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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9701 CHEMISTRY

9701/22 Paper 2 (Structured Questions AS Core), maximum raw mark 60

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Question	Mark Scheme	Mark	Total
1 (a)	<table><tr><th>name of particle</th><th>relative mass</th><th>relative charge</th></tr><tr><td>proton</td><td>1</td><td>+1</td></tr><tr><td>electron</td><td>1/1836</td><td>–1</td></tr><tr><td>neutron</td><td>1</td><td>0</td></tr></table>	[1] [1] [1]	[3]
(b) (i)	Mass of an atom(s) relative to $1/12^{th}$ (the mass) of (an atom of) carbon-12 **OR** relative to carbon-12 which is (exactly) 12	[1] [1]	[2]
(ii)	% of third isotope = 10 $\frac{(24\times79)+(26\times11.0)+10x}{100}=24.3$ 10x = 248 x = 24.8 (3s.f.)	[1] [1] [1]	[3]
(c) (i)	anode $2Cl^- \rightarrow Cl_2 + 2e^-$ cathode $Mg^{2+} + 2e^- \rightarrow Mg$	[1] [1]	[2]
(ii)	Mg O H Cl $\frac{31.65}{24.3}$ $\frac{20.84}{16}$ $\frac{1.31}{1}$ $\frac{46.2}{35.5}$ 1.30 1.30 1.31 1.30 = 1:1:1:1 MgOHCl	[1] [1]	[2]
(d) (i)	Na_2O basic / alkaline; Al_2O_3 amphoteric / acidic and basic; SO_3 acidic Na_2O (giant) ionic **AND** SO_3 (simple / molecular) covalent	[1] [1]	[2]
(ii)	$Na_2O + 2HCl \rightarrow 2NaCl + H_2O$ $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$ $Al_2O_3 + 2NaOH + 7H_2O \rightarrow 2NaAl(OH)_4(H_2O)_2$ **OR** $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$ **OR** $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$ **OR** $Al_2O_3 + 2OH^- + 7H_2O \rightarrow 2[Al(OH)_4(H_2O)_2]^-$ **OR** $Al_2O_3 + 2OH^- + 3H_2O \rightarrow 2[Al(OH)_4]^-$ **OR** $Al_2O_3 + 2OH^- \rightarrow 2AlO_2^- + H_2O$ $SO_3 + NaOH \rightarrow NaHSO_4$ **OR** $SO_3 + 2NaOH \rightarrow Na_2SO_4 + H_2O$	[1] [1] [1] [1]	[4]

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Question	Mark Scheme	Mark	Total
			[18]
2 (a) (i)	$2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$ reagents and formulae balancing	 [1] [1]	[2]
(ii)	S (is oxidised) –2 to (+)4 O (is reduced) 0 to –2	[1] [1]	[2]
(b) (i)	T = 400 – 600 °C (chosen as a compromise because) High T increases rate ora High T decreases yield / moves eqm left / makes less SO_3 as forward reaction exothermic ora	[1] [1] [1]	[3]
(ii)	High pressure increases rate as collision frequency increases ora High pressure moves eqm right / favours forward reaction as more moles on left ora Uneconomic to use high pressures / high yield at low pressure	[1] [1] [1]	[3]
(c) (i)	Reaction (too) exothermic / acid spray produced	[1]	[1]
(ii)	$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$	[1] [1]	[2]
(d)	Preservative owtte antimicrobial / antioxidant / reducing agent	[1] [1]	[2]
(e) (i)	$12.35 \times 0.01 / 1000 = 1.235 \times 10^{-4}$	[1]	[1]
(ii)	$1.235 \times 10^{-4} \times 1000 / 50 = 2.47 \times 10^{-3}$	[1]	[1]
(iii)	$2.47 \times 10^{-3} \times 64.1 = 0.158327$ g = 158 (3 sf only)	[1]	[1]
			[18]
3 (a) (i)	Bond breaking = C*l*-C*l* = 242 C-H = 410 = 652 kJ Bond forming = C-C*l* = 340 H-C*l* = 431 = 771 kJ Enthalpy change = 652 – 771 = –119	 [1] [1] [1]	[3]
(ii)	UV / High T / sunlight	[1]	[1]

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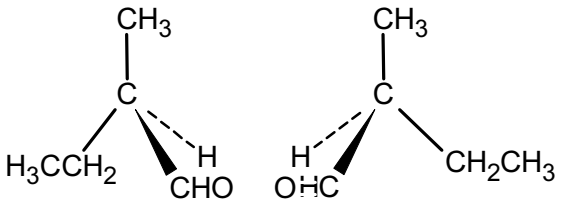
Question	Mark Scheme	Mark	Total
(iii)	Initiation $Cl_2 \rightarrow 2Cl\bullet$ Propagation $C_2H_6 + Cl\bullet \rightarrow \bullet C_2H_5 + HCl$ $\bullet C_2H_5 + Cl_2 \rightarrow C_2H_5Cl + Cl\bullet$ Termination $\bullet C_2H_5 + \bullet C_2H_5 \rightarrow C_4H_{10}$ All three names correctly assigned	 [1] [1] [1] [1] [1]	[5]
(b) (i)	ethene	[1]	[1]
(ii)	KOH / NaOH ethanolic **AND** heat / reflux	[1] [1]	[2]
(iii)	H_2 **AND** Pt or Ni (catalyst)	[1]	[1]
			[13]
4 (a) (i)	**A** = $CH_3CH_2CH_2CH_2CHO$ **B** = $CH_3CH_2CH(CH_3)CHO$ **C** = $(CH_3)_2CHCH_2CHO$ **D** = $(CH_3)_3CCHO$	[1] [1] [1] [1]	[4]
(ii)		[1+1]	[2]
(b) (i)	Fehling's / Benedict's **OR** Tollens' **OR** dichromate **OR** manganate Warm / heat Fehling's / Benedict's =(Brick)-red ppt Tollens' = silver / mirror **OR** grey/black precipitate Dichromate = orange to green Manganate = purple to colourless with the aldehyde / A-D	[1] [1] [1]	[3]
(ii)	(2,4-)DNP(H) / Brady's reagent Orange / yellow / red-orange / yellow-orange ppt	[1] [1]	[2]
			[11]

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