

# Homogeneous and Heterogeneous Equilibria

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## Introduction

A system in which all reactants are in same phase is known as homogeneous system.

For example in the reaction  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ , all the reactant and products are in gas phase so this is a homogeneous system.

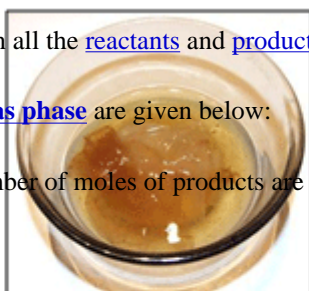
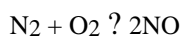
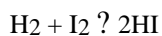
## Homogeneous Equilibria



When in a equilibrium reaction all the [reactants](#) and [products](#) are in same phase, it is known as [homogeneous equilibrium](#).

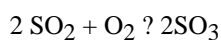
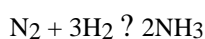
**Examples of equilibrium in [gas phase](#)** are given below:

(I) The reactions in which number of moles of products are equal to number of moles of reactants

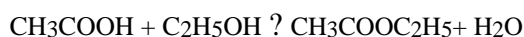


### Homogeneous Chemical Equilibrium

(II) The reactions in which number of moles of products are not equal to number of moles of reactants

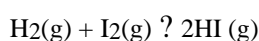


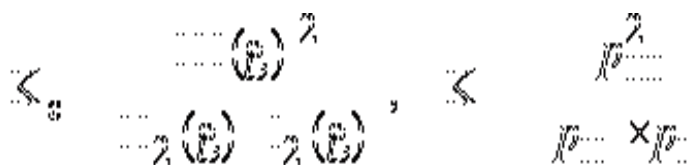
**Examples of equilibrium in [liquid phase](#)** are:



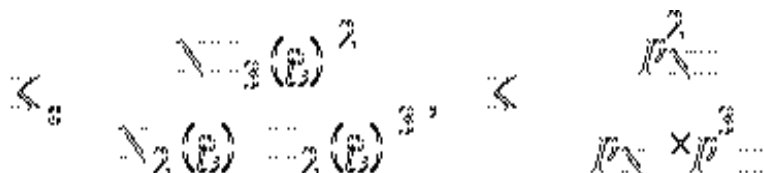
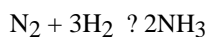
**Expression for equilibrium constant:**

For the reaction of hydrogen and iodine to form hydrogen iodide

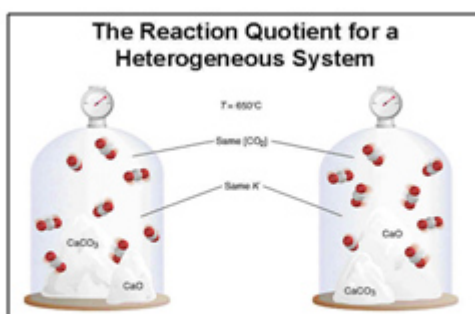




For the reaction of formation of ammonia from hydrogen and oxygen



## Heterogeneous Equilibria

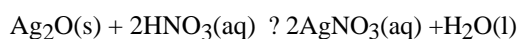
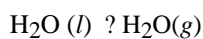
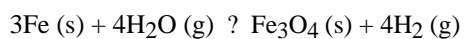
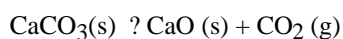


The equilibrium in which the reactants and products of a reaction

### Heterogeneous Chemical Equilibrium

are present in two or more than two phases, is called a heterogeneous equilibrium.

Some **examples** of [heterogeneous equilibrium](#) are:

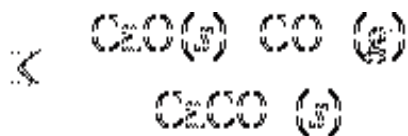


The position of the heterogeneous equilibrium is independent of the amount of pure solid or pure liquid present in the reaction mixture.

As the concentration of solids and liquids remains almost constant during the reaction they do not appear in the equilibrium expression.

### Expression for equilibrium constant:

For the decomposition of calcium carbonate to calcium oxide and carbon dioxide



But by convention  $[\text{CaCO}_3(\text{s})] = 1$ ,  $[\text{CaO}(\text{s})] = 1$

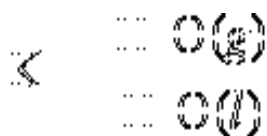
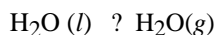
Hence,  $K = [\text{CO}_2(\text{g})]$

It is better to express the concentration of a gas in terms of partial pressure, the equilibrium constant of this reaction can be expressed as



Above equation explains why concentration of  $\text{CO}_2$  becomes constant after the equilibrium is attained in the decomposition of calcium carbonate in a closed vessel.

(ii) For the equilibrium



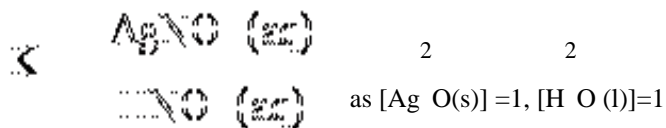
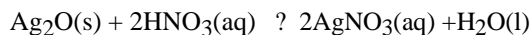
But by convention  $[\text{H}_2\text{O}(\text{l})] = 1$

Hence,  $K_c = [\text{H}_2\text{O}(\text{g})]$

Or, in terms of pressure,  $K = p(\text{g})$

This explains why [vapour pressure](#) of water is constant at constant temperature.

(iii) In the reaction of silver oxide with nitric acid



## Why vapour pressure of water is constant at constant temperature?

Try to answer. Still need help? Want to know more about it? [Click here](#) to schedule live help from a certified tutor!

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1. <http://www.chemguide.co.uk/physical/equilibria/kc.html>
2. <http://www.brightstorm.com/science/chemistry/chemical-equilibrium/heterogeneous-equilibrium-homogeneous-equilibrium>
3. [http://www.attanolearn.com/excel/5560\\_homogeneous-heterogeneous-equilibria.jsf](http://www.attanolearn.com/excel/5560_homogeneous-heterogeneous-equilibria.jsf)
4. <http://www.freefictionbooks.org/books/p/23058-the-phase-rule-and-its-applications-by-findlay?start=8>
5. [http://www.nyu.edu/classes/tuckerman/honors.chem/lectures/lecture\\_21/node6.html](http://www.nyu.edu/classes/tuckerman/honors.chem/lectures/lecture_21/node6.html)

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