Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY (US) **0439/41**

Paper 4 Extended Theory **October/November 2016**

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.

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

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Question	Answer	Marks
1(a)	**H**	**1**
1(b)	**G**	**1**
1(c)	filtration	**1**
1(d)	fractional distillation	**1** **1**
1(e)	add / mix / stir / dissolve / shake / heat with water filter / decant heat (filtrate) or (leave filtrate to) evaporate	**1** **1** **1**
1(f)	electrons (electrons) move / flow (throughout structure)	**1** **1**

Question	Answer	Marks
2(a)(i)	melt(ing)	**1**
2(a)(ii)	sublimation / sublime	**1**
2(a)(iii)	condensing / condensation	**1**
2(b)	overcome / break the attractive forces	**1**
2(c)	**E AND** particles hit the walls (of the container) more often	**1**

Question	Answer	Marks
3(a)(i)	heated / evaporated / boiled	**1**
3(a)(ii)	any 2 from: (**O** is) more viscous / thicker (**O** is) darker (**O** has) longer / bigger molecules / more carbon atoms (**O** has a) higher boiling point **OR** melting point (**O** is) less flammable	**2**
3(b)	any 2 from: similar / same chemical properties same functional group trend / pattern in physical properties (neighbouring members) differ by CH_2 common methods of preparation	**2**
3(c)	any 2 structures from: pentane methylbutane dimethylpropane	**2**
3(d)	correct structure with any number from 1 to 6 of the hydrogen atoms replaced by chlorine atoms	**1**
3(e)(i)	(ends in) ene	**1**
3(e)(ii)	**M1** 88.24 / 12 **AND** 11.76 / 1 **M2** 7.353 / 7.353 (= 1) **AND** 11.76 / 7.353 = (1.6) **M3** C_5H_8	**1** **1** **1**
3(e)(iii)	relative molecular mass	**1**

Question	Answer	Marks
4(a)(i)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ **M1** formulae **M2** balancing	**2**
4(a)(ii)	(nitrogen) air / atmosphere (hydrogen) steam / water / hydrocarbons / natural gas	**1** **1**
4(a)(iii)	(temperature) answer in range 370–470 °C (pressure) answer in range 150–300 atm	**1** **1**
4(b)(i)	**M1** forward and reverse reactions (occur) **M2** amounts / moles / concentrations (of reagents and products) constant **OR** **M2** rate of forward and reverse reactions equal	**1** **1**
4(b)(ii)	endothermic **AND** yield increases as temperature increases	**1**
4(b)(iii)	**M1** yield decreases (as pressure increases) **M2** because more moles / molecules (of gas) on the right **M3** so position of equilibrium moves left	**1** **1** **1**

Question	Answer	Marks
5(a)	(gas) oxygen (test) glowing splint (result of test) relights	**1** **1** **1**
5(b)	reference to ions / ionic ions cannot move in solid **OR** are in fixed positions in solid ions can move when in solution	**1** **1** **1**
5(c)(i)	copper ions / Cu^{2+} gain of electrons / oxidation number decreases	**1** **1**
5(c)(ii)	any 3 from: anode decreases (in mass) copper removed (from anode) / solid (copper from anode) becomes aqueous cathode increases (in mass) copper deposited / added / Cu^{2+} deposited as Cu (on cathode)	**3**
5(c)(iii)	copper is both added and removed (at same rate) **OR** the concentration (of copper ions) does not change	**1**

Question	Answer	Marks
6(a)	large / big molecule made from (many) monomers (joined together)	**1** **1**
6(b)(i)	amide / peptide	**1**
6(b)(ii)	(can be) broken down by microbes / bacteria	**1** **1**
6(b)(iii)	starch / cellulose / DNA / RNA / polysaccharides /	**1**

Question	Answer	Marks
6(c)(i)	**M1** at least one correct ester linkage between boxes **M2** at least two boxes shown and sufficient correct C and O atoms to make **two correct** ester linkages **M3** continuation bond(s) **AND** if more than one repeat unit is shown, the repeat unit must be correctly identified	**1** **1** **1**

Question	Answer	Marks
7(a)	0.025 **M1** 50 / 1000 (=0.05) **M2** (0.05 × 0.5) = 0.025	 **1** **1**
7(b)	0.0125	**1**
7(c)	0.55 **M1** 44 **M2** 0.55	 **1** **1**
7(d)	0.3	**1**

Question	Answer	Marks
8(a)(i)	any 4 from: slowed down acid became less concentrated **OR** fewer particles per unit volume fewer collisions per second **OR** lower collision rate (then the reaction) stopped all the hydrochloric acid reacted	**4**
8(a)(ii)	any 4 from: faster (reaction) (powder has) larger surface area more collisions per second **OR** higher collision rate same volume of gas amount / moles hydrochloric acid is not changed	**4**
8(b)	any 5 from: temperature increased particles have more energy (particles) move faster more collisions per second **OR** higher collision rate more particles have sufficient energy to react / activation energy more of the collisions are successful	**5**