

Markscheme

May 2019

Chemistry

Standard level

Paper 2

12 pages

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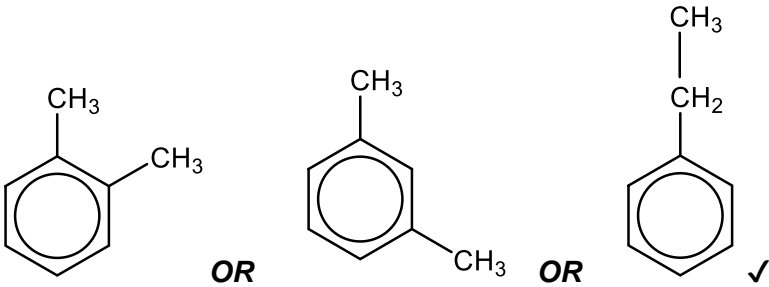
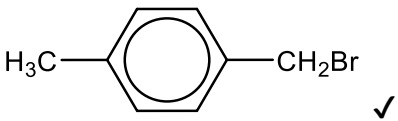
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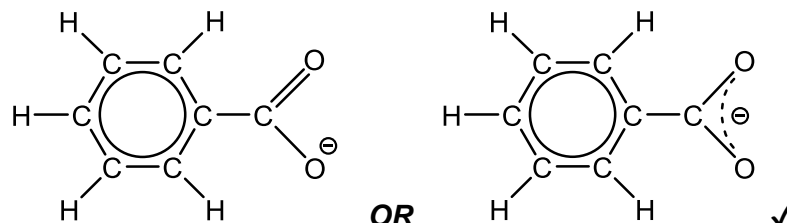
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Question			Answers	Notes	Total
1.	a		<p>Number of signals: 2 ✓</p> <p>Ratio: 3:2 OR 6:4 ✓</p>	<p>Accept any correct integer or fractional ratio. Accept ratios in reverse order.</p>	2
1.	b				1
1.	c	i	<p>$\text{Br}_2 \rightarrow 2\text{Br}\cdot$ ✓</p> <p>«sun»light/UV/hv OR high temperature ✓</p>	<p>Do not penalize missing radical symbol on Br. Accept “homolytic fission of bromine” for M1.</p>	2
1.	c	ii	 <p>HBr ✓</p>	<p>Accept condensed formulae, such as $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_2\text{Br}$. Accept skeletal structures.</p>	2

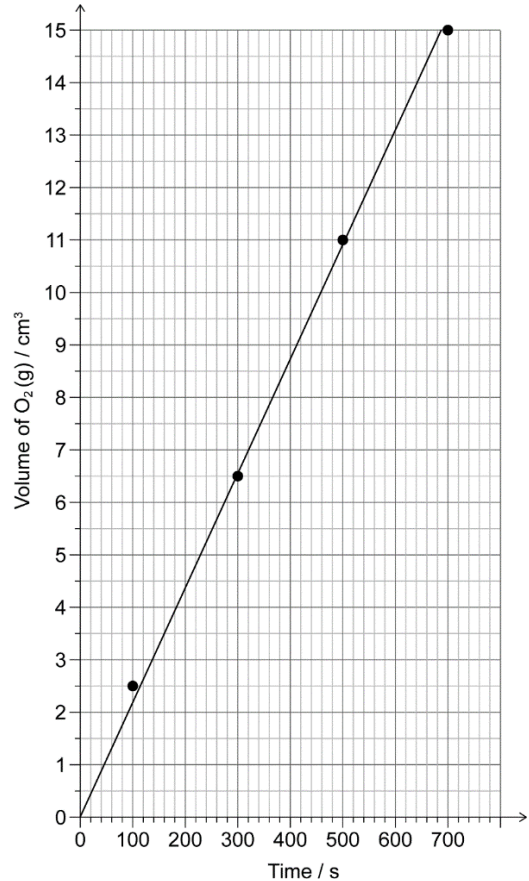
Question			Answers	Notes	Total
2.	a		 <p style="text-align: center;">OR</p>	<p>Accept Kekulé structures.</p> <p>Negative sign must be shown in correct position- on the O or delocalised over the carboxylate.</p>	1
2.	b	i	<p>ALTERNATIVE 1: $[H^+] \llcorner 10^{-2.95} \llcorner = 1.122 \times 10^{-3} \llcorner \text{mol dm}^{-3} \llcorner \checkmark$ $\llcorner [OH^-] = \frac{1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}}{1.22 \times 10^{-3} \text{ mol dm}^{-3}} \llcorner \Rightarrow 8.91 \times 10^{-12} \llcorner \text{mol dm}^{-3} \llcorner \checkmark$</p> <p>ALTERNATIVE 2: $\text{pOH} = \llcorner 14 - 2.95 \llcorner \Rightarrow 11.05 \checkmark$ $\llcorner [OH^-] = 10^{-11.05} \llcorner \Rightarrow 8.91 \times 10^{-12} \llcorner \text{mol dm}^{-3} \llcorner \checkmark$</p>	<p>Award [2] for correct final answer.</p> <p>Accept other methods.</p>	2
2.	b	ii	$2C_6H_5COOH(s) + 15O_2(g) \rightarrow 14CO_2(g) + 6H_2O(l)$ correct products \checkmark correct balancing \checkmark		2
2.	c		$\llcorner \text{intermolecular} \llcorner$ hydrogen bonding \checkmark	<p>Accept diagram showing hydrogen bonding.</p>	1

Question			Answers	Notes	Total
3.	a	i	<p>«3-D/giant» regularly repeating arrangement «of ions» OR lattice «of ions» ✓</p> <p>electrostatic attraction between oppositely charged ions OR electrostatic attraction between Na⁺ and O²⁻ ions ✓</p>	<p><i>Do not accept "ionic" without description.</i></p>	2
3.	a	ii	<p><i>Sodium oxide:</i> $\text{Na}_2\text{O (s)} + \text{H}_2\text{O (l)} \rightarrow 2\text{NaOH (aq)}$ ✓</p> <p><i>Phosphorus(V) oxide:</i> $\text{P}_4\text{O}_{10} \text{(s)} + 6\text{H}_2\text{O (l)} \rightarrow 4\text{H}_3\text{PO}_4 \text{(aq)}$ ✓</p> <p><i>Differentiation:</i> NaOH / product of Na₂O is alkaline/basic/pH > 7 AND H₃PO₄ / product of P₄O₁₀ is acidic/pH < 7 ✓</p>		3

(continued...)

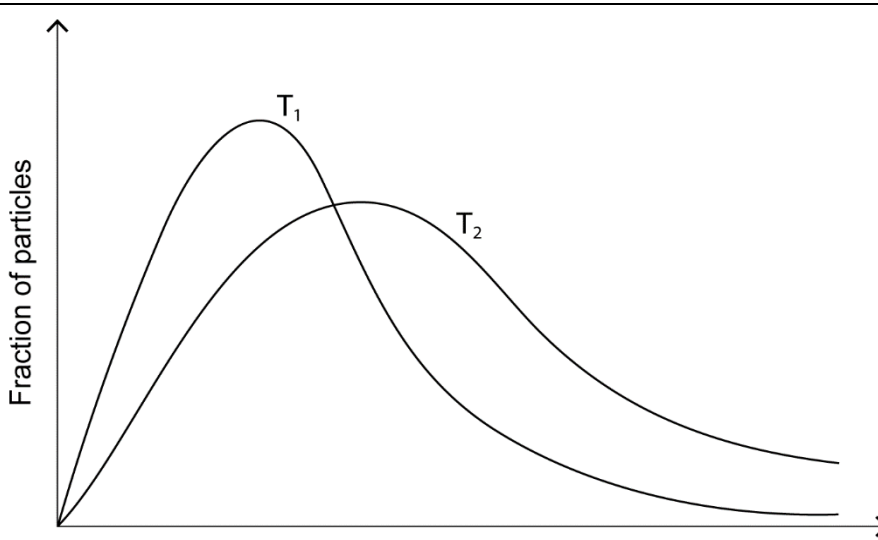
(Question 3 continued)

Question			Answers	Notes	Total
3.	b		$n(\text{Na}_2\text{O}_2)$ theoretical yield «= $\frac{5.00 \text{ g}}{61.98 \text{ g mol}^{-1}}$ » = $0.0807/8.07 \times 10^{-2}$ «mol» OR mass Na_2O_2 theoretical yield «= $\frac{5.00 \text{ g}}{61.98 \text{ g mol}^{-1}} \times 77.98 \text{ g mol}^{-1}$ » = 6.291 «g» ✓ % yield «= $\frac{5.50 \text{ g}}{6.291 \text{ g}} \times 100$ » OR « $\frac{0.0705}{0.0807} \times 100$ » = 87.4 «%» ✓	Award [2] for correct final answer.	2
3.	c	i	$\Sigma\Delta H_f$ products = $2 \times (-1130.7) / -2261.4$ «kJ» ✓ $\Sigma\Delta H_f$ reactants = $2 \times (-510.9) + 2 \times (-393.5) / -1808.8$ «kJ» ✓ $\Delta H = \text{«}\Sigma\Delta H_f \text{ products} - \Sigma\Delta H_f \text{ reactants} = -2261.4 - (-1808.8) = \text{»} -452.6$ «kJ» ✓	Award [3] for correct final answer. Award [2 max] for “+452.6 «kJ»”.	3
3.	c	ii	only valid for covalent bonds OR only valid in gaseous state ✓		1
3.	d		NaOH ✓	Accept correct equation showing NaOH as a product.	1
3.	e		IV ✓		1

Question			Answers	Notes	Total
4.	a		decomposes in light ✓	Accept "sensitive to light".	1
4.	b	i	 <p>points correctly plotted ✓ best fit line AND extended through (to) the origin ✓</p> <p>Average rate of reaction: «slope (gradient) of line => 0.022 «cm³ O₂ (g) s⁻¹» ✓</p>	Accept range 0.020–0.024 cm ³ O ₂ (g) s ⁻¹ .	3

(continued...)

(Question 4 continued)

Question			Answers	Notes	Total
4.	b	ii	 <p>peak of T₂ to right of AND lower than T₁ ✓ lines begin at origin AND T₂ must finish above T₁ ✓</p>		2
4.	b	iii	<p>E_a marked on graph ✓ explanation in terms of more “particles” with $E \geq E_a$ OR greater area under curve to the right of E_a in T₂ ✓</p>		2
4.	b	iv	<p>manganese(IV) oxide OR manganese dioxide ✓</p>	Accept “manganese(IV) dioxide”.	1

(continued...)

(Question 4 continued)

Question		Answers	Notes	Total
4.	c	move «position of» equilibrium to right/products ✓	Accept "reactants are always present as the reaction is in equilibrium".	1
4.	d	$M(\text{H}_2\text{O}_2) = 2 \times 1.01 + 2 \times 16.00 = 34.02 \text{ «g» } \checkmark$ $\text{«% H}_2\text{O}_2 = 3 \times \frac{34.02}{314.04} \times 100 = \text{» } 32.50 \text{ «%» } \checkmark$	Award [2] for correct final answer.	2

Question			Answers	Notes	Total
5.	a		partial dissociation «in aqueous solution» ✓		1
5.	b		ethanoic acid/vinegar reacts with NaOH ✓ moves equilibrium to left/reactant side ✓ releases Cl ₂ (g)/chlorine <u>gas</u> OR Cl ₂ (g)/chlorine <u>gas</u> is toxic ✓	Accept “ethanoic acid produces H ⁺ ions”. Accept “ethanoic acid/vinegar reacts with NaOCl”. Do not accept “2CH ₃ COOH + NaOCl + NaCl → 2CH ₃ COONa + Cl ₂ + H ₂ O” as it does not refer to equilibrium. Accept suitable molecular or ionic equations for M1 and M3.	3
5.	c	i	$\begin{array}{c} \text{H} : \overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{N}}} : \overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{Cl}}} : \\ \quad \quad \quad \text{H} \end{array}$ <p style="text-align: right;">✓</p>	Accept any combination of dots/crosses or lines to represent electron pairs.	1
5.	c	ii	Molecular geometry: «trigonal» pyramidal ✓ H–N–H bond angle: 107° ✓	Accept angles in the range of 100–109.	2

Question			Answers	Notes	Total
6.	a		${}_{26}^{54}\text{Fe}$ ✓		1
6.	b		<p>«A_r =» $54 \times 0.0584 + 56 \times 0.9168 + 57 \times 0.0217 + 58 \times 0.0031$</p> <p>OR</p> <p>«A_r =» 55.9111 ✓</p> <p>«A_r =» 55.91 ✓</p>	<p>Award [2] for correct final answer.</p> <p>Do not accept data booklet value (55.85).</p>	2

(continued...)

