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

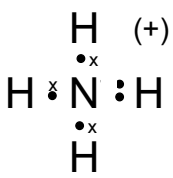
This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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

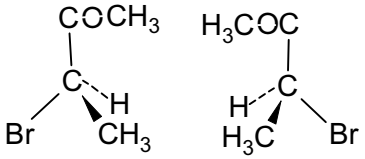
Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2016 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

Question	Mark Scheme	Mark	Total
1 (a) (i)	$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$	[1]	[1]
(ii)	$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$	[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)	$FeCl_3 + 6H_2O \rightarrow [Fe(H_2O)_6]^{3+} 3Cl^-$ OR $FeCl_3 + 6H_2O \rightarrow [Fe(H_2O)_6OH]^{2+} + H^+ + 3Cl^-$	[1]	[1]
			[10]
2 (a)	$NH_3 + HNO_3 \rightarrow NH_4NO_3$	[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]

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)	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ N changes from –3 to +2 (so oxidation) O changes from 0 to –2 (so reduction)	[1] [1] [1]	[3]
(d) (i)	 (+)	[1+1]	[2]
(ii)	shape = tetrahedral angle = 109°–109.5°	[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 owtte	[1] [1]	[2]
(b) (i)	$C_{12}H_{26} \rightarrow 2C_2H_4 + C_8H_{18}$	[1]	[1]

Question	Mark Scheme	Mark	Total
(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)	$2NO + 2CO \rightarrow N_2 + 2CO_2$ / $NO + CO \rightarrow \frac{1}{2}N_2 + CO_2$	[1]	[1]
(iii)	$NO + \frac{1}{2}O_2 \rightarrow NO_2$ $NO_2 + SO_2 \rightarrow SO_3 + NO$ $SO_3 + H_2O \rightarrow H_2SO_4$ / $2H^+ + SO_4^{2-}$ / $H^+ + HSO_4^-$	[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 / $Cr_2O_7^{2-}$ 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]

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)	$CH_3COCH(=)CH_2$	[1]	[1]
(ii)	one of the double-bonded C atoms / first C has 2H atoms attached **ora** so no cis-trans / *E-Z* / 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]