5.5 TEST MS

1. (a) Electron pair acceptor **(1)**

1

(b) Formula of gas CO_2 **(1)**

Formula of precipitate $V(OH)_3$ <u>or</u> $[V(OH)_3(H_2O)_3]$ **(1)** 2

[3]

2. (a) (i) Oxide or hydroxide dissolves **(1)**
in both acids and alkalis **(1)**

(ii) Equation 1 $Cr(OH)_3(H_2O)_3$ <u>or</u> $Cr(OH)_3 + 3H^+ \rightarrow [Cr(H_2O)_6]^{3+}$ **(1)**

Equation 1 $Cr(OH)_3(H_2O)_3 + 3OH^- \rightarrow [Cr(OH)_6]^{3-}$
<u>or</u> $Cr(OH)_3$ or$[Cr(OH)_4(H_2O)_2]^-$ **(1)**
4

(b) *Plan* add excess **(1)**
$NaOH$ <u>or</u> NH_3 **(1)**
filter **(1)**
removes $Fe(OH)_2$ <u>or</u> Cr(III) in filtrate **(1)**

Formula of complex chromium (III) ion
$[Cr(OH)_6]^{3-}$ <u>or</u> $[Cr(NH_3)_6]^{3+}$ <u>or</u> $[Cr(OH)_4(H_2O)_2]^-$ **(1)** 5

[9]

3. (a) $3d^{10}\ 4s^1$ or reverse order **(1)**
$3d^9$ **(1)**

(allow full configuration if correct; if wrong penalise once) 2

(b) (i) copper(II) hydroxide / tetraaquadihydroxycopper(II) hydroxide **(1)**

$Cu(OH)_2$ / $Cu(OH)_2(H_2O)_4$ **(1)** 2

(ii) idea of ligand exchange (Cl^- for H_2O) (equation acceptable) **(1)**
ligands not required, but any given must be correct

$[Cu\ Cl_4]^{2-}$ **(1)**

tetrahedral / square planar **(1)** 3

[7]

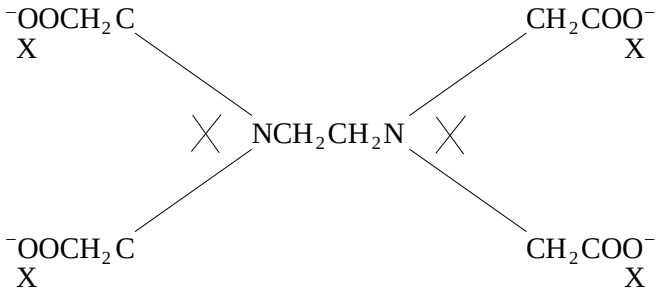
4. (a) Co **(1)**
$[CoCl_4]^{2-}$ **(1)**
$[Co(H_2O)_6]^{2+}$ **(1)** 3

(b) Ag **(1)**
AgCl **(1)**
$[Ag(NH_3)_2]^+$ **(1)** 3

(c) Cr **(1)**
$[Cr(OH)_3(H_2O)_3]$ or $Cr(OH)_3$ **(1)**
$[Cr(OH)_6]^{3-}$ or $[Cr(OH)_4(H_2O)_2]^-$ **(1)** 3

[9]

5. (a)



(1) 1

(b) (i) blue <u>or</u> blue-green **(1)**
$[Cu(OH)_2(H_2O)_4]$ <u>or</u> $Cu(OH)_2$ **(1)**

(ii) EDTA bonds to Cu^{2+} **(1)**
strongly **(1)**
or so no aqua ion present to hydrolyse 4

[5]

6. (a) Forms blue or pink or blue / green percipitate **(1)**

Not green

of $Co(H_2O)_4(OH)_2$ etc **(1)**

(Precipitate) dissolves or forms a solution (in excess ammonia) **(1)**

Forms yellow or pale brown 'straw' (coloured solution) **(1)**

Containing $[Co(NH_3)_6]^{2+}$ **(1)**

Darkens or goes brown on standing in air **(1)**

as $[Co(NH_3)_6]^{3+}$ formed **(1)**

Due to oxidation (by O_2 in air) or by reaction with oxygen (QoL) **(1)** 8

(b) Fe^{3+} has a large charge **(1)**
and smaller size than Fe^{2+} **(1)**

NB *Fe^{3+} has a higher charge size ratio or higher surface density of charge or higher charge density scores (2)*

NB ***Lose these two marks if candidates refer to either atoms or molecules***

Greater polariation (of water) by Fe^{3+} or more hydrolysis occurs
or Fe^{3+} weakens the OH bond more

Allow converse statement

Fe^{2+} higher pH than Fe^{3+} or Fe^{3+} more acidic or solution of
Fe^{3+} contains more H+ **(1)** 4

NB ***allow marks for correct hydrolysis equation i.e.***

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

if accompanied by a statement that this equilibrium lies further to the right for Fe^{3+} than for Fe^{2+} (1) and more H^+ produced/pH lower (1)
(Allow converse statement)

Fe^{2+} with Na_2CO_3; green precipitate **(1)**
of $FeCO_3$ **(1)**

Fe^{3+} with Na_2CO_3; (rust)/brown or red/brown percipitate (Not red) **(1)**
of $[Fe(H_2O)_3(OH)_3]$ etc

Allow $Fe_2O_3.xH_2O$ but not Fe_2O_3 (1)

and allow (carbon dioxide) gas evolved **(1)** 5

[17]