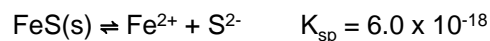


A systematic approach to solving complex equilibrium problems.

In many cases, multiple equilibria coexist in a system, making calculating concentrations more challenging because the position of one equilibrium may influence the position of others.

Example: How many grams of iron(II) sulfide can be dissolved in 100 mL of 0.1 F KCl?



How do we tackle this problem? We can't simply set up two equilibrium constant expressions, there are too many unknowns!

Use a more systematic approach: We need to write enough relationships to **describe the chemistry** and to solve for all of our unknowns.

1

Here's the Plan:

1. Write the pertinent reactions:

Account for how all species get into the system

2. Write **the** charge balance equation.

Charge balance requires that the total positive charge is equal to the total negative charge.

2

Here's the Plan:

3. Write mass balance equations.

Mass balance requires that the total number of moles (or atoms) of a particular element must always equal the amount of that atom delivered to the solution. (conservation of matter)

3

Here's the Plan:

4. Write equilibrium constant expressions for all equilibria.

5. Count equations and unknowns.

Five equations, Five unknowns. (spectator ions)

6. Solve for all the unknowns.

Algebra, here we come!

Life becomes easier if we use computer-based tools

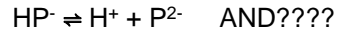
- Solve problem *iteratively* (repeated substitutions)
- Use numerical solution routines

4

Strategy Applies Regardless of Number of Equilibria

Consider the HP^- equilibrium for 0.10M KHP:

1. Write the pertinent reactions.



2. Write **the charge balance** equation.

3. Write mass balance equations.

4. Write equilibrium constant expressions for all equilibria.

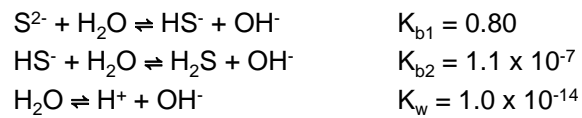
5. Count equations and unknowns.

6. Solve for all the unknowns.

5

Strategy Applies Regardless of Number of Equilibria

Now consider adding the following equilibria to the FeS discussion:



Life gets even more complicated!!! Strategy still works!

1. Write the pertinent reactions.
2. Write the *charge balance* equation.
3. Write mass balance equations.
4. Write equilibrium constant expressions for all equilibria.
5. Count equations and unknowns.
6. Solve for all the unknowns.

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