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# Lecture.9

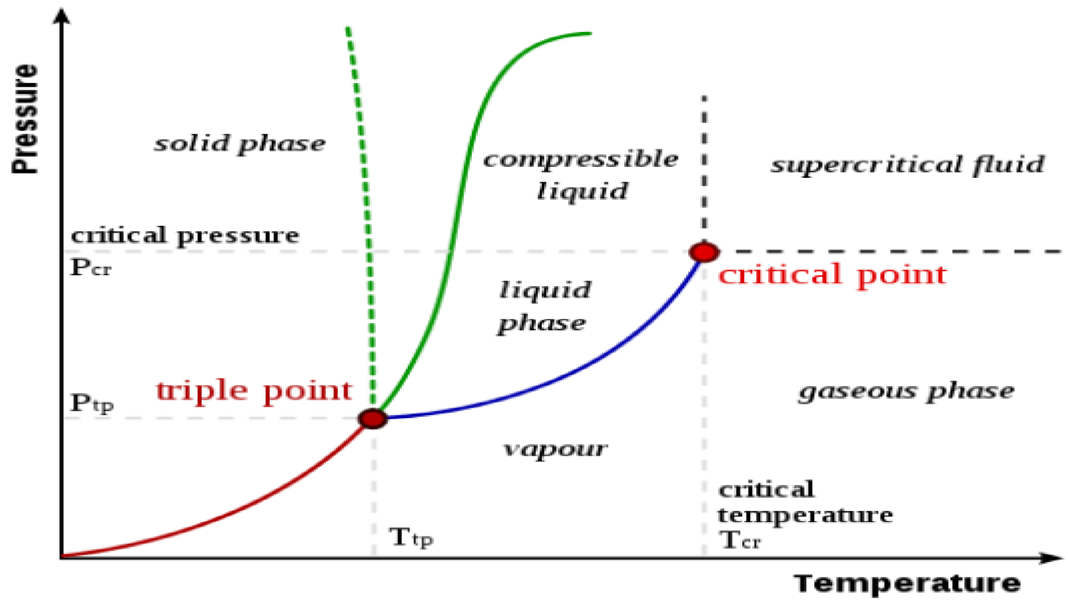
## What is the Difference Between First and Second Order Phase Transition

The **key difference between first and second order phase transition** is that first order phase transitions depend on the first power of the reactant concentration in a rate equation, whereas second order phase transitions depend on the second power of the concentration in the rate equation.

A phase transition is a change of phase of matter, which is a physical process of transition of a state of a medium to a different state of the same medium, which is identified by parameters such as density and volume. Generally, this term is used to describe phases such as solid, liquid, gas, and plasma. The types of phase transitions include melting, boiling, sublimation, vaporization, ionization, deposition, condensation, and recombination.

## What is First Order Phase Transition?

First order phase transitions are chemical reactions in which the rate of reaction depends on the molar concentration of one of the reactants involved in the reaction. Therefore, the sum of the powers to which the reactant concentrations are raised in the rate law equation will always be 1. If a single reactant takes part in these reactions, the concentration of that reactant determines the rate of the reaction. But sometimes, there is more than one reactant taking part in these reactions. In such cases, one of these reactants will determine the rate of the reaction.




We can characterize a first order phase transition by the discontinuity of thermodynamic variables, including density and entropy. Moreover, this type of transition is usually displayed by changes in volume.

What is Second Order Phase Transition?

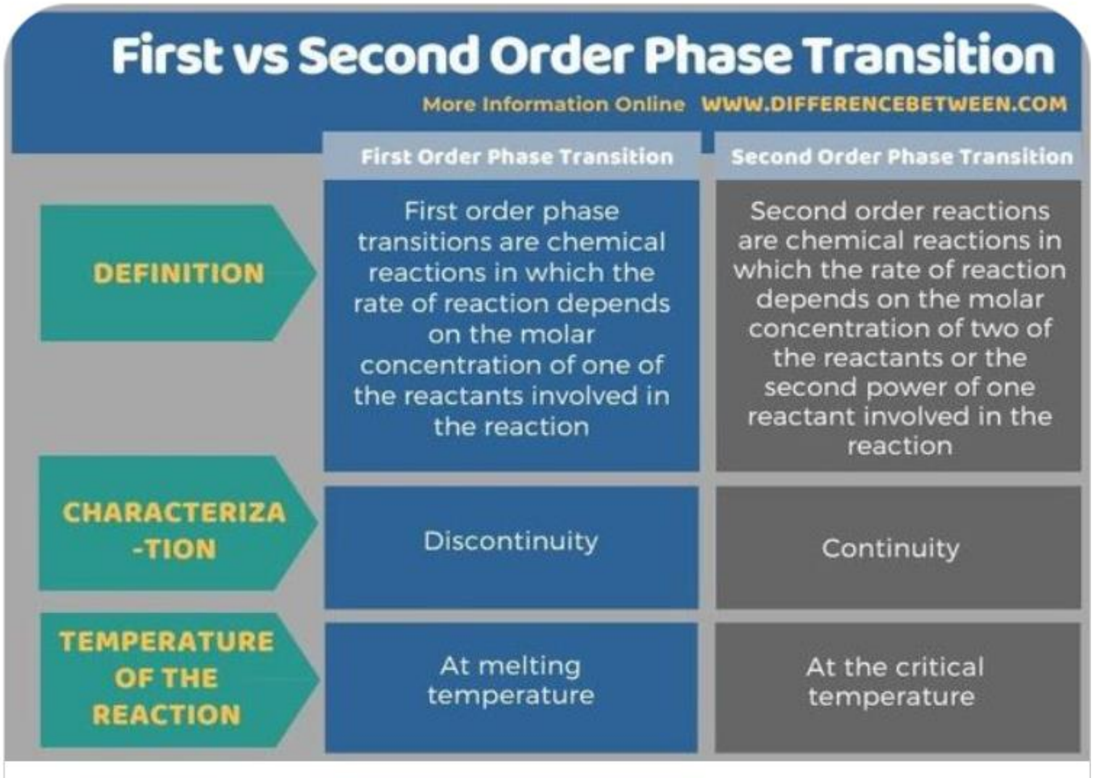
Second order phase transitions are chemical reactions in which the rate of reaction depends on the molar concentration of two of the reactants or the second power of one reactant involved in the reaction. Therefore, the sum of the powers to which the reactant concentrations are raised in the rate law equation will always be 2. If there are two reactants, the rate of reaction will depend on the first power of the concentration of each reactant.

A second phase transition is also known as a continuous phase transition because it is characterized by a divergent susceptibility, a power law decay of correlations near criticality, etc. The theory behind the second order phase transitions was developed by scientists using the Landau theory.

What is the Difference Between First and Second Order Phase Transition?

First order and second order reactions can occur as phase transitions. The key difference between first and second order phase transition is that first order phase transitions depend on the first power of the reactant concentration in a rate equation, whereas second order phase transitions depend on the second power of the concentration in the rate equation.

Below is a summary of the difference between first and second order phase transition in tabular form for side-by-side comparison.



**First vs Second Order Phase Transition**

More Information Online WWW.DIFFERENCEBETWEEN.COM

| | First Order Phase Transition | Second Order Phase Transition |
|---|---|---|
| DEFINITION | First order phase transitions are chemical reactions in which the rate of reaction depends on the molar concentration of one of the reactants involved in the reaction | Second order reactions are chemical reactions in which the rate of reaction depends on the molar concentration of two of the reactants or the second power of one reactant involved in the reaction |
| CHARACTERIZA-TION | Discontinuity | Continuity |
| TEMPERATURE OF THE REACTION | At melting temperature | At the critical temperature |

**Summary – First vs Second Order Phase Transition**

First order phase transitions are chemical reactions in which the rate of reaction depends on the molar concentration of one of the reactants involved in the reaction. Second order reactions, on the other hand, are chemical reactions in which the rate of reaction depends on the molar concentration of two of the reactants or the second power of one reactant involved in the reaction. The key difference between first and second order phase transition is that first order phase transitions depend on the first power of the reactant concentration in a rate equation, whereas second order phase transitions depend on the second power of the concentration in the rate equation.