Marks 4

- Magnesium hydroxide, $Mg(OH)_2$, is used as treatment for excess acidity in the stomach. Its solubility product constant, K_{sp}, is 7.1×10^{-12} M^3. Calculate the pH of a solution that is in equilibrium with $Mg(OH)_2$(s).

The dissolution equilibrium is: $Mg(OH)_2(s) \leftrightarrows Mg^{2+}(aq) + OH^-(aq)$

Hence, $K_{sp} = [Mg^{2+}(aq)][OH^-(aq)]^2$

If $[Mg^{2+}(aq)] = x$ then $[OH^-(aq)] = 2x$ and $K_{sp} = (x)(2x)^2 = 4x^3$

As $K_{sp} = 7.1 \times 10^{-12}$, $x = 1.2 \times 10^{-4}$ M and so $[OH^-(aq)] = 2.4 \times 10^{-4}$ M

As pH + pOH = 14.0 and pOH = $-\log[OH^-(aq)] = -\log(2.4 \times 10^{-4}) = 3.6$:

pH = 14.0 – 3.6 = 10.4

Answer: **pH = 10.4**

Determine whether 3.0 g of $Mg(OH)_2$ will dissolve in 1.0 L of a solution buffered to a pH of 8.00.

If pH = 8.00 then pOH = 14.00 – 8.00 = 6.00. As pOH = $-\log[OH^-(aq)]$:

$[OH^-(aq)] = 1.00 \times 10^{-6}$.

As $K_{sp} = [Mg^{2+}(aq)][OH^-(aq)]^2 = 7.1 \times 10^{-12}$, the $[Mg^{2+}(aq)]$ is:

$$[Mg^{2+}(aq)] = \frac{K_{sp}}{[OH^-(aq)]^2} = \frac{7.1\times10^{-12}}{(1.00\times10^{-6})^2} = 7.1\,M$$

As 1 mol of $Mg(OH)_2$(s) dissolves to give 1 mol of $[Mg^{2+}(aq)]$, this is also the number of moles of $Mg(OH)_2$(s) which dissolves.

The molar mass of $Mg(OH)_2$ is (24.31 (Mg)) + 2×(16.00 (O) + 1.008 (H)) = 58.326

The mass of $Mg(OH)_2$ which can dissolve is therefore 7.1 × 58.326 = 410 g.

<u>YES</u> / NO