Marks 5

- Cisplatin, $[Pt(NH_3)_2Cl_2]$, is a particularly effective chemotherapy agent against certain types of cancer. Calculate the concentration of $Pt^{2+}(aq)$ ions in solution when 0.075 mol of cisplatin is dissolved in 1.00 L of a 1.00 M solution of NH_3. K_{stab} of $[Pt(NH_3)_2Cl_2] = 3.4 \times 10^{12}$.

The initial concentration of cisplatin when 0.075 mol is dissolved in 1.00 L is 0.075 M.

As K_{stab} refers to the formation of the complex, the reaction table is:

	$Pt^{2+}(aq)$	$2Cl^-(aq)$	$2NH_3(aq)$	$\rightleftharpoons$	$[Pt(NH_3)_2Cl_2]$
Initial	**0**	**0**	**1.00**		**0.075**
Change	**+x**	**+2x**	**+2x**		**-x**
Equilibrium	**x**	**2x**	**1.00 + 2x**		**0.075 - x**

Hence:

$$K_{stab} = \frac{[Pt(NH_3)_2Cl_2]}{[Pt^{2+}][Cl^-]^2[NH_3]^2} = \frac{(0.075-x)}{(x)(2x)^2(1.00+2x)^2} = 3.4 \times 10^{12}$$

As K_{stab} is so large, x will be very, very small and so (1.00 + 2x) ~ 1.00 and (0.075 – x) ~ 0.075. With this:

$$K_{stab} \sim \frac{(0.075)}{(x)(2x)^2(1.00)^2} = \frac{(0.075)}{(4x)^3} = 3.4 \times 10^{12}$$

$x = [Pt^{2+}(aq)] = 1.8 \times 10^{-5}$ M

Answer: **1.8×10^{-5} M**

What changes would occur to the values of K_{stab} for cisplatin and the concentration of $Pt^{2+}(aq)$ ions if solid KCl were dissolved in the above solution?

K_{stab}	increase	**no change**	decrease
$[Pt^{2+}(aq)]$	increase	no change	**decrease**

(i) **K_{stab} is the stability constant – it is a constant at any given temperature.**

(ii) **From Le Chatelier's principle, if $[Cl^-(aq)]$ is increased then the equilibrium will shift to the right and so $[Pt^{2+}(aq)]$ will decrease.**