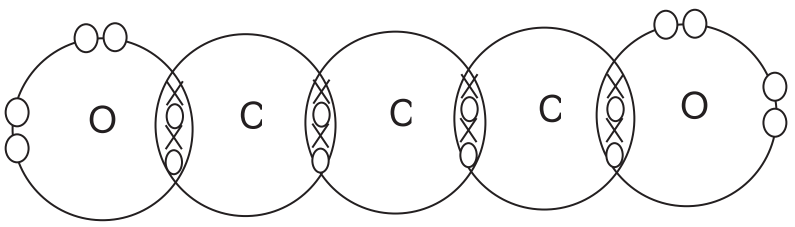
2019 Sec 4EX Prelims Pure Chem MS

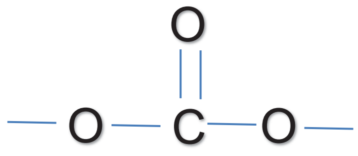
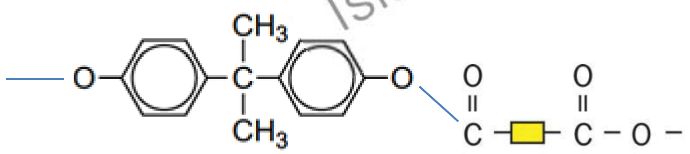
	MCQ							
1	D	11	D	21	B	31	D	
2	C	12	D	22	D	32	A	
3	D	13	C	23	C	33	B	
4	A	14	A	24	C	34	A	
5	B	15	D	25	D	35	B	
6	D	16	C	26	D	36	B	
7	A	17	B	27	B	37	D	
8	D	18	C	28	C	38	B	
9	A	19	A	29	B	39	A	
10	A	20	C	30	A	40	B	

	Section A			Marks	Markers report
A1	(a) (b) (c) (d) (e)	hydrogen sulfur dioxide propane nitrogen ammonia		[1] [1] [1] [1] [1]	
	(f)	(i) (ii)	$N_2 + 3H_2 \leftrightharpoons 2NH_3$ 450 – 500 °C 200 – 250 atm Powdered iron as catalyst	[1] [2 for 1m, 3 for 2m]	
A2	(a)	(i)	$H^+ + H_2O \rightarrow OH^- + H_2$	[1]	
		(ii)	Hydrogen has been reduced as the oxidation state of hydrogen decreases from +1 to 0 while Hydrogen ion has been reduced as the oxidation state of hydrogen increases from -1 to 0.	[0.5] [1] [0.5] [1]	
	(b)	(i)	Nickel has a much higher density compared to sodium Nickel has a much higher melting point compared to sodium	[1] [1]	
		(ii) (iii)	For the hydrogenation of vegetable oil to margarine. Since an alloy of nickel and copper consist of atoms of different	[1] [1]	

			sizes, Therefore, this disrupts the regular arrangement of the pure metal, making it harder to slide when a force is applied As a result, this causes it to be less malleable.	[1]	
A3	**(a)**	Z, W, X, Y		[1]	
	(b)	**(i)**	hydrogen gas	[1]	
		(ii)	iron	[1]	
		(iii)	lead / copper / silver	[1]	
A4	**(a)**	**(i)**	It has a functional group of CHO / it has a general formula of $C_nH_{2n+1}CHO$.	[1]	
		(ii)	Propanal has a higher melting / boiling point than ethanal Propanal has a higher viscocity than ethanal Propanal has a lower flammability than ethanal	[2 for 1m, 3 for 2m] [1] [1]	
	(b)	**(i)**	C_2H_5OH + CuO → CH_3CHO + Cu + H_2O	[1]	
		(ii)	Mole of ethanal = 11 / 44 = 0.25 mol Mole ratio of ethanol: ethanal = 1:1 =0.25:0.25 Mass of ethanol = 0.25 * 46 = 11.5g Therefore, % purity of ethanol = 11.5 / 15 = 76.7 %	[1] [1]	
	(c)	Comparing relevant example (e.g ethanol and ethanal) with the same number of carbon atoms, the number of hydrogen atoms are different. Therefore, they are not isomers as this will result in different molecular formula.		[1] [1]	
A5	**(a)**	It should be a gas at room temperature. This is because it exist as a simple molecular structure in which molecules are held by weak intermolecular forces.		[1] [1]	

	(b)			[1m for the correct number of sharing electrons, 1m for correct number of unshared valence electrons]	
	(c)	**(i)** **(ii)**	Addition polymerisation	[1m for 2 repeat units, 1m for correct arrangement of a repeat unit]	
A6	**(a)**	Calcium sulfate		[1]	
		Magnesium sulfate		[1]	
	(b)	To make sure all the acid has been reacted.		[1]	
	(c)	Heat until a saturated solution is formed		[1]	
		Cool the solution, crystallisation takes place			
		Filter the crystals to remove left over solution / Dry crystals between filter paper		[1]	
A7	**(a)**	**(i)**	$E_2 - E_1$: enthalpy change/ ΔH	[1]	
			$E_3 - E_1$: activation energy for backward reaction	[1]	
			$E_3 - E_2$: activation energy for forward reaction.	[1]	
	(b)	**(i)**	Bond breaking: (1 x 612)+(4 X 412) + (2 x 463) = +3186 kJ	[1]	

			Bond making: (5 x 412) + 463 + 348 + 358 = -3229 kJ	[1]	
			Overall Enthalpy = +3186kJ -3229kJ = -43 kJ		
		(ii)	less energy is taken in during the breaking of bonds in ethane and steam molecules compared to	[1]	
			energy given out during making of bonds in ethanol molecules	[1]	
			Therefore, energy is released to the surroundings which raises temperature.	[1]	

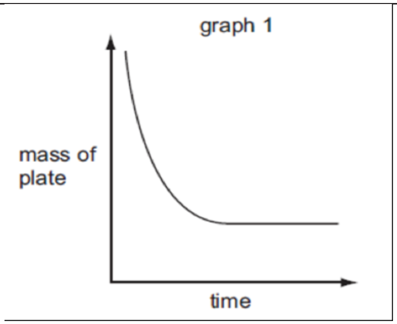
	Section B				
B8	**(a)**			[1]	
	(b)	Disposal of polycarbonates results in the formation of BPA and carbon dioxide. Carbon dioxide is a greenhouse gas which will result in global warming. In addition, BPA is non-biodegradable and can leach into water bodies which could cause harm to marine life. It leaches more over time as it ages in the landfills		[1] [1] [1]	
	(c)	**(i)**	It is acting as a **catalyst** for the reaction. It is not used up over time.	[1] [1]	
		(ii)	94 – 16 – 6(12) – 12 = 4 Therefore, x = 4.	[1]	
		(iii)	n for the polycarbonate = 18 000 / (4 * 76 + 4*12 + 3*16 + 6) = 44.33 ≈ 45 45 moles of diphenyl carbonate is required to form the poly carbonate. Therefore, 90 moles of phenol is required. Mass of phenol required = 90 * 94 = 8460 g.	[1] [1] [1]	
	(d)			[1m for correct formula, 1m for n]	

[Turn over

B9	**(a)**	X: $4OH^-(aq) \rightarrow O_2(g) + 2H_2O(l) + 4e^-$ Y: $2H^+(aq) + 2e^- \rightarrow H_2(g)$		[1] [1]	
	(b)	**(i)**	The overall equation of the electrolysis: $2H_2O \rightarrow 2H_2 + O_2$ Therefore, 1 mole of oxygen is formed at X for every moles of hydrogen formed at Y. / For every **4** moles of electrons, 1 mole of oxygen gas is formed at X while 2 moles of hydrogen are formed at Y.	[1] [1] [1] [1]	
		(ii)	Since oxygen is more soluble than hydrogen, less oxygen will be collected at X. Therefore, the ratio of hydrogen collected compared to oxygen will be greater than 2:1	[1] [1]	
	(c)	The universal indicator will turn purple at Y The is because there is a reduction in H^+ ions, resulting in a decrease in acidity / increase in alkalinity		[1] [1]	
B10	**(a)**	**(i)**	The amounts of CO, SO_2 and PM10 emissions are lower when using biodiesel than fossil diesel. [1] On the contrary, the amount of NOx exhaust emission is higher when burning biodiesel than fossil diesel. [1]	[1] [1]	
		(ii)	There is more amount of CO produced. CO is a pollutant which binds irreversibly with haemoglobin in red blood cell to form carboxyhaemoglobin, impairing its ability to transport oxygen causing breathing difficulties and death. There is more SO_2 produced. SO_2 irritate the eyes and lungs and causes breathing difficulties	[1] [1]	
	(b)	Burning of biodiesel releases CO_2 to the atmosphere. Biodiesel is formed from plants which absorb CO_2 in the atmosphere during photosynthesis.		[1]	

<table>
<tr><td></td><td></td><td colspan="2">Hence there is no net increase of CO_2 in the atmosphere.</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>One molecule of $CFCl_3$ produces a Cl atom under UV light which reacts with one molecule of O_3 to form one molecule of ClO
Another Cl atom is regenerated when one molecule of ClO reacts with an O atom.</td><td>[1]
[1]</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>From graph,
<table>
<tr><td></td><td>C</td><td>F</td><td>Cl</td></tr>
<tr><td>moles</td><td>2</td><td>4</td><td>2</td></tr>
<tr><td>simplest ratio</td><td>1</td><td>2</td><td>1</td></tr>
</table>
The empirical formula is CF_2Cl.
From graph,
<table>
<tr><td></td><td>C</td><td>F</td><td>Cl</td></tr>
<tr><td>Mass of 1 mole of compound/g</td><td>24</td><td>76</td><td>71</td></tr>
</table>
Mr of CFCs = 171
n = 2
Molecular formula is $C_2F_4Cl_2$</td><td>[1]
[1]</td><td></td></tr>
<tr><td>Or
B10</td><td>(a)</td><td colspan="2">zinc</td><td>[1]</td><td></td></tr>
</table>

[Turn over

	(b)	**(i)**		[1]	
		(ii)	Gradient is less steep as the concentration of iodine is halved, resulting in a slower speed of reaction. Half the mass of zinc reacted since only half the number of mole of the limiting reagent, iodine is present.	[1] [1]	
	(c)	At 15 °C, the zinc atoms and iodine molecules have lower kinetic energy. Hence, less particles have energy greater or equal to the activation energy. The frequency of effective collisions between the zinc atoms and iodine molecules decreases. Hence, speed of reaction decreases.		[1] [1] [1]	
	(d)	**(i)**	$ZnI_2 + Cl_2 \rightarrow ZnCl_2 + I_2$	[1]	
		(ii)	I^- loses electrons to form I_2 while Cl_2 gains electrons to form Cl^- ions Therefore, I^- has being oxidised while Cl_2 is reduced	[1] [1]	