

Cambridge
International
AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY

9701/23

Paper 2 AS Level Structured Questions

May/June 2016

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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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	23

Question	Mark Scheme	Mark	Total
1 (a) (i)	$\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$	[1]	[1]
(ii)	$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{Fe}^{2+} \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O}$	[1]	[1]
(iii)	$(0.025 \times 32.0/1000) = 8 \times 10^{-4}$	[1]	[1]
(iv)	$(8 \times 10^{-4} \times 6) = 4.8 \times 10^{-3}$	[1]	[1]
(v)	$(4.8 \times 10^{-3} \times 250/25.0) = 4.8 \times 10^{-2}$	[1]	[1]
(vi)	$(4.8 \times 10^{-2} \times 55.8) = 2.68/2.678$	[1]	[1]
(vii)	$(2.68/3.35) = 80\%$	[1]	[1]
(b) (i)	covalent small(er) difference in electronegativity between Fe and Cl (than between Al and Cl)	[1] [1]	[2]
(ii)	$\text{FeCl}_3 + 6\text{H}_2\text{O} \rightarrow [\text{Fe}(\text{H}_2\text{O})_6]^{3+} 3\text{Cl}^-$ OR $\text{FeCl}_3 + 6\text{H}_2\text{O} \rightarrow [\text{Fe}(\text{H}_2\text{O})_6\text{OH}]^{2+} + \text{H}^+ + 3\text{Cl}^-$	[1]	[1]
			[10]
2 (a)	$\text{NH}_3 + \text{HNO}_3 \rightarrow \text{NH}_4\text{NO}_3$	[1]	[1]
(b) (i)	line from origin AND below left-hand end of original with peak to right of and lower than original crosses original once AND above right-hand end of original AND above energy axis	[1] [1]	[2]
(ii)	(curves show) more molecules with $E > E_a$ (at higher T) so greater frequency of successful (owtte) collisions / more successful (owtte) collisions per unit time	[1] [1]	[2]
(iii)	catalysed E_a shown to left of original on horizontal axis so more molecules with $E > E_a$ (in presence of catalyst)	[1] [1]	[2]

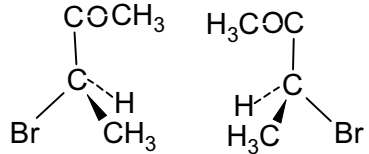
Page 3	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(iv)	production of ammonia is <u>exothermic</u> / (forward) reaction <u>exothermic</u> position of eqm would move to left/reverse/reduce yield (at higher T)	[1] [1]	[2]
(c)	$4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$ N changes from -3 to $+2$ (so oxidation) O changes from 0 to -2 (so reduction)	[1] [1] [1]	[3]
(d) (i)	$\begin{array}{c} \text{H} \quad (+) \\ \cdot_x \\ \text{H} \times \text{N} : \text{H} \\ \cdot_x \\ \text{H} \end{array}$	[1+1]	[2]
(ii)	shape = tetrahedral angle = $109^\circ - 109.5^\circ$	[1] [1]	[2]
(e)	eutrophication / algal bloom / stimulates growth of algae (bacteria) use up oxygen when decomposing the plants / algae block light for plants so less oxygen produced aquatic life / fish die (due to lack of oxygen)	[1] [1] [1] [1]	[max 3]
			[19]
3 (a) (i)	vaporise / boil / turn to gas	[1]	[1]
(ii)	increasing molecular size / no of carbon atoms per molecule / length of carbon chain	[1]	[1]
(iii)	increasing b.pt / decreasing volatility increasing viscosity increasing density increasing depth of colour decreasing flammability / decreasing 'cleanliness' of flame	[1] [1]	[2]
(b) (i)	$\text{C}_{12}\text{H}_{26} \rightarrow 2\text{C}_2\text{H}_4 + \text{C}_8\text{H}_{18}$	[1]	[1]

Page 4	Mark Scheme	Syllabus	Paper
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(ii)	ethene use = <u>making</u> polythene / plastic / polymers feature of ethene = double bond / unsaturated octane / alkane use = fuel / petrol feature of octane / alkane = flammability / releases energy when burned / combusted	[1] [1] [1] [1]	[4]
(c) (i)	(produced by) reaction of (atmospheric) oxygen and nitrogen due to high temperature / engine provides energy / combustion provides energy	[1] [1]	[2]
(ii)	$2\text{NO} + 2\text{CO} \rightarrow \text{N}_2 + 2\text{CO}_2$ / $\text{NO} + \text{CO} \rightarrow \frac{1}{2}\text{N}_2 + \text{CO}_2$	[1]	[1]
(iii)	$\text{NO} + \frac{1}{2}\text{O}_2 \rightarrow \text{NO}_2$ $\text{NO}_2 + \text{SO}_2 \rightarrow \text{SO}_3 + \text{NO}$ $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$ / $2\text{H}^+ + \text{SO}_4^{2-}$ / $\text{H}^+ + \text{HSO}_4^-$	[1] [1] [1]	[3]
(iv)	lowers pH of rivers / lakes / kills fish leaches (toxic) aluminium from soil (into rivers / lakes) leaches away soil nutrients damage to buildings / statues / trees / plants / crops ocean acidification / damage to coral	[1] [1] [1] [1] [1]	[max 2]
			[17]
4 (a)	3-hydroxybutan(-2-)one	[1]	[1]
(b)	H_2 / $\text{Cr}_2\text{O}_7^{2-}$ or names heat / reflux / warm	[1] [1]	[2]
(c) (i)	absorption at 1670–1740 C (=) O absorption at 2850–3000 C (-) H absorption at 3200–3650 O (-) H	[1] [1] [1]	[3]

Page 5	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(ii)	no absorption at 3200–3650 O-H disappears/no O-H bond in diacetyl	[1] [1]	[2]
(d) (i)	CH ₃ COCH(=)CH ₂	[1]	[1]
(ii)	one of the double-bonded C atoms/first C has 2H atoms attached ora so no cis-trans/ <i>E-Z</i> /geometric(al) isomerism possible OR no chiral C so mirror images superimposable/molecule not asymmetric	[1] [1]	[2]
(iii)	asymmetric/chiral C atom/carbon with four different groups/atoms attached	[1]	[1]
(iv)		[1+1]	[2]
			[14]