Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 2 – IPSP

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Exercise Sheet 2 (SoSe 2012)

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Date of Submission: Apr. 27^{th} 2012

Submission Place: Marked mailbox next to room 302 (Linnestr. 5)
Submission Time: 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper.
Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

Exercises:

1. At very low temperatures, the specific heat of a metal is given by $c = aT + bT^3$. For copper, $a = 0.0108\,J/kg \cdot K^2$ and $b = 7.62 \cdot 10^{-4}\,J/kg \cdot K^4$. (a) What is the specific heat of copper at $4.00\,K$? (b) How much heat is required to heat copper from 1.00 to 3.00 K? (6 Points)

2. In this problem, 1.00 mol of an ideal diatomic gas is heated at constant volume from 300 to 600 K. (a) Find the increase in the internal energy of the gas, the work done by the gas, and the heat absorbed by the gas. (b) Find the same quantities if this gas is heated from 300 to 600 K at constant pressure. Use the first law of thermodynamics and your results for (a) to calculate the work done by the gas. (c) Again calculate the work done in Part (b). This time calculate it by starting from $dW = ...$ (8 Points)

3. During a cold day, you can warm your hands by rubbing them together. Assume the coefficient of kinetic friction between your hands is 0.500, the normal force between your hands is 35.0 N, and that you rub them together at an average relative speed of 35.0 cm/s. (a) What is the rate at which mechanical energy is dissipated? (b) Assume further that the mass of each of your hands is 350 g, the specific heat of your hands is 4.00 kJ/kg·K, and that all the dissipated mechanical energy goes into increasing the temperature of your hands. How long must you rub your hands together to produce a 5.00°C increase in their temperature? (6 Points)

4. Given that the integral $\int_0^\infty = v^3 e^{-av^2}\,dv = \frac{1}{2a^2}$, calculate the average speed v_{av} of molecules in a gas using the Maxwell-Boltzmann distribution function.