Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/42**

Paper 4 A Level Structured Questions **October/November 2017**

MARK SCHEME

Maximum Mark: 100

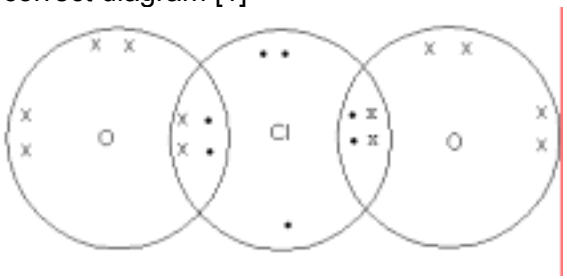
Published

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.

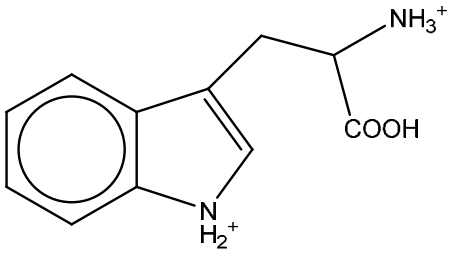
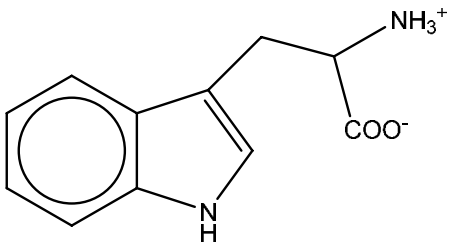
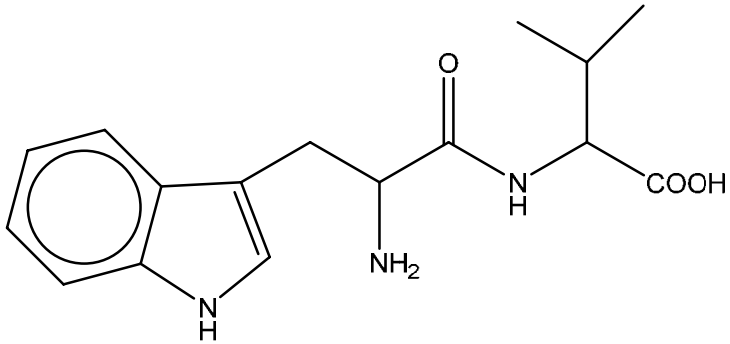
Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

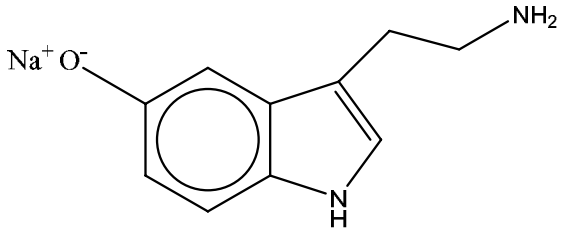
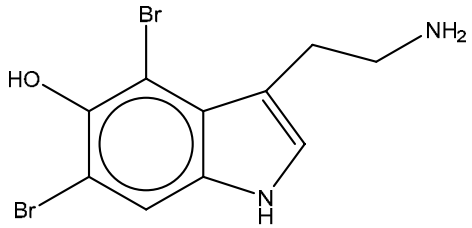
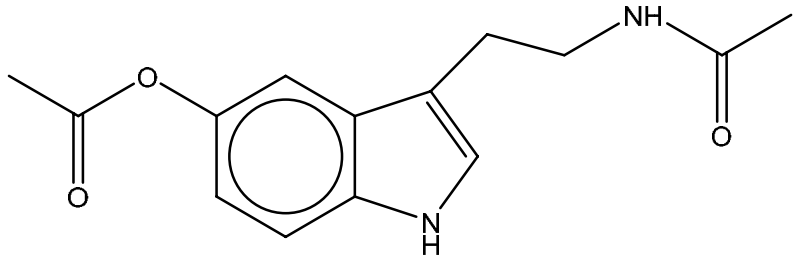
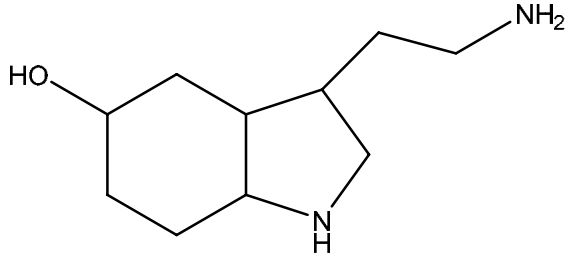
Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

Question	Answer	Marks
1(a)	C*l* +3 to +4 (and oxidised)	**1**
	C*l* 0 to –1 (and reduced)	**1**
1(b)	19 electrons total [1] correct diagram [1] 	**2**
1(c)(i)	the exponent / power to which a concentration is raised in the rate equation	**1**
1(c)(ii)	(0.0022 = *k* (0.01) × (0.06)) k = 3.7 (3.67)	**1**
	$mol^{-1}\ dm^3\ s^{-1}$	**1**
1(c)(iii)	initial rate = 5.50×10^{-3}	**1**
	[C*l*O$_2$] = 0.048	**1**
1(d)(i)	slowest step (in a multi-step reaction)	**1**
1(d)(ii)	1 mole of F_2 and 1 mole C*l*O$_2$ reacting in the rate-determining step	**1**
	1st step is rate-determining step **and** a balanced mechanism consistent with overall equation e.g. $ClO_2 + F_2 \rightarrow ClO_2F_2$ $\quad ClO_2 + ClO_2F_2 \rightarrow 2ClO_2F$ **or** $ClO_2 + F_2 \rightarrow ClO_2F + F$ $\quad ClO_2 + F \rightarrow ClO_2F$	**1**
1(e)	k increases (as rate increases)	**1**

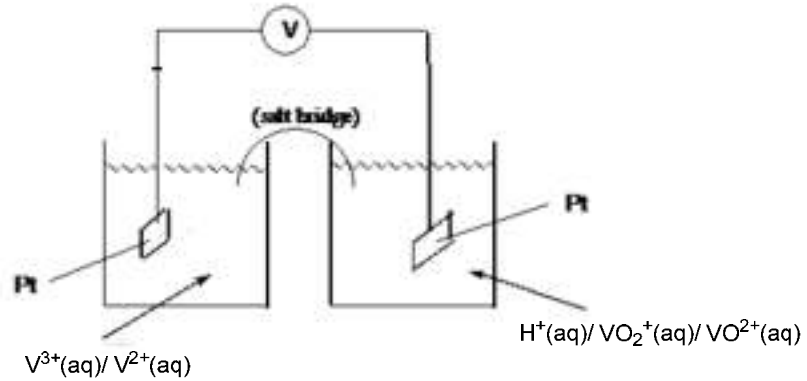
Question	Answer	Marks
2(a)(i)	$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$	**1**
2(a)(ii)	moles of Mg_3N_2 = 2.52 / 100.9 = 0.025 (0.0249)	**1**
	(moles of $Mg(OH)_2$ = 0.075 (0.0749)) mass of $Mg(OH)_2$ = (0.075 × 58.3) = 4.37 g or 4.4 g	**1**
2(b)	solubility increases (down the group)	**1**
	ΔH_{latt} and ΔH_{hyd} both decrease / less exothermic / more endothermic	**1**
	but ΔH_{latt} decreases more (than ΔH_{hyd} decreases)	**1**
	ΔH_{sol} becomes more negative / more exothermic / less endothermic	**1**
2(c)(i)	$K_{sp} = [Mg^{2+}] [OH^-]^2$	**1**
2(c)(ii)	$K_{sp} = (1.7 \text{ x } 10^{-4}) \times (2 \times 1.7 \times 10^{-4})^2 = 2.0 \times 10^{-11}$ (1.97×10^{-11})	**1**
	$mol^3\ dm^{-9}$	**1**
2(d)	cations become bigger / ionic radius increases	**1**
	polarisation/distortion of anion / hydroxide ion decreases	**1**

Question	Answer	Marks
3(a)(i)	 pH 1  pH 5.9	**2**
3(a)(ii)	 peptide link [1] rest of the structure [1]	**2**

Question	Answer	Marks
3(b)		8

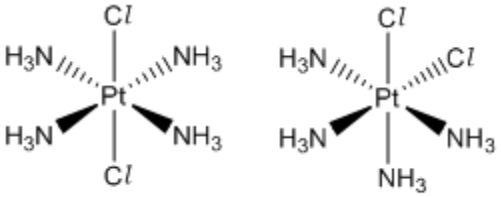
reagent	structure of product	type of organic reaction
Na	 [1]	redox or reduction
excess $Br_2(aq)$	 [1]	(electrophilic) substitution
excess CH_3COCl	 acylated OH [1] acylated $NH_{(2)}$ [1]	condensation (or addition + elimination)
excess H_2 / Pt catalyst	 [1]	reduction or hydrogenation or addition

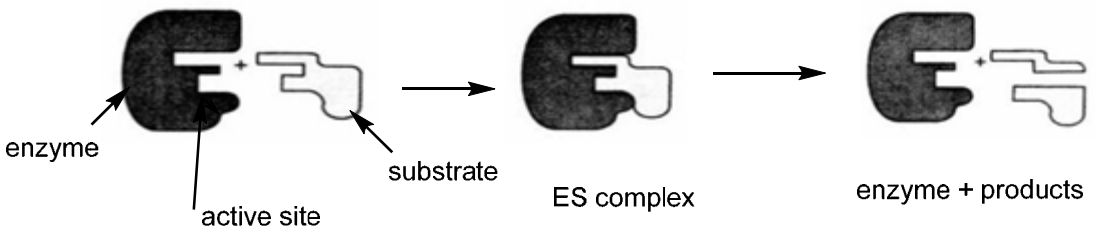
Question	Answer	Marks
3(c)(i)	(spectrum of M) contains a broad peak (for O–H) at 2500–3000 cm^{-1} ***or*** (spectrum of M) contains peak (for C=O) at 1640–1750 cm^{-1} ***or*** (spectrum of M) lacks (NH_2 peak) at 3300–3500 cm^{-1}	**1**
3(c)(ii)	5 or 6 peaks	**1**
	OH/NH protons exchange with deuterium ***or*** –OH / –NH + D_2O → –OD / –ND + DHO	**1**
3(d)	ester **and** hydrolysed	**1**

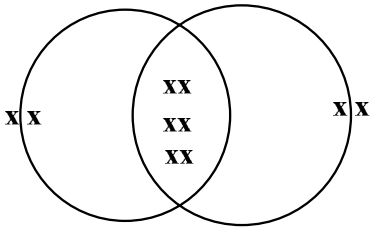
Question	Answer	Marks
4(a)(i)	$E^{\ominus}_{cell}$ = 1.00 – (–0.26) = (+)1.26 V	**1**
4(a)(ii)	$VO_2^+ + V^{2+} + 2H^+ \rightarrow VO^{2+} + V^{3+} + H_2O$	**1**
4(a)(iii)	 solutions labelled correctly in one half-cell [1] solutions labelled correctly in both half-cells [1] two graphite or platinum electrodes [1] salt bridge and voltmeter [1]	**4**

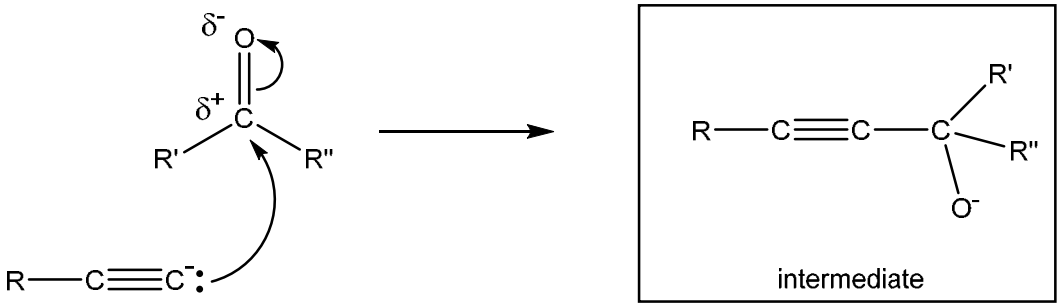
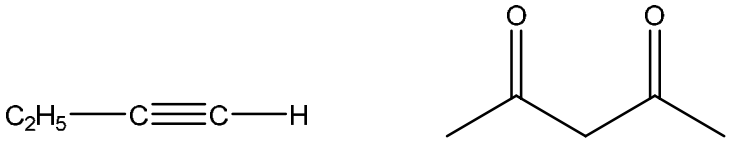
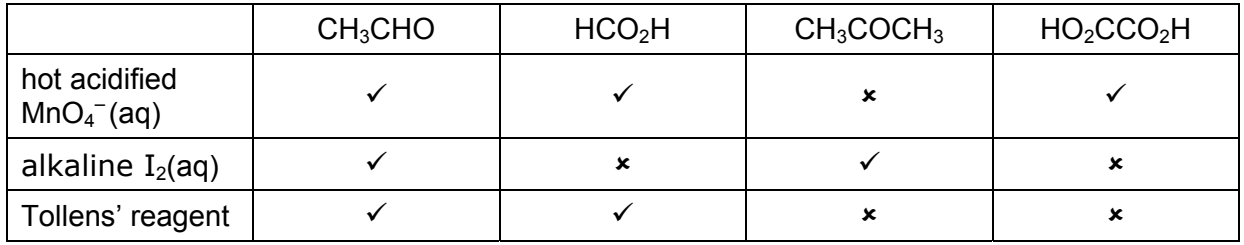
Question	Answer	Marks
4(b)	• V^{2+}(aq) and Sn^{4+}(aq): yes and $E^{\ominus}_{cell}$ = +0.15 – (–0.26) = +0.41 V [1] $2V^{2+} + Sn^{4+} \rightarrow 2V^{3+} + Sn^{2+}$ [1] • VO^{2+}(aq) and Fe^{3+}(aq) no reaction [1]	**3**

Question	Answer	Marks
5(a)	(Na^{+}) 0.095 / 0.181 = 0.525 **and** octahedral **and** co-ordination no. = 6	**1**
	(Mg^{2+}) 0.065 / 0.181 = 0.359 **and** tetrahedral **and** co-ordination no. = 4	**1**
5(b)	enthalpy change = (–642) – (2 × –106) = **–430**	**1**
5(c)(i)	–106 = 147 + 121 + 736 + (–349) + lattice energy lattice energy = –761	**3**
5(c)(ii)	$MgCl_2$ more exothermic / negative / bigger than $MgCl$ **and** $NaCl$ more exothermic / negative / bigger than $MgCl$	**1**
	(reason for $MgCl_2$) higher charge / lower radius of Mg^{2+} cation	**1**
	(reason for $NaCl$) smaller radius of Na^{+} cation	**1**
5(d)	energy change when 1 mole of atoms / ions each gain an electron **or** energy change when 1 mole of atoms / ions gain 1 mole of electrons	**1**
	gaseous	**1**

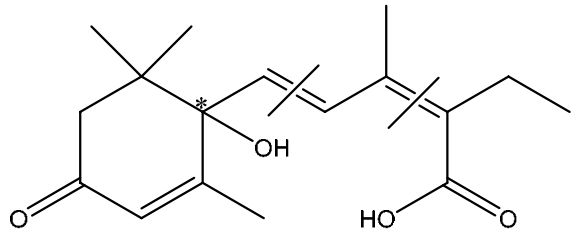
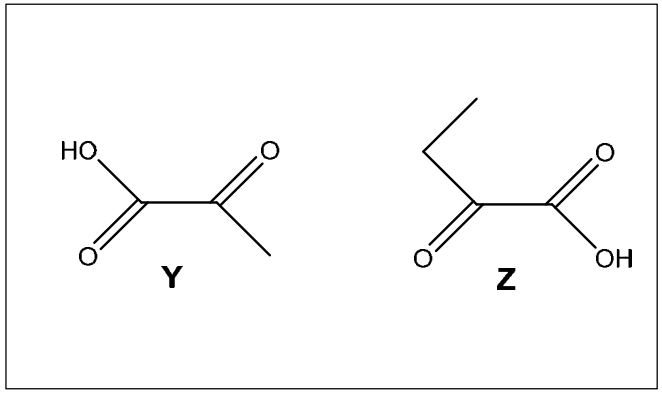
Question	Answer	Marks
6(a)	central metal atom/ion surrounded by (one or more) ligands	**1**
6(b)	<table><tr><td></td><td>co-ordination number</td><td>oxidation number</td></tr><tr><td>$[Pt(NH_3)_4Cl_2]^{2+}$</td><td>6</td><td>+4</td></tr><tr><td>$[PtCl_4]^{2-}$</td><td>4</td><td>+2</td></tr></table>	**2**
6(c)		**2**
6(d)	(HNO_3 +) $AgNO_3$ reagent	**1**
	$[Pt(NH_3)_4Cl_2]Br_2$ with cream ppt. (of AgBr) **and** $[Pt(NH_3)_4Br_2]Cl_2$, with white ppt. (of AgCl) observation with both	**1**
6(e)	octahedral: both	**1**
	square planar: geometric	**1**
	tetrahedral: neither	**1**

Question	Answer	Marks
6(f)	diagrams  Marks can be awarded from words or diagram. Any three marking points from: • substrate shape is complementary to active site • the substrate binds / bonds / fits into the active site • products are released • lower E_A / bonds weakened in substrate	3

Question	Answer	Marks
7(a)(i)	$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$	1
7(a)(ii)		1
7(b)	C_nH_{2n-2}	1
7(c)(i)	delocalised electrons	1
7(c)(ii)	CH	1
7(c)(iii)	less dense	1

Question	Answer	Marks
7(d)(i)	 2 curly arrows [1] dipole [1] intermediate [1]	3
7(d)(ii)	nucleophilic addition	1
7(d)(iii)	 [1] **Q** [1] **R**	2
7(e)		4

	CH_3CHO	HCO_2H	CH_3COCH_3	HO_2CCO_2H
hot acidified MnO_4^-(aq)	✓	✓	×	✓
alkaline I_2(aq)	✓	×	✓	×
Tollens' reagent	✓	✓	×	×

Question	Answer	Marks
8(a)(i)	 circle or asterisk on correct C atom only [1] lines through the two correct bonds only [1]	**2**
8(a)(ii)	ketone, (tertiary) alcohol, alkene, carboxylic acid two for each mark	**2**
8(a)(iii)	sp carbons = 0 sp^2 carbons = 8 sp^3 carbons = 9	**1**
8(a)(iv)		**2**
8(b)(i)	**compound** / **spot** J / 2 K / 3 L / 1	**1**

Question	Answer	Marks
8(b)(ii)	The more polar the compound **and** stronger attractive forces to the (polar) stationary phase ora: less polar compound **and** weaker attractive forces to the (polar) stationary phase	**1**
8(b)(iii)	R_f = retardation factor **or** retention factor **or** R_f =distance moved by compound from baseline over distance travelled by solvent front	**1**