

Mark Scheme (Results)

Summer 2015

GCE Chemistry (6CH05/01)

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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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:
  - i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  - ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  - iii) organise information clearly and coherently, using specialist vocabulary when appropriate

**Section A (multiple choice)**

Question Number	Correct Answer	Reject	Mark
<b>1</b>	C		1

Question Number	Correct Answer	Reject	Mark
<b>2</b>	A		1

Question Number	Correct Answer	Reject	Mark
<b>3</b>	C		1

Question Number	Correct Answer	Reject	Mark
<b>4</b>	B		1

Question Number	Correct Answer	Reject	Mark
<b>5</b>	C		1

Question Number	Correct Answer	Reject	Mark
<b>6</b>	B		1

Question Number	Correct Answer	Reject	Mark
<b>7</b>	B		1

Question Number	Correct Answer	Reject	Mark
<b>8</b>	D		1

Question Number	Correct Answer	Reject	Mark
<b>9</b>	C		1

Question Number	Correct Answer	Reject	Mark
<b>10</b>	D		1

Question Number	Correct Answer	Reject	Mark
<b>11</b>	C		1

Question Number	Correct Answer	Reject	Mark
<b>12</b>	A		1

Question Number	Correct Answer	Reject	Mark
<b>13</b>	D		1

Question Number	Correct Answer	Reject	Mark
<b>14</b>	D		1

Question Number	Correct Answer	Reject	Mark
<b>15</b>	A		1

Question Number	Correct Answer	Reject	Mark
<b>16</b>	D		1

Question Number	Correct Answer	Reject	Mark
<b>17</b>	D		1

Question Number	Correct Answer	Reject	Mark
<b>18</b>	A		1

Question Number	Correct Answer	Reject	Mark
<b>19</b>	B		1

Question Number	Correct Answer	Reject	Mark
<b>20</b>	B		1

## Section B

Question Number	Acceptable Answers	Reject	Mark
<b>21a(i)</b>	<p>Ni: <math>(1s^2 2s^2 2p^6) 3s^2 3p^6 3d^8 4s^2</math> (1)</p> <p>Cu: <math>(1s^2 2s^2 2p^6) 3s^2 3p^6 3d^{10} 4s^1</math> (1)</p> <p>ALLOW capital letters, subscripts for superscripts ALLOW 4s before 3d</p> <p>Penalise omission of <math>3s^2 3p^6</math> once only if rest is correct</p>		2

Question Number	Acceptable Answers	Reject	Mark
<b>21a*(ii)</b>	<p>First electron removed is from <b>4s</b> (in both atoms) (1)</p> <p>Second electron in Cu (is harder to remove so it is) EITHER closer to nucleus/in inner shell OR less shielded (1)</p> <p>IGNORE Comments about second electron being in full shell/ in a 3d shell/in a 3d orbital Reference to <math>3d^{10}</math> stability</p>		2

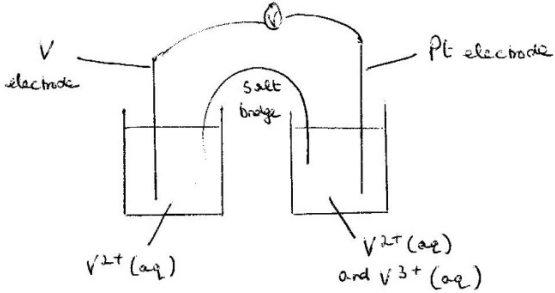
Question Number	Acceptable Answers	Reject	Mark
<b>21a(iii)</b>	<p>(attraction on (3d) electrons increases due to) number of protons increasing / nuclear charge increasing</p> <p>IGNORE The charge density of the <math>2^+</math> ions increases Effective nuclear charge</p>		1

Question Number	Acceptable Answers	Reject	Mark
<b>21b(i)</b>	$2\text{Cu}^+(\text{aq}) \rightarrow \text{Cu}(\text{s}) + \text{Cu}^{2+}(\text{aq})$ IGNORE Eqm sign for $\rightarrow$	Reverse equation Any equation involving electrons	1

Question Number	Acceptable Answers	Reject	Mark
<b>21b(ii)</b>	Both white  ALLOW (both) Colourless (1)  COMMENT Ignore states eg solution/precipitate  As have $3d^{10}$ / have a full 3d sub-shell / <b>ALL</b> 3d orbitals are full (1)  IGNORE Does not have partially filled d orbitals They do not absorb light No d-d transitions occur		2

Question Number	Acceptable Answers	Reject	Mark
<b>21c</b>	(Zinc) does not form a (stable) <b>ion</b> with incompletely/partially filled d orbitals  ALLOW d sub-shell for d orbitals The only (stable) <b>ion</b> formed by zinc has full d sub-shell It does not form a (stable) oxidation state with incompletely/partially filled d orbitals	Element has full d shells.	1

**Total for Question 21 = 9 marks**

Question Number	Acceptable Answers	Reject	Mark
22(a)(i)	 <p>Beaker with V electrode in solution containing <math>V^{2+}(aq)</math> AND beaker containing <math>V^{2+}(aq)</math> and <math>V^{3+}(aq)</math> with Pt electrode</p> <p>N.B. Both solution levels must be shown (1)</p> <p><b>Labelled</b> salt bridge AND connections to voltmeter ALLOW Suitable name or formula of salt for label</p> <p>ALLOW Salts eg NaCl in salt bridge (1)</p> <p>Ion concentrations = <math>1 \text{ mol dm}^{-3}</math> ALLOW M for <math>\text{mol dm}^{-3}</math> Concentrations given in one beaker only (1)</p> <p>Beaker positions may be reversed</p> <p>Ignore references to temperature and pressure</p>	<p>Salt bridge neither dipping into nor touching solution unless penalised in MP1</p> <p>Salt bridge containing an alkali/acid</p> <p>1 mole of <math>V^{2+}</math> and 1 mole of <math>V^{3+}</math></p>	3



Question Number	Acceptable Answers	Reject	Mark
<b>22(a)(ii)</b>	<p><b>First mark</b>  <math>2V^{3+} + V \rightarrow 3V^{2+}</math>  Balanced equation, either direction  ALLOW  Eqm sign for <math>\rightarrow</math></p> <p>IGNORE  State symbol even if incorrect (1)</p> <p><b>Second mark</b>  Correct direction  ALLOW  If balancing is incorrect or <math>e^-</math> included in equation (1)</p>	$e^-$ included	2

Question Number	Acceptable Answers	Reject	Mark						
<b>22b(i)</b>	<table border="1"> <tr> <td>([VO<sup>2+</sup>(aq) + 2H<sup>+</sup>(aq)], [V<sup>3+</sup>(aq) + H<sub>2</sub>O(l)]  Pt)</td> <td>+0.34</td> </tr> <tr> <td>([VO<sub>2</sub><sup>+</sup>(aq) + 2H<sup>+</sup>(aq)], [VO<sup>2+</sup>(aq) + H<sub>2</sub>O(l)]  Pt)</td> <td>+1.00</td> </tr> <tr> <td>Sign and value needed</td> <td></td> </tr> </table>	([VO <sup>2+</sup> (aq) + 2H <sup>+</sup> (aq)], [V <sup>3+</sup> (aq) + H <sub>2</sub> O(l)]  Pt)	+0.34	([VO <sub>2</sub> <sup>+</sup> (aq) + 2H <sup>+</sup> (aq)], [VO <sup>2+</sup> (aq) + H <sub>2</sub> O(l)]  Pt)	+1.00	Sign and value needed			1
([VO <sup>2+</sup> (aq) + 2H <sup>+</sup> (aq)], [V <sup>3+</sup> (aq) + H <sub>2</sub> O(l)]  Pt)	+0.34								
([VO <sub>2</sub> <sup>+</sup> (aq) + 2H <sup>+</sup> (aq)], [VO <sup>2+</sup> (aq) + H <sub>2</sub> O(l)]  Pt)	+1.00								
Sign and value needed									

Question Number	Acceptable Answers	Reject	Mark
<b>22(b)(ii)</b>	<p><b>A:</b> (+)0.32 (V) (1)</p> <p>VO<sup>2+</sup> (may be shown as a product in an overall equation) (1)</p> <p>EITHER Bubbles / effervescence (of colourless gas) OR Colour changes (from yellow) to blue</p> <p>TE on negative <math>E_{\text{cell}}</math> for 'stays yellow'</p> <p>ALLOW (from yellow) to green if justified by partial reduction (1)</p> <p><b>B:</b> -0.2(0) (V) (1) no change / stays blue (1) If B=+0.2 or other positive value allow colour change from blue to green or brown.</p> <p>EITHER Consistent use of rule that reaction occurs when <math>E_{\text{cell}}</math> is positive OR Consistent use of rule that no reaction occurs when <math>E_{\text{cell}}</math> negative ALLOW If implied but not stated specifically (1)</p>	Violet          Stays violet	6

Question Number	Acceptable Answers	Reject	Mark
<b>22c(i)</b>	<p>V<sup>2+</sup> + 2H<sub>2</sub>O → VO<sub>2</sub><sup>+</sup> + 4H<sup>+</sup> + 3e<sup>-</sup> OR Ox number of V increases by 3, ox number of Mn decreases by 5</p> <p>ALLOW Balanced full equation 5V<sup>2+</sup> + 3MnO<sub>4</sub><sup>-</sup> + 4H<sup>+</sup> → 5VO<sub>2</sub><sup>+</sup> + 3Mn<sup>2+</sup> + 2H<sub>2</sub>O</p>	Reverse equation unless used to deduce final correct equation.	1

Question Number	Acceptable Answers	Reject	Mark
<b>22(c)(ii)</b>	(35.50 × 0.0200/1000) = 7.1(0) × 10 <sup>-4</sup> / 0.00071		1

Question Number	Acceptable Answers	Reject	Mark
22(c)(iii)	<p><b>In final answer</b>  <b>92.2 scores 3 marks</b>  <b>33.2 scores 2 marks</b> (ratio inverted)  <b>55.3 scores 2 marks</b> (ratio 1:1)</p> <p>METHOD 1  Mol <math>V^{2+}</math> reacting = <math>7.10 \times 10^{-4} \times 5/3</math>  = <b><math>1.18333 \times 10^{-3}</math></b>  = mol <math>VO_2^+</math>  TE on answer to (c)(ii) (1)</p> <p>Mass <math>NH_4VO_3</math> = <math>(1.183 \times 10^{-3} \times 116.9)</math>  = <b>0.1382927 g</b>  TE from <math>4.26 \times 10^{-3}</math> = 0.497994 (1)</p> <p>% purity = <math>(0.1382927 \times 100 / 0.150)</math> =  (92.19333)  = <b>92.2%</b>  TE from 0.497994 = 33.2% (1)</p> <p>METHOD 2</p> <p>If 100% pure, moles of <math>NH_4VO_3</math>  = <math>0.150 / 116.9 = 1.283 \times 10^{-3}</math> (1)</p> <p>Mol <math>V^{2+}</math> reacting = <math>7.10 \times 10^{-4} \times 5/3</math>  = <b><math>1.18333 \times 10^{-3}</math></b>  = mol <math>VO_2^+</math>  TE on answer to (c)(ii) (1)</p> <p>% purity =  = <math>1.18333 \times 10^{-3} \times 100 / 1.283 \times 10^{-3}</math>  = <b>92.2%</b> (1)</p> <p>ALLOW TE at each step provided that each number used is to at least 2sf</p>	<p>x 3/5  = <math>4.26 \times 10^{-4}</math></p>	3

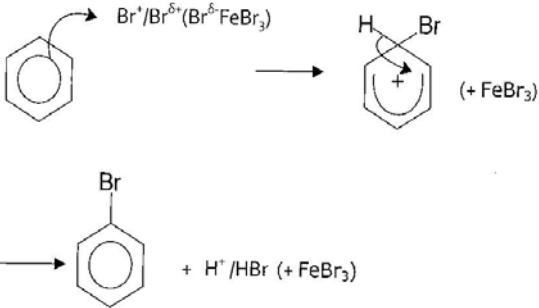
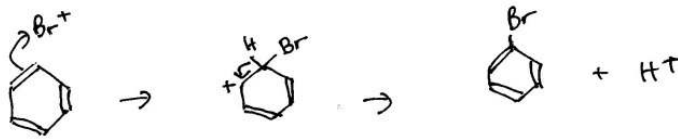
**Total for Question 22 = 17 marks**

Question Number	Acceptable Answers	Reject	Mark
<b>23(a)</b>	All carbon to carbon bonds same length/ longer C-C and shorter C=C not present  IGNORE Just "benzene has a delocalised ring" Benzene does not have C=C double bonds Any references to shape/ bond angles		1

Question Number	Acceptable Answers	Reject	Mark
<b>23(b)(i)</b>	$(3 \times -118) = -354 \text{ (kJ mol}^{-1}\text{)}$		1

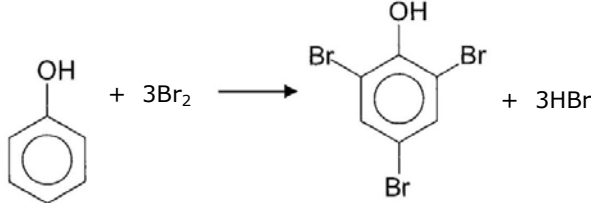
Question Number	Acceptable Answers	Reject	Mark
<b>23(b)(ii)</b>	<p><b>First mark</b> Relative levels with names or formulae (1)</p> <p><b>Second mark</b> Value <math>-149 \text{ (kJ mol}^{-1}\text{)}</math> + arrow in correct direction ALLOW double-headed arrow (1)</p> <p>TE from value in (b)(ii) IGNORE <math>3\text{H}_2</math> if shown / cyclohexene / other arrows/values</p>	Diagram inverted scores 0          +149	2

Question Number	Acceptable Answers	Reject	Mark
<b>23(b)*(iii)</b>	The p/pi-/Π/6 electrons (of carbon) (1) are delocalised in benzene (but not in X) (1)		2

Question Number	Acceptable Answers	Reject	Mark
23(c)	<p><b>First mark:</b>  <math>\text{FeBr}_3 + \text{Br}_2 \rightarrow \text{FeBr}_4^- + \text{Br}^+</math>  OR  <math>\text{Br}-\text{Br} + \text{FeBr}_3 \rightarrow \text{Br}^{\delta+} \dots \text{Br}^{\delta-}\text{FeBr}_3</math> (1)  Ignore state symbols even if wrong</p> <p><b>Second, third and fourth marks:</b>  <b>Either</b></p>  <p>Arrow from benzene ring electrons (from <b>inside</b> the hexagon) to <b>Br<sup>+</sup> / Br<sup>δ+</sup></b> (..... Br<sup>δ-</sup>FeBr<sub>3</sub>) (1)</p> <p>Correctly drawn intermediate with delocalisation covering at least three carbon atoms, but not the carbon atom bonded to the bromine, with the positive charge shown inside the horseshoe</p> <p>The bonds to H and Br may be dotted (1)</p> <p>Arrow from / close to C-H <b>bond</b> to inside the hexagon <b>and</b> H<sup>+</sup> / HBr as product (1)</p> <p><b>OR</b></p>  <p>Use of Kekulé structure for benzene and intermediate with arrow from C=C double bond to <b>Br<sup>+</sup> / Br<sup>δ+</sup></b> (..... Br<sup>δ-</sup>FeBr<sub>3</sub>) (1)</p> <p>Correctly drawn intermediate with + charge on the C atom next to the C bonded to H and Br</p>	Gap in wrong place	4

	The bonds to H and Br may be dotted (1)		
	Arrow from / close to C-H <b>bond</b> to bond beside + charged C <b>and</b> H <sup>+</sup> / HBr as product (1)		
	Each marking point is independent		

Question Number	Acceptable Answers	Reject	Mark
<b>23(d)(i)</b>	Bromine goes colourless OR It/the mixture goes from brown to colourless  ALLOW Red-brown/ Orange/ yellow/ combinations of these colours  Bromine is decolorised (1)  White precipitate/solid forms / Steamy fumes (1)  IGNORE Antiseptic smell Gets hot	Goes clear   Red to colourless  Bromine is discoloured  Effervescence	2

Question Number	Acceptable Answers	Reject	Mark
<b>23(d)(ii)</b>	 <p>Organic product with structure shown (1)            Rest of equation correct            ALLOW            C<sub>6</sub>H<sub>5</sub>OH or Kekule for phenol (1)             C<sub>6</sub>H<sub>5</sub>OH + 3Br<sub>2</sub> → C<sub>6</sub>H<sub>2</sub>Br<sub>3</sub>OH + 3HBr            Scores MP2 only            Substitution of 1Br or 2Br in any position in balanced equation scores MP2 only.</p>		2

Question Number	Acceptable Answers	Reject	Mark
*23(d)(iii)	<p><b>Lone pair of electrons on oxygen</b> (may be shown on a diagram)</p> <p><b>and</b></p> <p>EITHER overlaps with pi cloud</p> <p>OR Feeds into / donates into / interacts with benzene ring</p> <p>(1)</p> <p>Activating benzene ring / increasing electron density of ring / making attack by <b>electrophiles</b> easier (1)</p> <p>COMMENT 'Lone pair of electrons on oxygen increases electron density of ring' scores (2)</p> <p>ALLOW benzene becomes a better nucleophile for MP2</p>	<p>OH group overlaps</p> <p>Just 'making it more reactive'.</p>	2

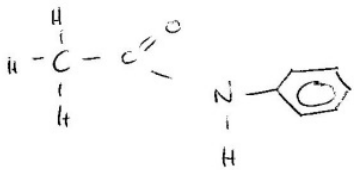
**Total for Question 23 = 16 marks**

Question Number	Acceptable Answers	Reject	Mark
<b>24(a)(i)</b>	Concentrated nitric acid AND concentrated sulfuric acid ALLOW 'concentrated nitric and sulfuric acids' Concentrated HNO <sub>3</sub> and concentrated H <sub>2</sub> SO <sub>4</sub>	Extra reagents	1

Question Number	Acceptable Answers	Reject	Mark
<b>24(a)(ii)</b>	To prevent multiple substitutions/ to stop di- or trinitrobenzene forming ALLOW To stop further substitution (of NO <sub>2</sub> )/ further nitration  IGNORE further reaction	Further <b>addition</b> of nitro groups	1

Question Number	Acceptable Answers	Reject	Mark
<b>24(a)(iii)</b>	Tin/ Sn AND <b>concentrated</b> HCl/ <b>concentrated</b> hydrochloric acid  ALLOW Iron/Fe or Zn/Zinc for tin Conc for concentrated	Dilute HCl	1

Question Number	Acceptable Answers	Reject	Mark
<b>24(b)(i)</b>	C <sub>6</sub> H <sub>5</sub> NH <sub>3</sub> <sup>+</sup> Cl <sup>-</sup>  ALLOW C <sub>6</sub> H <sub>5</sub> NH <sub>3</sub> Cl		1

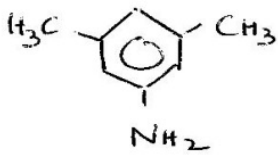
Question Number	Acceptable Answers	Reject	Mark
<b>24(b)(ii)</b>	  ALLOW C <sub>6</sub> H <sub>5</sub> for benzene Undisplayed CH <sub>3</sub>	Skeletal formula  Structural formula	1



Question Number	Acceptable Answers	Reject	Mark
<b>24(b)(iii)</b>	<p><b>D</b> (transition metal) complex ion  ALLOW  Transition metal complex / copper complex  IGNORE  Formulae of ions (1)</p> <p><b>F</b> (azo) dye / azo compound / diazo compound  ALLOW  diazonium compound  molecule for compound (1)</p>		2

Question Number	Acceptable Answers	Reject	Mark
<b>24b(iv)</b>	<p>Benzenediazonium chloride  ALLOW  Phenyldiazonium chloride</p>	<p>Benzadiazonium chloride  Diazonium salt</p>	1

Question Number	Acceptable Answers	Reject	Mark
<b>24b(v)</b>	<p>HCl + NaNO<sub>2</sub>  OR  Hydrochloric acid + Sodium nitrite / nitrate(III)  OR  alternative cation to Na<sup>+</sup></p> <p>IGNORE  HNO<sub>2</sub>  Concentration of HCl</p>	HCl + HNO <sub>2</sub>	1

Question Number	Acceptable Answers	Reject	Mark
<b>24b(vi)</b>	 <p>ALLOW any substitution positions <math>C_6H_3(CH_3)_2NH_2</math> H- <math>C_6H_2(CH_3)_2NH_2</math> Kekule structure</p>	$C_6H_2(CH_3)_2NH_2$	1

**Total for Question 24 = 10 marks**

Question Number	Acceptable Answers	Reject	Mark
<b>25(a)(i)</b>	$  \begin{array}{c}  \text{H} \\    \\  ^+\text{H}_3\text{N} - \text{C} - \text{COO}^- \\    \\  \text{CH}_2\text{OH}  \end{array}  $ <p>OR <math>\text{HOCH}_2\text{CH}(\text{NH}_3^+)\text{CO}_2^-</math></p> <p>ALLOW Charge on <math>\text{NH}_3</math> shown on N atom</p>		1

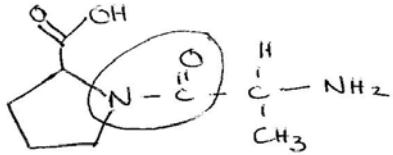
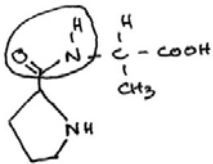
Question Number	Acceptable Answers	Reject	Mark
<b>*25(a)(ii)</b>	<p><b>EITHER</b></p> <p>At pH 5.68 both NH<sub>2</sub> groups on lysine will be NH<sub>3</sub><sup>+</sup> / lysine has an overall positive charge while serine has no overall charge (1)</p> <p>So only lysine will move to negative terminal / in an electric field (1)</p> <p><b>OR</b></p> <p>lysine has a greater positive charge (than serine) (1)</p> <p>Lysine will move faster / further in an electric field (1)</p> <p>ALLOW They have different charges so will move different distances/ at different speeds 1 mark max</p> <p>IGNORE Answers based on molecular mass</p>		2

Question Number	Acceptable Answers	Reject	Mark
<b>*25(b)</b>	<p><b>COMMENT</b></p> <p>Ignore references to H bonds from amino and carboxyl groups and assume that "phenylalanine cannot form H bonds" refers to R group in the compound.</p> <p>Serine has an OH (alcoholic) group which can form H bonds with water (1)</p> <p>Benzene ring in phenylalanine is bulky / is large and non-polar / is hydrophobic / London forces between phenylalanine molecules are significant ALLOW van der Waals etc for London</p> <p>ALLOW If MP1 is not scored, 'phenylalanine cannot form H bonds with water' can score MP2 (1)</p>	VdW / id-id	2

Question Number	Acceptable Answers	Reject	Mark
<b>25(c)</b>	H, -H, H-  ALLOW NH <sub>2</sub> CH <sub>2</sub> CO <sub>2</sub> H / NH <sub>2</sub> CH <sub>2</sub> COOH  $  \begin{array}{c}  \text{H} \\    \\  \text{H}_2\text{N} - \text{C} - \text{C} \begin{array}{l} \nearrow \text{O} \\ \searrow \text{OH} \end{array} \\    \\  \text{H}  \end{array}  $		1

Question Number	Acceptable Answers	Reject	Mark
<b>25(d)(i)</b>	(Measure) the amount of / angle of / degree of / extent of rotation (of plane of polarization/ plane polarized light)  IGNORE direction they rotate the light	Just "polarimetry"	1

Question Number	Acceptable Answers	Reject	Mark
<b>25(d)(ii)</b>	(Leu has 1 chiral C but) Ile has 2 chiral C / 2 asymmetric C atoms OR The R group in Ile contains a chiral C (Leu has 2 optical isomers but Ile has 4 optical isomers)  ALLOW Ile has (1) more chiral C (than leu) Chiral centres shown on formulae	Leu has no chiral C	1

Question Number	Acceptable Answers	Reject	Mark
<b>25(e)</b>	 <p>CON circled with N as part of ring (1) Fully correct structure (1)</p> <p>ALLOW -CH(CH<sub>3</sub>)NH<sub>2</sub> shown skeletally</p> <p><b>OR</b> Dipeptide using NH<sub>2</sub> from alanine and COOH from proline, with correct structure and CONH circled <b>This scores max (1)</b></p> 	Just N-C circled	2

Question Number	Acceptable Answers	Reject	Mark
<b>25(f)(i)</b>	<p>CH<sub>3</sub>CHO / CH<sub>2</sub>CHOH</p> <p>ALLOW Displayed or semi-displayed formula C<sub>2</sub>H<sub>4</sub>O</p>	CH <sub>3</sub> COH (unless with correct structure)	1

Question Number	Acceptable Answers	Reject	Mark
<b>25(f)(ii)</b>	C <sub>18</sub> H <sub>9</sub> NO <sub>4</sub>		1

Question Number	Acceptable Answers	Reject	Mark																																								
25(f)(iii)	<p><b>Several methods are possible.</b>  <b>Amount of O should have been calculated and final answer should be consistent with masses/mols in calculation. There should be evidence of working at each stage for 4 marks</b></p> <p><b>MP1</b>  2.614 g CO<sub>2</sub> contain 0.7129 g C  0.2673 g H<sub>2</sub>O contain 0.0297 g H</p> <p>OR  2.614 g CO<sub>2</sub> contain 0.059409 mol CO<sub>2</sub>  0.2673 g H<sub>2</sub>O contain 0.01485 mol H<sub>2</sub>O (1)</p> <p><b>MP2</b>  Mass O in Q = (1.00 – 0.7129– 0.0297 –0.04620)  = <b>0.2112</b> g (1)</p> <table> <thead> <tr> <th></th> <th>%</th> <th>mol/100g</th> <th>ratio</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>71.29</td> <td>5.94</td> <td>18</td> </tr> <tr> <td>H</td> <td>2.97</td> <td>2.97</td> <td>9</td> </tr> <tr> <td>N</td> <td>4.62</td> <td>0.33</td> <td>1</td> </tr> <tr> <td>O</td> <td>21.12</td> <td>1.32</td> <td>4</td> </tr> </tbody> </table> <p><b>MP3</b>  Number of moles of each element  OR  Number of mol in 100g  Allow TE for incorrect mol of H – see calculation below (1)</p> <p><b>MP4</b>  Ratio stated must follow from numbers in calculation  (so empirical formula is consistent with the molecular formula of <b>Q</b>) (1)</p> <p><b>OR</b>  <b>Calculation following error in H scores max (3)</b>  If mass H is wrongly calculated as 0.01485 g,  then mass O will be 0.22605 (TE for MP2) (1)</p> <table> <thead> <tr> <th></th> <th>%</th> <th>mol/100g</th> <th>ratio</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>71.29</td> <td>5.94</td> <td>18</td> </tr> <tr> <td>H</td> <td>1.48</td> <td>1.48</td> <td>4.5</td> </tr> <tr> <td>N</td> <td>4.62</td> <td>0.33</td> <td>1</td> </tr> <tr> <td>O</td> <td>22.60</td> <td>1.41</td> <td>4.27</td> </tr> </tbody> </table>		%	mol/100g	ratio	C	71.29	5.94	18	H	2.97	2.97	9	N	4.62	0.33	1	O	21.12	1.32	4		%	mol/100g	ratio	C	71.29	5.94	18	H	1.48	1.48	4.5	N	4.62	0.33	1	O	22.60	1.41	4.27		4
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	Number of moles of each element (TE for MP3) (1) Ratio stated and empirical formula said not to be consistent (TE for MP4) (1)		
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Question Number	Acceptable Answers	Reject	Mark
<b>25(f)(iv)</b>	Mass of molecular ion in mass spectrum = 303 / any sensible fragment with mass eg 302 / 158 / 145 or smaller fragment (1)  ALLOW Molecular ion based on formula in f(i)  Number of peaks in nmr = 2 / 3 ALLOW 5 (1)	4	2

**Total for Question 25 = 18 marks**

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