1.1	***1.2***	***1.3***	***1.4***	***1.5***	***1.6***	***1.7***	***Total***
1	1	4	1	3	18	3	31

Copper Ammonia Equilibria (CODS-CT Team Round Pt. 2 #1)

Perhaps the most famous complex of copper is the Copper (II) Ammonia complex. This system will be explored through the following 3 equilibria:

$Cu^{2+} + NH_3 \rightleftharpoons Cu(NH_3)^{2+}$	(1) $K_f = 2 \times 10^4$
$Cu^{2+} + H_2O \rightleftharpoons Cu(OH)^+ + H^+$	(2) $K_a = 1 \times 10^{-5}$
$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$	(3) $K_b = 2 \times 10^{-5}$

Further complexation of ammonia is ignored due to the low initial concentration of NH_3 present.

1.1 What is the pH of a 0.012 M solution of NH_3 in water?
1.2 What is the pH of a 0.01 M solution of $Cu(NO_3)_2$ in water?

We can simplify the final problem we hope to study by ***ignoring the complexation equilibria*** (1) and considering only acid base reactions (2-3) for now.

To 1.0 L of solution, a student adds 0.01 moles of $Cu(NO_3)_2$ and 0.012 moles of NH_3 so that the final analytical concentrations are 0.01 M Cu^{2+} and 0.012 M NH_3. If we ignore the complexation equilibria, the pH of the solution thus prepared can be calculated to be 8.60.

1.3 What are the concentrations of Cu^{2+}, $Cu(OH)^+$, NH_3, and NH_4^+ in this solution?
1.4 What is the K_{eq} of the reaction $Cu^{2+} + NH_3 + H_2O \rightleftharpoons Cu(OH)^+ + NH_4^+$?

To 1.0 L of solution, a student adds 0.01 moles of $Cu(NO_3)_2$ and 0.012 moles of NH_3 so that the final analytical concentrations are 0.01 M Cu^{2+} and 0.012 M NH_3. This time we will consider all 3 equilibria listed above.

1.5 Write out all equations you can construct from the given information which you will use to solve the system.
1.6 Determine the final concentrations of all 7 aqueous species (excluding NO_3^-)
1.7 State all approximations which you used (if you used any)