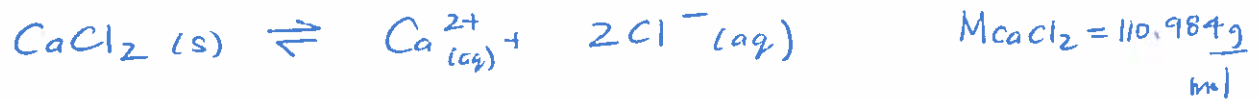


K_{sp} and Le Chatelier Station Review

Station #1

Calculate the K_{sp} for CaCl₂ if 2.00g of CaCl₂ is required to saturate 100.0 mL of solution.



$$C = 2.00\text{g CaCl}_2 \times \frac{1\text{mol}}{110.984\text{g}} \times \frac{1}{0.1\text{L}}$$

$$= 0.1802 \frac{\text{mol}}{\text{L}}$$

$$[\text{Ca}^{2+}] = 0.1802 \frac{\text{mol}}{\text{L}}$$

$$[\text{Cl}^{-}] = 2(0.1802 \text{ mol/L}) \\ = 0.3604 \text{ mol/L}$$

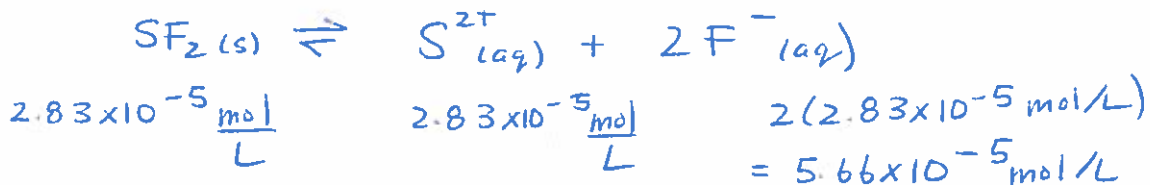
$$K_{sp} = [\text{Ca}^{2+}][\text{Cl}^{-}]^2 \\ = (0.1802)(0.3604)^2$$

$$= 0.0234 \text{ or } 2.34 \times 10^{-2}$$

∴ the K_{sp} is 2.34×10^{-2}

Station #2

The solubility of SF₂ is 2.83×10^{-5} M. Calculate the K_{sp}.



$$K_{sp} = [\text{S}^{2+}][\text{F}^{-}]^2 \\ = (2.83 \times 10^{-5})(5.66 \times 10^{-5})^2 \\ = 9.07 \times 10^{-14}$$

∴ the K_{sp} is 9.07×10^{-14}

Station #3

Calculate the concentration of lithium and carbonate ions in a saturated solution of lithium carbonate given $K_{sp} = 1.7 \times 10^{-3}$



I

C - x + 2x + x

E - x + 2x + x

$$K_{sp} = [\text{Li}^+]^2 [\text{CO}_3^{2-}]$$

$$1.7 \times 10^{-3} = (2x)^2 (x)$$

$$1.7 \times 10^{-3} = 4x^3$$

$$x = 0.07518$$

$$\begin{aligned} [\text{Li}^+] &= 2x \\ &= 2(0.07518) \\ &= 0.15 \text{ mol/L} \end{aligned}$$

$$[\text{CO}_3^{2-}] = 0.075 \text{ mol/L}$$

∴ the concentration of Li ions is 0.15 mol/L
and the concentration of carbonate ions is
0.075 mol/L

Station #4

- a) Write the dissociation equation for silver chloride $K_{sp} = 1.77 \times 10^{-10}$
 b) Predict what will happen if sodium chloride is added to the solution (direction of shift, and concentration of silver ions)
 c) What is the molar solubility of silver chloride in Water and 0.15 M solution of NaCl



b) • If $Na^+ Cl^-$ is added it will make it shift to the left since Cl^- is on the right side.
 • the concentration of silver ions will decrease.

c)

	$AgCl(s)$	Ag^+	Cl^-	in water
I				
C	-x	+x	+x	
E				

Water

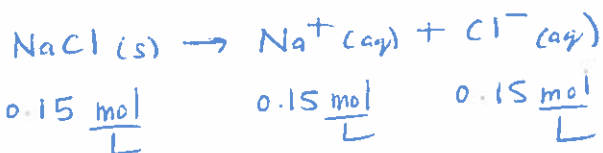
$$K_{sp} = [Ag^+][Cl^-]$$

$$1.77 \times 10^{-10} = (x)(x)$$

$$1.77 \times 10^{-10} = x^2$$

$$x = 1.33 \times 10^{-5}$$

∴ the molar solubility is $1.33 \times 10^{-5} \text{ mol/L}$



	$AgCl(s)$	Ag^+	Cl^-
I			0.15
C	-x	+x	+x
E		x	0.15+x

$$K_{sp} = [Ag^+][Cl^-]$$

$$1.77 \times 10^{-10} = (x)(0.15+x)$$

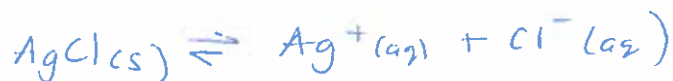
check $\frac{0.15}{1.77 \times 10^{-10}} \geq 1000$
 x is small wrt 0.15.

$$1.77 \times 10^{-10} = 0.15x$$

$$x = 1.2 \times 10^{-9} \text{ mol/L}$$

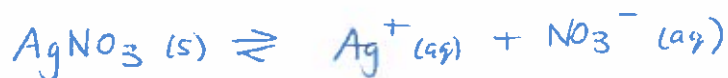
∴ the molar solubility in NaCl is 1.2×10^{-9}

Station #5



Determine if silver chloride will form a precipitate if 0.05 mL of 6.0M of silver nitrate is added to 1.0 L of 0.1M of sodium chloride.

$$K_{sp} = 1.77 \times 10^{-10}$$



$$V = 0.00005 \text{ L}$$

$$C = 6.0 \text{ mol/L}$$

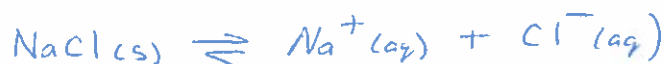
$$n = 0.00005 \text{ L} \times \frac{6.0 \text{ mol}}{\text{L}}$$

$$= 0.0003 \text{ mol}$$

$$\text{total volume} = 0.00005 \text{ L} + 1.0 \text{ L}$$

$$= 1.00005 \text{ L}$$

$$[\text{Ag}^+] = \frac{0.0003 \text{ mol}}{1.00005 \text{ L}} = 0.000299985 \frac{\text{mol}}{\text{L}}$$



$$V = 1.0 \text{ L}$$

$$C = 0.1 \text{ mol/L}$$

$$n = 1.0 \text{ L} \times \frac{0.1 \text{ mol}}{\text{L}}$$

$$= 0.1 \text{ mol}$$

$$[\text{Cl}^-] = \frac{0.1 \text{ mol}}{1.00005 \text{ L}} = 0.099995 \frac{\text{mol}}{\text{L}}$$

$$Q_{sp} = [\text{Ag}^+][\text{Cl}^-]$$

$$= (0.000299985)(0.099995)$$

$$= 3. \times 10^{-5} > K_{sp}$$

∴ a precipitate will form.

Station #6

In the following reaction



What happens to

a) $[\text{H}_2\text{O}]$ if O_2 is added

proceeds right $[\text{H}_2\text{O}] \uparrow$

b) $[\text{H}_2\text{S}]$ if O_2 is added

proceeds right $[\text{H}_2\text{S}] \downarrow$

c) $[\text{O}_2]$ if H_2S is removed

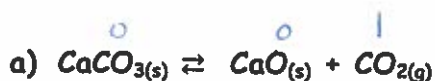
proceeds left $[\text{O}_2] \uparrow$

d) $[\text{H}_2\text{S}]$ if S is added

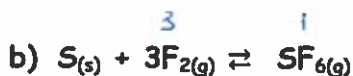
no effect \because S is a solid.
it wouldn't be in the equilibrium equation.

Station #7

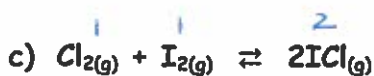
How would you change the volume of each of the following reactions to increase the yield of the products?



$\uparrow V (\downarrow P)$



$\downarrow V (\uparrow P)$



changing V & P has no effect
same # of molecules on each side

Station #8

Which direction would the following equations shift to if the temperature was increased?

