Victoria School
2019 Chemistry O Levels / 6092
Suggested Answer Key

PAPER 1

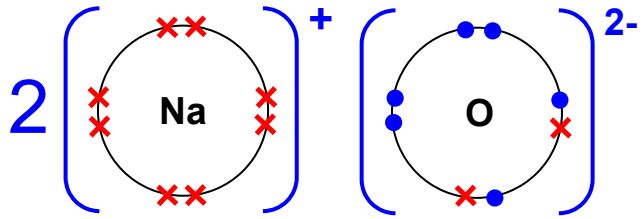
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
A	B	C	D	D	D	C	B	A	C	D	C	B	C	A	D	D	B	B	A
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
C	A	C	C	A	B	B	A	A	A	D	A	C	A	B	B	B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

PAPER 2 (SECTION A)

Question		Answer	Mark
A1	**a**	**D** and **G**	1
	b	**A** and **E**	1
	c	**C**	1
	d	**G**	1
	e	**A**	1
A2	**a**	Isotopes are atoms of the same element with the same number of protons but different number of neutrons. Isotopes **1**, **2** and **3** have the same number of 16 protons but different number of neutrons, i.e. 13, 14 and 15 respectively.	1 1
	b	The data shows that all 3 isotopes have the same number of 6 outer shell electrons. The isotopes have the same chemical reactions as they are in the same group.	1

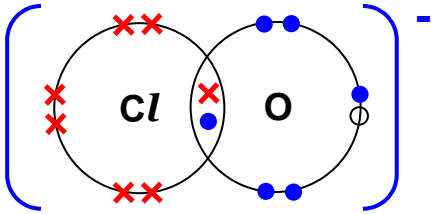
	ci	X: **sulfur** Y: **oxygen** Z: **zinc**	1
	cii	lowest melting point: **Y (oxygen)** **X (sulfur)** highest melting point: **Z (zinc)** **Z** (zinc) has the highest melting point as it has a <u>giant metallic structure</u> so <u>a lot of energy is used to overcome the strong metallic bonds between the positive ions and sea of delocalised electrons</u>. **X** (sulfur) and **Y** (oxygen) both have <u>simple molecular structures</u>. However, <u>X has a higher relative molecular mass than **Y**</u>, hence <u>more energy is used to overcome the weak intermolecular forces of attraction in **X**</u>, hence higher melting point than **Y**.	1 1 1
	ciii	**Z** **Z** is a <u>reactive metal</u> and <u>metals react with dilute acids to form salts and hydrogen gas</u>.	1 1
A3	**a**	Lead is a <u>reactive metal which can react with dilute nitric acid</u>. Gold is a <u>less reactive metal than lead and cannot react with dilute nitric acid</u>.	1 1
	b	Lead compounds react with dilute nitric acid to form <u>lead nitrates which are soluble in water.</u> Lead compounds react with dilute hydrochloric acid and dilute sulfuric acid to form <u>lead chlorides and lead sulfates respectively, which are insoluble in water.</u>	1 1
	ci	<u>Lead and aluminium ions react with aqueous ammonia to form a white precipitate which is insoluble in excess</u> aqueous ammonia. Hence, it is <u>not possible to distinguish</u> between lead and aluminium ions. <u>Zinc ions react with aqueous ammonia to form a white precipitate which dissolves in excess</u> aqueous ammonia to form a colourless solution. Hence, only zinc ions can be identified.	1 1
	cii	Add <u>aqueous sodium chloride</u> (or any other solutions containing chloride ions) to the solutions of lead ions and aluminium ions.	1

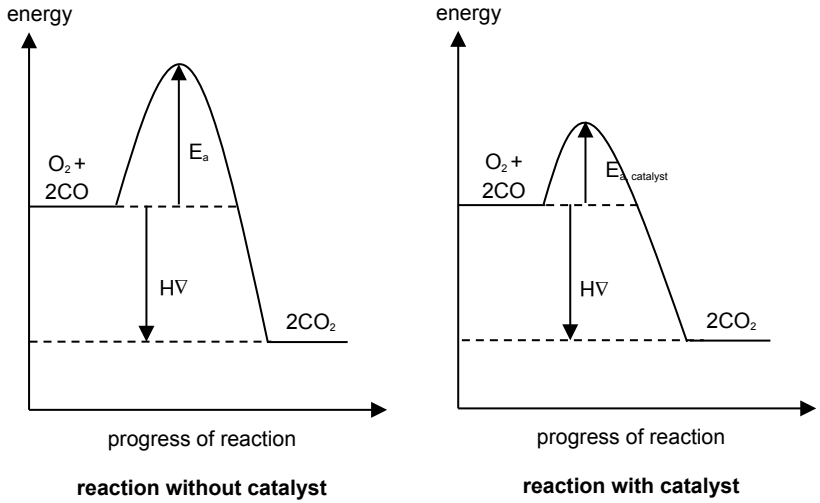
		There will be a white precipitate observed for the solution of lead ions but no visible reaction for the solution of aluminium ions. [Note: can also add any solutions containing iodide ions. Yellow precipitate will be formed for the solution of lead ions]	
	ciii	Add excess aqueous sodium hydroxide to the solution, followed by a piece of aluminium foil. Warm gently. Effervescence of colourless and pungent gas will be observed. Gas turns moist red litmus paper blue, so ammonia gas is given off.	1 1 1
A4	**a**	$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$ 1m – balanced equation 1m – state symbols	2
	bi	<table><tr><th></th><th>distance travelled / cm</th><th>M_r</th></tr><tr><td>NH_3</td><td>60</td><td>17</td></tr><tr><td>HCl</td><td>40</td><td>36.5</td></tr></table>	1
	bii	No [must state but not marks] As the M_r increases, the distance travelled by the gas decreases, which shows that the rate of diffusion has decreased. However, the rate of diffusion is not inversely proportional to the M_r as the product of distance travelled and M_r are not related by a constant value, i.e. for NH_3, 60 x 17 = 1020, for HCl, 40 x 36.5 = 1460. [Note: y is inversely proportional to x when y = k/x, hence k = yx]	 1 1
	c	Similarity: The white ring of solid ammonium chloride will be formed at the same position in both experiments. Difference: The time taken for the white ring to form in experiment **B** is longer than the time taken in experiment **A**.	1 1

A5	**a**	experiment using sodium: **Red litmus indicator turns blue.** **Sodium burns in oxygen to form <u>sodium oxide, which is a basic oxide</u>. Sodium oxide <u>dissolves in the solution to form an alkali</u>, which turns red litmus indicator blue.** experiment using sulfur: **Red litmus indicator remains red.** **Sulfur burns in oxygen to form <u>sulfur dioxide, which is an acidic oxide</u>. Sulfur dioxide <u>dissolves in the solution to form an acid</u>, hence red litmus indicator remains red.** 1m – both observations correct 1m – explanation for sodium 1m – explanation for sulfur	3
	b	 1m – cation 1m – anion	2
	ci	$4Na + O_2 \rightarrow 2Na_2O$ No. of moles of Na = 0.50 / 23 = 0.021739 mol No. of moles of Na_2O = 0.021739 / 4 x 2 = 0.01087 mol Theoretical yield of Na_2O = 0.01087 x (2 x 23 + 16) = 0.67394 g = 0.674 g (to 3 s.f.)	1 1
	cii	Mass of Na_2O = 94.82 – 94.50 = 0.32 g	1

		Percentage yield = 0.32 / 0.67394 x 100% = 47.5% (to 3 s.f.)	1
	ciii	• The sodium sample was impure, such that some of the impurities reacted with oxygen to form gaseous oxides which escaped, resulting in a lower mass of sodium oxide. • Some of the sodium oxide fumes could have escaped, resulting in a lower mass of sodium oxide. [any one of the above or any other possible answers]	1
A6	**a**	Magnesium is more reactive than iron so it loses electrons more readily than iron. Hence it is oxidised more easily and corrodes in place of iron, protecting the pipe from rusting. $Mg \rightarrow Mg^{2+} + 2e$	1 1
	bi	Oil and paint acts as a protective layer and cover the surface of the pipe, preventing the iron from being exposed to oxygen and water.	1 1
	bii	Oil and paint are easily scratched off and damaged, which causes the pipes to rust as the pipes are exposed to oxygen and water.	1
A7	**a**	Different metals have different reactivities, hence when two different metals are connected, the flow of electrons from the more reactive to less reactive metal produces a voltage. The larger the difference in the reactivity of the 2 metals, the larger the voltage produced.	1 1
	b	<table><tr><td>metal 1</td><td>metal 2</td><td>predicted voltage / V</td></tr><tr><td>copper</td><td>iron</td><td>**any value between 0.61 – 1.09**</td></tr><tr><td>silver</td><td>magnesium</td><td>**any value between 1.57 – 4.00**</td></tr></table>	1 1

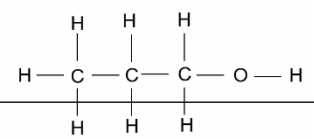
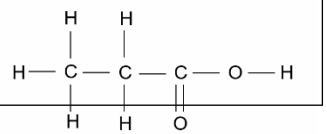
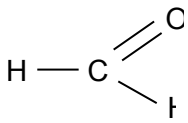
PAPER 2 (SECTION B)

Question		Answer	Mark
B8	a	The chlorate(I) ion is negatively charged and contains an oxygen atom covalently bonded to a chlorine atom.	1
	bi	$NH_2Cl + NaOCl \rightarrow NHCl_2 + NaOH$ $NHCl_2 + NaOCl \rightarrow NCl_3 + NaOH$	1
	bii	Oxidation state of nitrogen in NH_2Cl is -1. Oxidation state of nitrogen in $NHCl_2$ is +1. Oxidation state of nitrogen in NCl_3 is +3. [2m – 3 correct, 1m – 2 correct, 0m – 1 or 0 correct] The oxidation state of nitrogen increases from -1 in NH_2Cl to +1 in $NHCl_2$ and +1 in $NHCl_2$ to +3 in NCl_3. This is oxidation, so sodium chlorate(I) acts as the oxidising agent.	2 1
	c	 1m – bonding electrons 1m – non-bonding electrons	2
	d	Percentage by mass of chlorate(I) in sodium chlorate(I) [$NaOCl$] = [(16 + 35.5) / (23 + 16 + 35.5)] x 100% = [51.5 / 74.5] x 100% = 69.1% (to 3 s.f.) Percentage by mass of chlorate(I) in calcium chlorate(I) [$Ca(OCl)_2$] = [2(16 + 35.5) / (40 + 2(16) + 2(35.5))] x 100% = [103 / 143] x 100% = 72.0% (to 3 s.f.)	1 2
	e	CaO_2	1

	f	Hypochlorite bleaches reacts to form <u>compounds of nitrogen with chlorine which are irritating and toxic</u> to people. Hydrogen peroxide bleaches breaks down compounds and <u>produces water which is harmless</u> to people.	1
B9	**a**	stage 2: **Carbon monoxide gas molecules adsorb onto the surface of the catalyst** stage 3: **Each carbon monoxide molecule forms bonds with an oxygen atom to form a carbon dioxide molecule** stage 4: **Carbon dioxide gas molecules are detached from the surface of the catalyst.**	1 1 1
	b	 **reaction without catalyst** **reaction with catalyst** 1m – shape of both energy profile diagrams + label reactants/products 1m – label both activation energies, where $E_{a,\ catalyst} < E_a$ 1m – label both enthalpy changes, ΔH (same value)	3
	c	The palladium catalyst <u>provides an alternative pathway of lower activation energy</u> for the reaction to occur. <u>Hence, more particles have the minimum energy for reaction to occur</u>. There are <u>more collisions between oxygen and carbon monoxide molecules and the surface of the catalyst, hence increasing the frequency of effective collisions between reacting particles</u>. Thus, rate of reaction increases.	1 1

<table>
<tr><td rowspan="6">EITHER

B10</td><td>a</td><td>oxygen / acidified aqueous potassium manganate(VII) / acidified aqueous potassium dichromate(VI)

[any two of the above]</td><td>2</td></tr>
<tr><td>bi</td><td>
<table>
<tr><td>name of series</td><td>alcohols</td><td>carboxylic acids</td></tr>
<tr><td>name of third member</td><td>propanol</td><td>propanoic acid</td></tr>
<tr><td>displayed formula of third member</td><td>  </td><td>  </td></tr>
</table>
1m – both names correct
1m – both displayed formula correct</td><td>2</td></tr>
<tr><td>bii</td><td>  </td><td>1</td></tr>
<tr><td>ci</td><td>$CH_3OH + CO \rightarrow CH_3COOH$</td><td>1</td></tr>
<tr><td>cii</td><td>HI.

It is <u>not used up and is regenerated</u> in the final stage of the process.</td><td>1

1</td></tr>
<tr><td>di</td><td>The yield of ethanoic acid will decrease. [must state but no mark]

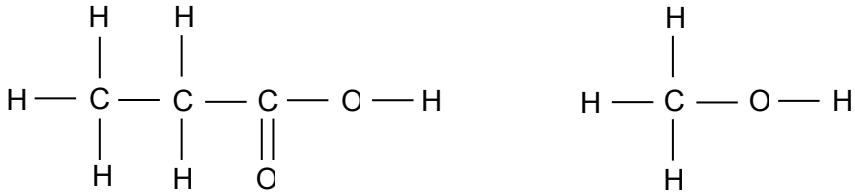
There will be less CO and H_2O in stages 2 and 3 of the process to react to form ethanoic acid.</td><td>

1</td></tr>
<tr><td>dii</td><td>Hydrogen is used as a raw material in the Haber Process to manufacture ammonia.</td><td>1</td></tr>
</table>

<table>
<tr><td>OR

B10</td><td>a</td><td>Isomer 1 & 2 are <u>carboxylic acids</u> which are <u>weak acids</u>. Hence the Universal Indicator will turn from <u>green to orange/yellow</u>.

Isomer 3 is an <u>ester</u> and is <u>neutral</u>. The Universal Indicator will remain <u>green</u>.</td><td>1
1

1</td></tr>
<tr><td></td><td>b</td><td> 
propanoic acid

methanol

1m – displayed formula of propanoic acid
1m – displayed formula of methanol
1m – names of both molecules</td><td>3</td></tr>
<tr><td></td><td>ci</td><td><table>
<tr><td>element</td><td>carbon</td><td>hydrogen</td><td>oxygen</td></tr>
<tr><td>mass in 100 g / g</td><td>62.1</td><td>10.3</td><td>27.6</td></tr>
<tr><td>A_r</td><td>12</td><td>1</td><td>16</td></tr>
<tr><td>number of moles / mol</td><td>62.1 / 12
= 5.175</td><td>10.3 / 1
= 10.3</td><td>27.6 / 16
= 1.725</td></tr>
<tr><td>mole ratio</td><td>5.175 / 1.725
= 3</td><td>10.3 / 1.725
= 6</td><td>1.725 / 1.725
= 1</td></tr>
</table>
empirical formula of R: C_3H_6O</td><td>1

1

1</td></tr>
<tr><td></td><td>cii</td><td>$C_6H_{12}O_2$ / $C_5H_{11}COOH$</td><td>1</td></tr>
</table>