Victoria School
2022 Chemistry O Levels / 6092
Suggested Answer Key

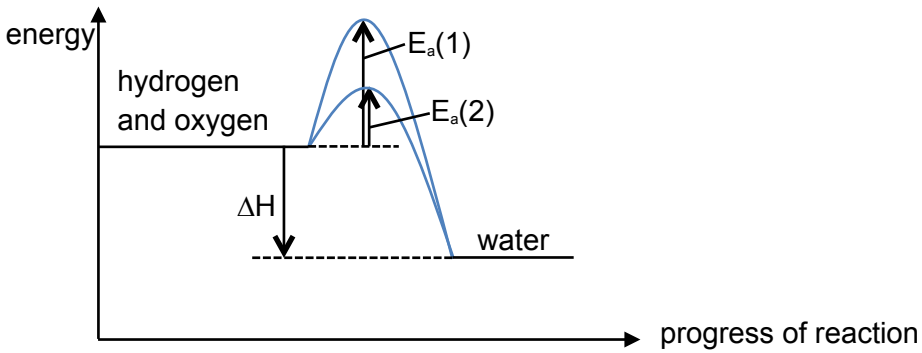
PAPER 1

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

PAPER 2 (SECTION A)

Question		Answer	Mark
A1	**a**	M	1
	b	R	1
	c	MQ_3	1
	d	T	1
	e	Q and Z	1
	f	RQ_4	1
A2	**a**	The perfume molecules/particles are always in random motion and will diffuse from a region of higher concentration to a region of lower concentration.	1
	b	The particles must be packed closely together and in disorderly arrangement. The label “a few seconds later” should be changed to a few minutes/hours later.	1 1
	c	The distance moved by the ions in beaker B will be larger than that in beaker A. Since the water in beaker B is at a higher temperature of 30 °C, the ions will gain more heat from it and hence possess higher kinetic energy resulting in higher rate of diffusion.	1 1

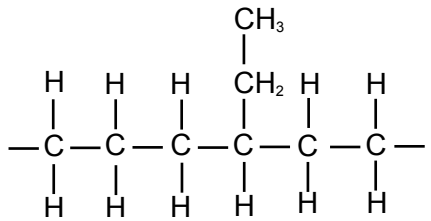
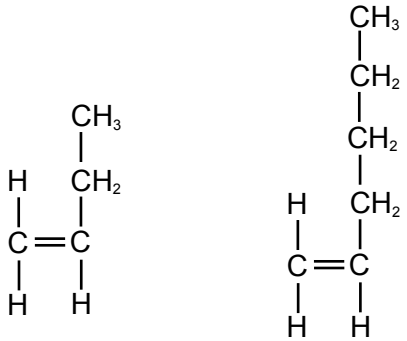
		The distance moved by V^{2+} ions in beaker C will be larger than Cu^{2+} ions in beaker A. V has an A_r of 51 while Cu has an A_r of 64. V^{2+} ions will diffuse faster due to their lower mass and cover a larger distance in the same amount of time.	1 1
A3	**a**	carboxylic acid alkene alcohol	1
	bi	Add aqueous bromine changes reddish-brown bromine to colourless	1 1
	bii	B is a weak acid which dissociate partially when dissolved in water to produce a low concentration of H^+ ions.	1
	biii	D will be oxidised to form ethanoic acid.	1 1
	ci	<table><tr><td>element</td><td>C</td><td>H</td><td>O</td></tr><tr><td>mass per 100 g / g</td><td>40.0</td><td>6.7</td><td>53.3</td></tr><tr><td>amount / mol</td><td></td><td></td><td></td></tr><tr><td>mole ratio</td><td>3.33 ÷ 3.33 = 1</td><td>6.7 ÷ 3.33 = 2</td><td>3.33 ÷ 3.33 = 1</td></tr><tr><td>empirical formula</td><td colspan="3">CH_2O</td></tr></table>	1 1 1
	cii	Compound B Compound B has molecular formula $C_2H_4O_2$/the ratio of C:H:O is 1:2:1.	1
A4	**a**	<table><tr><td>halogen</td><td>colour and state at room temperature and pressure</td></tr><tr><td>chlorine</td><td>yellow green colour and gaseous state</td></tr><tr><td>bromine</td><td>reddish brown colour and liquid state</td></tr><tr><td>iodine</td><td>purple black colour and solid state</td></tr></table>	colour [1] state [1]
	bi	The reactivity of the halogens decreases down the Group. (must state but no mark) Chlorine, being placed on top of bromine and iodine, is the most reactive as it can displace both bromine and iodine from their respective halide solutions. Bromine, being placed below chlorine but above iodine, is less reactive than chlorine and hence unable to displace chlorine from the chloride solution, but more reactive than iodine and hence can displace iodine from the iodide	1 1

		solution. Iodine, being placed below chlorine and bromine, is the most unreactive as it neither displace chlorine nor bromine from their respective halide solutions.	
	bii	In A, aqueous bromine has displace iodine from aqueous iodide forming the brown aqueous iodine. In B, aqueous iodine is present and did not undergo any reaction.	1
	c	The fluorine molecule gains two electrons readily during chemical reactions and is reduced to two fluoride ions.	1
	di	Although the C*l* atom reacted with the O_3 molecule to form C*l*O, the C*l*O reacts with another ozone molecule to form back C*l* atom. Hence, the C*l* atom remains chemically unchanged at the end of the reaction.	1
	dii	C*l* atoms will react and break down O_3 molecules repeatedly in the presence of UV light, causing ozone depletion. This will allow more harmful UV radiation from the sun to enter the atmosphere and cause skin cancer or eye damage.	1 1
A5	**a**	$2H_2 + O_2 \rightarrow 2H_2O$	1
	b	Since $2H_2 \equiv O_2$, volume of O_2 needed = 500 ÷ 2 = 250 cm^3 volume of air needed =	1 1
	c	Aqueous potassium hydroxide contains free mobile ions but not water which consists of neutral covalent molecules.	1
	d		product [1] $E_a(1)$ [1] $E_a(2)$ [1] ΔH [1]
A6	**a**	Heat the solution in a beaker. This will remove the water in the solution thereby causing the solution to become concentrated.	1 1
	bi	$(NH_4)_2SO_4 + O_2 \rightarrow N_2 + 4H_2O + SO_2$	formula [1] balancing [1]
	bii	nitrogen: -3 to 0 sulfur: +6 to +4	1 1
	c	manufacture of detergents/fertilisers	1

	d	Because large amount of energy is required for heating in process 2, the processes do not follow the principle of using minimum amounts of energy. Both processes 1 and 2 use ammonium sulfate waste. Process 2 uses oxygen from air which is renewable. Hence both processes follow the principle of using raw materials which are renewable or use waste from other processes. Process 1 produces only water while process 2 produces water and nitrogen, which are all harmless.	1 1 1

PAPER 2 (SECTION B)

Question		Answer	Mark
B7	**a**	Both LDPE and LLDPE contain side chains that are made up of only carbon and hydrogen atoms. However, LDPE contains side chains that have more than one carbon atom while LLDPE contains side chains with only one carbon atom.	1 1
	b	Empirical formula for LDPE is CH_2. For LDPE with 4000 carbon atoms: Total molecular mass = 4000 x 14 = 56 000 Total mass of 1 mol of LDPE = 56 000 x 1 = 56 000 g Total mass of 1 molecule of LDPE = 56 000 ÷ (6×10^{23}) = 9.33×10^{-20} g For LDPE with 40 000 carbon atoms: Total molecular mass = 40 000 x 14 = 560 000 Total mass of 1 mol of LDPE = 560 000 x 1 = 560 000 g Total mass of 1 molecule of LDPE = 560 000 ÷ (6×10^{23}) = 9.33×10^{-19} g Range between 9.33×10^{-20} and 9.33×10^{-19} g	 1 1 1
	ci	LDPE and LLDPE have side chains to push the polymer chains away from each other while HDPE has no side chains. Hence, HDPE polymer chains can be arranged closer together with more molecules per unit volume, making it more dense.	1 1
	cii	LDPE has more side chains than LLDPE and HDPE, hence LDPE has a lower softening temperature and is weaker than the other two polymers. Thus, it is less suitable to be used as building materials, packaging or hot drinks containers.	 1 1

	di		1
	dii		2
B8	**a**	Lithium and beryllium tend to <u>lose electrons to form positive ions</u> and <u>ionic compounds</u>, hence the elements show metallic properties. From boron to fluorine, the elements tend to <u>share electrons</u> with other <u>non-metal</u> elements to form <u>molecules</u> and <u>covalent compounds</u>, hence the elements show non-metallic properties. Neon <u>does not react</u> with other elements to form compounds as it is stable and has a <u>completely filled valence shell of electrons</u>.	1 1 1
	b	Lithium has a <u>giant metallic structure</u> with <u>metallic bonds between valence electrons and positive ions</u>. A moderate amount of energy is needed to overcome the metallic bonds. Graphite has a <u>giant molecular structure</u> with <u>strong covalent bonds between atoms</u>. A large amount of energy is needed to overcome the strong covalent bonds. Oxygen has a <u>simple molecular structure</u> with <u>weak intermolecular forces of attraction</u>. Little energy is needed to overcome the intermolecular forces of attraction. As <u>more energy</u> is needed to <u>overcome covalent bonds</u> in graphite <u>than metallic bonds</u> in lithium, which in turn requires more energy to overcome compared to <u>intermolecular forces of attraction</u> in oxygen.	1 1 1

		Hence, graphite has a very high melting point, lithium has a low melting point and oxygen has a very low melting point. The mobile valence electrons in lithium and graphite allows them to conduct electricity. Oxygen is unable to conduct electricity as it does not contain any mobile charged particles.	1 1
EIT HER **B9**	**a**	Anode: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ Cathode: $2H^+ + 2e^- \rightarrow H_2$ In both experiments, reactions at both electrodes are the same. In both experiments, hydrogen ions are preferentially discharged over sodium ions as hydrogen ions gain electrons more easily than sodium ions to form hydrogen gas. In experiment 2, hydroxide ions are preferentially discharged over chloride ions as hydroxide ions lose electrons more easily than chloride ions to form oxygen gas. In experiment 1, only hydroxide anions are present and hydroxide ions are discharged to form oxygen gas. Therefore, the ratio of the volume of gases collected is the same in both experiments. As the same number of moles electrons are involved in the reaction at both electrodes, double the number of moles of hydrogen gas is formed compared to oxygen gas. Hence, double the volume of hydrogen gas is formed compared to oxygen gas.	1 1 1 1 1
	b	In experiment 3, chlorine gas is produced at the anode instead of oxygen gas. In both experiments, hydrogen gas will be produced at the cathode.	1
	c	Colour in experiment 2: green Colour in experiment 3: violet In experiment 2, as hydrogen ions and hydroxide ions are both discharged, the pH of the electrolyte remains at 7. In experiment 3, hydrogen ions and chloride ions are discharged, leaving sodium hydroxide in the electrolyte. Hence, the electrolyte becomes more alkaline.	1 1 1
OR **B9**	**a**	Experiment 1 Zinc rod: $Zn \rightarrow Zn^{2+} + 2e^-$ Aqueous copper(II) sulfate: $Cu^{2+} + 2e^- \rightarrow Cu$ Zinc is more reactive than copper, hence zinc displaces copper from the aqueous copper(II) sulfate solution.	 1

		The blue solution turns colourless as copper(II) ions in the solution is replaced by zinc ions. A red-brown solid is deposited due to copper metal being formed. Experiment 2 Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$ Anode: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ Copper(II) ions are preferentially discharged over hydrogen ions as copper(II) ions gain electrons more easily than hydrogen ions to form copper metal. Hence, blue solution turn colourless. Red-brown solid is deposited at the cathode due to copper metal formed. Hydroxide ions are preferentially discharged over sulfate ions as hydroxide ions lose electrons more easily than sulfate ions to form oxygen gas. Effervescence of colourless gas is observed at the anode due to oxygen gas formed.	1 1 1 1
	b	Experiment 1: The mass of the solution increases as there is the same number of moles of zinc ions formed and the copper(II) ions reduced. The zinc ions replacing the copper(II) ions have a higher relative atomic mass. Experiment 2: The mass of the solution decreases as copper(II) ions are reduced to form copper that coats on the cathode and hydroxide ions are oxidised and lost as oxygen gas at the anode. The ions discharged are not replaced.	2 1
	c	In experiment 3, copper anode dissolves instead of effervescence being observed. Copper anode is oxidised to formed copper(II) ions instead of hydroxide ions being discharged. Blue solution remains. For every one mole of copper(II) ions discharged from the cathode, one mole of copper(II) ions dissolves into the solution from the anode. Hence, the concentration of copper(II) ions remains unchanged.	1 1