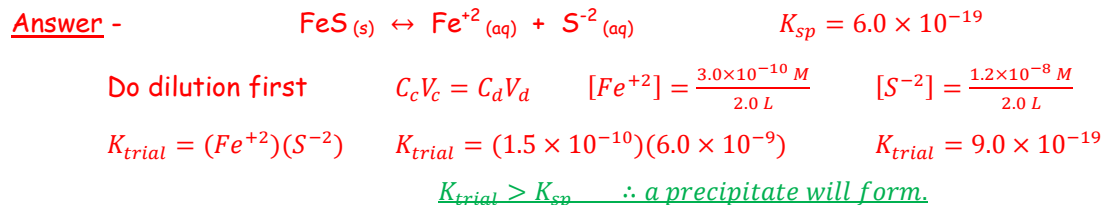


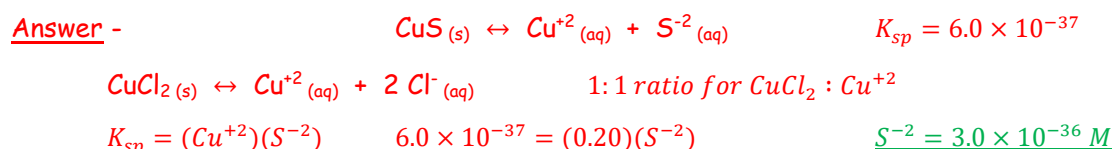
## Solubility Constant Product Calculations Practice

### Part 2

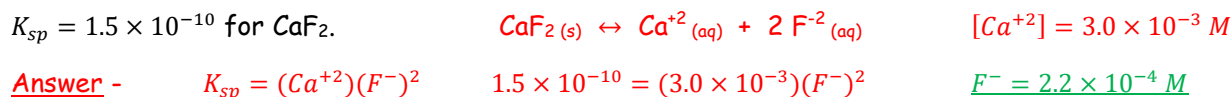
1.) Will a precipitate form if 1.0 L of  $3.0 \times 10^{-10} M Fe^{+2}$  is added to 1.0 L of  $1.2 \times 10^{-8} M S^{-2}$ ?



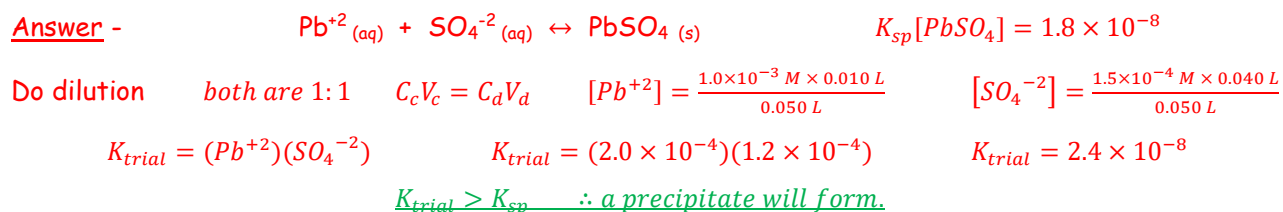
2.) What concentration of  $S^{-2}$  is required to just start precipitation of CuS from a 0.20 M solution of  $CuCl_2$ ?



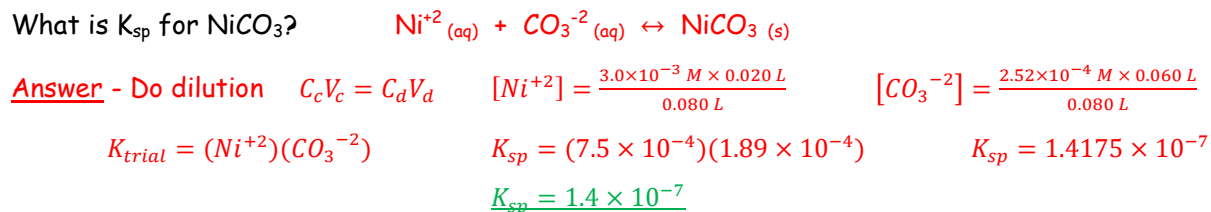
3.) What  $F^{-}$  concentration is required to just start precipitating  $CaF_2$  from a  $3.0 \times 10^{-3} M$  solution of  $CaNO_3$ ?



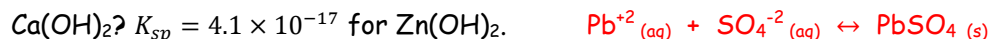
4.) Will a precipitate form when 10.0 mL of  $1.0 \times 10^{-3} M Pb(NO_3)_2$  is added to 40.0 mL of  $1.5 \times 10^{-4} M Na_2SO_4$ ?



5.) A precipitate barely forms when 20.0 mL of  $3.0 \times 10^{-3} M Ni^{+2}$  is added to 60.0 mL of  $2.52 \times 10^{-4} M CO_3^{-2}$ .



6.) Does a precipitate form when 25.0 mL of  $1.0 \times 10^{-4} M Zn(NO_3)_2$  is added to 45.0 mL of  $2.4 \times 10^{-5} M$



Answer -  $C_c V_c = C_d V_d$  1:1 ratio  $[Zn^{+2}] = \frac{1.0 \times 10^{-4} M \times 0.025 L}{0.070 L} = 3.5714 \times 10^{-5} M$   
 1:2 ratio  $[OH^-] = \frac{2.4 \times 10^{-5} M \times 0.045 L}{0.070 L} = 1.5429 \times 10^{-5} \times 2 = 3.09 \times 10^{-5} M$   
 $K_{trial} = (Zn^{+2})(OH^-)^2$   $K_{trial} = (3.5714 \times 10^{-5})(3.09 \times 10^{-5})^2$   $K_{trial} = 3.4 \times 10^{-14}$   
 $K_{trial} > K_{sp} \therefore$  a precipitate will form.

7.) When 100.0 mL of  $4.0 \times 10^{-2} M$   $CaCl_2$  is added to 150.0 mL of  $2.9 \times 10^{-2} M$   $NaOH$ , A precipitate of  $Ca(OH)_2$  just starts to form. What is  $K_{sp}$  for  $Ca(OH)_2$ ?

Answer -  $C_c V_c = C_d V_d$  1:1 ratio  $[Ca^{+2}] = \frac{4.0 \times 10^{-2} M \times 0.100 L}{0.250 L} = 1.60 \times 10^{-2} M$   
 1:1 ratio  $[OH^-] = \frac{2.9 \times 10^{-2} M \times 0.150 L}{0.250 L} = 1.74 \times 10^{-2} M$   
 $K_{trial} = (Ca^{+2})(OH^-)^2$   $K_{sp} = (1.6 \times 10^{-2})(1.74 \times 10^{-2})^2$   $K_{sp} = 4.84416 \times 10^{-6}$   
 $K_{sp} = 4.8 \times 10^{-6}$

8.) Does a precipitate form when 20.0 mL of  $5.0 \times 10^{-5} M$   $Ca^{+2}$  is added to 35.0 mL of  $2.5 \times 10^{-4} M$   $C_2O_4^{-2}$  and the resulting solution is boiled down to a total volume of 25.0 mL.

Answer -  $Ca^{+2}_{(aq)} + C_2O_4^{-2}_{(aq)} \leftrightarrow CaC_2O_4 (s)$   $K_{sp}[CaC_2O_4] = 2.3 \times 10^{-9}$   
 $[Ca^{+2}] = \frac{5.0 \times 10^{-5} mol}{1 L} \times \frac{0.020 L}{0.025 L} = 4.0 \times 10^{-5} M$   $[C_2O_4^{-2}] = \frac{2.5 \times 10^{-4} mol}{1 L} \times \frac{0.035 L}{0.025 L} = 3.5 \times 10^{-4} M$   
 $K_{trial} = (Ca^{+2})(C_2O_4^{-2})$   $K_{trial} = (4.0 \times 10^{-5})(3.5 \times 10^{-4})$   $K_{trial} = 1.4 \times 10^{-8}$   
 $K_{trial} > K_{sp} \therefore$  a precipitate will form.

9.) If 0.10 M  $Pb^{+2}$  is added dropwise to a solution having 0.10 M  $Cl^-$ , 0.10 M  $I^-$ , and 0.10 M  $SO_4^{-2}$ , which precipitate will form first?

Answer - Solve which mixture needs the least amount of  $Pb^{+2}$  added.

1.)  $Pb^{+2}_{(aq)} + 2 Cl^-_{(aq)} \leftrightarrow PbCl_2 (s)$   $K_{sp}[PbCl_2] = 1.2 \times 10^{-5}$   
 $1.2 \times 10^{-5} = (Pb^{+2})(0.10)^2$   $[Pb^{+2}] = 1.2 \times 10^{-3} M$

2.)  $Pb^{+2}_{(aq)} + 2 I^-_{(aq)} \leftrightarrow PbI_2 (s)$   $K_{sp}[PbI_2] = 8.5 \times 10^{-9}$   
 $8.5 \times 10^{-9} = (Pb^{+2})(0.10)^2$   $[Pb^{+2}] = 8.5 \times 10^{-7} M$

3.)  $Pb^{+2}_{(aq)} + SO_4^{-2}_{(aq)} \leftrightarrow PbSO_4 (s)$   $K_{sp}[PbSO_4] = 1.8 \times 10^{-8}$   
 $1.8 \times 10^{-8} = (Pb^{+2})(0.10)$   $[Pb^{+2}] = 1.8 \times 10^{-7} M$   
 $\therefore PbSO_4$  requires the smallest amount of lead.