SOLUBILITY PRODUCT CALCULATIONS

1. $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

For every mole of silver chloride which dissolves, you will get 1 mole of each of the ions.

Therefore $[Ag^+] = 1.34 \times 10^{-5}$ mol dm^{-3}

$[Cl^-] = 1.34 \times 10^{-5}$ mol dm^{-3}

$K_{sp} = [Ag^+][Cl^-] = 1.80 \times 10^{-10}$ mol^2 dm^{-6}

Don't forget the units - they would probably count for a mark in an exam. If you got this easy calculation wrong, it is most likely because you have mis-entered 1.34×10^{-5} mol dm^{-3} on your calculator. Re-read the first green box on the Chemguide page.

2. $Sr(OH)_{2(s)} \rightleftharpoons Sr^{2+}_{(aq)} + 2OH^-_{(aq)}$

For every mole of strontium hydroxide which dissolves, you will get 1 mole of Sr^{2+} ions and 2 moles of OH^- ions.

Therefore $[Sr^{2+}] = 0.0431$ mol dm^{-3}

$[OH^-] = 2 \times 0.0431 = 0.0862$ mol dm^{-3}

$K_{sp} = [Sr^{2+}][OH^-]^2 = 3.20 \times 10^{-4}$ mol^3 dm^{-9}

3. $SrCO_{3(s)} \rightleftharpoons Sr^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)}$

For every mole of strontium carbonate which dissolves, you will get 1 mole of Sr^{2+} ions and 1 mole of CO_3^{2-} ions.

If the solubility of strontium carbonate is s mol dm^{-3}, then

$[Sr^{2+}] = s$ mol dm^{-3}

$[CO_3^{2-}] = s$ mol dm^{-3}

$K_{sp} = [Sr^{2+}][CO_3^{2-}] = s^2 = 1.10 \times 10^{-10}$ mol^2 dm^{-6}

$s = 1.05 \times 10^{-5}$ mol dm^{-3}

4. $Ca_3(PO_4)_{2(s)} \rightleftharpoons 3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)}$

For every mole of calcium phosphate which dissolves, you will get 3 moles of Ca^{2+} ions and 2 moles of PO_4^{3-} ions.

If the solubility of calcium phosphate is s mol dm^{-3}, then

$[Ca^{2+}] = 3s$ mol dm^{-3}

$[PO_4^{3-}] = 2s$ mol dm^{-3}

$K_{sp} = [Ca^{2+}]^3 [PO_4^{3-}]^2 = (3s)^3 \times (2s)^2 = 108s^5 = 1.0 \times 10^{-26}$ mol^5 dm^{-15}.

$$s = \sqrt[5]{\frac{1.0 \times 10^{-26}}{108}}$$

$= 2.5 \times 10^{-6}$ mol dm^{-3}

Notes:

Don't quote this to more than 2 significant figures, because that is all the solubility product is quoted to.

If you couldn't sort out how to find the fifth root of the expression for s, read the last green box on the Chemguide page you have come from. If that fails, read your calculator manual.

I have no confidence in the values for solubility products that I have used in these questions. Different sources give quite different values, and I have no way of knowing which is correct. It may, of course, be that they relate to different temperatures. This doesn't affect the way the calculations are done, and you don't need to worry about it.