

Writing Excellence answers to **Solubility and Equilibrium** questions

Solubility and Equilibrium QUESTION	
<p><b>Question:</b> The solubility of zinc hydroxide, <math>\text{Zn}(\text{OH})_2</math>, can be altered by changes in pH. Some changes in pH may lead to the formation of complex ions, such as the zincate ion, <math>[\text{Zn}(\text{OH})_4]^{2-}</math></p> <p>Use equilibrium principles to explain why the solubility of zinc hydroxide increases when the pH is less than 4 or greater than 10.</p>	
ANSWER	
1. write the <b>equation</b> for the dissociation of salt	$\text{Zn}(\text{OH})_{2(s)} \rightleftharpoons \text{Zn}^{2+}_{(aq)} + 2\text{OH}^{-}_{(aq)}$
2. Explain that $\text{OH}^-$ ions are formed during dissociation	When $\text{Zn}(\text{OH})_{2(s)}$ dissolves then $\text{OH}^{-}_{(aq)}$ ions are produced
3. write the <b>equation</b> for the reaction of $\text{H}_3\text{O}^+$ ions + $\text{OH}^-$ ions when adding acid (due to pH being less than 4)	$\text{H}_3\text{O}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
4. link removal of $\text{OH}^-$ ions (product) to <b>equilibrium</b> shifting AND change in solubility	When the pH is less than 4 there are excess $\text{H}_3\text{O}^+$ ions present. These react with the $\text{OH}^-$ ions to produce water and remove $\text{OH}^-$ ions from the solution. so equilibrium shifts to the right to produce more $[\text{OH}^-]$ , therefore more $\text{Zn}(\text{OH})_2$ will dissolve, and increase solubility
5. write the <b>equation</b> for the formation of the complex ion $[\text{Zn}(\text{OH})_4]^{2-}$ with excess $\text{OH}^-$ ions (due to pH being greater than 10)	$\text{Zn}(\text{OH})_{2(s)} + 2\text{OH}^- \rightarrow [\text{Zn}(\text{OH})_4]^{2-}$ OR $\text{Zn}^{2+} + 4\text{OH}^- \rightarrow [\text{Zn}(\text{OH})_4]^{2-}$
6. link removal of $\text{OH}^-$ ions (product) to <b>equilibrium</b> shifting AND change in solubility	When the pH is greater than 10 there are excess $\text{OH}^-$ ions present. These react with the $\text{Zn}(\text{OH})_2$ ( $\text{Zn}^{2+}$ ) to produce a soluble complex ion, $[\text{Zn}(\text{OH})_4]^{2-}$ and remove $\text{OH}^-$ ions from the solution. so equilibrium shifts to the right to produce more $[\text{OH}^-]$ , therefore more $\text{Zn}(\text{OH})_2$ will dissolve, and increase solubility
<p><b>NOTE:</b> The white column is how your answer would appear on your test paper so make sure you <b>write out complete sentences</b>. The grey area is just to help you structure your answer and would not appear in the question.</p>	