5.6 Application of le Chatelier's Principle Assignment

1. Consider the following equilibrium system:

$PbCl_{2(s)} \rightleftharpoons Pb^{2+}_{(aq)} + 2Cl^-_{(aq)}$

Describe what happens to the solubility of $PbCl_2$ when the following substances are added to the solution. Why?

a) $Pb(NO_3)_2$

decrease solubility b/c ↑[Pb²⁺]

b) NaCl

↑ [Cl⁻] ∴ ↓ solubility

c) H_2O

increase solubility b/c more solvent

d) $AgNO_3$

$AgCl_{(s)}$ ∴ ↑ solubility

∴ ↓ [Ag⁺]

e) NaBr

$PbBr_{2(s)}$

↓ [Pb²⁺] ∴ ↑ solubility

2. Consider the following equilibrium system:

$AgBr_{(s)} \rightleftharpoons Ag^+_{(aq)} + Br^-_{(aq)}$

Describe what happens to the solubility of $AgBr_{(s)}$ when the following substances are added to the solution. Why?

a) $Pb(NO_3)_2$

$PbB_{2(s)}$ ∴ ↓[Br⁻]

↑ solubility

b) $AgNO_3$

↑ [Ag⁺]

∴ ↓ solubility.

c) NaCl

$AgCl_{(s)}$ ∴ ↓ [Ag⁺]

∴ ↑ solubility

d) NaBr

↑ [Br⁻]

∴ ↓ solubility

3. Explain why more $Zn(OH)_2$ dissolves when 3 M HCl is added to a saturated solution of $Zn(OH)_2$. Start by writing the correct equilibrium equation.

$Zn(OH)_{2(s)} \rightleftharpoons Zn^{2+}_{(aq)} + OH^-_{(aq)}$

add $HCl \rightleftharpoons H^+_{(aq)} + Cl^-_{(aq)}$

$H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)}$

$\therefore \downarrow [OH^-]$

$\therefore \uparrow$ solubility of $Zn(OH)_2$ (and more solvent)

4. Explain three ways in which the Haber-Bosch process utilizes Le Chatelier's principle to increase the yield of ammonia in industrial fertilizer production.

- removal of NH_3
- $\downarrow$ temp
- $\uparrow$ pressure