

Chem12 Le Chatelier's Principle-30

Le Chatelier's principle states : If an equilibrium system is subjected to a change, then processes will occur that will tend to counteract that change. That is, the equilibrium will shift to the side that will oppose the change.

Consider the reaction : $\text{N}_2\text{O}_4(\text{g}) + 59.0 \text{ kJ} \rightleftharpoons 2\text{NO}_2(\text{g})$

We can cause a shift in the equilibrium in several ways.

If we increase T (add heat) the reaction shifts right, to relieve the stress. The concentration of NO_2 increases and the concentration of N_2O_4 decreases. The reverse happens if we reduce T.

If we increase or decrease concentrations of the reactants or products the equilibrium will shift. For example, if we increase the concentration of NO_2 the equilibrium shifts left and more N_2O_4 is created. The reverse happens if the NO_2 concentration is decreased.

If the volume decreases (pressure increases) the equilibrium will shift to the side with the least number of moles of gas, which would be left in this case. Again, the reverse happens when pressure decreases.

If a catalyst is added to a system at equilibrium, there will be no shift. If the system is not yet at equilibrium, then the equilibrium will be established faster.

If we add an unreactive gas such as helium, or a solid, there is no shift.

Important : In all of the above situations, K_{eq} will remain constant unless there is a change in temperature. K_{eq} is said to be temperature dependent.

Exercise 1 : Given : $\text{Fe}(\text{OH})_3(\text{s}) \rightleftharpoons \text{Fe}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq})$.

Predict whether the equilibrium shifts left, right, or not at all when the following changes are made.

a) decrease Fe^{3+} b) increase pressure c) add $\text{Fe}(\text{OH})_3(\text{s})$

Exercise 2 : Given : $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^{+}(\text{aq}) \rightleftharpoons \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

$$H = -55\text{kJ}$$

Predict whether the equilibrium shifts left, right or not at all.

- | | | |
|--|-----------------------------------|-----------------------|
| a) add $\text{Na}_2\text{CO}_3(\text{aq})$ | b) decrease the volume | c) add NaOH |
| d) increase T | e) remove $\text{CO}_2(\text{g})$ | f) add KNO_3 |

Answers : 1)a) R b) N, c) N, 2)a) R, b) L, c) L, d) L, e) R, f) N.