

Quadrant II – Transcript and Related Materials

Programme : Bachelor of Science (First Year)

Subject : Chemistry

Paper Code : CHC 102

Paper Title : Physical Chemistry and Organic Chemistry

Unit : 1

Module Name: Integral and Differential Enthalpies of Solution and Dilution

Module No : 04

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Notes:

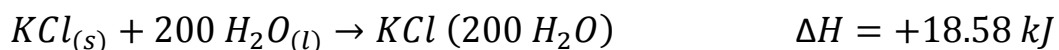
Enthalpy of Solution:

The amount of heat evolved or absorbed when 1 mole of the solute is dissolved in a given amount of the solvent is called the enthalpy of solution of the solute at that concentration and temperature. It is therefore, necessary to express the enthalpy change with reference to the concentration of the solution and the temperature selected. For comparable studies temperature selected is 298 K. For this purpose, a term integral enthalpy of solution is often used.

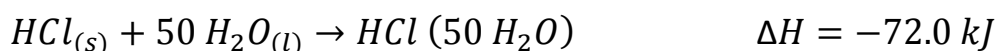
Integral Enthalpy of Solution:

It is defined as the enthalpy change when one mole of solute is dissolved in a solvent to give a solution of a specified concentration. The state of solution of a substance is described in terms of moles of solvent used per mole of solute dissolved at atmospheric pressure and room temperature.

If for example, one mole of potassium chloride is dissolved in 200 moles of water, heat absorbed, viz., 18.58 kJ, is the integral enthalpy of solution of potassium chloride at this concentration. This is expressed by a thermochemical equation as:



Similarly when one mole of gaseous hydrogen chloride is dissolved in 50 moles of water, heat evolved is 72.0 kJ. Thus, integral enthalpy of solution of gaseous hydrogen chloride per mole when dissolved in 50 moles of water is 72.0 kJ and ΔH has a negative sign. The thermochemical equation is written as:



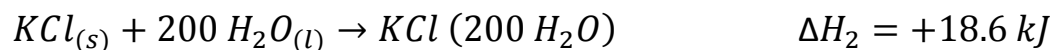
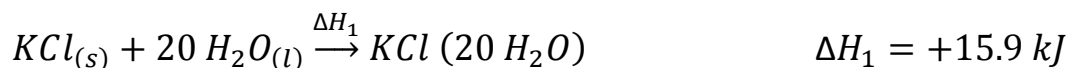
If the amount of the solvent used is so large that a further addition of solvent no longer causes a change in the integral heat of solution per mole of the solute, the integral heat of solution is said to be heat of solution at infinite dilution.

Enthalpy of Dilution

Change of enthalpy when a solution containing one mole of a solute is diluted from one concentration to another is called enthalpy of dilution. Enthalpy of dilution can be determined from heat of solution data at respective concentrations and the applications of Hess's law of constant heat summation.

Integral enthalpy of solution for one mole of KCl dissolved in 20 moles of water is +15.9 kJ and in 200 moles of water is 18.6 kJ. Calculate the enthalpy of dilution.

$$\Delta H_1 + \Delta H_{dil} = \Delta H_2$$



$$\text{Enthalpy of dilution } \Delta H_{dil} = \Delta H_2 - \Delta H_1$$

$$= 18.6 - 15.9$$

$$= 2.7 \text{ kJ}$$

Thus when the solution containing one mole of KCl dissolved in 20 moles of water is diluted by the further addition of 180 moles of water to have 200 moles of total water, heat absorbed will be 2.7 kJ per mole of KCl.

Differential Enthalpy of Solution:

It is defined as the enthalpy change produced when one mole of a solute is dissolved in such a large volume of solution of a specified concentration that the addition of 1 mole of solute does not affect the concentration.

To illustrate, consider a solution containing one mole of potassium chloride dissolved in 10 moles of water. Now, if we take a large volume of this solution, say 200 litres and dissolve one mole more of potassium chloride in it, the heat change produced will be called the differential enthalpy of solution of potassium chloride when the solution is already at the given concentration.