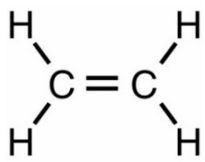
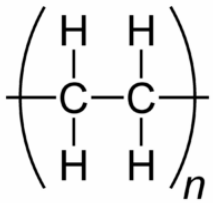
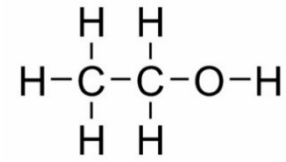
Victoria School
2015 Chemistry O Levels / 5073
Suggested Answer Key

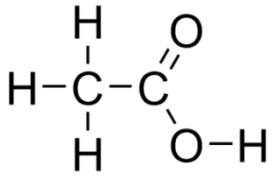
PAPER 1

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

PAPER 2 (SECTION A)

Question		Answer	Mark
A1	**a**	**A** – non-metal **B** – metal **D** – metal **E** – non-metal	1
	bi	C	1
	bii	A	1
	biii	B	1
	c	The elements in the table form different compounds by gaining or losing electrons, hence they have different oxidation states. For example, Element A has an oxidation state of -2 as it gains two electrons to form an ion of charge 2-. Since, Group 0 elements have a fully filled valence/outermost electron shell, they do not bond with any other elements to form compounds, hence do not have any oxidation states.	1 1

A2	**ai**	As the <u>reactivity of the metal decreases</u>, the <u>temperature needed for the reduction of its oxide decreases</u>.	1
	aii	700°C Iron is <u>less reactive than zinc but more reactive than lead</u>. Hence the <u>temperature needed to reduce iron oxide with carbon is lower than 900°C but higher than 400°C</u>.	 1 1
	b	**Metal:** Magnesium **Metal oxide:** Silver Oxide	1
	c	Zinc oxide and Hydrogen	1 1
A3	**a**	Name of compound / Structural formula / Process(es) used to manufacture the compound **ethene**  Fractional distillation of **<u>crude oil / petroleum</u>** followed by catalytic **<u>cracking</u>** **poly(ethene)**  **<u>Addition polymerisation</u>** of ethene ethanol  Two separate processes can be used. Process 1: Catalytic **<u>addition</u>** of **<u>steam</u>** to ethene. Process 2: **<u>Fermentation</u>** of glucose	1 1 2

		ethanoic acid  **Oxidation** of ethanol	1
	bi	Both acids react with metal oxides to form salt and water only in a neutralisation reaction.	1
	bii	Dilute ethanoic acid is a weak acid while dilute hydrochloric acid is a strong acid. Hence, ethanoic acid undergoes partial dissociation when dissolved in water but hydrochloric acid undergoes full dissociation when dissolved in water. The concentration of hydrogen ions is lower in ethanoic acid than hydrochloric acid, thus lower frequency of effective collisions between the hydrogen ions and metal oxide particles so the rate of reaction in ethanoic acid is slower than in hydrochloric acid.	1 1
A4	**a**	600 – 700 °C	1
	b	Extraction of aluminium from bauxite requires the ionic solvent to be heated to 900 °C compared to recycling used cans which only requires heating to 700 °C, hence more heat energy is required for extraction from bauxite. Also, extraction of aluminium from bauxite makes use of electrolysis which requires electrical energy. Both processes increase the use of energy in extraction from bauxite.	1 1
	c	Concentrated sodium hydroxide is very caustic/corrosive and causes harm to living tissues, such as chemical burns and skin irritation. Carbon dioxide is a greenhouse gas which traps excess heat in the atmosphere. This leads to global warming which will result in ice caps melting, sea levels rising and causing flooding in low lying areas.	1 1
	d	Aluminium is a finite resource and hence recycling helps to conserve natural resources / Land will be free for other purposes such as agriculture and housing with a decrease in mining of bauxite / Fewer landfills will be required for disposal of waste materials generated from the extraction of aluminium from bauxite. [Any one possible answer]	1
	ei	Alloy	1

	eii	Duralumin is stronger and harder than pure aluminium so the aircraft will be able to withstand the high pressure.	1
A5	**a**	At the cathode: $2H^+ + 2e \rightarrow H_2$ At the anode: $4OH^- \rightarrow 2H_2O + O_2 + 4e$	1 1
	bi	For every 4 moles of electrons that passes through the set-up, 2 moles of hydrogen gas and 1 mole of oxygen gas are produced. Hence the theoretical ratio of hydrogen to oxygen is 2:1.	1 1
	bii	Oxygen is soluble in water. Hence some of the oxygen gas produced will dissolve in water, resulting in the volume of oxygen collected to be smaller than expected. The ratio of hydrogen to oxygen will become higher than 2:1.	1 1
	biii	No more oxygen can dissolve in water, hence the volume of oxygen collected increases and the difference from the expected ratio becomes smaller after some time.	1
	c	The concentration of sodium chloride increases. Hydrogen and hydroxide ions are being discharged, which is essentially the electrolysis of water. Hence, the volume of water decreases and concentration of sodium chloride increases.	1
	d	Similarity: Hydrogen gas is produced at the cathode for electrolysis of both dilute and concentrated sodium chloride. Difference: Oxygen is produced at the anode for electrolysis of dilute sodium chloride but chlorine gas is produced at the anode for the electrolysis of concentrated sodium chloride.	1 1
	e	Platinum is an unreactive metal and hence it is an inert electrode. It does not react with the products formed at the electrodes.	1
A6	**a**	Limestone is insoluble in water but quicklime reacts exothermically with water to form an alkaline solution. Slaked lime is an alkali which is formed by adding water to quicklime. In the aqueous state, quicklime and slaked lime can dissociate into hydroxide ions to neutralise the acidity quickly.	1 1

	bi	Blast furnace slag is a <u>waste material</u> and hence by using it to make products, it is <u>more economical and incurs less cost</u>.	1
	bii	Group IV and Group V oxides are <u>acidic oxides as they are non-metal oxides</u>, hence they <u>do not react with acids</u> to neutralise the acidity.	1 1
	c	Percentage by mass of calcium in quicklime: = 40 / (40 + 16) x 100% = 71.4% (to 3 s.f.) Percentage by mass of calcium in limestone: = 40 / (40 + 12 + 3 x 16) x 100% = 40.0% (to 3 s.f.) Percentage by mass of calcium in slaked lime: = 40 / (40 + 2 x 16 + 2 x 1) x 100% = 54.1% (to 3 s.f.) Hence, quicklime has the highest percentage by mass of calcium.	1 1 1
	d	$CaCO_3 \rightarrow CaO + CO_2$ No. of moles of limestone = (25 x 1000 x 1000) / (40 + 12 = 3 x 16) = 250000 mol Mole ratio of limestone : carbon dioxide = 1 : 1 No. of moles of carbon dioxide = 250000 mol Volume of carbon dioxide = 250000 x 24 = 6000000 dm^3	 1 1 1

PAPER 2 (SECTION B)

Question		Answer	Mark
B7	**a**	As the <u>number of carbon atoms in each alkane molecule increases, the boiling point increases</u>.	1
2015 Answer		As the number of carbon atoms in each alkane molecule increases, the <u>melting point generally increases, except for the</u> **5**	

		melting point of propane (-188 °C).	
	b	Propane. The melting point of propane should be higher than -183°C but its melting point is -188°C, which is lower.	1
	c	Melting point: -80°C (between -76°C to -92°C) Boiling point: 98°C (between 96°C to 104°C)	1
	d	As the number of carbon atoms in each alkane molecule increases, the boiling point and flashpoint increase.	1
	e	As the alkane becomes more branched, the flashpoint decreases / Isomerism decreases the flashpoint. The flashpoint of straight chain pentane is -49°C but in branched alkane 1, where there is one branch, the flashpoint decreases to -57°C. In branched alkane 2, where there are two branches, the flashpoint decreases further to -65°C. Similarly, straight chain octane has a flashpoint of 13°C but branched chain alkane 3 has a flashpoint of 4°C, which is lower.	1 1 1 1
	fi	Pentane and branched alkane 2 have lower flashpoints than octane so they will decrease the flashpoint of the mixture. In cold countries, where the temperature is low, the mixture will burn more easily at low temperatures. Hence this mixture works better than pure octane alone.	1 1
	fii	In hot weather, the temperature is high so the winter blend petrol will evaporate easily. Since the petrol tank is not airtight, the petrol vapour will escape faster than it can burn, resulting in increased loss of petrol.	1 1
B8	**a**	The lean burn engine will result in a lower amount of carbon monoxide and nitrogen monoxide formed compared to a normal car engine.	1

		With a higher amount of air in the mixture, there will be a larger amount of oxygen so there is more complete combustion. Hence, less carbon monoxide will be formed due to incomplete combustion. Nitrogen reacts with oxygen in the engine under high temperatures to form nitrogen monoxide. With a lower running temperature of the engine, there will also be lesser nitrogen monoxide formed.	1 1
	b	$2CO + 2NO \rightarrow N_2 + 2CO_2$	1
	ci	At increased amounts of air, the percentage of carbon monoxide which is successfully removed by converter increases until it remains constant while the percentage of nitrogen monoxide which is successfully removed by converter decreases until it remains constant. Percentage of carbon monoxide removed increases due to the increased amount of oxygen in air, which leads to more carbon monoxide being oxidised to form carbon dioxide and removed from the catalytic converter. Since carbon monoxide and nitrogen monoxide reacts together in the catalytic converter, the decreased amount of carbon monoxide present in the converter will result in lesser nitrogen monoxide being removed, hence percentage of nitrogen dioxide removed decreases.	1 1 1
	cii	As the percentage of carbon monoxide successfully removed increases, the percentage of nitrogen monoxide successfully removed did not show any changes. Also, when the percentage of carbon monoxide successfully removed is at maximum, the percentage of nitrogen monoxide successfully removed is not at zero.	1
EI TH ER B9	**a**	When lithium chloride dissolves in water, heat energy is lost to the surroundings. Hence, the energy change is negative and the reaction is an exothermic reaction. However, when sodium chloride dissolves in water, heat energy is absorbed from the surroundings. Hence, the energy change is positive and the reaction is an endothermic reaction. For lithium chloride, the temperature of the surroundings increases as heat energy is given out. For sodium chloride, the temperature of the surroundings decreases as heat energy is absorbed. Since the energy change for lithium chloride is greater than that for sodium chloride, the temperature increase for lithium chloride is larger than the temperature decrease for sodium chloride.	1 1 1

			1
	bi	There is a decrease in temperature so heat energy is absorbed from the surroundings. This shows that the dissolving of potassium chloride is an endothermic process.	1
	bii	No. of moles of potassium chloride = 4.0 / (39 + 35.5) = 0.05369 mol Enthalpy change when 1 mole of potassium chloride dissolves = 1 / 0.05369 x (+720) = +13400 J/mol = +13.4 kJ/mol (to 3 s.f.)	1 1 1
	biii	When dissolved in water, the arrangement of the potassium and chloride ions changes from a closely packed, orderly arrangement to a less closely packed and disorderly arrangement. The movement of potassium and chloride ions changes from vibrating and rotating in fixed positions to sliding over one another.	1 1
OR **B9**	**ai**	Fluorine is a more reactive halogen than bromine so it displaces bromine solution which is brown from colourless potassium bromide solution. $F_2 + 2Br^- \rightarrow Br_2 + 2F^-$	1 1 1
	aii	For chlorine gas, the colourless solution on the filter paper turns brown. Chlorine is a more reactive halogen than bromine so it displaces bromine solution which is brown from colourless potassium bromide solution . For iodine gas, no visible change is observed. Iodine is a less reactive halogen than bromine so it is unable to displace bromine from potassium bromide solution.	1 1 1

	bi	$3F_2(g) + 2Fe(s) \rightarrow 2FeF_3(s)$ Balanced chemical equation [1m] State symbols [1m]	2
	bii	The oxidation state of iron increases from 0 in Fe to +3 in FeF_3 so Fe has been oxidised by F_2. Hence, fluorine acts as an oxidising agent as it oxidises iron. OR The oxidation state of fluorine decreases from 0 in F_2 to -1 in FeF_3 so F_2 has been reduced. Hence fluorine acts as an oxidising agent as itself has been reduced. [any one] Since F_2 gains electrons to form fluoride ions, F_2 has been reduced and fluorine is an oxidising agent. OR Since Fe loses electrons to form iron(III) ions, Fe has been oxidised by F_2, so fluorine is an oxidising agent. [any one]	1 1