**ANSWERS** **Solubility with change in pH**

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| **2018** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | In a saturated solution:Fe(OH)3  Fe3+ + 3OH–As the pH is lowered, [H3O+] increases. The H3O+ will remove and neutralise OH– /H3O+ + OH– → 2H2OA decrease in [OH–] will result in the forward reaction being favoured, to restore equilibrium/ minimise the change.This causes more solid Fe(OH)3 to dissolve, i.e. the solubility of Fe(OH)3 increases / so that [Fe3+][OH–] will again equal *K*s. | Recognises Fe(OH)3 is moresoluble when the pH is lowered. | Explains that the solubility of Fe(OH)3 increases due to removal of OH– from the equilibrium. | Fully explains, using equilibriumprinciples, how the solubility ofFe(OH)3 increases when the pH islowered. Must include neutralisation equation. |

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| **2017** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | When copper(II) hydroxide is dissolved in an acidic solution, the H3O+ ions neutralize the OH– ions / H3O+ + OH– → 2H2OA decrease in [OH-] will result in the forward reaction being favoured, to restore equilibrium / minimise the change.This causes more solid Cu(OH)2 to dissolve, i.e. the solubility of Cu(OH)2 increases /so that [Cu2+][OH–] will again equal *K*s. | Recognises OH– ions are reacting with acid. | Partial explanation for an increase in solubility. | Complete explanation for the increased solubility of Cu(OH)2 in an acidic solution. |

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| **2016** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | Ag2CO3(*s*)  2Ag+(*aq*) + CO32–(*aq*)Ag+(*aq*)+ 2NH3(*aq*)→ [Ag(NH3)2](*aq*)The equilibrium responds by favouring the forward reaction and thus more dissolves. | * One correct equation.
* Recognises that a complex ion is formed.
 | Explanation linked to the effect on equilibrium. | Correct explanation, giving both correct equations. |

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| **2015** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | The H3O+ from the acidic solution reacts with the CO32–. This reduces [CO32–], causing the equilibrium to shift towards the products / RHS to replace some of the lost CO32–. Therefore more solid CaCO3 will dissolve. 2H3O+ + CO32– → 3H2O + CO2 (or other correct alternative). | Recognises H3O+ will remove / neutralise the CO32– from the equilibrium. | Recognises H3O+ will remove / reacts with CO32– with a relevant balanced equation AND uses equilibrium principles to link to an increased solubility of CaCO3. |  |

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| **2014** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | Zn(OH)2(*s*) ⇌ Zn2+(*aq*) + 2OH–(*aq*)When pH is less than 4 / low, [OH–] is decreased due to the reaction with H3O+ to form water, H3O+ + OH– → H2Oso equilibrium shifts to the right to produce more [OH–], therefore more Zn(OH)2 will dissolve.When pH is greater than 10 / high, then more OH– is available and the complex ion (zincate ion) will form.Zn(OH)2(*s*)+ 2OH– → [Zn(OH)4]2– OR Zn2+ + 4OH– → [Zn(OH)4]2– This decrease in [Zn2+] causes the position of equilibrium to shift further to the right, therefore more Zn(OH)2 dissolves.  | * Writes the equilibrium equation.
* Recognises solubility increases at pH of less than 4 (acidic conditions) **due to removal of OH–.**

OR Recognises the solubility increases at a pH greater than 10 **due to formation of a complex ion.** | * Partial explanation for BOTH changes in pH, not fully related to the effect on the equilibrium.

OROne change in pH fully explained. | * Complete explanation for BOTH changes in pH.
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| **2012** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | When the pH is decreased, [H3O+] will increase. The H3O+ will react with the OH– and therefore remove them from the equilibrium. This will cause the reaction to replace some of the removed OH–. As a result more Fe(OH)3 will dissolve, so decreasing the pH will increase the solubility of Fe(OH)3. | States [OH–] decreases / [H3O+] increases causing Fe(OH)3 to be more soluble. | Either:States the change in [OH–], its impact on the equilibrium position and therefore more Fe(OH)3 dissolves.ORDiscussion of effect of decreasing pH on Fe(OH)3 dissolving in terms of [H3O+]/ [OH–] changing. | Complete discussion of effect of decreasing pH on Fe(OH)3 solubility, including role of H3O+ (reacting with OH–). |

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| **2011** | **Evidence** | **Achieve** | **Merit** |  **Excellence** |
|  | Raising the pH will increase the concentration of OH– ions.This will initially cause additional precipitate to form.Once the pH has been increased sufficiently (enough OH- has been added) the formation of a complex ion with Zn2+ will occur, lowering OH– ion concentration in solution.Thus the precipitate will redissolve as a complex ion and less precipitate will be at the bottom of the test tube. | Recognises that [OH–] has increased.Recognises equilibrium will shift to the left. | ONE of:• Recognises that a complex ion will form and links this to either less solid remaining orequilibrium shifting to the right.• Identifies equilibrium shifting to the left due to additional OH–.• Explains equilibrium shifting to the left in terms of the I.P. now exceeding Ks. | Complex ion forms, precipitatere-dissolves, as equilibriumshifts in the forwards direction /to RHS. This shift to the right will occur so more Zn2+ and OH– will dissolve into solution so that the solution becomes saturated again. |

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