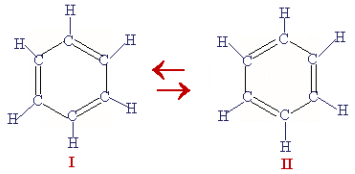
Homework 2

Distributed: Wednesday, January 24, 2001 **Due: Wednesday, January 31, 2001**

This homework assumes you have already done the suggested textbook problems (see http://ir.chem.cmu.edu/chem106/).

Please show your work.

1) (4 points) Benzene is often written as a resonance hybrid of 2 equivalent structures, the ΔH^o_f for gaseous benzene has been determined from its heat of combustion to be +82.8 kJ/mol.



I II

$6C(s) + 3H_2(g) \rightarrow C_6H_6$ $\Delta H^o_f = +82.8$ kJ/mol

Use the bond enthalpy data in Table 7.3 and additional data in Appendix D of your book to estimate ΔH^o_f in kJ/mol for structure I above

How does your calculated value compare with the experimental value for benzene?

The difference between the calculated value and the experimental values is called resonance energy.
Based on your results, does the resonance lower or raise the energy of benzene?

2) (3 points) 16.6 grams of calcium chloride, $CaCl_2$ are dissolved in an insulated cup containing 1000 ml of water at 25°C. Use the reaction below and the ΔH^o_f values in Appendix D to determine the temperature of the water after the calcium chloride has dissolved.

$$CaCl_{2(s)} \rightarrow Ca^{2+}_{(aq)} + 2\ Cl^-_{(aq)}$$

3) (3 points) Both CCl_4 (carbon tetrachloride) and CS_2 (carbon disulfide) are liquids used as solvents in special industrial applications. Using data from Appendix D, calculate ΔH^o and ΔG^o for combustion of these liquids

$$CCl_{4(l)} + 5\ O_{2(g)} \rightarrow CO_{2(g)} + 4\ ClO_{2(g)}$$

$$CS_{2(l)} + 3\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ SO_{2(g)}$$

Based upon your results, would you recommend any precautions against fires for industrial plants using either solvent? Please explain your recommendations.