Unit 4 Chemical Systems and Equilibrium

7.1 Recognizing Equilibrium

- Many chemical reactions do not go to completion. In other words, a balance is reached when the reactants form products at the same rate the products react to reform the reactants.
- Unlike you learned in the past, many reactions are reversible. E.g. $H_{2(g)} + I_{2(g)} \quad 2HI_{(g)}$
- Important thing to remember that it will look like it is a static system but it will be quite dynamic with the forward reaction in perfect balance with the reverse reaction.

Terms to Know

- Closed System: a system that may exchange energy but not matter with its surroundings.
- Equilibrium: a balance between forward and reverse processes occurring at the same rate.
- Forward Reaction: in an equilibrium equation, the left to right reaction.
- Reverse Reaction: in an equilibrium equation, the right to left reaction.
- Solubility Equilibrium: a dynamic equilibrium between a solute and a solvent in a saturated solution in a closed system.
- Phase Equilibrium: dynamic equilibrium between different physical states of a pure substance in a closed system.
- Chemical Reaction Equilibrium: a dynamic equilibrium between reactant and products of a chemical reaction in a closed system.

Types of Equilibrium:

Solubility Equilibrium

- Both dissolving and crystallizing processes take place at the same rate with no observable changes.

Phase Equilibrium

- Phase changes occur at the same rate in both directions.
- E.g. At 0°C water will both melt and freeze at the same rate.

Chemical Reaction Equilibrium

- The most complex type of equilibrium.
- Not all reactions go to completion and sometimes the system is modified to force the reaction.
- E.g. Cement production at high temperatures: $CaCO_{3(s)} \quad CaO_{(s)} + CO_{2(g)}$
  This reaction usually does not go to completion and when it cools down the CaO returns to $CaCO_3$. To ensure that the product remains, CO_2 is allowed to leave the reaction chamber that prevents the reverse reaction from taking place.

The Four Conditions That Apply to All Equilibrium Systems

1. Equilibrium is achieved when both the forward and reverse reaction rates are equal.
2. The macroscopic properties are constant.
3. Equilibrium can only be reached in a closed system.
4. Equilibrium can be reached from either direction (products or reactants)

Homework

- Read 7.1
- All Questions
- Express Lab (If we have time to do it in class)