Molecular Physics (Prof. Käs) **WS 2007/08**
Universität Leipzig
Fakultät für Physik und Geowissenschaften

Problem Set 1

Due date: October 15, 2007

Problem 1)
The density of water vapor at 327.6 atm and 776.4 K is 133.2 g dm^{-3}.
a) Determine the molar Volume, V_m, of water and the compression factor, Z, from these data.
b) Calculate Z from the *van der Waals* equation with a = 5.464 L^2 atm mol^{-2} and b = 0.0305 L mol^{-1}
(3 points)

Problem 2)
Calculate the *van der Waals* parameters of the gas methane from its critical constants (p_c = 45.60 atm, V_c = 98.70 cm^3 mol^{-1} and T_c = 190.6 K) and estimate the radius of the molecules (which are to be approximated as spherical).
(3 points)

Problem 3)
2.00 mol of He - which is to be considered here as a perfect gas - is expanded isothermally at 22.0 °C from 22.8 L to 31.7 L. This is done
a) reversibly,
b) against a constant external pressure equal to the final pressure of the gas and
c) freely (against zero external pressure).
Calculate q, w, ΔU, and ΔH for the three processes.
(4 points)

Problem 4)
The expression C_p / (J K^{-1}) = 20.17 + 0.4001 (T/K) describes the constant-pressure heat capacity of a sample of a perfect gas as a function of temperature.
Calculate q, w, ΔU, ΔH when the temperature is raised from 0.0 °C to 100.0 °C
a) at constant pressure
b) at constant volume.
(3 points)

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Winter term 07/08

Announcement:

Please notice the following rules. Failure to comply with these rules might lead to point deductions.

1) Always staple your exercise sheets. Paper clips are not sufficient to keep a work together.

2) You may use any kind of pen/ball pen, however DO NOT USE RED, which is reserved for the corrector.

3) Always **clearly indicate** your work, i.e. assignments to exercises have to be made clearly!! Also, make your thoughts transparent by writing some short comments.

4) Deliver your exercises on time.

Thank you! And have fun and success!!