

Be sure to show all work, use the correct number of significant figures, circle final answers and use correct units in all problems.

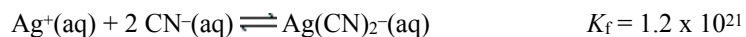
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**Question #1:** 10 points

- a. Write the balanced equation for the equilibrium of copper(II) hydroxide,  $\text{Cu}(\text{OH})_2$ , in water and the  $K_{\text{sp}}$  expression.  $K_{\text{sp}} = 2.2 \times 10^{-20}$  at  $25^\circ\text{C}$ .
- b. What is the solubility of copper(II) hydroxide at  $25^\circ\text{C}$ ?
- c. What is the solubility of copper(II) hydroxide at  $25^\circ\text{C}$  if the initial  $[\text{Cu}^{+2}] = 0.010\text{ M}$ ?
- d. Will a precipitate form when 10.0 mL of 0.0015 M copper(II) nitrate is mixed with 10. mL of 0.015 M sodium hydroxide?

**Question #2:** 4 points

Given the following reactions,



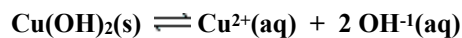
determine the equilibrium constant for the reaction below.

**Question #3:** 6 points

- a. A solution of  $\text{Na}_2\text{SO}_4$  is added dropwise to a solution that is 0.010 M  $\text{Ba}^{2+}$  and 0.010 M  $\text{Ag}^{+1}$ . Neglecting volume changes, which salt precipitates first,  $\text{BaSO}_4$  ( $K_{\text{sp}} = 1.1 \times 10^{-10}$ ) or  $\text{Ag}_2\text{SO}_4$  ( $K_{\text{sp}} = 1.7 \times 10^{-5}$ )?
- b. What is the concentration of the cation that precipitates first when the second cation begins to precipitate?

**Answers****Question #1:** 10 points

- a. Write the balanced equation for the equilibrium of copper(II) hydroxide,  $\text{Cu}(\text{OH})_2$ , in water and the  $K_{\text{sp}}$  expression.  $K_{\text{sp}} = 2.2 \times 10^{-20}$  at  $25^\circ\text{C}$ .



$$K_{\text{sp}} = [\text{Cu}^{2+}][\text{OH}^{-1}]^2$$

- b. What is the solubility of copper(II) hydroxide at  $25^\circ\text{C}$ ?

$$x = 1.8 \times 10^{-7} \text{ M}$$

- c. What is the solubility of copper(II) hydroxide at  $25^\circ\text{C}$  if the initial  $[\text{Cu}^{+2}] = 0.010 \text{ M}$ ?

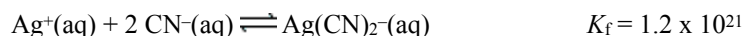
$$x = 7.5 \times 10^{-10} \text{ M } (7.4 \times 10^{-10} \text{ ok})$$

- d. Will a precipitate form when 10.0 mL of 0.0015 M copper(II) nitrate is mixed with 10. mL of 0.015 M sodium hydroxide?

**Yes, solid forms**

**Question #2:** 4 points

Given the following reactions,



determine the equilibrium constant for the reaction below.



$$K_{\text{net}} = 6.5 \times 10^8$$

**Question #3:** 6 points

- a. A solution of  $\text{Na}_2\text{SO}_4$  is added dropwise to a solution that is 0.010 M  $\text{Ba}^{2+}$  and 0.010 M  $\text{Ag}^{+1}$ . Neglecting volume changes, which salt precipitates first,  $\text{BaSO}_4$  ( $K_{\text{sp}} = 1.1 \times 10^{-10}$ ) or  $\text{Ag}_2\text{SO}_4$  ( $K_{\text{sp}} = 1.7 \times 10^{-5}$ )?

**$\text{BaSO}_4$  precipitates first**

- b. What is the concentration of the cation that precipitates first when the second cation begins to precipitate?

$$6.5 \times 10^{-10} \text{ M}$$