Worksheet: Common Ion Effects

In this worksheet, we will practice using the solubility product to calculate the impact of a common ion on the dissolution or precipitation of a salt.

Q1: In a solution of 0.025 M NaCl in contact with solid AgCl, what is $[Ag^+]$ at equilibrium? The K_{sp} of AgCl is 1.6×10^{-10}.

A 1.6×10^{-9} M

B 5.1×10^{-8} M

C 4.0×10^{-7} M

D 7.9×10^{-8} M

E 6.4×10^{-9} M

Q2: The solubility product of $CaSO_4 \cdot 2\,H_2O$ is 2.4×10^{-5}. What mass of this salt will dissolve in 1.0 L of a solution with a SO_4^{2-} concentration of 0.010 M?

A 0.34 g

B 0.54 g

C 0.41 g

D 0.69 g

E 0.72 g

Q3: In a 0.00133 M solution of KF in contact with solid CaF_2, what is $[Ca^{2+}]$ at equilibrium? The K_{sp} of CaF_2 is 4.0×10^{-11}.

A 2.3×10^{-5} M

B 1.2×10^{-6} M

C 1.3×10^{-5} M

D 4.4×10^{-6} M

E 5.1×10^{-5} M

Q4: What is the concentration of sulfate ions when $BaSO_4$ just begins to precipitate from a solution that is 0.0758 M in Ba^{2+}? The K_{sp} of $BaSO_4$ is 2.30×10^{-8}.

A 6.07×10^{-7} M

B 3.03×10^{-7} M

C 2.30×10^{-8} M

D 0.0758 M

E 1.21×10^{-6} M

Q5: What is the concentration of PO_4^{3-} when Ag_3PO_4 starts to precipitate from a solution with an Ag^+ concentration of 0.0125 M? The K_{sp} of Ag_3PO_4 is 1.8×10^{-18}.

A 2.3×10^{-15} M

B 1.2×10^{-14} M

C 9.2×10^{-13} M

D 1.4×10^{-16} M

E 3.0×10^{-15} M

Q6: What is the concentration of Sr^{2+} when SrF_2 starts to precipitate from a solution that is 0.0035 M in F^-? The K_{sp} of SrF_2 is 4.3×10^{-9}.

A 3.0×10^{-5} M

B 5.2×10^{-5} M

C 1.2×10^{-6} M

D 3.5×10^{-4} M

E 4.5×10^{-5} M

Q7: For 0.500 L of a solution containing 19.50 g of K_2SO_4 in contact with solid Ag_2SO_4, what is $[Ag^+]$ at equilibrium? The K_{sp} of Ag_2SO_4 is 1.2×10^{-5}.

A 1.3×10^{-4} M

B 7.4×10^{-4} M

C 7.4×10^{-3} M

D 6.4×10^{-4} M

E 1.4×10^{-2} M

Q8: A sample of $CoCO_3$ ($K_{sp} = 1.0 \times 10^{-12}$) is contaminated with 0.1 g of $NiCO_3$ ($K_{sp} = 1.36 \times 10^{-7}$). The sample is treated with the minimum amount of water required to completely dissolve the $NiCO_3$. Noting that the two carbonate salts dissolve in the same volume of water, calculate the mass of $CoCO_3$ that is also washed away.

A 4×10^{-7} g

B 6×10^{-10} g

C 5×10^{-5} g

D 1×10^{-10} g

E 7×10^{-7} g

Q9: A solution contains 0.010 M of both Cu^{2+} and Cd^{2+}. Sulfide ions are added to the solution until 99.9% of the Cu^{2+} ions have been precipitated as CuS. Calculate the percentage of Cd^{2+} ions remaining in solution. The K_{sp} value CuS is 8.5×10^{-45} and that of CdS is 1.0×10^{-28}.

A 99.9%

B 95.1%

C 100.0%

D 80.3%

E 99.0%

Q10: In a solution of 0.025 M$TlNO_3$ in contact with solid TlCl, what is $[Cl^-]$ at equilibrium? The K_{sp} of TlCl is 1.7×10^{-4}.

A 6.8×10^{-3} M

B 5.6×10^{-3} M

C 6.0×10^{-4} M

D 4.3×10^{-3} M

E 4.8×10^{-4} M

Q11: In 2.250 L of solution containing 8.156 g of $Mg(NO_3)_2$ in contact with solid MgC_2O_4, what is $[C_2O_4^{2-}]$ at equilibrium? The K_{sp} of MgC_2O_4 is 7.0×10^{-7}.

A 2.9×10^{-5} M

B 6.4×10^{-4} M

C 3.1×10^{-6} M

D 7.2×10^{-4} M

E 8.0×10^{-2} M

Q12: In a solution of 0.0313 M KF in contact with solid BaF_2, what is $[Ba^{2+}]$ at equilibrium? The K_{sp} of BaF_2 is 1.84×10^{-7}.

A 1.88×10^{-4} M

B 6.50×10^{-3} M

C 1.59×10^{-3} M

D 1.73×10^{-4} M

E 2.01×10^{-4} M

Q13: How many grams of $Pb(OH)_2 (K_{sp} = 1.2 \times 10^{-15})$ will dissolve in 500 mL of a 0.050 M $PbCl_2$ solution?

A 8.1×10^{-7} g

B 9.3×10^{-6} g

C 1.2×10^{-15} g

D 0.16 g

E 4.8×10^{-3} g

Q14: A solution contains all of the following carbonates at the same concentration. If $[CO_3^{2-}]$ is gradually increased, which carbonate is first to precipitate?

A $MgCO_3 (K_{sp} = 3.5 \times 10^{-8})$

B $BaCO_3 (K_{sp} = 4.4 \times 10^{-5})$

C $CaCO_3 (K_{sp} = 4.2 \times 10^{-7})$

D $SrCO_3 (K_{sp} = 3.9 \times 10^{-9})$

E $MnCO_3 (K_{sp} = 5.1 \times 10^{-9})$

Q15: A solution contains all of the following carbonates at the same concentration. If $[CO_3^{2-}]$ is gradually increased, which carbonate is last to precipitate?

A $MnCO_3 (K_{sp} = 5.1 \times 10^{-9})$

B $BaCO_3 (K_{sp} = 4.4 \times 10^{-5})$

C $CaCO_3 (K_{sp} = 4.2 \times 10^{-7})$

D $MgCO_3 (K_{sp} = 3.5 \times 10^{-8})$

E $SrCO_3 (K_{sp} = 3.9 \times 10^{-9})$