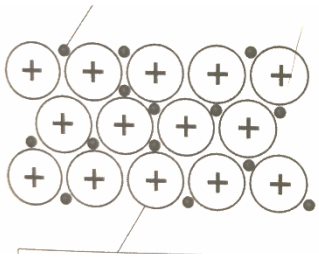
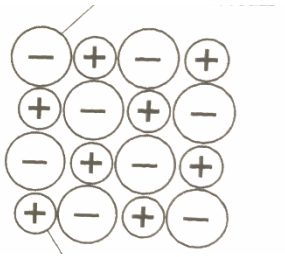
Victoria School
2020 Chemistry O Levels / 6092
Suggested Answer Key

PAPER 1

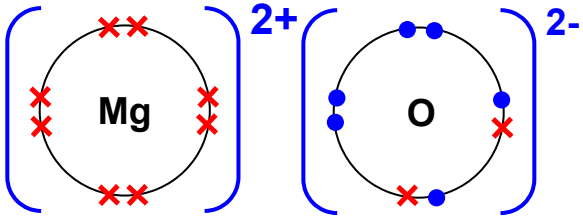
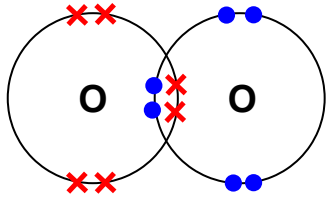
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	D	A	A	B	C	B	A	A	B	A	A	C	D	B	C	B	D	C	C
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
C	B	B	A	D	A	B	D	D	B	D	C	D	C	D	D	A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

PAPER 2 (SECTION A)

Question		Answer	Mark
A1	**ai**	calcium hydroxide	1
	aii	hydrogen **AND** iron	1
	aiii	graphite	1
	aiv	ethanol	1
	av	graphite	1
	avi	hydrogen **AND** graphite	1
	b	True, True, False, False	1
A2	**a**	Under the conditions of the car engine, the nitrogen and oxygen molecules gain thermal energy and thus gain kinetic	1

		energy and move faster. In addition, there are more reactant particles that have the minimum energy for reaction to occur. There are more collisions between the reactant particles, hence increasing the frequency of effective collisions between reacting particles. Thus, rate of reaction increases.	1 1
	bi	equation 1: $2NO + O_2 \rightarrow 2NO_2$ equation 2: $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$	1 1
	bii	sulfur dioxide	1
A3	**a**	electron  (metal) cation anion  cation	1 for metal 1 for ionic
	b	Metals have a sea of mobile (delocalised valence) electrons that are able to move and carry charge. Ionic compounds are able to conduct electricity in molten and aqueous states as the giant ionic structure collapses and the ions are able to move and carry charge.	1 1
	ci	In pure iron, the iron atoms are of the same size and arranged in regular rows. Hence, the layers of iron atoms can slide over each other easily with lesser force, resulting in pure iron being malleable and ductile. In mild steel, the addition of different sized carbon atoms disrupt the regular/orderly arrangement of the metal lattice. Hence, the layers of iron atoms can no longer slide over each other as easily when a force is applied, resulting in iron alloy being stronger and more brittle.	1 1
	cii	The table shows that iron atoms have a larger atomic radius than the carbon atoms but are shown in the diagram to be smaller.	2

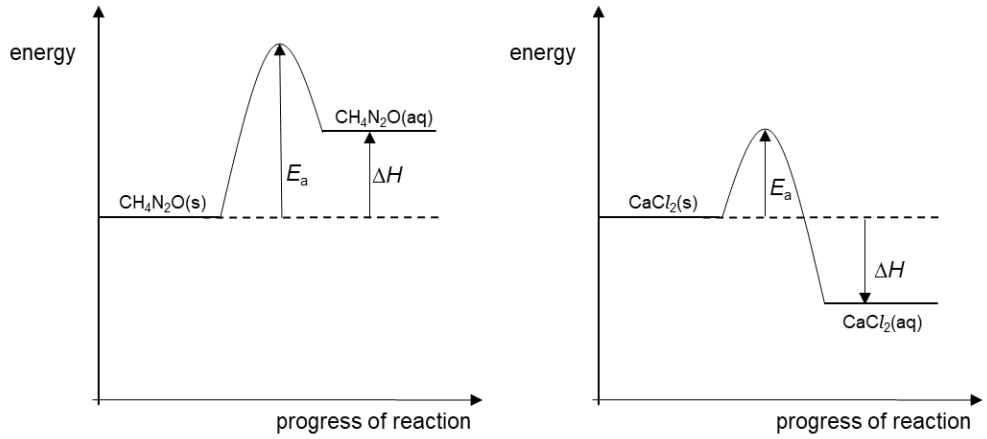
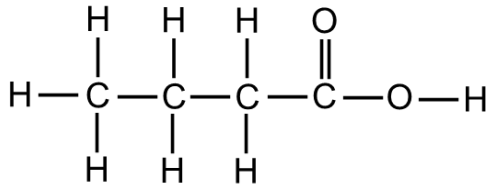
		OR The table shows that there are 3 types of elements in mild steel, but only iron and carbon are shown in the diagram. OR The percentage by mass of carbon is the diagram is approximately 3.5% but it is stated in the table to be only 0.25%. **CHOOSE ANY 2 ANSWERS**	
A4	**a**	The iron can should be made the cathode/connected to the negative terminal of the battery, while a piece of tin should be made the anode/connected to the positive terminal of the battery. Both items should be dipped into the electrolyte which is an aqueous solution containing Sn^{2+} ions/ aqueous tin(II) nitrate.	1 1 1
	b	$Sn(s) + 2H^{+}(aq) \rightarrow Sn^{2+}(aq) + H_2(g)$	1
	ci	Poly(ethene) does not react with dilute acids found in food/is non-biodegradable.	1
	cii	Macromolecule: A large molecule made up of many small molecules succesively joined together. Addition polymerisation: The successive additon of monomers that are joined together to form only one (large) product without any loss of atoms or molecules.	1 1
A5	**a**	The melting point of silicon dioxide is higher than carbon dioxide. Silicon dioxide has a high melting point as it has a giant molecular structure so a lot of energy is used to overcome the strong covalent bonds between the atoms. Carbon dioxide has a low melting point as it has a simple molecular structure so less energy is used to overcome the weak intermolecular forces of attraction.	1 1 1
	b	acidic oxide: CO_2, NO_2, P_2O_5, SiO_2 (Choose any one) basic oxide: Li_2O, BeO, Na_2O, MgO (Choose any one)	1
	ci		1 for cation 1 for anion

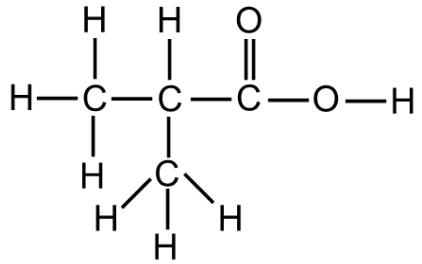
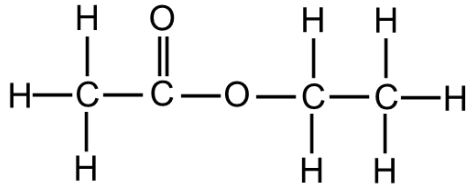
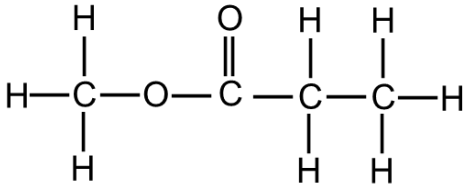
		 1m – cation 1m – anion  1m – bonding elections 1m – non-bonding electrons	1 for bonding 1 for non bonding
	cii	In magnesium oxide, the <u>magnesium atom loses electrons to the oxygen atom</u> forming <u>a cation and an anion</u> respectively. The <u>oppositely charged ions</u> are held together by <u>strong electrostatic forces of attraction/ionic bonds</u>. In oxygen, the 2 atoms <u>share 2 pairs of electrons</u> and are held together by <u>strong electrostatic forces of attraction</u> between the <u>shared electrons and the nuclei of the 2 atoms</u>.	1 1
A6	**a**	$2M + H_2 \rightarrow 2MH$	1
	bi	Amount of LiH = 8.0 / 8 = 1.00 mol	1

		Amount of NaH = 24.0 / 24 = 1.00 mol Amount of KH = 40.0 / 40 = 1.00 mol Each reaction produces 1 mole of metal hydride per gram of oxygen reacted. The information in the table matches the statement made by Beth, not Jean.	 1
	bii	Amount of H_2 = 1.0 / 2 = 0.500 mol 0.500 mol H_2 ≡ 1. 00 mol RbH Mass of RbH = 1.00 x (85+1) = 86.0 g Therefore 1 gram of hydrogen will produce 86.0 g of rubidium hydride. As this is an increase of more than 16.0 g from the mass of potassium hydride produced, I do not agree with Ryan.	 1 1
	c	The potassium would <u>glow even brighter than sodium/burst into flame</u>. Potassium is more reactive than sodium and thus loses electrons more readily. Hence it would give a more vigorous reaction than sodium.	1 1
	d	The oxidation state of <u>oxygen</u> <u>decreases from 0 in O_2 to -2 in water</u>, hence this is <u>reduction</u> The oxidation state of <u>sodium</u> <u>increases from 0 in Na to +1 in NaH</u>, hence this is <u>oxidation</u>.	1 1

PAPER 2 (SECTION B)

Question		Answer	Mark
B7	a	30 g of NaCl dissolves in 100cm^3 of water 300 g of NaCl will dissolve in 1dm^3 of water Amount of NaCl = 300 / (23+35.5) = 5.13 mol Any value between 5.1 and 6.8 mol	1
	B	Similarity: Increasing the mass of both NaCl and $CaCl_2$ initially caused the freezing point of water to drop. Difference: Once more than 20 g of salt is added, the $CaCl_2$ continues to cause a drop in the freezing point while the freezing point in the solution with NaCl begins to increase. Difference: On addition of 40g of salt, the NaCl solution becomes saturated, but the $CaCl_2$ can still dissolve. Difference: $CaCl_2$ will eventually increase the freezing point above 0 °C Difference: $CaCl_2$ gives a lower freezing point of -45 °C as compared to NaCl which only reduced the freezing point to -20 °C. (Pick any 2 differences)	1 1 1
	c	Hygroscopic de-icers attract water vapour from the air that allows them to form a solution on the surface of the ice, allowing the de-icer to dissolve even when there is little liquid water available. De-icers that dissolve exothermically are able to release heat when they dissolve and melt the ice under the layer of water, allowing them to work deeper into the ice.	2
	d		1 for both E_a 1 for both ΔH 1 for both general shape and equation

			
	e	Urea does not speed up the corrosion of metal. **OR** Urea is non-toxic to plants	1
	f	Chloride (Cl^-). All de-icers that are harmful to plants contain chloride ions.	1
B8	**a**	X,Y and Z all have the same empirical formula and the same M_r, meaning that they have the same molecular formula, but different structural formula as shown in the table.	1
	b	Isomer X  Functional Group: carboxyl	1 for each structure 1 for both carboxyl 1 for ester

		Isomer Y  Functional Group: carboxyl Isomer Z  **OR**  Functional Group: ester	
	c	Effervescence of colourless gas observed due to formation of hydrogen gas. The rate of effervescence would be the same for both reactions as they produce solutions of the same pH at the same concentrations.	1 1
EITHER **B9**	**a**	Table 9.1 shows that all the bonds have different bond lengths, but in the ball and stick diagram, the bonds are all shown to be the same length. Table 9.2 shows that all the atoms have different atomic radii, but all the atoms shown in the ball and stick model are	1

		shown to be the same size. In the dot and cross diagram the C-C and C-O bonds are shown to have the same bond length as do the C-H and O-H bonds. However, table 9.1 shows that these bonds have different bond lengths.	1 1
	bi	C_2H_6O	1
	bii	The molecular formula of ethanol cannot be further simplified.	1
	ci	$C_2H_4 + H_2O \rightarrow C_2H_5OH$ Amount of ethene = 1000 / 24 = 41.67 mol 41.67 mol C_2H_4 ≡ 41.67 mol C_2H_5OH Amount of ethanol = 41.67 mol Mass of ethanol = 41.67 x (12x2 + 1x6 + 16) = 1916.82 g Yield of ethanol = 1916.82 x 5/100 = 95.841 g ≈ 95.8 g	 1 1 1 1
	cii	Unreacted ethene is pumped back into the reactor to be reacted again.	1
OR **B10**	**ai**	Atom economy = $\frac{(14x2)+(1x8)+32+(16x4)}{(14x2)+(1x8)+12+(16x3)+40+32+(16x4)} = 56.9\%$	1 1
	aii	Process 2 $CaCO_3$ as a by-product in addition to $(NH_4)_2SO_4$, but process 1 produces $(NH_4)_2SO_4$ as the only product, so all reacting atoms are used.	1 1
	b	Amount of ammonia = 1000 / 24 = 41.67 mol 2 mol NH_3 ≡ 1 mol H_2SO_4 Amount of H_2SO_4 = 41.67 / 2 = 20.84 mol Mass of sulfuric acid = 20.84 x (1x2+32+16x4) = 2042.32 g ≈ 2040 g	1 1 1
	ci	The mixture should be filtered to remove calcium carbonate as the residue.	1

		The filtrate should be heated until saturated then allowed to cool and crystallise. The resulting solid ammonium sulfate can then be obtained by filtering out the crystals.	1
	cii	Calcium ions and sulfate ions can react together to form a solid calcium sulfate instead of reacting with the ammonium carbonate to form ammonium sulfate.	1