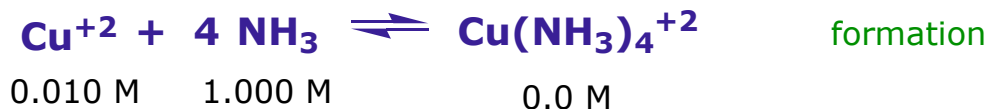


## Examples of Solving Complex Ion Equilibrium

A solution has initial  $[\text{Cu}^{+2}] = 0.010 \text{ M}$  and initial  $[\text{NH}_3] = 1.000 \text{ M}$ . The complex ion  $\text{Cu}(\text{NH}_3)_4^{+2}$  forms in solution with  $K_f = 5.01 \times 10^{13}$ . Calculate the  $[\text{Cu}^{+2}]$  when equilibrium is achieved.

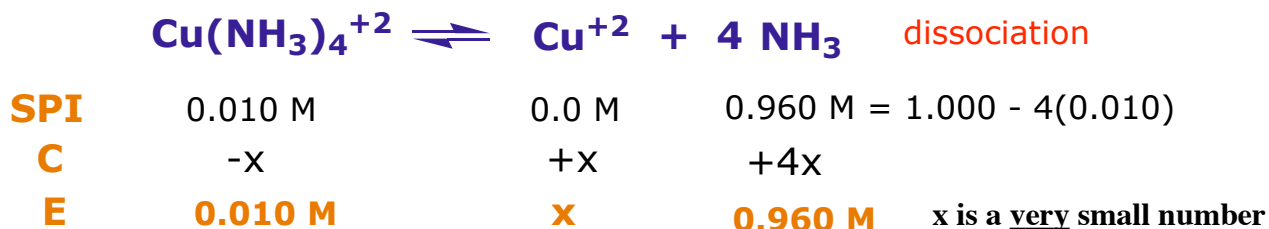


Since the **formation equilibrium constant** is so large, solving the usual "ICE" table will give an equilibrium molarity of  $\text{Cu}^{+2}$  equal to 0.

$$K_f = \frac{[\text{Cu}(\text{NH}_3)_4^{+2}]}{[\text{Cu}^{+2}] [\text{NH}_3]^4}$$

To find the actual molarity (a **very small number**), one must solve this kind of problem for the reverse reaction, a **dissociation**. This is set up by first converting all metal ion into complex, the product of formation, and then using the reverse reaction in a "SPICE" table.

Start with **Product Initially**



**Now plug into  $K_d$   
and solve for  $x$**

$$K_d = \frac{[\text{Cu}^{+2}] [\text{NH}_3]^4}{[\text{Cu}(\text{NH}_3)_4^{+2}]}$$

A solution has initial  $[\text{Fe}^{+3}] = 0.0050 \text{ M}$  and initial  $[\text{C}_2\text{O}_4^{-2}] = 0.075 \text{ M}$ . The complex ion  $\text{Fe}(\text{C}_2\text{O}_4)_3^{-3}$  forms in solution with  $K_f = 2.00 \times 10^{20}$ . Calculate the  $[\text{Fe}^{+3}]$  when equilibrium is achieved.

