Marks 5

- $BaSO_4$ is used as a contrast agent in medical imaging. It has a K_{sp} of 1.1×10^{-10}. What is the molarity of Ba^{2+} ions in a saturated aqueous solution of $BaSO_4$?

The dissolution reaction is:

$$\mathbf{BaSO_4(s) \rightleftharpoons Ba^{2+}(aq) + SO_4^{2-}(aq) \qquad K_{sp} = [Ba^{2+}(aq)][SO_4^{2-}(aq)]}$$

From the reaction, $[Ba^{2+}(aq)] = [SO_4^{2-}(aq)]$. Hence if $[Ba^{2+}(aq)] = S$:

$$\mathbf{S^2 = K_{sp} = 1.1 \times 10^{-10}}$$
$$\mathbf{S = 1.0 \times 10^{-5}\ M}$$

Answer: **1.0×10^{-5} M**

What is the molar solubility of $BaSO_4$ in the presence of a 0.1 M solution of Na_2SO_4?

The added SO_4^{2-} will dominate over that produced in the dissolution reaction so $[SO_4^{2-}(aq)] = 0.1$ M. For the dissolution reaction to still be at equilibrium:

$$\mathbf{K_{sp} = [Ba^{2+}(aq)][SO_4^{2-}(aq)] = 1.1 \times 10^{-10}}$$

With $[SO_4^{2-}(aq)] = 0.1$ M,

$$\mathbf{[Ba^{2+}(aq)] = K_{sp} / [SO_4^{2-}(aq)] = 1.1 \times 10^{-10} / 0.1\ M = 1 \times 10^{-9}\ M}$$

Answer: **1×10^{-9} M**

The lethal concentration of Ba^{2+} in humans is about 60 mg L^{-1} (4×10^{-4} M). Is there any advantage to administering $BaSO_4$ in the presence of 0.1 M Na_2SO_4 solution? Explain your reasoning.

No. The lethal $[Ba^{2+}(aq)]$ is 40 times greater than the $[Ba^{2+}(aq)]$ in normal aqueous solution.

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