Victoria School
2018 Chemistry O Levels / 6092
Suggested Answer Key

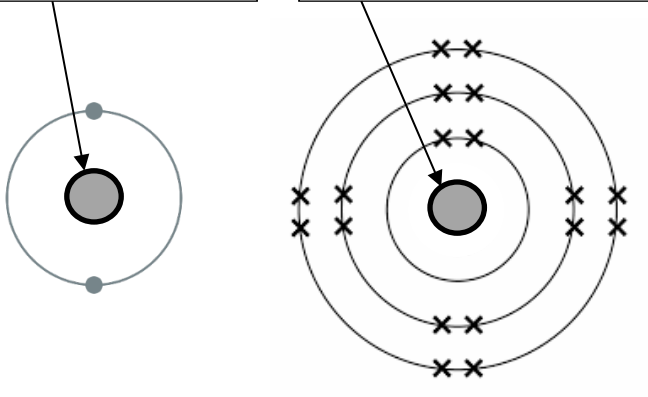
PAPER 1

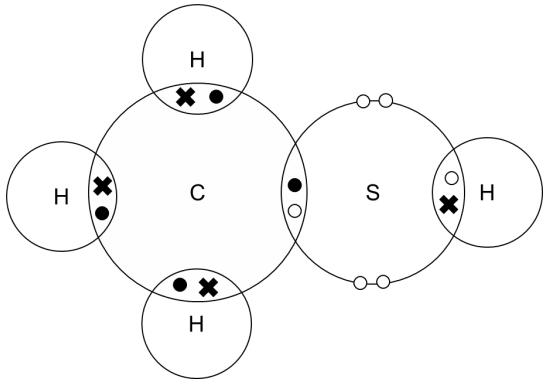
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	B	C	D	A	A	B	C	D	B	C	C	B	B	A	D	C	D	B	A
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
B	A	A	A	D	B	D	D	A	D	C	D	A	D	B	B	D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

PAPER 2 (SECTION A)

Question		Answer	Mark
A1	**ai**	Ammonia, carbon dioxide	1
	aii	Silicon dioxide	1
	aiii	Ammonia	1
	aiv	Lead(II) nitrate	1
	av	Ammonia	1
	b	False True True False [Every 2 correct – 1 mark]	2

A2		Chlorine Copper Molten sodium chloride	1 1 1
A3		Row 1: formulae of reagents used: **$CuO(s)$ / $CuCO_3(s)$ / $Cu(OH)_2(s)$** Row 2: formulae of salt: **$KNO_3(s)$** method used: **titration** of $KOH(aq)$ with $HNO_3(aq)$ Row 3: formulae of reagents used: **$Pb(NO_3)_2(aq)$ and** **$H_2SO_4(aq)$ / $(NH_4)_2SO_4(aq)$ / $Na_2SO_4(aq)$ / $K_2SO_4(aq)$ or any Group I sulfate** method used: **ionic precipitation / addition of the two aqueous reagents / solutions, filtration to obtain the residue**	1 1 1 1
A4	**a**	Metals contain positive ions in a 'sea' of delocalised electrons. The electrons can move to conduct electricity. In solutions of ionic compounds, the ions dissociate from the giant ionic lattice structure and can move to conduct electricity.	1 1
	b	Metals remain unchanged when electricity is passed through. Solutions of ionic compounds break down into their elements/simpler substances when electricity is passed through.	1
A5	**a**	Nitrogen: **78** Oxygen: **21**	1
	bi	The density of helium is the lowest (0.17 g/dm^3) as compared to the other gases and it would easily rise to the upper atmosphere and escape into outer space.	1
	bii	Density of argon = 40/24 = 1.67 g/dm^3 (to 3 s.f.)	1

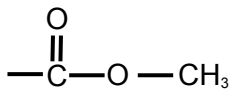
	biii	The percentage of helium in dry air is 0%, which means it cannot be obtained from fractional distillation of liquid air to be used for different purposes. Helium is also a finite resource on earth and should be conserved and used for more important purposes like MRI scanners in hospitals which will benefit patients, rather than on filling party balloons which is for leisure and not important.	1 1
	ci	Helium nucleus contains **2 protons and 2 neutrons**. Argon nucleus contains **18 protons and 22 neutrons**.  1m – helium 1m – argon	2
	(ii)	Both helium and argon are <u>chemically inert</u>. This is because both helium and argon have <u>fully filled outermost electron shells of 2 and 8 electrons respectively</u>. Hence they do not need to lose, gain or share electrons.	1 1
A6	**a**	The <u>temperature of 450 °C used in Stage 2 is lower than the temperature of 800 °C used in Stage 1</u>. Hence, <u>less energy is required to maintain a lower temperature</u> in the reactor in Stage 2. The <u>reaction in Stage 1 is endothermic so energy is taken in</u> from the surroundings, compared to the <u>exothermic reaction in Stage 2 which releases energy to the surroundings</u>. Hence, the reaction in Stage 2 requires less energy.	1 1
	b	Carbon monoxide is a toxic gas which <u>reacts readily and irreversibly with haemoglobin to form carboxyhaemoglobin</u>. This <u>reduces the oxygen carrying capacity of the blood, leading to dizziness/fatigue and eventually death</u>.	1

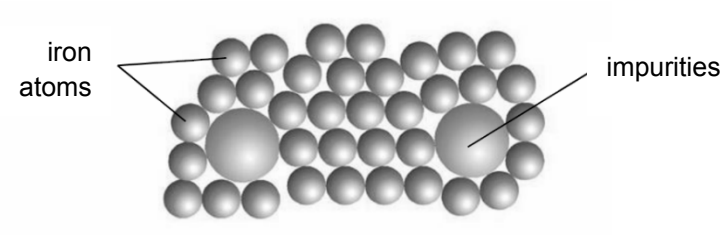
		Burning carbon monoxide will produce carbon dioxide which is less toxic and harmful.	1
	ci	The percentage by volume of nitrogen to hydrogen is 1:3, which is the same as the stoichiometric/reacting ratio of nitrogen to hydrogen in the equation in Stage 2.	1 1
	cii	Both gases have different relative molecular masses (M_r). Nitrogen has an M_r of 28 while hydrogen has an M_r of 2. However, one mole of each gas occupy the same volume of 24 dm^3 at room temperature and pressure.	1
	ciii	• Recycling the unreacted gases helps allows them to react again, improving the yield of ammonia. • Obtaining nitrogen from fractional distillation of liquid air and hydrogen from cracking of crude oil fractions is costly as a lot of energy is used in these processes. Recycling the unreacted gases helps to save cost. • Hydrogen is obtained from the cracking of crude oil fractions. Crude oil is a non-renewable resource. Hence, recycling the unreacted hydrogen helps to conserve crude oil. [any 2 of the above]	2
	di	 1m – bonding electrons 1m – non-bonding electrons	2
	dii	The coating on the catalyst reduces the surface area of the catalyst in contact with the reactants, hence decreasing the frequency of effective collisions between the reacting particles and the surface of catalyst, decreasing the rate of reaction.	1
A7	**a**	• Both have 1 valence electron and tends to lose the electron to form positive ions with a charge of 1+.	2

		• Both have low densities. • Both have low melting points. • Both are good reducing agents. [any 2 of the above]	
	b	• Hydrogen is a gas but the Group I elements are solids/metals at room temperature and pressure. • Hydrogen can gain 1 valence electron to form a negative hydride ion with a 1- charge but the Group I elements can only lose 1 valence electron to form a positive ion with a 1+ charge. • Hydrogen exists as a diatomic molecule / has a simple molecular structure but Group I elements exist as positive ions in a 'sea' of delocalised electrons / have giant metallic structures. • Hydrogen cannot conduct electricity in all states but the Group I elements can conduct electricity in solid and molten states. • Hydrogen cannot react with water but Group I elements react with water to form alkalis and hydrogen gas. [any 2 of the above]	2
	ci	$Ag_2O(s) + H_2(g) \rightarrow 2Ag(l) + H_2O(g)$ 1m – balanced equation 1m – state symbols	2
	cii	H_2 is oxidised. Ag_2O is reduced. The oxidation state of hydrogen increases from 0 in H_2 to +1 in H_2O / H_2 gains an oxygen atom to form H_2O. The oxidation state of silver decreases from +1 in Ag_2O to 0 in Ag / Ag_2O loses an oxygen atom to form 2Ag.	1 1 1
	ciii	observations: For magnesium oxide, there is no visible reaction. For copper(II) oxide, the black solid turns reddish brown. The more reactive a metal is, the more difficult it is to reduce the metal oxide by hydrogen. Magnesium is more reactive than copper and above hydrogen gas in the reactivity series so magnesium oxide cannot be reduced by hydrogen. Copper is below hydrogen gas in the reactivity series and copper(II) oxide is reduced by hydrogen to form copper metal and steam.	1 1 1

PAPER 2 (SECTION B)

Question		Answer	Mark
B8	a	It will be difficult to distinguish between potassium, rubidium and caesium because the flame colours of these elements are different shades of violet, which are quite similar. The intense yellow-orange colour flame of sodium will also result in difficulty in observing the flame colours of the other Group I elements as it will most likely overpower the other colours.	1 1
	bi	The mixture contains sodium and rubidium. This is the emission spectra of these elements are present in the emission spectrum of the mixture. The mixture does not contain lithium and potassium because the emission spectra of these elements are not present in the emission spectrum of the mixture. There are some unknown elements present in the mixture as there are some emission spectra present which do not belong to any Group I elements.	1 1 1
	bii	The emission spectra of all the Group I elements (caesium and francium) will be needed.	1
	ci	NaCl NaBr Na_2SO_4 [3 correct – 2 marks, 2 correct – 1 mark, 1 correct – 0 marks]	2
	cii	Concentration of Mg^{2+} ion = (0.15 / 0.6) x 0.00420 mol/dm^3 = 0.00105 mol/dm^3 (to 3 s.f.) Concentration of Na^+ ion = (1.0 / 0.6) x 0.00420 mol/dm^3	1 1

		= 0.00700 mol/dm^3 (to 3 s.f.)	
	d	Ion chromatograms are able to identify any ions, even those which contain multiple atoms. However, emission spectrums are only able to identify the types of elements present. In addition, ion chromatograms are able to measure the relative amount or concentration of each ion present in the mixture.	1 1
B9	**a**	Vegetable oils contains three ester linkages / functional groups.	1
	b		2
	c	The <u>untreated oils contains acids which will react with the potassium hydroxide</u> catalyst. This reduces the amount of potassium hydroxide catalyst present to catalyse the reaction to make biodiesel, hence the <u>rate of the reaction will decrease.</u>	1 1
	d	Average volume of KOH used = (21.50 + 21.60) / 2 = 21.55 cm^3 Volume of KOH required to neutralise 1 kg of oil = 21.55 x (1000 / 10.0) = 2155 cm^3 = 2.155 dm^3 Mass of KOH required = 1.00 x 2.155 = 2.155 g = 2.16 g (to 3 s.f.)	1 1 1
EIT HER	**a**	C(s) + O_2(g) → CO_2(g) Coke reacts with the oxygen in hot air to produce carbon dioxide.	1

B10		$CO_2(g) + C(s) \rightarrow 2CO(g)$ The carbon dioxide then reacts with more coke to form carbon monoxide. $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$ Carbon monoxide acts as a reducing agent to reduce iron(III) oxide in haematite to form iron.	1 1 1
	bi	Impurities in haematite / silicon dioxide / sand	1
	bii	In pure iron, the same-sized atoms are arranged in orderly layers. The layers of atoms can slide past one another easily when a force is applied so pure iron is soft. The presence of impurities will disrupt the orderly arrangement of the iron atoms due to the atoms of the impurities having different atomic radii. Hence, it is more difficult for the layers of atoms to slide over one another without breaking any metallic bonds when a force is applied. This makes impure iron harder and stronger.  	1 1 1
	c	• Scrap steel contain components of iron. Using scrap steel to make new steel helps to recycle iron because iron is a finite resource. Less land will have to be mined for ores, thus more land will be available for agriculture, industrial and housing purposes. • Extraction of iron from ores to make new steel requires a lot of energy which is generated by burning fuels. Using scrap steel to make new steel uses lesser energy, which helps to conserve the limited fossil fuel supply. • Extraction of iron from ores to make new steel results in a lot of waste material generated which needs to be disposed in landfill sites, which take up a lot of land. Using scrap steel to make new steel reduces the need for landfill space. [any 2 of the above]	2
OR	**a**	Crude oil is heated and vapourised in a furnace before it enters the fractionating column.	1

B10		The vapours consist of different fractions with different boiling points. As the vapours rise up the column, they will cool and condense at different temperatures. The lighter fractions consist of shorter-chain hydrocarbons with a lower range of boiling points while the heavier fractions consist of longer-chain hydrocarbons with a higher range of boiling points. The fractionating column is cooler at the top than at the bottom. The lighter fractions will rise to the top of the fractionating column and be collected there while the heavier fractions will be collected at the bottom of the fractionating column.	1 1 1 1
	b	Process **A** is isomerisation. Pentane and the product formed have the same molecular formula of C_5H_{12} but different structural formula (i.e. pentane is arranged in a straight chain but the product has a branch) Process **C** is cracking. Heptane is a long chain hydrocarbon with molecular formula C_7H_{16} which is broken down into the product which is a short-chain hydrocarbon with molecular formula C_2H_4. Process **B** is neither. Hexane has a molecular formula of C_6H_{14} but the product has a molecular formula of C_6H_{12}, hence they are not isomers as they have different molecular formula. The number of carbon atoms in hexane and the product is the same, so the process is not cracking as hexane is not broken down into a shorter-chain hydrocarbon.	1 1 1 1
	c	• Cracking produces large amounts of short chain alkenes and alkanes for making plastics, ethanol and other useful chemicals. • Cracking converts heavier fractions of petroleum which are high in supply but low in demand into lighter fractions which are low in supply but high in demand. [any 1 of the above]	1