to form a polymer, with the removal of a small molecule, such as water. In addition polymerisation, the monomers are unsaturated(carbon-carbon double bond) and they join together without losing any molecules or atoms / only single product.	1 1

PAPER 2 (SECTION B)

Question		Answer	Mark
B7	a	The impurities are ethanoic acid and ethyl ethanoate. (state but no marks) Ethanoic acid is formed from the oxidation of ethanol with oxygen in the air in the presence of bacteria. Ethyl ethanoate is formed from the reaction between ethanol and ethanoic acid.	 1 1
	b	Ethanol is carbon neutral as it comes from sugarcane. As sugar cane grows, it absorbs carbon dioxide during photosynthesis, which offsets the carbon dioxide produced when ethanol is burnt. It is also renewable as it can be regrown and replaced within a short period time. However, ethanol can be produced from the ethene which comes from non-renewable sources such as crude oil. Separation of ethanol via distillation method requires the burning of fossil fuels to provide heat to boil the liquid mixture. The burning produces carbon dioxide and hence not carbon neutral.	 1 1
	ci	E70 contains 70% of ethanol by mass. % by mass of oxygen = 16/(2 x 12 + 6 +16) x 100% = 16/46 x **70%** = **24.3%**	 1 1
	ii	Increasing the amount of oxygen would result in more complete combustion of the fuel, thus producing less poisonous gas like carbon monoxide.	1
	d	GGE of LPG = 34 200/26 500 = **1.3** **[reject 1.29 as data shows 2 s.f.]** Comment on storage space: LPG would require more storage space than petrol.	1 1
	e	Molar mass of octane = 8 x 12 + 18 = 114 g/mol Mass density of petrol in g/dm^3 = 0.75 x 1000 = 750 g/dm^3 No. of moles of octane in 1 dm^3 = mass/molar mass = 750/114 = **6.579 mol**	 1

		Energy density of octane =5470 x 6.579 = **35 987 kJ ≈ 36 000 kJ/L**	1 1
B8	**a**	In experiment 1, sulfuric acid, a dibasic acid is used as compared to a monobasic acid(HCl) in experiment 2. Hence the concentration of H^+ ions in experiment 1 is twice that of experiment 2. As there are more reactant particles per volume, the frequency of effective collisions increases, rate increases and hence the volume of gas collected is twice higher in experiment 1 than 2. In experiment 3, the HCl used is at a higher temperature than experiment 2. The reactant particles would have a higher kinetic energy hence more particles would have energy greater than or equal to the activation energy. The frequency of effective collisions increases, rate increases and hence the volume of gas collected is higher in experiment 3 than 2.	1 1 1 1
	bi	$Zn + 2H^+ \rightarrow Zn^{2+} + H_2$	1
	bii	The oxidation state of Zn increases from 0 in Zn to +2 in Zn^{2+}. Oxidation occurred. The oxidation state of hydrogen increases from +1 in H^+ to 0 in H_2. Reduction occurred. Or Zinc loses electrons to form zinc ion(Zn^{2+}). Oxidation occurred. H^+ gains electrons to form H_2. Reduction occurred. **Wrong to say hydrogen is reduced, it should be hydrogen ions/H^+ is reduced.**	1
	c	Add excess zinc to 25.0 cm^3 of 1.0 mol/dm^3 of HCl. Measure the volume of gas evolved after 30s. Repeat the experiment by adding 1g of copper added to the same acid. The experiment with copper added will produce a higher volume of gas in 30s. Note: zinc must be added in excess as reaction cannot proceed without zinc as copper cannot react with acid **No need to mention about weighing the mass of copper as it does not refer to the experimental results given in the table.**	1 1
EIT	**ai**	Hydrogen gas and zinc oxide	1

HER **B9**		Reject: water	
	aii	Mass of solid increases as zinc gained oxygen from steam to form zinc oxide.	1
	bi	Calcium nitrate $Ca(NO_3)_2$	
	bii	To about 1cm^3 of calcium nitrate/sample, add aqueous sodium hydroxide dropwise and then in excess. A white precipitate forms that is insoluble in excess. To about 1cm^3 of calcium nitrate/sample, add an equal volume of aqueous sodium hydroxide. Add aluminium foil to the mixture and warm the mixture gently. Damp red litmus paper turns blue.	1 1 1 1
	c	0 cm^3 for copper and any value greater than 40 cm^3 for calcium. Copper is below hydrogen in the reactivity series/unreactive and is unable to react with steam, hence no hydrogen gas is produced. Calcium is more reactive than zinc, hence it will react with steam at faster rate, producing more hydrogen gas in the first two minutes of reaction.	1 1 1
OR **B9**	**ai**	The total mass of white precipitate formed after one minute is the highest for copper(II) carbonate, followed by lead carbonate and then zinc carbonate. The reactivity of the metals increases from copper to lead to zinc. The more reactive the metal, the more thermally stable the metal carbonate formed, and a smaller volume of carbon dioxide is produced in one minute of heating.	1 1
	aii	Aqueous ammonia and aqueous sodium hydroxide. Add aqueous ammonia and aqueous sodium hydroxide to separate 1cm^3 samples of each solution.	1

		White precipitate formed in the zinc nitrate solution is soluble in excess aqueous ammonia to form a colourless solution but insoluble in excess aqueous sodium hydroxide. Blue precipitate formed in the copper(II) nitrate solution is soluble in excess aqueous ammonia to form a dark blue solution but insoluble in excess aqueous sodium hydroxide. White precipitate formed in the lead(II) nitrate solution is soluble in excess aqueous sodium hydroxide to form a colourless solution but insoluble in excess aqueous ammonia.	1 1 1
	aiii	Red-brown solid forms. / Grey solid dissolves. Blue solution turns colourless. Magnesium is more reactive than copper. Hence, magnesium displaces copper from the copper(II) solution.	1 1 1
	b	$MgCO_3$ (s) → MgO (s) + CO_2 (g)	1