Mark Scheme (Results)

January 2019

Pearson Edexcel International
Advanced Level
In Chemistry (WCH05)
Paper 01 Transition Metals and Organic Nitrogen

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Section A (multiple choice)

Question Number	Correct Answer	Mark
1	**The only correct answer is D** ***A*** *is not correct because not all d block metals are transition elements.* ***B*** *is not correct because the definition should refer to incompletely filled d orbitals.* ***C*** *is not correct because it must refer to ions, not just the atoms of the element.*	1

Question Number	Correct Answer	Mark
2	**The only correct answer is C** ***A*** *is not correct because this sequence is typical of a Group 1 element.* ***B*** *is not correct because this sequence is typical of a Group 3 element.* ***D*** *is not correct because this sequence is typical of a Group 2 element.*	1

Question Number	Correct Answer	Mark
3	**The only correct answer is B** ***A*** *is not correct because the oxidation numbers in columns 1 and 2 are incorrect.* ***C*** *is not correct because the oxidation number in column 2 is incorrect.* ***D*** *is not correct because the oxidation number in column 1 is incorrect.*	1

Question Number	Correct Answer	Mark
4	**The only correct answer is B** ***A*** *is not correct because 2 nitrate ions have a total drop in oxidation number of +6 so each M must increase by 2.* ***C*** *is not correct because 2 nitrate ions have a total drop in oxidation number of +6 so each M must increase by 2.* ***D*** *is not correct because 2 nitrate ions have a total drop in oxidation number of +6 so each M must increase by 2.*	1

Question Number	Correct Answer	Mark
5(a)	**The only correct answer is C** ***A*** *is not correct because* V^{3+} *is in the least positive half-cell.* ***B*** *is not correct because* V^{2+} *is a reducing agent.* ***D*** *is not correct because* Cl^- *is a reducing agent.*	1

Question Number	Correct Answer	Mark
5(b)	**The only correct answer is A** ***B*** *is not correct because* I^- *would reduce V(V) to V(IV).* ***C*** *is not correct because* Cl_2 *would oxidise V(IV) to V(V).* ***D*** *is not correct because* Cl^- *is not strong enough to reduce any species in the table.*	1

Question Number	Correct Answer	Mark
6	**The only correct answer is A** ***B*** *is not correct because* $E^{\ominus}$ *is proportional to ln K* ***C*** *is not correct because* $E^{\ominus}$ *is proportional to* $\Delta S_{total.}$ ***D*** *is not correct because* $E^{\ominus}$ *is proportional to* $\Delta S_{total.}$	1

Question Number	Correct Answer	Mark
7	**The only correct answer is D** ***A*** *is not correct because Cl has oxidation numbers above and below 0* ***B*** *is not correct because Br has oxidation numbers above and below +1* ***C*** *is not correct because S has oxidation numbers above and below +4*	1

Question Number	Correct Answer	Mark
8	**The only correct answer is D** ***A*** *is not correct because there are not different arrangements of the ligands in space.* ***B*** *is not correct because there are not different arrangements of the ligands in space.* ***C*** *is not correct because there are not different arrangements of the ligands in space.*	1

Question Number	Correct Answer	Mark
9	**The only correct answer is B** ***A*** *is not correct because it is not oxidised in the reaction.* ***C*** *is not correct because products cannot be separated if they are not desorbed.* ***D*** *is not correct because metals do not form hydrogen bonds*	1

Question Number	Correct Answer	Mark
10	**The only correct answer is B** ***A*** *is not correct because none of the functional groups is ionised.* ***C*** *is not correct because protonation of* NH_2 *would not occur at pH 12.* ***D*** *is not correct because protonation of* NH_2 *would not occur at pH 12.*	1

Question Number	Correct Answer	Mark
11	**The only correct answer is C** ***A*** *is not correct because this is not a good method for separating solids.* ***B*** *is not correct because amino acids are not volatile.* ***D*** *is not correct because a small scale method is more suitable for identification purposes.*	1

Question Number	Correct Answer	Mark
12	**The only correct answer is B** ***A*** *is not correct because C2 is connected to 4 different groups.* ***C*** *is not correct because C3 is connected to 4 different groups.* ***D*** *is not correct because C2 is connected to 4 different groups.*	1

Question Number	Correct Answer	Mark
13	**The only correct answer is A** ***B*** *is not correct because the hydrogen environments on CH_2 and CH_3 are equivalent.* ***C*** *is not correct because the only hydrogen environments are on CH_2 and CH_3; this answer is the number of C atoms.* ***D*** *is not correct because the only hydrogen environments are on CH_2 and CH_3; this answer is the number of H atoms.*	1

Question Number	Correct Answer	Mark
14	**The only correct answer is C** ***A*** *is not correct because this is the number of protons on each atom.* ***B*** *is not correct because it is the number of protons on the carbons in the ethyl group and a singlet for the first methyl group.* ***D*** *is not correct because there is a quartet for the CH_2 but only one triplet for a methyl group.The other methyl gives a singlet.*	1

Question Number	Correct Answer	Mark
15	**The only correct answer is B** ***A*** *is not correct because methanol not hydrogen, is the fuel in the cell.* ***C*** *is not correct because the conditions are alkaline, not acidic* ***D*** *is not correct because this is an oxidation; it should be a reduction reaction.*	1

Question Number	Correct Answer	Mark
16	**The only correct answer is D** ***A*** *is not correct because this compound is an acid, not an ester.* ***B*** *is not correct because this compound is not a benzoate.* ***C*** *is not correct because this compound is not a benzoate.*	1

Question Number	Correct Answer	Mark
17	**The only correct answer is C** ***A*** *is not correct because alcohols do not react with chloroalkanes.* ***B*** *is not correct because an addition copolymer would form.* ***D*** *is not correct because carboxylic acids do not react with amides.*	1

Question Number	Correct Answer	Mark
18(a)	**The only correct answer is A** ***B*** *is not correct because steam distilling is needed.* ***C*** *is not correct because steam distilling is needed.* ***D*** *is not correct because the ether must be distilled off.*	1

Question Number	Correct Answer	Mark
18(b)	**The only correct answer is A** ***B*** *is not correct because the C=C will decolourise acidified potassium manganate(VII).* ***C*** *is not correct because phosphorus(V) chloride does not react with C=C or the aldehyde group.* ***D*** *is not correct because the CHO will form silver with Tollens' solution.*	1

Section B

Question Number	Acceptable Answers	Reject	Mark
19(a)(i)	X: Platinum / $Pt_{((s))}$ **and** Y: Platinum / $Pt_{((s))}$		1

Question Number	Acceptable Answers	Reject	Mark
19(a)(ii)	**M1:** Iron(II) sulfate should be 2 mol dm^{-3} **OR** Iron(III) sulfate should be replaced with 2 mol dm^{-3} iron(III) chloride **and** Iron(II) sulfate should be 2 mol dm^{-3} ALLOW Any method that produces a equimolar mixture of iron(II) and iron(III) ions eg 1 volume iron(III) sulfate + 2 volumes iron(II) sulfate of same concentration (1) **M2** Mixture should be 1 mol dm^{-3} with respect to each iron ion (in standard electrode) ALLOW The mixture is equimolar with respect to each iron ion Calculation showing concentrations are equimolar in mixture (1) M2 is independent of M1		2

Question Number	Acceptable Answers	Reject	Mark
19(a)(iii)	Potassium manganate((VII))/ potassium permanganate/ $KMnO_4$ (1) Manganese(II) sulfate/ $MnSO_4$ (and (dilute) sulfuric acid / H_2SO_4) ALLOW Manganese(II) nitrate/ $Mn(NO_3)_2$ Manganese(II) chloride/ $MnCl_2$ (1) IGNORE MnO_4^- , H^+ , Mn^{2+}, H_2O, "acidified" Dilute hydrochloric acid/ HCl	Incorrect oxidation number eg Potassium manganate(VI)/ Concentrated sulfuric acid Concentrated hydrochloric acid MnO, $Mn(OH)_2$	2

Question Number	Acceptable Answers	Reject	Mark
19(a)(iv)	White **and** precipitate / ppt(e) / solid (1) $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ Balanced equation with state symbols (1) M1 and M2 to be marked independently	Just "an insoluble salt forms" If reference made to bubbles	2

Question Number	Acceptable Answers	Reject	Mark
19(a)(v)	Potassium nitrate/ KNO_3 / Sodium nitrate / $NaNO_3$ ALLOW Sodium chloride/ NaCl/ potassium chloride / KCl/ potassium sulfate/ K_2SO_4/ sodium sulfate/ Na_2SO_4 If name and formulae given both must be correct.	Iodides Group II salts	1

Question Number	Acceptable Answers	Reject	Mark
19(a)(vi)	((+1.51) –(+0.77)) = (+) **0.74** (V) ALLOW .74	-0.74	1

Question Number	Acceptable Answers	Reject	Mark
19(b)(i)	**M1** $E^{\ominus}$ for item 36 = +0.17 (V) (and Fe^{3+}| Fe^{2+} = +0.77 (V)) OR E_{cell} =+0.60 (V)) (1) **M2** E_{cell} is positive (so the reaction is feasible/ spontaneous) This depends on some data having been used to do a calculation or comparison, even if item 45 (0.4V) or 48 (+0.51V) has been used. ALLOW TE on incorrect positive value in M1 The SO_2 half cell is less positive than the Fe^{3+}| Fe^{2+} half cell / SO_2 is a more powerful reducing agent than Fe^{2+} (so it will work) (1)	+0.40(V) ($E^{\ominus}$ for reduction of H_2SO_3) +0.51(V)	2

Question Number	Acceptable Answers	Reject	Mark
19(b)(ii)	**M1** Mol MnO_4^- = ((24.50)(0.0250)/1000)) = 6.125 x 10^{-4} / 0.0006125 (1) **M2** Mol Fe^{2+} in 25 cm^3 = (6.125 x 10^{-4} x5) = 3.0625 x 10^{-3} / 0.0030625 (1) **M3** Mol Fe_2O_3 used to make 250 cm^3 solution =((3.0625 x 10^{-3} x10) /2) =1.53125 x 10^{-2} / 0.0153125 (1) **M4** Mass Fe_2O_3 = (159.6 x 1.53125 x 10^{-2}) = 2.443875 g **and** % Fe_2O_3 = ((2.443875 /3.00) x 100) = 81.4625% / 81.46 % / 81.5% (1) ALLOW TE at each stage Ignore SF except 1 SF 81.67 if Fe = 56 is used.		4

Question Number	Acceptable Answers	Reject	Mark
19(b)(iii)	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ **and** $Fe^{2+} \rightarrow Fe^{3+} + e^-$ (1) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow$ $2Cr^{3+} + 7H_2O + 6\ Fe^{3+}$ (1) ALLOW Multiples for any of the equations Correct final equation scores (2) Ignore state symbols even if incorrect.		2

Question Number	Acceptable Answers	Reject	Mark
19(b)(iv)	The colour change at the end point with manganate(VII) is clearer / more distinct / more obvious OR With dichromate(VI) the end point would not be a clear change / would be from greenish yellow to yellowish green ALLOW MnO_4^- does not need an indicator/ is self indicating Any reasonable colours IGNORE Potassium dichromate is toxic/ Is more expensive/ Is a better oxidising agent/ Has a higher $E^\ominus$ value	Reaction occurs more readily	1

(Total for Question 19 = 18 marks)

Question Number	Acceptable Answers	Reject	Mark
20(a)(i)	$2Cu^{2+} + 4I^{-} \rightarrow 2CuI + I_2$ OR Multiples IGNORE State symbols even if incorrect	Cu_2I_2	1

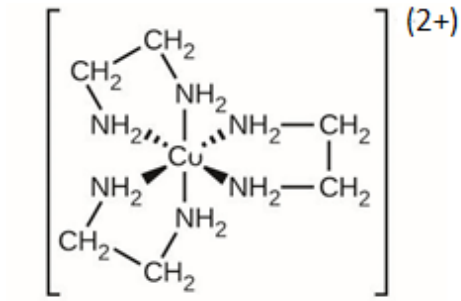
Question Number	Acceptable Answers	Reject	Mark
20(a)(ii)	$(1s^2)\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ (4s^0)$ ALLOW $p_x^2\ p_y^2\ p_z^2$ in 2p and 3p $(1s^2)\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ (4s^0)$ $(1s^2)\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^{10}$	$[Ar]3d^{10}$	1

Question Number	Acceptable Answers	Reject	Mark
20a(iii)	Zn^{2+} / Ga^{3+} ALLOW Ge^{4+}	As^{5+} Se^{6+} Br^{7+} Ga^{4+}	1

Question Number	Acceptable Answers	Reject	Mark
20(b)(i)	The (3)d orbitals split / (3)d sub shell splits (into two groups). ALLOW (3)d energy level splits Can be shown on a diagram	 The orbital splits	1

Question Number	Acceptable Answers	Reject	Mark
***20(b)(ii)**	**M1** The gap between groups of energy levels is different with different ligands/ The 3d orbitals split to different extents with different ligands (1) **M2** Electrons **absorb/ gain** energy of specific frequencies when moving from lower to higher levels OR Different frequencies of photons are absorbed when the energy gap differs (1) **M3** The colour seen depends on the energy/ frequency gap (between the two groups of energy levels) OR The colour seen is due to the remaining frequencies/ the complementary colour is seen ALLOW Colour (seen) is due to reflected light Colour given out depends on energy gap (1)	 Emit energy Colour depends on energy **emitted**	3

Question Number	Acceptable Answers	Reject	Mark
20(b)(iii)	Octahedral / octahedron (shape) IGNORE diagrams		1

Question Number	Acceptable Answers	Reject	Mark
20(b)(iv)	3 ligands in an octahedral complex ALLOW CH_2CH_2 skeletal: H_2N NH_2 Skeletal not showing Hs on NH_2 N N (1) bonds from N to Cu, these can be lines, dots, wedges, arrows ALLOW bond to one end of ligand only/incorrect ligand containing N (1) This structure scores both marks  (2+) IGNORE Charge, brackets Lone pairs on N	Two nitrogens from one ligand **obviously** at 180° to the copper	2

Question Number	Acceptable Answers	Reject	Mark
20(b)(v)	$[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow [CuCl_4]^{2-} + 6H_2O$ OR $[Cu(H_2O)_6]^{2+} + 4HCl \rightarrow [CuCl_4]^{2-} + 6H_2O + 4H^+$ OR $[Cu(H_2O)_6]^{2+} + 4HCl \rightarrow [CuCl_4]^{2-} + 2H_2O + 4H_3O^+$ (1) IGNORE state symbols even if incorrect lack of [ ] Tetrahedral ALLOW Square planar (1) M2 independent of M1		2

Question Number	Acceptable Answers	Reject	Mark
20(b)(vi)	Step **1**: acid-base / neutralisation Deprotonation (of complex) / protonation of ammonia ALLOW (ionic) precipitation (1) Step **2**: Ligand **and** Exchange / substitution / replacement ALLOW 'Ammonia substitutes for water' (1) Final product: $[Cu(NH_3)_4(H_2O)_2]^{2+}$ ALLOW $[Cu(NH_3)_4]^{2+}$ Round brackets, lack of [ ] brackets (1)	electrophile $[Cu(NH_3)_6]^{2+}$	3

Question Number	Acceptable Answers	Reject	Mark
20(b)(vii)	Step 1: pale blue **precipitate/ solid** forms (1) Step 2: (precipitate dissolves to give) deep / dark blue **solution** (1) Two correct colours with missing states can score (1) The blue colour in step 2 must be a darker blue than the colour in step one. e.g. Either pale blue step 1, blue step 2 or blue step 1, dark blue in step 2		2

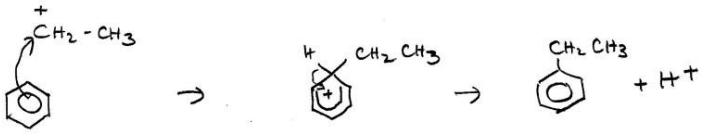
Question Number	Acceptable Answers	Reject	Mark
***20(b)(viii)**	**M1** No change in number of moles of reactant going to product when ammonia complex forms. There are more moles of product when the diamino complex forms OR Increase in the number of moles of product is greater when diamino complex forms (1) **M2** So greater increase in ΔS_{system} / entropy when diamino complex forms ALLOW $\Delta S_{reaction}$ for ΔS_{system} Reverse argument in M2 based on smaller increase in ΔS_{system} when ammonia complex forms (1) **M3** When ΔS_{system} increases,(and $\Delta S_{surrounding}$ remains constant) $\boldsymbol{\Delta S_{total}}$ increases so K increases (1)		3

	Application of: $\Delta S_{total} = \Delta S_{system} + \Delta S_{surrounding}$ $\Delta S_{total} = R\ln K_c$ scores M3		

(Total for Question 20 = 20 marks)

Question Number	Acceptable Answers	Reject	Mark
***21(a)**	Isomers of dichlorobenzene in which one has a single bond between the C atoms bonded to Cl and the other has a double bond have not been found. Can be shown on a Kekulé diagram. (1) (X-ray diffraction shows that) all carbon-carbon bonds are the same (length) OR intermediate between C=C and C-C (not as in Kekulé) OR shows that benzene is a regular hexagon ALLOW All bonds are same length (1) IGNORE Reference to bond angles Benzene undergoes substitution reactions rather than additions	Cl can be in positions other than 1 or 2 Cl_2 would add across each double bond The electron density is even	2

Question Number	Acceptable Answers	Reject	Mark
21(b)	**M1** Phenol forms (2,4,6)-tribromophenol / formula ALLOW multiple substitution occurs (1) **M2** Phenol reacts with bromine **water** (at room temperature/ without heating) (1) **M3** Benzene forms bromobenzene/ C_6H_5Br / one Br substitutes. (1) **M4** Benzene (reacts with bromine and) requires a catalyst of; iron/ iron(III) bromide/ a halogen carrier (1) ALLOW Alternative M3 and M4 **M3** Benzene reacts (with bromine) to form $C_6H_6Br_6$ / 1,2,3,4,5,6 – hexabromocyclohexane /six Br add to it. (1) **M4** When **heated** in uv light (1) M2 and M4 dependent on correct or near miss for M1 and M3 respectively.	Hydroxyl benzene for phenol Bromine water Bromine water	4

Question Number	Acceptable Answers	Reject	Mark
21(c)	**M1** $C_2H_5Cl + AlCl_3 \rightarrow AlCl_4^- + C_2H_5^+$ ALLOW $FeBr_3$ / $FeCl_3$ / $AlBr_3$ for $AlCl_3$ + on alkyl can in any position (1)  **M2** Curly arrow from on or within the circle to $C_2H_5^+$ ALLOW curly arrow from anywhere within the hexagon ALLOW curly arrow to any part of the $C_2H_5^+$ ion, including the + charge TE for error in electrophile eg $C_2H_4^+$ (1) **M3** Intermediate structure including charge with horseshoe covering at least 3 carbon atoms **and** facing the tetrahedral carbon atom **and** some part of the positive charge must be within the horseshoe ALLOW dotted horseshoe (1) **M4** Curly arrow from C−H bond to anywhere in the hexagon, reforming the delocalised structure (1) IGNORE missing H^+ Reaction of $AlCl_4^-$ in last step Correct Kekulé structures score full marks	Curly arrow on or outside the hexagon Dotted bonds to H and C_2H_5 unless part of a 3D structure	4

Question Number	Acceptable Answers	Reject	Mark
21(d)(i)	(New peak in phenylethene at) (C=C) 1669 — 1645 (cm^{-1}) OR (=C—H) 3095 — 3010 (cm^{-1}) ALLOW 2962-2853 (cm^{-1}) (alkane C-H) would not be present in phenylethene. If bonds are identified they must be correct. IGNORE Values for ethylbenzene peaks	Single value which is not a range	1

Question Number	Acceptable Answers	Reject	Mark
21(d)(ii)	 ALLOW Bracket in polymer around side chain or round entire unit	Just 2 units Either n missing	1

(Total for Question 21 = 12 marks)

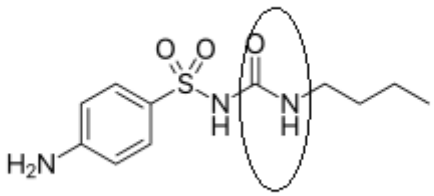
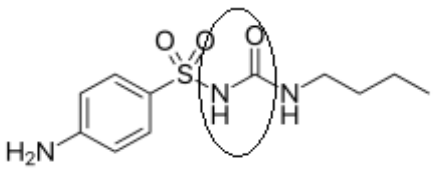
Section C

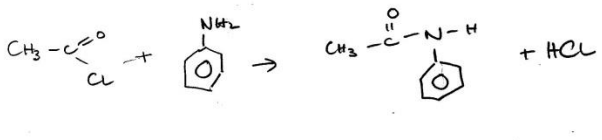
Question Number	Acceptable Answers	Reject	Mark
22(a)(i)	Compound A : nitrobenzene/ $C_6H_5NO_2$ (1) Concentrated nitric acid + concentrated sulfuric acid **and** temperature 55°C ALLOW "Concentrated nitric and sulfuric acid" 50 - 60°C "Heat at less than 55°C" (1)	Temperatures above 60°C Or less than 50°C	2

Question Number	Acceptable Answers	Reject	Mark
22(a)(ii)	Tin + (concentrated) hydrochloric acid / Sn + HCl ALLOW Iron/Fe for tin IGNORE Hydrogen H_2 **followed by** NaOH	Dilute HCl HCl(aq) Sulfuric acid	1

Question Number	Acceptable Answers	Reject	Mark
22(b)	$C_6H_5NH_2 + 2CH_3I \rightarrow C_6H_5N(CH_3)_2 + 2HI$ OR $C_6H_5NH_2 + 2CH_3I \rightarrow C_6H_5NH(CH_3)_2^+ + I^- + HI$ ALLOW C_6H_5 shown as delocalised ring Reaction shown in 2 steps Error in alkyl group if rest is correct e.g. ethyl for methyl IGNORE Use of molecular formulae		1

Question Number	Acceptable Answers	Reject	Mark
22(c)	$NaNO_2$ + HCl / sodium nitrite plus hydrochloric acid ALLOW Nitrous acid / HNO_2 Sulfuric acid for hydrochloric (1) A temperature in the range of 0 – 10 (°C) ALLOW < 10 (°C) (1) Mark independently	Concentrated hydrochloric acid Concentrated sulfuric acid Nitric acid	2

Question Number	Acceptable Answers	Reject	Mark
22(d)(i)	 OR  ALLOW 2 separate ellipses overlapping at the C=O	Circles including both nitrogens in chain	1

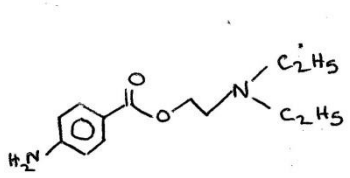
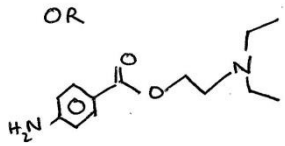
Question Number	Acceptable Answers	Reject	Mark
22(d)(ii)	$CH_3COCl + C_6H_5NH_2 \rightarrow CH_3CONHC_6H_5 + HCl$ OR  OR Equation with 2H substituted $2CH_3COCl + C_6H_5NH_2 \rightarrow (CH_3CO)_2NC_6H_5 + 2HCl$ Balanced equation (1) CONH displayed, showing C=O connected to N-H and connected to the benzene ring through N ALLOW NH for N-H correct skeletal formula (1)	$CH_3NHCOC_6H_5$	2

Question Number	Acceptable Answers	Reject	Mark
22(e)(i)	$C_9H_{11}NO_2$ ALLOW Elements in any order eg $C_9H_{11}O_2N$ Answer written beside formula IGNORE $H_2NC_6H_4COOCH_3$		1

Question Number	Acceptable Answers	Reject	Mark
22(e)(ii)	92: $C_6H_4NH_2^+$ ALLOW $C_6H_6N^+$ (1) 120: : $C_6H_4NH_2CO^+$ ALLOW $C_7H_6NO^+$ OR $C_6H_4CO_2^+$ / $C_7H_4O_2^+$ (1) Penalise missing charges once only + charge can be anywhere on ion	Formulae with hexagons if number of H not clear C_9H_{12} Fragments with correct mass which could not form from benzocaine	2

Question Number	Acceptable Answers	Reject	Mark
22(e)(iii)	C_2H_5OH OR Skeletal formula, including H on OH group IGNORE Molecular formula (1) $C_6H_4NH_2COOH$ / $C_6H_4H_2NCOOH$ OR $C_6H_4NH_3^+COOH$/ $Cl^-C_6H_4NH_3^+COOH$ (1) OR Skeletal formula, including H on OH group		2

Question Number	Acceptable Answers	Reject	Mark
22(f)(i)	**Ignore SFs in M1,2,3** **M1** 242.4 of CO_2 contains ((242.4 x12)/44) =66.11 g C 76.30 g H_2O contains((76.3 x 2)/18) = 8.48 g H (1) **M2** Mass O = (100 – 66.11 – 8.48 – 11.86) = 13.55 g ALLOW TE on M1 **only if** calculation method is correct (1) **M3** Moles per 100 g: C 5.50 H 8.48 N 0.847 O 0.847 ALLOW TE from masses in M1 and M2 (1) **M4** $C_{13}H_{20}N_2O_2$ ALLOW TE on M3 **only if** there are 13C Elements in any order (1)	Calculation based on mass O in CO_2 + mass O in H_2O	4

Question Number	Acceptable Answers	Reject	Mark
22(f)(ii)	 OR  OR $-CH_3$ and $-C_3H_7$ for 2 C_2H_5 groups ALLOW $-CH_2CH_3$ for $-C_2H_5$ 2 correct alkyl groups (1) Rest of molecule (1)		2

(Total for Question 22 = 20 marks)

Total for Section C = 20 marks

Total for Paper = 90 marks