Marks 6

- Magnesium hydroxide, $Mg(OH)_2$, is used as treatment for excess acidity in the stomach. Calculate the pH of a solution that is in equilibrium with $Mg(OH)_2$. The solubility product constant, K_{sp} of $Mg(OH)_2$ is 7.1×10^{-12} M^2.

The dissolution equilibrium is: $Mg(OH)_2(s) \rightleftharpoons Mg^{2+}(aq) + 2OH^-(aq)$. As two mol of anion is produced for every one mol of cations, the expression for the solubility product is:

$$K_{sp} = [Mg^{2+}(aq)][OH^-(aq)]^2 = (S)\times(2S)^2 = 4S^3 \text{ where } S \text{ is the molar solubility}$$

$$\text{Hence, } [OH^-(aq)] = 2S = 2 \times \sqrt[3]{\frac{7.1\times10^{-12}}{4}} = 2.4 \times 10^{-4} \text{ M.}$$

The pOH = $-\log_{10}[OH^-(aq)] = -\log_{10}[2.4 \times 10^{-4}] = 3.6$

As pH + pOH = 14.0, the pH = 14.0 – 3.6 = 10.4

ANSWER: **10.4**

Determine whether 2.0 g of $Mg(OH)_2$ will dissolve in 1.0 L of a solution buffered to a pH of 7.00.

At pH = 7.00, pOH = 14.00 – 7.00 = 7.00 and hence $[OH^-(aq)] = 10^{-7}$ M.

The formula mass of $Mg(OH)_2$ is:

$$\text{formula mass} = (24.31\ (Mg) + 2\times(16.00\ (O) + 1.008\ (H))\ \text{g mol}^1$$
$$= 58.326\ \text{g mol}^1$$

Therefore 2.0 g contains:

$$\text{number of moles} = \frac{\text{mass}}{\text{formula mass}} = \frac{2.0\,\text{g}}{58.326\,\text{g mol}^{-1}} = 0.034 \text{ mol}$$

As each mole of $Mg(OH)_2$ generates 1 mole of Mg^{2+}, if all of the $Mg(OH)_2$ dissolves in 1.0 L of solution then $[Mg^{2+}(aq)] = 0.034$ M. The buffer removes the OH^- produced so that $[OH^-(aq)] = 10^{-7}$ M.

The ionic product is then:

$$Q = [Mg^{2+}(aq)][OH^-(aq)]^2 = (0.034) \times (10^{-7})^2 = 3.4 \times 10^{-16}$$

As Q is much smaller than K_{sp}, all of the solid will dissolve.

ANSWER: <u>**YES**</u> / NO