

# Chapter 15 Part 1

Dr. Turner

# A question

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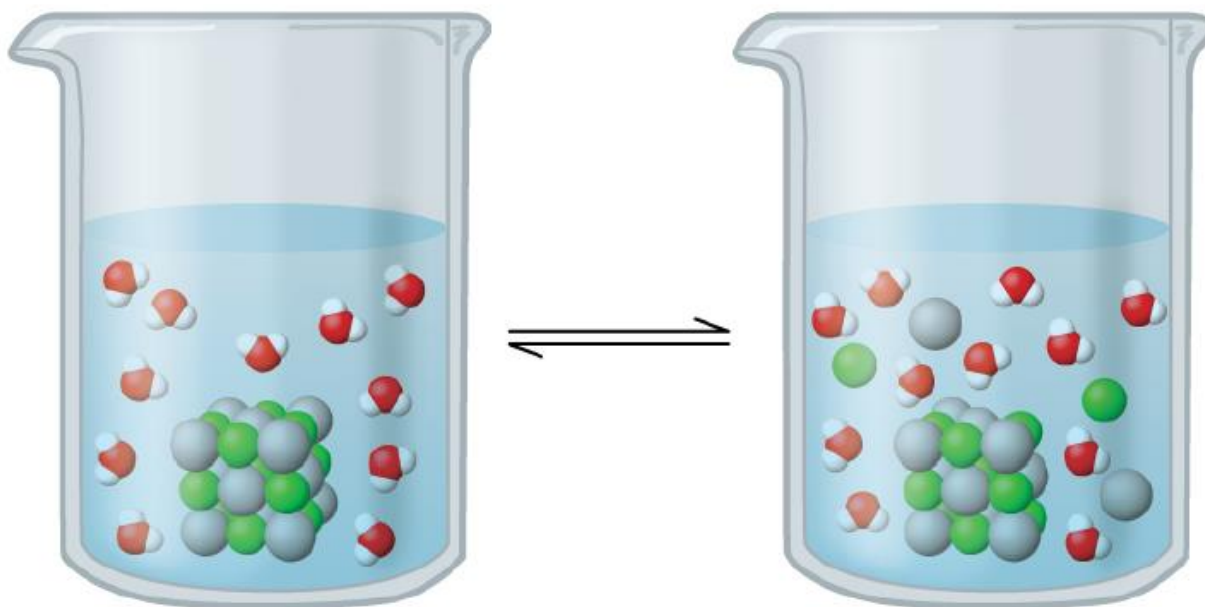
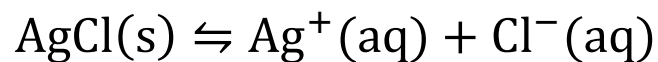
Is AgCl soluble based on the solubility rules?

# A question

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Is AgCl soluble in general?

# Solubility Equilibrium



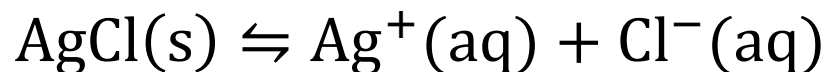
- The large white dots are  $\text{Ag}^+$
- The smaller green dots are  $\text{Cl}^-$

# Solubility Equilibrium

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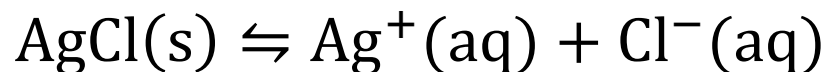
- Solubility equilibrium is a measure of dissolution of a solid in aqueous solution

# Solubility Equilibrium



Based on our previous discussions of equilibrium expressions and which states are included in equilibrium expressions, write the solubility product ( $K_{sp}$ ) expression for the reaction above.

# Solubility Equilibrium



$$K_{\text{sp}} = [\text{Ag}^+][\text{Cl}^-] = 1.77 \times 10^{-10}$$

Based on the expression above, would you expect AgCl to have a high or low solubility in water?

# $K_{sp}$ and solubility

Identify the compound likely to be the most soluble.





# $K_{sp}$ Expressions

For each of the ionic compounds (1) write the equations for the dissolution and (2) the solubility product constant expressions.

- A.  $\text{CaF}_2$
- B.  $\text{BaCO}_3$
- C.  $\text{Cu}_3(\text{AsO}_4)_2$
- D.  $\text{Eu}(\text{OH})_3$

# Formally, what is solubility?

- The solubility of a compound is the maximum possible concentration of that compound that can dissolve in a solvent

# Calculating Solubility from $K_{sp}$

Calculate the molar solubility of AgCl in water at 25°C, given that its  $K_{sp} = 1.77 \times 10^{-10}$ .

# Calculating Solubility from $K_{sp}$

Calculate the molar solubility of  $\text{PbI}_2$  in water at  $25^\circ\text{C}$ , given that its  $K_{sp} = 7.1 \times 10^{-9}$ .

# Calculating $K_{sp}$ from solubility

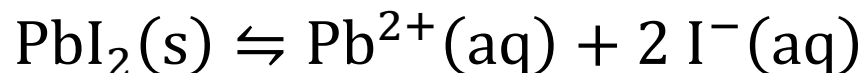
A handbook lists the solubility of  $\text{CaSO}_4$  (136 g/mol) at  $25^\circ\text{C}$  as 0.20 g  $\text{CaSO}_4$ /100 mL. What is the  $K_{sp}$  of  $\text{CaSO}_4$ ?

# Relating $K_{sp}$ and molar solubility

Identify the correct relationship between the solubility product constant,  $K_{sp}$ , and molar solubility,  $s$ , for  $\text{Al}(\text{OH})_3$ .

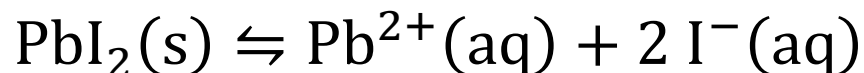
- A.  $K_{sp} = s$
- B.  $K_{sp} = 3s^2$
- C.  $K_{sp} = s^4$
- D.  $K_{sp} = 9s^4$
- E.  $K_{sp} = 27s^4$

# Common Ion Effect



What direction will the reaction shift to reestablish equilibrium if we add 0.10 M NaI (aq)?

# Common Ion Effect



What direction will the reaction shift to reestablish equilibrium if we add 0.10 M NaI (aq)?

Thus, does the addition of the common ion  $\text{I}^{-}$  make the  $\text{PbI}_2$  more or less soluble?



# Common Ion Effect

What is the molar solubility of  $\text{PbI}_2$  in 0.10 M  $\text{KI(aq)}$ ? The  $K_{\text{sp}}$  of  $\text{PbI}_2$  is  $7.1 \times 10^{-9}$ .

# Common Ion Effect

What is the molar solubility of  $\text{Cd}_3(\text{AsO}_4)_2$  in 0.0045 M  $\text{Li}_3\text{AsO}_4(\text{aq})$ ? The  $K_{\text{sp}}$  of  $\text{Cd}_3(\text{AsO}_4)_2$  is  $2.2 \times 10^{-33}$ .