

**CHEMISTRY****9701/23**

Paper 2 AS Level Structured Questions

**May/June 2017**

MARK SCHEME

Maximum Mark: 60

**Published**

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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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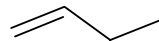
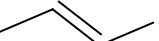
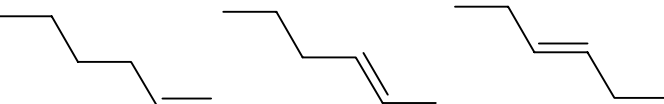
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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	(molecules / isomers with) the same molecular formula / same number of atoms of each element	<b>1</b>
	different structural / displayed formulae / different arrangement of bonds	<b>1</b>
1(b)(i)	4	<b>1</b>
1(b)(ii)	6	<b>1</b>
1(b)(iii)	molecular = C <sub>4</sub> H <sub>8</sub>	<b>1</b>
	empirical = CH <sub>2</sub>  using alternative supplied data molecular = C <sub>6</sub> H <sub>12</sub>  empirical = CH <sub>2</sub>	<b>1</b>

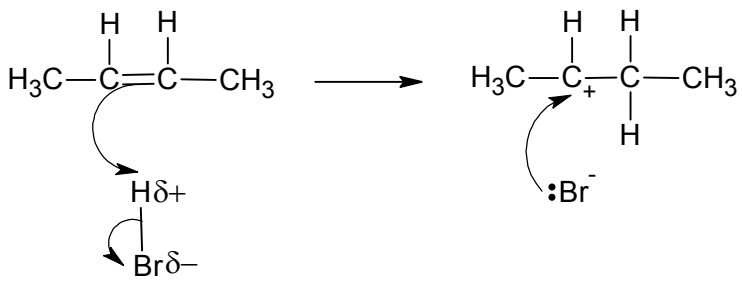
Question	Answer	Marks
1(b)(iv)		1
	 alternative using supplied data: any two	1
		
1(b)(v)	correct conversions of data to SI / consistent units $P = 100\,000$ ; $V = 25 \times 10^{-6}$ ; $T = 310$	1
	calculation of $n$ ( $= pV / RT$ ) $n = \frac{100 \times 10^3 \times 25 \times 10^{-6}}{8.31 \times 310}$	1
	calculation of mass $m$ ( $= n \times M_r$ ) AND answer correct to <b>3sf</b> $m = 9.705 \times 10^{-4} \times 56 = 0.0543$ (g)	1
	Alternative answer for using $C_6H_{12}$ : $m = 9.705 \times 10^{-4} \times 84 = 0.0815$ (g)	
	<b>Total:</b>	<b>11</b>

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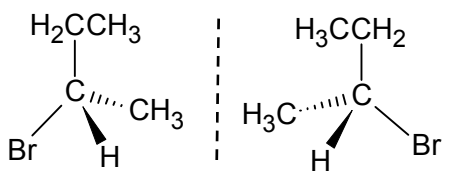
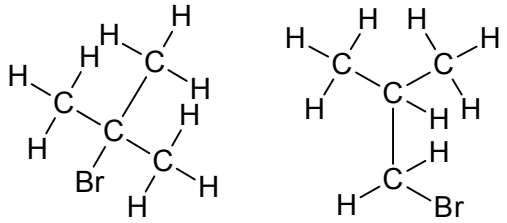
Question	Answer			Marks
2(a)(i)	halogen	colour	state	2
	chlorine	yellow / green	gas	
	bromine	red / brown / orange	liquid	
	iodine	grey / black	solid	
2(a)(ii)	increasing number of electrons			1
	(gives) increasing strength of van der Waals' / id-id forces / London / dispersion forces			1
2(b)	oxidising power decreases down the group.		<i>ora</i>	1
	ability to accept electrons decreases (down the group)		<i>ora</i>	1
	because (outer shell experiences) more shielding			1
	OR increased distance from nucleus (to outer shell) (outweighs the increasing nuclear charge down the group) <i>ora</i>			
2(c)(i)	solid sodium chloride: steamy / misty / white fumes			1
	solid sodium iodide: purple fumes			1
2(c)(ii)	(conc sulfuric) not powerful enough oxidising agent (to oxidise chloride)			1
	OR chloride not powerful enough reducing agent (to reduce sulfuric acid)			
	iodide reduces sulfuric acid			1
	OR iodide / I <sup>-</sup> is oxidised OR sulfuric acid oxidises iodide			



Question	Answer	Marks
3(b)(ii)	2 marks for any two points: <ul style="list-style-type: none"> <li>Benefit of using a catalyst in terms of increasing rate or economic benefit i.e. (less heat required)</li> <li>Creates alternative pathway with lower <math>E_a</math></li> <li>More molecules with <math>E &gt; E_a</math></li> </ul>	2
3(b)(iii)	(rate) increases AND correct explanation in terms of 'more collisions'	1
	more successful collisions per unit time / higher chance of successful collisions per unit time / higher proportion of successful collisions per unit time	1
	(yield) increases and shifts equilibrium to the right / in the forward direction / towards $\text{SO}_3$ / towards the product / in exothermic direction	1
	to oppose the change or oppose the increase in pressure / fewer molecules on RHS so eqm moves to right (to oppose change)	1
3(c)(i)	$\text{SO}_2 = 0.01$ (mol) AND $\text{SO}_3 = 0.99$ (mol)	1
3(c)(ii)	$n_{\text{TOT}} = 1.505$	1
	$p_{\text{O}_2} = 1.50 \times 10^5 \times (0.505 / 1.505) = 5.03 \times 10^4$ (Pa)	1
3(d)(i)	$(K_p =) \frac{p_{\text{SO}_3}^2}{p_{\text{O}_2} \times p_{\text{SO}_2}^2}$	1
3(d)(ii)	0.1946737305	1
	$\text{Pa}^{-1}$	1
	<b>Total:</b>	<b>17</b>

Question	Answer	Marks
4(a)	cracking	1
4(b)	<b>In any order</b> $\text{CH}_2=\text{CHCH}_2\text{CH}_3$ / $\text{CH}_2\text{CHCH}_2\text{CH}_3$ / $\text{CH}_2\text{CHC}_2\text{H}_5$ AND $\text{CH}_3\text{CH}=\text{CHCH}_3$ / $\text{CH}_3\text{CHCHCH}_3$ AND $(\text{CH}_3)_2\text{C}=\text{CH}_2$ / $(\text{CH}_3)_2\text{CCH}_2$	1
4(c)(i)	(different) molecules with the same (molecular and) structural formula	1
	(due to) different arrangement in space caused by C=C / double bond	1
4(c)(ii)	 <p>arrow from the C=C double bond drawn to the H</p> <p>dipole on H–Br in correct orientation AND arrow from the H-Br bond to the Br<sup>δ-</sup></p> <p>correct carbocation from the structure with C=C drawn</p> <p>Br<sup>-</sup> with lone pair, negative charge AND arrow from lone pair to the positively charged carbon atom of intermediate</p>	1
		1
		1
		1

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Question	Answer	Marks
4(d)(i)	a (tetrahedral) atom with four different groups / atoms / substituents attached OR a carbon (atom) with four different groups / atoms / substituents attached	1
4(d)(ii)	but-1-ene	1
4(d)(iii)	 <p data-bbox="347 614 1904 726">One 3D structure of 2-bromobutane which must have 2 bonds shown the same and two different, i.e. <b>three</b> bond types altogether, e.g. two solid lines, one wedge and one dash. If two bonds are drawn in the plane of the paper, i.e. single solid lines, they must <b>not</b> be at 180 degrees to each other.</p> <p data-bbox="347 742 1904 790">Second structure either mirror of first OR all bonds drawn the same with position of two groups swapped.</p>	1
4(d)(iv)	intermediate / (secondary carbo) cation from <b>X</b> is more stable      ora OR charge density of C <sup>+</sup> (of the intermediate of <b>X</b> ) is reduced	1
	(due to) electron-releasing character / (positive) inductive effect of alkyl groups / / due to electron releasing alkyl group	1
4(e)(i)	(2-)methylpropene / (2-)methylprop-1-ene	1
4(e)(ii)		2
	<b>Total:</b>	<b>17</b>