Chapter 17 – Practice Problems with Solubility and K_{sp} – ANSWERS

1.

Solid	Balanced Equation	K_{sp}
barium carbonate	$BaCO_3(s) \leftrightarrows Ba^{2+}(aq) + CO_3^{2-}(aq)$	$K_{sp} = [Ba^{2+}][CO_3^{2-}]$
calcium chromate	$CaCrO_4(s) \leftrightarrows Ca^{2+}(aq) + CrO_4^{2-}(aq)$	$K_{sp} = [Ca^{2+}][CrO_4^{2-}]$
silver sulfate	$Ag_2SO_4(s) \leftrightarrows 2\ Ag^{+}(aq) + SO_4^{2-}(aq)$	$K_{sp} = [Ag^{+}]^2[SO_4^{2-}]$
magnesium hydroxide	$Mg(OH)_2(s) \leftrightarrows Mg^{2+}(aq) + 2\ OH^{-}(aq)$	$K_{sp} = [Mg^{2+}][OH^{-}]^2$

2.

Name	Molar Mass (g/mol)	Solubility of the Solid Compound (g/L)	Cation concentration in a saturated solution (*M*)	Anion concentration in a saturated solution (*M*)
barium carbonate	197.34	0.014	$[Ba^{2+}] = 7.1 \times 10^{-5}$	$[CO_3^{2-}] = 7.1 \times 10^{-5}$
calcium chromate	156.08	0.010	$[Ca^{2+}] = 6.4 \times 10^{-5}$	$[CrO_4^{2-}] = 6.4 \times 10^{-5}$
silver sulfate	311.80	4.8	$[Ag^{+}] = 0.030$	$[SO_4^{2-}] = 0.015$
magnesium hydroxide	58.32	0.0096	$[Mg^{2+}] = 1.6 \times 10^{-4}$	$[OH^{-}] = 3.2 \times 10^{-4}$

3.

Name	Calculated value of K_{sp}
barium carbonate	$(7.1 \times 10^{-5})(7.1 \times 10^{-5}) = 5.0 \times 10^{-9}$
calcium chromate	$(6.4 \times 10^{-5})(6.4 \times 10^{-5}) = 4.1 \times 10^{-9}$
silver sulfate	$(0.030)^2(0.015) = 1.4 \times 10^{-5}$
magnesium hydroxide	$(1.6 \times 10^{-4})(3.2 \times 10^{-4})^2 = 1.6 \times 10^{-11}$

4.

Name	Formula	K_{sp}	Cation concentration in a saturated solution (M)	Anion concentration in a saturated solution (M)
barium carbonate	$BaCO_3$	5.0×10^{-9}	$[Ba^{2+}] = 7.1 \times 10^{-5}$	$[CO_3^{2-}] = 7.1 \times 10^{-5}$
calcium sulfate	$CaSO_4$	2.4×10^{-5}	$[Ca^{2+}] = 4.9 \times 10^{-3}$	$[SO_4^{2-}] = 4.9 \times 10^{-3}$
silver carbonate	Ag_2CO_3	8.1×10^{-12}	$[Ag^{+}] = 2.6 \times 10^{-4}$	$[CO_3^{2-}] = 1.3 \times 10^{-4}$
zinc hydroxide	$Zn(OH)_2$	3.0×10^{-16}	$[Zn^{2+}] = 4.2 \times 10^{-6}$	$[OH^{-}] = 8.4 \times 10^{-6}$

5.

Formula	Equation that shows why the solid is more soluble in an acidic solution
PbF_2	$PbF_2 + 2\,H^+ \leftrightarrows Pb^{2+} + 2\,HF$
$Ni(OH)_2$	$Ni(OH)_2 + 2\,H^+ \leftrightarrows Ni^{2+} + 2\,H_2O$
$CaCO_3$	$CaCO_3 + 2\,H^+ \leftrightarrows Ca^{2+} + H_2O + CO_2$
CuS	$CuS + 2\,H^+ \leftrightarrows Cu^{2+} + H_2S$

6.

(a)

$M_1V_1 = M_2V_2$

$(5.0 \times 10^{-4}\ M)(50.0\ \text{mL}) = (\ M_2\ )(100.0\ \text{mL})$

$[Ca^{2+}] = 2.5 \times 10^{-4}\ M$

$M_1V_1 = M_2V_2$

$(3.0 \times 10^{-3}\ M)(50.0\ \text{mL}) = (\ M_2\ )(100.0\ \text{mL})$

$[F^{-}] = 1.5 \times 10^{-3}\ M$

(b) $Q = [Ca^{2+}][F^-]^2 = (2.5 \times 10^{-4})(1.5 \times 10^{-3})^2 = 5.6 \times 10^{-10}$

(c) A precipitate of CaF_2 **will** form in the beaker because the value of Q is **more** than the value of K_{sp}.