

# AQA Chemistry A-level

## Topic 2.6 - Reactions of Ions in Aqueous Solution

### Flashcards

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Are 2+ ions or 3+ ions more acidic in solution? why?



# Are 2+ ions or 3+ ions more acidic in solution? why?

3+ ions are much more acidic

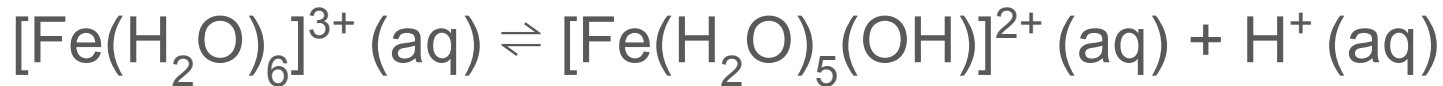
3+ ions are smaller and more highly charged, so have a higher charge density. They attract the electrons from the oxygen of the ligands much more strongly. This weakens the O-H bonds, so the complex readily releases a  $H^+$  ion into the solution, making it acidic.



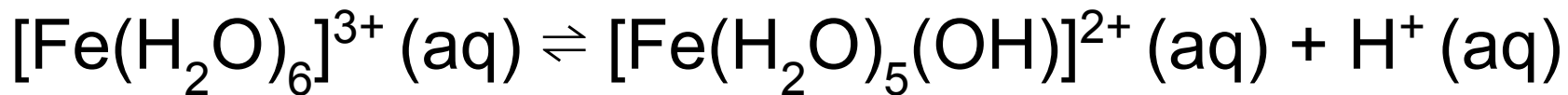
Write an equation for the hydrolysis of a  $3+$  ion to release a proton



Write an equation for the hydrolysis of a 3+ ion to release a proton



What kind of acid is the  
complex ion acting as?  
Why?



What kind of acid is the complex ion acting as?

Why?  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} (\text{aq}) \rightleftharpoons [\text{Fe}(\text{H}_2\text{O})_5(\text{OH})]^{2+} (\text{aq}) + \text{H}^+ (\text{aq})$

Bronsted-Lowry - donates a proton



# Define a Lewis acid





# Define a Lewis acid

# Electron pair acceptor



# Define a Lewis base



Define a Lewis base

Electron pair donor



What is acting as the Lewis acid and what is acting as the Lewis base during the formation of complex ions?



What is acting as the Lewis acid and what is acting as the Lewis base during the formation of complex ions?

The metal ion is acting as the Lewis acid and the ligands as Lewis bases



# Fill in the table for $\text{Fe}^{2+}$ reactions

Test	Complex ion	Colour
In aqueous solution		
Add NaOH (dropwise and excess)		
Add $\text{NH}_3$ (dropwise and excess)		
Add $\text{Na}_2\text{CO}_3$		



# Fill in the table for $\text{Fe}^{2+}$ reactions:

Test	Complex ion	Colour
In aqueous solution	$[\text{Fe}(\text{H}_2\text{O})_6]^{2+} (\text{aq})$	<i>Green</i>
Add NaOH (dropwise and excess)	$[\text{Fe}(\text{H}_2\text{O})_4(\text{OH})_2] (\text{s})$	<i>Green ppt, goes brown on standing in air</i>
Add $\text{NH}_3$ (dropwise and excess)	$[\text{Fe}(\text{H}_2\text{O})_4(\text{OH})_2] (\text{s})$	<i>Green ppt, goes brown on standing in air</i>
Add $\text{Na}_2\text{CO}_3$	$\text{FeCO}_3$	<i>Green ppt</i>



Why does the green ppt go brown on standing in air in the reaction of  $\text{Fe}^{2+}$  with  $\text{NH}_3$ ?





Why does the green ppt go brown on standing in air in the reaction of  $\text{Fe}^{2+}$  with  $\text{NH}_3$ ?

Oxygen in the air oxidises  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ , and  $[\text{Fe}(\text{OH})_3(\text{H}_2\text{O})_3]$  is brown, so colour changes



# Fill in the table for the reactions of $\text{Cu}^{2+}$

Test	Complex ion	Colour
In aqueous solution		
Add NaOH (dropwise and excess)		
Add $\text{NH}_3$ (dropwise)		
Add $\text{NH}_3$ (excess)		
Add $\text{Na}_2\text{CO}_3$		
Add concentrated HCl		



# Fill in the table for the reactions of $\text{Cu}^{2+}$

Test	Complex ion	Colour
In aqueous solution	$[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$	<i>Blue</i>
Add NaOH (dropwise and excess)	$[\text{Cu}(\text{H}_2\text{O})_4(\text{OH})_2] (\text{s})$	<i>Blue ppt</i>
Add $\text{NH}_3$ (dropwise)	$[\text{Cu}(\text{H}_2\text{O})_4(\text{OH})_2] (\text{s})$	<i>Blue ppt</i>
Add $\text{NH}_3$ (excess)	$[\text{Cu}(\text{H}_2\text{O})_2(\text{NH}_3)_4]^{2+} (\text{aq})$	<i>Deep blue solution</i>
Add $\text{Na}_2\text{CO}_3$	$\text{CuCO}_3$	<i>Blue-green ppt</i>
Add concentrated HCl	$[\text{CuCl}_4]^{2-} (\text{aq})$	<i>Pale Green/yellow solution</i>



# Fill in the table for the reactions of $\text{Fe}^{3+}$

Test	Complex ion	Colour
In aqueous solution		
Add NaOH (dropwise and excess)		
Add $\text{NH}_3$ (dropwise and excess)		
Add $\text{Na}_2\text{CO}_3$		



# Fill in the table for the reactions of $\text{Fe}^{3+}$

Test	Complex ion	Colour
In aqueous solution	$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$	<i>Purple solution, may look yellow-brown due to <math>[\text{Fe}(\text{H}_2\text{O})_5(\text{OH})]^{2+}</math> (aq)</i>
Add NaOH (dropwise and excess)	$[\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3] (\text{s})$	<i>Brown ppt, may look orange-brown</i>
Add $\text{NH}_3$ (dropwise and excess)	$[\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3] (\text{s})$	<i>Brown ppt, may look orange-brown</i>
Add $\text{Na}_2\text{CO}_3$	$[\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3] (\text{s})$	<i>Brown ppt, may look orange-brown, effervesence</i>



# Fill in the table with the reactions of $\text{Al}^{3+}$

Test	Complex ion	Colour
In aqueous solution		
Add NaOH (dropwise)		
Add NaOH (excess)		
Add $\text{NH}_3$ (dropwise and excess)		
Add $\text{Na}_2\text{CO}_3$		



# Fill in the table with the reactions of $\text{Al}^{3+}$

Test	Complex ion	Colour
In aqueous solution	$[\text{Al}(\text{H}_2\text{O})_6]^{3+}$	<i>Colourless solution</i>
Add NaOH (dropwise)	$[\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] (s)$	<i>White ppt</i>
Add NaOH (excess)	$[\text{Al}(\text{OH})_4]^- (aq)$	<i>Colourless solution</i>
Add $\text{NH}_3$ (dropwise and excess)	$[\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] (s)$	<i>White ppt</i>
Add $\text{Na}_2\text{CO}_3$	$[\text{Al}(\text{H}_2\text{O})_3(\text{OH})_3] (s)$	<i>White ppt, effervescence</i>



# Fill in the table for the reactions of $\text{Co}^{2+}$

Test	Complex ion	Colour
In aqueous solution		
Add NaOH (dropwise and excess)		
Add $\text{NH}_3$ (dropwise and excess)		
Add $\text{Na}_2\text{CO}_3$		
Add HCl		





# Fill in the table for the reactions of $\text{Co}^{2+}$

Test	Complex ion	Colour
In aqueous solution	$[\text{Co}(\text{H}_2\text{O})_6]^{2+}$	<i>Pink</i>
Add NaOH (dropwise and excess)	$[\text{Co}(\text{H}_2\text{O})_4(\text{OH})_2] (\text{s})$	<i>Blue ppt</i>
Add $\text{NH}_3$ (dropwise and excess)	$[\text{Co}(\text{NH}_3)_6]^{2+} (\text{aq})$	<i>Pale brown solution</i>
Add $\text{Na}_2\text{CO}_3$	$\text{CoCO}_3 (\text{s})$	<i>Purple ppt</i>
Add HCl	$[\text{CoCl}_4]^{2-} (\text{aq})$	<i>Blue solution</i>

