Name of the Student:_____
Max. Marks : 16 Marks **Time : 16 Minutes**

Mark Schemes

Q1.

This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.	
Level 3 **5-6 marks**	All stages are covered and the explanation of each stage is correct and virtually complete (ie two from stages 2 and 3 and three from stage 1). Answer communicates the whole explanation, including equations, coherently and shows a logical progression through all three stages.
Level 2 **3-4 marks**	All stages are covered (NB 'covered' means min two from stage 1) but the explanation of each stage may be incomplete or may contain inaccuracies. **OR** two stages covered and the explanations are generally correct and virtually complete (i.e. two from stages 2 and/or 3 and/or three from stage 1). Answer is coherent and shows some progression through all three stages. Some steps in each stage may be incomplete.
Level 1 **1-2 marks**	Two stages are covered (NB 'covered' means min two from stage 1) but the explanation of each stage may be incomplete or may contain inaccuracies. **OR** only one stage is covered but the explanation is generally correct and virtually complete (i.e. two from stages 2 and/or 3 and/or three from stage 1). Answer shows some progression between two stages.
Level 0 **0 mark**	Insufficient correct chemistry to gain a mark.

Indicative Chemistry content

Stage 1 IDs (Allow ppts if shown as products in equations or on the table)

(Allow names - with oxidation states for Fe compounds)

(1a) **BOTH** red-brown ppts from **L** = $Fe(H_2O)_3(OH)_3$ / $Fe(OH)_3$

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(1b) green ppt from **M** = $Fe(H_2O)_4(OH)_2$/$Fe(OH)_2$ for NH_3

AND M = $FeCO_3$ with Na_2CO_3

(1c) white ppt with **L** = AgCl **AND** white ppt with **M** = $BaSO_4$

(1d) **L** = $FeCl_3$ **AND M** = $FeSO_4$

Stage 2 Reactions with sodium carbonate

(ALLOW if any 3+ compared with any 2+)

(2a) carbon dioxide is gas produced from **L** (could come from equation)

(2b) Fe^{3+} / $Fe(H_2O)_6^{3+}$ (in **L**) is more acidic than Fe^{2+} / $Fe(H_2O)_6^{2+}$ (in **M**) **ora**

(2c) Fe^{3+} is smaller / has higher charge / greater charge density of Fe^{3+} / is more polarising (makes ion a better proton donor)

Stage 3 Equations

(ECF from incorrect 3+ ion in L and/or 2+ ion in M)

(3a) $Fe(H_2O)_6^{3+} + 3NH_3 \rightarrow Fe(H_2O)_3(OH)_3 + 3NH_4$ + **AND**

$2Fe(H_2O)_6^{3+} + 3CO_3^{2-} \rightarrow 2Fe(H_2O)_3(OH)_3 + 3CO_2 + 3H_2O$

(3b) $Fe(H_2O)_6^{2+} + 2NH_3 \rightarrow Fe(H_2O)_4(OH)_2 + 2NH_4$ + **AND**

$Fe(H_2O)_6^{2+} + CO_3^{2-} \rightarrow FeCO_3 + 6H_2O$ **OR** $Fe^{2+} + CO_3^{2-} \rightarrow FeCO_3$

(3c) $Ag^+ + Cl^- \rightarrow AgCl$ **AND** $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

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Q2.

(a) **M1** **B** = $Al(H_2O)_3(OH)_3$

Ignore [ ]

1

M2 bubbles/effervescence

M2 *Do not allow gas evolved*

1

M3 $2\ [Al(H_2O)_6]^{3+} + 3CO_3^{2-} \rightarrow 2\ Al(H_2O)_3(OH)_3 + 3H_2O + 3CO_2$

M3 *Ignore absence of square brackets around Al complex*

M3 *Allow correct balanced equations with Na_2CO_3*

1

(b) **M1** **C** = $[Al(OH)_4]^-$ OR $[Al(H_2O)_2(OH)_4]^-$ OR $[Al(OH)_6]^{3-}$

1

M2 Excess NaOH

M2 *Allow excess OH^-*

1

M3 $[Al(H_2O)_6]^{3+} + 4\ OH^- \rightarrow [Al(OH)_4]^- + 6\ H_2O$

OR

$[Al(H_2O)_6]^{3+} + 4\ OH^- \rightarrow [Al(H_2O)_2(OH)_4]^- + 4\ H_2O$

OR

$[Al(H_2O)_6]^{3+} + 6\ OH^- \rightarrow [Al(OH)_6]^{3-} + 6\ H_2O$

M3 *Allow equations to form $Al(H_2O)(OH)_5^{2-}$*

M3 *Allow correct balanced equations with NaOH*

1

(c) $[Al(EDTA)]^-$

Do not penalise absence of square brackets

1

(d) **M1** $[Al(H_2O)_6]^{3+} + H_2O \rightleftharpoons [Al(H_2O)_5(OH)]^{2+} + H_3O^+$ OR

$[Al(H_2O)_6]^{3+} \rightleftharpoons [Al(H_2O)_5(OH)]^{2+} + H^+$

Accept other equations

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1

M2 Al3+ has a small size and high charge OR has a high charge density

1

M3 Weakens the OH bond (in water) releasing H+ ions

***M2** Allow the aluminium ion has a small size and high charge OR has a high charge density*

1

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