Cambridge International AS & A Level

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CHEMISTRY **9701/23**

Paper 2 AS Level Structured Questions **May/June 2016**

MARK SCHEME

Maximum Mark: 60

Published

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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]

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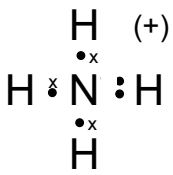
Question	Mark Scheme	Mark	Total
(iv)	production of ammonia is <u>exothermic</u> / (forward) reaction <u>exothermic</u> position of eqm would move to left / reverse / reduce yield (at higher T)	[1] [1]	[2]
(c)	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ N changes from –3 to +2 (so oxidation) O changes from 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]

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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]

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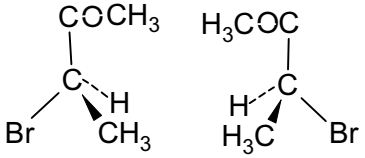
Question	Mark Scheme	Mark	Total
(ii)	no absorption at 3200–3650 O-H disappears / no O-H bond in diacetyl	[1] [1]	[2]
(d) (i)	$CH_3COCH(=)CH_2$	[1]	[1]
(ii)	one of the double-bonded C atoms / first C has 2H atoms attached **ora** so no cis-trans / *E-Z* / geometric(al) isomerism possible OR no chiral 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]

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