**Chemistry 6854: First Law In-Class exercises: part 1**

**Spring 2016 Alfred State**

1) 1 mole of ideal gas is compressed isothermally from 2 to 0.5 dm3 at 300 K.

1. Using the sign conventions for work in McQuarrie what is the work done (in J) ? (R=8.314 J/K mol)
2. How much heat was absorbed to do the work ?

2) A 1 mole sample of monatomic ideal gas is compressed adiabatically from 2 to 0.5 dm3 starting at

300 K.

1. Without doing any calculations, will the temperature increase or decrease inside the system as the adiabatic compression occurs ? Explain your answer.
2. Compute the actual temperature the gas attains at 0.5 dm3.
3. Compute the work (with correct sign) carried out during this compression
4. Since the compression is done adiabatically, where does the energy come from to change the temperature ? Does it make sense that the compression stroke here is used as a model for a refrigerator run in reverse, e.g. a heat pump ?

**Chemistry 6854: First Law In-Class exercises: part 2**

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2.1 Given the data in the table provided, use Hess’ Law to ΔrHo for:

ΔrHo

1. OH(g) 🡪H(g) + O(g)
2. H2O(g) 🡪 2H(g) + O(g)
3. H2O(g)🡪 H(g) + OH(g)

reaction known ΔrHo

½ H2(g) + ½ O2(g) 🡪 OH(g) 38.95 kJ/mol  
 H2(g) + ½ O2(g) 🡪 H2O(g) -241.814 kJ/mol

H2(g) 🡪2 H(g) +435.994 kJ/mol

O2(g) 🡪 2O(g) +498.34 kJ/mol

(see also problems 19.35-19.36 pp 804-5)

2.2. Given the heats of formation for the gas compounds listed, and the bond enthalpies listed below, find the single bond enthalpies for H-O and N-H

NH3 H2O

ΔHfo (kJ/mol) -45.94 -241.8

Bond enthalpy (kJ/mol) per product atom\*

H2🡪 2H 217.9 Calculated vs Actual Bond Enthalpies

O2🡪 2O 249.17

|  |  |  |
| --- | --- | --- |
| Bond | Calculated | Actual1 |
| H-O |  | 459.8 |
| N-H |  | 390.8 |

1 in kJ/mol Klotz, p 69 table 5.3 (1964)

N2🡪 2N 472.68

\*thus, the reaction H2🡪 2H requires 2 x 217.9 kJ=435.8 kJ