

# Mark schemes

1

(a) Brown ppt/solid 1

Gas evolved/effervescence 1



*Must be stated, Allow CO<sub>2</sub> evolved. Do not allow CO<sub>2</sub> alone*

*Correct iron product (1) allow Fe(OH)<sub>3</sub> and in equation*

*Balanced equation (1)*

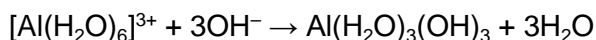
2

(b) White ppt/solid 1

Colourless Solution

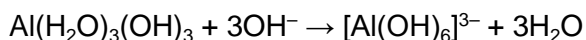
*Only award M2 if M1 given or initial ppt mentioned*

1



*Allow  $[\text{Al}(\text{H}_2\text{O})_6]^{3+} + 3\text{OH}^- \rightarrow \text{Al}(\text{OH})_3 + 6\text{H}_2\text{O}$*

1



*Allow formation of  $[\text{Al}(\text{H}_2\text{O})_{6-x}(\text{OH})_x]^{(x-3)-}$  where  $x = 4, 5, 6$*

*Allow product without water ligands*

*Allow formation of correct product from  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$*

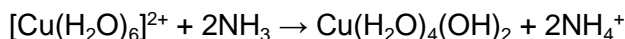
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(c) Blue ppt/solid 1

(Dissolves to give a) deep blue solution

*Only award M2 if M1 given or initial ppt mentioned*

1

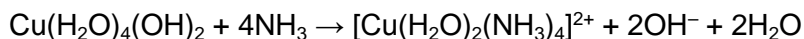


*Allow  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 2\text{NH}_3 \rightarrow \text{Cu}(\text{OH})_2 + 2\text{NH}_4^+ + 4\text{H}_2\text{O}$*

*Allow two equations:  $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$*

*then  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 2\text{OH}^- \rightarrow \text{Cu}(\text{OH})_2 + 4\text{H}_2\text{O}$  etc*

1

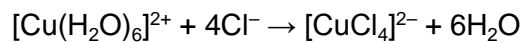


*Allow  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{NH}_3 \rightarrow [\text{Cu}(\text{H}_2\text{O})_2(\text{NH}_3)_4]^{2+} + 4\text{H}_2\text{O}$*

1

(d) Green/yellow solution

1



1

[14]

2

(a) oxidation state of N in  $\text{Cu}(\text{NO}_3)_2$ : +5;

1

oxidation state of N in  $\text{NO}_2$ : +4;

1

oxidation product: oxygen;

1

(b) copper-containing species:  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ ;

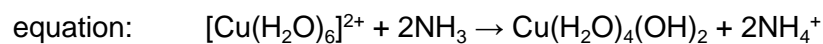
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shape: octahedral;

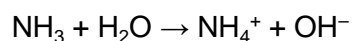
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(c) (i) precipitate B:  $\text{Cu}(\text{H}_2\text{O})_4(\text{OH})_2$  or  $\text{Cu}(\text{OH})_2$  or name;

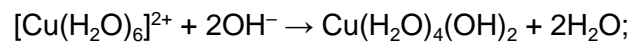
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OR



and



1

(ii)  $\text{NH}_3$  accepts a proton;

1

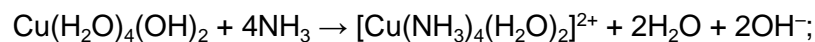
(d) (i) identity:  $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$ ;

1

colour: deep blue;

1

equation:



1

(ii)  $\text{NH}_3$  is an electron pair donor;

1

(e) identity:  $[\text{CuCl}_4]^{2-}$ ;

1

colour: yellow-green;

1

shape: tetrahedral;

1

(f) (i)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$  ;

1

(ii) role of Cu: a reducing agent;

1

[17]

3

(a) Iron

1

Heterogeneous; catalyst in a different phase from that of the reactants

1

Poison; a sulphur compound (allow sulphur)

1

Poison strongly adsorbed onto active sites/ blocked

1

Poison not desorbed or reactants not adsorbed or catalyst surface area reduced

1

(b) Pale green solution

1

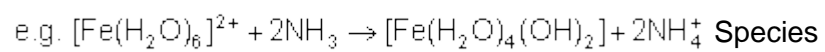
Green precipitate formed

1

Insoluble in excess ammonia

1

Equation:



1

Balance

1

*NB Allow equations with  $\text{H}_2\text{O}$  and  $\text{OH}^-$  if reaction of  $\text{H}_2\text{O}$  with  $\text{NH}_3$  also given*

Max 4

[9]