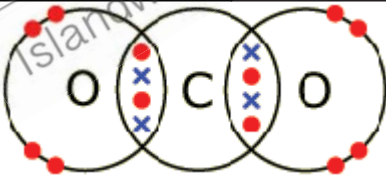


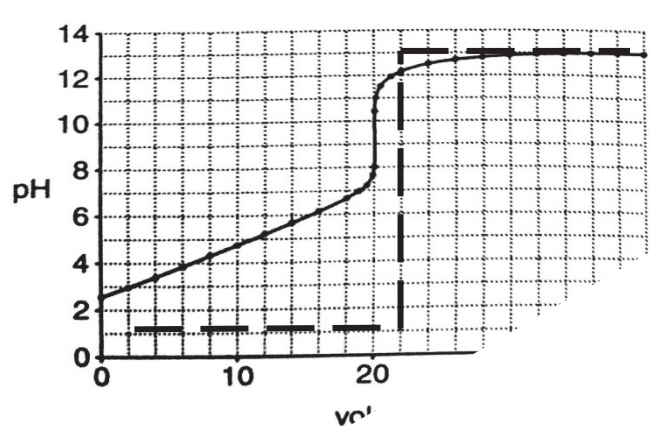
6092 Chemistry Preliminary Examination 2019 Marking Scheme

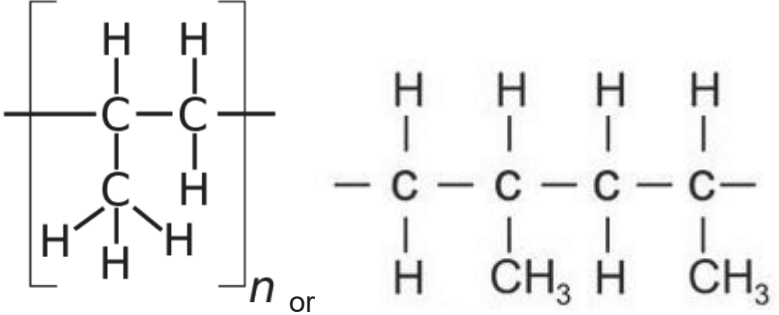
Multiple-Choice Questions [40 M]

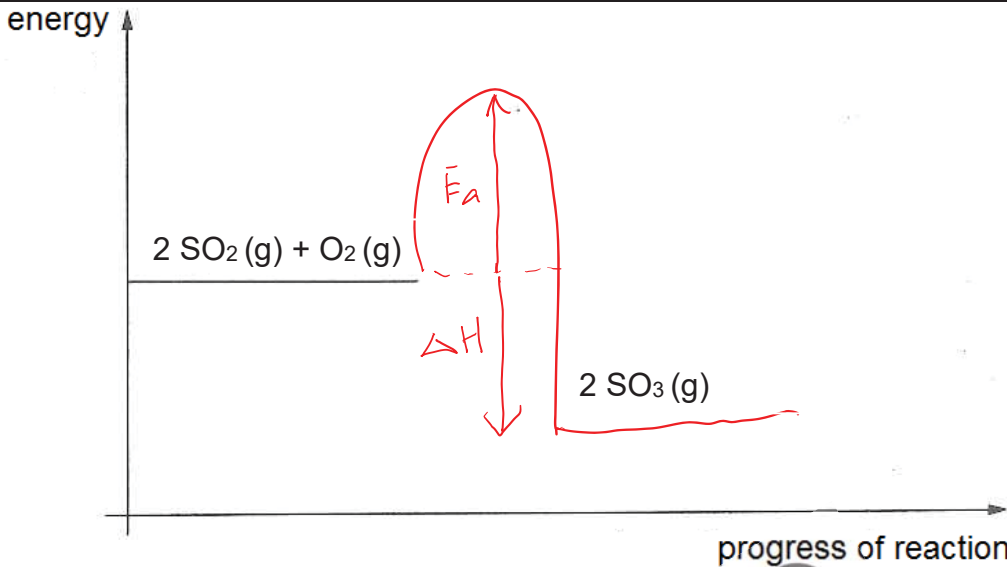
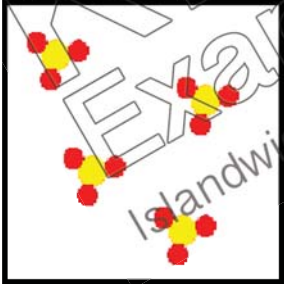
1	2	3	4	5	6	7	8	9	10
A	C	C	B	D	B	D	B	B	D
11	12	13	14	15	16	17	18	19	20
C	D	B	C	B	B	B	D	D	D
21	22	23	24	25	26	27	28	29	30
B	A	D	C	D	B	C	A	B	A
31	32	33	34	35	36	37	38	39	40
A	C	B	D	B	A	A	C	D	B

Section A: Short-Structured Questions [50 M]

1	(a)	B	[1]
	(b)	E	[1]
	(c)	(i) Carbon monoxide	[1]
		(ii) neutral	[1]
	(d)	(i) Any noble gas (e.g. helium, neon, argon, etc)	[1]
		(ii) It has a complete valence shell / complete outermost shell / noble gas configuration and does not need to gain / lose / share electrons.	[1]
2	(e)	It is an ionic compound. Since its ions are held / fixed in an ionic lattice structure, <u>no mobile ions are available to act as charge carriers</u> . Hence F ₂ O does not conduct electricity in the solid state.	[1] [1]
	(a)	(i) Each C atom is bonded to 4 other C atoms by strong covalent bonds in a tetrahedral structure; large amount of energy is needed to break these strong bonds, resulting in a high melting point	[1] [1]
		(ii) The network of covalent bonds is less extensive than diamond / each carbon atom is bonded to 3 carbon atoms in graphite while each carbon atom is bonded to 4 carbon atoms in diamond	[1]
	(b)	(i)  [1]: Electrons involved in bonding are drawn correctly [1]: No other valence electrons are drawn	[2]
		(ii) Each C atom is bonded covalently to 3 other atoms in a hexagonal structure. Free moving electron from each C atom can act as charge carriers to move across layers to conduct electricity.	[1] [1]
		(iii) test: measure the melting point / boiling point of carbon dioxide observation: melting point / boiling point is fixed OR melting point / boiling point matches the recorded melting point / boiling point in scientific data. Award [1] only if both test and observation are correct.	[1]

3	(a)	1.HX is a strong acid due to its: lower pH; higher electrical conductivity OR HY is a weak acid due to its: higher pH. lower electrical conductivity; 2. Strong acid dissociates completely in water to form H ⁺ ions. Weak acid dissociates partially in water to form H ⁺ ions. 3. The higher concentration of H ⁺ ions contributes to its high conductivity; The low concentration of H ⁺ ions contributes to its low electrical conductivity. <i>Answers like difference of pH2 or higher or lower pH did not score marks.</i>	[1] [1] [1]										
	(b)	 Graph should show the same volume of NaOH ; Starts at pH 1 ; Ends at pH 12	[1]										
4	(a)	zinc to copper in the wire	[1]										
	(b)	Cu ²⁺ (aq) + 2e ⁻ → Cu(s)	[1]										
	(c)	<table border="1"><thead><tr><th>meter reading / V</th><th>metal</th></tr></thead><tbody><tr><td>+1.10</td><td>Zinc</td></tr><tr><td>+0.78</td><td>Iron</td></tr><tr><td>0.00</td><td>Copper</td></tr><tr><td>-0.46</td><td>Silver</td></tr></tbody></table> Award [1] for every 2 correct answers	meter reading / V	metal	+1.10	Zinc	+0.78	Iron	0.00	Copper	-0.46	Silver	[2]
meter reading / V	metal												
+1.10	Zinc												
+0.78	Iron												
0.00	Copper												
-0.46	Silver												
5	(a)	Mr of propene = 3(12) + 6(1) = 42 Number of moles of propene = 1/42 = 0.0238095238 mol Number of moles of bromine = Number of moles of propene ∴ mass of bromine = 0.0238095238 x 2(80) = 3.80952380952 ≈ 3.81 g (3 s.f.)	[1] [1]										

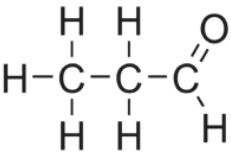
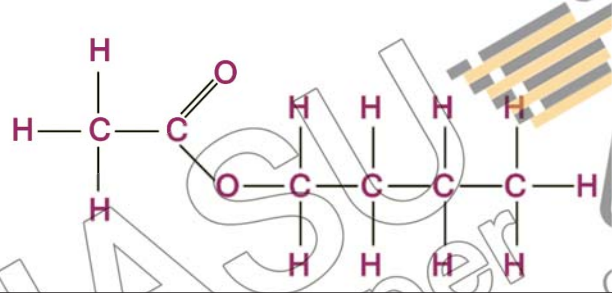
(b)					[1]																					
(c)	Mr of propene = 42 Number of propene molecules = 7350 / 42 = 175 Number of carbon atoms = 175 x 3 = 525				[1] [1]																					
6	(a)	electrode P: $4\text{OH}^- (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + \text{O}_2 (\text{g}) + 4\text{e}^-$ electrode S: $\text{Cu}^{2+} (\text{aq}) + 2\text{e}^- \rightarrow \text{Cu} (\text{s})$			[1] [1]																					
	(b)	Hydroxide ions are discharged at electrode R (anode) to give oxygen gas. Hence, with the decrease in concentration of hydroxide ions, the pH decreases as the solution becomes less alkaline.			[1] [1]																					
7	(a)	<table><thead><tr><th>salt</th><th>method 1</th><th>method 2</th><th>method 3</th></tr></thead><tbody><tr><td>ammonium chloride</td><td></td><td></td><td>✓</td></tr><tr><td>lead(II) sulfate</td><td>✓</td><td></td><td></td></tr><tr><td>sodium sulfate</td><td></td><td></td><td>✓</td></tr><tr><td>zinc nitrate</td><td></td><td>✓</td><td></td></tr></tbody></table> Award [1] for every 2 correct answers	salt	method 1	method 2	method 3	ammonium chloride			✓	lead(II) sulfate	✓			sodium sulfate			✓	zinc nitrate		✓					[2]
salt	method 1	method 2	method 3																							
ammonium chloride			✓																							
lead(II) sulfate	✓																									
sodium sulfate			✓																							
zinc nitrate		✓																								
	(b)	(i)	• Copper(II) chloride is soluble, so cannot use method 1 • Copper cannot react with dilute acid, so cannot use method 2 • Copper oxide, hydroxide and carbonate are all insoluble, so cannot use method 3 Deduct [1] for every 1 mistake			[2]																				
		(ii)	• Add <u>excess</u> copper(II) oxide/hydroxide/carbonate to dilute hydrochloric acid • Filter the mixture • Heat the filtrate until saturated • Cool the hot filtrate to allow it to crystallize • Collect crystals and wash with cold deionised water Award [1] for every 2 correct steps Award [3] for all correct steps			[3]																				
8	(a)	When the temperature is too low, the speed of reaction is too low; when the temperature is too high, the cost of maintaining the high temperature is too high; (also accept: when the temperature is too high, the yield is too low)			[1] [1]																					

(b)	 - the formulae of the reactants and products of the reaction, - a label for the activation energy of reaction, - a label for the enthalpy change of reaction. Deduct [1] for every 1 error.	[2]
(c)	When pressure increases, there are more molecules of sulfur dioxide and oxygen per unit volume; frequency of effective collisions increases so rate increases	[1] [1]
(d)	In the absence of water (or little amount of water), most of the sulfuric acid molecules do not ionise to form hydrogen ions, hence it would not react with steel; in dilute sulfuric acid, the hydrogen ions from the acid ionises completely, reacting with the iron in steel tanks;	[1] [1]
(e)	Any transition metal (e.g. copper, silver, gold) that is below hydrogen in reactivity series. It has multiple oxidation state.	[1]
(f)		[1]

Section B: Long-Structured Questions [30M]

9	(a)	(i) $2 \text{C}_8\text{H}_{18} + 25 \text{O}_2 \rightarrow 16 \text{CO}_2 + 18 \text{H}_2\text{O}$	[1]
		(ii) Mole ratio of [allow ecf for mole ratio] $2 \text{C}_8\text{H}_{18} : 25 \text{O}_2$ $3 : 37.5$ Number of moles of $\text{O}_2 = \frac{3}{2} \times 25$ $= 37.5 \text{ mol}$ [1] Volume of $\text{O}_2 = 37.5 \times 24.0$ $= 900 \text{ dm}^3$ [1]	[2]

	(iii)	$2 \text{C}_8\text{H}_{18} + 25 \text{O}_2 \rightarrow 16 \text{CO}_2 + 18 \text{H}_2\text{O}$ C_8H_{18} loses H atom / gains O atom to form CO_2 , hence C_8H_{18} is reduced. O_2 gains H atom / loses O atom to form H_2O , hence O_2 is oxidised.	[1] [1]
	(b)	Diesel contains a <u>higher number of carbon atoms</u> than petrol [1]. As the <u>number of carbon atoms increases</u> , the <u>molecular size of the hydrocarbons increases</u> . The <u>intermolecular forces of attraction</u> between the hydrocarbons <u>increases</u> . [1] Hence more energy is needed to overcome the intermolecular forces of attraction between the hydrocarbons . Hence diesel is a fraction of crude oil that is removed at a higher boiling point than petrol. [1]	[3]
	(c)	Three-way catalytic converter. Based on the chart, the three-way catalytic converter produces the <u>lowest mass of hydrocarbons, carbon monoxide and nitrogen oxides as compared to two-way catalytic converter</u> . Hence the three-way catalytic converter is a more effective catalytic converter. [1] OR Three-way catalytic converter can remove hydrocarbons, carbon monoxide and nitrogen oxides while two-way catalytic converter can only remove hydrocarbons and carbon monoxide. Hence the three-way catalytic converter is a more effective catalytic converter.	[1]
	(d)	Nitrogen oxides are <u>not converted in a two-way catalytic converter</u> . As a result, the <u>nitrogen oxides react with oxygen and dissolve in rainwater to form acid rain</u> , which corrodes limestone buildings, destroys aquatic life and plants.	[1]
10	(a)	$\text{NH}_4^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{NH}_3 (\text{g}) + \text{H}_2\text{O} (\text{l})$	[1]
	(b)	Percentage mass of nitrogen in ammonium chloride $= 14 / (14 + 4 + 35.5) \times 100$ $= 26.2\%$ (3 s.f.)	[1]
	(c)	(i) Ammonia has a relative molecular mass of 17, and is less dense than hydrogen chloride gas, with a relative molecular mass of 36.5. Hence ammonia gas diffuses faster than hydrogen chloride gas, forming the white solid ring closer to concentrated hydrochloric acid.	[1] [1]
		(ii) The white solid would appear faster as the rate of diffusion is faster;	[1]
	(d)	No visible change will be observed. Bromine is less reactive than chlorine and is unable to displace chloride from ammonium chloride.	[1] [1]
	(e)	Step 1: In an evaporating dish, heat gently to sublime ammonium chloride. Step 2: Place an inverted filter funnel over the evaporating dish to cool down and condense the gaseous ammonium chloride to form white solid. Diagram drawn must be labelled properly to be awarded [1]. Student will need to state step 2 to get full credit.	[1] [1]
	(f)	As we go down the group, the boiling point or melting point increases / density increases / colour intensity increases / changes from gas to liquid to solid.	[1]

11	Either						
(a)	(i)		aldehyde	chemical formula	structural formula	[1]	
			propanal	C_3H_6O			
		Award [1] only when all answers are correct					
	(ii)	These molecules have the <u>same functional group</u> of CHO./ These molecules have the <u>same general formula</u> , $C_nH_{2n}O$./ Each member's molecular formula differs from the next member by CH_2 . Award [1] for each correct answer.					[2]
(b)	Oxidising agent: acidified potassium manganate Observation: Violet potassium manganate decolourises.					[1] [1]	
(c)	(i)	<u>Condensation</u> reaction occurs when the molecules join with one another <u>covalently</u> to form a <u>new product</u> , with the <u>elimination</u> of <u>small molecules</u> such as water.					[1]
	(ii)						[1]
(d)	(i)	Similarity: Both reactions eliminate / release / produce water molecules / involve ester bond formation [1]. Difference: Ethyl pentanoate is a simple molecule but Terylene is a macromolecule / Terylene has more than one ester linkage but ethyl pentanoate has only one. [1]					[2]
	(ii)	Terylene is <u>non-biodegradable</u> and will <u>remain</u> on Earth for a long time. Hence, Terylene will take up <u>space in landfill sites</u> , causing <u>land pollution</u> .					[1]
11	Or						
(a)	X: aspirin Y: acetaminophen Z: caffeine Award [1] for 1 or 2 correct answer Award [2] for all correct answers					[2]	
(b)	Based on the R_f values, <u>caffeine</u> has the highest affinity for the silica gel. [1] Caffeine has the <u>lowest R_f</u> value as compared to aspirin and acetaminophen, this shows that the <u>distance moved</u> by caffeine on the TLC plate is <u>the shortest distance</u> . Hence this shows that caffeine has high affinity for silica gel. [1]					[2]	

(c)	The <u>experimental melting points</u> for all three compounds are <u>lower</u> than the <u>literature values</u> . [1] A possible reason is that <u>compounds X, Y and Z</u> are <u>not 100% pure</u> . [1] Or the compounds may contain <u>impurities</u> .		[2]
(d)	(i)	Concentrated sulfuric acid, warm/heat (under reflux)	[1]
	(ii)		[2]
		Award [1] for each correct answer	
	(iii)	The process is similar to esterification, which is a <u>reversible</u> process. Hence some of the product, acetaminophen, formed is <u>converted back</u> to reactant particles.	[1]

