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Part A. Effect of Changing pH

Q1. *(1 pt)* Record your observations from Part A:

Add NaOH to Cu^{2+}: Solution turns dark blue ~~(Cu^{2+} + Na^+)~~ $Cu(OH)_2$

Change pH to 4: Solution turns light blue (Cu^{2+} + Na^+)

Change pH to 10: Solution returns to dark blue ($Cu(OH)_2$)

Q2. *(1 pt)* Write the net ionic equation, including phases, for the reaction of Cu^{2+} and NaOH:

$2NaOH_{(aq)} + Cu^{2+}_{(aq)} \rightarrow Cu(OH)_{2(s)} + 2Na^+_{(aq)}$: $\cancel{2Na^+_{(aq)}} + 2OH^-_{(aq)} + Cu^{2+} \rightarrow Cu^{2+} + 2OH^- + \cancel{2Na^+}$

$$\boxed{2OH^-(aq) + Cu^{2+}(aq) \rightleftharpoons Cu(OH)_2(s)}$$

Q3. *(2 pt)* Explain your observations in pH 4 solution by referencing Le Châtelier's Principle and the reaction written in Q2.

Changing the pH to 4 (acidic) adds stress to the above reaction so that the reverse reaction is favored, due to Le Chatlier's Principle. This is because the OH^- ions create a basic solution so when the pH is acidic, the rxn will shift to reach ~~an~~ more equivibrilized state. (balance pH)

Q4. *(2 pt)* Explain your observations in pH 10 solution by referencing Le Châtelier's Principle and the reaction written in Q2.

Due to Le Chatlier's Principle, increasing the pH to 10 would cause the forward reaction to be favored. Since the OH^- ions in the above reaction create a basic solution, increasing the pH would drive the rxn forward to balance the pH.

Part B. Effect of Changing Concentration

Q5. *(1 pt)* Record your observations from Part B:

Add NaCl to Ag^+: Solution turns white/cloudy ($AgCl$ + Na^+)

Add NH_3: Solution returns clear ($Ag(NH_3)_2^+$ + Na^+ + NH_3)

Q6. (*1 pt*) Write the net ionic equation, including phases, for the reaction of Ag^+ and NaCl:

$Ag^+ + \cancel{Na}Cl \longrightarrow AgCl + \cancel{Na}^+$

$\boxed{Ag^+_{(aq)} + Cl^-_{(aq)} \longrightarrow AgCl_{(s)}}$

Q7. (*2 pt*) Explain your observations upon adding NH_3 by referencing Le Châtelier's Principle and the reaction written in Q6.

when NH_3 is added, the reverse reaction is favored because the NH_3 reacts with the Ag^+ to form $Ag(NH_3)_2^+$. Since at least some Ag^+ react with NH_3, there is not as much Ag^+ to react with Cl^-.

Part C. Effect of Changing Temperature

Q8. (*0.5 pt*) Record your observations from Part C when you mixed NaCl and Pb^{2+}:

Add NaCl to Pb^{2+}: Clear solution goes to white/cloudy ($PbCl_2 + Na^+$)

Add Heat: Solution returns to Clear ($Pb^{2+} + Na^+$)

Q9. (*0.5 pt*) Record your observations from Part C when you mixed Na_2SO_4 and Ca^{2+}:

Add Na_2SO_4 to Ca^{2+}: Clear solution stays clear ($Ca^{2+} + Na^+$

Add Heat: Solution turns Cloudy ($CaSO_4 + Na^+$

Q10. (*2 pt*) What is the sign (±) of ΔH for the reaction shown below? Explain your answer with reference to Le Châtelier's Principle.

$$PbCl_2(s) \rightleftarrows Pb^{2+}(aq) + 2Cl^-(aq)$$

(−) The sign is negative because the reaction is endothermic and needs heat to react. Due to Le Chatlier's principle, heat stresses the rxn by shifting it to the right.

Q11. (*2 pt*) What is the sign (±) of ΔH for the reaction shown below? Explain your answer with reference to Le Châtelier's Principle.

$$CaSO_4(s) \rightleftarrows Ca^{2+}(aq) + SO_4^{2-}(aq)$$

(+) The sign is Positive because the reaction is exothermic. By increasing the heat, due to Le Chatlier's principle, the reverse reaction is favored.