**ANSWERS Solubility of solids in solutions with a common ion**

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| **2018** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
| **(i)****(ii)****(iii)** | *K*s = [Ag+][Cl-]The Ag+ is a common ion. By increasing [Ag+], the equilibriumwill shift towards the reactants to use up some of the extra Ag+, so more solid AgCl will form, i.e. the solubility of AgCl willdecrease. | • Correct *K*s expression.• Identifies Ag+ is a common ion / [Ag+] increases.• Correct substitution into Q expression.ORCorrect [Ag+] or [ Cl–]. | • Explains the effect of increasing[Ag+] using equilibrium principles.• Correct process to determine *Q* and compare with *K*s. | Correct calculation andcomparison with *K*s to determine whether AgCl will form a precipitate. |

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| **2017** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
| **(i)****(ii)** **(iii)**  | AgBr ⇄ Ag+ + Br–Br– is a common ion / added to solutionAn increase in [Br-] will result in the reverse reaction being favoured, to restore equilibrium / minimise the change.This results in a decrease in [Ag+] (since Ag+ reacts with some of the added Br– to help use it up) / AgBr becomes less soluble, (until [Ag+][Br–] is again equal to *K*s.)AgBr ⇄ Ag+ + Br–*K*s(AgBr) = [Ag+] [Br–]5 ×10−13 = [Ag+ ]× 0.150 × 4065[Ag+ ] = 5.42 ×10−12 mol L−1 | Correct equation.Solubility of AgBr or [Ag+] decreases.Correct *K*s expression. | Links increase in [Br–] to reverse reaction being favoured ORa decrease in solubility of AgBr OR[Ag+] decreasing.Correct calculation | Full explanation linking an increase in [Br–] to a shift In equilibrium towards the reactants, and subsequent decrease in the solubilityof AgBr OR[Ag+] decreasing.Correct calculation with unit and significant figures. |

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| **2016** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | AgNO3 dilution:  = 0.0382Na2CO3 dilution: = 0.141*Q / I.P.* = [0.03818]2[0.1406] = 2.06 × 10–4As *Q / I.P.* > *K*s, a precipitate will form. | * Correct value for *Q* calculated with incorrect dilution.

ORONE dilution calculated correctly. | Correct value for *Q* calculated, based on correct dilutions, but no conclusion given. | Correct value for *Q* calculated, based on correct dilutions, with the correct conclusion. |

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| **2015** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | Pb(OH)2 ⇌ Pb2+ + 2OH–*Q* = [Pb2+][OH–] 2pH =12.6pOH = 1.4[OH–] = 0.0398[Pb2+] = 0.5 × 0.00421 = 2.105 × 10–3[OH–] = 0.5 × 0.0398 = 1.99 × 10–2*Q* = (2.105 × 10–3) × (1.99 × 10–2)2*Q* = 8.34 × 10–7Since *Q* > *K*s, a precipitate of Pb(OH)2 will form. | * Correct equation / expression.

 * Compares incorrect *Q* value to *K*s, to prove Pb(OH)2 forms a precipitate.

OR  Correct working. | * Method uses correct *Q* expression but has one calculation error

AND Compares *Q* and *K*s to prove a Pb(OH)2 precipitate forms. | * Correct calculation with comparison of *Q* and *K*s to prove Pb(OH)2 forms a precipitate.
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| **2014** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | *n*(Pb(NO3)2) =  = 6.04 × 10–3 mol∴[Pb2+] = 6.04 × 10–3 mol / 0.500L = 1.21 × 10–2 mol L–1*Q* = (1.21 × 10–2) x (0.440)2  = 2.34 × 10–3As *Q* > *Ks*, **a precipitate will form.** | * One calculation step correct.
* Compares incorrect *Q* and *K*s to make a valid conclusion.
 | * One calculation error AND Compares *Q* and *K*s to make a valid conclusion.
 | Answer correct with supporting calculation and correct conclusion. |

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| **2012** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | Fe(OH)3(*s*) ⇌ Fe3+(*aq*) + 3OH–(*aq*)Ion Product (IP) = [Fe3+] [OH–]3At pH 7, [OH–] = 1 × 10–7 mol L–1IP = [1.05 × 10–4] [1 × 10–7]3 = 1.05 × 10–25Since IP > *K*s, Fe(OH)3 will form a precipitate | Correct IP expressionORCompares IP and *K*s to make avalid conclusion. | Method uses correct IP expression but has one calculation error ANDCompares IP and *K*s to make a valid conclusion (3 significant figures). | Answer correct with supporting calculation (3 significant figures). |

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| **2010** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | Ag2CrO4(*s*) sm eq arrow 2Ag+(*aq*) + CrO42–(*aq*)**Less silver chromate dissolves**. Silver chromate is in equilibrium. More chromate ions shift this to the left. | Correctly recognises how solubility changes ANDidentifiesshift direction in that solution. | Complete discussion for ONE effect ANDsolubility change identified in the other (see rest of question in complex 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 complex ions) |

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| **2008** | **Evidence** | **Achieve** | **Merit** | **Excellence** |
|  | *n*(Pb(NO3)2) = 1.00 g = 3.02 × 10–3 mol 331 g mol–1 If the lead nitrate is dissolved in the 500 mL, then **[Pb2+] = 6.04 × 10–3 mol L–1***Q*s = [Pb2+] [Cl–]2 = 6.04 × 10–3 × (0.440)2 = **1.17 × 10–3**As *Q*s (1.17 × 10–3) exceeds *K*s (1.60 × 10–5), **a precipitate will form.** | One step correct.Eg:Correct [Pb2+].Correct solubility calculation from incorrect inputs.Correct conclusion from incorrect inputs. | Method uses correct IP expression but has one error.Eg [Pb2+] incorrect or fails to square 0.440.Correct conclusion from calculated answer.Incorrect or no conclusion from correct calculation. | Answer correct with supporting calculation and reasoning. |

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