CAMBRIDGE INTERNATIONAL EXAMINATIONS

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

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.

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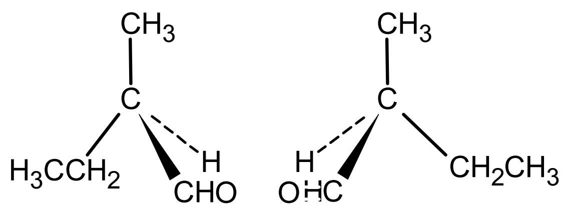
CAMBRIDGE
International Examinations

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

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]

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]