**ANSWERS Solubility of solids in solutions forming a complex ion**

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| **2018** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | The SCN– ions can form a complex ion with  Fe3+ ions:  Fe3+ + SCN– [FeSCN]2+  Since the Fe3+ are removed from the equilibrium, more Fe(OH)3 dissolves to replace some of the Fe3+, i.e. equilibrium will shift towards the products / speed up the forward reaction. As a result, the solubility of Fe(OH)3 increases. | Identifies that the solubility of  Fe(OH)3 will increase when KSCN is added. | Explains that the solubility of Fe(OH)3 will increase due to removal of Fe3+ from the equilibrium / formation of a  complex ion. | Fully explains, using equilibrium  principles, how the solubility of the  Fe(OH)3 solid increases when  KSCN is added. Must include  complex ion equation. |

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| **2013** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | Dissolving 0.0100g of silver chromate in 50 mL water will result in solid being present, as the required amount to make a saturated solution is 1.44 × 10–3 g in 50 mL, so any more than this will form a solid.  If the same mass is added to 50 mL of ammonia, more will dissolve and less solid will be present due to the formation of a complex ion.  The Ag2CrO4 will dissociate completely and form an equilibrium.  Ag2CrO4 2Ag+ + CrO42–  Ag+ + 2NH3 [Ag(NH3)2]+  The silver ion will then react further with NH3, removing it from the above equilibrium. Thus, more Ag2CrO4 will dissolve to re-establish equilibrium. | * Recognises that more dissolves in B.   Recognises that a complex ion  forms. | * Recognises that more dissolves in beaker B with link to an equation. * Recognises that in ammonia a silver complex ion will form. | * Links equilibrium of silver chromate with silver & ammonium complex ion removal and hence more dissolves. * Recognises  0.0100 g > 1.44 × 10–3, therefore solid Ag2CrO4 is present.   Correct equation of formation of  complex ion. |

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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 or  equilibrium 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, precipitate  re-dissolves, as equilibrium  shifts 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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| **2010** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | Ag2CrO4(*s*) sm eq arrow 2Ag+(*aq*) + CrO42–(*aq*)  **More silver chromate dissolves.**  Ammonia complexes with silver ions.  Ag+ + 2NH3 → [Ag(NH3)2]+  This removes silver ions from the equilibrium mixture. The silver chromate equilibrium will shift to the RHS.  **Note:** accept NH3 solution increases OH– ion concentration so that Ag+ reacts with this and precipitates out of solution (as Ag2O). Hence, less Ag+ in solution results in more Ag2CrO4 dissolving. | Correctly recognises how solubility changes  AND  identifiesshift direction in that solution. | Complete discussion for ONE effect AND  solubility change identified in the other (see rest of question in common ions)  OR  Correctly recognises how solubility changes in BOTH solutions ANDshift identified for BOTH solutions. | Complete discussion for BOTHeffects including formula for the complex ion formed. (see other questions in common ions)  The discussion in the ‘Note’ in the evidence column is acceptable. |

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| **2009** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | Dilute NH3 will react with Ag+ to produce the complex ion [Ag(NH3)2]+.  Ag+ + 2NH3 → [Ag(NH3)2]+  This decreases [Ag+].  This moves the solubility equilibrium below to the right  AgCl(*s*) ↔ Ag+(*aq*) + Cl–(*aq*)  increasing the solubility of AgCl / causing more AgCl to dissolve,  therefore the precipitate disappears. | Identifies formation of a complex ion.  OR  States ammonia reacts with / removes silver ions therefore causing AgCl to dissolve. | Both equations correct with limited reasoning  **OR**  One equation correct  with related sound  reasoning  **OR**  Sound reasoning for  both parts with no  equations  **OR**  States a complex ion forms  with a correct equilibrium or ionic product statement. | Full discussion with both equations included.  **OR**  Full discussion with  descriptions of both  equations in words. |

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