COMPLEXION

$$Ag^+(aq) + NH_3(aq) \rightleftharpoons Ag(NH_3)^+(aq)$$

$$K_1 = \frac{[Ag(NH_3)^+]}{[Ag^+]\,[NH_3]} = 2.1 \times 10^3$$

$$Ag(NH_3)^+(aq) + NH_3(aq) \rightleftharpoons Ag(NH_3)_2^+(aq)$$

$$K_2 = \frac{[Ag(NH_3)_2^+]}{[Ag(NH_3)^+]\,[NH_3]} = 8.0 \times 10^3$$

$$Ag^+(aq) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)_2^+(aq)$$

$$K_f = K_1 K_2 = 1.7 \times 10^7$$ FORMATION CONSTANT

$$K_f >> 1$$

CONSIDER 0.200 mol of $AgNO_3$ AND DISSOLVE IT IN 0.500 L OF A 1.000 M NH_3.

ASSUMPTION: ALL THE Ag^+ FORMS A COMPLEX ION $Ag(NH_3)^+$

FIRST WE NEED TO CALCULATE THE CONC.

$$[Ag(NH_3)_2^+] = \frac{0.200 \text{ mol } Ag(NH_3)_2^+}{0.500 \text{ L}} = 0.400 \text{ M}$$

$$[NH_3] = \frac{0.500 \text{ mol } NH_3 - 2(0.200 \text{ mol } NH_3)}{0.500 \text{ L}}$$

$$[NH_3] = 0.200 \text{ M}$$

SECOND WE CALCULATE $[Ag(NH_3)^+]$

$$Ag(NH_3)_2^+(aq) \rightleftharpoons Ag(NH_3)^+(aq) + NH_3(aq)$$

I	0.400	—	0.200
C	$-x$	x	x
E	$0.400 - x$	x	$0.200 + x$

$$\frac{1}{K_2} = \frac{x(0.200+x)}{(0.400-x)}$$

$$\frac{1}{K_2} \cong \frac{0.200}{0.400} X = \frac{X}{2.00}$$

$$X \cong \frac{2.00}{K_2} \cdot = \frac{2.00}{8.0} 10^{-3}$$

$$X = 2.5 \times 10^{-4}$$

$$\boxed{[Ag(NH_3)_2^+] = 2.5 \times 10^{-4} M}$$

FINALLY

NOW WE CAN USE THE FIRST EQUILIBRIUM AND

$$[Ag^+] = \frac{1}{K_1} \frac{[Ag(NH_3)^+]}{[NH_3]}$$

$$= \frac{2.5 \times 10^{-4}}{2.1 \times 10^3} \frac{1}{0.200}$$

$$= \frac{2.5}{4.2} \times 10^{-6} = 6.0 \times 10^{-7}$$

$$\boxed{[Ag^+] = 6.0 \times 10^{-7} M}$$

$$[Ag(NH_3)_2^+] >> [Ag(NH_3)^+] >> [Ag^+]$$