

Marks
4

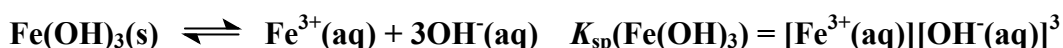
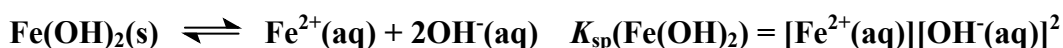
- The presence of iron in inorganic qualitative analysis is detected by the precipitation of the hydroxide using a buffer of pH 8. The solubility product constant of $\text{Fe}(\text{OH})_3$ is $4 \times 10^{-38} \text{ M}^4$ and that of $\text{Fe}(\text{OH})_2$ is $4 \times 10^{-15} \text{ M}^3$. Is it more sensible to try and detect the presence of Fe^{2+} ions or Fe^{3+} ions? Show all working and then give a reason for your answer.

Using $\text{pOH} = -\log_{10}([\text{OH}^-(\text{aq})])$ and $\text{pH} + \text{pOH} = 14.0$:

$$\text{pOH} = (14.0 - 8.0) = 6.0 \text{ and}$$

$$[\text{OH}^-(\text{aq})] = 1 \times 10^{-6} \text{ M}$$

The solubility equilibria and products are :



Hence,

$$[\text{Fe}^{2+}(\text{aq})] = \frac{K_{\text{sp}}(\text{Fe}(\text{OH})_2)}{[\text{OH}^-(\text{aq})]^2} = \frac{(4 \times 10^{-15})}{(1.0 \times 10^{-6})^2} = 4 \times 10^{-3} \text{ M}$$

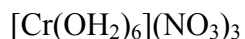
$$[\text{Fe}^{3+}(\text{aq})] = \frac{K_{\text{sp}}(\text{Fe}(\text{OH})_3)}{[\text{OH}^-(\text{aq})]^3} = \frac{(4 \times 10^{-38})}{(1.0 \times 10^{-6})^3} = 4 \times 10^{-20} \text{ M}$$

As $\text{Fe}(\text{OH})_2(\text{s})$ $\text{Fe}(\text{OH})_3(\text{s})$ dissolves to give 1 $\text{Fe}^{2+}(\text{aq})$ and 1 $\text{Fe}^{3+}(\text{aq})$, these are also the molar solubilities.

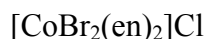
The solubility of $\text{Fe}(\text{OH})_3$ is much lower so it will precipitate at much lower iron concentrations. It is therefore easier to detect Fe^{3+} .

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- Name the following complexes.



hexaaquachromium(III) nitrate



dibromidobis(ethylenediamine)cobalt(III) chloride

en = ethylenediamine = $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$