**Exercise 10: Enthalpy of reaction and Van 't Hoff isobar**

The exercise is conducted using the Virtual Lab program and a spreadsheet. The online version of the application is available on the website:

<http://chemcollective.org/vlab/vlab.php>

The data obtained in the Virtual Lab program and the calculated values should be recorded in the appropriate tables under the 'ex10' tab in the spreadsheet "Physical Chemistry ".

To launch the relevant task, select the following tabs:

***File>>Load Assignment>>Chemical Equilibrium>>DNA Binding Problem***

1. Conduct synthesis reactions based on the available solutions of nitrogen bases. Pour 10 cm³ of 0.1 M solutions of two selected bases into a 250 cm³ beaker. Set the temperature of the reaction mixture to 25 °C (T1), read the equilibrium concentrations at this temperature, calculate the number of moles of products and substrates, calculate their mole fractions, and finally determine the equilibrium constant based on the mole fractions. The results should be recorded in Table 1.

**Example reaction:** **G + C = GC**

Equilibrium constant determined **KX = XGC/(XG∙XC)**

based on mole fractions

Next, the above procedure should be repeated for the same pair of nitrogen bases at temperatures of 50 °C (T2) and 90 °C (T3), setting the appropriate temperature of the reaction vessel each time and recording the read and calculated values in Table 2 and Table 3, respectively.

The reaction constant should be determined at three temperatures for all possible combinations of nitrogen bases (a total of 6 reactions).

1. Calculate the enthalpy of the reaction based on Van 't Hoff's isobar equation:

**ΔH=R∙ln(KA/KB) ∙ (TA∙TB/(TA-TB))**

R - gas constant - **8.3145 J∙K⁻¹mol⁻¹**  
Equilibrium constant for temperature A **– KA**  
Equilibrium constant for temperature B **– KB**  
Remember to express the temperature in Kelvin!

Calculations should be performed for three sets of temperatures: **ΔH₁ (T₂-T₁); ΔH₂ (T₃-T₁); ΔH₃ (T₃-T₂)** for each of the 6 pairs of nitrogen bases. Additionally, for each pair of nitrogen bases, the average enthalpy of the reaction and its standard deviation (SD = standard deviation) should be calculated. The results should be recorded in Table 4.

**Report**  
The collected data and calculated values should be summarized in Tables 1, 2, and 3 for each temperature. Table 4 should present the calculated enthalpy values. Provide example calculations and conclusions.