Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY (US) **0439/41**

Paper 4 Extended Theory **October/November 2017**

MARK SCHEME

Maximum Mark: 80

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.

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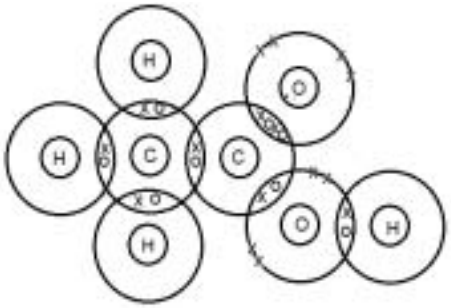
Question	Answer	Marks
1(a)(i)	**B**	**1**
1(a)(ii)	**A**	**1**
1(a)(iii)	**C**	**1**
1(a)(iv)	**E**	**1**
1(b)	O^{2-} **M1** O **M2** $^{2-}$	**2**

Question	Answer	Marks
2(a)(i)	**S**	**1**
2(a)(ii)	**S**	**1**
2(a)(iii)	**V**	**1**
2(b)	any value in the range 130–145 °C	**1**
2(c)	sublimation	**1**
2(d)(i)	Brownian motion	**1**
2(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	**1**
	(the bombarding particles) move randomly	**1**

Question	Answer	Marks
3(a)(i)	brown / orange solid (forms / is made) **OR** solution becomes paler / colourless	**1**
3(a)(ii)	magnesium is oxidised **AND** copper ions are reduced **OR** magnesium loses electrons **AND** copper ions gain electrons **OR** magnesium increases in oxidation number **AND** copper decreases in oxidation number	**1**
3(a)(iii)	Cu^{2+} **OR** copper(II) ions **OR** copper ions	**1**
	gains electrons	**1**
3(a)(iv)	$3Mg + Fe_2O_3 \rightarrow 3MgO + 2Fe$ **M1** Fe_2O_3 **AND** MgO **M2** fully correct	**2**
3(b)(i)	prevents air / oxygen **AND** water from reaching the steel	**1**
3(b)(ii)	magnesium is more reactive than iron / steel	**1**
	the magnesium corrodes (before the iron / steel) **OR** the magnesium corrodes preferentially	**1**
3(b)(iii)	copper is less reactive than iron / steel	**1**

Question	Answer	Marks
4(a)(i)	→ $2(C_2H_5OH)$ + $2CO_2$ **M1** carbon dioxide made as product **M2** balanced	**2**
4(a)(ii)	any 2 from: • 37 °C • anaerobic • glucose is aqueous • yeast	**2**
4(b)(i)	(concentrated) phosphoric acid	**1**
4(b)(ii)	92 If full credit is not awarded, allow 1 mark for M_r of ethene = 28	**2**
4(c)(i)	(acidified) potassium manganate(VII) **OR** potassium (di)chromate(VI)	**1**
4(c)(ii)	 **M1** all shared pairs of electrons correct for single bonds **M2** 2 shared pairs of electrons for the C=O bond **M3** total of 8 electrons on each O including 4 non-bonding electrons and no additional non-bonding electrons	**3**
4(d)(i)	partially ionised / dissociated	**1**

Question	Answer	Marks
4(d)(ii)	**M1** (acids) have same concentration	**1**
	M2: measure pH **OR** describe how to measure pH (such as use Universal Indicator) **M3**: lower pH corresponds to the stronger acid / hydrochloric acid **OR** **M2**: add calcium / magnesium / zinc / iron **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid **OR** **M2**: rate of reaction with (metal) carbonate **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid **OR** **M2**: rate of reaction with (named) metal oxide **M3**: dissolves faster means that reaction is with the stronger acid / hydrochloric acid **OR** **M2**: electrical conductivity **M3**: greater conductivity corresponds to the stronger acid / hydrochloric acid **OR** **M2**: add sodium hydroxide (or other named alkali) **M3**: greater temperature change corresponds to the stronger acid / hydrochloric acid	**2**
4(e)	structure of propanoic acid	**1**
	propanoic acid	**1**
	structure of butan-1-ol	**1**
	butan-1-ol	**1**

Question	Answer	Marks
5(a)(i)	*start colour:* green *end colour:* black	**1**
5(a)(ii)	$CuCO_3 \rightarrow CuO + CO_2$	**1**
5(b)(i)	(*copper(II) ions)* add sodium hydroxide (solution)	**1**
	(*copper(II) ions)* blue ppt.	**1**
	(*nitrate ions*) add aluminium **AND** aqueous sodium hydroxide **AND** warm	**1**
	ammonia given off / gas turns damp (red) litmus blue	**1**
5(b)(ii)	2 / 2 / 4 / 1	**1**
5(c)(i)	becomes paler	**1**
	equilibrium moves right	**1**
	(because) fewer moles (of gas) on right	**1**
5(c)(ii)	equilibrium moved right / more N_2O_4 / less NO_2	**1**
	(forward) reaction exothermic	**1**

Question	Answer	Marks
6(a)	aluminium is more reactive than carbon	**1**
6(b)(i)	oxide ion has an outer shell with six dots and two crosses	**1**
	oxide ion has a charge of 2^-	**1**

Question	Answer	Marks
6(b)(ii)	(electrostatic) forces of attraction between ions	**1**
	(are) strong **OR** require lots of energy to overcome	**1**
6(c)(i)	*the wires:* electrons	**1**
	the electrolyte: ions	**1**
6(c)(ii)	any 2 from: • increases conductivity • as a solvent • lowers the operating temperature	**2**
6(c)(iii)	$Al^{3+} + 3e^- \rightarrow Al$	**1**
6(c)(iv)	oxygen is made at the anode	**1**
	the anodes are made of carbon	**1**
	oxygen (made) reacts with carbon	**1**
6(d)	aluminium coated with layer of (unreactive) aluminium oxide	**1**

Question	Answer	Marks
7(a)(i)	more particles (of acid) in a given volume / dm^3 / cm^3	**1**
	more collisions per second / unit time **OR** greater collision rate	**1**

Question	Answer	Marks
7(a)(ii)	particles have more energy / particles move faster / more collisions per second / more collisions per unit time / greater collision rate	**1**
	more (of the) particles / collisions have energy greater than the activation energy / more particles have sufficient energy to react / more collisions have sufficient energy to react / a greater percentage of collisions are successful	**1**
7(b)(i)	0.075 If full credit is not awarded, allow 1 mark for M_r of CuO = 80	**2**
7(b)(ii)	0.05	**1**
7(b)(iii)	4 (g) **M1** moles copper(II) oxide that reacted = (0.05 / 2) = 0.025 mol **M2** mass copper(II) oxide = ((0.075 – 0.025) × 80) = 4 g	**2**
7(c)	$CCl_2CuH_4O_2$ **M1** 41.52 / 35.5; 37.43 / 64; 2.34 / 1; 18.71 / 16 **OR** 1.17 : 0.58 : 2.34 : 1.17 **M2** appropriate scaling to give whole number ratios	**2**