

## Gibbs - Helmholtz equation :

Gibbs-Helmholtz equation is a thermodynamic equation used for calculating changes in the Gibbs free energy of a system as a function of temperature. It was originally presented by Hermann von Helmholtz. It describes how the Gibbs free energy, which was presented originally by Josiah Willard Gibbs, varies with temperature.

The equation is  $\rightarrow$

$$\left[ \frac{\partial \left( \frac{G}{T} \right)}{\partial T} \right]_p = - \frac{H}{T^2}$$

where  $H$  is the enthalpy,  $T$  the absolute temperature and  $G$  the Gibbs free energy of the system, all at constant pressure  $p$ .

The equation states that the change in  $G/T$  ratio at constant pressure as a result of an infinitesimally small change in temperature is a factor  $H/T^2$ .

## Thermodynamic equation of state:

In thermodynamics, an equation of state is a thermodynamic equation relating state variables, which describes the state of matter under a given set of physical conditions, such as pressure, volume, temperature, or internal energy. Most modern equations of state are formulated in the Helmholtz free energy.

Equations of state are useful in describing the properties of pure substances and mixtures in liquids, gases, and solid states as well as the matter state of matter in the interior of stars.

At present, there is no single equation of state that accurately predicts the properties of all substances under all conditions. An example of an equation of state correlates densities of gases and liquids to temperatures and pressures, known as the ideal gas law, which is roughly accurate for weakly polar gases, which is at low pressures and

moderate temperatures. This equation becomes increasingly inaccurate at higher pressures and lower temperatures and fails to predict condensation from a gas to a liquid.

The general form of an equation of state may be written as

$$f(p, V, T) = 0$$

where  $p \rightarrow$  Pressure of the system.

$V \rightarrow$  Volume " " "

$T \rightarrow$  Temperature " " "