

**Chemistry**

Advanced GCE A2 7882

Advanced Subsidiary GCE AS 3882

**Mark Schemes for the Units**

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**January 2007**

**3882/7882/MS/R/07J**

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### Advanced Subsidiary GCE Chemistry (3882)

#### MARK SCHEME ON THE UNITS

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**Mark Scheme 2811**  
**January 2007**

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit <u>      </u> = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument																			
<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>																		
1 (a) (i)	(atoms of) <b>same element/same atomic number</b> ..... with different numbers of neutrons/different masses ✓	[1]																		
(b) (i)	<table border="1" data-bbox="480 613 1273 927"> <thead> <tr> <th rowspan="2">isotope</th> <th rowspan="2">percentage composition</th> <th colspan="3">number of</th> </tr> <tr> <th>protons</th> <th>neutrons</th> <th>electrons</th> </tr> </thead> <tbody> <tr> <td><sup>85</sup>Rb</td> <td>71 to 73</td> <td>37</td> <td>48</td> <td>37</td> </tr> <tr> <td><sup>87</sup>Rb</td> <td>27 to 29</td> <td>37</td> <td>50</td> <td>37</td> </tr> </tbody> </table> <p style="text-align: center;">must add mark up to 100 ✓</p>	isotope	percentage composition	number of			protons	neutrons	electrons	<sup>85</sup> Rb	71 to 73	37	48	37	<sup>87</sup> Rb	27 to 29	37	50	37	✓ ✓ [3]
isotope	percentage composition			number of																
		protons	neutrons	electrons																
<sup>85</sup> Rb	71 to 73	37	48	37																
<sup>87</sup> Rb	27 to 29	37	50	37																
(ii)	ie 1 mark for each atomic structure; 1 for % compositions. $A_r = \frac{(85 \times 72) + (87 \times 28)}{100} / 85.56 \checkmark$ $= 85.6 \checkmark$ 2nd mark for significant figures 71/29: 85.58 = 85.6 73/27: 85.54 = 85.5	[2]																		
(c)	carbon-12/ <sup>12</sup> C ✓	[1]																		
(d)	atomic radii of Rb > atomic radii of elements above/ Rb has electrons in shell further from nucleus / Rb has more shells ✓  Rb has <b>more</b> shielding ✓ ( <i>'more' is essential</i> )  (increased) nuclear charge is outweighed / despite increased nuclear charge .....by at least one of the factors above/ less attraction/ held less tightly ✓	[3]																		
(e) (i)	<b>Simplest (whole number) ratio</b> of atoms/moles/elements ✓	[1]																		
(ii)	ratio Rb : Ag : I = 7.42/85.5 : 37.48/108 : 55.10/127 or 0.0868 : 0.347 : 0.434 or 1 : 4 : 5 ✓ = RbAg <sub>4</sub> I <sub>5</sub> ✓	[2]																		
		<b>Total: 13</b>																		

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<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
2 (a) (i)	8-14 ✓	[1]
(ii)	$\text{Ca(OH)}_2(\text{aq}) + \text{CO}_2(\text{g}) \longrightarrow \text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$ 1st mark for species in equation ✓ 2nd mark for rest with st symbols ✓ Allow H <sub>2</sub> O as either 'l' or 'aq'	[2]
(iii)	precipitate disappears/goes clear/goes colourless ✓ $\text{Ca(HCO}_3)_2$ $\text{CaH}_2\text{C}_2\text{O}_6$ ✓	[2]
(b) (i)	$1s^2 2s^2 2p^6 3s^2 3p^6$ ✓	[1]
(ii)	3 ✓	[1]
(iii)	10 ✓	[1]
(iv)	'dot-and-cross' of Ca <sup>2+</sup> with either 8 electrons or no electrons. ✓ 'dot-and-cross' of 2OH <sup>-</sup> correct ✓ N.B. H electron and Ca electrons can look the same.	[2]
(c) (i)	Heat CaCO <sub>3</sub> ✓ $\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$ ✓ Add water to CaO (or + H <sub>2</sub> O in equation) ✓ $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2$ ✓	[4]
(d)	neutralising (acid) soils/neutralising sewage/ softening water in water treatment/ neutralising acid water ✓	[1]
		<b>Total: 15</b>

Question	Expected Answers	Marks
<b>Abbreviations, annotations and conventions used in the Mark Scheme</b> / = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit _____ = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument		
<b>3</b>		
(a) (i)	attraction between oppositely charged ions ✓	[1]
(ii)	shared pair of electrons ✓✓ <i>'shared electrons' scores 1 mark only</i>	[2]
(b) (i)	attraction of an <b>atom/element</b> for electrons ✓ in a (covalent) bond/bonded pair ✓	[2]
(ii)	one element attracts bonded pair more /is more electronegative than other ✓ → δ- on more electronegative atom and δ+ on less electronegative element in example ✓ <i>May need to look for these marks in (c) if not given here.</i>	[2]
(c)	H-bond shown between H of one molecule and O, N or F of another ✓ H-bond shown going to a lone pair ✓	[2]
		<b>Total: 9</b>

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit _____ = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument																	
<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>																
4 (a)	<table border="1" data-bbox="496 566 1203 775"> <thead> <tr> <th>element</th> <th>structure</th> <th>bonding</th> <th></th> </tr> </thead> <tbody> <tr> <td>Mg</td> <td>giant</td> <td>metallic</td> <td>✓</td> </tr> <tr> <td>Si</td> <td>giant</td> <td>covalent</td> <td>✓</td> </tr> <tr> <td>S</td> <td>simple</td> <td>covalent</td> <td>✓</td> </tr> </tbody> </table> <p>1 mark for each correct row</p>	element	structure	bonding		Mg	giant	metallic	✓	Si	giant	covalent	✓	S	simple	covalent	✓	[3]
element	structure	bonding																
Mg	giant	metallic	✓															
Si	giant	covalent	✓															
S	simple	covalent	✓															
(b)	<p>Si has strong forces between atoms/ covalent bonds are broken ✓</p> <p>P has weak forces between molecules/ intermolecular forces/van der Waals' forces are broken ✓</p>	[2]																
(c)	<p>From Na → Al, no of <b>delocalised</b> electrons increases ✓</p> <p>charge on positive ion increases/ ionic size decreases/ charge density increases ✓</p> <p>attraction between + ions and electrons increases/ metallic bonding gets stronger ✓</p>	[2 max]																
		<b>Total: 7</b>																

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<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
5 (a) (i)	12 x 50/1000 = 0.600 mol ✓	[1]
	(ii)	
	4 mol HCl → 1 mol Cl <sub>2</sub> / moles Cl <sub>2</sub> = 0.15 mol ✓ vol of Cl <sub>2</sub> = 0.15 x 24 = 3.60 dm <sup>3</sup> ✓ <i>2nd mark is consequential on molar ratio given</i>	[2]
(b)	Evidence that the oxidation number of Mn has reduced <b>and</b> one of the oxidation numbers correct (ie MnO <sub>2</sub> : ox no of Mn = +4 or MnCl <sub>2</sub> : ox no of Mn = +2 ✓ The <b>other</b> oxidation number of Mn is correct, ie in MnO <sub>2</sub> : ox no of Mn = +4 <b>or</b> in MnCl <sub>2</sub> : ox no of Mn = +2 ✓	[2]
(c) (i)	2Na(s) + Cl <sub>2</sub> (g) → 2NaCl(s) ✓✓ 1st mark for equation 2nd mark for state symbols	[2]
	(ii)	
	Giant ionic (lattice) or 3D ✓ with alternating Na <sup>+</sup> and Cl <sup>-</sup> ✓	[2]
	With Br <sup>-</sup> , goes yellow/orange/red ✓ <i>'precipitate' makes this incorrect.</i>  With I <sup>-</sup> , goes purple/brown/brown ✓ <i>'precipitate' should be ignored</i>  Cl <sub>2</sub> + 2Br <sup>-</sup> → Br <sub>2</sub> + 2Cl <sup>-</sup> ✓ Cl <sub>2</sub> + 2I <sup>-</sup> → I <sub>2</sub> + 2Cl <sup>-</sup> ✓ Or full equations using soluble halides, eg NaBr If both equations given with correct species but not balanced, award 1 mark  reactivity trend: Cl more reactive than both Br and I/ Cl is the most reactive ✓  Cl (atoms) are smaller (ora) / attraction for electrons or electron affinity is greater / Cl is a stronger oxidising agent ✓ <i>ignore any reference to 'electronegativity'.</i>	[6]
	QoWC: At least 2 sentences in which the meaning is clear. ✓	[1]
		<b>Total: 16</b>

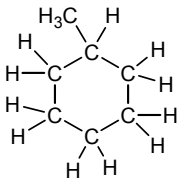
**Mark Scheme 2812**  
**January 2007**

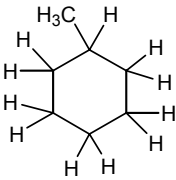
2812

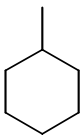
Mark Scheme

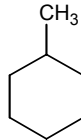
January 2007

## Q1

- (a) separation by (differences in) boiling point ✓
- (b)  $C_7H_{16} \longrightarrow C_4H_{10} + C_3H_6$  ✓
- (c) (i) Any of
- 






- ✓
- (ii)  $C_7H_{16} \longrightarrow C_7H_{14} + H_2$  (or by structural formula) ✓
- (d) (i) 2,2-dimethylpentane ✓
- (ii) 3-methylhexane, 3,3 dimethylpentane or (3)-ethylpentane in any unambiguous form. ✓✓
- (iii) 2,2,3-trimethylbutane ✓
- (iv) if branched, difficult to pack/less surface interaction/less points of contact ✓  
less van der Waals' forces/ less intermolecular bonds/less energy needed to boil ✓
- (e) (i) (A fuel whose feedstock is obtained) from a plant/animal excrement ✓
- (ii) fossil fuels are non-renewable because they take millions of years to form/  
ethanol is renewable because the plant (sugar beet, cane) can be re-grown ✓

[Total: 12]

2812

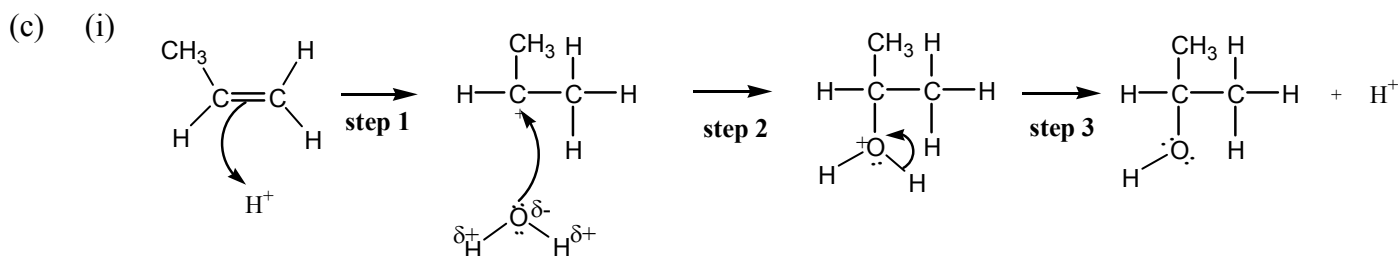
Mark Scheme

January 2007

## Q2

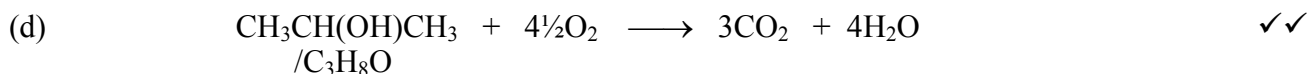
- (a) (i)  $C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5OH(l) \text{ or } (aq) + 2CO_2(g)$  balanced equation ✓  
 state symbols can be awarded only if equation shows  $C_6H_{12}O_6$ ,  $C_2H_5OH$  and  $CO_2$  ✓
- (ii) anaerobic, aqueous, temp range 25 – 40 °C/warm to just above room temp ✓✓
- (iii) no more bubbles/gas/ $CO_2$  ✓

- (b) (i) phosphoric acid/ $H^+$ /sulphuric acid ✓
- (ii) lone/electron pair of electrons acceptor ✓



- Step 1 curly arrow from  $\pi$ -bond to  $H^+$  ✓
- Step 2 curly arrow from lone pair on the  $O^{\delta-}$  to  $C^+$  ✓
- Step 3 curly arrow from  $O-H$  bond to  $O^+$  ✓

- (ii) catalyst ... no marks because it is **not** consumed/used up in the reaction/owtte ✓



(1 mark if correct formula for all four chemicals and 1 mark for correct balancing)

- (e) ethanoic acid/  $CH_3COOH/CH_3COCl$  ✓

[Total: 14]

2812

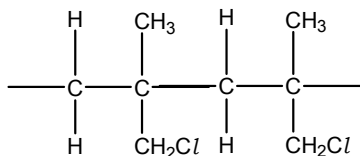
Mark Scheme

January 2007

Q3

(a) 3-chloro(-2-)methylprop-1-ene/1-chloro(-2-)methylprop-2-ene ✓

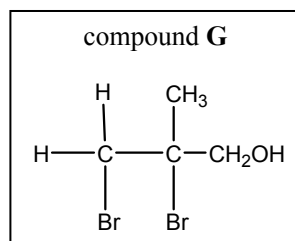
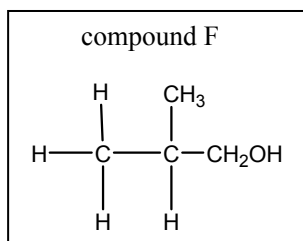
(b)



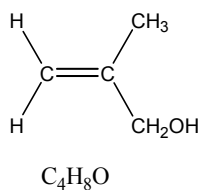
Backbone of 4 carbons  
and a reasonable attempt  
gets 1 mark.

✓✓

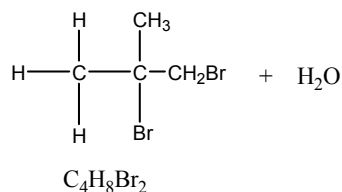
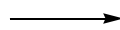
(c) (i)



(ii)



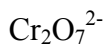
+ 2 HBr



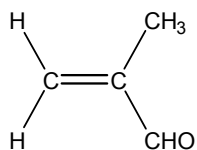
✓✓

1 mark for HBr

(iii)

 $\text{H}^+$  and reflux ✓

(iv)



/ methylprop-2-enal ✓

(d) **infra-red**(alcohol) **E** would show absorption  $3230 - 3550 \text{ cm}^{-1}$  ✓(carboxylic acid) **I** would show **either** an absorption  $1680 - 1750 \text{ cm}^{-1}$  **or**  $2500 - 3300 \text{ cm}^{-1}$  ✓**I** contains  $\text{C}=\text{O}$  at approx  $1700 \text{ cm}^{-1}$  but **E** doesn't get both marks ✓✓

[Total: 12]

2812

Mark Scheme

January 2007

## Q4

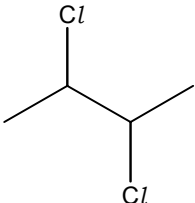
(a) (i) uv/sunlight/high temperature (range 400 – 700 °C) ✓

(ii)  $Cl_2 \longrightarrow 2Cl\bullet$  ✓ $C_4H_{10} + Cl\bullet \longrightarrow HCl + \bullet C_4H_9/C_4H_9\bullet$  ✓ $\bullet C_4H_9/C_4H_9\bullet + Cl_2 \longrightarrow C_4H_9Cl + Cl\bullet$  ✓

(iii) any two free radicals from (a) (ii) ✓

(iv) homolytic (fission) ✓

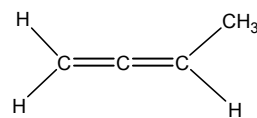
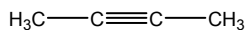
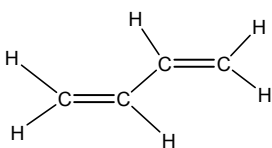
(b) (i) 2,3-dichlorobutane ✓

(ii)  ✓(iii) any dichlorobutane **except** 2,3-dichlorobutane. ✓

(c) (i) ethanol ✓

(ii) elimination ✓

(iii) any one from:



✓

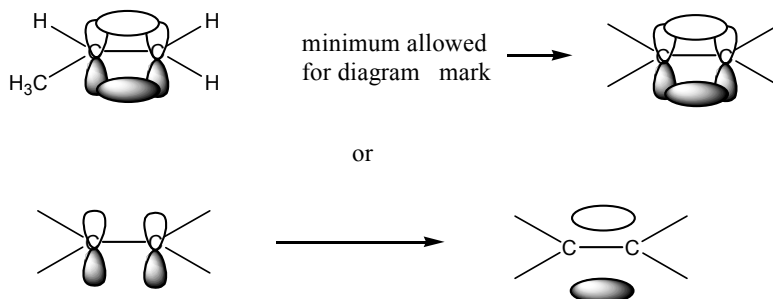
[Total: 12]

2812

Mark Scheme

January 2007

Q5

**Bonding:**  $\pi$ -bond formed by overlap of (adjacent) p-orbitals/ $\pi$ -bond labelled on diagram ✓diagram to show formation of the  $\pi$ -bond ✓

2

**Shape/bond angles:**tetrahedral around the  $\text{CH}_3$  ✓bond angle =  $109^\circ 28'$  ( $109$ - $110^\circ$ ) ✓trigonal planar around each C in the  $\text{C}=\text{C}$  ✓bond angle =  $120^\circ$  ( $118$ - $122^\circ$ ) ✓

4

**Cis-trans***cis* & *trans* correctly labelled eg but-2-ene ✓

require a double bond because it restricts rotation ✓

each C in the  $\text{C}=\text{C}$  double bond must be bonded to two different atoms or groups ✓

3

QWC

Allow mark for well constructed answer and use of **three** terms like:

orbital, tetrahedral, trigonal, planar, rotation, spatial, stereoisomers, geometric ✓

[Total: 10]

**Mark Scheme 2813/01**  
**January 2007**

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Question	Expected Answers	Marks
<b>1</b> (a) (i)	$\text{MgCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ balancing ✓ state symbols ✓	2
(ii)	$\text{MgCO}_3 + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{CO}_2 + \text{H}_2\text{O}/$ $\text{CO}_3^{2-} + 2\text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O} \checkmark$	1
(b)	(as the reaction proceeds) the concentration decreases ✓ (rate) of collision decreases ✓ reaction stops when all of one reagent is used up ✓	3
(c) (i)	sketch to show slower rate of production ie less steep (must not be straight line)✓ final volume the same but reached later ✓	2
(ii)	rate is slower <b>because</b> weak acid is partially ionised/ dissociated ✓ lower <b>concentration</b> of $\text{H}^+$ in weak/ higher <b>concentration</b> of $\text{H}^+$ in strong/ HCl ✓	2
		Total: 10









**Mark Scheme 2813/03**  
**January 2007**

**AS Practical Exam 2813/03  
Jan 2007: Mark Scheme**

**Skill P: 16 marks** (out of 19 available)

**G Gas collection method – 9 marks**

- G1 Adds measured quantity of sulphuric acid to known mass of baking powder [1]
- G2 Collects the gas in a gas syringe/measuring cylinder/inverted burette [1]  
**or** measures total mass of materials at start, then mass loss after reaction
- G3 Uses excess dilute sulphuric acid **and** states reason for excess [1]
- G4 Draws a neat accurate diagram of apparatus (using a ruler) [1]  
*If mass loss method is described, a wool plug must be shown*
- G5 “Inner tube” (or equivalent) used to prevent premature start of reaction [1]
- G6 Waits until no more gas collected before measuring volume of gas. [1]  
*A specific observation is required (fizzing stops or syringe plunger stops moving)  
Mass loss: measurement must be to constant mass (aw)*
- G7 Repeats whole experiment until volumes of gas are consistent/takes mean [1]
- G8 CO<sub>2</sub> is [slightly] soluble in water (or acid) [1]
- G9 Uses water/acid pre-saturated with CO<sub>2</sub> [1]  
**or** uses hot water **or** uses acid that is more concentrated  
**or** states that syringe collection is more accurate since less water involved

**C Calculations etc – 6 marks**

- C1 **Background theory:** baking powder liberates CO<sub>2</sub> when heated **or** when acidified. [1]  
**and** the CO<sub>2</sub> produced makes dough/cakes/bread (etc) rise.
- C2 Researches typical % mass of NaHCO<sub>3</sub> in baking powder (stating source of info) [1]  
**or** states three components of baking powder (starch, bicarb and an organic acid)  
**or** realises that method assumes that no other type of carbonate is present
- C3 **Equation** for reaction:  $2\text{NaHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{CO}_2 + 2\text{H}_2\text{O}$  [1]
- C4 **Calculates** suitable mass of NaHCO<sub>3</sub> so that syringe is not over-filled with gas [1]
- C5 **Calculates** suitable volume **or** concentration of sulphuric acid to use [1]  
*Calculation must implicitly use a correct mole ratio*
- C6 **Calculates** % NaHCO<sub>3</sub> in baking powder from mass used and volume of gas [1]  
*Accept an intelligible calculation leading to any answer **below** 100%*

**S Sources etc – 4 marks**

S1 Researches hazard of **and** explains a safety measure for the sulphuric acid [1]  
*Sulphuric acid is corrosive if > 1.5M (and irritant at lower concentrations)*  
*Treat any gross overstatement of hazard as a CON*

S2 References to two secondary sources quoted as footnotes or at end. [1]  

- *Books must have chapter or page numbers*
- *An Internet reference must go beyond the first slash of web address*
- *Accept one specific reference a page in "Hazcards"*

S3 **QWC**: text is legible and spelling, punctuation and grammar are accurate [1]

*Accept not more than **five** different errors in legibility, spelling, punctuation or grammar.*

- *Treat ICT slip in text (eg "cm3") as one error.*
- *Don't penalise an error that has already been penalised in an equation.*

S4 **QWC**: information is organised clearly and accurately [1]

*Can you say "yes" to all three of the following questions?*

- *Is a word count given and between 450 and 1050 words?*  
*Accept a total word count or any word numbering in the margin*
- *Is scientific language used correctly? Allow **one** error, only, without penalty.*  
*Is there any error of terminology - eg "strong" for "concentrated"?*  
*Is there an incorrect chemical formula in the text?*  
*If units are quoted in text or in calculations are they [normally] correct?*
- *Is the description written logically, coherently and without undue repetition?*



**Page 6 – 4 marks (Part 3)**

- 3(c)  $M_r$  of  $\text{Na}_2\text{CO}_3 = 106$  [1]  
*Allow ecf to candidate's answer in 3(a), either  $\text{NaOH} = 40$  or  $\text{Na}_2\text{O} = 62$*
- Number of moles of residue, correctly calculated from candidate's data [1]
- 3(d) Ratio = 2:1 [1]
- 3(e) Equation fully correct:  $2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$  [1]

**Page 8 – 4 marks (Part 4)**

- 4(a) Both temperatures clearly labelled **and** recorded to  $0.5^\circ\text{C}$  (*ie one decimal place*) [1]  
 Temperature drop correctly worked out **and** unit shown (somewhere) [1]
- Accuracy** – 2 marks [2]
- Candidate's temperature drop within  $0.8^\circ\text{C}$  of supervisor's **mean** → 2 marks
  - Candidate's temperature drop within  $1.5^\circ\text{C}$  of supervisor's **mean** → 1 mark

**Page 9 – 5 marks (Part 4)**

- 4(b) Temperature change/fall shown in formula [1]  
 Heat absorbed, correctly calculated (=  $105 \times \text{temp fall}$ ) [1]
- 4(c) No of moles of  $\text{HCl} = 0.025$  [1]
- 4(d)  $\Delta H/\text{kJ} = \frac{\text{heat}}{\text{no of moles}} \times \frac{1}{1000}$  [1]  
*This is a method mark*
- $\Delta H$  value calculated: correct answer is expressed in kJ, to 2 or 3 sf. [1]  
*Positive sign is not required, but penalise a negative sign with the answer*

**Pages 10 + 11 – 14 marks (maximum, out of 19). Part 5**

- 5(a) **2 marks** (*but 1 on question paper*)
- Constant mass or third and fourth mass readings should be [nearly] equal [1]  
 To ensure that the solid has completely reacted/decomposed [1]
- 5(b) **4 marks** (*but 3 on question paper*)
- Yellow flame contains soot/carbon. [1]  
 A deposit of soot would increase the mass of the crucible and residue [1]

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Yellow flame has a lower temperature  
or yellow flame heat is [too] gentle [compared to a cone flame] [1]

Heating would be required for a longer period  
or the  $\text{NaHCO}_3$  might not decompose [completely] (*owtte*) [1]

**5(c) 2 marks**

Potential error = 0.02 g, because two readings are involved [1]

% error =  $\frac{0.02}{\text{mass of NaHCO}_3} \times 100$  (ignore sf) [1]  
*Give 1 mark (out of 2) for use of 0.01 in this expression*

**5(d) 2 marks**

Repeat experiment **and** take mean/ignore anomalous results [1]

Consistent readings are evidence of reliability [1]

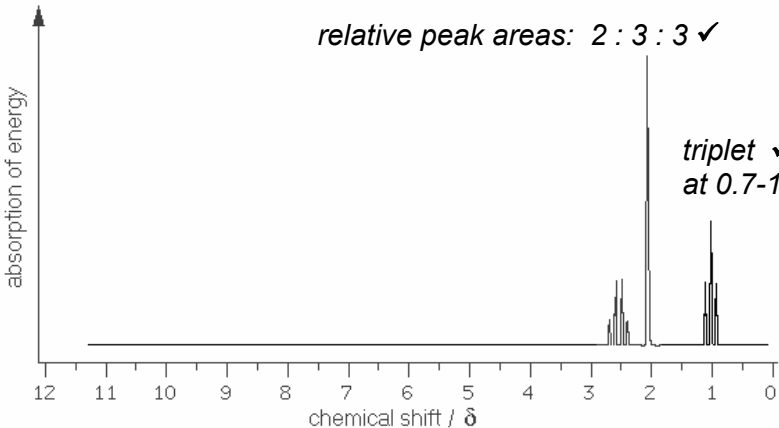
**5(e)** 9 marks (*but 6 on question paper*)

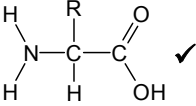
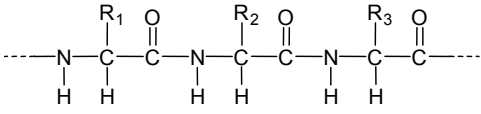
Mark the best **three** strands from those below

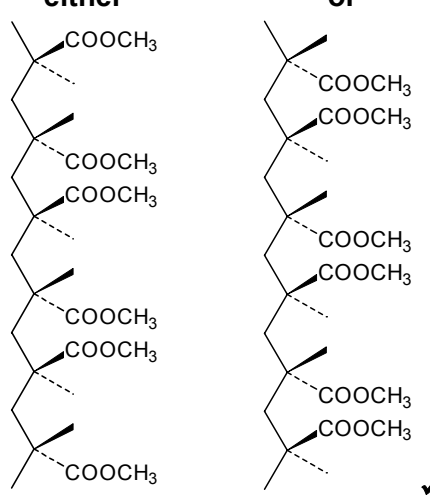
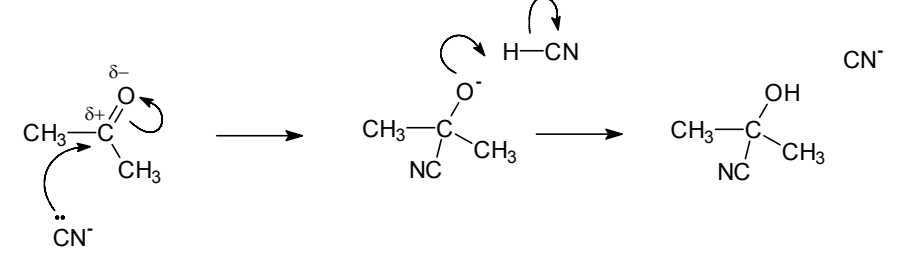
- Heat gains (*accept "losses"*) during reaction [1]
  - These result from convection **or** conduction [1]
    - Use a lid **or** thermos flask *or* thicker/better/more insulation/calorimeter [1]
- Loss of [acid] spray during reaction [1]
  - Use a lid **or** bigger cup **or** acid that is more dilute [1]
- Inaccuracy of the thermometer **or** temperature drop is [too] small [1]
  - This results in a high percentage error in the measurement [1]
    - Allow a reasonable attempt to calculate % error for thermometer*
  - Use acid that is more concentrated [to increase the temperature change] *or* use a thermometer reading to 0.1oC **or** one more accurately calibrated (*owtte*) [1]
- There were still some bubbles/fizzing when the final temp reading was taken [1]
  - This shows that the reaction had not finished [1]
    - Use NaHCO<sub>3</sub> with greater surface area/ more powdered *or* use acid that is more concentrated [1]
- Pipette/burette is more accurate than a measuring cylinder (*owtte*) [1]
  - Sensible % error for one piece of apparatus correctly calculated [1]

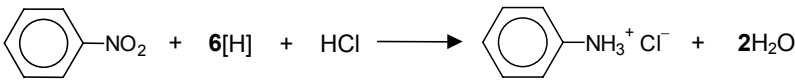
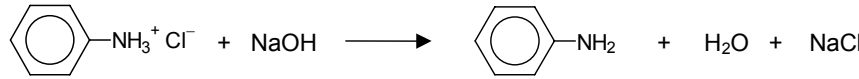




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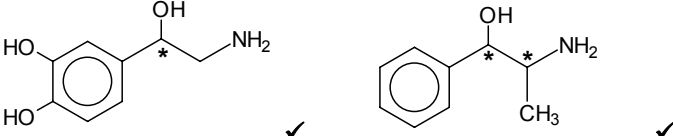
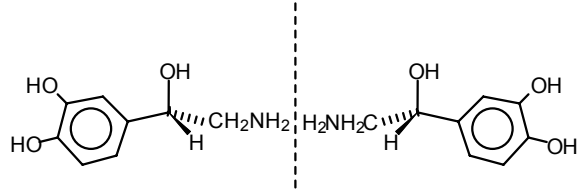
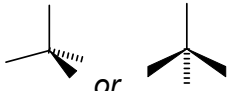

Qu. No.		Marks
1 (a) (i)	<p><i>Tollens' reagent / ammoniacal silver nitrate ✓</i></p> <p><i>silver mirror / precipitate ✓</i></p> <p><i>butanoate / butanoic acid / unambiguous formula or structure ✓</i></p> <p><b>(ii) Any of:</b></p> <p><i>Br<sub>2</sub> - decolourises – (electrophilic) addition</i></p> <p><i>Na – fizzes – redox</i></p> <p><i>SOCl<sub>2</sub> / PCl<sub>5</sub> / acid chloride – white fumes –</i>  <i>substitution/chlorination</i></p> <p><i>carboxylic acid + conc H<sub>2</sub>SO<sub>4</sub> / acid chloride – sweet smell –</i>  <i>esterification/ condensation</i></p> <p><i>test ✓ - observation ✓ - type of reaction ✓</i></p>	<p>[3]</p> <p><b>NOT</b>  2-4DNPH to  give no  precipitate</p> <p>[3]</p>
(b)	<p><i>recrystallise /purify (the precipitate) ✓</i></p> <p><i>measure melting point ✓</i></p> <p><i>compare with known values ✓</i></p>	<p>[3]</p>
(c) (i)	<p><i>the peak is due to the CH<sub>3</sub>CO- group ✓</i></p> <p><i>not split, so next to a C with no protons / has no neighbouring proton /</i>  <i>δ value is in the range 2.0 – 2.9 ✓</i></p>	<p>[2]</p>
(ii)	<p><i>adjacent to a C with three protons / to a CH<sub>3</sub> ✓</i></p>	<p>[1]</p>
(iii) and (iv)	<p><i>relative peak areas: 2 : 3 : 3 ✓</i></p>  <p><i>mark any additional incorrect peaks first</i></p>	<p>[3]</p>
		<p>[Total: 15]</p>

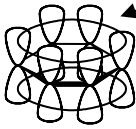
Qu. No.		Marks
2	<p><b>General formula of an <math>\alpha</math>-amino acid</b></p> <p><math>RCH(NH_2)COOH</math> / </p> <p><b>Diagram to show length of polypeptide / repeat unit – eg</b></p> <p></p> <p><b>with:</b></p> <p>displayed peptide bond ✓</p> <p>correct structure with a minimum of two amino acids joined (can be scored by a dipeptide) ✓</p> <p>idea of polymerisation shown by 'end bonds' ✓</p> <p>loss of water ✓</p> <p>relate variety to different R groups / sequence of amino acids ✓ <b>AW</b></p> <p><b>Quality of written communication:</b> correct organisation and use of <b>both</b> of the terms: <u>condensation polymer(isation)</u> and <u>peptide bond/link</u> ✓</p>	[7]
[Total: 7]		

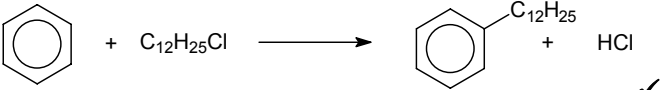
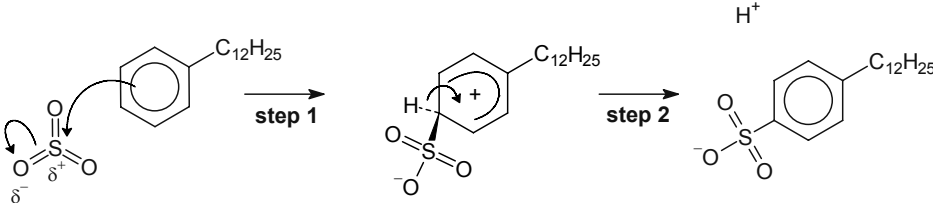
Qu. No.		Marks
3 (a)	<p><i>addition</i> ✓ <span style="float: right;"><i>NOT "additional"</i></span></p>	[1]
(b) (i)	<p><b>either</b> <span style="margin-left: 150px;"><b>or</b></span></p> 	[1]
(ii)	<p><i>isotactic</i> ✓  <i>group is on the same side / has the same 3-D spatial arrangement (along the chain)</i> ✓ <b>AW</b></p>	[2]
(c) (i)	<p><b>stage 2</b>  <i>HCl/H<sub>2</sub>SO<sub>4</sub></i> ✓  <i>presence of water implied – eg dilute /aq / suitable named concentration and warm/heat/reflux</i> ✓</p> <p><b>stage 4</b>  <i>CH<sub>3</sub>OH</i> ✓  <i>reflux/distil with conc H<sub>2</sub>SO<sub>4</sub></i> ✓</p> <p style="text-align: right;"><i>second mark is dependent on the first</i></p>	[4]
(ii)	<p><i>add an extra carbon / lengthen the carbon chain</i> ✓</p>	[1]
(d) (i)	<p><i>nucleophilic addition</i> ✓</p>	[1]
(ii)	<p><i>eg</i></p>  <p><i>curly arrow breaking C=O</i> ✓ (<i>dipole not essential</i>)  <i>curly arrow from lone pair of :CN<sup>-</sup> to the correct carbon</i>  <i>structure of the intermediate</i> ✓  <i>curly arrow –O<sup>-</sup> to H<sup>+</sup> / HCN / H<sub>2</sub>O</i> ✓ (<i>second curly arrow not essential</i>)</p>	[4]
<b>[Total: 14]</b>		

Qu. No.		Marks
4 (a) (i)	 <p><math>\text{C}_6\text{H}_5\text{NO}_2 + 6[\text{H}] + \text{HCl} \longrightarrow \text{C}_6\text{H}_5\text{NH}_3^+ \text{Cl}^- + 2\text{H}_2\text{O}</math></p> <p><math>\text{H}_2\text{O}</math> as product ✓    balancing ✓</p>	[2]
(ii)	<p>reducing agent ✓</p>	[1]
(b)	 <p><math>\text{C}_6\text{H}_5\text{NH}_3^+ \text{Cl}^- + \text{NaOH} \longrightarrow \text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{O} + \text{NaCl}</math></p> <p>(or as the ionic equation without <math>\text{Na}^+</math> or <math>\text{Cl}^-</math>)</p> <p><math>\text{C}_6\text{H}_5\text{NH}_2</math> ✓    balanced ✓</p>	[2]
(c)	<p>moles <math>\text{C}_6\text{H}_5\text{NO}_2</math> used = <b>0.0300</b> (mol) ✓</p> <p>theoretical yield of <math>\text{C}_6\text{H}_5\text{NH}_2</math> = <b>2.79(3)</b> (g) ✓ or ecf</p> <p>actual 72.1% yield = <b>2.014</b> (g) / (calculator value 2.013753) ✓ or ecf</p> <p>to three sig figs = <b>2.01</b> (g) ✓ or ecf</p>	[4]
(d)	<p><b>Primary amines as bases</b></p> <p>lone pair on N ✓</p> <p>lone pair is donated to the <math>\text{H}^+</math> / dative covalent bond ✓</p> <p>or both marks can be shown by a suitable diagram – eg</p>  <p><b>Why phenylamine is weaker</b></p> <p>lone pair / electrons move away from the N in phenylamine towards the benzene ring <b>AW</b> ✓</p> <p>because the lone pair on the N is (partially) delocalised around the benzene ring</p> <p>or diagram to show – eg</p>  <p>so is less available to donate / lower electron density on N ✓</p> <p>(ignore references to ethylamine or to the inductive effect)</p>	[5]
<b>[Total: 14]</b>		

Qu. No.		Marks
5 (a)	$\begin{array}{l} \text{CH}_3\text{COOH} + \text{SOCl}_2 \longrightarrow \text{CH}_3\text{COCl} + \text{SO}_2 + \text{HCl} / \\ \text{CH}_3\text{COOH} + \text{PCl}_5 \longrightarrow \text{CH}_3\text{COCl} + \text{POCl}_3 + \text{HCl} \\ \text{reactants } \checkmark \qquad \qquad \qquad \text{products } \checkmark \end{array}$	[2]
(b)	$\text{CH}_3\text{COCl} + \text{H}_2\text{O} \longrightarrow \text{CH}_3\text{COOH} + \text{HCl} \checkmark$	[1]
(c)	<p><b>Any three of:</b></p> <ul style="list-style-type: none"> <li>• absorption at 2500-3300(<math>\text{cm}^{-1}</math>) for O-H (in COOH)</li> <li>• absorption at 1000-1300 (<math>\text{cm}^{-1}</math>) for C-O</li> <li>• absorption at 1680-1750 / below 1750 (<math>\text{cm}^{-1}</math>) for C=O</li> <li>• no peak at ~600 (<math>\text{cm}^{-1}</math>) / no C-Cl peak</li> </ul> <p style="text-align: right;"><b>ANY 3 out of 4 marks ✓✓✓</b></p>	[3]
(d)	<p>ethanoic acid because:</p> <p><math>M_r = 60 \checkmark</math></p> <p>60 = <math>m/e</math> value / mass of the molecular ion / furthest right peak / correct peak indicated on the spectrum</p> <p><b>or</b></p> <p>any valid evidence based on the the absence of peaks due to Cl or valid fragmentation peaks that would distinguish them ✓</p>	[2]
<b>[Total: 8 ]</b>		

Qu. No.		Marks
6 (a) (i)	<i>bromine / sodium hydroxide (solution) / FeCl<sub>3</sub></i> ✓	[1]
(ii)	<i>OH / phenol group in noradrenaline circled</i> ✓	[1]
(iii)	<i>decolourises /white ppt / dissolves (in water better) / violet</i> ✓	[1]
(b) (i)		[2]
(ii)	<i>optical (isomerism)</i> ✓	[1]
(iii)	<i>(stereo)isomers are non-superimposable (mirror images) / the molecule is asymmetric / the carbon has four different groups attached</i> ✓	[1]
	 <p data-bbox="1043 954 1362 987"><i>for the 3-D bonds allow:</i></p>  <p data-bbox="1043 1088 1171 1122"><i>or</i></p>  <p data-bbox="1043 1099 1171 1133"><i>but NOT:</i></p> <p data-bbox="277 1200 823 1234"><i>one 3-D isomer with all groups correct</i> ✓</p> <p data-bbox="277 1267 1015 1335"><i>second isomer is a mirror image of a reasonable attempt at 3-D</i> ✓</p>	[3]
(c)	<p data-bbox="277 1413 472 1447"><b>Any three of:</b></p> <ul data-bbox="336 1480 1015 1827" style="list-style-type: none"> <li><i>only one stereoisomer has the right 3-D shape / shape similar to noradrenaline / is (pharmacologically) active <b>ora</b></i></li> <li><i>presence of other (inactive) stereoisomers: will increase the amount needed for the dose</i></li> <li><i>may give harmful side effects</i></li> <li><i>may increase cost of separation</i></li> </ul> <p data-bbox="663 1850 1031 1883"><b>ANY 3 out of 4 marks</b> ✓✓✓</p>	[3]
<b>[Total: 12]</b>		

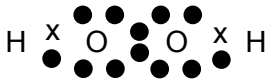
Qu. No.		Marks
7	<p><b>Discussion of the <math>\pi</math>-bonding</b></p> <p><i>p</i>-orbitals overlap ✓</p> <p>above and below the ring ✓</p> <p>(to form) <math>\pi</math>-bonds / orbitals ✓</p> <p>(<math>\pi</math>-bonds / electrons) are <u>delocalised</u> ✓</p> <p><b>Other valid points – any two of:</b></p> <ul style="list-style-type: none"> <li>• ring is planar /</li> <li>• C-C bonds are equal length / have intermediate length/strength between C=C and C-C /</li> <li>• <math>\sigma</math>-bonds are between C-C and/or C-H</li> <li>• bond angles are <math>120^\circ</math></li> </ul> <p style="text-align: right;"><b>MAX 2 out of 4 marks</b> ✓✓</p> <p><b>Quality of written communication</b> two or more sentences with correct spelling, punctuation and grammar</p>	<p>any of the first three marks are available from a labelled diagram eg</p>  <p style="text-align: right;">4 marks</p> <p style="text-align: right;"><b>[6]</b></p> <p style="text-align: right;"><b>[1]</b></p>
<b>[Total: 7]</b>		

Qu. No.		Marks
8 (a) (i)	<p><math>C_{12}H_{25}Cl/Br</math> ✓</p> <p><math>AlCl_3 / FeBr_3</math> etc ✓</p>	[2]
(ii)		[1]
(iii)	<p><i>H on benzene is replaced / swapped / substituted by <math>C_{12}H_{25}</math> / another group</i> ✓</p>	[1]
(b) (i) and (ii)	 <p><i>structure of intermediate</i> ✓✓ (deduct one mark for each error)</p> <p><i>curly arrows</i> ✓✓✓</p>	[5]
(c) (i)	<p><i>hydrolysis</i> ✓</p> <p><i>(sorbitan monolaurate is an) ester</i> ✓</p> <p><i>broken down to form an alcohol and carboxylic acid/salt</i> ✓ <b>AW</b></p> <p><i>/ equation to show the reaction</i></p>	[3]
(ii)	<p><i>sorbitan monolaurate is made from a renewable resource / not based on crude oil</i> ✓ <b>AW</b></p>	[1]
[Total: 13]		



**Mark Scheme 2815/01  
January 2007**

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit _____ = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument		
<b>Question</b>	<b>Expected answers</b>	<b>Marks</b>	<b>Additional guidance</b>
<b>1 (a)</b>	Increase in the number of electrons in the outer shell (in the atom of the element in Period 3) / increase in oxidation number of the element in Period 3 (1)	1	
<b>(b)</b>	Ions are not able to move / aw (1)	1	<b>Ignore</b> reference to electrons
<b>(c) (i)</b>	$\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$ / $\text{Al}_2\text{O}_3 + 6\text{H}^+ \rightarrow 2\text{Al}^{3+} + 3\text{H}_2\text{O}$ (1)	1	<b>Allow</b> $\text{Al}^{3+}$ and $\text{Cl}^-$ as products <b>Not</b> $\text{Al}_2\text{Cl}_6$ <b>Ignore</b> State symbols
<b>(ii)</b>	$\text{Al}_2\text{O}_3 + 3\text{H}_2\text{O} + 6\text{NaOH} \rightarrow 2\text{Na}_3\text{Al}(\text{OH})_6$	1	
<b>(d)</b>	Lots of covalent bonds / many covalent bonds (1) have to be broken which needs a large amount of energy (1)	2	<b>Allow</b> network structure (1)
<b>(e)</b>	(Reacts with water) to form an acidic solution / $\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$ (1)	1	<b>Ignore</b> it is acidic
		<b>Total = 7</b>	

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit <u>      </u> = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	Mark s	Additional guidance
Question	Expected answers	Mark s	Additional guidance
2 (a)	Oxidation because oxidation state of Hg changes from 0 to +2 so oxidation (1) Reduction because oxidation number of O changes from -1 to -2 (1)  Or  Correct identification of all the oxidation numbers (1) Correct identification of oxidation and reduction (1)	2	<b>Allow</b> ecf for the identification of oxidation and reduction from wrong oxidation numbers
(b)	Does not have an incomplete set of d electrons / does not have a partially filled d orbital / does not have a partially filled d sub-shell / ora (1)	1	<b>Allow</b> use of 3d
(c) (i)	Correct 'dot and cross' diagram (1)  	1	<b>Ignore</b> inner shell of oxygen atoms
(ii)	Idea that lone pair repulsion is greater than bond pair repulsion / 2 bonded pairs and two lone pairs (1) Bond angle of 104° – 105° (1)	2	<b>Allow</b> any bond angle between 95 to 106° (1) <b>Allow</b> ecf from wrong 'dot and cross' diagram
		<b>Total</b> = 6	



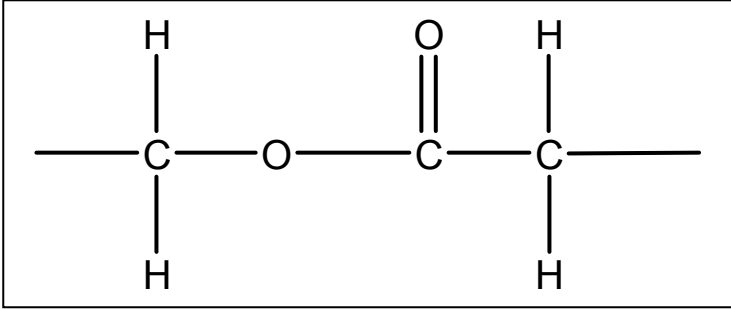

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit <u>      </u> = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument		
Question	Expected answers	Marks	Additional guidance
3 (d) (i)	$\text{Fe}(\text{H}_2\text{O})_6^{3+} + \text{SCN}^- \rightarrow [\text{Fe}(\text{H}_2\text{O})_5(\text{SCN})]^{2+} + \text{H}_2\text{O}$ (1)	1	
(ii)	<p><b>Any five from</b>  Known amounts or volumes of <math>\text{FeCl}_3</math> and <math>\text{KSCN}</math> (and water) are mixed together (1)</p> <p>Absorbance of solution is measured (1)</p> <p>Idea of a fair test (same overall volume and changing the volumes of the other reagents in a logical way) (1)</p> <p>Volumes or amounts of reagents that give maximum absorbance are determined (1)</p> <p>Molar ratio of reagents calculated / moles of substances must be calculated (1)</p> <p>The molar ratio should be one to one (1)</p>	5	<b>Allow</b> marks from an appropriate graph
(e) (i)	$\text{MnO}_2 + 4\text{H}^+ + 2\text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + 2\text{H}_2\text{O} + 2\text{Fe}^{3+}$ (1)	1	<b>Ignore</b> state symbols
(ii)	<p>Moles of <math>\text{Fe}^{2+}</math> that reacted with <math>\text{MnO}_2 = 0.02 - 0.0123 = 0.0077</math> (1)  Mass of <math>\text{MnO}_2 = 0.00385 \times 86.9 = 0.335</math> (1)  % purity = 66.4% (1)</p> <p>Alternatively</p> <p>Moles of <math>\text{MnO}_2</math> in 0.504 = 0.00580  So moles of <math>\text{Fe}^{2+}</math> that should react with this is 0.0116 (1)  Moles of <math>\text{Fe}^{2+}</math> that reacted with <math>\text{MnO}_2 = 0.02 - 0.0123 = 0.0077</math> (1)  % purity = 66.4% (1)</p>	3	<b>Allow</b> ecf within question  <b>Allow</b> 66.4 – 66.5
		<b>Total = 20</b>	

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Question	Expected answers	Marks	Additional guidance
4	<p><b>Definition – maximum 3 marks</b></p> $\text{Mg}^{2+}(\text{g}) + 2\text{Cl}(\text{g}) \rightarrow \text{MgCl}_2(\text{s}) \quad (1)$ The enthalpy change that accompanies the formation of one mole of a solid (compound) (1); from its constituent gaseous ions (1) <p><b>Born-Haber cycle – maximum 5 marks</b></p> Correct formulae on cycle (1) Correct state symbols (1) Use of 2 moles of Cl(g) ie 246 (1) Use of 2 moles of Cl <sup>-</sup> (g) 1.e. 698 (1) -2526 kJ mol <sup>-1</sup> (1) <p><b>Comparison – maximum 3 marks</b></p> <p><b>Any three from</b>  Na<sup>+</sup> has a larger radius than Mg<sup>2+</sup> / ora (1)  Br<sup>-</sup> has a larger radius than Cl<sup>-</sup> / ora (1)  Na<sup>+</sup> has a lower charge than Mg<sup>2+</sup> / ora (1)  Strongest attraction is between Mg<sup>2+</sup> and Cl<sup>-</sup> / MgCl<sub>2</sub> has the strongest attraction between its ions / ora (1)</p> <p><b>Or</b></p> Na <sup>+</sup> has a lower charge density than Mg <sup>2+</sup> / ora (1) Br <sup>-</sup> has a lower charge density than Cl <sup>-</sup> / ora (1) Strongest attraction between ions which have the highest charge density / MgCl <sub>2</sub> has the strongest attraction between its ions / ora (1) <p><b>And QWC</b></p> One mark for correct spelling, punctuation and grammar in at least two sentences (1)	12	<p><b>Allow</b> marks from an equation  <b>Allow</b> energy released / energy change  <b>Not</b> energy required  <b>Allow</b> ionic compound / salt</p> <p>Every formula must have the correct state symbol at least once  <b>Allow</b> -2403 / -2875 (2)  <b>Allow</b> -2752 (1)  Unit required</p> <p>Penalise the use of incorrect particle only once within the answer. Penalise it the first time an incorrect particle is mentioned</p>

**Mark Scheme 2815/02**  
**January 2007**

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<b>1</b>	<p>(a) (i) HOH<sub>2</sub>CCHOHCHOHCH<sub>2</sub>CHO Accept displayed .✓ <b>1</b></p> <p>(ii) Any two points.✓✓ AW.                  • Both are condensation polymers of nucleotides/ contain monomers with base, sugar and phosphate.                  • Sugar-phosphate polymer/backbone or mention of phosphodiester links.                  • Base attached to sugar.                  • Both contain the bases ACG. <b>2</b></p> <p>(iii) Base uracil/U in RNA but thymine/T in DNA✓                  Double helix in DNA/single strand in RNA✓                  DNA is a much longer molecule✓ AW Any two. <b>2</b></p> <p>(b) Four points from the following.✓✓✓✓.AW.                  • Double helix unwinds with breaking of hydrogen bonds/ mention of enzyme helicase.                  • The base pairs are CG and AT.                  • Exposed bases become hydrogen bonded to complementary bases on free nucleotides/ mention of nucleotide triphosphates/ both strands act as templates for replication                  • Incoming nucleotides attached to growing chain by a (phosphate) ester link / the joining of each nucleotide is catalysed by DNA polymerase                  • Semi-conservative replication/ each of the two resulting double helices contains one original strand and one newly synthesised strand <b>4</b></p> <p>(c) (i) In the genetic code the triplets UCU and UUC code for different amino acids✓ - accept any similar argument that refers to actual bases on the m-RNA or t-RNA. This results in different t-RNA bringing different amino acids to same place on m-RNA/ use of term translation.✓AW <b>2</b></p> <p>(ii) Possibility of hydrogen bonding✓ with serine's OH sidechain ✓ - give mark for van der Waals with phenylalanine if either of these two is missed.                  This can lead to (a different tertiary structure and) wrong shape for active site.✓ <b>3</b></p> <p>(iii) TAAAGACCA ✓ ignore numbering. <b>1</b></p> <p style="text-align: right;"><b>Total</b> <b>15</b></p>	

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Question	Expected Answers	Marks
<p>3 (a)</p> <p>(b)</p> <p>(c) (i)</p> <p>(ii)</p> <p>(d) (i)</p> <p>(ii)</p>	$  \begin{array}{ccccccc}  & & \text{H} & & \text{O} & & \text{H} \\  & &   & &    & &   \\  \text{H}_2\text{N} & - & \text{C} & - & \text{C} & - & \text{N} & - & \text{C} & - & \text{COOH} \\  & &   & & & &   & &   \\  & & \text{H} & & & & (\text{CH}_2)_4\text{NH}_2 & &   \end{array}  $ <p>✓ for CONH and ✓ for rest. Accept reverse order.</p> <p>At low pH <math>-\text{COO}^-</math> becomes <math>-\text{COOH}</math>/ uncharged ✓  At high pH <math>-\text{NH}_3^+</math> becomes <math>-\text{NH}_2</math> /uncharged ✓  If they suggest uncharged versions at pH 7, give one only of these marks. Allow use of amine and carboxyl groups which are not on sidechains.  Ionic attractions disrupted by changes. ✓  (Independent mark)</p> <p>Inhibitor does not compete for active site/binds somewhere other than on the active site. ✓</p> <p>Heavy metal ion replaces hydrogen on the cysteine or  accept a formula <math>-\text{NHCH}(\text{CH}_2\text{SAg})\text{CO}</math> ✓. <math>\text{Hg}^{2+}</math> similarly.</p> <p>This changes shape of enzyme/active site ✓.</p> <p>Four proteins/polypeptides ✓, <u>each</u> with a haem group/<math>\text{Fe}^{2+}</math> ✓, aggregate to form complete haemoglobin/ are held together by weak attractions (accept one example of these) ✓. AW</p> <p>The iron ion/atom combine <u>reversibly</u> ✓ with oxygen/<math>\text{O}_2</math> ✓ but not plain O. Accept reference to binding at high <math>\text{O}_2</math> concentrations and vice versa for second mark. AW</p> <p style="text-align: right;">Total</p>	<p>2</p> <p>3</p> <p>1</p> <p>2</p> <p>3</p> <p>2</p> <p>13</p>

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Question	Expected Answers	Marks
2 (a) (i)	<div style="text-align: center; border: 1px solid black; padding: 10px; width: fit-content; margin: 0 auto;">  </div> <p style="text-align: center;">The spare bonds at each end are optional.✓</p>	1
(ii)	Triglyceride has a fatty/carboxylic acid esterified/attached instead of the phosphate ✓. Accept triglyceride has three fatty acids attached, but not simply has no phosphate.	1
(iii)	<div style="text-align: center; margin-bottom: 5px;">  </div> Hydrophilic/polar etc      Hydrophobic/nonpolar etc Both labels for ✓.	1
(b)	Active site has (specific)shape to fit the/substrate phospholipid ✓ Accept answer based on R groups in active site matching those on substrate. Catalytic site is in correct position to catalyse hydrolysis of the C <sub>2</sub> ester group only / when bound to active site only the C <sub>2</sub> ester is in correct position to be hydrolysed ✓. AW .	2
(c)	To remove/hydrolyse fat stains✓.	1
(d) (i)	Higher substrate concentration leads to increased number of collisions per unit time/ plenty of free active sites therefore rate = k[S] . ✓ AW	1
(ii)	All the active sites are in use✓; adding more substrate cannot increase rate/ rate depends on rate at which products leave the active site/ [E] is limiting factor/ reaction is zero order with respect to S✓.AW	2
	<b>Total</b>	9

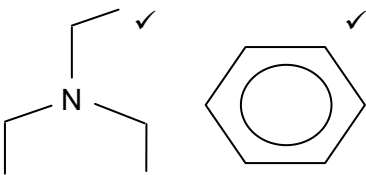
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Question	Expected Answers	Marks
<p>4 (a)</p> <div data-bbox="456 607 1249 1317" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> </div>	<p>A correct glycosidic link ✓  Correct stereochemistry for each link ✓✓  They need all but one of the C<sub>1</sub> and C<sub>4</sub> hydrogen atoms to score both stereochemistry marks but can score 1 mark if only two are missing.  Skeletal structures accepted.</p> <ul style="list-style-type: none"> <li>• linear/straight chain polymer</li> <li>• hydrogen bonded to neighbouring chain</li> <li>• hydrogen bonding between OH groups (any drawing here must be correct)</li> <li>• microfibrils make up fibres with great tensile strength</li> <li>• insoluble</li> </ul> <p>Any four of these points.  QWC At least two sentences in which meaning is clear, and in which there are fewer than two mistakes of spelling, punctuation and grammar.✓</p> <p style="text-align: right;">Total</p> <p style="text-align: right;">Paper Total</p>	<p style="text-align: center;">3</p> <p style="text-align: center;">4</p> <p style="text-align: center;">1</p> <p style="text-align: center;">8</p> <p style="text-align: center;">45</p>
<p>(b)</p>		



**Mark Scheme 2815/04**  
**January 2007**

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Question	Expected Answers	Marks
1 (a)	<p><math>R_f</math> value is distance moved by a component/spot/solute divided by distance moved by solvent. ✓</p> <p>Retention time is the time between injection and emergence (or detection) of a component. ✓</p>	2
(b) (i)	Partition / adsorption ✓	1
(ii)	<p>Role of gas: carrier gas / mobile phase / to carry to sample through the chromatography column ✓</p> <p>Role of liquid: stationary phase ✓</p>	2
(iii)	Trace with two peaks drawn ✓	1
(iv)	<p>Measure <b>area</b> under each peak ✓</p> <p>Find total area ✓</p> <p><math>\% = (\text{area of one peak} / \text{total area}) \times 100\%</math> ✓</p>	3
(c) (i)	$^{37}\text{Cl}$ / $^{81}\text{Br}$ / Cl or Br isotopes that differ by mass of two (either $^{37}\text{Cl}$ or $^{81}\text{Br}$ ) or contains isotopes with 2 extra neutrons ✓	1
(ii)	<p>If similar height halogen is bromine / bromine isotopes have similar / same abundance ✓</p> <p>If in ratio 3 : 1 then halogen is chlorine / chlorine isotopes are in abundance ratio 3 : 1 ✓</p>	2
		<b>Total: 12</b>

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Question	Expected Answers	Marks
<b>2</b> (a)	<p>(i) Energy levels are quantised / energy levels are discrete / specific gap between energy levels in the H atom ✓</p> <p>(ii) Electrons fall / drop back ✓ <i>from higher levels to <u>different</u> energy levels</i> ✓</p> <p>(iii) Convergence limit signifies the fall of an electron from (n = ) infinity to a particular energy level / wavelength at which the electron is at the edge of the atom / point at which the atom is ionised / point at which electron orbitals or lines merge or close together ✓</p> <p>(iv) Electron in ground state / n = 1 / lowest energy level / Lyman series can be used ✓</p> <p>(v) Multiply by 1000 and divide by L to give J per atom  <math>1312 \times 1000 / 6.02 \times 10^{23} = 2.179 \times 10^{-18} \text{ J}</math></p> $E = hf \text{ so } f = E/h$ $f = 2.179 \times 10^{-18} \text{ J} / 6.63 \times 10^{-34} \text{ J s}$ $= 3.287 \times 10^{15} \text{ s}^{-1}$ $\lambda = c/f = 3.0 \times 10^8 \text{ m s}^{-1} / 3.287 \times 10^{15} \text{ s}^{-1}$ $= 9.126 \times 10^{-8} \text{ m}$ $9.13 \times 10^{-8} \text{ m answer to three sig figs}$ (allow 9.12 for answer kept in calculator) <p>Use of correct formulae as above or using <math>E = hc/\lambda</math> ✓  Correct use of L ✓  Correct answer of <math>9.126 \times 10^{-8} \text{ m}</math> (allow 9.12 or 9.13) ✓  Answer to 3 sig figs ✓</p>	<p>1</p> <p>2</p> <p>1</p> <p>1</p> <p>4</p>

Question	Expected Answers	Marks
(b) (i)	 <p>NOTE: mark incorrect answers first</p>	2 (1 for each molecule circled)
(ii)	<p>Electronic / electron transitions / any mention of electrons being involved ✓            From low to high energy levels / to excited states            n to pi* / pi to pi* ✓</p>	1 1
		<b>Total: 13</b>



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<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
4 (a)	(M : M + 1 = 74.6 : 6.5) No. of carbon atoms = $(6.5 \times 100) / (74.6 \times 1.1)$ ✓ = 7.92 therefore eight carbons / C <sub>8</sub> ✓	2





**Mark Scheme 2815/06**  
**January 2007**

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<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
<b>1</b> (a) (i)  (ii)  (iii)  (b) (i)  (ii)	<b>+3</b>  <b>Cis and trans forms drawn in 3-D (only award these marks if C has been chosen)</b>  <b>Type of isomerism is cis-trans/geometric</b>  <b>(concentrated) hydrochloric acid/sodium chloride/ Other suitable named ionic chloride but <u>not</u> just chloride or Cl<sup>-</sup></b>  <b>Ligand substitution / ligand exchange</b>	<b>1</b>  <b>2</b>  <b>1</b>  <b>1</b>  <b>1</b>  <b>Total: 6</b>

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Question	Expected Answers	Marks
2 (a)	<b>Emf/voltage/potential difference (of electrochemical cell) comprising a (Cu/Cu<sup>2+</sup>) half cell combined with a standard hydrogen electrode</b> <b>1 atm, 1 mol.dm<sup>-3</sup>, 298K (all 3 needed but can transfer mark if stated in (b) )</b>	1 1 1
(b)	<b>Salt bridge and voltmeter</b> <b>Platinum electrode dipping into 1 mol dm<sup>-3</sup> H<sup>+</sup></b> <b>Hydrogen gas feed</b> <b>(Accept a suitable alternative standard electrode)</b> <b>(See additional sheet for diagram)</b>	1 1 1
(c) (i)	<b>Decolorised / add starch which is decolorised</b> <b>Allow blue/black → white or brown → white</b> <b>Do not allow colourless</b>	1
(ii)	<b>moles S<sub>2</sub>O<sub>3</sub><sup>2-</sup> = 23.20x0.100/1000 = 0.00232 moles</b> <b>Cu<sup>2+</sup> ≡ S<sub>2</sub>O<sub>3</sub><sup>2-</sup> / moles Cu<sup>2+</sup> = 0.00232 moles</b> <b>But 25 cm<sup>3</sup> of original = 10x 0.00232 = 0.0232 moles</b> <b>Concentration of original = 1000 x 0.0232 / 25</b>	1 1 1 1
(iii)	<b>Because concentration of Cu<sup>2+</sup> is less than 1 mol dm<sup>-3</sup> / less than standard</b> <b>equilibrium moves to left (reducing +ve value of E)</b>	1 1  <b>Total: 13</b>



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Question	Expected Answers	Marks
4 (a) (i)  (ii)  (b) (i)  (ii)  (c) (i)  (ii)	<b>Stainless steel + corrosion resistance or alloys for tools + hardness or other named alloy/use/property</b> <b>Allow chrome plating with attractive or barrier to corrosion</b> <b>Chromium <math>1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1</math> (allow....<math>4s^1 3d^5</math>)</b>  $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$ <b><math>Cr_2O_7^{2-} / Cr^{3+}</math> has more positive electrode potential</b> <b>Therefore <math>Cr_2O_7^{2-}</math> is the stronger oxidising agent which oxidises <math>Fe^{2+}</math> to <math>Fe^{3+}</math> (ora)</b> <b>Emf = (+) 0.56 V</b>  <b>Orange to yellow</b>  <b>Hydroxide ions react with or remove <math>H^+</math> ions</b> <b>Position of equilibrium moves to the right (to produce more <math>H^+</math> ions and <math>CrO_4^{2-}</math> which is yellow)</b>	   1 1  1 1  1 1  1  1  1  <b>Total: 9</b>

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Question	Expected Answers	Marks
5 (a)  (b) (i)  (ii)  (c)	For colour, need at least 1 d-electron and a space in higher energy d-orbital for it to be promoted to. Cu <sup>+</sup> has no space / has a full d-sub shell.  Pigment ( accept dye) / colouring paints  Dative covalent/co-ordinate  Red-brown solid is copper / Cu Blue solution is [Cu(H <sub>2</sub> O) <sub>6</sub> ] <sup>2+</sup> / Cu <sup>2+</sup> (aq) / CuCl <sub>2</sub> 2CuCl → Cu + CuCl <sub>2</sub> / 2Cu <sup>+</sup> → Cu + Cu <sup>2+</sup> Cu(I) compounds are unstable in solution / Disproportionate or explained.	1 1  1  1 1 1 1  <b>Total: 8</b>

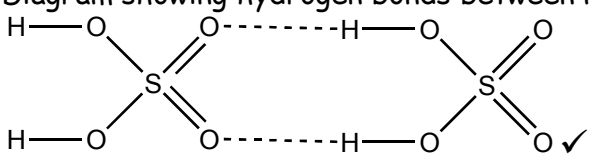
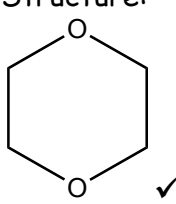
**Mark Scheme 2816/01**  
**January 2007**



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Question	Expected Answers	Marks
2 (a)	$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} \checkmark$	[1]
(b) (i)	$PCl_5 > 0.3 \text{ mol dm}^{-3}$ ; $PCl_3$ and $Cl_2 < 0.3 \text{ mol dm}^{-3} \checkmark$	[1]
(ii)	At start, system is out of equilibrium with too much $PCl_3$ and $Cl_2$ and not enough $PCl_5$ / $\frac{0.3 \times 0.3}{0.3} = 0.3$ is greater than $K_c = 0.245 \text{ mol dm}^{-3} \checkmark$	[1]
(c) (i)	$K_c$ does not change as temperature is the same $\checkmark$	[1]
(ii)	Fewer moles on left hand side $\checkmark$ system moves to the left to compensate for increase in pressure by producing less molecules $\checkmark$	[2]
(d) (i)	$K_c$ decreases (as more reactants than products) $\checkmark$	[1]
(ii)	Forward reaction is exothermic/ reverse reaction is endothermic $\checkmark$ equilibrium $\longrightarrow$ left to oppose increase in energy/ because $K_c$ decreases $\checkmark$	[2]
(e) (i)	$4PCl_5 + 10MgO \longrightarrow P_4O_{10} + 10MgCl_2 \checkmark$	[1]
(ii)	$100g P_4O_{10} = \frac{100}{284} / 0.35(2) \text{ mol } \checkmark$ moles $PCl_5$ needed = $4 \times 0.352 = 1.408/1.4 \text{ mol } \checkmark$ mass $PCl_5 = 1.4(08) \times 208.5 = 293.568 / 294 \text{ g} / 291.9 \text{ g } \checkmark$ $\checkmark$ for use of 284 for $P_4O_{10}$ and 208.5 for $PCl_5$ 73.4/72.975/72.3 g scores 3 marks (no use of '4' factor) 18.35 g from dividing by 4 scores 3 marks	[4]
		Total: 14

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<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
3 (a) (i)	Ionic product ✓	[1]
(ii)	$K_w = [H^+(aq)][OH^-(aq)]$ ✓ <i>state symbols not needed</i>	[1]
(b)	$\text{moles of HCl} = \frac{5 \times 10^{-3} \times 21.35}{1000} = 1.067 \times 10^{-4} \text{ mol } \checkmark$ $\text{moles of Ca(OH)}_2 = \frac{1.067 \times 10^{-4}}{2} = 5.34 \times 10^{-5} \text{ mol } \checkmark$ $\text{concentration of Ca(OH)}_2 = 40 \times 5.34 \times 10^{-5}$ $= 2.136 \times 10^{-3} \text{ mol dm}^{-3} \checkmark$ 2 marks for $4.27 \times 10^{-3} / 8.54 \times 10^{-3} \text{ mol dm}^{-3}$ (no factor of 4)	[3]
(c)	$[OH^-] = 2 \times 2.7 \times 10^{-3} = 5.4 \times 10^{-3} \text{ mol dm}^{-3} \checkmark$ $[H^+(aq)] = \frac{K_w}{[OH^-(aq)]} = \frac{1.0 \times 10^{-14}}{5.4 \times 10^{-3}} = 1.85 \times 10^{-12} \text{ mol dm}^{-3}$ ✓ $\text{pH} = -\log(1.85 \times 10^{-12}) = 11.73/11.7 \checkmark$ ecf is possible for pH mark providing that the $[H^+]$ value has been derived from $K_w/[OH^-]$ If pOH method is used, pOH = 2.27. would get 1st mark, $\text{pH} = 14 - 2.27 = 11.73$ gets 2nd mark. Commonest mistake will be to not double $OH^-$ and to use $2.7 \times 10^{-3}$ This gives ecf answer of 11.43/11.4, worth 2 marks. $\text{pH} = 11.13$ from dividing by 2: worth 2 marks	[3]
(d)	8 ✓	[1]
		<b>Total: 9</b>

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit <u>      </u> = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	
<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
4 (a)	$\text{Ca}_3(\text{PO}_4)_2 + 2\text{H}_2\text{SO}_4 \longrightarrow \text{Ca}(\text{H}_2\text{PO}_4)_2 + 2\text{CaSO}_4$ ✓	[1]
(b)	$\text{H}_2\text{PO}_4^-(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{HPO}_4^{2-}(\text{aq})$ / $\text{H}_2\text{PO}_4^-(\text{aq}) \rightleftharpoons 2\text{H}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq})$ ✓ (or equivalent with $\text{H}_2\text{O}$ forming $\text{H}_3\text{O}^+$ )	[1]
(c) (i)	$\text{HPO}_4^{2-}$ ✓	[1]
(ii)	$\text{H}_3\text{PO}_4$ ✓	[1]
(iii)	$\text{H}_2\text{PO}_4^-$ produced $\text{Ca}(\text{H}_2\text{PO}_4)_2$ or on LHS of an attempted equilibrium equation ✓ 2 equations/equilibria to shown action of buffer ✓✓ from: $\text{H}_2\text{PO}_4^- + \text{H}^+ \rightleftharpoons \text{H}_3\text{PO}_4$ / $\text{H}_2\text{PO}_4^- \rightleftharpoons \text{H}^+ + \text{HPO}_4^{2-}$ / $\text{H}_2\text{PO}_4^- + \text{OH}^- \rightleftharpoons \text{H}_2\text{O} + \text{HPO}_4^{2-}$ / $\text{H}^+ + \text{OH}^- \rightleftharpoons \text{H}_2\text{O}$	[3]
		<b>Total: 7</b>

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit <u>      </u> = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	
Question	Expected Answers	Marks
5 (a)	<p>Sulphuric acid molecules form hydrogen bonds ✓</p> <p>Diagram showing hydrogen bonds between molecules:</p>  <p>or H bond from H-O to O-H (as in water) ✓</p> <p>hydrogen bonds break (on boiling) ✓</p>	[3]
(b)	Correct equation for a metal ✓ Correct equation for a carbonate ✓ Correct equation for a base ✓	[3]
(c) (i)	$SO_4^{2-} \longrightarrow H_2S$ : S from +6 to -2 ✓ $I^- \longrightarrow I_2$ : I from -1 to 0 ✓	[2]
(ii)	$10H^+ + SO_4^{2-} + 8I^- \longrightarrow 4I_2 + H_2S + 4H_2O$ ✓	[1]
(d)	<p><b>A:</b> CO ✓  <math>HCOOH/H_2CO_2 \longrightarrow CO + H_2O</math> ✓</p> <p><b>B:</b> C ✓  <math>C_{12}H_{22}O_{11} \longrightarrow 12C + 11H_2O</math> ✓</p> <p><b>C:</b> <math>C_4H_8O_2</math> ✓  <math>2C_2H_6O_2 \longrightarrow C_4H_8O_2 + 2H_2O</math> ✓</p> <p>Structure:</p>  <p>accept any sensible structure of <math>C_4H_8O_2</math></p>	[2] [2] [3]
		Total: 16

**Mark Scheme 2816/03  
January 2007**

2816/03

Mark Scheme

January 2007

**PLAN (A)****A Test for iron(III) ions (3 marks)**

- A1 Add [hot] acid to dissolve the iron(III) oxide [1]
- A2 Add thiocyanate ions to produce a red colouration [1]  
*Use of Hexacyanoferrate(II) ions, going blue, is an acceptable alternative*
- A3 Chemical equation correct:  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} + \text{SCN}^- \rightarrow [\text{Fe}(\text{SCN})(\text{H}_2\text{O})_5]^{2+} + \text{H}_2\text{O}$  [1]  
*Allow equation for  $\text{Fe}^{3+}$  without water ligands*

**B Mass of zinc carbonate (7 marks)**

- B1 Shake/stir the calamine mixture **and** measure out a known volume/mass of it [1]
- B2 Add excess of specified acid [1]  
**and** statement/implication that  $\text{ZnCO}_3$  gives off a gas but  $\text{Zn}(\text{OH})_2$  does not [1]  
*B2 is **not** awarded if candidate heats the reacting mixture*
- B3 Neat diagram of apparatus showing suitable method of gas measurement [1]  
*Collection in gas syringe, inverted burette or measuring cylinder is acceptable*  
*Measurement of mass loss method requires [cotton] wool plug to be shown*  
*Gas absorption requires use of soda lime **or** a concentrated aqueous alkali*
- B4 Measure volume of gas produced when fizzing stops/ volume stops increasing [1]  
*Mass loss method requires weighing to constant mass to be described*  
*Gas absorption method also requires weighing to constant mass*
- B5 **One** accuracy precaution [1]
  - Use of "inner tube" or similar **and** reason/ how it is used
  - Repeat, until consistent readings are obtained **or** take mean
  - Use of acid/water pre-saturated with  $\text{CO}_2$  to reduce solubility of the gas
- B6 Equation for reaction:  $\text{ZnCO}_3 + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$  [1]  
**and** links mass of  $\text{ZnCO}_3$  used to capacity of gas collector by calculation [1]  
*Absorption method must calculate minimum mass of active absorbent needed*
- B7 Calculation of the [minimum] volume/concentration of acid required [1]

**C % by mass of zinc carbonate (5 marks)**

- C1 Filters a known mass/volume of calamine to collect the [suspended] solid. [1]
- C2 Uses Buchner/ reduced pressure filtration [1]  
**or** filters with high quality filter paper **or** filters more than once [1]  
**or** is aware of the problem that some solid may go through filter paper
- C3 Uses a pre-weighed filter paper **and** washes the solid collected [with water] [1]
- C4 Dries the solid to constant mass in an oven [at low temperature] **or** desiccator [1]

2816/03

Mark Scheme

January 2007

C5 Uses the mass of zinc carbonate from “B” and mass of residue obtained to deduce %.  
*Specimen calculation with figures for B is needed for mark C5* [1]

**S Safety and sources (4 marks)**

S1 Hazard researched for the acid used in the procedure, plus safety measure [1]  
*No mark if hazard is overstated of*

S2 References to two secondary sources quoted as footnotes **or** at end. [1]  
*Books must have page numbers*  
*Internet reference must go beyond the first slash of web address*  
*Accept one specific reference to Hazcards without any qualification*

S3 QWC: text is legible and spelling, punctuation and grammar are accurate [1]  
*Allow mark for not more than five errors in spelling, punctuation or grammar.*

S4 QWC: information is organised clearly and coherently [1]

- *Is a word count given and within the limits 450 – 1050 words?*  
*Accept a total word count or any word numbering in the margin*
- *Is scientific language used correctly – allow one error without penalty.*
- *Are the descriptions of both parts of the method presented logically?*

**TEST (B)**

**Page 3 (Part 1) Measurements (6 marks)**

Black solid/residue formed **or** green/turquoise → black colour change [1]

Four weighings clearly listed, recorded to 2 (or 3) d.p., **and** unit given somewhere [1]

Fourth weighing is within 0.02 g of the third (*ie constant mass*) [1]  
*If the mass increases, it must be within 0.01g*

Mass of residue **and** mass of malachite both shown (**and** correctly subtracted) [1]

**Accuracy (2)**

*Calculate the supervisor's %  $\frac{\text{mass of residue}}{\text{mass of malachite}}$  (to one decimal place)*

*Calculate candidate's %  $\frac{\text{mass of residue}}{\text{mass of malachite}}$*

*If % mass of residue is within 1.5% of supervisor's % value → 2 marks*

*If % mass of residue is within 3.0% of supervisor's % value → 1 mark*

**Page 4 (Part 2) Calculation of  $M_r$  of malachite (5 marks)**

(a) “2” shown in front of CuO [1]

(b)  $M_r$  of CuO = 79.5 [1]

Moles of CuO =  $\frac{\text{mass of residue}}{79.5}$  correctly calculated [1]

(c)  $n(\text{malachite}) = 0.5 \times n(\text{CuO})$  [1]  
*This [first] mark cannot be awarded ecf to a 1:1 ratio in the equation above.*

$M_r$  of malachite correctly calculated [ =  $\frac{\text{mass}}{\text{number of moles}}$  ] [1]



**Spread penalty:**

Spread is defined as the difference between the titres used by candidate to compute the mean or the difference between the two closest accurate titres (whichever is the greater).

- if accurate readings differ by more than  $0.50 \text{ cm}^3$ , subtract 1 mark
- if accurate readings differ by more than  $0.70 \text{ cm}^3$ , subtract 2 marks
- if accurate readings differ by more than  $0.90 \text{ cm}^3$ , subtract 3 marks
- if accurate readings differ by more than  $1.20 \text{ cm}^3$ , subtract 4 marks
- if accurate readings differ by more than  $1.50 \text{ cm}^3$ , subtract 5 marks

There are no negative marks for accuracy: the minimum is 0 (out of the 5 marks available).

**Pages 8 + 9 (Part 4)                      Calculation from titration                      (7 marks)**

- (a)  $n(\text{thiosulphate}) = \frac{20}{248} \times \text{mean titre} / 1000$  [1]  
*This mark is a "method" mark for knowing how to calculate n as above*
- (b)  $n(\text{iodine})$  correctly calculated [1]  
*Expected answer =  $0.5 \times (a) = \text{approx } 0.0009 \text{ mol}$*
- (c)  $n(\text{CuSO}_4) = \text{"b"} \times 2 \times 10$  [1]  
*This is a "method" mark for using mole ratio and scaling up*
- (d)  $M_r$  of malachite =  $\frac{\text{mass of X used}}{\text{number of moles}} = \frac{2m}{(c)}$  [1]  
*This method mark is awarded to candidates for quoting correct figures*  
 $M_r$  of malachite correctly calculated from answer (c) [1]  
*Expect answer of approximately 230*  
*Give 1 mark ecf for an  $M_r$  resulting from an incorrect use of the 1:2 mole ratio*
- (e) Mass of  $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2 = 221$  [1]  
**or** correct calculation of mass of water (=  $M_r - 221$ )
- $n = \frac{(250 - 221)}{18} = 1.6(1)$  (if data supplied was used) [1]  
*Most candidates will use their own  $M_r$  to calculate n.*

**Pages 10 - 12 (Part 5)                      Evaluation                      (14 marks)**

Award maximum 14 marks: 17 marking points are available.

**(a) 5 marks**

- (i) Cooling with a lid reduces/prevents absorption of water [vapour] [1]
- (ii) The aim is to achieve "constant mass" [1]  
 This ensures that decomposition was complete **or** reaction has finished [1]  
*Allow reference to all of the water [of crystallisation] being driven off*
- (iii) Repeat the whole procedure [1]  
 Results should be consistent/very similar/the same to show reliability [1]

(b) **6 marks maximum** available (*but only 5 on Question Paper*):

Mark the best **three** strands (each 2 marks)

Marking points can be awarded in (a)(iii)

- In **Part 1**, the procedure is simpler **or** there are fewer measurements needed [1]
- So **Part 1** has less cumulative error (*ora*) [1]
- In the titration the end-point [colour change] is inaccurate/imprecise [1]
- The colours grey and off-white are similar **or** the grey colour disappears gradually, not suddenly [1]
- In **Part 1** the [percentage] error is high because some masses are small [1]
- Use larger quantity of malachite **or** a balance reading to 3 d.p. [1]
- Titration is repeated (but the mass loss experiment was not) [1]
- Consistent **or** accurate titres were obtained with 0.1 cm<sup>3</sup> [1]
- % error for use of burette/pipette is lower than that for the balance **or** titration equipment is accurately calibrated [1]
- Reasonable attempt at a % accuracy calculation to justify this statement [1]

(c) **6 marks available** (*but only 4 on Question paper*)

Balanced equation:  $\text{CuCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$  [1]

No of moles of sulphuric acid used =  $\frac{1 \times 10}{1000} = 0.01$

**or** volume of acid =  $\frac{0.01 \times 1000}{1} = 10 \text{ cm}^3$  [1]

$\text{Cu}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + 2\text{H}_2\text{O}$  [1]

*Combined equation:  $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2 \cdot n\text{H}_2\text{O} + 2\text{H}_2\text{SO}_4 \rightarrow 2\text{CuSO}_4 + \text{CO}_2 + (n+3)\text{H}_2\text{O}$*

*Scores both equation marks. Allow 1 mark if "H<sub>2</sub>O" is balanced wrongly*

10 cm<sup>3</sup> of H<sub>2</sub>SO<sub>4</sub> are needed to react with [0.01 mol of] Cu(OH)<sub>2</sub> in malachite **or** 20 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> H<sub>2</sub>SO<sub>4</sub> are required to react fully with malachite [1]

H<sub>2</sub>SO<sub>4</sub> (0.03 mol) is an excess quantity [1]

Excess acid ensures that all of the malachite reacts/dissolves [1]

**Advanced GCE Chemistry (3882/7882)  
January 2007 Assessment Series**

**Unit Threshold Marks**

Unit		Maximum Mark	a	b	c	d	e	u
2811	Raw	60	47	41	35	29	23	0
	UMS	90	72	63	54	45	36	0
2812	Raw	60	47	41	35	30	25	0
	UMS	90	72	63	54	45	36	0
2813A	Raw	120	94	85	76	67	59	0
	UMS	120	96	84	72	60	48	0
2813B	Raw	120	94	85	76	67	59	0
	UMS	120	96	84	72	60	48	0
2813C	Raw	120	89	80	71	63	55	0
	UMS	120	96	84	72	60	48	0
2814	Raw	90	73	66	59	52	46	0
	UMS	90	72	63	54	45	36	0
2815A	Raw	90	66	59	52	45	39	0
	UMS	90	72	63	54	45	36	0
2815C	Raw	90	68	60	52	45	38	0
	UMS	90	72	63	54	45	36	0
2815E	Raw	90	67	59	52	45	38	0
	UMS	90	72	63	54	45	36	0
2816A	Raw	120	96	86	76	66	56	0
	UMS	120	96	84	72	60	48	0
2816B	Raw	120	96	86	76	66	56	0
	UMS	120	96	84	72	60	48	0
2816C	Raw	120	90	79	68	57	46	0
	UMS	120	96	84	72	60	48	0

**Specification Aggregation Results**

Overall threshold marks in UMS (*i.e.* after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
<b>3882</b>	300	240	210	180	150	120	0
<b>7882</b>	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>U</b>	<b>Total Number of Candidates</b>
<b>3882</b>	14.6	35.2	53.6	77.1	92.7	100.0	401
<b>7882</b>	16.5	59.1	78.3	93.0	98.3	100.0	136

437 Candidates aggregated this series.

For a description of how UMS marks are calculated see:  
[http://www.ocr.org.uk/exam\\_system/understand\\_ums.html](http://www.ocr.org.uk/exam_system/understand_ums.html)

Statistics are correct at the time of publication.

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