

---

**CHEMISTRY**

**9701/43**

Paper 4 A Level Structured Questions

**May/June 2016**

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 will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2016 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2016</b>	<b>9701</b>	<b>43</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
<b>1 (a) (i)</b>	$\text{Ca(OH)}_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$	[1]
<b>(ii)</b>	$\text{Ba(OH)}_2$ is soluble, OR $\text{BaCO}_3$ is insoluble	[1]
<b>(iii)</b>	$\text{Mg(OH)}_2$ is insoluble / not very soluble will not form ppt. of $\text{MgCO}_3$	[1] [1]
<b>(b)</b>	carbonates are more stable down the group due to increase in cationic size / radius (causing) less polarisation of $\text{CO}_3^{2-}$ ion	[1] [1] [1]
<b>(c)</b>	radius of $\text{Ni}^{2+} = 0.070 \text{ nm}$ ; radius of $\text{Ca}^{2+} = 0.099 \text{ nm}$ so $\text{NiCO}_3$ decomposes more readily than $\text{CaCO}_3$	[1] [1]
		<b>[Total: 9]</b>
<b>2 (a) (i)</b>	Co: ... $3s^23p^63d^74s^2$ Co <sup>2+</sup> : ... $3s^23p^63d^7$	[1]
<b>(ii)</b>	solution starts pink turns blue pink is $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ blue is $[\text{CoC}_4]^{2-}$ this complex is tetrahedral	[1] [1] [1] [1] [1]

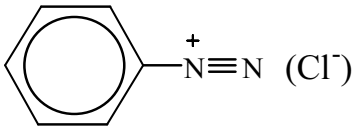
Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

Question	Answer	Marks
(b)		[1] [1] [1]
		<b>[Total: 9]</b>
3 (a)	$K_p = \frac{\{p(\text{CS}_2) \times (p(\text{H}_2))^4\}}{\{(p(\text{H}_2\text{S}))^2 \times p(\text{CH}_4)\}}$ units: $\text{atm}^2$ OR $\text{Pa}^2$	[1] [1]
(b) (i)	$p(\text{H}_2\text{S}) = 196 \text{ atm}$ $p(\text{H}_2) = 8 \text{ atm}$	[1] [1]
(ii)	$K_p = \frac{(2 \times 8^4)}{(196^2 \times 98)} = 2.176 \times 10^{-3}$	[1]
(c) (i)	$\Delta S^\circ$ will be positive, because more gas moles on the RHS/products	[1]
(ii)	$\Delta S^\circ = \frac{(\Delta H^\circ - \Delta G^\circ)}{T} = \frac{(241 - 51)}{1000} = 0.19 \text{ OR } 190$ $\text{kJ mol}^{-1} \text{K}^{-1}$ OR $\text{J mol}^{-1} \text{K}^{-1}$	[1] [1]
(d)	$\Delta G^\circ$ will become less positive/more negative as $T$ increases, ...because $\Delta S^\circ$ is positive (or $-T\Delta S^\circ$ is more negative) ...therefore the reaction becomes more feasible/spontaneous as $T$ increases	[2]
		<b>[Total: 10]</b>

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

Question	Answer	Marks
4 (a) (i)	SCP is the EMF / potential of a cell composed of two electrodes (OR half cells) under standard conditions (OR at 289 K OR 1 mol dm <sup>-3</sup> )	[1]
(ii)	voltmeter and salt bridge	[1]
(iii)	<b>A</b> is Ag <b>B</b> is Ag <sup>+</sup> (aq) or AgNO <sub>3</sub> (aq) <b>C</b> is Pt <b>D</b> is Fe <sup>2+</sup> (aq) and Fe <sup>3+</sup> (aq)  (combination of <b>A</b> and <b>B</b> can be reversed with combination of <b>C</b> and <b>D</b> )	[3]
(b) (i)	Ag <sup>+</sup> + Fe <sup>2+</sup> → Ag + Fe <sup>3+</sup>	[1]
(ii)	$E = E^{\ominus} + 0.059 \log [\text{Ag}^+] = 0.80 - 0.03 = 0.77 \text{ V}$ so $E_{\text{cell}} = 0.77 - 0.77 = 0.0 \text{ V}$	[1] [1]
		<b>[Total: 8]</b>
5 (a) (i)	pK <sub>a</sub> = -log K <sub>a</sub>	[1]
(ii)	diacids are more acidic than CH <sub>3</sub> CO <sub>2</sub> H HO <sub>2</sub> C– group is electron-withdrawing, stabilising the monoanion OR HO <sub>2</sub> C– group is electron-withdrawing, weakening the O–H bond OR monoanion is stabilised by H–bonding as n increases, the electron–withdrawing group is further away from the ionising CO <sub>2</sub> H group OR the (intervening) alkyl groups destabilise the anion	[1] [1] [1]
(iii)	removing H <sup>+</sup> from an anion is not electrostatically favourable	[1]
(b) (i)	a solution which <i>resists</i> changes in pH when <i>small</i> amounts of H <sup>+</sup> or OH <sup>-</sup> are added	[1] [1]

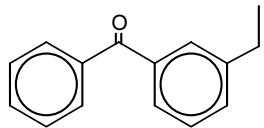
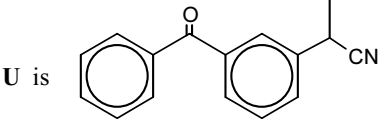
Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

Question	Answer	Marks
(ii)	$\text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}^+ \rightarrow \text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{H} + \text{Na}^+$ $\text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{NaOH} \rightarrow \text{NaO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}_2\text{O}$	[1] [1]
		<b>[Total: 9]</b>
6 (a) (i)	$\text{C}_6\text{H}_5\text{NO}_2 + 6\text{e}^- + 6\text{H}^+ \longrightarrow \text{C}_6\text{H}_5\text{NH}_2 + 2\text{H}_2\text{O}$	[1]
(ii)	$2\text{C}_6\text{H}_5\text{NO}_2 + 14\text{HCl} + 3\text{Sn} \rightarrow 2\text{C}_6\text{H}_5\text{NH}_3\text{Cl} + 3\text{SnCl}_4 + 4\text{H}_2\text{O}$	[2]
(b)	(M <sub>r</sub> values: C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> = 123 C <sub>6</sub> H <sub>5</sub> NH <sub>3</sub> Cl = 129.5) theoretical yield = $5.0 \times 129.5/123 = 5.26\text{ g}$ percentage yield = $100 \times 4.2/5.26 = 79.8\%$ (80%)	[1] [1]
(c) (i)	C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub> = 93 yield of phenylamine = $4.2 \times 93/129.5 = 3.016\text{ g}$	[1]
(ii)	mass left in water = $3.016 - 2.68 = 0.336\text{ g}$ $K_{\text{part}} = (2.68/50)/(0.336/25) = 3.99$	[1] [1]
(d)	phenylamine is less basic than ethylamine the lone pair on N is delocalised over the ring... ...making it less available for reaction with a proton/δ+ H	[2]
(e) (i)	step 1: HNO <sub>2</sub> OR (NaNO <sub>2</sub> + HCl) at T ≤ 10 °C step 2: boil/heat in water	[1] [1]
(ii)	E is 	[1]
		<b>[Total: 13]</b>

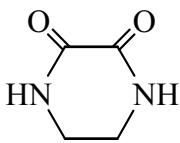
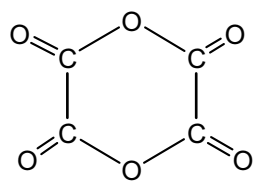
Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

Question	Answer	Marks
7 (a) (i)		[2]
(ii)	$M_r = 233$	[1]
(b) (i)	$\text{NH}_2\text{CH}(\text{CH}_2\text{OH})\text{CO}_2^-$	[1]
(ii)	<b>F</b> is a DC power supply <b>G</b> is the anode OR positive electrode <b>I</b> is the cathode OR negative electrode <b>H</b> is filter paper (OR gel) soaked in <b>buffer</b> solution	[4]
(iii)	<b>P</b> is $\text{NH}_2\text{CH}_2\text{CO}_2^-$ or $\text{NH}_2\text{CH}_2\text{CO}_2\text{H}$ or glycine <b>S</b> is $[\text{ala-ser-gly}]^{(-)}$ glycine is the smallest, so travels fastest; tripeptide is the largest, so travels slowest	[1] [1] [1]
(c) (i)	heat with $\text{H}_3\text{O}^+$ OR heat with $\text{OH}^-(\text{aq})$	[1]
(ii)	hydrolysis	[1]
		[Total: 13]
8 (a)	$\Delta H = [2(-580) + 3(-286) + 3(-1438)] - [-2061 + 4(-437) + 3(-814)]$ $= -81 \text{ kJ mol}^{-1}$	[2]
(b) (i)	<i>cis-trans</i> OR geometrical	[1]

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

Question	Answer	Marks
(ii)	in a complex the d-orbitals are split into 2 energy levels colour is due to absorption of light (in visible region) electron promotion to higher orbital absorbs a photon the d-d energy gap is different for the two complexes, hence different colours	[1] [1] [1] [1]
		[Total: 7]
9 (a)	T is  U is 	[1] [1]
(b)	step 1: $C_6H_5COCl + AlCl_3$ (+ heat) step 2: $CH_3CH_2Cl + AlCl_3$ (+ heat) step 3: $Br_2$ + light (or heat) step 4: $KCN$ + heat (in ethanol) step 5: $H_3O^+$ OR $H^+$ in $H_2O$ OR $HCl$ (aq) etc AND heat/boil/reflux	[1] [1] [1] [1] [1]
(c)	step 1: electrophilic substitution OR nucleophilic substitution step 5: hydrolysis OR nucleophilic substitution	[1] [1]
		[Total: 9]
10 (a)	$n(MnO_4^-) = 0.02 \times 15.2/1000 = 3.04 \times 10^{-4} \text{ mol}$ $n(C_2O_4H_2) = 3.04 \times 10^{-4} \times 5/2 = 7.6 \times 10^{-4} \text{ (in } 25 \text{ cm}^3) = 3.04 \times 10^{-3} \text{ mol in } 100 \text{ cm}^3$ $M_r = 24 + 64 + 2 = 90$ mass of $C_2O_4H_2 = 3.04 \times 10^{-3} \times 90$ $= 0.2736 \text{ g (0.274)}$ percentage = $0.2736 \times 100/40 = 0.68\%$	[1] [1] [1]
(b) (i)	$SOCl_2$ or $PCl_5$ or $PCl_3$	[1]

<b>Page 8</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2016</b>	<b>9701</b>	<b>43</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
<b>(ii)</b>	<b>J</b> is $\text{CH}_3\text{OCO}-\text{COOCH}_3$ <b>K</b> is 	[1]  [1]
<b>(c) (i)</b>	$\text{CH}_3$ at $\delta$ 15 $\text{CH}_2\text{O}$ at $\delta$ 65	[1] [1]
<b>(ii)</b>	Only one peak, so only one type/environment of C atom	[1]
<b>(d) (i)</b>	<b>M</b> is $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ <b>N</b> is $\text{CH}_3\text{OCO}-\text{CO}_2\text{H}$ <b>O</b> is $\text{CH}_3\text{OCO}-\text{COOCH}_3$	[3]
<b>(ii)</b>	<b>L</b> is 	[1]
		<b>[Total: 13]</b>