
CHEMISTRY

9701/41

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.

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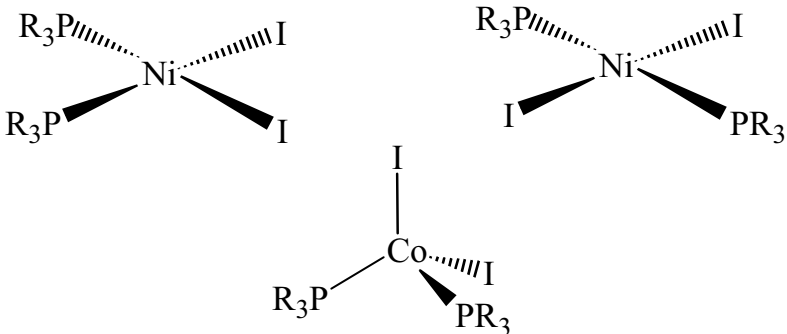
Cambridge is publishing the mark schemes for the May/June 2016 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.



Page 2	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
1 (a) (i)	$\text{Ca(OH)}_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$	[1]
(ii)	Ba(OH)_2 is soluble, OR BaCO_3 is insoluble	[1]
(iii)	Mg(OH)_2 is insoluble / not very soluble will not form ppt. of MgCO_3	[1] [1]
(b)	carbonates are more stable down the group due to increase in cationic size / radius (causing) less polarisation of CO_3^{2-} ion	[1] [1] [1]
(c)	radius of $\text{Ni}^{2+} = 0.070 \text{ nm}$; radius of $\text{Ca}^{2+} = 0.099 \text{ nm}$ so NiCO_3 decomposes more readily than CaCO_3	[1] [1]
	[Total: 9]	
2 (a) (i)	Co: $\dots 3s^2 3p^6 3d^7 4s^2$ Co ²⁺ : $\dots 3s^2 3p^6 3d^7$	[1]
(ii)	solution starts pink turns blue pink is $[\text{Co(H}_2\text{O)}_6]^{2+}$ blue is $[\text{CoCl}_4]^{2-}$ this complex is tetrahedral	[1] [1] [1] [1] [1]

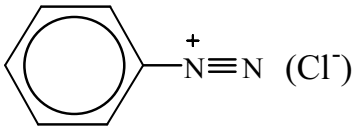
Page 3	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
(b)		[1] [1] [1]
		[Total: 9]
3 (a)	$K_p = \{p(\text{CS}_2) \times (p(\text{H}_2))^4\} / \{(p(\text{H}_2\text{S}))^2 \times p(\text{CH}_4)\}$ units: atm^2 OR Pa^2	[1] [1]
(b) (i)	$p(\text{H}_2\text{S})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

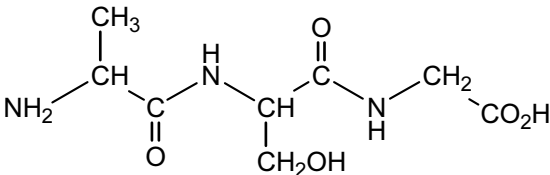
Page 4	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
4 (a) (i)	SCP is the EMF / potential of a cell composed of two electrodes (OR half cells) under standard conditions (OR at 289 K OR 1 mol dm ⁻³)	[1]
(ii)	voltmeter and salt bridge	[1]
(iii)	A is Ag B is Ag ⁺ (aq) or AgNO ₃ (aq) C is Pt D is Fe ²⁺ (aq) and Fe ³⁺ (aq) (combination of A and B can be reversed with combination of C and D)	[3]
(b) (i)	Ag ⁺ + Fe ²⁺ → Ag + Fe ³⁺	[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]
		[Total: 8]
5 (a) (i)	pK _a = -log K _a	[1]
(ii)	diacids are more acidic than CH ₃ CO ₂ H HO ₂ C– group is electron-withdrawing, stabilising the monoanion OR HO ₂ 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 ₂ H group OR the (intervening) alkyl groups destabilise the anion	[1] [1] [1]
(iii)	removing H ⁺ 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 ⁺ or OH ⁻ are added	[1] [1]

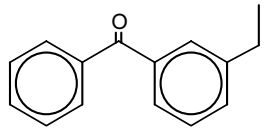
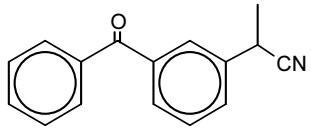
Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
(ii)	$\text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}^+ \rightarrow \text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{H} + \text{Na}^+$ $\text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{NaOH} \rightarrow \text{NaO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}_2\text{O}$	[1] [1]
		[Total: 9]
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 _r values: C ₆ H ₅ NO ₂ = 123 C ₆ H ₅ NH ₃ 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 ₆ H ₅ NH ₂ = 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 ₂ OR (NaNO ₂ + HCl) at $T \leq 10^\circ\text{C}$ step 2: boil/heat in water	[1] [1]
(ii)	E is 	[1]
		[Total: 13]

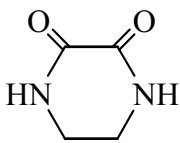
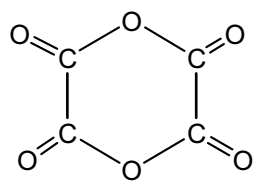
Page 6	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
7 (a) (i)		[2]
(ii)	$M_r = 233$	[1]
(b) (i)	$\text{NH}_2\text{CH}(\text{CH}_2\text{OH})\text{CO}_2^-$	[1]
(ii)	F is a DC power supply G is the anode OR positive electrode I is the cathode OR negative electrode H is filter paper (OR gel) soaked in buffer solution	[4]
(iii)	P is $\text{NH}_2\text{CH}_2\text{CO}_2^-$ or $\text{NH}_2\text{CH}_2\text{CO}_2\text{H}$ or glycine S 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 H_3O^+ 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]

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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: $\text{C}_6\text{H}_5\text{COCl} + \text{AlCl}_3$ (+ heat) step 2: $\text{CH}_3\text{CH}_2\text{Cl} + \text{AlCl}_3$ (+ 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)	$n(\text{MnO}_4^-) = 0.02 \times 15.2/1000 = 3.04 \times 10^{-4} \text{ mol}$ $n(\text{C}_2\text{O}_4\text{H}_2) = 3.04 \times 10^{-4} \times 5/2 = 7.6 \times 10^{-4} \text{ (in } 25 \text{ cm}^3) = 3.04 \times 10^{-3} \text{ mol in } 100 \text{ cm}^3$ $M_r = 24 + 64 + 2 = 90$ mass of $\text{C}_2\text{O}_4\text{H}_2 = 3.04 \times 10^{-3} \times 90$ = 0.2736 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]

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Question	Answer	Marks
(ii)	J is $\text{CH}_3\text{OCO}-\text{COOCH}_3$ K is 	[1] [1]
(c) (i)	CH_3 at δ 15 CH_2O at δ 65	[1] [1]
(ii)	Only one peak, so only one type/environment of C atom	[1]
(d) (i)	M is $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ N is $\text{CH}_3\text{OCO}-\text{CO}_2\text{H}$ O is $\text{CH}_3\text{OCO}-\text{COOCH}_3$	[3]
(ii)	L is 	[1]
	[Total: 13]	

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1 (a) (i)	dative (covalent) <i>or</i> coordinate Hydrogen / H (bonding)	2
(ii)	octahedral	1
(iii)	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} \rightarrow \text{Mg}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$ $\text{Mg}(\text{NO}_3)_2 \rightarrow \text{MgO} + 2\text{NO}_2 + \frac{1}{2}\text{O}_2$ <i>any three of</i> (solid) dissolves / turns to liquid condensation on tube <u>white</u> solid (forms / remains) brown fumes (evolved) gas formed that relights a glowing splint	4
(iv)	M_r values: $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} = 256.3$ $\text{MgO} = 40.3$ or (loss in molar mass = $256.3 - 40.3 = 216$) percentage loss = $100 \times 216 / 256.3 = \mathbf{84.3 / 84.4\%}$	2
(b)	(cat)-ionic radius / ion size increases (down the group) less polarisation / distortion of nitrate ion / NO_3^-	2
(c)	$2\text{AgNO}_3 \rightarrow 2\text{Ag} + 2\text{NO}_2 + \text{O}_2$	1
		[Total: 12]
2 (a) (i)	(an acid that is) partially / incompletely ionised / dissociated	1
(b) (i)	$\text{p}K_a = -\log K_a$ or $K_a = 10^{-\text{p}K_a}$	1

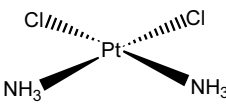
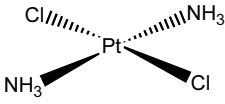
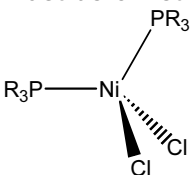
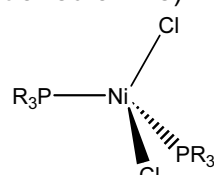
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(ii)	ethanoic acid (1) is more acidic than propanoic acid (2) due to smaller electron-donating (R/ alkyl) group/ less electron-donating (R/ alkyl) group(s) 2-chloropropanoic acid (3) is more acidic than propanoic acid (2) due to electron-withdrawing/ electronegative (Cl/ chlorine) atom 2-chloropropanoic acid (3) is more acidic than 3-chloropropanoic acid (4) since the Cl/ chlorine/ electronegative atom is closer to the CO_2^-/ acid	3
(c) (i)	M1: voltmeter / V and salt bridge labelled M2: Cu and Cu^{2+} / CuSO_4 (any soluble Cu(II) salt) M3: H_2 (arrow in) and H^+ / HCl / H_2SO_4 / any mineral acid M4 Pt and one solution at 1 M / 1 mol dm^{-3} OR H_2 at 1 atm	4
(ii)	$E^\ominus_{\text{cell}} = 0.34 \text{ (V)}$ and $(\text{Cu}^{2+})/\text{Cu}$ is the positive electrode	1
d (i)	$K_a = 1.23 \times 10^{-5}$ $[\text{H}^+] = \sqrt{(K_a \cdot c)} = \sqrt{(1.23 \times 10^{-5} \times 0.1)} = 1.11 \times 10^{-3} \text{ mol dm}^{-3}$ pH = 3.0 (2.96) ecf from $[\text{H}^+]$	2

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(ii)	$E = 0.0 + 0.059 \log(1.11 \times 10^{-3})$ OR $= -0.17(4)V$ so new $E_{\text{cell}} = 0.34 + 0.17 = \mathbf{0.51V}$ ecf from (d)(i)	2
		[Total: 14]
3 (a) (i)	$(\text{CH}_3)_2\text{CHCN}$	1
(ii)	reaction 1: NH_3 (in ethanol) under pressure (+ heat) or heat NH_3 in a sealed tube reaction 2: KCN/NaCN and heat/reflux (in ethanol) reaction 3: $\text{H}_2 + \text{Ni}$ or LiAlH_4	3
(b) (i)	$\text{CH}_3\text{CH}_2\text{NH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{NH}_3^+ (+) \text{OH}^-$	1
(ii)	ethylamine is more basic than ammonia... because of electron-donating (alkyl/ethyl/R) group (in ethylamine) which makes the <u>lone pair</u> (on N) more available for donation or the <u>lone pair</u> (on N) more available for a proton/ H^+	2
(c) (i)	A solution which resists/minimises/roughly maintains changes in <u>pH</u> when (small amounts of) H^+ or OH^- are added	1
(ii)	$\text{CH}_3\text{NH}_2 + \text{H}^+ \rightarrow \text{CH}_3\text{NH}_3^+$ $\text{CH}_3\text{NH}_3\text{Cl} + \text{OH}^- \rightarrow \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} + \text{Cl}^-$	2
		[Total: 10]

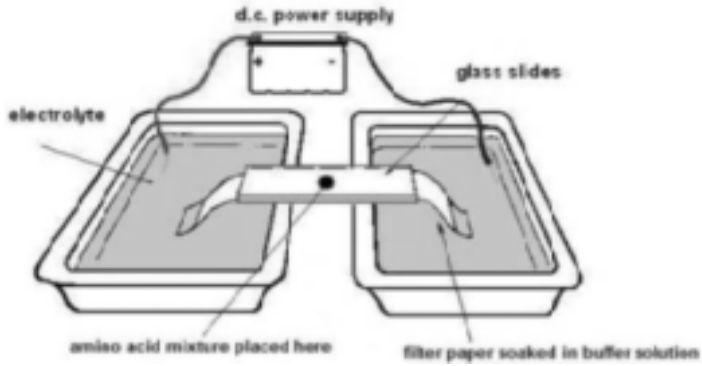
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4 (a) (i)	 (cis)  (trans)	2
(ii)	cis is (more) polar due to both Cl^(δ-) on same side or cis is (more) polar as dipoles do not cancel / unsymmetrical or trans is non-polar as it is bond dipoles cancel	1
(iii)	(This can only be <i>cis</i>) its mirror image is the same / superimposable or the distance between two coordinating nitrogens / oxygens is too small to bond <i>trans</i> or difficult for the NH₂ and O to change places (since 5-membered rings can only bridge adjacent positions)	1
(b) (i)	It's not square planar or it's tetrahedral	1
(ii)	must be 3D structure (i.e. tetrahedral-like)   <i>etc</i>	1
		[Total: 6]

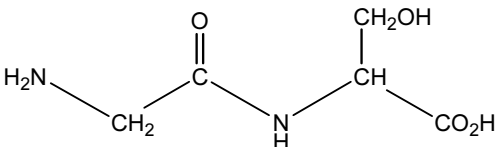
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6 (a)	<i>essential mark</i> M1 the reactants/substrate has a shape complementary/specific to active site – can be awarded from a labelled diagram as below or diagrams showing this specificity clearly <i>any two of</i> M2: reactants/substrate binds to/fits into the active site of the enzyme M3: (Interaction with site) causes a specific bond to be weakened, (which breaks) or lowers activation energy M4: forms an E-S complex M5: products released from enzyme/active site labelled diagrams 	3
(b) (i)	δ 26 is CH₃-CO δ 52 is CH₃-O δ 169 is CH₃CO δ 167 is phenyl-CO <u>Phenyl ethanoate</u> is B <u>methyl benzoate</u> is A M1 = any two correct δ linked to phenylethanoate/methyl benzoate M2 = the rest correct	2
(ii)	heat with H₃O⁺ (to hydrolyse the ester) then add Br₂(aq)/bromine water decolourises/gives white ppt. (with phenol from B)	3
		[Total: 8]

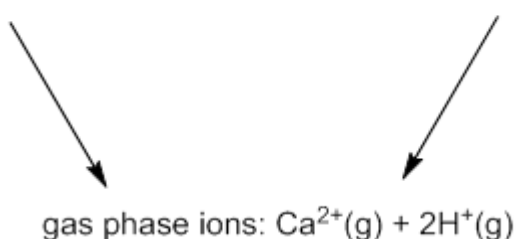
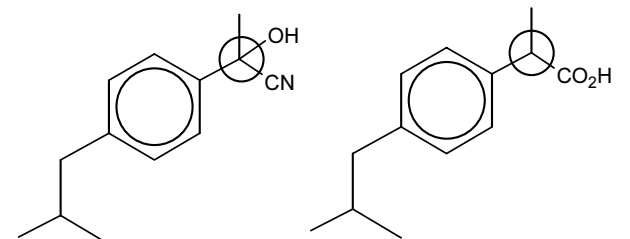
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7 (a) (i)	labelled with M1: <u>DC</u> power supply + and – / battery / cell / + and – sign (on cell / electrodes) with a complete circuit M2: buffer solution / electrolyte labelled M3: (amino acid) mixture / x on (filter) paper / gel / agarose 	3
(ii)	direction of movement related to charge (of amino acids) distance travelled depends on charge / M_r (of amino acids)	2
(b) (i)	Asp + Val: pH 12 because Asp will be $-\text{CH}_2\text{COO}^-$ (R-group) moves further (to positive electrode than Val) or pH 12 Asp more negative so moves further (to positive electrode) or pH 12 because Asp has a charge of 2– but Val has a charge of 1– or best at pH 7 because Asp will be negatively charged (anionic) but Val neutral	1
(ii)	Lys + Ser: pH 2 because Lys will be $(\text{CH}_2)_4\text{NH}_3^+$ (R-group) moves further (to negative electrode than Ser) or pH 2 Lys more positive so moves further (to negative electrode) or pH 2 because Lys has a charge of 2+ and Ser has a charge of 1+ or pH 7 because Lys is positively charged (cationic) but Ser neutral / zwitterionic	1

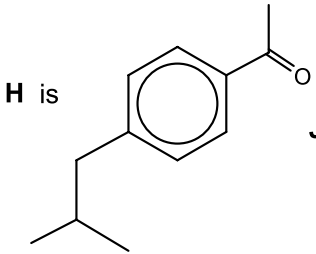
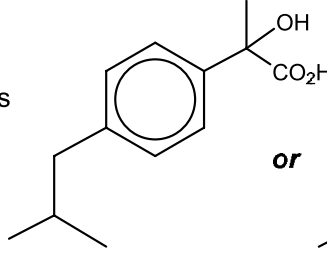
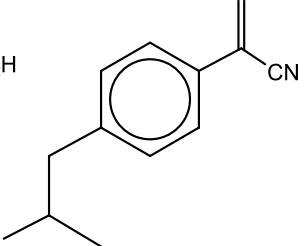
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(iii)	Tyr + Phe: pH 12 because Tyr will be $\text{C}_6\text{H}_5\text{CH}_2\text{O}^-$ (R-group) moves further / more / faster (to positive electrode than Phe) or pH12 because Tyr has a charge of 2– but Phe has a charge of 1–	1
(c) (i)	 M1: for –CONH– as shown above M2: for rest of molecule and correct connectivity of the bonds	2
(ii)	<i>from the IR spectrum</i> • E is O-H or N-H (allow NH_2) • F is C=O • G is C-O	2
		[Total: 12]
8 (a)	M1: solubility increases (down the group) M2: because lattice energy decreases faster than does ΔH_{hyd} M3: ΔH_{sol} / enthalpy of solution becomes more exothermic / less endothermic	3
(b) (i)	Should be the same / similar (enthalpy change), as (both acids) are fully ionised / strong acids	1

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(ii)	$\text{Ca(s)} + 2\text{H}^+(\text{aq}) \longrightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2(\text{g})$  gas phase ions: $\text{Ca}^{2+}(\text{g}) + 2\text{H}^+(\text{g})$ $x = \Delta H_{\text{at}}(\text{Ca}) + \text{IE}(1) + \text{IE}(2) - 2\Delta H_{\text{hyd}}(\text{H}^+) + \Delta H_{\text{hyd}}(\text{Ca}^{2+}) - 2\text{IE}(\text{H}) - E(\text{H}-\text{H})$ $x = 178 + 590 + 1150 + 2(1090) - 1576 - 2(1310) - 436$ $x = -534 \text{ kJ mol}^{-1}$	4
(c)	$\text{CH}_3\text{CO}_2\text{H}$ is incompletely ionised / weak acid / weaker acid enthalpy change of ionisation (of CH_3COOH) is $+2 \text{ kJ mol}^{-1}$ or energy needed to ionise / dissociate (CH_3COOH)	2
		[Total: 10]
9 (a)		1

Page 11	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
(b)	H is  J is  J1 <i>or</i>  J2	2
(c)	step 1: $(\text{CH}_3)_2\text{CHCH}_2\text{Cl} + \text{AlCl}_3$ (+ heat) step 2: $\text{CH}_3\text{COCl} + \text{AlCl}_3$ (+ heat) step 3: $\text{HCN} + \text{NaCN}$ <i>or</i> $\text{HCN} + \text{base}$ <i>or</i> $\text{HCN} + \text{CN}^-$ (steps 4 and 5 could be reversed on J) If J1 step 4 then step 5 J2 step 5 then step 4 step 4: H_3O^+ + heat/aqueous HCl + heat step 5: conc H_2SO_4 + heat/ conc H_3PO_4 + heat <i>or</i> Al_2O_3 + heat step 6: $\text{H}_2 + \text{Ni}$ (+ heat)	6
(d)	step 1: electrophilic substitution <i>or</i> alkylation step 6: reduction / hydrogenation / addition	2
		[Total: 11]

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.

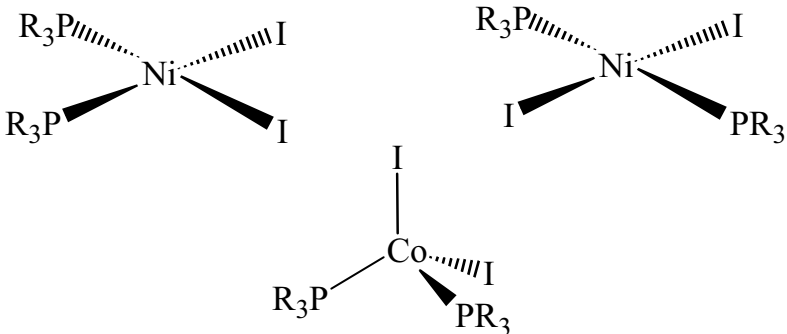
Cambridge is publishing the mark schemes for the May/June 2016 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.



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

Question	Answer	Marks
1 (a) (i)	$\text{Ca(OH)}_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$	[1]
(ii)	Ba(OH)_2 is soluble, OR BaCO_3 is insoluble	[1]
(iii)	Mg(OH)_2 is insoluble / not very soluble will not form ppt. of MgCO_3	[1] [1]
(b)	carbonates are more stable down the group due to increase in cationic size / radius (causing) less polarisation of CO_3^{2-} ion	[1] [1] [1]
(c)	radius of $\text{Ni}^{2+} = 0.070 \text{ nm}$; radius of $\text{Ca}^{2+} = 0.099 \text{ nm}$ so NiCO_3 decomposes more readily than CaCO_3	[1] [1]
	[Total: 9]	
2 (a) (i)	Co: $\dots 3s^2 3p^6 3d^7 4s^2$ Co ²⁺ : $\dots 3s^2 3p^6 3d^7$	[1]
(ii)	solution starts pink turns blue pink is $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ blue is $[\text{CoCl}_4]^{2-}$ this complex is tetrahedral	[1] [1] [1] [1] [1]

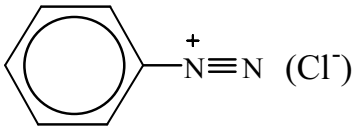
Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

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

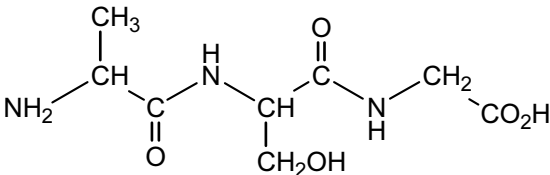
Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

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 ⁻³)	[1]
(ii)	voltmeter and salt bridge	[1]
(iii)	A is Ag B is Ag ⁺ (aq) or AgNO ₃ (aq) C is Pt D is Fe ²⁺ (aq) and Fe ³⁺ (aq) (combination of A and B can be reversed with combination of C and D)	[3]
(b) (i)	Ag ⁺ + Fe ²⁺ → Ag + Fe ³⁺	[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]
		[Total: 8]
5 (a) (i)	pK _a = -log K _a	[1]
(ii)	diacids are more acidic than CH ₃ CO ₂ H HO ₂ C– group is electron-withdrawing, stabilising the monoanion OR HO ₂ 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 ₂ H group OR the (intervening) alkyl groups destabilise the anion	[1] [1] [1]
(iii)	removing H ⁺ 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 ⁺ or OH ⁻ are added	[1] [1]

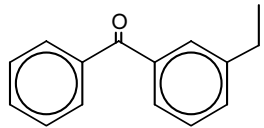
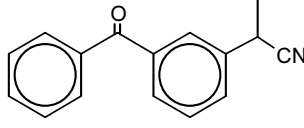
Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

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]
		[Total: 9]
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 _r values: C ₆ H ₅ NO ₂ = 123 C ₆ H ₅ NH ₃ 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 ₆ H ₅ NH ₂ = 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 ₂ OR (NaNO ₂ + HCl) at $T \leq 10^\circ\text{C}$ step 2: boil/heat in water	[1] [1]
(ii)	E is 	[1]
		[Total: 13]

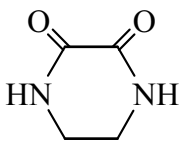
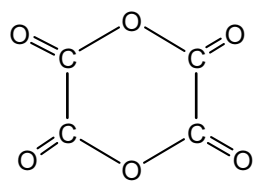
Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	43

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)	F is a DC power supply G is the anode OR positive electrode I is the cathode OR negative electrode H is filter paper (OR gel) soaked in buffer solution	[4]
(iii)	P is $\text{NH}_2\text{CH}_2\text{CO}_2^-$ or $\text{NH}_2\text{CH}_2\text{CO}_2\text{H}$ or glycine S 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 H_3O^+ 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: $\text{C}_6\text{H}_5\text{COCl} + \text{AlCl}_3$ (+ heat) step 2: $\text{CH}_3\text{CH}_2\text{Cl} + \text{AlCl}_3$ (+ 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)	$n(\text{MnO}_4^-) = 0.02 \times 15.2/1000 = 3.04 \times 10^{-4} \text{ mol}$ $n(\text{C}_2\text{O}_4\text{H}_2) = 3.04 \times 10^{-4} \times 5/2 = 7.6 \times 10^{-4} \text{ (in } 25 \text{ cm}^3) = 3.04 \times 10^{-3} \text{ mol in } 100 \text{ cm}^3$ $M_r = 24 + 64 + 2 = 90$ mass of $\text{C}_2\text{O}_4\text{H}_2 = 3.04 \times 10^{-3} \times 90$ = 0.2736 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]

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

Question	Answer	Marks
(ii)	J is $\text{CH}_3\text{OCO}-\text{COOCH}_3$ K is 	[1] [1]
(c) (i)	CH_3 at δ 15 CH_2O at δ 65	[1] [1]
(ii)	Only one peak, so only one type/environment of C atom	[1]
(d) (i)	M is $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ N is $\text{CH}_3\text{OCO}-\text{CO}_2\text{H}$ O is $\text{CH}_3\text{OCO}-\text{COOCH}_3$	[3]
(ii)	L is 	[1]
	[Total: 13]	